Observed Ancient Solar Eclipses

virtual laboratory for archaeometry https://www.archaeometry.org

contact: chronist@archaeometry.org *latest revision*: **2024.04.08**

The 2024 Canon SAROS is based on our **constant deceleration Model** of the Earth's rotation:

$\Delta T = a + c * t^2$ [s] où **t** = $(36524.24)^{-1}$ *(JD – 2'378'497) [cy] with JD_o: +1800.01.01

It reflects the stability of the sea level over the last 6 millenia, a period we call the Heliocene. Retrodictions are generated by Xavier JUBIER's **5MCSE** freeware in the **&dT=**xxxx url-*mode*.

c = 32.4 [s cy^{-2}] lies within PANG's limits for ancient SE, i.e.: 27.5 > **c < 32.5** [s cy^{-2}]**.**

a = - 20 [s] , an offset to take into account the mini post-Maunders rebound effect.

The period is limited **from -1911 up to +1912.** After this time, ***c** decreases* with the ***"geomorphic exit"*** out of the Heliocene, see *daily measurements of LOD (Length Of Day).*

The Canon SAROS lists **50 documented solar eclipses** prior to the creation of the Bureau Int.'l de l'Heure in 1913. Important are the eclipses anchoring ***Calendrical Eras*** *(Nilotic, HuangDi, AUC, Seleucid, Hirji, Anno Domini).* In our critical review appeared the case of two clergymen: the iman of Cordoba, in 218 AH and the bishop of Mende, in 1239 AD who misused the expression: *stars appeard in the sky as if it were midnight,* while they were outside of the path of totality.

The *retro*dictive power of our OASE DeltaT-Model is comforted by 6 fairly well documented observation reports of **4 total** & **2** ***pearled*** solar eclipses in :

- **584**.05.28 River Halas Battlefield: ALYATTES + Miletus: THALES .
- **135**.04.15 Babel Tower: ARSACE V (alias MITHRIDATES I *Philhellène*) .

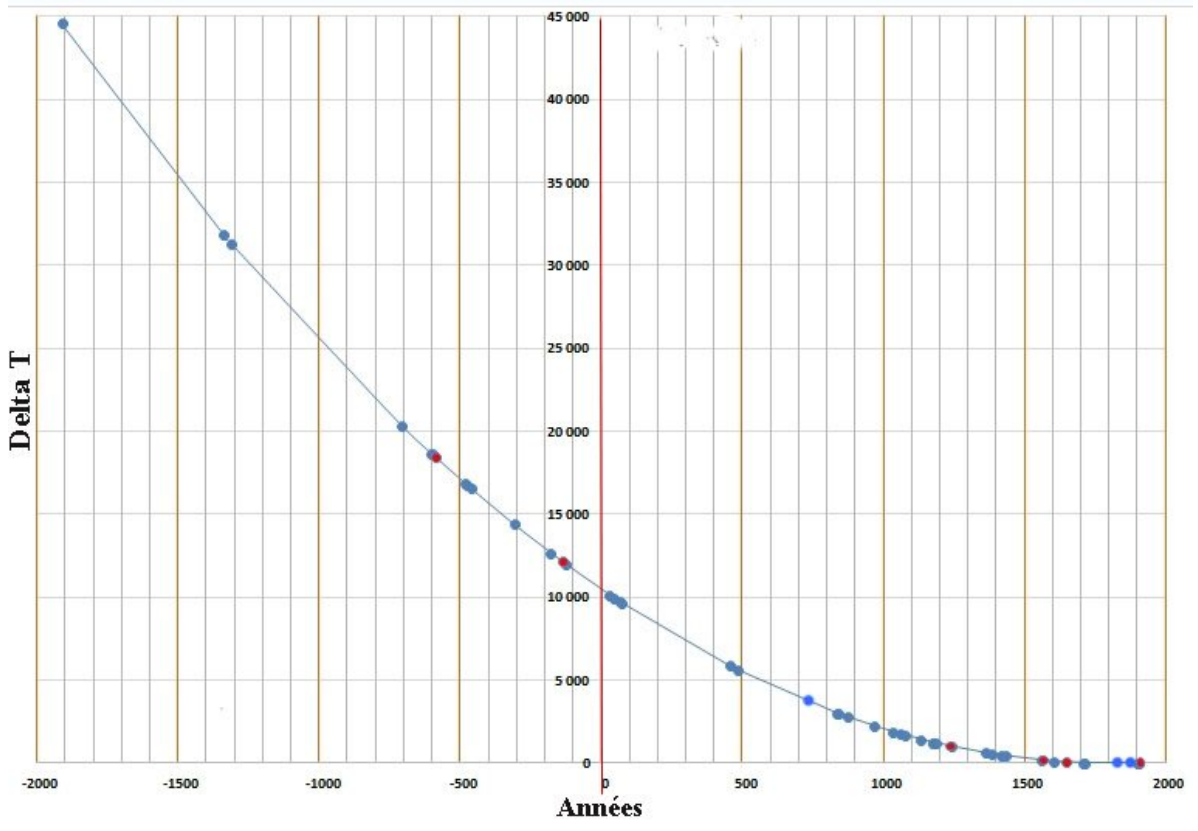
+1239.06.03 Cardeña Monastery .

