Errata and Notes for

Calendrical Calculations: The Millennium Edition

Edward M. Reingold and Nachum Dershowitz
Cambridge University Press, 2001

1:34pm, April 21, 2003

Do I contradict myself? Very well then I contradict myself.
(I am large, I contain multitudes.)

—Walt Whitman: *Song of Myself*

All those complaints that they mutter about... are on account of many places I have corrected. The Creator knows that in most cases I was misled by following... others whom I will spare the embarrassment of mention. But even were I at fault, I do not claim that I reached my ultimate perfection from the outset, nor that I never erred. Just the opposite, I always retract anything the contrary of which becomes clear to me, whether in my writings or my nature.

—Maimonides: *Letter to his student Joseph ben Yehuda* (circa 1190), *Iggerot HaRambam, I. Shilat, Maaliyot, Maaleh Adumim, 1987, volume 1, page 295* [*in Judeo-Arabic*]

If you find errors not given below or can suggest improvements to the book, please send us the details (email to `reingold@iit.edu` or hard copy to Edward M. Reingold, Department of Computer Science, Illinois Institute of Technology, 10 West 31st Street, Suite 236, Chicago, IL 60616-3729 U.S.A.). If you have occasion to refer to errors below in corresponding with the authors, please refer to the item by page and line numbers *not* by item number.

Our thanks to the following people for the indicated errata:

Birgir T. Arnar: Errata corrections.
Helmer Aslaksen: 21, 24, 125, 130, 148, 171, 187, 201.
Irv Bromberg: 64, 97, 101, 143.
Simon Cassidy: 80.
John Cross: 112, 117, 121, 127, 133, 136, 138, 140, 161, 163, 176, 190, 203, 204, 250.
Ehssan Dabal: 182, 218, 221, 236.
Michael H. Deckers: 55.
Idan Dershowitz: 245.
Robert H. Douglass: 14, 19, 23, 25, 31, 47, 79, 106, 114, 142, 144, 174, 183, 186, 191, 193, 195, 199, 200, 209.
Donald W. Fausett: 113.
Jean Forget: 181.
Nazli Goharian: 177.
Winfried Görke: 115.
Peter Zilahy Ingerman: 124, 241.
Svante Janson: 18, 26, 33, 45, 46, 49, 50, 86, 189.
Daher Kaiss: 85.
Richard P. Kelly: 146, 160, 208.
Richard M. Koolish: 137, 147.
Jonathan Leffler: 129, 213, 214, 219, 226, 228–230, 232, 239.
Zhuo Meng: 156, 157.
Akshay Regulagedda: 197.
Nigel Richards: 188.
Theodore M. Rolle: 9.
Arthur J. Roth: 27, 34–37, 39–41, 43, 44, 51–54, 60–63, 68, 69, 71–74, 76–78, 83, 87, 88, 90–92, 94, 96, 98–100, 107–109, 116.
Robert A. Saunders: 131, 220, 233.
Michael R. Stein: 102.
Otto Stolz: 10, 29, 67.
Robert H. van Gent: 80, 118.
Oscar van Vlijmen: 28, 149, 151, 154, 155, 158, 224.
Mark Woolcott: 251-s.
Lara Zoble: Errata corrections.

A list of errata in order by date added or last modified is given at the end of this document.

The latest version of this document can be obtained from the Web site `http://www.calendarists.com`

The severity of an error is indicated by the red asterisks preceding the error number. No asterisk indicates a note or a trivial error, a single asterisk a more serious error, a double asterisk an even more serious error, and so on. The serious errors below are: 95, 119, 122, 123, 124, 138, 150, 163, 166, 168, 182, 188, 190, 202, 205, 206, 221, 235, 236, 238, 242, 243, 244.

An error that has been corrected in some printings is marked by a green circle containing the number of the printing in which the error was fixed. The corrected errors below are: 2, 9, 11, 19, 20, 37, 40, 41, 67, 69, 75, 78, 79, 90, 94, 95, 99, 100, 102, 104, 106, 115, 119, 121, 122, 123, 124, 126, 127, 129, 136, 138, 144, 150, 165, 166, 167, 168, 169, 178, 179, 182, 184, 187, 190, 192, 193, 195, 197, 199, 200, 202, 203, 204, 205, 206, 208, 211, 214, 217, 218, 221, 222, 231, 235, 236, 237, 238, 242, 243, 244, 245, 251-a, 251-c.

The printing history of the book is as follows:

Printing	Date	Notes
First	July, 2001	Paperback and hard-cover
Second	November, 2002	Paperback; most serious (and many minor) errors corrected and CD revised

1. Cover: The dials in Nathan ben Meir Hademer's *Sefer Ha-Evronot* shown on the cover are used as follows to determine the Julian season: Add up the numbers on each of the three circles (for metonic cycle number, year within cycle, season within year) to find how long after the molad of the month the Julian season begins. That is why each ordinary year (for example) contributes 10d 21h 204p, the excess of solar over lunar, using the Julian solar year length and 12 mean lunations. The manuscript has other dials for other calculations.

2. (2) Title page: Reingold's affiliation should read

   University of Illinois at Urbana-Champaign
   and
   Illinois Institute of Technology

3. Page xix, bottom: We should have included the "box notation" introduced on page 23 in the table of notations and the representation of field selection by subscripting with the bold field name.

4. Good quote from the Koran (Jonah, 10, 5): "It is He who gave the sun its radiance, the moon its luster, and appointed its stations so that you may compute years and numbers. God did not create them but with deliberation. He distinctly explains His signs for those can understand." (Translation by Ahmed Ali, *Al-Qur'an: A Contemporary Translation*, Princeton University Press, 1988.)

5. Good quote from *De Computo Dialogus*: "Quis enim potest intelligere dies et tempora et annos, nisi per numerum?" [Who can understand days and seasons and years, save by number?] See top of page xxv and footnote 20 in *Bede: The Reckoning of Time*, Faith Wallis, Liverpool University Press, Liverpool, 1999.

6. Good quote from I. B. Singer, *The Family Moskat* (page 39 in the Penguin edition): "He spent his days and half his nights writing a book on the history of calendars."

7. Good quote from Benjamin Franklin, *Poor Richard*, 1738:

   If you wou'd not be forgotten
   As soon as you are dead and rotten,
   Either write things worth reading,
   or do things worth the writing.

8. Good quote from Theodore Roosevelt's, annual address of the president of the American Historical Association, delivered at Boston, December 27, 1912. From the *American Historical Review* **18**, 3,

pages 473–489: "Many learned people seem to feel that the quality of readableness in a book is one which warrants suspicion. Indeed, not a few learned people seem to feel that the fact that a book is interesting is proof that it is shallow. This is particularly apt to be the attitude of scientific men."

9. (2) Page xxix, line −16: Add a comma between "Goldberg" and "Shiho". (Courtesy of Theodore M. Rolle, February 25, 2002.)

10. Page xxix: Good quote for the acknowledgments section: "The author has tried to indicate every known blemish in [2]; and he hopes that nobody will ever scrutinize any of his own writings as meticulously as he and others have examined the ALGOL report." Donald E. Knuth, "The Remaining Trouble Spots in ALGOL 60," *Communications of the ACM* **10** (1967), page 611. (Courtesy of Otto Stolz, November 7, 2001.)

11. (2) Page xxxii, line 6: Delete the phrase "and a Patent Pending on them."

12. Chapter 1: Frontispiece possibility—the oil painting of Joseph Scaliger in the Senate Hall at Leiden.

13. Page 8, line 2: Add "6-day weeks (Japan),".

14. Page 8, line −11: Change "longest" to "longest at mid-day". (Courtesy of Robert H. Douglass, June 21, 2002.)

15. Page 9, last paragraph: See pages 677–678 of [2] for a discussion of the etymology of the term "leap".

16. Page 11, introductory quotation for section 1.2: This is a loose translation of a famous Talmudic dictum from *Sanhedrin* 97b. The omitted words from Braude's translation (page 112 of his book) are "for the coming of the Messiah". The exact Talmudic wording is "Blasted be the bones of those who calculate the end". Braude is the first author's mother-in-law's uncle—his father, (the first author's wife's great-grandfather) was one of the first Orthodox Rabbis in Chicago around 1900. The book is dedicated to his children.

17. Sections 1.2–1.8: The following could go in section 1.2, if we move the sentence in the middle of page 19 ('We use the term "moment"...') back there also:

$$\textbf{fixed-from-moment}\,(t) \stackrel{\text{def}}{=} \lfloor t \rfloor \tag{17-A}$$

$$\textbf{time-of-day-from-moment}\,(t) \stackrel{\text{def}}{=} t \mod 1 \tag{17-B}$$

Then the following would go in section 1.8:

$$\textbf{clock-from-moment}\,(t) \stackrel{\text{def}}{=} \tag{17-C}$$

$$\mathit{hour} : \mathit{minute} : \mathit{second}$$

where

$$\begin{aligned}
\mathit{tod} &= \textbf{time-of-day-from-moment}\,(t)\\
\mathit{hour} &= \lfloor \mathit{tod} \times 24 \rfloor\\
\mathit{minute} &= \lfloor \mathit{tod} \times 24 \times 60 \mod 60 \rfloor\\
\mathit{second} &= \mathit{tod} \times 24 \times 60 \times 60 \mod 60
\end{aligned}$$

$$\textbf{time-from-clock}\left(\boxed{\begin{array}{c|c|c} \textit{hour} & \textit{minute} & \textit{second} \end{array}}\right) \stackrel{\text{def}}{=} \tag{17-D}$$

$$\textit{hour} + \tfrac{1}{60} \times \left(\textit{minute} + \frac{\textit{second}}{60}\right)^{\text{h}}$$

The function **clock-from-moment** would replace the current **time-from-moment** on page 24. In Lisp (for page 320) these functions are

```
(defun fixed-from-moment (tee)
   ;; TYPE moment -> fixed-date
   ;; Fixed-date from moment tee.
   (floor tee))

(defun time-of-day-from-moment (tee)
   ;; TYPE moment -> time-of-day
   ;; Time from moment tee.
   (mod tee 1))
```

```
(defun fixed-from-moment (tee)
   ;; TYPE moment -> fixed-date
   ;; Fixed-date from moment tee.
   (floor tee))

(defun time-of-day-from-moment (tee)
   ;; TYPE moment -> time-of-day
   ;; Time from moment tee.
   (mod tee 1))
```

18. Page 12, line −11: Change "Trê" to "Trē". (Courtesy of Svante Janson, January 31, 2003.)

19. (2) Page 12, line −14: The Julian day number is wrong; it should be 2,431,772. (Courtesy of Robert H. Douglass, April 23, 2002.)

20. (2) Page 13, line 1: Change "Pept" to "Pepet".

21. Page 13, lines 12–13: Delete "of the seventy-seventh sexagesimal cycle". (Courtesy of Helmer Aslaksen, November 13, 2001.)

22. Page 13, line 14: Change "Tula" to "Kārtika" (see erratum 198).

23. Page 14: The Ecclesiatical Day starts at the previous sunset, not at sunrise as indicated; the ancient Egyptian day began at dawn (sunrise?). The corrected figure is given as Figure 23-A. (Courtesy of Robert H. Douglass, June 12, 2002.)

24. Page 16, line 16: Change "For calendars like the Balinese Pawukon, in which cycles are unnumbered," to "For calendars like the Chinese or Balinese Pawukon, in which cycles are unnumbered,". (Courtesy of Helmer Aslaksen, November 13, 2001.)

25. Page 17, Table 1.2: Delete the entry for the Zoroastrian calendar. (Courtesy of Robert H. Douglass, June 19, 2002.)

26. Page 20, line −6: Change "for $y > 0$." to "for $y > 0$ and $x \not\equiv 0 \pmod{y}$." (Courtesy of Svante Janson, January 31, 2003.)

27. Page 21, (1.14) and (1.15): This fifth consequence of (1.11) is a generalization of the first (on page 20). (Courtesy of Arthur J. Roth, April 19, 2002.)

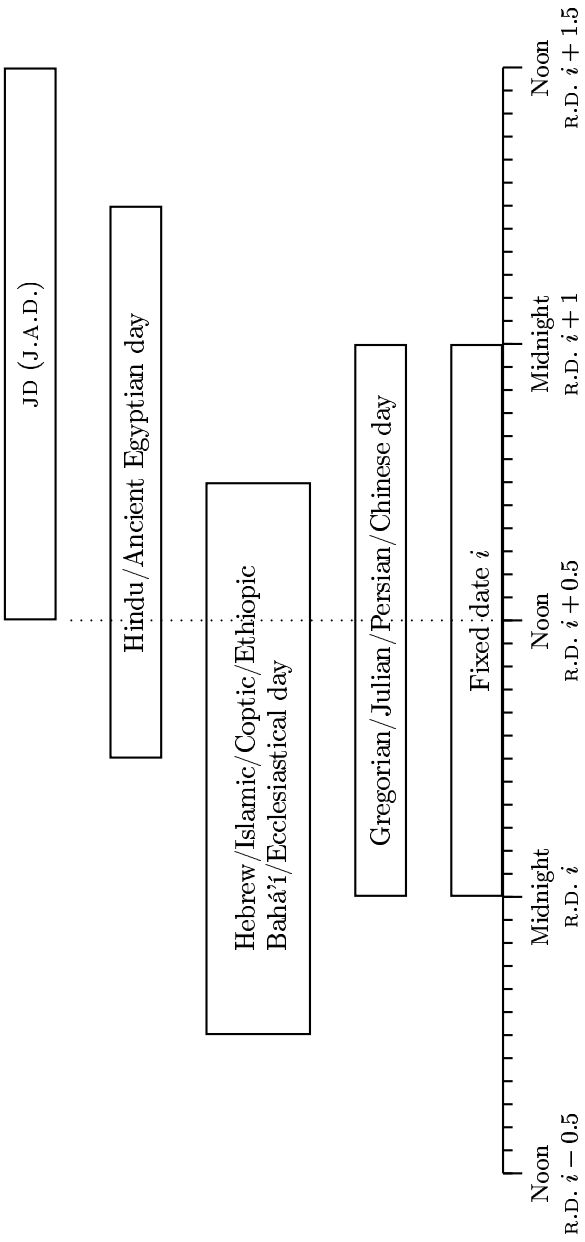

Figure 23-A: Replacement for page 14 (see erratum 23).

28. Pages 21–22, equations (1.19) and (1.20): We should give definitions of $\sum$, MIN and MAX (using tail recursion), the same way we do for the binary search operator MIN in equation (1.22). (Courtesy of Oscar van Vlijmen, May 8, 2002.)

29. Page 23, top two paragraphs ("We represent... unchanged."): We should have been careful to distinguish fixed-length records (and field selection by field name which we never define!) used for dates and times from lists of varying length. Both are represented in the Lisp code by lists, but in the text we use box notation for records and angle brackets for lists. (Courtesy of Otto Stolz, November 7, 2001.)

30. Section 1.9: The development of the ancient Egyptian calendar is discussed in *The Calendars of Ancient Egypt*, Richard A. Parker, University of Chicago Press, Chicago, 1950.

31. Page 24, line −7: Change "noon" to "dawn". (Courtesy of Robert H. Douglass, June 18, 2002.)

32. Page 24: The months of the Egyptian calendar were:

(1) Thoth	30 days	(7) Phamenoth	30 days
(2) Phaophi	30 days	(8) Pharmuthi	30 days
(3) Athyr	30 days	(9) Pachon	30 days
(4) Choiak	30 days	(10) Payni	30 days
(5) Tybi	30 days	(11) Epiphi	30 days
(6) Mechir	30 days	(12) Mesori	30 days
		(13) (Unnamed)	5 days

    Variants of these month names are still used in the Coptic calendar (see erratum 75).

33. Page 26, line 9: Change "had" to "have". (Courtesy of Svante Janson, January 31, 2003.)

34. Page 29, lines 9–13: This paragraph and equation (1.45) are wrong. Change the text "Note that if... in the Chinese calendar (Chapter 16)." to read "Note that formula (1.42) for the last k-label day on or before day number d remains correct even if the cycle of labels is $1, 2, \ldots, m$ (that is, based at 1 instead of 0). We use this in the Chinese calendar (Chapter 16)." (Courtesy of Arthur J. Roth, December 23, 2001.)

35. Page 31, line 14: Change that line from "$(ck) \bmod d = g$" to "$k\frac{c}{g} \bmod \frac{d}{g} = 1$". (Courtesy of Arthur J. Roth, December 23, 2001.)

36. Page 33, lines 3–4: Change "the time of day (as a fraction of a day)" to "the time of day or month (as a fraction of the day or month)". (Courtesy of Arthur J. Roth, December 23, 2001.)

37. (2) Page 33, line −6: Change the section from "2.2" to "2.1". (Courtesy of Arthur J. Roth, April 19, 2002.)

38. Page 33, line −1: Change the phrase "Islamic months" to "Islamic months (leap year)". Add a line just before the last line of the table for "Islamic months (ordinary year)" with $c = 12$, $l = 6$, $\Delta = 1$, $L = 29$, $\bar{L} = 59/2$, $\delta = 1/2$. (See Erratum 87.)

