

SEEING RED

Mars Mania and the Real Mars

by

Dave Rubincam

Geodynamics Branch,
NASA Goddard Space Flight Center
Greenbelt, MD 20771

voice: 301-614-6464

fax: 301-614-6522

email: rubincam@core2.gsfc.nasa.gov

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NASA, the National Aeronautics and Space Administration, is very interested in finding Earth-like planets. One of the missions on the drawing boards is its Terrestrial Planet Finder, and doubtless more advanced projects will follow. The ultimate goal is to find life elsewhere in the universe.

Imagine that sometime in the mid- to late- 21st century scientists find a promising planet and turn in the following observations:

“Has at either pole a white region, which may be considered as snow or ice, not dissimilar to the polar regions of the Earth.”

“The inclination of the axis does not differ much from that of the Earth, so that the seasons are analogous.”

“It might be thought that the variable grey spots are due to vegetation undergoing the alternations of the seasons.”

“The duration of the rotation was evaluated at 24 hours 39 minutes.” (Recall that the Earth rotates once upon its axis in 24 hours.)

A planet so like our own! Perhaps harboring life! Maybe even intelligent life!

If such reports would fire your imagination, then you can begin to understand a mania which swept our own planet. For these are not the hypothetical observations of some distant world deep in the heart of the galaxy, but the real reports of astronomers peering into our own celestial backyard. And not in the 21st century. They are actual descriptions of the planet Mars--made in the 19th century.

By then astronomers had been observing Mars for thousands of years. The ancients, like anyone who looked up at it, could see the planet had an orange-red color--perhaps inspiring the Greeks and Romans to think of blood, since they named it after Ares and Mars, their respective gods of war. It was the Roman name which stuck.

The ancients also could not fail to notice that it wandered across the sky like the other planets (which they also named after their gods). But, without telescopes, that's all they knew. They didn't know Mars' rusty hue was due to minerals containing iron. They

didn't know the wandering was due to the Earth and Mars orbiting around the Sun. They didn't even know that the Earth was a planet; Copernicus, Kepler, and Galileo had to straighten them out on that.

Contrary to popular opinion, Galileo did not cobble together the first spyglass; but he did improve upon it and made pioneering astronomical observations. When we think of astronomers we invariably think of telescopes, but the fact is, astronomy--which wags have dubbed the world's second oldest profession--had to limp along without its most essential instrument for millenia. Only in the last 400 years was the telescope invented.

The sight of Mars through the telescope revolutionized our knowledge of the Red Planet. By the time of those 19th century reports, astronomers knew certain things reliably. Mars was smaller than the Earth, having only half its diameter. And, thanks to the discovery of its two moons in 1877, could compute (with an assist from our old friend Kepler and his third law) that Mars had only one-tenth the Earth's mass and one-third the surface gravity. They also knew the length of Mars' day was a little longer than ours, and that its axis was tilted by nearly the same amount, just as they stated.

Other things they got half-right. Mars indeed has polar caps. In fact, it has two kinds of caps. The ones which the astronomers saw advance in the winter hemisphere and recede in the summer hemisphere are made of solid carbon dioxide--better known as dry ice--and so are not ordinary snow and ice like they thought. In winter the ground gets so cold that about one-third of Mars' carbon dioxide atmosphere freezes out, making its dry ice cover. Exactly how it gets deposited on the surface is not known; does it simply grow gently like frost, directly from the atmosphere, or does it fall as some sort of snow? "It may do both," says NASA Mars investigator David E. Smith.

Despite the large area they cover, the seasonal caps aren't very deep: a few inches to a few feet at most. The real action is in the other sort of caps, called the permanent caps, which were also visible from Earth.

The permanent caps occupy much less area than the seasonal ones; but they hang around all of the time, summer or winter. And they are much, much deeper: like two miles deep. Best of all, scientists have good reasons for believing that they are made of water--good old H₂O. True, it's locked away as ice at those cold north and south poles, but there are over a million billion tons of it. Plus the Mars Odessey mission has recently shown that, at less chilly latitudes, there is enough ice beneath the surface to fill Lake Michigan twice over. And there may be lots of liquid water deep underground. Lack of the most essential fluid in the universe shouldn't be a problem--there's plenty for visiting astronauts and future settlers.

A lot of what those 19th century astronomers said was a mess. One can hardly blame them. Despite powerful telescopes, they had to peer through our turbulent atmosphere and scan the surface of a body which seldom comes closer to the Earth than 35,000,000 miles and make judgments. Many of those judgments were subconscious.

The "variable grey spots" were indeed variable--and moreover seen to be green by many observers, enhancing the idea that they might be vegetation. The Martian equivalent of trees and grass. We know now that the markings on Mars are not green (mostly less red shading to grey), and the changing outlines are most likely due to winds blowing dust around, perpetually covering and uncovering darker rock.

The green color was a trick of the brain. But their grey matter seeing green wasn't the worst trick that those nefarious neurons pulled on the poor astronomers. The worst was those cursed canals.

Giovanni Schiaparelli wasn't the first astronomer to see thin, straight features crisscrossing the surface of the Red Planet like a spider web, but his 1877 announcement that there were "canali" on Mars got the most publicity. Being Italian, he of course used the Italian word for "channels" to describe what he thought were natural features. It was easy for English language readers to dump the "i" and see "canal," a word pregnant with much more meaning than the more neutral word "channel."

Canals are artificial waterways. If they are artificial, they had to be built by somebody. Lower animals don't go around building canals. That somebody had to be intelligent. Ergo, there must be an advanced civilization on Mars. The mania was on.

Its principal stoker was the wealthy businessman turned amateur astronomer Percival Lowell, a member of the prominent Massachusetts family. (His sister was the cigar-smoking poet Amy.) In a series of books, *Mars* (1895), *Mars and Its Canals* (1906), and *Mars as the Abode of Life* (1908), Percival Lowell laid out his thesis: the thin lines, which ran for hundreds of miles, were not just canals but also surrounding strips of vegetation. The canals brought precious water from the poles to irrigate a parched planet. Mars was slowly drying up over the eons. The noble Martians were making a valiant but hopeless attempt to stave off the coming thirst and cold.

What the Martians looked like, Lowell wasn't prepared to say. But he was sure that they were peaceful. What else could they be? They had to band together against the relentless drying.

The frenzy reached its height in 1907 when the *Wall Street Journal* declared that the big news that year was not the depression which gripped the country, but rather that "...conscious, intelligent human life exists upon the planet Mars." What was forgotten in the uproar was that there were many outstanding astronomers of the day, who, squinting through their telescopes as hard as they might, simply could not see any canals up there. Worse, the ones who thought they saw waterways said that sometimes the canals would double--as though a single-lane road had suddenly become a divided highway. Most ominously, while some observers said that the canal network would stand out sharp as etchings when the atmosphere was unnaturally calm, others saw canals disappear during the quiescent moments, with the lines breaking up into a series of disconnected smudges. Something was wrong somewhere.

The furor gradually died down, leaving the astronomical community with the feeling that vegetation was a distinct possibility, but intelligent life and canals was probably carrying

things a bit too far. A mostly conservative bunch, the astronomers were agreed about one thing: Lowell's hoopla left them with a lingering distaste for planetary astronomy. The professionals rotated their observatory domes and pointed their telescopes elsewhere. Observations of the planets languished for decades.

Science fiction writers, on the other hand, had a field day: Percival Lowell was just what they needed. For H. G. Wells, Edgar Rice Burroughs and the others, it was off to the races. For their millions of avid readers, Mars became Main Street.

Lowell's well-stirred pot boiled over in 1938, when Orson Welles made his famous radio broadcast and the public thought we were actually being invaded by Martians (see the accompanying article on Howard Koch). Then it simmered until the 1960s, when the Mariner 4, 6, and 7 spacecraft snapped pictures as they flew past our celestial neighbor.

The images revealed a stunning disappointment. There were impact craters everywhere. Moreover, Mars' atmosphere was thin and consisted of unbreathable carbon dioxide. And the thin atmosphere and generally cold temperatures meant that liquid water could not exist anywhere on the surface. Rather than a second Earth, Mars seemed to be dead world more like the Moon. Cornell professor Carl Sagan (who, like many of us, grew up on Burroughs) sang the blues for a red planet, as he said in his *Cosmos* (1980) television series.

The canals were kaput. The astronomers who saw them were the victims of a too-distant target seen through a roiling atmosphere, plus the subconscious data processor inside their craniums. The brain always tries to make sense out of what the eye sees; not being able to discern the stripes of the tiger amid the shadows of the bushes doesn't have much survival value. But with Mars, the subconscious didn't help; it automatically connected isolated dots into long chains, and *voilà*: canals! The conscious mind didn't help, either: after Schiaparelli's announcement, astronomers knew what they *ought* to be seeing.

