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RECURRENCE AND EXTINCTION OF THE SAROS SERIES

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Abstract. Analyzing the succession of the beginning and end years of the Saros -13, -12 ... 190 series, we find that most of the beginning or end years are arranged in ascending order, but from time to time some series begin or end before the series which it follows. The values for time travel are on average 183.8 years for the beginning of the Saros series and -153.7 years for the end of the Saros series. These occur with a recurrence of 587.99 years for the start of the Saros series and with a recurrence of 560 years for the end of the Saros series. It is shown that the number of years after which a new Saros series begins - steps at start, is 600.05 year and the number of years after wich a saros series end - steps at end, is 563.74. On the other hand, the chart of the intervals between the start years of the Saros series highlights the fact that at about 595 years the Saros series have high values around 1500 years. It also shown that the increase in the duration of the Saros series, also with 18 years, from 1226 years to 1514 years is accompanied by a decrease in Saros cycles on average by 2h 57m 26s. The size chart of the Saros series shows that their size decreases slowly over time. Thus around 3000 B.C. the large series have values around 1533 years, and around 2500 A.D. they have values around 1393 years. In the same periods the small series have values of 1399 years and 1249 years. Therefore, the size of the Saros series decreases slowly over time until extinction.

Key words: Saros Series, solar eclipses.

1. INTRODUCTION

The cycles of solar eclipses are well known, such as: Saros, Methon, Mayan, Inex, Exeglimos, Tetradia, Hybridia ... a total of 82 cycles (van Gent, 2020). To these are added two cycles of 8 and 10 years discovered by us (Olenici, 2021). Various distributions of eclipses are also known depending on their type (partial, annular, total, hybrid), month, annual frequency, frequency depending on magnitude, distribution by centuries, distribution in Saros series, etc. (Espenak, 2020).

Interestingly, all the eclipses are completely arranged on a sawtooth-like mat with serrated edges in a sawtooth shape called Saros Inex Panorama (Wikipedia, 2022).

In this paper we set out to study whether there are any cycles in the distribution of Saros series. For this we plotted the beginning and end of the Saros series, the beginning and end steps of the Saros series, and the size of the Saros series on various charts.

The result is that several recurrence cycles of the Saros series have been highlighted and that the duration of the Saros series is slowly decreasing over time until extinction.

2. SAW TEETH OF THE SAROS SERIES

If we graphically represent the beginning and end dates of the 203 Saros series from -3277 BC to 2995 AD (Espenak, 2020) we obtain two charts that have the so-called *sawteeth* shape in Figure 1.

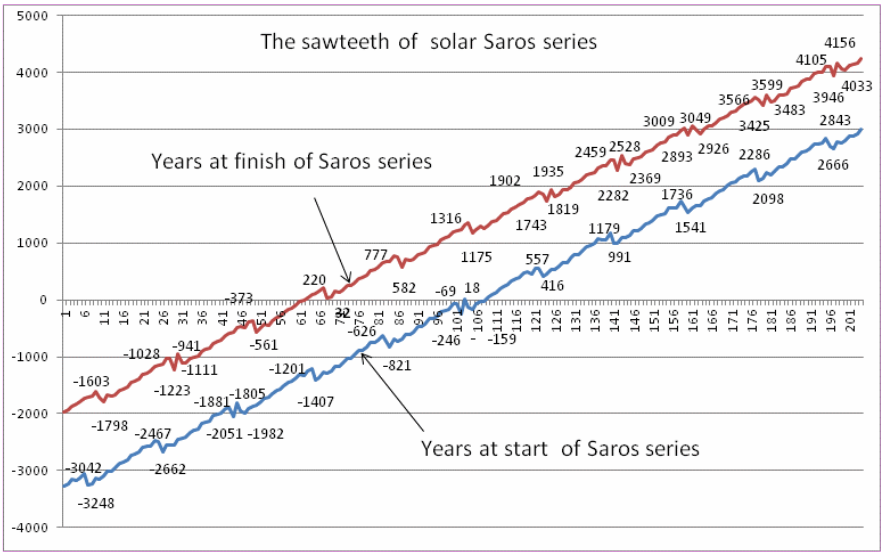

Fig. 1 – The sawtooth chart of the beginnings and endings of the Saros series from -3277 to 2995.

The numbers on the blue series (bottom) show the beginning years of the Saros series and the numbers on the red series (above) shows the end years of the Saros series.

For example: -3248 is the start year of the series with no. **-7**, and -3042 is the start year of the series with no. **-8**. Similarly, -1798 is the end year of the series with no. **-3**, and -1603 is the end year of the series with no. **-5**.

Carefully analyzing these series, we find that *they are not linear*, they show some fluctuations due to the fact that the beginning of some series occurs rather *earlier* than the beginning of the previous series. Most of these fluctuations are small, but from place to place where the series look sheared - at the top of their teeth, the beginning and end years of the Saros series have the highest values of return in time.

