

A Description of the Passage of the Shadow of the MOON, over ENGLAND,
In the Total Eclipse of the SUN, on the 22^d Day of April 1715 in the Morning.

Early 18th-Century Maps of Solar Eclipse Paths

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Summary of the slides on the following presentation

The earliest eclipse maps, i.e. maps that depict the path of totality of a solar eclipse across the Earth's surface, are usually attributed to the English astronomer Edmond Halley (1656-1742).

There is ample evidence that Halley was an innovative scientist with an interest in mapping problems. Notable examples are his charts of the Atlantic Ocean (published in 1701) and the Indian/Pacific Oceans (1702) which delineate the compass variation.

However, this presentation will show several examples of earlier eclipse maps designed by French, Dutch and German astronomer-cartographers.

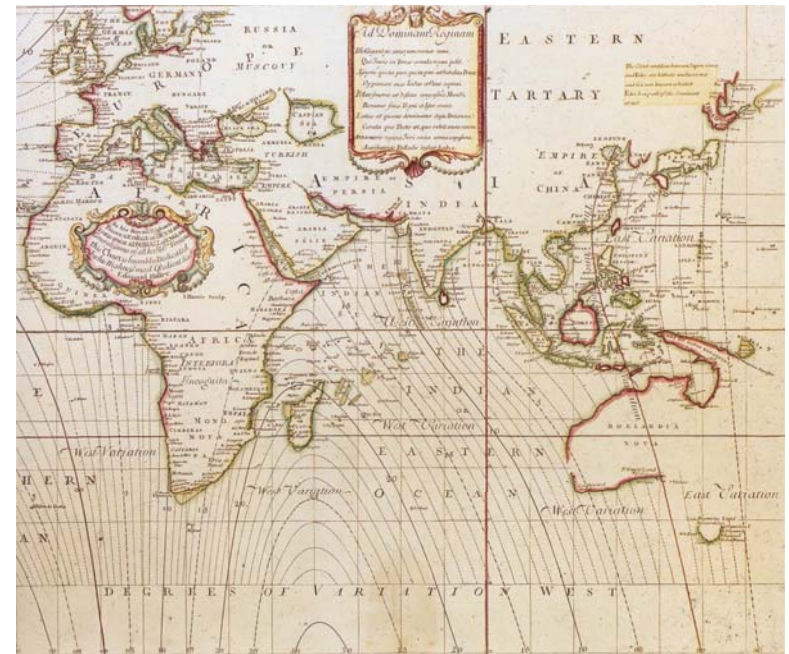
The earliest eclipse map appears to have been published in 1700 by the French astronomer Jean-Dominique Cassini (1625-1712), depicting the path of the solar eclipse of 23 September 1699. Later sources claim that Cassini also produced a map of a solar eclipse in 1664 (or 1661) but efforts to verify this have been unsuccessful.

The next solar eclipse that was visible from Europe, the total solar eclipse of 12 May 1706, was the subject of several eclipse maps drawn by Dutch and German astronomer-cartographers.

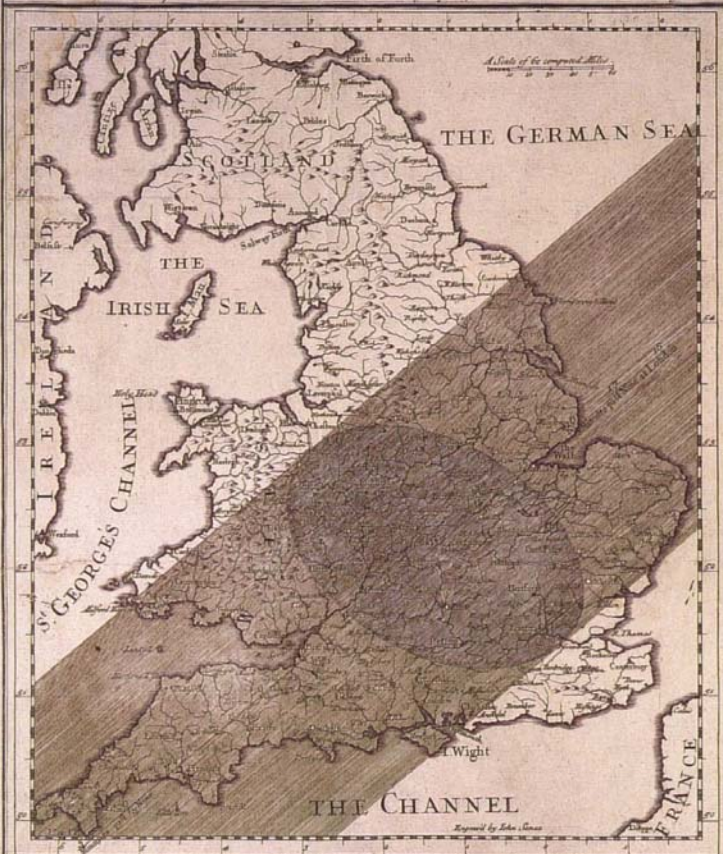
The last slides of this presentation show some examples of later eclipse maps.



Edmund Halley (1656-1742) and his isoline maps of the magnetic deviation (1701/02)



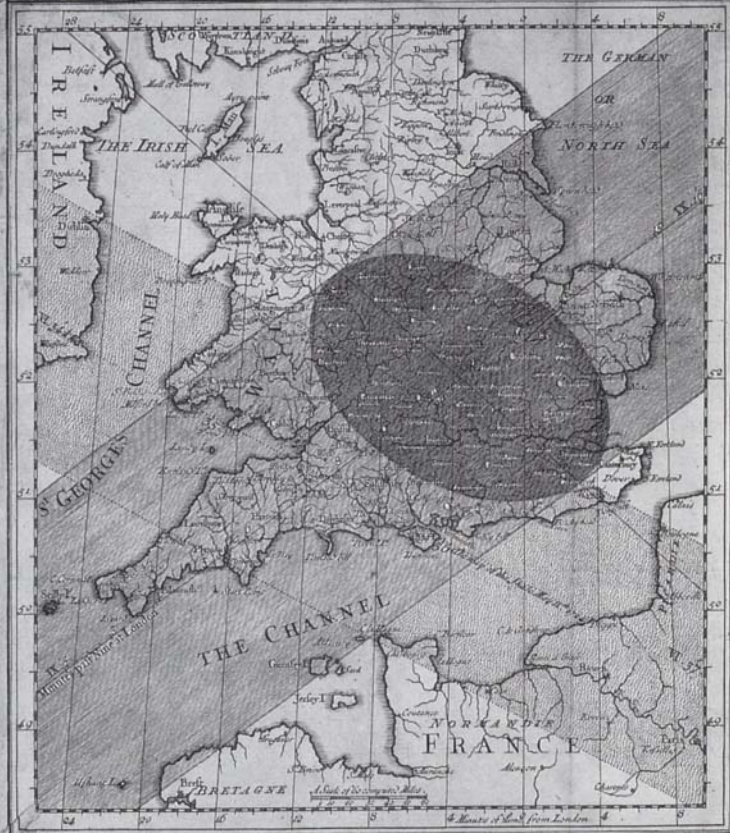
A Description of the Passage of the Shadow of the Moon, over England, In the Total Eclipse of the SUN, on the 22^d Day of April 1715 in the Morning.



