

Florence Nightingale

I. Bernard Cohen

Scientific American 250(3):128-137, March 1984.

Florence Nightingale is remembered as a pioneer of nursing and a reformer of hospitals. She herself saw her mission in larger terms: to serve humanity through the prevention of needless illness and death. For much of her long life (1820-1910) she pursued this mission with a fierce determination that gave everything she did a singular coherence. Her greatest contributions were undoubtedly her efforts to reform the British military health-care system and her establishment, through the founding of training programs and the definition of sound professional standards, of nursing as a respected profession. Much of what now seems basic in modern health care can be traced to pitched battles fought by Nightingale in the 19th century. Less well known, because it has been neglected by her biographers, is her equally pioneering use of the new advanced techniques of statistical analysis in those battles.

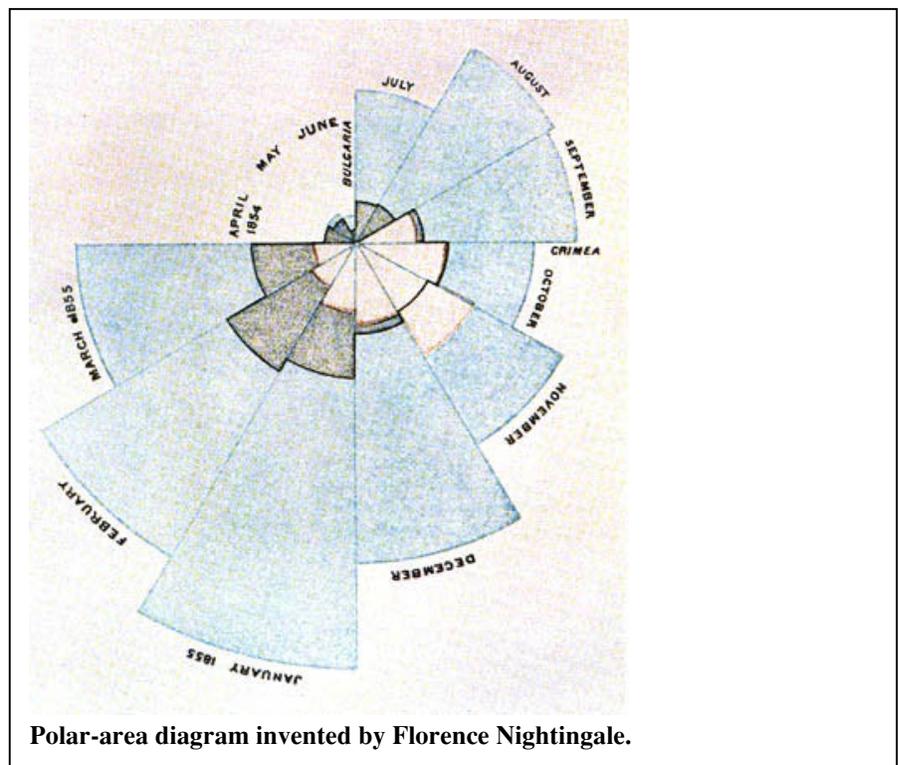
Nightingale learned at first hand as chief nurse during the Crimean War (1854-56) that improved sanitary conditions in military hospitals and barracks could sharply cut the death rate and save thousands of lives. Her battle was to convince skeptical men in power. At a time when the collection and analysis of social statistics was still uncommon Nightingale recognized that reliable data on the incidence of preventable deaths in the military made compelling arguments for reform. Thus in addition to advancing the cause of medical reform itself she helped to pioneer the revolutionary notion that social phenomena could be objectively meas-

ured and subjected to mathematical analysis.

Nightingale's achievements are all the more impressive when they are gauged against the background of social restraints on women in Victorian England. Her father, William Edward Nightingale, was an extremely wealthy landowner, and the family moved in the highest circles of English society. In those days women of Nightingale's class did not attend universities and did not pursue professional careers; their purpose in life was to marry and bear children. Nightingale was fortunate: her father believed women should be educated, and he personally taught her Italian, Latin, Greek, philosophy, history and—most unusual of all for women of the time—writing and mathematics. When in her early twenties Nightingale expressed an interest in

nursing, her father took that interest seriously enough to consult with physicians about the suitability of such a career.

