"Inner" planets really means all those out to Mars. Mercury and Venus are the "inferior" planets—meaning "lower," nearer than Earth to the Sun. They always appear in the Sun's general direction; we have to see them in the day or not too far into the night. Mercury, angled at no more than 28° from the Sun, hides in twilight. Venus, far brighter and separating from the Sun by up to 47°, can be found by day if you know where to look, is often visible soon after or even before sunset, and may set hours after or rise hours before the Sun. Because Mercury and Venus accompany the Sun around the sky, they every year have conjunctions with all or most of the other planets, including each other.

MERCURY

—is the solar system's innermost planet. (Vulcan, hypothetical planet even nearer to the Sun, was never found.) So it is the fastest-moving, and is also (Pluto being no longer classed as a major planet) the smallest, only 1.4 times wider than the Moon. It orbits the Sun 4.15 times a year, but from Earth, moving forward more slowly, it appears to go around 3.15 times.

These "apparitions" are very unequal because of Mercury's eccentric and inclined orbit. When it is near aphelion (farthest from the Sun), it is on the southward-sloping part of its orbit. The result is that it favors Earth's southern hemisphere. When it moves out to a large elongation (anguiar distance from the Sun), for south-hemisphere observers it does so at a steep angle or even vertically above the horizon, whereas for northerners it moves out at tantalizingly low angles.

In 2017 Mercury makes three and a half apparitions in the pre-dawn sky, alternating with three into the sunset sky. That is, in January it swings out on the westward side of the Sun (rightward, as seen from our northern hemisphere), and is in our pre-dawn sky, until it disappears behind the Sun (superior conjunction), to reappear on the eastward ("left," or evening) side in March-April; and so on.

For the north hemisphere, the best evening apparition is, as usual, in spring: the one centering on April 1. The evening ones of around Jan. 13 and Sep. 13 are good. For southerners, the May 17 morning and July 30 evening maxima of elongation allow Mercury to be seen higher above the sunrise and sunset horizons than it ever is for northerners.

VENUS

In the famous 8-year cycle (see the section about it that follows), the phenomena of 2009 recur in 2017, only 2-3 days earlier.

In January, Venus is the conspicuous "evening star," at easternmost elongation (47.2° from the Sun, a maximum that can vary from 45.4° to 47.3°). As it rushes at increasing apparent speed on its curve inward to overtake us on the inside, its shape in the telescope becomes an ever larger but thinner crescent. This swoop down the sunset skies of February and March is as in the prelude to every inferior conjunction—with the difference, in this year of the cycle, of a climax, caused by a lucky relation to the ecliptic plane. Venus crossed northward through it on Jan. 17; therefore is northernmost above the plane on March 14, and on March 25 passes 8.29° north of the Sun. The amount of this clearance is increasing as the dates of northernmost latitude and inferior conjunction get closer together: 2009 Mar. 27 8.16°, 2017 Mar. 25 8.29°, 2025 Mar. 23 8.41°, 2033 Mar. 20 8.52°, 2041 Mar. 18 8.61°, 2049 Mar. 15 8.68°.

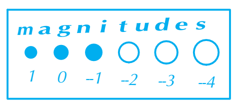
Venus reappears in the pre-dawn sky, and is the high "morning star" that will be noticed from May to October.

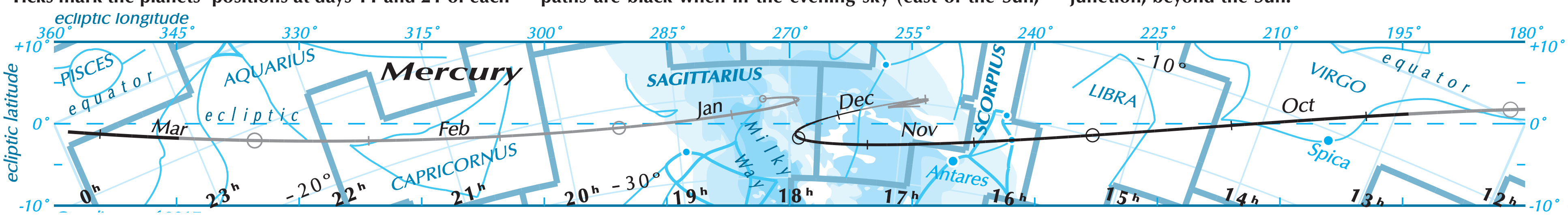
VENUS		r.a.(2000)	dec.	hedis	gedis	elo	mag	dia"
Jan 12 13	max.elong.east	22 44 49	-8 30	0.721	0.684	47	-4.4	24.5
Jan 13 2	0.4ºN of Neptune	22 46 44	-8 15	0.721	0.680	47	-4.4	24.6
Jan 17 18	ascending node	23 3 23	-6 2	0.721	0.646	47	-4.5	25.9
Feb 17 7	max.illum.area	0 25 21	7 28	0.718	0.427	40	-4.6	39.2
Feb 20 17	perihelion	0 30 14	8 38	0.718	0.405	39	-4.6	41.3
Mar 2 14	stat.in r.a.>retr	0 36 44	11 12	0.719	0.347	32	-4.6	48.2
Mar 14 6	max.lat.north	0 26 57	11 52	0.719	0.298	19	-4.3	56.2
Mar 25 10	inf.conj.with sun	0 4 3	9 29	0.720	0.281	-8	-4.0	59.6
Apr 12 24	stat.in r.a.>dir.	23 40 20	3 18	0.723	0.330	-27	-4.4	50.7
Apr 30 4	max.illum.area	23 59 38	1 30	0.725	0.435	-39	-4.5	38.5
May 9 7	descending node	0 21 30	2 20	0.726	0.502	-43	-4.5	33.4
Jun 2 15	1.8ºS of Uranus	1 40 27	8 3	0.728	0.693	-46	-4.3	24.1
Jun 3 12	max.elong.west	1 43 45	8 19	0.728	0.700	-46	-4.3	23.9
Jun 12 21	aphelion	2 19 31	11 10	0.728	0.776	-46	-4.2	21.6
Jul 5 4	max.lat.south	3 53 17	17 36	0.727	0.951	-43	-4.1	17.6
Aug 5 20	max.declin.north	6 25 7	21 59	0.724	1.180	-38	-4.0	14.2
Aug 30 11	ascending node	8 28 47	19 3	0.720	1.334	-32	-4.0	12.5
Oct 3 5	perihelion	11 10 17	6 46	0.718	1.505	-24	-3.9	11.1
Oct 5 13	0.2ºN of Mars	11 20 60	5 42	0.718	1.515	-23	-3.9	11.1
Oct 24 23	max.lat.north	12 49 42	-3 39	0.719	1.587	-19	-3.9	10.5
Nov 13 6	0.3ºN of Jupiter	14 20 22	-12 38	0.721	1.642	-14	-3.9	10.2
Dec 15 16	2.2ºS of Mercury	17 6 46	-22 41	0.726	1.698	-6	-3.9	9.9
Dec 19 24	descending node	17 30 20	-23 15	0.726	1.702	-5	-3.9	9.8
Dec 25 18	1.1ºS of Saturn	18 1 50	-23 39	0.727	1.706	-3	-3.9	9.8
Dec 28 11	max.declin.south	18 16 45	-23 42	0.727	1.708	-3	-3.9	9.8

