Considerations on Grattan Guinness Cycle, of 391Yrs

Otis P Armstrong

Considerations on Grattan Guinness Cycle, of 391Yrs by OP Armstrong 7/21/15

A. Grattan-Guinness' Cycle (GGC), of 391 years was applied to dates of intense eclipse cycles. A normal year will have 2 solar (S) and 2 lunar (L) eclipses for a total of 4 eclipses. Some say the maximum number of eclipses that can happen in a year is seven. This review found that 8 eclipses can happen in a little as 370 days, or possibly less. Consider the year 26 to 27AD. Here are found 3 Solar and 5 lunar eclipses in 370 days from August 1/26AD unto August 6/27AD. These eclipses are detailed in the following Table. The column JD# is the Julian Day number. The difference of e#-1 less e#-8 is 369.67 Julian days, very close to 1 solar year.

26/27AD 8 eclipses in 370D						Visible?
AD	mo	dy	ty	JD#	e#	Israel
26	aug	1	S	1730767.04	1	noVis
26	aug	17	L	1730782.54	2	Vis
27	jan	11	L	1730929.90	3	noVis
27	jan	26	S	1730945.17	4	Vis
27	feb	9	L	1730959.34	5	Vis.mr
27	jly	7	L	1731107.07	6	noVis
27	jly	22	S	1731121.69	7	noVis
27	aug	6	L	1731136.71	8	Vis
26	feb	6	S	1730590.94	0	Vis

A. Grattan-Guinness' Cycle, of 391 years was applied to dates around 27AD as shown in the next table. Two separate 4,000 year long sequences were reviewed. Both sequences were found to contain the 7 eclipse pattern. These rare seven year sequences all match AGG's 391 year cycle.

#	Year	Eclipse		Year	Eclipse
1	1982	4S+3L=7		1917	4S+3L=7
2	1591	4S+3L=7		1526	4S+3L=7
3	1200	4S+3L=7		1135	4S+3L=7
4	809	4S+3L=7		744	4S+3L=7
5	418	3S+3L=6		353	4S+3L=7
6	27	3S+5L=8		-38	3S+4L=7
7	-364	3S+4L=7		-429	3S+4L=7
8	-755	4S+3L=7		-820	3S+3L=6
9	-1146	3S+4L=7		-1211	3S+4L=7
10	-1537	3S+3L=6		-1602	3S+4L=7
11	-1928	4S+3L=7		-1993	4S+3L=7
12	-2319	ND>2kBC		-2384	ND>2kBC
13	-2710	ND>2kBC		-2775	ND>2kBC
14	-3101	ND>2kBC		-3166	ND>2kBC
15	-3492	ND>2kBC		-3557	ND>2kBC
16	-3883	ND>2kBC		-3948	ND>2kBC

As all 22 eclipses matched the GGC, it was decided to take a different approach. Simply find a beginning year with 7 or 8 eclipses, then evaluate the end year. This was done for another date set also. It was seen that about 1 in 10 Years have the 7+ pattern. The more rare eight (8) eclipse sequence is found less than once in 80 years.

Considerations on Grattan Guinness Cycle, of 391Yrs by OP Armstrong 6.15/15

A. Grattan-Guinness' Cycle, of 391 years was verified by dates of intense eclipse cycles, with start end sequences detailed in the below Table.

Start	EclPttrn	End	EclPttrn
1917	4S+3L=7	-1993	4S+3L=7
1935	5S+3L=8	-1975	4S+3L=7
1982	4S+3L=7	-1928	4S+3L=7
2000	4S+3L=7	-1910	5S+3L=8
2002	3S+5L=8	-1908	3S+5L=8
2010	4S+3L=7	-1900	4S+3L=7
2012	3S+4L=7	-1898	3S+4L=7
2013	3S+4L=7	-1897	3S+3L=6
2018	4S+3L=7	-1892	4S+3L=7
2020	3S+4L=7	-1890	3S+5L=8

A. Grattan-Guinness' Cycle, of 391 years was arrived at by speculative interpretation of the Hour, and the Day, the Month, and the Year; time of Revelation 19, see table to right.

A. Grattan-Guinness Cycle, of 391 years may also be arrived at using the Saros-Inex method, as shown below:

I=Innex or 28.945Yr, S=Saros or 18.03Yr
16I-4S=16(28.95)-4(18.03)=391=17*23
10I-15S=10(28.95)-15(18.03)=19
390=65*6 =6i+12s & 65Yr=i+2s

The Saros - Inex method was conceived by a Dutch astronomer in 1955. Since then, it gained acceptance as one way to verify eclipse and lunar cycles. In this system, each cycle is an integer combination of these 2 cycles.

Grattan Guinness Cycle, 391Yrs		
Item	Count	Lunar Months
The Hour	1	1.0000
The Day	12	12.0000
TheMonth	tt	371.0480
The Year	12X	4452.5756
LunarMonths	Sum	4836.6236
Now Convert to Solar Years		
Lun Years	∑/12	403.0520
Days	354.367	142828.3557
Solar Year	365.242	391.0511
INT(SolarYears)		391.0000
tt 371.048=360*365.2422/354.3671		
The day has 12 hours to work		

Alternative: 360 + 30 +1 =391

Six thousand years of civilized history may be counted by combination of GGC start years and the ending 7 or 8 eclipse cycle date. Between 1865 and 2027, there were five of an 8 eclipse start year or 1 in 33 and about 1 in 7 years have the 7 eclipse sequence. The base of the 1865AD year is 4000BC by the GGC sequence. The base of year 2027 is 3839BC by GGC sequence. This shows the 'End from start' idea.

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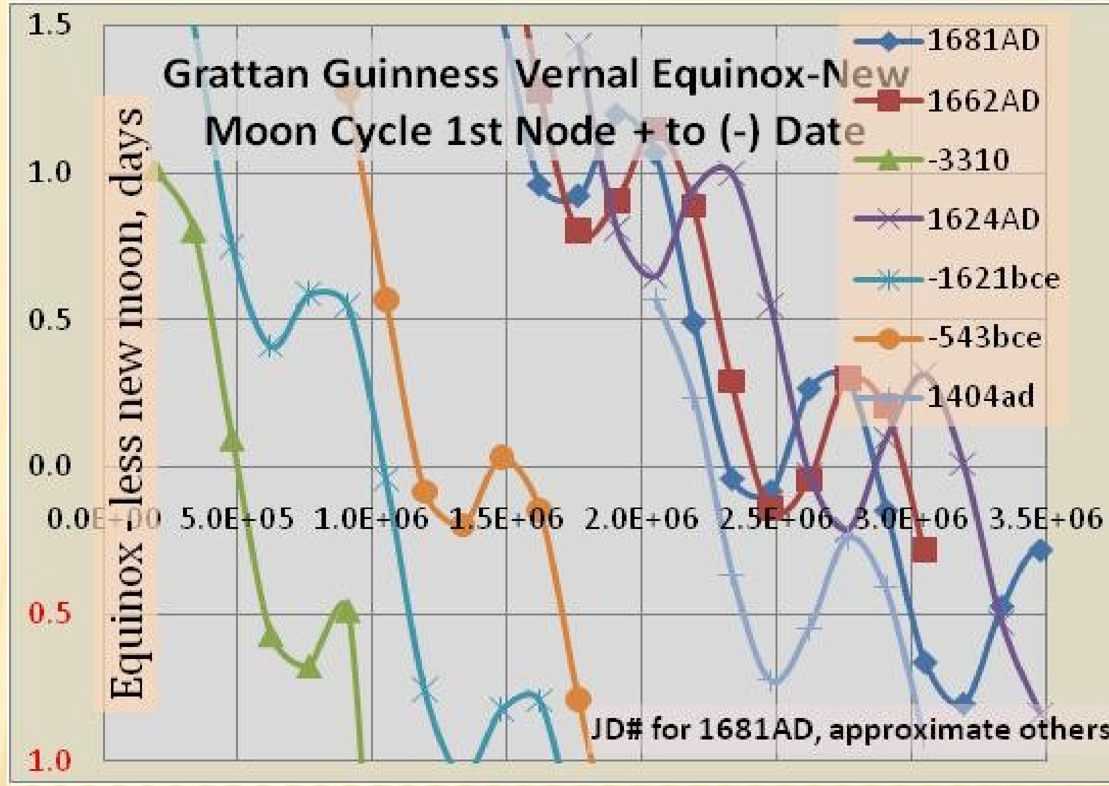
Here is an evaluation of some GGC's showing Spring Equinox dates near or on a new moon conjunction of nearly same date.
The alignment of double conjunctions can be seen to last about 6 cycles of 391 years. Ridgeway showed the GGC to develop an error of 1 day in 1738 year, or about 5 cycles. From J. Geisen & use RMS average at 82% Inex, on page2, expected stability is: ((0.18*1700*0.82*26680)^½ = 2587 YR or about 7 cycles. By the Eclipse patterns of page1, a stability of 3900 years is indicated. For example look at the 1681 series for +/- one day alignment near the plus to minus node. There one can count off about 12 cycles of 391 years each, or around 4700 years for near alignment.