If pursuing any career was a radical step for a woman of Nightingale's social class, however, taking up nursing seemed out of the question even in her enlightened family. It was not "the physically revolting part of a hospital" that offended William Nightingale so much as what seemed to be overwhelming evidence of the dissolute habits of nurses. Nurses in those days lacked training they were almost always coarse and ignorant women, given to promiscuity and drunkenness. Nightingale herself later told her father she had been informed by the head nurse in a London hospital that she "had never known a nurse who was not drunken" and that most of the nurses



engaged in “immoral conduct” with the patients in the wards, not surprisingly, her parents hoped their daughter would give up her unusual ambition, marry and settle down.

By all accounts Florence Nightingale was an attractive young woman, and it was not for lack of opportunity that she rejected marriage. Indeed, she once was tempted to accept a suitor, but after a long courtship she reluctantly concluded that she could never satisfy her “moral” and “active” nature “by spending a life with him in making society and arranging domestic things.” Conventional marriage, she wrote in her diary, meant “to be nailed to a continuation and exaggeration” of her “present life,” a prospect that seemed to her “like suicide.” God, she decided, had envisioned for her a different fate. She was one of those whom he “had clearly marked out...to be single women.”

When her parents forbade her to take up nursing, Nightingale turned for comfort to religion. It was to remain a driving force in her life. Her religious feelings, however, centered on the conviction that the best way to serve God was through service to mankind. Thus in the difficult years of her twenties she did not give up her ambition to pursue a career; she read voraciously on medicine and health care, spent some time inspecting hospitals in London and worked privately with children of the slums, whom she called her “little thieves at Westminster.” Still, she was frustrated.

Finally in 1851 Nightingale was able to break away from home, spending three months near Dusseldorf in Germany at a hospital and orphanage run by a Protestant order of “deaconesses.” Later, in spite of the protests of her

family, she served an apprenticeship at another hospital, this one operated by the Sisters of Mercy in St. Germain, near Paris. At the age of 33 she was at last starting out in her chosen profession.

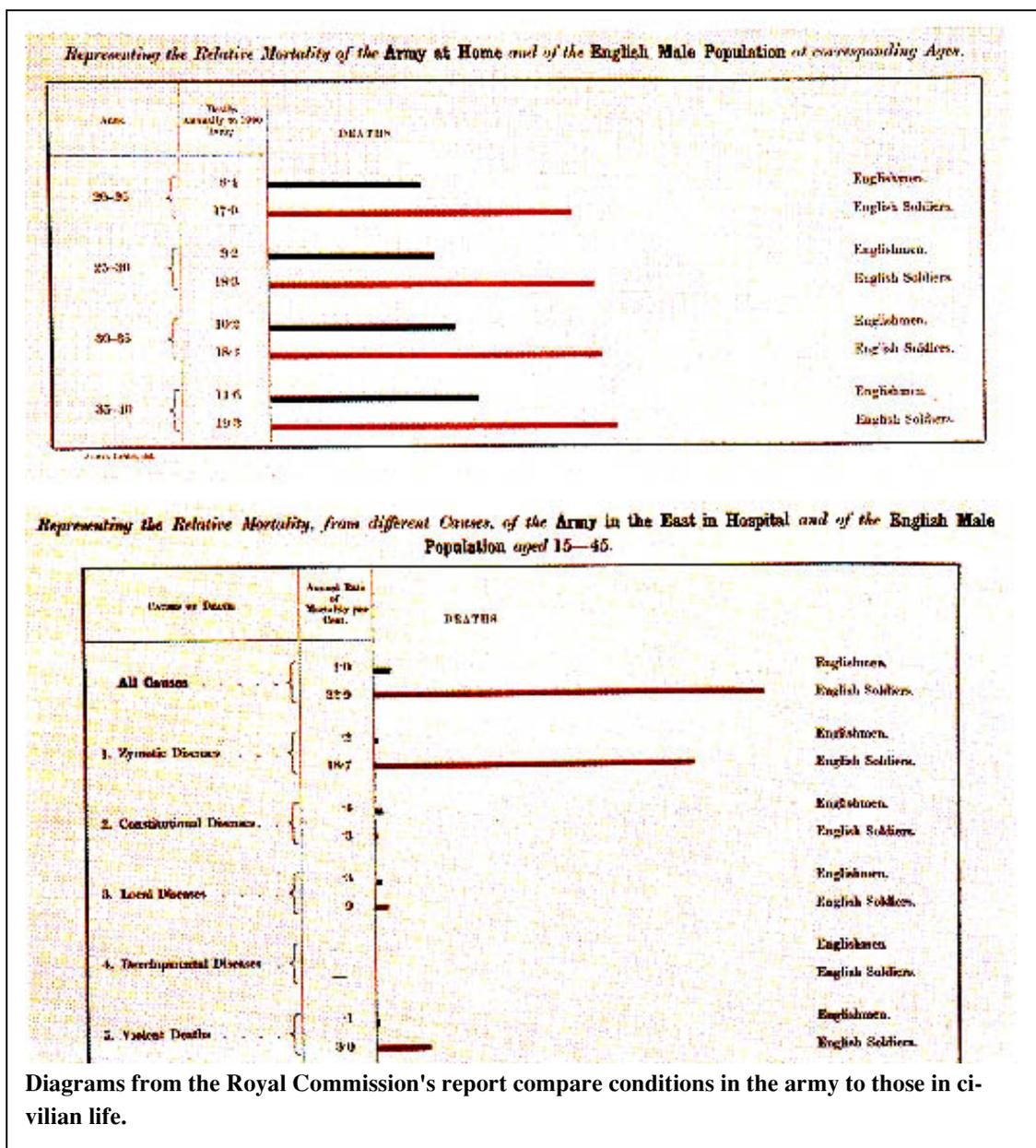
Returning to London in 1853, Nightingale soon got her first “situation” (an unpaid one) as superintendent of a London “establishment for gentlewomen during illness.” Her job was to supervise the nurses and the functioning of the physical plant and to guarantee the purity of the medicines. Although she succeeded in creating a model institution by the standards of the day, one that was open to patients of all classes and religions, she was disappointed that she could not accomplish what even then she had come to consider her primary aim: the establishment of a formal training school for nurses.

