Graunt's *Observations* : a model of demography's whole design

(A new reading on the first and most influential book ever written in demography)

António Francisco

This essay provides a new reading of John Graunt's *Observations*. The first section of the paper reviews the main portraits of Graunt's work in the literature. Three main portraits are identified; together they show that demographic historiography has so far failed to recognize the broad legacy demographers have inherited from the first and certainly most influential book ever written in demography. Against this background, the second part of the essay discusses why Graunt's *Observations* provided the paragon for demography's whole design. This discussion is structured and concentrates on five elements: (1) defined subject matter; (2) methodological approach and specific methods of inquiry; (3) intellectual and institutional context; (4) a common language or discourse; and (5) utility of the results. These five elements have are considered among the most important features to define a given science, and while they are closely interconnected they are also distinct.

The first element is considered in the three sections, which together show that a coherent subject of inquiry runs right through the *Observations*; the definition of a proper subject matter is its first important contribution to the making of demography.

Secondly, the methodological foundation of the *Observations* are compared with the original methods of inquiry established by Graunt. Graunt's method of inquiry went far beyond the classical Baconian methodology in two ways: he sketched a research program which led to what is now known as descriptive statistics; and for the first time he applied an elementary mathematical method of proportional estimates to the interpretation a large number of social data. Graunt's method has shown to be very powerful because it allows to study regularities from masses of data with recourse to the observation of frequencies in time series; such regularities can neither be seen through abstract mathematics applied to small numbers, nor by using purely qualitative information.

Thirdly, with regard to the intellectual and institutional context of the inception of demography two important features have marked Graunt's *Observations*: the influential philosophy of science at the time, the so-called Natural Philosophy; and the establishment of the English Royal Society, the scientific institution which soon embodied the new philosophy and the scientific attitude worldwide. Thus, demography was born in the context of the remarkable intellectual movement set by prominent philosophers and scientists, such as Bacon, Boyle, Harvey, Hobbes, Newton and Petty. But in this context, perhaps the most unexpected feature was that the debut of the scientific study of population came from the mind of an amateur rather than any of the mainstream scholars at that time. Although this can be understood in association with the originality of the subject and methods of inquiry established by Graunt, following his death a controversy emerged about the authorship of the *Observations*. Throughout the centuries this controversy has had its sporadic bursts until recent times, and it can be used to understand how a classic in science is or is not appreciated throughout time.

Fourth, Graunt's discourse contains some of the allegories and metaphors proper of the Baconian rhetoric (i.e., observations, natural history). However, the concepts found in the *Observations* which became important for the construction of demography's own discourse (i.e. christenings, burials and several sexual terms) were used more in literal than figurative sense. Thus, Graunt's discourse contributed to the rhetoric of the 'natural philosophy' because it established operational concepts which became part of a proper demographic discourse.

The fifth and final element refers to Graunt's research findings and conclusions. The utility of the results need to be understood in close association with the above four elements. The paper calls attention for two aspect concerning the utility of Graunt's research results. On the one hand, the *Observations* dealt with the variety of issues which became the heart of the scope of demography ever since. On the other hand, Graunt's work led to four different and new streams of new investigation: survey data, the field of mortality, the study of population growth, and the development of statistical tests focused on the stability of sex ratios.

1. Introduction

> Historiography is a dialogue between an interrogating present and an interrogated past. Separated forever from the living past, the interrogating historian in following his proper art can reconstruct only from what he sees and understands (Crombie, 1994: 8).

A new reading on the most influential book ever written in demography

At the heart of this essay is a paradox. The deeper we dig into the content and structure as well as the social and intellectual context of Graunt's *Natural and Political Observations made upon the Bills of Mortality* (1662), the more the established historiography on earlier demography turns into a creaking and ugly edifice. This is an unfortunate finding, for two main reasons. Certainly, current demographic textbooks usually make one or two references to Graunt's work. But disturbingly, after more than three centuries demographers have not yet come to terms with the full dimensions of Graunt's contribution for the making of demographic science.

Contemporary demographic historiography usually reduces the importance of Graunt's book (*Observations* hereafter) to the utility of its findings and conclusions; following its first edition in 1662, time and again some authors have called attention for an even more important feature in Graunt's book: the originality and power of Graunt's new method of inquiry. But as this paper demonstrates, overall demographers' failure to recognize the long-lasting influence of Graunt's contribution to modern demography seem to be associated with their failure to accept the *Observations* as the paragon for demography's whole design, and in particular for the bulk of its content.

The bulk of demography can be called 'descriptive' as opposed to what I call elsewhere an 'explanatory demography' (Francisco, 1996). It is more than a coincidence that the distinctions between description and analysis, or description and explanation, are frequently drawn are the concern of both statisticians as well as demography. It is true that the distinction among the cognitive content entailed by such concepts like description, analysis, and explanation is somewhat blurred; but after all, the historians of statistics seem to have come to an agreement that the descriptive statistical analysis of numerical data on population 'occurred first in 1662 when John Graunt analyzed the weekly reports on vital statistics for London, which had been published regularly since 1604' (Hald, 1990: 82).

Yet from a demographic point of view today, just as for Graunt and the philosopher to whom he associated his own work, 'the end rules the method' (Bacon, 1875: 254). It is not the purpose of this essay to discuss directly the issue which have worried demographers over many times: is demography a substantive rather than a mere application of statistics? Nor will I consider any further the need to go beyond the scope of statistics as far as the distinction

between the two types of demographic analysis I discussed in my Ph.D thesis. In any case, the content of this paper has been elaborated as a background for such a debate; thus, the alternative reading of Graunt's contribution to the debut of demography provided here may at least offer an indirect contribution to demonstrate how important the *Observations* has become to the making of descriptive demography.

Briefly speaking, descriptive demography can be defined as the body of demographic analysis directed at the systematic collection of information with the objective to describe population characteristics, primarily with respect to the levels and trends of its size and structure. On this perspective, it may be advanced that the style of work of the average demographer today seems rather more Grauntian than, say, Malthusian.

This assertion may be found, at this stage of the paper, strange for two main reasons. First, demographers have learned from conventional demographic historiography that it is well acceptable, as Kreager (1991: 207) criticized, 'to lump together all writings before 1800 as 'pre-Malthusian' and considered them chiefly for their anticipation of Malthus or of the controversies he aroused'. This a rather misleading reconstruction of earlier development of demography, in part for the reason mentioned by Kreager: that early population inquiry is judge in terms of later developments of which past writers could not have been aware.

The second, and perhaps the most fundamental reason, refers to the very odd picture that demographers have of themselves as social scientists. Often demographers regard themselves as scholars who are testing hypotheses produced elsewhere; this position is nourished by the misconception that they can study what the reality of population is independent of theory. On these grounds Graunt's work has not been regarded theoretical: either because 'description is not knowledge', as Wunsch (1984: 3) put it, or because apparently Graunt did not set his research aiming at testing explicit hypotheses related to any underlying theory.

Graunt's remark, in one of his two dedications, that 'the whole Pamphlet, not two hours reading' has shown to be only partially true, if not somewhat deceiving. It is true that in less than two hours one can learn the main factual findings and conclusions about the population of London which Graunt described. However, after 334 years the controversy that the content and the circumstances of the publication of the *Observations* occurred are issues not yet settled.

The allegation that we now have no time even to read papers published a few, let alone 334, years ago is nonsense when applied to Graunt's book. This is not just any book, but the first in more than three centuries of demography. Secondly, the *Observations* have long ago passed the test of ageing, and it is the one can safely lay claim as the fountainhead of demography as a science. However, this picture is hardly the one students get in demographic literature. Indeed, nor can the accounts of Graunt's legacy to modern demography be regarded as monolith and well established. So what are the main portrait of Graunt's contribution to demography found in demographic literature? This question is dealt with in the first part of this essay. Three somewhat distinct portraits of Graunt's work are identified below; each of these three portraits suggest that contemporary historiography depicts the inception demography as a cracked mirror, for the images students can learn from the debut of demography are of three

main types: completely distorted, very fragmentary, or somewhat reductionists. Taken together, these portraits illustrate the failure to recognize the broad and long-lasting legacy that contemporary demography has inherited from Graunt's *Observations.*

Against the overview provided in the first part, the second part of this essay provides an alternative reading of Graunt's book, one which portraits the *Observations* as the paragon for demography's whole design. The bulk of this discussion is framed around five elements: (1) its subject matter and objectives; (2) its methodological approach and specific methods of inquiry; (3) its intellectual and institutional context; (4) its discourse or language of communication; and (5) the utility of its results. These five features have been chosen because they appear to play an crucial role in the making of any science, and in this case, demography as well. Moreover, they take into consideration not only the limitations of the portraits identified in the first part, but also the need to recognize that even though they are closely interconnected to each other, they should not be conflated into one another because the role of each depends upon the others.

The main purpose of this essay is not to encourage the reader to seek out Graunt's book and read it in its original form and for its own sake. It might be true, as Flew (1970: 8) put it, that 'The classics, as the cynic said, are like the aristocracy; we learn their titles and thereafter claim acquaintance with them'. But there is a certain irony in this statement that runs against itself. Flew's remark was made in his Introduction to Malthus's *Essay on the Principle of Population*, a classic which seems to have provoked rather more reasons than Graunt's *Observations* to motivate people to go beyond the title of Malthus's book. If one assumes that the latter has been read more often than the *Observations*, both within and across several allied disciplines of demography, Graunt's book would have to be classic as a super-classic. In any case, even if it has become widely acceptable in our field to mention the classics without having to bother reading them at all, this habit can neither be attributed to negligence, nor even dismissed as an absolute anachronism. While demographers trust on the reconstructions elaborated by the historians of their own field, in the end historiography of science exists just for that: to avoid that all scholars of each age should seek out the classics and trace in their original forms the development of the main ideas of their field.

Therefore, more than just encourage the reader to seek out Graunt's book and read it for its own sake, or even as an outsider or naive reader, this essay is concerned mainly with the historical reconstructions of the evolution of population inquiry. As Crombie put it in the paragraph chosen as epigraph of this introduction, the interrogating historian his guided by his proper art; the interrogated past is reconstructed from what the historian sees and understands.

With regard to the debut of demography, and Graunt's book in particular, the existing historical reconstruction seem less ingenuous than contemporary historians make their readers to believe. On this, some will perhaps be puzzled that I find it necessary to place a great deal of attention to the philosophy of science lying behind the dialogue between the practice of present historians and the events and aspects of Graunt's work which they to see as much as to ignore and understand. To borrow a phrase from Blaug (1980: 33), if Popper is right about the myth of induction, those who want 'to tell it as it is' will find themselves driven 'to tell it as it should be'.

In short, this paper is mainly concerned in challenging those who are interested in the history of demographic ideas to re-consider the existing portraits of Graunt's book. Just as demographers cannot understand what the reality of population is independent of theory, it would be naive to believe that the historical recollection and the practice of historians are generally guided by the events of the interrogated past. If Crombie (1994: 8) is right, 'We are alerted to the past by experience of the present'.

Demographers need to know the historical background of their field to be able to comprehend their past as much as to be well-situated to comprehend what lies ahead. So in a third and final part, this essay discusses the usefulness of the new reading of Graunt's *Observations* proposed here. Three main aspects are discussed concerning the possible implications of a more accurate and comprehensive understanding of the debut and earlier development of demography for teaching and research.

Reading Graunt's *Observations* and everything that appeared relevant to understand its context was more than entertaining. Moreover, it is pleasing that this essay has been motivated by a topic of which Graunt was certainly not aware: a two-sex demography as I envisaged it in my Ph.D thesis (Francisco, 1996); but how and why a two-sex demography has anything to do with Graunt's *Observations* is not addressed in this essay. Beyond that, I can just feel pleased for the understanding and support I received from the supervisors of my Ph.D thesis; the words of one of them are of particular interest here, in that they sum up the circumstances against which this essay has developed: 'I am glad you are reading Kreager and the classics of the field. I fear that few people passing through the ANU demography program even get to hear of Graunt, let alone Kreager's other "early moderns" '.[*]

---

[*] The bulk of this essay was finilizaed in March of 1995 and appears in my PhD thesis as Appendix A (Francisco, 1996). Preliminary ideas expanded here can be found in a paper presented at the Seventh National Conference of The Australian Population Association (Francisco, 1994). I am grateful for the encouragement I received from my supervisors and advisers, Professors Geoffrey McNicoll, John Caldwell, Gavin. Jones, Dr. David Lucas and Dr. Chris Young. I thanks also the editing by Mrs Wendy H. Cosford, the reading by Dr Miroslava Prazak, and discussion with the participants at a seminar on 30 April 1996 in Department of Demography at the Australian National University. Finally, in the context of the examination of my Ph.D thesis I had the privilege of receiving from Dr Philip Kreager detailed questions for clarification and remarks. The improvements made to the version of this paper in my Ph.D thesis are particular due to Dr Kreager.

1. The new birth of science and the fountainhead of demography

> There is no hope except in a new birth of science; that is, in raising it regularly up from experience and building it afresh; which no one (I think) will say has yet been done or thought of (Bacon, 1620/1875: 94)

When was demography born?

If one had to date the birth of demography it would certainly have to be January of 1662: the date of the first publication of John Graunt's *Observations.* This does not mean that this book can, in any way, be portrayed as a complete treatise on demography. But it can undoubtedly be considered the beginning of a new approach to the study of society and the fountainhead of modern demography's whole design but its name. Although the baptism of this field only occurred about two centuries later, when the French scholar Achille Guillard invented the word in 1855, demography is by now more than three hundred and thirty years old.

That population dynamics has always attracted the interest of prominent thinkers of all times is attested by the earlier writings on population issues. Writers in ancient India, China, and Greece were concerned with the 'optimum' or best population. Yet the systematic study of population leading to the independent body of theory in social sciences called demography is a product of the Scientific Revolution, which began with Copernicus (1473-1543) and lasted through the sixteenth and seventeenth centuries. The radical change in the world view observed between 1500 and 1700 is best known for the achievements of Copernicus, Galileo, and Newton. These, among other intellectuals of the seventeenth century, changed radically the scientific and philosophical bases of disciplines such as astronomy, physics and chemistry; though these disciplines started their independence from philosophy much earlier, only in the seventeenth century did they redeem themselves from the 'old' system of sciences standing on Aristotelian Scholasticism (Purver, 1967; Capra, 1988: 38; Hald, 1990: 19-30).

But to grasp the theory of knowledge which cradled earlier demography there are two important and influential English philosophers. Francis Bacon (1561-1626) is an author often credited as the architect of modern science. His influence in earlier population theory was not so much because he is said to have been the first to use the concept of 'population' (Lorimer, 1959: 125); even more important is the fact that the 'New Philosophy' he strongly advocated provided the grounds for the development of important aspects of demography's whole design associated with its epistemological, methodological, institutional and ideological basis. In turn, Thomas Hobbes (1588-1679) was 'the most conspicuous English philosopher in the whole period between Bacon and John Locke' (Stephen, 1904: 1). This is not apparent by reading conventional history of science where Hobbes has often been written off because of the controversies he aroused and his mechanistic materialism and atheism (Feuer, 1963; Skinner, 1956, 1965-66; Gert, 1967; Shapin and Schaffer, 1985: 8). However, the author of *Leviathan*

systematized Bacon's philosophy, declared that all knowledge is based on sensory perception, and proclaimed geometry as the fundamental science; following the death of Bacon, he became the most active English natural philosopher, having significant intellectual links with prominent European thinkers and with his disciples (Bevan, 1894:80-102; Skinner, 1965: 151-178; 1965-66:153-67) such as William Petty.

It was not pure coincidence that demography was born in the context of the remarkable intellectual movement set by geniuses like Bacon, Harvey, Boyle, Hobbes and Newton. Beyond that, this was the time when priority to empirical observation and research gathered momentum. It was the time when the English Royal Society was becoming the leading institution in the development of scientific knowledge; and the time when 'the Royal Society met', as Pearson (1978: 12) put it, 'to find out things and did not exist merely to publish papers'.

Weird amateur, weird book or weird historiography?

'I would give a great deal for a portrait of John Graunt', so wrote Pearson (1978: 10) in his famous lectures during the 1920s and 1930s. What is more ironic about this is that Graunt is said to have been a collector of prints and a close friend of the portrait painter John Hayls (Hull, 1899: xxxiv). But while a portrait of Graunt would be worth a thousand words about him, at least a full account of the little that is known about his life seems to have already been accomplished. Unfortunately, the same cannot be said about his contribution to demography. Although the *Observations* is an oft-told tale, in the main it is a badly-told tale.

Graunt's name has not just survived against all odds but is increasingly shining among the greatest *Styles of Scientific Thinking in the European Tradition* (Crombie, 1994: 52-53, 1346-1351, 1356, 1394, 1424-1426). It is therefore odd that past demographers seem to have had very little reason to be proud of the birth of their discipline associated with Graunt's name. The exaggerated emphasis given to some details of Graunt's biography is curious, particularly when one takes into consideration the little that is known about his life. His best reputation is as haberdasher of small wares and the son of a London draper, rather than perhaps the most important amateur, or a 'free-holder' (Graunt, 1662/1962: 7) as he put it, in the making of demography.

One gets the impression that something strange is behind the insidious contempt towards Graunt: either he should not be mentioned among the geniuses of his time, though he is there just because there was no better choice to attribute the paternity of demography; or something very awry has happened with the historiography of earlier population theory in the modern period. After all, it is as if demography came into being as an unwanted birth from an accidental encounter between seventeenth century science and an intrusive trader. Graunt's ordinary education certainly did not help; even the studies he did on his own, in the morning before business hours, have not been good enough to recognize him an unconventional amateur.

But was this the main reason authors like Thomlinson (1976:12) found it safer to place Graunt's work under the shadow of Malthus's stature: 'If Graunt can be called the father of demography, Malthus was certainly its first professional'? This innocent view of the professional academy is unfortunate on two grounds. On the one hand, it dismisses the work of those professionals on the study of population to whom Malthus himself turned to borrow the available data he needed to support his argument. Graunt, Petty, Newton, Boyle and even Malthus were all known as 'natural philosophers'; they predated the creation not only of the word 'demography' but also the word 'scientist'. According to Hald (1990: 3), 'the word "scientist" was coined about the middle of the 19th century, reflecting an ongoing specialization and professionalization'.

On the other hand, the attribution of the fatherhood metaphor to Graunt has been received with much contempt by social scientists of all times. There is a reason for that. It is rather unusual that not one but two totally new scientific fields, as in this case demography and statistics, were created by a man strange to scientific thinking. The problem, though, is that in the history of science the so-called 'fathers' of new scientific fields do not appear as in ordinary life, in which even accidental and incautious affairs with strangers sometimes lead to new births. To paraphrase Matthews (1995: 46), as the Cambridge number theorist G.H. Hardy discovered in 1913, not all amateur scientists are yo-yos. Matthews made these remarks in a review of a book on Pierre de Fermat (1601-1665), a French contemporary of Graunt considered to be the 'most famous of all "amateur" number theorists" (Matthews, 1995: 46). Like Fermat, Graunt was not a 'natural philosopher' by profession; but undoubtedly the reason both authors became part of the history of science is not because of the ways they made their living.

In short, the conjecture that demography either comes from nowhere or is a by-product of its allied disciplines, classical statistics and political economy, is but an elegant way of calling it a bastard science. This view can and should be challenged, but before it is important to review the main view on Graunt's work provided by the literature.

Demographic historiography: portraits of Graunt's work in a cracked mirror

The immediate and most popular portraits of Graunt's work are easily found in contemporary textbooks and other demographic sources. It is not a monolithic image, and in fact can be classified in three main groups, according to what their view of Graunt's contribution to demography.

I

First, perhaps the most weird portrait of Graunt's work is what may be called the *nonsense portrait*. This corresponds to the view which completely dismisses Graunt's

contribution to the inception of demography as a crucial stage in population theorizing. At least two flagrant examples in modern historiography of population theory illustrate the nonsense portrait. On the one hand, Overbeek's 1974 book, *History of Population Theory*, makes no single reference to Graunt's *Observations*. Not even the chapter preceding the classics of population theory, 'mercantilism, physiocracy and population theory', has singled out the name and the work of Graunt. On the other hand, there is the examples of Valentei's books, *An Outline Theory of Population* (1977) and *The Theory of Population: Essays in Marxist Research* (1978). The former of these two book starts with Marx and finishes with Lenine. Graunt's book is mentioned once (a footnote in page 256) in over more than 300 pages. In the second, Valentei treats early population theory like Overbeek, 'as a mere preliminary to Malthus and later writers on the interplay of individual choice and market forces (Kreager, 1991: 208). This approach, as Kreager maintained, 'now almost a century old, has been to lump together all writings before 1800 as "pre-Malthusian" and to consider them chiefly for their anticipation of Malthus or for the controversies he aroused' (p. 207).

In addition to this, one should not live the impression that the neglect of Graunt's books by some historians of population theory is because they only learned its title. Instead, the absence of Graunt's *Observation* in the nonsense portrait seems to have been the product of a conscious choice, and reflects a very odd conception of the nature of science. This conception entails the view that even when someone comes along with a completely new study on population, he or she may be assumed to have worked independent of theory. Curiously, this is not what one understands from Overbeek's (1974: viii) remarks about the arbitrariness of his choices from the wide range of authors going back to Plato and Aristotle; according to his explanation the authors own interests and prejudices determined what was included or omitted.

II

The second portrait of Graunt's book can be called the *fragmentary portrait*. The term 'fragmentary' is borrowed from Kreager. In his 1991 paper, Kreager criticized what he called the 'fragmentary' understanding provided by the conventional dated historiography on population inquiry, in three terms: the approaches in which population is cut adrift from its early modern sources; the tendency to alienate modern attitudes towards population from the ideas of which they were a part; and the tendency to set aside quantitative from theoretical and qualitative methods. However, with regard specifically to the *Observations* the fragmentary portrait seems to be characterized by the emphasis given to the utility of Graunt's findings and conclusions.

The allegation, as Glass (1963: 6) wrote, that 'Each age looks at a "classic" in terms of its own interests and problems and thus the points of emphasis differ accordingly' is not very adequate as far as demographer's attitude towards Graunt's findings. Glass asserted that 'whatever the particular and varying emphases, demographers in general would agree that probably the most outstanding qualities of Graunt's (1963: 7) work are first, the search for regularities and configurations in mortality and fertility'. In reality, though, the view expressed in textbook and literature in general indicates that demographer's recognition is almost

exclusively limited to the field of mortality: the proportional mortality by causes of death, and the anticipation of the life table. As Lorimer wrote in 1959:

> Real continuity in the development of interests and methods of inquiry from early to modern times seems to have been largely limited to investigations of mortality and the formulation of life expectations. If there is any 'apostolic succession' from John Graunt to modern demographers, it passes through this rather limited field (Lorimer, 1959: 158).

In 1976, although Thomlinson spoke about Graunt as of the 'greatest eminence among the demographic pioneers', he also reduced the importance of his work to the 'study of the causes of death (including a primitive life table)' (pp. 9, 112, 121, 148) and the 'population of the environment' (p. 531). Recently, it has become somewhat fashionable to introduce a mortality chapter in conventional textbooks of demography with an historical note on its origin by just referring to the name of Graunt (see Newell, 1988: 61; Diamond and McDonald, 1994: 29). Perhaps, Lucas and Meyer's (1994) recently re-edited textbook already attempts a glimpse on Graunt's work certainly more consistent with the image one would expect about someone who deserves to be called 'the father of demography'. In a brief reference to the *Observations* Lucas (1994: 1) introduced Graunt's work to the reader as 'a study of births and deaths'; he added that its author answered questions similar to those that contemporary demographers ask whenever they study the population of a specific country.[1]

The fragmentary portrait comprises most of the work done so far on Graunt, though it is concerned mainly with the utility, accuracy, and implications of his wide range of findings and conclusions; as Box 1 below highlights Graunt himself enumerated at least 15 principal findings and conclusions in one of the two dedications of his book.

Neither of the images derived from the interest and discussion that Graunt's findings motivated is false, but they are partial and indeed misleading if they are from the rest of Graunt's own logic of investigation. As Kreager (1993: 521) correctly pointed out, the fragmentary view is 'rather narrow and teleological'; besides focusing on isolated aspects of the work of earlier classics, in this case Graunt's work, it 'often sought to enliven its perspective by including brief biographical sketches or other details from the social background'. Since the late nineteenth century several authors have, in fact, made important efforts to come to terms with the intriguing persistence of Graunt in the history of science.

In 1899, Hull used the opportunity of editing Petty's economic writings to highlight the close connection of Graunt's book with his acknowledged works; he provided an extensive account of Graunt's life and work, especially his contribution to the science of statistics, and discussed the disputed authorship of the *Observations*. In the first three decades of the twentieth century several authors gathered additional details of Graunt's life and called attention to some important but isolated features of his work: in 1910, Knibbs spoke of Graunt as the first who recognized 'the human being as the basic unit' in statistical analysis (Knibbs, 1910:

---

[1] Lucas and Meyer's (1994) textbook contains only two other references to the name of Graunt: the one already mentioned above, made by Diamond and McDonald (1994: 29); the other is also from Lucas (1994: 19) in which he cited Thomlinson's comparison between the stature of Graunt and Malthus, presumably simply to introduce the latter as the 'first professional' and the central figure in earlier modern population theory.

509). Pearson (1978: 10), in his famous Lectures in the 1920s and 30s, discussed Graunt's life and work against the background of the London of Charles II, the Great Plague, the early meetings of the Royal Society and Petty's profitable ventures in Ireland; in particular he highlighted the features which supported his claim that Graunt was 'the first statistician, - the first man to deal with vital statistics - the first statistician who became a Fellow of the Royal Society' (Pearson, 1978: 10). Towards the late 1920s and during the 1930s authors such as Lansdowne (1927) and Greenwood (1928, 1933, 1948) involved themselves in heated disputes about the authorship of the *Observations*.

After the centenary and the bicentenary had passed unnoticed, the interest in Graunt increased as the tercentenary of the publication of the *Observations* approached. In 1959, Lorimer in his analysis of the development of demography gave a significant emphasis to Graunt's work. And in 1962, the association of Graunt's book with the birth of demography was celebrated publicly, perhaps for the first time, to mark its tercentenary. The Royal Society organized an international symposium on 15-16 November 1962 for 'A Discussion on Demography'. This meeting brought together some of the most outstanding demographers of the 20th century, namely F. Notestein, L. Henry, J. Hajnal, W. Brass, and R. Freedman. Among the speakers, Glass (1963) and Sutherland (1963a) contributed with a comprehensive and, so far, the most up-to-date account of Graunt's life. They also reviewed Graunt's contribution to demography and the controversy upon the true authorship of the *Observations.* Yet, that these two authors put an end to the authorship dispute, as Kreager suggested in 1988, seems to be an exaggeration. The tercentenary of Graunt's book motivated other articles which dispute the view that Petty's contribution to the *Observations* was strictly limited (Matsukawa, 1962; Kargon, 1963; Groenewegen, 1967; Cullen, 1975); but this is a point to which this essay returns later.

III

The third portrait of Graunt's work corresponds to what can be called the *reductionist portrait*; it comprises approaches which reduce the importance of the *Observations* mainly to the novelty and power of Graunt's method of inquiry. Broadly speaking, one could probably considered this portrait as part of the fragmentary. But the reductionist portrait entails an important shift of attention as compared with the one which stress the utility of Graunt's findings and conclusions. In the process of digging deeper into the content and structure of Graunt's scientific work and doing full justice to his contribution to the fountainhead of modern demography the shift towards the method of inquiry has been an important one.

