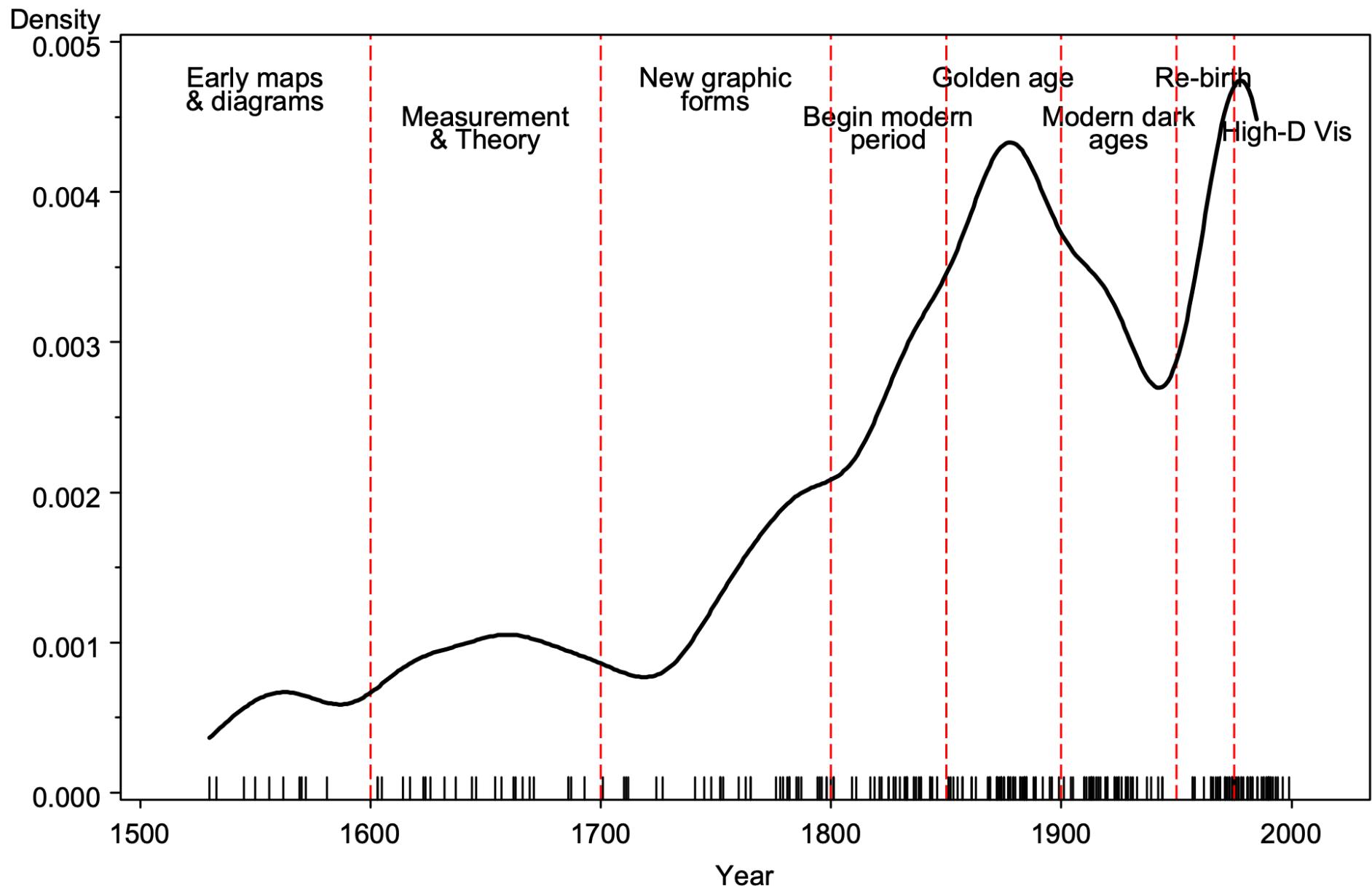


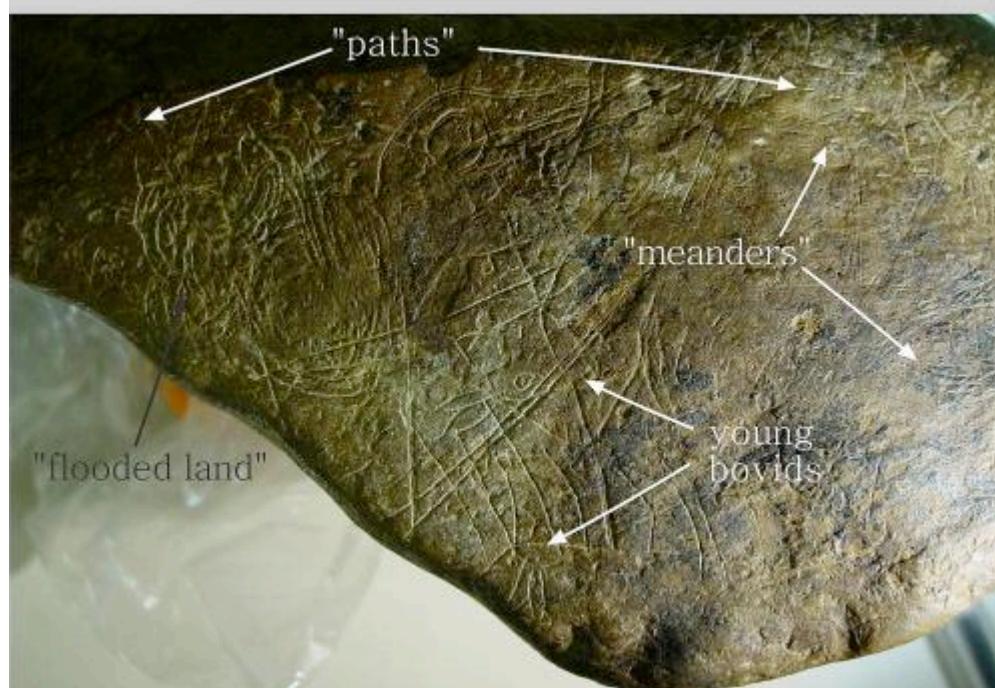
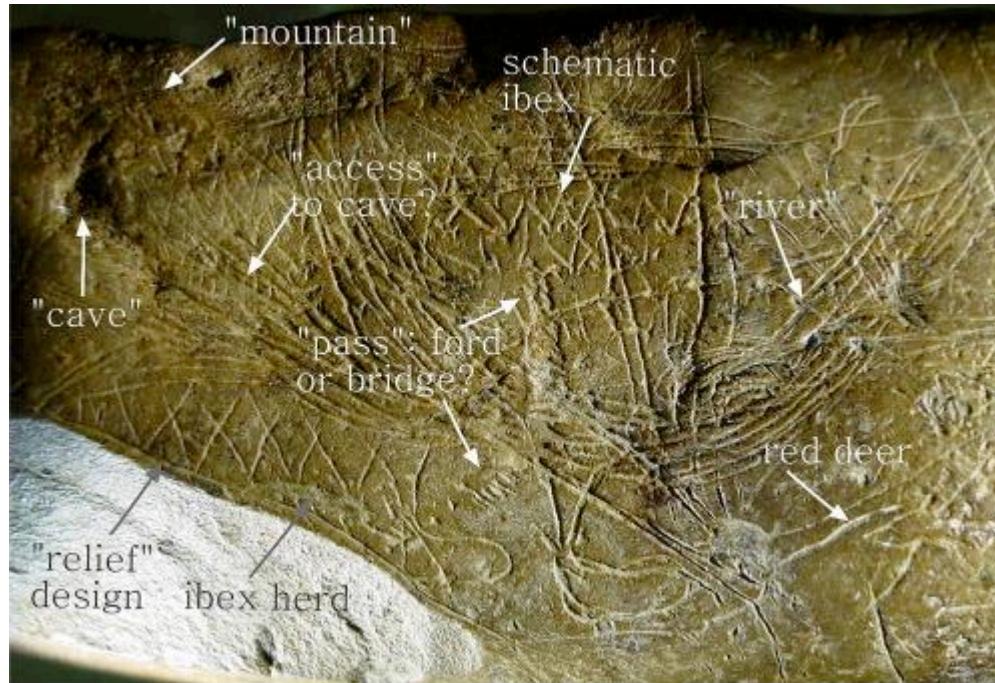
# brief history of data visualisation

## Milestones: Time course of developments



# pre-1600

- geometric diagrams
- tables of the positions of stars and other celestial bodies
- maps to aid in navigation and exploration



# engraved stone blocks from the late magdalenian in abauntz cave (13660 calbp\*)



Journal of Human Evolution  
Volume 57, Issue 2, August 2009, Pages 99-111



Review

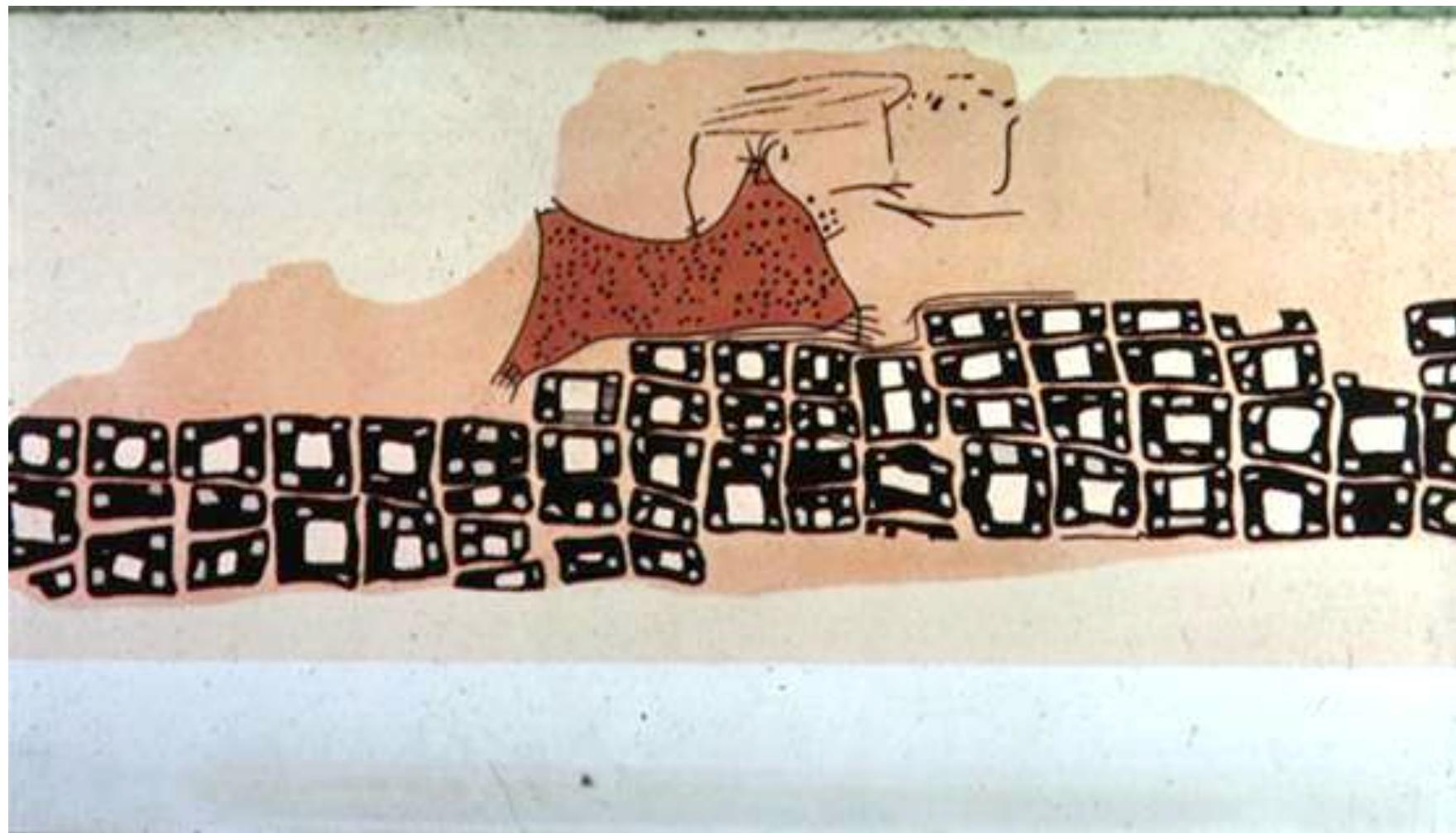
A palaeolithic map from 13,660 calBP: engraved stone blocks from the Late Magdalenian in Abauntz Cave (Navarra, Spain)

P. Utrilla, C. Mazo, M.C. Sopena, M. Martínez-Bea, R. Domingo

the meandering course of a river crossing the upper part of side a of the block, joined by two tributaries near two mountains

\*calibrated years before the present

the most ancient map (~6200 b.c.)?



the most ancient map (~6200 b.c.)?



found in 1963 by *james mellaart* in *ankara*

9 feet long

depicts a town plan, matching *catal hyük* itself, showing the congested "beehive" design of the settlement and displaying a total of some 80 buildings

eruption of *hasan dag*, rising to a height of 10,672 feet, and standing at the eastern end of the *konya plain*

the oldest world map (~550 b.c.)?



the most ancient world map (~550 b.c.)?

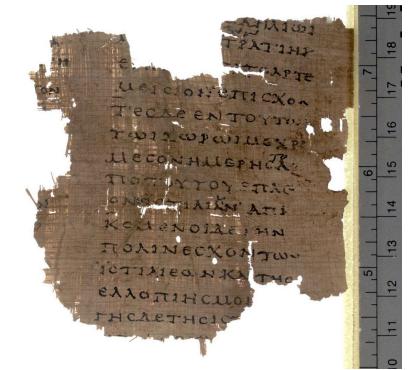


attributed to *Anaximander*

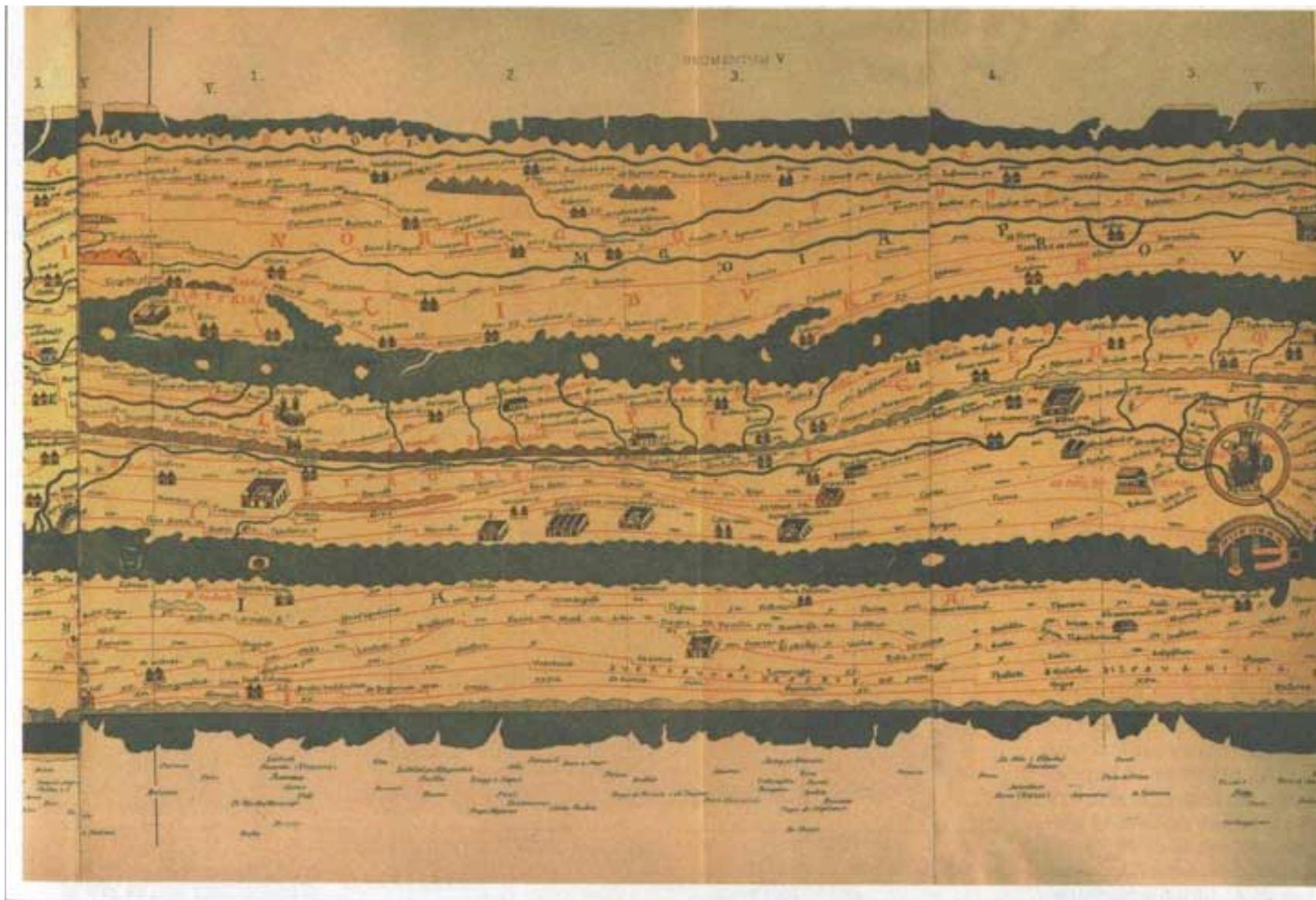
author of the first surviving lines of  
western philosophy c. 610–546 b.c.