39. Page 35, lines 1–3: Change "These three short gaps and... $\Delta = 8$)." to "If we associate each leap year with the gap preceding it and number the gaps 0, 1, ... 10, these three short gaps are numbers 2, 6, and 9, to which formula (1.57) could also be applied (with $c = 11$, $l = 3$, and $\Delta = 2$)." (Courtesy of Arthur J. Roth, December 23, 2001.)

40. (2) Page 36, line 8: Change "(1.59)" to "(1.58)". (Courtesy of Arthur J. Roth, December 23, 2001.)

41. (2) Page 39, line 12: Subtract one from the righthand side; that is, change the equation to read

$$y = \left\lceil \frac{m + 1 - \frac{2{,}093{,}611}{2{,}160{,}000}}{\frac{2{,}226{,}389}{180{,}000}} \right\rceil - 1.$$

    (Courtesy of Arthur J. Roth, April 17, 2002.)

42. Pages 46–49: Pope Gregory XIII was not only responsible for the institution of the revised calendar, but he was also responsible for a bull *Vices eius nos* (September 1, 1577) organizing regular missionizing sermons by apostate Jews that the Jewish community of Rome was forced to attend and subsidize. His bull *Sancta mater ecclesia* (September 1, 1584) specified more precise conditions: beadles armed with rods made sure the Jews paid attention and checked that they had not put wax in their ears. These sermons took place throughout the Papal States and much of the Roman Catholic world, as well in the church nearest the Jewish quarter in Rome, San Gregorio della Divina Pietà (the front of which has an inscription in Hebrew and Latin, beside an image of the crucified Jesus, quoting from *Isaiah* 65:2–3, "I have spread out My hands all the day unto a rebellious people, that walk in a way that is not good, after their own thoughts; a people that provoke me to my face continually."

43. Page 48, line 8: The values $c = 12$ and $L = 30$ are obvious: There are 12 months and the ordinary length is 30 days. The value $l = 7$ comes from the 7 long months of 31 days; the value $\Delta = 11$ forces January to be month number 1 (rather than 0), necessary for the applicability of formulas (1.60) and (1.64). (Courtesy of Arthur J. Roth, February 5, 2002.)

44. Page 48, equation (2.2): Change the period after the equation to a comma and add the phrase "where, as in the derivation of (1.64), the first day of the year is $n = 0$; that is, n is the number of prior days in the year rather than the day number in the usual sense." (Courtesy of Arthur J. Roth, December 31, 2001.)

45. Page 48, line 1 of the footnote: Change "Varro gives the year of the founding of Rome as 753 B.C.E." to "Varro's statements imply the year of the founding of Rome to be 753 B.C.E." (Courtesy of Svante Janson, February 17, 2003.)

46. Page 48, line −4 (of the footnote): Bede's work *De Temporum Ratione* has been translated by Faith Wallis, *Bede: The Reckoning of Time*, Liverpool University Press, Liverpool, 1999 (also University of Pennsylvania Press, Philadelphia, 2000). (Courtesy of Svante Janson, January 31, 2003.)

47. Page 49, lines 10: Change "according to the calendar still in use" to "according to the calendar then in use". (Courtesy of Robert H. Douglass, May 10, 2002.)

48. Page 49, lines 18–19: There is a 1712 Swedish almanac showing February having 30 days: It is *Allmanach, på åhret effter Christi födelse 1712* (system number 0672155 in the National Library of Sweden).

49. Page 50, line 6: Change "in England" to "in England under the Julian calendar". (Courtesy of Svante Janson, February 17, 2003.)

50. Page 50, first paragraph: Here is an oddity relating to the when the year starts. At the Salisbury cathedral in England, one of the hundreds of tombstones making up the floor of the cathedral is a 16 inch by 37 inch stone with an inscription reading

H S E
THE BODY OF THO
THE SONN OF THO
LAMBERT GENT.
WHO WAS BORNE
MAY Y 13 AN DO
1683 & DYED FEB
19 the same year

A modern English translation reads: "Here lies the body of Thomas Lambert the son of Thomas Lambert, Gentleman. Who was born May the 13th Anno Domini 1683 and died February 19th the same year." From the middle of the 11th century the English calendar began on March 25 each year. This continued until 1752 when the English Parliament passed an act adopting the Gregorian Calendar with January 1 as the start of the year. See *Copies of the Epitaphs in Salisbury Cathedral, Cloisters and Cemetry*, James Harris, Brodie and Dowding, Salisbury, 1825. (Courtesy of Svante Janson, February 17, 2003.)

51. Page 51, lines −7 to −1: Change "We add together...since the epoch is determined by" to "We start at the R.D. number of the last day before the epoch (**gregorian-epoch** − 1 = 0, but we do it explicitly so that the dependence on our arbitrary starting date is clear); to this, we add the number of nonleap days (positive for positive years, negative otherwise) between R.D. 0 and the last day of the year preceding the given year, the corresponding (positive or negative) number of leap days, the number of days in prior months of the given year, and the number of days in the given month up to and including the given day. The number of leap days between R.D. 0 and the last day of the year preceding the given year is determined by" (Courtesy of Arthur J. Roth, December 31, 2001.)

52. Page 53, line 13: Change "is also correct" to "is correct even". (Courtesy of Arthur J. Roth, December 31, 2001.)

53. Page 55, line 2: Change "has 30 days," to "has 30 days and we count months starting from December,". (Courtesy of Arthur J. Roth, February 5, 2002.)

54. Page 55, line 11: Change "work" to "works". (Courtesy of Arthur J. Roth, December 31, 2001.)

55. Pages 55, lines 8–9: The parenthetical remark that "these lower and upper bounds come from considering each of the twelve month numbers" is too obscure—the detailed analysis is as follows. The sum on the left side of equation (2.1) on page 48 has a corrective term, the floor of

$$C(m) = \frac{7m - 2}{12}$$

which is

m	1	2	3	4	5	6	7	8	9	10	11	12
$\lfloor C(m) \rfloor$	0	1	1	2	2	3	3	4	5	5	6	6

which we show as a set of points $(m, \lfloor C(m) \rfloor)$ in Figure 55-A. Each of these points can be moved upward by any amount less than 1 without changing the value of $\lfloor C(m) \rfloor$); each of these ranges is represented as a half open line segment in Figure 55-A. The problem is to determine lines $L(m) = am + b$ so that $\lfloor L(m) \rfloor = \lfloor C(m) \rfloor$ for the twelve integer values, $1 \le m \le 12$. In other words, we want to determine lines that transect each of the twelve half open line segments in Figure 55-A. The line we know about, $C(m) = (7m - 2)/12$, is shown in Figure 55-A also.

To cut both the half open line segments $[(7, 3), (7, 4))$ and $[(9, 5), (9, 6))$, a line $L(m) = am + b$ must have slope $a > 1/2$; to cut both the half open line segments $[(2, 1), (2, 2))$ and $[(7, 3), (7, 4))$, a line $L(m) = am + b$ must have slope $a < 3/5$. To see that any slope $1/2 < a < 3/5$ is possible, we give an explicit line for each slope in that range: $a = 1/2 + \epsilon$, $b = 1/2 - 8\epsilon$ works for $0 < \epsilon \le 1/12$, and $a = 3/5 - \epsilon$, $b = -1/5 + 2\epsilon$ works for $0 < \epsilon \le 1/35$. Because $1/2 + 1/12 > 3/5 - 1/35$, there exists a b for each value of a, $1/2 < a < 3/5$. (Courtesy of Michael H. Deckers, January 16, 2002.)

56. Pages 55, line −10: Delete "[16] or" since Ore's book does not seem to mention Zeller's congruence.

57. Page 55, line −8: Give and explain the Zeller congruence.

58. Chapter 2 or 3: Good quote attributed to Voltaire (= François Marie Arouet): "The English mob preferred their calendar to disagree with the Sun than to agree with the Pope and they refused to accept a reform for which one should have been grateful to the Grand Turk if he had proposed it" (see page 71 of George Sarton's *Six Wings*: *Men of Science in the Renaissance*, Indiana University Press, 1957). Pierre Gordon's *Les fêtes à travers les âges* (Editions Arma Artis, 1983) gives the quote "n'être pas d'accord avec le soleil plutôt que de l'être avec Rome." Nothing like this appears in the writings of Voltaire available on line.

59. Page 56: We could (should?) simplify **alt-fixed-from-gregorian** to:

alt-fixed-from-gregorian (2.25)

$$\left(\boxed{\textit{year}} \; \boxed{\textit{month}} \; \boxed{\textit{day}} \right) \stackrel{\text{def}}{=}$$

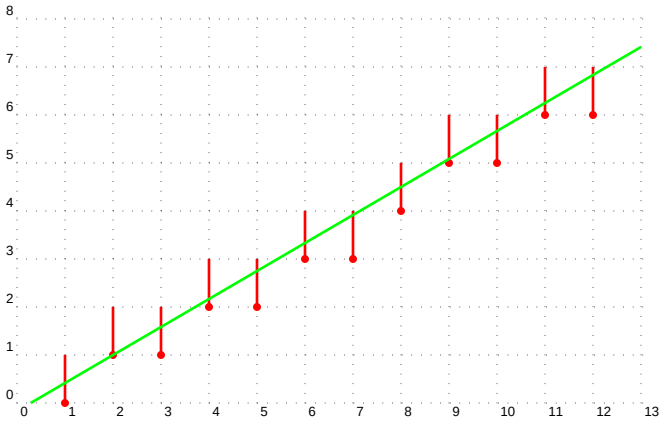

Figure 55-A: The twelve half open line segments giving the ranges that the corrective line must transect, along with the correction of equation (2.1) on page 48, $C(m) = (7m - 2)/12$; see erratum 55.

$$\textbf{gregorian-epoch} - 307 + 365 \times y + \left\lfloor \frac{y}{4} \right\rfloor - \left\lfloor \frac{y}{100} \right\rfloor + \left\lfloor \frac{y}{400} \right\rfloor + \left\lfloor \frac{2 + 3 \times m}{5} \right\rfloor + 30 \times m + day$$

where

$$m = (month - 3) \mod 12$$

$$y = year - \left\lfloor \frac{m}{10} \right\rfloor$$

Or, in Lisp (page 327):

```
(defun alt-fixed-from-gregorian (g-date)
  ;; TYPE gregorian-date -> fixed-date
  ;; Alternative calculation of fixed date equivalent to the
  ;; Gregorian date.
  (let* ((month (standard-month g-date))
         (day (standard-day g-date))
         (year (standard-year g-date))
         (m (mod (- month 3) 12))
         (y (- year (quotient m 10))))
    (+ gregorian-epoch
       -307          ; Days in March...December.
       (* 365 y)     ; Ordinary days since epoch.
       (quotient y 4); Julian leap days since epoch...
       (-            ; ...minus century years since epoch...
        (quotient y 100))
       (quotient     ; ...plus years since epoch divisible...
        y 400)       ; ...by 400.
       (quotient     ; Days in prior months this year.
        (+ 2 (* 3 m)) 5)
       (* 30 m)
       day)))        ; Days so far this month.
```

60. Page 56, line −2: Change "3" to "**march**"; in the Lisp code, this is on page 328, line 11 of `alt-gregorian-from-fixed`. (Courtesy of Arthur J. Roth, December 31, 2001.)

61. Page 57, lines 15 and −3: The "2" is needed because the number of days in years 1 through n of the 400-year cycle can fall short of $365.2425 \times n$ by as much as 1.4775 days (for $n = 303$). Thus 2 is the smallest integer we can add that guarantees that for the first day of any year n, $approx \geq n - 1$. (Courtesy of Arthur J. Roth, December 31, 2001.)

62. Page 58, last line: Change "of the k-day" to "of the last k-day". (Courtesy of Arthur J. Roth, December 31, 2001.)

63. Page 59, line 7: Add "or" at the beginning of the line. (Courtesy of Arthur J. Roth, December 31, 2001.)

64. Page 59: Consider having **daylight-saving-start** return a moment rather than a fixed date, since D.S.T. typically starts at 2 a.m. Also, consider renaming **daylight-saving-end** to **standard-time-start** because it will return the moment immediately after D.S.T. ends (as given, **daylight-saving-end** returns a fixed date which, being an integer, corresponds to midnight, at which time D.S.T. would still be in effect in most locales). Also, perhaps we should mention the E.U. D.S.T. rules. (Courtesy of Irv Bromberg, October 1, 2002.)

65. Pages 60, 72, and 124: Reference [1] should be

    > "The Calendar," *The Nautical Almanac and Astronomical Ephemeris*, His Majesty's Stationery Office, London, 1931–1934; revised 1935–1938; abridged 1939–1941. (Written by J. K. Fotheringham.)

    Fotheringham wrote the article, but is credited with authorship only in the preface (in the 1933 edition at least); hence our mysterious index entries to him when his name does not appear on those pages.

66. Pages 61: Delete Ore's book [16] as a reference (see erratum 56).

67. (2) Page 64, last line: There is a missing y before the equal sign. This error was introduced somehow by the compositor. (Courtesy of Otto Stolz, November 7, 2001.)

68. Page 65, lines 1 to 5: Change "We add together...including the given date." to "We start at **julian-epoch** − 1, the R.D. number of the last day before the epoch; to this, we add the number of nonleap days (positive for positive years, negative otherwise) between the last day before the epoch and the last day of the year preceding the given year, the corresponding (positive or negative) number of leap days, the number of days in prior months of the given year, and the number of days in the given month up to and including the given day." (Courtesy of Arthur J. Roth, December 31, 2001.)

69. (2) Page 67, line 5: Change "July 4" to "July 6". (Courtesy of Arthur J. Roth, December 31, 2001.)

70. Page 67, second paragraph: See pages 92–94 and 678–680 of [2] for a discussion of the placement of the leap day on the Julian calendar. We should mention that despite the official Roman calendar, unofficial and medieval usage made the day after February 23 the leap day; the resulting changes to **fixed-from-roman** and **roman-from-fixed** are simple.

71. Page 68, equation (3.11): This is the first example of how the translation of the Lisp `cond` was handled differently from that of Lisp's nested `if` construction. For example, the function

```
(defun u (a)
  (if (< a 0)
      (value1)
    (if (< a 1)
        (value2)
      (value3))))
```

is translated as

$$\mathbf{u}\,(a) \stackrel{\text{def}}{=} \begin{cases} \textbf{value}_1 & \textbf{if } a < 0 \\ \textbf{value}_2 & \textbf{if } a \geq 0 \text{ and } a < 1 \\ \textbf{value}_3 & \textbf{otherwise} \end{cases} \tag{71-A}$$

but

```
(defun v (a)
  (cond ((< a 0) (value1))
        ((< a 1) (value2))
        (t (value3))))
```

is translated as

$$\mathbf{v}\,(a) \stackrel{\text{def}}{=} \begin{cases} \textbf{value}_1 & \textbf{if } a < 0 \\ \textbf{value}_2 & \textbf{if } a < 1 \\ \textbf{value}_3 & \textbf{otherwise} \end{cases} \tag{71-B}$$

The intention in both cases is clear and in Lisp the nested `if` and the `cond` are algorithmically identical (each condition is checked only if all the previous conditions have failed). However, the translation of the nested `if` explicitly displays the failure of all the previous conditions, while the translation of `cond` does not. The translation of the `if` form is more mathematically precise, but the translation of the `cond` form is more concise. (Courtesy of Arthur J. Roth, December 31, 2001.)

72. Page 70, line −8: Change "Because the Julian year is always at least as long... at all." to read "With the current alignment of the Julian and Gregorian calendars, and because the Julian year is always at least as long as the corresponding Gregorian year, Eastern Orthodox Christmas occurs at most once in a given Gregorian year—in modern times it occurs near the beginning. However, far in the past or the future, there are Gregorian years in which it does not occur at all (1100, for example); as the two calendars get further out of alignment (it will take some 50,000 years for them to be a full year out of alignment), Eastern Orthodox Christmas will migrate throughout the Gregorian year." The next sentence, "We write..." should begin a new paragraph. (Courtesy of Arthur J. Roth, February 5, 2002.)

73. Page 71, line −10: Add the following sentence at the end of the line "Recall that...": "Tens of thousands of years from the present, the alignment of the Gregorian and Julian calendars is such that some Julian dates occur twice in a Gregorian year—the first example of this is Julian date February 28 occurring twice in Gregorian year 41104; the function **julian-in-gregorian** correctly returns a list of two R.D. dates in such cases." (Courtesy of Arthur J. Roth, February 5, 2002.)

74. Page 71, line −9: Delete the words "zero or one". (Courtesy of Arthur J. Roth, February 5, 2002.)

75. (2) Page 75, line −14: Change "The months are called by Arabic names in Coptic (Sahidic):" to "The months are called by coptized forms of their ancient Egyptian names; in Coptic (Sahidic) they are:". (See erratum 32.)

76. Page 76, lines −8 to −6: Change "Add together...in *month*:" to "Start at **coptic-epoch** − 1, the R.D. number of the last day before the epoch; to this add the number of nonleap days (positive for positive years, negative otherwise) between this date and the last day of the year preceding *year*, the corresponding (positive or negative) number of leap days, the number of days in prior months in *year*, and the number of days in *month* up to and including *day*:" (Courtesy of Arthur J. Roth, February 5, 2002.)

