Now is the Time to Observe MARS

This December, Mars will be in the same position in the sky as it was during the legendary apparition of December 1960, when northern observers experienced some of the best views of Mars ever seen.

Mars image: NASA and the Hubble Heritage Team (STScI/AURA)Acknowledgment: J. Bell (Cornell U.), P. James (U. Toledo), M. Wolff (Space Science Institute), A. Lubenow (STScI), J. Neubert (MIT/Cornell)

Background: NASA/JPL/Cornell

A Special Event

At 10 p.m. EST on the night of December 23, the full Moon will pass just north of Mars. In fact, in some parts of the world, the Moon will pass right in front of Mars: northwestern Canada, Alaska, Arctic regions, northern Russia, eastern Europe, and the northeastern British Isles. This will emphasize just how tiny Mars is in comparison to the Moon, in contrast to the internet hoax which circulates every August about Mars being as big as the Moon!

Mars rising above the southeastern horizon on the night of closest approach (December 19th) as seen at 11 p.m. EST from mid-northern latitudes. Even with the naked eye, Mars will be a spectacular sight, ringed by first magnitude stars on all sides, but shining more brightly than any of them.

Finding Mars

Where you will find Mars in the sky depends on your location, the current date, and the time of night you're looking. But there's an easy, accurate way of finding the Red Planet: use a program like Starry Night®. It is as simple as telling Starry Night® your observing location. It will show the sky for the present time and date. If you won't be observing until later, change the time accordingly.

Starry Night® will then show you the present position of Mars, assuming it's above the horizon. This year Mars is surrounded by a huge ring of the brightest stars in the sky, so it should be easy to spot, even in a light-polluted city sky.

Mars takes a little more than twice as long as the Earth to make one orbit around the Sun—both planets come close to each other once every 26 months.

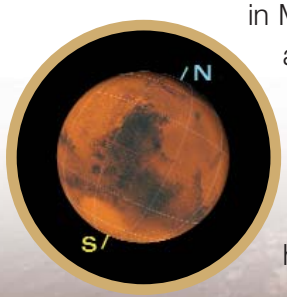
Mars was about as close as it can be to Earth on August 2003, about 34.6 million miles (55.7 million km). Twenty-six months later it wasn't quite as close: 43.6 million miles (70.2 million km) on October 29th. This year, Mars will be even farther away: 54.8 million miles (88.2 million km).

Is this bad news for Mars observers? Not really: in August 2003, Mars was located in Aquarius, really low in the sky for northern observers. This year it will be located in Gemini, almost overhead, and above most of the atmospheric turbulence. So, even though Mars is farther away, and hence smaller in size, it should actually be easier to see more detail this year than in recent years because of steadier images.

Just to clear up a possible point of confusion, the date when Mars is closest to the Earth is December 19, but the actual date of opposition (when the Sun, Earth and Mars line up exactly) is 5 days later, on December 24. This difference is because Mars' orbit around the Sun is elliptical rather than circular, so that it's a tiny bit closer a few days before opposition.