Nightingale stayed only a year at her first job, because greater opportunities awaited her. In September, 1854, British and French troops invaded the Crimea, on the north coast of the Black Sea, in support of Turkey in its dispute with Russia. (Russia had long had territorial ambitions in Turkey, particularly with regard to Constantinople, the Orthodox holy city; one of the proximate causes of the Crimean War was the Russian demand that it be given a protectorate over the Orthodox subjects of the Turkish sultan.) The allied forces scored a quick victory at the Battle of the Alma River on September 20, and then began a siege of the Russian naval base at Sevastopol. Public jubilation in Britain soon turned to dismay when the Crimean correspondent of *The Times*, William Howard Russell, reported that sick and wounded British soldiers were being left to die without medical attention. Not only were there too few surgeons and “not even linen to make ban-

dages” but also there was not a single qualified nurse in the British military hospital at Scutari (near Constantinople). The French, on the other hand, had sent 50 Sisters of Mercy to the Crimea.

It was a golden opportunity for the ambitious Nightingale. She immediately wrote to a longtime friend, Sidney Herbert, the “Secretary at War,” to volunteer her services. As it happened, a letter from Herbert was already on its way to her, asking her to recruit a corps of trained nurses and lead them to Scutari. When Nightingale left for Turkey on October 21, 1854, accompanied by 38 nurses, she had the official backing of the government (although not of the army) and, perhaps more important, the private financial support of a special fund raised by *The Times*. Besides making her an international heroine, her work in the Crimea and the conditions she saw there were to determine her mission for the rest of her life.

The conditions Nightingale and her party found when they arrived at Scutari on November 5, the day of the major Battle of Inkerman, were appalling. The hospital barracks was infested with fleas and rats. Under the buildings, as a commission of inquiry later reported, “were sewers. . . loaded with filth. . . through which the wind blew sewer air up the pipes of numerous open privies into the corridors and wards where the sick were lying” on straw mats, in a state of overcrowding that got even worse after Inkerman. The canvas sheets, according to Nightingale, were “so coarse that the wounded men begged to be left in their blankets”; moreover, the laundry was done in cold water, with the result that many linens returned as clean were so “verminous” that they had to be destroyed. Essential surgical and medical



supplies were lacking, or their distribution was blocked by military red tape.