The like Eclipse having not for many Ages been seen in the Southern Parts of Great Britain, I thought it not improper to give the Publick an Account thereof, that the sudden darkness when the Sun will be visible about the Sun, may give us some ground to the People, who would, if undisturb'd, be apt to look upon it as Ominous, and to interpret it as portending evil to our King and Country. King George and his Government which they observe. Surely they will see that there is nothing in it more than a Natural, and necessary result of the Motion of the Sun and Moon, and how well these are understood will appear by this Eclipse. According to what has been formerly Observed, compared with our best Tables we conclude the Center of the Moon's Shade will be very nearly Lizard point, when it is about 5 miles past Nine at London, and that from thence in Eleven minutes of Time it will cross the whole Kingdom, passing by Plymouth, Bristol, Gloucester, Downport, Peterborough, Boston, near the small part of Ireland. On each side of the Strait for about 2 Miles the Sun

will be totally darkned, but for less Time, as you are nearer those Limits, and are represented in the Scheme, passing on the one side near Chelster, Leeds, and York, and on the other by Chelchester, Gravesend, and Harwich. At London we compute the Middle to fall at 12 min. past 9 in the Morning when its duration whether it will be a total Eclipse or no London being so near the Southern Limit. The first beginning will be there at 9 min. past Eight and last at 12 min. past Ten. The Oval figure shows the passage of the Moon will take up a fifth of the Middle at London, and its Center will pass on the 25th of March with a Velocity of nearly 10 Geographical Miles in a min. of Time. The Figures are directed to Observe it, and especially the duration of total Darkness, with all the care they can, for thereby the Situation and dimensions of the Shade, will be nearly determined, and by means thereof we may be enabled to predict the like Appearances for the future, to a greater degree of certainty than can be pretended to at present, for want of such Observations. By these humble Servants Edmund Halley

A Description of the Passage of the Shadow of the Moon over England, In the Total Eclipse of the Sun on the 11th Day of May 1724 in the Evening, Together with the Passage of the Shadow as it was Observed in the last total Eclipse of 1715. By W. F. Halley, R.S.S. Astr. Roy.



Since the Publication of our Predictions of this Eclipse has had the desired effect, and many curious Persons have been excited thereby to communicate their Observations from most parts of the Kingdom, we thought it might not be unacceptable to replicate after the same manner the passage of the Shade, as it really happened, and hereby it will appear that the true Numbers pretend not to be altogether perfect, yet the correction they need is very small. At London the Eclipse was carefully Observed to begin at 8. 6 min. and to become total at 9. 9. It continued total 3. 23, and ended at 12. 21. And by the Accounts we have received from Abroad the Center of the Shade pass nearly over Plymouth, Exeter, Buckingham, and Huntingdon, leaving Bath and Lynn a little on the left, and Oxford and Ely on the right. The Southern Limit pass over Cranbrook in Kent, leaving Newcastle and Canterbury every little without. And the Northern Limit entered on the Coast of Wales in St. David's Bay, & left England near Flamborough-head, all which the Map more particularly directs. The greater diameter of the Shade having been exactly 11 Miles 1000 Yards, and 1/20th of an Inch.

The Numbers on the middle parallel lines in our former, denote the place of the Center of the Shade at so many minutes past Nine at London. By help of this kind of the Center diameter of the Shade's Oval figure is 9 on the Center moved passing every place before the greatest Obscurity was 200 some instant as at London we may very nearly find the time of the greatest darkness at any other place in 2 Days. For drawing a line parallel to the equatorial diameter thro' the proposed place it will cut the Center of the Shade at 6 minutes of greatest Obscurity reckoned as at London, and by allowing of difference of Meridians, at 6 place still. Thus for example, the greatest Eclipse will be found at York at 6. 10, at Dublin 8. 42, at Bristol 8. 43.4. Also in the same manner may the time of total Darkness be had, by drawing a line parallel to the way of the Shade by 6 these proposed. For as much of the line as falls within of the Shade's Oval, measured on the Scale of minutes, will show how long that place continued within the true Shade's shadow. Thus, as it will pass over the Isle of England in 2 Days, it will be there 1724 May 11. It will be at Northernmost place very near Dublin & Oxford. But it will pass near London when it begins at 5. 34 of greatest at 6. 12 & ends at 12. 21 in Evening.

Edmund Halley's maps of the paths of the solar eclipses of 3 May 1715 and 22 May 1724



Jean-Dominique Cassini (1625-1712)

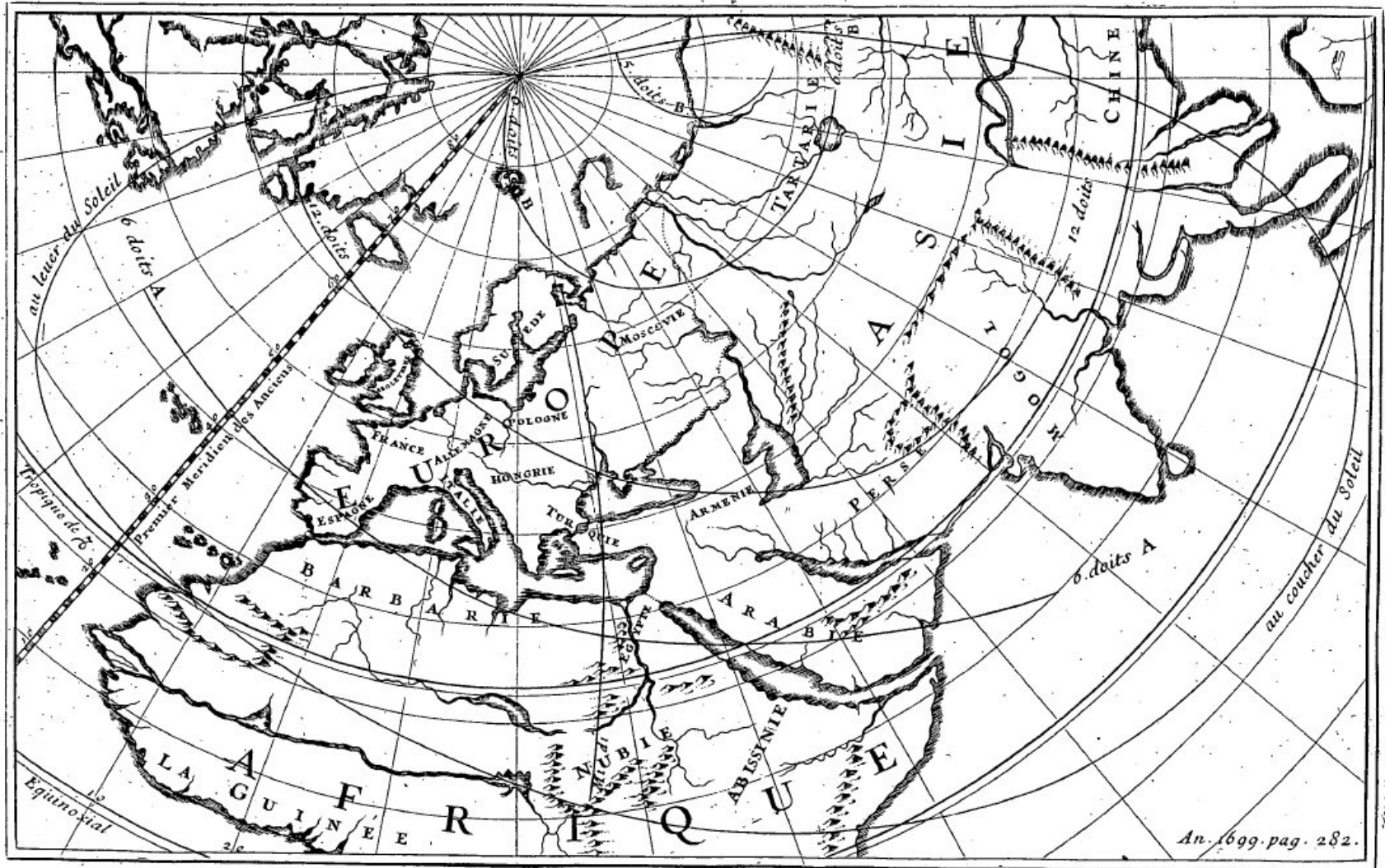
According to Otto Neugebauer (*A History of Ancient Mathematical Astronomy*, 1975, p. 1093):

