Life before EXCEL: some historical statistical graphs

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Introduction

In this age of the personal computer, where complex pictorial representations of data can be produced at the press of a button or the click of a mouse, we tend to take statistical graphics very much for granted, and it is difficult to imagine how revolutionary the first simple charts were. What follows is a description of some of the most influential of these early attempts to display data, and the stories and characters behind them.

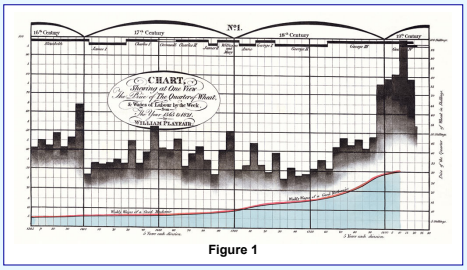


Figure 1

William Playfair (1759-1823) is generally regarded as the originator of the statistical graph. A Scottish engineer and political economist, he led a colourful life: at one point he was personal assistant to James Watt, inventor of the steam engine, and he was present at the storming of the Bastille in Paris in 1789. At various times he also dabbled in silver-smithing, journalism, banking and blackmail. His 1821 chart (Figure 1) 'shewing at one view the price of the quarter of wheat & wages of labour by the week, from the year 1565 to 1821' was a major innovation, and shows the first examples of both bar and line charts. In true patriotic fashion, the time axis is conveniently divided into the reign periods of the English monarchs. Playfair's conclusion, which is not immediately apparent from his graph, was that wheat had become cheaper in relative terms over time. That this conclusion was correct can be seen clearly from the modern (2006) re-drawing of the graph by Michael Friendly and Howard Wainer (Figure 2).

Playfair was also responsible for the first pie chart (Figure 3), which showed the proportions of the Turkish Empire which fell in Africa, Asia and Europe before 1789. This was part of a wider graph (Figure 4) showing the populations (in millions) and the tax revenue (in millions of pounds) for Russia, Turkey, Britain and France - showing that, in comparative terms, Britain was overtaxed. Plus ça change!

William Playfair died penniless in Covent Garden in 1823.

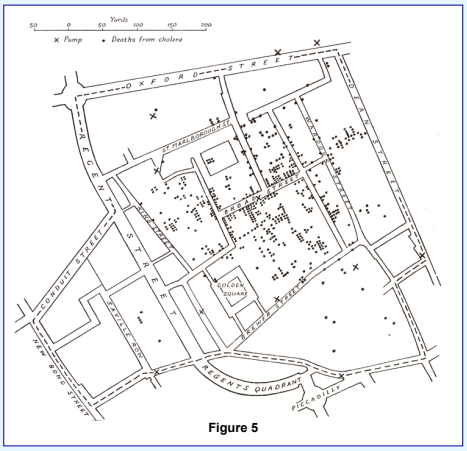


Figure 5

John Snow (1813-1858), the 'godfather of epidemiology', was born in York, where his father worked in the local coal yards. He was a doctor of medicine, apprenticed at one time to the physician to George Stephenson and his family. He is renowned for his 'spot map' (an early form of geospatial mapping) showing the deaths from cholera during the 1854 outbreak in Soho, superimposed on a map of the area around Broad Street (Figure 5). This led to the source of the outbreak being traced to the Broad Street water pump (the well for which, it subsequently transpired, had been dug only three feet from an old cesspit). Snow thus established that cholera was a waterborne disease - and not, as was then believed, caused by vapours or 'miasma'. The pump handle was subsequently removed on 8th September, 1854 - an event which is symbolically re-enacted every September by the John Snow Society, following the annual Pumphandle Lecture. The site of the original pump can be found just outside the John Snow public house in Broadwick Street.

Snow died of a stroke at the age of 45, and is buried in Brompton Cemetery.

Florence Nightingale (1820-1910), named after the Italian city in which she was born, is well known for her nursing exploits during the Crimean war. She was also a formidable social reformer and statistician, and the first woman (in 1858) to be elected Fellow of the Statistical Society of London (the forerunner of the present day Royal Statistical Society). Her 'coxcomb' or 'wedge' charts (Figure 6) demonstrated dramatically that far more deaths in British soldiers in the Crimea were caused by infections and preventable diseases than by wounds, and she successfully lobbied for improved sanitation in military hospitals – thereby greatly reducing the death rate.

