

Errata for  
*Calendrical Calculations: The Ultimate Edition*

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The severity of an error is indicated by the **red** asterisks preceding the error number. No asterisk indicates a trivial error, a single asterisk a minor error, and so on.

If you find errors not given below or can suggest improvements to the book, please send email to nachum@tau.ac.il. The latest version of this document can be obtained at <http://www.calendarists.com>.

Line counts are positive counting down from the first line of text on the page, excluding the header, and negative counting up from the last line of text on the page *including footnote lines*.

Our thanks to all those who pointed out errors or suggested improvements.

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### CORRECTIONS: TEXT

1. Page 17, line 13 (in Table 1.2), the Gregorian value of the Samaritan epoch should read: March 1,  $-1638$ . (Courtesy of Ariq Arar, December 25, 2018.)
2. Page 25, sentence before Sect. 1.9: should be “within a hundred-thousandth of a day”, as in the 3rd ed. (Courtesy of Irv Bromberg, April 28, 2019.)
- \*3. Page 130, line  $-3$ , add at end of sentence: or is Friday, in which case it is advanced to Thursday. (Courtesy of Irv Bromberg, May 5, 2024.)
4. Page 150, Sect. 9.3: Change 1776 to 1774.
5. Page 294, footnote, second sentence should read, deleting superfluous word and shifting the dates: For example, using Yallop’s imperfect criterion (Eq. 14.100), there would have been a 31-day observation-based lunar month in Babylon extending from August 26, 2006 through September 25, 2006. (Courtesy of Ariq Arar, December 25, 2018.)
6. Page 321, line 13, change to the following, because there are conflicting conventions of numbering years: for example, the Chinese year overlapping Gregorian years 1966–67 was a leap year, but, 19 years later, the Chinese year overlapping 1985–86 was a common year. (Courtesy of Ariq Arar, December 25, 2018.)
- \*7. Page 347, Table 20.4, correcting errors of arithmetic: The offset for the Kollam era should be  $-746$ , and for the Nepalese,  $-801$ . The same corrections should be made in our *Calendrical Tabulations*. (Courtesy of Ariq Arar, December 25, 2018.)
- \*8. Page 381, after Eq. 21.7: Correct to say that, like Losar, other important feasts are also celebrated in the intercalary month in leap years—per Ms. Tsering Choezom, head of the Astro-science Department of Men-Tsee-Khang. (Courtesy of Julia Jacobi, November 11, 2023.)

9. Page 388, replace caption of frontispiece with this: Page from a 1911 Ottoman-Turkish calendar. The uppermost portion gives the date Kânûn-ı Evvel 18, 1327 on the left, using the Turkish Rumi variant of the Julian calendar; on the right is the Islamic date, Muḥarram 11, 1330 A.H. Below those are the year (1911), month (December), and day of week (Sunday) in Bulgarian, plus the length of the month (31). Below that on the left is the Julian date, December 18, 1911 C.E., in Greek—adding that it is the feast day of the martyrs, Sebastian and Zoe—and the Gregorian date, December 31, 1911, and day of week in French on the right—noting that it is Silvester. The time of midday in Turkey is given at the left- and right-hand edges, and the date of the full moon is given at the middle edges. Further below are entries for the date in Armenian on the left—adding that it’s the fourth week of Advent—and giving the times of sunrise, sunset, and noon in French on the right—the latter according to Turkish time, measured from sunrise; below yet is the Hebrew date, Tevet 10, 5672 A.M., with the day of the week given in Ladino, borrowing the Arabic term *alḥad* for Sunday. (Courtesy of Ariq Arar, December 25, 2018, and James R. Russell, May 26, 2019.)

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## CORRECTIONS: FUNCTIONS

10. Function **time-from-clock** (Eq. 1.43) has a spurious 24 in the basis. It should be

```
(/ (from-radix hms nil (list 60 60)) 24))
```

This function is never used elsewhere in the code; it was for displaying output only. (Courtesy of Benjamin Yang, April 25, 2018.)

