

The statistical thinking and ideas of Florence Nightingale and Victorian politicians

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Florence Nightingale's most influential statistical ideas and work grew out of an intellectually stimulating childhood, a talent for academic excellence and a life-long propensity to organise quantitative information that began when she was a child. Her statistical thinking, which coalesced with many of her Victorian religious ideas, fuelled the many prodigious statistical projects she undertook and the innovative statistical graphs she developed. A practitioner of evidence-based medicine she used her extensive statistical data, much of which involved calculating death-rates, to produce major health reforms in military and civilian hospitals, usually with the full support of the government. Yet despite the overwhelming prominence of statistics in her work and life, less is known about her role as the 'Passionate Statistician', the sobriquet given to her in 1913 by her first biographer, Sir Edward Cook. Nightingale's statistical work is often treated by her biographers as though it were secondary to and quite separate from her ideas about nursing whereas it could be argued that the two were often interwoven.ⁱ She understood the influential role of statistics and used them to support her convictions.

The statistical methods and ideas of the Belgian astronomer and social statistician **Adolphe Quetelet** (1796-1874) and the medical statistician, **William Farr** (1807-1893) provided a statistical channel for the health reforms that Nightingale vigorously campaigned to see implemented. Her statistical innovations were astutely observed by Karl Pearson (1857-1936) who remarked in 1924 that

*were I a man of wealth I would see that Florence Nightingale was commemorated, not only by the activities symbolised by the 'Lady of the Lamp', but by the activities of the 'Passionate Statistician'. I would have found a Nightingale Chair of Applied Statistics to carry out the ideals expressed in her letters.*ⁱⁱ

Her family's social and political connections to Parliament provided Florence with opportunities that would not have normally been available to Victorian women. Her maternal grandfather, William Smith, MP for Norwich, sat in the House of Commons for nearly 50 years as an abolitionist, and her family's neighbour at Lee Hurst, Lord Palmerston, became Prime Minister during the Crimean War. Meeting

these men as a child made it possible for her to later get the support from the inner circles of Parliament and Whitehall for her statistically designed sanitary reforms in military and civilian hospitals. Nightingale understood that one individual alone could not have as much impact on making radical changes in people's life without an official imprimatur from the government.

William Farr
(1807-1893)



Adolphe Quetelet
(1795-1874)



Florence had a privileged upbringing in a liberal-humanitarian household. All her solidly upper-middle-class family were Unitarian dissenters and intellectually adventurous free thinkers (individuals who formed opinions about religion on the basis of reason, without recourse to authority or established beliefs). Her parents were part of the intellectual avant-garde that endorsed women's education.ⁱⁱⁱ Whilst various tutors taught Florence and her elder sister Parthenope arithmetic, botany, French and geography as well as drawing and piano, their father, William Edward Nightingale, a graduate of Trinity College, Cambridge gave them a university education at home. After Florence had finally begun this rigorous education at the age of 12, she wrote that 'I have the most enormous desire of acquiring. For 7 years of my life I thought of little but cultivating my intellect.'^{iv} Her father, William Edward Nightingale, taught them mathematics, Latin and Greek. Nightingale's upbringing thus nourished and stimulated her enthusiasm of mathematics. By the time she was nine years old, she was already organizing data from garden fruits and vegetables in a tabular format.^v This edifying background, in tandem with Nightingale's religious beliefs, played a pivotal role in shaping her ideas about statistics.

After her father inherited an enormous fortune from his uncle, he settled down to the life of a country gentleman. The family had a 14-bedroom house in **Lee Hurst** in Derbyshire (now the Derbyshire Royal Infirmary) where they stayed in the summer and a Georgian mansion in **Embley Park** in Hampshire (now the Hampshire Collegiate School) that came with 100 acres, where they lived most of the year. They also had rooms in Mayfair for the spring and autumn London seasons. The family toured the Continent where they attended many operas in Italy and socialised in Paris. Florence was tall, slim and attractive, and according to those who worked alongside her, she was charming even-tempered, amiable and a pleasant companion.

Lee Hurst
Derbyshire



Embley Park
Hampshire



As a child she had a desire to nurse the sick and remembered that her daydreams were all about hospitals; she thought these daydreams symbolised that ‘God had called her to Him in that way.’^{vi} This calling meant, much to her relief, that she would not have to be tied to a life of society through the stifling constraints of a Victorian upper-middle class marriage. Consequently, this divine inspiration gave her the opportunity to develop her intellectual pursuits. By the time she was in her twenties, she had rejected the supernatural and miraculous underpinnings of Christianity, and awaited the coming of a female Christ.^{vii} Nightingale proposed a form of religion in which human beings actively contributed to the realisation of God’s law through their work. Statistical laws provided her with a viable pathway that could reveal God’s providential plan.