She set up the Nightingale Training School at St. Thomas' Hospital on 9 July 1860. Now known as the Florence Nightingale School of Nursing and Midwifery, this is part of King's College London. During the 1870s she supported the idea of instituting a medal for achievement in statistics, in memory of Adolphe Quetelet, and in the early 1890s she and Francis Galton (see below) formulated plans for a new Chair of Applied Statistics at Oxford. Sadly, the proposals came to nothing. In 1883, Nightingale was awarded the Red Cross by Queen Victoria, and in 1907 she became the first woman to be awarded the Order of Merit.

On 13 August 1910, at the age of 90, she died peacefully in her sleep in her room at 10 South Street, Park Lane. The offer of burial in Westminster Abbey was declined by her relatives, and she is buried in the graveyard of St. Margaret's Church in East Wellow, Hampshire.

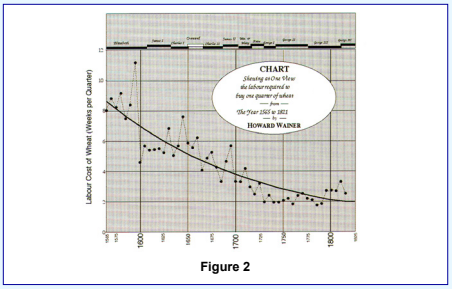


Figure 2

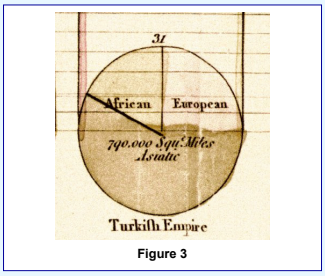


Figure 3

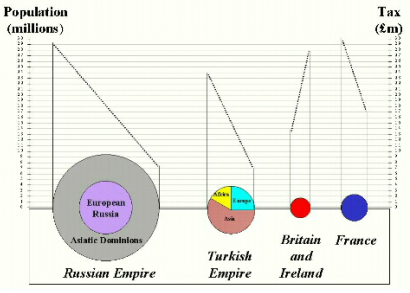
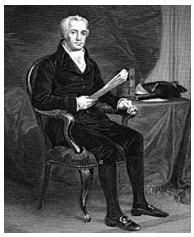
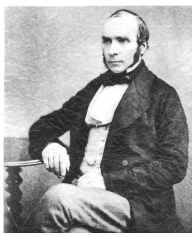


Figure 4

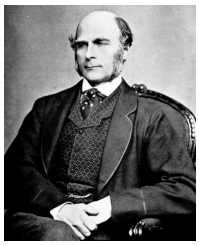


William Playfair (1759-1823)



John Snow (1813-1858)

Florence Nightingale (1820-1910)



Francis Galton (1822-1911)

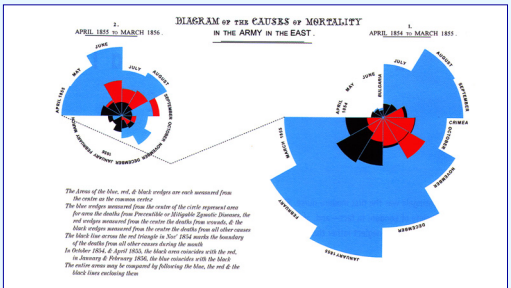


Figure 6

Francis Galton (1822-1911) - scientist, statistician and African explorer - was a cousin of Charles Darwin. He was born in Birmingham, the youngest of eight children of a prominent Quaker family. He studied medicine at King's College London and mathematics at Cambridge. He was a man of diverse talents, and was responsible (amongst many other projects) for the first weather map, a theory of anticyclones, and the system for classifying fingerprints still in use today. He wrote a treatise on how to make the perfect cup of tea, and published a 'beauty map' of the British Isles – based on the number of attractive women he encountered on his travels. (London came out with the highest score; Aberdeen the lowest.)