The attention to the novelty and power of Graunt's method was first acknowledged some years after the first edition. As Kargon (1963: 347; see also Hald, 1990: 106) put it, 'It was not William Petty or Robert Moray, but rather Christian Huygens who first noticed the novelty and power of Graunt's method'. Kargon's (1963) interesting and persuasive article discussed explicitly the importance of distinguishing the utility of the *Graunt's* findings and conclusions from its fertile and powerful methods. Moreover, besides putting Bacon's and

Graunt's programs in parallel Kargon explained with some persuasiveness the circumstances of the reception of the *Observations* in 1662.

> Those who were interested in Graunt's *Observations*, like Moray and his fellow members of the Royal Society, were primarily intrigued by the fascinating factual information which Graunt had brought to light. Thus Christian Huygens was the first not only to apply and carefully reason with Graunt's innovation but also to appreciate fully the intrinsic merits of the approach. He linked the new probability theory to a statistical approach and thus anticipated a potent combination in future generations (Kargon, 1963: 348).

In 1978, Vilquin (1978: 420) argued further that Graunt merits the unquestionable title of father of demography 'not just because the *Observations* are, chronologically, the first book in which a given science appeared'. Vilquin stressed that Graunt sketched the methodological basis of demography. In 1985 Jacques and Michel Dupâquier described the work of both Graunt and Petty within the scope suggested by the title of their book *Histoire de la Démographie: la statistique de la population des origines à 1914.* The authors of this book reacted to Vilquin position with reservation, though they expressed their scepticism in a simple sentence between brackets: 'le problème est de savoir s'il est possible de parler de "fondateur" pour un domaine scientique tout entier' (Dupâquier and Dupâquier, 1985: 137).

By the time Kreager wrote his paper called 'new light on Graunt' (1988), the discussion on Graunt had been running in circles for quite a long time; not only did the details of the little that is known about Graunt's life seem to be exhausted, but the tendency for insulating selected aspects of the *Observations* from any theoretical principle had long become self-defeating. The reasons were summed up with clarity by Kreager (1988: 129): 'any further advances could only be made by placing Graunt and his little book more fully in the intellectual and social context of their time'.

But perhaps the most important aspect of Kreager's recent papers (1988, 1991, 1993) is their damaging challenge to the putative historiography which still figures in demography today; in particular, he persuasively substantiated the main distinction made by Kargon (1963) between the utility of Graunt's findings and conclusions, on the one hand, and his fertile method, on the other. Unfortunately, Kreager did never mention Kargon's (1963) paper in his three articles; even in his 1993 paper, Kreager refers to Huygens but fails to explain how Huygens's interest for Graunt's method was rather older than his 1988 article implied.

In any case, Kreager's papers of 1988 called 'New light on Graunt' formulated two important questions concerning the method of inquiry found in the observations: 'First, what were the sources of Graunt's method? ...Is there in fact a coherent method which runs right through the *Observations*?' (Kreager, 1988: 139-130). Probably, the most interesting aspect Kreager discusses with regard to Graunt's method refers to his alternative technics of calculation, his method of keeping *accompts* drawn from the bookkeeping arithmetic he employed.

There are several limitations in Kreager's discussion which are discussed in the next section. However, it seems important here to clarify the reductionist nature of Kreager's portrait of Graunt's contribution to the making of demography. In his effort to throw new light on Graunt, Kreager has conflated and lumped together the important but relatively independent

features in any science, namely epistemology, methodology, institutional setting, and language of communication. Kreager discussed all these issues as part of a debate on the method of inquiry in demography and as opposed to the only feature remaining, the findings and conclusions of the *Observations*. In answering to his two questions mentioned above, Kreager correctly put Graunt and Bacon side-by-side and, thus, contrary to most authors he was not elusive about the methodological basis of Graunt's own methods.

'It remains for demography to lay claim to its distinguished past', so concluded Kreager his review of three recent contributions by Hacking (1975), Daston (1988), and Hald (1990) to correct the views in statistics and probability about the earlier past of these fields. But how can demographers claim any distinguished contribution of Graunt's book to demography?

The above overview shows that demographers have usually missed the opportunity to raise and lead, rather than join, a debate of interest across several disciplines concerning the extraordinary contribution of Graunt to science. Over the last century first were authors such as Hull (1899), Greendwood (1948), Pearson (1978) and Westegaard (1969) who insisted on the importance of Graunts' work mostly for the inception of statistics. More recently, Hald (1990) followed Hacking (1975) and Daston (1988) and convincingly laid claim on Graunt's distinguished contribution for statistics: that the *Observations* provided the paragon for descriptive statistical analysis of demographic data.

After all, authors from other allied disciplines have recognized Graunt's contribution for their own fields. With regard to the utility of Graunt's findings some of the aspects demographers have given more attention can be considered largely medical in their nature (Kargon, 1963). In turn, most of the features concerning Graunt's method of inquiry led to what is now known as descriptive statistics, and now generally independent of the subject of demography.

So is there anything still left for demographers to claim that has no been claimed yet? The short answer provide in the remaining of this essay is yes. But for that one needs to be open to look beyond the limits that has so far been imposed by the existing historiography. For instance, the above review suggest that in terms of priory to Graunt's contribution the attention has been generally concentrated on the utility of his findings and conclusion. An important step forward has been provide by those who called attention for the novelty and power of Graunt's method of inquiry.

Yet another important step proposed in the next section is to move from the method to the subject matter of demography. So the shift from the utility to the method, and now from the method to the subject-matter will set the grounds to understand the foundations of the starting point. That is, the best way to understand the utility of any scientific finding seems to be to look for the nature of the subject and the method of inquiry. After all, if Bacon (1875: 254) was right the 'end rules the method'; and taken together, the scientific results are explain by both the subject and the methods.

There is no doubt that several authors have acknowledged that Graunt 'was permeated with the spirit of that new philosophy which bade curiosity turn for satisfaction rather to

observation than to speculation' (Hull, 1899: lxxvii); but what such a spirit and new philosophy were all about, and how worthwhile for the development of demography they became, is often something considered beyond the scope of demographers' concerns. Moreover, it is striking that those who have written about Graunt's contribution to demography following the celebration of publication of the *Observations* in 1962 have paid no attention to the statement introducing the papers published in *Proceedings of the Royal Society*: '... the publication of his book founded *the subject of demography*' (Medawar and Glass, 1963: 1; emphasis added). As point above, Vilquin's (1978: 420) assertion that the *Observations* was 'the first book in which a given science appeared' was dismissed by the authors of one of the most important histories of (Dupâquier and Dupâquier, 1985).

It is hard to believe that Graunt and any scientists of his time, professional or amateurs, were aware how his simple and elegant 'new thing' would radically revolutionize the way social phenomena have ever since been studied. But to reduce the importance of Graunt's work either to some of its findings or the power of its new method conflicts even with Graunt's own attempt to place his research in the context of the two most important intellectual episodes of his time. On the one hand, the influential philosophy of science, the so-called Natural Philosophy strongly advocated by Bacon, and in particular his natural history upon life and death. On the other hand, the establishment of the English Royal Society, the scientific institution which soon embodied the new philosophy and the new scientific attitude worldwide.

So the next section discusses the provided by the new reading of Graunt's *Observations*, one which seems to be truly integrative because it takes into consideration the important features which a paragon for demography's whole design

2. The *Observations: a model of* demography's whole design

> those who cannot apprehend the reason of these enquiries are unfit to trouble themselves to ask them (Graunt, 1662: 51)

'There is no single standard conception of the scope or framework of demography', wrote Hauser and Duncan (1959: 1) more than three decades ago in their massive book called *The Study of Population: An Inventory and Appraisal*. Hauser and Duncan opted for assessing demography as a science from two main points of view: as 'a field of interest delimited by a frame of reference, data, and methods of study', and as 'a corpus of knowledge embracing existential propositions and explanatory principles'. These elements are included in the framework used here, though as part of different logical structure, which seems to accommodate better the aspects in the *Observations* that fit into the sequence of development that led to the accepted body of current demography.

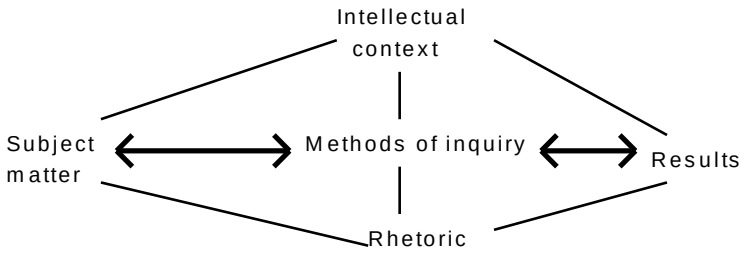
However remarkable and unexpected any of the findings and conclusion found in the *Observations* might have been, the most important aspect is to understand how did Graunt reach to them. This can only be possible if the results of Graunt's investigation are placed in the context of a framework comprehensive enough. There are at least five relatively distinct but closely interconnected elements which define any science, and in this case demography: (1) a subject-matter of its own, including its relatively independent epistemological issues, a proper scope of content, as well as justification, objectives and specific research agenda; (2) a fundamental methodology and an array of specific methods of inquiry drawn from different methodological settings; (3) the intellectual and institutional context, including the characteristics of demographic profession; (4) a common language of communication or discourse; and (5) the utility of its results and conclusions.

These five elements were somewhat brought together at once in the *Observations*; but in discussing its long-lasting and multiple implications some authors have acknowledge one or another at the expenses of the others. In contrast, the contention of this essay is that if the five elements are taken into consideration adequately the distinguished contribution of Graunt's book as a paragon for demography's whole design should become apparent. This does not mean that the five features can be isolated and considered totally separable from one another, as indeed as happened so hitherto. Instead, each element embedded the others, though they should not be conflated into one another because the role of each depends upon the others.

Figure 1 depicts the structure of five elements showing at the center the chain comprising the subject and objectives, the methods of inquiry and the results of the investigation. Curiously, as the overview provided above indicates that the recognition of the *Obsertation* usually goes first to its findings and conclusions; then the attention usually shifits to the noverty the noverty and power of the methods of inquiry, and seldom the subject-matter. Granted that this core chain is accepted, the scheme in Figure 1 suggests that the importance of Graunt's *Observations* can be better understood if one reverses the process of discussion,

starting from the subject-objectives and moves to the methodological aspects, as Bacon (1875: 254) put it, 'For the end rules the method'. In addtion to this chain two other additional dimensions contributed to the success of the *Observations* need to be taken into account: the intellectual and institutional context of Graunt's investigation and the rhetoric of his discourse. In these terms, and contrary to what usually happens, the results of the investigation can be understood as comprehensive logic of scientific discovery rather than the product of recondite magic or enigmatic genious.

Figure 1: A framework for the analysis of Graunt's 'Observations'



The discussion of Graunt's book according to the framework outlined here concentrates on the first edition of the *Observations*, reprinted in modern English by the *Journal of the Institute of Actuaries* in 1962 and the fifth edition of the *Observations* published in 1665. The first edition was much shorter, 58 pages in the reprinted version, while the much enlarged fifth version contains a total of 150 pages.

Over the first two centuries there were eight reprints of Graunt's book. The second some months after the first. The third and fourth editions were published during Graunt's life under the Royal Society's imprimatur. In 1676 a fifth edition was put out apparently under Petty's supervision. As Hull explained , since 1676 and until the end of the 19th century the *Observations* were printed but once in English, viz. in *A Collection of the Yearly Bills of Mortality from 1657 to 1758 , London: 1759*. There was also an anonymous German translation published at Leipzig in 1702 (Hull, 1899: 318). From this account Hull's reprint was the eighth. To my knowledge, during the 20th century Graunt's book was reprinted in 1939 by Willcox, in 1962 by the Institute of Actuaries (Benjamin, 1964), in 1973 by Laslett, and in a French translation by Vilquin (1978). The first version of the *Observations* I read was the one printed by Hull. However, after discovering that the Institute of Actuaries reprinted Graunt's book in a modern format without abridgment or alteration (Benjamin, 1964: 3) I tried to restrict the citations and references to the modern version. Only when citations used do not refer to the first edition Hull's reprint will be used, and only then is the date of edition included.

To get an idea of Graunt's overall demographic work one should look at the fifth edition of the *Observations* because this was the much enlarged and last version published while Graunt was still alive. The fifth edition comprises the following rubrics: two dedications, one to Lord Roberts and the other to Sir Robert Moray; a synoptic Index of 106 propositions

on 'the positions, observations, and questions contained in the discourse'; the preface; an Appendix of Tables; 'some further observations of Major John Graunt'; the 'advertisements for the better understanding of several Tables: videlicet', and the following 12 chapter headings:

1. Of the Bills of Mortality, their beginnings, and progress
2. General Observations upon the Casualties
3. Of Particular Casualties
4. Of the Plague
5. Other Observations upon the Plague, and Casualties
6. Of the Sickliness, Healthfulness, and Fruitfulness of Seasons
7. Of the differences between Burials, and Christenings
8. Of the difference between the numbers of Males, and Females
9. Of the growth of the City
10. Of the Inequality of Parishes
11. Of the number of Inhabitants
12. Of the Country Bills

The Conclusions

The content of the these chapters was summarized by Graunt in his Index of 106, which provides a good idea of 'the positions, observations, and questions contained in this discourse'. Graunt's Index in reproduced in Table 1 in annex, not just to give the read the opportunity to grasp quickly the content of the whole book; the last four columns in Table 1 estimate the portions of the book dedicated to eight main topics drawn from the topics enumerated in the sub-title in the cover of the book and first of the two dedications: (1) data appraisal; (2) death - diseases, health and longevity; (3) births - fruitfulness and productivity of marriage; (4) sex ratio - proportion between the sexes and ages; (5) migration between countries and the City of London; (6) Air (enviroment); (7) population change - the numbers of inhabitants and population growth; (8) population policies - government, trade and religion. The estimate of the portions of the book dedicated to these topics will be used below in the section dedicated to the utility of Graunt's results.

Box 1 provides what, in the language of today, may be called an 'executive summary' of Graunt's book. The paragraphs contained in Box 1 are extracted from the two dedications and the preface with the objective to illustrae the five elements which need to be taken into consideration to claim that the *Observations* provided the paragon for the whole design of demography as a social science.

The first and second paragraph highlight Graunt's scientific insight and motivation for the investigation he carried out on the population of the City of London. The two paragraghs are relevant for the consideration of the aspects comprised in the first element, the subject of demography; in particular, Paragraph 2 stresses that the subject of the book has 'fallen out to be both political and natural' and is part of of Bacon's discourse of life and death, one of the 'particular histories' within the phenomena of the universe.

While Graunt's book relates to natural history as a subject-matter, Paragragh 3 highlights that 'it depends upon the mathematics of my shop-arithmetic'. Paragraph 4 refers to Graunt's method of research, or as Hald (1990: 86) put it, 'His program for descriptive statistical

analysis'. Paragraph 5 highlights the logic of demographic discovery depicted in Figure 1 below, in which the process of demographic discovery moves from 'concepts' (general theory) to 'indicators' (auxiliary theory) and 'statistical models'. Paragraph 6 enumerates the 15 principal findings and conclusions found in the dedication to Lord Roberts; they detail the issues mentioned in the cover: 'Government, religion, trade, growth, air, diseases, and the several changes of the said City'.

Box 1: A sort of an Executive Summary of the Graunt's *Observations*

1. Having been born and bred in the City of London, and having always observed that most of them who constantly took in the weekly Bills of Mortality made little other use of them, than to look at the foot, how the burials increased or decreased; and, among the casualities, what had happened rare and extraordinary in the week current: so as they might take the same as a text to talk upon in the next company; and withal, in the Plague-time, how the sickness increased or decreased, that so the rich might judge of the necessity of their removal, and tradesmen might conjecture what doing they were like to have in their respective dealings: ... Now, I though that the wisdom of our City had certainly designed the laudable practice of taking and distributing these accounts, for other and greater uses than those above-mentioned, or at least, that some other uses might be made of them: and there upon I casting mine eye upon as many of the General Bills as next came to hand, I found encouragement from them, to look out all the Bills I could (Preface, p. 14).

2. The observations, which I happened to make (for I designed them not) upon the Bills of Mortality, have fallen out to be both political and natural, some concerning trade and Government, others concerning the air, countries, seasons, fruitfulness, health, diseases, longevity, and the proportions between the sex and ages of mankind. All which (because Sir Francis Bacon reckons his discourses of life and death to be natural history ... (Dedicatory to Sir R. Moray, p. 6)

3. as it relates to natural history, and as it depends upon the mathematics of my shop-arithmetic (p. 6)

4. Now having (I know not by what accident) engaged my thoughts upon the Bills of Mortality, and so far succeeded therein as to have reduced several great confused Volumes into a few perspicuous Tables, and abridged such observations as naturally flowed from them, into a few succinct paragraphs, without any long series of multiloquious deductions ... (Dedicatory to Lord Roberts, p. 4). ... I have reduced into Tables (the copies whereof are here inserted) so as to have a view of the whole together, in order to the more ready comparing of one year, season, parish, or other division of the City, with another, in respect of all the burials and christenings, and of all diseases and casualties happening in each of them respectively (Preface, p. 14).

5.I did then begin not only to examine the conceits, opinions and conjectures, which upon view of a few scattered Bills I had taken up; but did also admit new ones, as I found reason, and occasion from my Tables ... Moreover, finding some truths, and not commonly believed opinions to arise from my meditations upon these neglected papers, I proceeded further, to consider what benefit the knowledge of the same would bring to the world (p. 14).

6. I conceive ... how few starve of the many that beg:
- that the irreligious proposals of some, to multiply people by polygamy, is withal irrational and fruitless
- that the troublesome seclusions in the Plague-time is not a remedy to be purchased at vast inconveniences
- that the greatest Plagues of the City are equally and quickly repaired from the country:
- that the wasting of males by wars and colonies do not prejudice the due proportion between them and females
- that the opinions of Plagues accompanying the entrance of Kings is false and seditious
- that London, the Metropolis of England, is perhaps a head too big for the body, and possibly too strong
- that this head grows three times as fast as the body unto which it belongs, that is, it doubles its people in a third part of the time
-that our parishes are now grown madly disproportionable
- that our temples are not suitable to our religion
- that the trade, and very City of London removes westward
- that the walled City is but a one fifth of the whole pile
- that the old streets are unfit for the present frequency of coaches
- that the passage of Ludgate is a throat too straight for the body

- that the fighting men about London are able to make three as great armies as can be of use in this Island
- that the number of heads is such as hath certainly much deceived some of our Senators in their appointments of Pollmoney, etc. (Dedicatory to Lord Roberts, p. 4, 5).

Natural history and the subject of demography: from Bacon to Graunt

The subject of demography refers to the relatively independent epistemological knowledge set around the questions, puzzles and problems concerning population change; considered more broadly, the subject of demography can said to include the insights and motivation for a given scientific study, the goals and specific objectives, the scope of content and the kind of concepts and ideas developed, and the research agenda for further studies.

As Bacon wrote, the 'faculty of wise interrogating is half knowledge' (cited by Purver, 1967: 43). While the ability to ask the significant questions is of utmost importance at all stages in the research process, but how did in fact demography start off? As Wunsch (1984: 2) put it, 'Science starts off with a question, a problem, a puzzle'. If this view of science is correct as a general principle, it must have also be applicable to the beginning of demography as a science.

It took an alert and interrogating intellect such as Graunt's to be inspired and motivated to wonder about something as familiar as people's births, deaths, and movements. A legitimate issue here would be associated with the question, why did it take so long for the subject-matter of demography to come about? The oft-told tale about the lack of data is a badly-told tale and, in fact, the answer provided by Hacking (1975: 102) to a similar question regarding the emergence of probability and statistics around the same period seems to be equally valid to demography: only when epistemological criteria can be grasped independently of the causal theory can demography emerge (Hacking, 1975: 104-5).

Epistemological issues are the first, if not the main expression of identity of a given science; they are concerned with questions such as, what should and can be known about population? Who should be studied (i.e. women, children, men, specific age groups? What kinds of concepts can be used? What is the purpose of demographic analysis? From this point of view, demography started off with the insight described by Graunt in the Preface (see Paragragh 1 in Box 1). Graunt's explanation acknowledges the practical uses of the Bills Mortality as opposed to what 'other uses might be made of them'.

In this insight lies Graunt's interrogating faculty, and this may be considered his first contribution to the making of the subject of demographic. Such a faculty cannot be understood as a by-product of any of his specific concepts or indexes, nor even the powerful method he developed. Instead, Graunt was aware of the opinions, conjectures, and superstitons concerning population change. In his dedication to John Toberts, the Baron of Truno, Lord Privy-Seal, and one of His Majesty's most Honourable Privy Council, Graunt wrote:

> Now, although your Lordship most excellent discourses have well informed me that your Lordship is no stranger to all these positions; yet because I knew not that your Lordship had ever deduced them from the Bills of Mortality, I hoped it might not be ungrateful to your Lordship, to see unto how much profit that one talent might be improved, besides the many curiosities concerning the waxing and waning of diseases, the relation between healthful and fruitfull seasons, the difference between the city and country air, etc. All which, being new, to the best of my knowledge (p. 5).

Graunt's expectation that 'some other uses might be made of them [the data in the Bills]' (p. 14) may be comparable to the story that Newton was inspired by an apple hitting his head (Hawking, 1988: 5).[2] Although insights do not explain the remaining of the research process, in a way they trigger many original approaches upon specific puzzles such as those concerning population change in Graunt's time. The failure of other to make any scientific use of the data available contained the embryo of Graunt's success in creating the subject-matter of demography.

The need to define both the subject-matter and its objectives and methods was one of the characteristic features of the scientific movement throughout the seventeenth century. Such need became the leitmotif of the research, from Galileo and Bacon to Descartes and Hobbes (Crombie, 1994: 45). Like most demographers now, Graunt did not worry about whether science starts with a question, a problem and a puzzle or a method. He seems to have been mostly concerned that everything he had at his disposition fit together. In any case, the second dedication of the *Observations* make it explicit that it was to Bacon's natural history that Graunt explicitly associated his *Observations*. The problem that remains, however, is how contemporary readers interpret this specific link between Graunt's *Observations* and the Natural Philosophy advocated by Bacon?

Many demographers may have thought Graunt's reference to Bacon trivial, mainly because Graunt made it in the context of his rather apologetic *Epistle Dedicatory to ... Sir Robert Moray, ... President of the Royal Society of Philosophers*. But at least some have acknowledge the link between Bacon and Graunt for the methodological inspiration that the former might have provided. However, when one considers carefully Bacon's concept of science it appears that Graunt referred to 'natural history' as a subject matter rather than a method of inquiry.

This aspect needs some further considerations, particularly because Kreager (1988: 130) has the central concept of 'natural history' as a stage in Bacon's method: 'Natural history was the first stage of Bacon's new scientific method, in which direct observations of nature and man were compiled and given a preliminary order'. Likewise, in 1991 Kreager once again considered 'Natural history' a method: 'This method proceeded by observing and comparing visible signs of balance and imbalance in different individuals and populations' (Kreager, 1991: 220).

The reduction of natural to a method attributed to Bacon is neither supported by Bacon's writings, nor by the interpretationts made by several authors who cast their attention into Bacon's scientific method (Fowler, 1889: 54-68; Jardine, 1974: 120-132; Kargon, 1963: 342-343; Purver, 1967: 35; Rossi, 1968: 135-223). Although this is not the adequate place to review this matter extensive, it seems useful to mention some of Bacon's remarks found in his 'plan of the work' for the *Great Instauration*.

---

[2] According to Hawking this story is 'almost certainly apocryphal. All Newtwon himself ever said was that the idea of gravity came to him as he sat "in a contemplative mood" and "was occasioned by the fall of an apple" ' (Hawking, 1988: 5).

Bacon divided the plan of this work into six parts, and the first three parts are the most important to understand the place of 'natural history' in his scientific logic. 'The first part exhibts a summary or general description of the knowledge which the human race at present possesses', Bacon (1875: 23) explained. With regard to the second part, Bacon continued, 'the next point is to equip the intellect for passing beyond' the ancient arts. 'To the second part therefore belongs the doctrine concerning the better and more perfect use of human reason in the inquisition of things, and the true helps of the understanding'. The art which Bacon proposed, which he called 'Interpretation of Nature', was 'a kind of logic'; but the difference between it and 'the ordinary logic' was meant to be 'great; indeed immense'.

> For the ordinary logic professes to contrive and prepare helps and guards for the understanding, as mine does; and in this one point they agree. But mine differs from it in three points especially; viz. in the end aimed at; in the order of demonstration; and in the starting point of the inquiry ... Now my plan is to proceed regularly and gradually from one axiom to another, so that the most general are not reached till the last (Bacon, 1875: 23-24).

But the greatest change he introduced, Bacon explained, was

> in the form itself of induction and the judgment made thereby. For the induction of which the logicians speak, which proceeds by simple enumeration, is a pueril thing; concludes at hazard; is always liable to the upset by a contradictory instance; takes into account only what is known and ordinary; and leads to no result. Now what the sciences stand in need of is a form of induction which shall analyse experience and take it to pieces, and by a due process of exclusion and rejection lead to an inevitable conclusion (Bacon, 1875: 25).

'Natural history' appear in the third part of Bacon's plan of work as the subject where the new methods need to be applied: 'But I design not only to indicate and mark out the ways but also to enter them'; this

> embraces the Phenomena of the Universe; that is to say experience of every kind, and such a natural history as may serve for a foundation to build philosophy upon ... Those however who aspire not to guess and divine, but to discover and know ... must go to facts themselves for everything ... The only hope therefore of any greater increase or progress lies in a reconstruction of the sciences. Of this reconstruction the foundation must be laid in natural history, and that of a new kind and gathered on a new principle. For it is in vain that you polish the mirror if there are no images to be reflected; and it is as necessary that the intellect should be supplied with fit matter to work upon, as with safeguards to guide its working (Bacon, 1875: 28).

For Bacon 'natural history' corresponds to the creation of factual 'images' and 'fit matter to work upon'. He considers both his 'history' and his 'logic' different from those in use: 'For first, the object of the natural history which I propose is ... to give light to the discovery of causes and supply a suckling philosophy with its first food' (Bacon, 1875: 28-29). Thus, 'By such a natural history ...I conceive that a safe and convenient approach may be made to nature, and matter supplied of good quality and well prepared for the understanding to work' (Bacon, 1875: 30-31). Still, thoughout the development of his books Bacon reinforces the same view:

> Natural History, which in its subject (as I said) is threfoold, is in its use twofold. For it is used either for the sake of the knowlegde of the particular things which it contains, or as the primary material of philosophy and the stuff and subject-matter of true induction ... Let them but remember this, and they will find out for themselves the method in which the history should be composed. For the end rules the method. (Bacon, 1875: 254).

A clear indication that Graunt considered is subject a 'particular history', in Bacon terms, of the phenomena of the Universe is confirmed by his explicit reference to Bacon's book called *The History of Life and Death, or the Second Title in Natural and Experimental Hsitory for the Foundation of Philosophy: being the third part of the Instauratio Magna.* This book dealt with one of Bacon's suggested topics in his 'catalogue of particular histories'; the catalogue included 130 titles, starting with the 'History of the heavenly bodies; or astronomical history' and finishing the 'History of the natures and powers of figures'.[3]

Bacon clearly distinguished the epistemological issues, namely the 'faculty of wise interrogating', from his methodological philosophy. In the case of *The History of Life and Death* Bacon was concerned in explaining the process of gradual 'bodily decay and the atrophy of old age' and, in particular, he identified the subject of his study as follows:

> There are therefore two subjects of inquiry; the one, the consumption or depredation of the human body; the other, the repair or refreshment thereof; with a view to the restraining of the one (as far as may be), and the strengthening and comforting of the other' (Bacon, 1861: 219).

