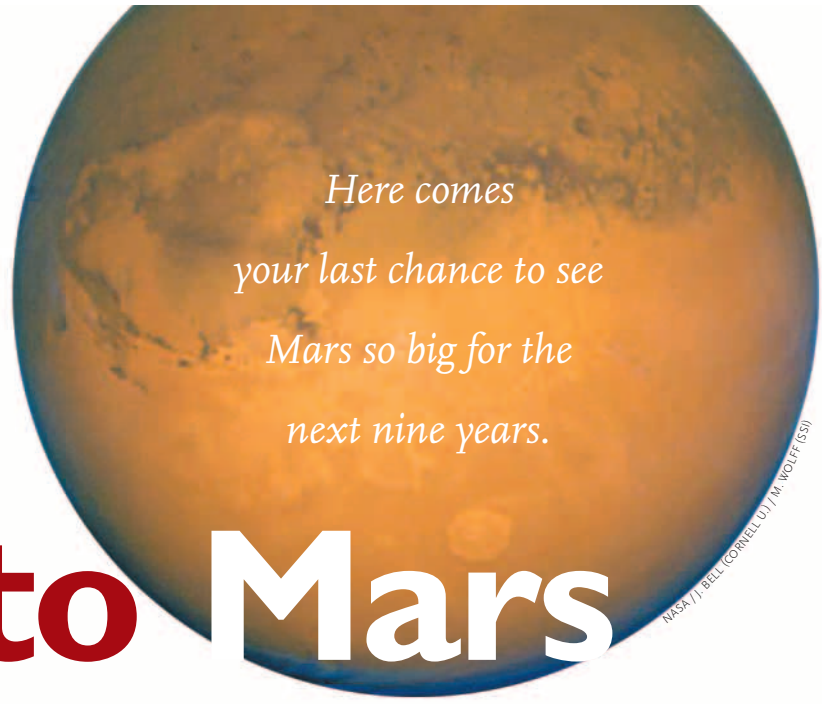
Your Telescopic Guide to Mars



ALAN MACROBERT

Mars is approaching Earth, and if you have a telescope, you'll want to make the most of the opportunity in the coming months. It'll be a long time before we get another chance this good.

Not often do we get a close look at Mars. It's a small world to begin with, about half the diameter of Earth, and it spends most of the time far away on the other side of its orbit from us. Mars usually ranks as one of the most disappointing objects in amateur astronomy — a tiny, featureless orange blob. The only time we get a decent look at its surface markings, clouds, dust storms, and changing polar caps is during the months around *opposition*, when Mars comes closest. Oppositions of Mars happen a little more than two years apart, but not all of them are equal. The best come in bunches of two or three that repeat in a cycle averaging 16 years long.

We're currently on the downswing of that cycle. In August 2003 Mars grew to a record-breaking apparent diameter of 25.1 arcseconds, and in October 2005 it reached 20.2″. This time around, Mars will max out at 15.9″ when it passes closest to Earth on December 18th. Even so, that's bigger than it will appear again until four oppositions later, in 2016.

This October, Mars enlarges from 9.8″ to 12.1″ as it shines in the east late at night. It takes till the end of November to reach 15.0″ across.

But there's good news too. This year's observing season finds Mars riding the northernmost part of the ecliptic, in Gemini and Taurus above Orion. This means it passes very high overhead every night for observers at mid-northern latitudes — far above the thick layers of air and poor atmospheric seeing that troubled northern observers during the previous few close-ups.

Then again, Mars underwent major dust storms in July and August. How much surface detail you see depends on the quality of not only Earth's atmosphere but Mars's too. Will the dust settle out fast enough to allow good, high-contrast views? Or will remaining dust paint a yellow wash over everything? Only time will tell.

Mars is already shining brightly in the early-morning sky, inviting observers to see what they can see. By early November you'll catch the planet high up by midnight. Mars reaches opposition on December 24th, Christmas Eve, when it rises around sunset and shines high in late evening. It will be an early-evening object during the months thereafter as it recedes into the distance.

