Data Visualization

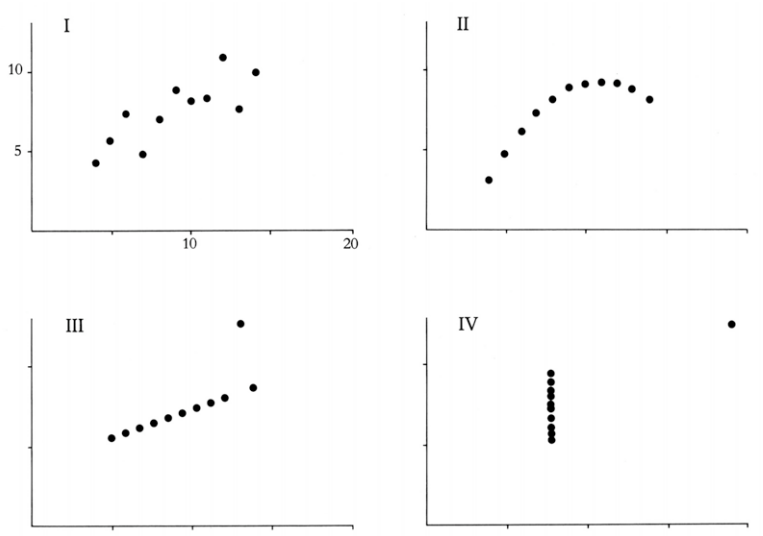
Steve Marschner

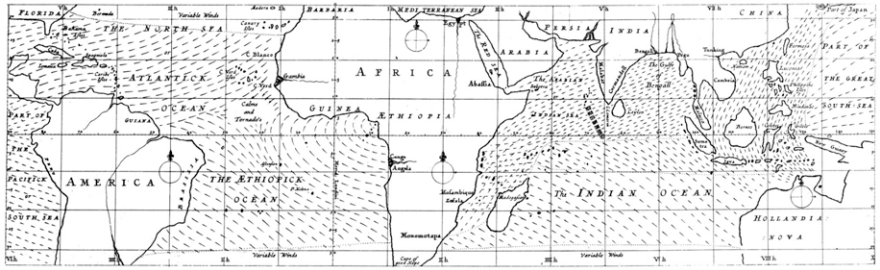
Cornell CS 322

unless noted, images are from our supplementary textbook:
Tufte, *The Visual Display of Quantitative Information*

I		II		III		IV	
X	Y	X	Y	X	Y	X	Y
10.0	8.04	10.0	9.14	10.0	7.46	8.0	6.58
8.0	6.95	8.0	8.14	8.0	6.77	8.0	5.76
13.0	7.58	13.0	8.74	13.0	12.74	8.0	7.71
9.0	8.81	9.0	8.77	9.0	7.11	8.0	8.84
11.0	8.33	11.0	9.26	11.0	7.81	8.0	8.47
14.0	9.96	14.0	8.10	14.0	8.84	8.0	7.04
6.0	7.24	6.0	6.13	6.0	6.08	8.0	5.25
4.0	4.26	4.0	3.10	4.0	5.39	19.0	12.50
12.0	10.84	12.0	9.13	12.0	8.15	8.0	5.56
7.0	4.82	7.0	7.26	7.0	6.42	8.0	7.91
5.0	5.68	5.0	4.74	5.0	5.73	8.0	6.89

N = 11
mean of X's = 9.0
mean of Y's = 7.5
equation of regression line: $Y = 3 + 0.5X$
standard error of estimate of slope = 0.118
t = 4.24
sum of squares $X - \overline{X} = 110.0$
regression sum of squares = 27.50
residual sum of squares of Y = 13.75
correlation coefficient = .82
$r^2 = .67$





E. Halley. Map illustrating trade winds. 1686

[NASA]

Space Shuttle mission STS-51-L, about 75 sec. after liftoff. 1986

HISTORY OF O-RING DAMAGE ON SRM FIELD JOINTS

SRM No.	Cross Sectional View: Erosion Depth (in.)	Cross Sectional View: Perimeter Affected (deg)	Cross Sectional View: Nominal Dia. (in.)	Top View: Length Of Max Erosion (in.)	Top View: Total Heat Affected Length (in.)	Clocking Location (deg)
22A	None	None	0.280	None	None	36°-66°
22A	NONE	NONE	0.280	NONE	NONE	338°-18°
15A	0.010	154.0	0.280	4.25	5.25	163
15B	0.038	130.0	0.280	12.50	58.75	354
15B	None	45.0	0.280	None	29.50	354
13B	0.028	110.0	0.280	3.00	None	275
11A	None	None	0.280	None	None	--
10A	0.040	217.0	0.280	3.00	14.50	351
2B	0.053	116.0	0.280	--	--	90

