



*J. R. Statist. Soc. A* (2014)  
177, Part 3, pp. 569–586

# Florence Nightingale, statistics and the Crimean War

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[Received July 2012. Final revision May 2013]

**Summary.** The paper presents Florence Nightingale's statistical work on the Crimean War, beginning with her iconic polar area charts. These are then adapted to give a more accurate portrayal of the relative causes of war hospital deaths. French statistical reports comparing British and French Army deaths are reported. The contention in the secondary literature that Nightingale was responsible for the high death rates in the war hospitals is rebutted, with comparative death rate data from the different hospitals.

**Keywords:** British Army; Crimean War; Florence Nightingale; French Army; Hospital deaths; Statistics

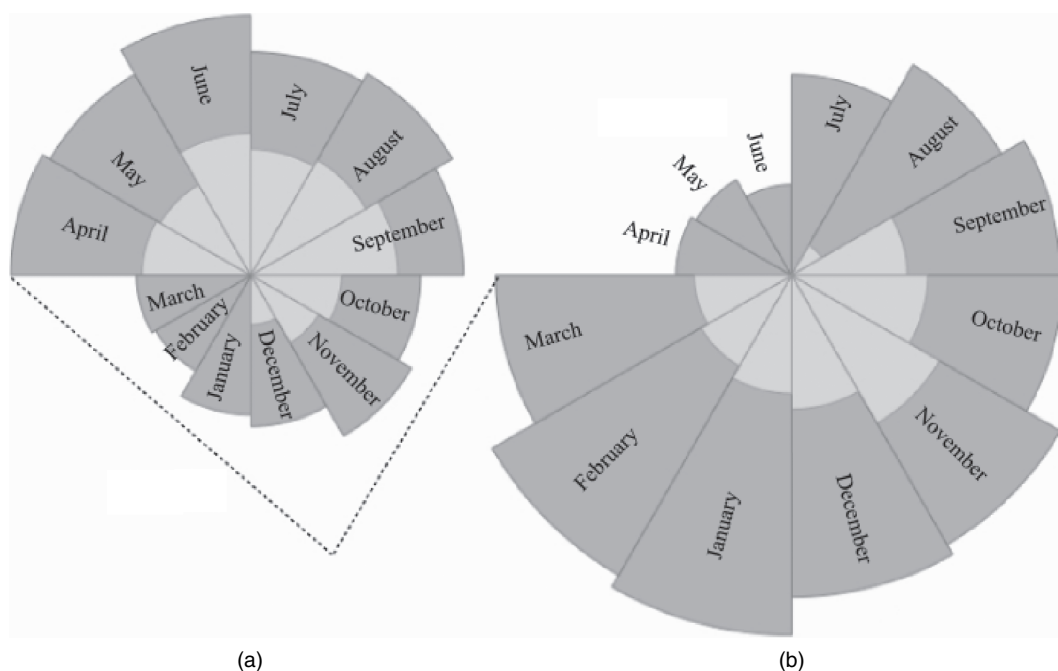
## 1. Introduction

The Crimean War (1854–1856) was a terrible war by any reasonable criteria. Florence Nightingale's work in it is reported in detail in McDonald (2010). The death rates were appalling: for the British Army 22.7% of troops sent, an even higher 30.9% for the French Army and an unknown (high) number for the Russians, compared with 2.3% of American troops during the Vietnam War. The vast majority of Crimean War deaths were due to preventable diseases. The gains made by the war were negligible, such as free access to trade on the Danube. Moreover, Russia soon began to make belligerent moves in the Balkans. The UK stayed out of the next 'Balkan wars'.

The Crimean War was formative for Nightingale, both for the lessons that she learned from it and the status that she acquired from her work. She never glorified war but came to understand that good could come out of evil: in the case of Crimea the end of serfdom in Russia, the creation of a new profession of nursing in Britain and major reforms in healthcare and nutrition for ordinary soldiers in the British Army. The methodology that she acquired post war in analysing what went wrong would ground her decades-long campaigns for social and healthcare reform. On her statistical work see McDonald (2003) and Stone (1997).

Nightingale started to work on ascertaining the causes of the high death rates immediately on her return to London. Her major collaborator was William Farr, Superintendent of Statistics at the General Register Office, and the most noted medical statistician of the time. He had already published charts on cholera, but the polar area charts he did with Nightingale went far beyond his earlier work. These charts were not included in the official Royal Commission report (UK, 1858a) or the shorter version based on it (UK, 1858b). They appeared first in Nightingale's privately circulated *Notes on Matters affecting the Health, Efficiency and Hospital Administration of the British Army* (Nightingale, 1858a). That report includes an enormous

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**Fig. 1.** Adapted polar area chart (adapted from Nightingale (1858a), page 315): (a) 1855–1856; (b) 1854–1855

number of tables, with detailed discussion. The landmark charts, however, appear with scarcely a comment.

In January of 1859 Nightingale published a short paper which focused on those charts, ‘A contribution to the sanitary history of the British Army during the late war with Russia’ (Nightingale, 1859a). She gave them next to Harriet Martineau for inclusion in her popular book, *England and Her Soldiers* (Martineau, 1859), where again they were not discussed.

Since the (one) coloured chart is well known and readily available on line, it is not reproduced here. Instead several adaptations are presented and the two less known, but most useful, black-and-white charts are. Next, material is reported comparing British Army death rates with those of the French Army. The French statistical analysis post dates that by Nightingale and the Royal Commission, so the devastating contrasts they revealed could not be discussed in their reports. Oddly, the material has been neglected by later commentators on the war. Finally comes a historiographical discussion of the secondary authors who attacked Nightingale’s Crimean War work, evidently without consulting the relevant statistics, British or French.

The basic data source for British Army deaths, which was used also by the French statisticians, was the 1040-page, two-volume report by the Director General of the Army Medical Department, Smith (1858). This *Medical and Surgical History of the British Army* reports data by regiment and disease in thorough detail, without any analysis of the scale of the death rates or what might be done to reduce them. There are meteorological charts and a surveyor’s map, but nothing on hospital size, overcrowding or sanitary conditions. There is one, interesting, rectangular area chart, showing deaths by type of disease.