One should bear in mind that Bacon was a philosopher rather than a scientist (Purver, 1967: 23), and did not apply his methodological theory regarding the rules of the discovery in the direction pointed out by Graunt four decades later. Though the separation between philosophy and science is hardly clear-cut, a good illustration of the difference between the two authors can be found by comparing Bacon's *History of Life and Death* and Graunt's *Observations*. In his book, Bacon laid down the philosophical anticipation of what would became since Graunt the core of descriptive demography: the estimation of the size and the characteristics of population, through measures such as means and proportions ratios. Since 'the end rules the method' (Bacon, p. 254), I will return to the latter in a moment; here the important aspect is to recognize that the reform brought about by Bacon's inductive method was only one aspect of his final goal, that is the 'restoration' of knowledge through a new philosophy of science (Purver, 1967; Rossi, 1968).

While the 'old philosophy' was in the process of being thrown aside he admonished students of all subjects to answer scientific problems by questioning nature and society and not by appealing to the authority of pre-established dogmas: 'From the neglect of observations, and the complication of causes, it is difficult to discover any rule for the length and shortness of life in animals' (Bacon, 1861: 239).

In this context, Bacon's concept of science and logic of science were of primordial importance. Ever since natural philosophy expanded, research has been the essence of scientific movement, and the need to define the subject-matter and the objectives and methods became an explicit priority:

---

[3] The 'History of Life and Death' is the the number 58 in this Catalogue of titles. The Catalogue is preceeded with a remark which reinforces the view proposed here with regard to Bacon's usage of the term 'natural history:

> And now should come the delineation of the particular histories. But I have at present so many other things to do that I can only find time to subjoin a Catalogue of their titles. As soon however as I have leisure for it, I mean to draw up a set of questions on the several subjects, and to explain what points with regard to each of the histories are especially to be inquired and collected, as concluding to the end I have in view, - like a kind of particular Topics (Bacon, 1875: 263).

> The answers to the essential question of how to proceed in scientific research: what questions to put to nature, by what methods to get answers, what to count as acceptable questions and answers, became clear only by the accumulation of successes and the making of failures (Crombie, 1994: 19).

In short, Graunt's reference to Bacon was neither intended to stress his own methodological inspiration, nor was made just because Baconianism was then extremely fashionable, especially among the supporters of the English Royal Society. He could have been more fashionable if had chosen more famous titles among Bacon's works, such as the *Instauratio Magna* and *Novum Organum*. The content of his investigation was related, as he stressed, to 'natural history' because 'they have fallen out to be both political and natural'; 'political' because they were concerned with 'trade and Governement', and 'natural' because they were concerned with 'the air, countries seasons, fruitfulness, health, diseases, longevity, and the proportions between the sexes and ages of mankind'.

This interpretation is shared by authors like Kargon (1963: 342-343) and Matsukana (1962: 56) who, like Kreager, have acknowledge the novelty and power of Graunt's method. However, Kreager could have provided a deeper understanding on Graunt's contribution to demography if he had not reduced the epistemological, methodological and rhetorical elements to a question of method. After all, his two important questions mentioned above concerning the method could also be raised with regard to the subject-matter: what were the sources of Graunt's subject of inquiry? Is there in fact a coherent demographic subject of inquiry which runs right through the *Observations*?

To paraphrase Kreager (1988: 130), the assessments by Glass, Sutherland, Hacking and others were of limited help not only with regard to Graunt's method, as Kreager suggested, but also his subject of inquiry. Past authors pick out those aspects of Graunt's essay which anticipate later demographic measures and statistical inferences, as well as later demographic questions and issues. They did not examine the wise interrogating faculty side--by-side the language and arithmetical techique of his text as a whole, and its organization in relation to the period's terms of reference in which Graunt worked. Had Kreager recognized the distinction and the interconnectedness among the main elements which define science discussed here, he would have produced a more transparent picture of his important critic upon the existing misunderstanding of earlier modern demography.

The ultimate goal of population research: 'the land and the hands'

The scope of content, the kind of concepts and ideas developed, and the research agenda for further studies is the third aspect component of the definition of the subject-matter of demogrpahy identified above.

Contrary to the widespread idea in demographic textbooks that the *Observations* were mainly concerned with mortality issues, Graunt's main objective was clearly much broader. Instead, his emphasis for the numbers of inhabitants and the changes in the population of the City of London is made explicit in the first edition and, five three years later, in the fifth and

'much enlarged' edition published in Graunt's life. In the first edition refers to the ill-founded popular ideas with regard to the estimates of the number of inhabitants in London:

> I have been several times in company with men of great experience in this City, and have heard them talk seldom under millions of people to be in London, all which I was apt enough to believe until, on a certain day, one of eminent reputation was upon occasion asserting that there was in the year 1661 two millions of people more than in the year 1625, before the great *Plague*; I must confess that until this provocation, I had been frighted with that misunderstood example of David, from attempting any computation of the people of this populous place; but hereupon I both examined the lawfulness of making such enquiries and, being satisfied thereof, went about the work itself in this manner ... the worst whereof doth sufficiently demonstrate that there are no millions of people in London, which nevertheless most men do believe (Graunt, p. 44-45).

In an Appendix he attached to the much enlarged edition of the *Observations* published in 1665 Graunt insisted:

> I never observed more enormous mistakes in any matter than concerning the number of people, Ale-houses, Coaches, Ships, Sea-men, Water-men, and several other Tradesmen, &c. The proportions of all which I have always thought is necessary to be known, in order to an exact Symmetry of the several members of a Common-wealth. I say, that the whole number of Inhabitants exceeds not 460000 (Graunt, 1665: 401).

While this sentence sums up the core of Graunt's investigation, seen from the distance of more than three centuries it contains a remarkable historical dimension. The same issue of how people can be deceived by common sense and make very wrong estimates of the number of inhabitants and the changes in the size of population lie at the heart of demographic analysis. After all, this is why demographic science was created and remains alive after more than three centuries; common sense grasps the surface of population phenomena, or the appearance rather than demographic reality. As Keyfitz put it,

> When people of good judgement made what seemed a perfectly safe forecast and something quite different materialized, we know that there must be changes, linkages, and variables operating in the depths of our society that strongly influence what appears on the surface. Indeed, perhaps the biggest difference between professional demographers and others who deal with populations is that the professionals know just enough to realize that the surface phenomena are influenced by these deeper ones (Keyfitz, 1980: 63).

From 'natural' to 'political' observations: objectivity without deceptive neutrality

As pointed out at the beginning of this section, another apects of the subject-matter of demography is associated with the goals, specific objectives and justification of the study. In 1988 Demeny dismissed with enough clarity the artificial dichotomy proposed by Hauser and Duncan in 1959 between the production of scientific knowledge in demography and its 'social engineering' purposes. Demeny (1988: 452) pointed out that it is doubtful that a neat polarization between the so-called 'fringe group' of demographers who perceived a role for population studies in policy formulation and problem solutions, and a 'preponderant proportion' who eschewed such a role, was ever correct. Certainly not in the case of Bacon and Graunt who explicitly stated the objectives and justification of their studies. As Kargon (1963: 342) pointed out, Bacon looked to scientific activity both to illuminate man's vista (the light-bearing) and to

produce scientific results of general utility (fruit-bearing). In turn, Graunt justified his own study in terms of a twofold purpose, natural or scientific and political; he made then apparent in the title and in the two dedications, as well as in several parts of the text such as the following:

> There seems to be good reason why the magistrate should himself take notice of the numbers of burials and christenings, viz. to see whether the City increase or decrease in people; whether it increases proportionately with the rest of the Nation; whether it be grown big enough, or too big, etc. But why the same should be made known to the People, otherwise than to please them, as with a curiosity, I see not (Graunt, 1662: 20).

Kreager's failure to distinguish method from subject of inquiry led him to another misconception concerning the notion of 'intrinsic' and 'extrinsic' values; he fooled himself and the reader when he wrote: 'Graunt says in his conclusion that his method is founded on a distinction between "intrinsic value" and "another value merely accidental, or extrinsic" ' (Kreager, 1988: 137).

Graunt used these two concepts to justify the purpose of his whole study, rather than his method of inquiry. 'It may be now asked, to what purpose tends all this laborious buzzling, and groping?', Graunt asked in the Conclusions of the *Observations*. To this question Graunt answered with a set of 13 additional and more specific questions which detail the scope of content of demography ever since:

> To know,
> 1. The number of the people?
> 2. How many males and females?
> 3. How many married and single?
> 4. How many teeming women?
> 5. How many of every septenary, or decade of years in age?
> 6. How many fighting men?
> 7. How much London is, and by what steps it hath increased?
> 8. In what time the housing is replenished after a plague?
> 9. What proportion die of each general and particular casualties?
> 10. What years are fruitful and mortal, and in what spaces and intervals they follow each other?
> 11. In what proportion men neglect the orders of the church, and sects have increased?
> 12. The disproportion of parishes?
> 13. Why the burials in London exceed the christenings, when the contrary is visible in the country? (Graunt, 1662: 51).

The place of this array of questions in the book can have two interpretations. On the one hand, it may be said that today such question would, perhaps, be displayed at the beginning of the book rather than to introduce its conclusions. This, like other all stages of research, is to a large extent a matter of choice between alternatives which are not always explicitly spelled out (Wunsch (1984: 2, 13).

On the other hand, the 13 questions can be interpreted as a summary of the issues dealt with in the book and also a sketch for future research. 'To this I might answer in general by saying that those who cannot apprehend the reason of these enquires are unfit to trouble themselves to ask them' (Graunt, p. 51).

In the following paragraphs Graunt went on stressing the usefulness of his enquires with commentaries, such as: 'I might answer by asking, why so many have spent their times and estates about the art of making gold?'. But in he then answered

> more seriously, by complaining, that whereas the art of governing, and the true politics, is how to preserve the subject in peace and plenty, that men study only that part of it, which teacheth how to supplant and over-reach one another, and how, not by fair out-running, but by tripping up each other's heels, to win the prize (p. 51).

And in the end, he saw his the ultimate aim of his study as follows:

> Now, the foundations, or elements of this honest harmless policy is to understand the land, and the hands of the territory to be governed, according to all their intrinsic and accidental differences (p. 51-52).

By intrinsic value Graunt meant 'the geometrical content, figure, and situation of all the lands of a kingdom, especially according to its most natural, permanent and conspicuous bounds' associated with the wealth of a country. In turn, by accidental or extrinsic value Graunt referred to the causes why the value of things change, 'though but of the same intrinsic goodness' (p. 52). As an example, he mentioned that the value of land often depends not just on its 'intrinsic goodness', but greater or lesser proximity to a good market. Correspondingly,

> It is no less necessary to know how many people there be of each sex, state, age, religion, trade, rank, or degree, etc. by the knowledge whereof trade and Government may be more certain and regular; for, if men knew the people as aforesaid, they might know the consumption they would make, so as trade might not be hoped for where it is impossible (p. 52).

According to Matsukawa the comprehensive surveys of 'the land and the hand' proposed by Graunt,

> constitute an integral part of a program for statistical surveys which modern state needs carry out before anything else ... Graunt himself, however, initiated the quantitative observation of not both the "land and hands" but only of the latter, and found out some quantitative regularities prevailing in the variations of population (the hands). At the same time, he came to grasp the socio-economic meanings underlyign these regularities (Matsukawa, 1962: 57).

Curiously, these passages of Graunt's book have been among the few parts which some authors saw as evidence of Petty's contribution to the *Observations*. Moreover, Graunt published his book in a very controversial period.[4] Hobbes was among the most critical of the way the empirical experiments had been promoted. As Shapin and Schaffer (1985: 112) notice, Hobbes considered that all experiments carry with them a set of theoretical assumptions embedded in the actual construction and functioning of the apparatus and that, both in principle and in practice, those assumptions could always be challenged. As yet, like Arnauld and Nicole, the authors of the Port Royal *La Logique, ou l'art de penset* published in 1662, Hobbes considered the evidence of testimony as *external* or extrinsic, while they saw the

[4] At the same time there emerged also several publications as part of the experimental program for natural philosophy, including those associated with Boyle's researches in pneumatics and the air-pump and on other related experiments from Henry Power, Robert Hooke, and John Wallis (Shapin and Schaffer, 1985).

evidence of things as *internal* (Hacking, 1975: 33).[5] Graunt's dedication to the president of the Royal Society acknowledged this debate, though only between the lines.

In summing up, the previous three sections have concentrated on the subject of demography as the first important contribution of Graunt's *Observations* to the making of demography as a science. The subject-matter has been perceived in a broad sense and comprising the scientific insights and motivation for the study of certain questions and empirical puzzles and problems; the specific scope of knowledge developed, and the aims and purposes of the investigation. These aspects are an integral part of the whole design of demography as a science; to overlook them and reduce the debut of new science to the methods used is misleading and, indeed, against the historical record; at best, it can only be justified on the grounds of demographer's own view towards the theory of knowledge in the present days.

The logic of demographic discovery: promising infinite utility hereafter[6]

The subject matter, or natural history in the Baconian perspective taken by Graunt, was an integral part of Bacon's scientific logic together with the inductive method. As the quotations from Bacon's own writing cited above show induction was part of a broader and rather more complex logic of scientific 'interpretation of nature'; such logic included several other categories, such as forms, progressive stages of certainty, the method of exclusions, the derivation of axioms, the principles of the sciences, simple natures, table and arrangements of instances, certainty and freedom.

It is beyond the scope of this essay to move much further into the link between Bacon's reform of induction and the development of his own logic, on which there is a large literature I refer to Fowler (1889: 54- 68), Jardine (1974), Malherbe and Pousser (1985), and Rossi (1968).

In previous sections I have accepted Wunsch's assertion that science starts off with a question, a problem, a puzzle. For some this position is somewhat irreconcilable with Bacon's strictly inductive method. As Charmels (1982: 3-5) put it, 'According to the naive inductivist, science starts with observation ... the body of scientific knowledge is built by induction from the secure basis provided by observation'. Bacon's (1875) rejection of the 'anticipations of the mind' seems to have been mostly determined by a very particular sort of deductivist method, the Aristotelian logic of syllogism. The current concept of deduction entails a generalization which

---

5 The same could be said, as Hacking (1975: 33-34) mentioned as well, about the distinction between 'arbitrary' and 'conventional' signs: 'Once natural signs have been distinguished from any sign of language, the concept of internal evidence is also distinguished'. Moreover, Hacking distinguished opinion, from evidence and signs. In turn, Hald (1990: 31) distinguished between two forms of evidence: 'the evidence of testimony, called external evidence, and the evidence of things, called internal evidence'; according to Hald this distinction was formulated explicitly in Arnauld and Nicole's *La logique, ou l'art de penser* (1662).

6 This is a paraphrase from Trevor-Roper (1967) p. xvi.

goes far beyond the Aristotelian idea of syllogistic inference; but even if assumes that Bacon's rejection of the anticipations of nature should be generalized to all deductive reasoning, then as Rossi (1968: 138) put it

> The anticipations of nature condemned by Bacon as arbitrary and non-conducive to experiment have proved invaluable to the evolution of science. The definitions and axioms of modern science are not, as Bacon would have wished, the fruit of inductions that gradually include wider generalisations: they are models serving to limit the field of enquiry. The inductions peculiar to each science have revealed their implicit relation to axiomatic methods of a deductive nature, which puts and end both to Bacon's opposition of inductive to deductive methods, and to the logico-philosophical theory claiming to describe the process of various scientific inductive generalisations (Rossi, 1968: 138).

It is in this context that the distinction and close relationship between the subject of inquiry and the method of analysis concerning needs to be careful consider with regard to Graunt's *Observations*. In the real process of scientific research induction appears closely related to deduction, including among those who reject the role of deductive constructions in the research process. Curiously, with regard to the myth of induction there is an interesting moral which Wunsch could have drawn from his comparison between the average demographer and a conjuror drawing out a rabbit from a top hat: both keep a lot up their sleeves.

To look deeper into the relationship between the two most important elements mentioned in Figure 1, the scheme depicted in Figure focus precisely on the link between subject and methods of inquiry applied to Graunt's book. This scheme is an adaptation of the Wunsch's main contention in his 1984 dedicated to the logic of demographic discovery: 'research in demography implies moving from theoretical concepts to auxiliary theory, and then from auxiliary theory to statiscal model' (Wunsch, 1984: 17).

There are several reasons why Wunsch's logic is useful here. First, while the paper makes specific references to a number of philosophies of science and theories of knowledge, including those from Blalock, Hemper, Piaget, Popper, and Kuhn, in turn the discussion is already applied to the subject of demography. Although Wunsch's paper is not the only one discussing explicitly the process of acquisition of knowledge in demography, it is one of the best among the very few dedicated to such a topic. Secondly, Figure 1 highlights mainly the logical process linking concepts, observational indicators, and statistical models. The fact that Wunsch (1984: 3) applied the logic of demographic discovery to the specific framework called 'the hyothetico-deductive method of explanation' does not mean that other models are beyond such a logic.[7]

Regardless of whether one accepts the 'hypothetico-deductive method', this rather more explicit deductive framework could even used as a frame to assess less elaborated logical models. Yet Figure 2 is intended to represent the the embryonic stage of the subject matter of demography in its close relationship with Graunt's method found in the *Observations*.

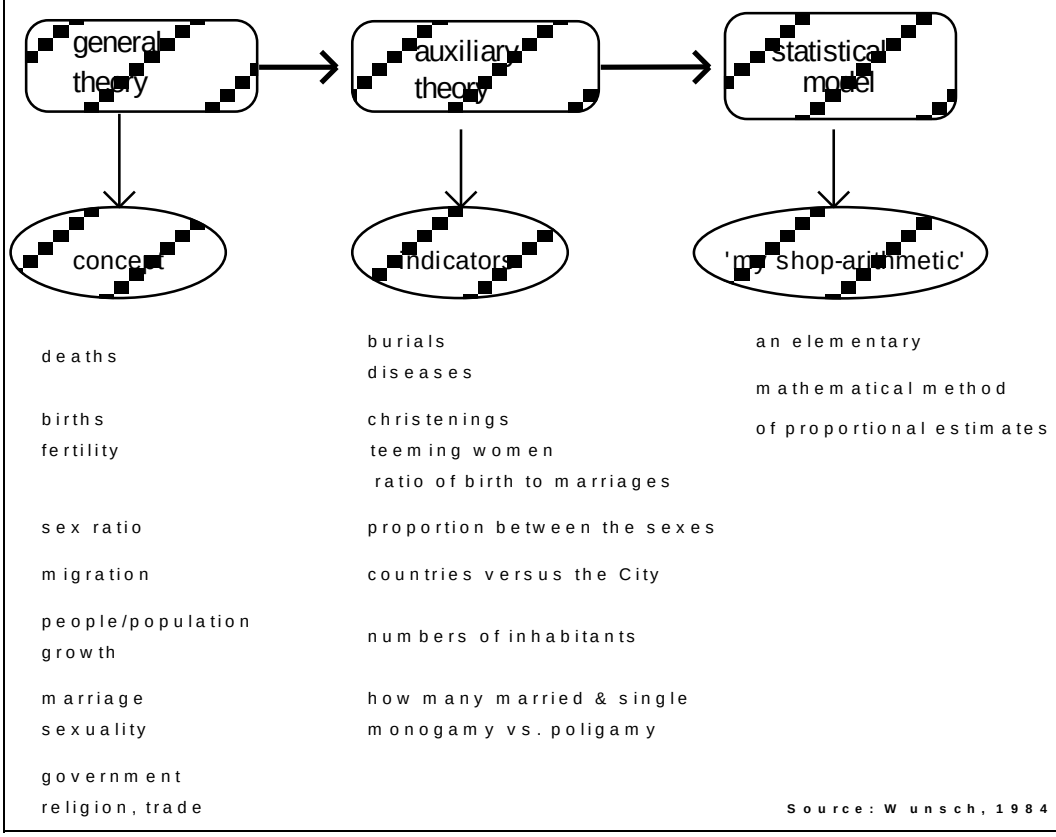
---

[7] Following his discussion of particular aspect of the the process of transformation of theory, through the auxiliary theory, into a statistical model for the case of the hypothetico-deductive method of explanation, Wunsch discussed aspects concerning 'confirmation, falsification, and decisions' applied to a paper by Caldwell (1979) called 'Education as a factor in mortality decline: an examination of Nigerian data'.

The first column of Figure 2 comprises the abstract concepts or the factual 'images' and 'fit matter to work upon' mentioned above with regard to the notion of natural history. Graunt's two main purposes were 'to increase the number of facts available (natural history), and to benefit the state by supplying useful information for it' (Kargon, 1963: 342-343). Some of the abstract concepts enumerated in the first column of Figure 1 are found in the *Observations* (including in its title), others may be considered implicit. For example, instead of 'population' Graunt used terms such as 'people', 'inhabitants', 'city', 'bills', and 'the whole pile' (Kreager, 1988: 134). Instead of 'sexuality' Graunt used terms, such as 'evil of adulteries and fornications', 'castration', 'polygamy' and 'monogamy'.

As Wunsch point out, abstract concepts are not immediately measurable, nor even 'all theoretical concepts have to be linked to empirical indicators; indeed, in various cases it may be quite difficult and probably impossible to derive an indicator translating a theoretical concept into an empirical measurable variable' (Wunsch, 1984: 7). Yet the important point concerning the development of the subject of demography is that demographers came to recognize and agree upon the three main concepts representing the components of population characteristics and change: deaths, births, marriages and territorial movements.

Figure 1: The logic of demographic discovery in Graunt's 'Observations'



However primitive it might have been, Graunt could not have undertaken his work if he had not transformed some abstract concepts into observational indicators; that is, if he did not transform theoretical concepts into auxiliary theory. The theoretical explanations, in the case of

the *Observations* take the form of 'conceits, opinions, conjectures' and new assumptions. Moreover, it is at this stage that 'the weekly Bills of Mortality' acquire the status of 'data', as Graunt elaborated specific empirical indicators. This happened, as Graunt himself explained, when he

> thought that the wisdom of our City had certainly designed the laudable practice of taking and distributing these accounts, for other and greater uses than those above-mentioned, or at least that some other uses might be made of them' (Graunt, p. 14).

As far as the myth of pure induction is concerned, Graunt's trusts on observation was far from naive. First, he relied on accounts which were not the product of his own direct observation or, as Bacon (1875: 40) put it, 'sensuous perceptions'. The data were gathered by the searchers who were 'ancient matrons, sowrn to their Office'. Graunt was aware and critical as to the accuracy of what the searchers reported to have seen that he found it necessary to make some corrections. 'Now, to make these corrections upon the perhaps, ignorant, and careless Searchers' Reports,' Graunt remarked,

> I considered of what authority they were in themselves, that is, whether any credit at all were to be given to their distinguishments: and finding that many of the casualities were but matter of sense, as wether a child were *Abortive*, or *Stillborn* ... Isay, that these distinguishments being but matter of sense, I concluded the Searchers' Report might be sufficient in the case ... As for *Comsumptions*, if the Searchers do but truly report (as they may) ... it matters not to many of our purposes whether the disease were exactly the same as physicians define it in their books ... In the matter of Infants I would desire but to know clearly, what the Searchers mean by Infants (Graunt, p. 21).

Secondly, despite the limitations of the searchers's observations due to their susceptibility to bribes, ignorance, drinking, advanced age and careless registation, Graunt concluded that the data were useful because they were able to report the opinion of the physcians, or in other cases their own senses were sufficient.

Thirdly, Graunt's concept of scientific observation is apparent in the Preface, one the one hand, when he points out that 'Having been born and bred in the City of London ... most of them who constantly took in the weekly Bills of Mortality made little other use of them'. On the other hand, after reducing the Bills into Tables, 'so as to have a view of the whole together', Graunt explained:

> I did then begin not only to examine the conceits, opinions and conjectures, which upon view of a few scattered Bills I had taken up; but did also admit new ones, as I found reason and occasion from my Tables' (Graunt, p. 14).

In the end, Graunt aim at 'finding some truths and not commonly believed opinions' (p. 14). That later demographers found Graunt's operation indicators such as burials and christenings too narrow and limited is just an indication that demography has developed ever since. But Graunt did just what Bacon recommended, 'whether or not anything can be known was to be settled not by arguing, but by trying' (cited by Crombie, 1994: 19); and here lies his extraordinary merit and achivement: the transformation of theoretical concepts into observational indicators.

Some of these concepts, for instance burials and christenings, were already in the data gathered in the Bills of Mortality. Graunt proceeded in classifying and interpreting them in

terms of specific categories or indicators such as the causes of diseases and casualties, males and females by years, number of married people and weddings. Moreover, he set his analysis within the basic demographic frame of reference of age, sex and marital status: 'to what purpose the distinction between males and females is inserted, or at all taken notice of; or why that of marriages was not equally given in?' (p. 20). Although he did not foresee how important these standard variables would turn out to be for the determination of the scope of demography, his analysis stood on them as if they were the natural variables of the scientific study of population.

Can we call Graunt's explanations a theory on population? Not in the full meaning of an 'hypothetico-deductive method of explanation', as Wunsch discussed it in 1984. But primitive as his theory-building might have been, Graunt's *Observations* are not independent of theory. He discussed and assessed critically the existing opinions, conjectures and superstitions on population, and in particular aspect such as: the causes of the epidemic and the pollution of air; the estimate of the numbers of inhabitants in the City of London by several different methods; the evolution of population which he traced to the Biblical conjectures; the stability of statistical ratios and the conceptions on marital relations, and the role of religious.

In summing up, Graunt contributed to Bacon's natural history by transforming the subject-matter of *History of Life and Death* into 'fit matter to work upon' in a systematic and with 'promising infinite utility hereafter' (Trevor-Roper, 1967: xvi). Graunt developed natural history by transforming abstract concepts into observable indicators and, in so doing, created a new subject for a systematic scientific study of population here much later would be called demography. Thus, demography started not with the parish registers established in the 1530s a warning system with the objective to help the authorities when measures should be taken against the epidemic (Hald, 1990: 82; Kargon, 1963: 338). Demography did not start with the searchers' observations and reports; it started with Graunt's realization that some other uses could be made of them: that is, they could be transformed into scientific data. The link between abstract concepts and data is depicted in the first and second columns of Figure 2, and the next section deals with the remaining of the its frameworks.

Bacon's powerful methodology and Graunt's program for the descriptive statistics

A distinction between methodology and method needs to be made clear now because this is a precondition for a good understanding of Graunt's inspiration and contribution to Bacon's methodology in the way he developed his own methods to study the population of the City of London. While methodology is concerned with the theory of scientific investigation, a method of inquiry refers to a technique or a set of tools for gathering, organizing and analysing the data (Birou, 1973: 253; Caws, 1967: 339; Harding, 1987: 1-3).

Long before Bacon's *Advancement of Learning* and *Novum Organum*, several methods of inquiry had been put in practice. According to Rossi (1968: 138) 'Modern science owes less to Bacon's empirical experimentalism than to Galieo's mathematical theories based on

quantitative and mechanical analyses'.[8] Indeed, Bacon developed not so much a scientific methods in the meaning defined above, but a holistic methodological theory on the new scientific methods within the so-called 'Natural Philosophy'. Strictly speaking, what is known as the Baconian inductive method constituted but a new methodological logic and approach for what is now called empirical research. Bacon advocated, better than any one else, the systematic collection and classification of all conceivable facts and histories of 'calendars, resembling an inventory of the estate of man, containing all inventions which are extant and whereof man is now possessed' (cited by Ornstein, 1938: 41).

Bacon clearly distinguished the epistemological issues, namely the 'faculty of wise interrogating', from his methodological philosophy. But he did not create a method, in terms of a set of techniques and specific tools useful for demonstrating and analysing specific issues.

> my method, though hard to practise, is easy to explain; and it is this. I propose to establish progressive stages of certainty. The evidence of the sense, helped and guarded by a certain process of correction, I retain. But the mental operation which follows the act of sense I for the most part reject; and instead of it I open and lay out a new and certain path for the mind to proceed in, starting directly from the simple sensuous perception (Bacon, 1875: 42).

