

BEN ZION KATZ

## A STUDY OF IDENTICAL YEARS IN THE HEBREW AND GREGORIAN CIVIL CALENDARS

It is well known that the Jewish calendar adds seven leap-months every nineteen years. It is less well known that there are pairs of years in which the Hebrew and Gregorian dates *and* the days of the week coincide; such pairs of years have been called “identical years.” In this paper, I examine the pairs of identical years as they occurred between 1784 and 2000. The most frequent interval separating pairs of identical years was 152 years, and roughly 1/400 pairs of years examined was identical.

### INTRODUCTION

It is well known that in order to adjust to the seasons, the lunisolar Jewish calendar follows the Metonic principle of adding seven leap-months every nineteen years, on the third, sixth, eighth, eleventh, fourteenth, seventeenth and nineteenth years. Thus, the Hebrew and Gregorian (civil) dates tend to coincide every nineteen years. Note how the first eight years and the last eleven years of the nineteen-year cycle form a “subcycle,” since the leap year occurs after two rather than three years at those points in the cycle. It is less well known that there are pairs of years in which the Hebrew and Gregorian dates *and* the days of the week also coincide. These pairs of years are known as “identical years” (*shanim zahot*).

One would have expected that since the Gregorian calendar begins on the same day of the week every five, six or seven years (because the Gregorian calendar advances one day of the week following a regular year and two days of the week following a leap year (and there are up to two Gregorian civil leap years every seven years) and because the Hebrew calendar generally repeats every nineteen years, that every  $19 \times 5$  (95),  $19 \times 6$  (114) or  $19 \times 7$  (133) years there would be a good chance of the Hebrew and Gregorian years coinciding identically. R. Sar Shalom

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estimated that about one in 500 years would be identical in the Hebrew and Gregorian calendars (*She'arim La'Luach Ha'Ivri* [Tel Aviv, 5744], p. 184). In this short paper, I examine the phenomenon of identical years as they occurred between 1784 and 2000.

## METHODS

To study the phenomenon of identical years, I used the data available in Salomon W. Freund's *Fargleich kalendar*, published in 1925 by Hebrew Publishing Company of New York. This calendar lists, for every Hebrew date, all the corresponding English dates and days of the week from 5545 (1784/5)–5760 (1999/2000), starting with Rosh Hashanah. I performed the calculations by hand, so there is always the possibility of error, but the general results should be robust. For each pair of years when Rosh Hashanah began on the same date and day of the week of the Gregorian civil calendar, beginning with the year 5760 (1999/2000) and working backwards until the year 5545 (1784/5), I checked whether the years continued to mirror each other at four timepoints: after 30 Cheshvan and 30 Kislev on the Hebrew calendar (because each of those months can have either 29 or 30 days, and thus, even if two years began identically, if Cheshvan or Kislev differed in the number of days they contained in the two years being examined, the years would continue differently); after February 28th on the Gregorian calendar (for the same reasoning, but this time the Gregorian civil calendar provided the variable length month); and then on 1 Nissan of the Hebrew calendar (in case one year of the pair being examined for identity was a leap year with an Adar II and one was not). I kept track of all years that were completely identical, as well as those that were partially identical (as was the case most recently with 5765 [2004/5] and 5754 [1993/4], where the years diverged after Cheshvan. I did not record years that began to line up after Rosh Hashanah, i.e. years that began a day or two “off” but because of a difference with Cheshvan, Kislev or February, would then line up later in the year.

## RESULTS AND DISCUSSION

The results are summarized in Table 1. As expected, nearly all of the identical years are separated by a multiple of nineteen years, although not every multiple (e.g., 1, 2, 7 and 9) is represented. In a few cases, the eleven-year subcycle of the nineteen-year cycle is evident, and in one case, the eight-year subcycle is noted. Oddly, even though there were twelve pairs of years eleven years apart that began identically (one pair of which continued for the entire year), there was not a single example of a pair of years beginning identically that were nineteen years apart;

neither were any identical pairs of years seen that were 38 (19 x 2), 133 (19 x 7) or 171 (19 x 9) years apart.