The Royal Commission (UK, 1858a) did not, remarkably, publish the total number of British Army deaths, or any overall indicator such as deaths as a percentage of troops sent. For this,

# DIAGRAMS OF THE MORTALITY IN THE ARMY IN THE EAST.

1.  
APRIL 1854 TO MARCH 1855

2.  
APRIL 1855 TO MARCH 1856

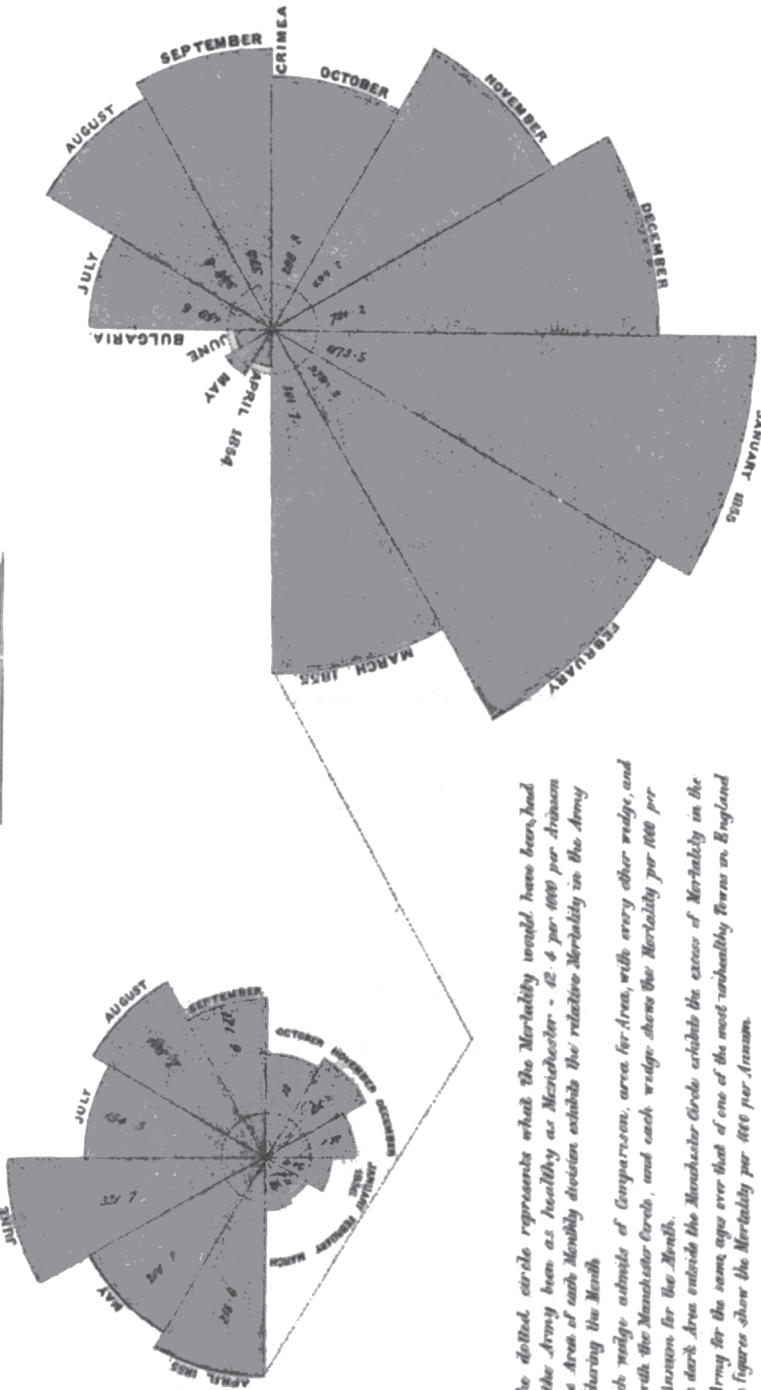


Illustration & notes - Martin's Lane

Fig. 2. Death rates of the Army in the East compared with civilian men's at Manchester (data from Nightingale (1858a), pages 320-321)



however, we have the French statisticians to thank—they did and drew conclusions accordingly, very much in favour of the reforms the British Government made. Nightingale, in her 1859 republication of evidence, included comparisons of death rates from the Scutari and Koulali hospitals to show how great the improvements were when sanitary reforms were brought in (UK (1858a), page xxxi, and Nightingale (1859b), reproduced in McDonald (2010), page 961). Her analysis of the mortality data, then, is all the more important for using official data, and reporting them fully: the bad and the good.

Nightingale's famous coloured polar area chart (only one chart was in colour) gave totals for three different causes of death, month by month, for the whole course of the British Army's stay in the East. The intention evidently was to highlight the large proportion of 'preventable' deaths, i.e. from 'zymotic diseases', compared with 'all other diseases' (effectively chest diseases) and wounds. (The 'zymotic' term, which Farr favoured, went out of use when precise disease causes became known.) Yet Nightingale believed that respiratory diseases were caused primarily by bad ventilation and hence could be (largely) prevented. By combining deaths from all diseases, against wounds, that point is clearly shown in Fig. 1.

Whereas Nightingale's coloured polar chart became iconic, for some purposes her two (neglected) black-and-white charts make at least as important points. One compares the death rates of soldiers in Scutari and Koulali hospitals with those of comparable civilian men in Manchester, which was an unhealthy industrial city (Fig. 2). It shows how the Crimean rates were brought down by the end of the war to about the same level as those of civilian men, which was a key result for her case that people can learn from mistakes and make fundamental improvements. The other (Fig. 3) compares the same soldiers' death rates with rates for soldiers in military hospitals in and around London, in other words with comparable hospitalized soldiers in peacetime conditions. Again, the chart serves to make Nightingale's point that knowledge could be applied for human betterment. After the reforms, soldiers' death rates were no worse than they would have been if they had stayed in England, or what might be thought of as a 'normal death rate' for sick soldiers. Nightingale was proud of this achievement and mentioned it frequently. So, we shall see, did the French statisticians, but not the recent secondary authors.

## 2. French statistical analysis of Crimean War death rates

Although, at the time of the Crimean War, the French were in advance of the British in hospital construction and military medicine, and able in statistics, they lagged far behind in analysing their mistakes. Several French medical doctors published analyses post war, but none with comprehensive tables or charts. Baudens (1857) was the first, with three lengthy articles in the *Revue des Deux Mondes*. Baudens died that same year, but the articles were subsequently published as a book, Baudens (1862a), and then in English translation, Baudens (1862b). He and other French sources routinely say 'English Army' (*armée anglaise*), here corrected to British Army. All were highly complimentary to the British Army on health and cleanliness, as well they should have been when firm data became available.

Partial French data came out soon after the war (Scrive, 1857), but the full official report (Chenu, 1865) was not published until 7 years after Nightingale (1858a). Chenu's 732-page report was then revised and reprinted as a book (Chenu, 1870). It uses different categories of causes of death from those in the British data; hence the most pertinent comparisons cannot be made (Fig. 4). In some tables there is a division between 'killed on the battlefield' and deaths from wounds and all diseases combined. In other places two types of disease are specified, '*scorbutique*' and '*typhique*', against deaths from wounds and other diseases combined. In both cases the