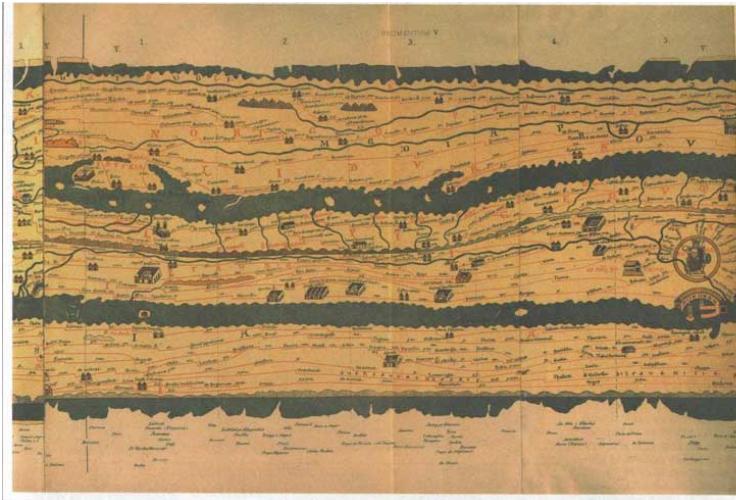


described in books II and IV  
of *Herodotus' histories'*



peutinger map (~350b.c.)





peutinger map (~350b.c.)

the first route map

- named after the XVI century german collector
- the whole of the roman world
- painted parchment 34 cm x 7 m
- utility vision of geography
- cartographic representations related to the imperial conquests.
- does not bring topographic information
- gives indications of distances and size of the places
- practical information for the traveller
- n-s distances represented on a smaller scale than e-w distances
- unfold or unroll the section which corresponded to its course.

# claudius ptolemy world map (~150 a c)



reconstituted in XV century

## claudius ptolemy world map (~150 a c)



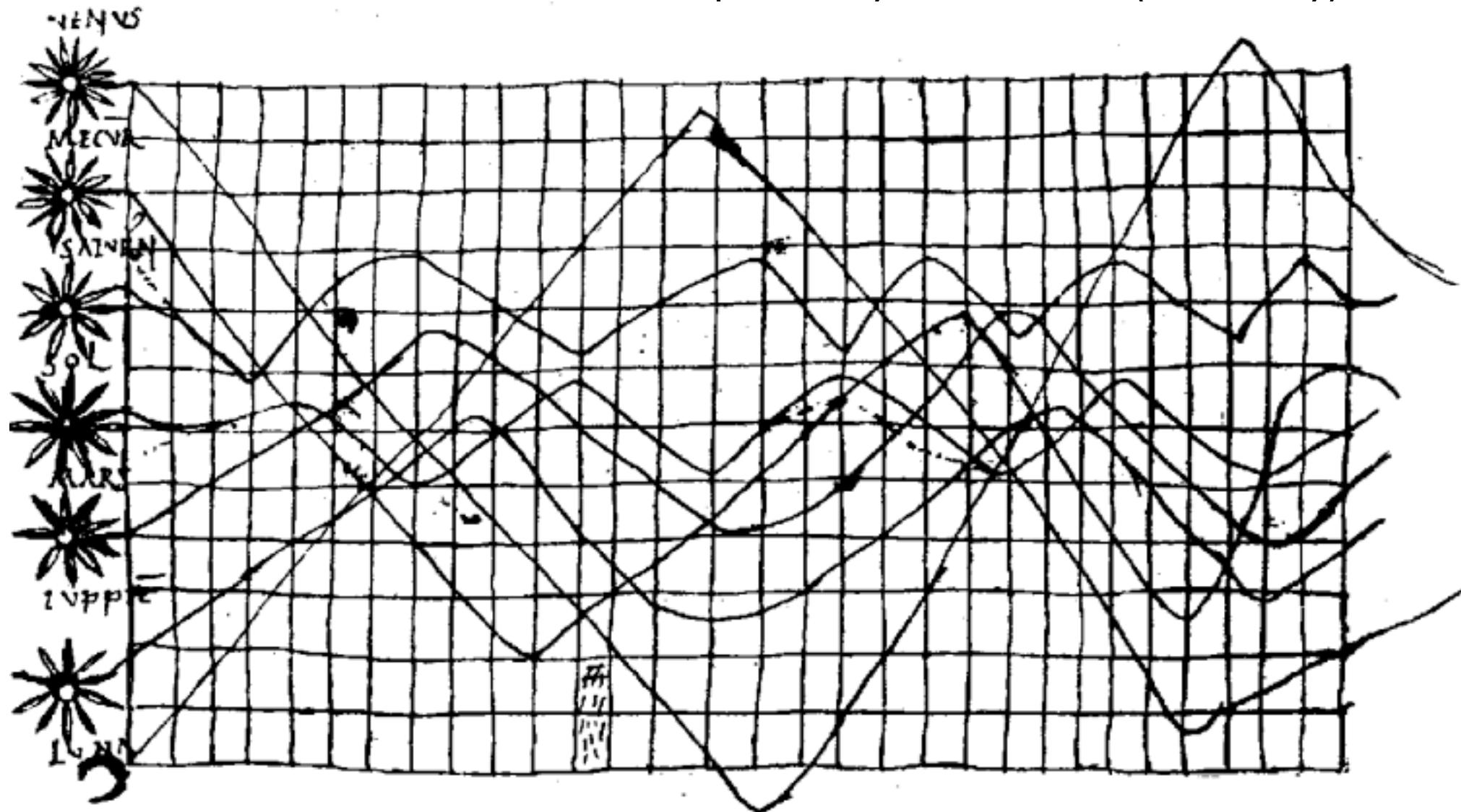
included in *ptolemy's book geography*

first use of longitudinal and latitudinal lines

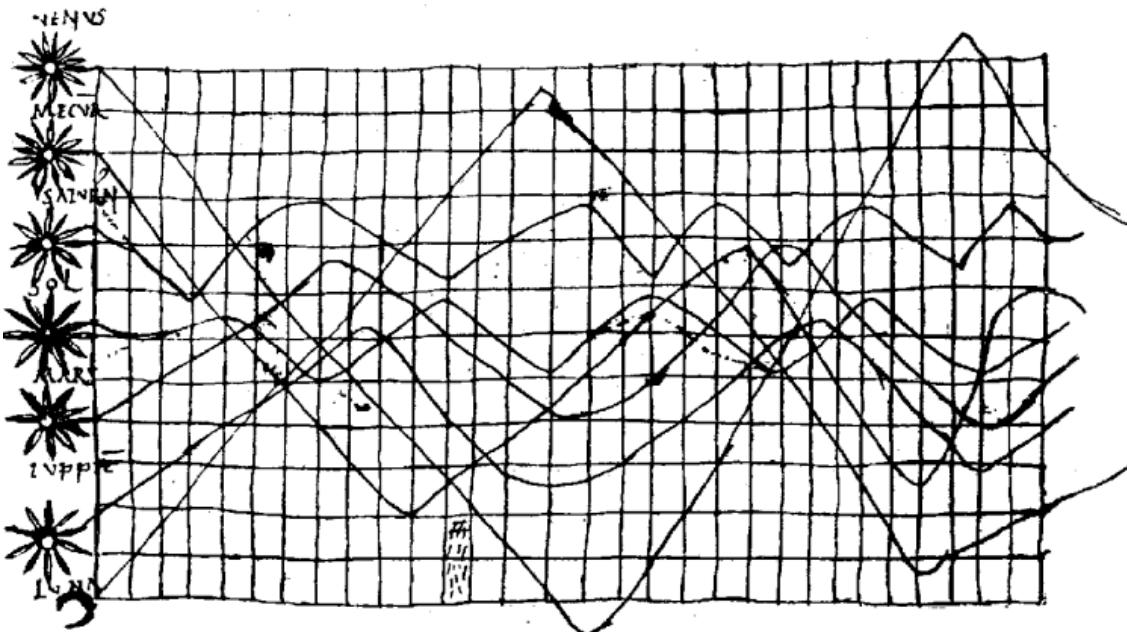
terrestrial locations by celestial observations

present form of the map was reconstructed  
by byzantine monks under the direction  
of *maximus planudes* shortly after 1295

planetary movements (X century)



## planetary movements (X century)



appendix to commentaries by *macrobius* on *cicero's in somnium scriponius*

multiple time-series graph of the changing position of the seven most prominent heavenly bodies over space and time

notable use of a grid

plot of inclinations of planetary orbits as a function of time

horizontal scale chosen independently for each planet

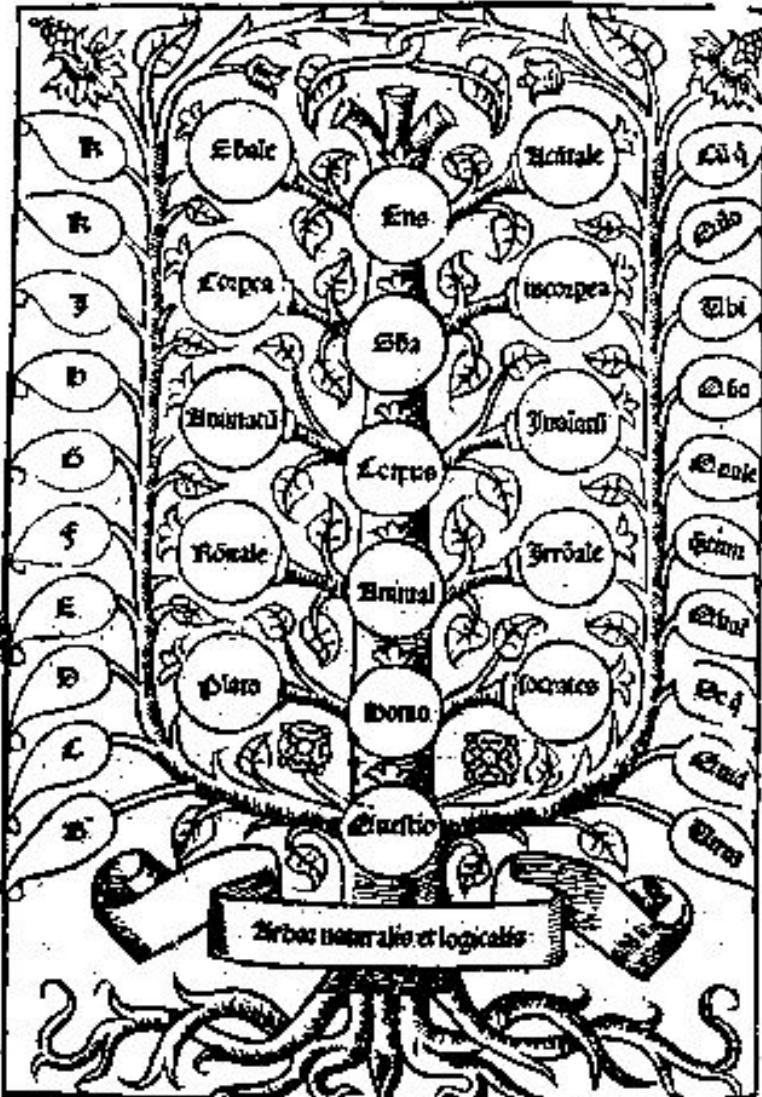
artifitium electionis personarum (r. IIull, 1280)

Hec est figura ex eis huius constant ac omnis continet 22  
 et postea quod doceat finis electio. Leto uisit huius be de  
 f. g. h. i. k. l. m. n. o. p. q. r. et huius ipse manifestum adiuuit  
 subiectu quod que mutatione repetitur et format infra scriptum  
 huius putato ostendit. Inveniatur interius huius apud illam  
 et postea atque uisit ostendit huius figura.

be	ed	de	ef	fg	gh	hi	ij	kl	lm	mn	no	op	pr
bd	cr	df	eg	fh	gi	hk	il	km	ln	mo	np	or	pr
br	cf	dg	eh	fi	gk	hl	im	hn	lo	mp	ng	or	
bf	eu	dh	ei	fl	gm	hn	in	ho	lp	mq	nr		
bg	ch	di	el	fl	gm	hn	io	kp	lq	mr			
bi	ci	ej	el	fm	gn	ho	ip	hq	lv				
bh	cl	dl	em	fn	go	hp	iq	kr					
bj	cl	dm	en	fo	jp	hq	"						
bl	cim	din	eo	Fp	gq	ir							
bm	en	do	ep	fq	jr								
bn	eo	dp	er	fr									
bo	cp	dp	er										
bp	ca	dr											
br	cr												
br	cr												

Hoc quidem figura sit utrumque simile potest alijs huius  
 etiam addigatur quatenus ut perquisitum est electione ipsi non  
 fiat frons nec simonia potest inveniatur.

# mechanical diagrams of knowledge (r. Ilull, 1305)

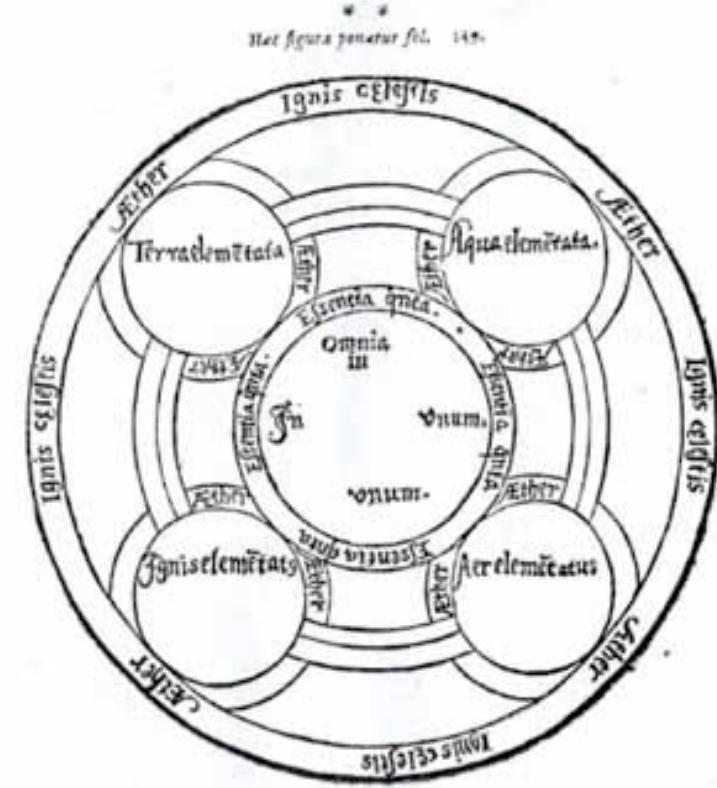


tree of knowledge

RAYMONDI LULLI

145

ata. Et media fructuorum agri de misca, propter quid sicut ele-  
mentum, fugit in aliud, & in aliud revertens, necessitate natura,  
propter intransitum est excepit aliorum, per aquam, in qua dicitur  
quod transirent alii, aquae continenti, pueri in hunc modo aqua-  
tum refugia securus fuit. Quapropter non intendimus quod  
transirent excepit, & transirent puerum, in qua puerum  
continuerunt alii, quoniam cibis nascitur in aqua deportatus, qui  
est diversus sapientia, in fide sua existens. Pueros in fide sua  
& pacem faciunt aquarum fortunam, quae primum exire plena esse non  
potest, & post remissione de re se colligantur. Quare puer,  
quoniam in quanto magis in puerum, tamen fugit in aqua fuisse, &  
vadat in eundem scilicet, quando puer de fortunam pueri amplexum  
matrem gressu, per excepitionem legi, quia nullo tempore  
est dux vacatio nativa plus enim diffusus erit quam illud puer  
poterit, & ex hoc excepitione effundimus Physici in operis veritatem  
& nos in extrahendis primis elementis. Unde volent  
aliqui Philologerum auxiliis posse dicere, quod natura vacua es-  
tare non potest, quoniam a se ipso retrocedere in suum proprium  
gradum, dum non habent de natura profunditatem omnem. Ideo,  
quia quoniam talis gradus continetur naturam arbi luminositas,  
& portio eius ruderis, dicta natura materna adhuc habet dictum lucis  
plenum, non obstante, quod arborum fructus huius proprie-  
tatis usque a dicto loco plus quam perdiderat, propter apparet  
in consuetudinibus pueri admodum ratiocinatus, naturaque puer  
apparet, quoniam dicitur puer, & tamen oculis dicitur puer fructu-  
dinem rei cuiusque moxius vacua omnibus entitibus natu-  
ratis. Sed falsum modis est materna magis simpliciter ipsa in  
dictis fructibus scientiam multam seculorum non habere. &  
simpliciter, que sunt extremitates magis simpliciter, deinceps  
in corporibus diuisim extremitates sicutus resipeta, videlicet  
elementum aqua singulis & actis partim simpliciter, qui per  
eleemos arboris vocantur, quia propter ipsi pueri signum exire, & illos  
exit utrum, nullum elementum recessu sibi auctoritate anima-  
tum de floribus, de fructibus, de arboribus, qui vocantur arbores, qui de-  
ficiunt pueri signum, neque per eum calorem corrumpi, qui  
temporibus illis sit propinquus & inservit. Ideo distributione et ipsi puer  
maniperunt extremitates dicta est aqua, quoniam de abeo in bullis (floribus)  
temporibus illis locum habet. Item natura lumen, et appetitus per-  
ficitur. Atque modis excepitione, & remissione inveniuntur  
locus naturae, quoniam illi pueri nonnaturae velutierunt, & velut  
miseris fine vocantur. & illi pueri, & per consequentem remis-  
serunt, & fine vocantur, quoniam non futurum est unquam regnandum per  
naturam, quod non erat absque illi vocante, quoniam cultuaria  
fructus pueri, sicut arbor, qui erat humoribus in hac ipsa, que