How to Observe

To both casual and serious observers, Mars offers challenges and, with a little luck, delights. In a high-quality 4- or 6-inch telescope on a night of excellent steady air, you may be able to make out the north polar cap or cloud hood, dark surface markings (depending on which side of Mars is facing Earth at the time), limb hazes, occasional white clouds, and possibly the bright patch of a fresh dust storm moving from day to day.

But Mars is never easy to study visually; every bit of what you see is a hard-won prize. Don't expect impressive views unless you have a large scope with first-rate optics in perfect collimation (optical alignment). Even then the limiting factor is usually Earth's atmosphere. Studying the planets means spending a lot of time watching and waiting for glimpses of detail when the seeing steadies. Moreover, the longer you watch, the more familiar with the scene and the better trained your eye becomes. Plan to spend lots of time at the eyepiece.

Color filters are a useful aid. They improve the delicate contrast of Martian features and sometimes help

in diagnosing their nature. Red and orange filters show Mars's surface markings best and may even steady the seeing slightly. As you move away from the red end of the spectrum toward the blue, you see less of the surface and more of the Martian atmosphere and clouds. Some visual observers swear by a magenta filter as a general-purpose Mars-watching tool, especially for small scopes.

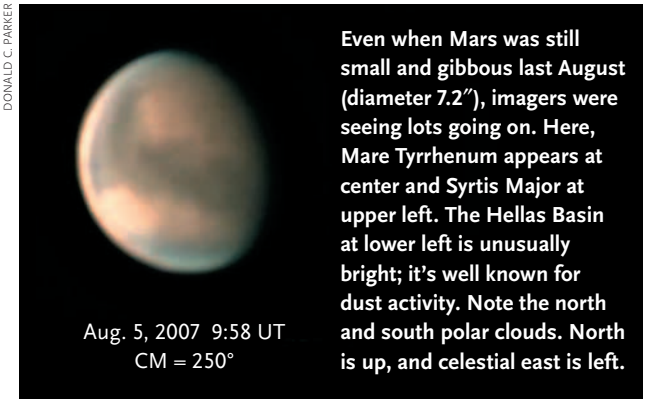
But the real excitement these days is in electronic imaging. A backyard amateur with a good 8-inch scope, a lightweight webcam, and a portable computer can match or beat the best ground-based Mars photography by professionals a generation ago. For how to do it, see last January's issue, page 129. Complete packages — including camera, filters, adapter, software, and instructions — now sell for less than the price of a premium eyepiece (for example, see the October issue, page 36). If you get halfway-good images, you're urged to submit them to the Mars database of the International Mars Watch, as described at the end of this article. And at that site you can see what everybody else is getting too.

Using the Map

It's one thing to detect a tiny, vague smudge on a small, shimmering disk. But the smudge becomes much more exciting if you can identify and name it. The Mars map on the next page will allow you to identify features you see by referring to the globes just under it. Below, the grid on the globes shows how the map's latitude and longitude lines project onto Mars's apparent disk as it changes its tip and tilt this observing season.

To find which side of Mars is visible at the time you observe, find the longitude of Mars's central meridian (CM) using the box on page 69. The CM is the imaginary line crossing the center of Mars's disk from pole to pole. Once you find its longitude, locate this on the scale along the top of the map. Features near this part of the map will be facing you on the planet's disk.