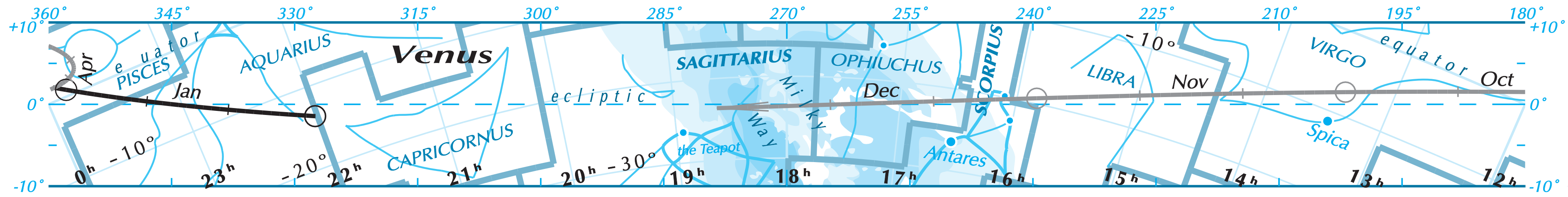
MERCURY		r.a.(2000)	dec.	hedis	gedis	elo	mag	dia"
Jan 4 20	max.lat.north	17 58 25	-20 12	0.337	0.731	-15	1.3	9.1
Jan 8 10	stat.in r.a.>dir.	17 54 6	-20 26	0.356	0.794	-20	0.5	8.4
Jan 17 9	max.illum.area	18 13 53	-21 42	0.407	0.971	-24	-0.1	6.9
Jan 19 10	max.elong.west	18 22 19	-21 58	0.417	1.009	-24	-0.2	6.6
Jan 28 6	descending node	19 7 30	-22 31	0.452	1.153	-23	-0.2	5.8
Jan 29 18	1.2ºS of Pluto	19 16 7	-22 29	0.456	1.174	-22	-0.2	5.7
Feb 7 14	aphelion	20 10 8	-21 20	0.467	1.277	-19	-0.3	5.2
Feb 27 21	max.lat.south	22 23 23	-12 17	0.412	1.381	-6	-1.1	4.8
Mar 4 5	1.1ºS of Neptune	22 53 16	-9 8	0.388	1.375	-3	-1.5	4.9
Mar 7 0	sup.conj.with sun	23 12 32	-6 55	0.372	1.363	2	-1.7	4.9
Mar 18 22	ascending node	0 35 25	3 49	0.314	1.221	11	-1.3	5.5
Mar 22 17	max.illum.area	1 0 15	7 15	0.308	1.140	15	-1.1	5.9
Mar 23 14	perihelion	1 5 45	8 0	0.308	1.119	15	-1.0	6.0
Mar 27 6	2.4ºN of Uranus	1 26 45	10 55	0.312	1.026	18	-0.7	6.5
Apr 1 10	max.elong.east	1 49 43	14 3	0.330	0.888	19	-0.0	7.5
Apr 2 19	max.lat.north	1 54 10	14 39	0.337	0.852	19	0.2	7.8
Apr 10 1	stat.in r.a.>retr	2 4 58	16 2	0.378	0.691	15	1.9	9.7
Apr 20 6	inf.conj.with sun	1 49 42	13 3	0.431	0.575	-2	5.7	11.6
Apr 26 5	descending node	1 37 9	10 7	0.452	0.573	-10	3.7	11.7
Apr 28 17	0.1ºS of Uranus	1 33 42	9 2	0.458	0.585	-13	3.0	11.4
May 2 14	stat.in r.a.>dir.	1 31 37	7 48	0.464	0.615	-18	2.1	10.9
May 6 14	aphelion	1 33 49	7 11	0.467	0.658	-22	1.5	10.2
May 7 24	2.2ºS of Uranus	1 35 38	7 8	0.466	0.675	-23	1.3	9.9
May 17 23	max.elong.west	2 1 46	8 49	0.449	0.822	-26	0.5	8.1
May 20 11	max.illum.area	2 11 27	9 42	0.440	0.864	-26	0.4	7.7
May 26 20	max.lat.south	2 41 25	12 35	0.412	0.975	-24	0.0	6.9
Jun 14 21	ascending node	4 57 27	22 40	0.314	1.285	-8	-1.5	5.2
Jun 16 16	max.illum.area	5 13 46	23 20	0.310	1.301	-6	-1.7	5.1
Jun 19 13	perihelion	5 41 6	24 10	0.308	1.319	-3	-2.1	5.1
Jun 21 14	sup.conj.with sun	6 0 41	24 32	0.309	1.324	1	-2.2	5.0
Jun 24 8	max.declin.north	6 27 14	24 43	0.315	1.322	4	-1.9	5.1
Jun 28 18	0.8ºN of Mars	7 8 24	24 18	0.332	1.299	9	-1.4	5.1
Jun 29 18	max.lat.north	7 17 25	24 5	0.337	1.290	10	-1.3	5.2
Jul 23 4	descending node	9 54 33	12 43	0.452	0.976	26	0.2	6.9
Jul 30 5	max.elong.east	10 22 19	8 48	0.465	0.871	27	0.4	7.7
Jul 30 9	max.illum.area	10 22 52	8 42	0.465	0.869	27	0.4	7.7
Aug 2 13	aphelion	10 32 10	7 8	0.467	0.823	27	0.6	8.1
Aug 12 6	stat.in r.a.>retr	10 45 29	3 46	0.454	0.695	22	1.3	9.6
Aug 22 19	max.lat.south	10 28 30	4 33	0.412	0.618	9	3.7	10.8
Aug 26 21	inf.conj.with sun	10 15 46	6 16	0.390	0.625	-4	4.8	10.7
Sep 1 24	4.1ºS of Mars	10 0 52	9 18	0.355	0.691	-11	2.6	9.7
Sep 4 16	stat.in r.a.>dir.	9 59 1	10 21	0.340	0.741	-14	1.6	9.0
Sep 10 20	ascending node	10 9 30	11 22	0.314	0.893	-18	-0.0	7.5
Sep 12 10	max.elong.west	10 15 20	11 14	0.311	0.937	-18	-0.3	7.1
Sep 15 12	perihelion	10 29 50	10 32	0.307	1.024	-17	-0.7	6.5
Sep 16 18	0.1ºN of Mars	10 36 37	10 5	0.308	1.058	-17	-0.8	6.3
Sep 19 14	max.illum.area	10 53 16	8 48	0.313	1.132	-15	-1.0	5.9
Sep 25 18	max.lat.north	11 33 24	4 54	0.337	1.264	-11	-1.2	5.3
Oct 8 21	sup.conj.with sun	12 58 54	-5 4	0.410	1.408	1	-1.5	4.7
Oct 18 15	1.0ºS of Jupiter	13 58 54	-12 3	0.450	1.425	7	-0.9	4.7
Oct 19 3	descending node	14 2 2	-12 24	0.452	1.424	7	-0.8	4.7
Oct 29 12	aphelion	15 4 32	-18 32	0.467	1.378	13	-0.5	4.9
Nov 18 18	max.lat.south	17 4 47	-25 23	0.412	1.123	21	-0.3	6.0
Nov 24 0	max.elong.east	17 31 18	-25 44	0.383	1.017	22	-0.3	6.6
Nov 24 1	max.declin.south	17 31 20	-25 44	0.383	1.017	22	-0.3	6.6
Nov 24 12	max.illum.area	17 33 27	-25 44	0.381	1.007	22	-0.3	6.6
Nov 28 10	3.1ºS of Saturn	17 48 2	-25 30	0.358	0.919	21	-0.2	7.3
Dec 3 8	stat.in r.a.>retr	17 55 54	-24 41	0.332	0.806	18	0.4	8.3
Dec 6 11	1.3ºS of Saturn	17 52 2	-23 50	0.319	0.743	14	1.3	9.0
Dec 7 20	ascending node	17 47 55	-23 23	0.314	0.721	12	1.9	9.3
Dec 12 12	perihelion	17 24 44	-21 38	0.307	0.678	2	5.0	9.9
Dec 13 2	inf.conj.with sun	17 21 19	-21 24	0.308	0.678	2	5.1	9.9
Dec 15 16	2.2ºN of Venus	17 6 47	-20 27	0.311	0.688	-7	3.4	9.7
Dec 22 17	max.lat.north	16 46 55	-19 23	0.337	0.798	-18	0.5	8.4
Dec 23 3	stat.in r.a.>dir.	16 46 52	-19 24	0.339	0.806	-19	0.4	8.3

TABLES OF PHENOMENA. Columns are: right ascension (in hours, minutes, seconds) and declination (in degrees and minutes), for epoch 2000; distance from Sun and Earth, in astronomical units; elongation from Sun (in degrees; negative means "westward"); magnitude; diameter in arc seconds. "Stat.in r.a.>dir." means "stationary in right ascension, starts to move direct (eastward)"; "retr" means retrograde (westward). "Inf." and "sup. conj." mean inferior and superior conjunction with the Sun; these divide the planet's morning and evening apparitions. Dates of greatest illuminated extent do not coincide with greatest elongation, and may be of more interest to telescopic observers. Dates of conjunctions with other planets are in right ascension.

CHARTS of the paths of Mercury and Venus, plotted in ecliptic latitude and longitude. (Plotted equatorially they would take up much more vertical space.) The more familiar grid of equatorial coordinates (right ascension and declination) is also shown, curving in relation to the ecliptic system. The ecliptic itself is marked by dashes 2° long. Ticks mark the planets' positions at days 11 and 21 of each month. At day 1 is an open circle, sized for magnitude (brightness), so that the planet can be compared with the stars. On the scale of the maps (2 cm to 15°) the planets' disks would be only a few hundredths of a millimeter wide. Mercury and Venus stay near the Sun; so they start and end each year near its winter position in Sagittarius. Their paths are black when in the evening sky (east of the Sun, left as seen from the northern hemisphere), gray in the morning sky (west or right of the Sun). Transition from black to gray is at inferior conjunction, when the planet passes in front of the Sun; gray to black at superior conjunction, beyond the Sun.