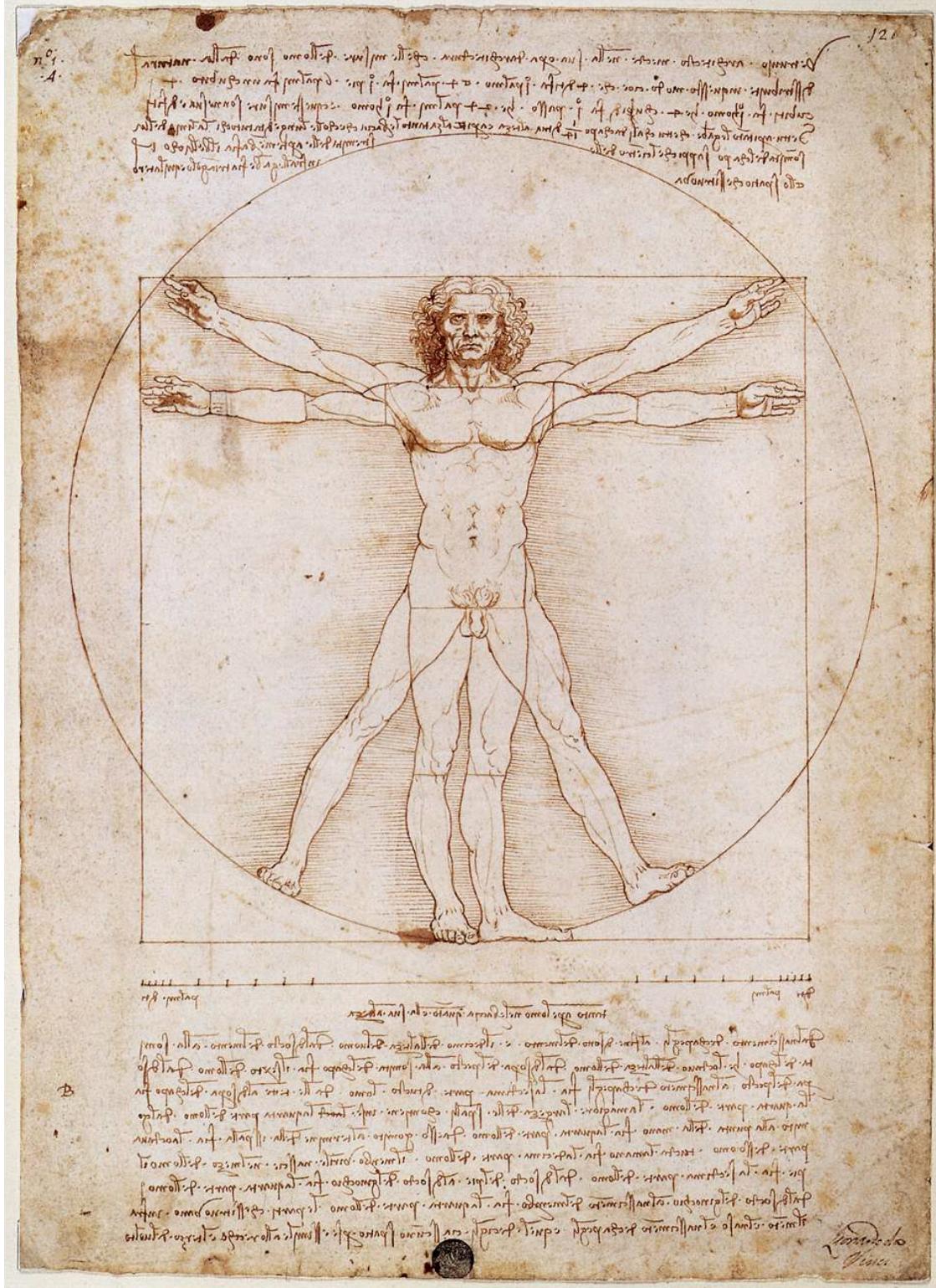
mechanical disks



## catalan atlas (a. cresques, 1375)



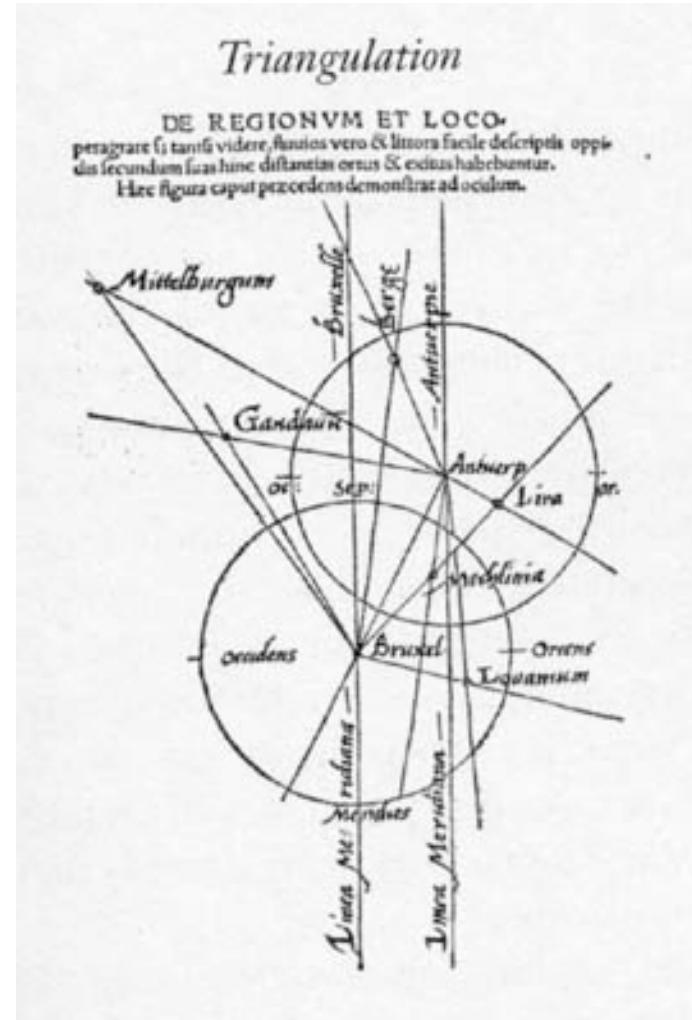
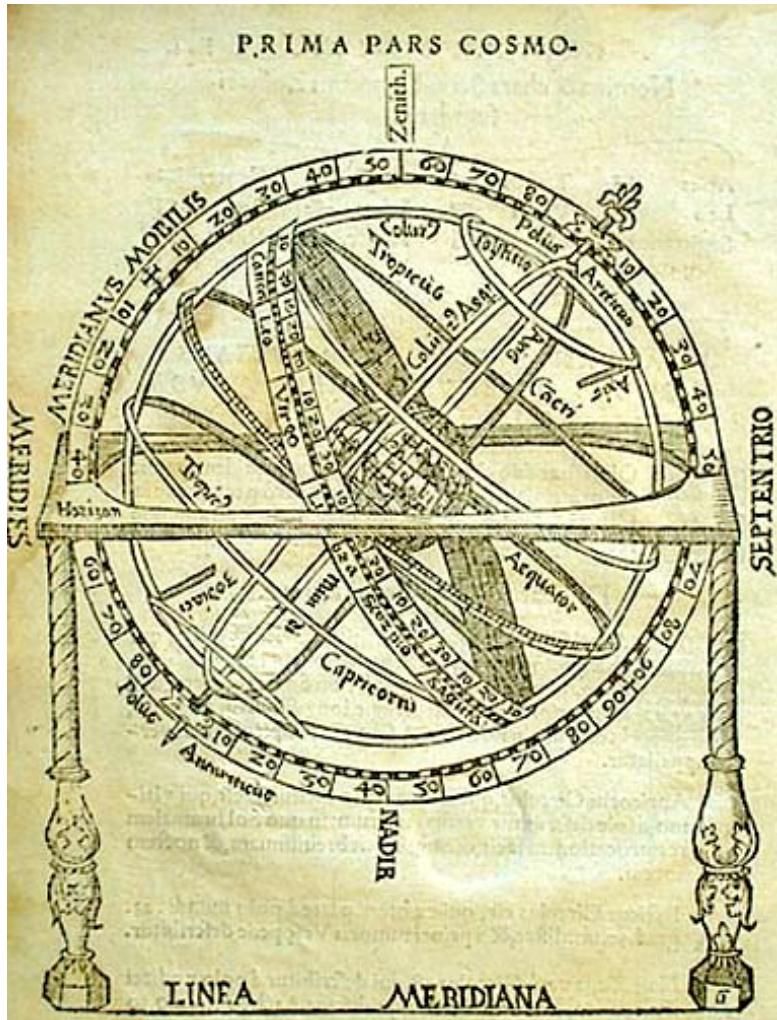
exquisitely beautiful visual cosmography, perpetual calendar, and thematic representation of the known world



## homo vitruvianus (l. da vinci, 1487)

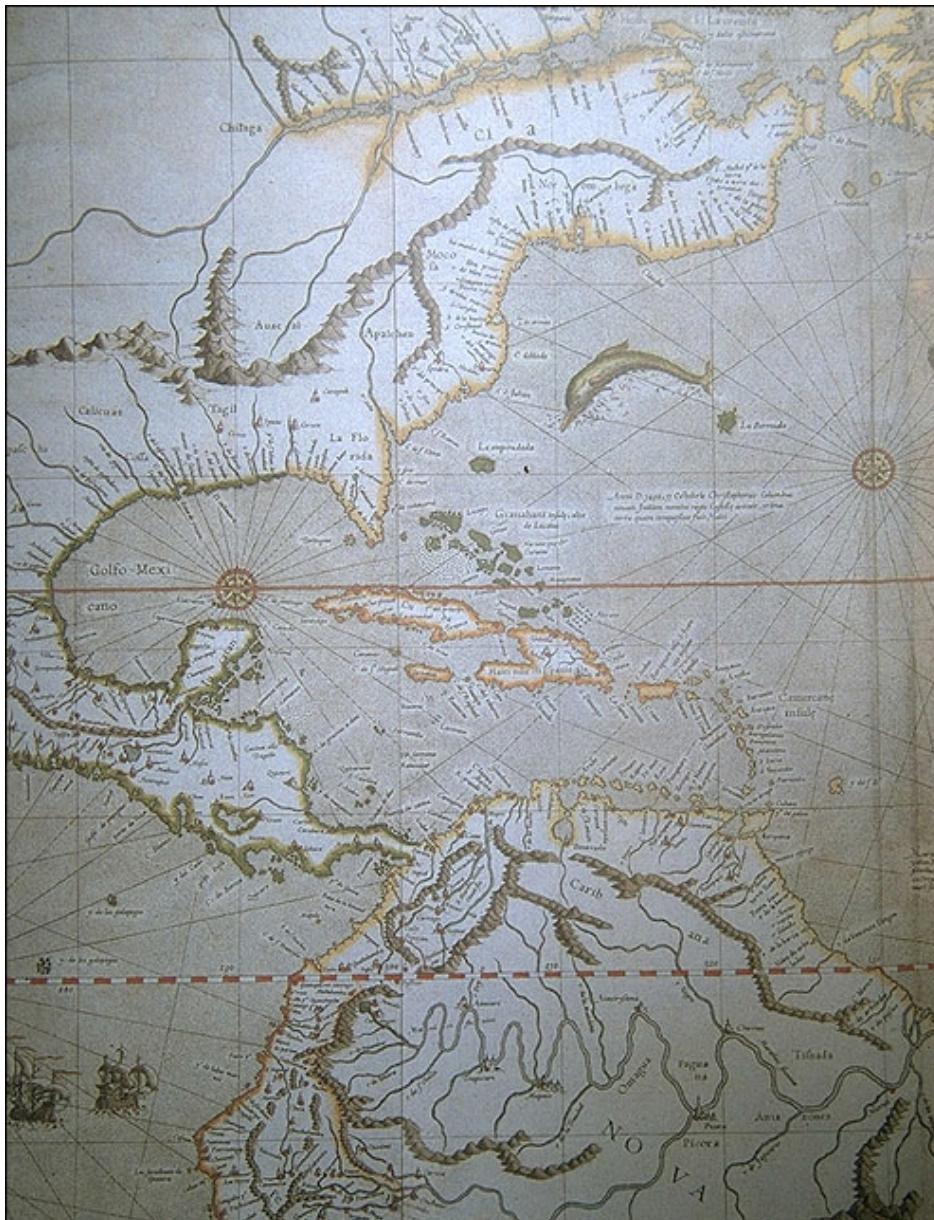
correlations of ideal human body proportions with geometry described by the ancient roman architect *vitruvius* in book III of his treatise *de architectura*.

## triangulation (r. gemma-frisius, 1533)



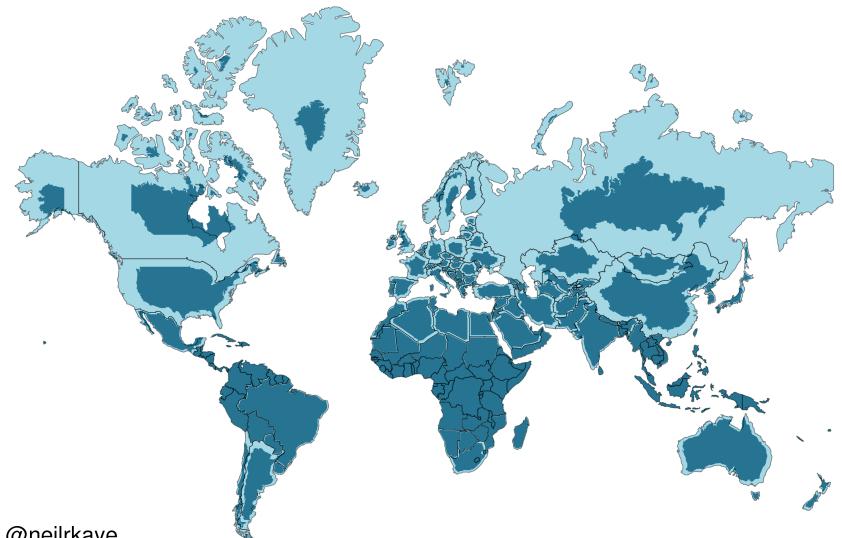
mapping locations by triangulation, from similar triangles, and with use of angles w.r.t meridians

## cylindrical projection (g. mercator, 1569)



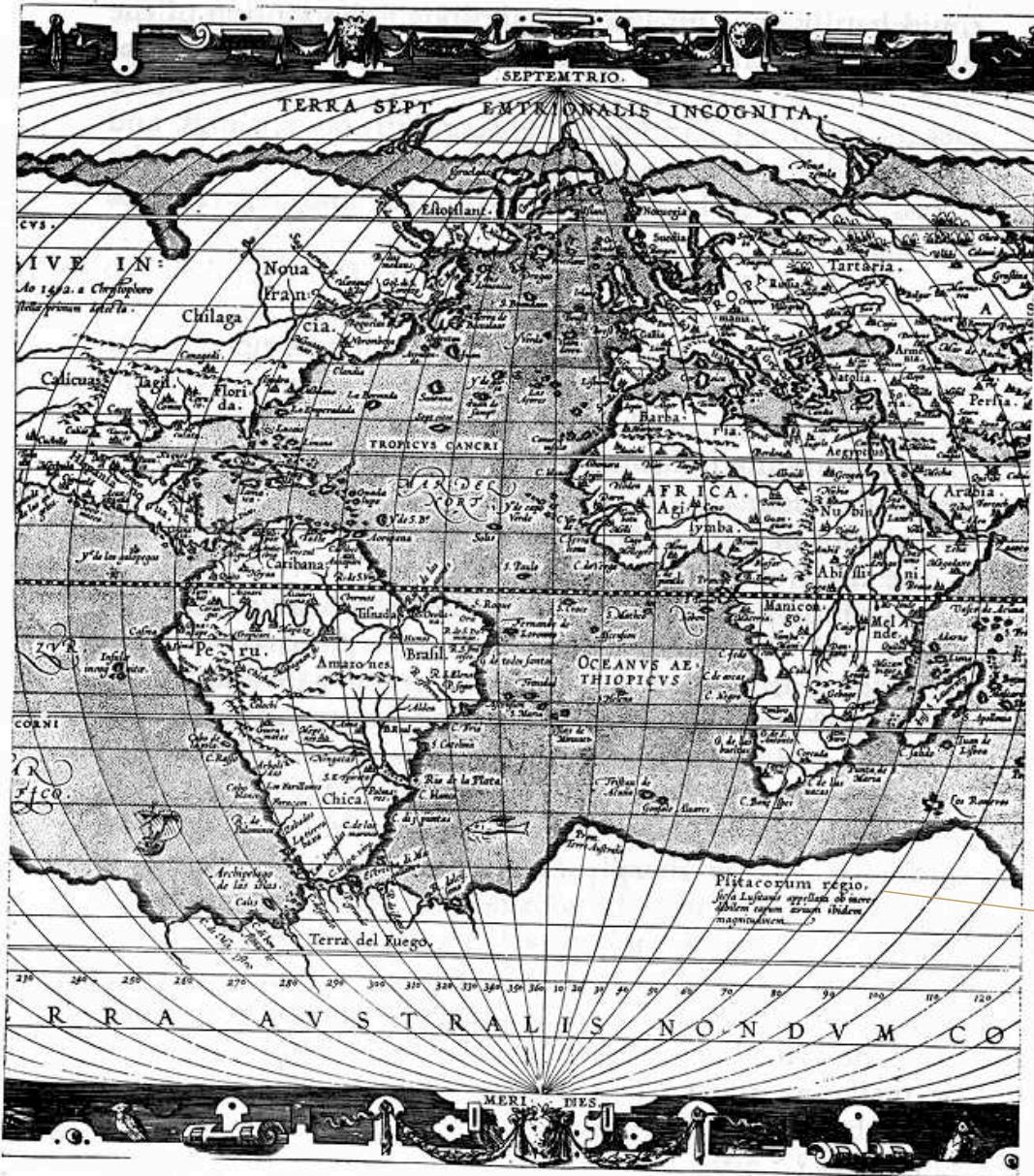
cylindrical projection for portraying the globe on maps, to preserve straightness of rhumb lines

