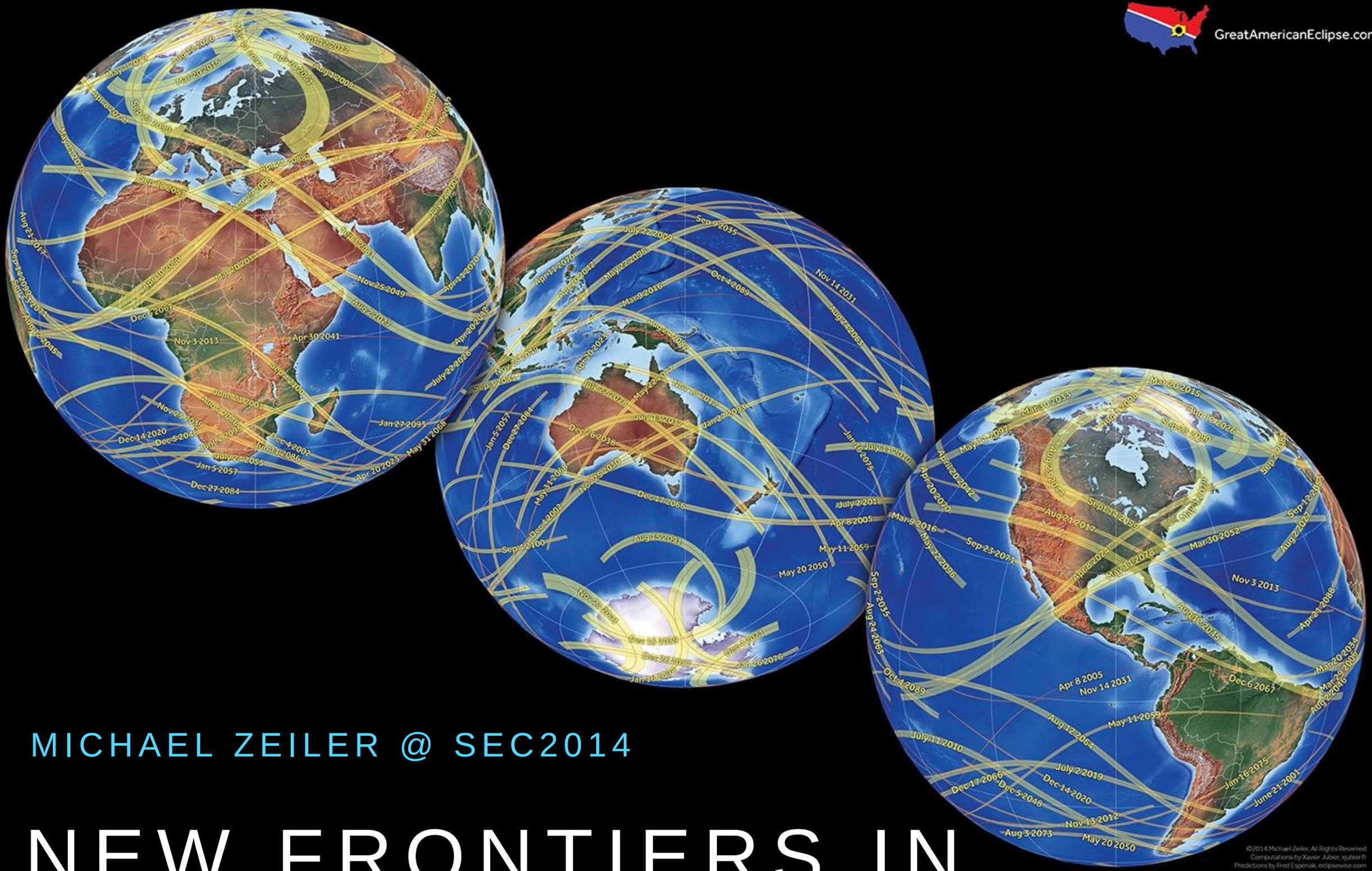


MICHAEL ZEILER @ SEC2014

NEW FRONTIERS IN ECLIPSE CARTOGRAPHY

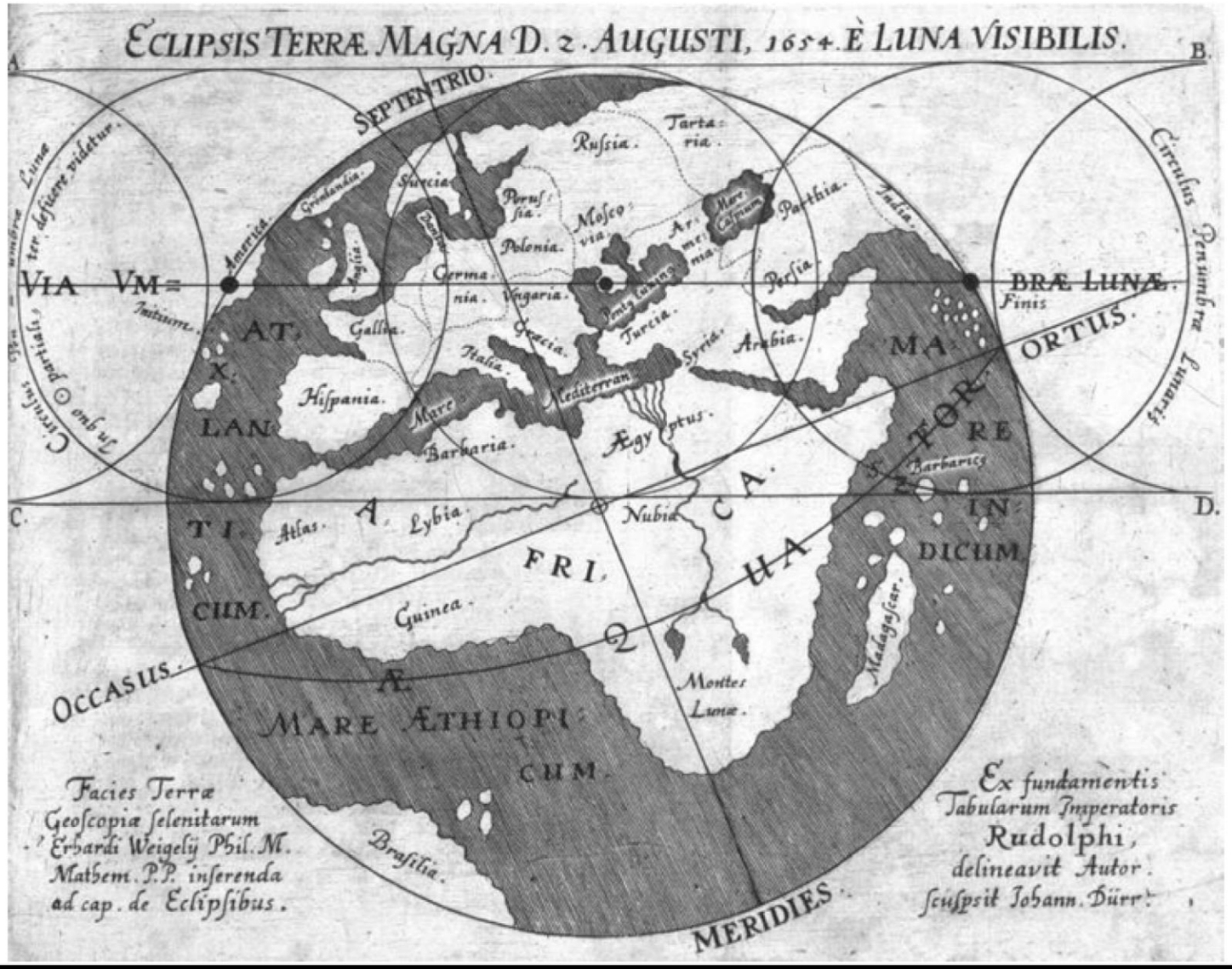
ECLIPSE MAPS TELL STORIES

Science
Artistry
Inspiration
Visualization
Humanity
Geography

Geography
Adventure
History
Splendor
Precision
Strategy

ERHARD WEIGEL, 1654

THE DAWN OF ECLIPSE MAPS

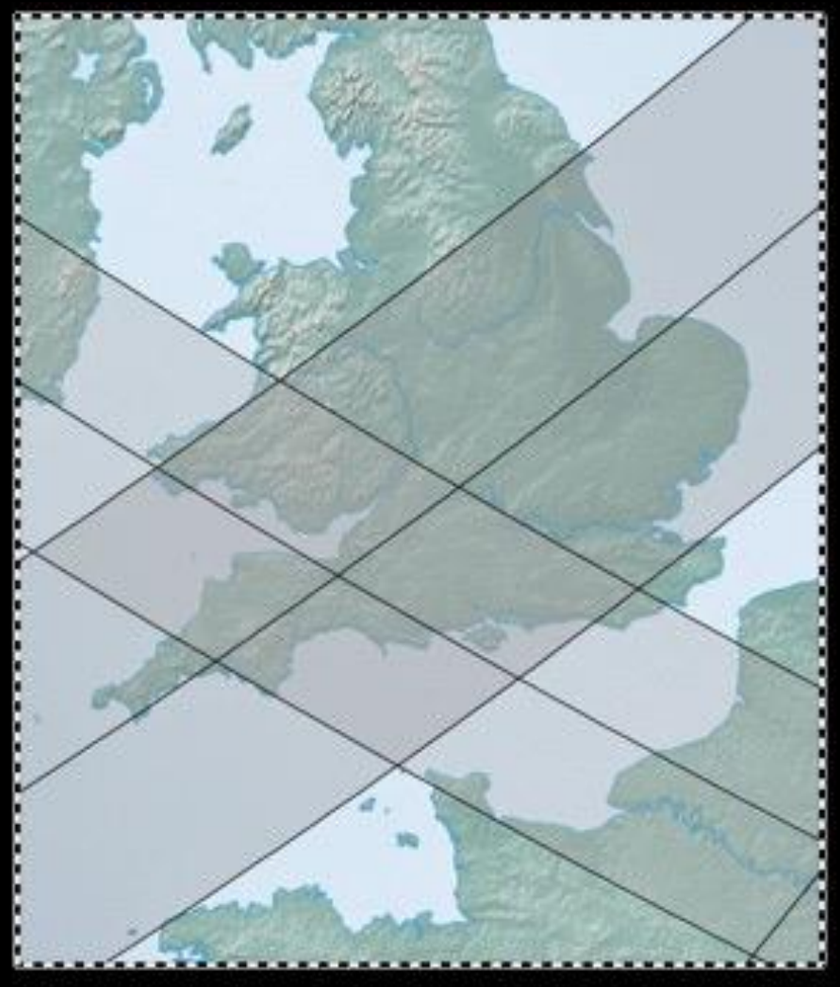


1706 - HOMANN, DOPPELMAYR, SCHENK

ARTISTRY

EDMUND HALLEY - 1715 & 1724

PRECISION



EDMUND HALLEY - 1715 & 1724

CITIZEN SCIENCE

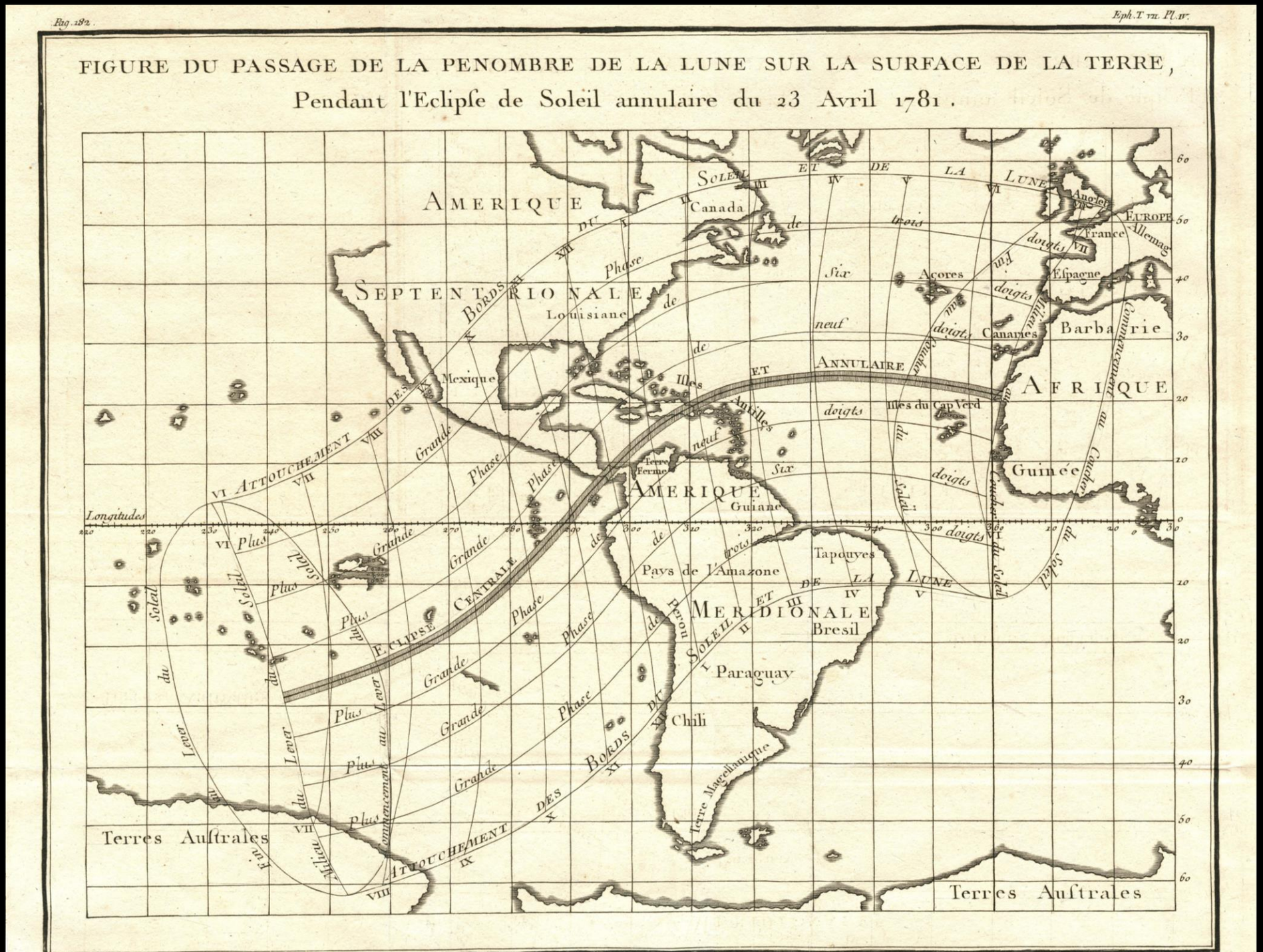
At London we Compute the Middle to fall at 13 min: past 9 in ye Morning, when 'tis dubious whether it will be a Total Eclips or no, London being so near ye Southern limit. The first beginning will be there at 7 min: past Eight, and ye end at 24 min: past ten The Ovall figure shews ye space ye Shadow will take up at ye Time of the Middle at London; and its Center will pass on to ye Eastwards, with a Velocity of nearly 30 Geographical Miles in a min: of Time.