+1567.04.09 Vatican Observatory: Christopher CLAVIUS .

+1652.04.08 Carrickfergus : John WYBARD .

+1912.04.17 Ovar #10: F.M. da COSTA LOBO / Plaisance-Gd CroixXing: Léon GAUMONT / Becklingen #4: R.R. SCHORR / Hagenau #3: K.R.GRAFF

In the chart Delta T vs Years of Christophe de Reyff, those 6 events are marked in red .



Notes on the Canon SAROS: **1./** Most entries are derived from Quotations about Solar Eclipses, compiled by David LeConte. **2./** 1 SAROS cycle lasts **6585.321 days** (18yr,10-12d.,8 h.), e.g. Chinese astronomers observed the -708 & -600 solar eclipses: SAROS 44 eclipses # 07 & 13. **3./** On 1900.05.28, à Wadesboro, Nevil Maskelyne has been the first to shot a clip of a Solar eclipse

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-584.05.28. Closing the controversy over how Thales of Miletus could possibly have predicted a solar eclipse to the Lydian king Alyattes, let us remind that at a given observation site, solar eclipses tend statistically, *but not* for astronomical reasons, to cluster, mostly with a time span of 18 or 17 lunar months. Aware of such *New Moon Cluster Time Series*, all over the world, shamans have succeeded at time to predict a solar eclipse, so did long ago Thales. He indeed became famous for predicting to the Lydian king the date of the forthcoming solar eclipse, allowing the king to stage the end of his long lasting war against the Medes. The list of the relevant solar eclipses over Miletus cast light on this prediction: after a cluster of 17 moons, the next *visible* eclipse will *most probably* occur at the upcoming 18th new moon. Six centuries later, Plinyi the Elder ***retrodicted*** in term of AUC the year of Thales eclipse as **CLXX**.

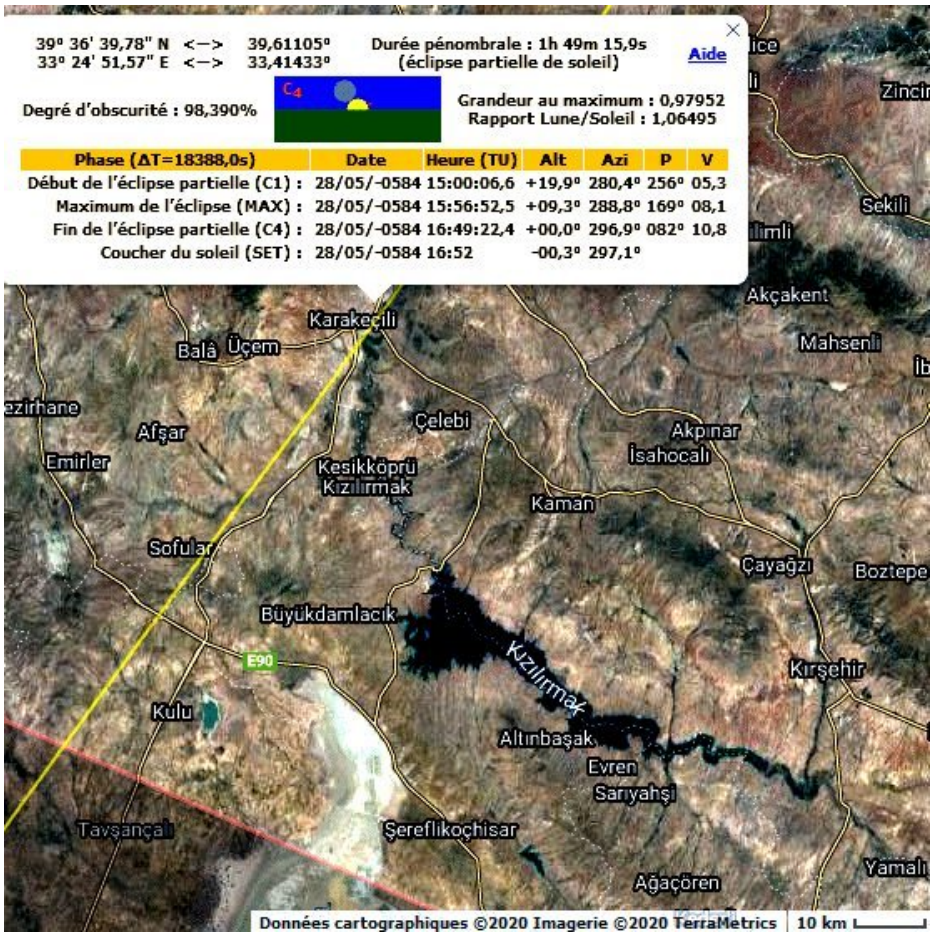
	Timelaps *Lunar months*		Date (*Local Time*) *sunset /sunrise*	Height	Masked
	35	18 [	-610.04.17/17:58C1 *18:39*	7°	<20%
		17 [	-609.09.30 / 08:37	30°	58%
		18 [	-607.02.13 / 15:42	20°	76%
			-606.07.30 / 09:41	53°	62%
			-602.05.18 / 08:11 SAROS 57/-05	36°	49%
223	35	18 [	-596.07.09 / 05:09 *04:47*	3°	72%
		17 [	-595.12.23 / 16:55 *17:00*	-0.1°	61%
			-593.05.09 / 08:19	36°	46%
	35	17[	-587.07.29 / 19:17 *19:26*	0.6°	93%
		18 [	-586.12.14 / 11:04	27°	74%
			-584.05.28 / 17:58 *19:14* SAROS 57/-04	13°	97%