World Mercator projection with true country size added



@neilrkaye

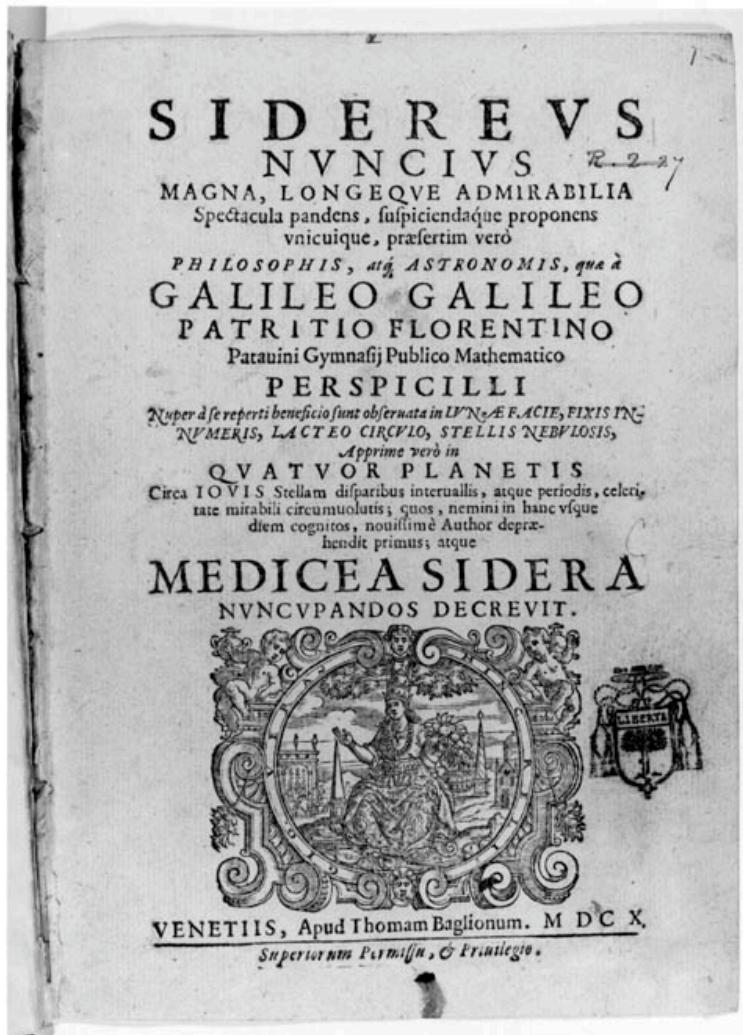
## first modern atlas (a. ortelius, 1570)



# 1600

- beginnings of visual thinking
- physical measurement of time, distance, and space
- astronomy, map making, navigation & territorial expansion
- growth in theory & dawn of practice
- analytic geometry, theory of errors, probability theory
- demographic statistics and "political arithmetic"
- positions of stars and other celestial bodies

# printed astronomical images (g. galilei, 1610)

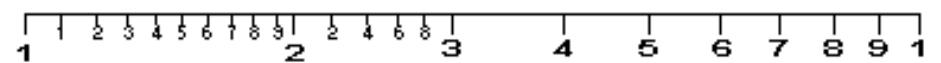


telescope observations

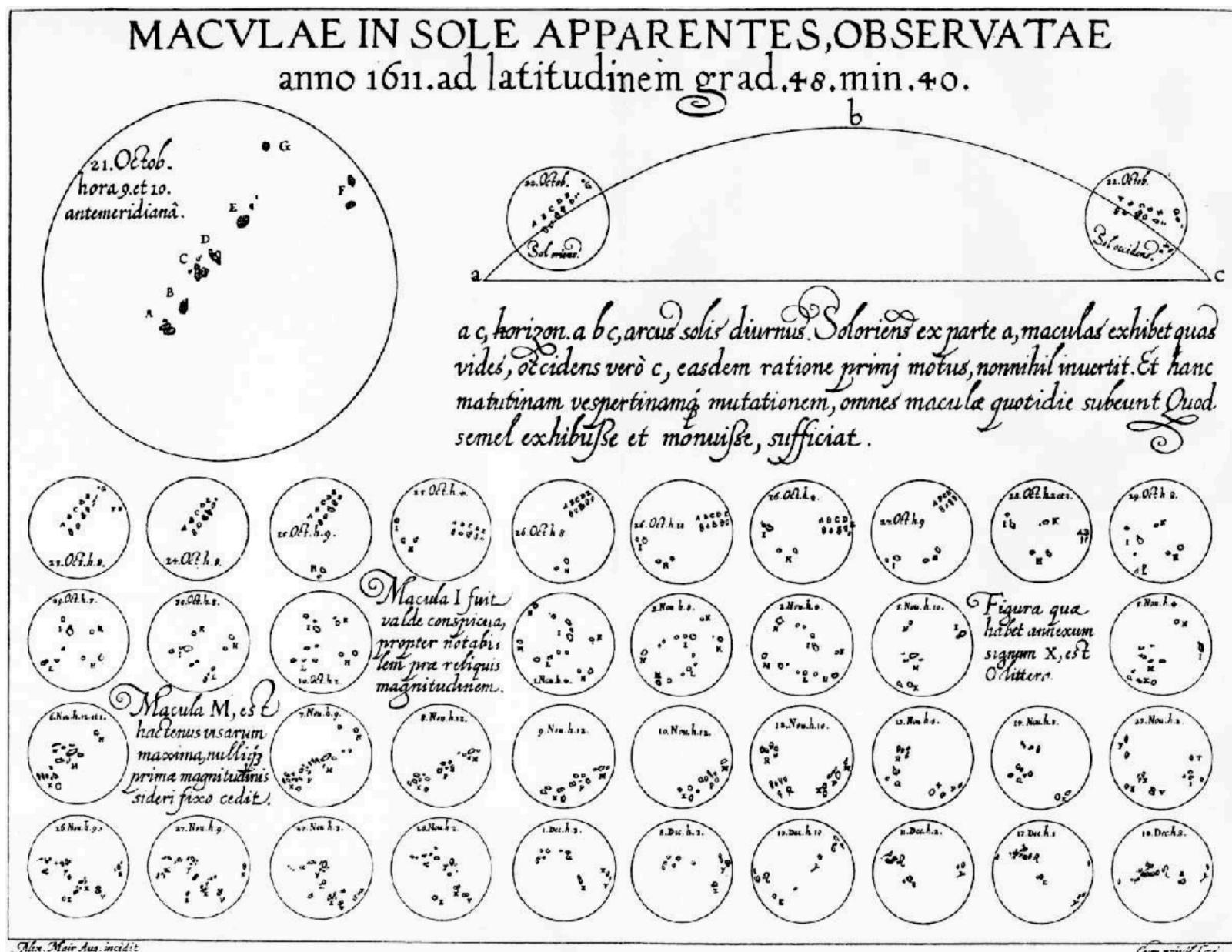


craters on the moon, the 4 satellites of *Jupiter* and a vast number of unseen stars

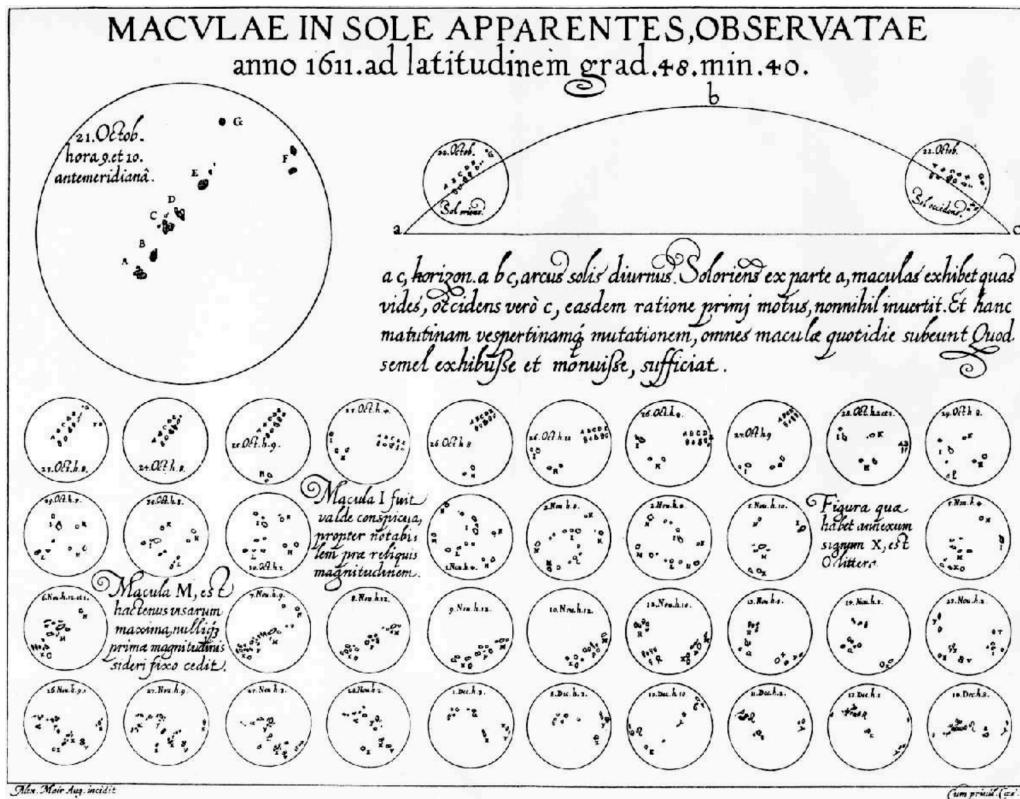
first logarithmic [gunter] scale (e. gunter & w. oughtred, 1620/1628)



sunspots (c. scheiner, 1626)

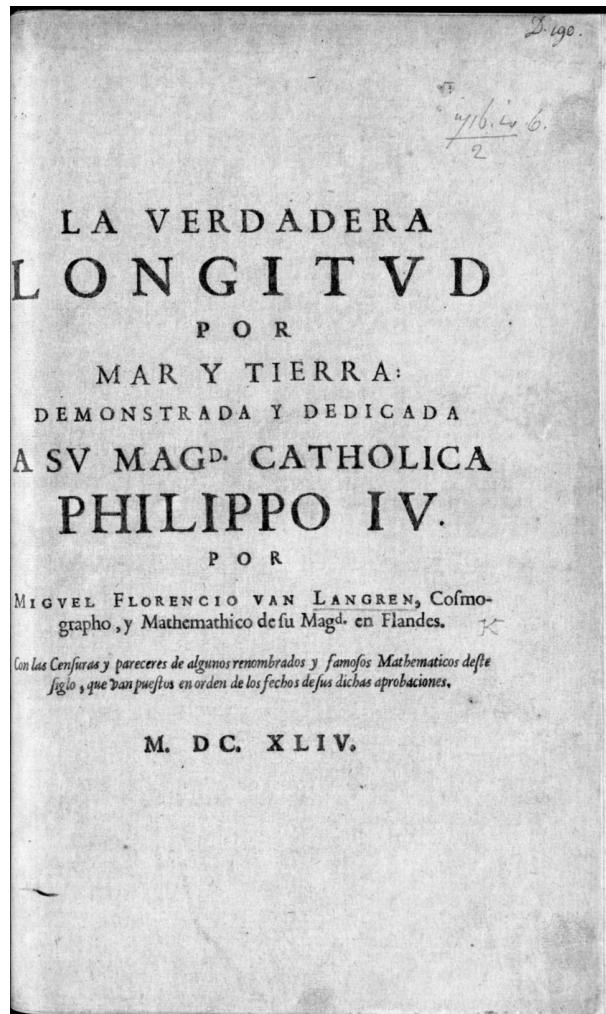


# sunspots (c. scheiner, 1626)



- a fundamental milestone in data visualisation
- changing configuration of sunspots in 23oct1611-19dec1611
- first introduction of the *small multiples*
- 7 groups of sunspots a-e in the large subplot are later repeated In the following 37 panels

# first data graph (m.f. van langren, 1644)



- variations in determination of longitude between *toledo* and *rome*

▲	Name	Longitude	Year	Longname	City	Country	Latitude
1	G. Jansonius	17.736	1605	Jan Jansson	Amsterdam	Flanders	52.37306
2	G. Mercator	19.872	1567	Gerardus Mercator	Leuven	Flanders	50.88333
3	I. Schonerus	20.638	1536	Johann Schoner	Bamberg	Germany	49.89167
4	P. Lansbergius	21.106	1530	Phillip van Lansberge	Middelburg	Belgium	51.50000
5	T. Brahe	21.447	1578	Tycho Brahe	Hven	Denmark	55.86667
6	I. Regiomontanus	25.617	1463	Johann Muller	Nuremberg	Germany	49.45000
7	Orontius	26.000	1542	Oronce Fine	Paris	France	48.86667
8	C. Clavius	26.340	1567	Christoph Clavius	Rome	Italy	41.90000
9	C. Ptolomeus	27.787	150	Claudius Ptolemaeus	Alexandria	Egypt	31.19806
10	A. Argelius	28.170	1610	Andrea Argoli	Padua	Italy	45.41667
11	A. Maginus	29.787	1582	Giovanni Antonio Magini	Bologna	Italy	44.48333
12	D. Origanus	30.128	1601	David Origanus	Frankfurt	Germany	52.34710

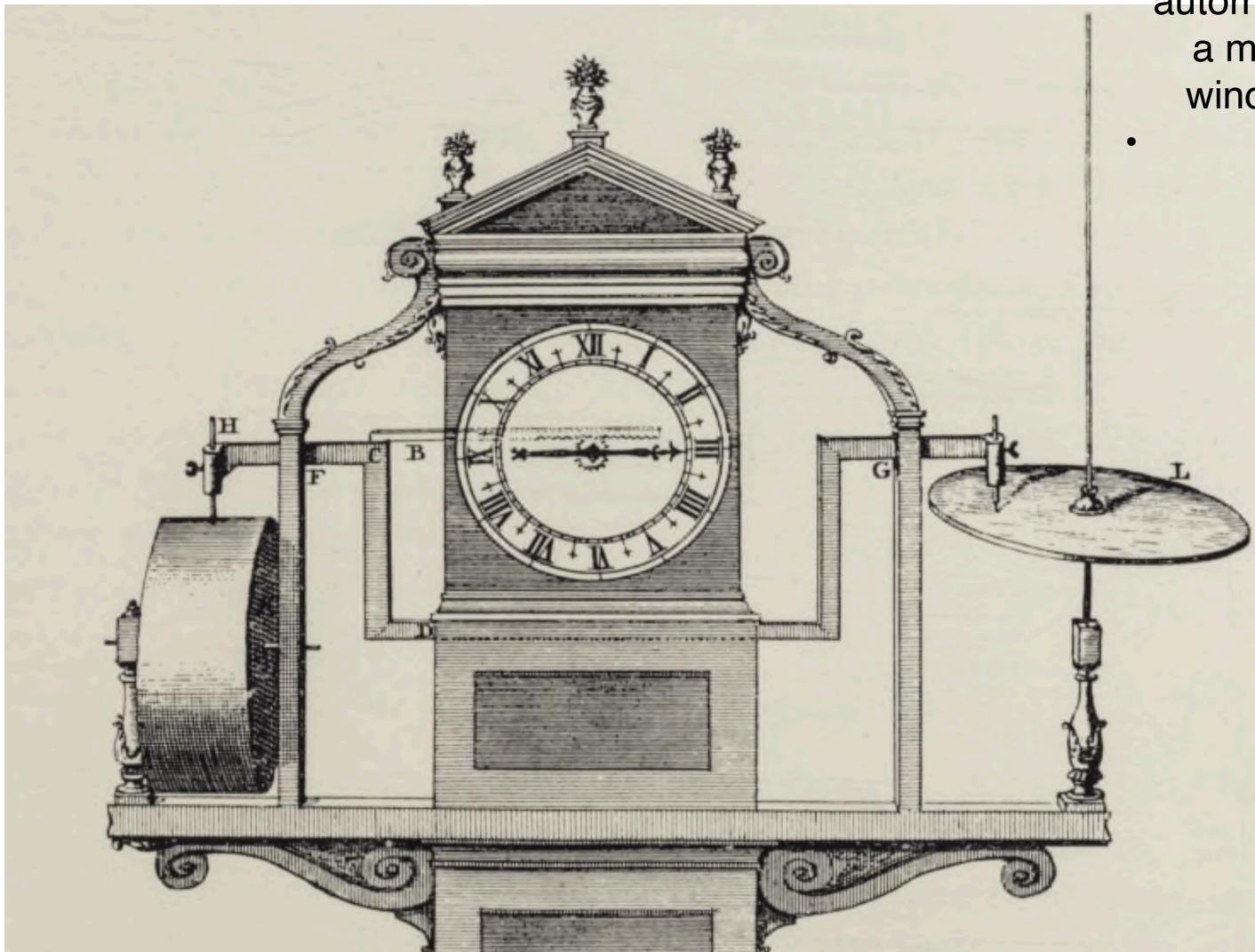
## first data graph (m.f. van langren, 1644)