NB. The Curious are desired to Observe it, and especially the du=ration of Total Darkness, with all the care they can; for therby the Situation and dimensions of the Shadow will be nicely de=termined; and by means therof we may be enabled to Predict the like Appearances for ye future, to a greater degree of certainty than can be pretended to at present, for want of such Observations.

By their humble Servant Edmund Halley.

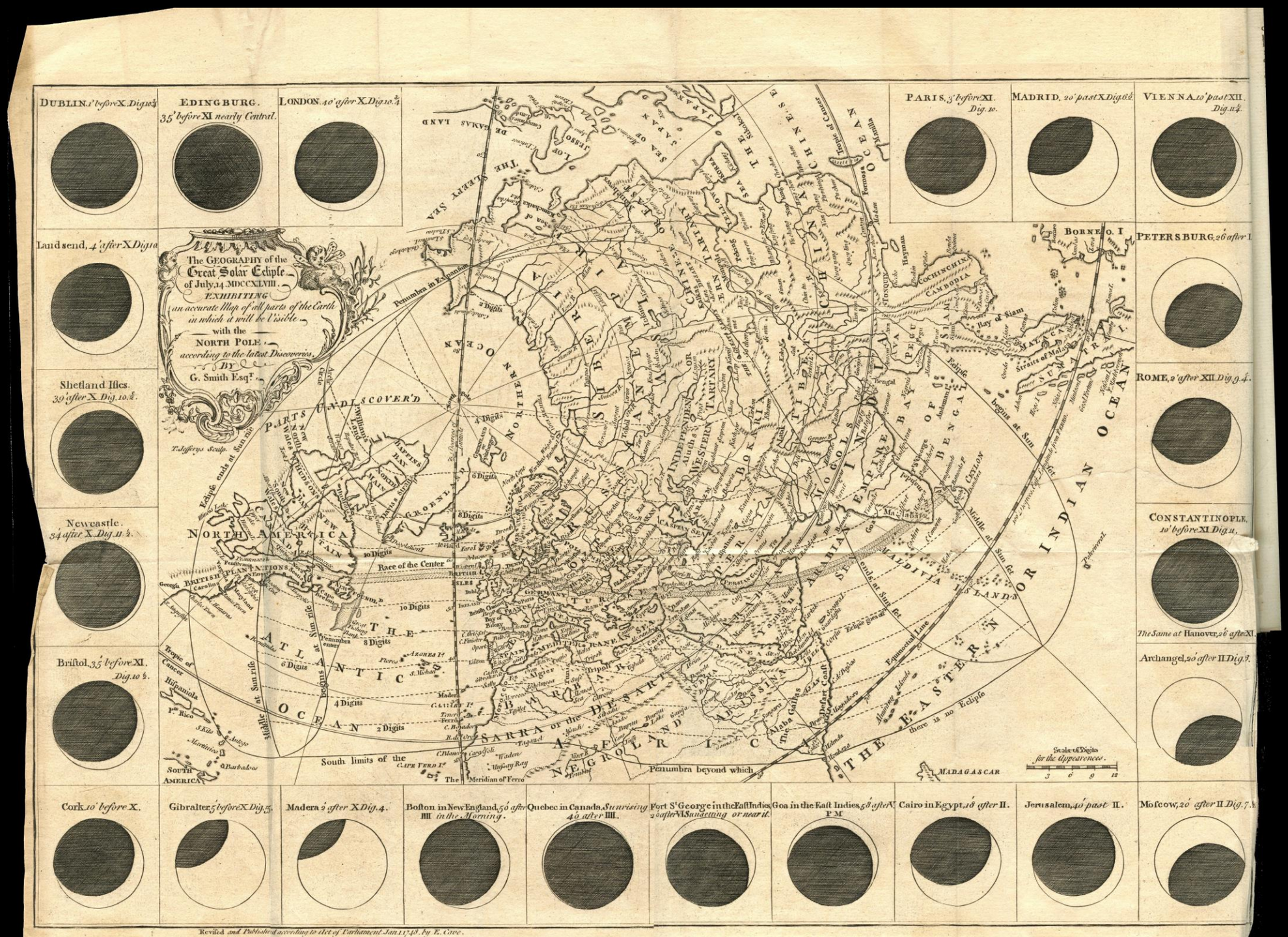
MADEMOISILLE DE ST LAURENT - 1781

GEOGRAPHY



GEORGE SMITH, 1748 - GENTLEMAN'S MAGAZINE

INFORMATION

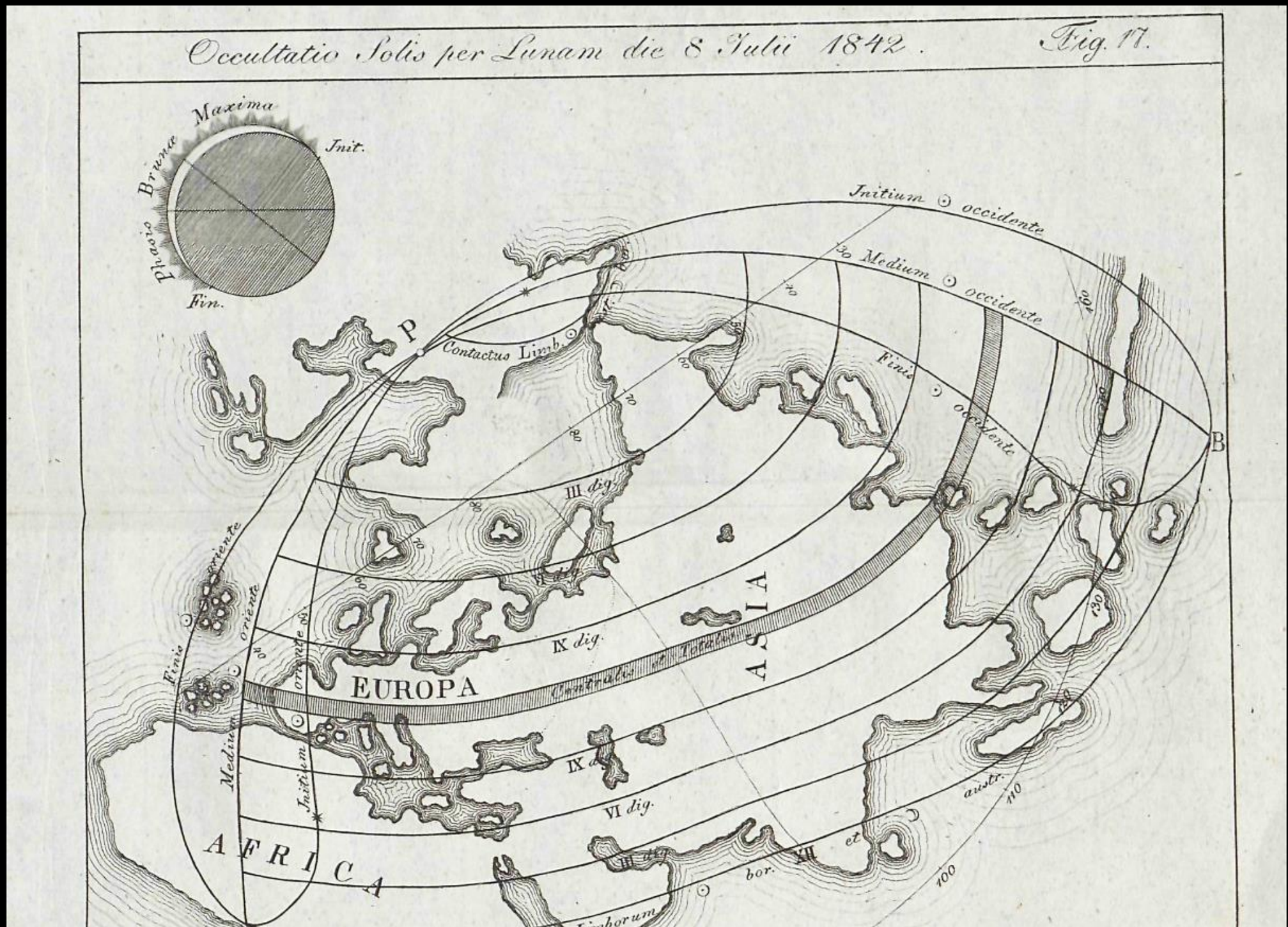


JUAN ANTONIO DE MENDOZA Y GONZALEZ, 1727

THE NEW WORLD

CASSIAN HALLASHKA, 1816 - ELEMENTA ECLIPSIUM

THE FIRST CANON

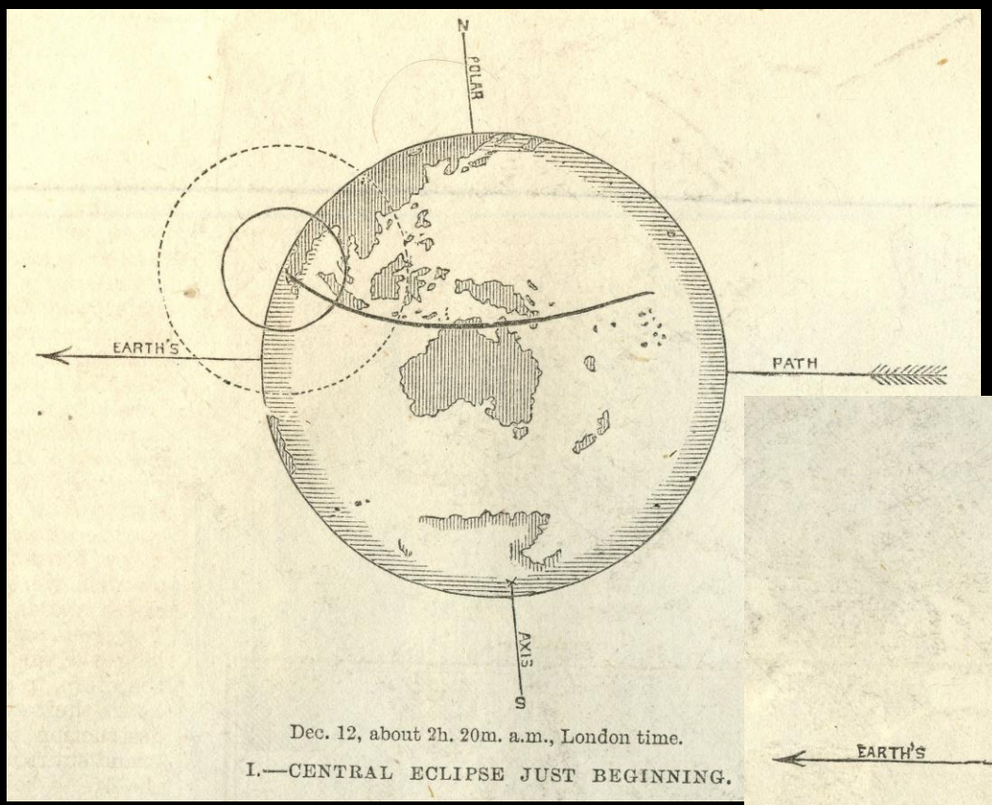


GRAY & BOWEN, 1831

FIRST US ECLIPSE MAP

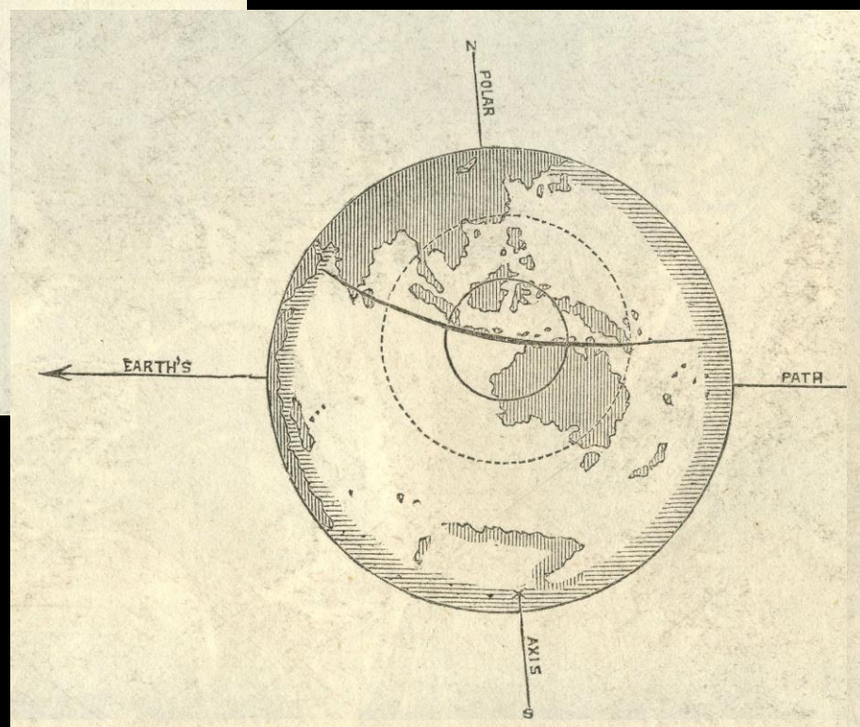
RICHARD PROCTOR, 1871

MOTION



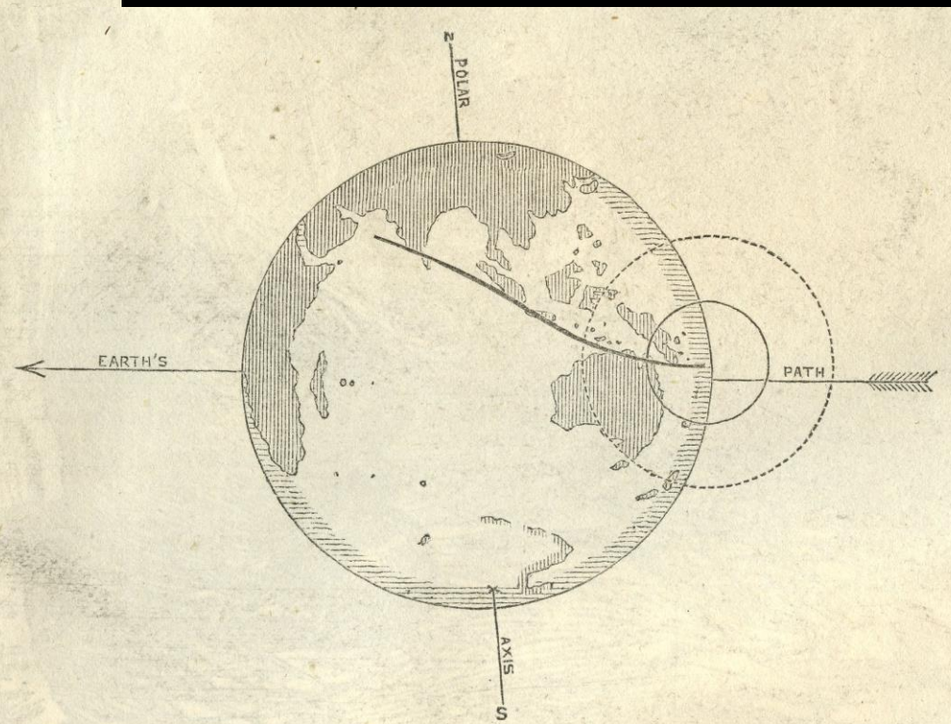
Dec. 12, about 2h. 20m. a.m., London time.