There were 141 pairs of years that began identically in the 216-year period, out of a total number of possible pairs of  $(216 \times 215/2 =) 23,220$  (0.6%) checked; 58 of those 141 pairs (41%, or 0.24% of the total pairs of years examined) matched identically for the entire year. 0.24%, or one in 400, is close to the prediction of Sar Shalom (op. cit.).

Some years matched with more than one other year. The largest gap without a pair of identical years, when there were at least 68 possible matching years, was between 5641 (1880/1) and 5628 (1867/8).

By far the most common pairs of identical years were separated by an interval of 152 (19 x 8) years, and these pairs were most likely to be completely identical. For the 63 years in which every year could have matched with a year up to 152 years later (i.e. from 5760 [1999/2000] until 5697 [1936/7]), slightly over half of the pairs of years (34) began identically, and, in slightly over two-thirds of the pairs of years, the entire year was identical. There were also spans of identical years that were separated by the same numbers of years (e.g., 5749 [1988/9]-5597 [1836/7]; 5748 [1987/8]-5596 [1835/6]; 5747 [1986/7]-5595 [1834/5], with each pair of identical years separated by 152 years). In fact, in those 63 years from 5760 (1999/2000) until 5697 (1936/7), there were relatively few years that did *not* at least begin identically with another year somewhere in the previous 152 years; those years were 5755 (1994/5), 5742 (1981/2), 5735 (1974/5), 5715 (1954/5), 5711 (1950/1), 5709 (1948/9) and 5705 (1944/5).

There were intriguing clusters within the data. For example, the first year of a pair of identical years separated by 136 ( $2 \times [19 \times 3 + 11]$ ) years did not occur between 5760 (1999-2000) and 5695 (1934/5), and then there were three such pairs of identical years, where the first year in the pair was between 5694 (1933/4) and 5682 (1921/2). Of the eight pairs of identical years separated by 125 years ( $19 \times 6 + 11$ ), all of them had the first year of the pair between 5684 (1923/4) and 5672 (1911/2). There was only one pair of identical years (5663 [1902/3] and 5549 [1788/9]) that was separated by 114 years ( $19 \times 6$ ). There was a strong clustering of identical pairs of years that were 84 ( $19 \times 4 + 8$ ) years apart, especially when the first year of the pair was between 5656 (1895/6) and 5645 (1884/5). There was a second strong clustering of identical pairs of years that were 68 years apart ( $19 \times 3 + 11$ ), with the first year of the pair being 5726 (1965/6). Finally, there were no pairs of years separated by 57 years ( $19 \times 3$ ) with the first of the pair being between 5760 (1999/2000) and 5717 (1956/7).

Almost every pair of years that was identical through 30 Cheshvan was identical for the entire year. Only one pair of years (separated by 68 years) was concordant through 30 Cheshvan but not through 30 Kislev (5670 [1090/10] and 5602 [1841/2]). Eight pairs of years that were identical through 30 Cheshvan and 30 Kislev were not concordant through February; of those eight pairs of years, four pairs (the second, fourth, sixth and eighth [5684 {1923/4}-5559 {1798/9}, 5680 {1919/20}-5555 {1994/5}, 5676 {1915/6}-5551 {1790/1} and 5672 {1911/2}-5547 {1786/7}]) were separated by 125 years ( $19 \times 6 + 11$ ), and four pairs (the first, third, fifth and seventh, 5704 {1943/4} -5667 {1886/7}, 5680 {1919/20}-5623 {1862/3}, 5676 {1916/6}-5619 {1858/9} and 5672 {1911/2}-5615 {1854/5}) were separated by 57 ( $19 \times 3$ ) years. See Table 2 for the complete data set.