Nightingale regarded science and statistics as a substitute religion; statistics was for her ‘the most important science in the world’.^{viii} She took much enjoyment from assembling statistical compilations, and

she wrote with a passionate conviction for sanitary reform.^{ix} She further maintained that ‘to understand God’s thoughts, we must study statistics for these are the measure of His purpose’.^x She shared with Francis Galton the idea that ‘the statistical study of natural phenomena was the “religious duty of man”’.^{xi} Nightingale’s ideology was rooted in the theology of the eighteenth-century clergyman, William Derham, from whose ideas she developed her view that ‘we learn the purpose of God by studying statistics’.^{xii} Moreover, her religious outlook offered her a way to establish the legitimacy of statistics in her work and life, within a religious Victorian culture. The study of statistics was thus a moral imperative and a religious duty: it was the surest way of learning the divine plan and directing action in accordance with it.

As a young woman, Nightingale met a number of Victorian literati at dinner parties hosted by her parents at their mansion in Embley Park, including the mathematician Charles Babbage (1791-1871). She was so fascinated with numbers at an early age that by the time she was twenty she wanted further tuition in mathematics, and she began receiving two-hour instructions from a Cambridge-trained mathematician. Her mathematical aptitude fuelled her predilection for statistics. In the mornings Nightingale would study material on the statistics of public health and hospitals, and eventually she accumulated a formidable array of statistical information. Her enjoyment was so immense that she found that the sight of a long column of figures was ‘perfectly reviving’. By then she had already read Quetelet’s book, whose statistical ideas invigorated her own convictions on the laws of statistics.

Like so many Victorians during this time, Nightingale felt empowered by the pervasive passion for statistics, which gave them a new tool to enumerate, classify and, ultimately, understand the social conditions of English society. A number of literary Victorians were, in equal measures, captivated and exasperated by the ubiquitous presence of statistics in their lives. Thomas Carlyle’s *Chartism*, Charles Dickens’s *Hard Times*, George Elliot’s *Middlemarch* and Elizabeth Gaskell’s *Cranford* exemplified how this new language of statistics infiltrated the vernacular of the Victorians.^{xiii} Dickens did not speak contemptuously about statistics, but he argued against the spurious usage of statistics, especially when it was used to justify the unequal distribution of wealth.

Many of the early Victorian statisticians regarded statistics as more than the mere collection of social data or a set of techniques, for them statistics was ‘the new study of man in society’, which would enable them to make predictions about the social conditions of the poor and the labouring classes.^{xiv} The health reformers and vital statisticians, William Farr and Edwin Chadwick, were instrumental in undertaking

statistical analyses, which led to the creation of the Public Health Acts to improve the deleterious circumstances of the poor, especially in the industrialized cities where perilous living conditions threatened the lives of so many Victorians.^{xv}

The steam printing press, the enormous rise in penny publications, the great increase in cheap literature and the development of the railway led to the proliferation of popular literature for the Victorians.^{xvi} The vast amount of available data that was harnessed by these statisticians enabled them to undertake statistical investigations of mass phenomena. Colossal amounts of data were collected by state agencies, private organisations and various individuals interested in such social phenomena as poverty, disease and suicide. This, in turn, led to a wide-spread dissemination of statistical information by the middle-classes who provided lectures, health tracts and medical advice in the popular press, self-help books and novels. Journalists, social reformers and MPs used statistics to floor their opponents.^{xvii}

The statistical societies in London and the provinces collected reams of statistical information, as did the parliamentary and royal commissions that provided the material for the widely-read Blue Books.^{xviii} Politicians had been using the word “statistics” ever since the Scottish landowner and first president of the Board of Agriculture, Sir John Sinclair (1754-1834) introduced the words ‘statistics’ and ‘statistical’ into the English language in 1798 in his *Statistical Account of Scotland*. These Georgian politicians were interested in matters of the state, such as land ownership and the population, mainly to determine the numbers who were liable for the military and to fix the rates of taxation. By the late 1820s and early 1830s, MPs embraced the newer fields of vital and social statistics, many of whom were members of the Statistical Society of London (which became the Royal Statistical Society in 1887). With the ever-growing use of statistics, for some MPs this meant that they could now ‘approach a question statistically, fiscally, politically, and *even* alphabetically’.^{xix}