I.—CENTRAL ECLIPSE JUST BEGINNING.



Dec. 12, about 4h. 0m. a.m., London time.

III.—CENTRAL ECLIPSE, BETWEEN JAVA AND NORTH AUSTR

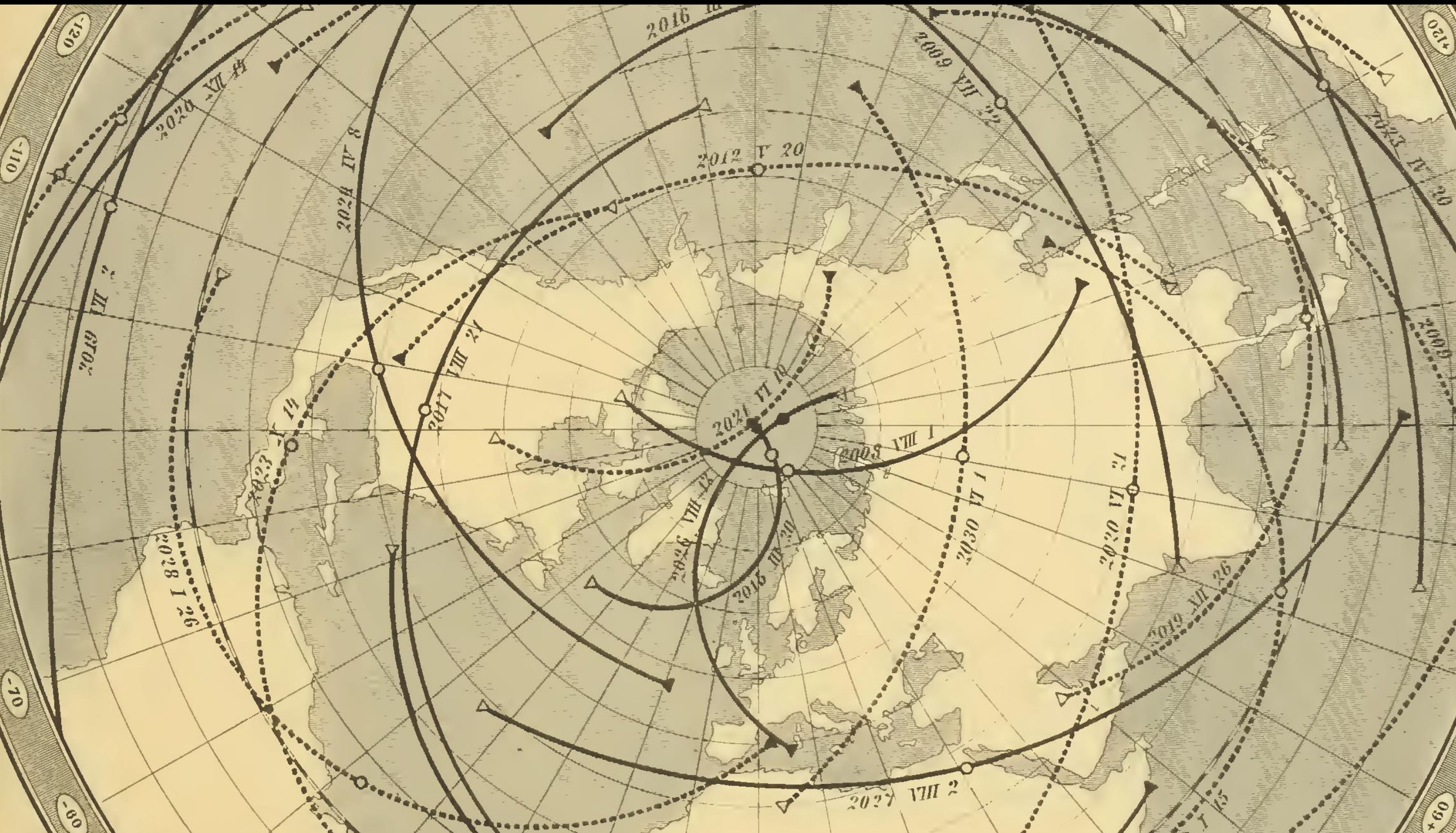


Dec. 12, about 5h. 40m. a.m., London time.

V.—CENTRAL ECLIPSE JUST ENDING.