11. Page 179, Eq. 11.19: The list of parameters should read “number name.” The code is in the correct order. (Courtesy of Ariq Arar, December 25, 2018.)
- \*\*12. Page 210, last line. In the definition of  $y_{2051}$  in **ephemeris-correction** (14.15), change the last + sign to −. The difference amounts to almost two minutes in 2051 (the worst case). (Courtesy of Nick Derham, September 8, 2021.)
- \*\*13. §20.5 (pages 358–362): For the astronomical versions of the Hindu calendars to work as advertised, the time zone of **hindu-location** (Eq. 20.26, page 351) needs be set to Greenwich, i.e. 0<sup>h</sup>. Then everything will be computed in U.T. With this, our calculations are in agreement with those in Appendix 1 of *Jantri 500* by Pal Singh Purewal, which uses the city of Amritsar, at 31° 38′ N, 74° 53′ E. It would be better to have **astro-hindu-sunset** (Eq. 20.42) as well as a new function **astro-hindu-sunrise**, instead of **alt-hindu-sunrise**, convert from standard, zone time to U.T., using **universal-from-standard**, and to use those in the astronomical lunar and solar calendars of Section 20.5. Both sunrise and sunset should use the same convention for depression angle, both 0° or both 47′. See Sect. 20.4. (Courtesy of Sarabveer Singh, January 27, 2020.)
14. Page 359: The Lahiri value for **ayanamsha** (Eq. 20.40) is based on coincidence of sidereal longitude 0° with Spica, taken as having tropical longitude 180°, in 285 C.E.—not Aries. Per Ptolemy, Hipparchus discovered precession based on the historical position of Spica. Therefore, **sidereal-start** (20.41) would better be defined as, in effect:

```
precession(solar-longitude-after(
  autumn, fixed-from-julian(1 September 285 C.E.)), hindu-location)
```

(Courtesy of Sarabveer Singh, April 19, 2020.)

15. Page 366, §20.6: For generality, instead of **ujain** in **hindu-tithi-occur** (Eq. 20.58), we should use **hindu-location**. (Courtesy of Michael Truog, June 16, 2023.)
16. Some implementations of Lisp (e.g. CLISP, in contrast to LispWorks) will not coerce an expression like `(+ (mins 34) dip (* (secs 19) (sqrt h)))` in the definition of **precession** (Eq. 14.39) to be a long real when **h** is an integer. This can lead to erroneous times for sunrise, for example. So, one can force **h** to be long, or insist in such cases that the parameters of a location be given as long reals and not integers or rationals.
17. Lisp function (20.26), line 1: For flexibility, **hindu-location** should be defined with **defparameter**, rather than **defconstant**.