These were the conditions that awaited patients arriving at Scutari after a slow sea voyage across the Black Sea and through the Bosphorus, weak and emaciated, suffering from frostbite and dysentery as well as from their wounds. In fact, the resulting epidemics of cholera and typhus, and not the injuries themselves, caused the greatest loss of life at Scutari. In February, 1855, the mortality rate at the hospital was 42.7 percent of the cases treated.

In her efforts to establish an effective hospital in Turkey, Nightingale showed real skill as an administrator. At every step, however, she was hampered by the military authorities, who resisted any change that might seem to be a concession of their own errors or incompetence. The military men resented the fact that Nightingale's authority was independent of the armed services, that she was a civilian and—far worse—that she was a woman. Hostility to her mission ran so high that at first her nurses were not allowed on the

wards. Even after she had achieved greater acceptance she had to struggle against petty officials, such as a supply officer who refused to distribute badly needed shirts from his store until the entire shipment of 27,000 could be inspected by an official of the Board of Survey.

In the face of such impediments it was Nightingale's independence from the military and, above all, her private source of funds that enabled her to accomplish so much at Scutari. She established her own laundry, including

boilers to heat the water, she installed extra kitchens in the hospital; she became, finally, the supplier of the entire hospital “a kind of General Dealer in socks, shirts, knives and forks, wooden spoons, tin baths, tables and forms, cabbage and carrots, operating tables, towels and soap, small tooth combs, precipitate for destroying lice, scissors, bed pans and stump pillows.” The money for these supplies and for the staff she recruited came not only from *The Times* fund but also from other philanthropists and from her own private funds.

While Nightingale was carrying out her administrative duties she still found time to attend to the sick herself, late at night, on endless rounds that gave rise to the legend of the “ministering angel” of the Crimea. At night she banned all other women from the ward (she had been obliged to send some of her nurses home for delinquent behavior) and made her way, according to the commissioner of *The Times* fund, “alone, with a little lamp in her hand,” through “those miles of prostrate sick.” Longfellow immortalized this “lady with a lamp” image in his poem of 1857 (“Lo! in that house of misery / A lady with a lamp I see”). There is, however, a more significant measure of Nightingale’s accomplishment, one that she herself stressed: by the spring of 1855, half a year after she arrived at Scutari, mortality in the hospital had dropped from 42.7 percent to 2.2 percent.

Nightingale returned to England in July, 1856, four months after the end of the war. By that time, at the age of 36, she was a world-famous and revered figure. She nonetheless shunned all attempts to honor her publicly, deciding instead that the most appropriate recognition for her services would be the

establishment of a commission to investigate military medical care. In the Crimea, she wrote, some 9,000 soldiers were lying “in their forgotten graves,” dead “from causes which might have been prevented.” The tragedy of needless death was continuing in every army barracks and hospital, even in peacetime. It could be ended only by instituting throughout the Army Medical Service the same sanitary reforms that had saved so many lives at Scutari. This was the task Nightingale set herself.

How could she convince people of the need for reform? Nightingale saw that the most compelling argument would be statistical. The idea of using statistics for such a purpose—to analyze social conditions and the effectiveness of public policy—is commonplace today, but at that time it was not. The science of social statistics was in its infancy, and in promoting the cause of medical reform Nightingale became a promoter of the new tool as well.

Seen simple as the collection of numerical data, statistics have a long history (going back at least to the Book of Numbers of the Old Testament), but the analysis of such data is only as old as the scientific revolution of the 17th century. Early attempts to analyze data on social phenomena were hampered by inadequacies both in the data themselves and in the mathematical tools of analysis. According to the historian of statistics Helen M. Walker, the rise of modern statistics in the 19th century had three roots: the development of the mathematical theory of probability, the emergence of the modern state with its agencies for collecting information on its citizens and their activities, and the theoretical interest of political economists in finding causes for human social behaviors. These “three movements,” Walker wrote, were pulled

together in the career of the mid-19th-century Belgian astronomer-statistician Lambert Adolphe-Jacques Quételet, widely regarded as the founder of modern social statistics. In 1841 Quételet organized Belgium’s central statistical bureau which became a model for similar agencies in other countries, and his international leadership in statistical research continued until his death in 1874.

