

Technical Notes

Calculations That Show Comets Began Near Earth

If the most clocklike comets can be shown to have begun near Earth with a very high probability (>99%), one can also directly conclude with a high probability that:

- ◆ The hydroplate theory is basically correct.
- ◆ Beginning in about 3290 ± 100 B.C., a powerful catastrophe launched massive amounts of rocks and water from Earth into space. Some of that material later merged by known forces to become comets.

If these conclusions are shocking to some individuals, here is their challenge: *Find an error in the calculations outlined below, or seriously consider the mathematical conclusions.* For more details, see “[When Was the Flood?](#)” on pages 484–486.

Step 1: Download from the internet the two papers referenced in Endnote 5 on page 486.¹ They are located at

<http://adsabs.harvard.edu/full/1981MNRAS.197..633Y>

and

<http://adsabs.harvard.edu/full/1994MNRAS.266..305Y>

After reading both papers, set up a workbook in Excel 2007 (or higher) with the following worksheets:

- a. Most Clocklike Comets
- b. True Deviations Squared
- c. Random Deviations Squared

Data and calculations from worksheets a–b will feed into subsequent worksheets.

Set up a table in the “Most Clocklike Comets” worksheet similar to [Table 40](#) and fill in all 49 rows. The yellow cells will require simple calculations. Select any Julian date converter on the internet and become comfortable converting from calendar dates to Julian dates and vice versa.

Table 40. Comet Convergence, Most Clocklike Comets (Step 1)

	A	B	C	D	E	F	G	H
1	Comet Halley				Comet Swift-Tuttle			
2	Perihelion Date (Calendar Date)	Julian Date	Latest Period Based on Julian Date (years)	Change in Period (years)	Perihelion Date (Calendar Dates)	Julian Date	True Period Based on Julian Date (years)	Change in Period (years)
3	-1403 Oct 15.68109	1208900.181090			-702 Apr 3.28685	1464744.786850		
4	-1333 Aug 25.50585	1234416.005850	69.860013		-573 Aug 1.41288	1511981.912880	129.330965	
5	-1265 Sep 5.39589	1259263.895890	68.031268	1.83	-446 Jun 2.14601	1558308.646010	126.838391	2.49
6	-1197 May 11.23252	1283983.732520	67.680670	0.35	-321 Sep 27.65803	1604082.158030	125.323722	1.51
...
47	1910 Apr 20.1785	2418781.677710	74.423873	2.26	1862 Aug 23.42278	2401375.922278	125.186982	2.17
48	1986 Feb 9.4589	2446470.958343	75.810738	-1.39	1992 Dec 12.32394	2448968.823940	130.305046	-5.12
49	Sample Standard Deviation of Period Changes (years):			1.56	Sample Standard Deviation of Period Changes (years):			2.98
1 year = 365.2422 days								

Step 2: Set up a table in the “True Deviations Squared” worksheet similar to [Table 41](#). Designate a row in column B for each of the past 4,000–6,000 years. In column C, calculate the corresponding Julian dates. In columns D and E (for comets Halley and Swift-Tuttle, respectively), calculate the number of days until (or since) that comet’s nearest perihelion. Square that number, and place the sum of those two squared numbers in the corresponding row in

column G. Place the minimum of the numbers in column G in cell G1 and the corresponding Julian date and calendar date in cells G2 and G3. That is the year in which the three bodies (Halley, Swift-Tuttle, and Earth) were closest to each other. However, the degree of closeness may not be statistically significant. That significance will be determined in Step 3. Plot column G vs. column B (time), as shown in [Figure 253](#).

Table 41. Comet Convergence, True Deviations Squared (Step 2)

	A	B	C	D	E	F	G
1				Comet Halley	Comet Swift-Tuttle	Minimum Sum of Squares in Column G:	1,210
2	Oldest Known Perihelion			1208900.181090	1464744.786850	Julian Date:	519968
3	Oldest Period (Julian Days)			25515.82	47237.13	Calendar Date:	3290 B.C.
4		Years Ago	Julian Date	Deviations from Perihelion Squared (Julian Days) ²			Sum of Columns D and E
5		4000	995513	85,717,656	9,870,112		95,587,768
6		4001	995148	92,614,162	7,708,570		100,322,733
7		4002	994783	99,777,472	5,813,833		105,591,305
8		4003	994417	107,207,586	4,185,899		111,393,484
...	
2004		5999	265394	377,999	339,907,280		339,656,279
2005		6000	265029	46,714	352,907,638		352,954,352

Excel spreadsheets have built in functions that can save you a great deal of time. Consider using the functions: SQRT (square root), STDEV (sample standard deviation), MIN (minimum), and RAND (random number). Also macros can repeat complex operations in milliseconds.