- variations in determination of longitude between *toledo* and *rome*



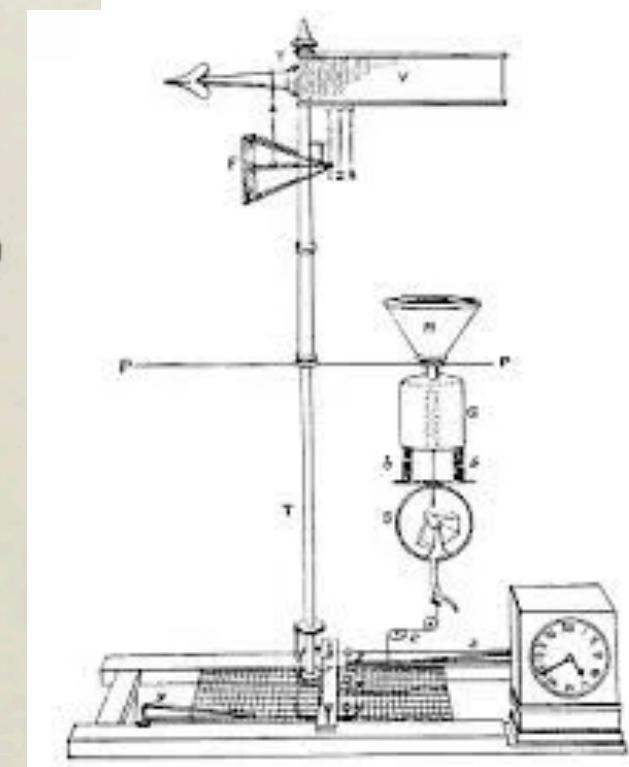
## weather clock (c. wren, 1663)

automatic recording device producing  
a moving graph of temperature and  
wind direction (in polar coordinates)

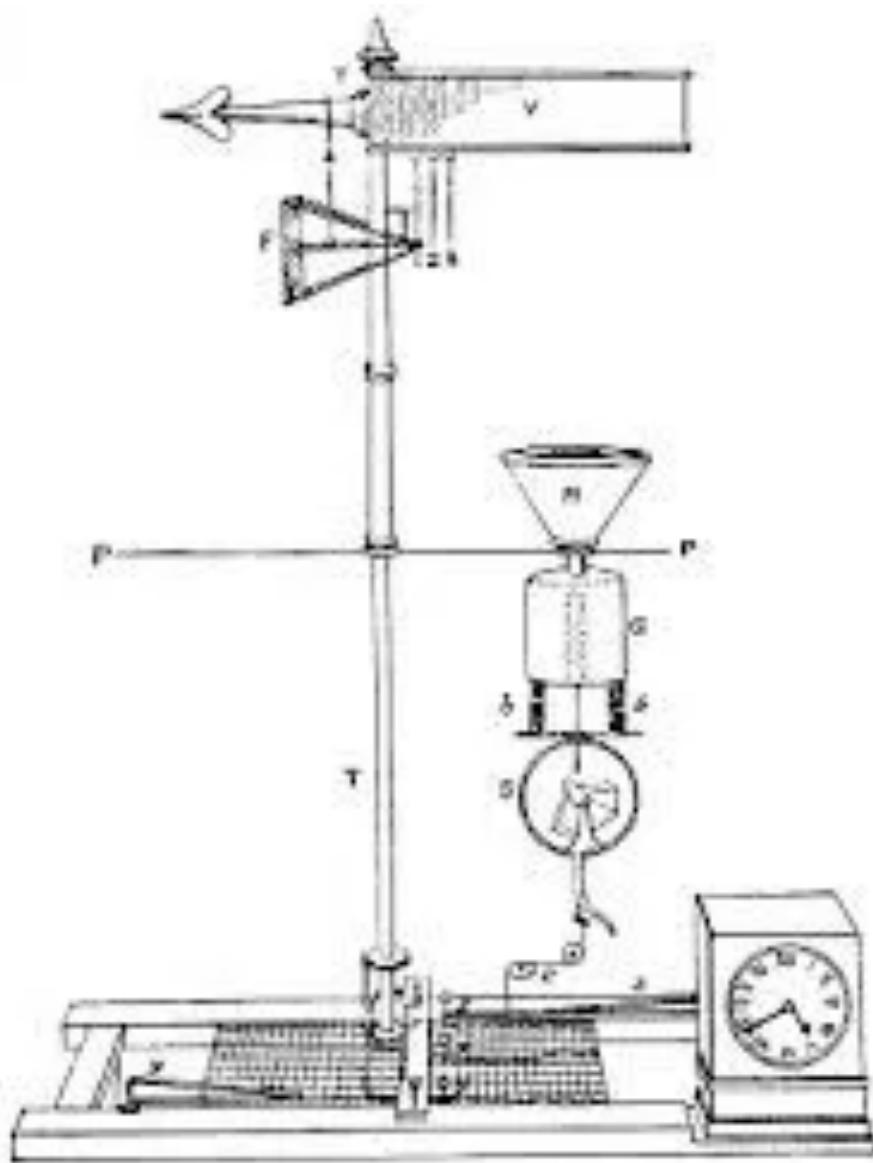


WEATHER-CLOCK

The design was submitted by Christopher Wren to the Royal Society, 9 December 1663.

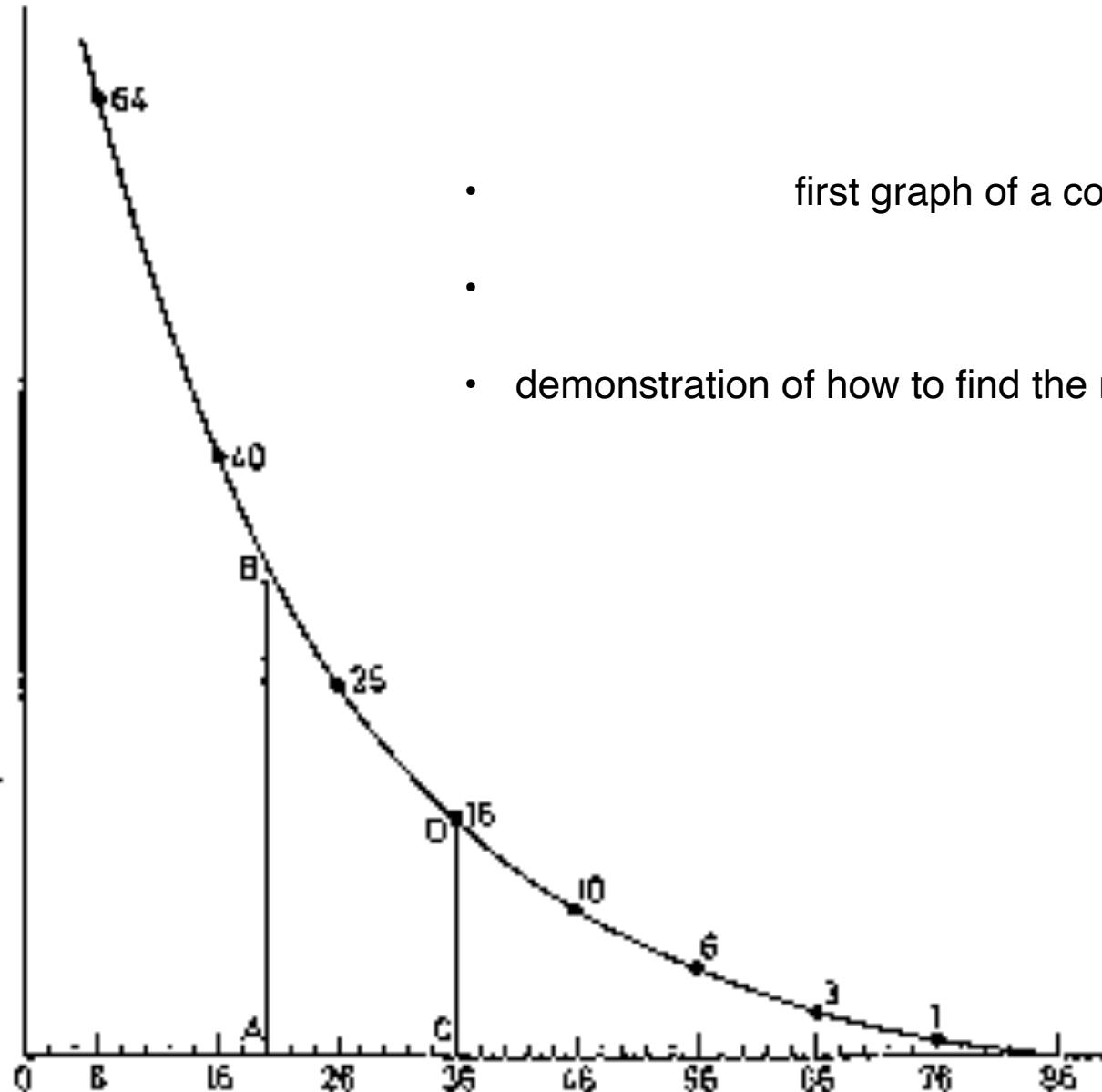


## weather clock (c. wren, 1663)



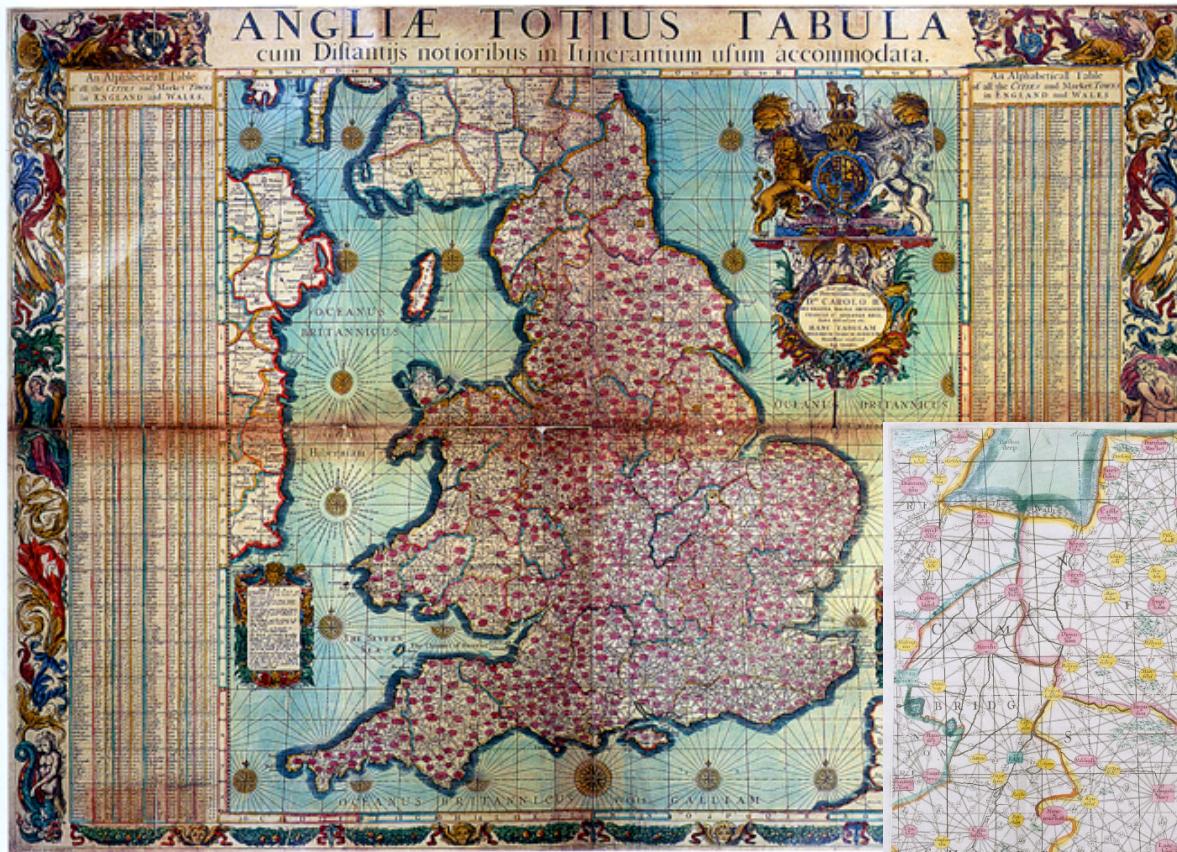
automatic recording device producing  
a moving graph of temperature and  
wind direction (in polar coordinates))

## life table (c. huygens, 1669)

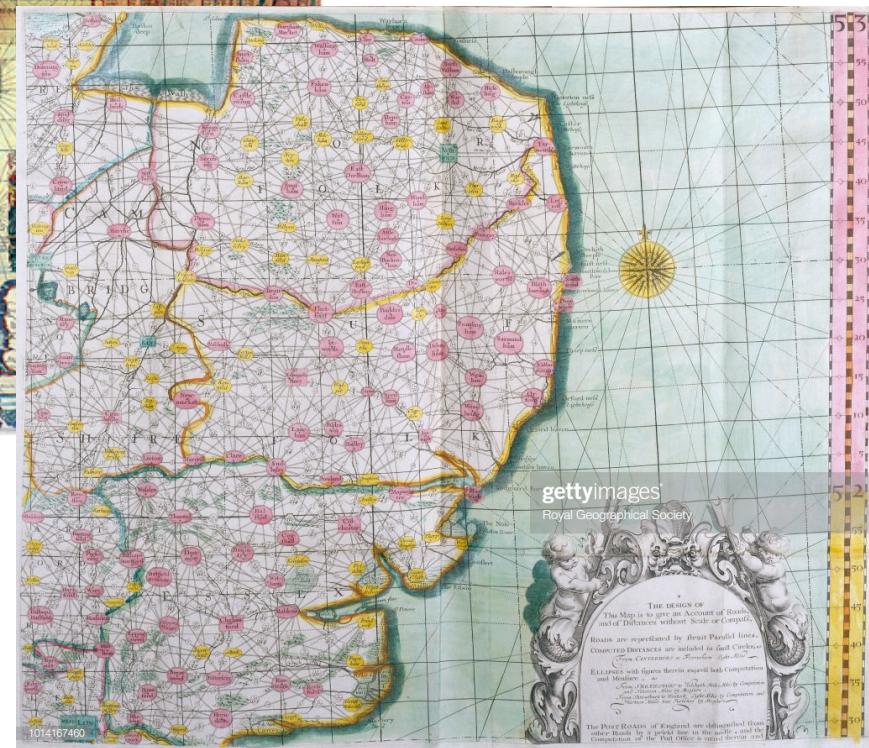


- first graph of a continuous distribution function
- graph of *gaunt's* life table
- demonstration of how to find the median remaining lifetime for a person of given age

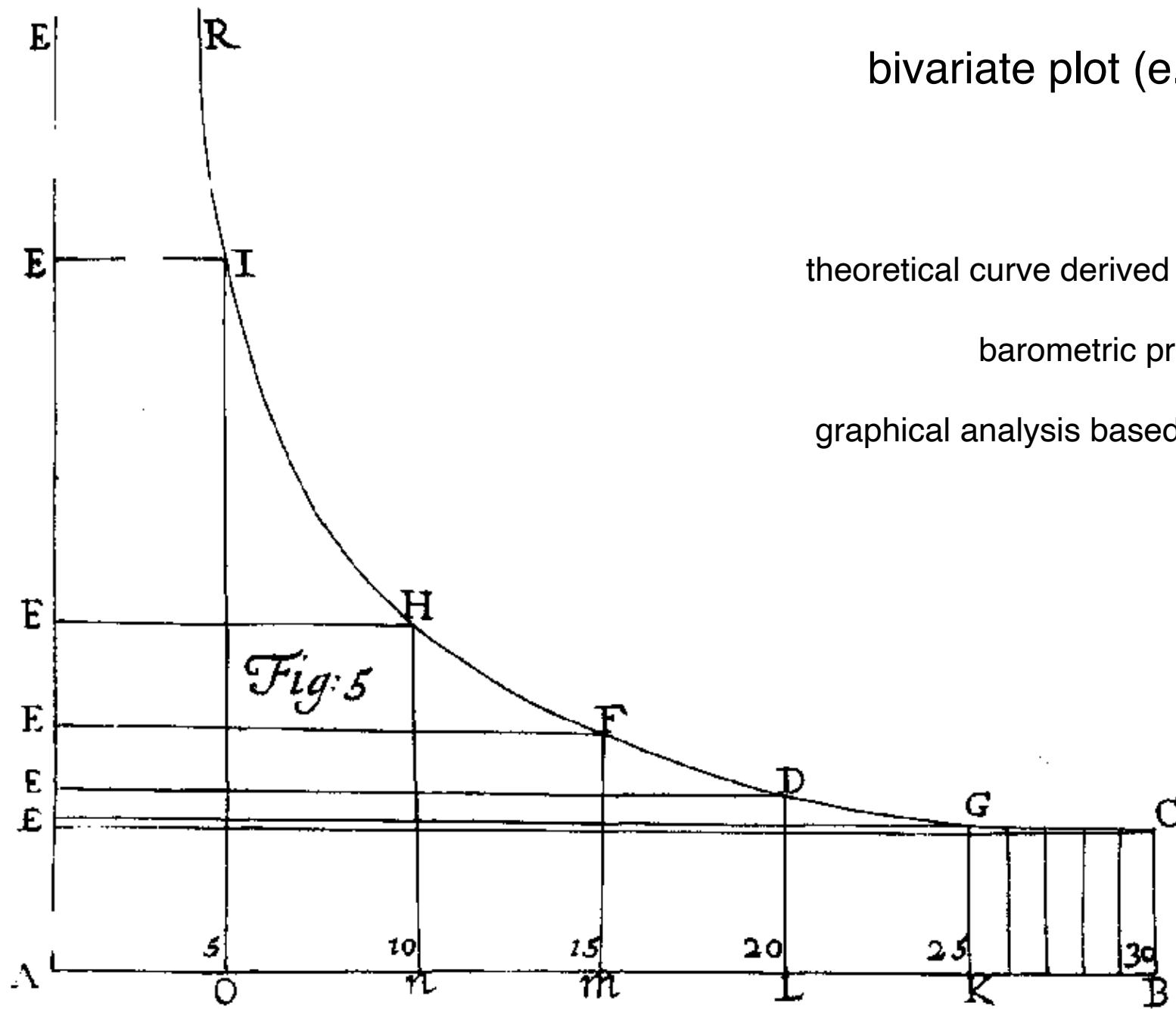
# network diagram on a map (j. adams, 1679)