DONALD C. PARKER

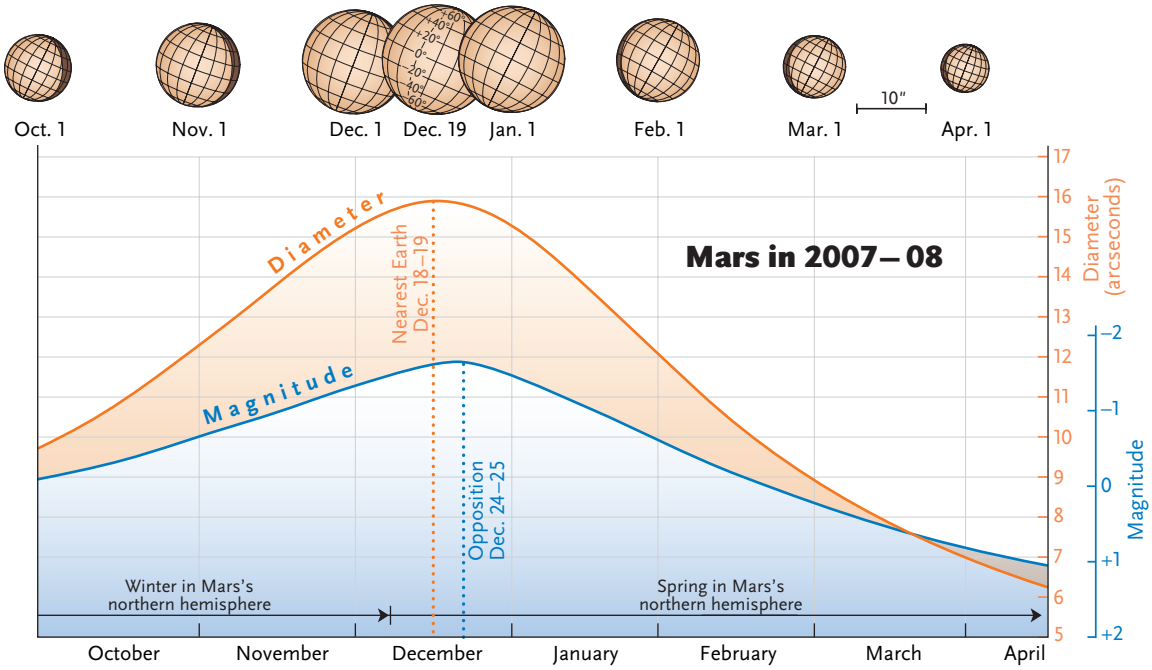


Even when Mars was still small and gibbous last August (diameter 7.2″), imagers were seeing lots going on. Here, Mare Tyrrhenum appears at center and Syrtis Major at upper left. The Hellas Basin at lower left is unusually bright; it's well known for dust activity. Note the north and south polar clouds. North is up, and celestial east is left.