If on the other hand the alignment is limited to +/- one-half a day, the cycle count is about 6 or 7 cycles or nearly 2300 years. The 19 year Metonic cycle can find additional GG cycles. In the plot, 1681 less 1662 is 19 years. A missing cycle is found for year 1643AD by adding 19 to 1624.The Metonic 19 year cycle only holds for about 4 GGC, as seen for the 1624 to 1681 series. Other cycles possibly useful to find additional Equinox conjunction dates are: 353, Unidos, and Gregoriana. The Gregoriana cycle of 372 years (135870.2d) gives same Gregorian date and weekday. The 353 cycle (128930.6d) also finds same Gregorian date. The equinox is nearly same Gregorian calendar date from year to year, these cycles offer a way to find different start points of Equinox dates near a new moon conjunction. The astronomical or true Equinox is not exactly the same Gregorian calendar date due to calendar leap year cycles. Also a 220 (half Babylon) year cycle is seen for minimum error, 1844,1624,1404,1184.

Minimum Error		
Series	Year	Δ
-3310	-3310	0.10
-1621	-1621	-0.04
-543	-934	0.03
1681	1681	-0.04
1662	2444	-0.04
1624	3970	0.01

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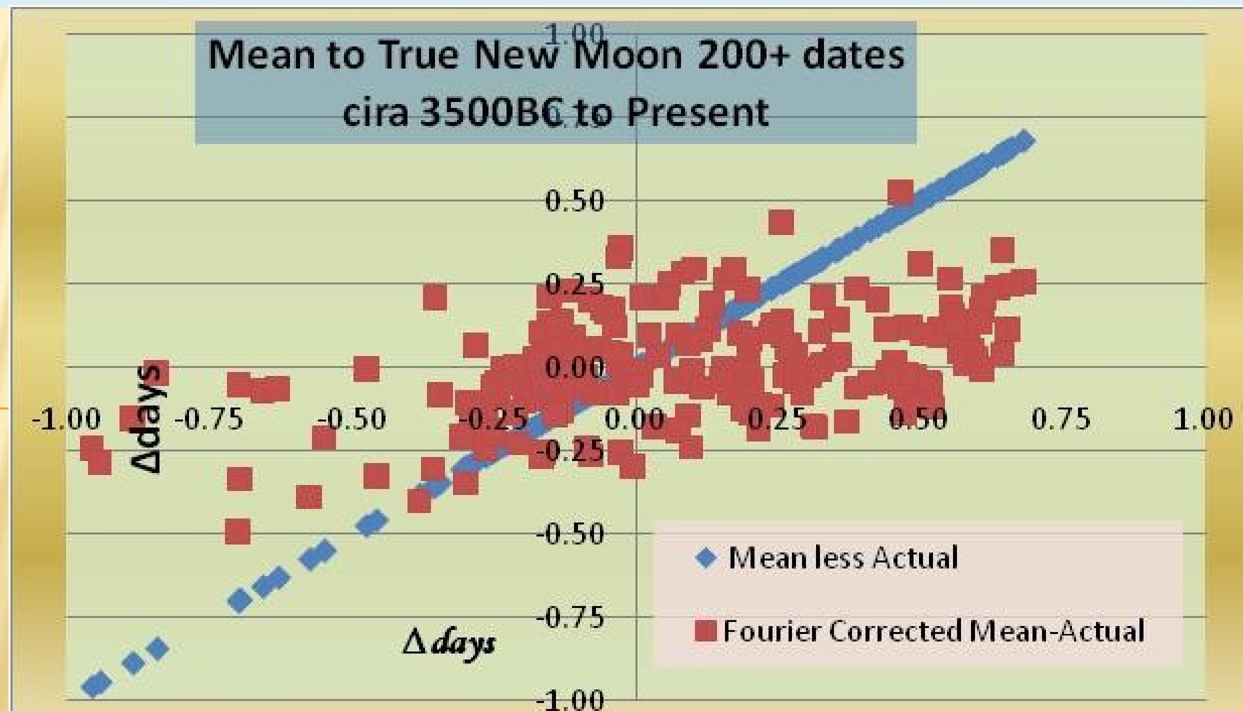
Here are results of correcting average lunation time by a Fourier Series using the Grattan Guinness cycle. Without correction the error ranged between -1 and plus 0.8 days. After correction, the error ranged between +/-0.5 day. The statistical error ranged +/- 0.25 days. The six terms used were:

1-Sidereal cycle
2-Anomalistic cycle
3-Metonic cycle,
4-Tropical Year,
5-Long Semester, and
6 Grattan Guinness cycle
Plus the delta T.

A review of lunar orbital patterns shows there are natural variations to the Synodic month, that cannot be simply predicted.

Mean NewMoon Correction by Fourier Series True=Mean+ΔT+a+∑(AsinF+BCosF)			
Eqn	A	B	F/(2π) & (2π=2*3.142) & a= 0.002 & JD#tbc=2421251.82
1	0.352	0.110	1*ABS((JD#-JD#tbc)/411.78-INT((JD#-JD#tbc)/411.78)))
2	-0.039	-0.007	(1*ABS((JD#-JD#tbc)/3232-INT((JD#-JD#tbc)/3232)))
3	0.001	0.001	(1*ABS((JD#-JD#tbc)/6939.69-INT((JD#-JD#tbc)/6939.69)))
4	-0.224	-0.117	(1*ABS((JD#-JD#tbc)/365.2422-INT((JD#-JD#tbc)/365.2422)))
5	-0.007	-0.015	1*ABS((JD#-JD#tbc)/206.71-INT((JD#-JD#tbc)/206.71))
6	0.022	0.023	(1*ABS((JD#-JD#tbc)/142809.9-INT((JD#-JD#tbc)/142809.9)))
1-Sidereal, 2-anomalistic, 3-Metonic, 4-Tropical Yr, 5-Long Semester, 6-GrattenG cycle			
ΔT per IBC=((LN2k)^4*(3.6E-22)-(7.8E-17)*(LN2k)^3+1.01E-10*(LN2k)^2+2.87E-8*(LN2k)+8.95E-5)			

LN2k = ((JD# - 2451550.098)/29.53059) for 207 data point StdDev=0.16, see chart



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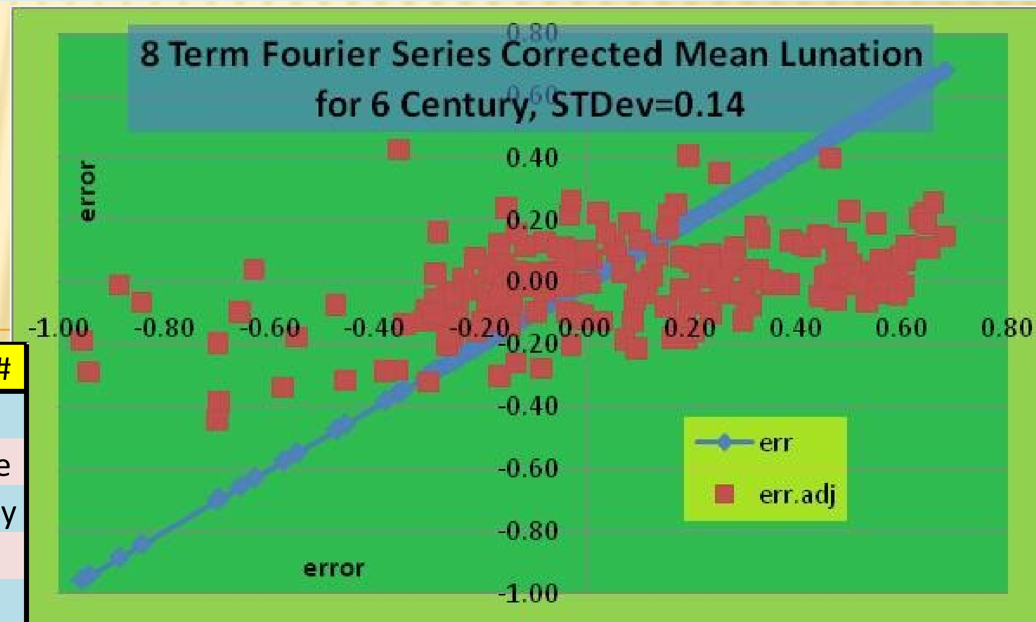
Another example is correction of average lunation time by an eight term Fourier Series. It yielded only slightly better results. After correction of same data, the error ranged between +/-0.4 day. The statistical error ranged +/- 0.25 days. The 8 terms used were: 1-Metonic cycle; 2,3,6- Delaunay Arguments ; 4-Full Moon Cycle, fumocy ; 5-Tropical Year; 7-Eclipse Year cycle; 8- Inex cycle, Plus the delta T.