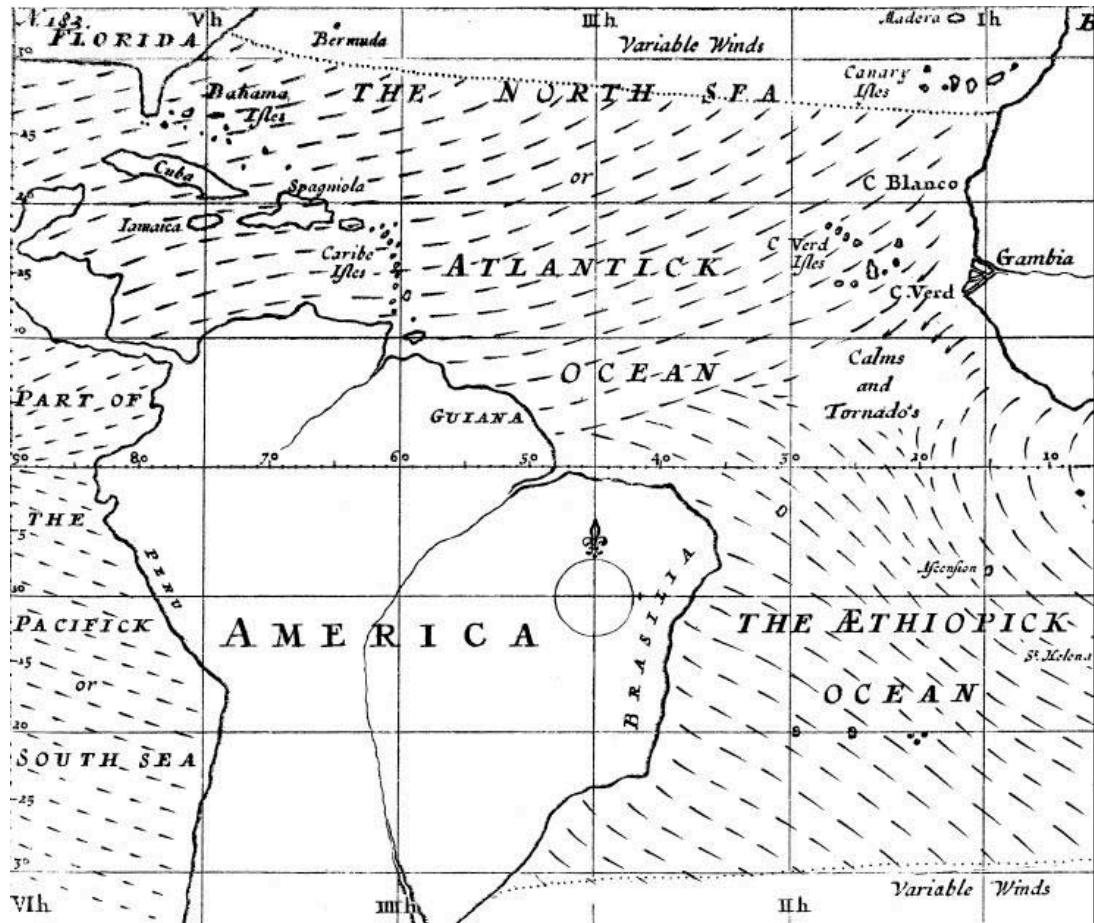
map of *england* showing  
distances between cities



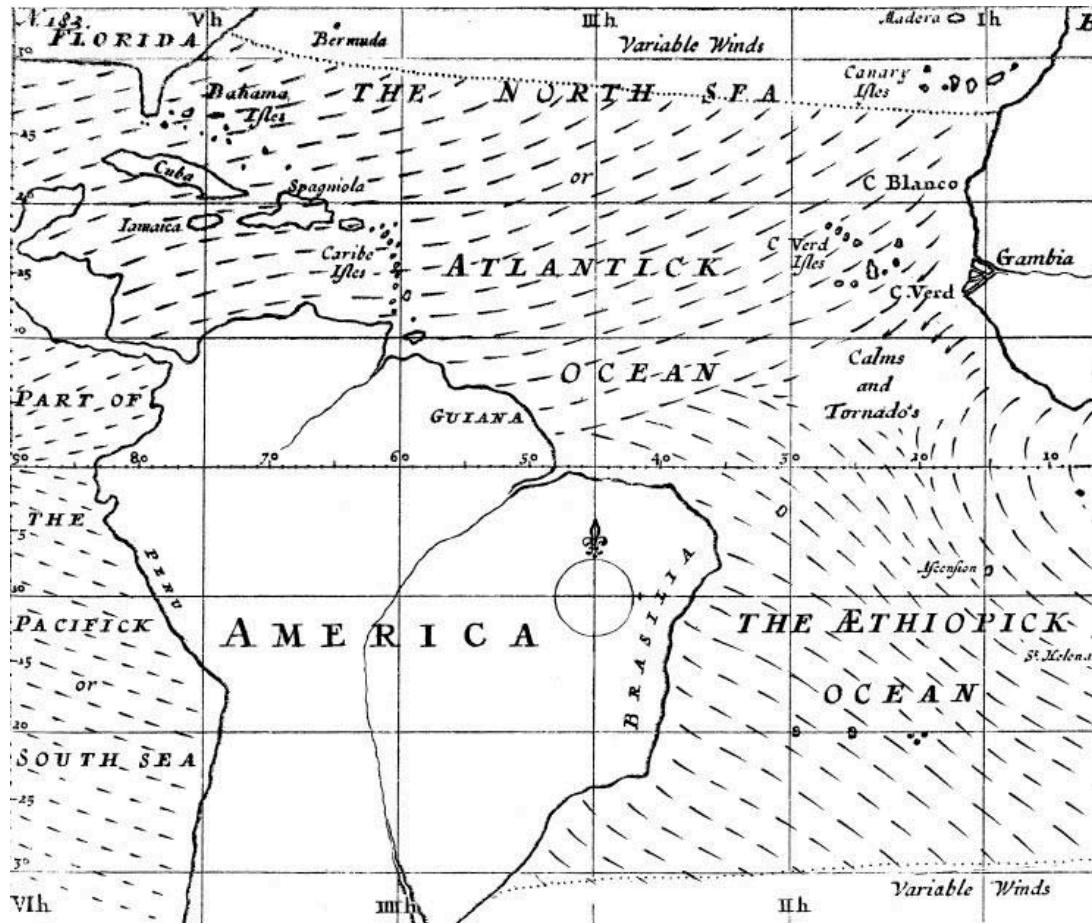
bivariate plot (e. halley, 1686)

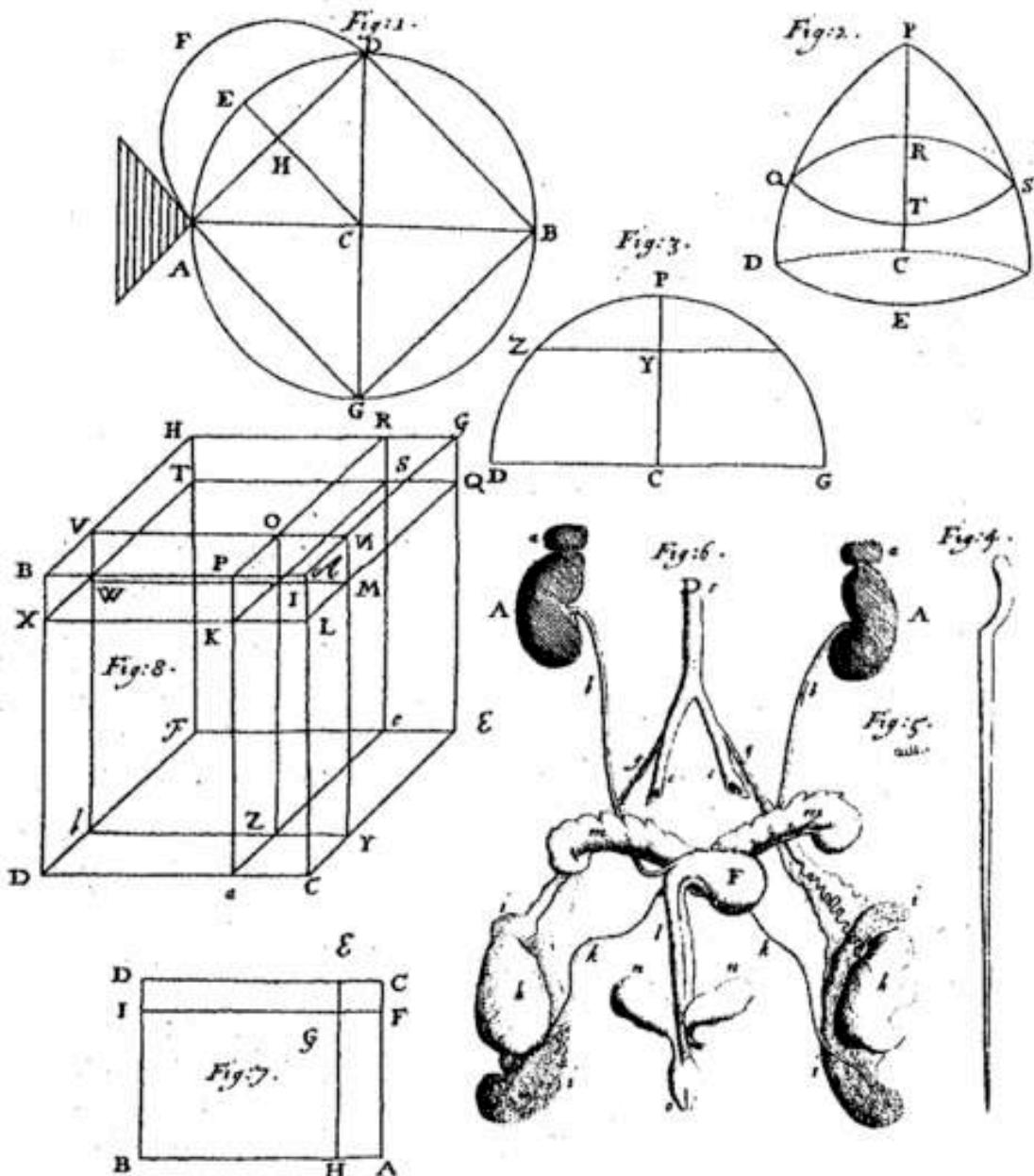


first weather map (e. halley, 1686)

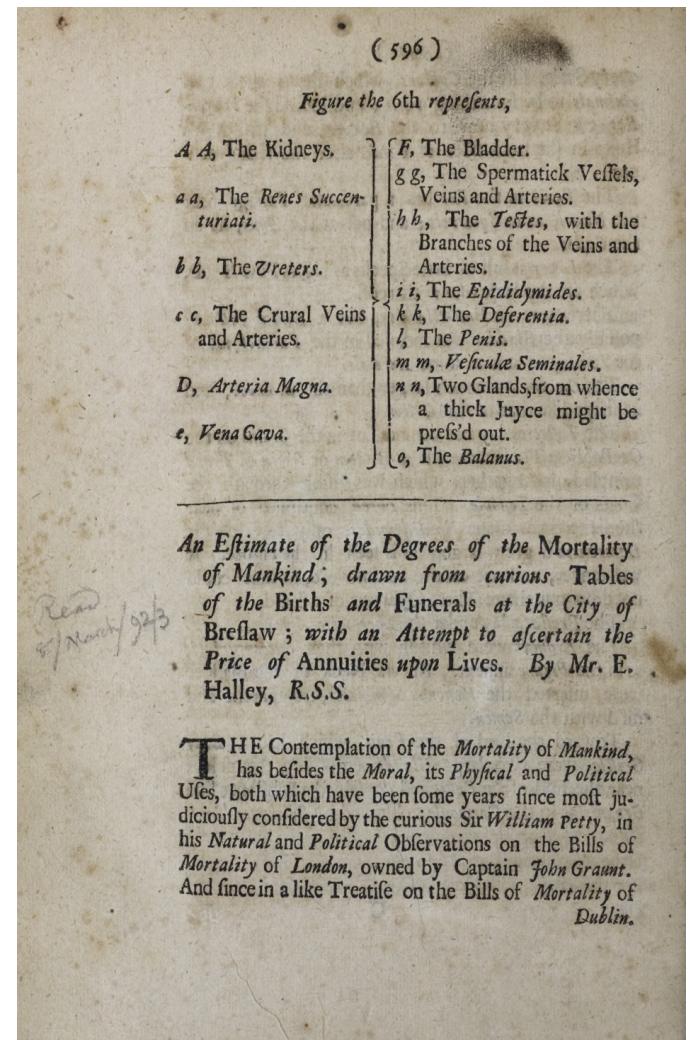


first weather map (e. halley, 1686)





probs (e. halley, 1686)



first use of areas of rectangles to display probabilities of independent binary events

1700

initial germination of the seeds of visualisation

more than just geographical position(isolines and contours)

thematic mapping of physical quantities, geologic, economic, and medical data.

early beginnings of statistical theory (measurement error)

novel visual forms

reproduction of data images (color printing, lithography)

# first contour map (e. halley, 1701)



- contour map showing curves of equal value
- isogonic map: lines of equal magnetic declination for the world
- possibly the first contour map of a data-based variable

literal line graph (f. hauksbee, 1712)

*A Table according to the Scheme of the Planes opened to an Angle of 40 Minutes, in Fig. 6.*

Distances in Inches and Parts of Inches from the touching Ends.	Number of Lines elevated at the several Distances.
9.	1.
6.	2.
4 $\frac{3}{4}$ .	3.
3.	4 $\frac{3}{4}$ .
2 $\frac{1}{2}$ .	6.
2.	7 $\frac{1}{2}$ .
1 $\frac{1}{2}$ .	10.
1 $\frac{1}{4}$ .	12.
1.	15.
Q $\frac{3}{4}$ .	19.
Q $\frac{1}{2}$ .	28.
Q $\frac{1}{4}$ .	50.

*A Table according to the Scheme of the Planes opened to an Angle of 20 Minutes, in Fig. 7.*

Distances in Inches and Parts of Inches from the touching Ends.	Number of Lines elevated at the several Distances.
13.	1.
9.	2.
7.	3.
6.	3 $\frac{3}{4}$ .
5.	5.
4.	6 $\frac{3}{4}$ .
3.	9.
2 $\frac{1}{2}$ .	12.
2.	15 $\frac{1}{2}$ .
1 $\frac{3}{4}$ .	18.
1 $\frac{1}{2}$ .	21 $\frac{1}{2}$ .
1 $\frac{1}{4}$ .	27 $\frac{1}{2}$ .
1.	35.
Q $\frac{3}{4}$ .	50.
Q $\frac{1}{2}$ .	76.

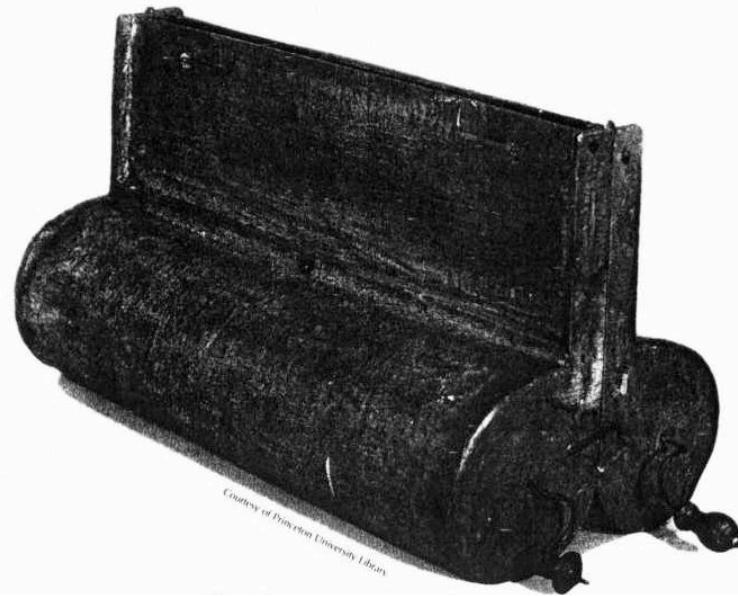
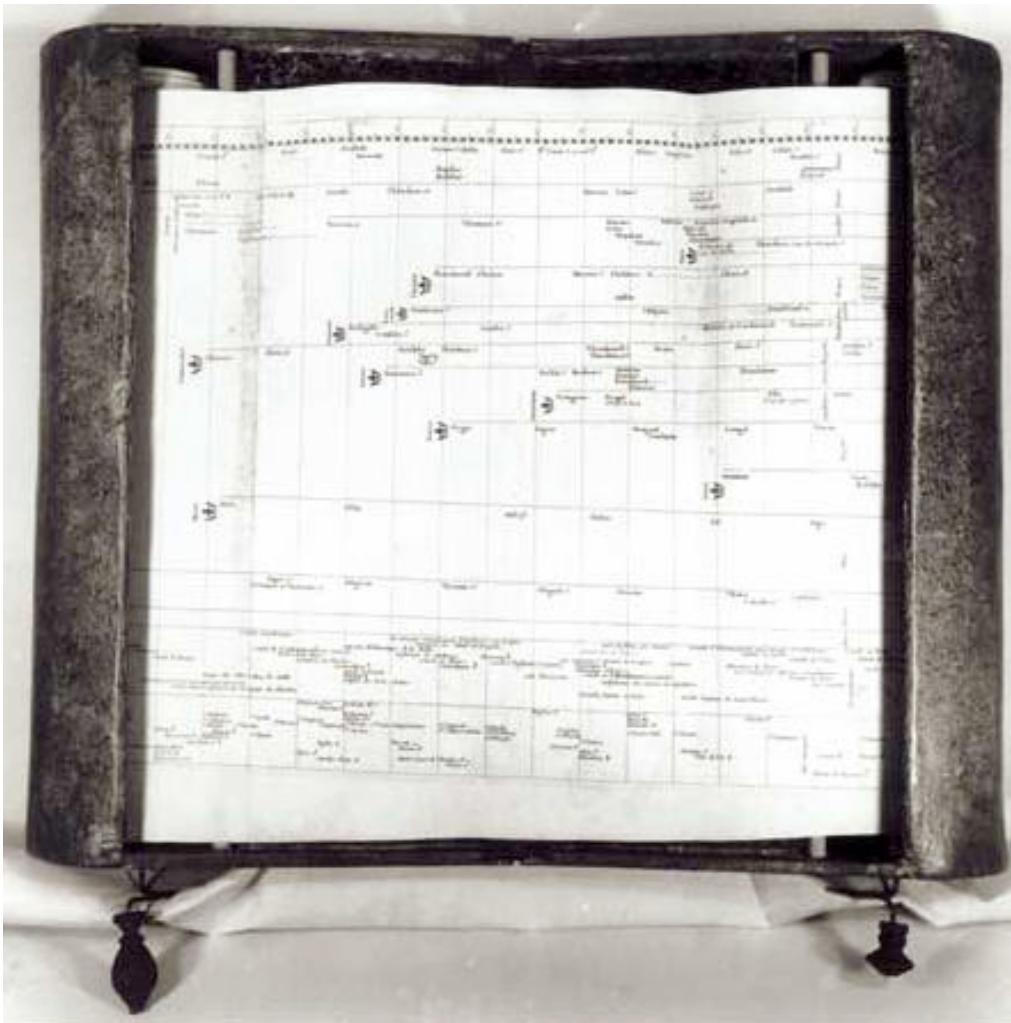
X. An Account of an Experiment touching the Ascent of Water between two Glass Planes, in an Hyperbolick Figure. By Mr. Francis Hauksbee, F. R. S.