Despite our prediction that pairs of identical years might be seen every 95, 114 or 133 years, no pairs of identical years were seen that were separated by 133 ( $19 \times 7$ ) years, while only a handful were separated by 95 ( $19 \times 5$ ) or 114 ( $19 \times 6$ ) years (see Table 1); 152 years was the most frequent interval separating pairs of identical years, and roughly 1/400 pairs of years examined was identical. I could find no general formula for predicting the occurrence of pairs of identical years or the patterns of clustering observed.

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**Table 1**  
**Data Summary for Identical Years, 5760 (1999/2000) - 5545 (1784/5)**

# Years Between Pairs	Pattern	Total/ Total Possible # Years	# Completely Identical years	# Partially Identical Years	Complete/ Total # Identical Years (%)	Comments
209	19 x 11	3/7 = 43%	1	2	33	
190	19 x 10	1/26= 4%	0	1	0	
163	19 x 8+11	7/53= 13%	0	7	0	
152	19 x 8	34/64=53%	24	10*	71	4/8 pairs identical only through Feb. 28 here.
136	2(57+11)	3/80 = 4%	0	3	0	None until 5694; three from 5694-82
125	19 x 6+11	8/91 = 9%	3	5	38	None until 5684; eight from 5684-72
114	19 x 6	1/102 = 1%	0	1	0	
95	19 x 5	4/121 = 3%	1	2	33	
84	19 x 4+8	11/132=8%	4	7	36	Strong clustering, esp. 5656-45
68	19 x 3+11	40/148=27%	20	20	50	None until 5726. Contains the only pair of years identical only through 29 Kislev.
57	19 x 3	21/159=13%	6	15*	29	None until 5716. 4/8 pairs identical only through Feb. 28 here.
11	0 + 11	12/205 = 6%	1	11	9	

\* four pairs of years identical only through February 28.

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**Table 2**  
**Identical Years, 5760 (1999/2000) - 5545 (1784/5)**

<b>Identical Years</b>	<b>Through 29 Cheshvan</b>	<b>Through 29 Kislev</b>	<b>Through 28 Feb.</b>	<b>Whole Year</b>	<b># Years Apart</b>
5760 (1999/2000) -5608 (1847/8)	xx				152 = 19x8
5759 (1998/9) -5675 (1914/5)	xx				84 = 19x4+8
5759 (1998/9) -5607 (1846/7)	xx				152
5759 (1998/9) -5550 (1789/90)	xx				209 = 19x11
5758 (1997/8) -5663 (1902/3)	xx				95 = 19x5
5758 (1997/8) -5606 (1845/6)	xx				152
5758 (1997/8) -5549 (1788/9)	xx				209
5757 (1996/7) -5662 (1901/2)	xx				95
5757 (1996/7) -5605 (1844/5)	xx				152
5757 (1996/7) -5594 (1833/4)	xx				163 = 19x8+11
5756 (1995/6) -5604 (1843/4)	xx				152
5754 (1993/4) -5670 (1909/10)	xx				84
5754 (1993/4) -5602 (1841/2)	xx				152
5754 (1993/4) -5545 (1784/5)	xx				209
5753 (1992/3) -5601 (1840/1)	xx				152
5753 (1992/3) -5590 (1829/30)	xx				163
5752 (1991/2) -5688 (1907/8)	xx				84
5752 (1991/2) -5600 (1839/40)	xx				152
5751 (1990/1) -5667 (1906/7)	xx				84
5751 (1990/1) -5599 (1838/9)	xx				152
5750 (1989/90) -5666 (1905/6)	xx				84
5750 (1989/90) -5598 (1837/8)	xx				152
5750 (1989/90) -5560 (1799/00)	xx				190 = 19x10
5749 (1988/9) -5597 (1836/7)	xx				152
5748 (1987/8) -5596 (1835/6)	xx				152
5747 (1986/7) -5595 (1834/5)	xx				152
5746 (1985/6) -5583 (1822/3)	xx				163
5745 (1984/5) -5734 (1973/4)	xx				11
5744 (1983/4) -5592 (1831/2)	xx				152
5743 (1982/3) -5591 (1830/1)	xx				152
5741 (1980/1) -5578 (1817/8)	xx				163
5740 (1979/80) -5588 (1827/8)	xx				152
5739 (1978/9) -5587 (1826/7)	xx				152
5738 (1977/8) -5586 (1825/6)	xx				152
5737 (1976/7) -5574 (1813/4)	xx				163
5736 (1975/6) -5584 (1823/4)	xx				152
5734 (1973/4) -5582 (1821/2)	xx				152