Step 3: In the “Random Deviations Squared” worksheet, repeat Step 2, but begin each comet’s backward march from a random point on its oldest known orbit instead of its perihelion. With a macro, repeat this process 1,000,000 times (for the time interval 4,000–6,000 years ago) and see what percent of those random trials produced a clustering at least as tight as you got in Step 2. Your answer should be only about 0.6 of 1%. Alternatively, if we began each comet’s backward projection from a random point on its oldest known orbit, we would have to search 333,333 years, on average, to find one clustering that was at least as tight. $[2,000/(0.006)= 333,333]$

Step 4: Calculate the expected error for each comet individually. Those errors can be determined by three different methods: A, B, and C. All give the same answer. Method A, a simple, intuitive approach, will now be explained using comet Halley as an example.

Method A: Geometric. Visualize a timeline extending back in time from Halley’s oldest known perihelion in 1403.80 B.C. If we tick off exactly 27 69.86-year increments on that timeline, we will be at 3290 B.C.—our best estimate for the time of the flood, but an estimate with some uncertainty on either side of 3290 B.C. How large is that uncertainty?

Method B: Algebraic. For a particular comet:

- t_0 : the Julian date for the oldest known perihelion
- t_i : an estimate of the Julian date for the i^{th} unknown perihelion
- P_0 : the oldest known period

Our best guess for all 27 time increments was the oldest known period (69.86 years), but there is an unknown error, x_1 , in the first unknown orbital period. That first period, now with a known but slightly different length of $69.86 + x_1$, becomes our best guess for all earlier periods, making the total error in our 3290 B.C. date for the flood, based just on the length of the first unknown period, 27 times x_1 . (The random number, x_1 , will be drawn from a normal distribution with a mean of zero and a standard deviation of 1.56 years.) With that first unknown period now known, we can repeat these steps for the next unknown period. That adds an error of 26 times x_2 . Generalizing, the expected error for either comet becomes:

Total Error =

$$N x_1 + (N-1) x_2 + (N-2) x_3 + \dots + 3 x_{N-2} + 2 x_{N-1} + x_N$$

where N , the number of periods a comet must take in going from its oldest known perihelion back to the best estimate for the time of the flood. For comet Halley, $N=27.000$. For comet Swift-Tuttle, $N=20.000$. Because the Total Error above is the sum of N independent random variables, such as $N x_1$ and $(N-1) x_2$, the standard deviation of the Total Error is

$$\begin{aligned} & \sigma \sqrt{N^2 + (N-1)^2 + (N-2)^2 + \dots + 3^2 + 2^2 + 1^2} \\ & = \sigma \sqrt{\frac{N(N+1)(2N+1)}{6}} \end{aligned}$$

For comets Halley and Swift-Tuttle, these values are 130 years and 159 years, respectively.