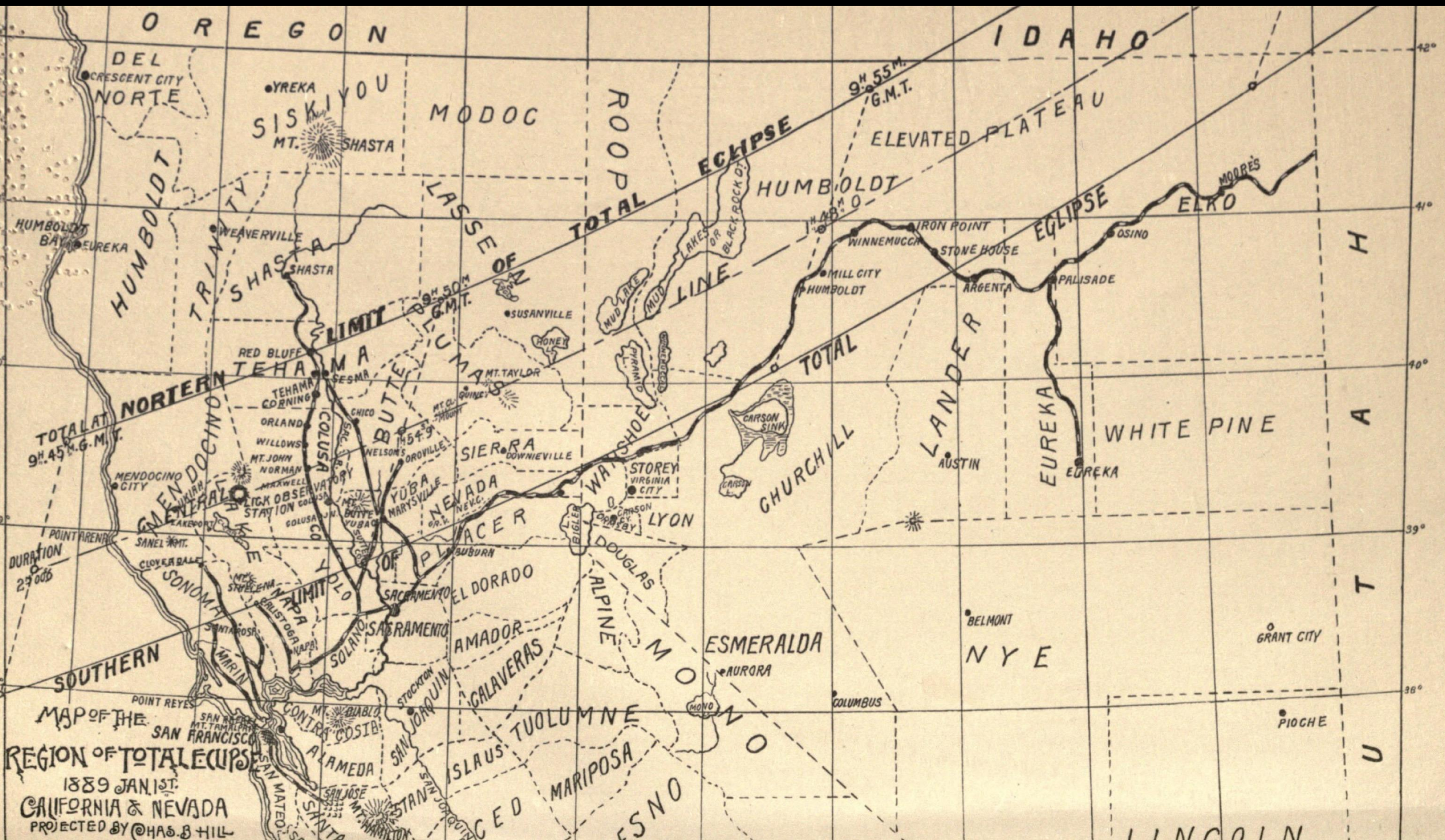
OPPOLZER, 1887 - CANON DER FINSTERNISSE

EPIC



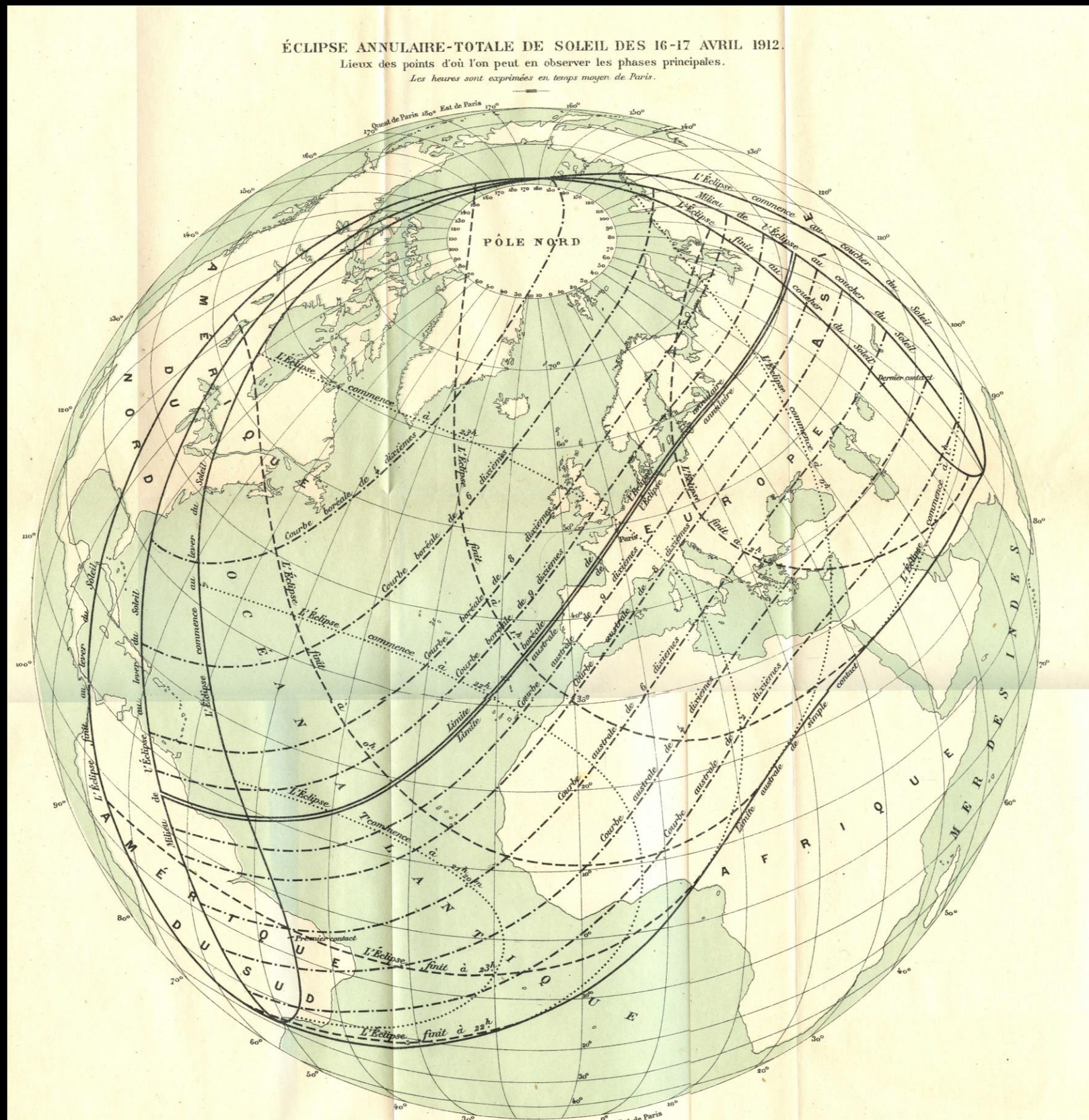
CHARLES B HILL, 1889

TYPOGRAPHY



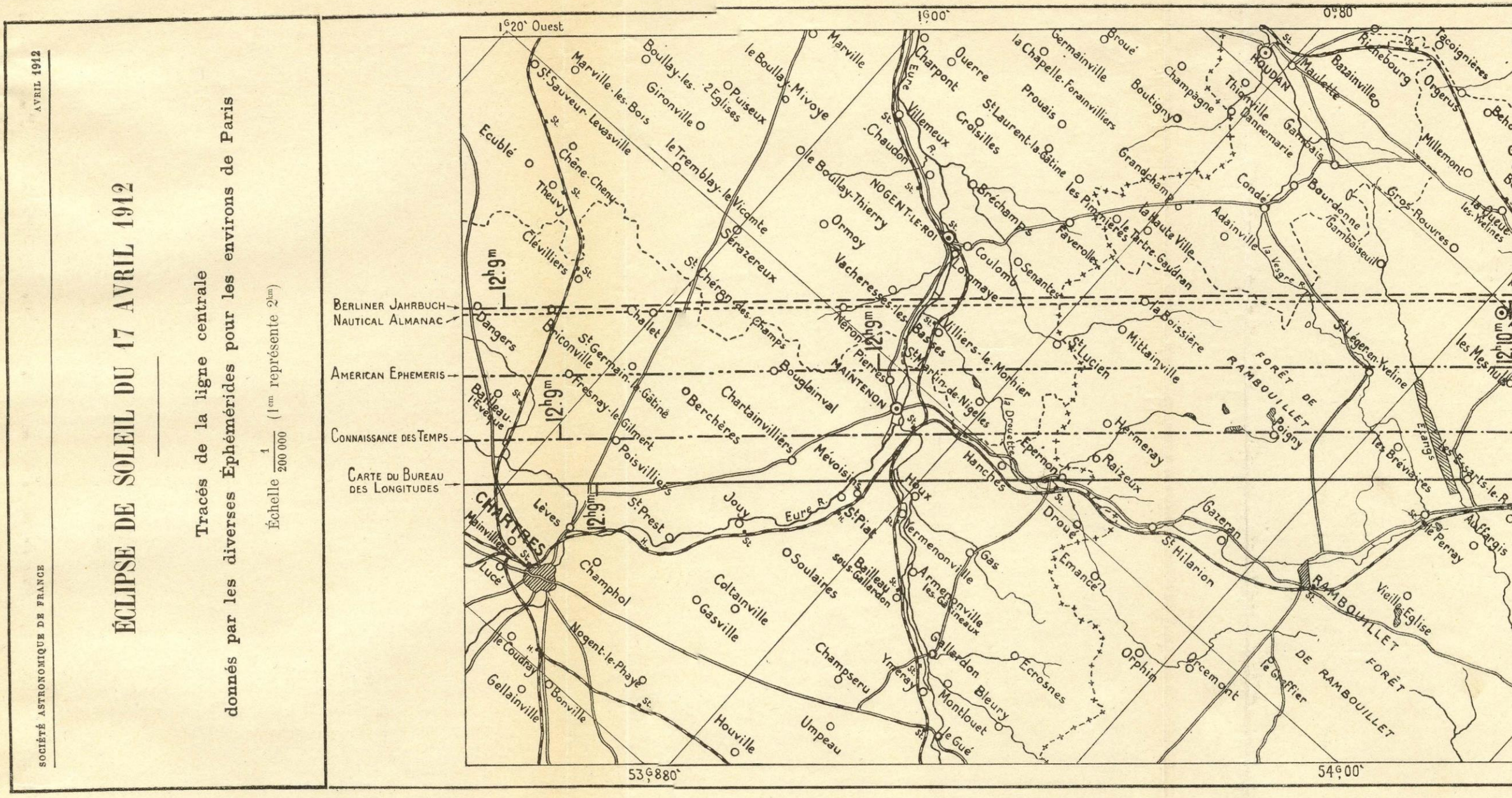
CONNAISSANCE DES TEMP, 1912

BEAUTY



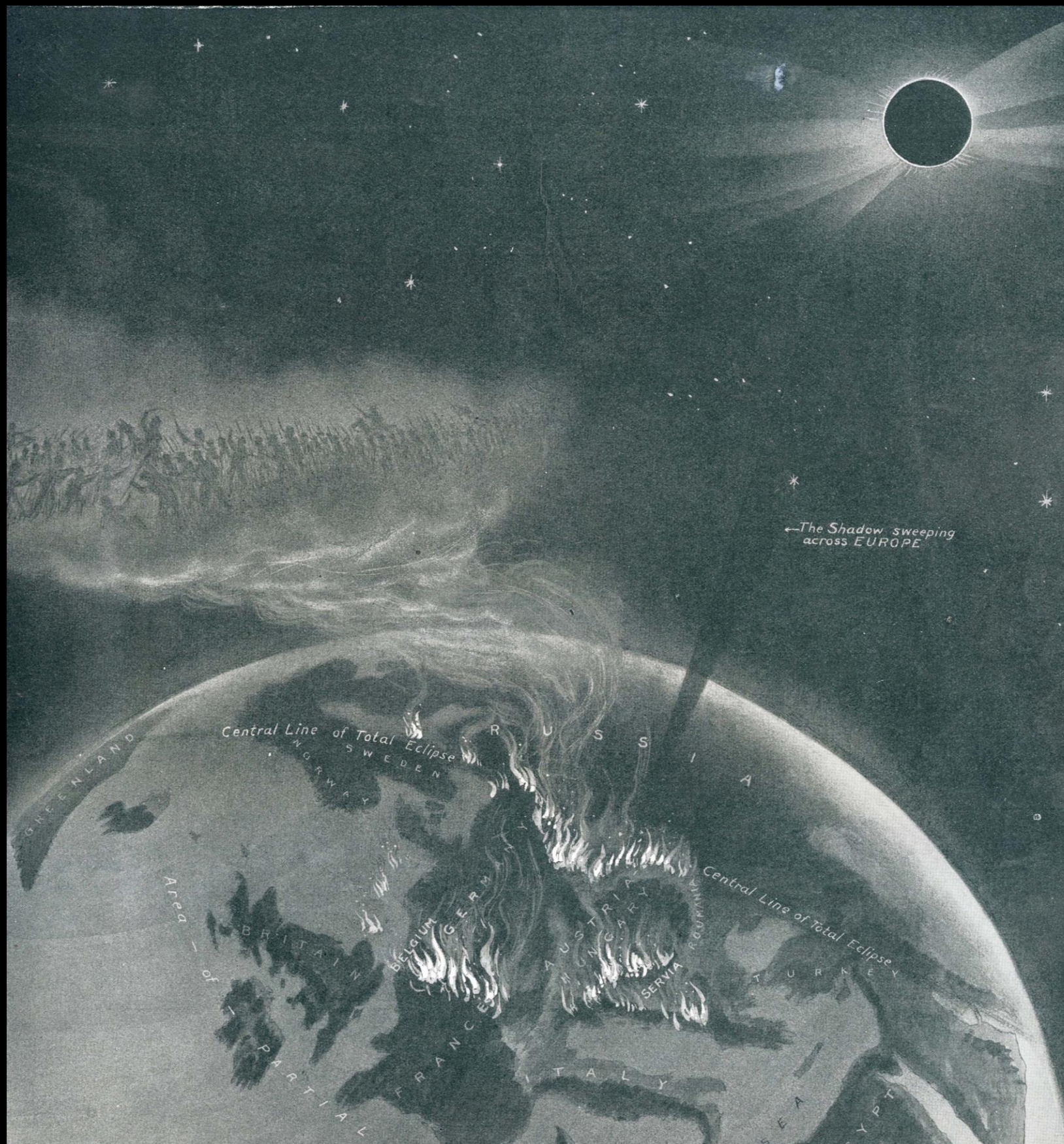
L'ASTRONOMIE, 1912

COMPUTATION



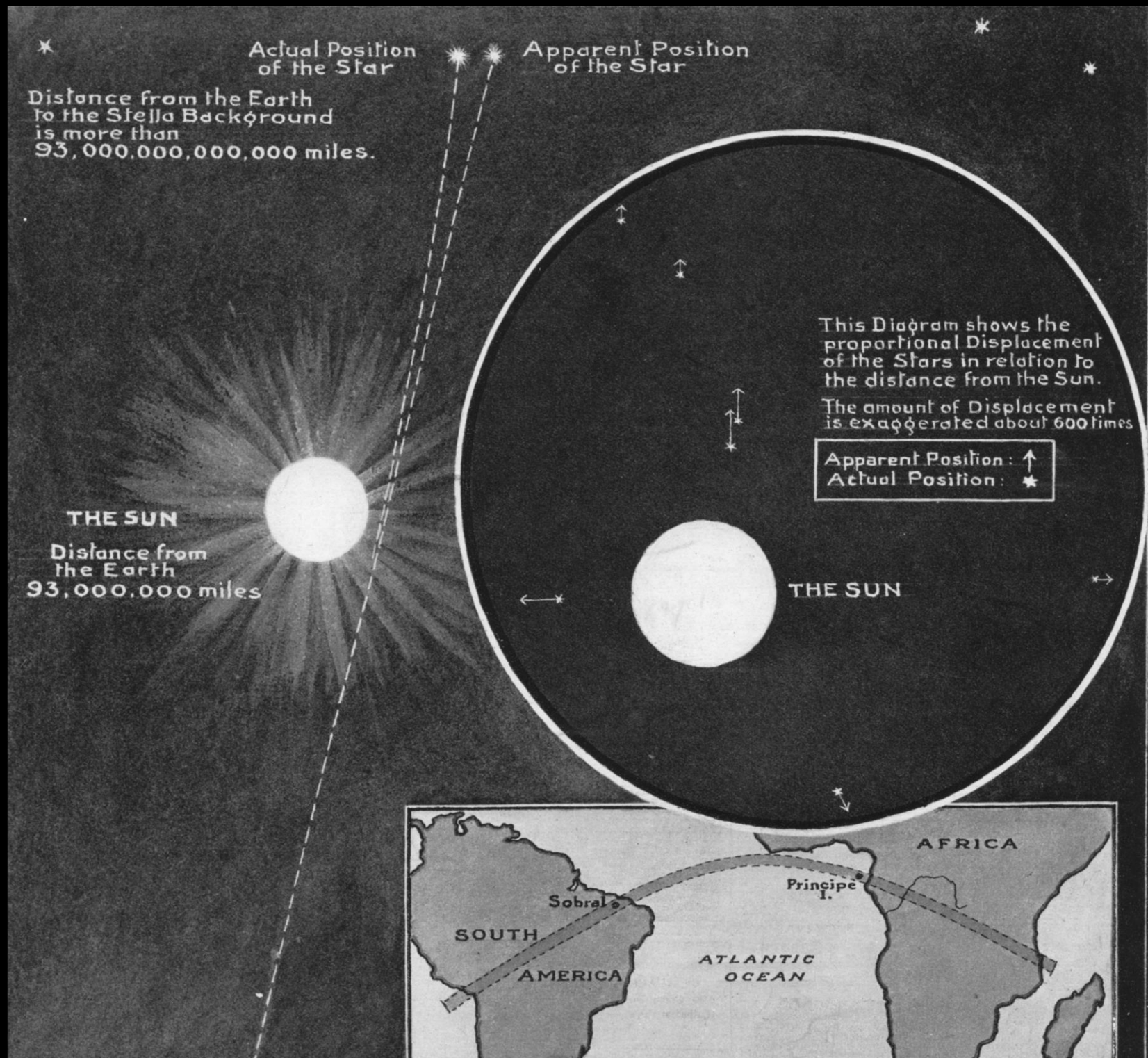
THE GRAPHIC, 1914

TERROR



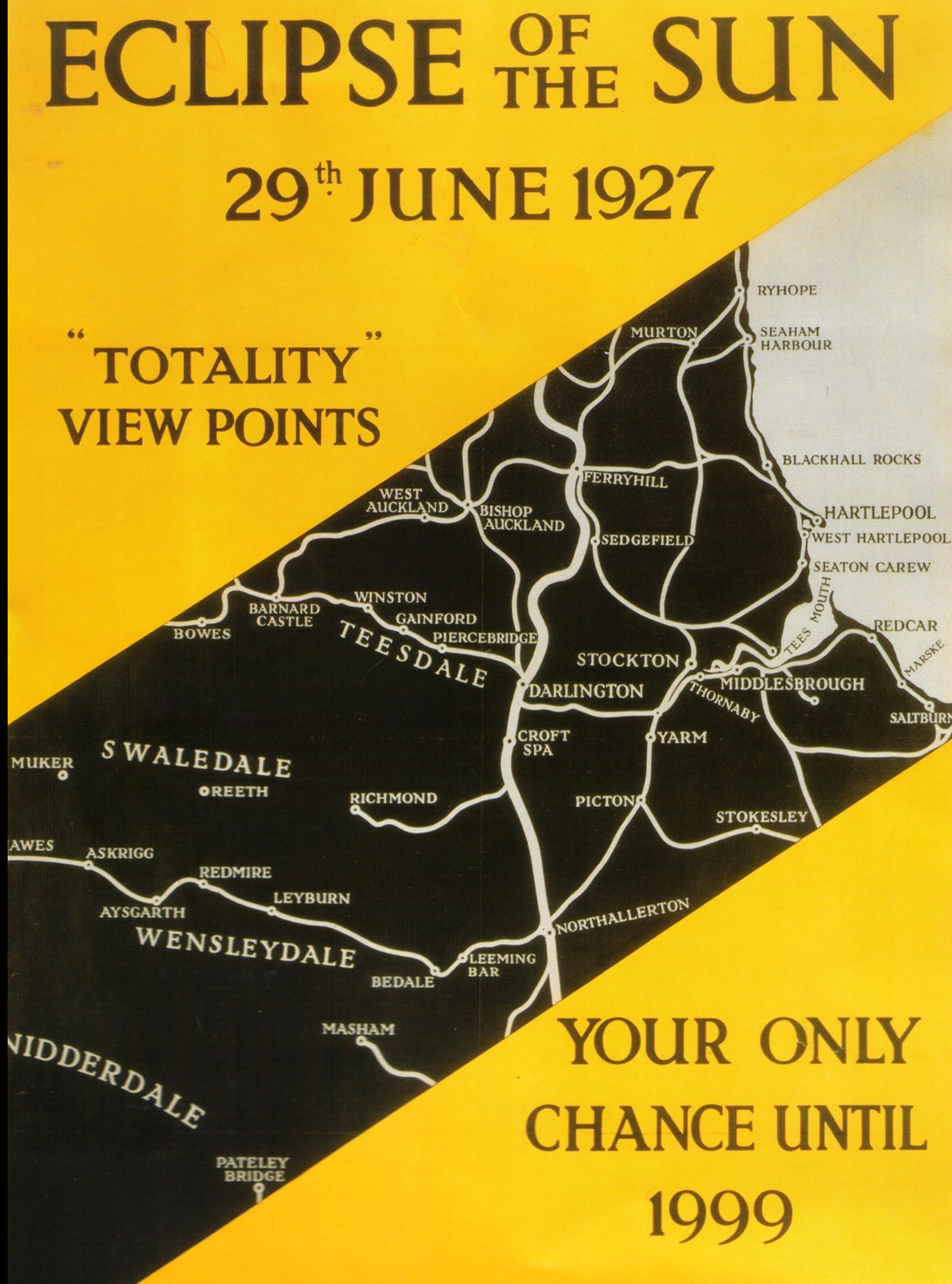
ILLUSTRATED LONDON NEWS, 1919

DISCOVERY



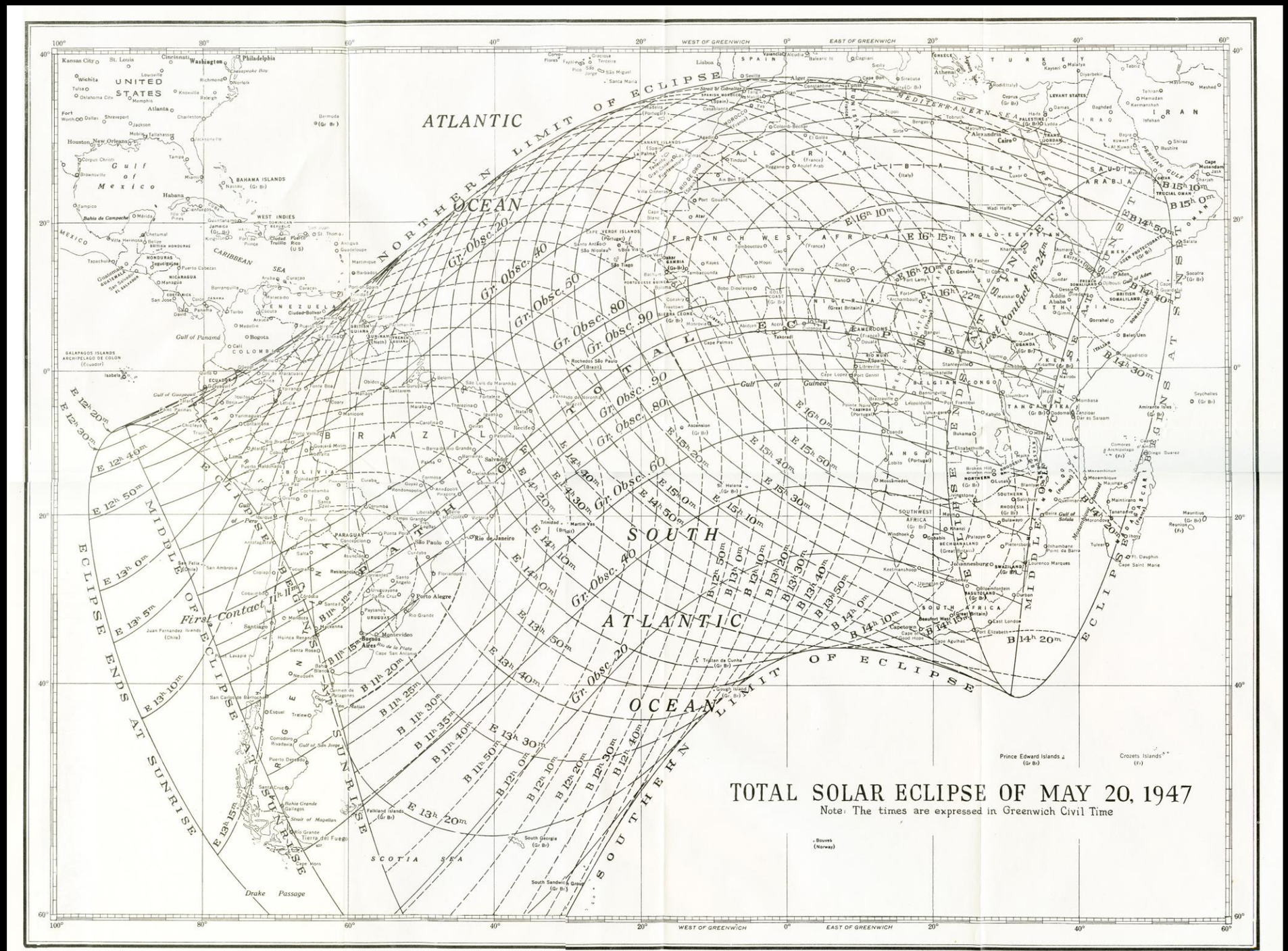
LNER, 1927