77. Page 78, lines −3 and −2: Delete "which spans two Gregorian years,". (Courtesy of Arthur J. Roth, February 5, 2002.)

78. (2) Page 79, line −15: Change "Kiyahk" to "Koiak". (Courtesy of Arthur J. Roth, February 5, 2002.)

79. (2) Page 79, lines −8 and −7: Change "Mary's Announcement (Parmoute 29)" to "Mary's Announcement (Paremotep 29)". (Courtesy of Robert H. Douglass, May 10, 2002.)

80. Pages 83, lines −7 and −8: Robert H. van Gent has observed that the "short" (52-week) ISO years occur $329/400 = 82.25\%$ of the time and "long" (53-week) ISO years occur $71/400 = 17.75\%$ of the time: The Gregorian cycle of 400 hundred years contains $146097 = 7 \times 20871$ days which is exactly 20871 weeks. Thus the ISO cycle of short/long years repeats after 400 years. Let s be number of short years and l be the number of long years in the cycle; we have

$$\begin{aligned} s + l &= 400 \\ 52s + 53l &= 20871 \end{aligned}$$

whose solution is $s = 329$, $l = 71$. Simon Cassidy has observed that an ISO year y is short if and only if $F(y-1) \not\equiv 3$ and $F(y) \not\equiv 4$ modulo 7, where

$$F(y) = y + \left\lfloor \frac{y}{4} \right\rfloor - \left\lfloor \frac{y}{100} \right\rfloor + \left\lfloor \frac{y}{400} \right\rfloor$$

Note that the $F(y)$ is concealed in the simplified **alt-fixed-from-gregorian** of erratum 59 because $365 \equiv 1 \pmod 7$; it gives the day of the week of December 31 in Gregorian year y. Thus Cassidy's rule says that the ISO year is short if and only if neither January 1 nor December 31 is a Thursday.

81. Chapter 5: The ISO calendar is reminiscent of a tenth century Icelandic calendar in which ordinary years had 52 weeks and every seventh year was a leap year with 53 weeks [Ari The Learned, *Libellum Islandorum* (*The Book of Icelanders*), c. 1130, in J. Benediktsson, ed., 1968, *Íslenzk fornrit I*: *Ískebdubgabók, Landnámabók fyrri hluti* (*The Book of Icelanders and the Book of Settlements*), Reykjavík: Hiðíslenzka fornritafélag]. See Porsteinn Vilhjálmsson, "Time-reckoning in Iceland before literacy," pp. 69–76 in *Archaeoastronomy in the 1990s*, Clive L. N. Ruggles, ed., Loughborough, UK Group D Publications, 1991.

82. Page 84: An alternative for **iso-from-fixed** is:

$$\textbf{iso-from-fixed}\,(date) \stackrel{\text{def}}{=} \boxed{year \mid week \mid day} \tag{5.3}$$

where

$$\begin{aligned} approx &= \textbf{gregorian-year-from-fixed}\,(date - 3) \\ year &= \begin{cases} approx + 1 & \textbf{if } date \geq \textbf{fixed-from-iso}\left(\boxed{approx + 1 \mid 1 \mid 1}\right) \\ approx & \textbf{otherwise} \end{cases} \\ week &= \left\lfloor \frac{date - \textbf{fixed-from-iso}\left(\boxed{year \mid 1 \mid 1}\right)}{7} \right\rfloor + 1 \\ day &= date \mod 7 \end{aligned}$$

or in Lisp (page 335):

```
(defun iso-from-fixed (date)
  ;; TYPE fixed-date -> iso-date
  ;; ISO (year week day) corresponding to the fixed date.
  (let* ((approx ; Year may be one too small.
          (gregorian-year-from-fixed (- date 3)))
         (year (if (>= date
                       (fixed-from-iso
                        (iso-date (1+ approx) 1 1)))
                   (1+ approx)
                 approx))
         (week (1+ (quotient
                    (- date
                       (fixed-from-iso (iso-date year 1 1)))
                    7)))
         (day (adjusted-mod date 7)))
    (iso-date year week day)))
```

83. Page 84, line −9: Change "the start of the approximate ISO year." to "the start of the year after the approximate ISO year." (Courtesy of Arthur J. Roth, February 5, 2002.)

84. Pages 84, reference: There was a minor revision of the ISO standard in December 2000 issued as ISO 8601:2000(E).

85. Page 87, line −8: There is a spurious *ya* in the Arabic for Monday; it should be يَوْم الاثنين. (Courtesy of Daher Kaiss, November 29, 2001.)

86. Page 89, line 8: Add at the end of the paragraph that the Bohras (an Ismailite Moslem sect of about 1 million in India) follow a book called *Sahifa* giving leap years 2, 5, 8, 10, 13, 16, 19, 21, 24, 27, and 29; this corresponds to $\Delta = 1$. Their epoch is Thursday, July 15, 622 C.E. (Julian). (Courtesy of Svante Janson, February 16, 2003.)

87. Page 89, line 9 to the beginning of (6.4): Replace the (6.3) and the text before and after it by the following version:

"To convert an Islamic date to its R.D. equivalent, start at **islamic-epoch** − 1, the R.D. number of the last day before the epoch; to this add the number of days between that date and the last day of the year preceding the given year [using formula (1.60)], the number of days in prior months in the given year, and the number of days in the given month, up to and including the given day. The number of days in months prior to the given month is also computed by (1.60) because the pattern of Islamic month lengths in an ordinary year satisfies the cycle formulas of Section 1.12 with $c = 12$, $l = 6$, $\Delta = 1$ (to count months from 1 instead of 0), and $L = 29$; because the leap day is day 30 of month 12, this works for leap years also:

$$\textbf{fixed-from-islamic}\left(\boxed{\textit{year}}\boxed{\textit{month}}\boxed{\textit{day}}\right) \stackrel{\text{def}}{=} \tag{6.3}$$

$$\textbf{islamic-epoch} - 1 + (\textit{year} - 1) \times 354 + \left\lfloor \frac{3 + 11 \times \textit{year}}{30} \right\rfloor +$$
$$29 \times (\textit{month} - 1) + \left\lfloor \frac{\textit{month}}{2} \right\rfloor + \textit{day}$$

Computing the Islamic date equivalent to a given R.D. date is slightly more complicated (though it is more straightforward than the computations for the Gregorian calendar or the Julian). We can calculate the exact value of the year using formula (1.64). We want to determine the month number in the same way, and then determine the day of the month by subtraction. Determining the month cannot be done

directly from (1.64) using the values $c = 12$, $l = 6$, $\Delta = 1$, and $L = 29$, which describe the common year month lengths, not the leap year. Indeed, no set of values with $c = 12$ can work properly in the cycle length formulas for the leap year because there are three 30s in a row (months 11, 12, and 1). However, the values $c = 11$, $l = 6$, $\Delta = 10$, $L = 29$ do work—not completely, but over the range $0 \le n \le 354$ in (1.64), which is all we care about; thus (6.3) remains correct if $\lfloor month/2 \rfloor$ is replaced with $\lfloor (6 \times month - 1)/11 \rfloor$. Hence the month can be determined using (1.64) and we obtain:"

The Lisp code for **fixed-from-islamic** (page 336) should be replaced by

```
(defun fixed-from-islamic (i-date)
  ;; TYPE islamic-date -> fixed-date
  ;; Fixed date equivalent to Islamic date.
  (let* ((month (standard-month i-date))
         (day (standard-day i-date))
         (year (standard-year i-date)))
    (+ (1- islamic-epoch)    ; Days before start of calendar
       (* (1- year) 354)     ; Ordinary days since epoch.
       (quotient             ; Leap days since epoch.
        (+ 3 (* 11 year)) 30)
       (* 29 (1- month))     ; Days in prior months this year
       (quotient month 2)
       day)))                ; Days so far this month.
```

(Courtesy of Arthur J. Roth, February 5, 2002.)

88. Page 95, line −7: Change "the days Sunday–Friday" to "the days, for the most part,". (Courtesy of Arthur J. Roth, April 17, 2002.)

89. Page 95, footnote: According to Chapter 4 of *Calendar and Community: A History of the Jewish Calendar, 2nd Century BCE to 10th Century CE*, Sacha Stern, Oxford University Press, Oxford, 2001, the Hebrew calendar calculations were not standardized or fixed until at least the ninth century.

90. (2) Page 98, line 1: Change "sunset" to "sunset (6 p.m.)". (Courtesy of Arthur J. Roth, April 17, 2002.)

91. Page 99, line 8: Delete "for a common year". (Courtesy of Arthur J. Roth, April 17, 2002.)

92. Page 99, line −16: Add the sentence "The current year cannot become too short because of this delay; it is shortened from 355 days to 354, with the following Rosh ha-Shanah being delayed until Saturday." (Courtesy of Arthur J. Roth, April 17, 2002.)

93. Page 99, last paragraph: The best source in English for details of the controversy is pages 264–275 of Stern's book (see erratum 89).

94. (2) Page 100, lines −7 to −4: Change the displayed equations to read:

$$\begin{aligned} \text{lcm}(69715, 181440)/69715 &= \text{2,529,817,920 / 69,715 parts} \\ &= \text{36,288 cycles} \\ &= \text{689,472 years} \end{aligned}$$

Change the sentence fragment on the lines following the displayed equations to read "for the excess parts to accumulate into an even number of weeks, and for the calendar to return to the same pattern of delays." (Courtesy of Arthur J. Roth, April 17, 2002.)

**95. (2) Page 101: Molad determination is wrong (the CD is correct). It should be:

$$\textbf{molad}\,(h\text{-}month, h\text{-}year) \stackrel{\text{def}}{=} \tag{7.7}$$

$$\begin{aligned}&\textbf{hebrew-epoch} - \tfrac{876}{25920} + \\ &\mathit{months\text{-}elapsed} \times \left(29 + 12^{\mathrm{h}} + \tfrac{793}{25920}\right)\end{aligned}$$

where

$$y = \begin{cases} \mathit{h\text{-}year} + 1 & \textbf{if } \mathit{h\text{-}month} < \textbf{tishri} \\ \mathit{h\text{-}year} & \textbf{otherwise} \end{cases}$$

$$\mathit{months\text{-}elapsed} = \mathit{h\text{-}month} - \textbf{tishri} + \left\lfloor \frac{235 \times y - 234}{19} \right\rfloor$$

Or, in Lisp (page 338):

```
(defun molad (h-month h-year)
  ;; TYPE (hebrew-month hebrew-year) -> moment
  ;; Moment of mean conjunction of h-month in Hebrew
  ;; h-year.
  (let* ((y ;; Treat Nisan as start of year.
          (if (< h-month tishri)
              (1+ h-year)
            h-year))
         (months-elapsed
          (+ (- h-month tishri)  ;; Months this year.
             (quotient ;; Months until New Year.
               (- (* 235 y) 234)
               19))))
    (+ hebrew-epoch
       -876/25920
       (* months-elapsed (+ 29 (hr 12) 793/25920)))))
```

96. Page 102, **hebrew-calendar-elapsed-days**: Change the variable *day* to *days*. (Courtesy of Arthur J. Roth, April 17, 2002.)

97. Page 105, last line of equation (7.16): the "+1" is in the wrong place, separating the function name, **fixed-from-hebrew**, from its argument, | *year* | *month* | 1 |. This error is caused by our automatic translation. (Courtesy of Irv Bromberg, September 23, 2002.)

98. Page 105, line −14: Change "begins after *date*" to "ends on or after *date*". (Courtesy of Arthur J. Roth, April 17, 2002.)

99. (2) Page 106, line 2: Change "(7.2)" to "(7.8)". This error is caused by our automatic translation; that translation needs to put the label definition in the TEX file for each function instead of it being placed manually after the command that inputs that file. (Courtesy of Arthur J. Roth, April 17, 2002.)

100. (2) Page 106, line 20: Change "Elul 30" to "Elul 29". (Courtesy of Arthur J. Roth, April 17, 2002.)

101. Page 107, equation (7.17): the "+1" is in the wrong place, separating the function name, **gregorian-year-from-fixed**, from its argument, **hebrew-epoch**. This error is caused by our automatic translation. (Courtesy of Irv Bromberg, September 22, 2002.)

102. (2) Page 107, line −9: Delete the spurious characters "The mi" after the word "these". (Courtesy of Michael R. Stein, August 7, 2001.)

103. Page 110, lines 5–6 and footnote: In Israel in 2001, Yom ha-Shoah was pushed forward from Friday to Thursday, but it was on Friday outside of Israel. It remains to be seen what will happen in future years.

104. (2) Page 110, line −5: Change "Hātūr" to "Athôr".

105. Page 110, last paragraph: We should mention that in Israel, *sh'ela* begins on Marḥeshvan 7.

106. (2) Page 111, line 5: Change "at 6 p.m. Wednesday evening, Baramhāt 30, 1641," to "at 6 p.m. on the eve of Wednesday, Paremotep 30, 1641,". (Courtesy of Robert H. Douglass, May 7, 2002.)

107. Page 111, **birkath-ha-hama**, equation (7.25): This function would be more consistent with other code (say, **omer**) if it returned either the date, when applicable, or **bogus** when not. Returning a list is peculiar since the event either occurs in a given year or does not. (Courtesy of Arthur J. Roth, April 17, 2002.)

108. Page 111, line −3: At the beginning of this line, add the sentence, "The birthday in an ordinary year of someone born during the first 29 days of Adar I in a leap year is on the corresponding day of Adar." (Courtesy of Arthur J. Roth, April 17, 2002.)

109. Page 113, line 13: Change "normal anniversary" to "normal (that is, birthday) anniversary". (Courtesy of Arthur J. Roth, April 17, 2002.)

110. Page 115, reference [18]: The more complete reference is A. Spier, *The Comprehensive Hebrew Calendar: Its Structure, History, and One Hundred Years of Corresponding Dates: 5660–5760, 1900–2000*, Behrman House, New York, 1952. Revised 2nd edition published with the new subtitle *Up to the Twenty-Second Century 5703–5860, 1943–2100*, Feldheim Publishers, New York, 1981. Revised 3rd edition published with the new subtitle *Twentieth to Twenty-Second Centuries, 5660–5860, 1900–2100*, Feldheim Publishers, New York, 1986.

111. Chapter 8: Good discussions of the history of the setting of the date of Easter are given in *The Sun in the Church: Cathedrals as Solar Observatories*, J. L. Heilbron, Harvard University Press, Cambridge, MA, 1999 and in *Anno Domini*: *The Origins of the Christian Era*, Georges Declercq, Brepols Publishers, Turnhout, Belgium, 2000.

112. Page 117, footnote: Change "Gauss's original paper contained an error" to "Gauss's original paper contained an error (which he later corrected)". (Courtesy of John Cross, February 6, 2002.)

113. Page 119, lines 2–3: The limiting dates for Orthodox Easter, March 22 and April 25, are Julian, not Gregorian. This is implicit in the use of **fixed-from-julian** in (8.1) at the bottom of the previous page, but we should have indicated it explicitly in the text. (Courtesy of Donald W. Fausett, March 21, 2002.)

114. Page 119, lines 3–4: Change "never coincided... C.E." to "have not coincided since 783 C.E." (Courtesy of Robert H. Douglass, June 14, 2002.)

115. (2) Page 119, line 5: Change "and 4 days." to "and 5 days." (Courtesy of Winfried Görke, January 28, 2002.)

116. Page 120, line −1: Change "in the second half" to "in the second half (after year 10)". (Courtesy of Arthur J. Roth, April 17, 2002.)

117. Page 120, lines −14 to −17: O'Beirne [11, page 174] says that the originators of the Gregorian calendar "had chosen [their Easter calculation] to be wrong with the moon rather than be right with the Jews." (Courtesy of John Cross, February 6, 2002.)

118. Page 122, lines 4–5. The source of the Kepler quote "Easter is a feast, not a planet" (in German, "Ostern ist ein Fest vnd khein Stern") is an unpublished paper *Ein Gespräch von der Reformation des alten Kalenders worauff die Correctio Gregoriana gegründet*, written in German by Kepler in 1613; a Latin translation of this paper was published by M. G. Hansch as *Liber singularis de Calendario Gregoriano sive de reformatione Calendarii Juliani necessaria et de fundamentis atque ratione correctionis Gregorianae*, (Leipzig, 1726). The German text of this paper has only been published as the *Dialogus de Calendario Gregoriano* in the Frisch edition (1858–1871) of Kepler's collected works, *Joannis Kepleri*

Opera Omnia, vol. 4 (1863), page 37. Kepler's paper is a dialogue between a "Mathematicus" (Kepler), two Catholics ("Confessarius" and "Cancellarius") and two Protestants ("Ecclesiastes" and "Syndicus") who argue the desirability of the Gregorian reform. Kepler, the imperial mathematician of Emperor Matthias, wrote this dialogue for the Emperor who wanted to be informed about this subject. Kepler was a proponent of the Gregorian calendar but he didn't care much about theological disputes and argued that the date of Easter, like other days of observance, should not depend on long and arduous calculations such as are necessary for predicting the positions of the planets. (Courtesy of Robert H. van Gent, December 23, 2001.)

