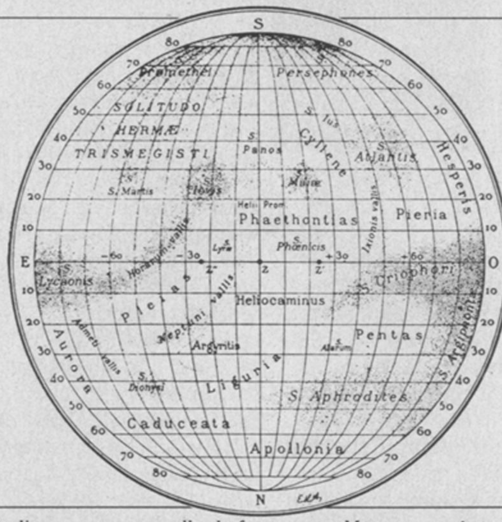
OTHER WORLDS OF 1922

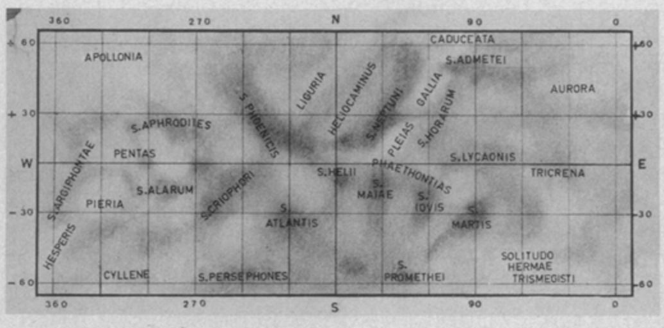
Decades before the Space Age, reality was already catching up with fantasy

BY JONATHAN EBERHART

Sixty years ago, the known solar system was a simpler place. No one knew of the acid clouds of Venus, the volcanoes of Io, the powerful radio bursts of Jupiter or the baffling complexities of three ringed worlds. Yet it would be unreasoning intolerance to think of that time as a mere dark age, to be illuminated only by the explorations of spacecraft. The shortage of data certainly allowed for greater freedom of speculation about the mysteries of other worlds, but even if the public at large was less exposed to the details of scientific subjects than it is today, planetary researchers of the time were earnestly engaged in laying the groundwork for the spectacular discoveries that would follow. Herewith, a modest tour of the planets around 1922—admittedly far from all-inclusive, but indicative, in hindsight, of the shape of things to come.



Antoniadi gave names to albedo features on Mercury, as shown in this 1914-22 map (above), but they had to be redistributed (below) when the planet's true rotation period was determined some 40 years later.



Clark Chapman/Planetary Science Institute

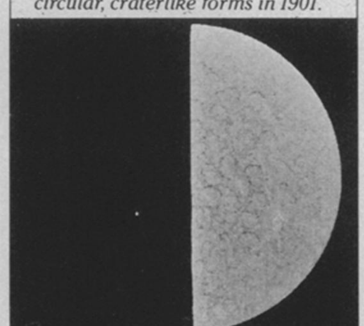
MERCURY

It was the home of the "twilight zone," a thin, globe-girdling band of terrain separating a hemisphere of eternal, searing day from one of endless night. Because it orbits so close to the sun, it never gets far from the edge of the solar disk as seen from earth, so it was—and still is—extremely difficult for earthbound astronomers to study. Copernicus, who triggered a revolution when he boldly asserted that earth was merely one of several planets circling the sun, is said to have mourned on his deathbed in 1543 that he had never seen Mercury.

The observing problem meant that surface markings which could have revealed how fast Mercury turned on its axis were all but invisible. German astronomer Johann Schroter peered at it from 1779 to 1813, believing he could see such features as a mountain 20 kilometers high, and concluded that a Mercurian day was just over 24 hours long. Later, Britain's W. F. Denning reported that surface patches on the planet were "so pronounced that they suggest an analogy with those of Mars," and adjusted the rotation period to 25 hours. But it was Giovanni Schiaparelli of Italy who set the stage for the twilight zone by concluding from his own observations in the 1880s that Mercury's day was the same as its year, 88 earth-days long, so that it always kept the same face toward the sun. This belief was still in full sway in 1922, and in fact would not be overturned until the 1960s, when radar measurements from earth revealed the true rotation period of 59 days, laying the twilight zone to rest forever.