Among his many statistical achievements, he is credited with the introduction of the standard deviation, the correlation coefficient and the regression line. His discovery of the phenomenon of 'regression to the mean' is illustrated in his famous chart (Figure 7) shown at the Royal Institution Lecture of 1877. Among his protégés was the great statistician Karl Pearson. He was knighted in 1909.

Perhaps unfortunately, Galton is best remembered as the founder of the eugenics movement. In June of 1873 he wrote a controversial letter to the Times entitled 'Africa for the Chinese', in which he argued that the Chinese, as a hard-working race capable of high civilization, should be encouraged to emigrate to Africa and displace the supposedly inferior aboriginal blacks. Shortly before his death at the age of 89, he completed his utopian eugenic novel 'Kantsaywhere'. It was rejected by his publisher, and most of the novel was subsequently burnt by his niece - although some fragments survive.

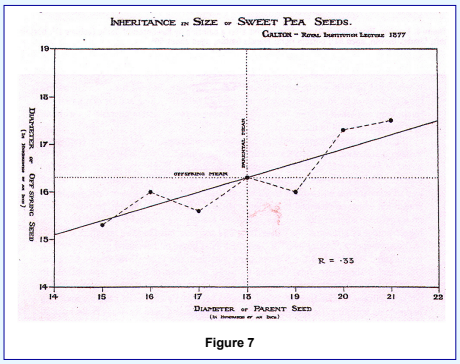


Figure 7

Charles Joseph Minard (1781-1870) was an engineer and cartographer, born in Dijon, France. His 1869 'Carte Figurative' (Figure 8), depicting the utter destruction of Napoleon's Grande Armée during his Russian campaign of 1812/13, is arguably the most poignant graph ever produced. It combines many elements, showing the physical route of the army in its advance on, and retreat from, Moscow, the location of the army at certain dates, and the temperatures encountered on the retreat. The size of the army is indicated by the width of the coloured zones (gold for advance, black for retreat), on a scale of 1 mm for 10,000 men. The corresponding numbers of men are shown at various points along the route. Thus we see an army of 422,000 men setting out on the grand enterprise. A fraction of the troops can be seen splitting off from the main army and pausing at Polotzk. These troops remained relatively undiminished, and rejoined the remnants of the main army in their retreat. By the time Napoleon reached Moscow, his troop numbers were reduced to 100,000 (still a formidable force), but he found little worth conquering – Czar Alexander I and the residents of Moscow had fled, burning the city behind them. Napoleon had little choice but to retrace his steps through the bleak Russian winter. As shown on the graph, the temperature fell as low as -30° C on 6th October, 1812. Only 10,000 of the original 422,000 survived. As with Florence Nightingale's soldiers, the majority had died from cold, hunger and disease – not from wounds or enemy action.

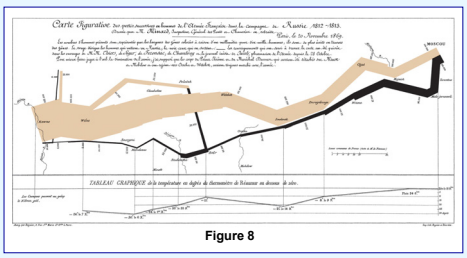


Figure 8

A companion, though less dramatic, graph (Figure 9) shows the depredations suffered by Hannibal's troops as he marched on Rome during the Second Punic War. The loss of life entailed in his famous crossing of the Alps (despite his elephants) is immediately evident.

As Minard's obituarist notes, his famous graph 'inspires bitter reflections on the cost to humanity of the madnesses of conquerors and the merciless thirst of military glory'.

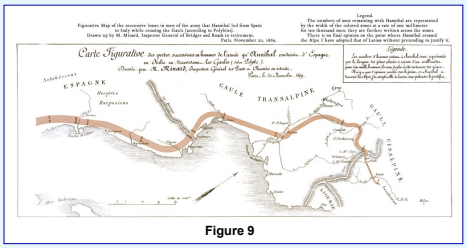


Figure 9

Conclusions

This has been a brief, and necessarily selective, introduction to the fascinating history of the statistical chart. Whilst statistical graphics have advanced enormously since the earliest simple diagrams, we owe an enormous debt of gratitude to the astute, and often larger than life, pioneering characters who created them.