Everyone spoke of an information overload, but what there was in fact was a non-information overload.

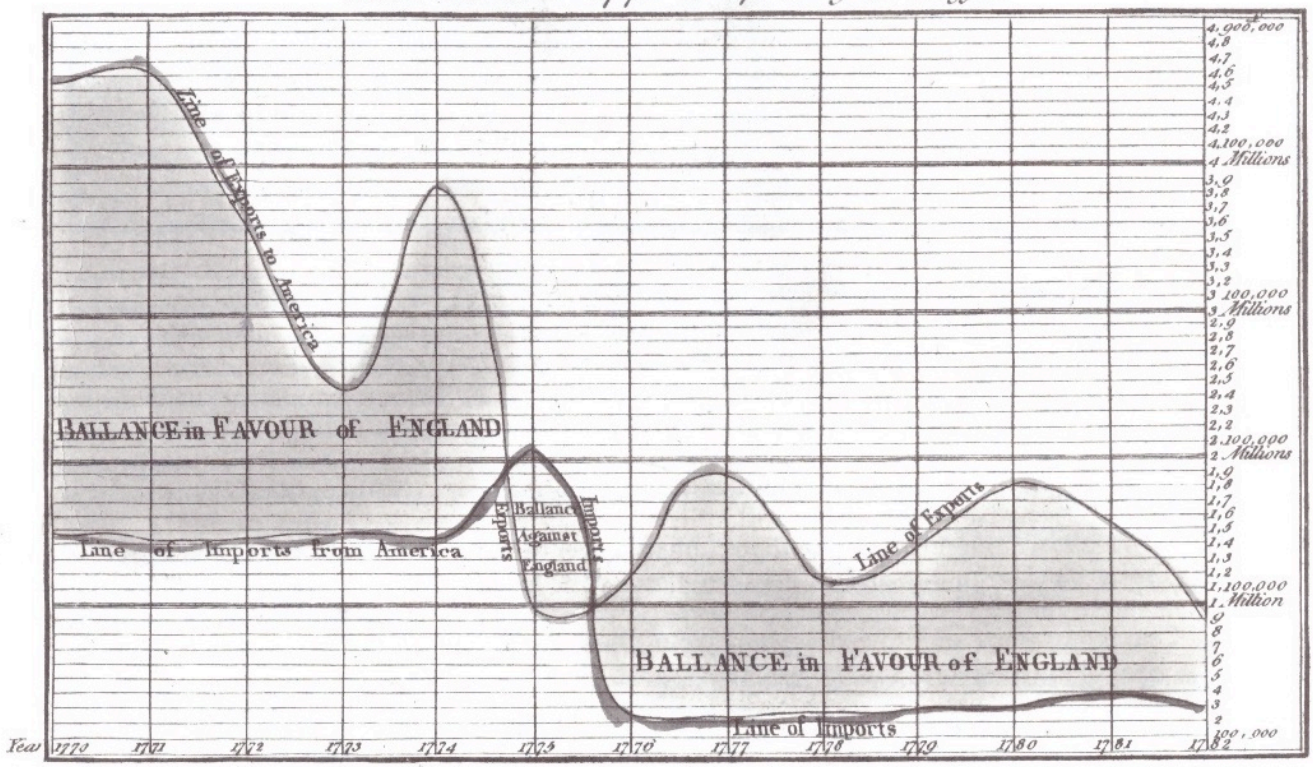
Richard Saul Wurman, *What-If, Could-Be* (Philadelphia, 1976)

4 *Data-Ink and Graphical Redesign*

Data graphics should draw the viewer's attention to the sense and substance of the data, not to something else. The data graphical form should present the quantitative contents. Occasionally artfulness of design makes a graphic worthy of the Museum of Modern Art, but essentially statistical graphics are instruments to help people reason about quantitative information.