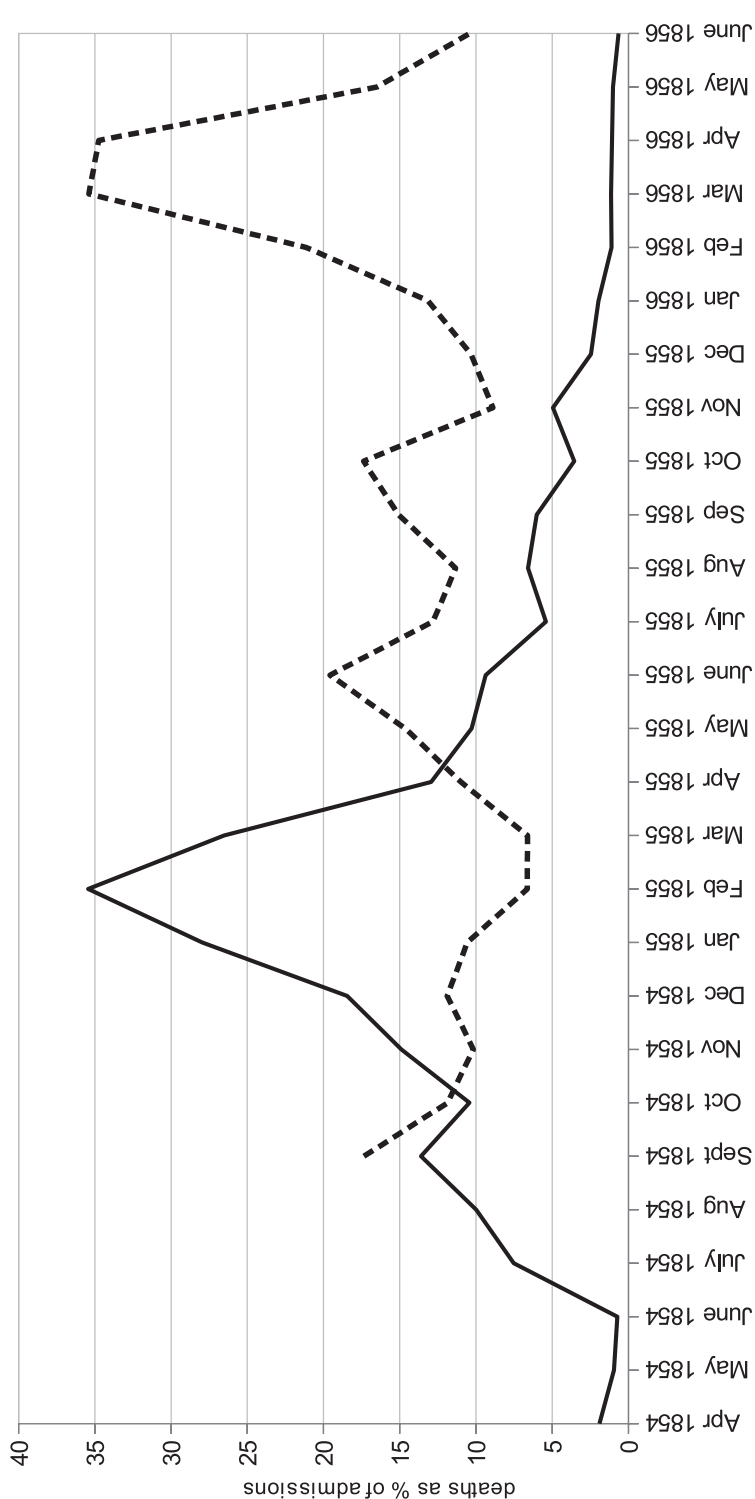


Fig. 4. Death rates per admissions, British (—) and French (---) armies by month (data from Scriver (1857), page 344, and Smith (1858), volume 2, page 251)

**Table 1.** Comparison of British and French Army deaths 1854–1856†

	<i>Total killed</i>	<i>Wounds and illness</i>	<i>Total deaths</i>	<i>Total troops</i>	<i>% deaths/troops</i>
French Army	10240	85375	95615	309268	30.9
British Army	2755	19427	22182	97864	22.7

†British Army data from Chenu (1865), page 611; for the French Army, page 579.

**Table 2.** Comparison of British and French Army death rates by winter†

	<i>Deaths</i>	<i>Total troops</i>	<i>% deaths/troops</i>
<i>1st winter</i>			
French Army	10934	89885	11
British Army	10989	47749	23
<i>2nd winter</i>			
French Army	21191	106634	20
British Army	606	27384	2.5

†Source: Chenu (1870), page 131.

French data blur the crucial distinction that is featured in the British data between deaths from wounds (immediate and later) and those from disease. Moreover, the designation of cause of death must be suspect, for many soldiers were weakened by scurvy, to succumb later to a bowel disease or fever. The comparison may overstate French deaths relative to British because the French included deaths after return to France to the end of December 1857, whereas the British did not include comparable later deaths. This is noted in Chenu (1865), page 579, although Table 1 itself specifies deaths from 1853 to 1856.

Chenu (1870) made an even more devastating comparison, based on deaths during the two winters of the war. Remarkably the French rates surged in the second year, even though hostilities ended in September. For the British Army, of course, the reductions in death rates began as soon as the sanitary reforms had been made, and they continued throughout the post-hostilities period, except for a new cholera epidemic. Chenu had separate lines for *scorbutique* and *typhique* deaths, although totals only are given in Table 2.

Chenu's comparative data show the British death rate falling dramatically in the second winter to nearly a 10th of that of the terrible first winter, whereas the French rate nearly doubled. The differences are staggering. Nightingale's references to the French Army in early correspondence during the war were overwhelmingly favourable, acknowledging its superiority in food, transport, shelter, orderlies and general preparations. Then, beginning in March 1855, the British made fundamental improvements, whereas the French did not. By November 1855 Nightingale was describing the French losses as greater than, 'proportionally even' to, theirs, in a letter probably to Sidney Herbert (McDonald (2010), page 257). In March 1856 she reported to Lady Cranworth that the sufferings of the French were now 'so frightful' that they had to have peace:

'They have lost 16,000 sick, one in eight, 10,000 down here [Scutari]. Typhus alone kills 50-60 per diem in these hospitals alone. The medical men are dying, three in one day. So are the sisters. They themselves tell the same story that we did last year' (McDonald (2010), page 349).

The British began to help the French with supplies, as the French had helped them the first year. In June 1856, long after hostilities had ceased, and when troops were being taken home, French typhus cases were still ‘too numerous’, she told Lady Cranworth (McDonald (2010), page 419).

An article by Le Fort on the Crimean War uses Chenu’s data, now with enormous compliments to the British (including Nightingale) and a stark denunciation of the French for failure to learn and prepare for a second winter. The British ‘imagined the dangers of the winter’ and acted so that the whole infantry was ‘warmly lodged, well nourished and clothed’. The French Army, by contrast, was ‘omnipotent in its incompetence and extreme in its lack of preparation’, in spite of the warnings repeatedly made by leading army doctors. The article was published in a medical journal in 1868, and reprinted in Le Fort (1896), volume 3, page 5.

Scrive also published deaths relative to admissions, 14.7% for the whole war, which again compare badly with the British hospitals, with a total death rate per admissions of 11.1%. The (partial) data in Scrive (1857) permit a comparison between the British and French Armies by month.

None of the authors who accused Nightingale of culpability for the ‘highest’ death rates seems to have taken the French analyses into account. Curiously, although F. B. Smith’s accusations in Smith (1982) were far more hostile than Small’s in Small (1998), Smith recognized that the British had succeeded in bringing down the death rates compared with the French, although he understated the British success. Thus he correctly noted that the British had ‘consistently reduced’ their death rates from disease after ‘the first terrible winter of 1854–55’, whereas those ‘in the French hospitals continued high and finally topped the worst British rates’ (Smith (1982), page 67). In fact, as Table 2 shows, the French death rates nearly doubled in the second winter, whereas the British fell to scarcely more than 10% of the first winter.

### 3. Secondary sources on Nightingale’s work in the Crimean War: a historiographical account

Nightingale was certainly the bearer of bad news on the Crimean War, especially with her massive Nightingale (1858a). Strangely, in recent years she has come to be *blamed* for the high death rates that she analysed and reported so graphically.