Graunt, contrary to Bacon, was neither a philosopher nor a professional scientist or 'natural philosophers'. However, Graunt revealed himself to be an extraordinary amateur in the field of social sciences. Sutherland (1963: 542) might be right when he conjectured that 'Graunt's lay status may have been an advantage in his enquiries rather than the reverse, by encouraging a degree of detachment from, and modesty towards, the handling of his data'. In Moreover, the fact that he considered his research to be 'a free-holder's vote' he certainly had the freedom of mind to experiment on new things without having to start directly, as Bacon recommended in the quotation just cited, 'from the simple sensuous perceptions'.

Yet Graunt's appraisal of the data he took from the Bills of Mortality might have been one of his best applications of the Baconian induction, as opposed to 'the induction which proceeds by simple enumeration' which Bacon (1875: 97) called childish. Graunt analysed social phenomena 'by proper rejections and exclusions' (Bacon, 1875: 97) until he reached plausible conclusions.

Another application of Bacon's methodological approach in the *Observations* refers to the process of reduction of 'several great confused Volumes into a few perspicuous, and abridged such observations as naturally flowed from them' (see Paragragh 4 in Box 1). This is consistent with Bacon's approach:

> Now my directions for the interpretation of nature embrace two generic divisions; the one how to educe and form axioms from experience; the other how to deduce and derive new experiments from axioms. The former again is divided into three ministrations; a

---

[8] 'Astronomy was the most important and the most advanced field of applied mathematics from antiquity until the 18th century' (Hald, 1994: 144). As Hauser and Duncan (1959: 4; see also Wunsch, 1984: 3) put it, demography is one of the observational sciences, such as astronomy and ethnology, but it is somewhat distinct from the experimental such as physics and chemistry. Is this because of the type of data, or are the data themselves a consequence of the nature of the subject matter and the nature of the fundamental methodology applied? This is not made clear by Hauser and Duncan because they framed and limited their discussion mostly to the importance of demographic data.

> ministration to the sense, a ministration to the memory, and a ministration to the mind or reason. For first of all we must prepare a *Natural and Experimental History*, sufficient and good; and this is the foundation of all; for we are not to imagine or suppose, but to discover, what nature does or may be made to do. But natural and experimental history is so various and diffuse, that it confounds and distracts the understanding, unless it be ranged and presented to view in a suitable order. We must therefore form *Tables and Arrangements of Instances*, in such a method and order that the understanding may be able to deal with them. And even when this is done, still the understanding, if left to itself and its own spontaneous movements, is incompetent and unfit to form axioms, unless it be directed and guarded. Therefore in the third place we must use *Induction*, true and legitimate induction, which is the very key of interpretation. But of this, which is the last, I must speak first, and then go back to the other ministrations (p. 127).

The originality of Graunt's method was not in the organization of the data in tables, as Bacon had long before laid great stress on the value of tables. The importance of Graunt's tabulation and organization of data needs to be seen in the context of the debut of descriptive statistics. This is has been acknowledge, from Pearson (1978) in the first decades of the twentieth century to Hald's history of probability and statistics and their applications before 1750. Hald placed a paragragh from Graunt's Preface (see paragraph 4 in Box 1) as epigragh of his Chapter 7 dedicated to Graunt's work, and in the text explained:

> His program for decriptive statistical analysis is announced in the paragraph we have chosen as epigraph. First he stresses the *reduction of data* from 'several great confused Volumes into a few perspicuous Tables,' and next his *statistical analysis of the tables* is presented in 'a few succint Paragraghs, without any long Series of multiloquious Deductions.' This admirable program has ever since been a goal for any statistical office (Hald, 1994: 86).

Of course, in saying this Hald did certainly not contradict his more general claim that 'By 1750 statistics had still not become a mathematical discipline' (Hald, 1994: 8). Although Hald demonstrated that between 1657 and 1708 no statistical theory emerged, this does not mean that the grounds of what is now called 'descriptive statistics' were not established in that same period. However, Kreager is apparently of different opinion; in his 1988 paper he questioned the idea, manifested by Sutherland and Galss, that Graunt's *Observations* constituted the paragon for the 'methodology of descriptive statistical analysis'. This divergence seems to have been caused by two factors. On the one hand, Kreager's argumentation suggests a certain confusion between the implications and the sources of Graunt's work. 'Obviously,' Kreager (1988: 135) wrote, 'the derivation of Graunt's method cannot be explained by its similarity at many points to later statistical and demographic science'. However, Sutherland and Glass were referring not to the sources but the imlications of Graunt's method, and on that certainly the derivation of modern statistical and demographic sciences can be explained by its similarity at many points to Graunt's *Observations*.

On the other hand, for Kreager 'Graunt's method is an original synthesis of two methods extant in the mid-seventeenth century, each addressed to discerning an inherent order beneath the manifold flow of events'. The first, Kreager asserted, which Graunt 'derived from Bacon, is a method of observations or natural history'. In previous versions of this paper I shared this interpretation (Francisco, 1996: 305), which reduces Bacon's method to his 'natural history'; but above I

because it appears that although 'natural history' is an integral part of Bacon's logic, ti should not be confused with his method.

According to Hald (1990: 82), a descriptive statistical analysis of numerical data on population and economy, which 'began again ... during the Renaissance' 'occurred first in 1662 when John Graunt analyzed the weekly reports on vital statistics for London, which had been published regularly since 1604'.

although Hald (1990: 104) was aware and referred Kreager's 1988 paper, he explicitly considered Graunt's *Observations* as 'A paragon for descriptive statistical analysis of demographic data' (Hald, 1994: 6).

Graunt's second concept of method, according to Kreager (1988: 137), was 'based on merchant bookkeeping'. Here lies the 'new light on Graunt' in Kreager's 1988 paper. In the past, several authors have stressed some features in Graunt's methods, which are now taken for granted in demographic analysis, such as: the justification of the study; the critical appraisal of the sources of the empirical; the definition of the methodology, the reduction of the data to a 'few perspicuous Tables', and the analysis of the data (see Benjamin, 1964: 1-3; Hull, 1899; Matsukawa, 1962; Glass, 1963; Kargon, 1963: 340; Sutherland 1963a, Hartwick, 1991; Dupâquier and Dupâquier, 1985: 134-137). While these authors noticed the roots of Graunt's method in Bacon's methodology, Kreager (1988: 135) called attention for 'The "method of double-entry" bookeeping, widely promoted in Graunt's time'; this method part of the current 'mercantile system of natural and intrinsic *balances*, embracing people and trade' (Kreager, 1988: 140). In this regard, Kreager suggested, Graunt's main 'contribution to Bacon's method ... was his development of arithmetical checks on observational consistency' (Kreager, 1988: 132, 137).

Just as the term 'demography' was attributed to the scientific study of population much latter, the same happened to Graunt's new method came to be called 'descriptive statistics'; this occurred, according to Hald (1994: 82) about 1800. Curiously, this process was not without incidents and controversy, at least for demography. Guillard, who is credited to have invented the term 'demography', in the preface of his book of 1855 openly apologized to the reader for not being strong enough and having accepted the demands of his book's editor to change its initial tittle; the editor had demanded, just for commercial reasons, to replace his envisaged title, *Studies on Comparative Demography*, by *Elements of Human Statistics or Comparative Demography* (Nazareth, 1988: 21). Curiously, considering how demographers have subsequently used the suggested subordination of demography to statistics demanded by the editor of Guillard's book, that incident turned out to be an irony against Guillard and the discipline that he named.

The simple reason that Graunt's *Observations* provided the paragon for the debut of descriptive statistics justifies that in the field of mathematical statistics and probability Graunt is also called the father of statistics. Graunt's sketch of his research program, which developed into what is now known as descriptive statistics, was motivated by his subject and objectives. Graunt's program for descriptive statistics was his most important contribution to Bacon's methodology; bu in a way, it was also an unexpected implication of Bacon's vision that 'the end rules the method'.

'The mathematics of my shop-arithmetic' and our first demogrphic measure

I the previous section I have stress Graunt's program of research,

which is relevant to understand only part of Figure 2 presented above. 'An auxiliar theory is an image (one out of several possible) ... a set of rules ... transforming theoretical concepts into observable variables' (Wunsch, 1984: 7). The set rules at Graunt's disposal were, one the one hand, were Bacon's method of 'rejections and exclusions', or his set of 'Tables of arrangement of instances' (Bacon, 1875: 127, 129, 137); on the other hand, as Kreager (1988: 135) suggested, there were the methods of double-entry bookkeeping.

While Graunt mentioned neither of these methods directly, he remarked explicitly that his natural history depended upon 'the mathematics of my shop-arithmetic' (Graunt, p. 6). This expression is consistent with his modest style and his lay status.[9] Yet to a demographer reading through the *Observations* today, three points which interrelate the three scientific features so far considered separated from one another, epistemology, methodology and method, should occur at once. First, population change can only be grasped by focusing on its components, including christenings (births), burials (deaths), weddings (nuptiality) and migration. Secondly, Graunt's long-lasting contribution to the inception of a scientific study of population should be found not so much in the answers he provided, but in the questions he raised and the methods he outlined to answer them. Thirdly, when a mass of empirical observations are put in order 'to have a view of the whole together', as Graunt put it, one may draw inferences and findings which small observations or merely qualitative interpretations are unfitted to show.

As Hull (1899: lxxviii) wrote, 'Johann Peter Süssmilch (1707-1767) was ... perhaps the first who clearly grasped the fact that when and only when sufficiently large numbers are taken into account, order and not accident appear'. And even though this aspect of the conceptualization of population escaped Graunt, Hull correctly acknowledged that the German demographer

> was not ... the first to make the growth of population a subject of independent investigation on its own account: Graunt certainly anticipated him in that ... Graunt first sought to utilize the bills for the discovery of the new truths. Parish registers had been kept for centuries, but who before Graunt used them to lay bare *Die göttliche Ordnung*? (Hull, 1899: lxxviii).

---

[9] Sutherland (1963: 542) considered that 'Graunt's lay status may have been an advantage in his enquiries rather than the reverse, by encouraging a degree of detachment from, and modesty towards, the handling of his data'.

Süssmilch himself considered Graunt his master. He wrote that the beautiful order between birth and duration of life and death had escaped mankind's notice for years; the understanding that deaths do not occur chaotically first came to light when man studied large numbers. The perspicacity of Pearson (1978: 318) could not miss Süssmilch's analogy of Graunt with the Columbus of statistics. Even though Pearson considered this in reference to the origin of statistics only, his remarks would be equally applicable to demography as well.

Kargon (1963: 337) asserted that Graunt's method was 'overshadowed by the achievements of Newton'. This seems to be only partially correct, for the experimental method associated especially with Newton's mechanics is by its nature different from Graunt's method. As Crombie (1994: 12) since the fourteenth century the concept of causality started to be expressed in terms of algebraic functions rather than the Aristotelian logic of subject and predicate. New Latin terminology were devised to express such fundamental quantities as velocity, acceleration, and instantaneous velocity. This new functional causality was used by Galileo and Newton and related events as sequences in time. 'Causes and definitions were replaced by forces and functions as the objects of scientific inquiry' (Crombie, 1994: 14).

Moreover, Newton's scientific method became extremely powerful over the past three centuries by formulating the equations appropriate to a particular system; such equations stand on the so-called 'initial conditions' and by solving them one analyses the state of the system. Conversely, Graunt set out a method characterized by gathering the observation data first and then elaborating the equations that are appropriate. For many years this method was considered less reliable than the one standing on the 'initial conditions', which specify the state of the system studied.

It is not accidental that now Graunt's contribution to the 'styles of scientific thinking' (Crombie, 1994) is becoming widely acknowledged. This seems to be associated with the development of the computer as the instrument of the new science of complexity (Pagels, 1989). The reductionist nature of the methods drawn from the 'initial conditions' is increasingly acknowledged in that, as Pagels (1989: 40) put it, the 'properties of the small things determined the behavior of larger things'. Mathematical equations are certainly more treatable and useful when they represent systems which are relatively simple and standing on simple conditions. This method is powerful in analytical terms at the expense of being reductionist; but once one tries to include as much complexity as is possible, the number of variables needed may lead to intractable situations.

This is where the simplicity of Graunt's method of proportional estimates becomes deceptive; its advantage is to be applicable to situations in which neither simple or complex mathematical equations nor qualitative methods are immediately suitable. In other words, it is the method adequate to deal with large numbers of statistical data. This is a powerful method because it allows the study of regularities which neither small numbers nor qualitative information can show.

Although the statistical and probabilistic techniques have improved remarkably over the past three centuries, Graunt's method of proportional estimates remained essentially unchanged. However, the situation has changed radically in the past three decades, with the

development of computers. Increasingly, Graunt's method has the potential to become as powerful as other instruments of observation, such as telescopes and microscopes. The prospects of the nature of knowledge obtained through census and survey data have been radically altered because the computer as a research instrument provides us new ways of seeing and simulating the reality of population.

So what was the merit of Graunt's method as compared with the one used by Newton and others? Scientists or natural philosophers in the time of Graunt were either purely qualitative in the regularities they observed and the prognoses made from them, or they dealt with mathematical systems which were relatively simple and standing on the so-called 'initial conditions'. In turn, the *Observations* set out a statistical method consisting of gathering the empirical data to which his 'method of proportional estimates' (Matsukawa, 1962: 55) could then be applied. This seems to have been used by Graunt for the first time to the interpretation of mass of observations associated with social phenomena. Although by then only elementary mathematics, or better arithmetics, was used, the method had shown to be seminal in the way of answering his questions. This seems to be what made the *Observations* seminal not only for demography but across a wide scientific spectrum of disciplines, including statistics, probability and medical sciences.

Perhaps, more important than being overshadowed by the achievements of the experimental methods advocated by scientists like Boyle and Newton, Graunt's method of proportional estimates needed to be developed. This has occurred through the development of mathematical statistics and probability, and more recently the development of computation. Only with the emergence of computer as a research instrument, large numbers of statistical data can be fully explored in new ways of seeing and simulating the reality of population, and ideed in the same footing as, for instance, the telescope and the microscope, . Throughout the twentieth century, an important development of demographic analysis corresponds to the transformation of Lotka's deterministic models of population dynamics based on continuous time and age variables into discrete time and age variables (Feller, 1941; Leslie, 1945, 1948). But in addition to that, as soon as computers became available to population researchers the style demographic had the possibility to change dramatically. As Keyfitz (1993: 534) put it:

> For demographers a change in style of work took place within a few years that was almost as dramatic as for the mathematician specializing in numerical analysis. With computer processing the census became more flexible ... But the computer went beyond improving the census; it plus sampling techniques provided a technical basis for surveys that produced new forms of data, measuring variables previously out of reach of demographers. The World Fertility Survey has been the most spectacular instance of this, and the data it has obtained for most of 50 countries is by no means yet fully exploited in analysis (Keyfitz, 1993: 534)

Although I agree that 'A purely descriptive approach is ... insufficient to understand the reasons or causes of the [demographic] process' (Wunsch, 1984: 3), the idea that 'description is not knowledge' seems rather puzzling. Already the ancient Greeks considered that description was an 'insufficient definition', an insufficient knowledge because could not be defined (Mora,

1978: 96). In any case, however inferior the descriptive knowledge might be, descriptions are indispensable steps in the overall cognitive process comprising other aspects, such as definition, demonstration, explication and prediction. Demography has often and widely been portrayed to be mainly descriptive, very much in the positivist sense of the terms generally postulated for natural and social sciences. But the fact that an explanatory approach entails a greater cognitive content than the descriptive, I doubt that demography can attempt to do anything without it.

This issue is important for a more subtle reason, concerning the relationship between the so-called inductive and deductive methods of reasoning. This problem plays a primordial role in the history of all sciences, and is particular pertinent if one considers Graunt's book appeared under the influence of Bacon's philosophy of science.

The bulk of demography is descriptive for population is characteristics primarily with respect to its quantity, structure, levels and trends in change of its numbers. I consider descriptive demography as opposed to may be called an explanatory demography (Francisco, 1996). While the former stands on a neuter or a one-sex methodological approach, the latter refers to the study of population from the point of view of a two-sex methodological approach seem as basis for an adequate study of the mechanisms and causation of demographic change as opposed to a simple description of what has happened. Thus, from a demographic point of view what should define its explanatory nature is its methodological framework. This is somewhat different from the use of this term in conventional statistics, in the sense that from a demographic point of view 'descriptive demography' should comprise both areas of the frequently-drawn distinction between 'analytic' and 'descriptive' surveys (Kalton, 1973: 2). That is, what should decide whether demographic is descriptive or explanatory is the nature of the methodological framework used in the study of population.

I will not enter any further into the distinction between the descriptive and explanatory areas of demography. But this brief reference to the matter is needed here to support the main contention discussed in this paper: that Graunt's *Observations* provided the paragon for descriptive demography, and thus for the bulk of what has been called demography. Moreover, the above remarks concerning the descriptive nature of demography should clarify a point concerning a paper by Wunsch (1984) which will be used extensively in this section.

The institutional and professional context of demography's birth

Institutions are like living beings: once born, they do their best to survive, adapt and develop. The same could be said about professions, the role of individual scientists, and main streams of thought. In this essay the latter aspects will be dealt with as part of the institutional and organizational setting in which the new scientific study of population became a fact without a proper name. The objective of this part is to argue that the context of the development of a

science in any stage of its growth cannot be underestimated. This point can be well illustrated with the controversies which two important events have aroused over the past three centuries: on the one hand, the foundation of the English Royal Society and, on the other, the reactions that the *Observations* and its author originated, especially the speculations about the authorship of Graunt's book.

Recently, several authors in other disciplines have revised carefully the institutional context of the inception of modern science in order to understand better the debut of their own fields. Some of those disciplines, such as statistics, probability, and medical statistics, were already mentioned in association with the name of Graunt. Likewise, in a few economic journals authors like Endres (1985) and Hartwick (1991) have also attempted their bit, while in mainstream demographic journals Kreager's important papers (1988, 1991, 1993) have filled part of a theoretical gap barely addressed before. However, the entire problem of the correlation between the *Observations* and the scientific and historical context in which this book appeared seems to be more complicated than even Kreager acknowledged.

Both the informal and formal processes associated with the foundation of the English Royal Society were far from peaceful and innocent. This important scientific institution was the result of informal meetings of men deeply interested in the new experimental method sketched by scientists like Galileo and strongly advocated by philosophers like Bacon. But the rise and institutionalization of earlier modern science generated strong controversies between and within its supporters and the critics. Among the many debates, one of the most famous was the disputes between Hobbes and Boyle; at stake was how to generate natural knowledge and, in particular, how to put Bacon's philosophy into action and develop further the new system of science. In the history of the philosophy of science Hobbes appears as the big loser; besides his reputation as an 'arch-atheist' , his ironic remarks certainly did not help: 'if people who tried such a farrago of experiments were to be called philosophers, the title might be bestowed upon apothecaries and gardeners and the like' (Stephen, 1904: 54). 'It is worth remembering', as Lansdowne (1927: xxiii) pointed out, 'that (according to Aubrey) Thomas Hobbes was, in his eightieth year, in grave danger of being burnt at the stake on account of the heterodox opinions to which he had given expression many years before!' But the fascinating history of the experimental method as a systematic means of generating natural knowledge was told by Shapin and Schaffer (1985) in their book *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life*.

The English Royal Society received its first Royal Charter in the same year that Graunt published his book. At the same time, the Society also adopted Bacon's 'new philosophy' as its official ideological stance, if not the only inspiration, in terms of philosophy of science (Clark, 1949: 132, cited by Endres, 1985: 247; Kargon, 1963; Purver, 1967: 129-130, 142). But despite its declarations and vigour in developing the new system of Natural Philosophy, the origin and creation of the Royal Society continues to provoke controversies among historians (see Purver, 1967; Webster, 1967; Jacob, 1975; Jacob, 1980; Jacob and Jacob, 1980; Hunter, 1989). This has been so since the middle of the eighteenth century, when Thomas Birch (1756-7) published his interpretation of the Society's history and portrayed the first historical account written by

Sprat (1959 [1667]) in his *History of the Royal Society* as the expression of a private opinion (Purver, 1967: 63).

Without entering into such a debate, in fairness the fact that a figure as eminent as Hobbes neither applied nor was invited to join the Royal Society seems an odd feature in the earlier history of this institution (Westfall cited by Cullen, 1975: 4). It may be argued, as Stephen (1904: 54) did, that this was natural on the grounds that the leading members of this body were Hobbes's antagonists. But this is a rather cynical view, the more so when one takes into consideration the innocent image that Thomas Sprat, the Society's first historian, portrayed of the Royal Society, and in particular his remarks about Graunt.

Immediately after Graunt distributed the first 50 copies of his book the Fellows of the Royal Society acknowledged its significance. The Society did not take long to demonstrate the fascination that the *Observations* produced among its members. As Birch reported, on February 12 of 1662,

> A committee consisting of Sir William Petty, Dr. Needham, Dr. Wilkins, Dr. Goddard, Dr. Ent, and Dr. Whistler, was appointed to examine Mr. Graunt's observations on the bills of mortality (Birch, 1986: 76).

On February 26 Graunt was elected a fellow of the society (Birch, 1968: 77). Between 1663 and 1665, Graunt's book was one of the very few works which went into several editions under the Society's auspices, using the imprimatur that it had been granted in its charter (see footnote 7).

Sprat used Graunt's example in his *History of the Royal Society* to illustrate the Society's openness to 'Men of different Religions, Countries, and Professions of Life', which even 'the *King* himself was pleased to make' (Sprat, 1702: 63, 67). His election, Sprat continued,

> was so far from being a prejudice, that he was a Shop-keeper of *London*; that His Majesty gave this particular charge to His Society, that if they found any more such Tradesmen, they should be sure to admit them all, without any more ado. From hence it may be concluded, what is their inclination towards the manual Arts; by the careful regard which their *Founder*, and *Patron*, has engaged them to have, for all sorts of *Mechanick Artift*' (Sprat, 1702: 67).[10]

However, if certain historians are right Sprat's book cannot be read as an innocent discourse because it was written with a agenda. That is, the book 'was intended to serve an apologetic function *par excellence*, finally materialized after various delays in 1667' (Hunter, 1989: 27). Sprat's emphasis on Graunt's election to the Society as an indication of the lack of prejudice against ordinary educated people seems rather 'unnatural' when compared with the Society's ostracism against a figure as prominent as Hobbes; whether the King influenced this it is not known, though he is said to have once called Hobbes 'the Bear' (Feuer, 1963: 196).

---

[10] On this Sutherland pointed out:

> It is of interest that the Society was able to follow this precept while Charles was still alive, and elect not merely another distinguished shop-keeper, but another draper. Anthony Leeuwenhoek of Deft was elected a Fellow of the Royal Society in 1679 in recognition of his pioneer microscopical observations (Sutherland, 1963b: 37; see also 1963a: 539).

Undoubtedly, Graunt could not be more opportune in the time he published the *Observations*. The Society was desperate for promoting good examples of inductive rather than speculative knowledge, and the principles of Arts and the Truth which Graunt defended in his book were congruent with Bacon's goals spelt out in his *History of Life and Death*:

> That 'Life is short and Art long' is an old proverb and complaint. It appears therefore to follow naturally that I who am earnestly labouring for the perfection of arts should take thought also, by the grace and favour of the Author of Life and Truth, about the means of prolonging the life of man (Bacon, 1861: 217).

Moreover, in his dedication to Sir Robert Moray, the President of the Society, Graunt declared his support to the Royal Society clearly and with eloquence:

> For you are not only His Majesty's Privy Council for Philosophy, but also his Great Council. You are the three estates, viz. the mathematical , mechanical and physical. You are his Parliament of Nature ... I am as well pleased to hear you are satisfied in a luciferous experiment, as that a breach hath been made in the enemy's works: and your ingenious arguings immediately from sense and fact, are as pleasant to me as the noise of victorious guns and trumpets. Moreover, as I contend for the decent rights and ceremonies of the Church, I also contend against the envious schismatics of your Society (p. 6-7).

Irrespective of both the quality of the *Observations* and Graunt's main profession, two main factors might have influenced the quick decision of the Society to invite him as full member: on the one hand, the two apologetic dedications, one to the political establishment and the other to the new leading scientific institution, and his friendship with influential members in the Society such as William Petty; on the other hand, the controversial developments surrounding the establishment of the Society itself.

This is where the long speculations around the authorship of the *Observations* needs to be placed. In dispute have been those who saw Graunt as the single author, and those who attributed, if not the whole book, at least some of its fundamental parts to his close friend Petty, who is credited as the pioneer of earlier political economy.

Perhaps the value of this controversy in the modern period is the opportunity which it provides to understand how a classic in science is or is not appreciated throughout time; in particular, it allows to grasp the academic intrigue and politics surrounding the birth, in this case, of demography.

The debate itself is somewhat disturbing, not only because of when it started but also how it has been conducted throughout this time. The first odd feature about the doubts on the true authorship of the *Observations* is to have started about one year after Graunt died, in part as a compliment to Petty who was still alive; apparently it was first raised in the diary of Evelyn, but to this other members of the society whispered their own views such as Bishop Burnet, Aubrey, Southwell, Houghton and Halley (Hull, 1899: xxxix-liv; Lansdowne, 1927: 273-282; Greenwood, 1948: 36-37).

After it had fallen into oblivion for some hundred years, McCulloch resumed the matter in 1854 when authors like Quételet and Knies portrayed the *Observations* as one of the pioneering works in the field of modern statistics (for more details, see Bevan, 1894: 42-43; Willcox, 1939: v-vi; Matsukawa, 1962: 51). For some time Hull's account on the dispute

appeared to have put an end to the debate by satisfying the two main sides in contention. However, in the late 1920s the authorship dispute resumed 'hotter than ever', as Matsukawa (1962: 53) wrote, 'due mainly to the publication in 1927 of *The Petty Papers* and in 1928 of *The Petty-Southwell Correspondence* in which "we now see him [Petty] in a new light".' Lansdowne (1927) and Greenwood (1928, 1933, 1948) (see also Westergaard, 1932: 16-19) involved themselves in heated discussions. In 1939, Willcox, the Dean of United States statisticians, also surveyed the authorship dispute and concluded: 'this book was the joint production of Graunt and Petty' (Willcox, 1939: iii); but in a comment about the two authors' different mental stature Willcox (1939: x) judged: 'To the trained reader Graunt writes statistical music: Petty is like a child playing with a new musical toy which occasionally yields a bit of harmony'.

Kreager's (1988: 129) recent comment that Glass's (1963) and Sutherland's (1963a) papers 'put an end to the old speculation that Petty wrote Graunt's book' seems weak in two ways: first, it fails to acknowledge the importance of all the debate; secondly, it in some way misleads the uninformed reader about the nature of the debate in that for many authors the issue was not so much 'that Petty wrote Graunt's book', but whether or what might have been his contribution and influence.

In 1975 Cullen called attention to a few features, which are of interest because he has been one of the very few authors who actually attempted to place this dispute in the context of the controversies surrounding the Royal Society's foundation. As Cullen wrote:

> the list of authorities who have decided that Petty's role in the work was strictly limited is an impressive one and includes all the important economists, demographers, and medical statisticians who have written on the subject. Their argument springs from an underlying distrust of Petty as an intellectual gadfly, a distrust which is backed by the obvious superiority of arithmetical and demographic skills evident in the *Observations* to those demonstrated in the known works of Petty. The most which these writers allow to Petty is that he may have suggested the work to Graunt, helped over a few details, possibly wrote the conclusion, and also persuaded Graunt to insert what has commonly been called a life table.
>
> In allowing this much, Greenwood, Professor Glass, and the others have allowed a very great deal (Cullen, 1975: 2).