One odd result of the 88-day misapprehension was triggered later in the 1920s, when E. M. Antoniadi produced a map of light and dark areas of the planet, complete with names, based on the presumption that his five years of observations encompassed only one hemisphere. Nearly half a century later, researchers trying to preserve Antoniadi's "classical" place names for a new brightness map (being prepared for comparison with the then-upcoming photos from the Mariner 10 spacecraft) had to go through the extra step of unraveling his work in order to reassign the names to their proper locations around 360° of longitude. And yet, as much as 80 percent of what he saw probably *was* from a single hemisphere: The varying tidal torque caused by the sun as Mercury travels its highly elliptical orbit (the least circular path of any major planet except Pluto) would have meant that only a limited range of longitudes was visible from earth during most of the occasions when Mercury was far enough away from the solar disk to be studied.

T. J. J. See portrayed Mercury with circular, craterlike forms in 1901.



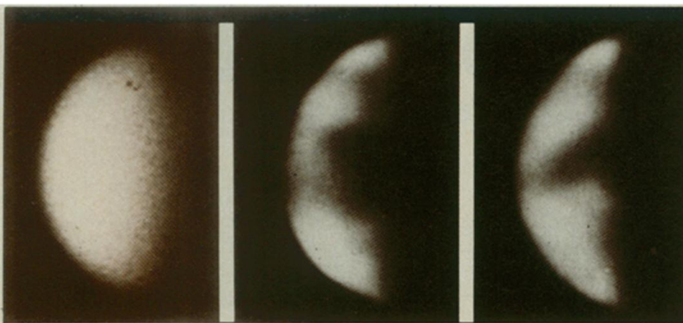
U.S. Naval Observatory

Although Mariner 10's photos were still decades away, astronomers in 1922 already had an idea of what to expect. Reflectance spectra, a low albedo and the absence of a surrounding halo due to refracted sunlight all pointed to the lack of a significant atmosphere, and thus suggested the possible presence of a heavily cratered, moonlike surface. One astronomer, T. J. J. See, in 1901 even produced a pale sketch showing what seemed to be round, craterlike forms, although researchers still argue about whether the difficult viewing situation would have allowed See to see any such detail.

Little else about Mercury was known. It was not until 1915, in fact, that Einstein's general theory of relativity was able to account for the well-known precession of the planet's orbit (Mercury's closest approaches to the sun advance in solar longitude by 43 arc-seconds per century). Until Einstein let them off the hook, some astronomers had spent decades looking vainly inside Mercury's orbit for an elusive planet whose mass could explain the effect. Even the mass of Mercury was known to no greater accuracy than about 25 percent, since it had no known satellites whose orbital characteristics could aid in the calculation.

VENUS

Even if you were not the sort to have been swayed by sheer flights of fancy, you might have given considerable credence to the writings of a Nobel laureate



Atmosphere of Venus is almost featureless by visible light (left), but reveals details in ultraviolet images such as these 1927 photos (center, right) by F. E. Ross.

Venus UV: Yerkes Obs., all others courtesy of Lowell Obs.

such as Swedish chemist Svante August Arrhenius. Certainly not the first to enter this particular arena, he nonetheless carried considerable weight when he speculated in 1918 that "everything on Venus is dripping wet. . . .A very great part of the surface. . . . is no doubt covered with swamps."

There were plenty of signs of a dense, cloudy atmosphere, after all, and on earth, clouds equal water, right? Only two years later, however, a spectral search for water and oxygen pointedly failed to reveal either (most of the atmosphere's little water is now known to be locked in the sulfuric acid of the clouds), prompting the contrary view that Venus was a dry, desertlike world. Still, while the all-concealing atmosphere discouraged observation, it had little such effect on speculation. "It is not impossible to imagine," wrote Wellesley College astronomy professor John Charles Duncan in a 1926 textbook, "that Venus is inhabited by beings who, because of this impenetrable mantle of clouds, are ignorant of the existence of the sun and of all other bodies exterior to their own planet." In 1932, infrared studies by Walter Adams and Theodore Dunham showed carbon dioxide to be a major constituent of the atmosphere, but it took radio measurements by Cornell H. Mayer nearly a quarter-century later to deliver a telling blow to life-on-Venus ideas by revealing a presumable surface temperature of 330°C (more than 600°F). It is in fact even hotter.