Lowell's elaborate superstructure came crashing down, undercut at its very base. Far from hosting an advanced society engaged in engineering projects on a tremendous

scale, Mars, like they said about television in those days, was a vast wasteland. Percival Lowell would have been crushed.

Mars' resurrection as an attractive tourist destination began in 1971, when Mariner 9 went into orbit around the ruddy world. But Mars, ever the tantalizer, decided not to reveal all its charms at once. Though its atmosphere is thin, its high winds can raise plenty of dust, and a stupendous global dust storm greeted the spacecraft. The polar caps showed dimly through the veil of dust along with some strange spots, but not much else. Mariner would have to wait. For weeks. The suspense grew.

Asaph Hall at the U.S. Naval Observatory had discovered the two tiny moons of Mars in 1877, the same year of Schiaparelli's announcement. (He was one of those astronomers who couldn't see any canals.) Nearly a century later, Sagan pleaded with the mission designers to photograph them, but was told that wasn't in Mariner 9's play book. Now, with embarrassingly little for Mariner to do, Sagan's idea looked pretty good, and mission controllers turned the camera skyward.

They discovered that the moons were oblong little things, with the innermost moon Phobos ("fear") being 17 miles from end to longest end, and the outermost Deimos ("panic") being just 9 miles. Where they come from is a mystery: were they formed in orbit at the same time Mars was? Or are they asteroids captured somehow? Wherever these small objects come from, they are big enough to extinguish the dinosaurs if dropped on Planet Earth.

Curiously, Phobos is inching toward the surface of Mars and will hit it in 40 million years or so. Before Mariner, Russian scientist Iosif Shklovskii proposed that Phobos was a hollow spacecraft being brought down by atmospheric drag, but the craters seen covering its surface scotched that notion. Today, the odds-on favorite explanation is that the miniscule tide raised in the solid body of Mars by Phobos is gravitationally pulling it down. Phobos itself will be responsible for its own demise. Celestial suicide! At least there are no

dinosaurs to kill. Deimos, on the other hand, is too small and far away from Mars to be moved much by the tides.

Down below, as the dust settled, Mariner saw more and more features emerge. By sheer chance *all three* previous spacecraft had flown past the most boring half of the planet. Now Mars had turned around, so to speak, and did a slow striptease. The sight made the scientists' tongues hang out.

First came the mighty volcanoes, whose tops were those strange spots showing through the dust. One, Olympus Mons, the solar system whopper, rises 13 miles high above the surrounding plain, with its base covering an area the size of Arizona. An astronaut standing on its flank would only be dimly aware he was on the side of a mountain. And it's not all that old by solar system standards, either: judging from the sparse accumulation of impact craters on its summit, it died maybe only hundreds of millions of years ago at most. Who knows? Perhaps even today it belches a little.

A gigantic canyon appeared, so huge it would stretch from coast to coast if it were placed in the United States. Too big to be opened by anything other than tectonic forces, Valles Marineris (named after the spacecraft) makes the Grand Canyon look like a mere gully. Smaller channels came into view, some of which might have had lava running down them, but others looked like they had been cut by flowing water early in Mars' history, when the climate must have been balmy. And what about that peculiar layered terrain surrounding each pole? Was it laid down like the layers of a cake as Mars' axial tilt swung high and low every 125,000 years, changing the climate? And, of course, Mariner revealed scads more impact craters.

What a place! Hollywood couldn't have pulled back the curtain more grandly. True, there were no spidery octopi slowly but surely drawing their plans against us, no four-armed green men on thotback chasing John Carter across the mossy dead sea bottoms, no flying saucer pads, but the Red Planet no longer seemed like a dead planet. Mars was back!

Nor was the irony of what they were seeing lost on the scientists. No water had flowed through the channels for untold ages, but here were honest-to-goodness linear features unsuspected by the oldtime astronomers. They had busied themselves drawing imaginary lines, while the real ones could not be seen from the Earth. Only Valles Marineris corresponds to a canal on the old maps, called "Agathadaemon." But not even today, without being told, can Valles Marineris be recognized from Earthbound telescopes for what it really is: a miles-deep crack in the world.

So: were the astronomers of old a bunch of bozos, with Percival Lowell, that interloping amateur, the chief nincompoop? That judgment would be too harsh. Straight lines *per se* on celestial bodies are not ridiculous. Europa, one of the big moons of Jupiter, has lots of long fractures; so many, in fact, that modern astronomers, with tongue firmly in cheek, have suggested that Lowell pointed his telescope in the wrong direction and was looking at Europa instead! (In reality Europa's fractures would have been invisible through Lowell's telescope, and were not discovered until long after his death, courtesy of the Voyager spacecraft.)

No, the oldtimers suffered from what afflicts all of us all day, every day: real life. It never goes straight like the canals, but twists and turns and ties itself in knots. In our own day we have had fiascoes like cold fusion and the "face" on Mars. So we shouldn't smirk. Hindsight, as someone once said, is the cheapest form of wisdom.

Probably more good than harm came out of it. Mars became firmly lodged in the public's consciousness as it never would have without the canals, and fired the imagination of children who would one day become scientists. Moreover, Percival Lowell unwittingly spawned a multibillion dollar entertainment industry. Where would books and movies be without his Mars?

Despite all the flybys and landers, unanswered questions still abound. Is Mars' core solid, or liquid like the Earth's? Was there once a thick atmosphere? Did an ocean cover the northern lowlands long ago? Has the surface now and then been swept by

massive local floods, with the water pouring out from underground reservoirs? And, most importantly, was there life?

Astoundingly, to this last question Mars itself may have sent the answer to the Earth. For the most part, meteorites are pieces of asteroids which come to us for free. But some meteorites are chipped off the Moon, and a precious few come from Mars. We know that's where they originate because the gases trapped in them are a dead ringer for the Martian atmosphere.

Poor Mars, which is right next door to the asteroid belt, is clobbered occasionally by small asteroids, which blast chunks of our neighbor into space. After wandering aimlessly through the void some of these rocks fall on our own globe. While in films like **War of the Worlds (1953)** and **Invaders from Mars (1953)** the Red Planet wreaks havoc on the Earth, there is only one reported case of Mars doing us any real damage: in Egypt back in 1911 a Martian meteorite supposedly killed a dog. (More meteorite mayhem: a non-Mars meteorite struck and bruised a woman in 1954 as she lay napping on her couch in her home in Alabama, while others have damaged parked cars in Illinois and New York, and smashed through houses in New England.)

Another Martian rock, discovered in Antarctica and christened ALH84001 (standing for Allan Hills + 1984 + 1) became in 1996 the world's most famous meteorite. That's when David McKay from the NASA Johnson Space Center and his colleagues announced that it might contain fossils of ancient Martian microbes. They *look* like microbes, and have adduced other, much more technical evidence that they might *be* what they look. But many scientists are not convinced, and the controversy rages. Is this the Martian canals all over again? Scientists on both sides are trying hard to avoid reading into the meteorite what isn't there.

If microbes were living on Mars millions of years ago, the implications are stupendous: life elsewhere in the universe! And if there was life back then, it might still

flourish on Mars today, below ground. Microbes aren't much company, but they would prove that we are not alone in the vastness of space.

With Martian meteorites providing natural spaceships, could Martian life contaminate the Earth? Maybe; but to survive the trip the bugs would have to be hardy. Incredibly, the reverse may have happened, with the Earth contaminating Mars. Professor Jay Melosh at the University of Arizona and his collaborators have shown that asteroids blasting our own planet in ancient times may have launched rocks which ended up on Mars. For all we know, microbes from Earth seeded Mars' ecosystem!

Even if Mars does not now have life, it will have in the future: us. Once we get there, where would we live? One interesting suggestion is: in the lava tubes. Over the past few years scientists like Susan Sakimoto, working at NASA's Goddard Space Flight Center, have been examining images and topography of long ridges that run down the sides of Martian volcanoes. "The best explanation of these ridges is that they are lava flows that were emplaced with subsurface plumbing systems. The central pipe or tube underlies the ridgeline, and in some cases emptied out as the flow stopped, leaving a system of centerline caves," she says.

If this is so, there is ready-made housing for future settlers. "It won't be air-tight, and hazards include rubble on the floor and the danger of the roof collapsing overhead unless you support it, but at least it would provide shelter from the huge daily surface temperature variations, cosmic radiation, and dust storms," says Sakimoto.

Lava tubes are fairly common where there are volcanoes; tourists can walk through a short one near the Kilauea volcano in Hawaii. What's different about Mars is the scale.