Small (1998) is the source of the most extreme accusations, with a bizarre scenario entirely lacking in hard evidence. His account has Nightingale learning of her culpability after the war, thanks to data provided by William Farr. She then, he claimed, felt so guilty that she promptly had a nervous breakdown. Small made the point numerous times, using the terms ‘guilt’ (Small (1998), pages 126–127 and 186), ‘shame’ (pages 123 and 125), ‘failure’ (pages 121–122, 186 and 198), ‘disaster’ (pages 127–128 and 186) and ‘breakdown’ (pages 125, 127, 172 and 186). In fact, however, far from having a ‘breakdown’, she was busy writing her ‘confidential’ report (Nightingale, 1858a), assisting behind the scenes on the official Royal Commission, preparing her own evidence for it and drafting the early version Nightingale (1858b). He further claimed that she never had anything favourable to say about the Crimean War hospitals after spring 1857, when she supposedly learned of her responsibility for the deaths (Small (1998), page 186). Yet much praise for the war hospitals—after the sanitary reforms had been made—can be seen throughout her writing, indeed for decades thereafter.

For example, Nightingale told colleague Douglas Galton that there was, the year before the Crimean War, ‘no hospital or sanitary organization ready for war’, the result of which was the ‘colossal calamity’. Yet, by 1864, ‘our hospital and *sanitary* administrations are the finest in the world’, and she cited actual reductions in mortality in support (McDonald (2012), page 428). Early in the Franco-Prussian War of 1870–1871, she said that the ‘sum total of what we



did' in the Crimean War was 'to show that the sufferings of armies which, in all preceding time, had been considered inevitable, were not so—but preventible' (McDonald (2011), page 715).

In 1878, to the widow of Supply Commissioner Alexander Tulloch, Nightingale praised that commission's work as 'the salvation of the army in the Crimea' (McDonald (2010), page 1031). In 1888, in a note to Douglas Galton, she again referred to the Supply Commission, now as having 'helped more than anything else to save the army' (British Library catalogue, Add Mss 45766 f176). As late as 1897, Nightingale was citing 'the tremendous lessons' learned from the 'tremendous blunders and unavoidable ignorances' of the Crimean War. But, thanks to the Sanitary Commission, 'we learnt the terrible lesson of the Crimean War on hygiene' (McDonald (2005), pages 929–930).

Her high opinion of the Sanitary Commission particularly can be seen in the polar area charts that she published, two of which divided the series between before and after its arrival, whereas the third had a label, 'commencement of sanitary improvements', at the same date, March 1855.

Small's views were subsequently disseminated widely in two British Broadcasting Corporation films, on BBC2 in 2001 and on BBC1 in 2008, the accusations further exaggerated in press coverage of them. For example, a *Sunday Times* headline proclaimed that 'Nightingale's nursing "helped kill soldiers"' (Brooks, 2001), whereas the later story called her 'the liability with a lamp' (Wavell, 2008).

Nurses gleefully joined in Small's accusations: Nightingale 'blamed herself' for soldiers' deaths 'because she had the means to prevent them and failed to act'. Small (1998) was cited also in that review on Nightingale discovering the implications of the high mortality statistics, when 'she broke down from overwhelming guilt'. The review called the book a 'must read for seekers of truth in knowledge' and 'an exciting revelation' (Poplin (2001), quotations at pages 235 and 236).

A short film of 2010 on BBC4, *The Beauty of Diagrams*, gave a positive portrayal of Nightingale's famous polar area chart, ignoring entirely her at least as useful black-and-white charts and bar charts. In contrast with the other films, it praised her work and exaggerated both her contribution to the production of the chart and its influence. Its stirring-up reforms, it said, had been sufficient to 'save millions' of lives. The film's numerous factual errors and exaggerations seem to be due to poor research rather than deliberate invention.

Small, and others, made frequent reference to the 'fact' that the death rate was highest at 'her', Nightingale's, hospital, the Barrack Hospital at Scutari. Neither he nor his supporters cited data on this point; nor are any available to the best of my knowledge, for the simple reason that deaths and death rates were not published separately for 'her' hospital. For most months the rates were combined for up to six Scutari buildings: the two largest hospitals ('her' hospital, the Scutari Barrack, and the General Hospital under matron H. A. Tebbutt but her general superintendence); two smaller hospitals (the Palace and Stable Hospitals); two ships (a Turkish hulk and the British *Bombay*), both of which, along with the Stable Hospital, were promptly closed on the urgent recommendation of the Sanitary Commission. For several months there was a seventh hospital, at Koulali, under the Irish Sisters of Mercy and not under Nightingale's jurisdiction at all.

Yet government sources themselves were perfectly clear in their references to hospitals in the plural. One 1855 report listed the Barrack, General, Palace and Stable Hospitals, the Turkish hulk, the *Bombay* and Koulali as 'the various Scutari hospitals' (UK (1855), page 46).

For February 1855 separate data are available for Koulali, so that the (combined) Scutari death rates can be compared with them. Nightingale herself referred numerous times to the highest death rates being at Koulali, for one month at 60% of the sick population, in fact an overstatement; the correct percentage is 46.6%, still the highest, whereas the percentage deaths

**Table 3.** Deaths in Scutari and Koulali hospitals, February 1855†

<i>Hospital</i>	<i>Deaths</i>	<i>Hospital population‡</i>	<i>Cases treated§</i>	<i>Rate per year of cases treated (%)</i>	<i>Rate per year of sick cases (%)</i>
Combined	1329	4178	3112	41.5	42.7
Koulali	302	648	581	46.6	52.0
Scutari	1027	3530	2531	29.1	40.6

†Source: the first two rows are from UK (1858a), volume 2, page 165, in McDonald (2010), page 903.

‡Mean of weekly numbers remaining in hospital.

§Mean of admissions and discharges, including deaths.

**Table 4.** Crimean War death rates by hospital†

<i>Hospital</i>	<i>Deaths</i>	<i>Hospital population‡</i>	<i>Cases treated§</i>	<i>Rate per year of cases treated (%)</i>
Scutari	June 1854–June 1856	4923	41325	11.9§§
Koulali	February 1855*–June 1855	509	1963	25.9
Varna	June 1854–January 1855	374	2846	13.1
Balaclava	October 1854–June 1856	438	5686	7.7
Castle	March 1855–June 1856	96	2554	3.8
Camp	April 1855–June 1856	204	1083	18.8
Monastery	July 1855–June 1856	28	911	3.1
Abydos	September 1854–September 1855	82	814	10.1
Smyrna	February 1855–November 1856	154	1887	8.2
Renkioi	October 1855–June 1856	50	1330	3.8

†From Nightingale (1859b), page 25.

‡Mean of weekly numbers remaining in hospital.

§Mean of admissions and discharges, including deaths.

[Note: correction added on March 26th, 2014, after initial publication on October 7th, 2013.

§§This entry has been corrected to read 11.9 instead of 1.9.

\*This entry has been corrected to read 1855 instead of 1854.]

of cases treated at Koulali was 52.0%, again the highest of all the hospitals (Nightingale (1859a), page 16). Interestingly, Nightingale included the Koulali alone data in the published table, but omitted them from the related chart. The correct comparison is in Table 3.