“The idea of investigating the total path of a solar eclipse [...] is of modern origin – probably developed in the time of J. Cassini under the influence of the great theoretical interest of the Venus transits of 1761 and 1769. [...] According to Lalande (Astron. II, p. 358, No. 1799; Bibl., p. 256, 1644 [read 1664]) Dom. Cassini constructed in 1664 for the first time the path of a solar eclipse (visible in Ferrara) on a terrestrial map. But there was no total solar eclipse in 1664 and no publication of Cassini with the title quoted by Lalande seems to be known.”

Entry in Lalande’s *Bibliographie astronomique* (1802):

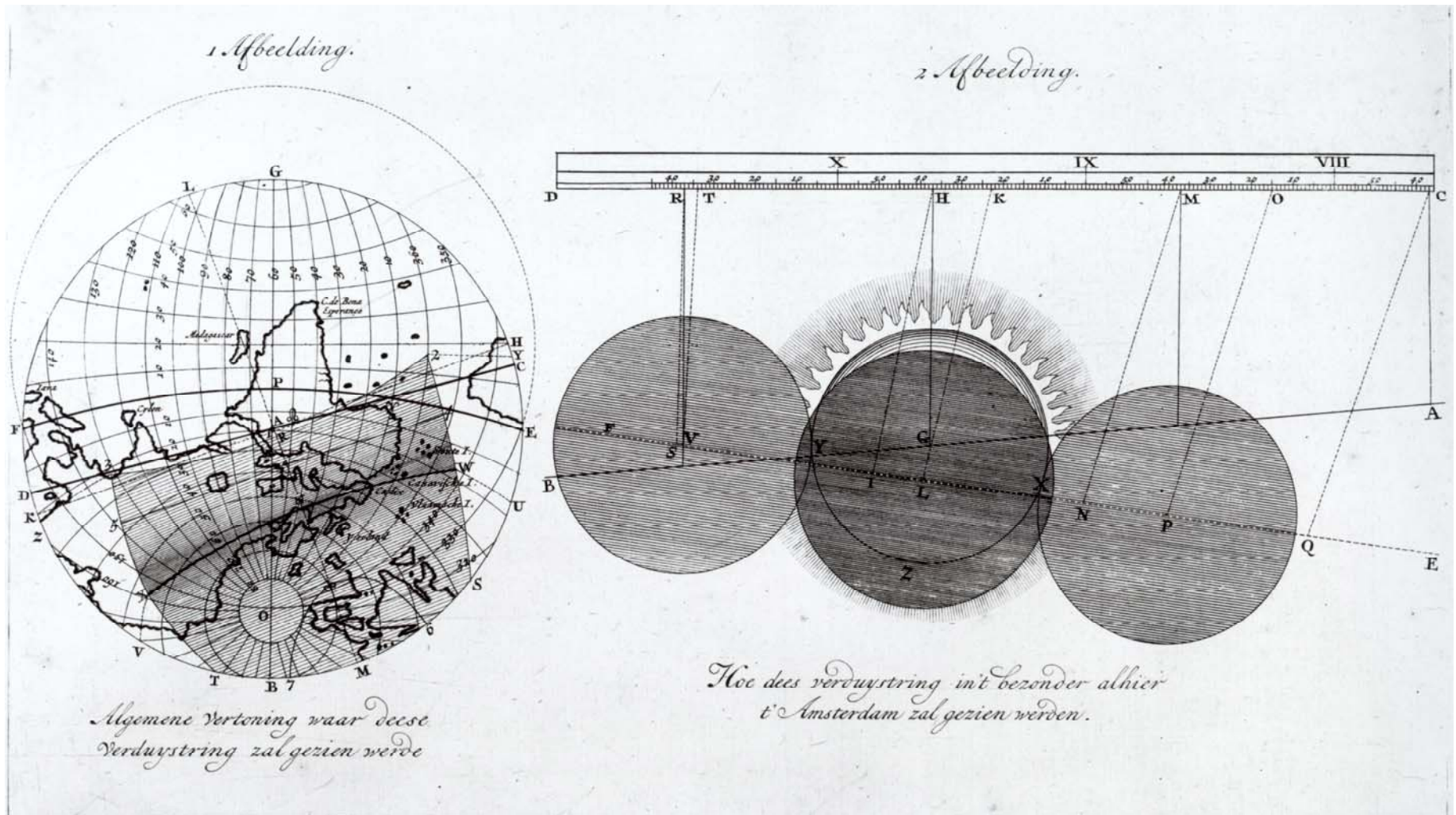
“Ferrarae, in-fol. Jo. Domenici Cassini Osservazione del eclisse solare fatta in Ferrara l’anno 1664, con una figura intagliata in rame, che rapresenta uno nuovo metodo di trovar l’apparenze varie che fa nel medesimo tempo in tutta la terra. Weidler, p. 527. = Astron. art. 1808.”