TOURISM



AMERICAN EPHEMERIS, 1947

PHENOMENA

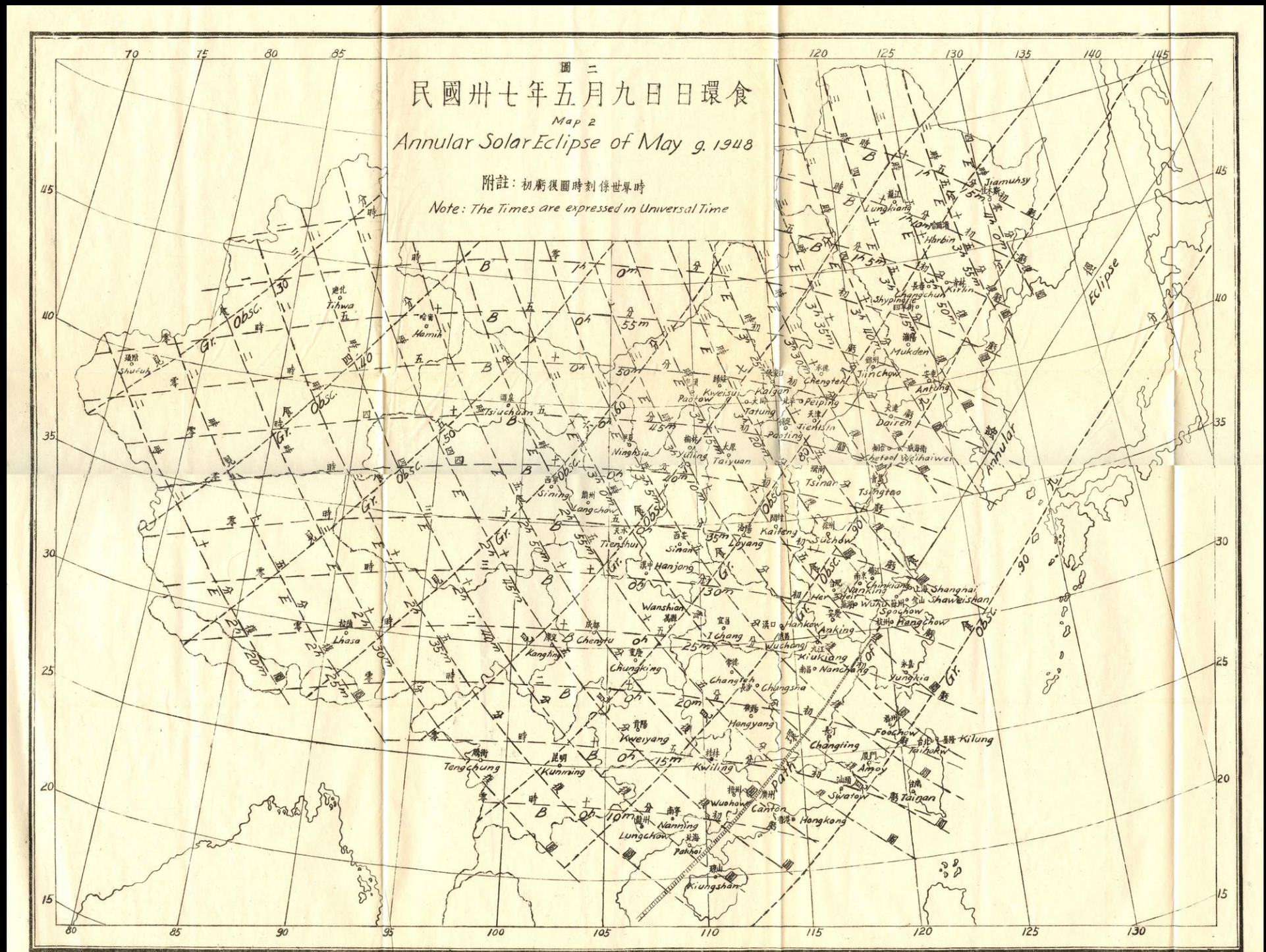


TOTAL SOLAR ECLIPSE OF MAY 20, 1947

Note: The times are expressed in Greenwich Civil Time

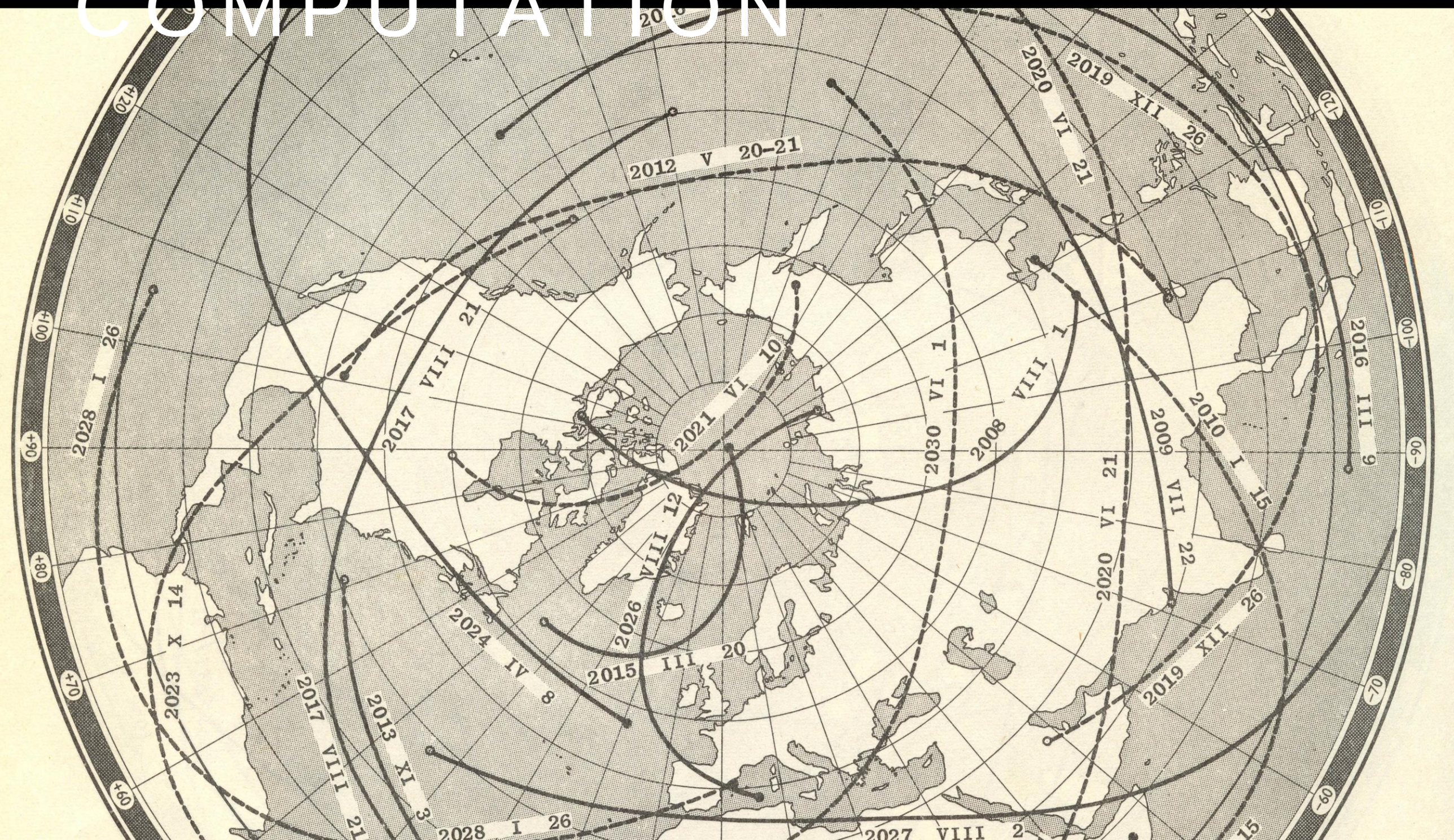
TSINGTAO OBSERVATORY, 1948

NATIONALISM



MEEUS, GROSJEAN, VANDERLEEN - 1966

COMPUTER COMPUTATION



FRED ESPENAK, NASA, 1979 TO PRESENT

AUTHORITY

Total Solar Eclipse of 1991 Jul 11

Geocentric Conjunction = 19:06:11.1 UT J.D. = 2448449.295962
Greatest Eclipse = 19:06:04.7 UT J.D. = 2448449.295888