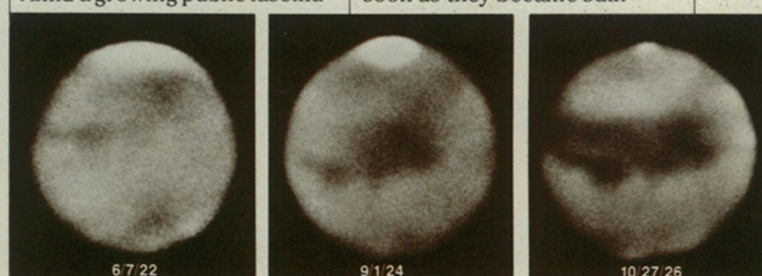
Still, the veil remained a formidable barrier, blocking access to even such fundamentals as the length of the planet's day. Some observers reported markings that they believed represented surface details seen through occasional breaks in the clouds, but the calculated rotational periods varied widely. Schiaparelli asserted that a day on Venus, as on Mercury, equaled its year (225 days in this case), while later measurements of spectral Doppler shifts produced estimates from 12 hours to 30 days. In 1922, H. Spencer Jones, later to become Britain's Astronomer Royal, wrote that "the true period remains unknown, and. . . . is one of the most difficult astronomical problems awaiting solution." Again, it took radar studies in the early 1960s to reveal the planet's 243-day, retrograde rotation.

Some researchers today question even whether the early observers could have seen cloud markings at all, since the contrast is so low in visible light. Far more pronounced details appear in ultraviolet light (a rare early example is the work of F. E. Ross in 1927), and cloudtop close-ups from spacecraft have been made through UV filters —revealing no holes to the ground.

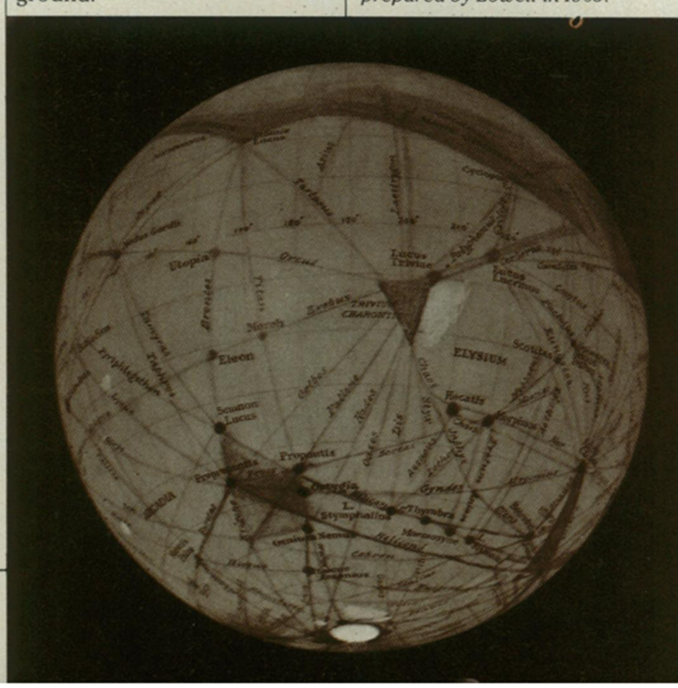
MARS

Mars in 1922 was still recovering from the war. Schiaparelli had innocently defined what would turn out to be the battlefield in 1877, but 17 years later it was Percival Lowell who fired, if not the first, at least the most explosive shot.

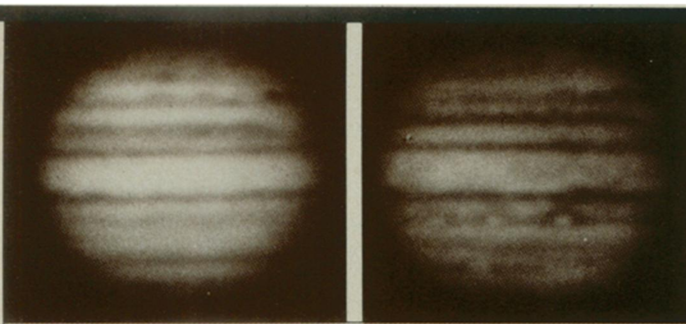
It is an oft-told tale. Observing from Milan through a small telescope, Schiaparelli reported glimpses on Mars of a widespread network of fine lines, which he termed "canali," an Italian word that he intended to mean nothing more specific than "channels." Mars, however, had long tantalized earthly observers, and it was perhaps inevitable that the word would be translated into English as "canals," carrying with it for some the implication of an artifact of a civilization. Schiaparelli remained noncommittal, later noting that the markings "may be described as canals, although we do not know what they are." But others were less circumspect. Amid a growing public fascination, the French astronomer Camille Flammarion wrote in 1892 that "the present inhabitation of Mars by a race superior to ours is very probable." And then came Lowell, who first propounded his ideas in 1894, during the first few weeks of work at his own Arizona observatory, and who ardently and single-mindedly championed them until his death in 1916. The canals, he said, indicated not only life on Mars (some observers cited apparent changes in them as due to seasonal variations in vegetation), but intelligence. "That life inhabits Mars," he wrote in 1907, "now is the only rational deduction from the observations in our possession; the only one which is warranted by the facts." Lowell was a vocal and powerful advocate for his theory. Others, such as Antoniadi, never "believed," and scientists and laymen alike took sides. Astronomy students would express confidence that they, too, would be able to see the controversial features as soon as they became sufficiently competent observers.