The earliest retrospective eclipse map (solar eclipse of 23 September 1699)



Published in J.D. Cassini, "Reflexions sur l'eclipse du 23. Septembre 1699. qui ont été omises dans leur place", *Histoire de l'Académie Royale des Sciences avec les mémoires de mathématique & de physique tirez des registres de cette Académie pour l'année MDCXCIX* (Paris, 1700).

The earliest predictive eclipse map (solar eclipse of 11 May 1706)



Symon van de Moolen's diagram on the solar eclipse of 11 May 1706 from a Dutch booklet published in 1705



Approximate path of the solar eclipse of 12 May 1706 according to Andreas van Luchtenburg. The eclipse is assumed to start in the Atlantic Ocean (A), reach its northernmost point above Moscow (B) and to end in China (C).



Johann Gabriel Doppelmayr (1677- 1750)

Native of Nuremberg where he lived and worked during most of his life.

- Visited Holland during 1700/1701 (Utrecht).
- Visited England (London, Oxford) in the summer of 1701.
- Returned to Holland to learn lens grinding in Leiden (1701/1702).

Designed many astronomical diagrams and maps for the Nuremberg publisher Johann Baptista Homann (1664-1724). Many of these were later published in his *Atlas Coelestis* (Nuremberg, 1742) and *Atlas Novus Coelestis* (Nuremberg, after 1742).

IOHANN GABRIEL DOPPELMAIR.
*Mathem. Prof. Publ. Noriberg Acad.,
Imperial Leopoldino-Caroline, Na-
turae curios. ut et Societ. Reg. Borus. Scient.
Sodalit.*



Doppelmayr's map of Europe (published in early 1707) depicting the circumstances of the solar eclipse of 12 May 1706 as observed by various astronomers ("*multis illustrium virorum*")

Geographica Repraesentatio

EUROPÆ die 12. Maji 1706 ECLIPSATA

per phaſium Solis (in 12 digitos diviſi) magnitudines quævis, ſuis locis appa-
rentes, cum via totalis Umbrae, ex multis Illuſtrium Virorum obſervationibus
indiquaque collectis, per arcus parallelos op̄i Dⁿⁱ J. GABR. DOFFELMAYR
H. ab. P. curioſe ſtenduntur Auctore J. B. Homanno, ut infra.

Zu bemerken

Daß aus dem hieby geſetzten Obſervationibus die Eintheilung dieſer Kunſternus-Carten
gemacht worden ſeyt, u. ſt die Bedeckung der Sonne an folgenden Orten groß beſundt worden
Dawer nach dem Zeit-Minuten

PARTIAL nach den ecliptiſchen Zellen.

Zu Barcelona	....	Zu Paris	10 $\frac{1}{2}$.
Arles	....	Strasßburg	11 $\frac{1}{2}$.
Zürch	4.	Rom	10 $\frac{1}{2}$.
Schaffhaufen	....	Bononia	11 $\frac{1}{2}$.
Elm	4	Genua	11 $\frac{1}{2}$.
Neuburg	5 $\frac{1}{2}$.	Jena	11 $\frac{1}{2}$.
Fürnberg	2 $\frac{1}{2}$.	Leipzig	11 $\frac{1}{2}$.
Leitz	0 $\frac{1}{2}$.	Berlin	11 $\frac{1}{2}$.
Breßlau	1.	Leiden	10 $\frac{1}{2}$.
Königsberg	....	Canterbury	10.

CIRCULUS

Detail from Doppelmayr's map of Europe with observations of the solar eclipse of 12 May 1706

ATLAS NOVVS COELESTIS

Musci IN QVO *Astronomi* *Francia* 1742.

MVNDVS SPECTABILIS,

ET IN EODEM

TAM ERRANTIVM QVAM INERRANTIVM STELLARVM
PHOENOMENA NOTABILIA,
CIRCA IPSARVM LVMEN, FIGVRAM, FACIEM, MOTVM, ECLI-
PSES, OCCVLTATIONES, TRANSITVS, MAGNITVDINES, DISTAN-
TIAS, ALIAQVE
SECVNDVM

NIC. COPERNICI

ET EX PARTE

TYCHONIS DE BRAHE

HIPOTHESIN,

NOSTRI INTUITU, SPECIALITER, RESPECTU VERO AD AP-
PARENTIAS PLANETARVM INDAGATV POSSIBILES, E PLANETIS PRI-
MARIIS, ET E LUNA HABITO, GENERALITER,

*E CELEBRIMORVM ASTRONOMORVM OBSERVATIONIBVS
GRAPHICE DESCRIPTA EXHIBENTVR*

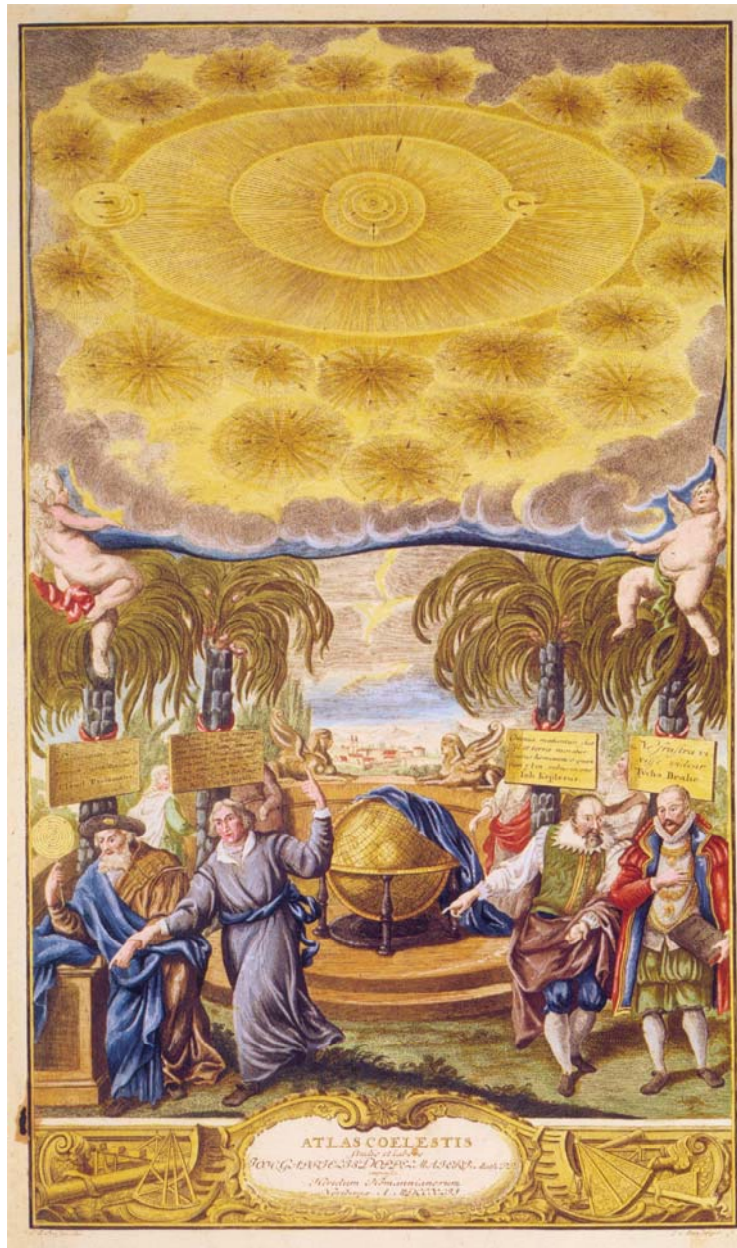
IOH. GABRIELE DOPPELMAIERO.