Again it is seen that the natural variations in Synodic month cannot be simply predicted, even with the Metonic Cycle, see below table.

Mean NewMoon Correction by Fourier Series True=Mean+ΔT+a+∑(AsinF+BCosF)			
Eqn	A	B	F/(2π) & (2π=2*3.142) & a= 0.002 & JD#tbc=2421251.82
1	0.0071	0.0358	1*ABS((JD#-JD#tbc)/6939.69-INT((JD#-JD#tbc)/6939.69)))
2	0.0226	0.0059	(0.22801011*JD#-558976) Delauny Lunar term Rads
3	0.0531	0.1022	(0.017200608*JD#-42162) Delauny Solar term, rads
4	0.3686	0.0781	(1*ABS((JD#-JD#tbc)/411,78-INT((JD#-JD#tbc)/411.78)))
5	0.2162	0.1050	1*ABS((JD#-JD#tbc)/365.2422-INT((JD#-JD#tbc)/365.2422))
6	0.0014	0.0060	(2*(0.22801011*C4-558976)) 2*Delauny Term, Rads
7	0.0705	0.0122	1*ABS((JD#-JD#tbc)/346.62-INT((JD#-JD#tbc)/346.62))
8	0.0028	0.0031	(1*ABS((JD#-JD#tbc)/10571.95-INT((JD#-JD#tbc)/10571.95)))
1-Metonic, 2, 3, 6-Delauny Terms, 4-FUMOCY, 5-Tropical Yr, 7-eclipse Yr 8.Inex			
ΔT per IBC=((LN2k)^4*(3.6E-22)-(7.8E-17)*(LN2k)^3+1.01E-10*(LN2k)^2+2.87E-8*(LN2k)+8.95E-5)			

LN2k = ((JD# - 2451550.098)/29.53059)+C, 207point StdDev=0.14, see chart

Experts in Jewish Lunisolar calendar explain: "The probability of having Rosh Hodesh on the day of the Molad is only 39%. There is a 47% chance of its coming one day later and a 14% chance (one year out of seven) of its being delayed by two days." 1989, *Arnold A. Lasker and Daniel J. Lasker , Behold a Moon Is Born!*



Metonic Cycle Lunar Error Illustrated by JD#		
G1917AD21Apr14:03	2421340.09	Start date
100 cycle 6939.69Dys	-693969.00	Difference
G17AD12Apr 14:09	1727371.09	Calc MetCy
G17AD13Apr 07:03	1727371.79	Table
Diff. MetCy-Table	0.71	Days

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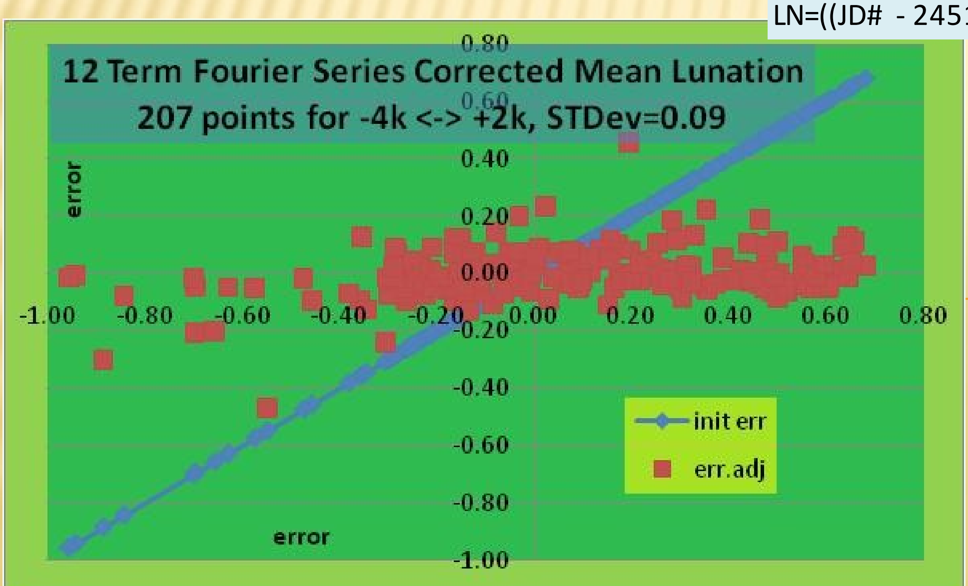
In this example, the average lunation time is corrected by an eleven term Fourier Series. This yields improved results. After correction of same data, the average error ranged between +/-0.17 day. The statistical error ranged +/- 0.20 days. The extra three terms used were variants of the lunar month. Although the natural variations in Synodic month cannot be simply predicted, even with the Metonic Cycle, it is likely that addition of more terms of longer and shorter cycle times, corresponding to system frequencies, the error could be reduced to uncertainty of the Delta T. However to accurately implement such a system would likely require four to five times more data points to be significant.

Mean NewMoon Correction by Fourier Series True=Mean+ΔT+a+∑(AsinF+BCosF)			
Eqn	A	B	F/(2π) & (2π=2*3.142) & a= -0.0001 & JD#tbc=2421251.82
1	0.0068	0.0261	1*ABS((JD#-JD#tbc)/6939.69-INT((JD#-JD#tbc)/6939.69)))
2	0.0053	0.0093	(0.22801011*JD#-558976) Delauny Lunar term Rads
3	0.1005	0.0398	(0.017200608*JD#-42162) Delauny Solar term, rads
4	0.6116	0.2587	(1*ABS((JD#-JD#tbc)/411,78-INT((JD#-JD#tbc)/411.78)))
5	1.2380	1.5434	1*ABS((JD#-JD#tbc)/365.2422-INT((JD#-JD#tbc)/365.2422))
6	0.0001	0.0093	(0.22801011*2*C4-558976)) 2*Delauny Term, Rads
7	0.0392	0.0050	1*ABS((JD#-JD#tbc)/346.62-INT((JD#-JD#tbc)/346.62))
8	0.0115	0.0018	(1*ABS((JD#-JD#tbc)/10571.95-INT((JD#-JD#tbc)/10571.95)))
9	0.3312	0.2744	1*ABS((JD#-JD#tbc)/27.5545-INT((JD#-JD#tbc)/27.5545))
10	1.3758	1.3768	(1*ABS((JD#-JD#tbc)/27.32158-INT((JD#-JD#tbc)/27.32158)))
11	0.0115	0.0249	1*ABS((JD#-JD#tbc)/27.32166-INT((JD#-JD#tbc)/27.32166))
1-Metonic, 2, 3, 6-Delauny Terms, 4-FUMOCY, 5-Tropical Yr, 7-eclipse Yr 8.Inex			
ΔT per IBC=((LN2k)^4*(3.6E-22)-(7.8E-17)*(LN2k)^3+1.01E-10*(LN2k)^2+2.87E-8*(LN2k)+8.95E-5)			

LN=((JD# - 2451550.098)/29.53059)+C, 207point StdDev=0.086, see chart



The GGC is also useful to get lunar series falling upon the same Gregorian date. As previously shown there exist variations in the data of experts. For example Nasa tables only go back to 2000BC. For NASA concluded the dT uncertainty is so great that calculations are meaningless. Such factors need be reviewed when using existing calculation routines.

The key points of this work were: **1) show both Synodic corrections and dT corrections are necessary; 2) this correction is possible using a Fourier Series concept.**