What Thales has not been able to predict, his stroke of luck so to speak, has been that, at the battle field on the river Halys, 600 km north-west from Miletus, a most spectacular double sunset took place: the eclipse reached its maximum of 98% at 17:56 local time, 9° over the horizon, then finished at 18:49, leaving 5 minutes to the sun to fully shine again.

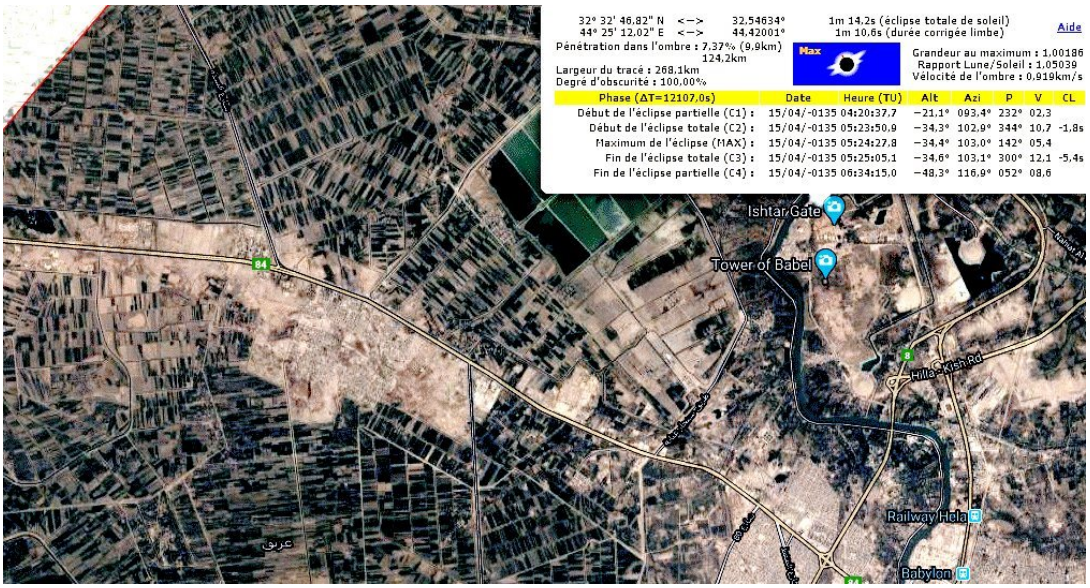
Walwet (Alyattes in Greek) seized the opportunity of the peace treaty to mint the first coin, a *double coin.* This artefact represents the record of this solar eclipse.

This first coin is in fact a Photoshop photomontage with 76% opacity of a *double coins*. The name of the king, Walwet meant *Lion* in Lydian. The dot on the lion's eye represents the solar eclipse. Later, on the anepigraphic coins minted by Croesus, the dot appears surrounded by rays.