Eclipse Magnitude = 1.0800 Gamma = -0.0043

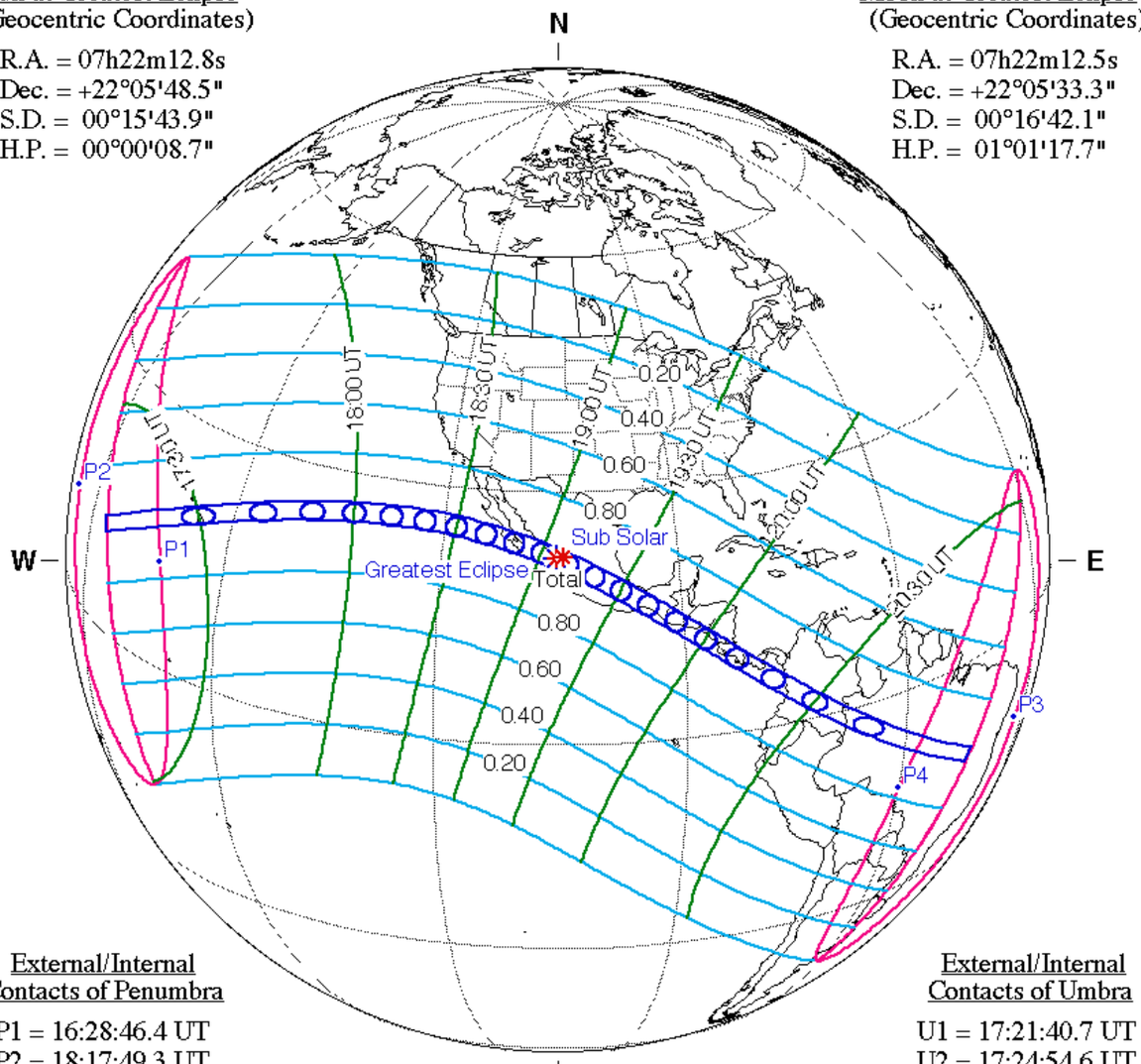
Saros Series = 136 Member = 36 of 71

Sun at Greatest Eclipse
(Geocentric Coordinates)

R.A. = 07h22m12.8s
Dec. = +22°05'48.5"
S.D. = 00°15'43.9"
H.P. = 00°00'08.7"

Moon at Greatest Eclipse
(Geocentric Coordinates)

R.A. = 07h22m12.5s
Dec. = +22°05'33.3"
S.D. = 00°16'42.1"
H.P. = 01°01'17.7"



External/Internal
Contacts of Penumbra

P1 = 16:28:46.4 UT
P2 = 18:17:49.3 UT

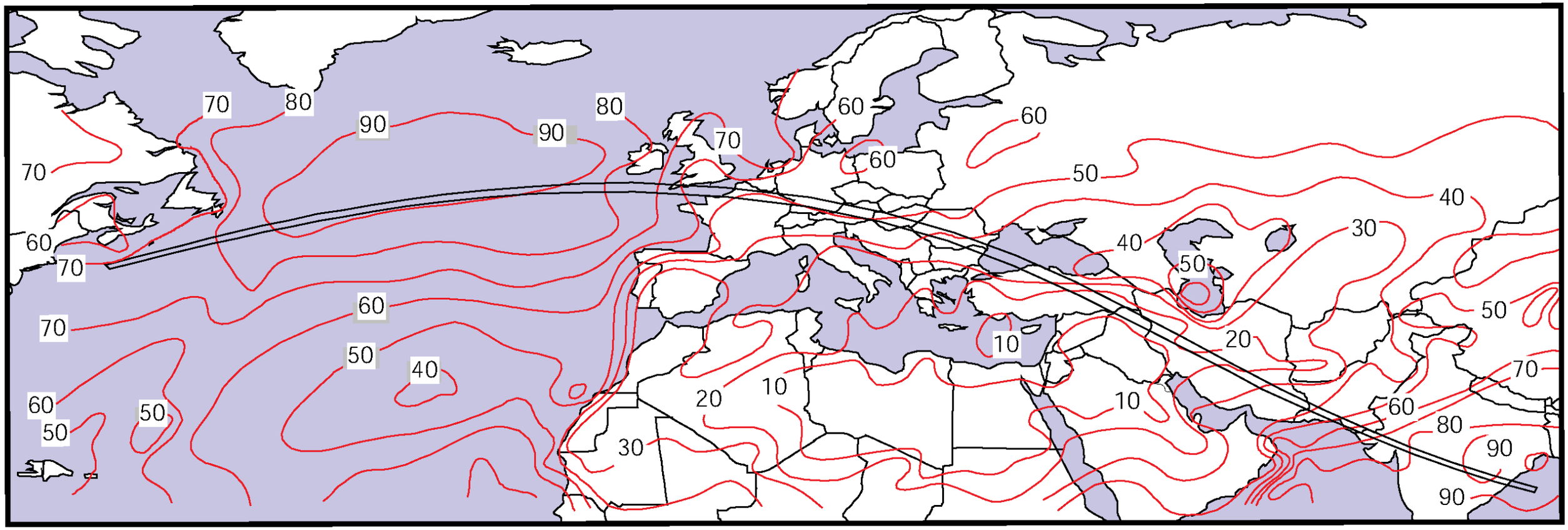
External/Internal
Contacts of Umbra

U1 = 17:21:40.7 UT
U2 = 17:24:54.6 UT

METEOROLOGY

Total Solar Eclipse of 1999 August 11

FIGURE 22: MEAN CLOUD COVER IN AUGUST ALONG THE ECLIPSE PATH



J. Anderson, Environment Canada - 1997 Jan

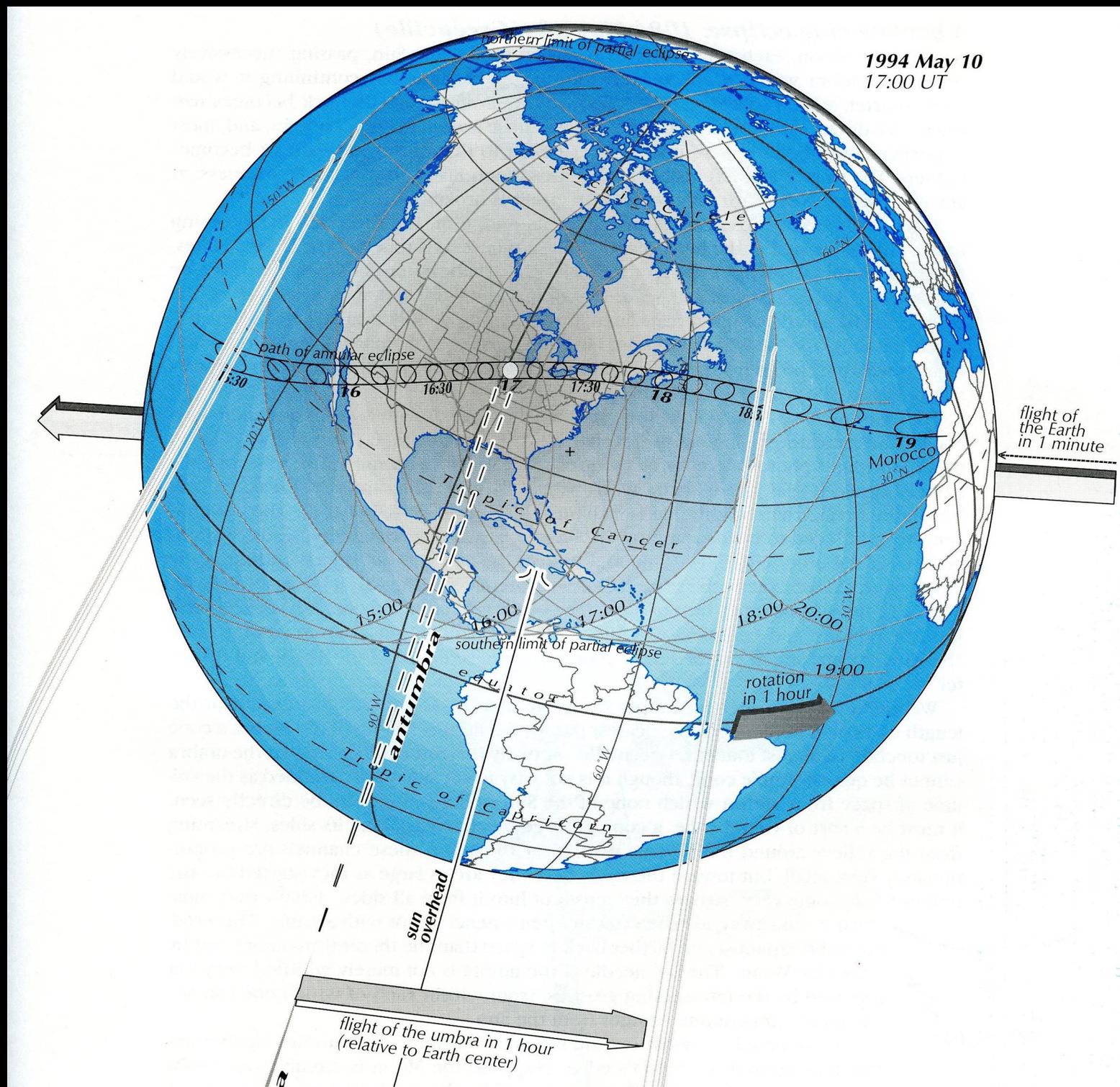
Figure 22: Mean cloud cover (in percent) along the eclipse track as determined by satellite measurements from eight years of analysis (1983-1990). These data are collected and analyzed globally from a number of satellites (International Satellite Cloud Climatology Project), and processed by computer. It provides an excellent comparative database for different locations around the globe. Statistics are collected over a 5° by 5° latitude/longitude area, and represent the large scale cloud characteristics of an area. Small scale variations are smoothed out.

FRED BRUENJES, 2001

CREATIVITY

GUY OTTEWELL, 1994

3D VISUALIZATION

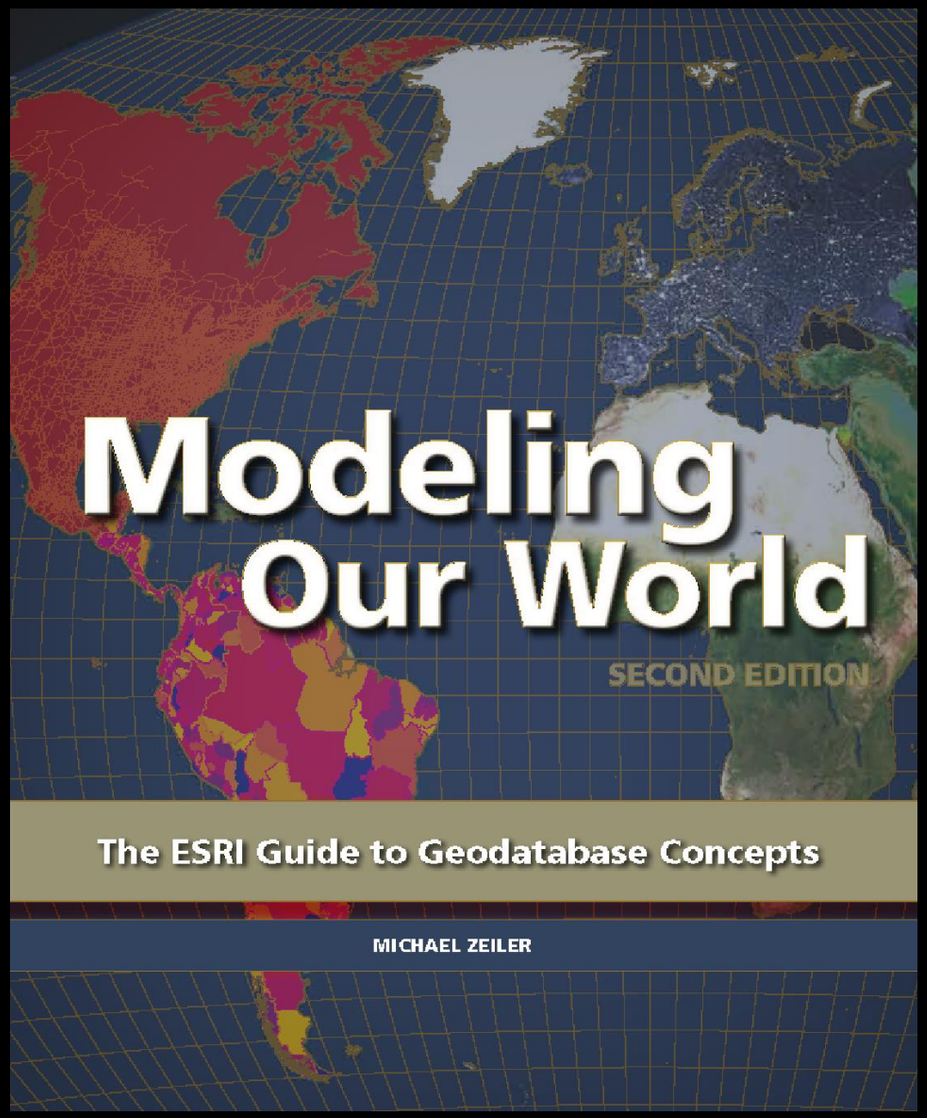


MICHAEL ZEILER, 2009

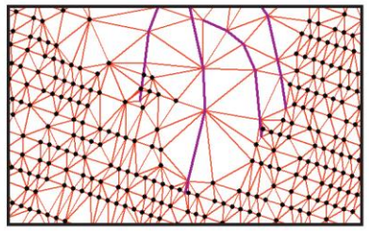
SOUVENIR

ESRI ARCGIS TERRAIN MAPPING

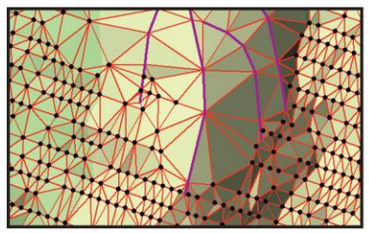
SURFACE MODELING



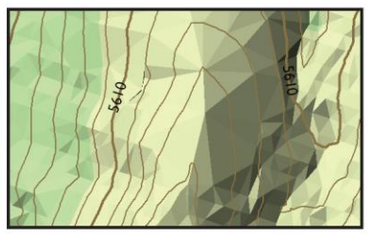
Lidar points with breaklines for ridges along a mountain top.