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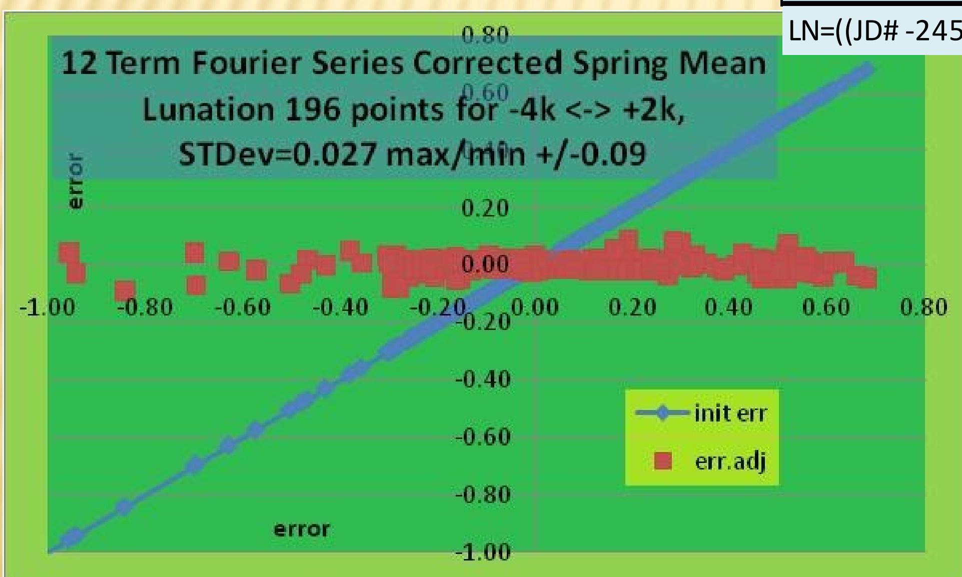
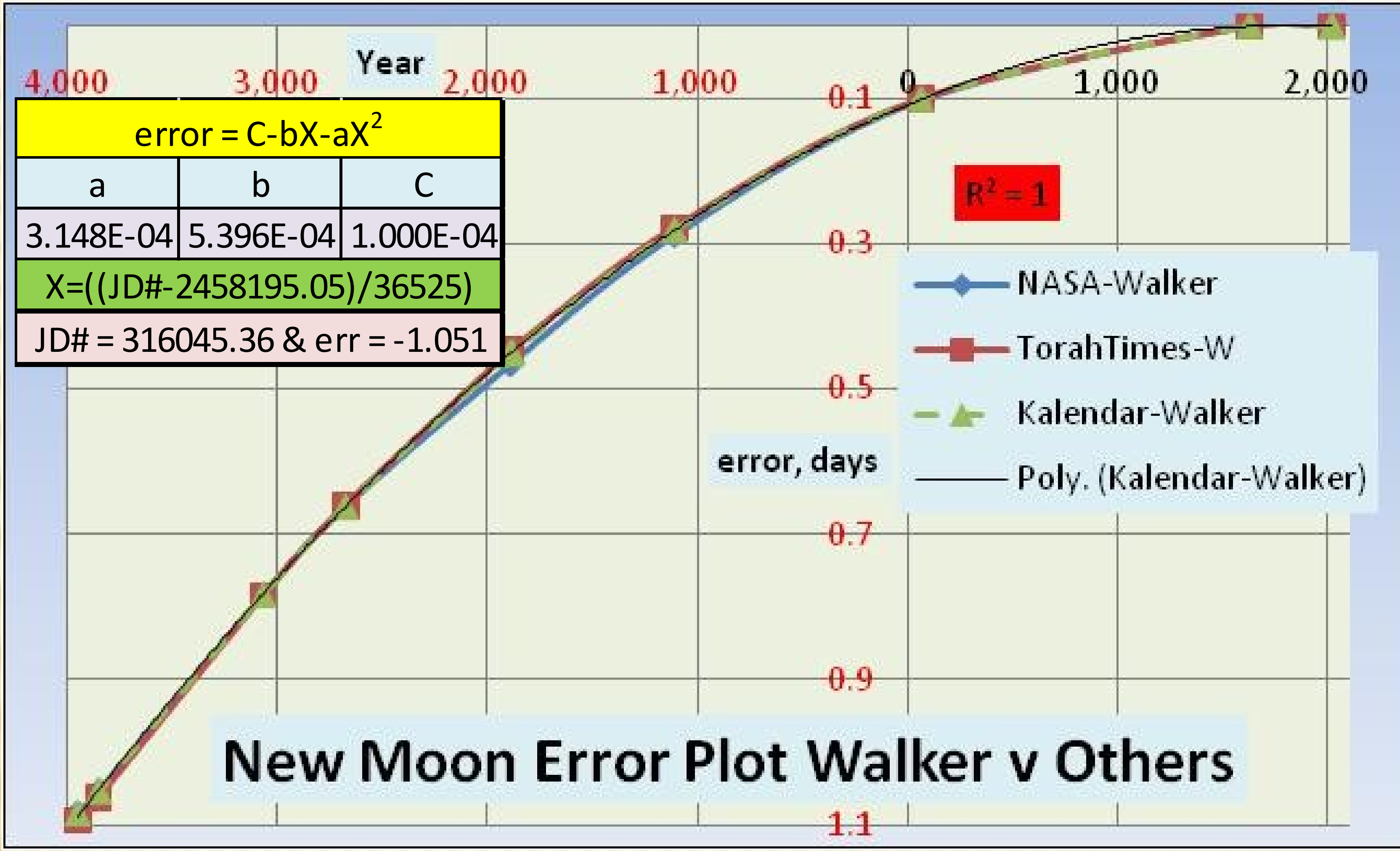
In this example, the average date of spring new moon is corrected by an eleven term Fourier Series. This yields greatly improved results. After correction, the average error ranged between +/-0.09 day. The statistical error ranged +/- 0.05 days. The terms used were same as the prior example. The natural variations in Synodic month cannot be simply predicted, even with the Metonic Cycle. Since larger errors were associated with non-spring moons; all dates that were not spring moons were changed to spring moons for same year. This yielded greatly improved results. Most likely another set of data for moon dates around autumn equinox would also have very low error.

Mean NewMoon Correction by Fourier Series True=Mean+ΔT+a+∑(AsinF+BCosF)			
Eqn	A	B	F/(2π) & (2π=2*3.142) & a= -0.18 & JD#tbc=2421251.82
1	0.0035	0.0014	1*ABS((JD#-JD#tbc)/6939.69-INT((JD#-JD#tbc)/6939.69)))
2	0.0035	0.0003	(0.22801011*JD#-558976) Delauny Lunar term Rads
3	0.0351	0.1006	(0.017200608*JD#-42162) Delauny Solar term, rads
4	0.0485	0.0312	(1*ABS((JD#-JD#tbc)/411,78-INT((JD#-JD#tbc)/411.78)))
5	3.8336	3.0777	1*ABS((JD#-JD#tbc)/365.2422-INT((JD#-JD#tbc)/365.2422))
6	0.0034	0.0003	(0.22801011*2*C4-558976)) 2*Delauny Term, Rads
7	0.0066	0.0036	1*ABS((JD#-JD#tbc)/346.62-INT((JD#-JD#tbc)/346.62))
8	0.0006	0.0030	(1*ABS((JD#-JD#tbc)/10571.95-INT((JD#-JD#tbc)/10571.95)))
9	0.0327	0.0319	1*ABS((JD#-JD#tbc)/27.5545-INT((JD#-JD#tbc)/27.5545))
10	3.4406	2.8621	(1*ABS((JD#-JD#tbc)/27.32158-INT((JD#-JD#tbc)/27.32158)))
11	0.2873	0.4318	1*ABS((JD#-JD#tbc)/27.32166-INT((JD#-JD#tbc)/27.32166))
1-Metonic, 2, 3, 6-Delauny Terms, 4-FUMOCY, 5-Tropical Yr, 7-eclipse Yr 8.Inex			
ΔT per IBC=((LN2k)^4*(3.6E-22)-(7.8E-17)*(LN2k)^3+1.01E-10*(LN2k)^2+2.87E-8*(LN2k)+8.95E-5)			

LN=((JD# -2451550.1)/29.531)+C, 196point StdDev=0.027, **Spring New Moon Only**



Another issue is variation between delta T of various researchers. For example Nasa tables only go back to 2000BC. The NASA data is slightly different from the others. The following graph shows the data of Walker, likely omitted a delta T correction. Plotting a second order correction factor on Walkers' data proves the point. Namely that his dates can be corrected to match others with near perfect statistical certainty, R^2=1. Determination of Dr. Bromberg's JD# for new moon is by: JD#NM=JD#- (HR.Age/24+MIN.Age/60/24)



The above plot of Walker new moon date (recommended save as offline) shows increased error with increasing time difference from present error . The NASA (Mr. Eclipse) data show slight variance to that of Kalendar and Torah Times results. However all three NASA, Kalendis, and Torah Times show Walker's new moon date to be in error for all but more recent dates. Since his date is easily corrected by a second order polynomial, it is concluded that Walker neglected to utilize a delta T correction factor.

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New Moon Data used in Fourier Series Correction of Synodic Date