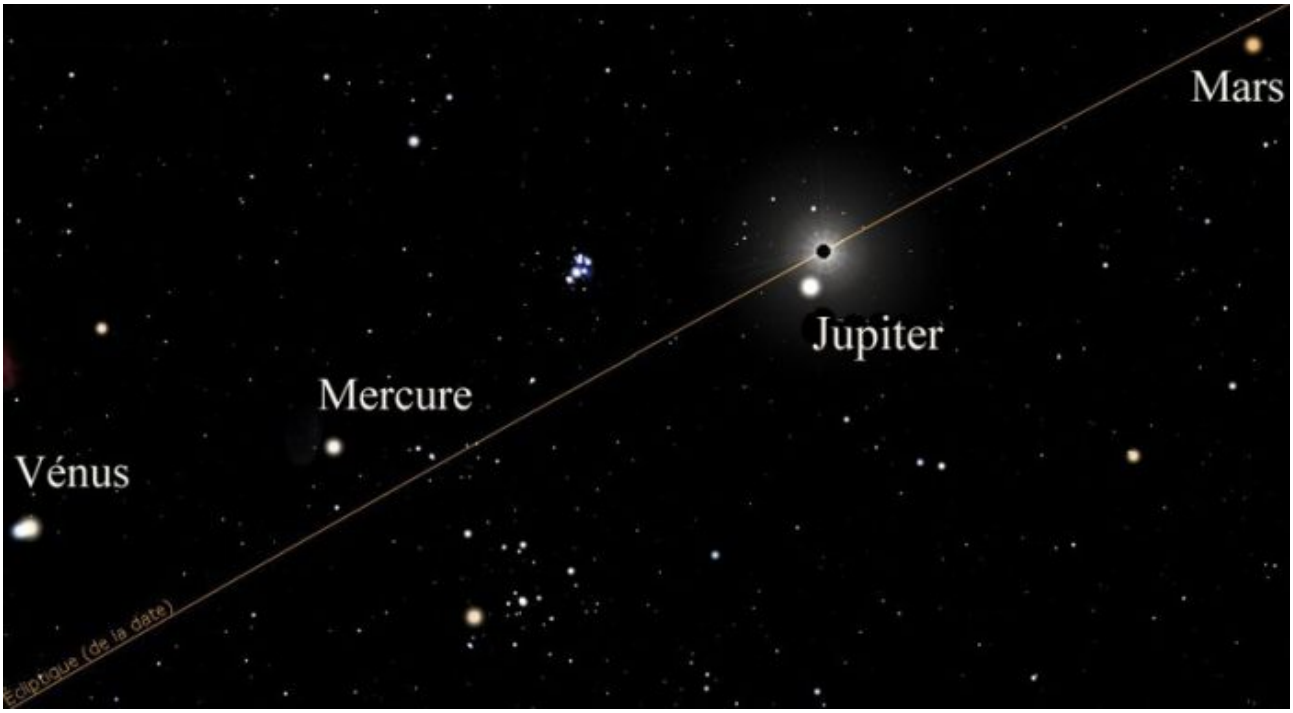
The exact site has not been reported but a fair guess is the vicinity of Karakeçili.



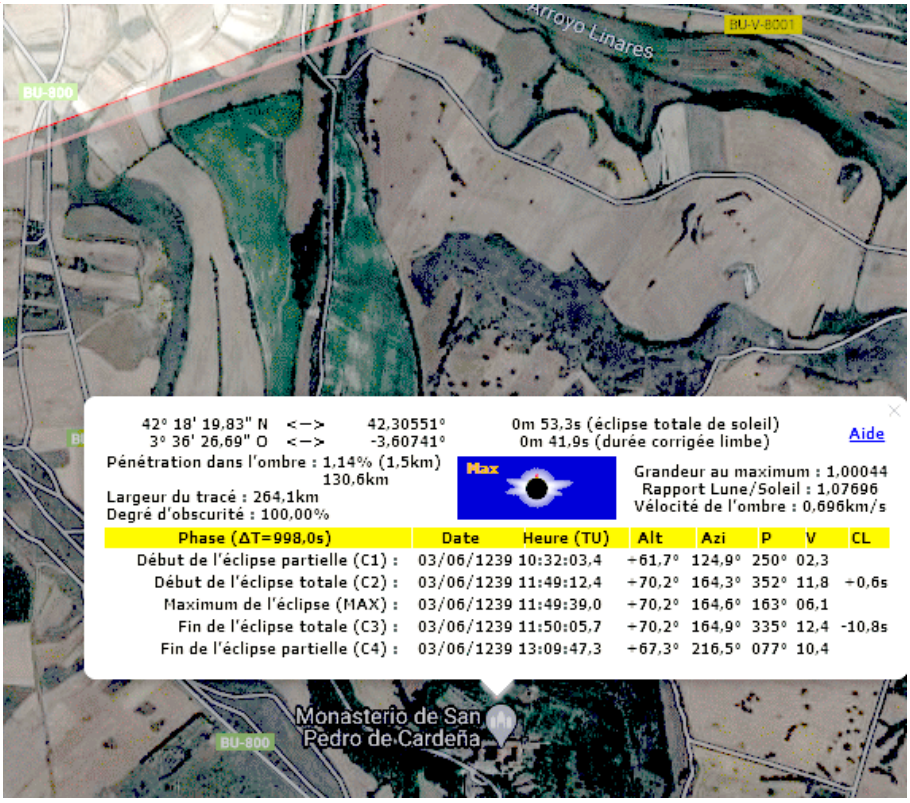
-135.04.15, The two reports of observation of this solar eclipse by Babylonian astronomers are engraved on clay tablets and the date is written as **175.13.29** according to the Seleucid Era Lunar Calendar). The exact observation site is unfortunately unknown, but our guess bent toward *the Babel Tower*!