*119. (2) Page 123: All the dates of "classical" Passover in Table 8.1 are off by at least one day (see erratum 168). The replacement table is shown in Table 119-A.

120. Pages 123–124: The Beckwith reference should be put in place in the caption of Table 8.1. Also, the title of that reference omits the series in which it is published (*Arbeiten zur Geschichte des antiken Judentums und des Urchristentums*).

121. (2) Page 124, line 6: Change "Gregorian" to "Julian". (Courtesy of John Cross, April 15, 2002.)

122. (2) Page 131, **fixed-from-old-hindu-solar: The functions **fixed-from-old-hindu-solar** and **old-hindu-solar-from-fixed** are inconsistent when the mean sun reaches 0° exactly at sunrise of New Year. To correct this, replace the floor operator in **fixed-from-old-hindu-solar** with ceiling and subtract 1 from its argument:

$$\textbf{fixed-from-old-hindu-solar}\left(\boxed{\textit{year}\mid\textit{month}\mid\textit{day}}\right) \stackrel{\text{def}}{=} \left\lceil \textbf{hindu-epoch} + \textit{year} \times \textbf{arya-solar-year} + (\textit{month} - 1) \times \textbf{arya-solar-month} + \textit{day} - \tfrac{5}{4} \right\rceil \tag{9.7}$$

or in Lisp (page 345):

```
(defun fixed-from-old-hindu-solar (s-date)
  ;; TYPE hindu-solar-date -> fixed-date
  ;; Fixed date corresponding to Old Hindu solar date.
  (let* ((month (standard-month s-date))
         (day (standard-day s-date))
         (year (standard-year s-date)))
    (ceiling
     (+ hindu-epoch ; Since start of era.
        (* year arya-solar-year) ; Days in elapsed years
        (* (1- month) arya-solar-month) ; ...in months.
        day -5/4)))) ; Midnight of day.
```

**123. (2) Page 132, lines 5–6: Change "Subtracting 1/4 of a day from the resultant moment and taking the floor has this effect." to "Subtracting 5/4 of a day from the resultant moment and taking the ceiling has this effect."

*124. (2) Page 138, line 2 of **fixed-from-old-hindu-lunar**: The boxed date should read $\boxed{\textit{year}\mid\textit{month}\mid\textit{leap}\mid\textit{day}}$. This is an error in the automatic translation. (Courtesy of Peter Zilahy Ingerman, February 16, 2002.)

125. Page 150, reference [5]: Change "Bibliography" to "Biography". (Courtesy of Helmer Aslaksen, February 14, 2002.)

126. (2) Page 155, bottom line of column 2: Change "Pept" to "Pepet".

Julian Year	Passover Eve		Easter Full Moon		
	Classical	Arithmetic	Orthodox	Gregorian	Proposed
9 C.E.	Saturday, March 30	Friday, March 29	Wednesday, March 27	Friday, March 29	Friday, March 29
10 C.E.	Friday, April 18	Wednesday, April 16	Tuesday, April 15	Thursday, April 17	Thursday, April 17
11 C.E.	Tuesday, April 7	Monday, April 6	Saturday, April 4	Monday, April 6	Monday, April 6
12 C.E.	Saturday, March 26	Friday, March 25	Thursday, March 24	Saturday, March 26	Saturday, March 26
13 C.E.	Friday, April 14	Friday, April 14	Wednesday, April 12	Friday, April 14	Friday, April 14
14 C.E.	Tuesday, April 3	Monday, April 2	Sunday, April 1	Tuesday, April 3	Wednesday, April 4
15 C.E.	Sunday, March 24	Friday, March 22	Thursday, March 21	Saturday, March 23	Sunday, March 24
16 C.E.	Saturday, April 11	Friday, April 10	Thursday, April 9	Saturday, April 11	Saturday, April 11
17 C.E.	Wednesday, March 31	Wednesday, March 31	Monday, March 29	Wednesday, March 31	Wednesday, March 31
18 C.E.	Tuesday, April 19	Saturday, March 19	Sunday, April 17	Tuesday, April 19	Monday, April 18
19 C.E.	Sunday, April 9	Friday, April 7	Wednesday, April 5	Friday, April 7	Saturday, April 8
20 C.E.	Thursday, March 28	Wednesday, March 27	Monday, March 25	Wednesday, March 27	Wednesday, March 27
21 C.E.	Wednesday, April 16	Monday, April 14	Sunday, April 13	Tuesday, April 15	Tuesday, April 15
22 C.E.	Sunday, April 5	Saturday, April 4	Thursday, April 2	Saturday, April 4	Sunday, April 5
23 C.E.	Thursday, March 25	Wednesday, March 24	Monday, March 22	Wednesday, March 24	Friday, March 26
24 C.E.	Wednesday, April 12	Wednesday, April 12	Monday, April 10	Wednesday, April 12	Wednesday, April 12
25 C.E.	Monday, April 2	Monday, April 2	Friday, March 30	Sunday, April 1	Sunday, April 1
26 C.E.	Friday, March 22	Friday, March 22	Thursday, April 18	Saturday, April 20	Saturday, April 20
27 C.E.	Thursday, April 10	Wednesday, April 9	Monday, April 7	Wednesday, April 9	Wednesday, April 9
28 C.E.	Tuesday, March 30	Monday, March 29	Saturday, March 27	Monday, March 29	Monday, March 29
29 C.E.	Sunday, April 17	Saturday, April 16	Friday, April 15	Sunday, April 17	Sunday, April 17
30 C.E.	Thursday, April 6	Wednesday, April 5	Tuesday, April 4	Thursday, April 6	Thursday, April 6
31 C.E.	Tuesday, March 27	Monday, March 26	Saturday, March 24	Monday, March 26	Tuesday, March 27
32 C.E.	Sunday, April 13	Monday, April 14	Saturday, April 12	Monday, April 14	Monday, April 14
33 C.E.	Friday, April 3	Friday, April 3	Wednesday, April 1	Friday, April 3	Friday, April 3
34 C.E.	Wednesday, March 24	Monday, March 22	Sunday, March 21	Tuesday, March 23	Tuesday, March 23
35 C.E.	Tuesday, April 12	Monday, April 11	Saturday, April 9	Monday, April 11	Monday, April 11
36 C.E.	Saturday, March 31	Friday, March 30	Thursday, March 29	Saturday, March 31	Friday, March 30
37 C.E.	Thursday, March 21	Wednesday, March 20	Wednesday, April 17	Friday, April 19	Thursday, April 18
38 C.E.	Tuesday, April 8	Monday, April 7	Saturday, April 5	Monday, April 7	Tuesday, April 8
39 C.E.	Saturday, March 28	Friday, March 27	Wednesday, March 25	Friday, March 27	Saturday, March 28
40 C.E.	Friday, April 15	Friday, April 15	Wednesday, April 13	Friday, April 15	Friday, April 15

Table 119-A: Replacement for Table 8.1 on page 123 (see erratum 119).

127. (2) Page 156: There is a spurious "5" above the word "Redite" at the top of the first column. (Courtesy of John Cross, January 25, 2002.)

128. Page 158: The calculation of **bali-pancawara-from-fixed** can be slightly simplified:

$$\textbf{bali-pancawara-from-fixed}\,(\mathit{date}) \stackrel{\text{def}}{=} \tag{11.7}$$

$$(\textbf{bali-day-from-fixed}\,(\mathit{date}) + 2) \mod 5$$

or in Lisp (page 351):

```
(defun bali-pancawara-from-fixed (date)
  ;; TYPE fixed-date -> 1-5
  ;; Position of date in 5-day Balinese cycle.
  (adjusted-mod (+ (bali-day-from-fixed date) 2) 5))
```

129. (2) Page 158, line −2 above the footnote: Change "(*ekiwara*)" to "(*ekawara*)". (Courtesy of Jonathan Leffler, April 8, 2002.)

130. Page 166, last line: The correct page in [13] is 93; it was page 89 in the first edition of [13]. (Courtesy of Helmer Aslaksen, November 13, 2001.)

131. Page 167, formula (12.2): Change this definition to

$$\textbf{mecca} \stackrel{\text{def}}{=} \tag{12.2}$$

$21°25'24''$	$39°49'24''$	$298m$	3

See also Errata 220 and 233. (Courtesy of Robert A. Saunders, April 8, 2003.)

132. Page 167, formula (12.4): The "mod 360" in **direction** is superfluous. The Lisp function `direction`, page 354, lines 18–22, should also have the `mod` function removed.

133. Page 167, formulas (12.4), first line: The "0" should have a degree symbol. This change requires addition of a call to `deg` to **direction** on page 354. There are numerous similar missing degree symbols! (Courtesy of John Cross, February 12, 2002.)

134. Section 12.2: Include the map of world time zones from H. M. Nautical Almanac Office (as in *Calendrical Tabulations: 1900–2200*). Perhaps mention `http://www.twinsun.com/tz/tz-link.htm` as a resource for time zones and the use of daylight saving time.

135. Page 169, lines 10–11: Clarify by changing the parenthetical comment "(except...mid-year)" to read "(except that we insert all leap seconds at the end of the year)".

136. (2) Page 170, line −16: Change "is added" to "is subtracted". (Courtesy of John Cross, February 8, 2002.)

137. Page 170, line −3: Clarify the parenthetical comment "(usually...January 1)" to read "(leap seconds have been added either between June 30 and July 1 or between December 31 and January 1)". (Courtesy of Richard M. Koolish, November 27, 2001.)

*138. (2) Page 171, **ephemeris-correction**: This function is not right for the range of years 1701–1799. It's unclear where this approximation came from, but it is nonsense. John Cross suggests

$$\textbf{ephemeris-correction}\,(t) \stackrel{\text{def}}{=} \tag{12.12}$$

$$\begin{cases}
\dfrac{year - 1933}{24 \times 60 \times 60} & \textbf{if } 1988 \leq year \leq 2019 \\
-0.00002 + 0.000297 \times c + 0.025184 \times c^2 - & \\
0.181133 \times c^3 + 0.553040 \times c^4 - 0.861938 \times c^5 + & \\
0.677066 \times c^6 - 0.212591 \times c^7 & \\
 & \textbf{if } 1900 \leq year \leq 1987 \\
-0.000009 + 0.003844 \times c + 0.083563 \times c^2 + & \\
0.865736 \times c^3 + 4.867575 \times c^4 + 15.845535 \times c^5 + & \\
31.332267 \times c^6 + 38.291999 \times c^7 + 28.316289 \times c^8 & \\
+ 11.636204 \times c^9 + 2.043794 \times c^{10} & \\
 & \textbf{if } 1800 \leq year \leq 1899 \\
\dfrac{\begin{array}{l} 8.118780842 - \\ 0.005092142 \times (year - 1700) + \\ 0.003336121 \times (year - 1700)^2 - \\ .0000266484 \times (year - 1700)^3 \end{array}}{24 \times 60 \times 60} & \\
 & \textbf{if } 1700 \leq year \leq 1799 \\
\dfrac{\begin{array}{l} 196.58333 - 4.0675 \times (year - 1600) + \\ 0.0219167 \times (year - 1600)^2 \end{array}}{24 \times 60 \times 60} & \\
 & \textbf{if } 1620 \leq year \leq 1699 \\
\dfrac{\dfrac{x^2}{41048480} - 15}{24 \times 60 \times 60} & \textbf{otherwise}
\end{cases}$$

where

$$year = \textbf{gregorian-year-from-fixed}(\lfloor t \rfloor)$$

$$c = \frac{1}{36525} \times \textbf{gregorian-date-difference}\left(\begin{array}{|c|c|c|}\hline 1900 & \textbf{january} & 1 \\ \hline \end{array}, \begin{array}{|c|c|c|}\hline year & \textbf{july} & 1 \\ \hline \end{array}\right)$$

$$x = 12^{\text{h}} + \textbf{gregorian-date-difference}\left(\begin{array}{|c|c|c|}\hline 1810 & \textbf{january} & 1 \\ \hline \end{array}, \begin{array}{|c|c|c|}\hline year & \textbf{january} & 1 \\ \hline \end{array}\right)$$

or in Lisp (pages 356–357):

```
(defun ephemeris-correction (tee)
  ;; TYPE moment -> fraction-of-day
  ;; Dynamical Time minus Universal Time (in days) for
  ;; fixed time tee.  Adapted from "Astronomical Algorithms"
  ;; by Jean Meeus, Willmann-Bell, Inc., 1991.
```

```
6     (let* ((year (gregorian-year-from-fixed (floor tee)))
7            (c (/ (gregorian-date-difference
8                   (gregorian-date 1900 january 1)
9                   (gregorian-date year july 1))
10                3652510)))
11      (cond ((<= 1988 year 2019)
12             (/ (- year 1933) 2410 6010 6010))
13            ((<= 1900 year 1987)
14             (poly c
15                   (list -0.0000210 0.0002910 0.0251810
16                         -0.1811310 0.5530410 -0.8619310
17                         0.6770610 -0.2125910)))
18            ((<= 1800 year 1899)
19             (poly c
20                   (list -0.0000010 0.0038410 0.0835610
21                         0.8657310 4.8675710 15.8455310
22                         31.3322610 38.2919910 28.3162810
23                         11.6362010 2.0437910)))
24            ((<= 1700 year 1799)
25             (/ (poly (- year 1700)
26                      (list 8.1187808410 -0.0050921410 0.0033361210
27                            -.0000266484010))
28                24110 6010 6010))
29            ((<= 1620 year 1699)
30             (/ (poly (- year 1600)
31                      (list 196.583310 -4.06710 0.02191610))
32                24110 6010 6010))
33            (t (let* ((x (+ (hr 1210)
34                            (gregorian-date-difference
35                             (gregorian-date 1810 january 1)
36                             (gregorian-date year january 1)))))
37                 (/ (- (/ (* x x) 4104848010) 15)
38                    24110 6010 6010))))))
```

This change causes the sample data to be wrong in some cases; see errata 243 and 244. We should replace Figures 12.1 and 12.2 with plots of the actual values versus those produced by **ephemeris-correction** as shown in Figures 138-A and 138-B, respectively. (Courtesy of John Cross, February 8, 2002.)

139. Paged 176–177 and page 208: Discuss the change in shape of the analemma and add the reference "The Shape of the Analemma" by B. M. Oliver, *Sky and Telescope*, July, 1972, pages 20–22.

140. Page 177, lines 13–14: Delete the degree symbols in the components of *eccentricity* which is a dimensionless quantity. This change requires deletion of the call to `deg` on lines 17–18 of **equation-of-time** on page 355. There are numerous similar extraneous degree symbols! (Courtesy of John Cross, February 8, 2002.)

141. Page 178, **midnight** and **midday**, equations (12.20) and (12.21): The following are very slightly more accurate versions of **midday** and **midnight**, taking the slight changes in the equation of time in different locations over the course of a day into account:

$$\textbf{midnight}\,(\mathit{date}, \mathit{locale}) \stackrel{\text{def}}{=} \tag{12.20}$$

$$\begin{array}{l} \textbf{standard-from-universal} \\ \quad (\,\textbf{local-from-apparent} \\ \qquad (\textbf{universal-from-local}\,(\mathit{date}, \mathit{locale}))\,, \\ \quad \mathit{locale}\,) \end{array}$$

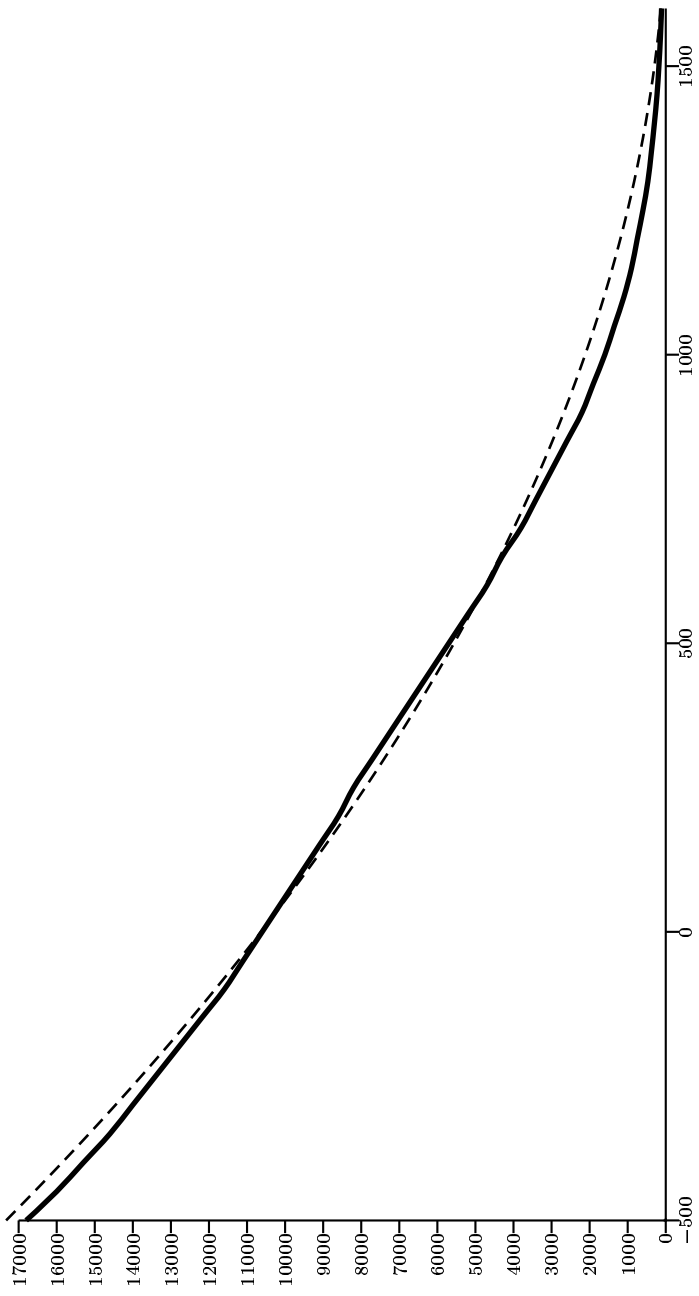

Figure 138-A: Replacement for Figure 12.1 on page 173. Difference between Dynamical (terrestrial) Time and Universal Time in atomic seconds plotted by Gregorian year. The dashed line shows the values of **ephemeris-correction**. Suggested by R. H. van Gent and based on [23, Chapter 14].