For example the Saros **-8** series starts in -3042 and the next **-7** series starts earlier in -3248. The difference is $-3248-(-3042)=-206$.

Next, we present the big differences for the beginnings of the Saros series - blue series. In parentheses are presented the Saros series in ascending order (**-8**, **-7**, ... **183**) and the beginning years (-3042, -3248, ..., 2666). Between parentheses, in italic, are the differences in years of the series that started earlier than their turn. Metaphorically speaking, these are series that *skipped over* or that *stole the start*.

(**-8**/-3042)	*-206*	(**-7**/-3248)
(**10**/-2467)	*-195*	(**12**/-2662)
(**29**/-1881)	*-170*	(**30**/-2051)
(**31**/-1805)	*-177*	(**33**/-1982)
(**50**/-1201)	*-206*	(**51**/-1407)
(**68**/-626)	*-195*	(**70**/-821)
(**86**/-69)	*-177*	(**88**/-246)
(**107**/557)	*-141*	(**109**/416)
(**126**/1179)	*-188*	(**127**/991)
(**144**/1731)	*-190*	(**146**/1541)
(**163**/2286)	*-188*	(**164**/2098)
(**181**/2843)	*-177*	(**183**/2666)

In this case we notice that the largest time returns of the start of the Saros series compared to the previous series have the values:

-206, *-195*, *-170*, *-177*, *-206*, *-195*, *-177*, *-177*, *-141*, *-188*, *-190*, *-188*, *-177*.

The average value of the big jumps at the beginning of the Saros series is *-183.8* years.

Let's apply the same reasoning to the chart that shows the end of the Saros series.

(**-4**/-1603)	*-195*	(**-3**/-1798)
(**13**/-1028)	*-195*	(**15**/-1223)
(**16**/-941)	*-170*	(**18**/-1111)
(**35**/-373)	*-188*	(**36**/-561)
(**53**/220)	*-188*	(**54**/32)
(**71**/777)	*-195*	(**73**/582)
(**89**/1316)	*-141*	(**91**/1175)
(**108**/1902)	*-159*	(**110**/1743)
(**111**/1935)	*-116*	(**112**/1819)
(**126**/2459)	*-177*	(**128**/2282)
(**129**/2528)	*-159*	(**131**/2369)
(**145**/3009)	*-116*	(**146**/2893)
(**147**/3049)	*-123*	(**149**/2926)

(**166**/3599) *-116* (**1676**/3483)
(**181**/4105) *-159* (**183**/3946)
(**184**/4156) *-123* (**186**/4033)

In this case we notice that the largest time returns of the end of the Saros series compared to the previous series have the values:

-195, *-195*, *-170*, *-188*, *-188*, *-195*, *-141*, *-159*, *-116*, *-177*, *-139*, *-116*, *-123*, *-116*, *-159*, *-123*.

The average value of the high back jumps of the Saros series is *-153.66* years.

Let's now calculate the intervals between the years that mark the return in time - recurrence, of the start of the Saros series. We will consider first the years at the base of the teeth. They have the values given by the differences below:

$3248 - 2662 = 586$
$2662 - 2051 = 611$
$2051 - 1982 = 69$
$1982 - 1407 = 575$
$1407 - 821 = 586$
$821 - 246 = 575$
$246 - 159 = 87$
$159 + 416 = 575$
$991 - 416 = 575$
$1541 - 991 = 550$
$2098 - 1541 = 557$

The average value of these intervals is 542.45 years. If we remove the value 87, which corresponds to a *double teeth*, then we get 587.99 years.

In other words, we can say that the start of the Saros series of return in time has a recurrence period of 588 years.

For the end of the Saros series these values are given by the differences below:

$1798 - 1223 = 575$
$1223 - 1111 = 112$
$1111 - 561 = 550$
$561 - 32 = 593$
$582 - 32 = 550$
$1175 - 582 = 593$
$1743 - 1175 = 568$
$1819 - 1743 = 76$
$2282 - 1819 = 463$
$2369 - 2282 = 87$
$2893 - 2369 = 524$
$2926 - 2893 = 33$

$3425 - 2926 = 499$
$3483 - 3425 = 58$
$3946 - 3483 = 463$
$4033 - 3946 = 87$

The average value of these differences is 388.73 years.

If we eliminate the small values - 112, 76, 87, 33, 58, 87, that correspond to the intervals between the double teeth we obtain 560 years. Therefore, in the case of the end of the Saros series, the recurrence period is around 560 years.

Here are two questions. What causes these recurrent periods and why do those double teeth appear from time to time?