Triangulation on points and breaklines.



Elevation gradient, hillshading, and triangulation.



Elevation gradient, hillshading, and calculated 2-foot contours. Map scale is 1:400; successive lidar points are spaced about one foot apart.

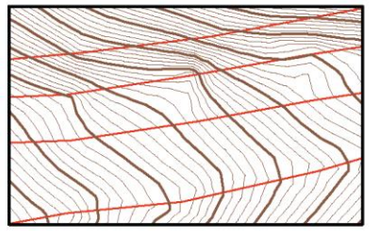
Terrain datasets can be made from different types of data. These include lidar and sonar points, breaklines and points derived from stereo photography, and other forms of survey data. The supported geometry types for input feature classes include points, multipoints, polylines, and polygons. Multipoints are used for large datasets such as lidar point collection.

The ability to incorporate a variety of data types into the definition of a surface offers maximum control to sculpt an accurate representation. Surface-specific points capture peaks and pits. Mass points add overall form and control. Breaklines indicate abrupt changes in slope that occur across linear features. Polygons delineate flat areas or areas of no data.

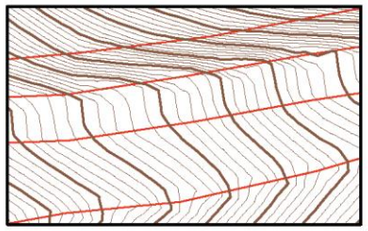
Hard or soft surface feature types

Hard and soft qualifiers for line and polygon feature types are used to indicate whether a distinct break in slope occurs on the surface at their location. This information influences the behavior of the natural neighbors interpolator. It interprets the terrain surface as smooth except when crossing hard lines and hard polygon boundaries. The natural neighbors interpolator is offered by tools that export a terrain to a raster, interpolate shape, and surface spot geoprocessing tools. All the surface feature types other than mass points support the hard or soft qualification.

Below are contours derived from a raster exported from a terrain dataset using the natural neighbors interpolator with soft and hard breaklines.

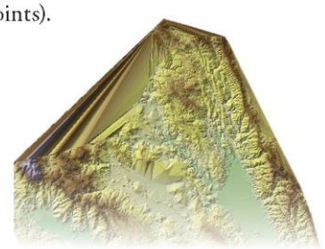


Contours derived from soft breaklines.



Contours derived from hard breaklines.

Some examples of hard features are lake shorelines, streams, building pads, curb lines along roads, and road cuts. Some examples of soft features are study area boundaries, ridge and valley lines for smooth or rolling topography, void area boundaries, and contours (contours can also be added as mass points).

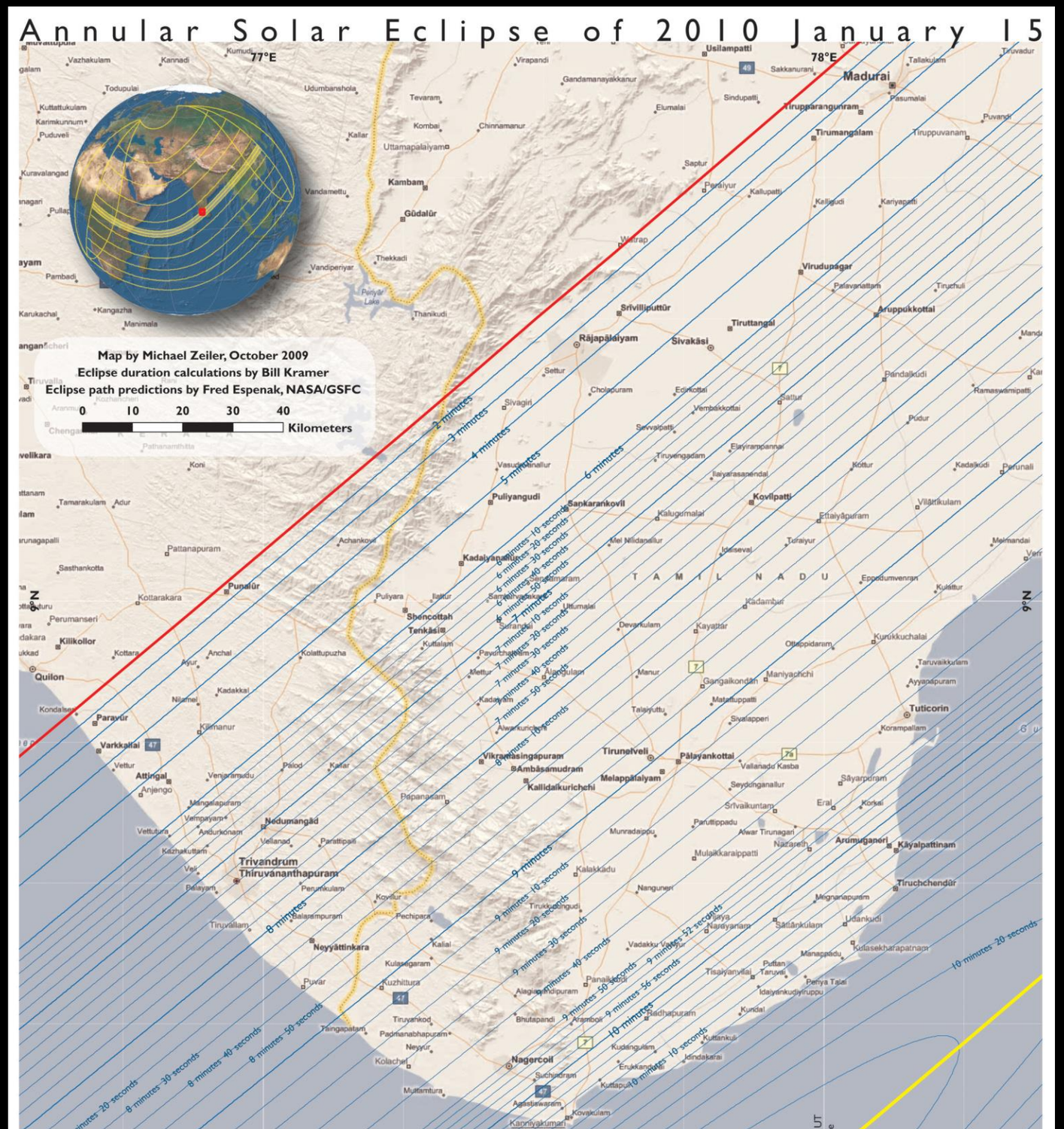


A terrain dataset mistakenly built without a clip polygon.

Same terrain dataset with a clip polygon for its boundary.