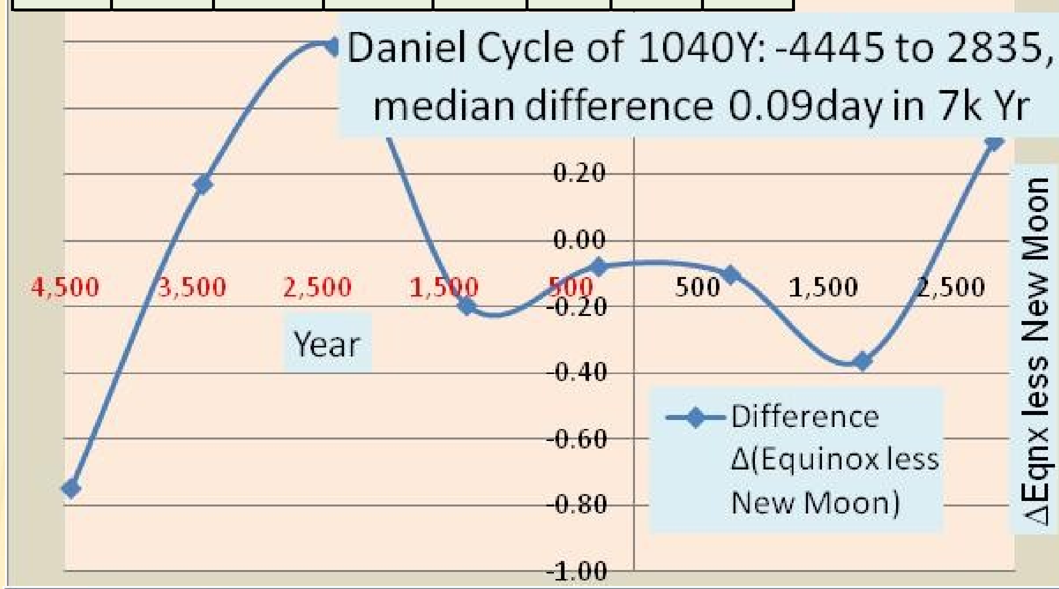
JD#NewMoon	JD#NewMoon	JD#NewMoon	JD#NewMoon	JD#NewMoon	JD#NewMoon	JD#NewMoon
2457101.907	2378963.685	2055721.850	1750346.915	1437706.237	1280661.879	1009276.207
2456009.110	2372732.806	2045858.721	1747068.999	1437352.170	1278831.714	1009187.510
2453823.925	2369070.920	2035611.903	1740128.978	1427489.003	1278832.023	1005998.224
2449069.803	2358853.633	2032334.106	1730945.048	1420549.243	1264568.272	990937.596
2446884.035	2344974.781	2025748.813	1722971.225	1417625.783	1243779.028	865432.614
2445053.931	2334756.939	2016741.940	1718985.137	1403745.895	1224023.190	862154.640
2444285.872	2331094.887	1998373.747	1712753.878	1403391.272	1199571.182	861711.974
2442897.931	2327816.913	1994711.760	1707261.129	1390249.820	1196293.248	856248.940
2442130.392	2325573.036	1991433.802	1692644.008	1389866.286	1182768.465	842369.370
2441775.990	2314291.695	1978617.745	1675131.891	1383280.995	1176183.187	819719.424
2435190.655	2279977.762	1940641.903	1652097.937	1380003.145	1155305.150	818980.784
2428250.676	2273746.996	1937363.930	1645158.158	1379649.112	1142223.296	814610.528
2427305.742	2263529.100	1906681.120	1621061.997	1375987.552	1138561.272	786852.131
2423142.045	2256943.757	1906327.026	1610844.089	1362108.023	1135283.273	759093.513
2422787.876	2256589.081	1899741.736	1591088.099	1356201.672	1128343.417	731334.265
2421310.671	2239431.910	1873931.950	1566637.013	1348228.084	1118775.326	588671.740
2421251.820	2229568.817	1865426.788	1563359.168	1342381.421	1104601.438	333201.940
2419509.986	2209458.862	1852256.156	1557127.939	1334349.156	1104247.205	326971.000
2414370.860	2198531.916	1851901.835	1556773.874	1332518.096	1100525.881	313446.090
2412924.667	2185006.780	1848623.992	1549834.210	1325578.181	1081951.060	309460.080
2412570.108	2161618.910	1845670.832	1532676.254	1320470.103	1081213.371	305827.660
2410001.106	2144462.052	1842392.918	1522812.969	1312053.285	1063996.122	295935.030
2407431.378	2137522.075	1808078.930	1520539.565	1306590.128	1061160.962	289349.720
2403031.902	2130936.751	1804416.902	1519151.162	1294542.239	1050176.145	286071.720
2400492.081	2127658.757	1801138.903	1509287.988	1292710.751	1046898.338	285717.010
2399754.009	2127304.095	1788322.934	1484837.079	1288311.412	1045716.917	282409.710
2392814.093	2123996.737	1760593.883	1458141.096	1284324.228	1027555.373	265961.050
2386612.803	2083830.628	1751438.849	1445324.830	1283201.472	1026787.988	261620.120

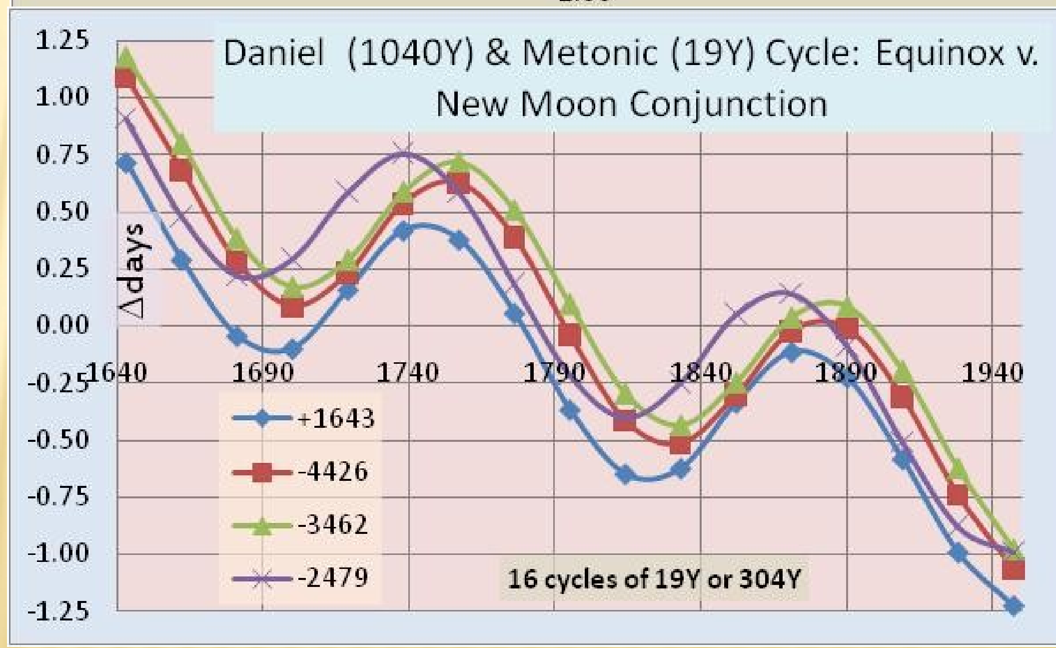
Considerations on Grattan Guinness Cycle, of 391Yrs by OP Armstrong 6.26/15

Here are other methods to find dates of near conjunction of Equinox and New Moon. In the 1st instance, the Hermetic Systems & Kalendis calendar programs were used to find some early Equinox Solar Eclipses. These eclipses tend to run in bands of various density. The Metonic cycle starting in year (-3139) had several. From there, steps of the Daniel Cycle were used to find additional years, see Table & upper graph. At each Daniel cycle start year the Metonic cycle can be used to find additional alignments, chart 2. Alternatively, there are a series of equinox Lunar Eclipse cycles when the moon moves behind or in opposition, years: -3010, -2991 and -2972. These may also be mapped by the Daniel Cycle.

The Daniel cycle was discovered by Swiss Astronomer Jean-Philippe de Cheseaux as the difference between Daniels' numbers of 2300 and 1260. The error in this cycle is about 1 day in 15,000 years. It is seen in lower graph that each series has a point of minimum error or maximum alignment of New Moon with Spring Equinox. Another accurate bible cycle is the Dawson Cycle of 630773.3 days, an average of 2300 and 1260 years. The bible periods of 391 (GGC), 486, (706=391+1260/4), and 2520 years are other bible based solar lunar cycles that may be used to predict alignments.

-4445	-3405	-2365	-1325	-285	755	1795	2835



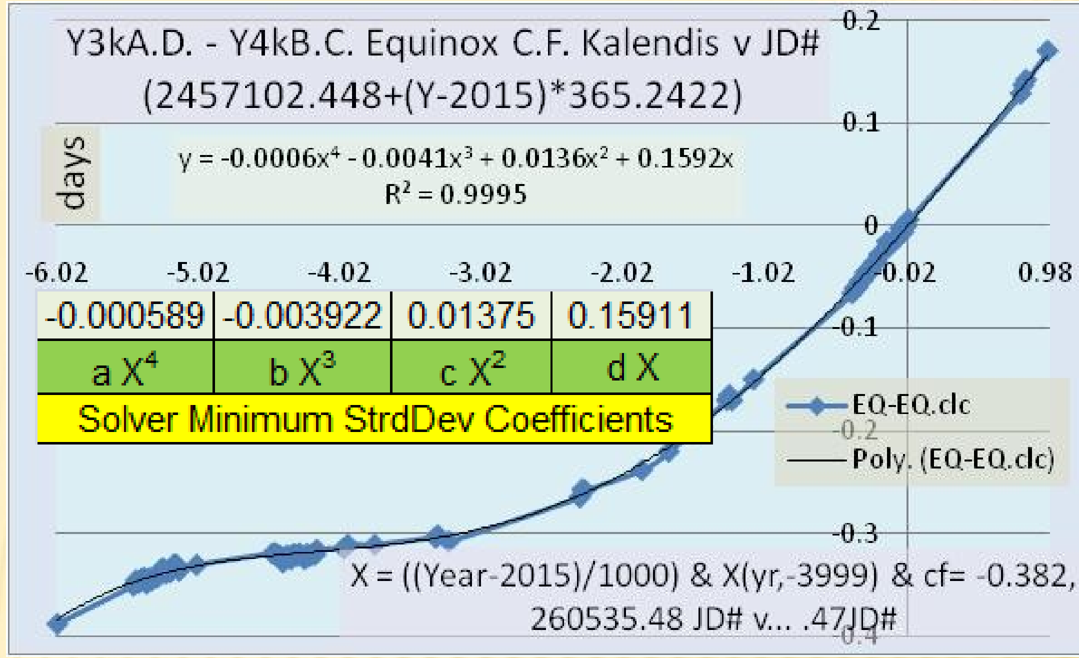


Considerations on Grattan Guinness Cycle, of 391Yrs by OP Armstrong 7.03/15

Considerations on calendar method to find years of near conjunction of Equinox and New Moon. The first step is to determine Julian Day number of the Astronomical Equinox. The 1st approximation is by JD# using year 2015 as a basis, as explained in graph. This date is then corrected by the 4th order polynomial as described by millennial year count from 2015. Year 2015 was selected because an eclipse happened on vernal equinox.