3. STEPS TO THE SAROS SERIES

Let us now present in detail the number of years after which a new Saros series begins compared to the previous one for all series from the period -3277 B.C. to 2995 A.D. For this, in the same way for two successive series, we will subtract from the beginning year of a series, the beginning year of the previous series.

The positive numbers tell us that the next series starts later and the negative numbers tell us that the next Saros series has already started earlier.

For example: **-13** series starts in -3277, **-12** series starts after 47 years in -3230; the **-11** series starts after 83 years in the year -3147, but the **-10** series already started 25 years before in the year -3172, and so on.

Below we present the whole series of differences in years between the beginnings of the 203 Saros series from the period -3277 Mar 15, until 2995 Aug 17. Compared to walking, we will call these numbers the steps of the series: the positive numbers are the **steps forward** and the negative numbers written in bold represent the **steps backwards**.

In the line below we present the steps forward and steps backward of the beginning of the Saros series.

47, 83, **-25**, 47, 83, **-206**, 11, 101, **-7**, 47, 83, 11, 7, 83, 11, 47, 83, 11, 47, 83, 11, 11, 101, **-25**, **-170**, 119, **-7**, **-7**, 101, 29, 11, 83, 47, 11, 101, 29, 11, 101, 29, 11, 83, 29, **-170**, 246, **-152**, **-25**, 65, 47, 11, 65, 65, 11, 65, 65, 11, 65, 65, 11, 65, 65, **-25**, 83, 47, **-206**, 29, 101, **-7**, 29, 83, 11, 47, 83, 11, 47, 83, 1, 47, 83,**-7**, 47, 83, **-98**, **-97**, 137, **-43**, 29, 83, 11, 29, 101, 11, 29, 101, 11, 29, 83, 29, 11, 101, **-7**, **-170**, 264, **-152**, **-25**, 83, 47, 11, 65, 47, 29, 65, 47, 29, 65, 47, 11, 83, 29, **-43**, 101, **-7**, **-134**, 47, 65, 11, 47, 65, 11, 65, 65, 11, 47, 83, 11, 47, 83, **-25**, 11, 119, **-188**, **-7**, 119, **-7**, 29, 83, 11, 29, 83, 29, 29, 83, 29, 11, 101, 11, **-7**, 119, **-97**, **-98**, 83, 29, 11, 11, 65, 47, 29, 65, 47, 11, 83, 47, 11, 65, 47, **-7**, 83, 29, **-188**, 47, 83, **-25**, 47, 83, 11, 47, 83, 11, 47, 65, 11, 47, 83, **-7**, 29, 83, **-152**, **-25**, 119, **-25**, 29, 83, 11, 29, 83

The chart in Figure 2 shows the starting steps of the Saros series.

In this case we notice that the average value of the positive steps (forwards) is 613 years, and the average value of the negative steps (backwards) is 614 years.

If we order the steps of the Saros series and enclose in parentheses the number of Saros series with the same step, we obtain for the (positive) steps (forwards) the following sequence:

$-206(2)$, $-188(2)$, $-170(3)$, $-152(3)$, $-134(1)$, $-98(2)$, $-97(2)$, $-43(2)$, $-25(9)$, $-7(12)$, $11(38)$, $29(25)$, $47(30)$, $65(20)$, $83(33)$, $101(11)$, $119(5)$, $137(1)$, $246(1)$, $264(1)$

If we plot these years we find that the maximum negative and positive values are repeated at approximately equal time intervals, on average at about 614.5 years. At the top of the curve are the early years of the Saros series, in Figure 2.

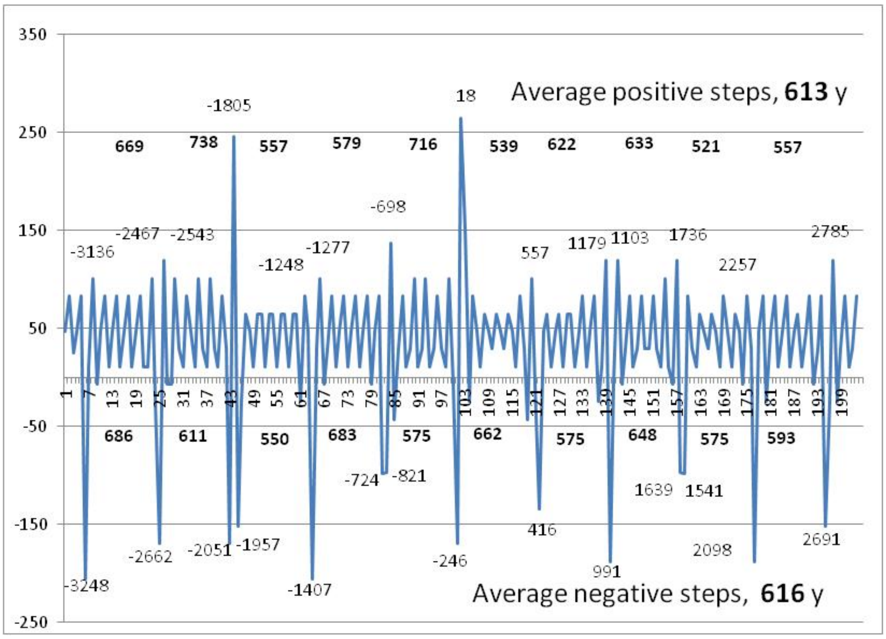

Fig. 2 – Step chart for the beginning of the Saros series.