Nineteenth-century scholars trying to make a science out of the study of human behavior faced a dilemma: the model science of those days was classical physics, with its deterministic laws describing natural phenomena, but human behavior seemed individual and indeterminate. Quételet’s resolution of the problem bypassed the question of the individual with the concept of a “average man.” He showed that whereas there are no laws determining individual behavior, there are regularities in the attributes and behavior of groups, and that these regularities could be characterized mathematically by the laws of probability: Quételet was convinced that even mental and moral traits, if only they could be measured accurately, would also follow regular laws of statistical distribution.

Quételet’s most original and most startling work was his analysis of the influence of such factors as sex, age, education, climate and season on the French crime rate (1831~). The data did not allow a prediction of who would commit what crime, but according to Quételet they did display regularities that would enable a scientist to “enumerate in advance how many individuals will stain their hands in the blood of their fellows, how many will be forgers, how many will be poisoners.” The discovery of these regularities led Quételet to the radical conclusion that “it is so-

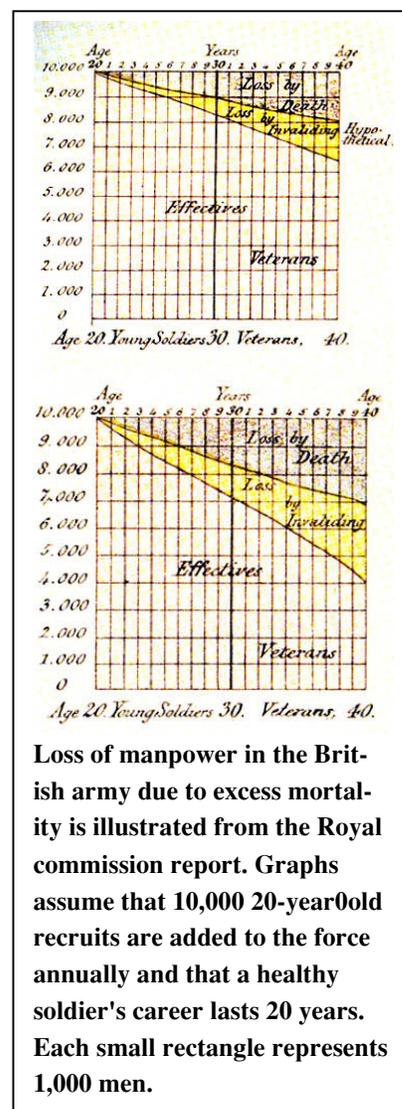
ciety which, in some way prepares these crimes, and the criminal is only the instrument that executes them.”

Although Quételet’s work was highly regarded by many scholars, it was abhorred by others. The determinism of his “social physics” was an anathema to people committed to the prevailing doctrines of free will and individual responsibility. John Stuart Mill, for example wrote at length against probability in general and its application to social science in particular. Another vocal opponent of the statistical view of man and society was Charles Dickens. His novel *Hard Times* was meant to satirize those people, Dickens later said, who could see nothing but “figures and averages,” those “addled heads” who would use the yearly average temperature in the Crimea “as a reason for clothing a soldier in nankeens [silks] on a night when he would be frozen to death in fur.” Dickens disliked the statistical view because he thought it was dehumanizing, and in *Hard Times* he portrayed the regularities found by statisticians in the rate of insanity, crime, suicide and prostitution as a “deadly statistical clock.”

Nightingale, on the other hand, was an ardent admirer of Quételet’s work, and she early displayed a predilection for collecting and analyzing data: At Scutari, apart from the all-important sanitary reforms she instituted, she also systematized the chaotic record-keeping practices; until then even the number of deaths was not known with accuracy. When she returned to England in 1856, she met William Farr, a physician and professional statistician. Under Farr’s guidance Nightingale soon recognized the potential of the statistics she had gathered at Scutari, and of medical statistics in general, as a tool for improving medical care in military and civilian hospitals.

Throughout military history until the 20th century the main cause of death in war was disease rather than wounds sustained in battle, and the Crimean War was no exception. Nightingale’s numbers still speak eloquently. During the first months of the Crimean campaign there was “a mortality among the troops at the rate of 60 percent per annum from disease alone,” a rate exceeding that of the Great Plague of 1665 in London and higher also “than the mortality in cholera to the attacks” (that is the mortality among those who had contracted the disease). In January, 1855 the mortality in all British hospitals in Turkey and the Crimea, measured in relation to the entire army in the Crimea, but not including men killed in action, peaked at an annual rate of 1,174 per 1,000. Of this number 1,023 deaths per 1,000 were attributable to “zymotic” disease (a category introduced by Farr including epidemic, endemic and contagious disease). This means that if mortality had persisted for a full year at the rate that applied in January, and if the dead soldiers had not been replaced, disease alone would have wiped out the entire British army in the Crimea.