- literal line graph
- inspired by observation of nature
- section of hyperbola
- capillary action of colored water between two glass plates

first modern contour map (p. buache, 1752)



# carte chronologique (j. barbeu-dubourg, 1753)



Courtesy of Princeton University Library

Photo: Don Bresc

- 54-foot scroll w/ annotated timeline of history from creation
- names and descriptive events grouped thematically,
- characters: martyr, tyrant, heretic, noble, upright, etc.
- professions: painter, theologian, musician, monk, etc.

## CHRONOGRAPHIE, OU DESCRIPTION DES TEMS;

CONTENANT TOUTE LA SUITE  
des Souverains de l'Univers, &  
des principaux événemens de chaque  
Siècle, depuis la Création du Monde  
jusqu'à présent;

EN TRENTÉ-CINQ PLANCHES  
gravées en Taille - douce, & réunies  
en une Machine d'un usage facile &  
commode,

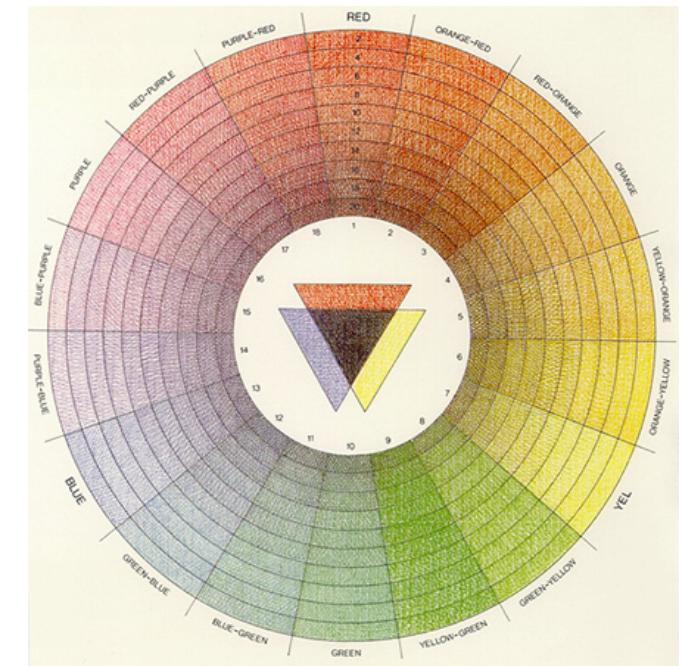
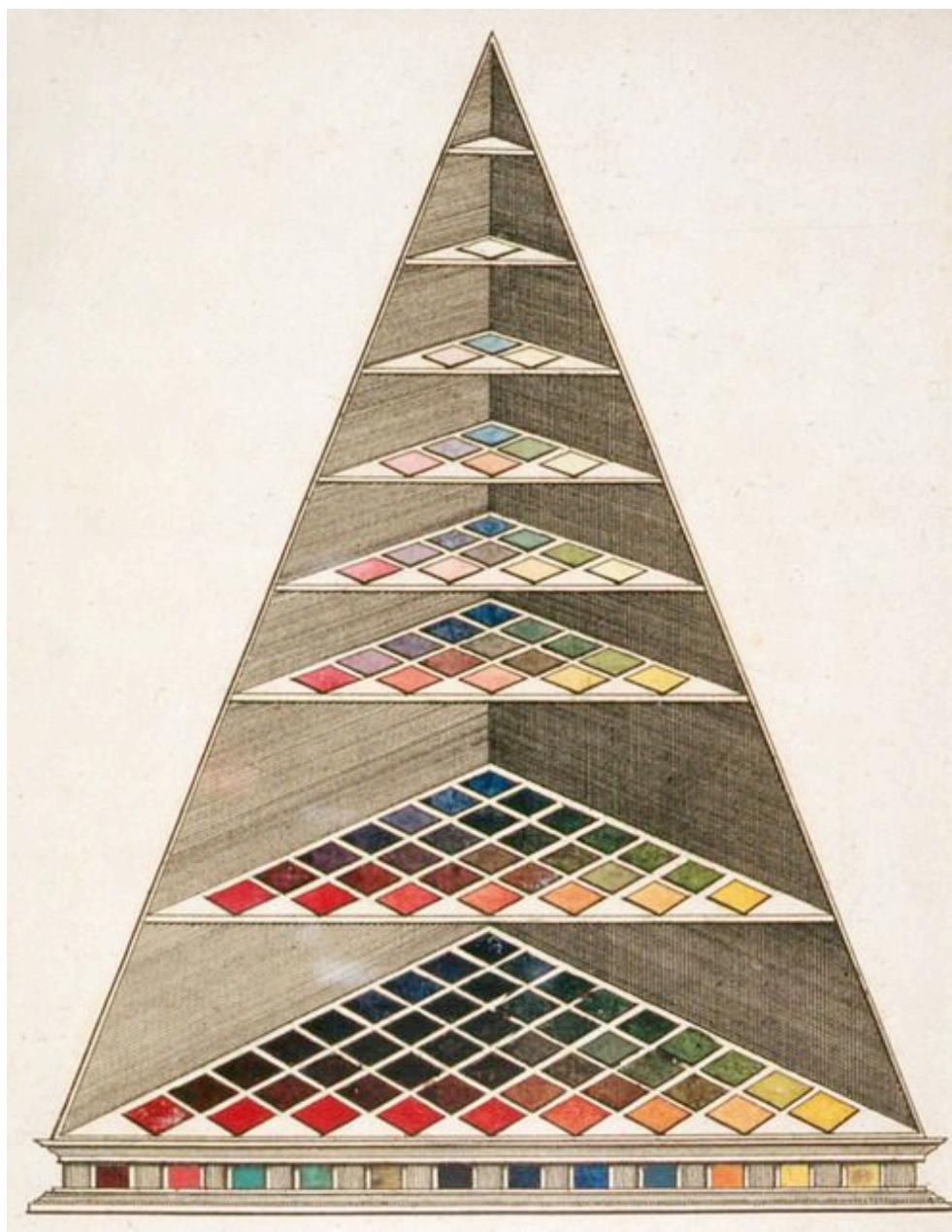
Par M. BARBEU DUBOURG, Docteur en Médecine,  
& Professeur de Pharmacie en l'Université de Paris,

A PARIS,  
L'AUTEUR, rue Saint Benoît, à côté  
de l'Abbaye Saint Germain.  
Chez LAMOTE, rue saint Denis, vis-à-vis la rue  
des Lombards, à la Croix d'or.  
Et FLEURY, Marchand Tapissier,  
à l'Estrapade.

1753. 2937/5  
Avec Approbation & Privilége du Roi.  
Imprimé par les dépouilles 12. avec la Machine 12 ou 13.

3306.9  
3306.9  
3306.9

# color system (m. harris/j.h. lambert/j.t. mayer, 1758-1772)



## beta density graph (t. bayes, 1763)

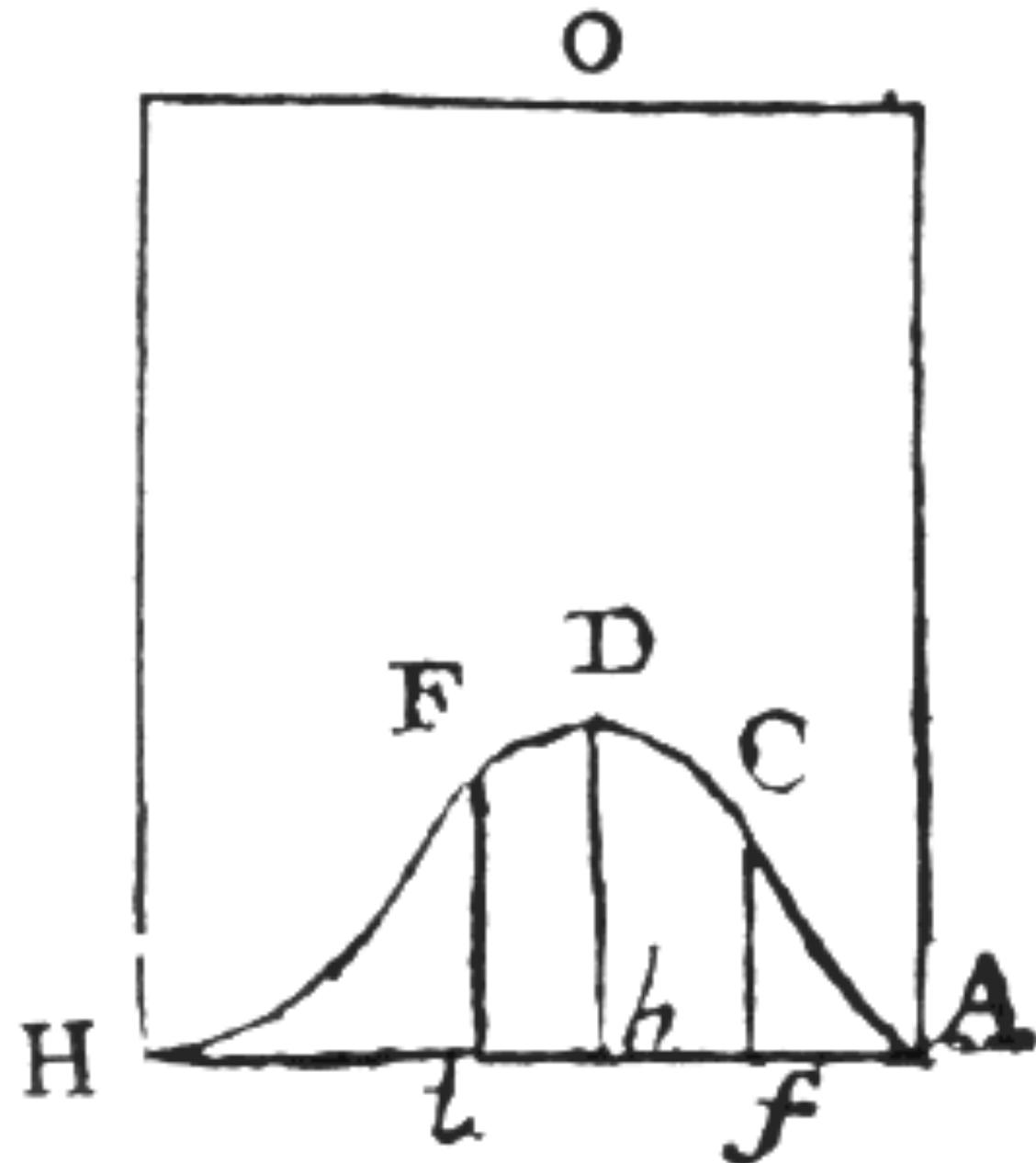
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LII. *An Essay towards solving a Problem in the Doctrine of Chances. By the late Rev. Mr. Bayes, F. R. S. communicated by Mr. Price, in a Letter to John Canton, A. M. F. R. S.*

Dear Sir,

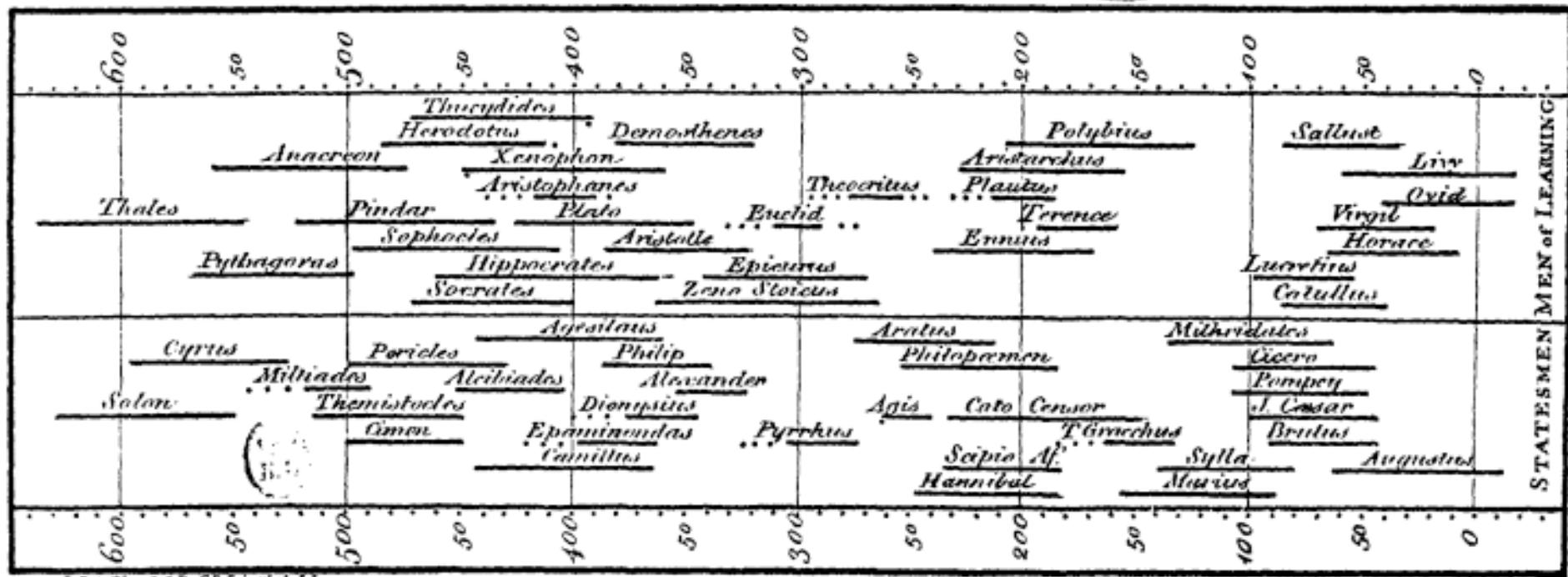
Read Dec. 23, 1763. I now send you an essay which I have found among the papers of our deceased friend Mr. Bayes, and which, in my opinion, has great merit, and well deserves to be preserved. Experimental philosophy, you will find, is nearly interested in the subject of it; and on this account there seems to be particular reason for thinking that a communication of it to the Royal Society cannot be improper.