Playfair's very first charts devoted too much of their ink to graphical apparatus, with elaborate grid lines and detailed labels. This time-series, engraved in August 1785, is from the early pages of *The Commercial and Political Atlas*:

CHART of IMPORTS and EXPORTS of ENGLAND *to and from all* NORTH AMERICA
From the Year 1770 to 1782 by W. Playfair

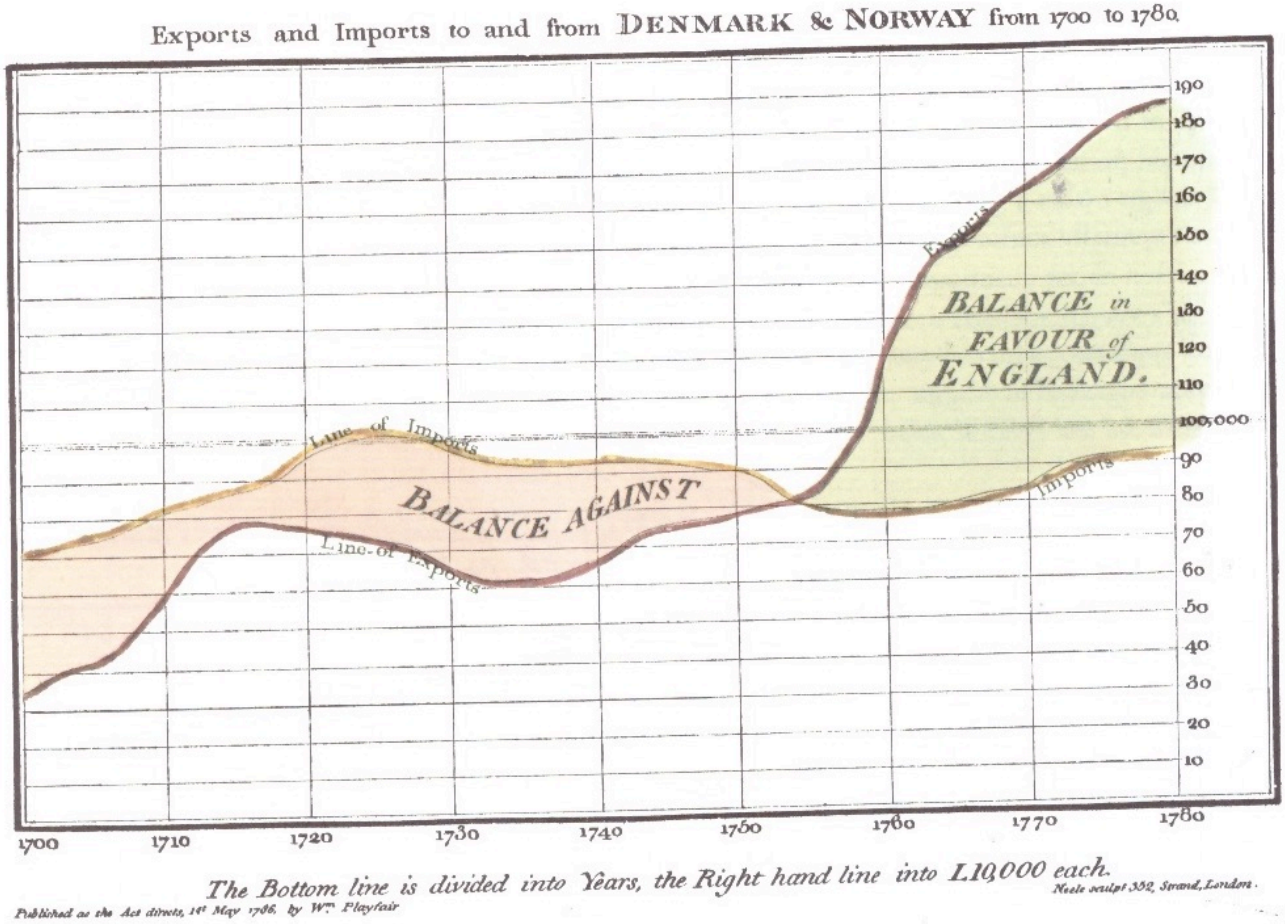


The Bottom Line is divided into Years the right-hand Line into HUNDRED THOUSAND POUNDS

J. Sinclair Sculp.

Publish'd as the Act directs 20th Aug.t 1785.

Within a year Playfair had eliminated much of the non-data detail in favor of cleaner design that focused attention on the time-series itself. He then began working with a new engraver and was soon producing clear and elegant displays:



This improvement in graphical design illustrates the fundamental principle of good statistical graphics:

> Above all else show the data.

The principle is the basis for a theory of data graphics.