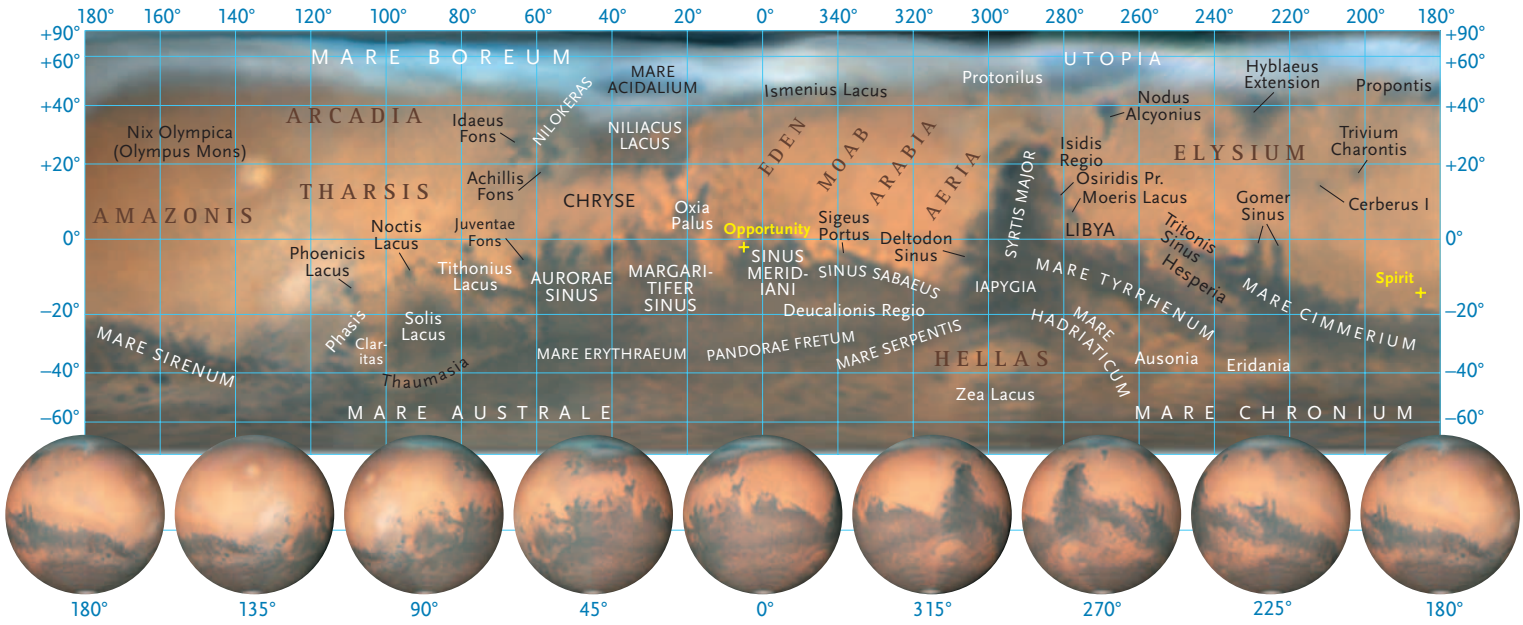
What to Look For

The polar caps. We see Mars nearly equator-on this year, as shown below. The south polar cap has been shrinking in the southern hemisphere's summer. That, combined with the planet's slight tilt, may make the cap undetectable. In contrast, the wintry north polar cloud hood should be large in October and November. Watch for it to start breaking up in December with the coming of northern-hemisphere spring — perhaps revealing the smaller, brighter north polar cap underneath the clouds.

Albedo features. The Martian surface markings — the dark "maria" and bright "terrae" picturesquely



Here at a glance are observing prospects for Mars for the coming months. On the globes, celestial north is up (but remember that many telescopes show south up), and celestial east is left. The celestial east side is Mars's morning side, and celestial west is the evening side. When your telescope's drive is turned off and the planet drifts across your field of view, celestial west is "preceding" — the direction the planet drifts toward — and celestial east is "following." For easy comparison with the map grid on the next page, lines of latitude and longitude are drawn on the globes every 20°.



DAMIAN PEACH

named by Mars mappers more than a century ago — are merely differences in the *albedo,* or reflectivity, of the surface rock, sand, and dust. Windstorms sometimes move the dust, resulting in both seasonal and long-term changes.

Syrtis Major, the planet's most prominent dark marking, has undergone a dramatic widening since the 1950s. It has also shown seasonal variations in its breadth: widest in the southern hemisphere's midwinter and narrowest during southern summer (the season currently).

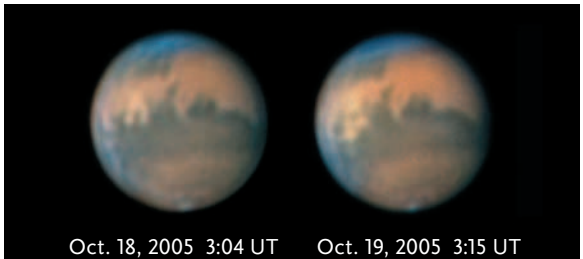
The area around Solis Lacus, sometimes called the "Eye of Mars," is notorious for undergoing major changes. So is the Trivium-Cerberus area on the rim of Elysium.