61A LH Center Field**
61A LH ~~CENTER~~ FIELD**
51C LH Forward Field**
51C RH Center Field (prim)***
51C RH Center Field (sec)***
41D RH Forward Field
41C LH Aft Field*
41B LH Forward Field
STS-2 RH Aft Field

*Hot gas path detected in putty. Indication of heat on O-ring, but no damage.
**Soot behind primary O-ring.
***Soot behind primary O-ring, heat affected secondary O-ring.

Clocking location of leak check port - 0 deg.

OTHER SRM-15 FIELD JOINTS HAD NO BLOWHOLES IN PUTTY AND NO SOOT NEAR OR BEYOND THE PRIMARY O-RING.

SRM-22 FORWARD FIELD JOINT HAD PUTTY PATH TO PRIMARY O-RING, BUT NO O-RING EROSION AND NO SOOT BLOWBY. OTHER SRM-22 FIELD JOINTS HAD NO BLOWHOLES IN PUTTY.

[from Tufte, *Visual Explanations*]

data presented by rocket's manufacturer to argue for canceling the launch.

BLOW BY HISTORY

SRM-15 WORST BLOW-BY
- 2 CASE JOINTS (80°), (110°) ARC
- MUCH WORSE VISUALLY THAN SRM-22

SRM 22 BLOW-BY
- 1 CASE JOINTS (30-40°)

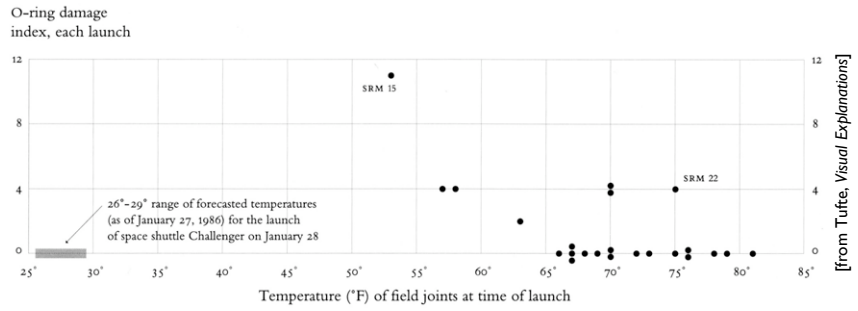
SRM-13A, 15, 16A, 18, 23A 24A
- NOZZLE BLOW-BY

HISTORY OF O-RING TEMPERATURES (DEGREES-F)

MOTOR	MBT	AMB.	O-RING	WIND
DM-1	68	36	47	10 MPH
DM-2	76	45	52	10 MPH
QM-1	72.5	40	48	10 MPH
QM-2	76	48	51	10 MPH
SRM-15	52	64	53	10 MPH
SRM-22	77	78	75	10 MPH
SRM-25	55	26	29 27	10 MPH 25 MPH

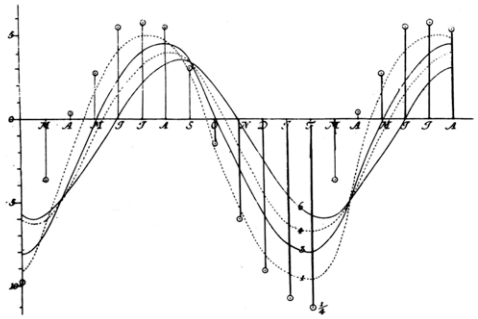
[from Tufte, *Visual Explanations*]

data presented by rocket's manufacturer to argue for canceling the launch.