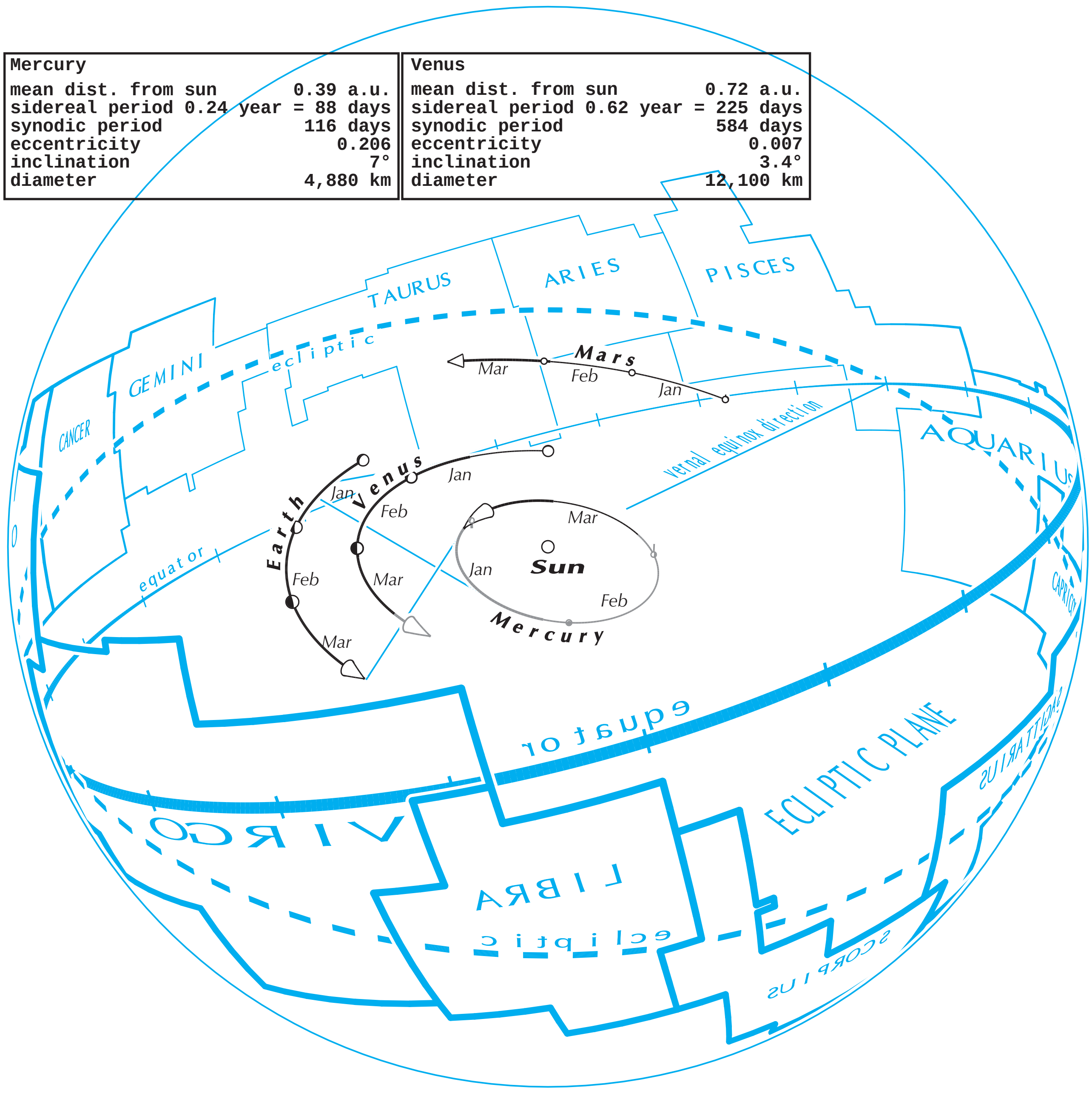


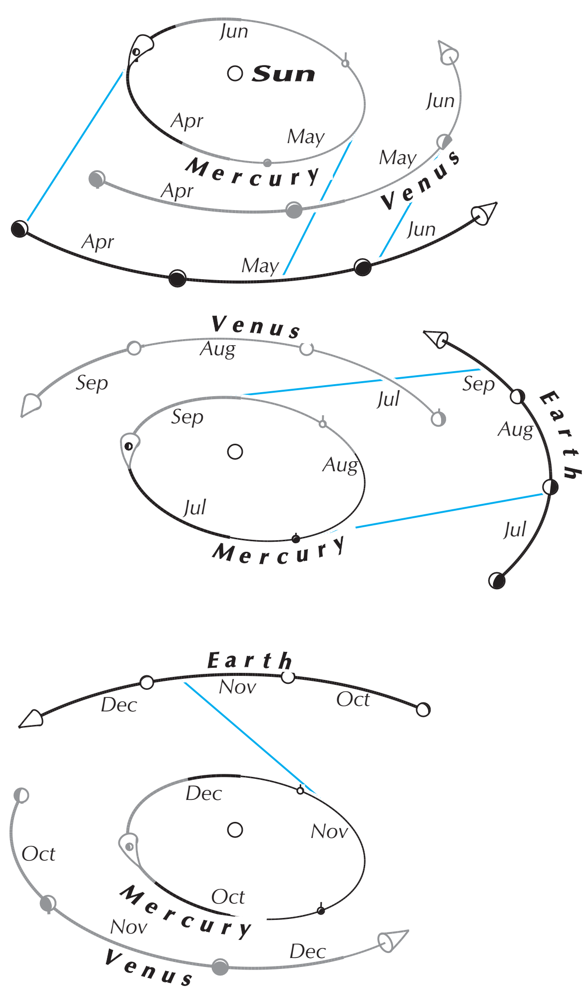




Mercury	
mean dist. from sun	0.39 a.u.
sidereal period 0.24 year = 88 days	
synodic period	116 days
eccentricity	0.206
inclination	7°
diameter	4,880 km

Venus	
mean dist. from sun	0.72 a.u.
sidereal period 0.62 year = 225 days	
synodic period	584 days
eccentricity	0.007
inclination	3.4°
diameter	12,100 km