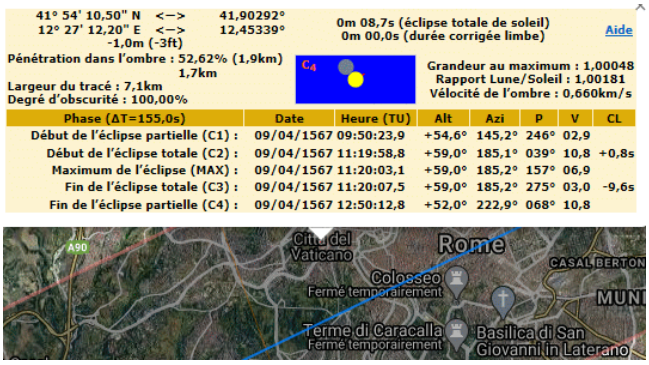
The visible Planets were also mentioned: Venus (dele-bat), Mercure (Gu4UD), “normal stars” (Múl. ŠID.MEŠ) , Jupiter (Múl.BABBAR) and Mars (AN), see below the retrodicted sky with Stellarium

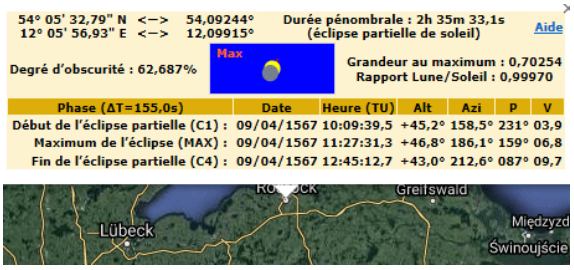


+1239.06.03. This eclipse has been observed at a *dozen of sites,* all well centered in the totality path. The site nearest of the Monastery of Cardeña at the Northern edge of the totality corridor strongly constrains the DeltaT-Model. In p. 373 of its “Chronicon”, the date is given in terms of the ERA Hispanica as : ***Era de MCCLXXVII.*** *Años III.Nonas de Junio à medio dia oscureció el Sol è fizose noche,* ***è vieron el Cielo estrellado***



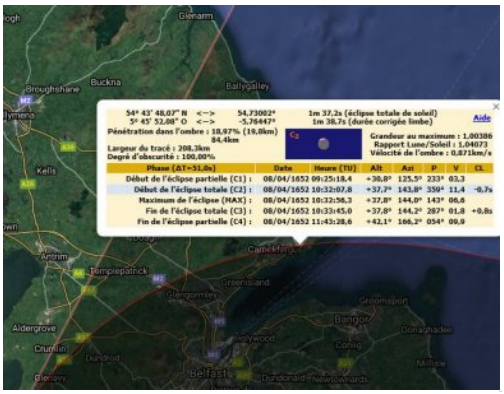
+1567.04.09 This *pearled* eclipse which occurred over Vatican City has been reported by Christopher **Clavius**. The same Clavius saw, 7 years earlier, a 1½ minute long total solar eclipse over Coimbra and he had the chance to observed this exceptional pearled solar eclipse… .





Tycho Brahe wrote to Clavius on 1600.01.05 from Benatky (near Prague) that as a young man he observed this eclipse in Rostock, *the phase there being about 7 dijits*… The retrodiction of this eclipse confirms beautifully the observation of the astronomer.

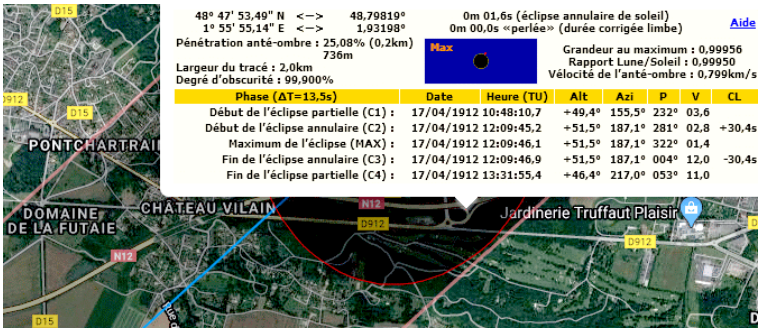
+1652.04.08 Carrickfergus, **Dr. John Wybard** reported: "*Luna momento quasi, et eximproviso, totam se intra Disci Solis orbitam seu ambitum (quatenus conspectui nostro appareret) tam agiliter injiciebat; ut circumagere aut circumvolutare videretur, sicut catillus, seu lapis molaris superior; Sole tunc circum-circa, ejus limbum seu marginem splendidulo vel corusco, apparente*." "The Moon, as if at that moment, and unexpectedly, threw itself so very nimbly between the entire path or circuit of the Sun's disc (in so far as it appeared to our sight); so that it seemed to move in a circle or roll around, like a plate or upper mill-stone; with the Sun, glowing or rather **shimmering, all around its rim or edge"**… indeed, an interesting decription of the corona!



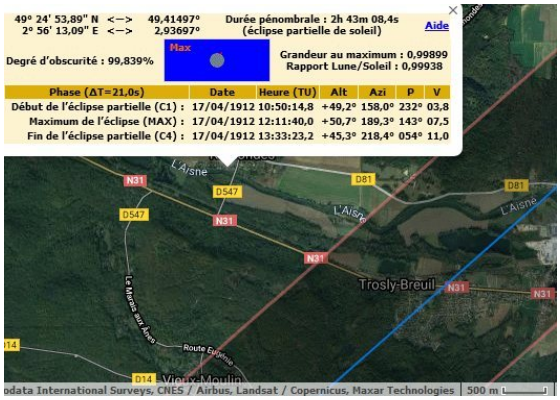
+1912.04.17 Abundant material has been collected during this *pearled* solar eclipse.