"Long lava tubes on the Earth are generally a few yards to tens of yards wide and run a mile or two to a few tens of miles," notes Sakimoto. "But on Mars, some of the flows are up to a few miles wide and run for over a hundred miles, and their cave systems could do the same."

One can almost envision underground outposts spaced out along them, connected by a subway. Shades of the canals!

Lowell was wrong. There is no intelligent life on Mars. Not yet, anyway. But once mankind does establish itself there, the red planet Mars will have completed its transformation from the god of war to the Earth's blushing bride.

What about beyond? Is there intelligent life elsewhere in the galaxy? Whatever the answer to this question, the outcome will be awesome. If aliens do exist, then they are probably millions of years ahead of us. Look at the fruits that 500 years of modern science have brought. What would 100,000 times 500 years bring?

If they don't exist, then the galaxy is ours, and we will have the heavy responsibility of taking care of it. Let us fervently hope that our stewardship of the stars will be better than it has been for Planet Earth.

Acknowledgments

Bob Stephens suggested this article. Susan Sakimoto and David E. Smith provided input. The views expressed here are solely the author's. Jim Roark gave valuable computer assistance. The 19th century quotations are from old issues of the journal *Observatory*, and from Camille Flammarion's book *La Planète Mars et ses Conditions d'Habitabilité* (1892) as translated by Patrick Moore; all references identifying the planet as Mars were edited out. The photos of Percival Lowell and his Mars globe are courtesy of Lowell Observatory. The drawing of Mars' canals breaking up into spots is from E. M. Antoniadi's book *La Planète Mars* (1930). The spacecraft photos are variously courtesy of NASA/JPL, Malin Space Science Systems, the MOLA Science Team, and Arizona State University. The "fossilized Martian" is courtesy of NASA/JSC. Many spacecraft images of Mars and other planets are available at <http://photojournal.jpl.nasa.gov>.

Figure 1

The dapper--and wealthy--Percival Lowell believed in a Martian civilization.

Courtesy Lowell Observatory.

Available at: http://www.lowell.edu/library/data/historic_photo/lowres/l_0049.gif

Figure 2

Lowell's globe shows numerous canals crisscrossing Mars. Courtesy Lowell Observatory.

Figure 3

Astronomer E. M. Antoniadi saw Schiaparelli's canals (left) dissolve into disconnected smudges (right) at high magnification when the Earth's atmosphere was calm. From *La Planete Mars* (1930) by E. M. Antoniadi.

Figure 4

Three-dimensional rendering of the super-volcano Olympus Mons. The height is exaggerated by a factor of 10. Courtesy NASA/MOLA Science Team.

Available at: <http://photojournal.jpl.nasa.gov>. Click on "Mars." In the box saying "Go directly to image" type in PIA02806.

Figure 5

The giant canyon system Valles Marineris would stretch from New York to San Francisco if placed on the Earth. Courtesy NASA/JPL.

Available at: <http://photojournal.jpl.nasa.gov>. Click on "Mars." In the box saying "Go directly to image" type in PIA00422.

Figure 6

This channel, named Ma'adim Valles, may have had water flowing through it eons ago. Courtesy NASA/JPL.

Available at: <http://photojournal.jpl.nasa.gov>. Click on "Mars." In the box saying "Go directly to image" type in PIA00414.

Figure 7

Did climate cycles cause these mysterious layers near the polar regions? Courtesy NASA/JPL/Malin Space Science Systems.

Available at:
http://www.msss.com/mars_images/moc/top102_Dec98_rel/npole/index.html

Figure 8

The Sojourner rover trundels across the rocky surface of Mars. Courtesy NASA/JPL.

Available at: <http://photojournal.jpl.nasa.gov>. Click on "Mars." In the box saying "Go directly to image" type in PIA01560.

Figure 9

Mars' permanent north polar cap contains billions of tons of water. Courtesy NASA/JPL/Malin Space Science Systems.

Available at: <http://photojournal.jpl.nasa.gov>. Click on "Mars." In the box saying "Go directly to image" type in PIA03204. Pick either image for reproduction.

Figure 10

Did massive local floods carve those teardrop-shaped “islands”? Courtesy NASA/JPL/ASU.

Available at: <http://themis.la.asu.edu/zoom-20020917a.html>

Figure 11

Phobos, the innermost moon, circles Mars three times a day. The big crater at left is called “Stickney,” which was Asaph Hall’s wife’s maiden name. Courtesy NASA/JPL.

Available at: <http://mars.jpl.nasa.gov/facts/images/p1.gif>

(Another image of Phobos is available at: <http://photojournal.jpl.nasa.gov>. Click on “Mars.” In the box saying “Go directly to image” type in PIA01333. That photo is Courtesy NASA/JPL/Malin Space Science Systems.)

Figure 12

Deimos, the outermost moon, circles Mars once every 30 hours. Its surface is smoother than Phobos’ due to Deimos’ deep layer of dust. Courtesy NASA/JPL.

Available at: <http://mars.jpl.nasa.gov/facts/images/d1.gif>

Figure 13

Europa, one of the big moons of Jupiter, looks a lot like Lowell’s vision of Mars. Under Europa’s fractured icy surface may be an ocean, perhaps harboring life. Courtesy NASA/JPL.

Available at: <http://photojournal.jpl.nasa.gov>. Click on “Mars.” In the box saying “Go directly to image” type in PIA01523

Figure 14

Is this a fossilized Martian? Only 1/100 the width of a human hair, it was found in a meteorite from Mars. Courtesy NASA/JSC.

Available at:

<http://spaceflight.nasa.gov/gallery/images/mars/meteorites/ndxpage1.html>. Where it says "INDEX" click on "2." The figure is the second from left in the bottom row.

Figure 15

Future abode for settlers? The gentle undulation is a lava tube running down the side of the Alba Patera volcano, whose summit crater is out of sight to the lower right. The arrows point to a chain of depressions where the roof of the tube has partially collapsed. The crater at upper left is an impact crater. Courtesy NASA/JPL and Susan Sakimoto.

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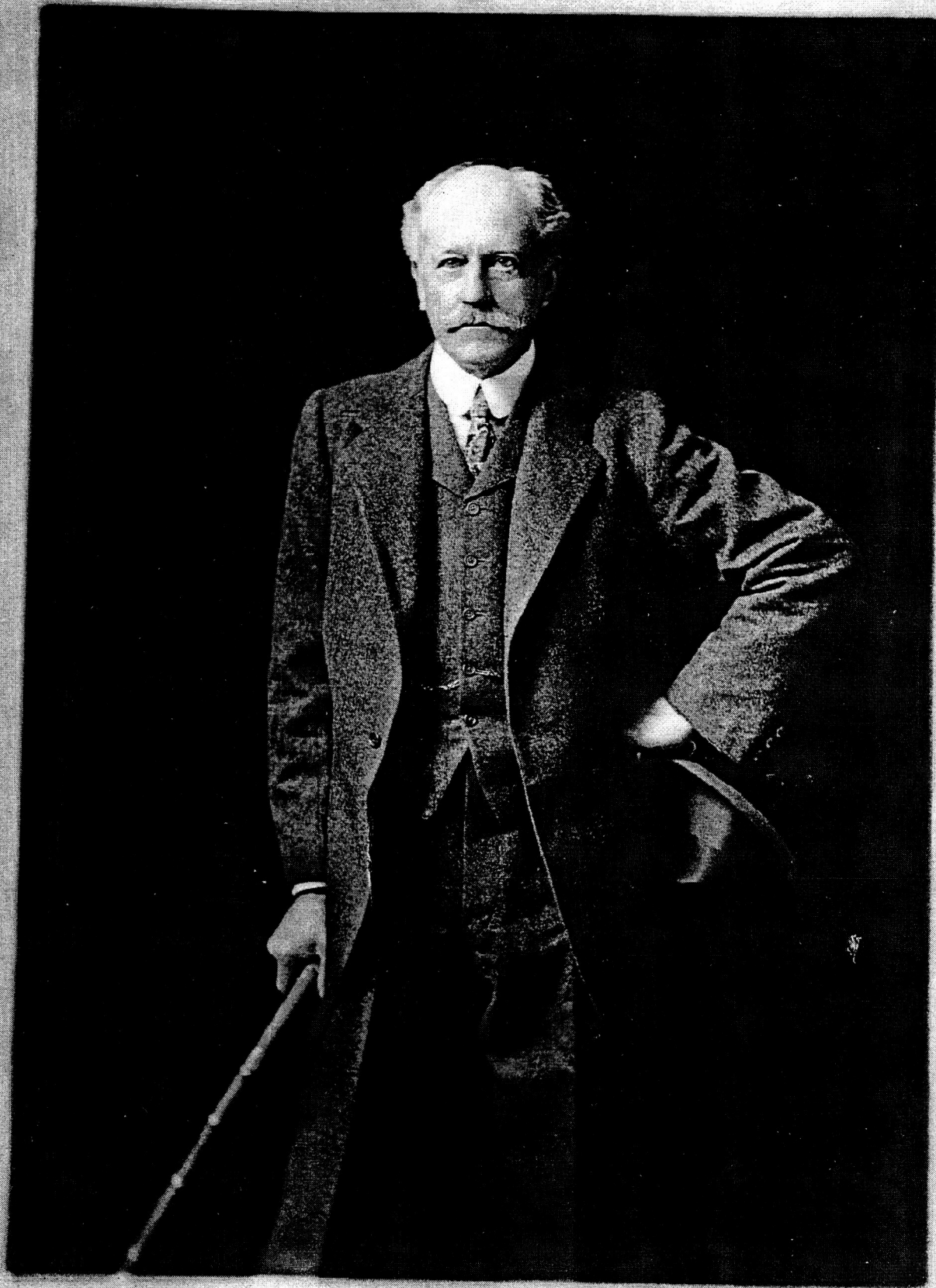


