Astronomy From Å to ZZ — Howard L. Cohen

A Brief Column for the Beginning Stargazer Introducing a New Astronomical Term Each Month

Astronomy is rich with terminology. This column will help beginning stargazers ease into the world of astronomy by *briefly introducing* a new but *basic astronomical term* (word, acronym or abbreviation) each month. This list, which began January 1999 with the letter *a*, is alphabetical but uses successive letters for each month's entry. (We will return to the letter *a* after twenty-six months.)

Word of the Month for December 1999

leap year A year inserted into a calendar to make the calendar correspond to a solar (tropical) year. Usually the intercalary year contains an extra day as in the Gregorian (Civil or Common) calendar or contains an extra month as in the Hebrew (Jewish calendar).

Intercalary rules depend on the calendar and can be simple or complex. The Julian calendar (introduced in 46 B.C.E.) adds an extra day to February every fourth year (for years *exactly divisible by four*). However, this rule still allows the Julian calendar to accumulate an error of one day in about 128 years.

The Gregorian calendar (now almost universally accepted) uses the same leap year rule as the Julian calendar but only adds an extra day in century years (1800, 1900, 2000, etc.) *if the century year is exactly divisible by 400*. **Thus, the year 1900 was not a leap year but the year 2000 will have an extra day.** Even with this modification, the Gregorian calendar still accumulates an error of one day in about 3,000 years.

Although other adjustments to this leap year system have been proposed, none has been made. For example, a "modified" Gregorian calendar could have a millennium year (1000, 2000, 3,000, 4,000, etc.) be a leap years *if not exactly divisible by 4,000*. This calendar would accumulate a one day error about every 15,000 years. Further altering the leap year rule by also including a rule that *a millennium year is a leap year if not exactly divisible by 10,000* could

reduce the error to one day in about 100,000 years. However, all this is hypothetical since the length of the tropical year is itself not constant.

The Gregorian calendar, introduced by Pope Gregory XIII in 1582, was gradually adopted by countries over the next several centuries. For example, Britain and the America colonies did not adopt the Gregorian calendar until 1752. And the U.S.S.R. did not adopt the Gregorian calendar for civil use until 1918.

Finally, the Orthodox Oriental Churches replaced the Julian calendar in 1923 by a modified Gregorian calendar for the Eastern churches. This *Easter Orthodox calendar* uses a different leap year rule for century years: *century years are leap years only if divisible by 900 and the remainder is either two or six*. This calendar is slightly improved over the Gregorian calendar since it only accumulates a one day error in about 30,000 years. The Eastern Orthodox calendar and the Gregorian calendars *will diverge in 2800 C.E.*, which will be a leap year in the Gregorian calendar but not in the Eastern Orthodox.

Other calendars add extra days in other ways. For example, the Islamic calendar, which is a lunar calendar, adds a thirtieth day to the twelfth month (Dhu al-Hijjah) eleven times over a thirty-year cycle (in years 2, 5, 7, 10, 13, 16, 18, 21, 24, 26 and 29).

In some calendars a leap year does not mean intercalating an extra day but an *entire month*. In a sense, these leap years are "long years." An example is the Hebrew calendar, a lunisolar calendar that adds a thirty-day month seven times in the nineteen-year *Metonic cycle* (in years 3, 6, 8, 11, 14, 17 and 19). ✿

References. J. Mitton 1991, *Concise Dictionary of Astronomy* (Oxford Univ. Press); I. Ridpath 1997, *A Dictionary of Astronomy* (Oxford Univ. Press); *Explanatory Supplement to the Ephemeris*, 1961; *Explanatory Supplement to the Astronomical Almanac*, 1992, ed. P.K. Seidelmann.