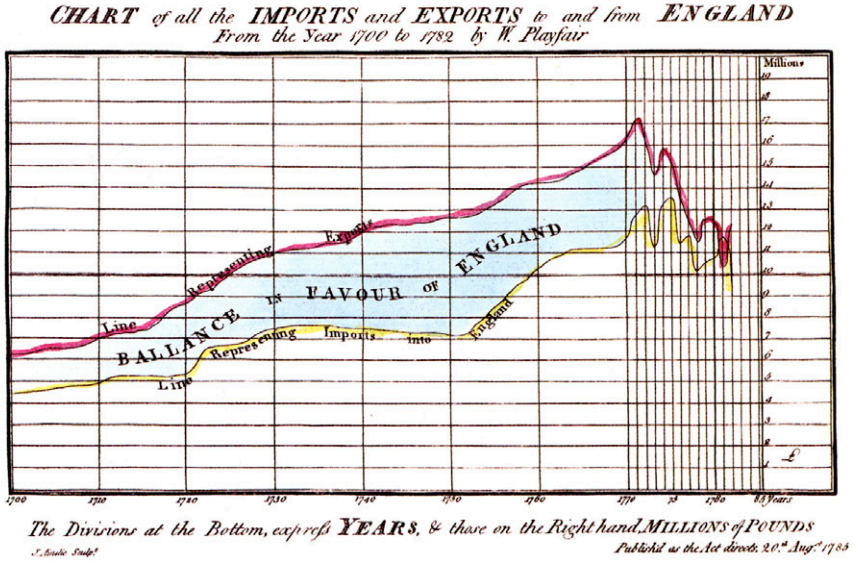


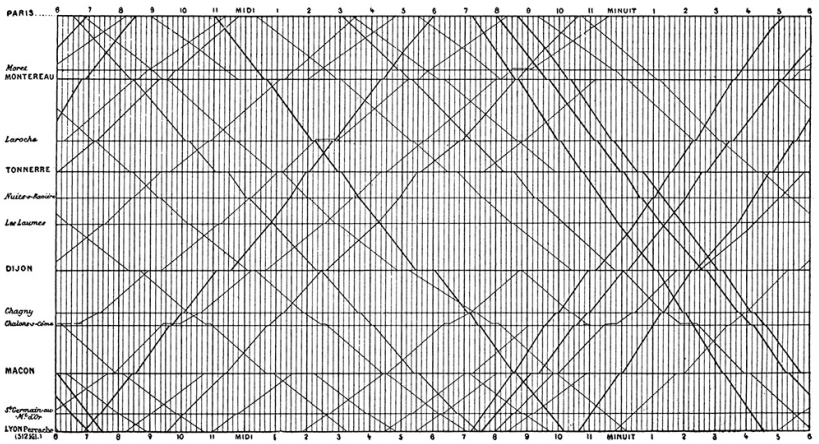
[from Tufte, *Visual Explanations*]