Therefore, there is a recurrence period of the beginnings of the Saros series at an interval of 614.5 years.

Interestingly, most steps have positive values (steps forward). Of these, the 246-year-old steps of the 30th series, which begins in 1805, and the 264-year-old steps of the 89th series, which begins in the 18th, are noteworthy.

Below we present the series of final steps of the Saros series:

47, 65, 29, 47, 65, 11, 29, 83, **-116**, **-79**, 129, **-7**, 11, 63, 29, 29, 83, 29, 29,83, 29, 29, 83, 29, 11, 101, **-7**, **-188**, 282, **-170**, **-7**, 83, 29, 11, 83, 47, 11,83, 47, 11, 83, 47, 11, 83, 29, **-25**, **-101**, 11, **-188**, 65, 65, **-7**, 65, 65, 11, 65, 65, 11, 65, 65, 11, 47, 65, 11, 47, 65, **-188**, 11, 101, **-7**, 29, 83, 11, 29, 83, 29, 29, 83, 29, 29, 83, 11, 11, 101, **-25**, **-170**, 137, **-25**, 11, 83, 29, 11, 101, 29, 11, 83, 47, 11, 83, 29, 11, 83, 29, **-170**, 65, 47, **-25**, 47, 65, 11, 65, 65, 11, 65, 47, 29, 47, 65, 11, 47, 65, **-43**, -116, 192, **-116**, 29, 83, 11, 29, 83, 29, 29, 83, 11, 29, 83, 29, 11, 11, 101, **-7**, **-170**, 246, **-134**, **-25**, 101, 29, 11, 83, 29, 11, 83, 47, 11, 83, 47, **-7**, 83, 29, **-116**, 156, **-62**, **-61**, 65, 65, **-7**, 65, 65, 11, 47, 65, 11, 65, 65, 11, 47, 65, **-43**, **-98**, 174, **-116**, 11, 101, 11, 11, **-101**, 11, 29, 83, 29, 11, 101, 11, 11, 101, **-7**, **-152**, 210, **-98**, **-25**, 83, 29, 11, 83.

In the chart of Figure 3 we can see the end steps of Saros series.

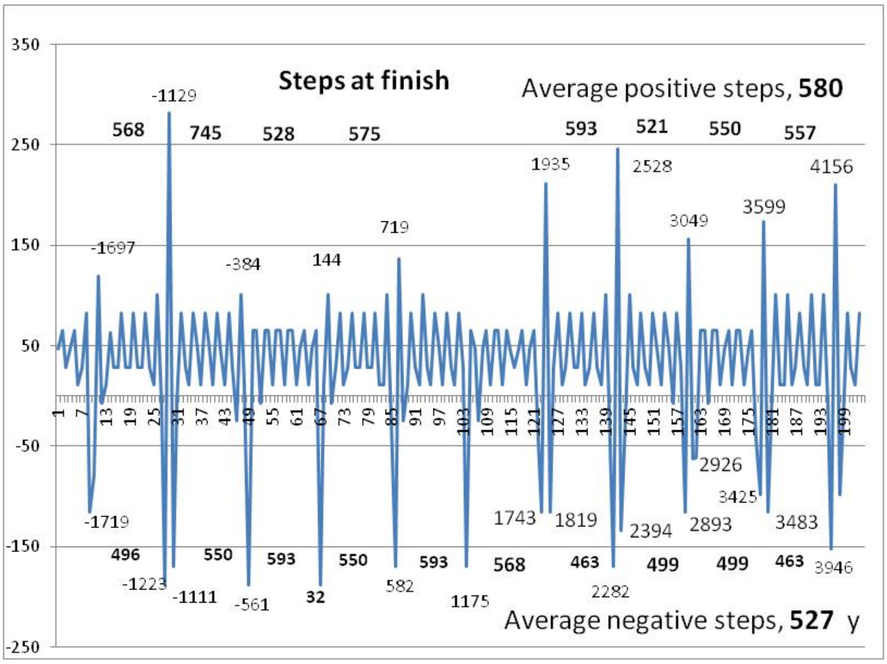

Fig. 3 – Chart of the end steps of the Saros series.

In this case we notice that the average value of the positive steps - forwards, is 580 years and the average value of the negative steps - backwards is 527 years. Therefore, the recurrence of the end of the Saros series occurs at an interval of about 553.5 years.