A simple bar chart (Fig. 5) has been used to depict the data from the published table in Nightingale (1859b), page 16, correcting the percentage error above noted, and adding two columns at the right to show the Koulali and Scutari numbers and rates separately. The data themselves are the same as those published in Smith (1858), volume 2, Table I.

When Nightingale published a later, fuller, edition of her 'Answers to written questions' (originally published in UK (1858a)), she added a table at her answer to question 15. It is reproduced here in Table 4, with an added column giving the rates. This permits another rough way of comparing the death rates in the different hospitals.

The validity of the comparisons leaves much to be desired, given that the data cover different time periods. The lowest three rates are of hospitals that opened after the sanitary improvements had been made. Moreover, the Monastery Hospital was a convalescent hospital and Renkioi consisted of completely new prefabricated huts with state of the art sanitation. Camp Hospital, with its high death rates, needs explanation, for no such hospital name appears in Nightingale's or Smith's reports. It is probably the hospital of the Sardinian Army, which joined the allies late,

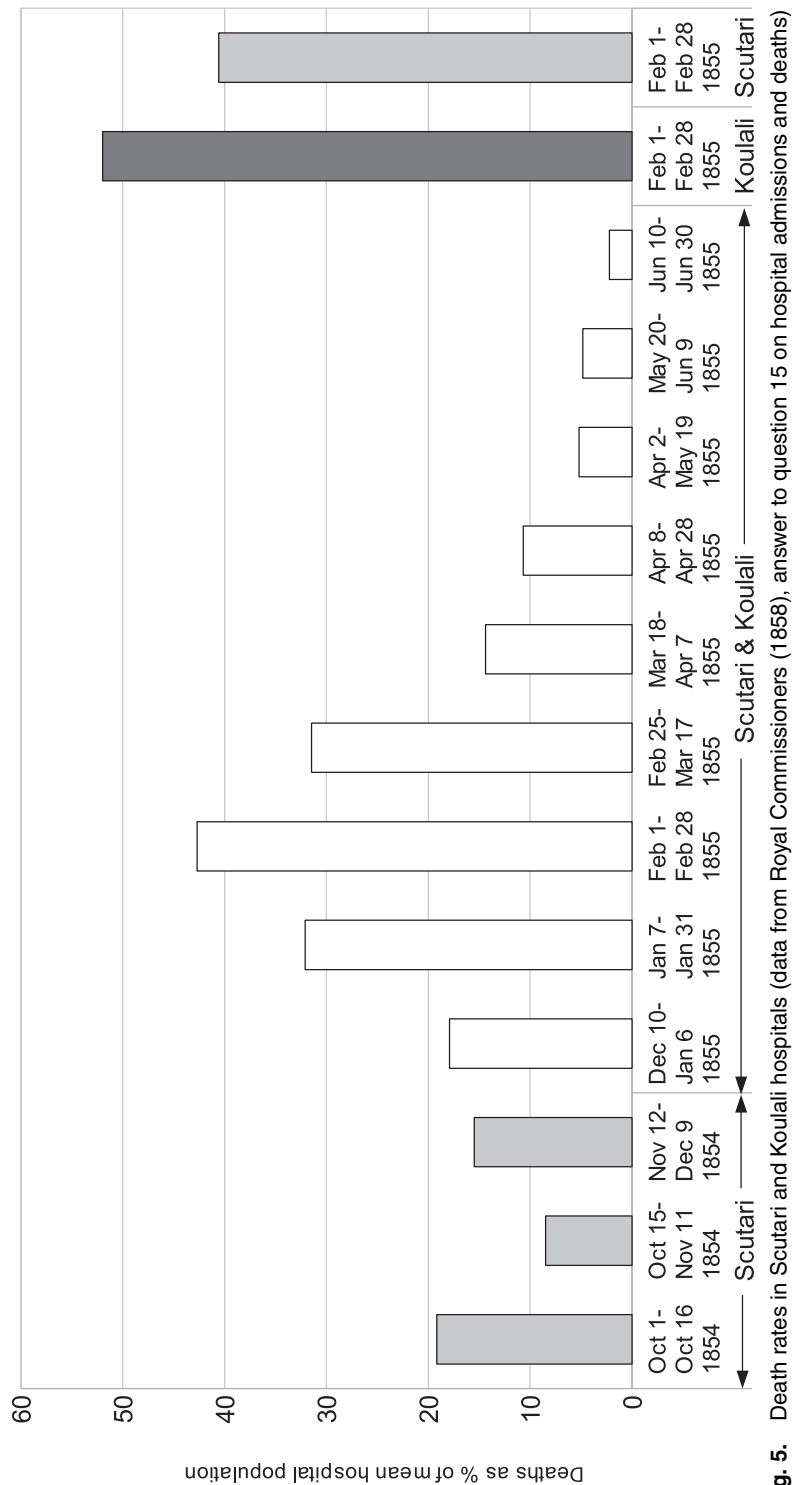


Fig. 5. Death rates in Scutari and Koulali hospitals (data from Royal Commissioners (1858), answer to question 15 on hospital admissions and deaths)

**Table 5.** Death rates by hospital and nursing responsibility†

<i>Hospital</i>	<i>Period</i>	<i>Deaths/admissions (%)</i>	<i>Nursing responsibility</i>
Koulali	February 1855–June 1855	25.9	Irish Sisters of Mercy
Camp	April 1855–June 1856	18.8	(Probably) Sardinian Sisters of Charity
Varna	June 1854–January 1855	13.1	No women nurses
Scutari	June 1854–June 1856	11.9	Nightingale (mainly)
Abydos	September 1854–September 1855	10.1	Civil‡
Smyrna	February 1855–November 1856	8.2	Civil
Balaclava	October 1854–June 1856	7.7	Nightingale
Renkioi	October 1855–June 1856	3.8	Civil
Castle	March 1855–June 1856	3.8	Nightingale
Monastery	July 1855–June 1856	3.1	Nightingale

†Source: the second and third columns are from Table 4.

‡Nurses hired by the civil doctors running the hospital.

**Table 6.** Crimean War death rates by type of hospital and sanitary condition†

<i>Hospital</i>	<i>Deaths/admissions (%)</i>	<i>Type of hospital</i>	<i>Sanitary condition</i>
Koulali	25.9	General	Worst, very serious defects
Camp	18.8	General	Half-buried, defective huts
Varna	13.1	General	Cholera conditions
Scutari	11.9	Mainly large	2nd and 3rd worst hospitals
Abydos	10.1	Small, civil	Not applicable
Smyrna	8.2	Convalescent	Serious defects
Balaclava	7.7	General	Excellent, stone, on heights
<i>Hospitals in operation only after sanitary reforms</i>			
Renkioi	3.8	Hut	Excellent, new prefabrication
Castle	3.8	Hut	Excellent, on heights
Monastery	3.1	Convalescent	Excellent, on heights

†The second column is from Table 5.

and which kept excellent hospital data (McDonald (2012), page 240). The dates fit. If British Army hospitals are meant, it is not clear which, for neither the dates nor the numbers suggest regimental hospitals. Deaths for hospitals of the Land Transport Corps were not included in Smith's report, but there is no reason to suppose that they are the 'Camp Hospital'.