Tufte's more convincing re-presentation of the same data. 1997

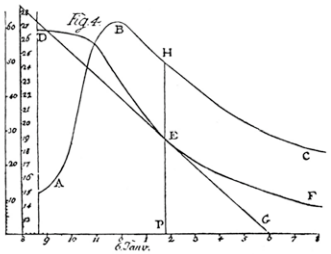


J.H. Lambert. Soil temperature over time at various depths. 1779

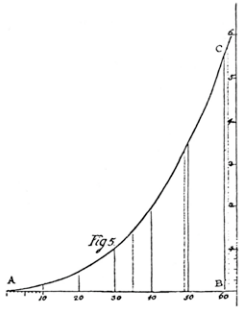




E.J. Marey. Train schedule for Paris–Lyon line. 1885

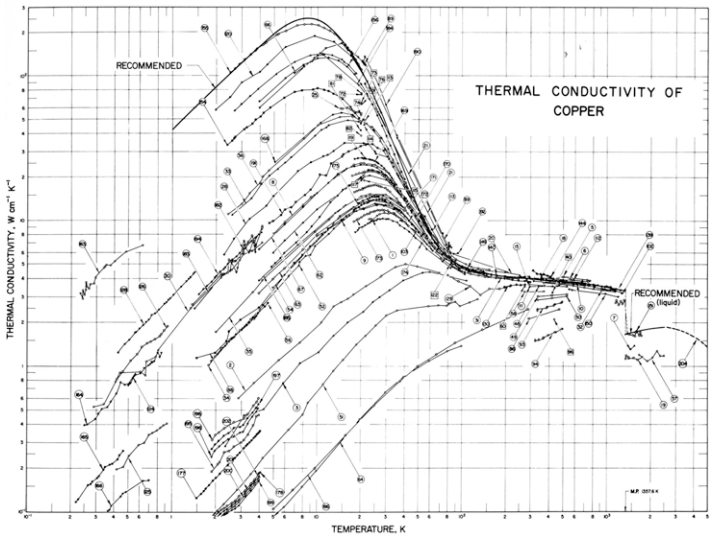


ABC: temperature over time
DEF: height of water over time

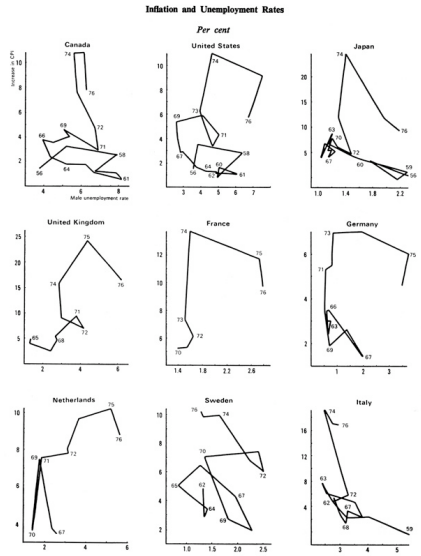


evaporation rate
vs. temperature

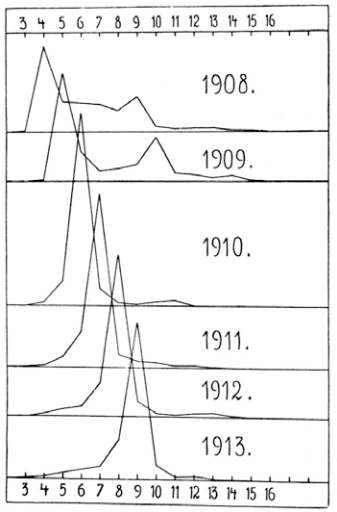
J.H. Lambert: influence of temperature on evaporation. 1769



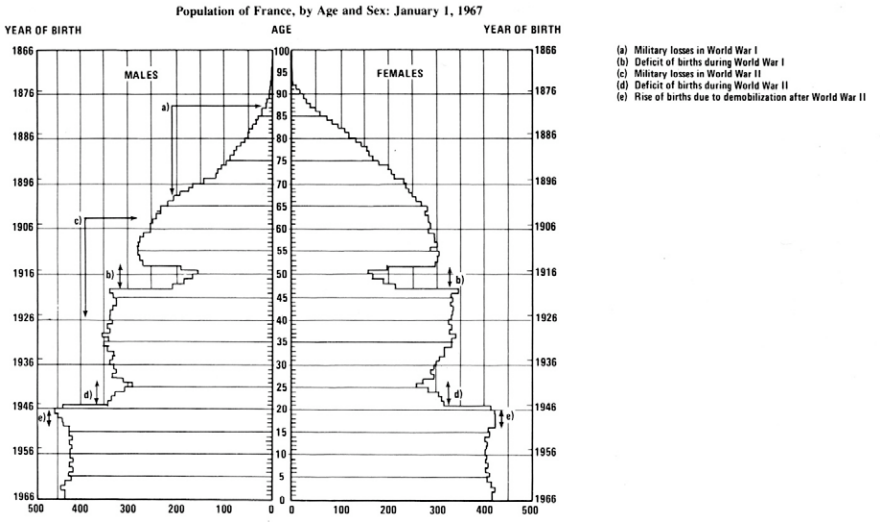
C.Y. Ho et al. Review of thermal conductivity data. 1974



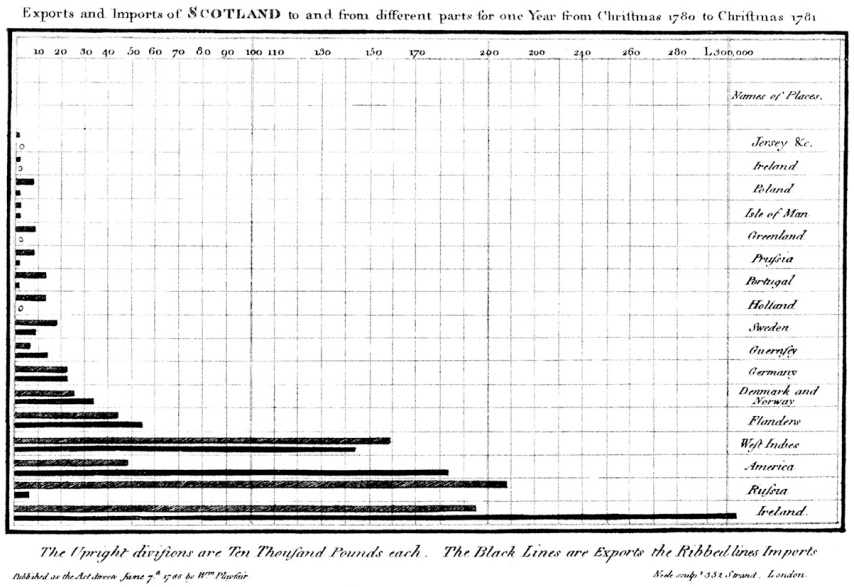
P. McCracken et al. Phillips curves. 1977