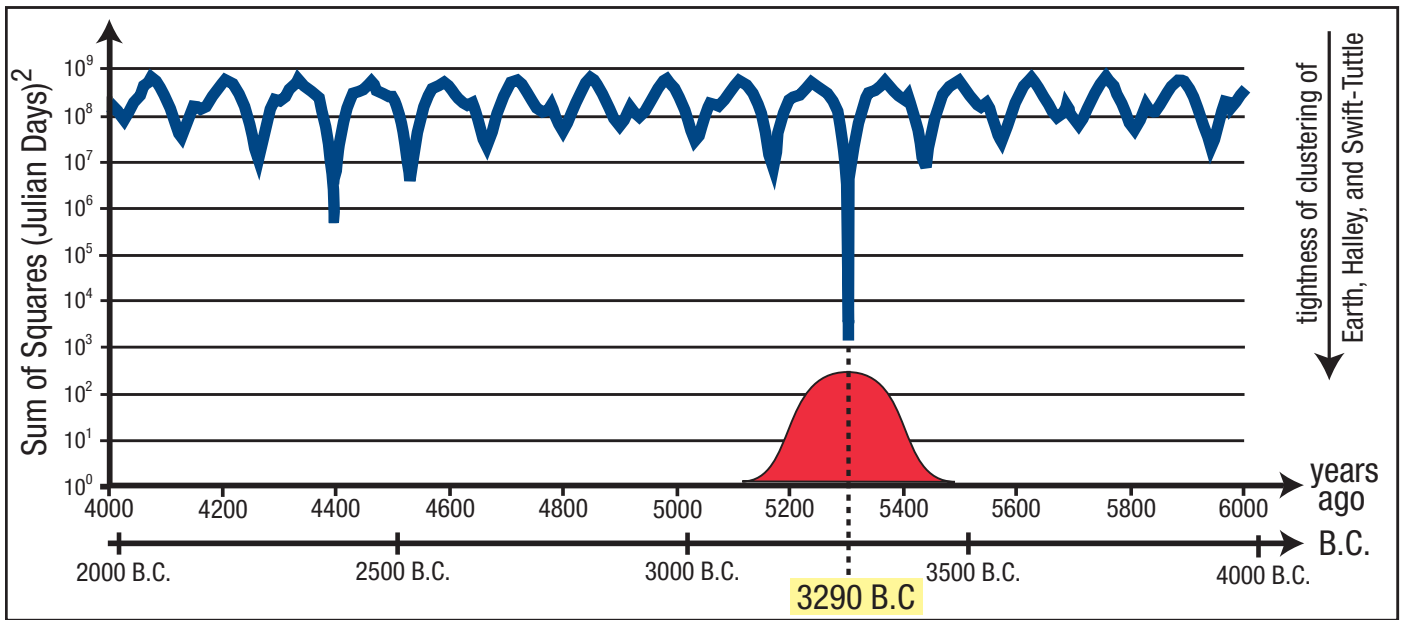


Figure 253: Comet Clustering. The tight clustering of comets Halley and Swift-Tuttle with Earth in 3290 B.C. (as shown above) does not mean that was the year of the flood. It simply means that 3290 B.C. is the most likely year of the flood, based on these calculations. As shown by the red normal distribution, the flood could have occurred within a hundred or so years of that date. The depth of this downward spike in 3290 B.C., however, is quite unusual. Had the backward projection of Halley and Swift-Tuttle started at a random point on their oldest known orbits instead of at their perihelions, it would take, on average, 333,333 years before a similar tightness of clustering of these three bodies (Earth and comets Halley and Swift-Tuttle) would be found. Is it merely a coincidence that we found a one-in-333,333-year event very near the time of the historical global flood—after a backward search of only 1290 years?

Also, basic physics tells us that gravitational perturbations are as likely to increase a comet’s period as to decrease a comet’s period; that is, a gravitational body, such as a planet, is as likely to pass in front of an orbiting comet at a certain distance as to pass behind it at that distance. While we may not know how the unknown periods changed, the *statistical* mean of those changes will be zero; therefore, **the mean of the possible dates for the flood is 3290 B.C.**

P_i : an estimate for the i^{th} unknown period

x_i : the i^{th} random variable from a $[0, \sigma]$ normal distribution of the changes in successive orbital periods of a comet

$$\begin{aligned}
 t_1 &= & t_0 - P_0 + x_1 & & P_1 = t_0 - t_1 & & P_0 - x_1 \\
 t_2 = t_1 - P_1 + x_2 &= (t_0 - P_0 + x_1) - (P_0 - x_1) + x_2 = & t_0 - 2P_0 + 2x_1 + x_2 & & P_2 = t_1 - t_2 = P_1 - x_2 = (P_0 - x_1) - x_2 = & & P_0 - x_1 - x_2 \\
 t_3 = t_2 - P_2 + x_3 &= (t_0 - 2P_0 + 2x_1 + x_2) - (P_0 - x_1 - x_2) + x_3 = & t_0 - 3P_0 + 3x_1 + 2x_2 + x_3 & & P_3 = t_2 - t_3 = P_2 - x_3 = (P_0 - x_1 - x_2) - x_3 = & & P_0 - x_1 - x_2 - x_3 \\
 & \dots & & & & &
 \end{aligned}$$

$$t_N = t_0 - NP_0 + Nx_1 + (N-1)x_2 + (N-2)x_3 + \dots + 3x_{N-2} + 2x_{N-1} + x_N$$

Methods A and B produce identical results and have probability distributions that depends on only σ and N .

Method C: Simulation. Instead of working with the long summations in Method B, a computer can generate each x_i as a random number from a $[0, \sigma]$ normal distribution and substitute them in the equations:

$$\begin{aligned}
 t_1 &= t_0 - P_0 + x_1 & P_1 &= t_0 - t_1 \\
 t_2 &= t_1 - P_1 + x_2 & P_2 &= t_1 - t_2 \\
 t_3 &= t_2 - P_2 + x_3 & P_3 &= t_2 - t_3 \\
 & \dots & & \\
 t_N &= t_{N-1} - P_{N-1} + x_N
 \end{aligned}$$

Each sequence of N random numbers (x_1, x_2, \dots, x_N) will give one simulated date for the flood, which will, in general, differ from 3290 B.C. Thousands of those simulated dates will give us the error estimates for each comet individually (of 130 and 159 years) that were found exactly in Methods A and B. Adding the additional information that both comets formed at about the same time—based on the statistical significance of $>99\%$ —allows the combined error estimate for the date of the flood to be reduced to ± 100 years.