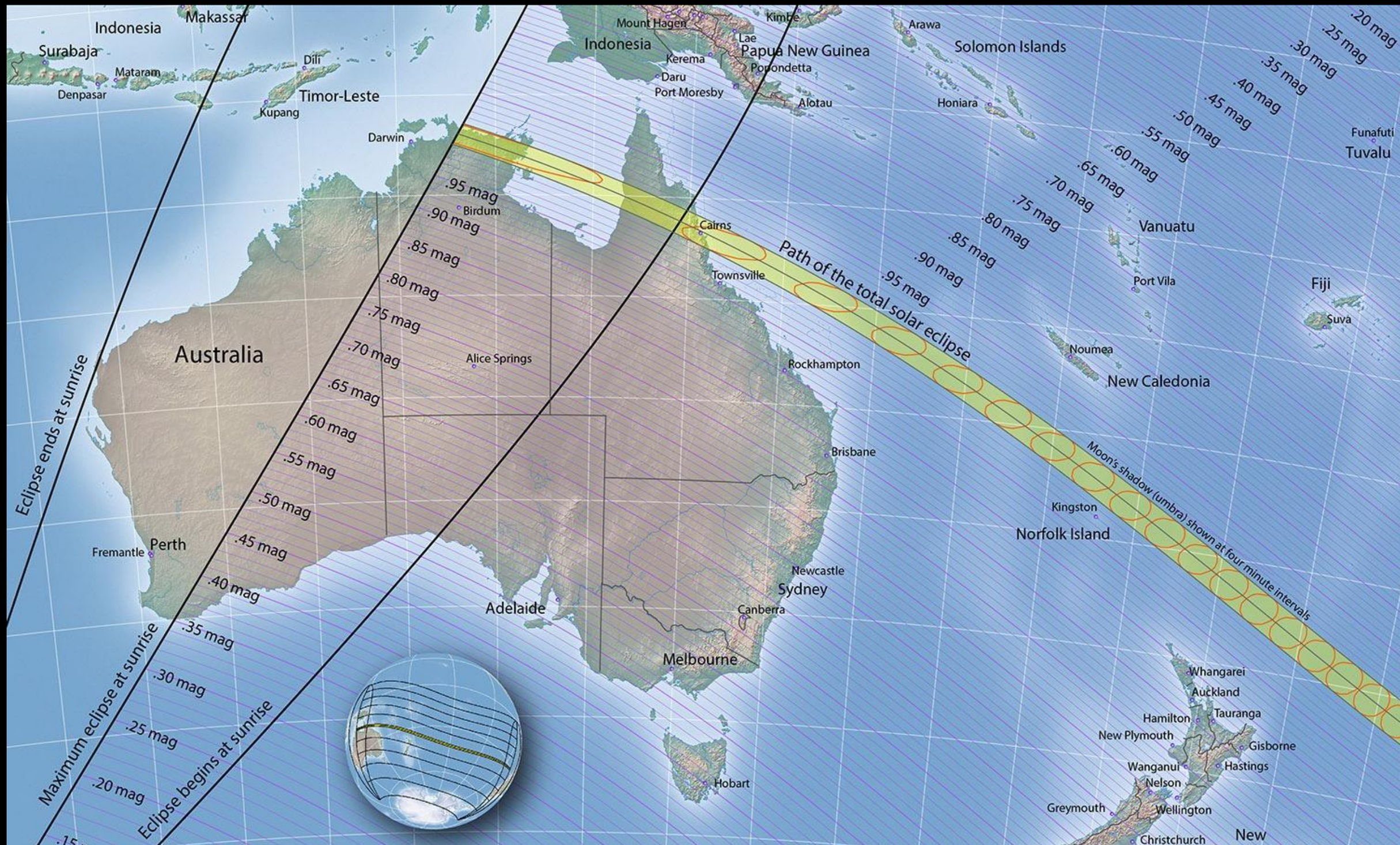
COLLABORATION WITH BILL KRAMER, KAGUYA LASER ALTIMETER

LIMB CORRECTION



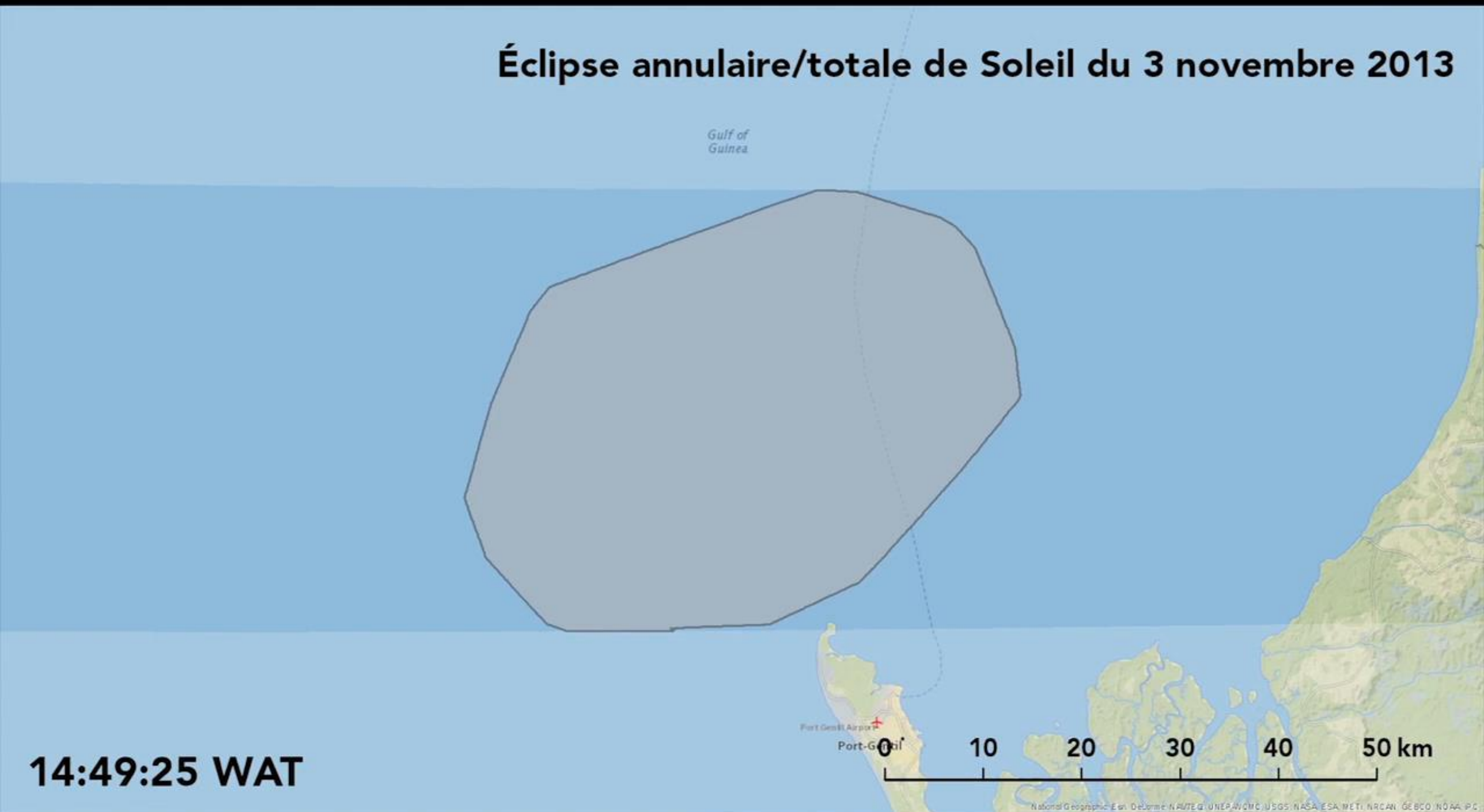
COLLABORATION WITH XAVIER JUBIER, SOLAR ECLIPSE MAESTRO

HIGH PRECISION



PHENOMENA PREDICTION

DOUBLE DIAMOND RING



ANIMATION

CHASING THE UMBRA

The Great American Eclipse
of August 21, 2017

9:56 a.m. PDT

10:56 a.m. MDT

11:56 a.m. CDT

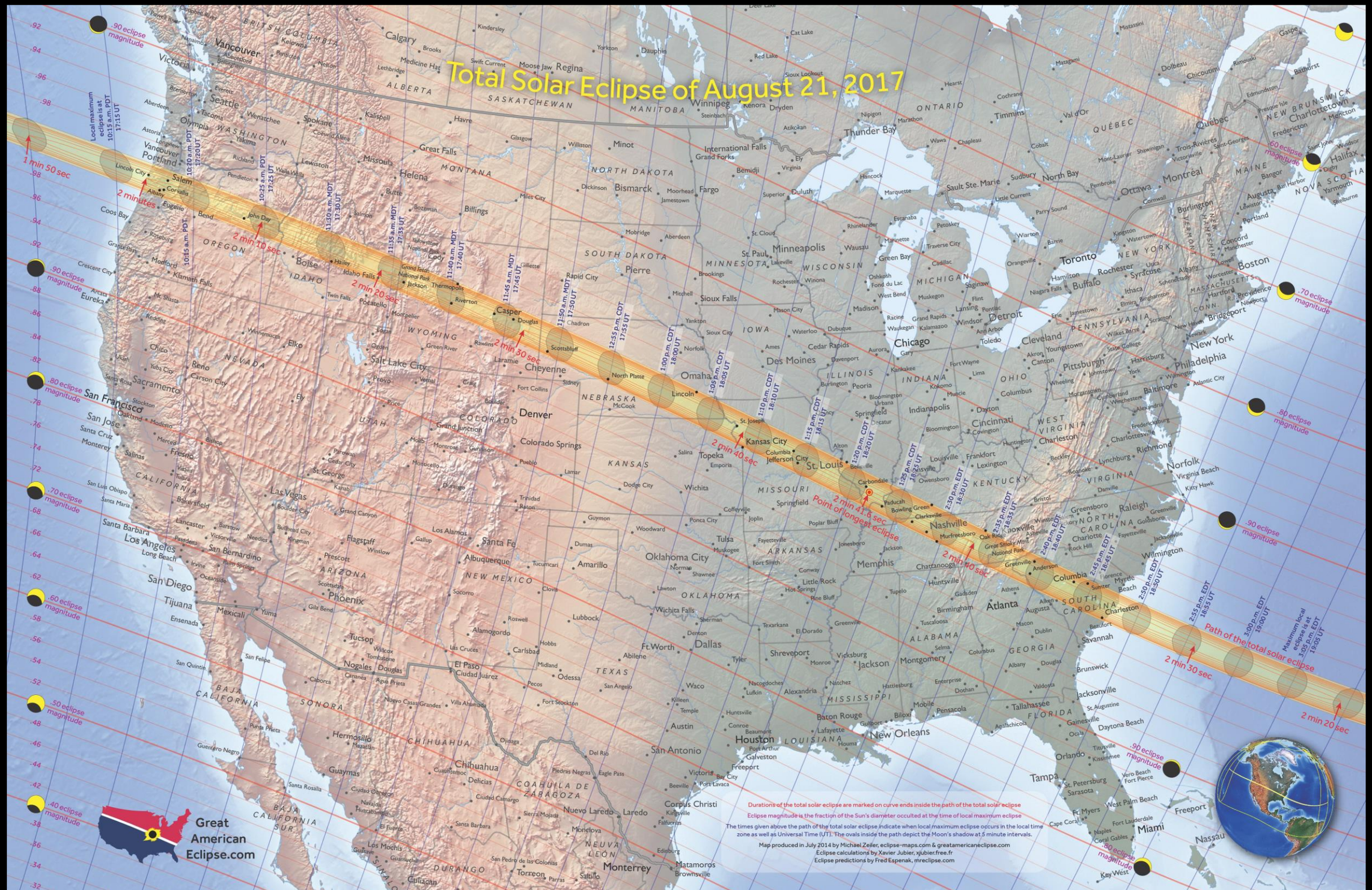
12:56 p.m. EDT

ANIMATION

VIEW FROM MOON

GREAT AMERICAN ECLIPSE.COM

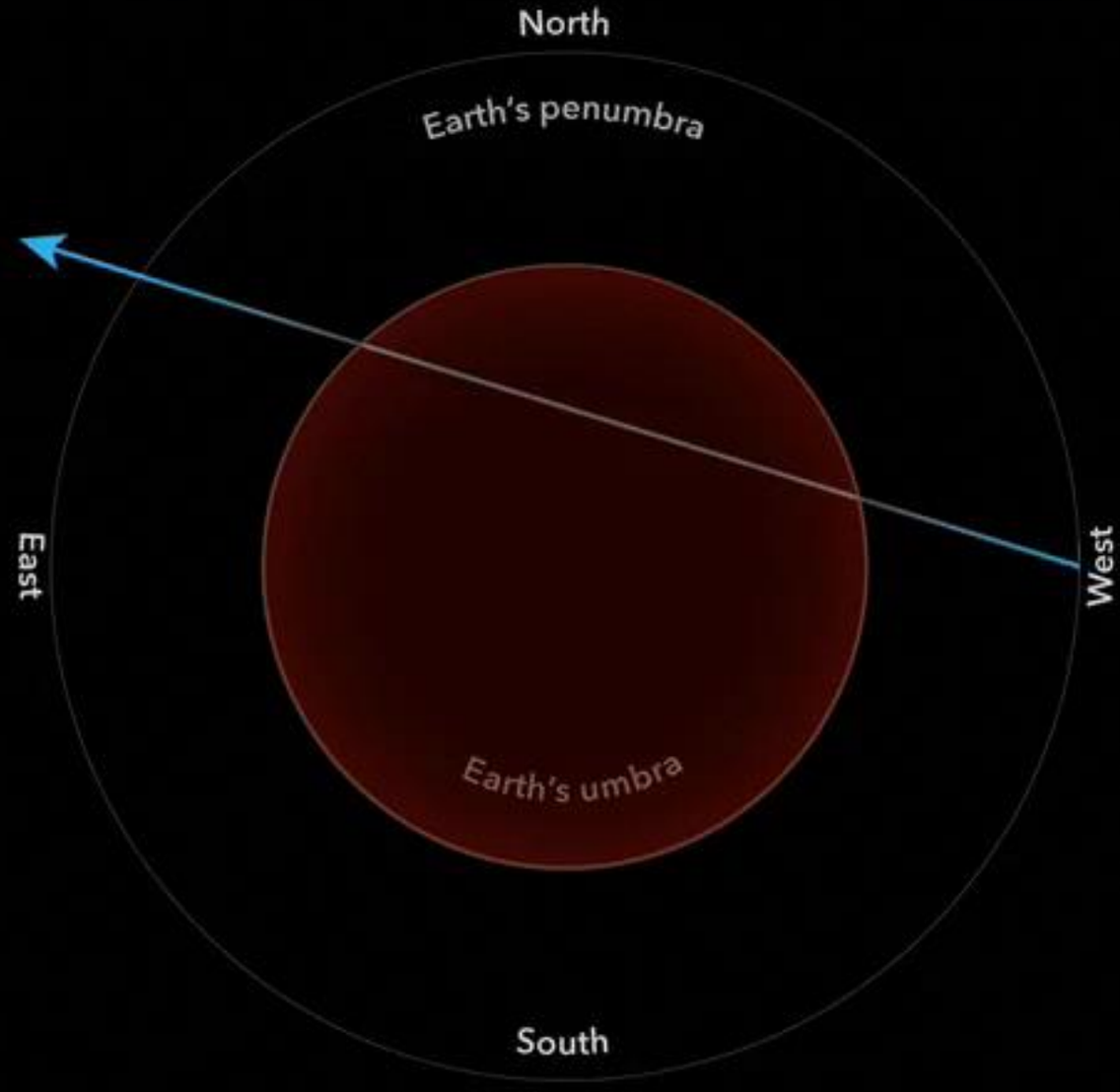
INSPIRING THE PUBLIC



LUNAR ECLIPSE

ANIMATED INFOGRAPHIC

TOTAL LUNAR ECLIPSE OF OCTOBER 8, 2014



Path of Moon through
the shadow of Earth

Universal Time is
8:00:20 UT

Partial eclipse begins
at 9:14 UT

Total eclipse begins
at 10:25 UT

Total eclipse ends
at 11:24 UT

Partial eclipse ends
at 12:34 UT

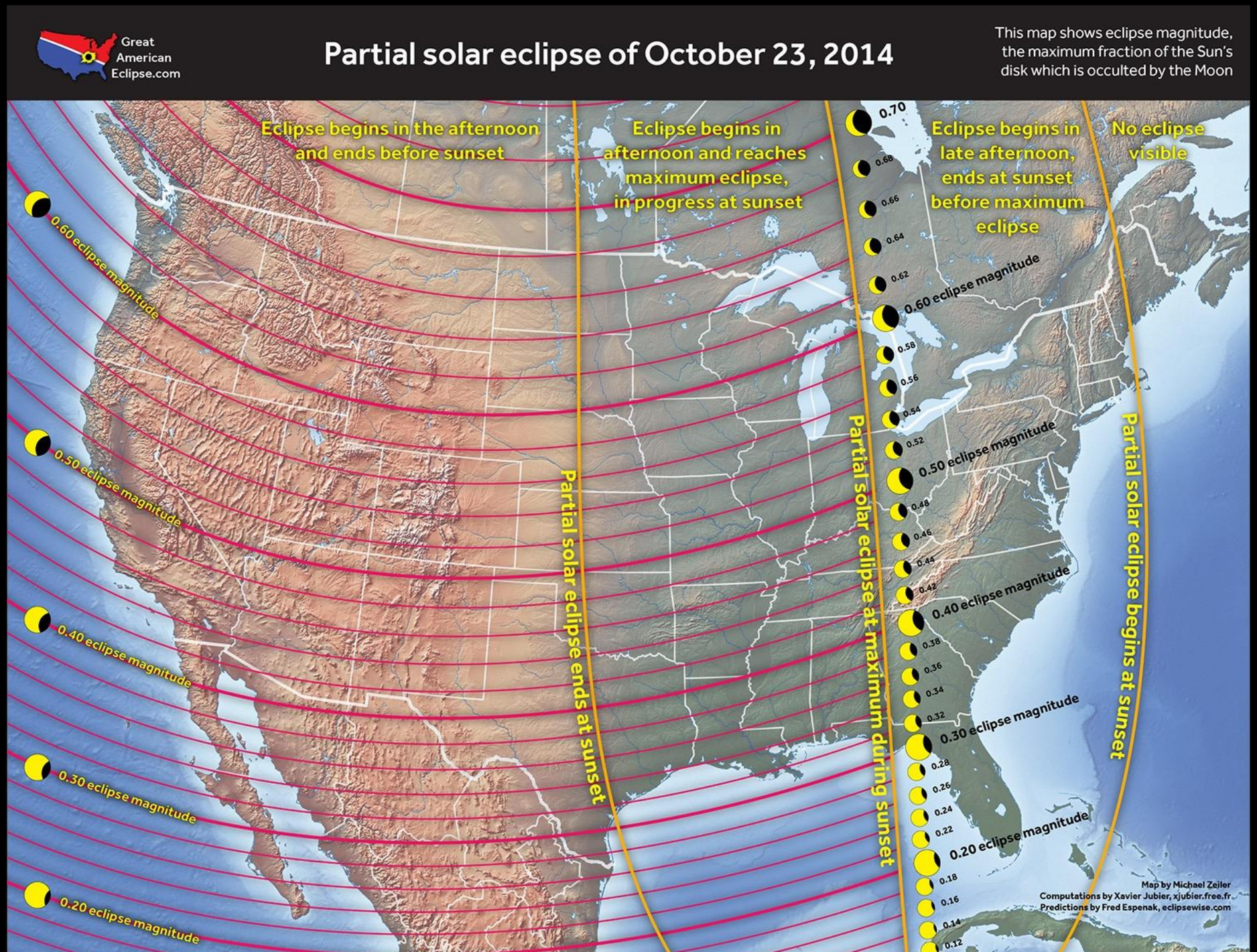
GreatAmerican
Eclipse.com

New York	4:00 a.m. EDT
Chicago	3:00 a.m. CDT
Hawaii	2:00 a.m. MDT
Denver	1:00 a.m. PDT
Los Angeles	10:00 p.m. HST
Sydney	7:00 p.m. AEDT
Beijing	4:00 p.m. CST

Side of Earth
facing the eclipse

2014 PARTIAL SOLAR ECLIPSE

SYMBOLIC



DIRECTIONS

INTERACTIVE WEB MAPS

OPTIMIZE AND STREAMLINE MAP PRODUCTION

TABLET APP - ATLAS OF COMING ECLIPSES

TABLET APP - ECLIPSE PRIMER & ROAD ATLAS FOR 2017

BUILDING OUT GREATAMERICANECLIPSE.COM

GUEST BLOGS

WEB FORUM

THANK YOU

QUESTIONS?