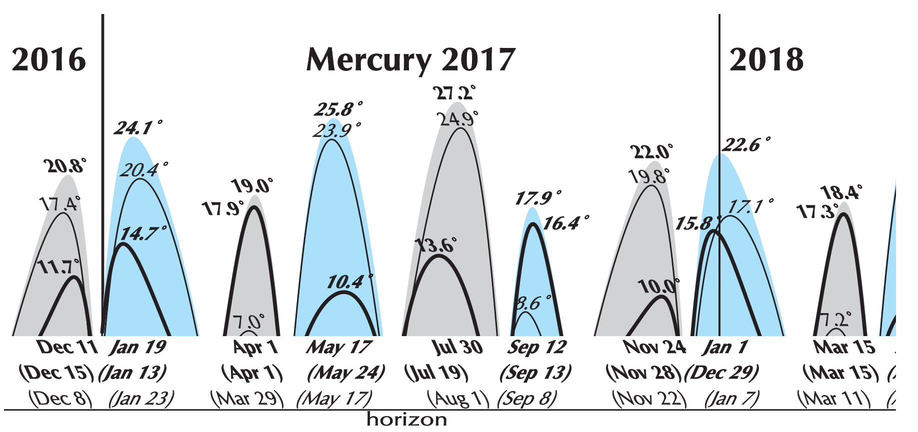


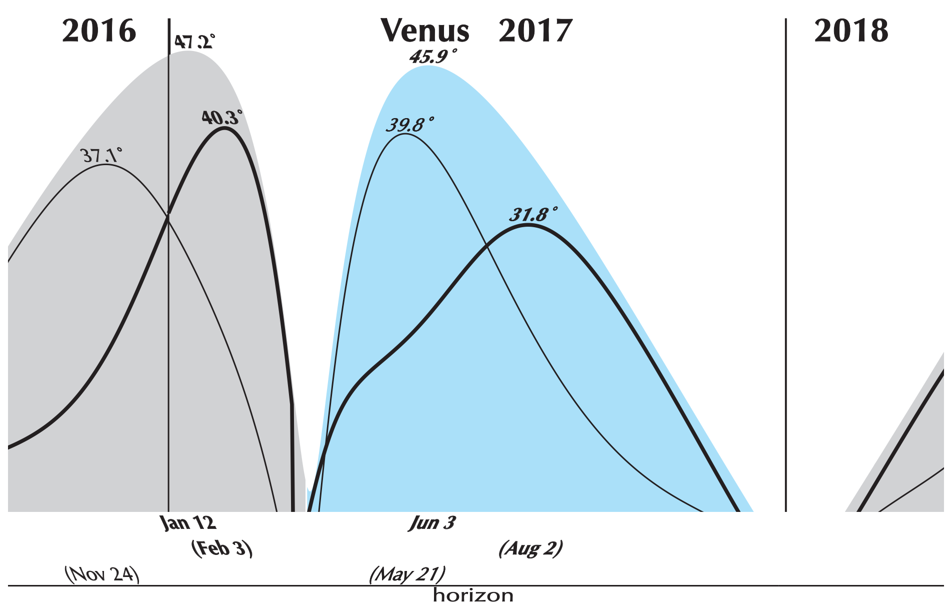


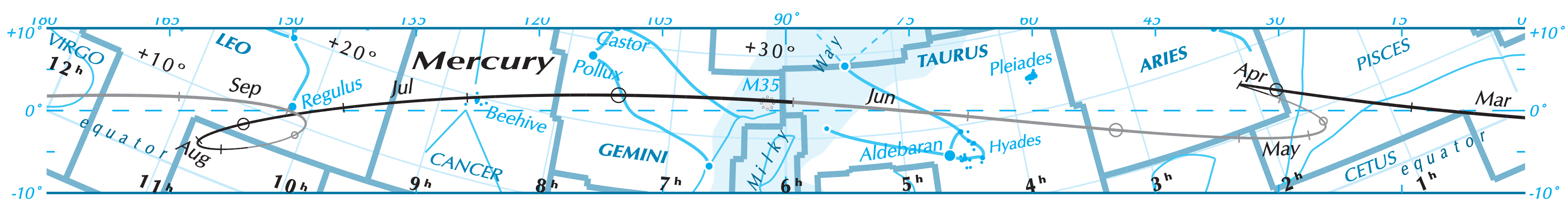
CONTINUATIONS of the motions of Mercury, Venus, and Earth in the other quarters of the year. The Earth goes around the Sun once in the year, but Venus 1.625 times and Mercury 4.15 times.

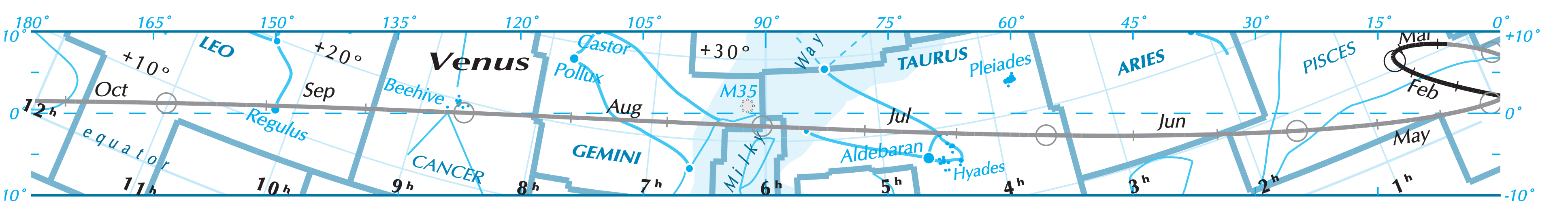
SPATIAL VIEW of the orbits of the inner planets during the first quarter of the year. This picture is heliocentric: the Sun is the fixed point and origin for measurements. The viewpoint in this and other spatial views in the book is from ecliptic longitude 230°, latitude +35°, in the head of the constellation Serpens, so that the 23½° tilt of the ecliptic plane to the equatorial plane can be seen. This view is from a distance of 6 astronomical units (a.u.) from the Sun. On an imaginary sphere, 2 a.u. out, are shown the planes of the equator and ecliptic, and the boundaries of the zodiacal constellations. The planets move nearly in the ecliptic plane, so as seen from the Earth they appear against the background of these constellations (except that part of the ecliptic, in the foreground, lies in Ophiuchus rather than Scorpius). Along the orbital paths, globes represent the planets at the start of each month. Their size is exaggerated 500 times, the Sun's only 5 times. When a planet is in or north of the ecliptic plane, its path is drawn with a thicker line. When it is in the morning sky (west of the Sun) as seen from the Earth, its course is shown in gray.

MERCURY AND VENUS APPARITI[G1]ONS compared. Blue areas represent morning apparitions (westward elongation); gray, evening apparitions (eastward). The top figures are the maximum elongations (angular distances the planet attains from the Sun), reached at the top dates shown beneath. Curves show the altitude of the planet above the horizon at sunrise or sunset, for latitude 40° north (thick line) and 35° south (thin), with maxima reached at the parenthesized dates below (40° north bold).