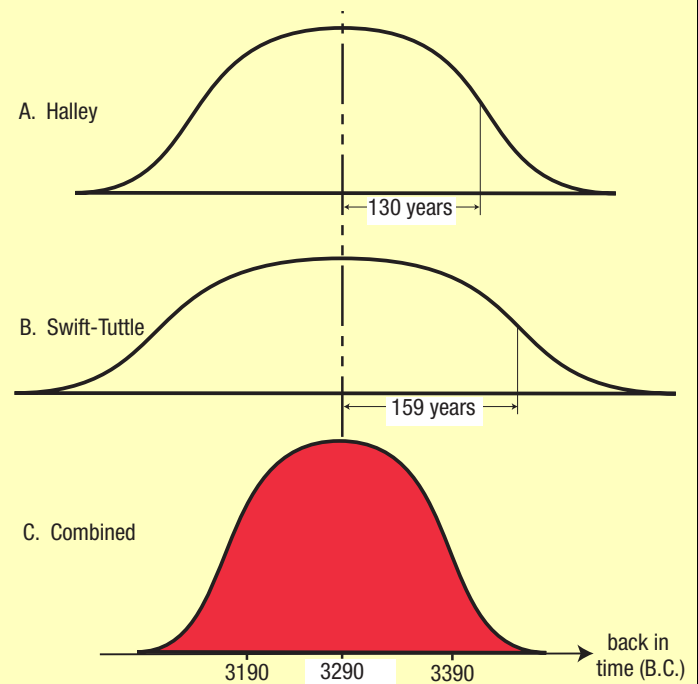
Figure 254: Probabilities for Perihelion Passage Dates. We have shown that if comets Halley and Swift-Tuttle had been projected back in time from their oldest known perihelions and *with their oldest known periods*, both comets would pass perihelion in the year 3290 B.C. Halley would have taken exactly 27 orbits and Swift-Tuttle exactly 22 orbits.

We also showed how unusual it is for both comets to be so close to Earth in any single year in the 2,000-year window in which almost all Bible scholars place the flood. Such a tight convergence would only happen 0.6 of 1% of the time. Nevertheless, the hydroplate theory explains why they were so close in the year of the flood.

Of course, each comet's period would have changed slightly with each orbit, so while the year 3290 B.C. might be our best guess if we had to pick only one year for the comet's simultaneous convergence with Earth, other years for the three-body convergence are also possible on either side of 3290 B.C. Projecting Halley back 27 orbits and allowing planetary perturbations similar to those seen with Halley's most recent 45 orbits give us the distribution of possible years shown in Figure A above. Likewise, Figure B above gives the probability distribution of the possible years in which Swift-Tuttle passed perihelion on its 22nd orbit back in time from where we know it was on 702.30 B.C.

Finally, we have one other piece of information. Given that we are 99.4% confident that Halley and Swift-Tuttle were both near Earth in the same year, we will add the constraint to Figures A and B above that Halley made its 27th perihelion pass in the same year Swift-Tuttle made its 21st perihelion pass.

It can be shown, with some calculus and probability theory, that distribution C gives the probabilities—for each of the years on either side of 3290



B.C.—that both comets were simultaneously near Earth on a single year. That distribution has a standard deviation (σ_c) of

$$\frac{1}{(130)^2} + \frac{1}{(159)^2} = \frac{1}{\sigma_c^2}; \quad \sigma_c \approx 100 \text{ years}$$

where Halley's and Swift-Tuttle's standard deviation in Figures A and B above were 130 years and 159 years, respectively.

References and Notes

1. For comet Halley, the computation by Kiang and Yeomans was terminated in 1404 B.C., because Halley passed close to Earth (0.04 AU). Earth's gravitational perturbation would have injected a large error that could not be rectified by a human observation even further back in time. With comet Swift-Tuttle, the backward computation by Yeomans et al. was terminated in 702 B.C for a similar reason.

Ending the backward projection was proper, because too much precision would have been lost for all earlier dates. An analogous situation occurs if someone is adding a thousand numbers, one of which has great uncertainty compared to all others. It makes no sense to claim high precision for the sum or to strive for further precision for the 999 good numbers when one number has little accuracy. That low precision number becomes the weak link in the chain.

However, with the statistical method used here, we are not forcing Halley and Swift-Tuttle to pass through (or near) points in space at specific times long ago. We are only looking for the tightest clustering of three bodies (Halley, Swift-Tuttle, and Earth) within a 2,000-year window: 4,000–6,000 B.C. Then we compare that tightness with the tightest clustering of those three bodies in that same 2,000-year window for each of a million **random** orbits of the two comets back to 6,000 B.C. Using the same step-back procedure, each of the million “step backs” begins not at their earliest known perihelion point, but at a random point on its earliest known orbit.

It turns out that less than 1% of the random orbits can produce a tighter clustering. Therefore, even though each comet experienced a large perturbation error, less than 1% of the random orbits could beat our actual orbit—a highly significant result.