He had, you know, the honour of being a member of that illustrious Society, and was much esteemed by many in it as a very able mathematician. In an introduction which he has writ to this Essay, he says, that his design at first in thinking on the subject of it was, to find out a method by which we might judge concerning the probability that an event has to happen, in given circumstances, upon supposition that we know nothing concerning it but that, under the same circum-



historical timeline (j. priestley, 1765)

# A Specimen of a Chart of Biography.



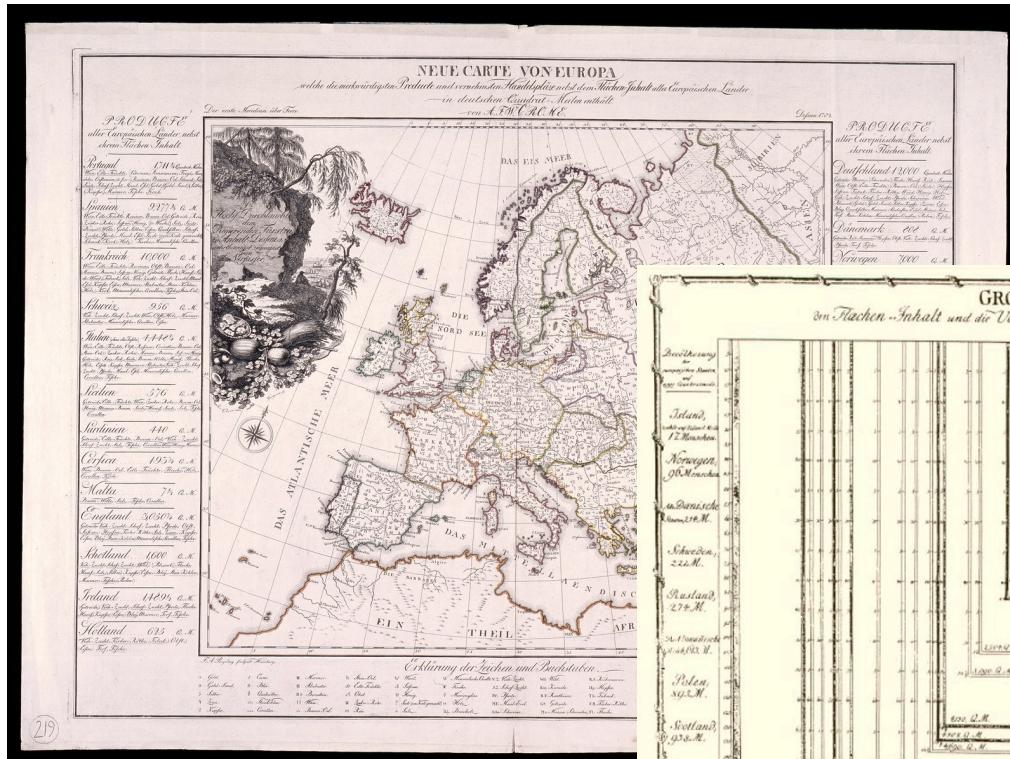
- life spans of 2,000 famous people, 1200 b.c. to 1750 a.d.
- quantitative comparison by means of bars

first semi-graphic display (j.h. lambert, 1779)

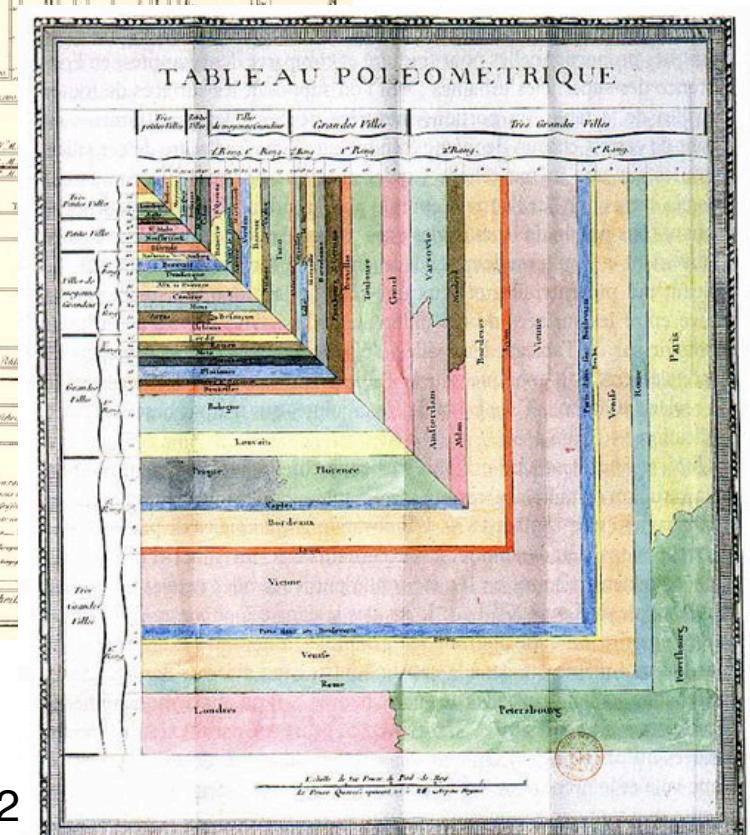
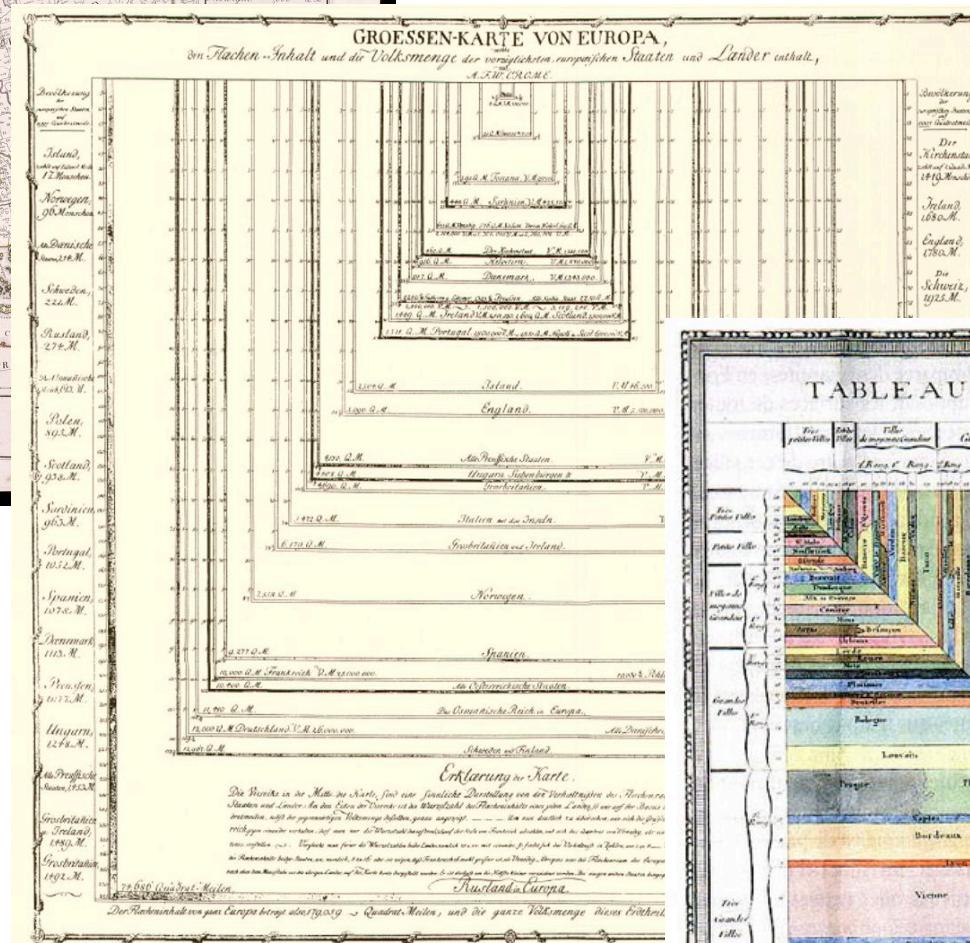
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Jun.						1		4	8	9	4	4	2	7	3		
Jul.													9	10	5	1	
Aug.													1	15	8	5	
Sept.													6	16	7	1	
Oct.													7				
Nov.													7				
Dec.					5	14	12										
1736	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Jan.	3	4	13	10	2												
Febr.	1	4	8	11	4	1											
Mart		1	5	17	5	3											
Apr.			1	5	7	10	5	2									
May					1	2	5		13	3	7						
Jun.									1	6	18	2	3				
Jul.										4	4	7	7	8	1		
Aug.										1	7	14	8				
Sept.										3	5	11	8	3			
Oct.										5	7	2	1				
Nov.					5	3	6	16	8	6	5	7					

combining tabular and graphical formats

## first thematic & comparison maps (a.f.w. crome, 1782/1786)

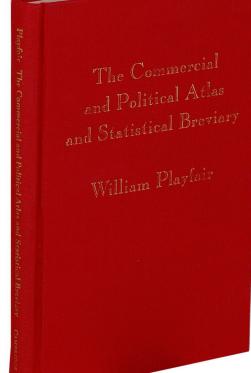


size of countries and size of its population  
of all states and countries in Europe.

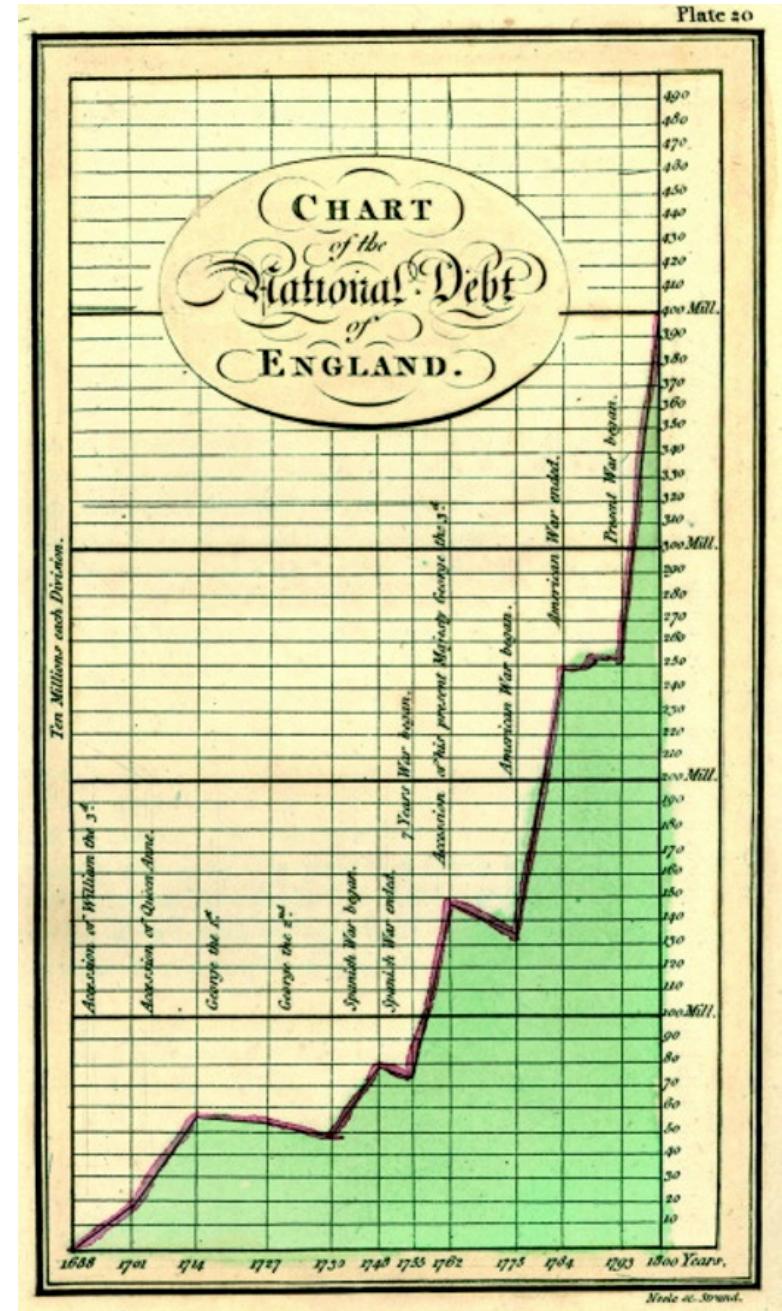
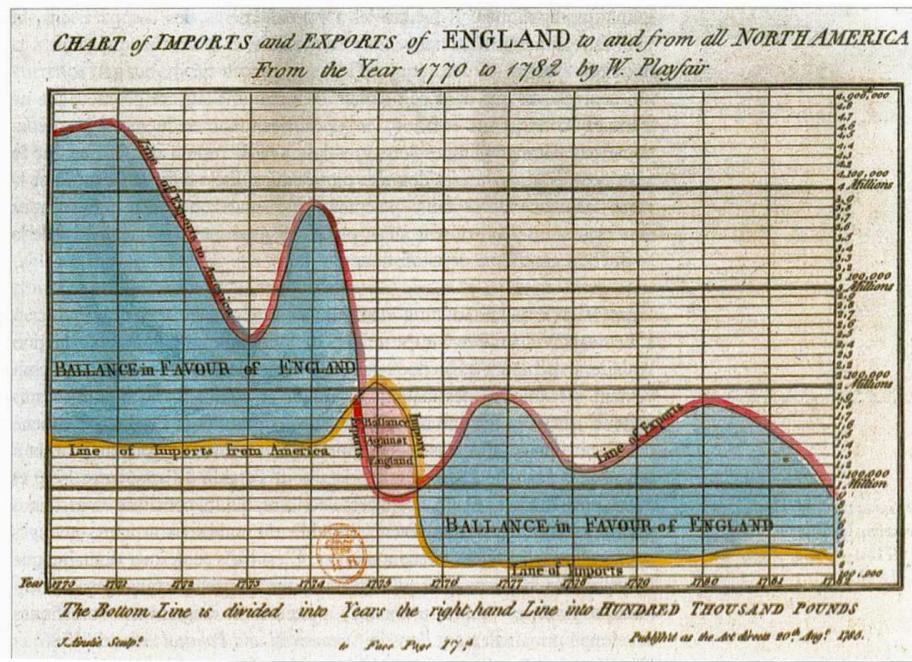
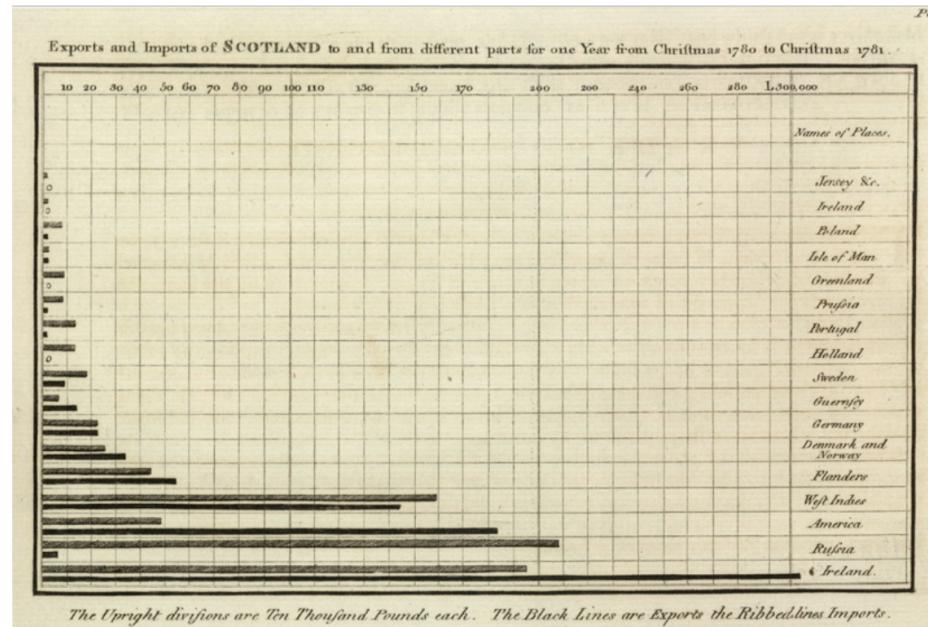


# line & bar plots (w. playfair, 1786)

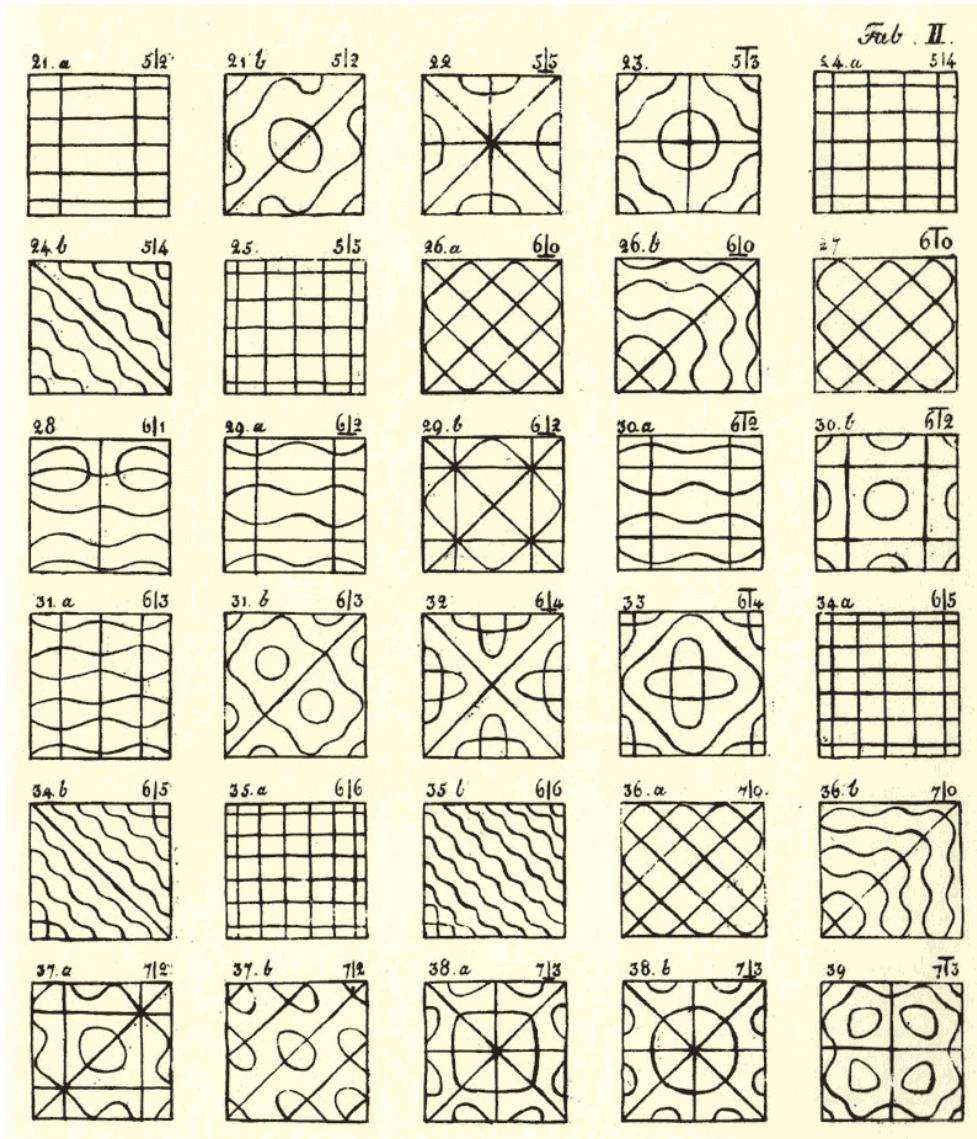
"the commercial and political atlas"



OAK KNOLL



# vibrational patterns (e.f.f. chiadni, 1787)



visualization of vibration patterns by spreading a uniform layer of sand on a disk, and observing displacement when vibration is applied

# epidemiological map (v. seaman, 1797)

mapping yellow fever in nyc