The data of Table 4 amply show that the rates for Koulali were higher than those of the Scutari hospitals, as were those at Varna, Bulgaria, where the soldiers were camped in the summer of 1854, before a shot had been fired, and before they were worn down by exposure and malnutrition. Cholera was rampant there. The data permit only a rough comparison, but one would think that they might suffice to give pause to any researcher contending that 'Nightingale's hospital' was the worst.

Another reconfiguration of the material, in Table 5, gives the rates in descending order, along with who was responsible for the nursing.

One last reconfiguration gives the death rates by type of hospital and its sanitary condition (Table 6).

Table 6 shows the importance of the hospitals' sanitary condition, type (huts the best, but not if 'half-buried') and the time of operation (after the Sanitary Commission's arrival best).

Small contended, again oddly and incorrectly, that the army's official report did not support Nightingale's allegations of higher mortality at Scutari, but that this revelation appeared only in Nightingale (1858b) (Small (1998), page 116). Yet Nightingale's source of statistics was the official report, and neither it nor hers has the rates highest at Scutari, but all clearly say 'Scutari and Koulali' or 'Scutari hospitals' in the plural. Smith never discussed this crucial matter in his massive report, and the data are tellingly buried in the second volume, but he did publish them, with the spelling Kulleli, as the 'General Hospital returns of the Bosphorus' (Smith (1858), volume 2, Table I).

Nightingale never blamed the nurses at the Koulali hospital for their high death rates, doubtless considering that they were no more responsible for the sewers and drains at 'their' hospital than she was at 'hers'. All three Bosphorus hospitals were drastically re-engineered. None of these secondary researchers mention any role of the War Office officials who inspected and approved the hospitals. A job title at the Army Medical Department was 'inspector general of hospitals', notably held by Dr John Hall, who, Nightingale felt, was responsible for much of what went wrong, with his superior in London, the Director General, Dr Andrew Smith.

Nightingale's short paper includes a revealing critique of Andrew Smith's published Scutari mortality statistics, that they exceeded those reported by his own medical officers by 500 (Nightingale (1859a), page 5). She rejected possible explanations that numbers of burials were added of persons not buried, or that medical officers 'officially made imperfect returns'. The best explanation, she thought, was that

'the Army Medical Department, in order to square the returns, added deaths here and there to the transport and Scutari returns, to reduce the discrepancies and to account for the unaccounted deaths to the greatest possible extent' (Nightingale (1859a), page 4).

In the case of deaths in transport, Dr Smith gave 883 for deaths from October 1st, 1854, to February 28th, 1855, whereas surgeons on board reported 706. Again, Nightingale adopted as the 'more probable hypothesis' that the statistics 'were afterwards "dressed" to account for 177 deaths' (Nightingale (1859a), page 5). The Director General, in short, fudged the figures.

Small contended, and exceptionally gave a figure, albeit a round number, that the '12,000' men sent from the 'primitive regimental hospitals' in the Crimea to 'Nightingale's hospital', resulted in an increased death rate from 1/8th to 3/8th, so that 'her hospital was easily twice as lethal' (Small (1998), pages 88–89). Of course death rates in a general hospital would be higher, for the worst cases were sent to them, whereas the less serious were kept in the regimental hospital. Gill and Gill (2005) pointed out that the Crimean War took place a century before the availability of antibiotics, and that there were few remedies to manage infectious diseases. They argued that the general hospitals at Scutari existed 'largely to segregate patients with fever from their healthy compatriots', to serve as 'fever wards' more than 'true military hospitals'. The soldiers were not sent to them 'to be healed so much as to die' (Gill and Gill (2005), page 1799). As Nightingale herself pointed out to Sidney Herbert in 1855 about the hospital in Smyrna, 'we pick all the ships, as they go through the Bosphorus, of their worst cases, and send on only convalescents' (McDonald (2010), page 171).

Small also failed to note that the 66 regimental hospitals varied enormously in size, facilities, death rates and propensity to send patients to the general hospitals. Again, the official report gave data which he ignored; the 560 pages of volume 1 of Smith (1858) are on regimental

hospitals. Their death rates ranged from a high of 12.9% of admissions to a low of 1.2%. The data distinguish deaths in the regimental hospitals from those of men transferred to the general hospitals. Not surprisingly, some of the hospitals with the lowest death rates were those with large numbers dying at the general hospitals, e.g. the 68th Regiment, which had only 34 deaths at its own hospital, but had 193 men die in (unspecified) general hospitals.

#### 4. Alternative explanation for the decline in general hospital mortality rates

Hinton (2010) took another crack at Nightingale's explanation of the decline in hospital death rates, that the 'disease status' of the army in the Crimea 'dictated in large measure the death rates in the Scutari hospitals', and further that it was 'the military authorities in the Crimea who were principally responsible for turning the sanitary disaster of 1854–55 into the sanitary success of 1855–56'. This is not a new explanation but the position of Principal Medical Officer Hall (1857), who attacked the report of the Sanitary Commission soon after its publication. Sutherland (1857a), its head, rebutted that critique and gave an even more detailed refutation in his own evidence to the Royal Commission (UK (1858a), volume 2, page 334).

The improved condition of the men sent was always acknowledged by the Sanitary Commissioners. Said Sutherland (1857a), page 54: 'The comparatively healthy condition of the army in the Crimea had thinned them of sick'. These improvements themselves, however, were to a great extent the product of the work of the Sanitary Commission there, who proceeded to improve the town and camps after renovating the hospitals. The Crimean hospitals needed much less work than the Bosphorus hospitals. Thus, the lower death rates at the Balaclava General Hospital Sutherland explained as due to its ventilation, its being a 'tolerably good' stone building without the drainage defects of Scutari, whereas the

'excessive mortality at Scutari and Koulali, if sick had not died there in large numbers, it would have contradicted all experience' (Sutherland (1857b), page 16), for 'the laws of nature are the same everywhere' (Sutherland (1857b), page 18).

Sutherland, in his reply to Hall, acknowledged that the Army Medical Department was not a sanitary department and that there were no charges against it in their report. He was complimentary about the 'devotions' of 'most' of the doctors but protested against the alleged inaccuracy of their facts. Systems had to be tried against their 'results', not the recommendations they generated, and the fact remained 'that during the 7 months of the Crimean War, October 1854 to April 1855, above a third part of the army' were 'swept away by disease', mainly preventable. He asked rhetorically whether there was not 'great reason' to doubt whether the hygiene of the army during that time was

'efficient, notwithstanding the recommendations made by Sir John Hall, and whether, in fact, the results were not as bad as if there had been no recommendations made at all?' (Sutherland (1857b), page 7).

The Barrack Hospital was in a 'worse condition' than the General Hospital when the Sanitary Commission arrived, and had 'greater structural defects' (Sutherland (1857b), page 8). Hall gave instructions for the Barrack Hospital to be 'properly cleansed, whitewashed and fitted up', but he failed to note that these were the instructions of Lord Raglan. He ordered

'... nothing about the drainage of the buildings, nothing about cleansing, trapping and flushing sewers belonging to them so as to prevent sewer air, that most fatal of all sources of atmospheric pollution, from diffusing itself through the air breathed by the sick, nothing even about opening the windows of the privies to allow the sewer air to escape before it could reach the corridors, nothing about ventilating the buildings, nothing about apportioning a proper cubic space for each patient, nothing about the proper burial of the dead' (Sutherland (1857b), page 11).