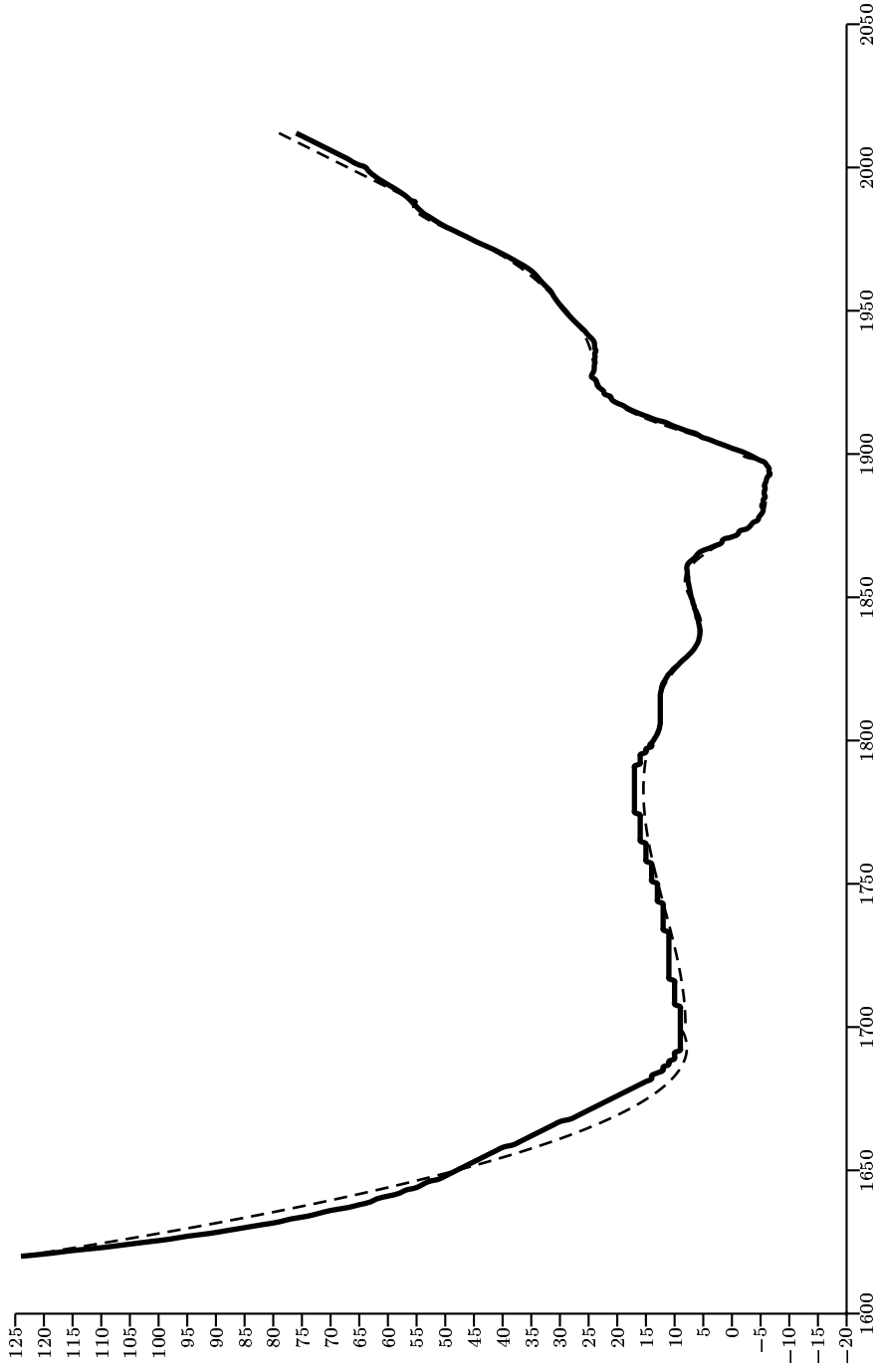

Figure 138-B: Replacement for Figure 12.2 on page 174. Difference between Dynamical (terrestrial) Time and Universal Time in atomic seconds plotted by Gregorian year. The dashed line shows the values of **ephemeris-correction**. Data supplied by R. H. van Gent [personal communication] based on *Astronomical Almanac for the Year 2000*, Nautical Almanac Office, United States Naval Observatory, Washington, D.C., pp. K8–K9; the extrapolated values to 2012 were obtained from the National Earth Orientation Service.

$$\textbf{midday}\,(\mathit{date}, \mathit{locale}) \stackrel{\text{def}}{=} \tag{12.21}$$

$$\begin{array}{l}\textbf{standard-from-universal}\\ \quad\Big(\textbf{local-from-apparent}\\ \qquad\big(\textbf{universal-from-local}\,(\mathit{date} + 12^{\text{h}}, \mathit{locale})\big)\,,\\ \quad \mathit{locale}\Big)\end{array}$$

or in Lisp (page 356):

```
(defun midnight (date locale)
   ;; TYPE (fixed-date location) -> moment
   ;; Standard time on fixed date of true (apparent)
   ;; midnight at locale.
   (standard-from-universal
    (local-from-apparent
     (universal-from-local date locale))
    locale))
```

```
(defun midday (date locale)
   ;; TYPE (fixed-date location) -> moment
   ;; Standard time on fixed date of midday at locale.
   (standard-from-universal
    (local-from-apparent
     (universal-from-local (+ date (hr 12l0)) locale))
    locale))
```

142. Page 180, line 3: Change "23.441884°" to "23.439291°". (Courtesy of Robert H. Douglass, April 30, 2002.)

143. Page 183, Table 12.1: This table, as well as Tables 12.3–12.6 are generated automatically from the Lisp code and they are all oddly arranged. It would be more sensible to have the columns in decreasing order by the first value; instead, one has to read across the rows to see the entries in decreasing order. (Courtesy of Irv Bromberg, March 5, 2003.)

144. (2) Page 185, line 10: Change "R.D. 729,014.34235" to "R.D. 730,475.31751". (Courtesy of Robert H. Douglass, April 25, 2002.)

145. Section 12.5: Good introductory quote from Bede's *De Temporum Ratione*: "Should someone rather less skilled in calculation nonetheless be curious about the course of the moon, we have also for his sake devised a formula adapted to the capacity of his intelligence, so that he might find what he seeks." Faith Wallis, *Bede: The Reckoning of Time*, Liverpool University Press, Liverpool, 1999 (also University of Pennsylvania Press, Philadelphia, 2000), page 63.

146. Section 12.5: The times of moonrise/set can be determined from **lunar-altitude** by sequentially scanning each hour of a given day for a rise/set event and then performing a bisection search within the hour for the minute. (Courtesy of Richard P. Kelly, March 28, 2002.)

147. Page 185, line −14: Clarify by changing "have the same longitude" to "have the same (celestial) longitude". (Courtesy of Richard M. Koolish, November 27, 2001.)

148. Page 185, lines −6 to −4: Clarify by changing "Approximations of this value... determinations." to "Approximations of this value are used in many lunar and lunisolar calendars." (Courtesy of Helmer Aslaksen, November 13, 2001.)

149. Pages 189 (captions of Tables 12.3 and 12.4) and 192 (caption of Table 12.5): The page references in the tables of coefficients are wrong. It is not clear why LaTeX got this wrong! (Courtesy of Oscar van Vlijmen, May 8, 2002.)

150. (2) Page 190: Slight differences between the approximations used by the functions **nth-new-moon and **lunar-phase** (which in turn uses **solar-longitude** and **lunar-longitude**) lead to rare occasions when t is very close to the time of a new moon and the code for **new-moon-before** and **new-moon-after** returns inconsistent values. To force consistency (not accuracy), we should use:

$$\textbf{new-moon-before}\,(t) \stackrel{\text{def}}{=} \tag{12.36}$$

$$\textbf{nth-new-moon}\left(\underset{k\geq n-1}{\text{MAX}} \quad \left\{\textbf{nth-new-moon}\,(k) < t\right\}\right)$$

where

$$\begin{aligned} t_0 &= \textbf{nth-new-moon}\,(0)\\ \phi &= \textbf{lunar-phase}\,(t)\\ n &= \text{round}\left(\frac{t - t_0}{\textbf{mean-synodic-month}} - \frac{\phi}{360^\circ}\right) \end{aligned}$$

$$\textbf{new-moon-after}\,(t) \stackrel{\text{def}}{=} \tag{12.37}$$

$$\textbf{nth-new-moon}\left(\underset{k\geq n}{\text{MIN}} \quad \left\{\textbf{nth-new-moon}\,(k) \geq t\right\}\right)$$

where

$$\begin{aligned} t_0 &= \textbf{nth-new-moon}\,(0)\\ \phi &= \textbf{lunar-phase}\,(t)\\ n &= \text{round}\left(\frac{t - t_0}{\textbf{mean-synodic-month}} - \frac{\phi}{360^\circ}\right) \end{aligned}$$

For robustness (independence of the phase at the R.D. epoch), we also subtract from t the moment n_0 of the first new moon after R.D. 0. In Lisp (pages 362–363):

```
(defun new-moon-before (tee)
   ;; TYPE moment -> moment
   ;; Moment UT of last new moon before tee.
   (let* ((t0 (nth-new-moon 0))
          (phi (lunar-phase tee))
          (n (round (- (/ (- tee t0) mean-synodic-month)
                       (/ phi (deg 360))))))
     (nth-new-moon (final k (1- n) (< (nth-new-moon k) tee)))))
```

```
(defun new-moon-after (tee)
   ;; TYPE moment -> moment
   ;; Moment UT of first new moon at or after tee.
   (let* ((t0 (nth-new-moon 0))
          (phi (lunar-phase tee))
          (n (round (- (/ (- tee t0) mean-synodic-month)
                       (/ phi (deg 360))))))
     (nth-new-moon (next k n (>= (nth-new-moon k) tee)))))
```

151. Pages 190–1: For **lunar-longitude** we should use the updated mean arguments (*solar-anomaly*, *moon-node*, etc.) given in the second edition of Meeus (page 338, based on Chapront, et al. [1998]), which can make a difference in arcseconds. (Courtesy of Oscar van Vlijmen, May 27, 2002.)

152. Page 191, lines 14–15: Add ° signs to the numbers 119.75, 131.849, 53.09, and 479264.29.

153. Page 192, caption of Table 12.5, second printing only: The page reference is wrong; it should be 190.

154. Pages 194–5: For **lunar-latitude** we should use the updated mean arguments (*solar-anomaly*, *moon-node*, etc.) given in the second edition of Meeus (page 338, based on Chapront, et al. [1998]), which can make a difference in arcseconds. (Courtesy of Oscar van Vlijmen, May 27, 2002.)

155. Page 195, **lunar-altitude**, equation (12.47): We should stress that this function gives the altitude in vacuum, not corrected for parallax or refraction. (Courtesy of Oscar van Vlijmen, May 10, 2002.)

156. Page 197, line −10: Change *shih* to *shí* and *ko* to *kè*. (Courtesy of Zhuo Meng, October 21, 2002.)

157. Page 197, line −10: We could expand the sentence on Chinese timekeeping to include a bit more detail. Ancient Chinese civilization divided a day into 10 *shí* and 100 *kè* based on marks on dripping pot; in the first century B.C.E., Chinese astronomers started to divide a day into 12 *shí*. Although 100 *kè* can not be divided equally into 12 *shí*, the *kè* was not changed until the early Qīng dynasty (mid 17th centry), when the it was redefined as an eighth of a *shí*, making 96 *kè* per day. (Courtesy of Zhuo Meng, October 31, 2002.)

158. Page 198, **moment-from-depression**, equation (12.48): We should mention that more information is available than simply **bogus** when the phenomenon does not occur: when *sine-offset* < -1 the sun does not set; similarly, when *sine-offset* > 1 the sun does not rise. (Courtesy of Oscar van Vlijmen, May 9, 2002.)

159. Page 199, **dawn** and **dusk**, equations (12.49) and (12.50): At extreme latitudes, and under rare conditions, these functions may return times that are a few minutes off—and not on the *date* requested—instead of returning **bogus**. Here are corrected versions:

$$\textbf{dawn}\,(\mathit{date}, \mathit{locale}, \alpha) \stackrel{\text{def}}{=} \tag{12.49}$$

$$\begin{cases} \textbf{bogus} & \textbf{if } \mathit{result} = \textbf{bogus} \\ \textbf{standard-from-local}\,(\mathit{result}, \mathit{locale}) & \textbf{otherwise} \end{cases}$$

where

$$\begin{aligned} \mathit{approx} &= \textbf{moment-from-depression} \\ &\quad (\mathit{date} + 0.25, \mathit{locale}, \alpha) \end{aligned}$$

$$\begin{aligned} \mathit{result} &= \textbf{moment-from-depression} \\ &\quad \left(\begin{cases} \mathit{date} & \textbf{if } \mathit{approx} = \textbf{bogus or} \\ & \quad \mathit{approx} < \mathit{date} \\ \mathit{approx} & \textbf{otherwise} \end{cases}, \mathit{locale}, \alpha \right) \end{aligned}$$

$$\textbf{dusk}\,(\mathit{date}, \mathit{locale}, \alpha) \stackrel{\text{def}}{=} \tag{12.50}$$

$$\begin{cases} \textbf{bogus} & \textbf{if } \mathit{result} = \textbf{bogus} \\ \textbf{standard-from-local}\,(\mathit{result}, \mathit{locale}) & \textbf{otherwise} \end{cases}$$

where

$$\begin{aligned} approx &= \textbf{moment-from-depression} \\ &\quad (date + 0.75, locale, \alpha) \end{aligned}$$

$$\begin{aligned} result &= \textbf{moment-from-depression} \\ &\quad \left(\begin{cases} date + 0.99 & \textbf{if } approx = \textbf{bogus or} \\ & \quad approx \geq date + 1 \\ approx & \textbf{otherwise} \end{cases}, locale, \alpha \right) \end{aligned}$$

or in Lisp (pages 359–360):

```
(defun dawn (date locale alpha)
  ;; TYPE (fixed-date location angle) -> moment
  ;; Standard time in morning of date at locale
  ;; when depression angle of sun is alpha.
  (let* ((approx (moment-from-depression ; approximate time
                  (+ date 0.2510) locale alpha))
         (result (moment-from-depression
                  (if (or (equal approx bogus)
                          (< approx date))
                      date
                    approx)
                  locale alpha)))
    (if (equal result bogus)
        bogus
      (standard-from-local result locale))))
```

```
(defun dusk (date locale alpha)
  ;; TYPE (fixed-date location angle) -> moment
  ;; Standard time in evening on date at locale
  ;; when depression angle of sun is alpha.
  (let* ((approx (moment-from-depression ; approximate time
                  (+ date 0.7510) locale alpha))
         (result (moment-from-depression
                  (if (or (equal approx bogus)
                          (>= approx (1+ date)))
                      (+ date 0.9910)
                    approx)
                  locale alpha)))
    (if (equal result bogus)
      bogus
      (standard-from-local result locale))))
```

160. Pages 199, line −2 and page 200, formulas (12.51) and (12.52): A slightly more accurate adjustment for refraction due to G. G. Bennett, "The Calculation of Astronomical Refraction in Marine Navigation", *Journal of Navigation*, vol. 35 (1982), pp. 255-259 is given in Jean Meeus's *Astronomical Algorithms*, 2nd ed., formula 16.3 on page 106. The refraction expressed in minutes of arc is

$$\frac{1}{\tan\left(h_0 + \frac{7.31}{h_0 + 4.4}\right)} + 0.001351521723799,$$

where h_0 is the apparent altitude in degrees and 0.001351521723799 is the zenith adjustment. Calculating this value with $h_0 = 0°$ of apparent altitude yields 34.478885263888294, or approximately $34'29''$.