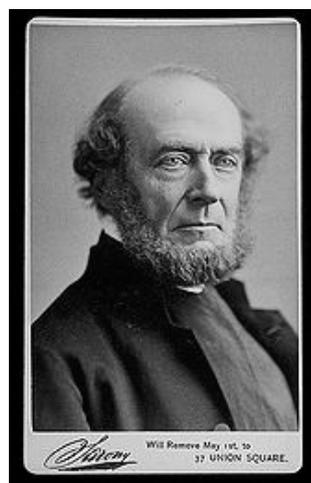
There were, however, a number of MPs who showed insight into some of the constraints of statistics and data collection. As the MP, Mr. Adler, put it, although MPs could ‘amass a considerable amount of statistical data, they did not know how to arrange, codify or interpret this information’.^{xx} The hon. Member, Colonel Robert Torrens, (1780-1864) went on to aptly remark that, ‘as our knowledge of statistics was lamentably imperfect, no good could possibly be derived from conclusions drawn from imperfect and incorrect data’.^{xxi} When parliamentary papers on reform bills or other laws were delayed, because papers were misplaced, one MP remarked that ‘in this age of statistics this [carelessness] might be called the statistics of shuffling’.

During a Parliamentary session in 1848, the Prime Minister, Benjamin Disraeli (1804-1881), remarked that

'I always regard [statistics] with great suspicion, as I listen to them with great perplexity. I cannot yield my conviction, nor make my experience succumb to those anonymous manuscript statistics. [Moreover,] I would not think it fair to other MPs when one MP supported his case with figures and statements to which nobody else could have access and when the data is not subjected to ordinary criticism'.^{xxii}

Disraeli was thus arguing for greater transparency in the House of Commons.

It was the Victorian MP, **Leonard Henry Courtney** (1832-1918), who gave us the much-used phrase: "Lies, Damned Lies and Statistics", which is often invoked to either bolster weak arguments or to disparage statistics that do not support a view. Courtney used the phrase in the summer of 1895 when he gave a speech on proportional representation in Saratoga Springs, New York.²³



Leonard Henry Courtney

He was an advocate of proportional representation in Parliament, but he resigned in 1884 when the Cabinet refused to include proportional representation in a parliamentary reform bill. The phrase, 'Lies, Damned Lies and Statistics' was actually quite commonly used by a number of British politicians in the latter part of the nineteenth and early twentieth centuries. A version of it was used to refer to expert witnesses in the law courts where it connoted a degree of falsehood: the first of which is a fib, the second a lie and the third, is statistics. It wasn't until 1924 when it was first used in the House of Commons, where it has been used ever since.

The Statistics of the Crimean War

Nightingale's statistical ideas and innovations came to fruition when she was working as a nurse during the Crimean War, which enabled her to implement life-changing polices. Whilst she volunteered her services to the war, her lifelong friend and Secretary at War, **Sidney Herbert** (1810-1861), eventually asked her to be 'Superintendent of the female nursing establishment in the English General Military Hospitals in Turkey' for the British troops fighting in the Crimean War, and to take a group of thirty-eight nurses with her.



Nightingale tending to the wounded soldiers



Sidney Herbert (1810-1861)

Once Nightingale arrived in the Crimea, she found herself amid utter chaos in the hospital at Scutari: there were no blankets, beds, furniture, food, or cooking utensils, but there were rats and fleas everywhere. Highlighting how the British failed to respond adequately to the exigencies of war, the indefatigable and first war-time reporter for *The Times*, William Howard Russell, remarked that the French were far better organised in medical matters.

Nightingale drew the government's attention to matters that went far beyond her ambit and exposed the administrative incompetence and disorganisation of the British military. Her exceptional capacity for large-scale organisation and the implementation of administrative reform enabled her to do the job efficiently.

Nightingale was dismayed by the statistical carelessness as well as the appalling lack of sanitation she found in the military hospitals. The medical records were in a deplorable state, as none had been maintained in a uniform manner. Moreover, there was a complete lack of co-ordination among hospitals and no standardised or consistent reporting. Each hospital had its own nomenclature (a system of words used to name things in a particular discipline) and classification of diseases, which were then tabulated on different forms, making comparisons impossible. Even the number of deaths was not accurate; *hundreds* of men had been buried, but their deaths were not recorded.

