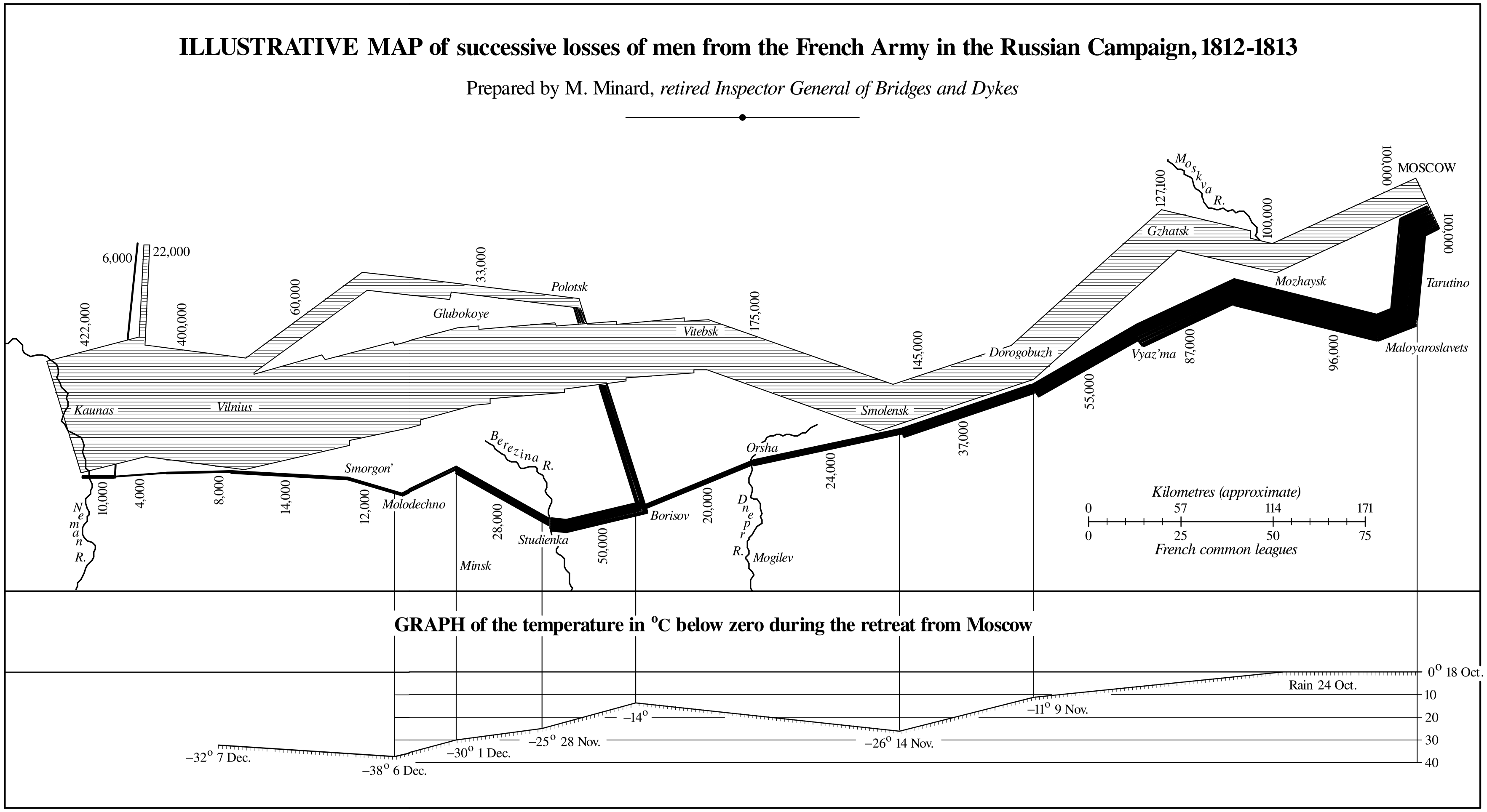
Figure 4.6. ANALYSIS STAGE: Other Graphical Methods 1

[A diagram adapted and redrawn from a reproduction of the French original (1861)]



NOTES: 1. The English spelling of some names on the map varies in different sources; the spellings used above are those in Plates 45 and 46 of *The Times Atlas of the World*, Comprehensive Edition, Times Books, New York, 1980, ISBN 0-8129-0906-2. [DC Library call number G 1021.T55 1980]

2. Although the distance of one league has differed both with country and with time, a metric equivalent of about 4 km would be expected in this map; thus, either the scale 0, 25, 50, 75 is wrong (0, 15, 30, 45 would be closer to correct) or a different distance for the French common league is involved.