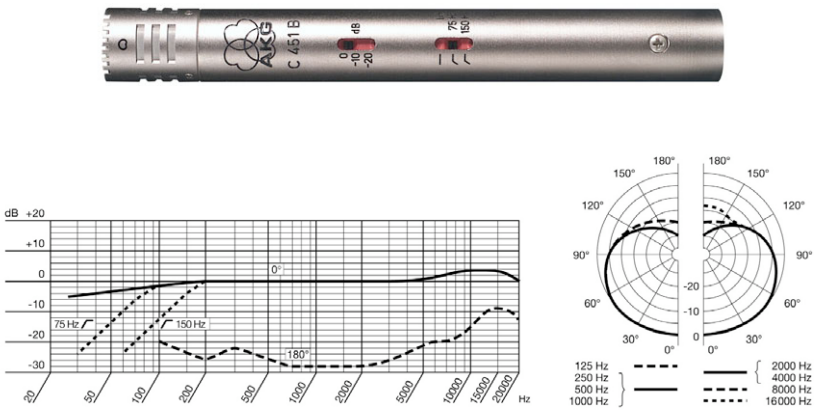


J. Hjort. Age composition of herring catches. 1914



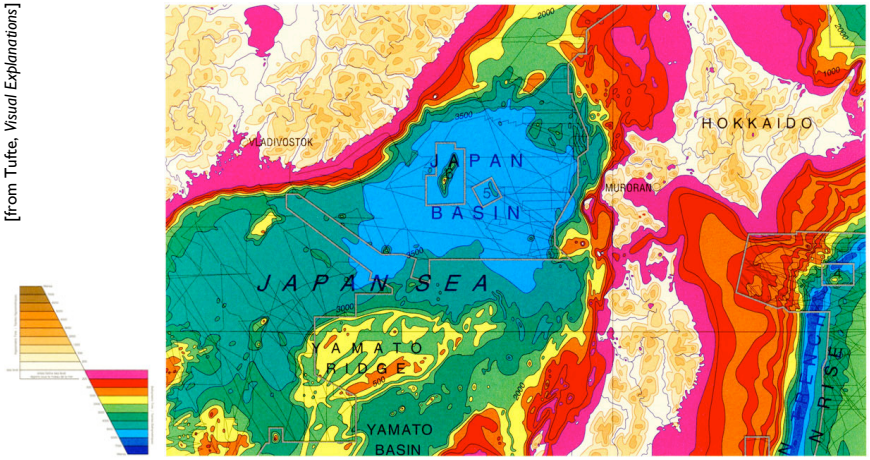
H.S. Shyrock & J.S. Siegel. Rendering of French government population data. 1973





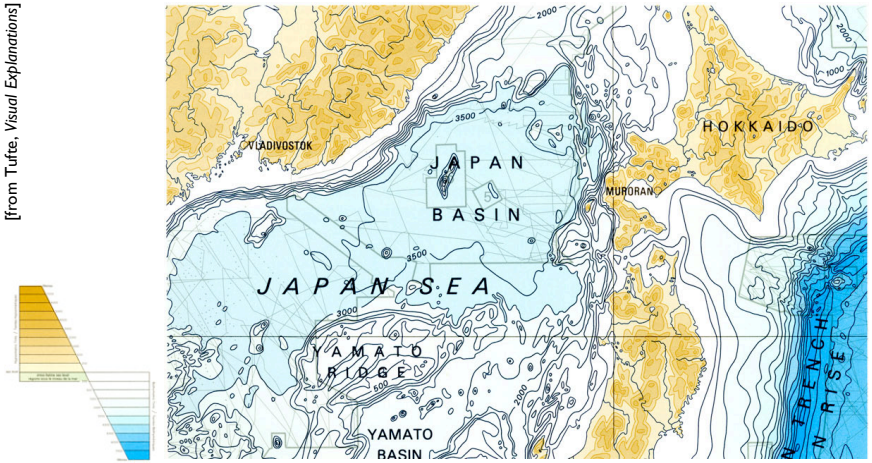
AKG Acoustics. Performance data for C451B microphone. 1973