One of the first books Nightingale wrote, *Notes on Matters Affecting Health, Efficiency, and Hospital Administration of the British Army* (1858), provided statistical evidence that showed how much of the mortality was due to the conditions of the hospitals.²⁴ She compared the death rates of the army in peacetime with the civilian rate and concluded that, 'our soldiers are enlisted to die in barracks'. The statistical data Nightingale collected during the first seven months of the Crimean campaign were later analyzed with the help of William

Farr. Shortly after the General Register Office was set up in 1832, the first Registrar General and novelist, Thomas Henry Lister (1800–1842) recruited William Farr (1807–1893) to compile the statistical records.²⁵ Farr's legacy with his colleague Thomas Rowe Edmunds (1803–1899) was 'the creation of the modern discipline of vital statistics and using these statistics to assess public health and welfare'.²⁶

Nightingale's Statistical Partnership with William Farr

It was Nightingale's close collaborative work with Farr that led to some of her most important statistical work. When they met at a dinner party at the home of Colonel Alexander Tulloch in the autumn of 1856, Farr was one of the foremost statisticians in Britain, and was sympathetic to Nightingale's ideas of reforms. She had just returned from the Crimea a national heroine and recognized that if such suffering were never to happen again, the Army Medical Service, and if necessary the army itself, must be reformed. She was about to begin her campaign for reform in the Army Medical Department when they met. They began a correspondence that would continue for twenty years, writing some four hundred letters between them.

Queen Victoria summoned Florence Nightingale to Balmoral the day after she returned from the Crimea. She was keen to meet The Queen and Prince Albert, an emphatic supporter and patron of science and statistics, and she successfully procured their support for a Royal Commission on the health of the army. On her recommendation Farr was appointed a member, as was the army doctor and statistician, Thomas Graham Balfour, FRS (1813–1891).

Nightingale gained Farr's expert statistical and actuarial advice along with his support and assistance with most of her statistical reports and papers that she read at society meetings. She relied on Farr for the analysis of the army reform returns of death and disease, and for some of his tactics of using mortality statistics argumentatively. Farr benefited from Nightingale's politically influential connections and her knowledge about nursing practices in major hospitals. Thus their twinned desires to see reforms in the Army Medical Department led to a fulfilling and productive professional relationship. They collaborated in the preparation of hospital statistics for her books on *Notes on Hospitals* (1859) and *Introductory Notes on Lying-in Institutions* (1871).²⁷ Nightingale was usually quite demanding in the support she expected from her associates, including many politicians she knew, but she treated Farr with deference and relied on flattery for his co-operation. As John Eyler recognised, this special treatment had to do with the extraordinary value she attached to statistics; she understood the power statistics had over politicians and how such information

could change their firmly established ideas, and thus prompt them to implement legal reform.²⁸

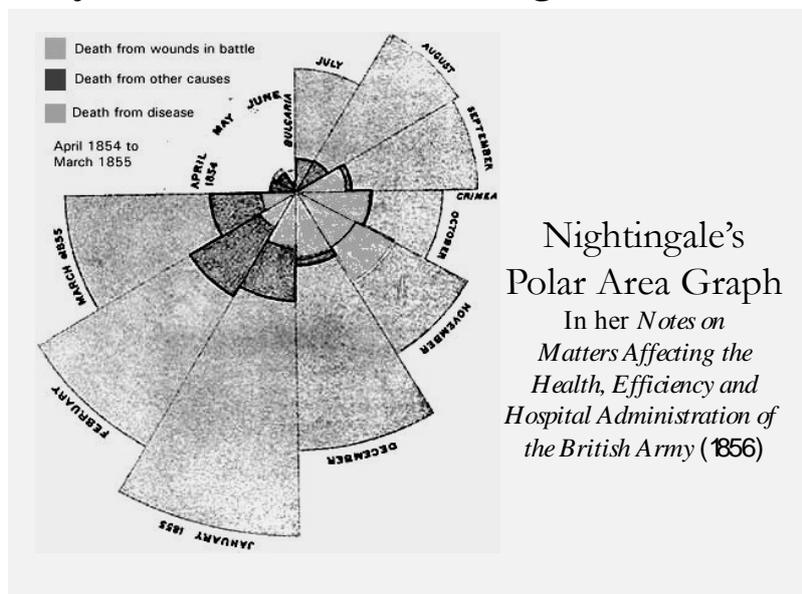
Given the amount of time Nightingale spent with Farr computing and analysing death rates, she eventually became quite competent with undertaking this work on her own. When she sent Farr the death rates she computed from her Crimean data in May 1857, he replied, “*I have read with much profit your admirable observations. It is like a light shining in a dark place.*”²⁹ He was quite enthusiastic about the diagrams and accompanying descriptions he received later that year, letting her know that ‘your speech is the best that ever was written on diagrams or on the Army’.³⁰ For Nightingale, the statistical evidence she accrued from her mortality rates in civilian and military hospitals enabled her to conclude that the relationship between unsanitary living condition and endemic diseases (such as typhus, typhoid and cholera) was the principal reason for such high mortality rates. Moreover, the Crimean data revealed that during the war more troops died from these diseases and unsanitary living conditions than in London during the Plague of 1655. Nightingale and Farr discovered there was an annual mortality rate of 60 percent for these soldiers. Between the ages of 25 and 35, the mortality rate in military hospitals was double that in civilian life.³¹