Clouds and hazes. The Martian atmosphere is ever-changing. White water-ice clouds, yellowish dust clouds, bluish limb hazes, and bright surface frosts have been studied with increasing interest in recent decades. The amount of cloudiness seems related to the seasonal sublimation of polar ice into the atmosphere, especially from the northern cap. The Mars Section of the Association of Lunar and Planetary Observers (ALPO) has found that clouds and surface fogs are more abundant during the spring and summer of the northern hemisphere. So this time around, we may see little cloud activity until perhaps February.

Use this map to identify what you see. North is up; west longitude is labeled along the top. Most telescopes will show only the largest dark regions. Damian Peach assembled the map and virtual disks from images he took in 2005. Each disk corresponds to the central-meridian longitude above it on the map. In 2005 Mars's southern hemisphere was tipped toward us, and the far-northern latitudes were covered by the north polar cloud hood. This time you'll have a nearly equal view of both the northern and southern hemispheres.

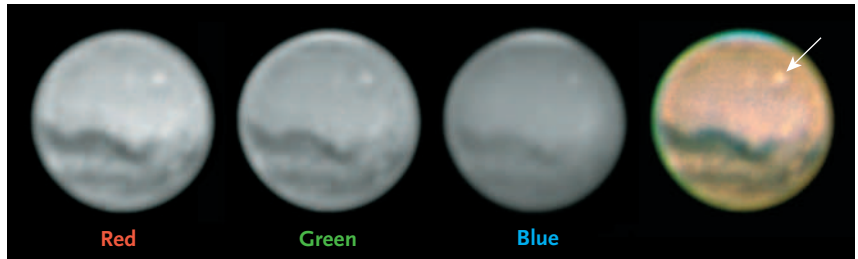
Discrete clouds recur at the same Martian sites, notably Libya, Chryse, and Hellas. The "Syrtis Blue Cloud" circulates around the Libya basin and across Syrtis Major; it's best seen near the planet's limb. Viewing this cloud through a yellow filter sometimes causes Syrtis Major to appear distinctly green.

Orographic clouds recur over windblown Martian mountains, just as orographic clouds do on Earth. The most famous



S&T: SEAN WALKER

Amateurs watched as a dust storm (the bright inverted V left of center) evolved rapidly in October 2005. Note how much it changed in 24 hours. *Sky & Telescope*'s Sean Walker took these images through a 7-inch scope at f/50 with a ToUcam Pro webcam.



M. P. MOBBERLEY

When moisture-laden winds blow across the broad, high volcano Olympus Mons, a hood of clouds (arrowed) sometimes forms. The 19th-century Mars mapper Giovanni Schiaparelli named this bright spot Nix Olympica, "the snow of Olympus," though he knew nothing of its origin. It was pure coincidence that the spot turned out to be a mountain. Dark Mare Sirenum is below. North is up in all images.

Which Side of Mars Are You Looking At?

What are the markings you're seeing on Mars? Is that darkish thing Sinus Meridiani, the plain where Opportunity is roving? If Mars looks bland, is it because your atmospheric seeing is poor or because we're facing Mars's bland side?

To compare what you see to the map and disks at left, you need to know which side of Mars you're looking at — in other words, the longitude of the disk's *central meridian*, the imaginary line down the center of the disk from pole to pole.

The table at right gives the Martian longitude on the central meridian at 0:00 Universal Time every day through the end of March. Read across the top to the month, and down to the date (which is also in Universal Time).

To find the central-meridian longitude at any other Universal Time, *add 14.62° for each whole hour,* plus *0.244° for each minute,* since 0:00 UT. If you get 360° or more, subtract 360°. The result is accurate to about 1°. (To convert Eastern Daylight Time into UT, add 4 hours; CDT 5 hours; MDT 6 hours; PDT 7 hours. When you're on standard time, add 1 more hour to these values).

For example, suppose you're out at 11:30 p.m. EST November 14th (which is 4:30 UT November 15th). The central-meridian longitude works out to 290°. The map shows that big, dark Syrtis Major will be centered on the planet's disk at that time.