The point made here by Cullen (1975: 3) is that the distrust of Petty's intellectual stature has often been guilty of so much innocence that, in the end, it has run against Graunt. This is apparent, when the arguments stress that Petty's works do not demonstrate the mastery of technique found in the *Observations*. As Cullen currently put it, 'to argue from this that Graunt was the principal author, is to attach more importance to technique than to theory, which hardly seems justified, especially at the foundation of a discipline' (Cullen, 1975: 2-3).

But perhaps even more significant in Cullen's (1975: 4) discussion are his references to authors like Bevan (1894), Feuer (1963) and Skinner (1965) who ventured the view that Petty's political arithmetic 'was built out of studying Hobbes'. These authors argued that the primacy which Hobbes gave to geometry strongly influenced Petty's mind to arithmetic and quantification. For this very reason and mainly because of 'the tense political and intellectual atmosphere of 1661-2', so Cullen hypothesized, 'Petty could scarcely afford to risk notoriety. He was naturally cautious all his life over publishing his works' (Cullen, 1975: 4). In the end,

Cullen decides that the *Observations* may have been 'more than the product of an off-hand remark as far as Petty's role was concerned. Graunt may have written the body of the work but the general framework and the whole conception were Petty's' (Cullen, 1975: 2-3).

Regardless of the standpoint one takes, at least two interesting and positive features emerge after any new conjecture about the authorship of Graunt's book. First, it substantiates the point made here that the making of science is not an innocent game; the broad institutional context in which science develops matters more than has been acknowledged. Secondly, as Greenwood (1933: 81) asserted, 'if the controversy induces anybody who has not done so to read Graunt's book, it will have done more good than more literary discussions'. As yet, from what has been said so far it seems that this debate can play a role beyond providing a motivation for reading the *Observations*. Because it has gone on for too long, the disputed authorship has established its own space in the history of science. Demographers should be the last to dismiss its significance for the history of their own field. Although there is no point in converting it into an intellectual rumination, it would also be unfortunate if it was converted into a wasted opportunity.

In fairness, while it must be acknowledged that despite the intractability of some of the aspects discussed, the debate had its moments of scientific quality there were also very nasty and disturbing ones. But after all, what is more pleasing is that not even the nastiest remarks against both authors damaged their deserved fame in science.[11] The hypothesis that Graunt never discussed his research project and ideas with friends as close as Petty seems totally inconsistent with his reputation as an interrogating intellect and self-educated person. Not even his stature would improve much if it were to be shown that Petty had no participation in the composition of the *Observations*. Beyond that, new comers to the field will probably benefit more if the close friendship between Graunt and Petty in their life were used to understand their long-lasting legacy. In particular, any attempt to dissociate Graunt's work and the overall English 'political arithmetic' school from the wider intellectual movement in which they appeared are totally self-defeating. This school has been frequently associated with William Petty (1623-1687), mainly because he named the school and contributed a great deal to its development. It now appears well established that between the two scholars Graunt (1620-1670) is the one who should be credited for his pioneering work which led to the inception of statistics and demography. Moreover, the earlier political arithmetic movement integrated fields as diverse as those now considered part of demography, political economy, statistics, and constitutional law (Pearson, 1978: 3). Thus, earlier studies of population shared the same social, intellectual and cultural environment of its allied disciplines, such as statistics, probability, political economy and even constitutional law. They were more like twins than descendants of one another. Indeed, they shared the background created by Bacon's natural philosophy. They shared the experimental method used in different ways to create knowledge

[11] On this see Lansdowne (1927: 274) who quoted Southwell's comments to Petty saying: 'Poor John ... The good man was herein a dwarf mounted on an elephant'. As Lansdowne (1927: 274) explained no one knows 'whether he accepted or deined Southwell's "soft impeachment".' With regard to Petty there is for example Willcox's (1939: x) cynic comparison of him with a child playing with a new musical toy (see above).

about nature. And in particular, they shared the mathematical method of proportional estimates which Graunt called his 'shop-arithmetic'.

Language of communication, metaphors and rhetoric

In demography, as in any science, abound metaphors and allegories as ways of communicating and expressing abstract concepts. This is true both in narrative expositions and in quantitative (statistical and mathematical) models, and it is an important part of scientific rhetoric or the art of scientif argumentation; it involves the use of concepts in two ways, the literal and the figurative, or allegorical at once (Highfill, 1992: 131; Klamer et al, 1988). To mention just one example, one of the most widely used metaphors in demography is the term 'universe' as the embodiment of the concept of population.

For Bacon the link between logic, rhetoric, and morality was rather intricate. According to Rossi for Bacon rhetoric 'was a part of logic; and "the duty and office of Rhetoric is to apply Reason to Imagination for the better moving of the Will", and for this reason becomes part of morality' (Rossi, 1968: 136). Some of the concepts mentioned above about Graunt's methods illustrate the important role of metaphors in understanding what was then called 'natural history'. For example, terms like 'observation' and 'sense' played a dual role in Bacon's and Graunt's works. To borrow Kreager's analogy between Graunt's conceptualization of population and the commercial enterprise:

> By referring interchangeably to his arithmetic in the language of natural history ('observations') and of trade ('accompts'), Graunt brought two concepts of intrinsic value into direct alignment: the generation of wealth and the generation of life (Kreager, 1988: 137-138).

But perhaps the most important feature in Bacon's writing was his celebration of knowledge as power and the associations he made with sexual metaphors. Instead of approaching nature as a living organism, in the literal way, for Bacon knowledge was expected to subjugate and master it as a machine-like object (Capra, 1988: 30; Endres, 1985: 247; Lloyd, 1993: 11). Here, Bacon's frequent use of sexual imagery turned out be his principal metaphor, which he used to express both the process and the outcome of scientific endeavour.

The most immediate illustration of Bacon' sexual metaphors is the title of one of his works, *The Masculine Birth of Time* (Farrington, 1951: 193-205). He considered the past science inspired by Plato, Aristotle and others as having produced only a 'feminized knowledge', and thus his alternative was to seek the transformation of science into a 'masculine birth' (Keller, 1985: 38; Lloyd, 1993: 12). Such a birth should be the product of violation and rape, because he though that mastery and domination should be exercised over nature as if was a forceful and aggressive seduction of a female. 'Let us establish', he wrote, ' a chaste and lawful marriage between Mind and Nature'; or yet, 'I am come in very truth leading to you Nature with all her children to bind her to your service and make her your slave' (cited by Keller, 1985: 36). Beyond his most overt well-known methodology, Bacon's reliance on an

explicit language of gender metaphors was important for the institutionalization of modern science during the seventeenth century. As Keller (1985: 40) wrote:

> For the founding fathers of modern science, the reliance on the language of gender was explicit: they sought a philosophy that deserved to be called 'masculine', that could be distinguished from its ineffective predecessors by its 'virile' power, its capacity to bind Nature to man's service and make her his slave (Keller, 1985: 7).

Graunt, in turn, used rhetoric not in figurative terms but to explain the characteristics of population in the City of London seen as matters of fact. However, with the exception of the terms mentioned above Graunt used concepts such as christenings, burials and several sexual terms in literal rather than figurative sense. In so doing, Graunt's art of persuasion contributed to the development of rhetoric in the discourse of 'natural philosophy' because it identified specific concepts which would progressively lead to a proper body of demographic rhetoric or discourse of argumentation.

In this context, his views on sexual matters involving the use of terms like polygamy, fornication, and adultery, are more interesting for their literal meaning and the specific approaches on reproduction and fertility they express. Seen through the lens of contemporary views Graunt's views on sexuality may appear absurd. But more important than judging them, demographers should not have much difficulty in understanding them as part of what is now called the attitudes, knowledge, and practices on fertility.[12]

> Kreager (1988: 131) correctly pointed out 'that the central concept of natural history, "observation", like "sense", plays a dual role in Bacon's and Graunt's works': on the one hand, it refers to the censorial looking and noting down natural relations and, on the other, to making remarks on them and drawing general inferences and practical implications. Bacon laid great stress on the value of tables as a method of presenting observations, as summary devices and aids to memory, and a structure of relations which can be checked by independent observers (Kreager, 1988: 130-1). In this context, the originality of Graunt's use of the value of tables was to have made them as effective in the manipulation of the quantitative information as a narrative report in a strictly qualitative analysis. Graunt's tabulations were preceded by a systematic organization of the data he used and explained (see Box 1 above).

On Graunt's research results as a source of diverse theoretical developments

The aspects discussed so far about the *Observations* were chosen not so much because they have been the most underestimated in the past, as compared with the utility of Graunt's findings. Instead, in the context of this analysis they are part and follow the logic of a coherent process of scientific discovery. That is, start from the questions or empirical puzzles that need to be better understood; define and use the methods of organization of the raw information, and

---

[12] In Chapter 2 of my Ph.D thesis I discuss in more detail 'Graunt's discovery of the statiscal stability of the sexes' and 'Graunt's speculations on the sex ratio' (Francisco, 1996: 17-27).

then its interpretation and analysis; and finally, present the important findings resulting from the analysis carried out; one needs to bear in mind that the overall process of research and, in particular, the presentation of the results and the type of reactions to them occur and depend on not only on the art of argumentation but also the intellectual and social condition at the time.

In any case, although there are no single and rigid logical rules on this process, at least little doubt seems to exist about that in any process of research the findings and conclusions are the end result. Perhaps, on this basis some may believe that demographers have generally stressed the utility of Graunt's findings because they represent what really matters in the end of overall research exercise. This view is what seems to justification assertions, such as the following offered by Keyfitz (1984: 438): 'For those in a hurry to find useable answers, methodology seems secondary to substantive work'. However, if one sees substantive work as the process of 'explanation-seeking-why-questions', then sound research findings depend as much on good methods as good questions. Keyfitz (1984: 438) himself also admitted that 'method is rarely entirely separable from substance, since serious papers in the literature contribute to both'.

In the end, with regard to Graunt's research results the questions that need consideration are: what were the important findings of Graunt's investigation? Is there in fact a coherent set of findings related to the wide spectrum of the subject of demography as it is perceived in modern times?

The findings and conclusions which Graunt himself considered relevant have already been highlighted above, in paragraph 6 of Box 1. There is no point in repeating what several authors have said about the originality of Graunt's findings and conclusions. But it may be useful to mention two examples which illustrate how far Graunt has succeeded in getting his findings appreciated. Almost a century ago Hull (1899: lxxvi) wrote: 'It cannot be contended that Graunt was completely master of the method of investigation to which he made noteworthy contributions'; but, Hull (1899: lxxvii) added, 'we must confess surprise that his faults are so few and his merits are so many'. In 1990, Hald recognized the 'new standards for statistical reasoning' set up by Graunt and accepted that he provided the paragon for descriptive statistical analysis of demographic data. In his review of the range of issues found the *Observations*, Hald placed particularly attention in the following: Graunt's critical appraisal of the rather unreliable data; his study of mortality by cause of death; his demonstration of the stability of statistical ratios; his life table; and his estimation of the number of inhabitants by several different methods.

In the context of this essay two fundamental points need to be clarified further. First, contrary to what has often been thought, the *Observations* were focused on the wide variety of issues which until now make up the core content of demography. Table 2 illustrates this assertion by showing the distribution of the number of pages in the book dedicated to eight main topics listed in Table 1.

Table 2: Percentages of the main subjects found in Graunt's book according to selected categories		
Code	**Designation**	**Percent**
1	Data appraisal	15
2	Deaths -Diseases, health and longevity	22
3	Birth - fruitfulness and productivity of marriage	11
4	Sex ratio - proportion between the sexes and ages	16
5	Migration between counties and the City of London	7
6	Air (environment)	2
7	Population change - the numbers and growth	19
8	Population policies - government, trade and religion	8
	Total	100
	Source: see Table 1.	

The eight categories enumerated in Table 2 were drawn from the topics enumerated in the sub-title in the cover of the book and the first dedication (see details in Table 1 above). They were then applied to the 106 propositions constituting the Index.

Far from being concerned with mortality alone, the table shows that Graunt seems to have been more interested in extracting from the data as much information as he could and, thus, shedding new light on some important political and social issues of his time. Therefore, he can hardly bear any responsibility for the fact that later authors have reduced the relevance of his work to one or another topic, customarily related to mortality.

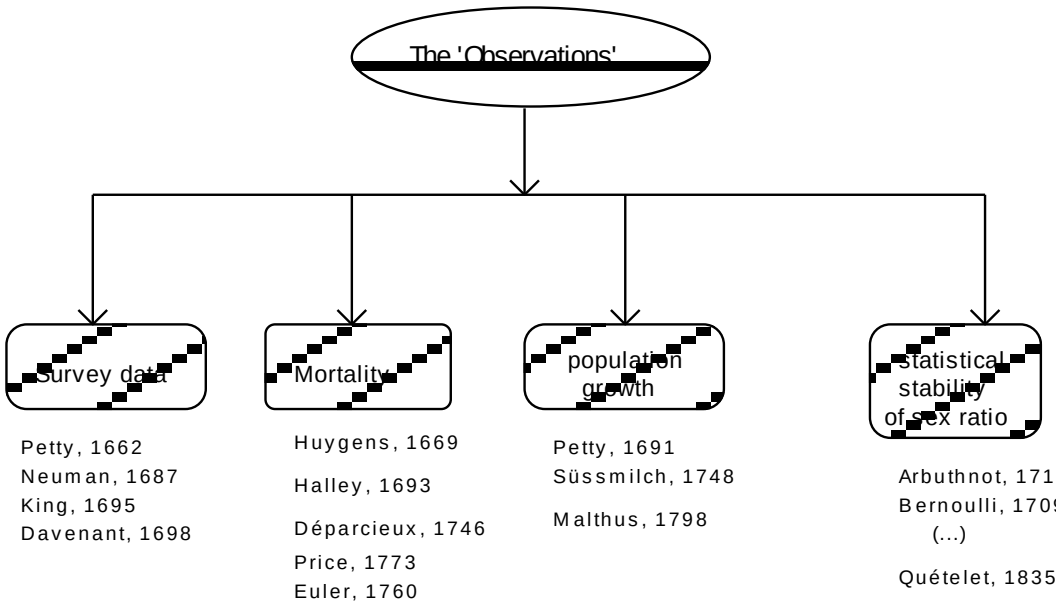
Curiously, even his so-called crude anticipation of a life table was motivated, as some authors noticed (see Sutherland, 1963a: 551-552; Hald, 1990: 100-101), not from an interest in mortality itself but the objective to calculate the number of 'fighting men' in London. It was Halley (1942 [1693]), some forty years later, who directed the study of expectancy of life to the study of mortality and proposed the first mathematical model known as the life table.

Graunt's strong emphasis given to the causes of deaths can be understood in two ways: on the one hand, the Baconian philosophy admonished researchers that they should subject themselves to scientific facts, rather than to the strength and excellency of the speculative wit, which invoked its own oracles. The intellect had its important role to play, but mainly in the interpretation of data. On the other hand, because Graunt left the data to speak for themselves, they were strongly biased towards burials as compared with christenings and migration. Although this might have misled later demographers about Graunt's goals, one should nevertheless bear in mind that it took more than two centuries for them to overcome the idea that mortality was not the primary determinant in the change of population composition.

Furthermore, Graunt seems to have been aware that although an erroneous or incomplete hypothesis might fit the data at some stage, further experiments should corroborate or invalidate it. 'How far I have succeeded in the premises, I now offer to the world's censure' (p. 14). He hoped that the 'world' would at least take his 'new thing' well, he wrote. But despite being convinced that he was offering a 'new thing' it is hard to believe that he expected that his 'lesson to the world' would become a masterpiece.

This leads to the second important point concerning the utility of Graunt's findings. That is, the diverse theoretical streams of investigation which have developed gradually ever since. Figure 2 depicts four distinctive streams of investigation: (1) the collection of empirical data. Some years after the first publication of the *Observations,* Petty and others gathered statistical data on a variety of social, economic and demography issues; (2) the field of mortality by studying the causes of death, the calculation of survivorship probabilities and expectation of life; late in the 1660s the Hugens brother began a correspondence on the expectation of life and the usefulness of Graunt's table for calculating values of life annuities. Although they never got to life annuities, they were interested on the expected and the median lifetime; this correspondence was only made public in 1895 (Kargon (1963: 347); Hald (1990: 106). Some four decades later Halley used the empirical data prepared by Caspar Neuman and proposed his mathematical model to estimate the degrees of mortality of mankind, the life table; (3) the study of population growth as a subject of independent investigation on its own account was also followed by Petty and later authors such as Süssmilch and Malthus; (4) the use of sex ratios to develop statistical test of their stability and variation; in 1710 Arbuthnot resumed Graunt's study on the stability of the sex ratio and took it in a new direction: he outlined the first probabilistic model to 'prove' his *Argument for Divine Providence, taken from the Constant Regularity Observed in the Births of both Sexes.* This investigation was continued for about two centuries by eminent authors such as Bernoulli, Moire, Derham, Süssmilch, Laplace, and Adolphe Quételet.

Figure 2 The 'Observations' as a source of diverse theoretical developments



These streams of investigation followed and are consistent with Graunt's twofold goals made explicit in the full title of the *Observations* and the two epistle dedications, that is to be political and natural or scientific (see paragraph 2, Box 1).

This admirable research program has ever since been the core of the subject of demographic content. In its fundamental way the topics involved in such a program make up the important body of demographic teaching and research in modern times, including the collection of empirical information, particularly survey and census data; the studies on the magnitude and changes of the number of births and deaths over time; the studies on the causes of the components of population change, namely the causes of mortality, fertility and migration; the estimates of population size by articulating the available data with feasible assumptions and methods; and the investigation of the regularities of sex ratios.

Even if one reduces the substance of demography to the methods that Graunt developed to study population change, it is curious to notice that in fields of statistics and probability much more than in demography has already been done to correct the views on those fields about the earlier past of their disciplines. Indeed, for two times demographers have missed the opportunity of being in the lead in a debate which is of interest across several disciplines. The first time was when authors such as Hull, Pearson, Westergaard and Greenwood provided the biographical accounts on Graunt's life. The second time was recently, when authors such as Hacking (1975), Daston (1988) and Hald (1990) demonstrated that Graunt's work was paramount to the earlier development of probability and statistics, and thereby the wider rise of social mathematics.

3. What is the usefulness of this new reading of Graunt's work?

> there is much pleasure in deducing so many abstruse and unexpected inferences ... And there is pleasure in doing something new, though never so little, without pestering the world with voluminous transcriptions (Graunt, 1662: 51)

This main purpose of this essay is not so much to encourage the reader to seek out Graunt's book and read it in the original form for its own sake. Instead, its central intension is to challenge those who are interested in the history of demographic ideas to reconsider the portraits of Graunt's contribution to contemporary demography. In other words, it should be apparent from the discussion above that more than just pleasure in reading Graunt's book or even making justice to earlier history of population theory the essay is particularly concerned with contemporary demography construction..

Demography has the reputation of having 'too little theory' (Hauser and Duncan, 1959: 43); see also Livi-Bacci, 1984. As de Bruijn (1993: 4) noticed recently, 'Some demographers even state that the discipline tends to be a tool kit rather than a substantive science'. But this state of affairs is far from new, and what may now appear to be going very awry in our discipline seems to be a relatively old problem. As this essay reveals demographers of all ages appeared to have been more interested on Graunt's book as a 'tool kit' than for its contribution to the substance of demography as a science. Unfortunately, for this reason the first and most influential book ever written in demography has so far been of little help against the tendency to insulate demographic methodology from any theoretical principles.

Yet no demographic book which has been written over the past three hundred or so years has deserved more serious theoretical study than that of Graunt. Only the failure to do so can explain why still in 1973 Laslett found himself in the uncomfortable position of insisting that it is not extravagant 'to class the *Observations* with Harvey's *De Motu Cordis* (1654), Newton's *Principia* (1687) or Locke's *Essay on Human Understanding* (1690)'; as he explained:

> But to the social scientists of our own day, the man who was the first to collect medical and vital statistics, to apply mathematics, if only very elementary mathematics, to social facts, to recognise urbanisation as a major effect on behaviour and on social structure, must be considered as ranking among the great natural scientists of the early years of the Royal Society (Laslett, 1973:1).

It is nevertheless doubtful that many demographers and other social scientists really accepted Laslett's justification for classing the *Observations* with the other masterpieces he mentioned. This essay made it clear that not long ago historians of our discipline, for instance Dupâquier and Dupâquier (1985), dismissed Vilquin's suggestion that Graunt can in fact be regarded as the founder of demography in its full scientific meaning. In this final part of the essay it seems important to consider the usefulness and implications of this new reading on Graunt's work. First, Table 3 provides a summary of the overall argument developed above.

Table 3. A summary of the five elements found in Graunt's *Observations*

Characteristics	Description

1. The subject of demography • What can be known about population? • Who should be studied (women, children, men, specific age groups)? • What kinds of concepts to use? • What is the purpose of demographic analysis?	The subject of demography has been defined by the epistemological and methodological knowledge steaming from the questions, puzzles and problems concerning population dynamics. Demography was born only when epistemological criteria could be grasped independently of the causal theory. This happened when Graunt transformed the inquiry concerning life and death set forth by Bacon into a systematic study of population change through concepts such as christenings, burials, numbers of inhabitants, marriage, differences of the sexes, and teeming women. The dominant philosophy of science in the 1660s admonished students of all subjects to answer scientific problems by questioning nature and society and not by appealing to the authority of pre-established dogmas. So demography started off with the array of questions which Graunt raised about population change in the City of London. Thus, the coherent subject of inquiry which runs right through the *Observations* is its first important contribution to the making of demography as a science.
2. Methodology and method of inquiry • How research should proceed? • What are the techniques for gathering evidence?	While methodology is concerned with how research should be carried out, the methods of inquiry refer to the techniques or set of tools for gathering, organizing and analysing the data. Just as with the subject of inquiry Graunt acknowledged in the Baconian methodology the roots of his own methods of inquiry. Graunt's method went far beyond the classical Baconian methodology in two ways. First, Graunt defined a set of techniques for organizing his data which turned into the program of descriptive statistics. Secondly, Graunt applied an elementary mathematical method of proportional estimates, and for the first time applied it in the interpretation of a large numbers of empirical social data. This method has shown to be very powerful because it allows the study of regularities from masses of data with recourse to the observation of frequencies of numbers in time series; such regularities can neither be seen through small numbers, nor purely qualitative information.
3. Institutional and professional context • How is the intellectual, social and political context of development of science, and in particular, its major breakthroughs?	The context of the development of a science in any of its stage cannot be underestimated. It was not pure coincidence that demography was born in the context of the remarkable intellectual movement set by prominent philosophers and scientists in his time, such as Bacon, Boyle, Harvey, Hobbes, Newton and Petty. Considering the unconventionality of Graunt's analysis, and in particular his new subject, methods and data, it is also not surprising that demography was sketched by an amateur rather than any of the mainstream scholars in science. The two most important intellectual episodes marking Graunt's *Observations* were: the influential philosophy of science called Natural Philosophy; the establishment of the English Royal Society, the scientific institution which soon embodied the new philosophy and the scientific attitude worldwide. With regard to the controversy and speculations about the authorship of Graunt's book its value today is to provide the opportunity to understand how a classic in science is or is not appreciated throughout time.
4. Language of communication ###	Graunt's discourse contains some of the allegories and metaphors proper of the Baconian rhetoric or art of persuasion (i.e., observations, natural history). However, the important concepts used in Graunt's exposition such as christenings, burials and several sexual terms, were important for their literal rather than figurative sense. Thus, Graunt's discourse contributed to the development of the rhetoric in the discourse of 'natural philosophy' because it identified some of the concepts which would progressively lead to a proper body of demographic rhetoric or discourse of argumentation.
5. Utility of the results • What were Graunt's findings? • Is there a coherent set of useful results relevant for modern demography?	Although there are no single and rigid logical rules on this process, at least little doubt seems to exist about that in any process of research the findings and conclusions are the end result. Two important features concerning Graunt's research results are considered here. First, that the *Observations* were focused on the wide variety of issues which until now make up the core content of demography (Table 2). Second, Graunt fostered four main streams of new investigation depicted in Figure 2: (1) Survey data; (2) the field of mortality; (3) the study of population; (4) the use of sex ratios to develop statistical test of their stability and variation.

One can, thus, conclude that there is more than just pleasure in reading Graunt's book. The five elements used for the discussion Graunt's book were selected on the basis of their relevant for the development of demography's whole design up to the present. If this essay can

be said to offer a more integrating and holistic reading of the *Observations* than those found in the literature it should contribute positively to the important goal implicit in Kreager's papers: that is, the need to overcome the dated historiography which still pervades demography today. This is more than a goal: to achieve it demands an extensive agenda aiming to produce a body of knowledge more consistent with the historical record. Such an agenda cannot be content with the convenient and fashionable tendency of claiming acquaintance with the classics of demography by just learning their titles.

Secondly, a more accurate and comprehensive understanding of our past should be of much utility in pedagogical terms. There are many ways in which Graunt's book could be used by new-comers to demographic studies. For instance, similar to the teaching notes which led to the book edited by Lucas and Kane (1985), *Asking Demographic Questions* could well be produced around the 13 main questions raised by Graunt rather than the answers he provided. After him many authors produced better explanations for the issues he raised, but what is important is the remarkable fact that overall demographers spend most of their professional life around the questions first outlined by Graunt. The utility of the approach would be to show the tyro in demography the way an interrogating intellect works and, to borrow once again Bacon's phrase, why the faculty of wise interrogating is half knowledge.

To some extent Lucas and Kane's book shows that in demography, as in any science, the questions we ask are the leitmotif for research. They did this in an elementary logic without any historical perspective; but an effective process of learning can hardly dispense with the latter. There are many ways of articulating the logic and the historic views, even when the main points of reference are current issues.

Another pedagogical way of bringing Graunt to the current teaching was implicit in Greenwood's (1933: 79) discussion of Graunt's on life tables. Greeenwood pointed out in the 1930s that Graunt anticipated and discovered that a certain type of mortality table could be calculated from a knowledge of deaths at ages only; as he added, 'the only contemporary who realized its immense importance was not Petty but Halley' (Greenwood, 1933: 79). Then Greenwood poses a sort of classroom exercise:

> Whether Graunt realized the limitations of his method, whether he recognized that, using as he did a growing population, his method under-estimated the probabilities of survivorship, is a nice question. The fallacy seems gross enough to us, but it would be an interesting experiment to take a dozen intelligent people without technical knowledge of statistics, to describe to them the process of constructing a life table by adding up the deaths in Graunt's way and to ask them to explain why, applied, say, to a current record of deaths at ages it will give wrong answers. I have never tried the direct experiment, but, judging from experience with students and from the fact that so intelligent a man as Edwin Chadwick did *not* realize the fallacy, I am not sure that it *is* one any intelligent person ought to detect at once. Halley, of course, recognized it, hence his attempt to secure data of a really stationary population (Greenwood, 1933: 79).

Correspondingly, similar exercises could be formulated on the basis of Graunt's investigation on the 'teeming women' and, in particular, his ratio of births to marriages as proxy to an index on fertility.

With regard to research it seems enough to mentioned that this essay emerged in the context of a Ph.D thesis which discusses the feasibility, usefulness and validity of what may be called a ‘two-sex demography’. The development of a demographic perspective drawing on methodologies which deal with the complementarity and interaction between the sexes is far from new field in demography itself. However, the 50-year old subject called 'two-sex problem' has never secured assent in conventional teaching. In research the two-sex problem has been isolated both from earlier anticipations of a two-sex demographic approach and contemporary important theoretical issues such the determinants of fertility. In turn, a two-sex perspective on fertility even addressed in the mainstream literature on fertility analysis; but as my thesis demonstrates, ever since Graunt’s *Observations* the problem of the scientific study of population has been twofold: how to study a population which constituted of two main sexes, and how not to study it as if it were asexual or had one sex only. In debating today the degree to which demographers can aspire to the creation of a two-sex demography in the future, an important message can be drawn from this paper: such a debate should never be trapped by a short-term historical memory.