What to Look For

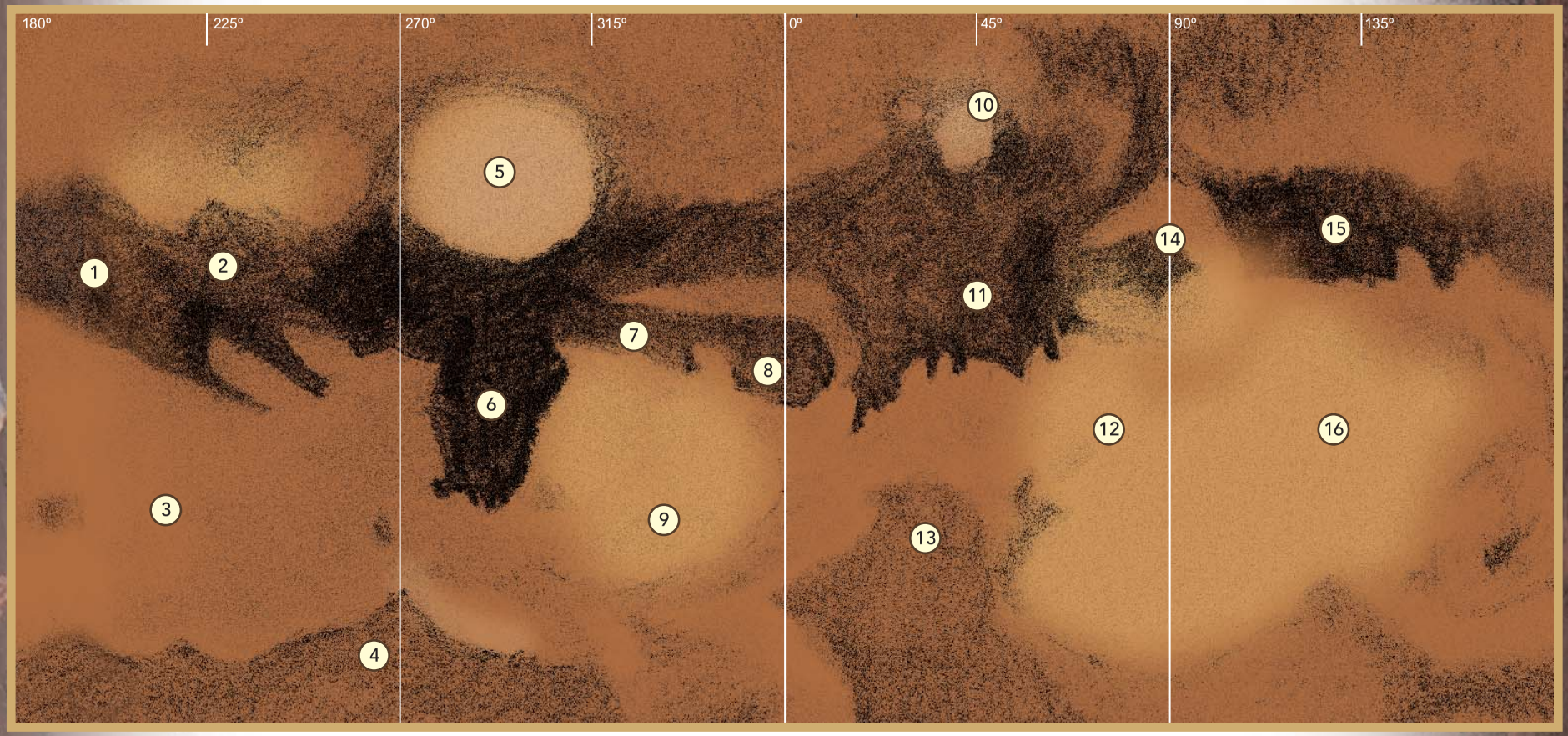
Like Earth, Mars is tilted relative to its orbital plane, and so it has seasons. Its pole however, points in a different direction than the Earth's, so the seasons on Mars are one season "out of phase" from those on Earth. In December 2007, it will be winter in Earth's northern hemisphere, and so it will be spring in Mars' northern hemisphere (and also autumn on Mars' southern hemisphere). This means that the mists of Mars' North Polar Hood will be dissipating, revealing its bright white North Polar Cap underneath, as its northern hemisphere tilts towards the Sun.



The many space voyages to Mars have shown us that it is a planet of spectacular topography, from the heights of **Olympus Mons**, the tallest shield volcano in the solar system, to the depths of the **Valles Marineris**, a chasm which dwarfs the Grand Canyon. However, seen from the Earth, these features vanish because, like our view of the full Moon, the lighting comes from directly overhead, so there are no defining shadows. What we do see is a pattern of light and dark, a mosaic of darker bare highlands and lighter sand-covered lowlands. Most of these darker regions are concentrated on Mars' southern hemisphere.