Nightingale wrote a report based on the army medical statistics and sent it as a confidential communication to the War Office and Army Medical Department. Eventually, the army adopted Farr’s nosology⁴⁰ and classification of disease, with modification. One of the main outcomes of the statistical aspect of the Royal Commission was the creation of a department of Army Medical Statistics. Nightingale and Farr later demonstrated that three times as many soldiers died at home and abroad during peacetime as when they were at war because of overcrowding and filth in the industrialized cities. The Surgeon-General and President of the Statistical Society of London (from 1888 to 1890), Thomas Graham Balfour, undertook statistical analyses of material relating to the Army Sanitary Commission of 1857 and its report of 1858. A year later he was appointed to work in the new Army Medical Statistics Department that Nightingale and Farr established. In this capacity, he compiled the first four volumes of *Statistics of the British Army*.

Farr was one of the first statisticians to make extensive use of circular diagrams and other pictorial aids.³² Like Nightingale, Farr understood that the use of visual aids and graphs should be aimed at those who were not accustomed to looking at statistical data or life tables.

⁴⁰ Nosology - is a branch of medicine that deals with classification of diseases.

Nightingale developed a flair for devising graphic methods, including her well-known polar area graph which was similar to the pie chart created by the Scottish economist William Playfair (1759 -1823) in 1801. Her **polar area graph**, which is equivalent to a modern circular histogram (used for illustrating grouped cyclic data), was cut into twelve equal angles, where each slice represented one month of the year, which, as you can see, revealed changes over time.³³



If we look at the polar area graph, we can see that the area of each coloured wedge, measured from the centre, is in proportion to the statistic it represents. The blue outer wedges represent the deaths from contagious diseases, such as cholera and typhus. The central red wedges show the deaths from wounds. The black wedges in between represent deaths from all other causes. If this rate had continued, and troops had not been replaced frequently, then disease alone would have killed the entire British Army in the Crimea. Her graph not only dramatized the extent of the needless deaths among the soldiers during the Crimean War, but it was used as corrective tool to persuade the government and medical profession that deaths were preventable if sanitation reforms were implemented in military and civilian hospitals.

Nightingale's investigation of London's hospital statistics in 1858 confirmed that the record-keeping needed to be revised. She found that in addition to just simple carelessness in the collation of statistical information, there was a complete lack of scientific coordination. For example, hospital statistics gave very little useful information on the average duration of hospital treatment or on the proportion of patients who recovered compared with those who died. As Statistical Superintendent to the GRO, Farr had found it deeply troubling that there were so many inconsistencies in the reporting of deaths in English hospitals, which did not use a standard nosology. A

Statistical Society Committee was set up for the campaign to keep hospital statistics in a uniform scheme that would permit comparative studies. After the International Statistical Congress, held in London in 1860, endorsed her plans she convinced London and a few Parisian hospitals to comply with her forms. Her hospital model forms were printed in 1859 and were adopted in 1861 by St. Bart's, St. Mary's, St. Thomas', University College, and Guy's hospitals. Later that year, the results of these hospital reports were published in the *Journal of the Statistical Society of London* in 1862.³⁴

Her skills in reporting and illustrating statistical data for sanitary reform in military and civilian hospitals led to her nomination by William Farr as the first woman to be elected a Fellow of the Statistical Society of London in October 1858. In the same year she was also elected to the Statistical Congress, and she was made an honorary foreign member of the American Statistical Association in 1874.

Teaching Statistics in Universities

Nightingale had long been aware that although Members of Parliament had access to an enormous amount of statistical data, they made no use of this information, if only because their university educations had not provided training about statistical methods. Nightingale argued that ministers legislated without knowing what they were doing, and that the men who were to govern and legislate needed to be taught statistics to understand the significance of the bewildering amount of statistical material they routinely received.

