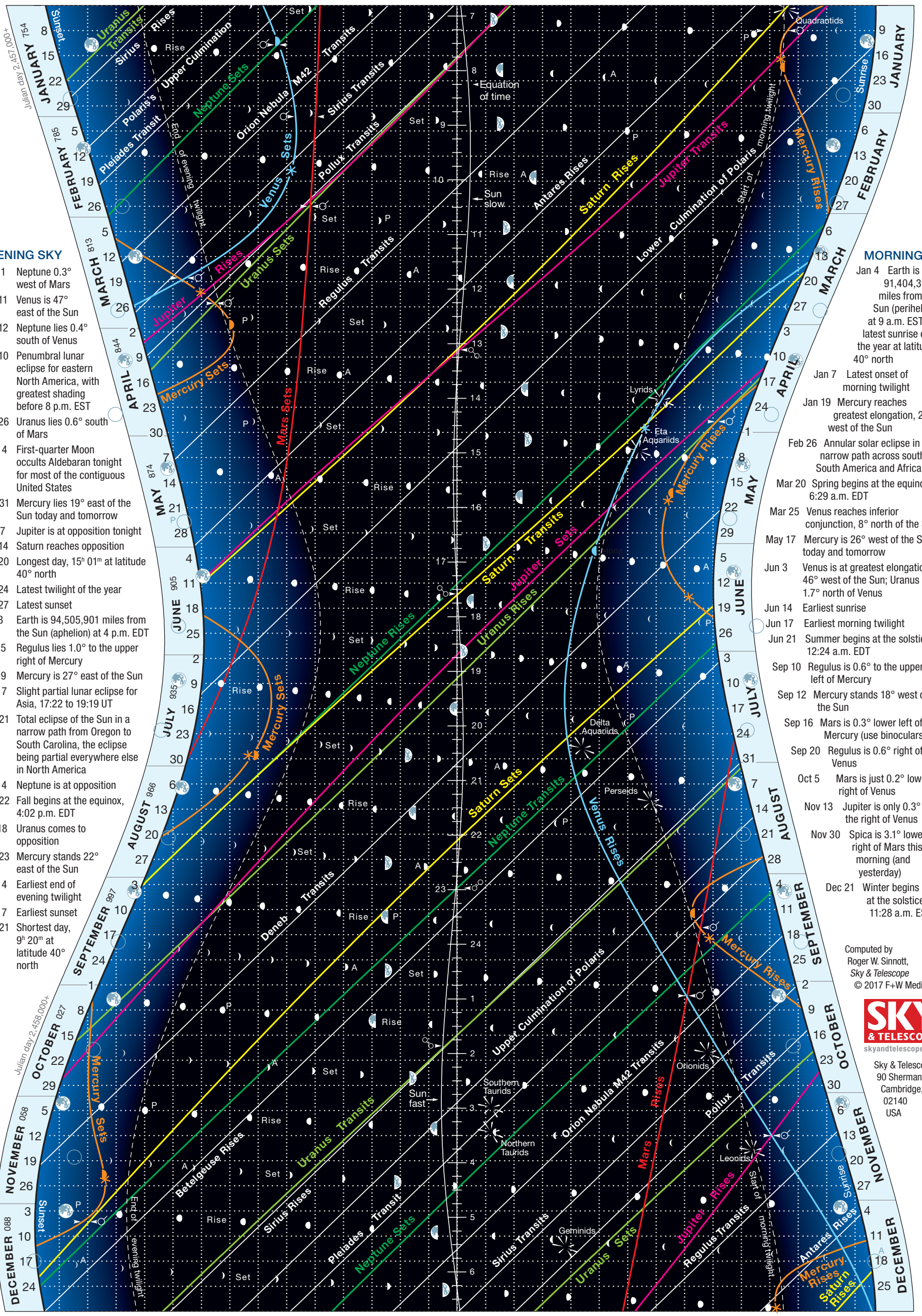
Skygazer's Almanac

40° N 2017

FOR LATITUDES NEAR 40° NORTH

A SUPPLEMENT TO *SKY & TELESCOPE*



EVENING SKY

- Jan 1 Neptune 0.3° west of Mars
- Jan 11 Venus is 47° east of the Sun
- Jan 12 Neptune lies 0.4° south of Venus
- Feb 10 Penumbral lunar eclipse for eastern North America, with greatest shading before 8 p.m. EST
- Feb 26 Uranus lies 0.6° south of Mars
- Mar 4 First-quarter Moon occults Aldebaran tonight for most of the contiguous United States
- Mar 31 Mercury lies 19° east of the Sun today and tomorrow
- Apr 7 Jupiter is at opposition tonight
- Jun 14 Saturn reaches opposition
- Jun 20 Longest day, 15h 01m at latitude 40° north
- Jun 24 Latest twilight of the year
- Jun 27 Latest sunset
- Jul 3 Earth is 94,505,901 miles from the Sun (aphelion) at 4 p.m. EDT
- Jul 25 Regulus lies 1.0° to the upper right of Mercury
- Jul 29 Mercury is 27° east of the Sun
- Aug 7 Slight partial lunar eclipse for Asia, 17:22 to 19:19 UT
- Aug 21 Total eclipse of the Sun in a narrow path from Oregon to South Carolina, the eclipse being partial everywhere else in North America
- Sep 4 Neptune is at opposition
- Sep 22 Fall begins at the equinox, 4:02 p.m. EDT
- Oct 18 Uranus comes to opposition
- Nov 23 Mercury stands 22° east of the Sun
- Dec 4 Earliest end of evening twilight
- Dec 7 Earliest sunset
- Dec 21 Shortest day, 9h 20m at latitude 40° north

MORNING SKY

- Jan 4 Earth is 91,404,322 miles from the Sun (perihelion) at 9 a.m. EST; latest sunrise of the year at latitude 40° north
- Jan 7 Latest onset of morning twilight
- Jan 19 Mercury reaches greatest elongation, 24° west of the Sun
- Feb 26 Annular solar eclipse in a narrow path across southern South America and Africa
- Mar 20 Spring begins at the equinox, 6:29 a.m. EDT
- Mar 25 Venus reaches inferior conjunction, 8° north of the Sun
- May 17 Mercury is 26° west of the Sun today and tomorrow
- Jun 3 Venus is at greatest elongation, 46° west of the Sun; Uranus is 1.7° north of Venus
- Jun 14 Earliest sunrise
- Jun 17 Earliest morning twilight