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## TRIVIA

18. Page xxxvi, epigraph, quoting the Fourth Earl of Chesterfield: “and could have understood me” should read “and they would have understood me.” (Courtesy of Nicolaas Mars, December 13, 2020.)
19. Page xl, ref. [16]: Delete instance of dittography. (Courtesy of Irv Bromberg, November 21, 2021.)
20. §1.7: The gcd program (Eq. 1.22) for greatest common divisor, though intended only for positive integers, allows for  $y = 0$  as terminating condition. (Courtesy of Walter E. Brown, December 20, 2022.)
21. Page 63, epigraph: von Lieven, as in the 3rd ed., not Lievenin (Courtesy of Ariq Arar, December 25, 2018.)
22. Page 99, epigraph: “meal” should be “meat.” (Courtesy of Michael Kaelbling, September 18, 2020.)
23. Page 99, epigraph: “modem” should be “modern.”
24. Page 161, Figure 10.1: The tick representing the conjunction before lunar month *11* should be placed just to the right of  $270^\circ$ . (Courtesy of Ariq Arar, December 25, 2018.)
25. Page 195, Section 13.1, item 1: Italicize second “or”, i.e. either *strictly before* or *at or before* some critical time of day.
26. Page 212, line below Eq. (14.16): Instead of  $t$ , it should be  $t_u$ . (Courtesy of Irv Bromberg, December 10, 2020.)
27. Page 215, lines 26–29: Replace this sentence with: The periodic pattern of the equation of time, shown in Figure 14.5, is sometimes inscribed as part of the analemma on sundials, usually in mirror image; Figure 14.6 on page 217 depicts a three-dimensional image of the equation. (Courtesy of Ariq Arar, December 25, 2018.)
28. Page 218–9: Replace “see page 219” (this *is* page 219) with “see the next section”. (Courtesy of Ariq Arar, December 25, 2018.)
29. Page 246, line 18: Add missing “a”, so it reads: marks on a dripping pot.
30. Page 257, §15.1, epigraph: Replace Hittites with Cathayans. (Courtesy of Ariq Arar, December 25, 2018.)
31. Page 314, Fig. 19.2: The Chinese month numbers should be set in italics and the degree signs should not. (Courtesy of Ariq Arar, December 25, 2018.)

32. Page 322, footnote: Delete “In the next section,”. (Courtesy of Ariq Arar, December 25, 2018.)
33. Page 329, footnote 14, end of page: Add comma before “but”.
34. Page 336, line 1: Move comma to after parentheses.
35. Page 341, caption of Table 20.2, more precisely: in 1982–1983. (Courtesy of Ariq Arar, December 25, 2018.)
36. Page 470, column 2, line 2: “preferred” is the preferred spelling. (Courtesy of Walter E. Brown, December 20, 2022.)

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## SUGGESTIONS

37. We might wish to refer to the multiple calendar works of the logician, Abraham Fraenkel: “Bestimmung des Datums des jüdischen Osterfestes für die Zeitrechnung der Mohammedaner” (1908); “Eine Formel zur Verwandlung jüdischer Daten in mohammedanische” (1909); and “Die Berechnung des Osterfestes” (1910).
38. Maybe incorporate the joke: “What happened to the man who stole the calendar?” “He got twelve months.” *New York Star*, Issue 2, Roland Burke Hennessy (1908).
39. Preface: Mention leap second glitches, <https://www.wired.com/2012/07/leap-second-glitch-explained>; <https://arstechnica.com/information-technology/2017/01/cloudflare-leap-second-software-panic-snafu-new-years-day/?comments=1&post=32568015>
40. §1.10: A comprehensive development of mixed-radix conversions, due to Irv Bromberg, may be found at <http://individual.utoronto.ca/intervalmath/mixed/radix.html>. (Courtesy of Irv Bromberg, June 7, 2022.)
41. §3.5: Mention perhaps the Berber variant of the Julian calendar [https://en.wikipedia.org/wiki/Berber\\_calendar](https://en.wikipedia.org/wiki/Berber_calendar).
42. §3.6: We can include more information on groups that celebrate Christmas according to the Julian calendar, which is January 7 (Gregorian) in this century. The Georgian church observes Christmas like Russia on January 7; the Ukrainian Orthodox church acted likewise until 2023 when it switched to December 25. We mention the Serbian church, which includes Montenegro and North Macedonia. Also, the Scottish island of Foula continues to use the old style calendar for their Christian holidays [<https://www.independent.co.uk/news/uk/home-news/foula-britain-remote-inhabited-island-christmas-celebration-two-weeks-late-a7513541.html>].

We say that many Jerusalem churches follow the Julian calendar, which is true of the Greek Orthodox Church of Jerusalem. In Armenia, Christmas—or, more precisely, the Feast of Nativity—is celebrated on January 6. So the Armenian Patriarchate of Jerusalem, which follows the Julian calendar, actually celebrates on January 18 nowadays.