Nightingale’s various methods of calculating mortality dramatized both the impact of disease and the effects of improved sanitary conditions. Calculated on an annual basis as a percentage of the patient population, the death rate the Scutari hospital reached an incredible 415 percent in February, 1855. In March, however, Nightingale’s sanitary reforms began to be implemented and mortality among the patients declined precipitously. By the end of the war, according to Nightingale, the death rate among sick British soldiers in Turkey was “not much more” than it was among healthy soldiers in England; even more remarkable, the mortality



among all British troops in the Crimea was “two-thirds only of what it [was] among our troops at home.”

The comparison suggested that the soldiers at home were living in their barracks under unhealthy conditions. After Farr had made Nightingale aware of the significance of mortality tables, she at once thought of comparing the mortality among civilians to that among soldiers. She found that in peacetime soldiers in England between the ages of 20 and 35 had a mortality rate nearly twice that of civilians. It is just as criminal, she wrote in 1857, “to have a mortality of 17, 19, and 20 per thousand in the Line, Artillery and

Guards in England, when that of Civil life is only 11 per 1,000, as it would be to take 1,100 men per annum out upon Salisbury Plain and shoot them.” (The 1,100 represented 20 per 1,000 of an enlisted force of 55,000.) Clearly the need for sanitary improvements in the military was not limited to hospitals in the field. By pressing her case with these statistics Nightingale eventually gained the attention of Queen Victoria and Prince Albert, as well as of the prime minister, Lord Palmerston. In spite of the passive resistance of the War Office, Nightingale’s wish for a formal investigation of military health care was granted in May, 1857, with the establishment of a Royal Commission on the Health of the Army.

It would not have been possible at that time for a woman to serve on such a board. Nightingale nonetheless strongly influenced the commission’s work, both because some of its members were her friends (including Sidney Herbert, the minister who sent her to the Crimea) and because she provided it with much of its information. As a statement of her own views she wrote and had privately printed an 800-page book titled *Notes on Matters Affecting the Health; Efficiency and Hospital Administration of the British Army*, which included a section of statistics accompanied by diagrams. Farr called it “the best [thing] that ever was written” either on statistical “Diagrams or on the Army.”

Nightingale was a true pioneer in the graphical representation of statistics: she invented polar-area charts, in which the statistic being represented is proportional to the area of a wedge in a circular diagram. Nightingale used these diagrams, which she called her “coxcombs” because of their vivid colors, to dramatize the extent to which deaths in the Crimea campaign has

been preventable. Farr was impressed with *Notes*, and much of Nightingale’s work found its way into the statistical charts and diagrams he prepared for the final report of the Royal Commission. As part of her “flank march” against the forces of resistance to medical reform, Nightingale had the statistical section of the report printed as a pamphlet and distributed widely in Parliament, the government and the army. She even had a few copies of the diagrams framed for presentation to officials in the War Office and in the Army Medical Department.

Nightingale’s efforts were not in vain. Four subcommissions were established to carry out the reforms recommended in the report of the Royal Commission. The first presided over physical alterations to military barracks and hospitals: improvements in ventilation, heating, sewage disposal, water supply and kitchens. Other subcommissions drafted a sanitary code for the army, established a military medical school and reorganized the army’s procedures gathering medical statistics.

Nightingale next turned her attention to the health of soldiers in India. She and Farr began to study the sickness and mortality records of the India Office, and she sent inquiry forms to the various British stations in India for information on sanitary conditions there. In 1858 and 1859 she lobbied successfully for the establishment of another Royal Commission to look into the Indian question. Two years later she submitted to the commission a report, based on the inquiries sent to the stations in India, on the conditions that were causing among the troops in India a death rate six times higher than the rate among civilians in England: defective sewage systems, overcrowding in the barracks, lack of exercise and inadequate hospitals,

among other things. The commission completed its own study in 1863. After 10 years of sanitary reform, in 1873 Nightingale reported that mortality among the soldiers in India had declined from 69 to 18 per 1,000.