My Ph.D thesis demonstrates that demographers of today cannot afford to treat Graunt as if he was part of a 'pre-history' of demography. This is so because the birth of anything cannot be seen as an anticipation or prelude of its own history; whether with living beings or scientific theories, their pre-history is the history of its predecessors and sources. Moreover, the history of demography as a scientific study of population did not start with Malthus's *Principle of Population*. Chapter 5 of my PhD thesis entitled 'Malthus's principle of population and sexual reproduction' discusses explicitly the important step forward provided by Malthus's *Principle of Population* in relation to Graunt's model of demography's whole design. Two sections in this chapter are of particular interest: 'Why was 1798 a turning point in the development of demography?'; 'Loss of innocence: what did Malthus do to demography that Graunt did not?'; 'Why has Malthus's principle of population been so successful?'.

In short, in my thesis I demonstrate that Malthus's *Principle of Population* was a turning point in the development of demography because he proposed a demographic approach remarkably different from the innocent approach found in Graunt's *Observations*. The legacy of Graunt's descriptive approach remarks so powerful today that, perhaps, the majority of demographers still believe they should be committed only to the naive seeing and the dispassionate noting and accounting inherited from Graunt's *Observations.*

After comparing Graunt's *Observations* and Malthus's *Essay on Population* from the point of view of the two-sex perspective outlined in my Ph.D thesis, an interesting conclusion emerged. That, as far as the construction of demographic theory, demographers of today seem to be rather more Grauntians than Malthusians. The reasons are associated with the distinction discussed in my thesis between the descriptive and explanatory demographic analyses. The idea of a two-sex demography need to be understood in context and process of moving from the former to the latter.

Neither Graunt nor Malthus can be said to have attempted to develop a two-sex approach in the sense discussed in my PhD thesis. However, two concepts in their work are

consistent with the principle of complementarity between the sexes. First, the sex ratio that Graunt discovered was not only the first measure ever created in demography. Indeed, it was also the simplest two-sex concept among several concepts and measures consistent with the core principle in a two-sex perspective: the complementarity between the sexes. In the sex ratio each sex is mediated by the other in a very simple but fundamental manner for theory construction. Secondly, the second postulate in the Malthusian principle of population, 'the passion between the sexes is necessary' expresses another dimension of the complementarity and interaction between the sexes.

This brings about a more general issue often overlooked whenever the classics of demography are discussed: why have some streams of their thoughts remained dormant or abandoned, while others inspired a great deal of useful ideas and debate? Malthus's well known dual principle of population has generated multiple and contradictory reactions. But between the two postulates of this principle only the first has been extensively debated and explored, while the second has been widely dismissed as a 'romantic but thoroughly erroneous theory' (Demeny, 1986: 478). However, in the next future demographers will have to admit having been deceived by the simplicity of concepts such as the sex ratio and the 'passion between the sexes'. From a two-sex approach Malthus's second postulate can be regarded as expressing in words what Graunt's sex ratio expresses through a quantifiable measure. That is, the complementarity between the sexes. After all, as my thesis demonstrates since Graunt the problem of the scientific study of population has been twofold: how to study a population which includes two sexes, and how not to study it as if it were asexual or had one sex only.

Perhaps for some this thesis is guilty of expanding, as Glass (cited by Behar, 1985: 173) put it, the merits of earlier writers on population beyond any real worth. Although my thesis strongly challenges the established portraits of Graunt's work, I have not been much interested in judging Graunt's own views and intentions; on the contrary, my main concern was to make sense of the views and intentions of those who claim acquaintance with him. In this way I hope that this work will be seen not just as an indictment, but as a compliment especially to those who inspired me to overcome the nasty pretension of trying to claim acquaintance with Graunt by simply learning the title of his book. Beyond that, I hope that my essay offers a deeper understanding of the inception of demography: one which should make demographers prouder of the remote origins of their discipline.

First, for the improvement of teaching and research within demography itself. Indeed, it can be show that better use could even be made of the *Observations* itself in terms of teaching, and a few examples are proposed. Secondly, there is the so-called interdisciplinary debate between demography and its allied disciplines, particular with statistics and political economy.

Whenever one becomes aware that existing historical reconstructions are inconsequent with their sources, or they provide no adequate answer to the questions put to them, one should have little hesitation but seek and read the original.

Table1: Graunt's 'Natural and Political Observations made upon the Bills of Mortality (1662)

	Chapters	An Index of the positions, observations and questions contained in this discourse	Page No.	No of pp.	%	code
I	Of the Bills of Mortality, their beginning, and progress	1. The occasion of keeping the account of burials arose first from the Plague, in the year 1592,	15	1	2.5	1
		2. Seven alterations and argumentations of the published Bills, between the years 1592 and 1662,	16-19	4	10.0	1
II	General observations upon the casualties	3. Reasons why the accounts of burials and christenings should be keep universally, and now called for and perused by the Magistrate,	20			1
		4. A true account of the Plague cannot be kept, without the account of other diseases,	20	1	2.5	1
		5. The ignorance of the Searchers no impediment to the keeping of sufficient, and useful account,	21	1	2.5	1
		6. That about one-third of all that were ever quick die under five years old, and about 36 per centum under six,	22			2
		7.That two parts of nine die of acute, and 70 of 229 of chronical diseases, and four of 229 of outward griefs,	22	1	2.5	2
		8. A Table of the proportions dying of the most notorious and formidable diseases, or casualties,	23			2
		9. That seven per centum die of 'Age',	23			2
		10. That some diseases and casualties keep a constant proportion, whereas some other are very irregular,	23	1	2.5	2
III	Of particular casualties	11. That not above one in 4000 are 'Starved',	24			2
		12. That it were better to maintain all beggars at the public charge, though earning nothing, than to let then beg about the streets; .and that employing them without discretion may do more harm than good,	24	1	2.5	2
		13. That not one in 2000 are 'Murdered' in London, with the reasons thereof,	25			2
		14. That not one in 1500 die of 'Lunatick',	25	1	2.5	2
		15. That few of those who die of the 'French-Pox' are set down, but coloured under the 'Consumption', etc.	26			2
		16. That the 'Rickets' is a new disease, both as to name, and thing; that for 14 dying threeof, in the year 1634, it hath gradually increased to above 500 in the year 1660,	26-7	1.25	3.1	2
		17. That there is another new disease appearing; as a 'Stopping of the Stomach', which hath increased in 20 years, from six to near 300,	27-8			2
		18. That the 'Rising of the Lights' (supposed in most cases to be the 'Fits of the Mother') have also increased in 30 years, from 44 to 249,	28			2
		19. That both the 'Stopping of the Stomach', and 'Rising of the Lights', are probably relics of or depending upon the 'Richets',	28			2
		20. That the 'Stone' decreases, and is wearing away,	28-9	2	5.0	2
		21. The 'Gowt' stands at a stay,	29			2
		22. The 'Scurvy' increases,	29			2
		23. The deaths by reason of 'Agues' are to those caused by 'Fevers', as one to 40,	29			2
		24. 'Abortives' and 'Stillborn', to those that are Christened are as one to 20,	29			2
		25. That since the differences in Religion, the Christenings have been neglected half in half,	29	0.75	1.9	2,3
		26. That not one woman in 100 dies in 'Child-bed', nor one of two hundred in her 'Labour',	30			2
		27. Three reasons why the registering of children hath been neglected,	30			1,2,3
		28. There was a confusion in the accounts of 'Chrysoms', 'Infants', and 'Convulsions'; but rectified in this Discourse,	30	1	2.5	2
IV	Of the Plague	29. There hath been in London within this age four times of great mortality, viz. in the years 1592, 1603, 1625 and 1636, whereof that of 1603 the greatest,	31	1	2.5	2
		30. In the years 1603 and 1625, about a fifth part of the whole died, and eight times more than were born,	32			2
		31. That a fourth part more die of the 'Plague' than are set down,	32			2
		32. The Plague in 1603 lasted eight years, that in 1636 twelve years, but that in 1625 continued but one single year,	32	1	2.5	2
		33. That alterations in the air do incomparably more operate as to the 'Plague', than the contagion of converse,	33			2,6
		34. That 'Purples', 'Small-pox', and other malignant diseases, fore-run the 'Plague',	33			2
V	Other observations upon the Plague, Casualties	35. A disposition in the air towards the Plague doth also dispose women to 'Abortions',	33			2,6
		36. That as about 1/5th part of the whole people died in the great Plague years, so two other fifth parts fled, which shows the large relation and interest which the Londoners have in the country,	33	1	2.5	5
		37. That (be the Plague great or small) the City is fully re-peopled within two years,	34			5
VI	Of the Sickliness, healthfulness, and fruitfulness of seasons	38. The years, 1618, 20, 23, 24, 32, 33, 34, 49, 52, 54, 56, 58, and 61, were sickly years,	34			2
		39. The more sickly the years is, the less fertile of births,	34-5	1.25	3.1	3
		40. That Plagues always come in with Kings' reigns is most false,	35			8
		41. That in London there have been 12 burials for 11 christenings,	35			4

VII	**Of the difference between burials and christenings**	42. The Autumn, or the Fall, is the most unhealthful season,	35	0.75	1.9	3
		43. That in the country the have been, contrary-wise, 63 christenings for 52 burials,	36			4
		44. A supposition, that the people in and about London are a fifteenth part of the people of all England and Wales,	36			5
		45. That there were six millions and an half of people in England and Wales,	36			5
		46. That the people in the country double by procreation but in 280 years, and in London in about 70, as hereafter will be shown; the reason whereof is, that many of the breeders leave the country, and that the breeders of London come from all parts of the country, .such persons breeding in the country aqlmost only as were born there, but in London multitudes of others,	36			5
		47. That about 6,000 per annum come up to London out of the country,	36			5
		48. That in London about three die yearly out of 11 families,	36	1	2.5	5
		49. There were about 25 millions of acres of land in England and Wales,	37			5
		50. Why the proportion of breeders in London to the rest of the people is less than in the country,	37			4
		51. That in London are more impediments of breeding than in the country,	37-8	1.25	3.1	4
		52. That there are 14 males for 13 females in London, and in the country but 15 males for 14 females,	38	0.75	1.9	4
VIII	**Of the difference between the numbers of males and females**	53. Polygamy useless to the multiplication of mankind, without castrations,	39			3
		54. Why sheep, and oxen out-breed foxes and other vermin-animals,	39			3
		55. There being 14 males to 13 females, and males being prolific 40 years and females but 25, it follows, that in effect there be 560 males to 325 females	39			4
		56. The said inequality is reduced by the later marriage of the males, and their employment in wards, sea voyage, and colonies	39			4
		57. Physicians have two women patients to one man, and yet more men die than women,	39-40	1.25	3.1	4
		58. The great emission of males into the Wars out of London in the year 1642 was instantly supplied,	40			4
		59. Castrations is not used only to meliorate the flesh of eatable animals, but to promote their increase also,	40	0.75	1.9	4
		60. The true 'ratio formalis' of the evil of adulteries and fornications,	41			4
		61. Where polygamy is allowed, wives can be no other than servants,	41			4
IX	**Of the growth of the City**	62. That 97, and 16 parishes of London are in 20 years increased from seven to twenve, and in 40 years from 23 to 52,	41			7
		63. The 16 parishes have increased farther than the 97, the one having increased but from nine to ten in the said 40 years,	41-2	1.25	3.1	7
		64. The ten out-parishes have in 54 years increased from one to four,	42			7
		65. The 97, 16, and ten parishes have 54 years increased from two to five,	42			7
		66. What great houses within the Walls have been turned into tenements,	42			7
		67. Cripplegate parish hath most increased, etc.,	42	1.75	4.4	7
		68. The City removes westwards, with the reasons thereof,	43			7
		69. Why Ludgate is become too narrow a throat for the City,	43			7
X	**Of the inequality of Parishes**	70. That there be some parishes in London two hundred times as big as others,	43	1	2.5	7
		71. The natural bigness and figure of a church for the reformed religion,	44			7
XI	**Of the number of inhabitants**	72. The City of London, and suburbs , being equally divided, would make 100 parishes, about the largeness of Christchurch, Blackfriars, or Colmanstreet,	44	1	2.5	7
		73. There are about 24,000 teeming women in the 97, 16, and ten parishes in and about London,	45			7
		74. That about three die yearly out of 11 families containing each eight persons,	45			7
		75. There about 12,000 families within the Walls of London,	45			7
		76. The housing of the 16 and ten suburb-parishes is thrice as big as that of the 97 Parishes within the Walls,	45			7
		77. The number of souls in the 97, 16, and two [?ten - Eds.} out-parishes is about 384,000,	45	1	2.5	7
		78. Whereof 199,000 are males, and 185,000 females,	46			7
		79. A Table shewing of 100 quick conceptions how many die within six years, how many the next decade, and so for every decade till 76,	46			2
		80. Tables, whereby may be collected how many there be in London of every age assigned,	46			2
		81. That there be in the 97, 16 and ten parishes near 70,000 fighting men, that is, men between the ages of 16 and 56,	46			7
		82. That Westminster, Lambeth, Islington, Hackney, Redriff, Stepney, Newington, contain as many people as the 97 parishes within the Walls, and are consequently 1/5th of the whole pile,	46			7
		83. So that in and about London are about 81,000 fighting men, and 460,0000 in all,	46	1	2.5	7
		84. Adam and Eve in 5,610 years might have, by ordinary proportion of procreation, begotten more people than are now probably upon the face of the earth,	47			7
		85. Wherefore the world cannot be older than the scriptures represent it,	47			7
XII	**Of the Country Bills**	86. That every wedding one with another produces four children,	47			3
		87. That in several places the proportion between males and females differ,	47			4
		88. That in ninety years there were just as many males as females buried within a certain great parish in the country,	47			7
		89. That a parish, consisting of about 2,700 inhabitants, had in 90 years but 1,059 more christenings than burials,	47	1	2.5	7
		90. There come yearly to dwell at London about 6,000 strangers out of the country, which swells the burials about 200 per annum,	48			2,5
		91. In the country there have been five christenings for four burials,	48			4
		92. A confirmation, that the most healthful years are also the most fruitful,	48	1	2.5	2,3
		93. The proportion between the greatest and least mortalities in the country are greater than the same in the City,	49			2,5

	94. The country air more capable of good and bad impressions, than that of the City,	49	1	2.5	1,5
	95. The differences also of births are greater in country, than at London,	50			4
	96. In the country but about one of fifty dies yearly, but at London one of 30, over and above the 'Plague',	50			2
	97. London not so healthful now as heretofore,	50			2
	98. It is doubted whether increase of people, or burning sea-coal were the cause, or both,	50	1	2.5	7
The Conclusion	99. The Art of making of gold would be neither benefit to the world, or the artist,	51	1	2.5	8
	100. The elements of true policy are to understand thoroughly the lands and hands of any country,	52			8
	101. Upon what considerations the intrinsic value of lands doth depend,	52			8
	102. And in what the accidental,	52			8
	103. Some of the few benefits of having a true account of the people,	52			8
	104. That but a small part of the whole people are employed upon necessary affairs,	52			8
	105.That a true account of people is necessary for the government and trade of them, and for their peace and plenty,	52-3	1.5	3.8	8
	106. Whether this account ought to be confined to the Chief Governors,	53	0.5	1.3	8
	Total	40	40	100	

Codes

1 - Data appraisal

2 - Deaths - diseases, health and longevity

3 - Births - fruitfulness and productivity of marriage

4 - Sex ratio - proportion between the sexes and ages

5 - Migration between countries and the City of London

6 - Air (environment)

7 - Population change - the numbers and growth

8 - Population policies (government, trade, and religion)

Box 1: Extracts from Bacon's *Novum Organum* (1620)

The Great Instauration - The Plan of the Work: Having thus coasted past the ancient arts, the next point is to equip the inttelect for passing beyond (p. 23). ... The art which I introduce with this view (which I call *Interpretation of Nature*) is a kind of logic; though the difference between it and the ordinary logic is great; indeed immense. For the ordinary logic professes to contrive and prepare helps and guards for the understanding, as mine does; and in this one point they agree. But mine differs from it in three points especially; viz. in the end aimed at; in the order of demonstration; and in the starting point of the inquiry (pp. 23-24).

For the end which this science of mine proposes is the invention not of arguments but of arts (p. 24). ... And as the intention is different, so accordingly is the effect; the effect of the one being to overcome an opponent in argument, of the other to command nature in action. In accordance with this end is also the nature and order of the demonstrations. For in the ordinary logic almost all the work is spent about the syllogism. Of induction the logicians seem hardly to have taken any serious thought, but they pass it by with a slight notice, and hasten on to the fomulae of disputation. I on the contrary reject demonstration by syllogism, as acting too confusedly, and letting nature slip out of its hands (p. 24). ... Now my plan is to proceed regularly and gradually from one axiom to another, so that the most general are not reached till the last: but then when you come to them you find them to be not empty notions, but well defined, and such as nature would really recognise as her first principle, and such as lie at the heart and marrow of things. But the greatest change I introduce is in the form itself of induction and the judgement made thereby. For the induction of which the logicians speak, which proceeds by simple enumeration, is a puerile thing; concludes at hazard; is always liable to be upset by a contradictory instance; takes into account only what is known and ordinary; and leads to no result. Now what the sciences stand in need of is a form of induction which shall analyse experience and take it to pieces, and by a due process of exclusion and rejection lead to an inevitable conclusion (p. 25). ... Nor is this all ... I begin the inquiry nearer the source than men have done heretofore; submitting to examination those things which the common logic takes on trust ... I hold that true logic ought to enter the several provinces of science armed with a higher authority than belongs to the principles of those sciences themselves, and ought to call those putative principles to account until they are fully established ... For certain it is that the senses deceive; but then at the same time they supply the means of discovering their own errors; only the errors are here, the means of discovery are to seek (pp. 25-26).

But I design not only to indicate and mark out the ways, but also to enter them. And therefore the third part of the work embraces the Phenomena of the Universe; that is to say, experience of every kind, and such a natural history as may serve for a foundation to bulid philosophy upon. For a good method of demonstration or form of interpreting nature may keep the mind from going astray or stumbling, but it is not any excellence of method that can supply it with the material of knowledge ... my history differs from that in use (as my logic does) in many things, - in end and office, in mass and composition, in subtlety, in selection also and setting forth, with a view to the operations which are to follow (pp. 27-28).

The second part of the work which is called The New Organon; or, True Directions Concerning the Interpretation of Nature: Those who have taken upon themselves to lay down the law of nature as a thing already searched out and understood ... have therein done philosophy and the sciences great injury (p. 39). ... Now my method, though hard to practise, is easy to explain; and it is this. I propose to establish progressive stages of certainty. The evidence of the sense, helped and guarded by a certain process of correction, I retain. But the mental operation which follows the act of sense I for the most part reject; and instead of it I open and lay out a new and certain path for the mind to proceed in, starting directly from the simple sensuous perception. The necessity of this was felt no doubt by those who attributed so much importance to Logic ... But this remedy comes too late to do any good ... Certainly if in things mechanical men had set to work with their naked hands, without help or force of instruments, just as in things intellectual they have set to work with little else than thenaked forces of the understanding, very small would the matters have been which, even with their best efforts applied in conjunction, they could have attemped or accomplished (p. 40). ... let there is in short be one method for the cultivation, another for the invention, of knowledge ... And to make my meaning clearer and to familiarise the thing by giving it a name, I have chosen to call one of these methods or ways *Anticipation of the Mind*, the other *Interpretation of Nature* (p. 42).

Aphorisms: Neither the naked hand nor the understanding left to itself can effect much. It is by instruments and helps that the work is done, which are as much wanted for the understanding as for the hand ... Human knowledge and human power meet in one; for where the cause is not known the effect cannot be produced. Nature to be commanded must be obeyed; and that which in contemplation is as the cause is in operation as the rule (p. 47). ... The syllogism consists of propositions, propositions consist of words, words are symbols of notions. Therefore if the notions themselves (whch is the root of the matter) are confused and over-hastily abstracted from the facts, there can be no firmness in the sperstructure. Only hope therefore lies in a true induction (p. 49).

There are and can be only two ways of searching into and discovering truth. The one flies from the sense and particulars to the most general axioms ... And this way is now in fashion. The other derives axioms from the senses and particulars, rising by a gradual and umbroken ascent, so that it arrives at the most general axioms last of all. This is the true way, but as yet untried. ... Both ways set out from the senses and particulars, and rest in the highest generalities; but the difference between them is infinite. For the one just glances at experiment and particulars in passing, the other dwells duly and orderly among them. The one, again, begins at once by establishing certain abstract and useless generalities, the other rises by gradual steps to that which is prior and better known in the order of nature (p. 50). ... That reason which is elicited from facts by a just and methodical process, I call *Interpretation of Nature* (p. 51). ... interpretations ... being gathered here and there from very various and widely dispersed facts, cannot suddenly strike the understanding; and therefore they must needs; in respects of the opinions of the time, seem harsh and out of time; much as the mysteries of faith do (p. 51-52).

The honour of the ancient authors, and indeed of all, remains untouched; since the comparison I callenge is not of wits or faculties, but of ways and methods, and the part I take upon myself is not that of a judge, but of a guide (p. 52).

For our road does not lie on a level, but ascends and descends; first ascending to axioms, then descending to works (p. 96). The understanding must not however be allowed to jump and fly from particulars to remote axioms and of almost the highest generality (p. 97). ... taking stand upon them as truths that cannot be shaken ... But then ... In establishing axioms, another form of induction must be devised than has hitherto been employed; and it must be used for proving and discovering not first principles (as they are called) only, but also the lesser axioms, and the middle, and indeed all. For the induction which proceeds by simple enumeration is childish; its conclusions are precacious, and exposed to peril from a contradictory instance; and it generally decides on too small a number of facts, and on those only which are at hand. But the induction which is to be available for the discovery and demonstration of sciences and arts, must analyse nature by proper rejections and exclusions; and then, after a suffcient number of negatives, come to a conclusion on the affirmative instances: which has not yet been done or even attempted, save only by Plato, who does indeed employ this form of induction to a certain extent for the purpose of discussing definitions and ideas. ... And this induction must be used not only to discover axioms, but also in the formation of notions. ... But in establishing axioms by this kind of induction, we must also examine and try whether the axiom so established be framed to the measure of those particulars only from which it is derived, or whether it be larger and wider. And if it be larger and wider, we must observe whether by indicating to us new particulars it confirm that wideness and largeness as by a colateral security; that we may not either stick fast in things already known, or loosely grasp at shadows and abstract froms; not at things solid and realised in matter. ... And here also should be remembered what was said above concerning the extending of the range of natural phiolosophy to take into the particular sciences, and the referring or bringing back of the particular sciences to natural philosophy; that the branches of knowledge may not be severed and cut off from the stem. For without this the hope of progress will not be so good (pp. 97-98) ... And now it is time for me to propound the art itself of interpreting nature ... For interpretation is the true and natural work of the mind when freed from impediments (p. 115).

The second book of Aphorisms concerning The Interpretation of Nature and the Kingdom of Man: On a given body to generate and superinduce a new nature or new natures, is the work and aim of Human Power ... It is correct position that 'true knowledge is knowledge by causes'. And causes again are not improperly distributed into four kinds; the material, the formal, the efficient, and the final (p. 119) ... though in nature nothing really exists besides individual bodies, yet in philosophy this very law, and the investigation, discovery, and explanation of it, is the foundation as well of knowledge as of operation. And it is this law, with its causes, that I mean when I speak of Forms ... If a man be acquainted with the cause of any nature (as whiteness or heat) in certain subjects only, his knowledge is imperfect ... But whosoever is acquainted with Forms, embraces the unity of nature in

substances the most unlike ... From the discovery of Forms therefore results truth in speculation and freedom in operation (p. 120).

The rule or axiom for the transformation of bodies is of two kinds. The first regards a body as a troop or collection of simple natures ... This kind of axiom ... deduces the thing from the forms of simple natures (p. 122). ... The second kind of axiom, which is concerned with the discovery of the *latent process*, proceeds not by simple natures, but by compound bodies, as they are found in nature in its ordinary course (p. 122) ... But as for any profound and radical operations on nature, they depend entirely on the prmary axioms. And in those things too where man has no means of operating, but only knowing, as in the heavenly bodies ... the investigation of the fact itself or truth of the things, no less than the knowledge of the causes and consents, must come from those primary and catholic axioms concerning simple natures (p. 123) ... the nearer it approaches to simple natures, the easier and plainer will everything become; the business being transferred from the complicated to the simple; from the incommensurable to the commensurable; from surds to rational quantities; ... And inquiries into nature have the best result, when they begin with physics and end in mathematics. Again, let no one be afraid of high numbers or minute fractions. For in dealing with numbers it is as easy to set down or conceive a thousand as one, or the thousandth part of an integer as an integer itself (p. 126).

From the two kinds of axioms which have been spoken of, arises a just division of philosophy and the sciences; (p. 126) ... Now my directions for the interpretation of nature embrace two generic divisions; the one how to educe and form axioms from experience; the other how to deduce and derive new experiments from axioms. The former again is divided into three ministrations; a ministration to the sense, a ministration to the memory, and a ministration to the mind or reason. For first of all we must prepare a *Natural and Experimental History*, sufficient and good; and this is the foundation of all; for we are not to imagine or suppose, but to discover, what nature does or may be made to do. But natural and experimental history is so various and diffuse, that it confounds and distracts the understanding, unless it be ranged and presented to view in a suitable order. We must therefore form *Tables and Arrangements of Instances*, in such a method and order that the understanding may be able to deal with them. And even when this is done, still the understanding, if left to itself and its own spontaneous movements, is incompetent and unfit to form axioms, unless it be directed and guarded. Therefore in the third place we must use *Induction*, true and legitimate induction, which is the very key of interpretation. But of this, which is the last, I must speak first, and then go back to the other ministrations (p. 127).

The investigation of Forms proceeds thus: a nature being given, we must first of all have a muster or presentation before the understanding of all known instances which agree in the same nature, though in substances the most unlike. And such collection must be made in the manner of a history, without premature speculation, or any great amount of subtlety (p. 127). ... This table I call the *Table of Essence and Presence* (p. 129) ... Secondly, we must make a presentation to the understanding of instances in which the given is wanting; because the Form, as stated above, ought no less to be absent when the given nature is absent, than present when it is present ... This is called the *Table of Deviation, or of Absence in Proximity* (p. 129) ... Thirdly, we must make a presentation to the understanding of instances in which the nautre under inquiry is found in different degrees, more or less; which must be done by making a comparison either of its increase and decrease in the same subject, or of its amount in different subjects, as compared one with another ... This Table I call the *Table of Degrees* or the *Table of Comparison* (p. 137) ... The work and office of these three tables I call the Presentation of Instances to the Understanding. Which presentation having been made, Induction itself must be at work; ... The first work therefore of true induction (as far as regards the discovery of Forms) is the rejection or exclusion of the several natures which are not found in some instance where the fiven nature is present, or are found in some instance where the given nature is absent (p. 145) ... Then indeed after the rejection and exclusion has been duly made there will remain at the bottom, all light opinions vanishing into smoke, a Form affirmative, solid and well defined (p. 146).

APHORISMS on the Composition of the Primary History - Nature exists in three states, and is subject as it were to three kinds of regime. Either she is free, and develops herself in her own ordinary course; or she is forced out of her proper state by the perverseness and insubordination of matter and the violence of impediments; or she is constrained and moulded by art and human ministry (p. 253) ... Natural History, which in its subject (as I said) is threefold, is in its use twofold. For it is used either for the sake of the knowledge of the particular things which it contains, or as the primary material of philosophy and the stuff and subject-matter of true induction ... For the end rules the method (p. 254).