Calculation Examples Year Dates				
Year	EqnxJDcor	A	B	C
3970	3171151.27	-0.24	**0.01**	0.35
2444	2613791.42	0.22	**-0.04**	0.05
2072	2477921.26	0.30	**-0.08**	0.02
2015	2457102.45	0.55	**0.55**	0.03
1977	2443223.24	0.72	**0.96**	0.04
1939	2429344.03	0.88	**0.45**	0.01
1681	2335111.50	0.46	**-0.04**	-0.02
1146	2139706.85	-0.29	**0.01**	0.01
793	2010776.31	-0.28	**-0.03**	-0.01
774	2003836.71	-0.20	**0.09**	-0.01
755	1996897.10	-0.11	**-0.11**	-0.03
402	1867966.57	-0.10	**0.16**	-0.01
383	1861026.97	-0.01	**-0.11**	-0.03
68	1745975.65	-0.16	**0.07**	-0.01
30	1732096.44	0.01	**0.20**	-0.03
11	1725156.84	0.09	**-0.11**	-0.04
-27	1711277.63	0.26	**-0.07**	-0.04
-562	1515873.02	-0.45	**-0.06**	0.00
-915	1386942.51	-0.41	**0.06**	0.00
-934	1380002.91	-0.33	**0.03**	-0.02
-1010	1352244.50	0.02	**0.06**	-0.02
-1621	1129081.50	-0.33	**-0.04**	-0.02
-1697	1101323.09	0.02	**-0.11**	-0.06
-1879	1034849.01	-0.71	**-0.08**	-0.01
-1898	1027909.40	-0.63	**-0.05**	-0.02
-3310	512187.39	-0.45	**0.10**	-0.03
-3997	261265.96	-	**-0.06**	-
-4016	254326.35	-	**-0.01**	-

This Table shows some example results. First column is common year, 2nd is Equinox date corrected per terms of graph, A or 3rd is lunar age on corrected Equinox date; B or 4th is Equinox date less new moon & both values from Kalendis program; C or 5th is A column (3) corrected.



This correction applied in 5th column is value from Fourier Series listed on page 7. This correction was found to be 85% effective and only valid for absolute values less than 0.70. For values of year 2015, Kalendis program shows Equinox JD# to be 2457102.448 and new moon conjunction as JD# 2457101.9. So the moon age by 2015 Equinox lunation number becomes:

29.531{(2457101.9-JD.Eqnx)/29.531 - INT((2457101.9-JD.Eqnx)/29.531)}.

This value, if over 2 days, is made negative by subtraction of 29.531. The negative lower values make it easier to screen for dates when Equinox is close to new moon. The result in Table are screened from about 8,000 years. The years 3970, 1146, 793, 934, and -4016 (Col.**B**) were found with closest approach of new moon and vernal equinox. One author claimed a series of Equinox eclipses but upon review, less than 1/3 were eclipses on the day of equinox. The others were just month of March eclipses.

Considerations on Grattan Guinness Cycle, of 391Yrs by OP Armstrong 7.03/15

Mr. James D. Dwyer (JDD) proposed that the year of Creation was on a day of Vernal Equinox and also the flood was likewise on an Equinox and an Eclipse. The 1st Table reviewed the possibility of such concept. In 1st instance all dates +/- 100 years from 4000BC were reviewed for such possibility.

Review James D. Dwyer Equinox Eclipse Creation & Flood Day Cycle Theory 1656Y 604841D							
Start Year	NewMoon	Equinox	Δ Day	Start Note	Flood, greg	JD# Flood	Result
-4062M20.13:55	237523.07	237525.21	2.14	EclipseNoEqnx	-2406Mr26	842371.2	NoEqNoEclip21
-4054M20.21	240446.36	240447.14	0.78	No Eclipse	-2398Mr26	845293.1	NoEqNoEclip21
-4016M21.20	254326.35	254326.35	-0.01	No Eclipse	-2360Mr25	859172.3	NoEqNoEclip21
-4005M20.18:57	258342.29	258344.01	1.72	EclipseNoEqnx	-2349Mr25	863190.0	EclipNoEqnx21
-3997M22.12:43	261266.02	261265.96	-0.06	Eclipse&Eqnx	-2341Mr26	866112.0	NoEqNoEclip21
-3986M20.02:22	265281.60	265283.62	2.03	EclipseNoEqnx	-2330Mr26	870129.6	EclipNoEqnx21
-3978M21.21:21	268205.38	268205.56	0.18	Eclipse&Eqnx	-2322Mr26	873051.6	EclipNoEqnx21
-3940M20.20:52	282084.37	282084.77	0.41	Eclipse&Eqnx	-2284Mr26	886930.8	EclipNoEqnx21
-3921M21.19:12	289024.31	289024.37	0.06	Eclipse&Eqnx	-2265Mr26	893870.4	EclipNoEqnx21

The years when a new moon and the Equinox happened concurrently were -4054, -4016, -3997, -3978, -3940, & -3921. Because an eclipse is a vector quantity, not all new moons are eclipses. The years of eclipses on equinox new moon dates were only; -3997, -3978, -3940, & -3921. Adding Dwyer's 604841 day eclipse cycle to these dates determined the following dates for eclipses about 1656 years future: -4005/-2349; 3986/2330; -3978/-2322, -3940/-2284, & -3921/-2265. None of these future year eclipses happened on a spring equinox. Thus the *Dwyer* theory is a bust, there are no double concurrences to be found. This is likely the reason he only speculated, but did not calculate.

Sundry 1-Cycle alignment from ancient Equinox New Moon, Δ days										
YR/Cycle	220	315	372	391	1040	1260	1656	1727	2300	4600
-4016	0.75	0.67	0.25	0.17	0.50	0.92	5	0.25	0.08	0.33
-3997	0.42	0.42	0.17	0.13	0.33	0.88	4	0.05	0.13	0.13
-3921	0.67	0.13	0.27	0.75	0.33	0.29	5	0.88	0.04	0.50
2/3.avg	0.55	0.27	0.21	0.15	0.33	0.60	4.50	0.15	0.06	0.23

The reason JDD's theory fails is shown in this 2nd Table. The better Lunar-Solar Cycles are found as: 2300, 1727, 391(Grattan Guinness Cycle), 372(Gregoriana), 315, and 1040(Daniel) years. The cycle of 1656 years was fudged to be a lunar or eclipse cycle. Mr. *Dwyer* made his eclipse cycle work by adding 5 days. For 1656 years is 604841 days, but *Dwyer* used 604846 days to make the eclipse or lunar cycle. In so doing he destroyed the solar side of the cycle so it cannot reproduce equinox cycles. Years near the Seder Olam creation date also did not conform to JDD's theory.

Considerations on Grattan Guinness Cycle, of 391Yrs by OP Armstrong 7.07/15

This Table reviews Solar Eclipses near the Vernal Equinox, (+/- 1 day). By this data, a Spring Equinox eclipse happens about once every 200 years. Not every new moon (NM) is an eclipse, for example 30AD, but a Solar Eclipse only happens on date of a new moon. This means there are more equinox new moons than equinox eclipses. As seen on page-12, there are several cycles that predict new moon dates near the equinox. But only the GGC cycle of 391 years (and Metonic variants of the GGC) can predict dates of both equinox and eclipse.

Most of Luis Vega's claimed equinox eclipses are only eclipses in Month of March, as seen in the table at right side. For example, his dates of 722, 1140, and 1562 and others of his claimed Equinox Eclipses are only eclipses in March. However they miss the Equinox date by more that 24 hours. Also Vega indicates that there are only 18 Equinox Solar Eclipses between 2015AD and 2250BC. If one counts only solar eclipses +/- 24 hours of Spring Equinox, then the count is about 20 eclipses. If a criteria of plus minus 2 days of Vernal Equinox, then this table counts over 40 such eclipses. Thus timing rapture date based on a theory of 18 Equinox Eclipses is not likely a correct procedure.