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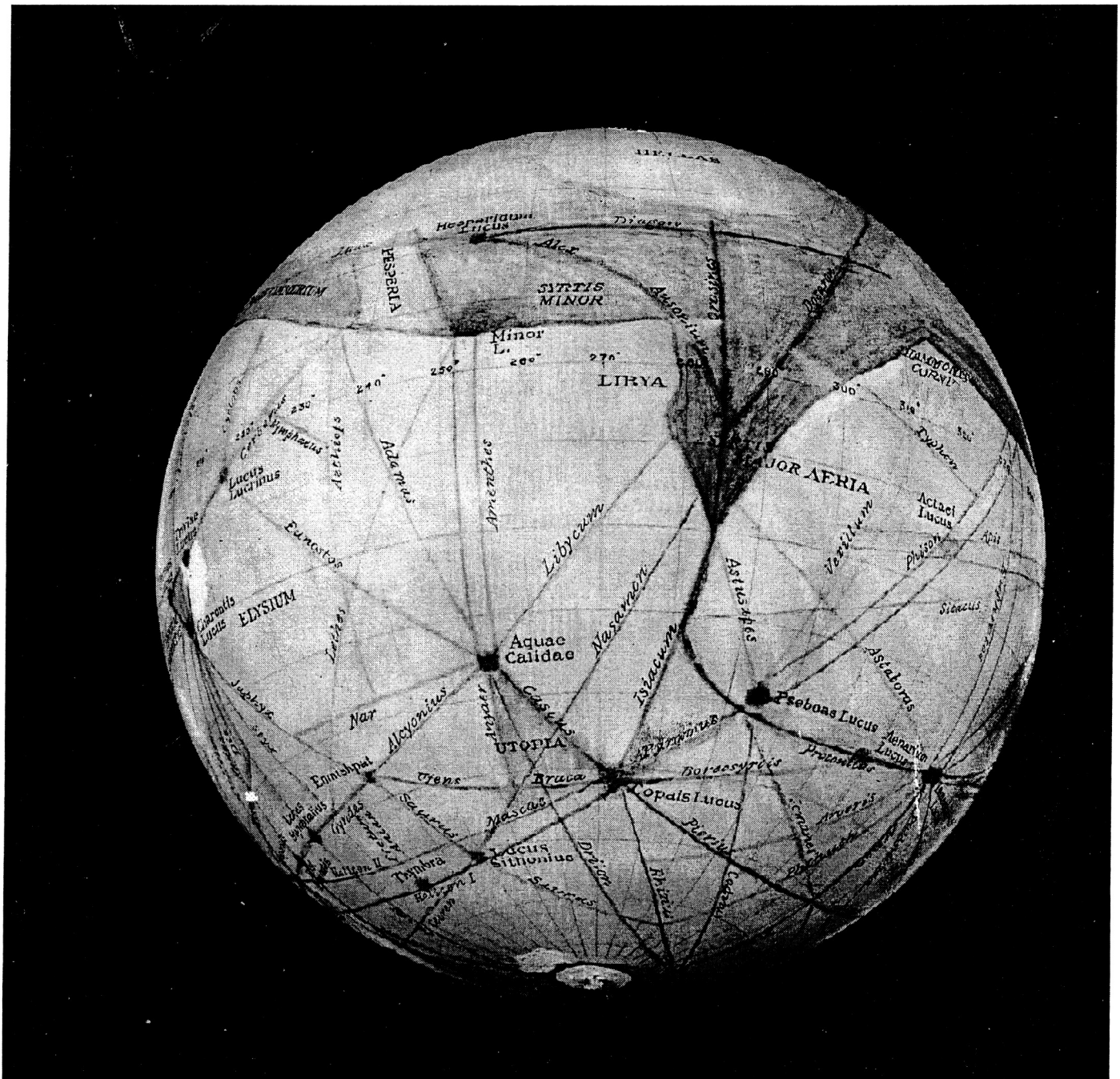


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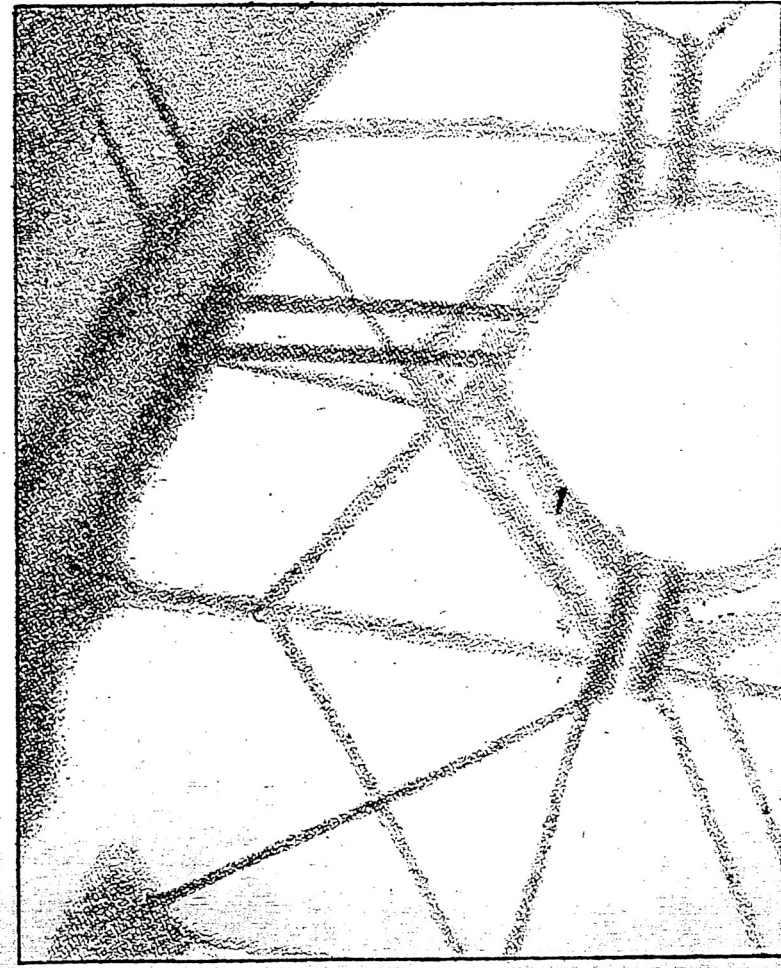


Fig. 7. — « Canaux » linéaires sombres, simples et doubles, entrevus par Schiaparelli entre 1877 et 1890 dans la région d'*Elysium*.

(Lunettes de 0^m218 et 0^m490).