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Identical Years	Through 29 Cheshvan	Through 29 Kislev	Through 28 Feb.	Whole Year	# Years Apart
5733 (1972/3) -5581 (1820/1)	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				152
5732 (1971/2) -5580 (1819/20)	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				152
5731 (1970/1) -5579 (1818/9)	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				152
5730 (1969/70) -5567 (1806/7)	xx				163
5729 (1968/9) -5587 (1816/7)	xx				152
5728 (1967/8) -5586 (1815/6)	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				152
5727 (1966/7) -5585 (1814/5)	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				152
5726 (1965/6) -5658 (1897/8)	xx				68 = 19x3+8
5726 (1965/6) -5563 (1802/3)	xx				163
5725 (1964/5) -5573 (1812/3)	xx				152
5724 (1963/4) -5656 (1895/6)	xx				68
5723 (1962/3) -5571 (1810/1)	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				152
5722 (1961/2) -5654 (1893/4)	xx				68
5722 (1961/2) -5570 (1809/10)	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				152
5721 (1960/1) -5653 (1892/3)	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				68
5721 (1960/1) -5569 (1808/9)	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				152
5720 (1959/60) -5568 (1807/8)	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				152
5719 (1958/9) -5708 (1947/8)	xx				11
5719 (1958/9) -5651 (1890/1)	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				68
5718 (1957/8) -5707 (1946/7)	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				11
5718 (1957/8) -5650 (1889/90)	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				68
5717 (1956/7) -5649 (1888/9)	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				68
5717 (1956/7) -5565 (1804/5)	xx				152
5716 (1955/6) -5659 (1898/9)	xx				57 = 19x3
5716 (1955/6) -5564 (1803/4)	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				152
5714 (1953/4) -5646 (1885/6)	xx				68
5713 (1952/3) -5645 (1884/5)	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				68
5713 (1952/3) -5561 (1800/1)	xx				152
5712 (1951/2) -5655 (1894/5)	xx				57
5710 (1949/50) -5642 (1881/2)	xx				68
5708 (1947/8) -5651 (1890/1)	xx				57
5707 (1946/7) -5650 (1889/90)	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				57
5706 (1945/6) -5638 (1877/8)	xx				68
5704 (1943/4) -5667 (1886/7)	XXXXXXXXXXXXXXXXXXXXXXXXXXXX				57
5704 (1943/4) -5636 (1875/6)	xx				68
5703 (1942/3) -5692 (1931/2)	xx				11
5703 (1942/3) -5635 (1874/5)	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				68
5701 (1940/1) -5633 (1872/3)	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				68
5700 (1939/40) -5643 (1882/3)	xx				57
5699 (1938/9) -5631 (1870/1)	xx				68