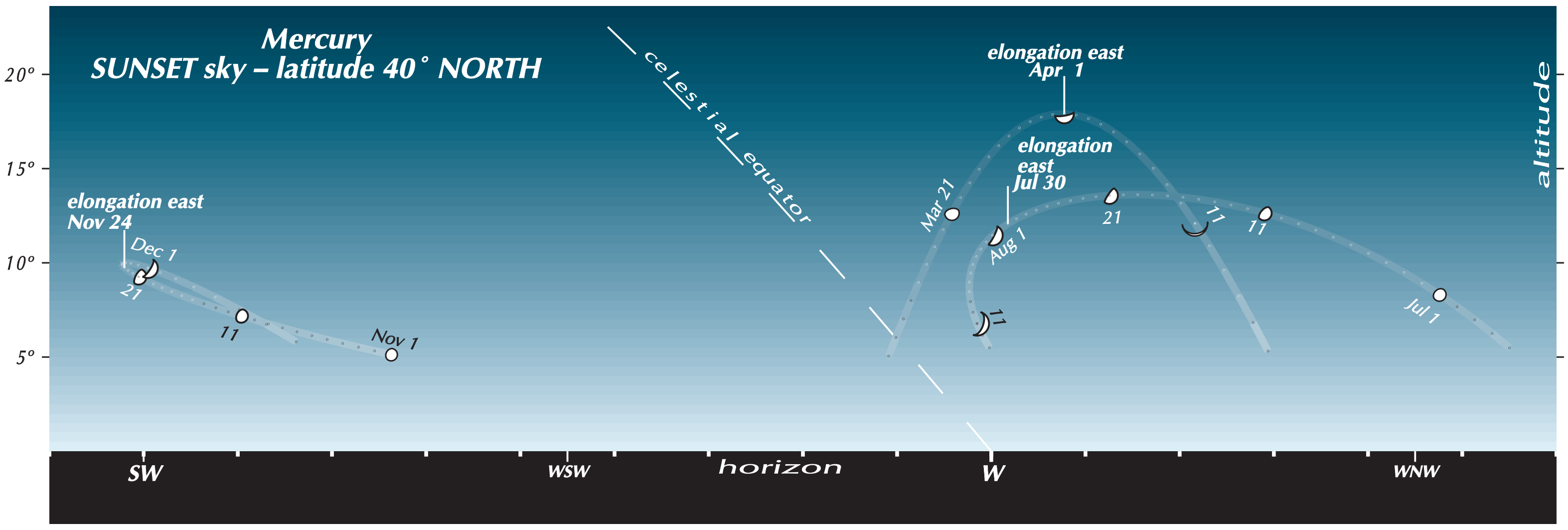


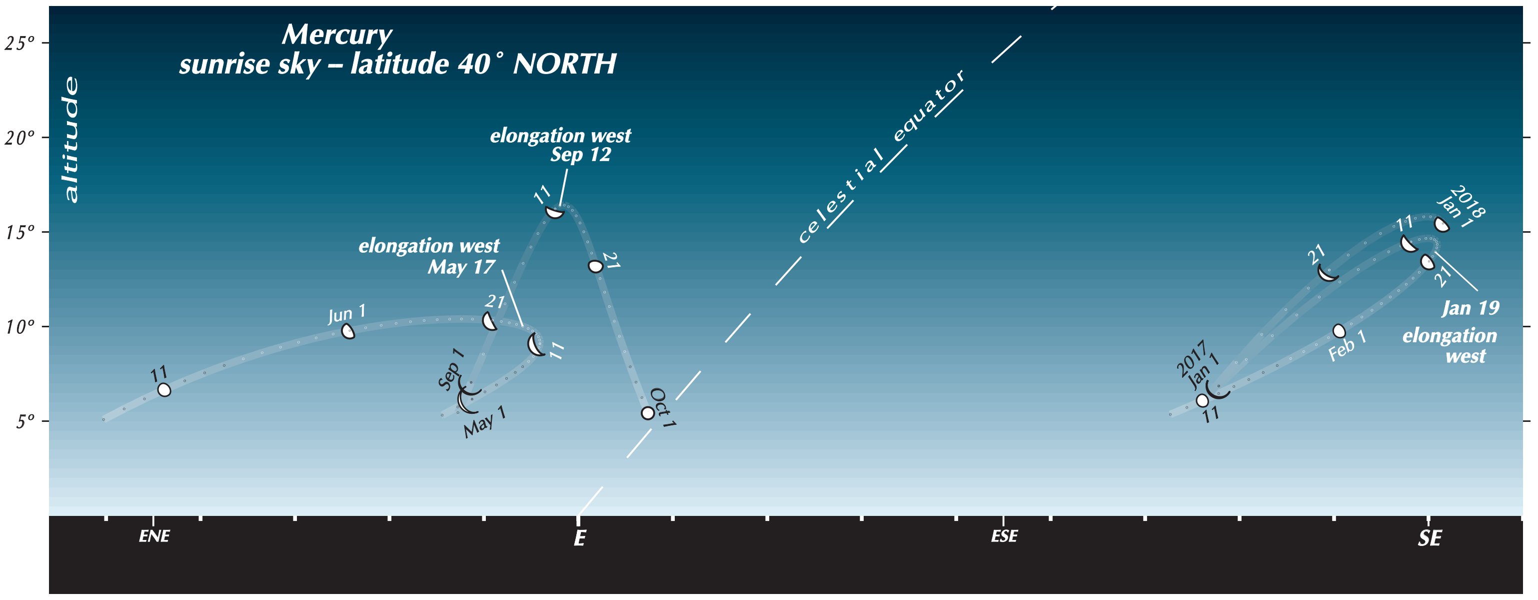


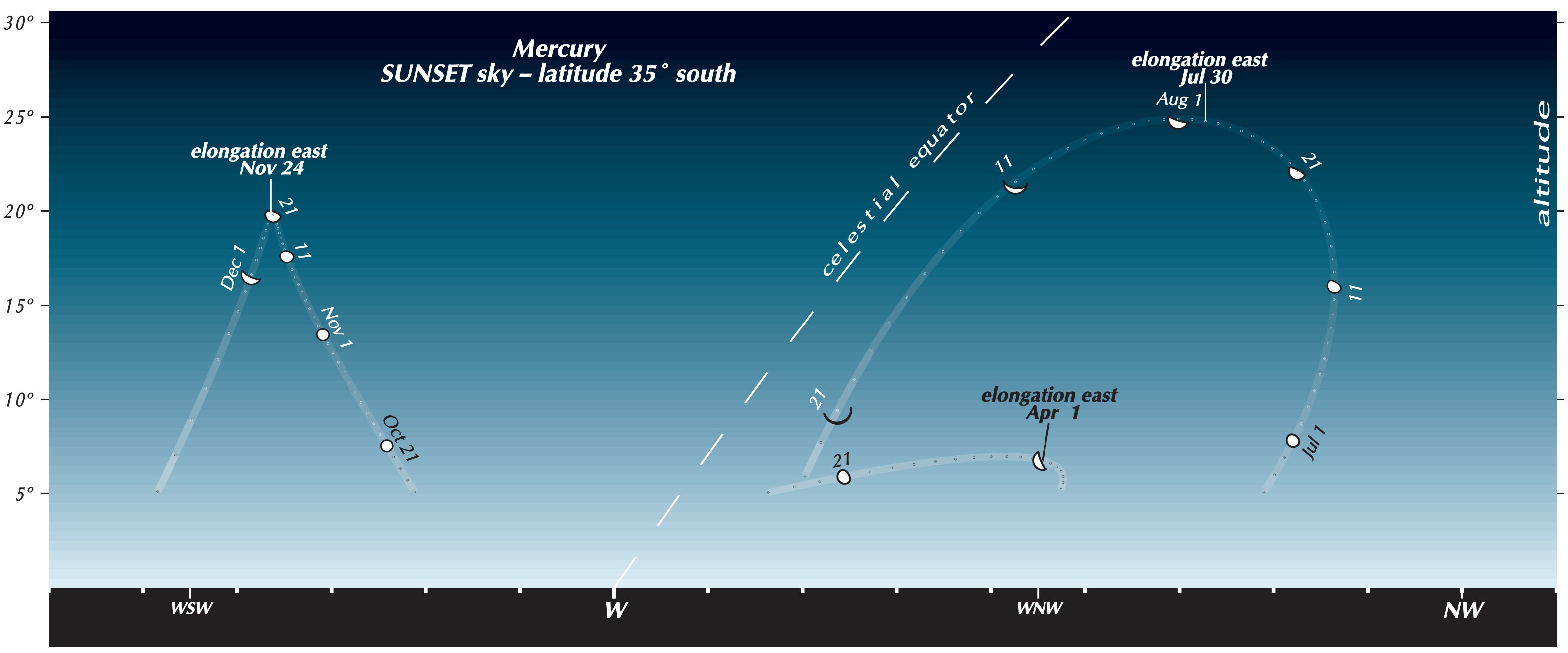


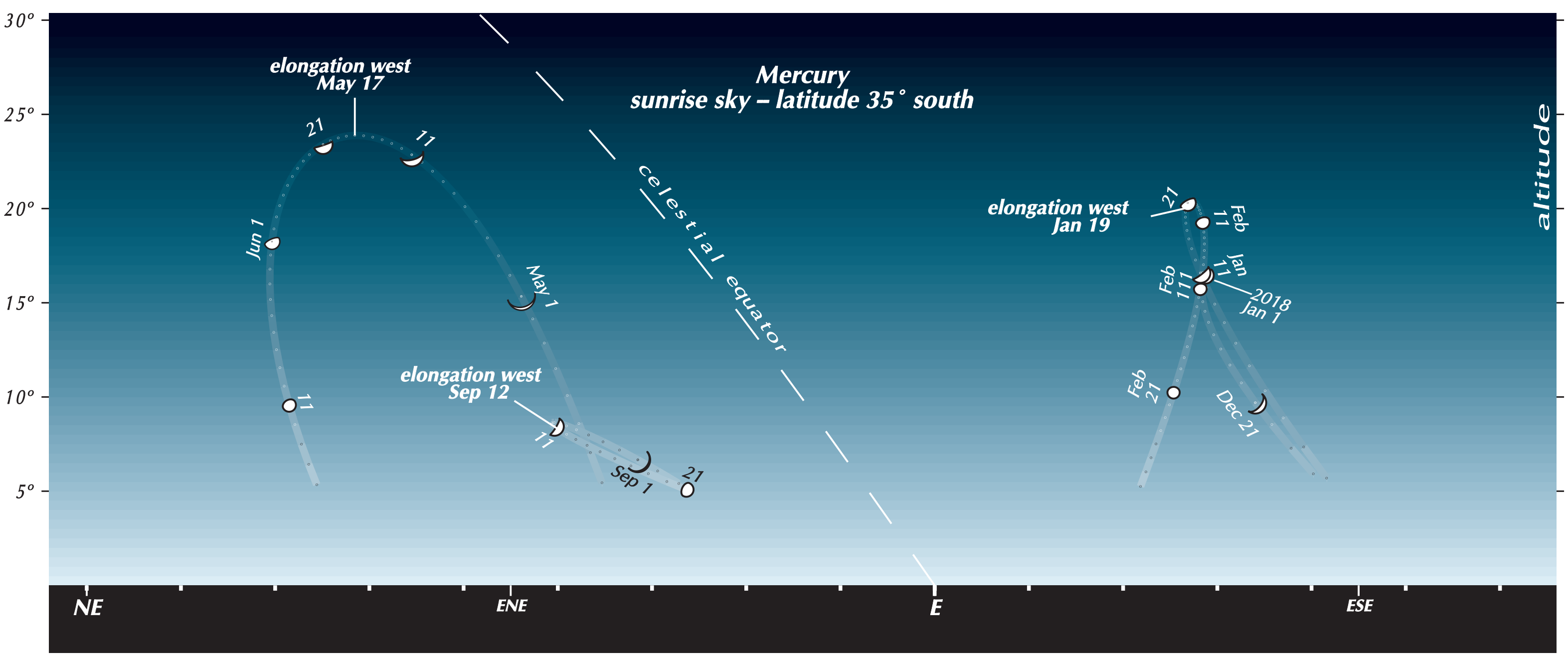


MERCURY AND VENUS HORIZON SCENES









Shown here are the visits of Mercury and Venus to the evening and morning skies, as they appear at sunset and sunrise for a northern latitude and (very differently) for a southern one.