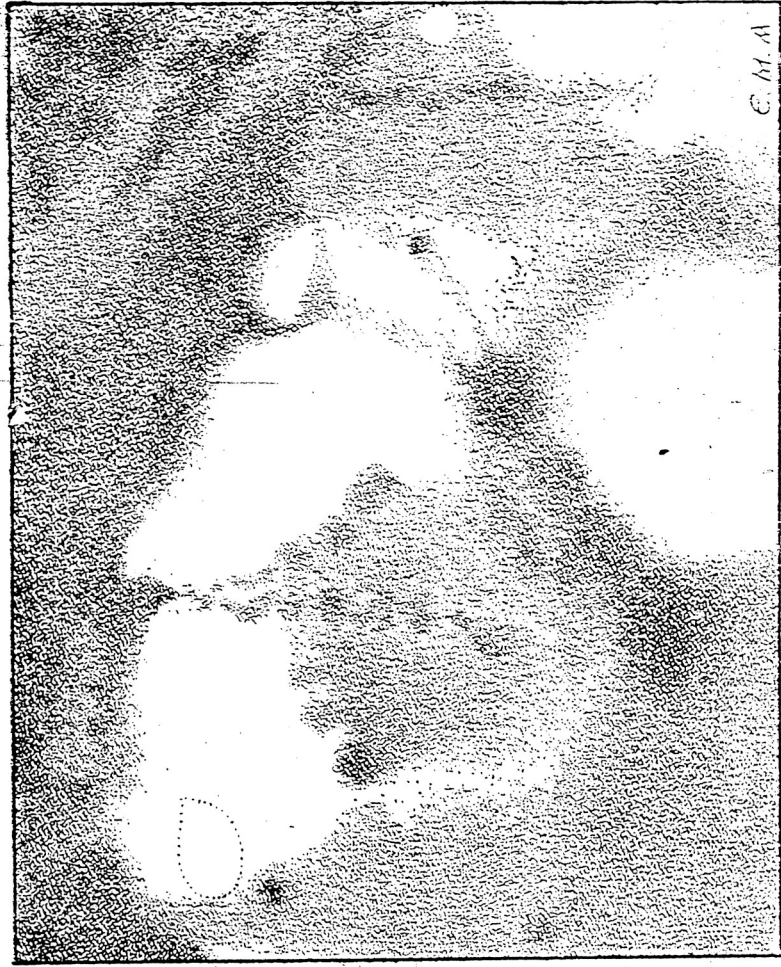


Fig. 8. — Résolution des mêmes détails en traits et ombres absolument irréguliers par l'auteur en 1909, 1911, 1924 et 1926.

(Lunette de 0^m83).

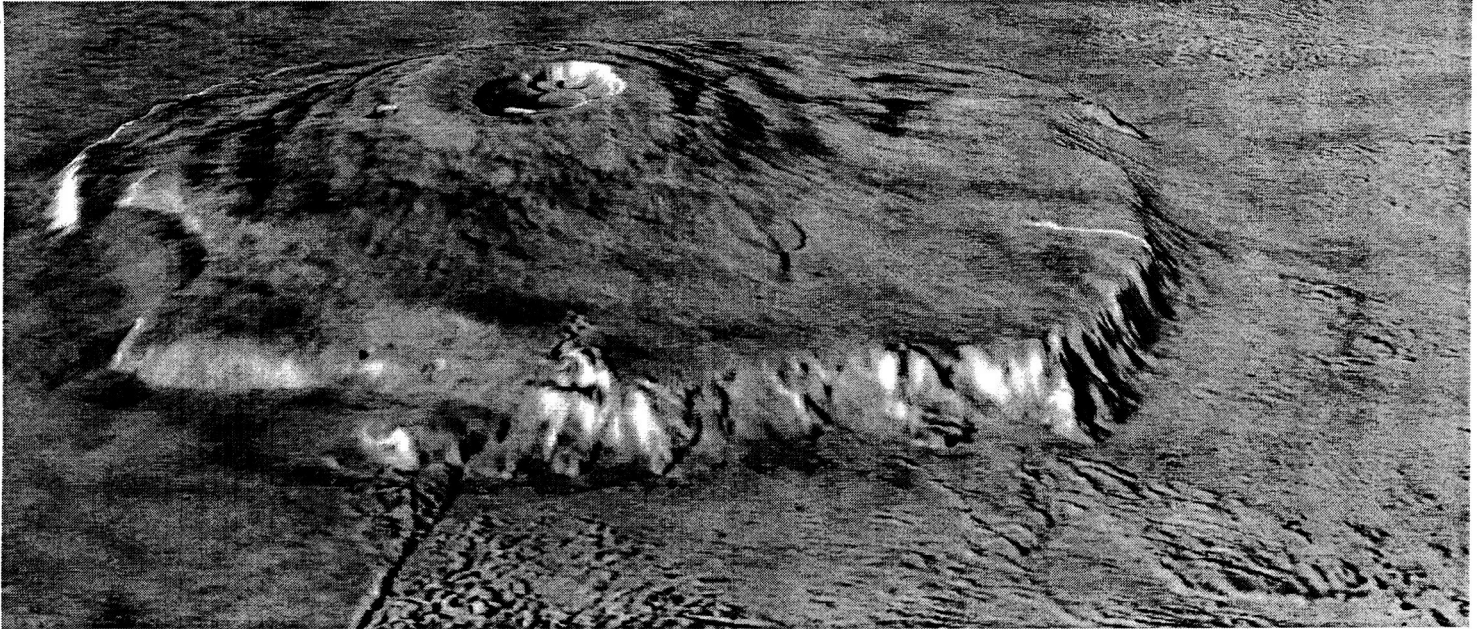


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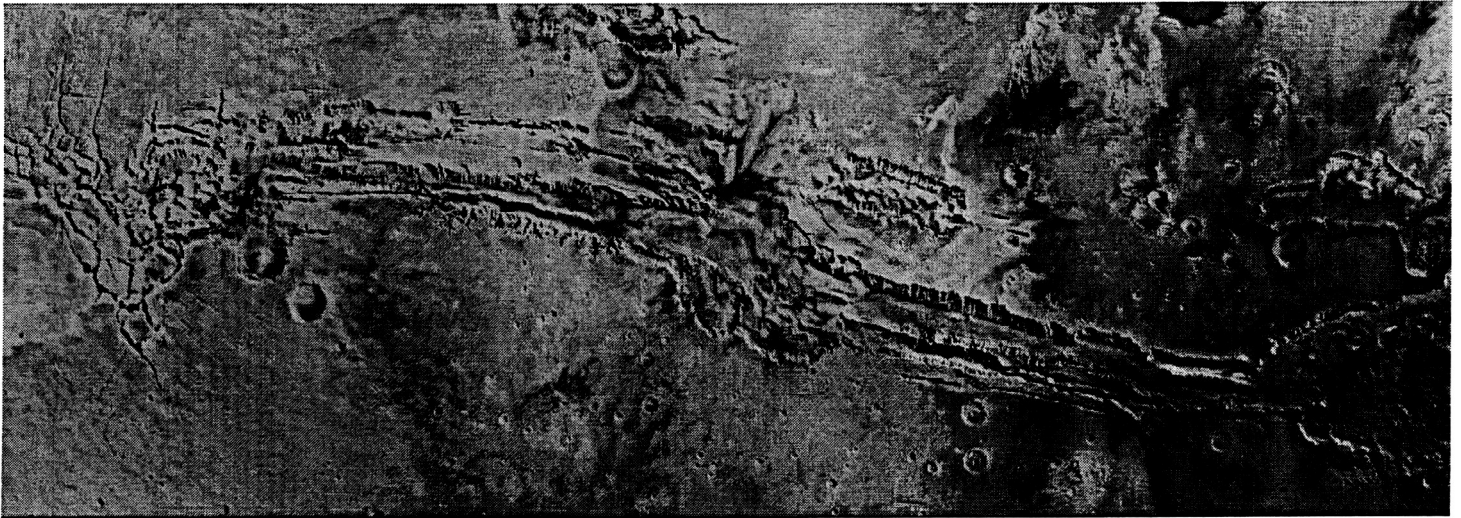