In this case, too, most of the steps have positive values, but there are six pairs of negative steps with low values.

If we order now the steps of the Saros series and enclose in parentheses the number of Saros series with the same step, we obtain the following sequence:

$-188(3)$, $-170(4)$, $-162(1)$, $-152(1)$, $-134(1)$, $-116(5)$, $-98(2)$, $-79(1)$, $-61(1)$, $-43(2)$, $-25(6)$, $-11(2)$, $-7(9)$, $11(38)$, $29(35)$, $47(17)$, $63(1)$, $65(27)$, $83(28)$, $101(11)$, $119(1)$, $137(1)$, $156(1)$, $174(1)$, $192(1)$, $210(1)$, $246(1)$, $282(1)$.

Note: looking carefully at the sequences of numbers that show the values of the steps of the Saros series, we find that they have quantified values. The most common are the steps that have the values 11, 25, 29, 47, 65, and 83 years.

3.1. POSSIBLE EXPLANATION

Now the natural question arises. What is the cause of the appearance of saw teeth and steps in the Saros series? The answer to this question is found in a personal communication from Patrick Rocher - *Canon des éclipses de Soleil, Statistique sur le canon de l'IMCCE, Période de -3000 (3001 avant J.-C.) au 1er janvier 3000*, P. Rocher, Institut de mécanique céleste et de calcul des éphémérides – Observatoire de Paris, where it is shown that the number of eclipses varies over time with a period of 586 years. This value is very close to the values between the saw teeth and the steps of the Saros series found by us.

In our case:

- at sawteeth graph 587.99 years - recurence period at start, 560 years - recurence period at end;
- at graphs of steps 600.05 years - recurrence period at start, 563.74 years - negative steps at beginning, 578.49 years - positive steps at end, 549 years - negative steps at end.

The average value of these is 577.94 years. We consider that, the difference of 8.06 years - $586 - 579.26$ is due to the fact that P. Rocher took into account the total number of eclipses, and we took into account separate cases.

On the other side given that the eclipses are a result of the Moon's positions relative to the Earth, it is possible that there is a still unknown motion of the Moon with a period of about 580 - 590 years.

In Figure 5 we can see the frequency of the number of eclipses according to P. Rocher. What graph gives the number of partial eclipses, non-partial eclipses and total eclipses over the period of six centuries. We can see a period of 586 Julian years. This period corresponds to the Tetradia (19 Inex + 2 Saros), corresponding to 7248 average moons and 7865.5 average draconic revolutions.

Another unique aspect related to the Saros series is that as the duration of the Saros series increases, the number of durations of the Saros cycles decreases.

In table 1, the first column is the number of eclipses in each series, the second column is the Saros cycle number, the third column is the duration in years of the

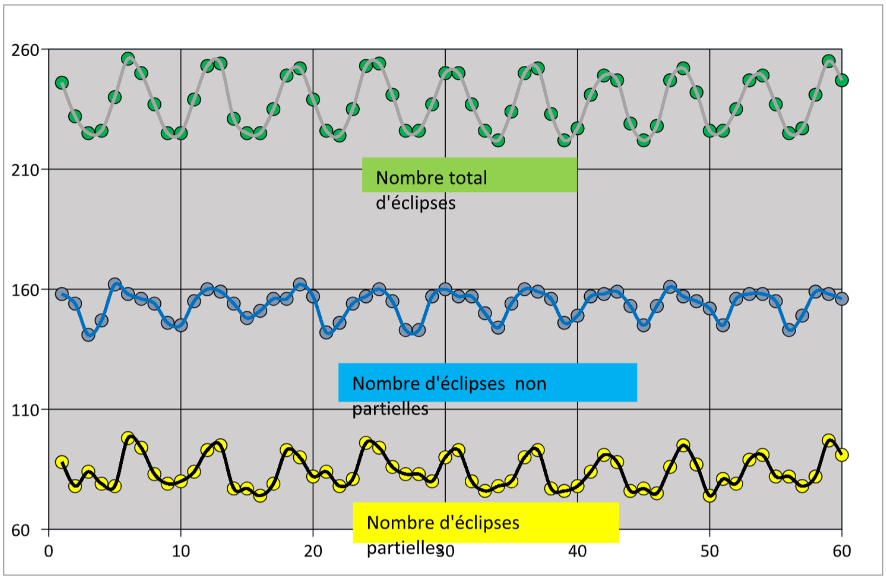

Fig. 4 – The frequency of number of eclipses according to P. Rocher.

Saros series, the fourth column is the average value of the cycles Saros from each series and the five column represent the and in the fifth column it represents the rate of decrease of the Saros cycle.