In Ovar at observation site #10 Francisco Miranda da COSTA LOBO was the only local observer lucky enough to be at the right spot. He took a short a movie and measured a laps of 14 sec between C2&C3 centered at 11:42:57, off by 27 sec.

<u>At Plaisance, at the Crossing of La Grand' Croix</u>, Léon GAUMONT took also a clip at 12:09:49 (only 3 sec off the Max).



<u>900 m over the Bridge of Rethondes</u>, the position of the Balloon Globule (Northside of Aisne, over Rethondes, 150m West from Bridge) was off totality by over 1500 m. A. Nicolleau took a picture & read Paul Tissandier read the chronometer at 12:11:51 (11 sec off).



<u>At Becklingen in site#4</u> Richard Schorr took a good picture at 12:23:49, only 1.7 sec off the max at 12:23:47.3. His measurement of C3 was 12:24:01.5 (off by 10 sec)

<u>In Hagenau in site #3</u> Kazimiers Romuald Graff made most useful observations. With C3 at 12:25:49.0, he is the *C3 chaser* in best agreement with the retrodicted C3: 12:25:47.3.

53° 26' 09,60" N <--> 53,43600°
11° 11' 48,12" E <--> 11,19670°
Pénétration anté-ombre : 44,50% (1,5km)
1,8km
Largeur du tracé : 6,6km
Degré d'obscurité : 99,661%
0m 06,7s (éclipse annulaire de soleil)
0m 00,0s «brisée» (durée corrigée limbe)
Aide
Max
Grandeur au maximum : 0,99868
Rapport Lune/Soleil : 0,99831
Vélocité de l'anté-ombre : 0,923km/s

Phase (ΔT=21,0s)	Date	Heure (TU)	Alt	Azi	P	V	CL
Début de l'éclipse partielle (C1) :	17/04/1912	11:05:58,6	+47,0°	176,8°	234°	04,1	
Début de l'éclipse annulaire (C2) :	17/04/1912	12:25:40,5	+44,7°	204,9°	201°	05,8	+18,0s
Maximum de l'éclipse (MAX) :	17/04/1912	12:25:43,9	+44,7°	204,9°	145°	07,7	
Fin de l'éclipse annulaire (C3) :	17/04/1912	12:25:47,3	+44,7°	204,9°	089°	09,5	-30,4s
Fin de l'éclipse partielle (C4) :	17/04/1912	13:44:00,2	+37,7°	228,9°	056°	11,0	

SAROS / #	JD (Julian Day) Common Era yy.mm.dd Anchored Era	ΔT [s]	Appellation Site *GPS Co-ordinates*	Universal Time @ Max. Eclipse Sun Altitude	Magnitude. type Duration [m/s]
23/ -22	1 023 332 -1911.09.24	44'581	PANG Double Sunset Sanmiao **Changde** E111.7° / N29.03	10:26 4.3°	0.979 annular 1m 14s
26/ 02	1 232 852 -1337.05.14 Nilotic	31'856	AKHENATEN **Thèbes** *E32.65/N25.70* Tell el-**Amarna** *E30.90 /N27.57*	12:09 53° 12:05 56°	0.944 1.013 4m 32s
35/ -04	1 242 390 -1311.06.24	31'328	MURSILI II bad omen **Amasya** (totality:whole Northern Hittite empire) *E 35.82 / 40.68*	11:08 63°	1.009 2m 24s
44/ 07	1 462 659 –708.07.17 HuangDi	20'351	LU HUAN GONG春秋1 **Jining-*RénChén District*** *E116.596 / N35.406*	07:48 42°	1.019 3m 27s
44/ 13	1 502 170 -600.09.20 HuangDi	18'630	LU XUAN GONG春秋2 **Jining** *E116.596 / N35.406*	07:52 30°	0.86 *penumbra* 2h 11m
57/-04	1 507 900 -584.05.28 AUC 170 (PLINYI)	18'388	THALES **Miletus** *E27.27/ N37.53* ALYATTES Double Sunset Lydians-Medes Battle **Karakeçili** *E33.414/N39.611*	15:58 13° 15:57 9°	0.966 *penumbra* : 1h 53m 0.980 *pen.*:1h 49m
50/ 05	1 545 847 –480.04.19	16'818	GAUBIL Chinese Annals # 35 **Shanghai** *E121.47 /N31.25*	05:05 62°	1.017 4m 19s
42/ 24	1 546 881 -477.02.17	16'776	PINDAR **Thiva** *E23.32 /N38.32*	10:03 37°	0.951 annular 4m 58s
50/ 06	1 552 432 -462.04.30	16'553	Cult of TANIT **Carthago** *E10.32 /N36.83*	12:35 60°	0.988
69/ -19	1 608 421 -309.08.15	14'382	AGATHOCLES' escape **Syracuse** *E15.298 / N37.047*	06:31 27°	1.000 0m 42s
56/ 21	1 655 376 –180.03.04	12'679	**Chang'an** *E108.94 / N34.26*	07:33 34°	1.007 2m 20 s
75/ -10	1 671 854 -135.04.15 Seleucid 175	12'107	ARSACE V *(Mithridates I)* **Babel Tower**/Babylon *BM45745* *E44.421 / N32.536*	05:24 34°	1.001 1m 14 s
79/ -20	1 674 630 -128.11.20	12'012	HIPPARCHUS **Çanakkale/Hellespont** *E26.402 / N40.148* **Alexandria** *E29.9 / N 31.2*	13:47 11° 14:01 11°	1.004 0m 14s 0.791
62/ 17	1 731 978 +29.11.24	10'131	PHLEGON **Niceaea** *(Iznik)* E27.172 /N 38.420	08:34 26°	1.004 1m 13s
75/ 00	1 737 706 +45.08.01 AUC 798	9'952	CLAUDIUS Birthday (Dio Cassius) **Roma** *E41.91 / N12.49*	08:29 48°	0.32