Thus we should change the $34'$ in line -2 of page 199 to $34'29''$ and change the definition of α in the last line of **sunrise** and **sunset** from $50' + dip$ to $50'29'' + dip$; the effect on sunrise/sunset times is trivial—just a few seconds. (Courtesy of Richard P. Kelly, January 23, 2003.)

161. Page 200, lines 17–18: Move the sentence "To convert... (page 170)." to page 199, immediately after formula (12.49), omitting the word "would". (Courtesy of John Cross, February 13, 2002.)

162. Page 201, line -3 of Table 12.7: Change "a.m." to "p.m."

*163. Pages 201–202: The function **standard-from-sundial** is incorrect for $hour > 18$ and very slightly inaccurate for $hour < 6$; the problem is that we should be using appropriate nighttime temporal-hours. To fix this we must rename **temporal-hour**, formula (12.56), more appropriately as **daytime-temporal-hour**:

$$\textbf{daytime-temporal-hour}(date, locale) \stackrel{\text{def}}{=} \tag{163-A}$$

$$\begin{cases} \textbf{bogus} & \textbf{if sunrise}(date, locale) = \textbf{bogus or} \\ & \quad \textbf{sunset}(date, locale) = \textbf{bogus} \\ \dfrac{\textbf{sunset}(date, locale) - \textbf{sunrise}(date, locale)}{12} & \\ & \textbf{otherwise} \end{cases}$$

and add the function

$$\textbf{nighttime-temporal-hour}(date, locale) \stackrel{\text{def}}{=} \tag{163-B}$$

$$\begin{cases} \textbf{bogus} & \textbf{if sunrise}(date + 1, locale) = \textbf{bogus or} \\ & \quad \textbf{sunset}(date, locale) = \textbf{bogus} \\ \dfrac{\textbf{sunrise}(date + 1, locale) - \textbf{sunset}(date, locale)}{12} & \\ & \textbf{otherwise} \end{cases}$$

This allows us to replace **standard-from-sundial** with

$$\textbf{standard-from-sundial}(date, hour, locale) \stackrel{\text{def}}{=} \tag{12.57}$$

$$\begin{cases} \textbf{bogus} & \textbf{if } h = \textbf{bogus} \\ \textbf{sunrise}(date, locale) + (hour - 6) \times h & \textbf{if } 6 \le hour \le 18 \\ \textbf{sunset}(date - 1, locale) + hour \times h & \textbf{if } hour < 6 \\ \textbf{sunset}(date, locale) + (hour - 18) \times h & \textbf{otherwise} \end{cases}$$

where

$$h = \begin{cases} \textbf{daytime-temporal-hour}(date, locale) & \\ & \textbf{if } 6 \le hour \le 18 \\ \textbf{nighttime-temporal-hour}(date - 1, locale) & \\ & \textbf{if } hour < 6 \\ \textbf{nighttime-temporal-hour}(date, locale) & \\ & \textbf{otherwise} \end{cases}$$

Or, in Lisp (page 360):

```
(defun daytime-temporal-hour (date locale)
  ;; TYPE (fixed-date location) -> real
  ;; Length of daytime temporal hour on fixed date at
  ;; locale.
  (if (or (equal (sunrise date locale) bogus)
          (equal (sunset date locale) bogus))
      bogus
    (/ (- (sunset date locale)
          (sunrise date locale))
       12)))
```

```
(defun nighttime-temporal-hour (date locale)
  ;; TYPE (fixed-date location) -> real
  ;; Length of nighttime temporal hour on fixed date at
  ;; locale.
  (if (or (equal (sunrise (1+ date) locale) bogus)
          (equal (sunset date locale) bogus))
      bogus
    (/ (- (sunrise (1+ date) locale)
          (sunset date locale))
       12)))
```

```
(defun standard-from-sundial (date hour locale)
  ;; TYPE (fixed-date real location) -> moment
  ;; Standard time on fixed date of temporal hour at
  ;; locale.
  (let ((h (cond ((<= 6 hour 18); daytime today
                  (daytime-temporal-hour date locale))
                 ((< hour 6)    ; early this morning
                  (nighttime-temporal-hour (1- date) locale))
                 (t             ; this evening
                  (nighttime-temporal-hour date locale)))))
    (cond ((equal h bogus) bogus)
          ((<= 6 hour 18); daytime today
           (+ (sunrise date locale) (* (- hour 6) h)))
          ((< hour 6)    ; early this morning
           (+ (sunset (1- date) locale) (* hour h)))
          (t             ; this evening
           (+ (sunset date locale) (* (- hour 18) h))))))
```

(Courtesy of John Cross, February 14, 2002.)

164. Page 203: Quote for Section 12.7: "And the sun rises and the sun sets—then to its place it rushes; there it rises again. It goes toward the south and veers torward the north." *Ecclesiates* 1, 5–6. This translation is per the Art Scroll series, following Rashi; Ibn Ezra and the *Midrash* take the latter part to refer to the wind, not the sun. Here, for example, is the new *JPS* translation:

> The sun rises, and the sun sets—
> And glides back to where it rises.
> Southward blowing,
> Turning northward,
> Ever turning.

165. (2) Page 203, line −3: Change "preceding" to "on".

**166. (2) Page 204, line 3: Delete the "−1" (see errata 235 and 242).

167. (2) Page 204, line 6: Change "last" to "first".

168. (2) Page 205, line 12: The function **visible-crescent was meant to check if the moon was visible on the evening prior to *date*. Thus, this line should read

$$(\textbf{dusk}(\mathit{date} - 1, \mathit{locale}, 4.5^\circ), \mathit{locale})$$

In Lisp (page 368, lines 4 and 7) that is

```
;; visibility of the new moon on the eve of date at locale
...
(dusk (1- date) locale (deg 4.510))
```

This change has far-reaching effect: all the dates in the column "Islamic: Observational" on page 397 should be one day earlier and all the dates of Passover in Table 8.1 on page 123 are off by at least one day.

169. (2) Page 205, line 16: Change "the day the new moon" to "the day after the new moon".

170. Page 205, equation (12.65): The function **phasis-on-or-before** should be rewritten as **visible-crescent-before** and should accept moments (instead of just fixed dates); in its present form it goes into an infinite loop for non-integer dates. Perhaps, in parallel to **new-moon-before**, it should return moments also. The word "phasis," though correct, is obscure.

171. Page 207, lines 2–6: Moslems in India, Pakistan, and Bangladesh base their calendar on reported Moon sightings; in Saudi Arabia and most of the Gulf countries they have simplified the calendar in which they start the lunar month if moonset is after sunset on the 29th day of the previous month, as seen from Mecca. In Egypt they require moonset to be at least 5 minutes after sunset. In the United States, according to Khalid Shaukat, national coordinator and consultant for the Islamic Shura Council of North America (which consists of the Islamic Society of North America, the Islamic Circle of North America, the Ministry of Imam W. Deen Mohammed, and the Jamaat Community of Imam Jamil Al-Amin) "a confirmed crescent sighting report in North America will be accepted as long as such a report does not contradict indisputable astronomical information." (Courtesy of Helmer Aslaksen, November 13, 2001.)

172. Section 12.9: Here is a more complete rendition of the observational Hebrew calendar.

$$\textbf{observational-hebrew-new-year}\,(\mathit{g\text{-}year}) \stackrel{\text{def}}{=} \tag{172-A}$$

$$\begin{cases} \mathit{new\text{-}moon} & \textbf{if } \mathit{equinox} < \mathit{set} \\ \textbf{phasis-on-or-before}\,(\mathit{new\text{-}moon} + 45, \textbf{jerusalem}) & \\ & \textbf{otherwise} \end{cases}$$

where

$$\begin{aligned} \mathit{jan}_1 &= \textbf{fixed-from-gregorian} \\ &\quad \left(\boxed{\mathit{g\text{-}year}} \boxed{\textbf{january}} \boxed{1} \right) \\ \mathit{equinox} &= \textbf{solar-longitude-after}\,(\mathit{jan}_1, \textbf{spring}) \\ \mathit{new\text{-}moon} &= \textbf{phasis-on-or-before} \\ &\quad (\lfloor \mathit{equinox} \rfloor + 10, \textbf{jerusalem}) \\ \mathit{set} &= \textbf{universal-from-standard} \\ &\quad (\,\textbf{sunset}\,(\mathit{new\text{-}moon} + 14, \textbf{jerusalem})\,, \\ &\quad\ \textbf{jerusalem}\,) \end{aligned}$$

observational-hebrew-from-fixed $(date) \stackrel{\text{def}}{=}$ (172-B)

$$\boxed{year \mid month \mid day}$$

where

$$\begin{aligned}
crescent &= \textbf{phasis-on-or-before}\,(date, \textbf{jerusalem}) \\
g\text{-}year &= \textbf{gregorian-year-from-fixed}\,(date) \\
ny &= \textbf{observational-hebrew-new-year}\,(g\text{-}year) \\
new\text{-}year &= \begin{cases} \textbf{observational-hebrew-new-year}\,(g\text{-}year - 1) & \textbf{if } date < ny \\ ny & \textbf{otherwise} \end{cases} \\
month &= \text{round}\left(\frac{crescent - new\text{-}year}{29.5}\right) + 1 \\
year &= \textbf{hebrew-from-fixed}\,(new\text{-}year)_{\,\textbf{year}} + \begin{cases} 1 & \textbf{if } month \geq \textbf{tishri} \\ 0 & \textbf{otherwise} \end{cases} \\
day &= date - crescent + 1
\end{aligned}$$

fixed-from-observational-hebrew (172-C)

$$\left(\boxed{year \mid month \mid day}\right) \stackrel{\text{def}}{=}$$

$$\textbf{phasis-on-or-before}\,(midmonth, \textbf{jerusalem}) + day - 1$$

where

$$\begin{aligned}
year_1 &= \begin{cases} year - 1 & \textbf{if } month \geq \textbf{tishri} \\ year & \textbf{otherwise} \end{cases} \\
start &= \textbf{fixed-from-hebrew}\left(\boxed{year_1 \mid \textbf{nisan} \mid 1}\right) \\
g\text{-}year &= \textbf{gregorian-year-from-fixed}\,(start + 60) \\
new\text{-}year &= \textbf{observational-hebrew-new-year}\,(g\text{-}year) \\
midmonth &= new\text{-}year + \text{round}\,(29.5 \times (month - 1)) + 15
\end{aligned}$$

classical-passover-eve $(g\text{-}year) \stackrel{\text{def}}{=}$ (172-D)

$$\textbf{observational-hebrew-new-year}\,(g\text{-}year) + 13$$

or in Lisp:

```
(defun observational-hebrew-new-year (g-year)
  ;; TYPE gregorian-year -> fixed-date
  ;; Fixed date of Observational (classical)
  ;; Nisan 1 occurring in Gregorian year g-year.
  (let* ((jan1 (fixed-from-gregorian
                (gregorian-date g-year january 1)))
         (equinox ; Date (UT) of spring of g-year.
          (solar-longitude-after
           jan1 spring))
         (new-moon ; First possible new moon.
          (phasis-on-or-before
           (+ (floor equinox) 10)
           jerusalem))
         (set ; Time (UT) of sunset at end of 15th.
          (universal-from-standard
           (sunset (+ new-moon 14) jerusalem)
           jerusalem)))
    (if ; Spring starts before end of 15th.
        (< equinox set)
        new-moon
      (phasis-on-or-before ; Otherwise next month.
       (+ new-moon 45)
       jerusalem))))
```

```
(defun observational-hebrew-from-fixed (date)
  ;; TYPE fixed-date -> hebrew-date
  ;; Observational Hebrew date (year month day)
  ;; corresponding to fixed date.
  (let* ((crescent ; Most recent new moon.
          (phasis-on-or-before date jerusalem))
         (g-year (gregorian-year-from-fixed date))
         (ny (observational-hebrew-new-year g-year))
         (new-year (if (< date ny)
                       (observational-hebrew-new-year
                        (1- g-year))
                     ny))
         (month (1+ (round (/ (- crescent new-year) 29.5))))
         (year (+ (standard-year (hebrew-from-fixed new-year))
                  (if (>= month tishri) 1 0)))
         (day (- date crescent -1)))
    (hebrew-date year month day)))
```

```
(defun fixed-from-observational-hebrew (h-date)
  ;; TYPE hebrew-date -> fixed-date
  ;; Fixed date equivalent to Observational Hebrew date.
  (let* ((month (standard-month h-date))
         (day (standard-day h-date))
         (year (standard-year h-date))
         (year1 (if (>= month tishri) (1- year) year))
         (start (fixed-from-hebrew (hebrew-date year1 nisan 1)))
         (g-year (gregorian-year-from-fixed
                  (+ start 60)))
         (new-year (observational-hebrew-new-year g-year))
         (midmonth ; Middle of given month.
          (+ new-year (round (* 29.5 (1- month))) 15)))
    (+ (phasis-on-or-before ; First day of month.
        midmonth jerusalem)
       day -1)))
```

```
(defun classical-passover-eve (g-year)
  (+ (observational-hebrew-new-year g-year) 13))
```

173. Page 211: The opening chapter quote is the translation by John C. Rolfe, Harvard University Press, 1946.

174. Page 213, line 13: Change "true noon" to "true (apparent) noon". (Courtesy of Robert H. Douglass, June 15, 2002.)

175. Page 213, line −7: Refer to Section 12.7 instead of 14.3.

176. Page 217, line 12: Change "before 474 A.P." to "since 474 A.P.". (Courtesy of John Cross, February 20, 2002.)

177. Page 223, chapter quote: Add a disclaimer footnote in Farsi:

نویسندگان لزومءً بَا نقطه نظرهَای در عبَارت موَافقت ندَارند.

(Courtesy of Nazli Goharian, July 25, 2002.)

178. (2) Page 223, Section 14.1, line 1: Delete "at sunset".

179. (2) Page 228, Section 14.3, line 1: Change "following" to "preceding".

180. Pages 228–229, replacement of **fixed-from-future-bahai** and `fixed-from-future-bahai` (page 374): Erratum deleted.

181. Page 235, lines 3 and 5: Change "Jour du Labour" and "Jour de la Récompense" to "Jour du Travail" and "Jour des Récompenses", respectively. (Courtesy of Jean Forget, April 20, 2000.)

*182. (2) Page 235, line −10 through (15.1): Change "Paris is. . . (15.1)" to "The Paris Observatory is $48°50'11''$ ($= 175811°/3600$) north, $2°20'15''$ ($= 187°/80$) east, 27 meters above sea level, and 1 hour after Universal Time, so we define

$$\textbf{paris} \stackrel{\text{def}}{=} \begin{array}{|c|c|c|c|}\hline 48°50'11'' & 2°20'15'' & 27m & 1 \\ \hline \end{array} \tag{15.1}$$

See also Errata 221 and 236. (Courtesy of Ehssan Dabal, April 10, 2002.)

183. Page 235, line −7: Change "used local mean time," to "used true (apparent) solar time,". (Courtesy of Robert H. Douglass, April 30, 2002.)

184. (2) Page 238, equation (15.9): This function was correct in our files, but somehow an old version got into the book! Replace (15.9) with:

$$\textbf{modified-french-from-fixed}\,(\mathit{date}) \stackrel{\text{def}}{=} \begin{array}{|c|c|c|}\hline \mathit{year} & \mathit{month} & \mathit{day} \\ \hline \end{array} \tag{15.9}$$

where

$$\mathit{approx} = \left\lfloor \frac{\mathit{date} - \textbf{french-epoch} + 2}{\frac{1460969}{4000}} \right\rfloor + 1$$

$$year = \begin{cases} approx - 1 & \textbf{if } date < \textbf{fixed-from-modified-french} \left(\boxed{approx \mid 1 \mid 1} \right) \\ approx & \textbf{otherwise} \end{cases}$$

$$month = \left\lfloor \frac{date - \textbf{fixed-from-modified-french} \left(\boxed{year \mid 1 \mid 1} \right)}{30} \right\rfloor + 1$$

$$day = date - \textbf{fixed-from-modified-french} \left(\boxed{year \mid month \mid 1} \right) + 1$$

See also Erratum 237.

185. Chapter 16: Reference for Chinese holiday customs: *The Moon Year*, Juliet Bredon and Igor Mitrophanow, Kelly & Walsh, Limited, Shanghai, 1927.

186. Page 242, line 19: Change "(12.4)" to "(12.25)". (Courtesy of Robert H. Douglass, June 13, 2002.)

187. (2) Page 243, line −11: The second Chinese character of Chǔshǔ should be 暑, the same as in the second and third lines above it. (Courtesy of Helmer Aslaksen, January 14, 2002.)

**188. Page 246. Because of Erratum 150, the calculated dates for Chinese new moons can be wrong very rarely (the only known instance is in January, 2481), leading to failure of the Chinese calendar algorithms (for dates in January 30, 2481–February 17, 2482). (Courtesy of Nigel Richards, January 30, 2002.)

189. Page 249, Figure 16.1: The light gray arrow from month 12 to leap 12 should be labeled 0.000 and the gray arrow from month 9 to leap 9 should be labeled 0.008. The second to the last sentence of the caption should read "The dashed lines from a month i to a following leap month i are labeled with the approximate probability that a randomly chosen month i is followed by a leap month; these probabilities are based on data from [1] for the Chinese calendar for the thousand years 1645–2644." (Courtesy of Svante Janson, January 31, 2003.)