Lord Brougham, who founded the *Edinburgh Review* and worked as a solicitor in Edinburgh for three years before becoming an MP in 1810,³⁵ argued that statistics should be to the legislator what the compass is to the navigator, but the actual course of legislation was often conducted without any such statistical compass. Whilst cabinet ministers were uneducated in statistics, Nightingale remarked that the results led to legislation that was “not progressive, but see-saw-y”, thus constantly changing, rather like a child's see-saw.³⁶ There were two exceptions to her pithy remarks, her friend and Secretary at War, Sidney Herbert, and the bookseller and Cabinet Minister, W. H. Smith (1825-1891), who expanded and developed the business his father, William Henry Smith (1792-1865), had started in the Strand in 1820. W. H. Smith served in Parliament from 1868 until his death in 1891 and held the posts of Secretary of the Treasury, First Lord of the Admiralty, and First Secretary for War.

On 8 November 1872 she wrote to her esteemed colleague, Adolphe Quetelet, to discuss the possibility of setting up a course of statistics at Oxford University, long established as the university where future Members of Parliament pursued their studies.³⁷ On learning that Quetelet died in February 1874, she thought that the only fitting

memorial to him was to establish the teaching of his statistics at Oxford. That a Department of Applied Statistics should be established at Oxford was partly due to her association with her old friend **Benjamin Jowett** (1817-1893), a Master of Balliol College and classical scholar who had translated the major works of Plato and Aristotle into English. Nightingale had developed such a competent knowledge of Greek literature that Jowett asked for her comments on the introduction to his translations of the dialogues of Plato.³⁸



Vanity Fair Illustration

Benjamin Jowett (1817 – 1893)

They first met in 1862 and developed a friendship from their discussions about religion. Jowett felt considerable affection and devotion towards Nightingale and wanted to help her set up a series of statistical lectures at Oxford. By New Year's Eve 1876, Jowett had a proposal for endowing a chair of applied statistics at Oxford; however, it wasn't until 1891 when Nightingale had the time to return to this project when they consulted Francis Galton about the details. Galton was not encouraging: he thought that it would be nearly impossible to set up a new professorship at Oxford or Cambridge because the subject was not part of the undergraduate examinations, and the plan inevitably sunk into oblivion. Nevertheless, a few months later the role of economic statistics fitted into the academic ethos of Oxford with the appointment of the economist and statistician, Francis Ysidro Edgeworth (1845-1926).³⁹

Galton suggested instead that it would be more suitable to train applied statisticians by six lectures a year at the Royal Institution. Pearson remarked later that he thought Nightingale had the better scheme: although the 'Royal Institution was valuable for announcing in a popular way the results of recent research, it was not an academic centre for training enthusiastic young minds to a new department in science'.⁴⁰ Nevertheless, Pearson commemorated Nightingale's idea when he established a Department of Applied Statistics at University College London in 1911⁴¹. More than a century

would pass before Oxford University renamed their Department of Biomathematics the Department of Applied Statistics in 1988.



Karl Pearson (1857-1936)

To conclude, for the Victorian MPs who could not keep pace with the rapid proliferation of statistical information beginning in the 1830s, they could no longer afford to ignore the overwhelming importance of the role of statistics in government, much of which was inconsistent and needed to be standardized. However, this did not happen on a large scale until 1918, in the aftermath of the Great War, owing to the work which **Karl Pearson**, his colleagues and students undertook during the war.

Although Florence Nightingale is rightly acknowledged and highly venerated for her role in reforming nursing in the mid-nineteenth century, she clearly deserves more recognition than she has received for revolutionizing nursing through her use of statistics. She brought about these fundamental changes through her dedication to her many prodigious statistical reports on standardizing hospital statistics and by implementing the use of medical statistics in the nursing profession. This investigative work led to a decline in the many preventable deaths that occurred throughout the nineteenth century in English military and civilian hospitals. Her pioneering use of evidence-based medicine became a powerful directive in garnering support from the medical community and the government. Nevertheless, it has to be said that Nightingale's statistical innovations and achievements are as important in the twenty-first century as they were in the mid-nineteenth century. Certainly, making statistical data accessible by using diagrams and charts is imperative for the medical sciences. Moreover, the development of randomized clinical trials in the mid-twentieth century and the growing reliance on evidence-based medicine in the twenty-first century demand an understanding of contemporary statistical methods, which will enable nurses to make informed decisions about current medical research and their patients.