(*continued overleaf*)

Background: The graphical display shown overleaf on page 4.25 is based on Charles Joseph Minard's original, produced in 1861; the latter came into prominence in North America in the 1980s, partly as a result of its use to epitomize 'graphical excellence' (see below). Tufte suggests that *It may well be the best statistical graphic ever drawn*, and he quotes E.J. Marey's statement that the display seems .... *to defy the pen of the historian by its brutal eloquence.* Within the last few years, the original display has been described by the Napoleonic Society in its *Members Bulletin*, and copies have been offered for sale as a poster by mail order; in addition, it is featured early in Program 2 of *Against All Odds: Inside Statistics.*

While the display *is* a notable example of good statistical practice in the presentation of graphical attributes, the reader should look beyond the superlatives and recognize that, first, there is disagreement over the details of some aspects of the events it portrays. Two examples are:

- ***the numbers of men involved*** – Minard's display indicates an invading army size of 422,000 and a remnant of 10,000 after the retreat. However, in stressing the strength (*viz.* about 80,000) of the French in cavalry, the *Encyclopædia Britannica* mentions an army size of 450,000; this source also says, about the crossing of the Berezina River late in November, 1812: *How many were killed can never be known, but three days later the total number of men reported fit for duty had fallen to 8,800 only.*. Further, the *Encyclopedia Americana* states: *When (the French Army) reached the Neman (December 14), it comprised only about 30,000 survivors; more than 500,000 men had disappeared in Russia.*
- ***the effect of the weather during the retreat*** – Tufte says that, during the retreat from Moscow, *It was a bitterly cold winter, and many froze on the march out of Russia*; the *Encyclopedia Americana* mentions that *Starvation, defections, harassment by the Cossacks, the early and bitter cold, the fighting..... ravaged the Grand Army.* However, the *Encyclopædia Britannica* comments: *Then began the celebrated retreat. It has generally been forgotten that the utter want of march discipline in the French, and not the climatic conditions, was responsible for the appalling disasters which ensued. Actually the frost came later than usual that year, Oct. 27, and the weather was dry and bracing; not till Nov. 8 did the cold at night become sharp. Even when the Berezina was reached on Nov. 26, the cold was far from severe, for the slow and sluggish stream was not frozen over.....*

Secondly, it it not clear from the graphical display about a number of matters, such as:

- is the position of the army at a given time represented by the *centre* of the relevant band?
- is the displacement between the advance and retreat bands of the army at the Neman River a fact, or is it an artifact of the graphical methodology used?
- did the invading French army really cross the Neman River on an approximately 75-kilometre front, as implied?
- the location marked as Mozhaysk at the right of the display might be better indicated as Borodino, where a battle on September 7, 1812, resulted in 38,000 Russian and 25,000 French casualties, according to the *Encyclopædia Britannica* (which gives the strength of the French Army as 128,000 at the start of the battle, close to Minard's figure of 127,000).
- to which temperature (*e.g.*, daytime, nighttime, maximum, minimum, average) does the lower temperature scale refer, and is the wind-chill taken into account?
- did the remnants of the French army, when the retreat had apparently become almost a rout, really cover about 110 km in approximately one day between December 6 and December 7?

These matters should not necessarily be taken as criticisms of the display but rather they serve as a reminder that graphical presentation of information is often a *compromise* – emphasizing one feature of the data may preclude (or distort) the display of one or more other features.

REFERENCES:
1. Tufte, E.R. *The Visual Display of Quantitative Information.* Graphics Press, Cheshire, Connecticut, 1983, page 40.
2. The Napoleonic Society of America: *Members Bulletin #21.* December, 1988, pages 16 and 23.
3. *Encyclopædia Britannica*, 1957 Edition, William Benton, Chicago, Volume 16, pages 109-111.
4. *Encyclopedia Americana*, 1956 Canadian Edition, Americana Corporation of Canada Limited, Montreal, Volume 19, page 701.

1 In the context of graphical excellence, Tufte comments: *Minard's graphic tells a rich, coherent story with its multivariate data, far more enlightening than just a single number bouncing along over time.* Six *variables* (our 'variates') *are plotted.* Identify these six variates.

2 Outline the extent to which you consider that Minard's display meets Tufte's five hallmarks of graphical excellence:

∗ the well-designed presentation of interesting information – a matter of *substance*, of *statistics* and of *design*;
∗ complex ideas communicated with *clarity*, *precision* and *efficiency*;
∗ giving the viewer the greatest number of ideas in the *shortest time* with the *least ink* in the *smallest space*;
∗ it is nearly always *multivariate*; ∗ it requires telling the *truth* about the data.