*190. (2) Page 257, formula (16.19): The boxed arguments to **chinese-name-difference** should be, $\boxed{stem_1 \mid branch_1}$ and $\boxed{stem_2 \mid branch_2}$, respectively. This is an error in the automatic translation. (Courtesy of John Cross, February 20, 2002.)

191. Page 258, equations (16.21) and (16.23): Explain that (16.21), **chinese-month-name-epoch**, is the name of of the zeroth elapsed month on the Chinese calendar, and (16.23), **chinese-day-name-epoch**, is the Chinese name for R.D. 0. (Courtesy of Robert H. Douglass, May 15, 2002.)

192. (2) Page 258, line −13: Change "(1.45)" to "(1.42)".

193. (2) Page 258, line −3: Change "1 a.m. to 1 a.m." to "11 p.m. to 11 p.m." (Courtesy of Robert H. Douglass, April 29, 2002.)

194. Page 259, line 8: For example, the Chinese year 4664 (overlapping Gregorian years 1966–67) was a leap year, but 19 years later Chinese year 4683 (overlapping Gregorian years 1985–86) was a common year.

195. (2) Page 260, line −13: Change "winter of year 1" to "winter of year 0". (Courtesy of Robert H. Douglass, April 26, 2002.)

196. Page 263, reference [1]: A more recent version of Aslaksen's paper can be found at `http://www.math.nus.edu.sg/aslaksen/calendar/cal.pdf`.

197. (2) Page 269, line 1 of footnote 3: Replace this line with "From 1300 C.E. until 1980 C.E., only Mārgaśīrsha (in the years beginning in 1315, 1380, 1521), Pausha (1334, 1399, 1540, 1681, 1822, 1963), and Māgha (1418, 1475) have been skipped. The omission of Māgha (and concomitant intercalation of Phālguna) in 1418 is not listed in [9] (only 4 minutes separate the start of the solar and lunar months). Also, according". (Courtesy of Akshay Regulagedda, September 6, 2002.)

198. Chapter 17: Mention that today the Hindu solar year usually begins with Vaiśākha, the second month of the lunar year.

199. (2) Page 272, bottom line: Replace "$\approx 1/223.5$" with "$\approx 1/233.5$". (Courtesy of Robert H. Douglass, April 29, 2002.)

200. (2) Page 275, line 16: Replace "(= 15,779,178,828 days)" with "(= 1,577,917,828 days)". (Courtesy of Robert H. Douglass, April 24, 2002.)

201. Page 277, **hindu-new-moon-before**: This function is misnamed since it stops bisecting once it has determined the zodiac sign. A better name would be **hindu-new-moon-sign-before**. (Courtesy of Helmer Aslaksen, August 19, 2002.)

202. (2) Page 279, last line on page of **fixed-from-hindu-solar (17.22): Change $\tau - 1$ to $\tau - 2$ in the lower limit of the MIN.

203. (2) Page 280, line −8: Change "which begins in 57 C.E.," to "which begins in 58 B.C.E.,". (Courtesy of John Cross, April 24, 2002.)

204. (2) Page 281, lines 16–17: Change "year number *year*" to "K.Y. year". (Courtesy of John Cross, April 24, 2002.)

*205. (2) Page 282, lines 3–4: The first occurrence of $leapday_1$ and $leapday_2$ should be day_1 and day_2, respectively. This is an error in the automatic translation.

*206. (2) Page 282, lines −4 and −8: The boxed date should read | *year* | *month* | *leap* | *day* | *leapday* |. This is an error in the automatic translation.

207. Page 283: Explain approximation.

208. (2) Page 283, top line: There is a minus sign missing between "*approx*" and "$\frac{1}{360^\circ}$". This error was introduced somehow by the compositor. (Courtesy of Richard P. Kelly, December 3, 2001.)

209. Page 283, **ujjain**, equation (17.27): Some sources differ as to the location to be used for the Hindu calendars. For example, the *Explanatory Supplement to the Astronomical Almanac* says (on page 592), "According to their [the Calendar Reform Committee's] proposals... [a]ll astronomical calculations are performed with respect to a Central Station at longitude 82°30' East, latitude 23°11' North." (Courtesy of Robert H. Douglass, May 6, 2002.)

210. Page 287, line −3: A correspondent claims that the Hindu sunrise is defined by the center of the Sun, not its upper limb, so we should use:

$$\textbf{alt-hindu-sunrise}\,(date) \stackrel{\text{def}}{=} \frac{1/60}{24} \times \text{round}\,(rise \times 24 \times 60) \qquad \text{(210-A)}$$

where

$$rise = \textbf{dawn}\,(date, \textbf{hindu-locale}, 0^\circ)$$

Or, in Lisp (page 390):

```
(defun alt-hindu-sunrise (date)
  ;; TYPE fixed-date -> rational-moment
  ;; Hindu sunrise at Hindu locale on date,
  ;; rounded to nearest minute, as a rational number.
  (let* ((rise (dawn date hindu-locale (deg 0))))
    (* 1/24 1/60 (round (* rise 24 60)))))
```

We also take refraction into account (and the radius of Earth), which may or may not be used by Hindus today.

211. (2) Page 292, line 9: Delete "of".

212. Section 17.5: Determining the fixed date of a Hindu lunar holiday is not easy because of expunged days and months. The following functions do it correctly (these functions are not in the book, but we needed them for *Calendrical Tabulations: 1900–2200*):

$$\textbf{almost-equal}\,(h, l) \stackrel{\text{def}}{=} \tag{212-A}$$

$$h_{\textbf{leap-month}} = l_{\textbf{leap-month}} \text{ and } h_{\textbf{month}} = l_{\textbf{month}}$$

$$\textbf{adjusted-hindu}\,(h) \stackrel{\text{def}}{=} \tag{212-B}$$

$$\begin{cases} d & \textbf{if almost-equal}\,(h, l) \text{ and } \{\text{not } h_{\textbf{leap-day}} \text{ or } l_{\textbf{leap-day}}\} \\ d-1 & \textbf{if } \{\textbf{almost-equal}\,(h, l) \text{ and } h_{\textbf{leap-day}} \text{ and not } l_{\textbf{leap-day}}\} \text{ or} \\ & \quad \textbf{almost-equal}\,(h, k) \\ \textbf{bogus} & \textbf{otherwise} \end{cases}$$

where

$$d = \textbf{fixed-from-hindu-lunar}\,(h)$$

$$l = \textbf{hindu-lunar-from-fixed}\,(d)$$

$$k = \textbf{hindu-lunar-from-fixed}\,(d-1)$$

$$\textbf{expunged}\left(\boxed{\textit{year} \mid \textit{month}}\right) \stackrel{\text{def}}{=} \tag{212-C}$$

$$\textit{month} \neq \textbf{hindu-lunar-from-fixed}\,(\textit{date})_{\,\textbf{month}}$$

where

$$\textit{date} = \textbf{fixed-from-hindu-lunar}\left(\boxed{\textit{year} \mid \textit{month} \mid \text{false} \mid 15 \mid \text{false}}\right)$$

$$\textbf{hindu-lunar-holiday}\,(\textit{year}, m, l, d, a) \stackrel{\text{def}}{=} \tag{212-D}$$

$$\left\{ \begin{array}{ll} \langle date_1 \rangle & \textbf{if } date_1 \neq \textbf{bogus and} \\ & \quad jan_1 \leq date_1 \leq dec_{31} \text{ and not } \textbf{expunged}\,(try_1) \\ \langle\,\rangle & \textbf{otherwise} \end{array} \right\}$$

$$\| \left\{ \begin{array}{ll} \langle date_2 \rangle & \textbf{if } date_2 \neq \textbf{bogus and} \\ & \quad jan_1 \leq date_2 \leq dec_{31} \text{ and} \\ & \quad \text{not } \textbf{expunged}\,(try_2) \\ \langle\,\rangle & \textbf{otherwise} \end{array} \right\}$$

where

$$jan_1 = \textbf{fixed-from-gregorian} \left(\boxed{year \mid \textbf{january} \mid 1} \right)$$

$$dec_{31} = \textbf{fixed-from-gregorian} \left(\boxed{year \mid \textbf{december} \mid 31} \right)$$

$$year_1 = \textbf{hindu-lunar-from-fixed}\,(jan_1)_{\,\textbf{year}}$$

$$year_2 = \textbf{hindu-lunar-from-fixed}\,(dec_{31})_{\,\textbf{year}}$$

$$try_1 = \boxed{year_1 \mid m \mid l \mid d \mid \mathbf{t}}$$

$$try_2 = \boxed{year_2 \mid m \mid l \mid d \mid \mathbf{t}}$$

$$date_1 = \textbf{adjusted-hindu}\,(try_1)$$

$$date_2 = \left\{ \begin{array}{ll} \textbf{adjusted-hindu}\,(try_2) & \textbf{if } year_1 \neq year_2 \\ \textbf{bogus} & \textbf{otherwise} \end{array} \right.$$

or in Lisp:

```
(defun almost-equal (h l)
  (and (equal (hindu-lunar-leap-month h) (hindu-lunar-leap-month l))
       (= (hindu-lunar-month h) (hindu-lunar-month l))))
```

```
(defun adjusted-hindu (h)
  (let* ((d (fixed-from-hindu-lunar h))
         (l (hindu-lunar-from-fixed d))
         (k (hindu-lunar-from-fixed (1- d))))
    (cond ((and (almost-equal h l)
                (or (not (hindu-lunar-leap-day h))
                    (hindu-lunar-leap-day l)))
           d)
          ((or (and (almost-equal h l)
                    (hindu-lunar-leap-day h)
                    (not (hindu-lunar-leap-day l)))
               (almost-equal h k))
           (1- d))
          (t bogus))))
```

```
(defun expunged (h-date)
  (let* ((year (hindu-lunar-year h-date))
         (month (hindu-lunar-month h-date))
         (date (fixed-from-hindu-lunar
                (hindu-lunar-date year month false 15 false))))
    (/= month (hindu-lunar-month (hindu-lunar-from-fixed date)))))
```

```
(defun hindu-lunar-holiday (year m l d a)
  (let* ((jan1 (fixed-from-gregorian (gregorian-date year january 1)))
         (dec31 (fixed-from-gregorian (gregorian-date year december 31)))
         (year1 (hindu-lunar-year (hindu-lunar-from-fixed jan1)))
         (year2 (hindu-lunar-year (hindu-lunar-from-fixed dec31)))
         (try1 (hindu-lunar-date year1 m l d t))
         (try2 (hindu-lunar-date year2 m l d t))
         (date1 (adjusted-hindu try1))
         (date2 (if (/= year1 year2)
                    (adjusted-hindu try2)
                  bogus)))
    (append (if (and (not (equal date1 bogus))
                     (<= jan1 date1 dec31)
                     (not (expunged try1)))
                (list date1)
              nil)
            (if (and (not (equal date2 bogus))
                     (<= jan1 date2 dec31)
                     (not (expunged try2)))
                (list date2)
              nil))))
```

213. Page 304, line −6: Delete the type *julian-centuries*. (Courtesy of Jonathan Leffler, April 8, 2002.)

214. (2) Page 306, line 11: The entry in the "Type or Range" column for *time* is missing; it should be ⟨*hour*, *minute*, *second*⟩. (Courtesy of Jonathan Leffler, April 8, 2002.)

215. Page 306, line 12: Delete the type *weekday*.

216. Pages 306–314: Change all 16 occurrences of the type *weekday* to the type *day-of-week*.

217. (2) Page 309, line 19 (result type of **hindu-day-count**): Change *rational-moment* to *integer*.

218. (2) Page 311, line 17 (type of **moment-from-depression**): Change parameter types to ⟨*moment*, *location*, *angle*⟩. (Courtesy of Ehssan Dabal, April 10, 2002.)

219. Page 312, line 7: **sacred-wednesdays** should have parameter type *(fixed-date, fixed-date)* not *gregorian-year*. (Courtesy of Jonathan Leffler, March 22, 2002.)

220. Page 313, line −11 (value of **mecca**): Change value to ⟨6427/300, 11947/300, 298, 3⟩. See See also Errata 131 and 233. (Courtesy of Robert A. Saunders, April 8, 2003.)

*221. (2) Page 313, line −3 (value of **paris**): Change value to ⟨175811/3600, 187/80, 27, 1⟩. See See also Errata 182 and 236. (Courtesy of Ehssan Dabal, April 10, 2002.)

222. (2) Page 317, second paragraph: Change "Please bear in mind...output." to "Please bear in mind the limits of the License and that the copyright on this book includes the code."

223. Page 318, line 13: Add "The predicate `evenp` tests whether an integer is even."

224. Page 320, line 11: We should take advantage of the non-case-sensitive nature of Lisp and use `L0` instead of the confusing looking lower case ell. (Courtesy of Oscar van Vlijmen, May 8, 2002.)

225. Page 322, line 14: Change "Two additional...searching:" to read "Two additional `sum`-like macros are used for searching; the first implements the MIN function, equation (1.19), and the second implements MAX, equation (1.20):".

226. Page 324, line 2 of `kday-on-or-before`, `kday-on-or-after`, `kday-nearest`, `kday-after`, and `kday-before`: Change the type `weekday` to `day-of-week`. (Courtesy of Jonathan Leffler, March 28, 2002.)

227. Page 328, lines 2–3 of `molad`: In the correction made in the second printing the variables *h-month* and *h-year* were not italicized.

228. Pages 328–329, line 2 of `nth-kday`, `first-kday`, and `last-kday`: Change the type `weekday` to `day-of-week`. (Courtesy of Jonathan Leffler, March 28, 2002.)

229. Page 329, line 2 of both `first-kday` and `last-kday`: There is a missing closing parenthesis after the `gregorian-date`. (Courtesy of Jonathan Leffler, April 1, 2002.)

230. Page 343, line 3 of `alt-orthodox-easter`: Change "alternate" to "alternative". (Courtesy of Jonathan Leffler, April 25, 2002.)

231. (2) Page 344, line 2 of `hindu-day-count`: Change `hindu-moment` to `integer`.

232. Page 351, line 2 of `bali-week-from-fixed`: There is a missing blank space before the `->`. (Courtesy of Jonathan Leffler, March 28, 2002.)

233. Page 354, **mecca**: Replace with

```
(defconstant mecca
  ;; TYPE location
  ;; Location of Mecca.
  (location (angle 21 25 24) (angle 39 49 24) (mt 298) 3))
```

See also Errata 131 and 220. (Courtesy of Robert A. Saunders, April 8, 2003.)

234. Page 358, just before `solar-longitude-after`: Add the sentence "The Lisp construct `1d-5` is the double-precision value 10^{-5}." (It would probably be better to define and use a global variable *accuracy* with that value and to do so with a long-float `1L-5` so as not to introduce an unneeded Lisp data type..)

235. (2) Page 367, line 6 of **sunset-in-haifa: Change this line to

```
      (sunset date haifa)
```

(see errata 166 and 242).

*236. (2) Page 375, **paris**: Replace with

```
(defconstant paris
  ;; TYPE location
  ;; Location of Paris Observatory.  Longitude corresponds
  ;; to difference of 9m 21s between Paris time zone and
  ;; Universal Time.
  (location (angle 48 50 11) (angle 2 20 15) (mt 27) 1))
```

See also Errata 182 and 221. (Courtesy of Ehssan Dabal, April 10, 2002.)

237. (2) Page 376, **modified-french-from-fixed**: This function was correct in our files (and on the CD), but somehow an old version got into the book! Replace with:

```
(defun modified-french-from-fixed (date)
  ;; TYPE fixed-date -> french-date
  ;; French Revolutionary date (year month day) of fixed
  ;; date.
  (let* ((approx   ; Approximate year (may be off by 1).
          (1+ (quotient (- date french-epoch -2)
                        1460969/4000)))
         (year (if (< date
                      (fixed-from-modified-french
                       (french-date approx 1 1)))
                   (1- approx)
                 approx))
         (month    ; Calculate the month by division.
          (1+ (quotient
               (- date (fixed-from-modified-french
                        (french-date year 1 1)))
               30)))
         (day      ; Calculate the day by subtraction.
          (1+ (- date
                 (fixed-from-modified-french
                  (french-date year month 1))))))
    (french-date year month day)))
```

See also Erratum 237.

**238. (2) Page 386, line 26 of `fixed-from-hindu-solar`: Change this line to

```
       (next d (- tau 2)
```

239. Page 392, line 2 of `sacred-wednesdays`: Change parameter type from `gregorian-year` to `(fixed-date fixed-date)`. (Courtesy of Jonathan Leffler, March 22, 2002.)

240. Page 395: For an explanation of our choice of dates in Appendix C, send an empty email message to `reingold@iit.edu` with subject field "send-dates-explanation".

241. Pages 396–400: Add the equation numbers and pages to the column headings to indicate which functions' output is given. It would be a nice idea to number the tables too. (Courtesy of Peter Zilahy Ingerman, May 20, 2002.)