Statistics, as Nightingale so effectively demonstrated, provide an organized way of learning from experience, and medical statistics can teach far more than the simple fact that unsanitary conditions kill. Uniform and accurate hospital statistics, she wrote, would “enable the value of particular methods of treatment and of special operations to be brought to statistical proof”; in short statistics would lead to improvement in medical and surgical practice. The problem was that the statistics kept by hospitals in Nightingale’s day were neither uniform nor consistently accurate. To remedy this she developed, with the aid of Farr and other physicians, a Model Hospital Statistical Form. The form was approved at the International Congress of Statistics, held in London in the summer of 1860.

The new scheme set out the basic categories of data that hospitals should collect: the number of patients in a hospital at the beginning and end of a year and the number of patients admitted during the year, the number of patients who had recovered or who had been either discharged as incurable or dismissed at their request, the number of patients who had died and the mean duration of hospital stays. Yet although the ideal of gathering uniform hospital statistics was clearly a good one, and far ahead of its time, the new scheme was never put into general practice. The proposed form itself was overly complex, and it included an idiosyncratic system for the classification of diseases devised by Farr with which many pathologists strongly disagreed. In medical science, unfortunately,

Nightingale did not display the same understanding that led her to recognize the value of medical statistics; for instance, she showed no interest in the new germ theory of disease and its implications for the treatment of contagious diseases.

Nightingale's commitment to statistics transcended her interest in healthcare reform, and it was closely tied to her religious convictions. To her, laws governing social phenomena, "the laws of our moral progress," were God's, laws, to be revealed by statistics. Quételet's science, she taught, was "essential to all Political & Social Administration," yet political leaders were for the most part completely untrained in the interpretation of statistics. The result of such ignorance, in Nightingale's view, was legislation that was "not progressive but see-saw-y," written by officials who "legislate without knowing what [they] are doing." That is why she experimented with graphical representations, which everyone could understand, and why she struggled to get the study of statistics introduced into higher education, although her dream of a university chair in statistics did not become a reality until after her death. Even today society has not come around fully to Nightingale's point of view, as is clear from the fact that statistics has yet to become a mandatory part of public education.

Something of the religious fervor Nightingale felt for statistics is evident from her annotation of her copy of Quételet's book *Physique Sociale*. On the title page she incorporated the title into a statement of her own creed:

The sense of infinite power
The assurances of solid certainty
The endless vista of improvement
from the principles of
PHYSIQUE SOCIALE
if only found possible to apply on
occasions
when it is so much wanted

To Nightingale, Quételet was the founder of "the most important science in the whole world," because "upon it depends the practical application of every other [science]." Judging from their correspondence, the respect seems to have been mutual.

Although statistics were important to Nightingale, during her later years of being "an influential" she by her own account yearned to return to nursing, her chosen profession, her first "call from God." She could not, however, because she lived a good part of her life after her return from the Crimea as an invalid, practically bedridden.

Although Nightingale's poor health may have been related to a fever she contracted while she was in the Crimea some have suggested that she did not have an organic illness at all, that her

invalidism was neurotic or even intentional. In any event confinement to her bedroom, where she received a steady stream of visitors, did not diminish her influence or keep her from establishing the professional status of modern nursing. With money from the Nightingale Fund (almost 50,000 pounds, raised by public subscription to honor "the Popular Heroine") she was able to realize an early goal, founding the Nightingale Training School for Nurses in 1860. She could not, as she had hoped, superintend the school, but it followed her principles: "(1) That nurses should have their technical training in hospitals specially organized for that purpose; (2) That they should live in a home fit to for their moral life and discipline."

Both principles were radical in their time. That they are accepted as commonplace today is testimony to Florence Nightingale's service to nursing which did as much as any scientific advance to improve the general quality medical care. In view of her other passion, it is appropriate that another telling indicator of that service is statistical: in 1861 the British census found 27,618 nurses in Britain, and it listed that figure in the tables of occupations under heading "Domestics"; by 1901 the number had increased to 64,214, and it was listed under "Medicine."



Who was Florence Nightingale? Watch this story, one of our 'British tales' videos about characters and people from British history, to find out! Preparation. In 1851, Florence went to Germany and learned about nursing. She carried a lamp and the soldiers called her "The lady with the lamp". In the Crimean War, there were no nurses in the army hospitals and many men died. At night, Florence talked to the injured soldiers and helped the men to write letters. When Florence returned to England, people called her a heroine.