ACADEMIARVM IMP. LEOPOLDINO-CAROLINAE ET PETRO-
POLITANE, SOCIETATVMQVE REGG. SCIENTIARVM, BRITANNICAE ET
BORVSSICAE, SODALI, NEC NON PROFESSORE PVBL. MATHEMA-
TVM NORIM.

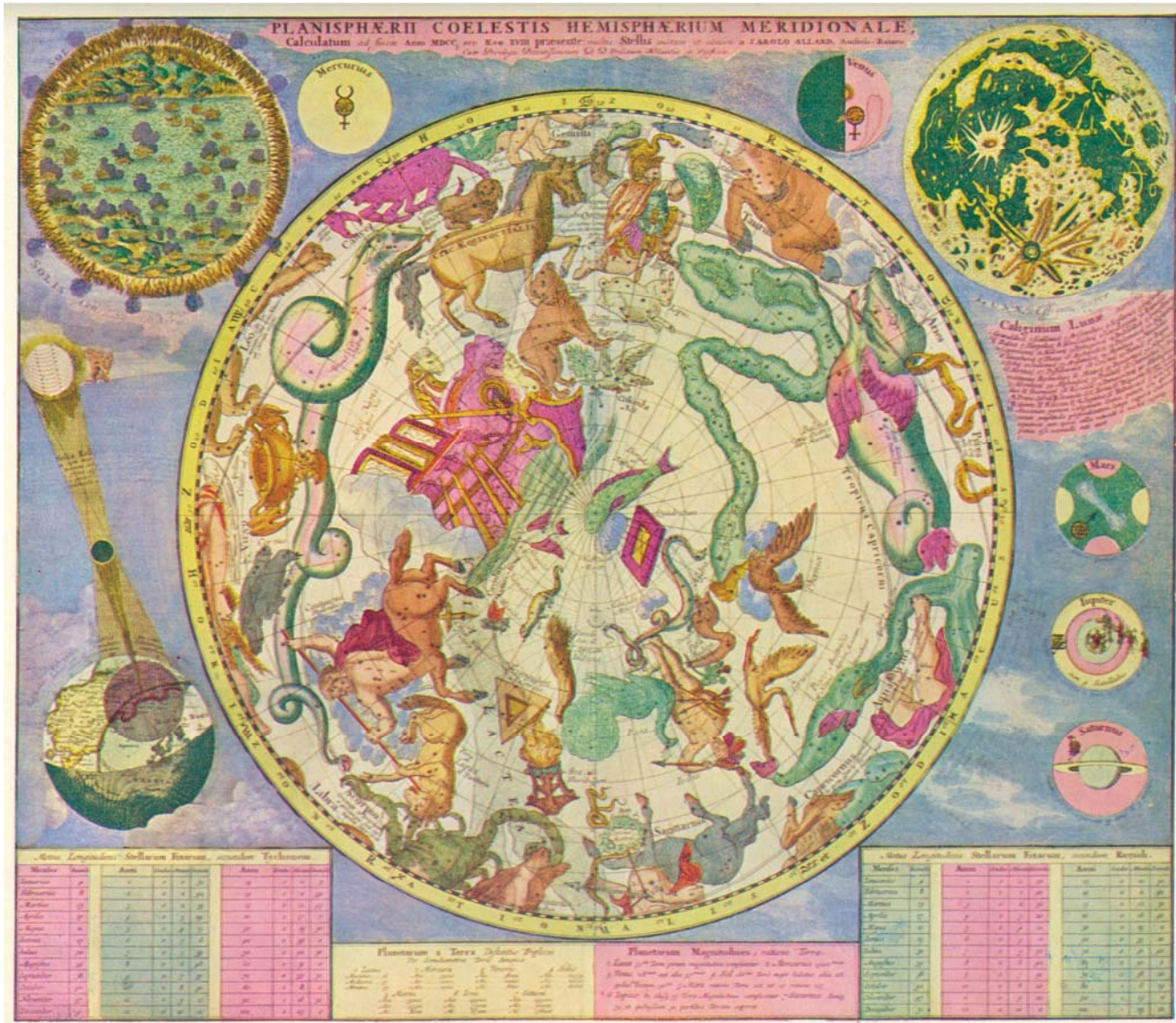


NORIMBERGAE,

Sumptibus Heredum Homannianorum. A. 1742.



Doppelmayr's *Atlas Novus Coelestis* (Nuremberg, after 1742)



**Carel Allard (1648-1709) – astronomical map depicting the southern celestial hemisphere (1708)
 Note the solar eclipse diagram and its similarity with Doppelmayr’s diagram**



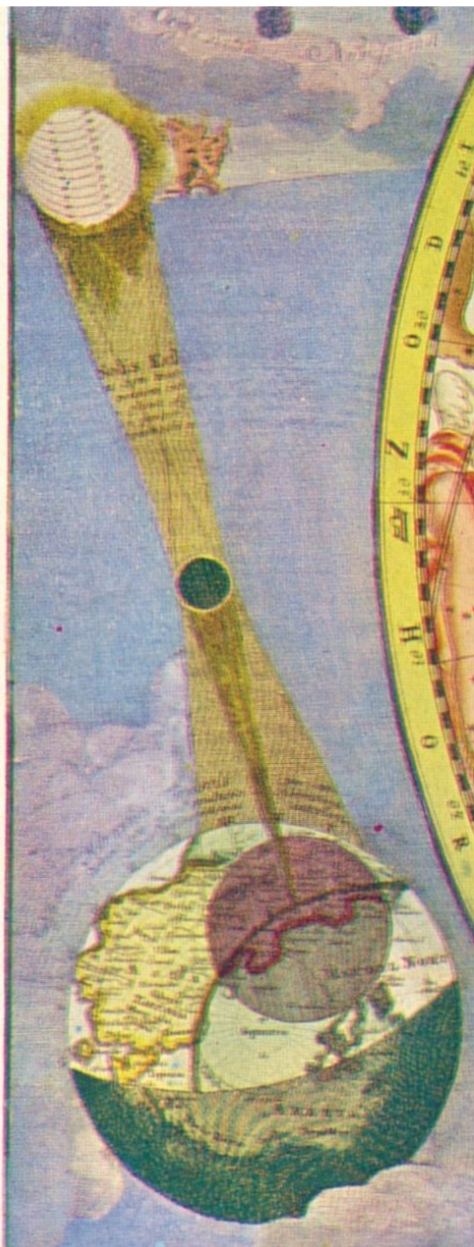
Detail from the Schenk map with the path of totality of the solar eclipse of 12 May 1706