Data-Ink

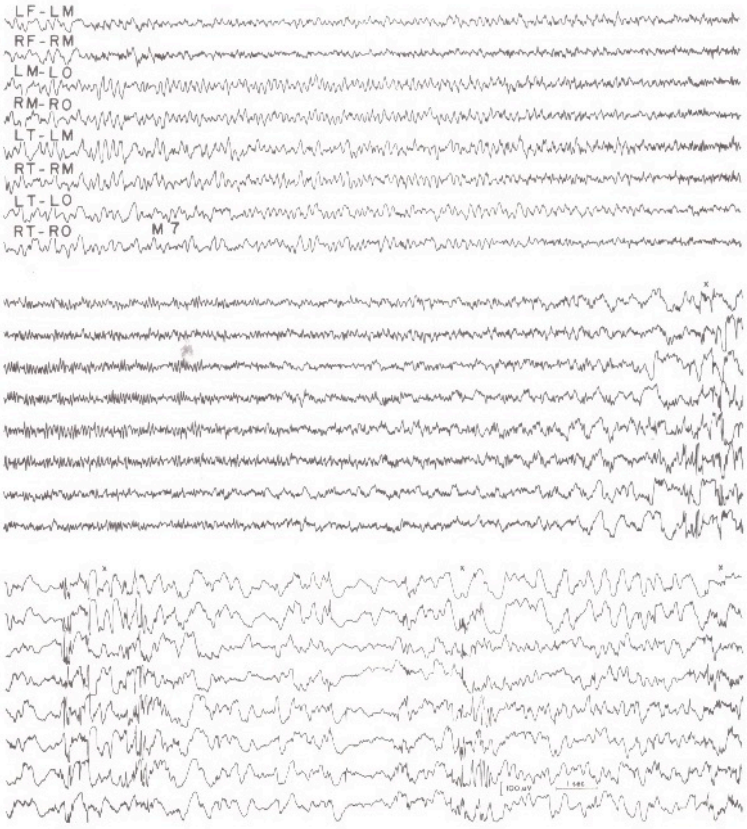
A large share of ink on a graphic should present data-information, the ink changing as the data change. *Data-ink* is the non-erasable core of a graphic, the non-redundant ink arranged in response to variation in the numbers represented. Then,

$$\text{Data-ink ratio} = \frac{\text{data-ink}}{\text{total ink used to print the graphic}}$$

= proportion of a graphic's ink devoted to the non-redundant display of data-information

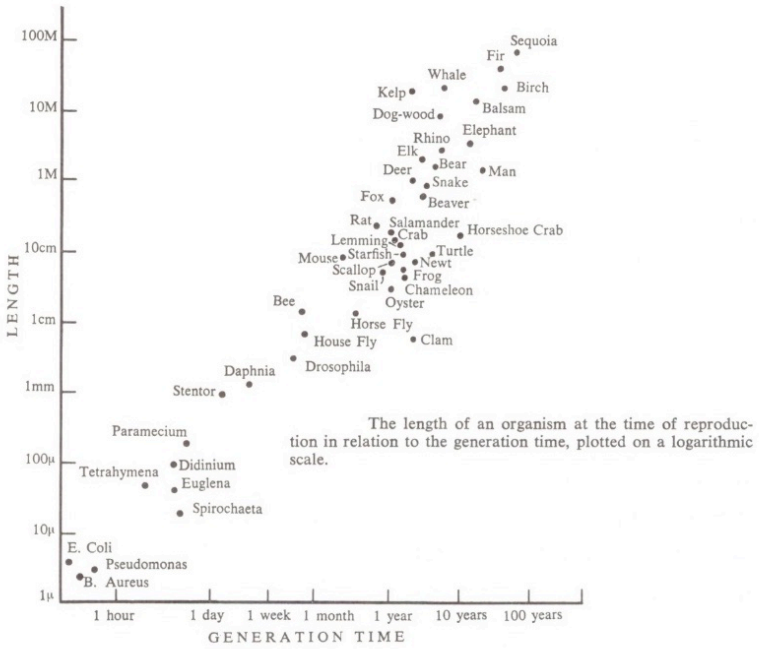
= 1.0 – proportion of a graphic that can be erased without loss of data-information.