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Identical Years	Through 29 Cheshvan	Through 29 Kislev	Through 28 Feb.	Whole Year	# Years Apart
5698 (1937/8) -5641 (1880/1)	xx				57
5698 (1937/8) -5630 (1869/70)	xx				68
5697 (1936/7) -5629 (1868/9)	xx				68
5696 (1935/6) -5639 (1878/9)	xx				57
5695 (1934/5) -5627 (1866/7)	xx				68
5694 (1933/4) -5626 (1865/6)	xx				68
5694 (1933/4) -5558 (1797/8)	xx				136 = 68x2
5693 (1932/3) -5625 (1864/5)	xx				68
5692 (1931/2) -5635 (1874/5)	xx				57
5687 (1926/7) -5686 (1915/6)	xx				11
5687 (1926/7) -5619 (1858/9)	xx				68
5687 (1926/7) -5551 (1790/1)	xx				136
5684 (1923/4) -5559 (1798/9)	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx				125 = 19x6+11
5683 (1922/3) -5672 (1911/2)	xx				11
5683 (1922/3) -5615 (1854/5)	xx				68
5683 (1922/3) -5547 (1786/7)	xx				136
5682 (1921/2) -5614 (1853/4)	xx				68
5682 (1921/2) -5557 (1796/7)	xx				125
5680 (1919/20) -5623 (1862/3)	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx				57
5680 (1919/20) -5555 (1794/5)	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx				125
5679 (1918/9) -5611 (1850/1)	xx				68
5679 (1918/9) -5554 (1793/4)	xx				125
5678 (1917/8) -5621 (1860/1)	xx				57
5677 (1916/7) -5609 (1848/9)	xx				68
5676 (1915/6) -5619 (1858/9)	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx				57
5676 (1915/6) -5551 (1790/1)	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx				125
5675 (1914/5) -5550 (1789/90)	xx				125
5674 (1913/4) -5663 (1902/3)	xx				11
5674 (1913/4) -5606 (1845/6)	xx				68
5674 (1913/4) -5549 (1788/9)	xx				125
5672 (1911/2) -5615 (1854/5)	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx				57
5672 (1911/2) -5547 (1786/7)	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx				125
5670 (1909/10) -5602 (1841/2)	xxxxxxxxxxxxxxxxxxxxx				68
5668 (1907/8) -5600 (1839/40)	xx				68
5667 (1906/7) -5599 (1838/9)	xx				68
5666 (1905/6) -5598 (1837/8)	xx				68
5663 (1902/3) -5606 (1845/6)	xx				57
5663 (1902/3) -5549 (1788/9)	xx				114 = 19x6
5662 (1901/2) -5605 (1844/5)	xx				57
5662 (1901/2) -5594 (1833/4)	xx				68



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<b>Identical Years</b>	<b>Through 29 Cheshvan</b>	<b>Through 29 Kislev</b>	<b>Through 28 Feb.</b>	<b>Whole Year</b>	<b># Years Apart</b>
5659 (1898/9) -5564 (1803/4)	xx				95
5656 (1895/6) -5572 (1811/2)	xx				84
5654 (1893/4) -5570 (1809/10)	xx				84
5653 (1892/3) -5569 (1808/9)	xx				84
5652 (1891/2) -5568 (1807/8)	xx				84
5649 (1888/9) -5565 (1804/5)	xx				84
5647 (1886/7) -5636 (1875/6)	xx				11
5645 (1884/5) -5561 (1800/1)	xx				84
5641 (1880/1) -5630 (1869/70)	xx				11
5628 (1867/8) -5560 (1799/80)	xx				68
5626 (1865/6) -5558 (1797/8)	xx				68
5624 (1863/4) -5556 (1795/6)	xx				68
5623 (1862/3) -5555 (1794/5)	xx				68
5621 (1860/1) -5610 (1849/50)	xx				11
5621 (1860/1) -5553 (1792/3)	xx				68
5620 (1859/60) -5552 (1791/2)	xx				68
5619 (1858/9) -5551 (1790/1)	xx				68
5616 (1855/6) -5548 (1787/8)	xx				68
5615 (1854/5) -5517 (1786/7)	xx				68
5614 (1853/4) -5557 (1796/7)	xx				57
5611 (1850/1) -5554 (1793/4)	xx				57
5610 (1849/50) -5553 (1792/3)	xx				57
5607 (1846/7) -5550 (1789/90)	xx				57
5606 (1845/6) -5549 (1788/9)	xx				57
5605 (1844/5) -5594 (1833/4)	xx				11
5603 (1842/3) -5546 (1785/6)	xx				57
5602 (1841/2) -5545 (1784/5)	xx				57
5601 (1840/1) -5590 (1829/30)	xx				11