Venus is so bright that it can often be found before sunset, or after sunrise. For Mercury you must look when the sky is dark enough, probably at least half or three-quarters of an hour after sunset, or before sunrise.

You can imagine the changed situation at, say, an hour after sunset by mentally raising the horizon-line about 12°. The sky will be darker, but the planets will be lower, more obstructed by atmosphere and trees, or even below the horizon.

Longitude makes little difference, because planets do not change their positions as fast as the Moon—even Venus never moves more than about a degree a day. If you are half way around the world, the planet will (by the corresponding time at your location) have moved only half the distance between two dots.

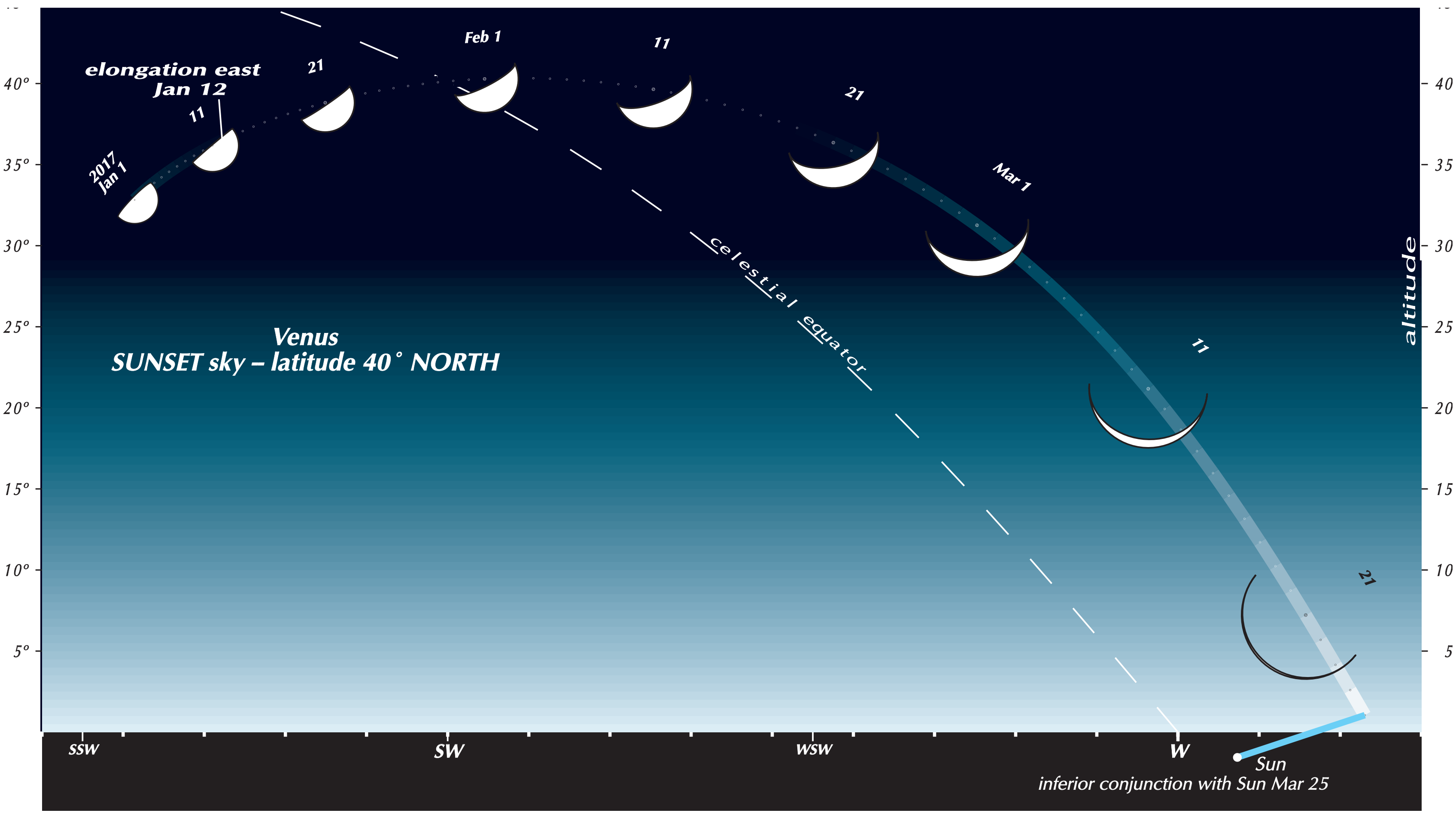
But latitude makes its usual great difference. If you are farther north, you must imagine the horizon tilted up on the south like a seesaw, around the Sun's position as a pivot. Or, which is the same thing, you will find the equator and also the trajectories of Mercury and Venus lying flatter. If you are at the north pole, the equator *is* the horizon, and the planets' travels south of the equator are below the horizon. Conversely as you move south, the horizon tilts down at its south end; in Ecuador or Uganda on the terrestrial equator, the celestial equator is vertical, and the planets' sallies, too, are roughly vertical; for South Africa or New Zealand, the celestial equator slopes in the opposite direction and so do the planets, leaping from the Sun generally rightward into the evening sky and leftward into the morning.

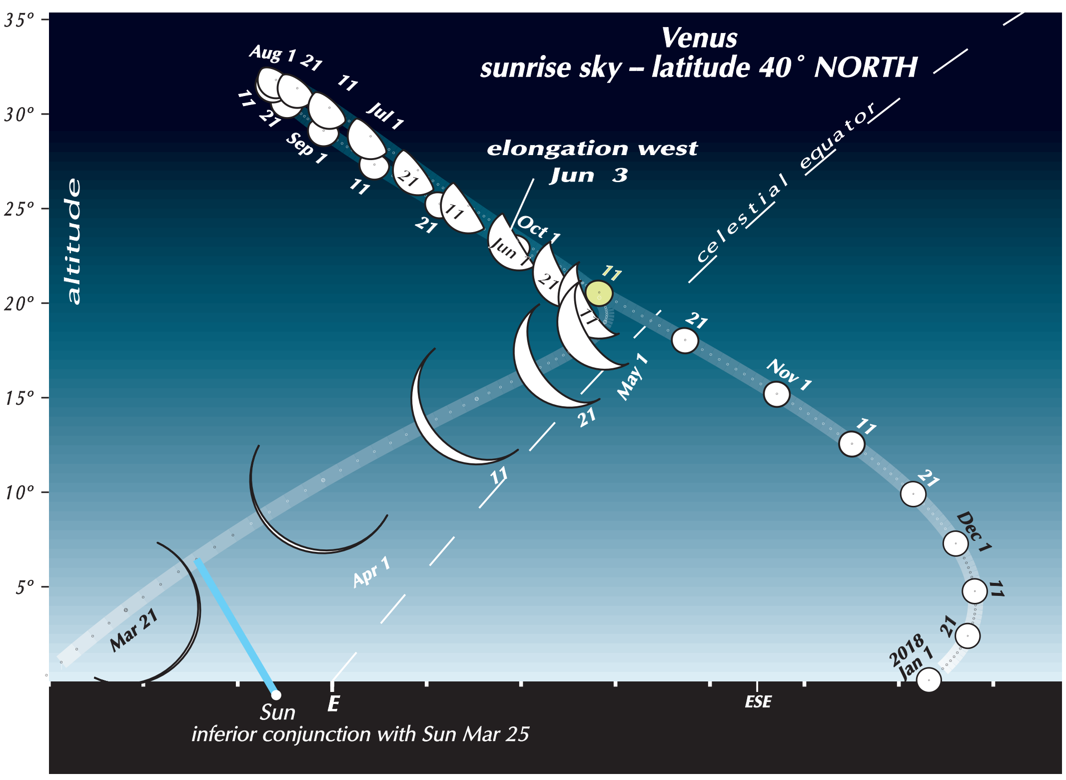
The coordinate system used is simple altazimuth. Ticks along the horizon are 5° apart. The scale is 1 centimeter to 4°, or 2.5 mm to 1°. The Sun's disk is shown to this scale, but the planets are exaggerated 480 times. Thus, for them, 1 mm represents 3 seconds of arc. Each image of Mercury or Venus is like a view through a powerful telescope at this point in the sky.