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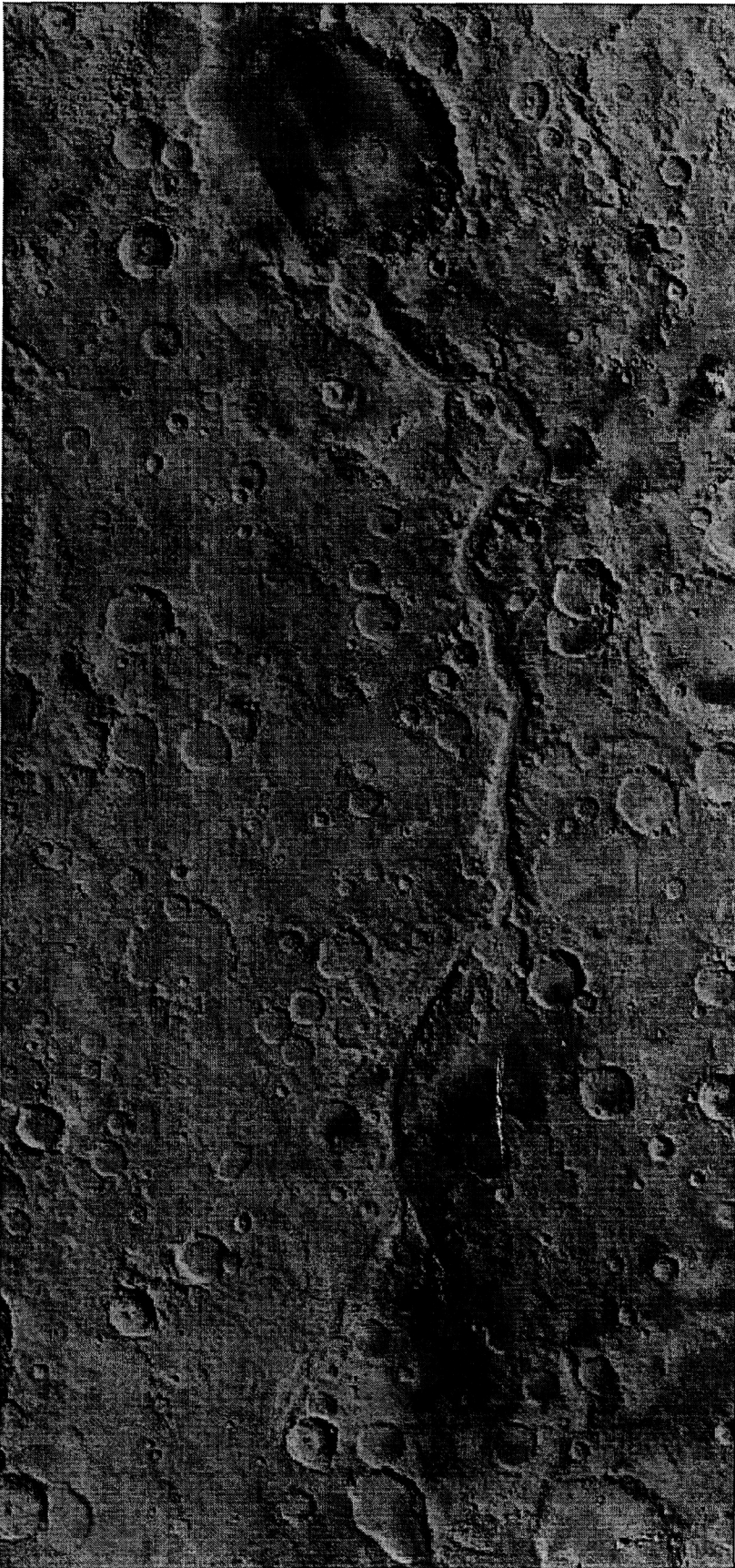


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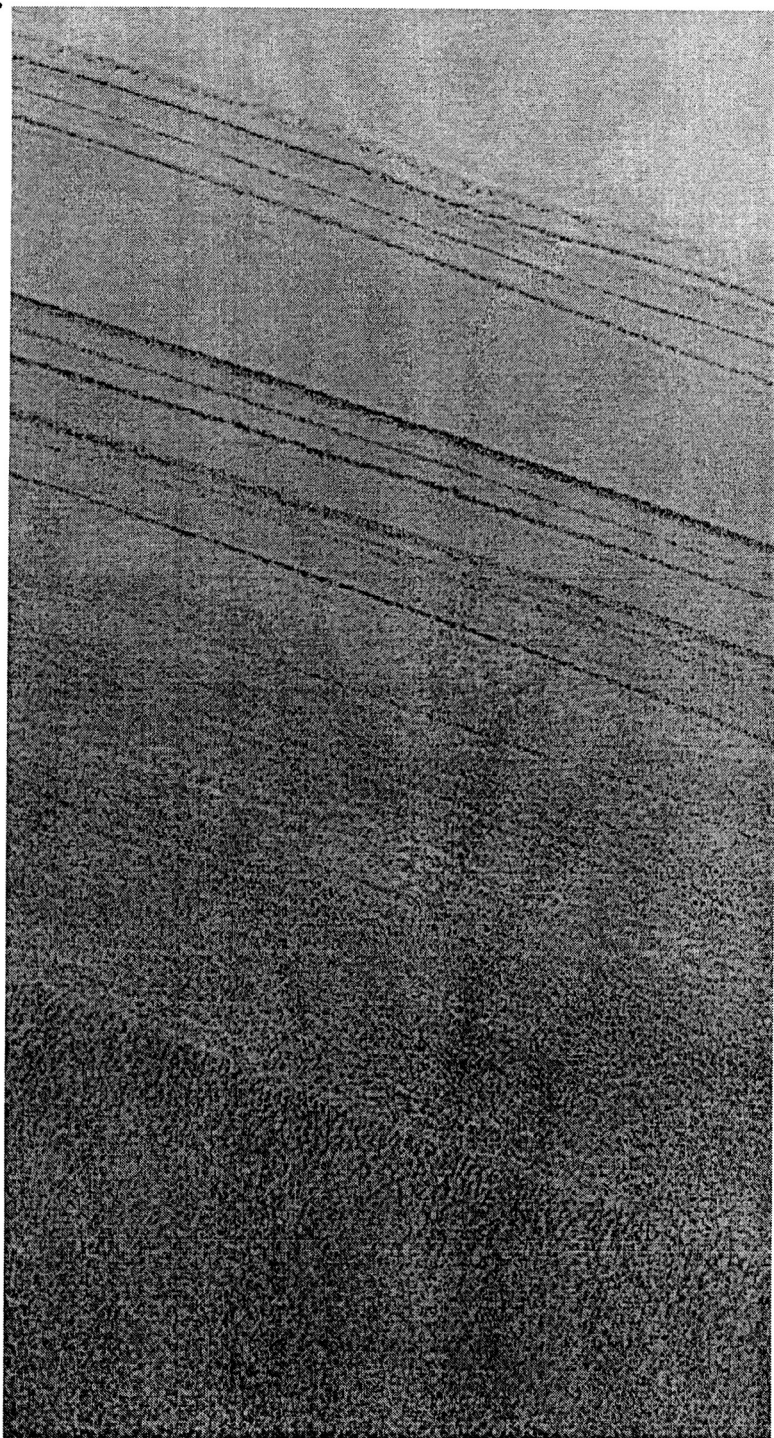


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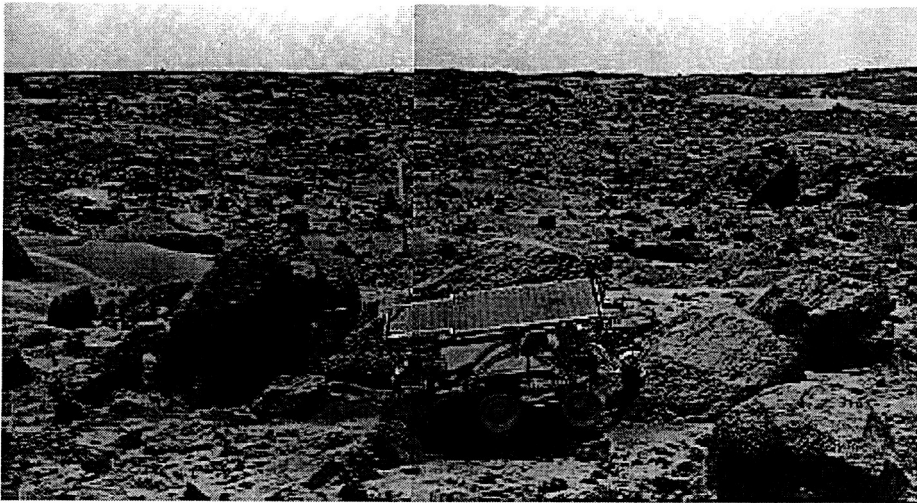


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The Sojourner rover trundels across the rocky surface of Mars. Courtesy NASA/JPL.