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ENDNOTES

- ⁱ See M. Eileen Magnello, “The Passionate Statistician” in Sioban Nelson and Anne Marie Rafferty (eds.) *Notes on Nightingale The influence and legacy of a nursing Icon* (Cornell University Press, 2010) pp. 114-129. Two books that underscore the significance of her statistical work include Edward Cook, *The Life of Florence Nightingale*, vol. 2 (London: Macmillan, 1913) and Barbara Montgomery Dossey, *Florence Nightingale Mystic, Visionary, Healer* (Springhouse, Pennsylvania: Springhouse Corp, 1999) Lynn MacDonald’s Volume 5, *Florence Nightingale on Society and Politics, Philosophy, Science, Education and Literature*, of her magisterial 16 volume *Collected Works of Florence Nightingale* provides extensive material on Adolphe Quetelet’s influence on Nightingale and John Eyler’s *Victorian Social Medicine: The Ideas and Methods of William Farr* (Baltimore: Johns Hopkins University Press, 1979), has two comprehensive chapters on Nightingale and Farr’s statistical work.
- ⁱⁱ Karl Pearson, *Life, Letters and Labours of Francis Galton* (Cambridge University Press)
- ⁱⁱⁱ On the Nightingale family and its social, religious, and political milieu, see Gillian Gill, *Nightingales: Florence and Her Family* (London: Hodder and Stoughton, 2004).
- ^{iv} Florence Nightingale, 18 March 1827. MS.8991, Nightingale letters (Claydon Collection), 1827-39, Rare Materials Room, Wellcome Library, London
- ^v Florence Nightingale, Letter to “Pop” [Parthenope], 24 February 1830. MS.8991, Nightingale letters (Claydon Collection), 1827-39 in the Rare Materials Room, Wellcome Library, London.
- ^{vi} Anna Stickler, *Florence Nightingale Curriculum Vitae with information about Florence Nightingale and Kaiserswerth*. (Diakoniewerk: Dusseldorf-Kaiserswerth, 1965), pp. 3-4.
- ^{vii} Mark Bostridge, *Florence Nightingale The woman and her legend* (London: Viking Press, 2008).
- ^{viii} Karl Pearson, *The Life, Letters and Labours of Francis Galton*, vol. 2 (Cambridge: Cambridge University Press, 1924), 250.
- ^{ix} John Eyler, *Victorian Social Medicine: The Ideas and Methods of William Farr* (Baltimore: Johns Hopkins University Press, 1979), 161.
- ^x Karl Pearson, *Life, Letters and Labours of Francis Galton*, 250.
- ^{xi} *Ibid.*, 414-15.
- ^{xii} Egon Pearson, ed., *The History of Statistics in the 17th and 18th Centuries, Against the Changing Background of Intellectual, Scientific Thought: Lectures by Karl Pearson, 1923* (London: Griffin Pub, 1975), 74. Also see James H. Cassidy, ‘Meteorology and Medicine in Colonial America: Beginnings of the Experimental Approach’. *Journal of the History of Medicine and Allied Sciences* 1969 XXIV(2):193-204; doi:10.1093/jhmas/XXIV.2.193 © 1969 by Oxford University Press.
- ^{xiii} Elizabeth Gaskell, best known for her biography of Charlotte Bronte and the recent BBC television series in 2007 on her book *Cranford* (1851), was born in London and grew up in Manchester where she would have been exposed to the ways in which unfettered industrialisation and sprawling urbanisation led to endemic disease, especially amongst the poor. It was these conditions that led to the establishment of the Manchester Statistical Society.