- Jun 21 Summer begins at the solstice, 12:24 a.m. EDT
- Sep 10 Regulus is 0.6° to the upper left of Mercury
- Sep 12 Mercury stands 18° west of the Sun
- Sep 16 Mars is 0.3° lower left of Mercury (use binoculars)
- Sep 20 Regulus is 0.6° right of Venus
- Oct 5 Mars is just 0.2° lower right of Venus
- Nov 13 Jupiter is only 0.3° to the right of Venus
- Nov 30 Spica is 3.1° lower right of Mars this morning (and yesterday)
- Dec 21 Winter begins at the solstice, 11:28 a.m. EST

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Skygazer's Almanac 40° N 2017

FOR LATITUDES NEAR 40° NORTH

What's in the sky tonight?

When does the Sun set, and when does twilight end? Which planets are visible? What time does the Moon rise?

Welcome to the *Skygazer's Almanac 2017,* a handy chart that answers these and many other questions for every night of the year. It is plotted for skywatchers near latitude 40° north — in the United States, Mediterranean countries, Japan, and much of China.

For any date, the chart tells the times when astronomical events occur during the night. Dates on the chart run vertically from top to bottom. The time of night runs horizontally, from sunset at left to sunrise at right. Find the date you want on the left side of the chart, and read across toward the right to find the times of events. Times are labeled along the chart's top and bottom.

In exploring the chart you'll find that its night-to-night patterns offer many insights into the rhythms of the heavens.

The Events of a Single Night

To learn how to use the chart, consider some of the events of one night. We'll pick January 8, 2017.

First find "January" and "8" at the left edge. This is one of the dates for which a string of fine dots crosses the chart horizontally. Each horizontal dotted line represents the night from a Sunday evening to Monday morning. The individual dots are five minutes apart.

Every half hour (six dots), there is a vertical dotted line to aid in reading the hours of night at the chart's top or bottom. On the vertical lines, one dot is equal to one day.