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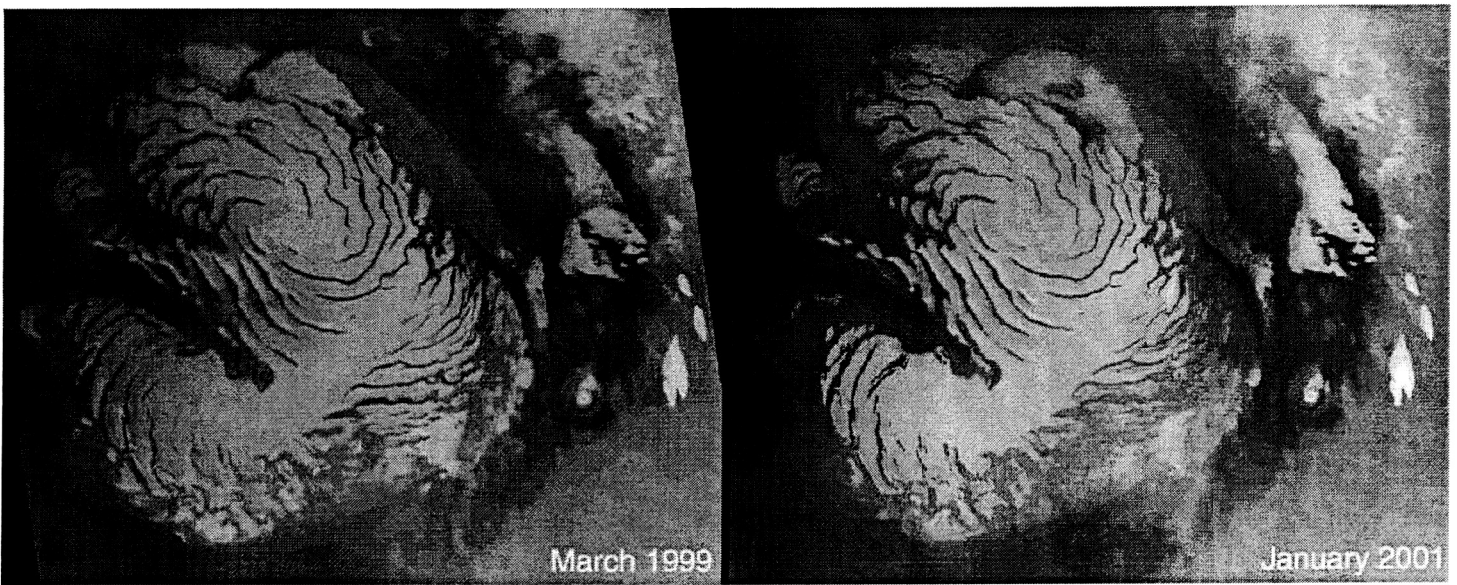


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Mars' permanent north polar cap contains billions of tons of water. Courtesy NASA/JPL/Malin Space Science Systems.

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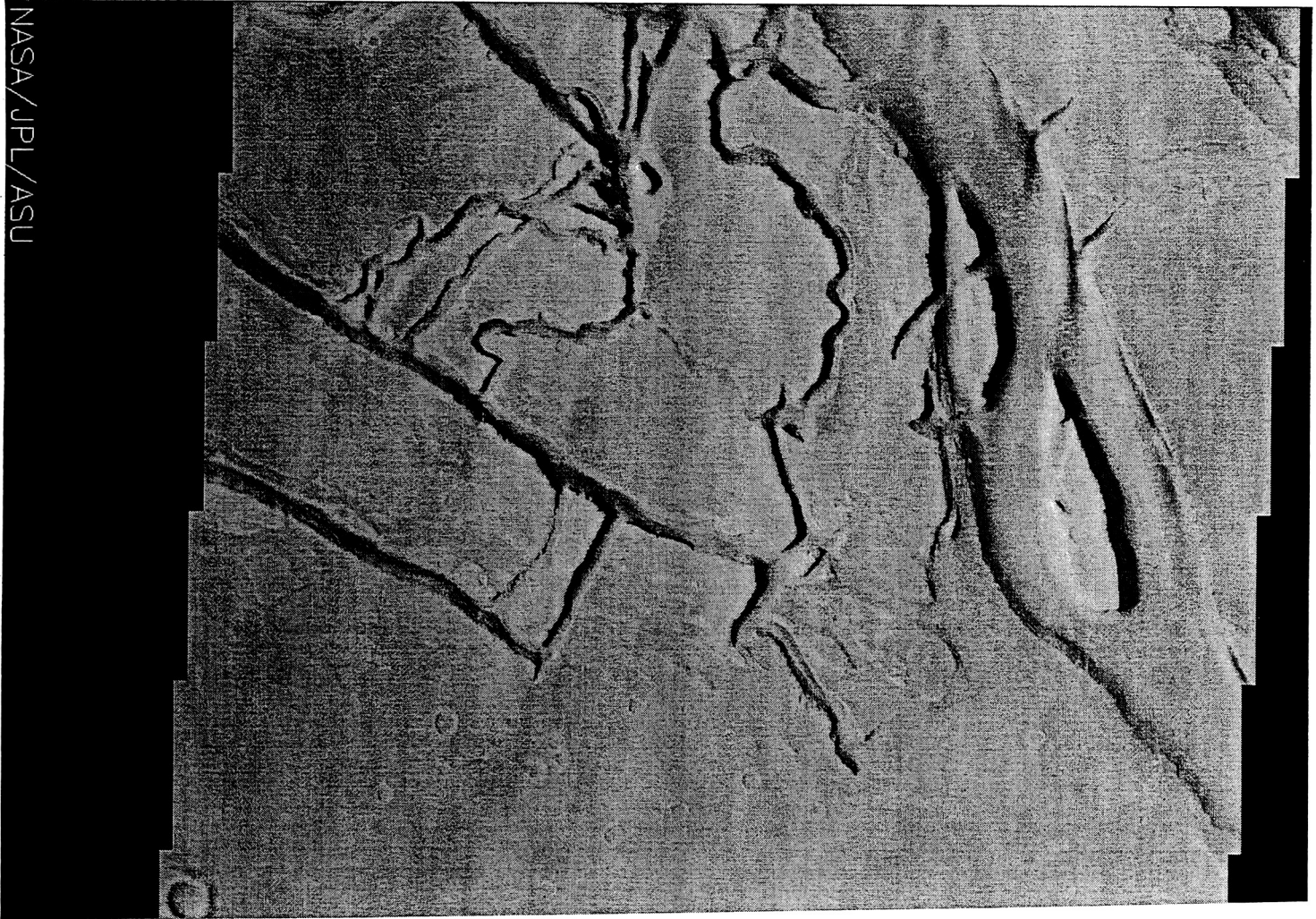


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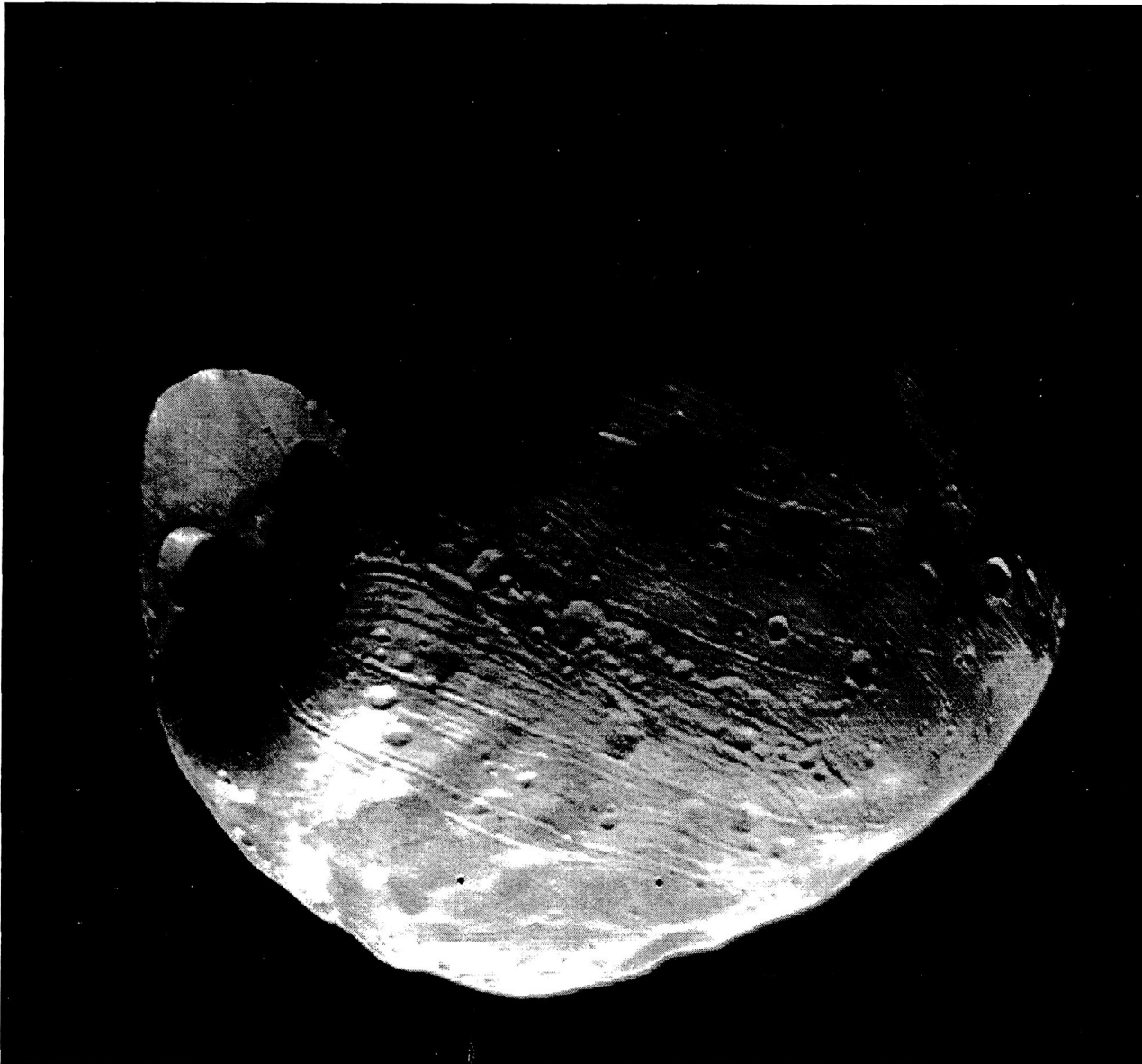


Figure 11

Phobos, the innermost moon, circles Mars three times a day. The big crater at left is called "Stickney," which was Asaph Hall's wife's maiden name. Courtesy NASA/JPL.