NASA Jet Propulsion Laboratory (NASA-JPL)

The most prominent dark marking on Mars is Syrtis Major, located at Martian longitude 290° (map on next page). It is usually seen as a triangular wedge shape, sometimes with a curved tip. Between it and the south pole is a large bright area called Hellas. Extending westward from Syrtis Major is a narrow dark band, Sabaeus Sinus, ending in a forked blob, Meridiani Sinus, so named because it defines the zero meridian in the Martian longitude system. This is the area that the Mars Rover Opportunity is currently exploring. Further west, at longitude 90°, is Solis Lacus, sometimes called "the eye of Mars" because of its resemblance to a gigantic eye. West of this is what Mars observers often call "the boring side of Mars" because of its lack of dark markings. Studies of Mars from orbiting space probes reveal otherwise, since this vast plain is the location of Mars' gigantic shield volcanoes. The dark markings begin again at around longitude 140° with the broad streak of the Mare Sirenum. This lies south of the crater Gusev, where the second Mars Rover, Spirit, is on the ground exploring. Mare Sirenum extends westward into Mare Cimmerium (longitude 230°) and then Syrtis Major comes into view again.



1. Mare Cimmerium
2. Mare Tyrrhenum
3. Elysium
4. Utopia
5. Hellas
6. Syrtis Major
7. Sinus Sabaeus
8. Sinus Meridiani
9. Arabia
10. Argyre
11. Mare Erythraeum
12. Tharsis
13. Niliacus Lacus
14. Solis Lacus
15. Mare Sirenum
16. Amazonis

The whole face of Mars with major albedo features labelled. South is at the top, as seen through Newtonian reflectors.

Observing Tips

Mars looks so big and bright to the naked eye, that the view through an amateur telescope might disappoint at first. Jupiter has its belts and moons, Saturn has its rings, but Mars looks like nothing more than a tiny orange dot at first glance. There are several secrets to getting Mars to reveal its sights to you.

The first secret is often the hardest to manage: you need a **good telescope**. Mars is just about the most demanding telescopic object out there, and requires good optics. A telescope you pick up at the local mall or off eBay is very unlikely to come close to what's needed. Unfortunately many people fall into this trap and end up with nothing more than a plastic toy. Sad to say, the same amount of money, spent at a store specializing in telescopes, would yield a much more worthy telescope capable of a lifetime of satisfying observing. Since most of us aren't likely to find a telescope store at the local mall, you will probably need to seek out telescope stores online, and one of the oldest and most reliable is **Orion Telescopes and Binoculars**. The advantage of any telescope dealer, local or Internet, is that you can actually talk to them about what you want, and get good solid advice. They want you as a long-term customer, and have a vested interest in making your first purchase a happy one.

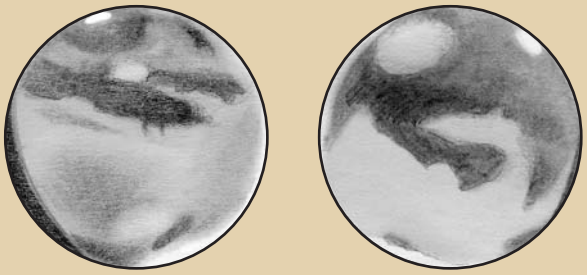
For satisfying views of Mars, a telescope of **4 inches aperture** is about the minimum we would recommend. With Mars, as with other astronomical objects, aperture rules, and any increase in aperture will pay real benefits in the quality of the view.

Because of the tiny size of Mars' disk, even at its closest, magnification is paramount. 200 power is the minimum with which to see the surface detail on Mars, and 300 power is even better. Good quality eyepieces are important, and often a **Barlow lens** is essential to get the necessary boost.

Filters are probably more useful for Mars than for any other planet. Our favorite is the #21 orange or #23A light red. This tends to enhance the contrast of Mars' detail and also to cut some of the glare from its bright surface. A #80A or #82A medium blue filter is very useful for enhancing the high clouds that appear above the poles and along the limb of the planet. Recently several companies, including Orion, have developed special Mars interference filters using the same principles as nebula filters. These enhance the most interesting features of Mars, the dark markings and the clouds, while reducing the overall glare.