Sutherland considered that the best recommendations for hygiene came from Raglan,

‘and nothing touched on or even recognized the chief defects, which eventually rendered these otherwise magnificent buildings little else than pest houses for the sick’ (Sutherland (1857b), page 11).

Hall attacked the Sanitary Commission report again in giving his own evidence to the Royal Commission, stating that the improvements had been made before it arrived. Sutherland again defended his commission in his evidence of July 17th, 1857 (UK (1858a), volume 2, page 334):

‘During three weeks ending March 17th, the date when our sanitary works began, 5522 sick yielded a mortality of 93 per 1000 and at Koulali 1127 sick yielded a mortality of 118 per 1000 during the same three weeks’.

He then summarized the clean-up: removal of dead animals, sewers opened and cleaned, open privies disinfected, closed and sealed up, wards over stables evacuated, graveyard disinfected and new rules for burials established.

‘Within the first three weeks of the improvements the mortality in all the hospitals fell to one half of what it was during the three weeks before. In three weeks more it was down to one third. During the next three weeks it had fallen to less than a fourth, and in six weeks more it was less than a tenth. At Koulali the mortality fell to an 18th part of what it was when the sanitary works were commenced, but at that hospital the defects were the most serious, and the loss of life from them had been the greatest’ (UK (1858a), volume 2, page 234).

The reports of the inspectors who did the actual work are available, with such details as ‘556 hand carts of filth’ removed from the Barrack and General Hospitals, while at Koulali ‘two tons of filth’ and twenty-four dead horses were removed (Sutherland (1857a), page 38). (‘Filth’ means faeces, rubbish and offensive matter.)

Nightingale in her own ‘confidential’ report described supervising the removal of tubs of excreta from the wards at the Scutari Barrack Hospital and quoted an official report describing faeces flowing across the floor from the plugged toilets (Nightingale (1858a), page 92).

The French data also constitute a refutation of the hypothesis of Hinton (2010) that the decline in Scutari hospital death rates was the result of the healthier condition of soldiers on entering those hospitals. The French Army suffered from the same conditions as the British, and yet their death rates rose considerably in the second year, whereas the British rates fell.

## 5. Applying the lessons of the Crimean War

By applying the lessons learned from the Crimean War to army hospitals in Britain, great reductions in rates of death, disease and length of hospital stay were achieved. These were so great that the two large military hospitals that were built after the war, the Royal Victoria Hospital, Netley, which opened in 1863, and the Herbert Hospital, Woolwich, in 1865, were overbuilt. The British Army then planned hospital beds for 10% of its force, but with the sanitary reforms made after the war beds for only 5–6% were needed. As Nightingale complained, ‘Really it is not our *fault* if the number of sick has fallen so much that they can’t fill their hospitals’ (McDonald (2011), page 408).

The American Civil War was the next major war for which Nightingale’s material was used, i.e. her forms for reporting diseases, hospital stays and deaths, and the final and very comprehensive edition of her *Notes on Hospitals* (Nightingale, 1863). How thoroughly her advice was used is far from clear, even for the Northern Army. The Confederate Army used her advice on nutrition, and probably her *Notes on Hospitals*, but not the forms. The largest Confederate Hospital, at Chimborazo, outside Richmond, Virginia, was a hut hospital, in effect employing ‘pavilion’

principles to reduce cross-infection. She concluded that, if the Americans, meaning the North, had properly used the advice gained from the Crimean War, they could have kept their hospital death rate to 3% instead of the actual 10% (McDonald (2011), page 679). Civil War mortality was enormous in absolute terms—an estimated 618 000 total deaths, of which 360 000 for the Union Army and 258 000 Confederate.

Nightingale saw commonalities between war and peacetime hospitals, army and civil, British and other, and used the lessons learned from the Crimea to press for broader reforms. She continued to work with Farr, but they never produced charts again at the ambitious level of those on the war. In a paper in 1865 she was interested to see, using data from army statistician Alexander Tulloch, that the ratio of deaths from disease to those from wounds was even higher in India than in the Crimean War (Vallée (2006), page 418).

One of the first places that the British Army used the war results was in China on the Taiping Rebellion, when the death rate was only 3% *per annum*, or little more than that of Crimean War hospitals in the second winter, 2.3%, after they had been reformed. Yet, as she stated in 1862, this had been achieved in a ‘hostile’ country, on ‘the opposite side of the world’, ‘notorious for its epidemic diseases’ (McDonald (2011), page 347).

During the Franco-Prussian War of 1870–1871, Nightingale assisted both sides with relief measures and again tracked mortality data. She noted the higher death rates in Prussian field hospitals, 1 in 5, compared with 1 in  $8\frac{1}{2}$  for France (McDonald (2011), page 606). These are enormous death rates, 20% and 11.7% respectively. Interestingly, the Prussian rates were worse, although it was the stronger power, better prepared for the war and of course the winner. The French rates, though lower, were the same as had occurred in the first winter of the Crimean War. The French also suffered unnecessary deaths from poor preparation in 1859 in the Second Italian War of Independence, when the unattended wounded left on the battlefield by both sides prompted Henri Dunant to found what became the Red Cross. Of course the French were long accustomed to high death rates in war from Napoleon I. The French Army was 500 000 strong when it invaded Russia in June 1812, whereas only 27 000 returned that winter, and about 380 000 men died and 100 000 were captured.

To prevent disasters in the future the British Army needed adequate and timely statistics. Tulloch’s ‘*Blue Books*’ were published too late to be of use—the men were already dead or discharged. Further, Nightingale said, whatever period of reporting was adopted, at the first appearance of any epidemic there should be day-by-day reporting. She wanted data for each regiment, monthly, on mean strength with the mean number of sick from fever, consumption and other causes, then aggregated to the whole army. The object was

‘for the Secretary of State for the War Department to be able to see the movements of the health of the army as clearly as the movements of time on the face of a clock’ (Nightingale (1858a), page 328).

To army statistician T. G. Balfour she commented

‘Not until we have a complete system of sanitary statistics in the army shall we be able to administer the laws of health with that certainty with which we know they are capable of being administered’ (McDonald (2012), page 333).

In a letter to Balfour in 1861, she was critical of army data for excessive aggregation in places. For example, it was wrong to group dysentery, diarrhoea and cholera together, for there might be no cholera and, whether or not there is, is important (McDonald (2012), page 398).

To James Paget, of St Bartholomew’s Hospital, who pioneered the collection of uniform hospital statistics for her, Nightingale wrote ‘The law of life after operations has not yet been ascertained. And no hospital statistics have yet been kept so as to ascertain it’ (McDonald



(2012), page 536). In that same 1861 letter she was critical of French surgeon Paul Topinard for not taking into account age, sex, occupation and condition of life in surgical outcomes, which are all factors well known to influence the results of operations. Nightingale gave Paget a handsome inkstand in appreciation of his work on standardizing hospital statistics, on display at the hospital.