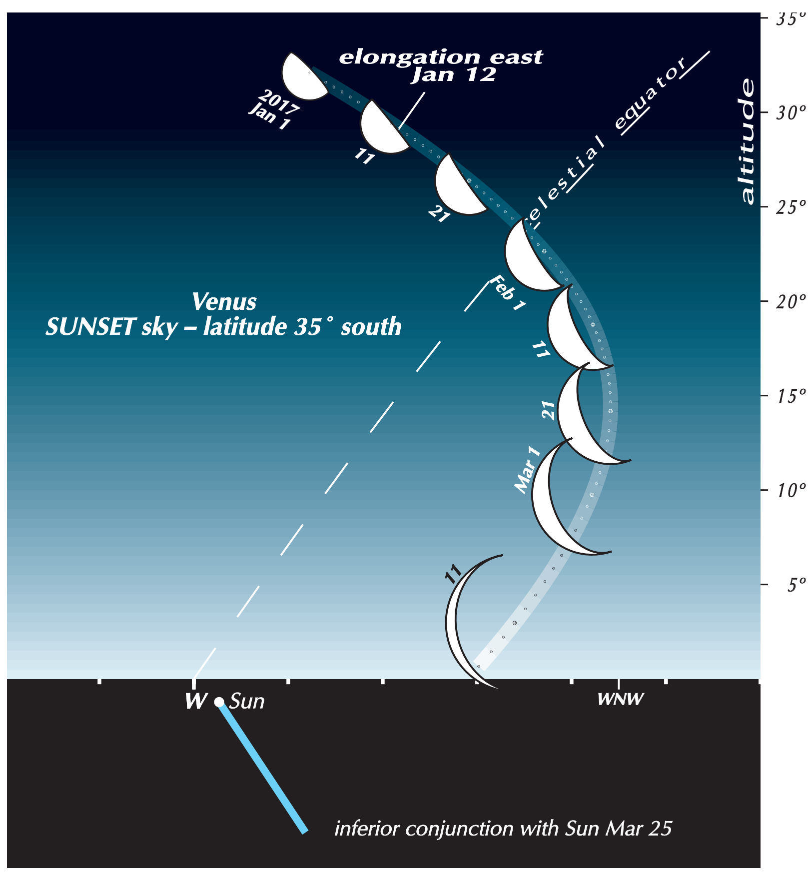
The planet images are at the 1st, 11th and 21st of each month. Dots show the actual positions of the planets for every day. These dots give a truer idea of the planets' actual sizes—though even they can be up to 9 times too large in Mercury's case. Mercury is cut off when it is below 5° of altitude; Venus is followed all the way down to the horizon and its conjunction with the Sun.

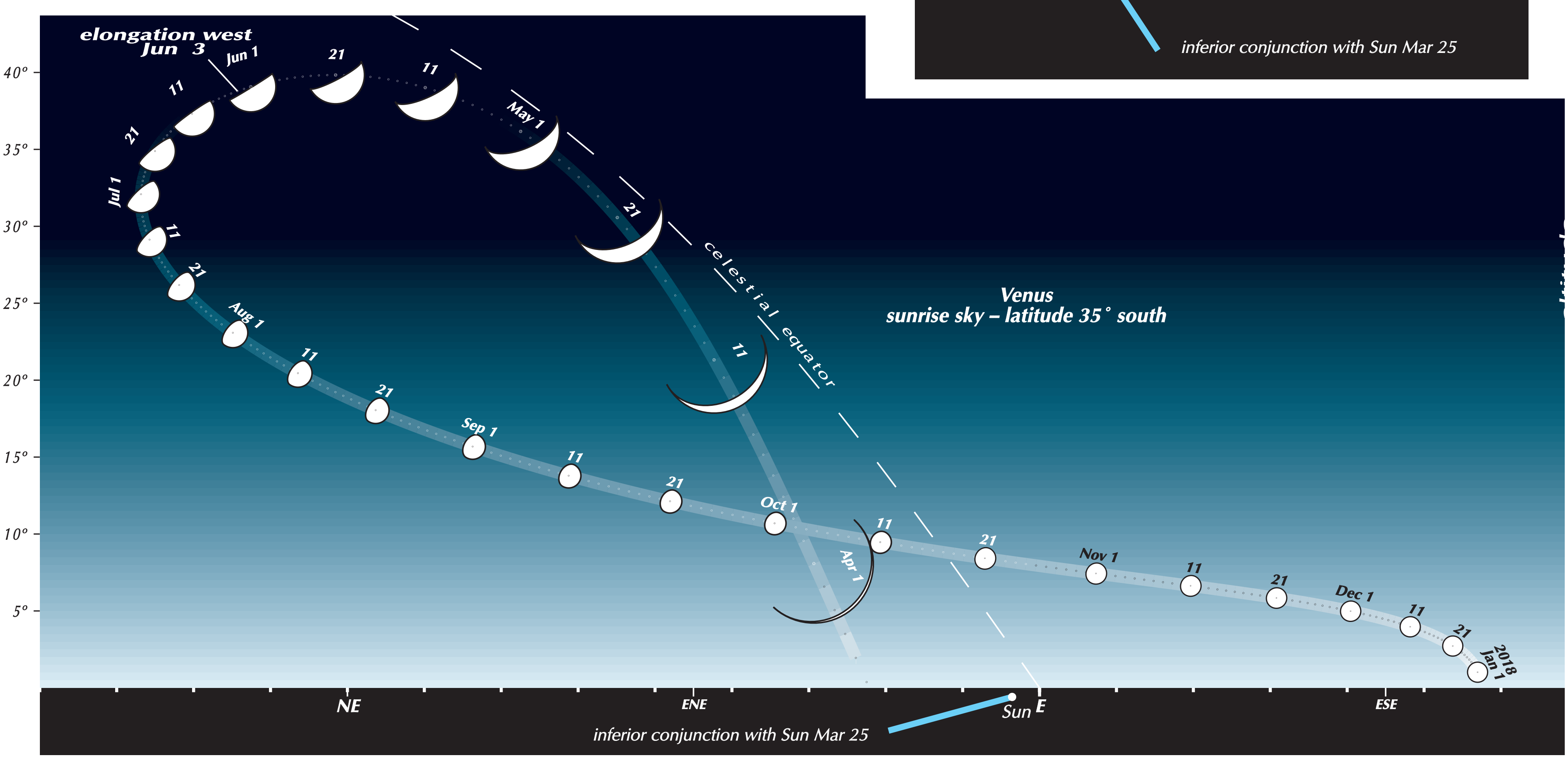
Dashes on the celestial equator are 2° long, but do not represent fixed points on the equator, since the horizon is always moving in relation to it. The ecliptic cannot be shown, since it is in a slightly different altazimuth position each day. It always runs through the Sun.

The Sun is shown only at the date of Venus's conjunction with it. (It is drawn at its actual sunset or sunrise position, about 50′ below the horizon, rather than its apparent position, refracted upward.) If shown for other dates it would shift left and right along the horizon—more than 30° north of the east or west point at midsummer, and the same amount south of it at midwinter. The Sun's position can be judged from the illuminated face of the planet pointing toward it.









THE VENUS 8-YEAR CYCLE

There is a highly noticeable rhythm in the motion of Venus: after 8 years it returns to the same place in the sky on almost the same date. This was known to, and of great interest to, ancient peoples such as the Maya.

The cause of it is that Venus goes around the Sun an integral number of times, 13, in 8 years. Venus's sidereal year is 225 days (more exactly, 224.7), and there are almost exactly 13 of these Venus-years in 8 Earth-years. (The synodic, or as-seen-from-Earth, period of Venus is 584 days, and there are 5 of these in 8 years.)

In this 8-year span, each heliocentric event of Venus, such as perihelion, happens 13 times, and each geocentric event, such as inferior conjunction, 5 times.