By this Table, the eclipse or new moon Julian Day number is the difference of "Equinox" less "Eq-NM". For year -2927, the New Moon or Eclipse time is 652075.2 less 1.0 or 652074.2.

Review of Some Near Equinox Eclipses with Equinox less Eclipse days

Year	Equinox	Eq-NM	Year	Equinox	Eq-NM	Year	Equinox	Eq-NM
-2946	645135.6	1.2	-2023	982254.1	-1.3	-600	1501993.8	-0.6
-2927	652075.2	1.0	-2015	985176.1	-3.2	-581	1508933.4	-0.3
-2908	659014.8	1.2	-2004	989193.7	-1.1	-562	1515873.0	-0.1
-2889	665954.4	1.5	-1754	1080504.3	0.7	-543	1522812.6	-0.1
-2870	672894.0	1.5	-1735	1087443.9	0.2	-535	1525734.6	-1.7
-2851	679833.6	1.2	-1716	1094383.5	-0.1	-255	1628002.4	1.0
-2843	682755.5	-0.2	-1697	1101323.1	-0.1	-228	1637863.9	-0.6
-2824	689695.1	-0.5	-1689	1104245.0	-1.8	-209	1644803.5	-0.3
-2805	696634.7	-1.0	-1670	1111184.6	-1.7	-190	1651743.1	-0.2
-2563	785023.3	2.7	-1651	1118124.2	-1.4	-171	1658682.7	-0.4
-2517	801824.5	1.4	-1632	1125063.8	-1.2	-152	1665622.3	-0.8
-2498	808764.1	1.3	-1390	1213452.5	1.7	30	1732096.4	0.2
-2479	815703.7	0.9	-1382	1216374.4	0.4	70	1746706.1	-8.2
-2471	818625.6	-0.5	-1371	1220392.1	1.4	71	1747071.4	2.5
-2460	822643.3	0.5	-1363	1223314.0	-0.1	79	1749993.3	1.0
-2452	825565.2	-0.9	-1344	1230253.6	-0.3	98	1756932.9	0.8
-2433	832504.8	-1.3	-1325	1237193.2	-0.2	117	1763872.5	0.9
-2414	839444.4	-1.4	-1306	1244132.8	0.1	136	1770812.1	1.2
-2395	846384.0	-1.3	-1298	1247054.7	-1.7	201	1794552.9	-0.6
-2368	856245.6	-2.8	-1260	1260933.9	-1.4	489	1899742.7	0.9
-2330	870124.8	-2.6	-999	1356262.2	1.2	508	1906682.3	1.2
-2191	920893.4	2.6	-991	1359184.1	-0.3	527	1913621.9	1.2
-2134	941712.2	2.4	-972	1366123.7	-0.5	573	1930423.0	-0.8
-2126	944634.2	1.0	-953	1373063.3	-0.3	592	1937362.6	-1.3
-2107	951573.8	0.6	-934	1380002.9	0.0	722	1984844.1	-4.3
-2088	958513.4	0.2	-888	1396804.0	-1.6	964	2073232.7	-1.5
-2080	961435.3	-1.2	-665	1478253.1	1.5	1140	2137515.4	-6.7
-2061	968374.9	-1.6	-646	1485192.7	1.2	1562	2291647.7	5.9
-2042	975314.5	-1.6	-619	1495054.2	-0.5	1624	2314292.7	1.0
-2023	982254.1	-1.3	-608	1499071.9	1.3	2015	2457102.4	0.5

Considerations on Grattan Guinness Cycle, of 391Yrs by OP Armstrong 7.15/15

This table looks at cycles that may predict eclipses on an equinox date. The year -934 was selected because an **eclipse** happened near a perfect Lunar Conjunction with the Vernal Equinox (see pages 11 & 13, 0.03 days difference). From the start date of -934, one cycle up and one cycle down was evaluated. The evaluation results are given in the columns to left and right of the cycle length. If an eclipse happened, a YES is given and NO for no eclipse. The average error is sum of absolute value of Equinox less new moon divided by 2, with result in days. The 1727 and 391 year cycles had the lowest error, 0.02 days. Some cycles are good at predicting equinox and new moon alignment but fail at eclipse prediction. Examples of these types of cycles are 2300 and 1727 years. Only two cycles, 1154 and 391 years, can predict New Moon-Equinox alignment together with eclipse. However, only Grattan Guinness cycle , GGC, does all three with a very low error, 0.02 days. The 1154 year cycle error was 0.60 day. This means the equinox alignment rapidly will degrade quickly.

+/- 1 Cycle Analysis-934base			
-D&Ecc	CY Yr	+D&Ecc	AvErr
M22ND	**2520**	M20No	**0.50**
M22ND	**2300**	M20No	0.19
M21No	1780	M20No	0.04
M22No	**1727**	M20No	0.02
M22No	1260	M21No	0.47
M21Yes	1154	M20Yes	0.60
M21No	**1040**	M21No	**0.29**
M21No	725	M21Yes	0.39
M20No	706	M20Yes	0.49
M21No	486	M21No	0.87
M21Yes	**391**	**M21Yes**	0.02
M21Yes	345	M21No	1.49
M20No	190	M20No	0.85
M21Yes	19	M21No	0.15
A	B	C	D

Reader is advised to review the graph on page 3. It shows how the GGC pattern works. The sinusoid nature of the Grattan Guinness Cycle, GGC, can lead to alignment fluxuations. Such as seen for start year -4035. For in that cycle are seen alternating dates of good alignment with dates of lesser alignments.

The eclipse dates prior to year -2999 were taken from the windows program EmapWin3.11 by Dr. Takesako. Eclipses data prior to -2999 are from Tables at Eclipse-wise. The dates of new moon and equinox were taken from Kalendis. The difference in time and date was calculated by Julian day numbers at Walker's page.

The next table shows results of the GGC predictions for a Solar Eclipse happening on or near the Vernal Equinox. Years in red are for equinox and new moon alignment +/-2.5 days of equinox. Years in brown are for equinox and new moon alignment greater than +/- 2.5 but less than 5 days of equinox, Blue values are dates more than +/-5 days away from spring equinox. The longest running cycle of good alignment was for start year -2451. This alignment was for 10 cycles or 3910 years. The longest running cycle of solar eclipses was for start year -1382 and lasted 4301 years. The shortest eclipse cycle was 2, starting -3921. The shortest Equinox new moon cycle was also just 2. The average alignment was 5 or 6 cycles, or 2000 years.

Considerations on Grattan Guinness Cycle, of 391Yrs by OP Armstrong 7.15/15

This is an expanded Table of Grattan Guinness Cycle Eclipses on or near a Spring Equinox. It differs from other table by using a larger range of alignment criteria, The eclipses or new moons in red are +/-2.5 days of Vernal Equinox. When date is appended with “n” that means there was NOT a solar eclipse by the Equinox new moon.

GrattanGuinness Cycle:Equinox & (n-no)Eclipse +/-2.5day of Equinox (EQ), +/->2.5 to 5 Day of EQ >5day/EQ