[from Tufte, *Visual Explanations*]

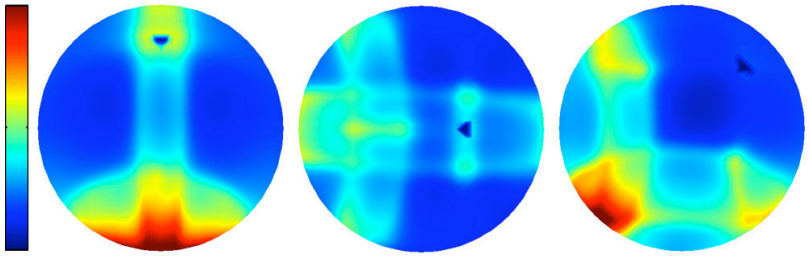


International Hydrographic Organization, 1984
(as deliberately corrupted by Tufte)

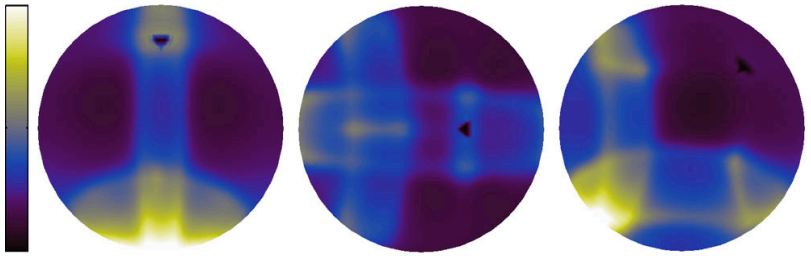
[from Tufte, *Visual Explanations*]



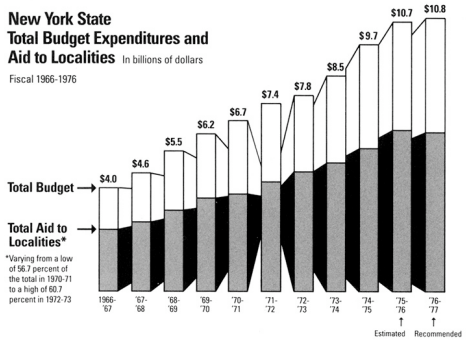
International Hydrographic Organization, 1984



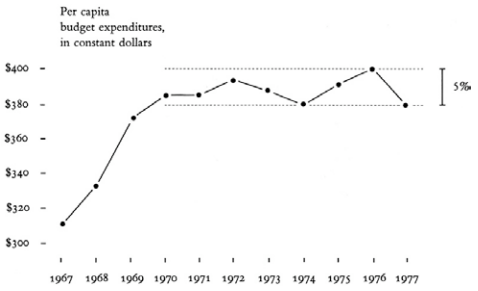
P. Irawan & S. Marschner. Scattering data for polyester cloth. 2007
(Matlab default colormap)



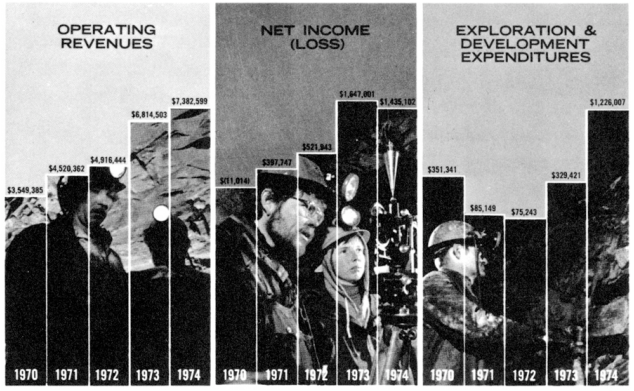
P. Irawan & S. Marschner. Scattering data for polyester cloth. 2007
(increasing value colormap)