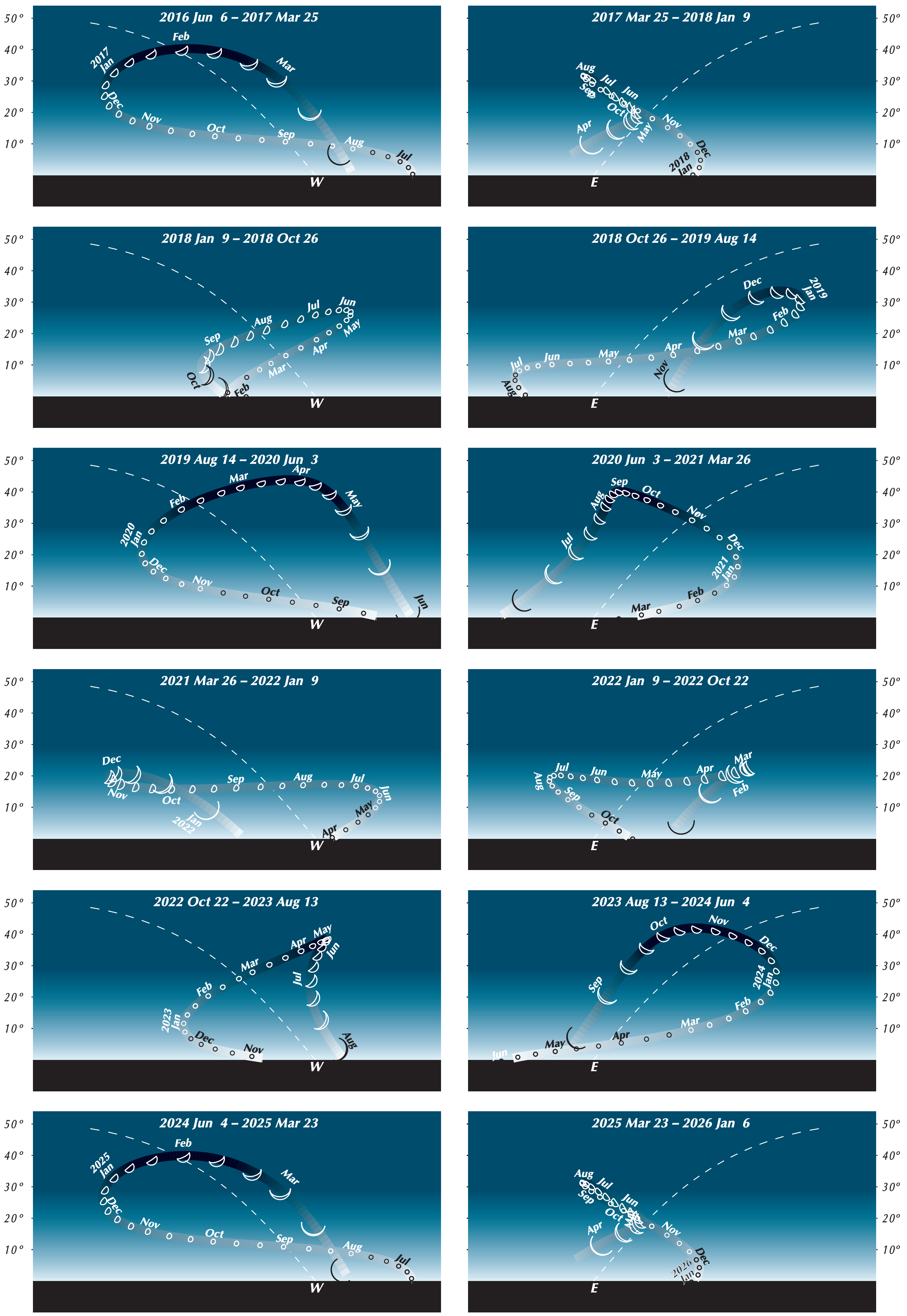
I think it worth noting that 5, 8, 13 are successive numbers in the famous Fibonacci series: 1+1=2; 1+2=3; 2+3=5; 3+5=8; 5+8=13; 8+13=21 . . . This series converges on the Golden Ratio, 0.618 . . . (the number that is its own inverse: 1/0.618 = 1.618), and crops up in proportions of Greek temples, spiral arrangements of leaves around plants, and the logarithmic spirals of shells, cyclones, and galaxies.

The behavior of Venus in 2017 repeats in 2025, 2018 repeats in 2026, and so on. Not quite exactly: the heliocentric phenomena such as perihelion and ascending node fall about 1 day earlier each 8th year, and the geocentric phenomena such as easternmost elongation and inferior conjunction fall in general a little over 2 days earlier.

Each of the 5 geocentric performances during the 8 years divides into an evening and a morning apparition. Our diagrams show the evening or eastward apparitions, as the planet comes from superior conjunction behind the Sun, swings out to easternmost elongation, then whirls in to overtake between us and the Sun at inferior conjunction. On the right are the morning apparitions, out to westernmost elongation and away around back to superior conjunction.

The diagrams are at sunset (left) and sunrise (right), for latitude 40° north. Below is the horizon; the dashed line is the celestial equator, which cuts the horizon at the west point (evening diagrams) or east point (morning). The scale is 0.7 mm per degree; Venus is drawn at 480 times scale, for days 1, 11, and 21 of each month; labels are at days 1.

You can see that the evening apparition 2016 Jun 6 to 2017 Mar 25 repeats in that of 2024 Jun 4 to 2025 Mar 23;



the morning apparition 2017 Mar 25 to 2018 Jan 9 repeats in that of 2025 Mar 23 to 2026 Jan 6. The flattened maneuvers that Venus performs 2021-2022 will be seen again in 2029-2030.

There are these 10 patterns that Venus traces—for latitude 40° north. For someone on the equator, the patterns will be erected like the celestial equator, and for southern latitudes they will be greatly different. Each pattern returns in 8 years, but with slow change through the centuries. So these diagrams will do, approximately, for cycles some way into the past and future.

These charts break the Venus cycle into 5 evening and 5 morning apparitions, but we could alternatively show it in 8 pairs of charts for the calendar years, as in our larger-scale charts for 2017.

Each of the 5 geocentric performances—indeed, each of the 10 apparitions, or each of the 8 years—has its character, to be repeated 8 years later. The remarkable difference between the shapes is caused by the directions at which we see Venus in relation to the Sun, which are caused by our changed positions around our own orbit.

The two types of year with exact Sun-conjunctions

In years of the **2004-2012-2020** type, Venus is at greatest eastern elongation about March 27, and for north-hemisphere observers this is the **highest evening elongation** of the whole cycle. Then it is at greatest latitude north of the ecliptic about April 11; and climbs about May 4 to its **northernmost declination** in the whole cycle (near El Nath or β Tauri, the Bull's northern horn-tip star). Like everything, this is subject to gradual change (as discussed by Jean Meeus in *Mathematical Astronomy Morsels III*, p. 326). The declination on 2004 May 4 was the highest in several centuries, 27°49′47″; on 2012 May 5 it was barely less, 27°49′01″; then will decline, not to reach as high till 2239 May 7 (with an even higher peak in 2263). The southernmost declinations come 18 months later: 2005 Nov. 6, 2012 Nov. 6, etc.

And on its way from its evening elongation toward the northernmost point, Venus climbs past the Pleiades. And, each time, the gradual change brings it north slightly sooner, so that in 2004 it grazed the southern fringe, in 2012 it moves deeper in, and each 8th year onward it will occult more stars of the cluster. ***See our chart on the April page.*** In 2028, as Fred Schaaf remarks on that page, Venus will pass between Atlas and Pleione, the parents of the Pleiades sisters.

After the northernmost point, Venus suddenly plunges south, toward Sun-conjunction. Its orbit is inclined about 3° to the ecliptic, and two times in each cycle the orbit plane, as seen by us, just about intersects the Sun. At one of these times Venus is at a superior conjunction, and passes behind the Sun's disk, instead of slightly north or south as usual: an *occultation* by the Sun, of course not observable. So this happens in years of the **2000-2008-2016-2024** type: 2000 June 11, 2008 June 9, 2016 June 6, 2014 June 4.

The other such times are half a cycle on—4 years—and find Venus at an *inferior* conjunction, passing between us and the Sun, and almost exactly in front of it, instead of well north or south. But not so exactly as at the superior conjunctions, because Venus is 6 times nearer to us. So at these each-8-year inferior conjunctions Venus still usually misses the Sun; only rarely does it actually pass in front: a **transit**. Two of those rare occasions were 2004 June 8 and 2012 June 6. Then it won't happen till 2117. These transits of Venus, and the commoner ones of Mercury, are a whole other subject!