From the analysis of the data in Table 1 we find that the duration of the Saros series increases by 18 years for the series between 1226 years and 1514 years, and the average duration of the corresponding Saros cycles decreases by 2h, 57m, 26s. An exception is the series of 1533 years which have a growth rate of 19 years, and the fact that the Saros cycles of the 1533 years and 1551 years have much more values of 18y, 12h, 17m, 03m, 24s.

As a conclusion of what is presented in this table, we can say that the well-known rule that the Saros cycle is a multiple of Synodic, Anomalistic and Draconic months is not universally valid.

Table 1

The increasing of duration of Saros series and the decresing of Saros cycles

Number of eclipses	Number of cycles	Duration of series (years)	Value of cycles (years, days, hours, minutes, seconds)	Difference (hours, minutes, seconds)
69	68	1226	18y, 10d, 17h, 43m, 09s	
70	69	1244	18y, 10d, 13h, 20m, 12s	04h, 22m, 57s
71	70	1262	18y, 10d, 09h, 49m, 49s	03h, 30m, 23s
72	71	1280	18y, 10d, 06h, 19m, 26s	03h, 30m, 23s
73	72	1298	18y, 10d, 02h, 49m, 03s	03h, 30m, 23s
74	73	1316	18y, 09d, 23h, 18m, 40s	03h, 30m, 23s
75	74	1334	18y, 09d, 20h, 40m, 51s	02h, 37m, 49s
76	75	1352	18y, 09d, 17h, 10m, 27s	03h, 30m, 24s
77	76	1370	18y, 09d, 14h, 32m, 38s	02h, 37m, 49s
78	77	1388	18y, 09d, 11h, 02m, 15s	03h, 30m, 23s
79	78	1406	18y, 09d, 08h, 24m, 34s	02h, 37m, 41s
80	79	1424	18y, 09d, 05h, 46m, 45s	02h, 37m, 49s
81	80	1442	18y, 09d, 03h, 08m, 55s	02h, 37m, 45s
82	81	1460	18y, 08d, 23h, 38m, 32s	02h, 30m, 23s
83	82	1478	18y, 08h, 21h, 00m, 00s	02h, 38m, 32s
84	83	1496	18y, 08d, 18h, 23m, 02s	02h, 36m, 58s
85	84	1514	18y, 08d, 16h, 37m, 46s	01h, 45m, 16s
86	85	1533	18y, 12d, 20h, 33m, 47s	Average 2h, 57m, 26s
87	86	1551	18y, 12h, 17h, 03m, 24s	03h, 30m, 23s

4. RECURRENCE OF LARGE SERIES AND EXTINCTION OF SAROS SERIES

If we plot the cahart of the Saros series according to their size, we find two things:

1. The large series are repeated at an interval of about 595 years.
2. Both large and small series tend to shrink in time until extinction Figure 5

We will consider the Long Series the series that lasts over 1350 years and the Short Series whose duration is under 1350 years. The large series represent 14.77% and the small series 85.22%.

In the following we will present in detail four groups of series with the help of which we will be able to estimate the era when the extinctions of the Saros series will take place.

The durations of the series are presented in bold numbers and in parentheses are the beginning years of the respective series.

The initial group **Gi** of the large series at the top left of the chart in Figure 5, has the durations: 1533 (-3241), 1551 (-3237), 1533 (-2662), 1515 (-2453). The average duration is 1533 years.

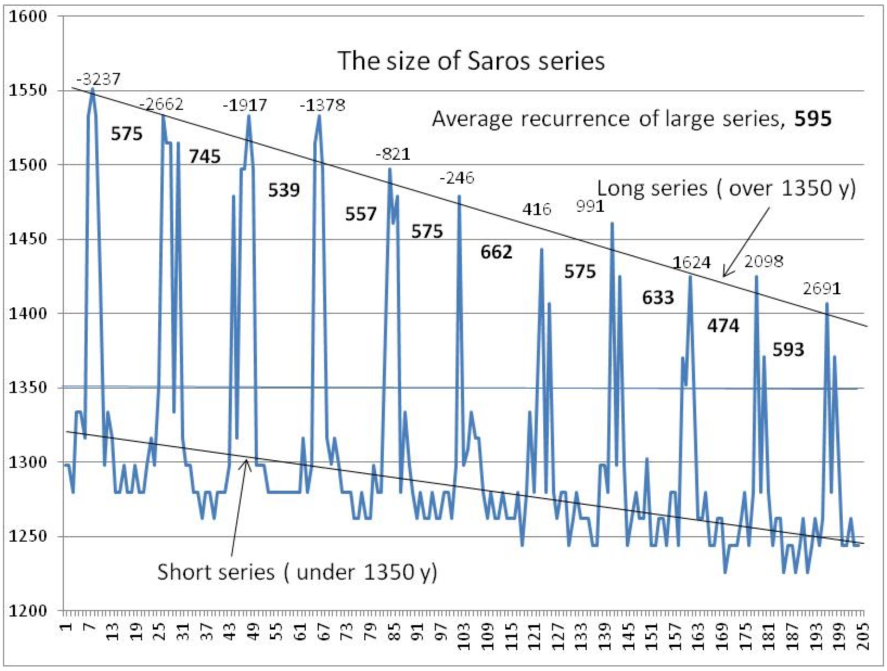

Fig. 5 – The size of the Saros series in the period 3277 B.C. - 2995 A.D. (−3237, −2662...269, represents the yearly years of long Saros series; 575, 745...593 represents the number of years between the beginnings of the large Saros series).