-4165n	-3774n	-3383n	-2992n	-2601	-2210	-1819	-1428	-1037	-646	-255	136	527	918	1309	1700n
-4146n	-3755n	-3364	-2973	-2582	-2191	-1800	-1409	-1018	-627	-236	155	546	937n	1328n	1719n
-4138n	-3747n	-3356n	-2965n	-2574n	-2183n	-1792n	-1401n	-1010n	-619	-228	163	554	945	1336	1727
-4127	-3736	-3345	-2954	-2563	-2172	-1781	-1390	-999	-608	-217n	174n	565n	956n	1347n	1738n
-4119n	-3728n	-3337n	-2946	-2555n	-2164n	-1773n	-1382	-991	-600	-209	182	573	964	1355	1746
-4108	-3717	-3326	-2935	-2544	-2153	-1762	-1371	-980n	-589n	-198n	193n	584n	975n	1366n	1757n
-4100n	-3709n	-3318n	-2927	-2536n	-2145	-1754	-1363	-972	-581	-190	201	592	983	1374	1765
-4089	-3698	-3307	-2916	-2525	-2134	-1743n	-1352n	-961n	-570n	-179n	212n	603n	994n	1385n	1776n
-4081n	-3690n	-3299	-2908	-2517	-2126	-1735	-1344	-953	-562	-171	220	611	1002n	1393n	1784n
-4062	-3671	-3280	-2889	-2498	-2107	-1716	-1325	-934	-543	-152	239n	630n	1021n	1412n	1803n
-4054n	-3663n	-3272n	-2881n	-2490n	-2099n	-1708n	-1317	-926	-535	-144	247	638	1029	1420	1811
-4043	-3652	-3261	-2870	-2479	-2088	-1697	-1306	-915n	-524n	-133n	258n	649n	1040n	1431n	1822n
-4035n	-3644n	-3253n	-2862n	-2471	-2080	-1689	-1298	-907	-516	-125	266	657	1048	1439	1830
-4024	-3633	-3242	-2851	-2460	-2069n	-1678n	-1287n	-896n	-505n	-114n	277n	668n	1059n	1450	1841n
-4016n	-3625n	-3234n	-2843	-2452	-2061	-1670	-1279	-888	-497	-106	285	676	1067	1458n	1849n
-3997	-3606	-3215	-2824	-2433	-2042	-1651	-1260	-869	-478n	-87n	304n	695n	1086n	1477n	1868n
-3978	-3587	-3196	-2805	-2414	-2023	-1632	-1241	-850n	-459n	-68n	323n	714n	1105n	1496n	1887n
-3970n	-3579n	-3188n	-2797n	-2406n	-2015	-1624	-1233	-842	-451	-60	331	722	1113	1504	1895n
-3959	-3568	-3177	-2786	-2395	-2004	-1613n	-1222n	-831n	-440n	-49n	342n	733n	1124n	1515n	1906n
-3940	-3549	-3158	-2767n	-2376n	-1985n	-1594n	-1203n	-812n	-421n	-30n	361n	752n	1143n	1534n	1925n
-3932n	-3541	-3150	-2759	-2368	-1977	-1586	-1195	-804	-413	-22	369n	760n	1151n	1542n	1933n
-3921	-3530	-3139n	-2748n	-2357n	-1966n	-1575n	-1184n	-793n	-402n	-11n	380n	771n	1162n	1553n	1944n
-3913	-3522	-3131	-2740	-2349	-1958	-1567	-1176	-785n	-394n	-3n	388n	779n	1170n	1561n	1952n
-3894	-3503	-3112	-2721	-2330	-1939	-1548n	-1157n	-766n	-375n	16n	407n	798n	1189n	1580n	1971n
-3875	-3484	-3093	-2702	-2311n	-1920n	-1529n	-1138n	-747n	-356n	35n	426n	817n	1208n	1599n	1990n
-3856	-3465n	-3074n	-2683n	-2292n	-1901n	-1510n	-1119n	-728n	-337n	54n	445n	836n	1227n	1618n	2009n
-3850n	-3459n	-3068n	-2677n	-2286n	-1895n	-1504n	-1113n	-722n	-331n	60n	451n	842n	1233	1624	2015
-3839n	-3448n	-3057n	-2666	-2275	-1884	-1493n	-1102	-711	-320	71	462	853	1244	1635	2026n
-3831n	-3440n	-3049n	-2658n	-2267n	-1876n	-1485n	-1094n	-703n	-312n	79	470	861	1252	1643	2034
-3812n	-3421n	-3030n	-2639n	-2248n	-1857n	-1466n	-1075n	-684	-293	98	489	880	1271	1662	2053
-3793n	-3402n	-3011n	-2620n	-2229n	-1838n	-1447	-1056	-665	-274	117	508	899	1290	1681	2072
A	B	C	D	E	F	G	H	I	J, (n: no eclipse) L			M	N	O	P

Considerations on Grattan Guinness Cycle, of 391Yrs by OP Armstrong 7.15/15

This is an abbreviated Table of Grattan Guinness Cycle Eclipses on or near a Spring or Vernal Equinox. It differs from prior table by using a tighter criteria for matching Equinox eclipses, +/- 1.5 days. Some of these dates may be checked by data in Table of page 11 and 13.

Some Years of GG Equinox & Eclipse Cycles +/-1.5day Equinox, +/->2Day

-3997	-3606	-3215	-2824	-2433	-2042	-1651	-1260	-869	-478n	-87n	304n
-3978	-3587	-3196	-2805	-2414	-2023	-1632	-1241	-850n	-459n	-68n	323n
-3940	-3549	-3158	-2767n	-2376n	-1985n	-1594n	-1203n	-812n	-421n	-30n	361n
-3921	-3530	-3139n	-2748n	-2357n	-1966n	-1575n	-1184n	-793n	-402n	-11n	380n
-2851	-2460	-2069n	-1678n	-1287n	-896n	-505n	-114n	277n	668n	1059n	1450
-2843	-2452	-2061	-1670	-1279	-888	-497	-106	285	676	1067	1458n
-2479	-2088	-1697	-1306	-915n	-524n	-133n	258n	649n	1040n	1431n	1822n
-2471	-2080	-1689	-1298	-907	-516	-125	266	657	1048	1439	1830
-2145	-1754	-1363	-972	-581	-190	201	592	983	1374	1765	2156n
-2107	-1716	-1325	-934	-543	-152	239n	630n	1021n	1412n	1803n	2194n
-1838n	-1447	-1056	-665	-274	117	508	899	1290	1681	2072	2463
-1857n	-1466n	-1075n	-684	-293	98	489	880	1271	1662	2053	2444
-1876n	-1485n	-1094n	-703n	-312n	79	470	861	1252	1643	2034	2425
-1895n	-1504n	-1113n	-722n	-331n	60n	451n	842n	1233	1624	2015	2406
-1735	-1344	-953	-562	-171	220	611	1002n	1393n	1784n	2175n	2566n
-1382	-991	-600	-209	182	573	964	1355	1746	2137	2528	2919
-684	-293	98	489	880	1271	1662	2053	2444	2835	ND	ND
-619	-228	163	554	945	1336	1727	2118	2509	2900	ND	ND
A	B	C	D	E	F	G	H	I	J, n: no eclipse.L		

Considerations on Grattan Guinness Cycle, of 391Yrs by OP Armstrong 7.20/15

Find mean new moon of equinox by Julian day number (JD#) Epact

Epact is age of moon (in days) upon January 1, for any year, Y, expressed in proleptic Gregorian reform of Julian calendar system. Linear method to find Epact is a counting method to determine moon age at 1January using average lunation time. The Metonic counting method was one of 1st ways to determine lunar age. The JD# of January 01 for any Gregorian year from -4010 to 3055 is calculated with high precision by Formula 3 of Table. Given JD# of 1January in a particular year, the moon age is the Epact, formula 1 or 2 of Table.

Sundry Epact systems have been proposed, this proposal uses the simplicity of the Julian Day number system. The counting of days by JD# for astronomical events is the natural order. The calendar conversion, then orders the date in any calendar of choice and thusly reckons the effect of leap years. Leap days are calendar events that are not associated with astronomical events.

A mean lunation is about 29.51 day. Thus, days unto end of Epact Moon is 29.51 less Epact. This means the 1st moon in January is also (29.51-E) days from 1January. There are then 2 more moons from this time unto the first moon in March, this being an additional 59 days. This is by Table formula 5, March's first moon.

For any proleptic Gregorian year, Y, the JD# of astronomical Vernal/Spring equinox is by Table formula 4, JD#.Equinox

The Catholic system calls the 1st Sunday after the 1st full moon after spring equinox to be Easter Sunday. The full moon is about 14.75 days after new moon. Thus 14.75 added to JD# of first March moon and it is just simple counting to find Easter Sunday JD#. If the first March moon JD# plus 14.75 is less than VE, then increment by (28.5 +14.75) days to 1st March moon and find next Sunday. All this is calculated by JD# and the final JD# is converted to Gregorian calendar date, if needed.

Because the Catholic VE is artificially set to 21 March, then to get the Gregorian Easter date, simply substitute JD# of 21March for year, Y. This JD# is by Table Formula 7. The counting of week days from a JD# is by Table formula 6.

The original 19 year Metonic cycle was eventually found to be deficient by one day in 228 years. This secondary correction is still linear.

Name (Nu)	Excel Name Formula-Yr-year, JD-JulianDay.astro
Epact.Cassidy.1	29.09-MOD(MOD(Yr,19)*11-INT((Yr-1502.57-12*MOD(Yr,19))/228),29.983)
Epact.Lunation# (2)	(1+MOD((365.242454*(-4006-Yr)),29.5306)) &if>=30, then subtract 30
JD# Jan1-(3)	257898.52-365.242454*(-4006-Yr)
JD# Equinox-(4)	(2457102.448+(Yr-2015)*365.2422)+((-0.0005947871)*((Yr-2015)/1000)^4+(-0.00392591)*((Yr-2015)/1000)^3+(0.013808751)*((Yr-2015)/1000)^2+(0.1590901)*((Yr-2015)/1000))
March 1st Moon	JD#.Jan1 + Epact + 59
Day of Week-(6)	(7-INT(MOD((1.5+JD#),7))) one is Sunday and 7 is Saturday, etc
JD#21March-(7)	257978.00-365.242454*(-4006-Yr)

However for holiday dates, the Epact method is deemed suitable. Typical Epact tables or Easter formula are given for years after 1900 and valid for about 300 years forward. If a larger range of dates are desired then another method such as this is needed. The below graph compares the methods over 7000 year range. From this graph, is seems the Lunation Number Epact is better than a Metonic Cycle.