New York Times. 1976



E. R. Tufte. Fair presentation of the same data. 1983

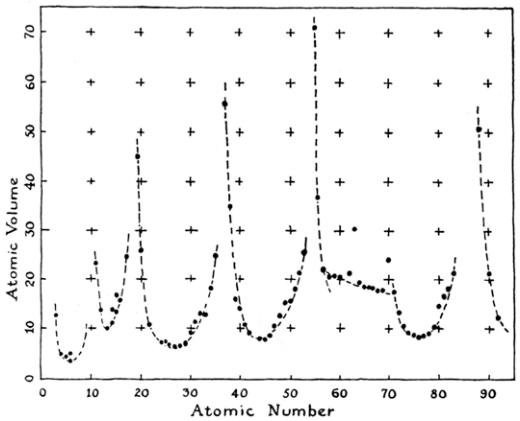


Day Mines, Inc. 1974

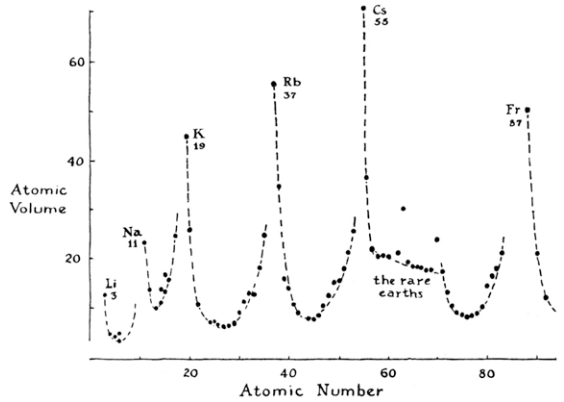
Above, this chart shows *quarterly* revenue data in a financial graphic for a legal case. Several dips in revenue are visible.

Aggregating the quarterly data into years, this chart above shows revenue by *fiscal year* (beginning July 1, ending June 30). Note the dip in 1982, the basis of a claim for damages.

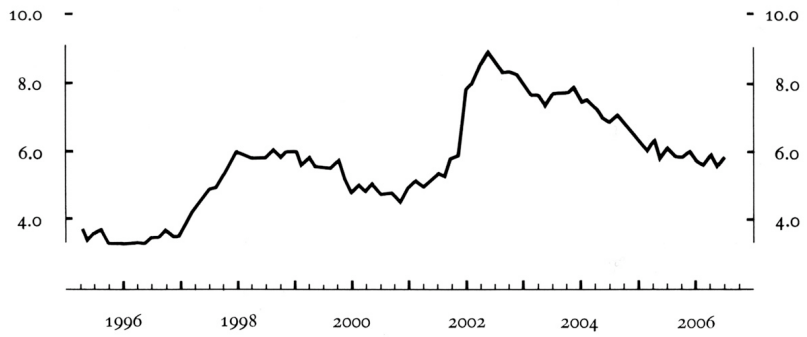
Shown above are the same quarterly revenue data added up into *calendar years*. The 1982 dip has vanished.



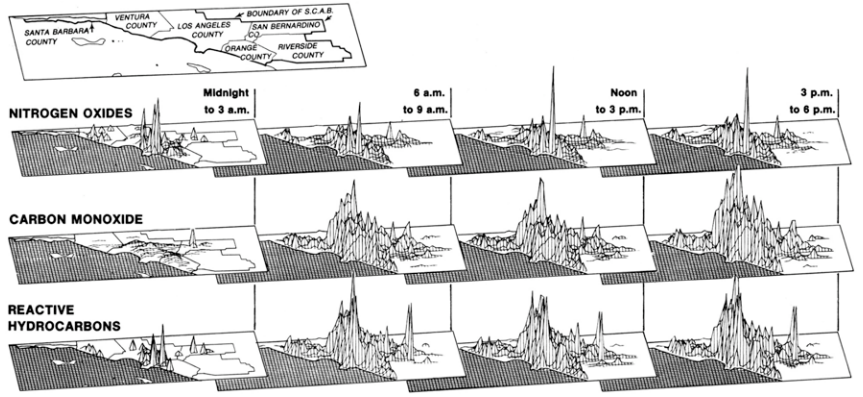
R. Hayward. From L. Pauling, *General Chemistry*. 1947