**Diagram from the Schenk map depicting the solar eclipse of 3 May 1715
 (after Symon van de Moolen)**



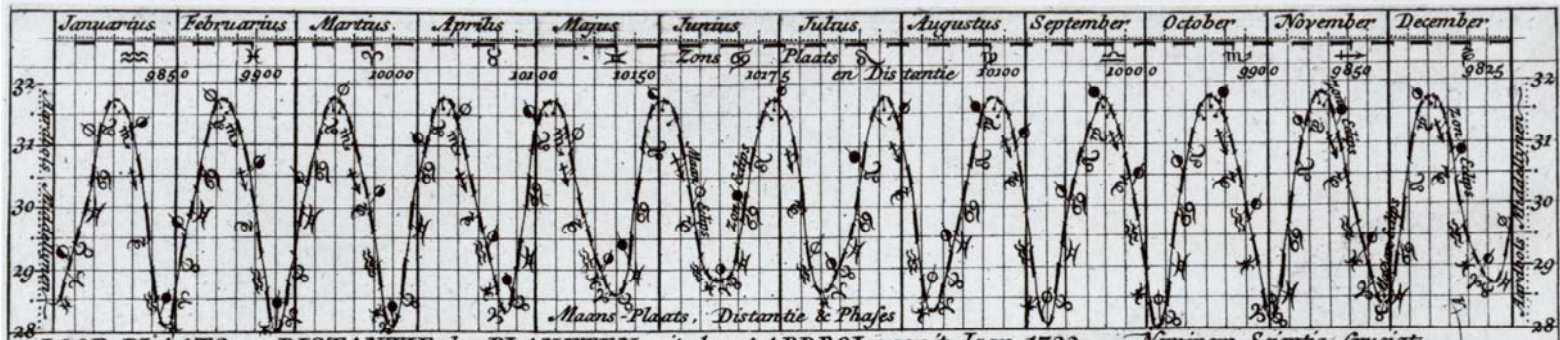
Doppelmayr (1707)



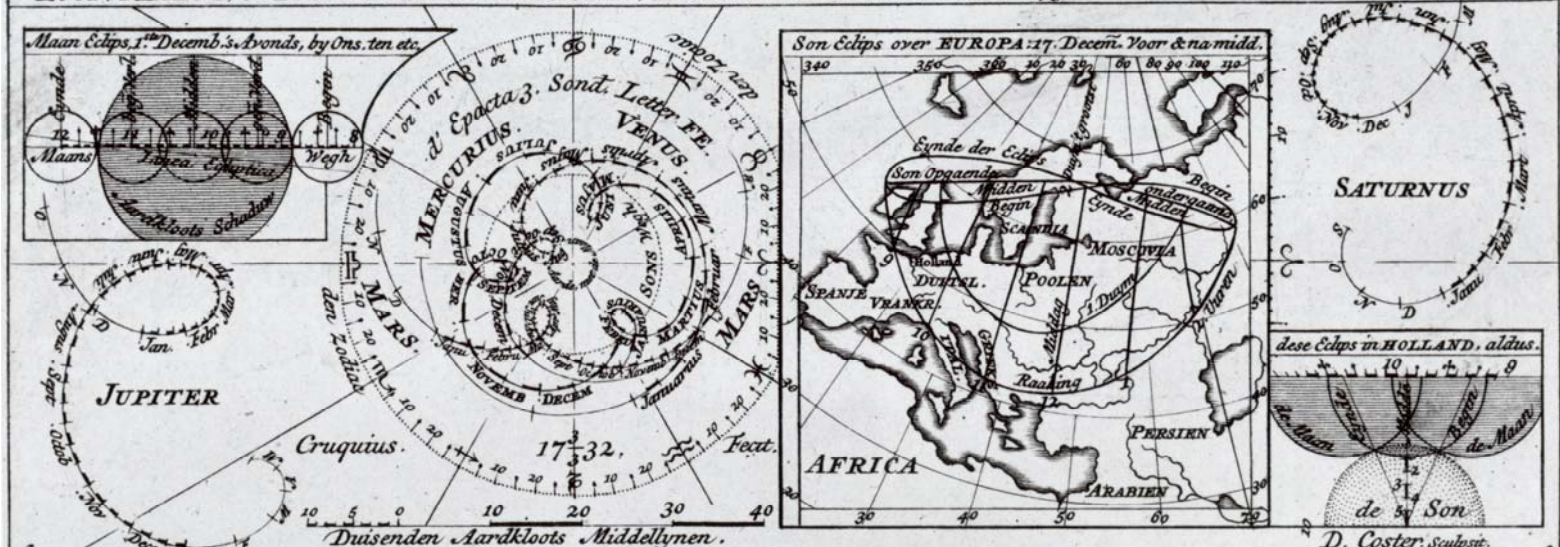
Carel Allard (1708)



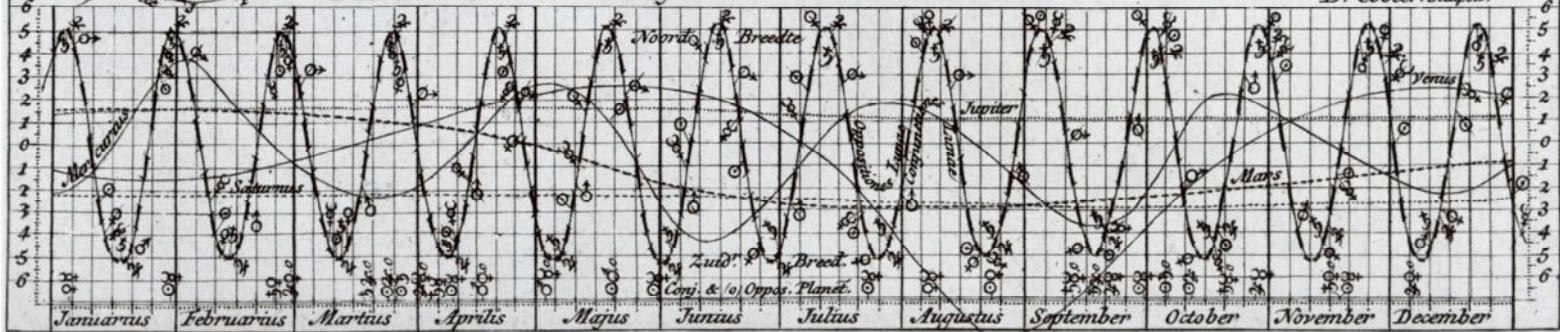
Petrus Schenk jr. (1715)