**242. (2) Page 397: All the future Bahai dates need to be incremented by 1, to agree with the change indicated in errata 166 and 235. All the Islamic Observational dates need to be decremented by 1 to agree with the change indicated in erratum 168. The corrected table is given as Table 242-A.

*243. (2) Page 399: There are minor changes for "Next Zhongqi" for R.D. 626596 and R.D. 645554 caused by the error in **ephemeris-correction** for 1701–1799 (erratum 138). The correct values are 626626.467423 and 645556.325334, respectively.

*244. (2) Page 400: There are several problems with the table. First, because of the correction to the latitude of Paris (see errata 182, 221, and 236), the column with subheading "Dawn in Paris"is wrong and all the entries change in that column (there are now three dates for which astronomical dawn does not occur in Paris). Second, because of careless rounding, all fractional times are 1/2 second off. Third, there are minor changes in all columns for R.D. 626596 and R.D. 645554 caused by the error in **ephemeris-correction** for 1700–1799 (erratum 138). Finally, the heading "Next Summer Solstice" is wrong, it should be "Next Solstice/Equinox" and it and the heading "Next New Moon" should say "(R.D. Moment)", not "(U.T.)". The corrected table is given as Table 244-A.

245. (2) Page 403, line 3 of second quote: Delete extraneous "of". (Courtesy of Idan Dershowitz, November 28, 2001.)

R.D.	Ethiopic			Islamic						Bahá'í										Mayan								
				Arithmetic			Observational			Western					Future					Long Count					Haab		Tzolkin	
−214193	−594	12	6	−1245	12	9	−1245	12	11	−6	6	3	7	12	−6	6	3	7	11	6	8	3	13	9	11	12	5	9
−61387	−175	4	12	−813	2	23	−813	2	25	−5	9	3	14	13	−5	9	3	14	13	7	9	8	3	15	5	3	9	15
25469	63	1	29	−568	4	1	−568	4	2	−4	2	13	10	17	−4	2	13	10	18	8	1	9	8	11	4	9	12	11
49217	128	2	5	−501	4	6	−501	4	7	−4	6	2	11	6	−4	6	2	11	6	8	4	15	7	19	5	12	9	19
171307	462	5	12	−157	10	17	−157	10	18	−3	4	13	16	9	−3	4	13	16	10	9	1	14	10	9	14	12	3	9
210155	568	9	23	−47	6	3	−47	6	3	−3	10	6	4	4	−3	10	6	4	5	9	7	2	8	17	4	5	7	17
253427	687	3	11	75	7	13	75	7	13	−3	16	10	13	7	−3	16	10	13	7	9	13	2	12	9	14	7	2	9
369740	1005	8	24	403	10	5	403	10	5	−2	14	6	2	17	−2	14	6	2	17	10	9	5	14	2	8	5	4	2
400085	1088	9	23	489	5	22	489	5	22	−2	18	13	4	8	−2	18	13	4	9	10	13	10	1	7	10	15	7	7
434355	1182	7	20	586	2	7	586	2	7	−1	4	12	1	3	−1	4	12	1	3	10	18	5	4	17	8	15	9	17
452605	1232	7	7	637	8	7	637	8	7	−1	7	4	19	9	−1	7	4	19	10	11	0	15	17	7	8	15	7	7
470160	1280	7	30	687	2	20	687	2	21	−1	9	15	1	13	−1	9	15	1	14	11	3	4	13	2	10	10	12	2
473837	1290	8	25	697	7	7	697	7	7	−1	10	6	2	19	−1	10	6	3	1	11	3	14	16	19	11	17	10	19
507850	1383	10	10	793	7	1	793	6	30	−1	15	4	5	8	−1	15	4	5	8	11	8	9	7	12	15	5	2	12
524156	1428	5	29	839	7	6	839	7	6	−1	17	10	17	16	−1	17	10	17	16	11	10	14	12	18	9	6	6	18
544676	1484	8	5	897	6	1	897	6	2	0	1	10	2	1	0	1	10	2	2	11	13	11	12	18	13	6	12	18
567118	1546	1	12	960	9	30	960	9	30	0	4	14	10	12	0	4	14	10	12	11	16	14	1	0	3	18	3	20
569477	1552	6	29	967	5	27	967	5	27	0	5	1	19	4	0	5	1	19	4	11	17	0	10	19	12	7	9	19
601716	1640	10	6	1058	5	18	1058	5	18	0	9	14	5	6	0	9	14	5	7	12	1	10	2	18	18	6	8	18
613424	1672	10	26	1091	6	2	1091	6	3	0	11	8	6	7	0	11	8	6	8	12	3	2	12	6	1	9	3	6
626596	1708	11	19	1128	8	4	1128	8	4	0	13	6	7	12	0	13	6	7	13	12	4	19	4	18	3	1	6	18
645554	1760	10	14	1182	2	3	1182	2	4	0	16	1	5	15	0	16	1	5	16	12	7	11	16	16	1	19	10	16
664224	1811	11	27	1234	10	10	1234	10	10	0	18	14	8	2	0	18	14	8	2	12	10	3	14	6	4	14	12	6
671401	1831	7	19	1255	1	11	1255	1	11	0	19	15	1	7	0	19	15	1	7	12	11	3	13	3	16	16	13	3
694799	1895	8	11	1321	1	21	1321	1	20	1	4	3	2	11	1	4	3	2	10	12	14	8	13	1	18	14	11	1
704424	1921	12	19	1348	3	19	1348	3	19	1	5	10	9	6	1	5	10	9	6	12	15	15	8	6	7	4	3	6
708842	1934	1	19	1360	9	8	1360	9	7	1	6	3	11	3	1	6	3	11	3	12	16	7	13	4	9	2	1	4
709409	1935	8	11	1362	4	13	1362	4	14	1	6	5	2	11	1	6	5	2	11	12	16	9	5	11	19	4	9	11
709580	1936	1	26	1362	10	7	1362	10	7	1	6	5	11	11	1	6	5	11	11	12	16	9	14	2	9	10	11	2
727274	1984	7	8	1412	9	13	1412	9	12	1	8	15	19	16	1	8	15	19	17	12	18	18	16	16	18	4	12	16
728714	1988	6	17	1416	10	5	1416	10	5	1	8	19	18	19	1	8	19	18	19	12	19	2	16	16	17	4	9	16
744313	2031	3	1	1460	10	12	1460	10	12	1	11	5	13	7	1	11	5	13	8	13	1	6	4	15	12	8	8	15
764652	2086	11	11	1518	3	5	1518	3	5	1	14	4	7	6	1	14	4	7	7	13	4	2	13	14	7	7	2	14

Table 242-A: Replacement for page 397 (see erratum 242).

R.D.	Solar Longitude at 12:00:00 U.T. (degrees)	Next Solstice/Equinox (R.D. Moment)	Lunar Longitude at 00:00:00 U.T. (degrees)	Next New Moon (R.D. Moment)	Dawn in Paris 48.84° N, 2.34° E, 27m (Standard Time)	Sunset in Jerusalem 31.8° N, 35.2° E, 800m (Standard Time)
−214193	119.474975	−213857.885383	245.036581	−214174.621008	0.095291 = 02:17:13	0.780311 = 18:43:39
−61387	254.252390	−61094.447554	209.009373	−61383.008248	0.277377 = 06:39:25	0.697040 = 16:43:44
25469	181.435260	25833.305203	213.821493	25495.802668	0.203567 = 04:53:08	0.734627 = 17:37:52
49217	188.662093	49574.080827	292.104807	49238.497566	0.212228 = 05:05:36	0.728250 = 17:28:41
171307	289.089403	171653.984713	156.851211	171318.433031	0.286372 = 06:52:23	0.708501 = 17:00:15
210155	59.119357	210459.464587	108.104381	210180.687915	0.096282 = 02:18:39	0.773952 = 18:34:29
253427	228.316498	253744.632597	39.417290	253442.854298	0.253733 = 06:05:23	0.700597 = 16:48:52
369740	34.466872	370070.362106	98.661798	369763.737893	0.149459 = 03:35:13	0.762484 = 18:17:59
400085	63.193926	400385.467959	333.062297	400091.570277	0.088475 = 02:07:24	0.776532 = 18:38:12
434355	2.462920	434718.238937	92.338110	434376.571202	0.209207 = 05:01:15	0.747826 = 17:56:52
452605	350.480679	452891.033496	78.211911	452627.186209	0.228544 = 05:29:06	0.742269 = 17:48:52
470160	13.502229	470512.003485	275.018078	470167.573455	0.189851 = 04:33:23	0.752843 = 18:04:06
473837	37.407733	474164.418920	128.420669	473858.848230	0.143912 = 03:27:14	0.764151 = 18:20:23
507850	81.030567	508131.957615	89.563254	507878.663442	**bogus**	0.783796 = 18:48:40
524156	313.862451	524478.621610	24.636880	524179.244329	0.272360 = 06:32:12	0.722257 = 17:20:03
544676	19.955639	545021.433864	53.507927	544702.752301	0.178064 = 04:16:25	0.755877 = 18:08:28
567118	176.060000	567394.307115	187.910712	567146.512283	0.196839 = 04:43:27	0.739393 = 17:44:44
569477	344.923458	569768.743350	320.182580	569479.202529	0.236577 = 05:40:40	0.739394 = 17:44:44
601716	79.964907	601999.244898	314.044964	601727.033423	0.045754 = 01:05:53	0.783812 = 18:48:41
613424	99.302275	613779.989199	145.475718	613449.761986	**bogus**	0.786840 = 18:53:03
626596	121.535304	626928.688049	185.032179	626620.369647	0.105596 = 02:32:04	0.781720 = 18:45:41
645554	88.567429	645828.317248	142.190205	645579.076668	**bogus**	0.786063 = 18:51:56
664224	129.289884	664548.570941	253.744068	664242.886600	0.122463 = 02:56:21	0.777882 = 18:40:09
671401	6.146911	671760.527969	151.649135	671418.970437	0.202855 = 04:52:07	0.749426 = 17:59:10
694799	28.251993	695136.040368	287.987873	694807.563367	0.162578 = 03:54:07	0.759976 = 18:14:22
704424	151.780633	704725.161646	25.626767	704433.491161	0.163288 = 03:55:08	0.761652 = 18:16:47
708842	185.945867	709201.678015	290.288335	708863.596972	0.208697 = 05:00:31	0.730378 = 17:31:45
709409	28.555608	709745.741746	189.913174	709424.404926	0.162019 = 03:53:18	0.760136 = 18:14:36
709580	193.347892	709932.167421	284.931761	709602.082675	0.216911 = 05:12:21	0.723741 = 17:22:11
727274	357.151263	727553.613128	152.339165	727291.209381	0.217686 = 05:13:28	0.745097 = 17:52:56
728714	336.170709	729014.587352	51.662475	728737.447666	0.247980 = 05:57:05	0.734479 = 17:37:39
744313	228.185702	744630.158285	26.691872	744329.573169	0.251892 = 06:02:43	0.699539 = 16:47:20
764652	116.439301	764990.025958	175.500487	764676.191300	0.094957 = 02:16:44	0.784233 = 18:49:18

Table 244-A: Replacement for page 400 (see erratum 244).

246. Page 416: The Lisp code for **molad** is on page 338, not page 337 as given in the index entry.

247. Add index entries for Easter (page 116), Mayan New Year (page 140), Kamasan, Bali (page 152), Paris (page 232), and Stewart Brand (page 302).

248. Page 420: Delete page 114 from the index entry for Spier.

249. Add index entries for Nathan ben Meir Hademer, Henri Bach, Jean-Pierre Rieb, Robert Wilhelm, and James F. Brison (back cover).

250. Back cover, lower lefthand corner: Nathan ben Meir Hademer's dials cover the range of years 1598–1770. (Courtesy of John Cross, February 18, 2002.)

251. CD: In addition to all the starred code changes above, the following items refer specifically to the compact disc supplied with the book:

    (a) (2) In the Java code **HinduSolar.java**, the definition

    ```
    public static final Location UJJAIN =
    new Location("Ujjain, India", angle(23, 9, 0), angle(75, 46, 0),
                 mt(0), 5 + 8d/75);
    ```

    should be

    ```
    public static final Location UJJAIN =
    new Location("Ujjain, India", angle(23, 9, 0), angle(75, 46, 6),
                 mt(0), 5 + 461d/9000);
    ```

    This only affects the computation of **altSunrise** (which is not otherwise used in the code). Similarly, in the Mathematica code, instead of

    ```
    Ujjain = Location["Ujjain, India", Angle[23, 9, 0], Angle[75, 46, 0],
                      Mt[0], 5 + 8/75]
    ```

    we need

    ```
    Ujjain = Location["Ujjain, India", Angle[23, 9, 0], Angle[75, 46, 6],
                      Mt[0], 5 + 461/9000]
    ```

    which affects **AltHinduSunrise**.

    (b) The CD will probably not work under Windows 95 because of insufficient support for long names.

    (c) (2) Four Java documentation files have names that are too long for the Macintosh, so links to them do not work.

    (d) Some files may not have the ideal creator codes for the Macintosh.

    (e) Some text files have newlines; others do not.

    (f) As in the book, all date conversions by the applet are as of noon.

    (g) The applet will not always work for dates that are more than 10,000 years before/after the present.

    (h) As emphasized in the book, the Observational Islamic code based on visibility from Cairo in the applet can only approximate actual practice.

    (i) As emphasized in the book, the modern Hindu calendars are subject to many regional differences; our applet follows one variant.

    (j) Viewing the applet requires a Java-enabled browser or an applet viewer.

    (k) Netscape on a Macintosh needs to be set up properly for the applet to work (because of insufficient Java support). Make certain that Netscape is using a full Java runtime environment (available at `http://www.apple.com/java`) and that your browser is using the required Netscape MRJ plugin (`http://www.mozilla.org/oji/MRJPlugin.html`).

    (l) The iCAB browser for the Mac does not size the applet properly.

    (m) The applet does not necessarily print the displayed date on your browser.

(n) The applet will not work on the Hebrew-enabled Mac Explorer because it does not support Java. An unofficial patch is at `http://purl.oclc.org/NET/Mitz/mrjfix`.

(o) Unicode fonts are needed to view the month names all the languages, but no available font is complete.

(p) We mainly use a visual left-to-right encoding of the month names, without ligatures. So some languages may not display properly with some browsers and/or some systems.

(q) Netscape under Hebrew-enabled Windows does not display right-to-left month names as desired.

(r) We should "freeze" the row and column headers in the spreadsheets on the CD.

(s) In the Java code **Ecclesiastical.java**, replace the line

```
+ 30 * quotient((7 * gYear) - 8, 19)
```

in the definition of the function **altOrthodoxEaster** with

```
+ 30 * quotient((7 * gYear) + 8, 19)
```

(Courtesy of Mark Woolcott, November 5, 2002.)

(t) In the Java code **French.java**, replace the lines

```
"Jour du Labour",
"Jour de la Recompense",
```

in the definition of the constant **decadeNames** with

```
"Jour du Travail",
"Jour des Recompenses",
```

The same change is needed in the Mathematica code in **SpecialDayNames[French, ASCII]**. See Erratum 181.

Copies of the revised CD are available from the authors.

The dates that errata were added to the list or last modified are as follows:

2001/07/01: 1–3, 7, 8, 12, 13, 22, 32, 48, 56, 57, 59, 65, 66, 82, 84, 93, 95, 103, 104, 111, 119, 120, 134, 135, 139, 164–169, 172, 175, 178, 179, 185, 192, 198, 205–207, 211, 212, 223, 225, 235, 242, 246, 247, 249.
2001/08/07: 102.
2001/11/07: 10, 29, 67.
2001/11/13: 21, 24, 130, 148, 171.
2001/11/27: 137, 147.
2001/11/28: 245.
2001/11/29: 85.
2001/11/30: 80.
2001/12/03: 208.
2001/12/23: 34–36, 38–40, 118.
2001/12/31: 44, 51, 52, 54, 60–63, 68, 69.
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2002/01/25: 127.
2002/01/28: 115.
2002/01/30: 188.
2002/02/05: 43, 53, 72, 74, 76–78, 83, 87.
2002/02/06: 112, 117.
2002/02/08: 136, 140, 152.
2002/02/12: 132, 133.
2002/02/13: 161.
2002/02/14: 125, 163, 187.
2002/02/16: 124.
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2002/02/20: 176, 190.
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2002/03/01: 150.
2002/03/14: 128, 138, 243.
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2002/03/20: 89.
2002/03/21: 30, 113.
2002/03/22: 219, 239.
2002/03/26: 122.
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2002/04/02: 129, 213–216, 226, 228, 229.
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2002/04/28: 94, 210, 230.
2002/04/29: 199, 203, 204.
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2002/05/02: 41, 88, 90–92, 96, 98, 100, 108, 109, 116, 183, 193.
2002/05/03: 20, 126, 234.
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2002/06/17: 114, 159, 174, 186.
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2002/06/21: 173.
2002/07/05: 14, 244.
2002/07/09: 141, 170.
2002/07/23: 162.
2002/07/25: 177.
2002/08/19: 99, 201.
2002/08/28: 6, 146.
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2002/12/03: 153.
2003/01/14: 181.
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