Orion's new **Mars Observation Filter Set** includes the three most popular filters for viewing Mars: #21, #82A, and special Mars interference filter.

Welcome to Mars Training Camp!



Mars sketches as it appeared in an 8" scope during opposition in 2005, M. Gatto

You can have the finest hardware in the store, and yet still have a disappointing first experience with Mars. The reason is that your eye and brain need to be trained in order to tease out faint detail at the limits of visibility. The best way of doing this is to make drawings of the planet at every opportunity.

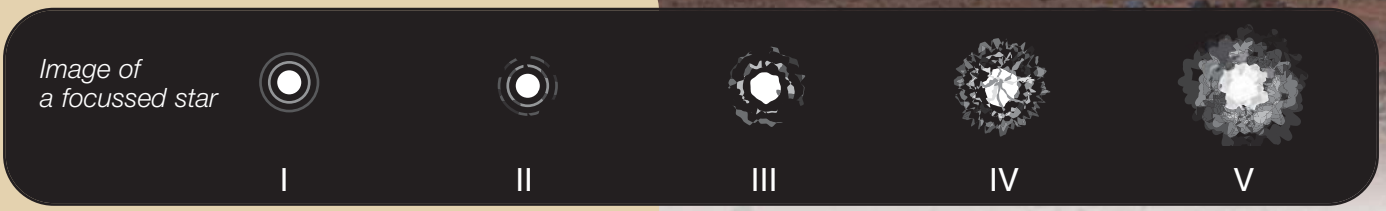
"Oh, no," I hear you cry, "I'm not an artist!" Artistic skill is not a requirement. What you are doing is attempting to copy, as accurately as you can, what you see on the disk of Mars. At first you won't see much, but as you concentrate, you'll soon be seeing more and more. As with deep sky observing, it sometimes helps to use averted vision, looking slightly off to one side of the planet.

While an ordinary HB pencil will do, you may get better results from a softer lead, such as a 2B. An "artist's stump" very useful. This is a tight roll of blotting paper sharpened at both ends, available from any artist's supply store. You use this to "smudge" the pencil lines, so that they take on a more realistic smooth shading. Finally an eraser with a sharp point is useful for removing shading to depict white areas. Ordinary paper will do, but you can organize your observations better if you use a standard form, such as this one designed by **Carlos Hernandez** (PDF).

Start your drawing with a circle 40 mm in diameter to represent the disk of Mars. Except when very close to opposition, Mars shows a slight phase because the sunlight is coming from one side or the other; draw this in first. Then draw in the areas that change little as Mars rotates, namely the polar regions. Finally, draw in the darker shadings towards the center of the disk, and note the time. This is important because Mars is rotating on its axis, and the apparent positions of surface features change fairly rapidly.

Your first sketches will be rough, but you'll find that they improve with each one you attempt. For each sketch, record at least the date and time; the observing form suggests a lot more data that can be recorded.

If you want to document your observation more thoroughly, use the blanks on the observing form. There are three circles for drawings: the left and right ones are for normal sketches, perhaps with and without a filter, while the middle one is for a diagram using numbers to indicate the darkness of features on a scale of 0 to 10. In order to compare observations around the world, dates and times are recorded in Universal Time (UT) which is a 24-hour clock based on the prime meridian in Greenwich, England. For example, if you made your drawing at 11:30 p.m. EST on December 5th 2007, you would convert this to 04:30 on December 6th in Universal Time (5 hours later). "Seeing" measures the steadiness of the image, usually with one of scales devised by **Pickering** or Antoniadi:



I Perfect seeing, without a quiver

II Slight quivering of the image with moments of calm lasting several seconds

III Moderate seeing with larger air tremors that blur the image

IV Poor seeing, Constant troublesome undulations of the image

V Very bad seeing, hardly stable enough to allow a rough sketch to be made

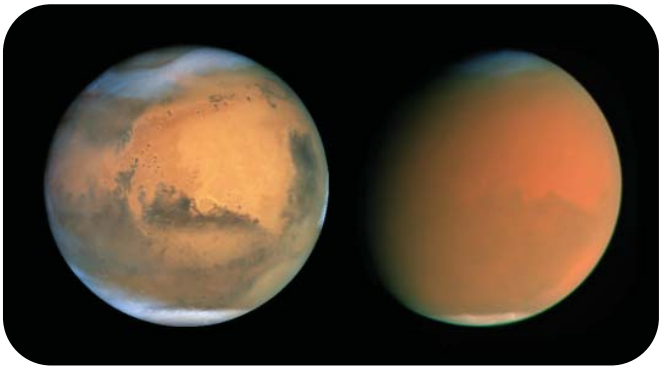
Tip: Starry Night® Pro and Pro Plus users can use the logbook feature in Starry Night® to add observing notes for Mars. You can also scan your sketches and add them to your logbook entries.

As the Planet Turns

One final step is needed in order to compare your drawing to **published maps**. You need to know what longitude on Mars was central on the disk at the time you made your drawing. You can do this easily using the Arkansas Sky Observatory's **Mars Physical Ephemeris Calculator**. For example, for the drawing mentioned above, enter 12 06 2007 and 04h 30m in the ASO calculator, and you get a central meridian of 94.3°. You can then compare your drawing to the features visible at that longitude on the map.

However, for a quick and easy picture of what Mars looked like at the time you made your drawing, check out a magnified view of Mars in Starry Night® at the time of your drawing, since the program does all the calculations for you automatically.

You should only compare your drawing to a map after you finish the observation, so as not to be influenced by what the map shows. At first, you will probably see nothing but vague smudges, but after a week or two of "training," you should be seeing much more detail. Some nights you may see nothing at all, and that may in fact be what is really there. The problem is with atmospheres: the atmosphere of Earth being unsteady and smearing the image of Mars, and the atmosphere of Mars sometimes carrying widespread dust storms which block our view of the surface. An online group like **MarsObservers** will keep you abreast of the weather and dust storms on Mars. The finest Mars observers on Earth post their images and drawings there every day, and there's always lively discussion of current events on the red planet.



Mars imaged in June 26, 2001 then again in Sept. 4, 2001 while engulfed in a global dust storm.
NASA, James Bell (Cornell Univ.), Michael Wolff (Space Science Inst.), and the Hubble Heritage Team (STScI-AURA)

A day on Mars, known as a "sol," is 39 minutes longer than a day on Earth. This means that if you observe Mars at the same time each night, the features on Mars will appear to drift in longitude because of Mars' slightly slower rotation rate. In fact it takes about 37 days before you will see exactly the same face of Mars at the same time.

Images of Mars

Taking good clear pictures of Mars has long been a major challenge to both professional and amateur astronomers alike. Making an exposure at the precise instant when the atmosphere is absolutely steady has been next to impossible. In recent years this has changed thanks to modern computer technology, and superb images of Mars are being taken regularly by a large number of amateur astronomers around the world. Their secret weapon is the lowly webcam. Using a webcam, you can make many exposures of Mars in rapid succession. Some will be good, some will be bad. If you discard the bad ones and combine the good ones in a computer process called stacking, you can produce an image that is much sharper than any of the images that went into it. Then programs like Adobe Photoshop allow you to further enhance the contrast and sharpness. The result is images which exceed the quality of anything that even the pros could manage more than a decade ago; some even come close to images taken with the Hubble Space Telescope.

If a simple webcam works well, what happens when you redesign a webcam specifically for planetary imaging? You can find out by using one of several such dedicated planetary cameras, for example the Orion StarShoot Solar System Color Imager II.

Don't Give Up!

Although Mars is a challenging object for the amateur astronomer, it is ultimately very rewarding. It is the only planet whose surface we can observe directly, and it is the planet that most closely resembles the Earth.

Geoff Gaherty

Geoff has been a life-long telescope addict, and is active in many areas of visual observation; he is a moderator of the Yahoo "Talking Telescopes" and "Marsobservers" groups.

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