Yet, a fair reading of the *Observations* cannot miss the wide spectrum of demographic issues addressed by its author, including: his analysis of births and deaths, the study of the statistical stability between males and females, the considerations on the population flows from the country to the City of London, his alternative methods of estimating population growth, and his remarks on sexuality and the role of marriage. But even more important, if we uncritically isolate any of Graunt's findings and conclusions from the whole design of the *Observations*, especially his subject-matter and methodology, we cannot grasp the fundamental paragon that provided for modern demography.

References

Arbuthnott, John (1710). 'An argument for Divine Providence, taken from the constant regularity observed in the births of both sexes'. *Phil. Trans.* 27, pp. 186-90; Reprinted in M. Kendall and R. Plackett (eds.) (1977), *Studies in the History of Statistics and Probability,* Vol. 2. London: Griffin, pp. 30-34.

Bacon, Francis (1861). 'The History of Life and Death - Natural and Experimental History for the Foundation of Philosophy: being the third part of the Instauratio Magna', in *The Works of Francis Bacon,* ed. James Spedding, Robert Ellis and Douglas Heath. Vol. V. London: Longman & Co.

Behar, Cem Lazare (1985). 'La mesure de la fécondité chez les premiers demographes'. *Annales de Démographie Historique*. Paris: Centre National de la Recherche Scientifique, pp. 173-196.

Benjamin, B. (1964). 'John Graunt's "Observations"'. *Journal of the Institute of Actuaries*, 90:1-3.

Bevan, Wilson L. (1894). *Sir William Petty: a Study in English Economic Literature.* Baltimore: American Economic Association.

Birch, Thomas (1968). *The History of the Royal Society of London*. New York: Johnson Reprint Corporation.

Birou, Alain (1973). *Dicionário das Ciências Sociais*. Lisboa: Publicaçöes Dom Quixote.

Blaug, Mark (1980). *The Methodology of Economics*. Cambridge: Cambridge University Press.

Boulanger, Paul-Marie (1980). 'Introduction à l'usage de quelques concepts épistémologiques, dans le champ de la démographie', *Working Paper 82,* Département de Démographie, Louvain-la-Neuve, Cabay.

Bruijn, Bart de (1993). 'Interdisciplinary backgrounds of fertility theory'. *Postdoctorate Onderzoekersopleiding Demografie (PDOD) Paper* 16. Groningen: The Netherlands.

Caws, Peter (1967). 'Scientific method', in *The Encyclopedia of Philosophy*, ed. Paul Edwards. New York: Macmillan, p. 339.

Caldwell, John (1979). 'Education as a factor in mortality decline: an examination of Nigerian data'. *Population Studies* 33: 395-414.

Capra, Fritjof (1988). *The Turning Point: Science, Society and the Rising Culture.* London: Fontana.

Clark, G. N. (1949). *Science and Social Welfare in the Age of Newton,* 2nd ed. Oxford: Clarendon Press.

Crombie, A. C. (1994). *Styles of Scientific Thinking in the European Tradition.* 3 vols. London: Duckworth.

Cullen, M. J. (1975). *The Statistical Movement in Early Victorian Britain: the Foundations of Empirical Social Research.* New York: Barnes & Nobles Books.

Daston, Lorraine (1988). *Classical Probability in the Enlightenment.* Princeton: Princeton University Press.

David, F. N. (1962). *Games, Gods and Gambling*. New York: Hafner Publishing Company.

Demeny, Paul (1986). 'Population and the invisible hand'. *Demography* 23, 4: 473-487.

Demeny, Paul (1988). 'Social science and population policy'. *Population and Development Review* 14, 3: 451-79.

Diamond, Ian and Peter McDonald (1994). 'Mortality', in *Beginning Population Studies*, ed. David Lucas and Paul Meyer. National Centre for Development Studies. Canberra: Australian National University, pp. 29-43.

Dupâquier, Jacques and Michel Dupâquier (eds.) (1985). *Histoire de la Démographie*. Paris: Librairie Académique Perrin.

Endres, A. M. (1985). 'The functions of numerical data in the writings of Graunt, Petty, and Davenant'. *History of Political Economy* 17, 2: 245-264.

Farrington, Benjamin (1951). 'Temporis Partus Masculus, an untranslated writing of Francis Bacon'. *Centaurus*, I: 193-205.

Feller, William (1941). 'On the integral equation of renewal theory'. *Annals of Mathematical Statistics* 12: 243-267.

Feuer, L. (1963). *The Scientific Intellectual: the Psychological and Sociological Origins of Modern Science*. New York: Basic Books.

Fitzmaurice, Edmond (1895). *The Life of Sir William Petty*. London: John Murray.

Fowler, Thomas (ed.) (1889). 'Introduction' in *Bacon's Novum Organum*, Oxford: Larendon Press.

Flew, Antony (1970). 'Introduction', in Thomas Malthus, *An Essay on the Principles of Population*, Harmondsworth: Penguin, pp. 7-55.

Francisco, António A.da S. (1994). 'Why demography treats men as a dispensable sex: the sex ratio and the search for the origin of the one-sex theory'. Paper presented at the Seventh National Conference of the Australian Population Association, Australia's Population Towards the 21th Century, Canberra 21-23 September.

Francisco, António A.da S. (1996). Consideration for a two-sex demography: when, why and how should both sexes matter demography?. Ph.D thesis, Australian National University.

Gert, Bernard (1967). 'Hobbes and psychological egoism'. *Journal of the History of Ideas*, 28, 4: 503-520.

Glass, D. V. (1963). 'John Graunt and his "Natural and Political Observations".' *Proceedings of the Royal Society, Series B*, 159: 2-37.

Graunt, John (1662). *Natural and Political Observations upon the Bills of Mortality*, First edition reprinted in W. Willcox (ed.), Baltimore, 1939; in *Journal of the Institute of Actuaries*, 90, 1964: 1-61, with a Foreword by B. Benjamim; in *The Earliest Classics: John Graunt ... and Gregory King*, Gregg International Publishers Limited, 1973, with an Introduction by Peter Laslett; Fifth edition reprinted in C. H. Hull (ed.): *The Economic Writings of Sir William Petty*, 1899, Cambridge University Press, Vol. 2, pp. 314-431.

Greenwood, Major (1928). 'Graunt and Petty'. *Royal Statistical Society Journal* 1: 79-85.

Greenwood, Major (1933). 'Graunt and Petty - a Re-statement'. *Royal Statistical Society Journal* 1: 76-81.

Greenwood, Major (1948). *Medical Statistics from Graunt to Farr.* Cambridge: Cambridge University Press.

Groenewegen, P. D. (1967). 'Authorship of the "Natural and Political Observations upon the Bills of Mortality".' *Journal of the History of Ideas*, 28, 4: 601-602.

Hacking, Ian (1975). *The Emergence of Probability*. London: Cambridge University Press.

Hald, Anders (1990). *A History of Probability and Statistics and Their Applications before 1750*. New York: Wiley.

Halley, Edmund (1942 [1693]). *Two Papers of the Degrees of Mortality of Mankind.* First published in 1693. Baltimore: Johns Hopkins University Press.

Harding, Sandra (ed.) (1987). *Feminism and Methodology.* Bloomington: Indiana University Press.

Hartley, Harold (1960). *The Royal Society: Its Origins and Founders.* London: Royal Society.

Hartwick, John (1991). 'Robert Wallace and Malthus and the ratios', in *Thomas Robert Malthus (1766-1834) and John Stuart Mill (1806-1873),* ed. Mark Blaug. Cambridge: Edward Elgar, pp. 295-317.

Hauser, Philip M. and Otis D. Duncan (eds.) (1959). *The Study of Population: An Inventory and Appraisal.* Chicago: University of Chicago Press.

Hawking, Stephen (1988). *A Brief History of Time: from the Big Bang to Black Holes.* New York: Bantam.

Highfill, Jannett K. (1992). 'Economics as allegory'. *Journal of Interdisciplinary Economics* 4, 2: 131-136.

Hull, Charles H. (ed.) (1899). *The Economic Writings of Sir William Petty, together with the Observations upon the Bills of Mortality*. 2 Vol., Cambridge University Press.

Hunter, Michael (1982). *The Royal Society and its Fellows 1660-1700: The Morphology of an Early Scientific Institution.* Preston: British Society for the History of Science.

Hunter, Michael (1989). *Establishing the New Science: The Experience of the Early Royal Society.* Woodbridge: The Boydell Press.

Jacob, James R. (1975). 'Restoration, reformation and the origins of the Royal Society'. *History of Science* 13: 155-176.

Jacob, James R. (1980). 'Restoration ideologies and the Royal Society'. *History of Science* 18: 25-38.

Jacob, James R. and Margaret C. Jacob (1980). 'The Anglican origins of modern science: the metaphysical foundations of the Whig Constitution'. *Isis* 71, 257: 251-267.

Jardine, Lisa (1974). *Francis Bacon Discovery and the Art of Discourse.* Cambridge: Cambridge University Press.

Kalton, G. (1973). *Introduction to Statistical Ideas for Social Scientists.* London: Charpman and Hall Ltd.

Kargon, Robert (1963). 'John Graunt, Francis Bacon, and the Royal Society: the reception of statistics'. *Journal of the History of Medicine and Allied Sciences* 18: 337-348.

Karmel, Arjo, Donald N. McCloskey and Robert M. Solow (1988). *The Consequences of Economic Rhetoric.* Cambridge: Cambridge University Press.

Keller, Evelyn Fox (1985). *Reflections on Gender and Science.* New Haven: Yale University Press.

Keyfitz, Nathan (1980). 'Population appearances and demographic reality'. *Population and Development Review* 6, 1: 47-64.

Keyfitz, Nathan (1982). 'Mathematical demography', in *International Encyclopedia of Population*, ed. John Ross, Vol. 2. New York: The Free Press, pp. 437-443.

Keyftz, Nathan (1993). 'Thirty years of demography and Demography'. *Demography* 30, 4: 533-549.

Knibbs, G. H. (1910). *The Problems of Statistics.* Presidential Address. Brisbane: Australian Association for the Advancement of Science.

Kreager, Philip (1988). 'New light on Graunt'. *Population Studies* 42: 129-140.

Kreager, Philip (1991). 'Early modern population theory: a reassessment'. *Population and Development Review* 17, 2: 207-227.

Kreager, Philip (1993). 'Histories of demography: a review article'. *Population Studies* 47, 3: 519-539.

Lansdowne, Marquis (ed.) (1927). *The Petty Papers.* 2 vol. London: Constable & Company Limited.

Laslett, Peter (ed.) (1973). 'Introduction', in *The Earliest Classics.* London: Gregg International Publishers Limited, pp. 1-10.

Leslie, P. H. (1945). 'On the use of matrices in certain population mathematics'. *Biometrika* 33: 183-212.

Leslie, P. H. (1948). 'Some further notes on the use of matrices in population mathematics'. *Biometrika* 35: 213-245.

Lloyd, Genevieve (1993). *The Man of Reason - 'Male' and 'Female' in Western Philosophy*. London: Routledge.

Lorimer, Frank (1959). 'The development of demography', in *The Study of Population: an Inventory and Appraisal.* Chicago: University of Chicago Press, pp. 124-179.

Lucas, David and Penny Kane (eds.) (1985). A*sking Demographic Questions*. National Centre for Development Studies, Demographic Teaching Notes 5. Canberra: Australian National University.

Lucas, David and Paul Meyer (eds.) (1994). *Beginning Population Studies,* second Edition. National Centre for Development Studies. Canberra: Australian National University.

Malherbe, Michel and Jean-Marie Pousseur (eds.) (1985). *Francis Bacon Science et Méthode*. Nantes: Librairie Philosophique J. Vrin.

Matsukawa, Shichiro (1962). 'The 300th anniversary of J. Graunt's "Observations" (1662)'. *Hitotsubashi Journal of Economics* 3: 49-60.

Matthews, Robert (1995). 'A Frenchman in his prime'. *New Scientist* No. 1976: 46.

Medawar, P. B. and D. V. Glass (1963). 'A discussion on demography'. *Proceedings of the Royal Society, Series B* 159: 2-37.

Mora, José Ferrater (1978). *Dicionário de Filosofia.* Lisboa: Publicaçoes Dom Quixote.

Newell, Colin (1988). *Methods and Models in Demography.* London: Belhaven Press.

Ornstein, Martha (1938). *The Role of Scientific Societies in the Seventeenth Century*. Chicago: University of Chicago Press.

Overbeek, Johannes (1974). *History of Population Theories.* Rotterdam: Rotterdam University Press.

Overbeek, Johannes (ed.) (1977). *The Evolution of Population Theory*. London: Greenwood Press.

Pagels, Heinz R. (1989). *The Dreams of Reason: The Computer and the Rise of the Sciences of Complexity*. New York: Bantam Books.

Pearson, Karl (1978). *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. Ltd.

Purver, Margery (1967). *The Royal Society: Concept and Creation.* London: Routlege & Kegan Paul.

Rossi, Paolo (1968). *Francis Bacon: from Magic to Science*. London: Routledge & Kegan Paul.

Shapin, Steven and Simon Schaffer (1985). *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life*. Princeton: Princeton University Press.

Skinner, Quentin (1965). 'I. History and ideology in the English revolution'. *Historical Journal* 8, 2: 151-178.

Skinner, Quentin (1965-66). ''Thomas Hobbes and His Disciples in France and England'. *Comparative Studies in Society and History* 8: 153-67.

Sprat, Thomas (1667). *History of the Royal Society of London, for the Improving of Natural Knowledge* (first published 1667), Second edition corrected printed in London, Rob. Scot, 1702; First edition reprinted with an Introduction by J. Cope and H. Jones (eds.), St. Louis, Washington University Press, 1959.

Stephen, Leslie (1904). *Hobbes*. London: Macmillan & Co.

Sutherland, Ian (1963a). 'John Graunt: A Tercentenary Tribute'. *Journal of the Royal Statistical Society* A 126: 537-556.

Sutherland, Ian (1963b). 'I. Sutherland (discussion meeting)'. *Proceedings of the Royal Society, Series B* 159: 35-37.

Thomlinson, Ralph (1976). *Population Dynamics: Causes and Consequences of World Demographic Change.* New York: Random House.

Trevor-Roper, H. R. (1967). 'Introduction' to *The Royal Society: Concept and Creation* by Margery Purver. London: Routledge & Kegan Paul, pp. xi-xvii.

Valentei, D. I. (1978). *The Theory of Population: Essays in Marxist Research.* Moscow: Progress Publishers.

Vilquin, Eric (1978). 'Une édition critique en français de l' oeuvre de John Graunt (1620-1674)'. *Population,* 2: 413-423.

Webster, C. (1967). 'The origins of the Royal Society'. *History of Science* 6: 106-128.

Westergaard, Harald (1969). *Contributions to the History of Statistics*. New York: Augustus M. Kelley Publishers.

Willcox, Walter, ed. (1939). ' Introduction', in *Natural and Political Observations made upon the Bill of Mortality by John Graunt.* Baltimore: Johns Hopkins University Press, pp. iii-xiii.

Wunsch, Guillaume J. (1984). 'Theories, models, and knowledge: the logic of demographic discovery'. *Genus,* 40, 1-2: 1-17.

The Australian National University
Demography Program, RSSS
Tuesday, 30 April 1996
Seminar Room A Coombs Building, 3:30 pm

Graunt's *Observations* : a model of demography's whole design

(A new reading on the first and most influential book ever written in demography)

António Francisco

The Australian National University
Demography Program, RSSS

Graunt's *Observations* : a model of demography's whole design

(A new reading on the first and most influential book ever written in demography)

António Francisco

Written paper

###

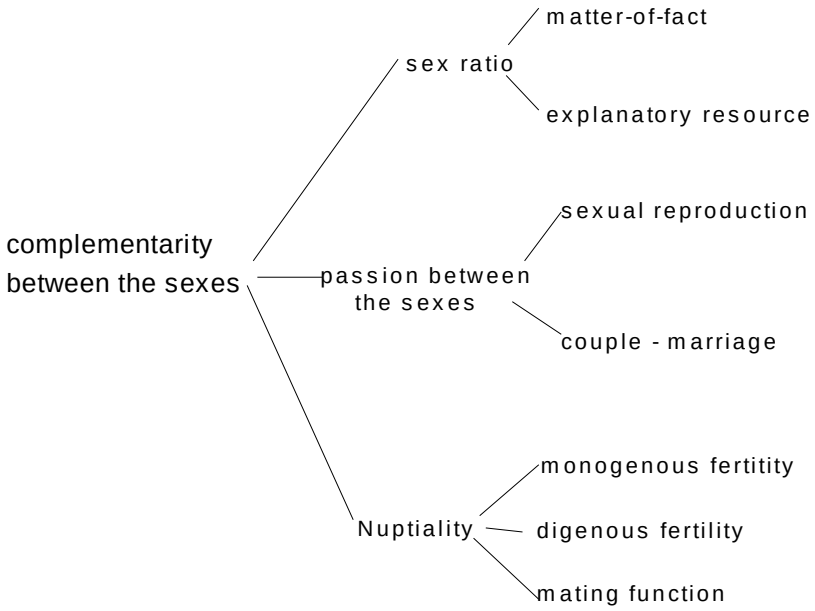
- To the Honourable Sir Robert Moray, Knight
- Table 1: *Natural and Political Observations made upon the Bills of Mortality* (1662): an Index of 106 propositions
- Box 1: A sort of an Executive Summary of Graunt's *Observations*
- Figure 1: Graunt's within the logic of demographic discovery according to Wunsch (1984).
- Table 2: Percentages of the main subjects found in Graunt's book according to selected categories
- Figure 2: The 'Observations' as a source of diverse theoretical developments

Oral presentation

- Objective of the seminar
- The new birth of science and the fountainhead of demography
  - When was demogarphy born
  - Weird book or weird historigraphy?
  - Demographic historiography: Graunt's portrait in a cracked mirror
- The *Observations*: a model of demography's whole design
  - (Table 1, Box 1)
  - From 'The History of Life and Death' to the 'Observations'
  - Promising infinite utility hereafter (Figure 1)
  - On Graunt's findings and results (Table 2)
- Graunt's investigation on population fostered at least four distinctive streams of investigation, which developed gradually ever since (Figure 2)

Tuesday 30 April 1996
Seminar Room ACoombs Building, 3:30 pm

Figure 1.1 A summary of the strands discussed between Chapters 2 and 7



Transparency 1

- If one had to date the birth of demography it would certainly have to be January of 1662: the date of the first publication of John Graunt's *Observations*

  (the date of the first epistle dedicatory was 25 Janaury 1662 and on 5 February 1662 Graunt presented fifty copies to the Royal Society)

- Although the baptism of this field only occurred about two centuries later, when the French scholar Achille Guillard invented the word in 1855, demography is by now more than three hundred and thirty years old.

- <u>On the natural philosophy before 1662:</u>
  - The 12th saw the rise of the European university with its four faculties:
    theology, law, medicine, and the arts (grammar, logic, rhetoric, arithmetic, music, geometry, and astronomy)
  - Latin, the official language of the Church, became the universal scholarly language.
  - The classial Greek works were in Latin translation, and the most important works used were those of Aristotle in phylosophy, ethic, and logic; Euclid in geometry; Ptolemy in astronomy; and Galen in medicine.
  - The attempts to reconcile Aristotelian ideas with Christian theology resulted in the in the powerful phylosophy which has been called Scholasticism
  - Aristotle's inductive-deductive method which lead to his scientific results were pushed to the background, and so the stress was for his logic with its laws of reasoning (the doctrine of syllogism

  - The systematic study of population leading to the independent body of theory in social sciences called demography is a product of the Scientific Revolution, which began with Copernicus (1473-1543) and lasted through the sixteenth and seventeenth centuries.

The radical change in the world view observed between 1500 and 1700 is best known for the achievements of Copernicus, Galileo, and Newton.

Between

Copernicus's *On the Revolutions of the Celestial Spheres* (1543)

Galilei (1564-1642): *Dialogue on the Two Chief World Systems* (1632)

to

Newton's *The Mathematical Principles of Natural Philosophy* (1687)

These, among other intellectuals of the seventeenth century, changed radically the scientific and philosophical bases of disciplines such as astronomy, physics and chemistry; though these disciplines started their independence from philosophy much earlier, only in the seventeenth century did they redeem themselves from the 'old' system of sciences standing on Aristotelian Scholasticism (Purver, 1967; Capra, 1988: 38; Hald, 1990: 19-30).

- But to grasp the theory of knowledge which cradled earlier demography there are two important and influential English philosophers.

  - **Francis Bacon (1561-1626)** is an author often credited as the architect of modern science. He became known for his attacks on scholastic philosophy and on Aristotle, in particular in his *Novum Organum* (The New Instrument [of Thought]) from 1620.

    His influence in earlier population theory was not so much because he is said to have been the first to use the concept of 'population' (Lorimer, 1959: 125).

    Certainly more important was his stress upon the necessity of systematic collection and classication of observations and experiments to get a broad basis for induction, and he warned against rash generalizations because observed correlations might be suripus. Bacon's 'New Philosophy' provided the grounds for the development of important aspects of demography's whole design associated with its epistemological, methodological, institutional and ideological basis

    - **Thomas Hobbes (1588-1679)** was 'the most conspicuous English philosopher in the whole period between Bacon and John Locke' (Stephen, 1904: 1).

      This is not apparent by reading conventional history of science where Hobbes has often been written off because of the controversies he aroused and his mechanistic materialism and atheism.

      However, the author of *Leviathan* systematized Bacon's philosophy, declared that all knowledge is based on sensory perception, and proclaimed geometry as the fundamental science; following the death of Bacon, he became the most active English natural philosopher, having significant intellectual links with prominent European thinkers and with his disciples (Bevan, 1894:80-102; Skinner, 1965: 151-178; 1965-66:153-67) such as William Petty.

- It was not pure coincidence that demography was born in the context of the remarkable intellectual movement set by geniuses like Bacon, Harvey, Boyle, Hobbes and Newton. This was the time when priority to empirical observation and

research gathered momentum. It was the time when the English Royal Society was becoming the leading institution in the development of scientific knowledge; and the time when 'the Royal Society met', as Pearson (1978: 12) put it, 'to find out things and did not exist merely to publish papers'.

- **Other features:**

- the 16th century saw a considerable progress in arithmetic, algebra and trignometry
- Zero was accepted as a number
- The sign = for equality was proposed about the middle of 16th century
- The two concepts of probability: (1) objective, statistical or aleatory probability;
  (2) subjective, personal, or epistemic probabilities
  about 100 years after Cardono (1565) Pascal, Fermat (1654), and Huygens (1657) took up the probability theory; Arnaut and Nicole (1662) published *La logique, ou l'art de penser*, which is said to contain the first numerical probabilities

- So while the first treatises on probability theory and their application to games of chance were prepared, Graunt prepared the first statistical analysis of data on the population of London. He did not have any knowlegde of the existing probability theory.

Weird book or weird historiography?

'I would give a great deal for a portrait of John Graunt' (Pearson, /1920s1978: 10)

Graunt's best reputation:

- haberdasher of small wares and the son of a London draper.
- 'If Graunt can be called the father of demography, Malthus was certainly its first professional' (Thomlinson, 1976:12)
- pioneer of the study of mortality

In other fields, particularly in statistics and probability a great deal has been done to correct the view on those fields about the earliers past of such disciplines:
Hull (1899)
Pearson (1920/1930s)
Westergaart (1969)
Greenwood (1928, 1933, 1948)
Hacking (1975)
Daston (1988)
Hald (1990)

Demographic historiography: portraits of Graunt's work in a cracked mirror

Three main portraits:

- *nonsense portrait.*

  Overbeek's 1974 book, *History of Population Theory*.

  Valentei (1978), *The Theory of Population: Essays in Marxist Research.*

  Valentei's (1977) another book, *An Outline Theory of Population*

- *middle-term portraits.*

  Lorimer (1959: 158)
  Thomlinson (1976: 9, 112, 121, 148)
  Newell (1988: 61)
  Diamond and McDonald (1994: 29)
  Lucas (1994: 1) (A study of 'births and deaths')

Real continuity in the development of interests and methods of inquiry from early to modern times seems to have been largely limited to investigations of mortality and the formulation of life expectations. If there is any 'apostolic succession' from John Graunt to modern demographers, it passes through this rather limited field (Lorimer, 1959: 158).

- *The 'fragmentary' portrait*

Hull (1899)
Knibbs (1910)

Graunt was the first who recognized ‘the human being as the basic unit’ in statistical analysis’ (Knibbs, 1910)

Pearson (1920s/1978)

'the first statistician, - the first man to deal with vital statistics - the first statistician who became a Fellow of the Royal Society' (Pearson, 1978: 10).

Lansdowne (1927)
Greenwood (1928, 1933, 1948)

Lorimer (1959)

Glass (1963)
Sutherland (1963a)
(The tercentenary of the *Observations* (1662)
Notestein, Henry, Hajnal, Brass Fredman)

'rather narrow and teleological ... often sought to enliven its perspective by including brief biographical sketches or other details from the social background' (Kreager, 1993).

- *The reductionist portraits*

  Matsukawa, 1962
  Kargon, 1963
  Groenewegen, 1967
  Cullen, 1975
  Kargon (1963)
  Vilguin (1978)

Graunt merits the unquestionable title of father of demography 'not just because the *Observations* are, chronologically, the first book in which a given science appeared' (Vilguin, 1978)

Dupaquiers(1985). *Histoire de la Démographie: la statistique de la population des origines à 1914.*

'le problème est de savoir s'il est possible de parler de "fondateur" pour un domaine scientique tout entier' (Dupâquier and Dupâquier, 1985: 137).

Kreager (1988, 1991, 1993) 'new light on Graunt' (1988),

integrated view of earlier modern writings on population?

Kreager (1988: 129): 'any further advances could only be made by placing Graunt and his little book more fully in the intellectual and social context of their time'.

2. The *Observations: a model of* demography's whole design

those who cannot apprehend the reason of these enquiries are unfit to trouble themselves to ask them (Graunt, 1662: 51)

In any science, a model of its whole design comprises at least five interconnected but relatively distinct features:

(1) a subject-matter of its own, including its relatively independent epistemological issues, a proper scope of content and specific research agenda;

(2) a fundamental methodology and an array of specific methods of inquiry drawn from different methodological settings;

(3) a network of organizational and institutional scientific settings, including the characteristics of demographic profession;

(4) a proper rhetoric and language of communication; and

(5) the utility of its results and conclusions. That all these features but the name were somewhat brought together at once in a rather small book like the *Observations* is remarkable.