The final group **Gf** on the right side of the large series lasts 1425 (2098), 1371 (2228), 1407 (2691), 1371 (2785). The average duration of this group is 1394 years.

The era of the initial group **Gi** is the average of the years in parentheses, and it is the year **-2898**. Similarly, the time of the final **Gf** group is **2450**. Therefore, from the year -2898, to the year 2450 A.D. the average duration of the large Saros series decreased from 1533 to 1394 years.

Similarly, the small series in the initial group Gi and in the lower left have the values:

1298 (-3230), 1280 (-3147), 1334 (-3172), 1334 (-3125), 1316 (-3042),
1298 (-3096), 1334 (-3013), 1280 (-2995), 1280 (-2872), 1298 (-2861),
1280 (-2814), 1280 (-2731), 1298 (-2720), 1280 (-2673), 1280 (-2590),
1298 (-2579), 1316 (-2568)

The average duration of this group is 1299 years.

The age of the initial group Si is the average of the years in the parentheses of these series and is the year **-2896**.

The small series in the final **Sf** group in the lower right have the values:

1244 (2250), 1262 (2333), 1262 (2344), 1226 (2391), 1244 (2485),

1226 (2532), 1244 (2597), 1262 (2608), 1246 (2655), 1244 (2738),
1262 (2731), 1244 (2760), 1280 (2666), 1245 (2789), 1244 (2872),
1262 (2883), 1244 (2912), 1244 (2995)

The average value of the series in this group is 1249.

The epoch era of the final group Sf is the average of the years in the parentheses of this series and is the year **2641**. Therefore, the average value of the small series decreased in the range -2896 B.C. until 2641 A.D. from 1299 years to 1249 years. These reductions in the Saros series tell us that the length of the Saros series gradually decreases over time to extinction.

Extrapolating the series, we could calculate in a first approximation the time intervals until the extinction of the Saros series.

4.1. EXTINCTIONS OF THE LARGE SAROS SERIES

To calculate the era when the extinction of the large series will take place, we use the diagram from Figure 6.

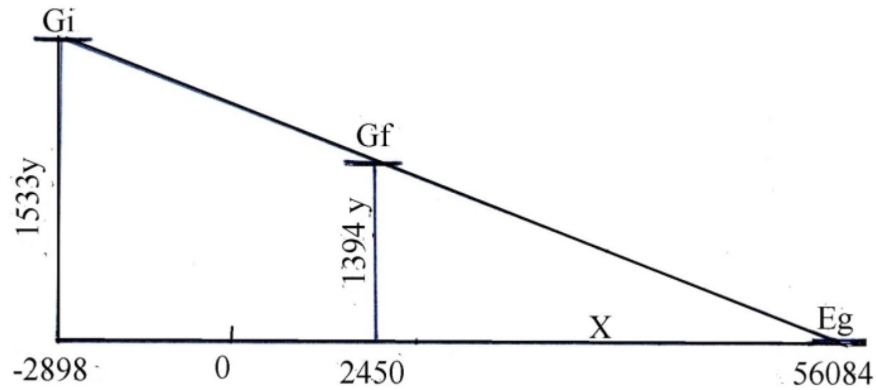

Fig. 6 – Chart of the extinction of the large Saros series.

Thus extending the straight line joining the average value (1533 years) of the duration of the Gi series group from the era -2898 with the average value of the duration (1394 years) of the Gf series group from the 2450 era, it meets the time axis at point Eg in epoch **56084**.

The calculation is simple. In the triangle in Figure 6 we can write the following relation, X being the time interval between the epoch 2450 until the extinction of Eg:

$$\frac{1394}{1453} = \frac{X}{(X + 2450 - (-2898))} \tag{1}$$

The value of X is $X = 53634$.

The Eg era in which the extinction of the Saros series takes place is $Eg = 2450 + X = 2450 + 53634 = 56084$ years.

4.2. EXTINCTIONS OF THE SMALL SAROS SERIES

Similarly, in the chart in Figure 7, we can see the extinction of the small Saros series.