A sweep of the eye shows that the line for the night of January 8–9 crosses many slanting *event lines*. Each event line tells when something happens.

The dotted line for January 8–9 begins at the heavy black curve at left, which represents the time of sunset. Reading up to the top of the chart, we find that sunset on January 8th occurs at 4:52 p.m. *Local Mean Time*. (All times on the chart are Local Mean Time, which can differ from your standard clock time. More on this later.)

Moving to the right, we see that evening twilight ends at 6:29 p.m., the time when the Sun is 18° below the horizon and the sky is fully dark. Then at 7:39 Polaris, the North Star, reaches upper culmination. This means it stands directly above the north celestial pole (by 40′ this year), a good time to check the alignment of an equatorial telescope.

At 8:33 p.m. the Pleiades transit the meridian, meaning the famous star cluster is due south and highest in the sky. At 8:46 the brilliant planet Venus sets in the west, followed by dim Neptune at 9:06 and red-orange Mars at 9:35.

The Great Orion Nebula (Messier 42) transits at 10:21, as does the bright star Sirius at 11:30. Transits of such celestial landmarks help indicate when they are best placed for viewing, and where the constellations are during the night.

Running vertically down the midnight line is a scale of hours. This shows the sidereal time (the right ascension of objects on the meridian) at midnight. On January 8–9 this is $7^h\ 16^m$. To find the sidereal time at any other time and date on the chart, locate that point and draw a line through it parallel to the white event lines of stars. See where your line intersects the sidereal-time scale at midnight. (A star's event line enters the top of the chart at the same time of night it leaves the bottom. Sometimes one of these segments is left out to avoid crowding.)

Near the midnight line is a white curve labeled *Equation of time* weaving narrowly right and left down the chart. If you regard the midnight line as noon for a moment, this curve shows when the Sun crosses the meridian and is due south. On January 8th the Sun runs slow, transiting at 12:07 p.m. This variation is caused by the tilt of Earth's axis and the ellipticity of its orbit.

Giant planet Jupiter rises at 12:29 a.m. and will become better placed for telescopic viewing toward dawn.

At 4:06 a.m. we see a Moon symbol, and the legend at the chart's bottom tells us it is at waxing gibbous phase, and setting. (So the night until now has been brightly moonlit.) Then at 4:49 a.m. Antares, a star we usually associate with a much later season, rises.

The ringed planet Saturn comes up at 5:26, and the first hint of dawn — the start of morning twilight — comes at 5:45. A few minutes later elusive Mercury rises, early enough before sunup that we should spot it later as it climbs higher. The Sun finally peeks above the horizon at 7:22 a.m. on January 9th.

Other Charted Information

Many of the year's chief astronomical events are listed in the chart's evening and morning margins. Some are marked on the chart itself.

Conjunctions (close pairings) of two planets are indicated on the chart by a ☌ symbol on the planets' event lines.

Here, conjunctions are considered to occur when the planets actually appear closest together in the sky (at appulse), not merely when they share the same ecliptic longitude or right ascension.

Opposition of a planet, the date when it is opposite the Sun in the sky and thus visible all night, occurs when its transit line crosses the Equation-of-time line (*not* the line for midnight). Opposition is marked there by a ☍ symbol, as is done for Jupiter on the night of April 7–8.

Moonrise and *moonset* can be told apart by whether the round limb — the outside edge — of the Moon symbol faces right (waxing Moon sets) or left (waning Moon rises). Or follow the nearly horizontal row of daily Moon symbols across the chart to find the word *Rise* or *Set*. Quarter Moons are indicated by a larger symbol. Full Moon is always a large bright disk whether rising or setting; the circle for new Moon is open. *P* and *A* mark dates when the Moon is at perigee and apogee (nearest and farthest from Earth, respectively).

Mercury and *Venus* never stray far outside the twilight bands. Their dates of greatest elongation from the Sun are shown by ◗ symbols on their rising or setting curves. Asterisks mark their dates of greatest illuminated extent in square arcseconds. In the case of Venus, this is very nearly when it is at greatest brilliancy, as on the evening of February 16th.

Meteor showers are marked by a starburst symbol on the date of peak activity and at the time when the shower's radiant is highest in the night sky. This is often just as morning twilight begins.