Nightingale's goals were ambitious. In Nightingale (1863), page 160, she stated

'With fixed data, arrived at on these principles, we can readily obtain the proportionate mortality, not only of the whole hospital, but of every ward of it, and also the proportionate mortality and duration of cases for each age, sex and disease. It need hardly be pointed out of what great practical value these and similar results would become, if obtained over a large number of hospitals. The laws which regulate diseased action would become better known; the results of particular methods of treatment, as well as of special operations, would be better ascertained than they are at present.'

## 6. The 'passionate statistician'

Nightingale has been described as the 'passionate statistician' for her ability to see real suffering people in the driest of statistics. The term seems to have come from her own reference to 'a woman historical writer' (identity not known) who called 'a full chronology of dry dates ... the most passionate of all reading'. Nightingale said that she was 'conscious of the same feeling in reading a column of dry and full statistical figures' (McDonald (2012), page 372). She told Sir John McNeill in 1857 that it was 'criminal to have a mortality of 17, 19 and 20 per 1000 in the army in England, when in civil life it is only 11 per 1000'. She likened it to taking 1100 men *per annum* out to Salisbury Plain and shooting them (McDonald (2010), page 500). In 1869, after army mortality in peacetime had been reduced over the preceding 4 years, 'We have 729 men alive who would have been dead ... and 5184 men ... on active duty who would have been "constantly sick" in bed', thanks to the sanitary measures taken (McDonald (2012), page 457).

All the while, the drier the statistics were the better, a position she shared with Farr. As she told army statistician Balfour in the letter above cited, no causal analysis should be allowed in the reporting of official statistics. Inferences as to causation and remedies were another, specialized stage of analysis.

## Acknowledgements

Thanks go to Patricia Warwick and Ken Simons for assistance on charts and to Alison Macfarlane and Eileen Magnello for comments on an earlier draft.

## References

- Baudens, L. (1857) Souvenirs d'une mission médicale a l'armée d'Orient: I. le campement des alliés (15 February 1857) 876–908; II. Les ambulances et le Service Chirurgical (1 April 1857) 587–616; III. Les hôpitaux, les épidémies et le typhus de Crimée (1 June 1857). *Rev. Deux Mondes*, June 15th, 590–635.
- Baudens, L. (1862a) *La Guerre en Crimée: les Campements, les Abris, les Ambulances, les Hôpitaux, etc.* Paris: Lévy.
- Baudens, L. (1862b) *On Military and Camp Hospitals and the Health of the Troops in the Field.* (Engl. transl. F. B. Hough). New York: Baillière.
- Brooks, R. (2011) Nightingale's nursing 'helped kill soldiers'. *Sunday Times*, July 8th, p. 14.
- Chenu, J.-Ch. (1865) *Rapport au Conseil de Santé des Armées sur les Résultats du Service Médico-chirurgical Pendant la Campagne d'Orient en 1854-56.* Paris: Masson.
- Chenu, J.-Ch. (1870) *De la Mortalité dans l'Armée et des Moyens d'Économiser la vie Humaine, Extraits des Statistiques Médico-chirurgicales.* Paris: Hachette.

- Gill, C. G. and Gill, G. (2005) Nightingale in Scutari: her legacy re-examined. *Clin. Infect. Dis.*, **40**, 1799–1805.
- Hall, J. (1857) *Observations on the Report of the Sanitary Commissioners in the Crimea, during the Years 1855 and 1856*. London: Clowes.
- Hinton, M. (2010) The Crimean Campaign 1854–1856: from sanitary disaster to sanitary success. *Conf., London*.
- Le Fort, L. (1896) *Oeuvres de Léon le Fort*, vols 1–3. Paris: Alcan.
- Martineau, H. (1859) *England and Her Soldiers*. London: Smith Elder.
- McDonald, L. (ed.) (2003) *Florence Nightingale on Society and Politics*. Waterloo: Wilfrid Laurier University Press.
- McDonald, L. (ed.) (2005) *Florence Nightingale on Women, Medicine, Midwifery and Prostitution*. Waterloo: Wilfrid Laurier University Press.
- McDonald, L. (ed.) (2010) *Florence Nightingale: the Crimean War*. Waterloo: Wilfrid Laurier University Press.
- McDonald, L. (ed.) (2011) *Florence Nightingale: Wars and the War Office*. Waterloo: Wilfrid Laurier University Press.
- McDonald, L. (ed.) (2012) *Florence Nightingale on Hospital Reform*. Waterloo: Wilfrid Laurier University Press.
- Nightingale, F. (1858a) *Notes on Matters affecting the Health, Efficiency and Hospital Administration of the British Army*. London: Harrison.
- Nightingale, F. (1858b) Notes on the sanitary condition of hospitals, and on defects in the construction of hospital wards, part I, 462–82; Note on the hospital plans, part II. *Trans. Natn. Ass. Promon Socl Sci*.
- Nightingale, F. (1859a) *A Contribution to the Sanitary History of the British Army during the Late War with Russia*. London: Harrison.
- Nightingale, F. (1859b) *Notes on Hospitals, with Evidence given to the Royal Commissioners on the State of the Army in 1857*, 2nd edn. London: Parker.
- Nightingale, F. (1863) *Notes on Hospitals*, 3rd edn. London: Longman, Green.
- Poplin, I. S. (2001) Review of Hugh Small. *Nursng Hist. Rev.*, **9**, 235–237.
- Scrive, G. (1857) *Relation Médico-chirurgicale de la Campagne d'Orient du 31 Mars 1854, Occupation de Gallipoli au 6 Juillet 1856, Évacuation de la Crimée*. Paris: Masson.
- Small, H. (1998) *Florence Nightingale: Avenging Angel*. London: Constable.
- Smith, A. (1858) *Medical and Surgical History of the British Army which served in Turkey and the Crimea*, vols 1, 2. London: Harrison.
- Smith, F. B. (1982) *Florence Nightingale: Reputation and Power*. London: Croom Helm.
- Stone, R. (1997) Florence Nightingale and hospital reform. In *Some British Empiricists in the Social Sciences 1650-1900*, pp. 303–338. Cambridge: Cambridge University Press.
- Sutherland, J. (1857a) *Report to the Right Hon Lord Panmure, G.C.B. &c, Minister at War, of the Proceedings of the Sanitary Commission dispatched to the Seat of War in the East 1855-56*. London: Harrison.
- Sutherland, J. (1857b) *Reply to Sir John Hall's 'Observations' on the Report of the Sanitary Commission despatched to the Seat of War in the East 1855-56*. London: Harrison.
- UK (1855) *Army Hospitals: Session 12 December 1854-14 August 1855*, vol. XXXIII.
- UK (1858a) *Report of the Commissioners appointed to Inquire into the Regulations affecting the Sanitary Condition of the Army and the Treatment of the Sick and Wounded*. London: Her Majesty's Stationery Office.
- UK (1858b) *Mortality of the British Army, at Home, and Abroad, and During the Russian War, as compared with the Mortality of the Civil Population in England*. London: Harrison.
- Vallée, G. (ed.) (2006) *Florence Nightingale on Health in India*. Waterloo: Wilfrid Laurier University Press.
- Wavell, S. (2008) The Liability with a Lamp. *Sunday Times*, June 1st.