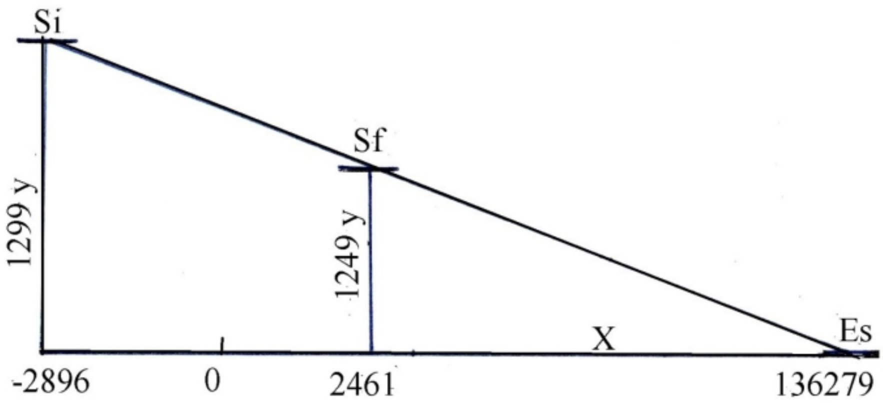

Fig. 7 – Chart of extinction of small Saros series.

In this case we can write the relationship:

$$\frac{1249}{1299} = \frac{X}{(X + 2641 - (-2896))} \tag{2}$$

In this case X represents the time interval between the epoch 2461 and the extinction epoch of the small series Es and has the value $X = 133818$.

Es has the value $Es = 2461 + X = 2461 + 133818 = 136279$ years.

4.3. REMARKS

1. The method of extrapolating graphs can help us to find out the value of the Saros series that took place many years before.

2. If we represent on the same chart both the decrease in time of large series and small series we can calculate the epoch in which large series (which shrinks faster) become equal to small series, it occurs at the point of intersection I in Figure 8.

In Figure 8 we can write the relations:

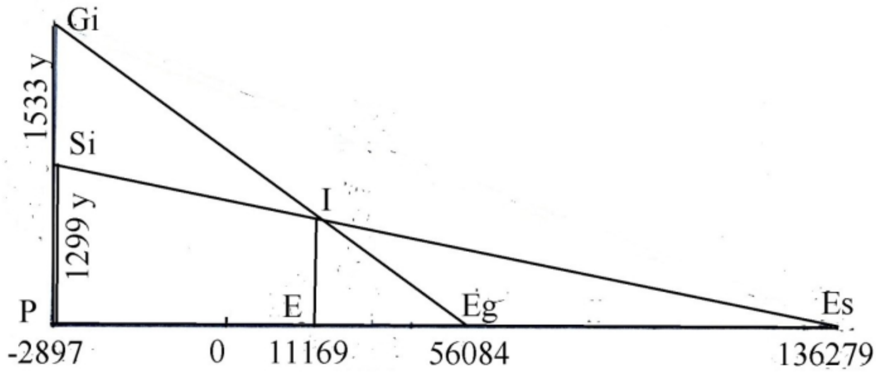

Fig. 8 – The epoch of equality E of the duration of the large series with the duration of the small series.

$$\frac{|EI|}{|EEg|} = \frac{|PGi|}{|PEg|} \tag{3}$$

$$\frac{|EI|}{|EEs|} = \frac{|PSi|}{|PEs|} \tag{4}$$

$$|EEs| - |EEg| = |PEs| - |PEg| \tag{5}$$

5. CONCLUSION

To conclude, we can say that in the graphs that show the distribution of the Saros series, there are several recurrence periods as follows:

1. The graphs showing the beginning and end of the Saros series look like saw-tooth.

2. The time distance between these teeth is 576 years for the beginning of the Saros series and 538 years for the end of the Saros series.

3. Saw teeth indicate that there is a series that starts much earlier than the next series, or ends much earlier than the next series. This advance is around -184 years for the start of the series and around -152.4 years for the end series.

4. The time intervals between the beginnings of the Saros series and their endings are not equal, they are similar to steps forward with positive values between 11 and 282 years and steps backward with negative values between -25 and -206 years.

5. The graphs with the steps of the Saros series show that the large positive steps are repeated at an interval of 604.6 years at the start and 583.5 years at the end of the Saros series, and the large negative steps are repeated at an interval of 614 years at the start and 537.4 years at the end of the Saros series.

6. As the duration of the Saros series increases (also by 18 years), the duration of the Saros cycles in the respective series decreases on average by 2h, 57m, 26s.

7. The graphical distribution of Saros series by size shows that there are two types of Saros series:

   (a) large Saros series dating from 1350 years to 1551 years. These represent 14.77% and are repeated on average every 595 years.

   (b) small Saros series between 1226 and 1350 years. These represent 85.22%, but being much more varied in duration, they do not have peaks that are systematically repeated at a certain time interval.

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