SAROS / #	JD (Julian Day) Common Era [yy/mm/dd/] Anchored Era	ΔT [s]	Appellation Site *GPS Co-ordinates*	Max. Eclipse Time UT Sun Alt.	Magnitude. type Duration [m/s]
62/19	1 745 149 +65.12.16	9'722	BUDDHA's rise (CHU dynasty) Xuzhou (*Jiangsu*) *E117.15 / N 34.25*	02:17 26°	1.002 1m 03s
79/ -09	1 747 069 +71.03.20	9'663	PLUTARCH Athens *E23.727 /N37.97*	09:30 48°	0.996 partial 0m 28s
91/-06	1 887 103 +454.08.10	5'844	ZU Chongzhi Jiankang *(Nanjing)* *E118.74 / N32.10*	00:45 41°	1.001 1m 03s
97/-16	1 897 852 +484.01.14	5'591	MARINUS Double Dawn Athens *E23.72 /37.97*	05:48 -0.1°	0.996
105/-22	1 989 012 +733.08.14 AD 733	3'664	BEDE the Venerable Jarrow Monastery *W1,4839/ N54,948*	08:49 33°	0.910
96/ 06	2 025 557 +833.09.17 Hijri 218	3'005	YAHYA b.Mu'amar Cordoba *W4,778 / N37.874*	09:55 41°	0.966
90/ 17	2 027 993 +840.05.05	2'964	csg - 0915 - *204* St-Gallen *E 9.376 / N 47.423* ANDREAS Bergomatis Bergamo *E9.66 / N45.70*	12:42 55° 12:43 56°	1.006 3m 02s 1.015 4m 25s
98/ 03	2 040 129 +873.07.28 Hijri 259	2'761	Abu IRANSHARI Neyshapur E36.24 / N 58.79	01 :36 4°	0.966 central annular 4m 27
105/-22	1 989 012 +733.08.14 AD 733	3'664	BEDE the Venerable Jarrow Monastery *W1,4839/ N54,948*	08:49 33°	0.910
98/ 03	2 040 129 +873.07.28 Hijri 259	2'761	Abu IRANSHARI Neyshapur E36.24 / N 58.79	01 :36 4°	0.966 central annular 4m 27
115/-19	2 074 976 +968.12.22	2'217	Leo the DEACON Constantinople *E28.957 / N41.002*	09:18 24°	1.007 2m 08s
111/-06	2 098 541 +1033.06.29	1'883	*...vraiment terrible* Cluny *E4.659 / N 46.434*	11:17 66°	0.986 central annular
102/ 04	2 108 759 +1061.06.20	1'747	AL-JAWSI Baghdad *E44.366 /N33.31*	04:35 31°	1.017 3m 20s
102/ 05	2 115 344 +1079.07.01 ERA 1117	1'662	Digitarq 1457770 Coimbra *O8.431 /N40.286*	13:37 68°	1.026 5m 01s
102/ 08	2 135 100 +1133.08.02	1'419	HONORE d'Autun Regensburg *E12.088 /N49.018*	11:47. 56°	1.015 3m 56s
96/ 25	Hijri 571 2 150 692 +1176.04.11 Seleucid 1487	1'240	IBN al ATHIR Cirze E42.17 / N 37.42 MICHEL the Syrian Antioch E36.16/ N36.20	04 :40 24° 04:36 19°	1.022 3m 21s 1.010 2m 30s