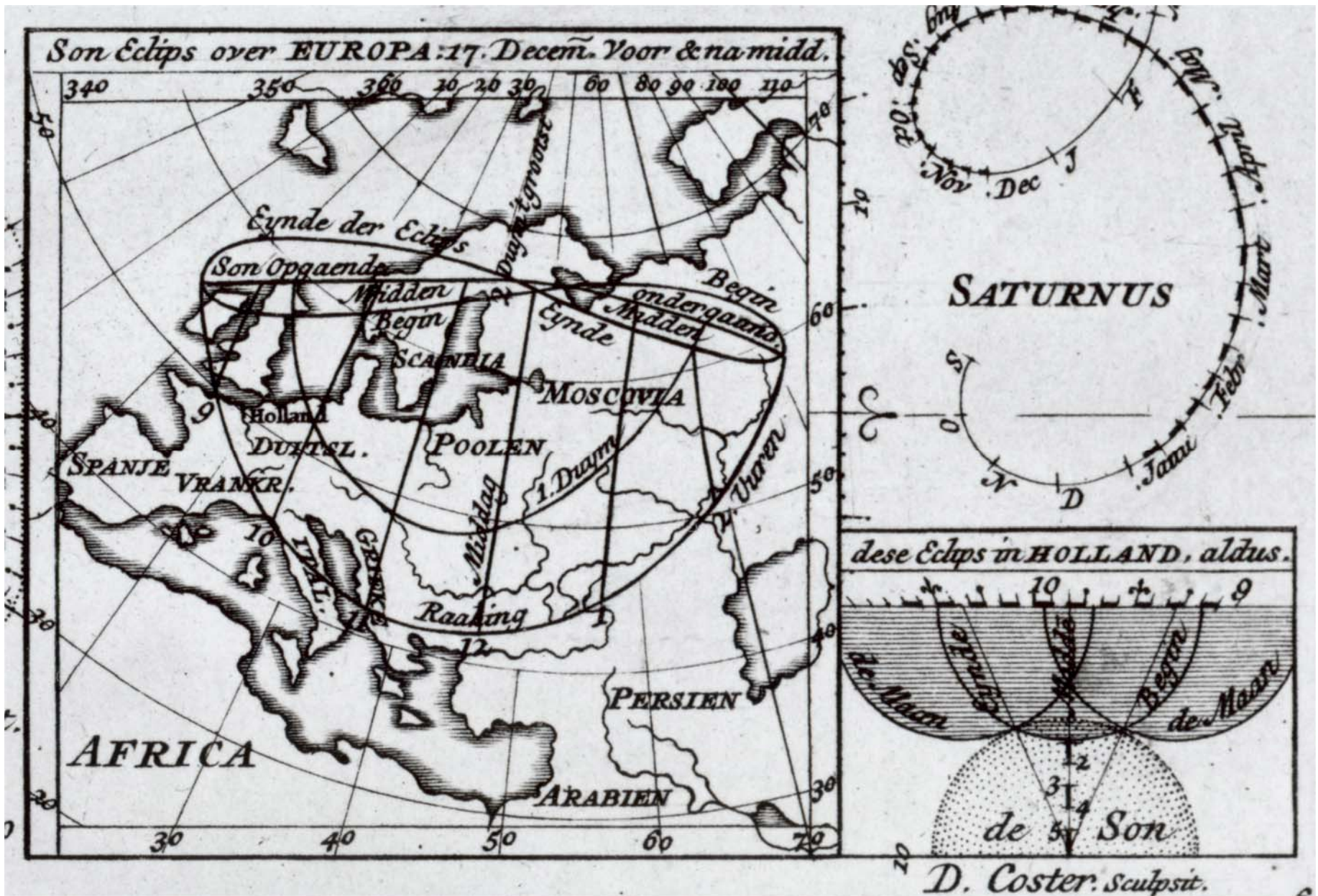
LOOP, PLAATS, en DISTANTIE der PLANETEN, uit den AARDBOL voor 't Jaar 1732. *Neminem Scientia Cruciat.*



D. Coster. sculpit.

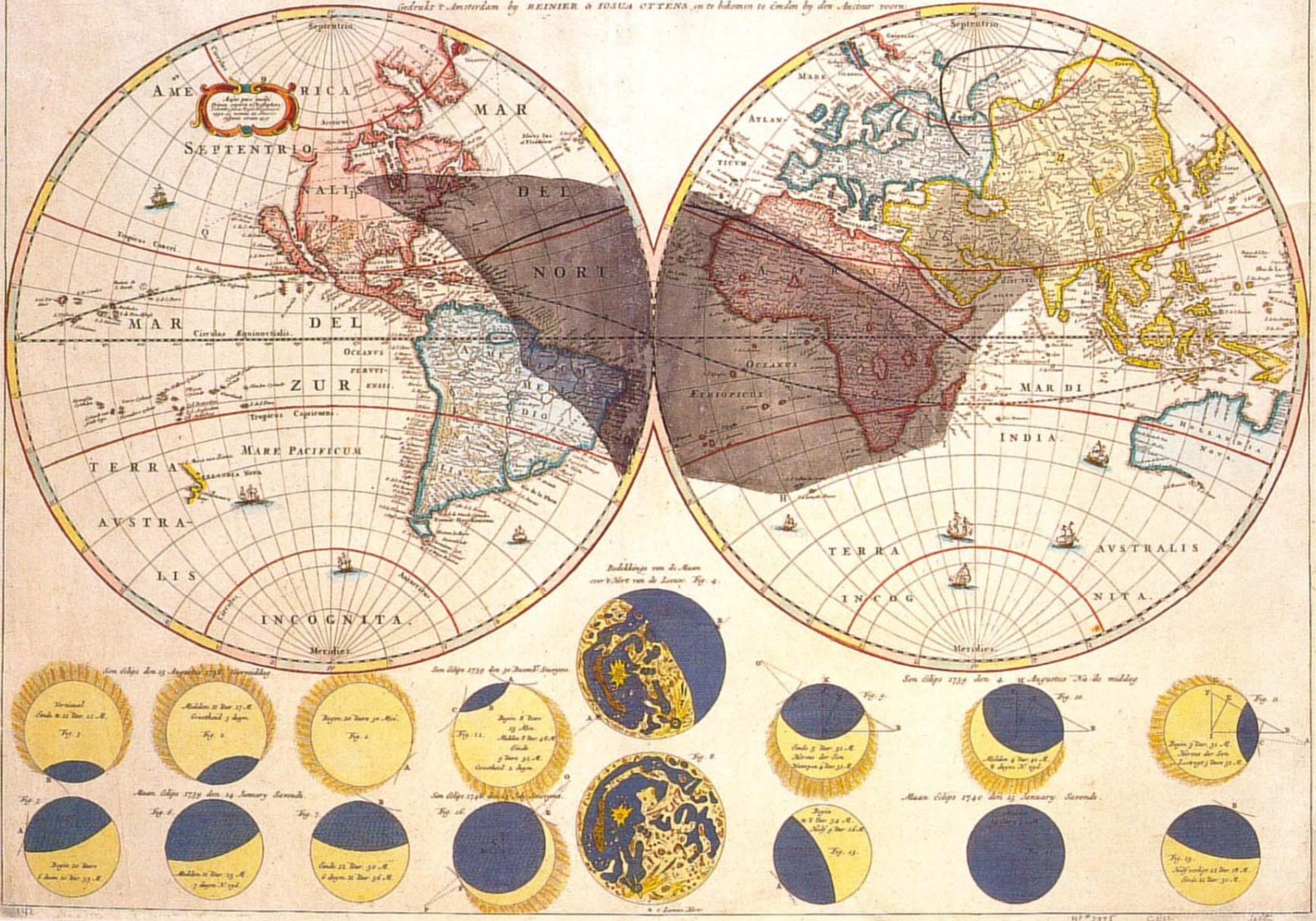


Nicolaus Samuel Cruquius (1678-1754) – diagram of the astronomical phenomena of 1732