Graunt's book (The fifth edition, much enlarged) comprises 150 pages which include the following rubrics:

Dedication to Lord Roberts
Dedication to Sir Robert Moray
a synoptic Index of 106 propositions on 'the positions, observations, and questions contained in the discourse'
the preface
an Appendix of Tables
'some further observations of Major John Graunt'
the 'advertisements for the better understanding of several Tables: videlicet'

the following 12 chapter headings:

1. Of the Bills of Mortality, their beginnings, and progress
2. General Observations upon the Casualties
3. Of Particular Casualties
4. Of the Plague
5. Other Observations upon the Plague, and Casualties
6. Of the Sickliness, Healthfulness, and Fruitfulness of Seasons
7. Of the differences between Burials, and Christenings
8. Of the difference between the numbers of Males, and Females
9. Of the growth of the City
10. Of the Inequality of Parishes
11. Of the number of Inhabitants
12. Of the Country Bills

The Conclusions

Table 1: Graunt's 'Natural and Political Observations made upon the Bills of Mortality (1662)

	Chapters	An Index of propositions, observations and questions contained in this discourse	Page No.	No of pp.	%	code
I	Of the Bills of Mortality, their beginning, and progress	1. The occasion of keeping the account of burials arose first from the Plague, in the year 1592,	15	1	2.5	1
		2. Seven alterations and argumentations of the published Bills, between the years 1592 and 1662,	16-19	4	10.0	1
II	General observations upon the casualties	3. Reasons why the accounts of burials and christenings should be keep universally, and now called for and perused by the Magistrate,	20			1
		4. A true account of the Plague cannot be kept, without the account of other diseases,	20	1	2.5	1
		5. The ignorance of the Searchers no impediment to the keeping of sufficient, and useful account,	21	1	2.5	1
		6. That about one-third of all that were ever quick die under five years old, and about 36 per centum under six,	22			2
		7.That two parts of nine die of acute, and 70 of 229 of chronical diseases, and four of 229 of outward griefs,	22	1	2.5	2
		8. A Table of the proportions dying of the most notorious and formidable diseases, or casualties,	23			2
		9. That seven per centum die of 'Age',	23			2
		10. That some diseases and casualties keep a constant proportion, whereas some other are very irregular,	23	1	2.5	2
III	Of particular casualties	11. That not above one in 4000 are 'Starved',	24			2
		12. That it were better to maintain all beggars at the public charge, though earning nothing, than to let then beg about the streets; .and that employing them without discretion may do more harm than good,	24	1	2.5	2
		13. That not one in 2000 are 'Murdered' in London, with the reasons thereof,	25			2
		14. That not one in 1500 die of 'Lunatick',	25	1	2.5	2
		15. That few of those who die of the 'French-Pox' are set down, but coloured under the 'Consumption', etc.	26			2
		16. That the 'Rickets' is a new disease, both as to name, and thing; that for 14 dying threeof, in the year 1634, it hath gradually increased to above 500 in the year 1660,	26-7	1.25	3.1	2
		17. That there is another new disease appearing; as a 'Stopping of the Stomach', which hath increased in 20 years, from six to near 300,	27-8			2
		18. That the 'Rising of the Lights' (supposed in most cases to be the 'Fits of the Mother') have also increased in 30 years, from 44 to 249,	28			2
		19. That both the 'Stopping of the Stomach', and 'Rising of the Lights', are probably relics of or depending upon the 'Richets',	28			2
		20. That the 'Stone' decreases, and is wearing away,	28-9	2	5.0	2
		21. The 'Gowt' stands at a stay,	29			2
		22. The 'Scurvy' increases,	29			2
		23. The deaths by reason of 'Agues' are to those caused by 'Fevers', as one to 40,	29			2
		24. 'Abortives' and 'Stillborn', to those that are Christened are as one to 20,	29			2
		25. That since the differences in Religion, the Christenings have been neglected half in half,	29	0.75	1.9	2,3
		26. That not one woman in 100 dies in 'Child-bed', nor one of two hundred in her 'Labour',	30			2
		27. Three reasons why the registering of children hath been neglected,	30			1,2,3
		28. There was a confusion in the accounts of 'Chrysoms', 'Infants', and 'Convulsions'; but rectified in this Discourse,	30	1	2.5	2
IV	Of the Plague	29. There hath been in London within this age four times of great mortality, viz. in the years 1592, 1603, 1625 and 1636, whereof that of 1603 the greatest,	31	1	2.5	2
		30. In the years 1603 and 1625, about a fifth part of the whole died, and eight times more than were born,	32			2
		31. That a fourth part more die of the 'Plague' than are set down,	32			2
		32. The Plague in 1603 lasted eight years, that in 1636 twelve years, but that in 1625 continued but one single year,	32	1	2.5	2
		33. That alterations in the air do incomparably more operate as to the 'Plague', than the contagion of converse,	33			2,6
		34. That 'Purples', 'Small-pox', and other malignant diseases, fore-run the 'Plague',	33			2
V	Other observations upon the Plague, Casualties	35. A disposition in the air towards the Plague doth also dispose women to 'Abortions',	33			2,6
		36. That as about 1/5th part of the whole people died in the great Plague years, so two other fifth parts fled, which shows the large relation and interest which the Londoners have in the country,	33	1	2.5	5
		37. That (be the Plague great or small) the City is fully re-peopled within two years,	34			5
VI	Of the Sickliness, healthfulness, and fruitfulness of seasons	38. The years, 1618, 20, 23, 24, 32, 33, 34, 49, 52, 54, 56, 58, and 61, were sickly years,	34			2
		39. The more sickly the years is, the less fertile of births,	34-5	1.25	3.1	3
		40. That Plagues always come in with Kings' reigns is most false,	35			8
		41. That in London there have been 12 burials for 11 christenings,	35			4

VII	**Of the difference between burials and christenings**	42. The Autumn, or the Fall, is the most unhealthful season,	35	0.75	1.9	3
		43. That in the country the have been, contrary-wise, 63 christenings for 52 burials,	36			4
		44. A supposition, that the people in and about London are a fifteenth part of the people of all England and Wales,	36			5
		45. That there were six millions and an half of people in England and Wales,	36			5
		46. That the people in the country double by procreation but in 280 years, and in London in about 70, as hereafter will be shown; the reason whereof is, that many of the breeders leave the country, and that the breeders of London come from all parts of the country, .such persons breeding in the country aqlmost only as were born there, but in London multitudes of others,	36			5
		47. That about 6,000 per annum come up to London out of the country,	36			5
		48. That in London about three die yearly out of 11 families,	36	1	2.5	5
		49. There were about 25 millions of acres of land in England and Wales,	37			5
		50. Why the proportion of breeders in London to the rest of the people is less than in the country,	37			4
		51. That in London are more impediments of breeding than in the country,	37-8	1.25	3.1	4
		52. That there are 14 males for 13 females in London, and in the country but 15 males for 14 females,	38	0.75	1.9	4
VIII	**Of the difference between the numbers of males and females**	53. Polygamy useless to the multiplication of mankind, without castrations,	39			3
		54. Why sheep, and oxen out-breed foxes and other vermin-animals,	39			3
		55. There being 14 males to 13 females, and males being prolific 40 years and females but 25, it follows, that in effect there be 560 males to 325 females	39			4
		56. The said inequality is reduced by the later marriage of the males, and their employment in wards, sea voyage, and colonies	39			4
		57. Physicians have two women patients to one man, and yet more men die than women,	39-40	1.25	3.1	4
		58. The great emission of males into the Wars out of London in the year 1642 was instantly supplied,	40			4
		59. Castrations is not used only to meliorate the flesh of eatable animals, but to promote their increase also,	40	0.75	1.9	4
		60. The true 'ratio formalis' of the evil of adulteries and fornications,	41			4
		61. Where polygamy is allowed, wives can be no other than servants,	41			4
IX	**Of the growth of the City**	62. That 97, and 16 parishes of London are in 20 years increased from seven to twenve, and in 40 years from 23 to 52,	41			7
		63. The 16 parishes have increased farther than the 97, the one having increased but from nine to ten in the said 40 years,	41-2	1.25	3.1	7
		64. The ten out-parishes have in 54 years increased from one to four,	42			7
		65. The 97, 16, and ten parishes have 54 years increased from two to five,	42			7
		66. What great houses within the Walls have been turned into tenements,	42			7
		67. Cripplegate parish hath most increased, etc.,	42	1.75	4.4	7
		68. The City removes westwards, with the reasons thereof,	43			7
		69. Why Ludgate is become too narrow a throat for the City,	43			7
X	**Of the inequality of Parishes**	70. That there be some parishes in London two hundred times as big as others,	43	1	2.5	7
		71. The natural bigness and figure of a church for the reformed religion,	44			7
XI	**Of the number of inhabitants**	72. The City of London, and suburbs , being equally divided, would make 100 parishes, about the largeness of Christchurch, Blackfriars, or Colmanstreet,	44	1	2.5	7
		73. There are about 24,000 teeming women in the 97, 16, and ten parishes in and about London,	45			7
		74. That about three die yearly out of 11 families containing each eight persons,	45			7
		75. There about 12,000 families within the Walls of London,	45			7
		76. The housing of the 16 and ten suburb-parishes is thrice as big as that of the 97 Parishes within the Walls,	45			7
		77. The number of souls in the 97, 16, and two [?ten - Eds.} out-parishes is about 384,000,	45	1	2.5	7
		78. Whereof 199,000 are males, and 185,000 females,	46			7
		79. A Table shewing of 100 quick conceptions how many die within six years, how many the next decade, and so for every decade till 76,	46			2
		80. Tables, whereby may be collected how many there be in London of every age assigned,	46			2
		81. That there be in the 97, 16 and ten parishes near 70,000 fighting men, that is, men between the ages of 16 and 56,	46			7
		82. That Westminster, Lambeth, Islington, Hackney, Redriff, Stepney, Newington, contain as many people as the 97 parishes within the Walls, and are consequently 1/5th of the whole pile,	46			7
		83. So that in and about London are about 81,000 fighting men, and 460,0000 in all,	46	1	2.5	7
		84. Adam and Eve in 5,610 years might have, by ordinary proportion of procreation, begotten more people than are now probably upon the face of the earth,	47			7
		85. Wherefore the world cannot be older than the scriptures represent it,	47			7
XII	**Of the Country Bills**	86. That every wedding one with another produces four children,	47			3
		87. That in several places the proportion between males and females differ,	47			4
		88. That in ninety years there were just as many males as females buried within a certain great parish in the country,	47			7
		89. That a parish, consisting of about 2,700 inhabitants, had in 90 years but 1,059 more christenings than burials,	47	1	2.5	7
		90. There come yearly to dwell at London about 6,000 strangers out of the country, which swells the burials about 200 per annum,	48			2,5
		91. In the country there have been five christenings for four burials,	48			4
		92. A confirmation, that the most healthful years are also the most fruitful,	48	1	2.5	2,3
		93. The proportion between the greatest and least mortalities in the country are greater than the same in the City,	49			2,5

	94. The country air more capable of good and bad impressions, than that of the City,	49	1	2.5	1,5
	95. The differences also of births are greater in country, than at London,	50			4
	96. In the country but about one of fifty dies yearly, but at London one of 30, over and above the 'Plague',	50			2
	97. London not so healthful now as heretofore,	50			2
	98. It is doubted whether increase of people, or burning sea-coal were the cause, or both,	50	1	2.5	7
The Conclusion	99. The Art of making of gold would be neither benefit to the world, or the artist,	51	1	2.5	8
	100. The elements of true policy are to understand thoroughly the lands and hands of any country,	52			8
	101. Upon what considerations the intrinsic value of lands doth depend,	52			8
	102. And in what the accidental,	52			8
	103. Some of the few benefits of having a true account of the people,	52			8
	104. That but a small part of the whole people are employed upon necessary affairs,	52			8
	105.That a true account of people is necessary for the government and trade of them, and for their peace and plenty,	52-3	1.5	3.8	8
	106. Whether this account ought to be confined to the Chief Governors,	53	0.5	1.3	8
	Total	40	40	100	

Codes

1 - Data appraisal

2 - Deaths - diseases, health and longevity

3 - Births - fruitfulness and productivity of marriage

4 - Sex ratio - proportion between the sexes and ages

5 - Migration between countries and the City of London

6 - Air (environment)

7 - Population change - the numbers and growth

8 - Population policies (government, trade, and religion)

Between 'The History of Life and Death' and the 'Observations'

As Bacon wrote, the 'faculty of wise interrogating is half knowledge'

Perhaps Graunt's core epistemological question is found in the Conclusions of the *Observations*: 'It may be now asked, to what purpose tends all this laborious buzzling, and groping?'. To this question Graunt answered with a set of 13 additional and more specific questions:

To know,

1. The number of the people?
2. How many males and females?
3. How many married and single?
4. How many teeming women?
5. How many of every septenary, or decade of years in age?
6. How many fighting men?
7. How much London is, and by what steps it hath increased?
8. In what time the housing is replenished after a plague?
9. What proportion die of each general and particular casualties?
10. What years are fruitful and mortal, and in what spaces and intervals they follow each other?
11. In what proportion men neglect the orders of the church, and sects have increased?
12. The disproportion of parishes?
13. Why the burials in London exceed the christenings, when the contrary is visible in the country? (Graunt, 1662: 51).

As Hull (1899: lxxviii) wrote, 'Johann Peter Süssmilch (1707-1767) was ... perhaps the first who clearly grasped the fact that when and only when sufficiently large numbers are taken into account, order and not accident appear'.

was not ... the first to make the growth of population a subject of independent investigation on its own account: Graunt certainly anticipated him in that ... Graunt first sought to utilize the bills for the discovery of the new truths. Parish registers had been kept for centuries, but who before Graunt used them to lay bare *Die göttliche Ordnung*? (Hull, 1899: lxxviii).

Süssmilch called Graunt the Columbus of statistics.

It was to Bacon's New Philosophy that Graunt explicitly associated his *Observations.*

The apologetic *Epistle Dedicatory to ... Sir Robert Moray, ... President of the Royal Society of Philosophers*.

Reference to Bacon's *The History of Life and Death.*[13] This book of Bacon's was concerned in explaining the process of gradual 'bodily decay and the atrophy of old age' (Bacon, 1861: 217); and as he put it

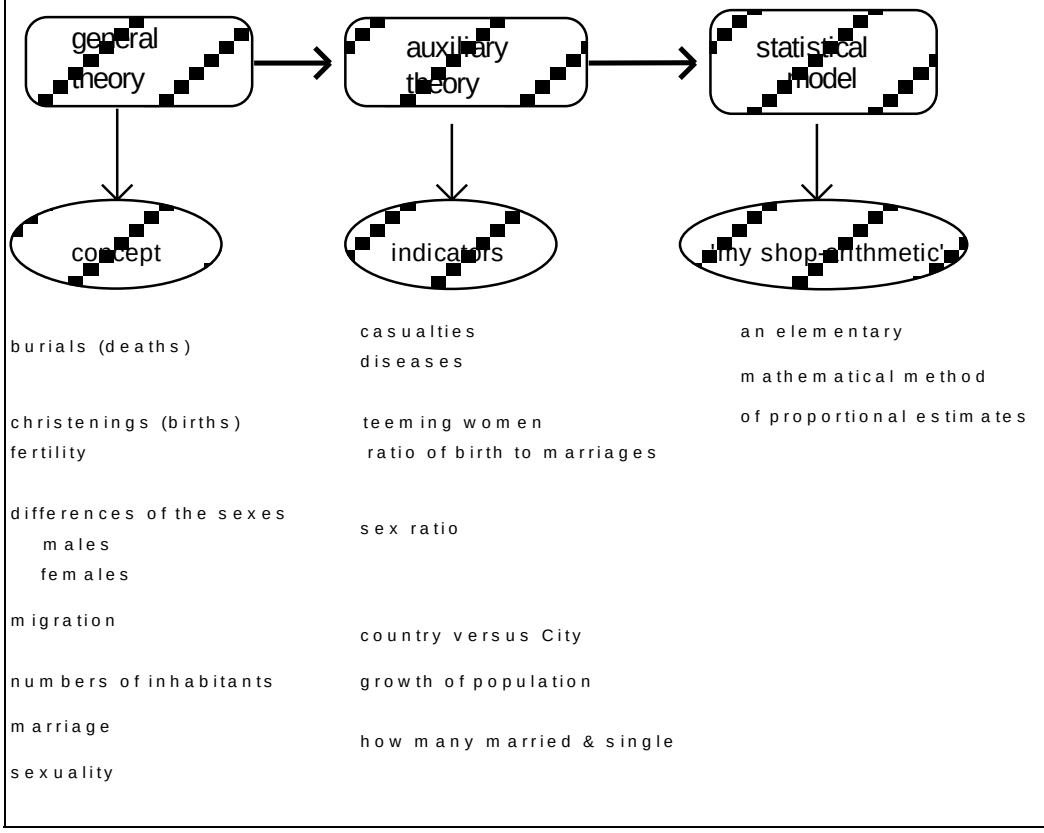
There are therefore two subjects of inquiry; the one, the consumption or depredation of the human body; the other, the repair or refreshment thereof; with a view to the restraining of the one (as far as may be), and the strengthening and comforting of the other' (Bacon, 1861: 219).

A13 Bacon included a second title, *Natural and Experimental History for the Foundation of Philosophy: being the third part of the Instauratio Magna.*

Promising infinite utility hereafter[14]

If Wunsch is correct that demography implies moving from theoretical concepts to auxiliary theory, and then from auxiliary theory to statistical model, somehow this sketch should appear through the *Observations*, even if only in its embryonic stage.
Can we call Graunt's explanations a theory on population?

Figure 1: Graunt's book within the logic of demographic discovery according to Wunsc



A14 This is a paraphrase from Purver (1967) p. xvi.

Graunt's discovery of the statistical stability of the sexes

When Graunt wrote his book there were obviously no demographic concepts as such; otherwise the *Observations* would not be seen today as the 'big bang' of the scientific study of population. The concepts used by Graunt in his investigation were concepts drawn from the common language; for example, christenings and births, burials and deaths, the number of inhabitants, the teeming-women, conceptions, and marriages. These were the primitive and earlier conceptual tools of demography; they became the seeds of the set of categories which have gradually made up the content of the population body of theory.

Among the concepts that Graunt used, the sex ratio was clearly the most persistent and had long-lasting implications. He did not call it sex ratio, but the term 'proportion between the number of males and females' clearly corresponds to its meaning. In the whole text of the *Observations* there is no other concept used so extensively; nor, which is probably even more important, is there a concept which was so successfully transformed into an operational definition and measurable indicator. To recall the logic of demographic discovery as proposed by Wunsch (see Annex A), the sex ratio is perhaps the best example of a demographic concept, which is still used nowadays, that Graunt succeeded in transforming from an abstract concept into an observational indicator.[15] This is the reason I consider that the sex ratio should be explicitly acknowledged as the first true demographic measure ever used in more then three hundred years of demography.

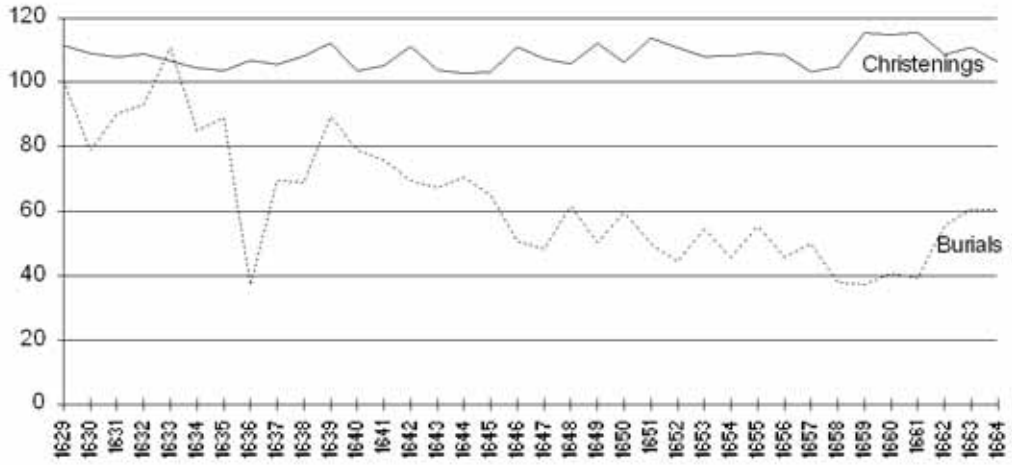
Before the publication of Graunt's *Observations* people had expressed intuitive guesses about the regularities between the sexes; but these were just qualitative guesses based on personal and subjective observations. Graunt was the first to apply elementary mathematics to an independent and relatively large data set with the objective of producing a solid knowledge about the differences between males and females from birth to death. The results he presented in his book were very much a surprise; at the time the common view held was that the population ratio was about three women to one man (Graunt, 1962: 46). Graunt's discussion on the sex ratio can be found mainly in Chapters 3, 7, 8, 12 and the annexed tables at the end of the *Observations*. Table 1.2.1 summarizes the data from annexed tables in Graunt's book and highlights the two important features in Graunt's investigation.

[15] As Figure 1 shows, Graunt managed to transform several other concepts into relatively measurable indicators. However, while it cannot be said that he grasped the notion of crude death and birth rates, or fertility rates, he explored the quantitative dimensions of the concept of 'proportion between males and females' in ways that remain almost completely unchanged.

Table 1.2.1 Summary of the sex ratios in Graunt's *Observations*, 1662								
	Christenings				**Burials**			
	Sex ratio	Maximum	Minimum	Ratio	Sex ratio	Maximum	Minimum	Ratio
London (1629-1636)	107	10034	8524	1.2	111	23359	8392	2.8
London (1637-1640)	107	10850	9160	1.2	115	13624	9862	1.4
London (1541-1648)	106	10670	6544	1.6	109	14059	9894	1.4
London (1649-1656)	110	7050	5612	1.3	111	13921	8764	1.6
London (1657-1664)	110	11722	5990	2.0	109	19735	12434	1.6
Total	108				111			
Romsey (1569-1578)	100	70	50	1.4	97	66	34	1.9
Romsey (1579-1588)	106	90	45	2.0	96	87	39	2.2
Romsey (1589-1598)	125	71	48	1.5	97	117	38	3.1
Romsey (1599-1608)	97	93	60	1.6	103	71	30	2.4
Romsey (1609-1618)	117	87	61	1.4	99	116	51	2.3
Romsey (1619-1628)	99	85	63	1.3	89	89	46	1.9
Romsey (1629-1638)	101	103	66	1.6	93	156	29	5.4
Romsey (1639-1648)	98	87	55	1.6	91	137	46	3.0
Romsey (1649-1658)	111	86	52	1.7	87	80	28	2.9
Total	105				94			
Tiverton (1560-1664)	101				91			91.7
Cranbrooke 1564-1649	105				104			12.3
Total parishes	103				95			
Total Country	108				110			

Source: Graunt's *Observations*, 5th edition, 1665, pp. 411-421.
(a) The maximum, minimum and ratios for Romsey are different from those given by Hald's (1990: 94) Table; when the original table is checked it seems that Hald did not pick up the correct numbers; for example, for christenings in 1589-1598 the minimum is 48 instead of 52; in 1639-1648 the minimum is 55 instead of 62; for burials in 1599-1608 the maximum is 71 instead of 53; and in 1619-1628 the minimum is 46 instead of 50.
(b) The age span in the case of London is based on the original tables and thus differs from those created by Hald (1990: 94)

Figure 1.2.1 Graunt's sex ratios for christenings and burials in London from 1629 to 1664



Between divine creation and chance: an argument from design

the Species may never fail, nor perish, since every Male may have its Female, and of a proportionable Age. This Equality of Males and Females is not the Effect of Chance but Divine Providence (Arbuthnot, 1710: 186)

Arbuthnot (1667-1735): an argument for Divine Providence

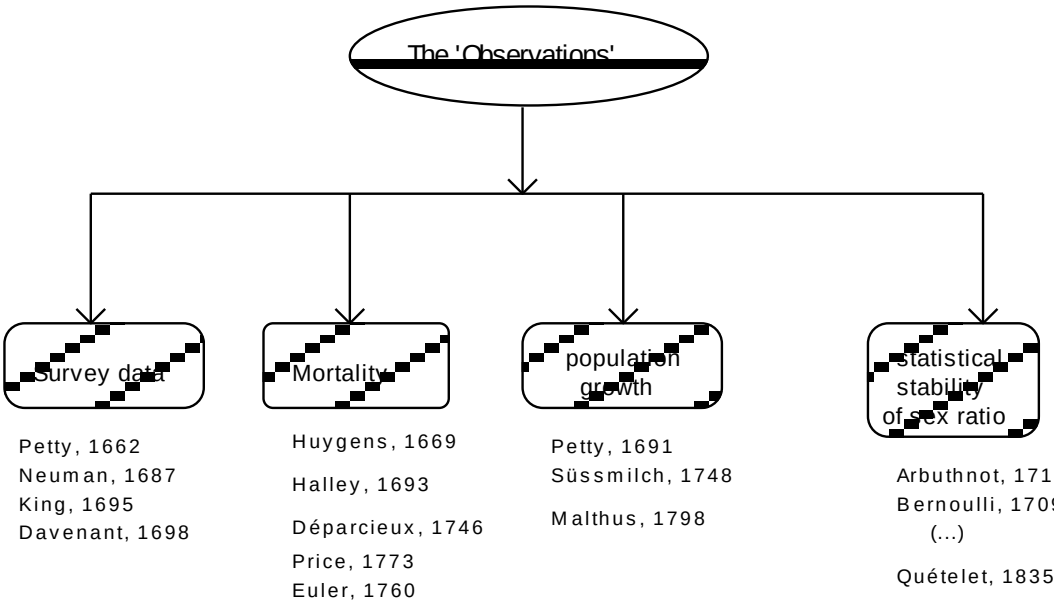
Table 1.3.1 Arbuthnot's data on the yearly number of males' and females' christenings in London from 1629 to 1710

Year	Males	Females	Year	Males	Females
1629	5218	4683	**1671**	6449	6061
1630	4858	4457	**1672**	6443	6120
1631	4422	4102	**1673**	6073	5822
1632	4994	4590	**1674**	6113	5738
1633	5158	4839	**1675**	6058	5717
1634	5035	4820	**1676**	6552	5847
1635	5106	4928	**1677**	6423	6203
1636	4917	4605	**1678**	6568	6033
1637	4703	4457	**1679**	6247	6041
1638	5359	4952	**1680**	6548	6299
1639	5366	4784	**1681**	6822	6533
1640	5518	5332	**1682**	6909	6744
1641	5470	5200	**1683**	7577	7158
1642	5460	4910	**1684**	7575	7127
1643	4793	4617	**1685**	7484	7246
1644	4107	3997	**1686**	7575	7119
1645	4047	3919	**1687**	7737	7214
1646	3768	3395	**1688**	7487	7101
1647	3796	3536	**1689**	7604	7167
1648	3363	3181	**1690**	7909	7302
1649	3079	2746	**1691**	7662	7392
1650	2890	2722	**1692**	7602	7316
1651	3231	2840	**1693**	7676	7483
1652	3220	2908	**1694**	6985	6647
1653	3196	2959	**1695**	7263	6713
1654	3441	3179	**1696**	7632	7229
1655	3655	3349	**1697**	8062	7767
1656	3668	3382	**1698**	8426	7626
1657	3396	3289	**1699**	7911	7452
1658	3157	3013	**1700**	7578	7061
1659	3209	2781	**1701**	8102	7514
1660	3724	3247	**1702**	8031	7656
1661	4748	4107	**1703**	7765	7683
1662	5216	4803	**1704**	6113	5738
1663	5411	4881	**1705**	8366	7779
1664	6041	5681	**1706**	7952	7417
1665	5114	4858	**1707**	8379	7687
1666	4678	4319	**1708**	8239	7623
1667	5616	5322	**1709**	7840	7380
1668	6073	5560	**1710**	7640	7288
1669	6506	5829			
1670	6278	5719			

Source: *Phil. Trans.*, 1710, Vol. 27: 186-90.

Table A.2: Percentages of the main subjects found in Graunt's book according to selected categories		
Code	**Designation**	**Percent**
1	Data appraisal	15
2	Deaths -Diseases, health and longevity	22
3	Birth - fruitfulness and productivity of marriage	11
4	Sex ratio - proportion between the sexes and ages	16
5	Migration between counties and the City of London	7
6	Air (environment)	2
7	Population change - the numbers and growth	19
8	Population policies - government, trade and religion	8
	Total	100
Source: see Table A2.		

Figure 2 The 'Observations' as a source of diverse theoretical developments



Natalie,

Very interesting seminar you gave yesterday. Can I say that your marxist background is paying off? Although the marxism of Marx and Engels is currently not very fashionable, I believe that whoever manages to use it creatively will benefit in terms of critical analysis.

Just two suggestions:

(1) Demographic transition theory

(2) HDI