Alternatively, you can use our Mars Profiler at SkyandTelescope.com/javascript. (Orient the Mars map there to match your scope.)

You'll soon notice that Mars shows nearly the same face from one night to the next. This is because the Martian day is only about 40 minutes longer than Earth's. To see other parts of Mars, you must view at a different time of night or wait for a week or more to pass. If viewed at the same time every night, Mars takes somewhat more than a month to complete one retrograde (backward) "rotation."

Longitude of Mars's Central Meridian at 0:00 UT

UT date	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
1	276°	344°	71°	158°	241°	332°
2	266°	335°	62°	149°	231°	322°
3	257°	326°	53°	140°	222°	313°
4	247°	317°	44°	132°	213°	304°
5	237°	307°	36°	123°	204°	294°
6	228°	298°	27°	114°	195°	285°
7	219°	289°	18°	105°	186°	275°
8	209°	280°	9°	96°	176°	266°
9	200°	270°	0°	87°	167°	257°
10	191°	261°	351°	79°	158°	247°
11	181°	252°	342°	70°	149°	238°
12	172°	243°	334°	61°	140°	228°
13	162°	234°	325°	52°	130°	219°
14	153°	224°	316°	43°	121°	209°
15	143°	215°	307°	34°	112°	200°
16	134°	206°	298°	25°	102°	190°
17	125°	197°	290°	16°	93°	181°
18	115°	188°	281°	7°	84°	172°
19	106°	179°	272°	358°	75°	162°
20	96°	170°	263°	349°	65°	153°
21	87°	161°	255°	340°	56°	143°
22	78°	152°	246°	331°	47°	134°
23	68°	143°	237°	322°	37°	124°
24	59°	134°	228°	313°	28°	115°
25	50°	125°	219°	303°	19°	105°
26	40°	116°	211°	295°	9°	96°
27	31°	107°	202°	286°	0°	86°
28	22°	98°	193°	277°	351°	77°
29	12°	89°	184°	268°	341°	67°
30	3°	80°	176°	259°		58°
31	354°		167°	250°		48°

Martian case is the W-shaped cloud formation sometimes caused by wind passing over the high peaks of Olympus Mons and the other volcanoes of the Tharsis plateau. Other orographic clouds can show up in Elysium.

Limb brightenings ("limb arcs") are caused by scattered light from dust and dry-ice particles high in the Martian atmosphere.

Morning clouds are isolated patches of surface fog or frosty ground near the morning limb (the planet's trailing edge as it drifts across an eyepiece field; the celestial east edge). Fogs usually dissipate by midmorning as Mars rotates. Frosts may persist for most of the Martian day.

Evening clouds really are clouds. They have the same appearance as morning clouds but occur on the planet's preceding limb. They tend to be larger and more numerous.

Dust storms. These can occur almost anytime, but they peak during the warmest season for Mars's southern hemisphere, meaning roughly June to September this year. The critical diagnostic of a dust storm is movement of a relatively bright patch that obscures dark features that were previously well defined.

For More Information

At each apparition, the ALPO Mars Section receives thousands of observations, now mostly webcam images; see www.lpl.arizona.edu/~rhill/alpo/mars.html. Also see the International MarsWatch site, at elvis.rowan.edu/marswatch. Both have more on observing and imaging the planet, detailed maps, what to expect as this apparition proceeds, and instructions for submitting observations of your own.

In this age of spacecraft in Martian orbit and rovers on the ground, it might seem that backyard amateurs have little role left to play in Martian science. But good data-gathering is always an act of faith; you never know what seemingly trivial item might someday become important. And continuing to do traditional, Earth-based observations in parallel with the on-site observations serves to correlate the two — helping to reveal the meanings of the century and more of Martian observations in the world's astronomical archives. ✦

By luck, ***Alan MacRobert*** *experienced first light in his 12.5-inch Newtonian reflector on September 21, 1988, when Mars appeared its largest (23.8″) between 1971 and 2003.*