Julian dates can be found from the numbers just after the month names on the chart's left. The Julian day, a seven-digit number, is a running count of days beginning with January 1, 4713 BC. Its first four digits early this year are 2457, as indicated just off the chart's upper left margin. To find the last three digits for evenings in January, add 754 to the date. For instance, on the evening of January 8th we have 754 + 8 = 762, so the Julian day is 2,457,762. For North American observers this number applies all night, because the next Julian day always begins at 12:00 Universal Time (6:00 a.m. Central Standard Time).

Time Corrections

All events on this *Skygazer's Almanac* are plotted for an observer at 90° west longitude and 40° north latitude, near the population center of North America. However, you need not live near Peoria, Illinois, to use the chart. Simple corrections will allow you to get times accurate to a couple of minutes anywhere in the world's north temperate latitudes.

To convert the charted time of an event to your civil (clock) time, the following corrections must be made. They are listed in decreasing importance:

Rising or Setting Corrections

North Latitude	Declination (North or South) 0°	5°	10°	15°	20°	25°
50°	0	7	14	23	32	43
45°	0	3	7	10	14	19
40°	0	0	0	0	0	0
35°	0	3	6	9	12	16
30°	0	5	11	16	23	30
25°	0	8	16	24	32	42

• **DAYLIGHT-SAVING TIME.** When this is in effect, add one hour to any time obtained from the chart.

• **YOUR LONGITUDE.** The chart gives the *Local Mean Time* (LMT) of events, which differs from ordinary clock time by a number of minutes at most locations. Our civil time zones are standardized on particular longitudes. Examples in North America are Eastern Time, 75° W; Central, 90°; Mountain, 105°; and Pacific, 120°. If your longitude is very close to one of these (as is true for New Orleans and Denver), luck is with you and this correction is zero. Otherwise, to get standard time *add 4 minutes* to times obtained from the chart for each degree of longitude that you are *west* of your time-zone meridian. Or *subtract 4 minutes* for each degree you are *east* of it.

Local Mean Time Corrections

Atlanta	+38	Los Angeles	–7
Boise	+45	Memphis	0
Boston	–16	Miami	+21
Buffalo	+15	Minneapolis	+13
Chicago	–10	New Orleans	0
Cleveland	+27	New York	–4
Dallas	+27	Philadelphia	+1
Denver	0	Phoenix	+28
Detroit	+32	Pittsburgh	+20
El Paso	+6	St. Louis	+1
Helena	+28	Salt Lake City	+28
Honolulu	+31	San Francisco	+10
Houston	+21	Santa Fe	+4
Indianapolis	+44	Seattle	+10
Jacksonville	+27	Tulsa	+24
Kansas City	+18	Washington	+8
Athens	+25	Lisbon	+36
Baghdad	+3	Madrid	+75
Beijing	+14	New Delhi	+21
Belgrade	–22	Rome	+10
Cairo	–8	Seoul	+32
Istanbul	+4	Tehran	+4
Jerusalem	–21	Tokyo	–19

For instance, Washington, DC (longitude 77°), is 2° west of the Eastern Time meridian. So at Washington, add 8 minutes to any time obtained from the chart. The result is Eastern Standard Time.

Find your time adjustment and memorize it. The table below shows the corrections from local to standard time, in minutes, for some major cities.

• **RISING AND SETTING.** Times of rising and setting need correction if your latitude differs from 40° north. This effect depends strongly on a star or planet's declination. (The coordinates of the Sun and planets can be found in each issue of *Sky & Telescope*.)

If your site is *north* of latitude 40°, then an object with a north declination stays above the horizon *longer* than the chart shows (it rises earlier and sets later), whereas one with a south declination spends less time above the horizon. At a site *south* of 40°, the effect is just the reverse. Keeping these rules in mind, you can gauge the approximate number of minutes by which to correct a rising or setting time from the table above.

Finally, the Moon's rapid orbital motion alters lunar rising and setting times slightly if your longitude differs from 90° west. The Moon rises and sets about two minutes earlier than the chart shows for each time zone east of Central Time, and two minutes later for each time zone west of Central Time. European observers can simply shift each rising or setting Moon symbol leftward a quarter of the way toward the one for the previous night.