Detail depicting the circumstances of the solar eclipse of 17 December 1732

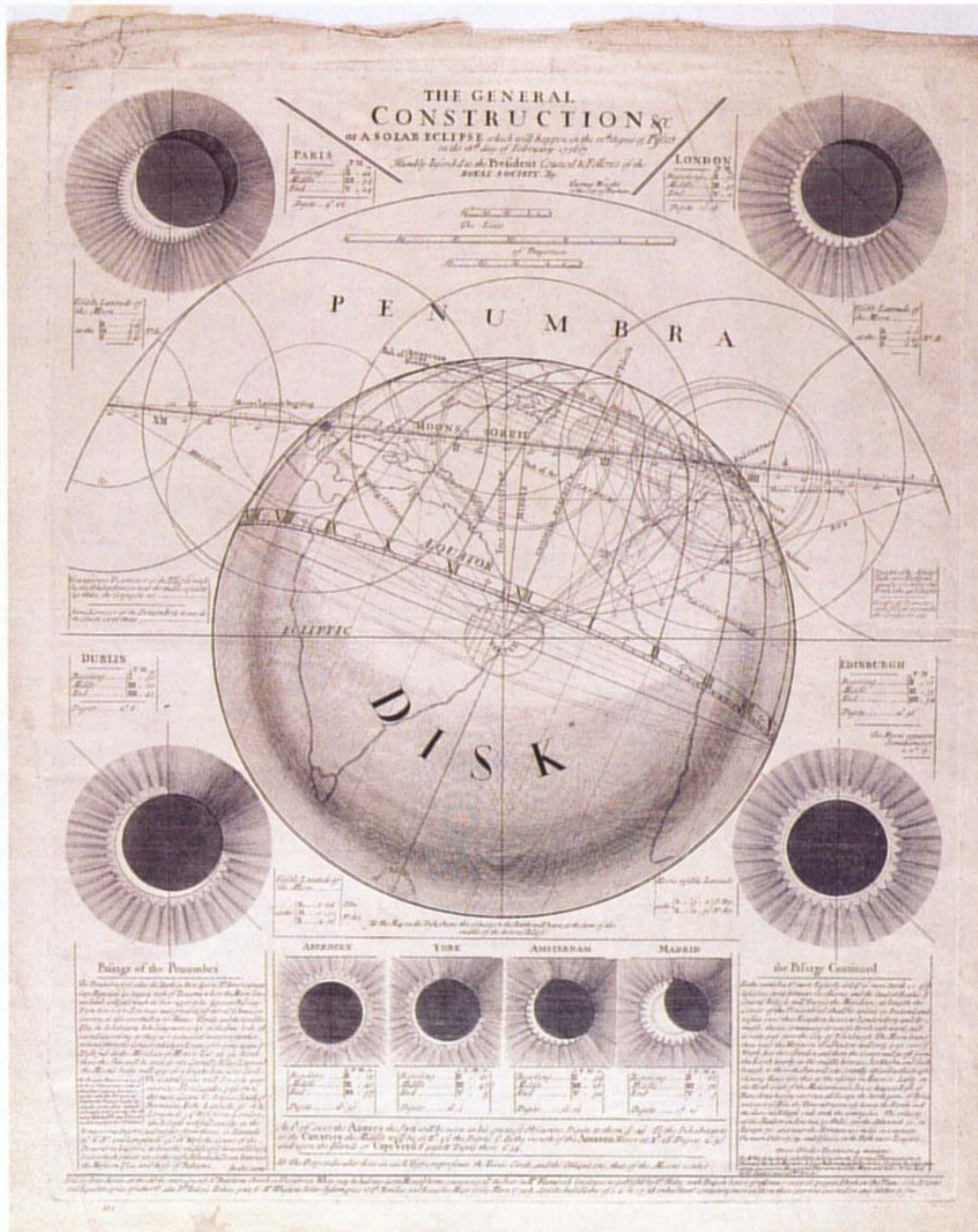
ASTRONOMISCHE HEMEL SPIEGEL waar in men sien kan de merkwaardigste hemelische verduydenissen aan Son, Maan, en Sterren, hoe dezelve zij na de ware justitie
 tot AMSTERDAM, en omleggende Steden zullen vertonen, sijnkende get. het Jaar 1740. naar by geroep is de verduydenisse van een groote Sons verduydenisse in t. Jaar 1738. Alsoe tot voortplanting
 der Astronomie en dienst der Liefhebbers van de Wis-kunst, in t. Licht gegeven door SYMON PANSER Stads-Mathematicus, leraar van de Wis-kunst en Astronomie tot EMBDEN.
 Gedrukt t. Amsterdam by BEINIER & JOHANN OTTENA, en te bekomen te vinden by den Auctour woon.



Symon Panser of Embden (1699-1754) – solar eclipses of 15 August 1738 and 4 August 1739



Robert Sayer (1725-1793/94) - solar eclipses of 1715, 1724, 1737, 1748 and 1764



Thomas Wright of Durham (1711-1786) – solar eclipse of 1 March 1737

Further reading:

- Geoff Armitage, *The Shadow of the Moon: British Solar Eclipse Mapping in the Eighteenth Century* (Map Collector Publications, Tring, 1997).
- Jay M. Pasachoff, “Halley as an Eclipse Pioneer: His Maps and Observations of the Total Solar Eclipses of 1715 and 1724”, *Journal of Astronomical History and Heritage*, vol. 2 (1999), pp. 39-54.
- Eli Maor, “Mapping the Moon’s Shadow”, *Sky & Telescope*, vol. 108 (2004), nr. 6, pp. 42-49.
- Robert H. van Gent, “Mapping the Lunar Shadow: The Earliest Solar Eclipse Maps”, in: G. Wolfschmidt & A.D. Wittmann (eds.), *Development of Solar Research* (Hamburg University Press, Hamburg, 2005 [= *Nuncius Hamburgensis: Beiträge zur Geschichte der Naturwissenschaften*, Band 2) – in press.