A few graphics use every drop of their ink to convey measured quantities. Nothing can be erased without losing information in these continuous eight tracks of an electroencephalogram. The data change from background activity to a series of polyspike bursts. Note the scale in the bottom block, lower right:



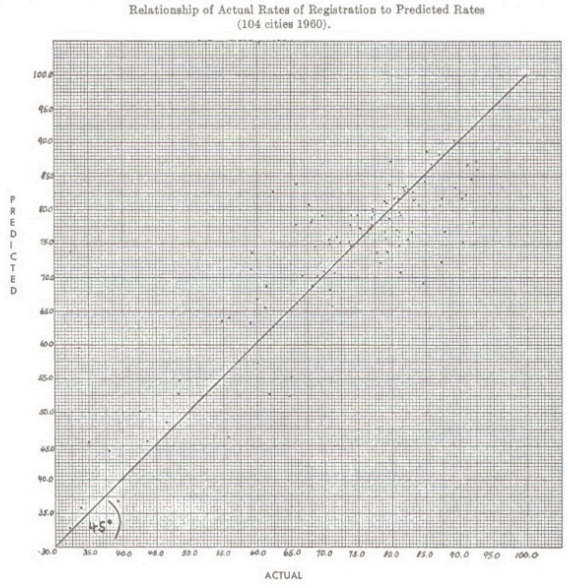
Kenneth A. Kooi, *Fundamentals of Electroencephalography* (New York, 1971), p. 110.

Most of the ink in this graphic is data-ink (the dots and labels on the diagonal), with perhaps 10–20 percent non-data-ink (the grid ticks and the frame):

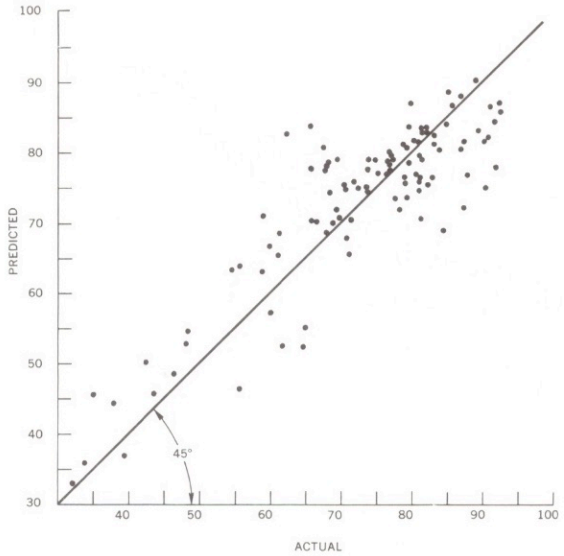


John Tyler Bonner, *Size and Cycle: An Essay on the Structure of Biology* (Princeton, 1965), p. 17.

In this display with nearly all its ink devoted to matters other than data, the grid sea overwhelms the numbers (the faint points scattered about the diagonal):



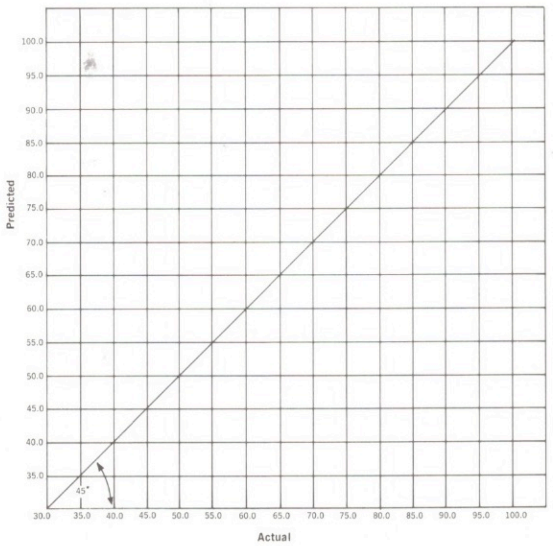
Another published version of the same data drove the share of data-ink up to about 0.7, an improvement:



Relationship of Actual Rates of Registration to Predicted Rates (104 cities 1960).

But a third reprint publication of the same figure forgot to plot the points and simply retraced the grid lines from the original, including the excess strip of grid along the top and right margins. The resulting figure achieves a graphical absolute zero, a null data-ink ratio:

Figure 19.1 Relationship of Actual Rates of Registration to Predicted Rates (104 cities, 1960)



The three graphics were published in, respectively, Stanley Kelley, Jr., Richard E. Ayres, and William G. Bowen, "Registration and Voting: Putting First Things First," *American Political Science Review*, 61 (1967), 371; then reprinted in Edward R. Tufte, ed., *The Quantitative Analysis of Social Problems* (Reading, Mass., 1970), p. 267; and reprinted again in William J. Crotty, ed., *Public Opinion and Politics: A Reader* (New York, 1970), p. 364.