.Available at: <http://mars.jpl.nasa.gov/facts/images/p1.gif>.

(Another image of Phobos is available at: <http://photojournal.jpl.nasa.gov>. Click on "Mars." In the box saying "Go directly to image" type in PIA01333. That photo is Courtesy NASA/JPL/Malin Space Science Systems.)

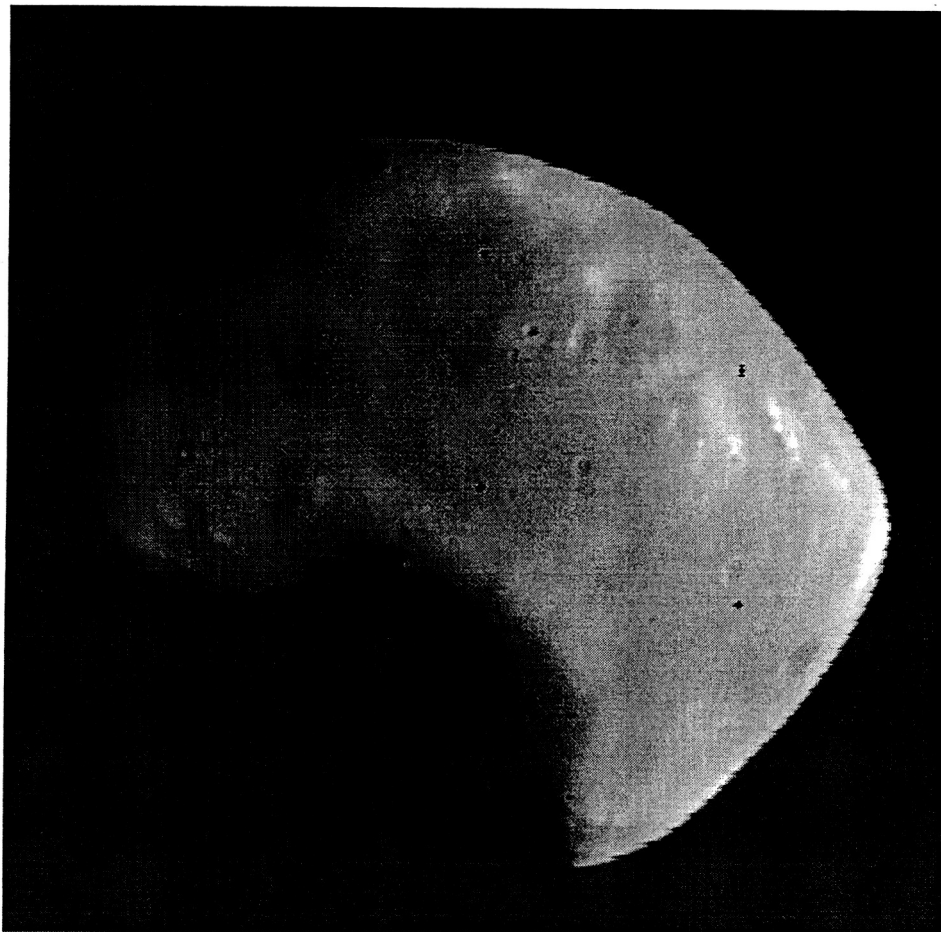


Figure 12

Deimos, the outermost moon, circles Mars once every 30 hours. Its surface is smoother than Phobos' due to Deimos' deep layer of dust. Courtesy NASA/JPL.

Available at: <http://mars.jpl.nasa.gov/facts/images/d1.gif>

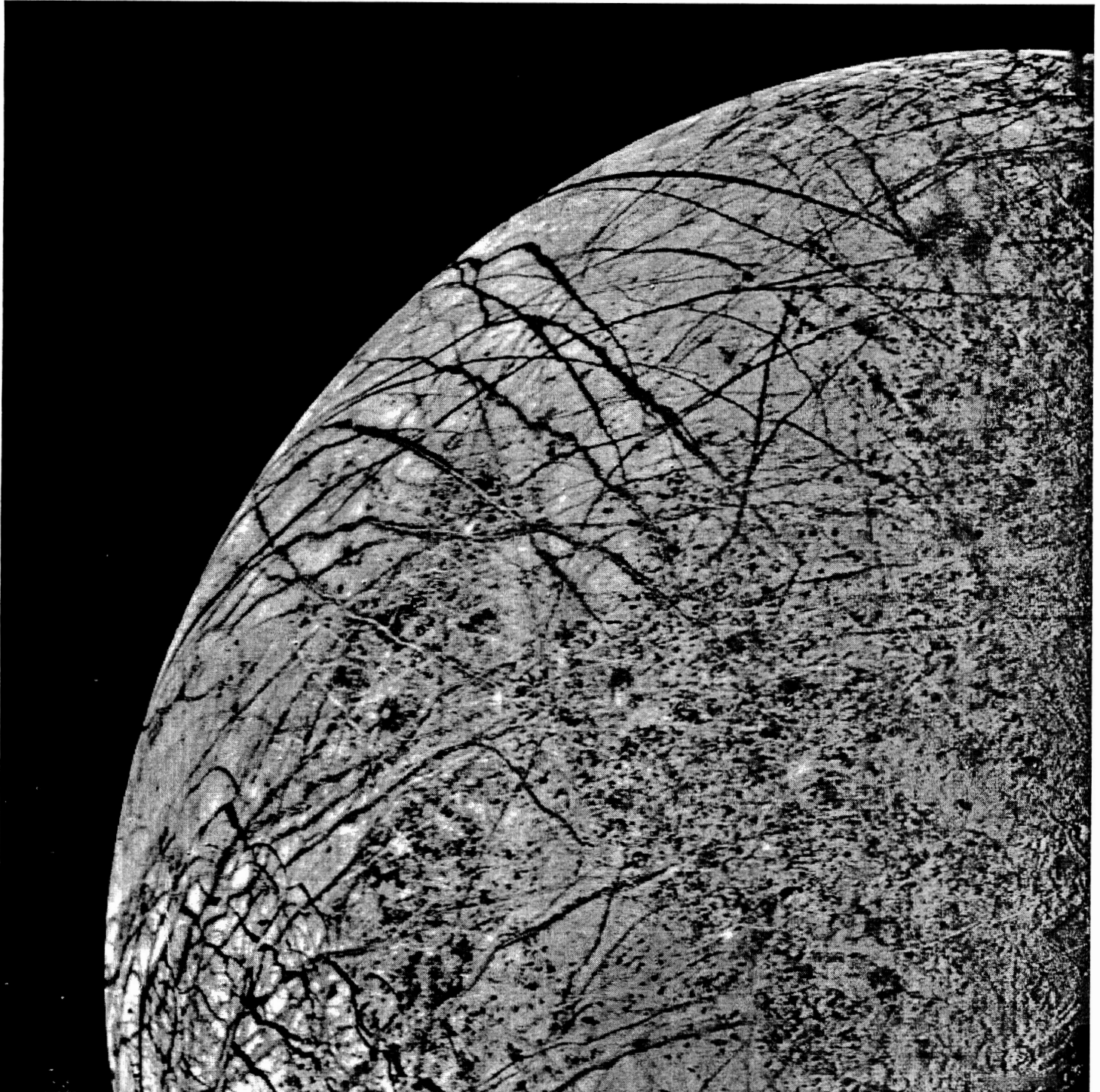


Figure 13

Europa, one of the big moons of Jupiter, looks a lot like Lowell's vision of Mars. Under Europa's fractured icy surface may be an ocean, perhaps harboring life. Courtesy NASA/JPL. Available at: <http://photojournal.jpl.nasa.gov>. Click on "Mars." In the box saying "Go directly to image" type in PIA01523