- ^{xiv} Lawrence Goldman, 'Statistics and the science of society in early Victorian Britain: An intellectual context for the General Register Office', *Journal for the Social History of Medicine*, 5 (1991), 415–435.
- ^{xv} M. Eileen Magnello, "Victorian Vital and Mathematical Statistics," *BSHM Bulletin: Journal of the British Society for the History of Mathematics* 21, no. 3 (2006): 219-29.
- ^{xvi} Benjamin Disraeli, 'National Representation' *Hansard paper, HC Deb 20 June 1848 vol 99 cc879-966 879*. Also see Martin Hewett. (2006) Why the notion of Victorian Britain *does* make sense. *Victorian Studies*, 48 (3), 395-438.
- ^{xvii} Sheila Smith, 'Blue Books and Victorian Novelists', *The Review of English Studies*, (1970) XXI (81) 23-40. p. 23. The two main Public Health Acts were in 1848 and 1875.
- ^{xviii} As Oz Frankel observed, 'while several blue books catered specifically to the public palate and became "best sellers" of sort, many enormous tomes languished in government warehouses to be sold as wastepaper. Their sheer size and impenetrability could perhaps signify state power but also symbolised the loss of control, a failure of the state's digestive system. For some, government had become an incontinent printer. See Oz Frankel, 'Blue Books and the Victorian Reader', *Victorian Studies*, Vol 46, 2 (Winter 2004), p. 308.
- ^{xix} Mr John Croker. 'Parliamentary reform – Bill for Scotland – Committee.' Commons, *Hansard Papers, HC Deb 04 October 1831 vol 7 cc1212-307*. (4 October 1831).
- ^{xx} Mr Adler, 'Poor-Laws (Ireland)', *Hansard Papers, HC Deb Vol 6 cc783-854*, 783 (29 August 1831).
- ^{xxi} Colonel Robert Torrens, 'Poor-Laws (Ireland)', *Hansard Papers, HC Deb Vol 6 cc783-854 783* (29 August 1831).
- ^{xxii} Benjamin Disraeli, PM, 'Sugar Duties (No. 2) Bill' House in Committee *Hansard Papers' HC Deb Vol 100 cc1042-65*, 1042, (31 July 1848)
- ²³ Leonard Henry Courtney, 'To my fellow disciples at Saratoga Springs', *The National Review* (London) 26, (1895) p. 25 (21-26).
- ²⁴ Florence Nightingale, *Notes on Matters Affecting Health, Efficiency, and Hospital Administration of the British Army: Founded Chiefly on the Experience of the Late War* (London: Harrison, 1858).
- ²⁵ I thank Roger Thatcher, Registrar General from 1976–1986, for bringing this to my attention. Personal Correspondence. (22 January 2007).
- ²⁶ John M. Eyler, 'Constructing Vital Statistics: Thomas Rowe Edmunds and William Farr, 1835-1845', *History of Epidemiology*, 47 (2002), 9.
- ²⁷ Her *Notes on Hospitals* was popular with general audiences, largely because of its clear, concise style and its practical common sense. Although the first edition (1859) did not contain statistical material, by the third edition, in 1863 a chapter was devoted to statistics.
- ²⁸ John Eyler, *Victorian Social Medicine: The Ideas and Methods of William Farr* (Baltimore: Johns Hopkins University Press, 1979), 160-161.
- ²⁹ Zachary Cope, *Florence Nightingale and the Doctors* (London: Museum Press, 1958), 299.
- ³⁰ *Ibid.*, 99-100.
- ³¹ Whereas 20 per 1,000 died in military hospitals, 10 per 1,000 died in civilian life.
- ³² William Farr, *Report on the Mortality of Cholera in England 1848-49*, (London, 1852).
- ³³ Florence Nightingale, *Notes on Matters Affecting Health, Efficiency, and Hospital Administration of the British Army: Founded Chiefly on the Experience of the Late War* (London: Harrison, 1858).

³⁴ ‘Proceedings of the Statistical Society from 20th November 1860 to 16th June, 1863’, *Journal of the Statistical Society of London* 26 (1863): 445-50. Also see William Farr, ‘Miss Nightingale’s ‘Notes on Hospitals’, *Medical Times and Gazette*, 13 February 1864, 166-67.

³⁵ As an MP, Lord Brougham took up the fight against the slave trade, opposed restrictions on trade with continental Europe, and proposed educational reforms in Parliament).

³⁶ Florence Nightingale to Benjamin Jowett, 3 January 1891, cited in *Dear Miss Nightingale: A Selection of Benjamin Jowett’s Letters*, ed. E. V. Quinn and J. M. Prese (Oxford: Clarendon Press, 1987), 423-24. Also cited in Sir Edward Cook, *The Life of Florence Nightingale*, vol. 2 (London: Macmillan, 1913), 396.

³⁷ Florence Nightingale, Letter to Adolphe Quetelet, (8 November 1872. 1868-75, Nightingale letters (Claydon Collection), Rare Materials Room, Wellcome Library, London. Also cited in John Bibby, *Notes towards a History of Teaching Statistics*, (John Bibby Books: Edinburgh, 1986), 113.

³⁸ Gillian Gill, *Nightingales: Florence and Her Family* (Chatham, Kent: Hodder and Stoughton, (2004), 128.

³⁹ Edgeworth, a student at Balliol College, Oxford received a First Class Degree in Literae Humaniores in 1869. His first set of statistical lectures was delivered at UCL in his Newmarch Lectures in 1884-1885 and 1890-1891.

⁴⁰ Karl Pearson, *Life, Letters and Labours of Francis Galton*, Vol II, Cambridge University Press, (1924), 419-20.

⁴¹ *Ibid.*, 416.