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121/ -23	2 151 578 +1178.09.13	1'395	ADELBERT III Mende *E3.498 /N44.517*	11:16 47°	1.010 3m 03s
115/-07	2 154 000 +1185.05.01	1'204	Novgorod *E31.27 / N 58.53*	14:27 26°	1.016 3m 20s
115/-04	ERA 1277 2 173 756 +1239.06.03	998	Coimbra *W8.412/N40.221* CardeñaW3.60734/N42.3044 1 Toledo *W4.02 /N39.85* Mende *E3.498/N 44.517* Montpellier *E3.88/N43.61* Firenze *E11.21/N43.8* Siena *E11.3/ N 43.3* Arezzo *E11.87/N43.46* Cesena *E12.25/N44.15* Split *E16.47/N43.53*	11:39 / 69° 11:50/ 70° 11:47 / 72° 12:04 / 68° 12:04 / 69° 12:18 / 65° 12:18 / 66° 12:19 / 65° 12:20 / 64° 12:27 / 62°	1.019 / 5m 05s 1.000/ 0m 53s 1.005 / 3m 09s 0.979 partial 1.010 / 3m 59s 1.033 / 5m 45s 1.028 / 5m 39s 1.032 / 5m 44s 1.023 / 5m 17s 1.027 / 5m 28s
102/ 14	2 174 612 +1241.10.06	990	Split *E16.43 /N43.50*	12:01 35°	1.006 2m 21s
108/ 46	2 218 288 +1361.05.05	603	PANG's 2nd *Double* sunset Songjiang *E121.2 / N31.0*	10:24 2°	1.002 1m 04s
102/ 22	2 227 295 +1386.01.01	535	Montpellier *E3.871/N43.611*	09:48 18°	1.012 2m 22s
108/ 12	2 238 043 +1415.06.07	459	Montpellier *E3.87/N43.61*	05:57 18°	1.016 2m 57s
121/-09	2 243 773 +1431.02.12	421	Antonio dei VEGHI Perugia *E12.388/43.112*	14:40 20°	1.013 2m 33s
118/06	2 291 081 +1560.08.21	166	CLAVIUS (Chr. KLAU) Coimbra *E8.412/ N40.221*	11.49 57°	1.002 1m 33s
112/ 21	2 293 503 +1567.04.09	155	CLAVIUS Vatican *E12.457 / N41.902* Tycho BRAHE Rostock *E 12.10/ N54.09*	11:20 59° 47°	1.000 0m 08s 0.70 partial
137/-24	2 307 559 1605.10.12	102	"La Noirceur" Marseille *E5.373 / N43.296*	13:06 34°	.982
133/ -11	2 324 539 +1652.04.08	51	John WYBARD Carrickfergus *W5.764 /N 54.730*	10:33 38°	1.003 1m 37s
133/ -05	2 344 294 +1706.05.12	8	Montpellier *E3.871/N43.611*	09:10 50°	1.033 3m 52s

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114/ 25	2 347 573 +1715.05.03	3	John FLAMSTEED Greenwich *E0.0 / N51.4777*	09:08 41°	1.012 3m 12s
133/-07	2 350 880 +1724.05.22	-1	CASSINI & LOUIS-XV Trianon: *Double sunset* *E2.1042/N48.8141* DESLILE Observatoire Paris *E2.33722 / N48.83639*	C3 18:38:25.9 Obs: 18:38:05 C3 18:38:25.4 8°	1.0137 2m 19.70s 1.016 2m 26.2s
124/07	2 394 024 +1842.07.08	-14	François ARAGO Perpignan *E2.895 /N 42.698* Montpellier *E3.871/N43.611* Ippolito CAFFI Venice *E12.34/N45.442*	05:37 12° 05:38 *13°* 05:40 20°	1.018 2m 16s 1.009 1m 58s 1.002 1m 01s
143/-23	2 410 502 +1887.08.19	4	Double Dawn Wilhelm KRANZ Wannsee /Berlin	4: 1.5°	1.037 1m 36s
126 / 08	2 415 168 +1900.05.28	13	Théophile MOREUX Palmeral of Elche *W 0.72 / N 38.26* A.C. CROMMELIN & E.W. MAUNDER El-Jazair / Algiers *E3.07 / N 36.7* Nevil MASKELYNE Wadesboro *W 80.08 / N 34.96*	16:13 34° 16:18 30° 13:46 42°	1.007 1m 14s 1.003 0m 51s 1.024 1m 44s
143 /-22	2 417 088 +1905.08.30	16	Théophile MOREUX Sfax *E 10.76 / N 34.74*	13.43 48°	1.021 3m 29s
137/-07	2 419 510 +1912.04.17	21	F.M. da COSTA LOBO Ovar #10 *W8.5977 /N40.854560* A. NICOLLEAU Balloon Globule *E2.93697/N49.41497/900m* Richard SCHORR Becklingen #4 *E9.8994° / N52.8719°* Kazimierz R. GRAFF Hagenow-Stadt (#3) *E11.1972/N53.4353*	MAX:11:42:30.1 obs .11:43:57±7 58° MAX:12:11:40.0 Obs. 12:11.51 51° MAX:12:23:47.3 Photo:12:23:58 46° C3: 12:25:47.3 Obs.12:25:49.0 45°	1.000 0m 01,3s 0.999 partial 0.998 annular 7.3 s 0.998 annular 6.7s