We should also mention here that the Coptic and Ethiopian churches follow their Julian-like calendar, with its offset leap-year rule. See Chapter 4. Thus, Orthodox Copts celebrate on December 25 or December 26 on the Julian calendar, which is January 7 or 8 Gregorian (in the 21st century).

All in all, Christmas is celebrated on three or four different dates in Jerusalem: December 25 (Catholics), January 7 (Greek Orthodox and Copts most years), January 8 (Copts in years divisible by four), and January 18 (Armenian).

43. §7.2 (page 109): Add the holiday Arba'een (meaning forty), celebrated by Shia on Şafar 20 or 21, 49 days after Islamic New Year (Muḥarram 1), which is 40 days after Ashura.
44. Mention in a footnote that in 1774 the minister of the King of Prussia presented to the Diet of Ratisbonne a rescript stating that “His Prussian Majesty, foreseeing that in 1778 the Easter of the Protestants would not come on the same day as that of the Roman Catholics, and that it might occasion some trouble because it coincided with the Passover of the Jews, desired that the states of the empire take suitable measures in order that the two Christian communions should celebrate Easter on the same day, especially in the states where the two worships were equally authorized by law.” Accordingly, the king fixed Easter 1778 on the 19th of April, with the Catholics, instead of on the 12th, with the Jews.
45. Chapter 10. We should give the names of the *tithis*, as in, for example, <https://en.wikipedia.org/wiki/Tithi>.
46. §11.1: Add a reference to Linden, J., and Bricker, V. (2023). “The Maya 819-Day Count and Planetary Astronomy”. *Ancient Mesoamerica*, 1–11. doi:10.1017/S0956536122000323 (Courtesy of Idan Dershowitz, April 21, 2023.)
47. §14.2: Leap seconds are to be abandoned by 2035, for at least a century. See <https://arstechnica.com/science/2022/11/network-crashing-leap-seconds-to-be-abandoned-by-2035-for-at-least-a-century>.
48. §14.6 (page 227): We might add the names for other full moons, not just the Harvest Moon, as given in the *Old Farmer’s Almanac*. They are: Wolf (January, or first full moon after the winter solstice); Snow, (February); Worm (March); Pink (April); Flower (May); Strawberry (June); Buck (July); Sturgeon (August); Corn (September); Harvest (full moon closest to autumnal equinox); Hunter’s (October); Beaver (November); Cold (December); Mourning (last full moon before winter solstice). Many other names are used; see Houssein Ksontini, <https://skyandtelescope.org/astronomy-resources/native-american-full-moon-names> and Vigdis Hocken and Aparna Kher, <https://www.timeanddate.com/astronomy/moon/full-moon-names.html>.
49. Page 248, (Eq. 14.91), the function name **standard-from-sundial** would be better named **standard-from-temporal**. Likewise **hindu-standard-from-temporal** rather than **hindu-standard-from-sundial** (Eq. 20.35). (Courtesy of Irv Bromberg, July 10, 2022.)
50. Page 322, line 3: Clarify that the calculations are done for the equivalent of 120° east meridian (after 1928). (Courtesy of Ariq Arar, December 25, 2018.)
51. Page 329. Add that Korean Thanksgiving is called *Chuseok*. This mid-Autumn festival is celebrated widely in Eastern Asia.
52. §19.10. In 2022, South Korea decided that for official records the Western method of specifying age will be used, starting with age 0 at birth, rather than the traditional age 1 at birth incremented each January 1st. Cf. the discussion for the Chinese calendar in §19.7. See <https://www.cnn.com/2019/06/03/health/south-korea-age-law-intl/index.html> and <https://edition.cnn.com/2022/12/09/asia/south-korea-international-age-law-intl-hnk/index.html>. This change took effect June 27, 2023; see, for example, <https://www.bbc.com/news/world-asia-66028606>. (Courtesy of Schulamith Halevy, June 4, 2019.)
53. Page 351: Explain that **hindu-location**, specifically **ujjain** (Eq. 20.25), has the zone set to local time, not standard time. Perhaps it would be better to convert from standard to local for consistency. (Courtesy of Sarabveer Singh, January 27, 2020.)