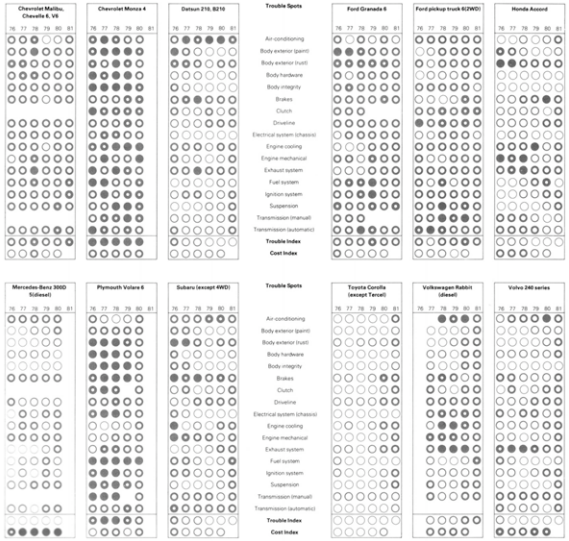
as modified by Tufte



Tufte's proposal for *range frames*



Los Angeles Times / G.J. McRae. 1979



Consumer Reports. Display of historical automobile reliability data. 1982

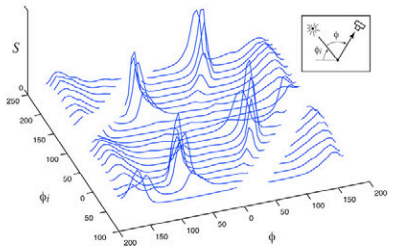


Figure 6: A measurement of scattering in the normal plane from a hair with substantial eccentricity. Bright glints appear whose location and strength depend on the orientation of the hair [subject HM].

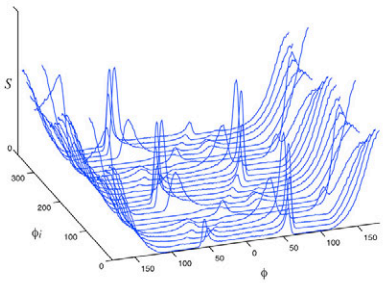
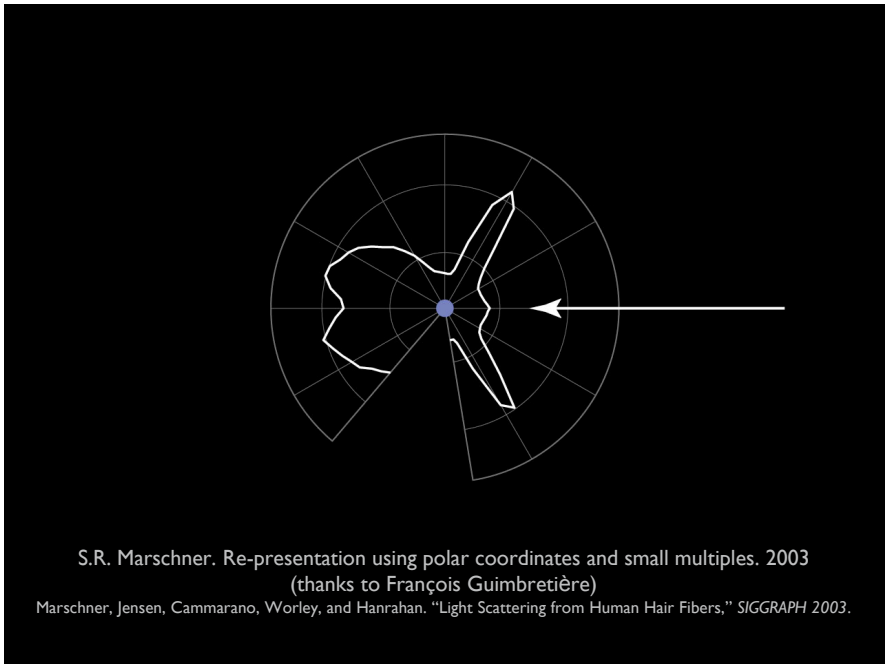


Figure 7: A photon-tracing simulation of scattering from a rough elliptical fiber. The axes are the same as in Figure 6.

S.R. Marschner. Presentation of fiber scattering data using default MATLAB plots. 2002



S.R. Marschner. Re-presentation using polar coordinates and small multiples. 2003
(thanks to François Guimbretière)
Marschner, Jensen, Cammarano, Worley, and Hanrahan. "Light Scattering from Human Hair Fibers," *SIGGRAPH 2003*.

hair
rotation
illumination