54. Page 359: It would probably be better to shift the value of **ayanamsha** (Eq. 20.40) to the range  $-180^\circ..180^\circ$  (Courtesy of Sarabveer Singh, April 21, 2020.)
55. Consider adding the calculation of the *samvatsara* per Sūrya Siddhānta. See Sewell & Dikshit, *The Indian Calendar*, pp. 32–39. (Courtesy of Ariq Arar, January 31, 2022.)
56. Page 366. Regarding Diwali:

In West Bengal the day of Vijayadashami [beginning of Diwali celebraton] is not always same as that of other Indian states. When it happens, it is one day after of Vijayadashami in other states. Most Indian states observe Vijayadashami based on Muhurata [time] and prefer the day when there is suitable combination of Tithi [phase] and Nakshatra [lunar station] during afternoon. Many religious books including Purana suggest to observe Vijayadashami after considering appropriate Muhurata. It seems with time West Bengal has drifted away from the above rule and prefers Dasami [19th] Tithi only without considering Muhurata to observe Vijayadashami. <https://dates.hindigk.in/bengal-vijayadashami-festival.html?year=1946>

Most observe Diwali on the (last) day when the moon is in its 30th tithi at sunset. As mentioned in the book, it is common to use astronomical calculations, rather than traditional ones. In other words, the critical time is sunset (in Prayagraj [=Allahabad], Uttar Pradesh, for example), rather than sunrise. We could use code like this:

```
(defun astro-diwali (g-year)
  (let* ((h-year (hindu-lunar-year
                 (hindu-lunar-from-fixed
                  (gregorian-new-year (1+ g-year))))))
        (approx ; day 30 at sunrise
             (hindu-date-occur h-year 7 30)))
    (final d (- approx 2) ; last time day 30
           (> (lunar-phase ; at sunset
               (universal-from-standard
                (astro-hindu-sunset d hindu-location)
                hindu-location))
              180L0))))
```

In Tamil Nadu, a different rule is used, and the main celebration is usually one day later. (Courtesy of Michael Truog, June 8, 2023.)

57. Page 366. Mention the Onam harvest festival celebrated in late summer in Kerala. The main (tenth) day of the 12-day event corresponds to when the moon is in the 22nd lunar mansion (nakṣatra), Śravaṇā (Thiruvonam in Malayalam; see Table 20.1), in the solar month Śravaṇā (Chingam; see Table 10.2), the first month of the Malayalam version of the Hindu solar calendar. Here is code:

```
(defun onam (g-year)
  ;; Fixed date of main (tenth) day of the Onam festival
  ;; in Gregorian year $g-year$.
  (let* ((n (gregorian-new-year g-year))
        (y (1+ (standard-year (hindu-solar-from-fixed n))))
        (m (fixed-from-hindu-solar (hindu-solar-date y 5 1))))
    (next d m (= (hindu-lunar-station d) 22))))
```

This means that the main event is the day in the 5th solar month (counting from Caitra) when the moon first enters the 22nd mansion (after sunrise). The details of the determining times of day need to be confirmed. A famous Malayalam proverb: “Kaanam vittum onam unnam” (One must have the Onam meal even if it means selling one’s property). (Courtesy of Paliath Narendran, August 22, 2021.)

58. §21.1: Classify the variations in the Southeast Asian Buddhist family of calendars, which includes the Tibetan. We mention the Bhutan, Mongolian, and Sherpa calendars; there are also variants in use in Burma, Cambodia, India, Laos, Malaysia, Myanmar, Singapore, Sri Lanka, Thailand, and Vietnam.
59. §21.2: Consider mentioning the old Thai new year, Songkran, analogous to Mēsha saṃkrāti, and its calculation.