Martian polar caps and other features were long known to show changes (above), though some observers saw more dramatic features, such as shown in this globe of the planet's "canals" (below), prepared by Lowell in 1903.



In time, the canal-mania waned—but not completely. H. Spencer Jones, in his conservative 1922 text, *General Astronomy,* noted that careful observers such as Barnard had failed to detect the canals, which might be merely a subjective impression "arising from the tendency of the eye to connect by straight lines faint markings which are visible only with difficulty." Jones's opinion seems clear, but in the absence of confirmatory evidence, the cautious astronomer would go only so far: "Whilst it would be unwise to make too definite an assertion," he wrote, "the balance of probability seems to be in favour of the supposition that the canals are subjective." Even a similarly careful student might not have completely disposed of the subject in his own mind, and in 1975, Cornell Uni-



Photos from 1909 and 1914 show changes in Jupiter's stripes.

versity's Carl Sagan and Paul Fox still felt it worth a detailed analysis of the Mariner 9 spacecraft's closeups to report: "The vast bulk of classical canals correspond neither to topographic nor to albedo features, and appear to have no relation to the real Martian surface."

Yet despite the limitations of observing from a distance, some essential details of the surface were well-known by 1922. Albedo changes were well established (though they are now largely attributed to the redistribution of dust by the wind), as were the seasonal retreat and advance of the polar caps. Sixty years later, a "water war" of a different kind is being waged, as researchers debate whether the natural Martian channels (most of them too small to be seen from earth) are due to water, lava, windblown dust, ice, mud or factors that even to this day remain unknown.

And the Marsquest continues. The 60th birthday of Science News coincides with the first day of the Viking 1 lander's fourth, 687-day Martian year on the job.

JUPITER

The spectacular markings of Jupiter had been known for centuries. Over time, astronomers had become aware that the planet's distinctive stripes could widen, shrink or even disappear, and that its variety of spots, ovals and other shapes could vary in decades or mere days. The famous Great Red Spot is now said by some to have existed since at least 1665, when Cassini reported a feature that he dubbed the "eye of Jupiter," though its continuity over the ages has not always been apparent. A number of accounts in the 1920s and 1930s placed its origin in 1878, when observers (perhaps aided by improvements in instrumentation) reported its conspicuous presence. "It is generally agreed," wrote Jones in 1922, "that in [that year] there was an eruption of some sort on the planet and that the gases poured out over the highest cloud zone and remained in a practically stationary position relatively to it."

As for ideas of the Jovian interior, a major transition was about to take place. For decades, the prevailing view had generally been that the major outer planets were huge, gaseous globes—and extremely hot. In 1923, however, Donald Menzel concluded from earlier spectral measurements that Jupiter and Saturn were in fact cold (though still warmer, at −110°C, than he believed could be sustained by solar radiation alone). The following year, Harold Jeffreys used calculations of the planets' moments of inertia to affirm an earlier finding that the two worlds are more condensed at their centers than is the earth. Adding in Menzel's temperatures, the already-known low bulk densities and other data, he concluded that Jupiter and Saturn probably consisted of small, rocky cores surrounded by mantles of ice and topped with deep, hydrogen-helium atmospheres. This was at least qualitatively similar to models of today, though the idea's refinement would depend on cosmochemical abundances not determined until the 1930s.

Neither hydrogen nor helium could be spectroscopically detected, but the presence of other atmospheric constituents had been suspected since at least 1905, when spectra taken by V. M. Slipher had revealed some conspicuous but then-unidentifiable bands. It was 1931 before they were finally attributed to methane and ammonia, an analysis confirmed by laboratory spectra two years later.

Faint markings on the surface of Jupiter's four major moons—Io, Europa, Ganymede and Callisto—had been reported since the 19th century. Several observers, including W. H. Pickering and B. F. Lyot, had even made sketchy maps of their findings, though they bore little correlation with the spectacular reality that would be revealed by the Voyager spacecraft in 1979.

SATURN

Knowledge of Saturn's rings came slowly. In 1610, Galileo thought his primitive telescope was revealing three planets in a line, and it was nearly 50 years before Christiaan Huygens figured out the true configuration. Another two centuries passed before James Clerk Maxwell demonstrated mathematically that they must be composed of individual particles rather than a solid or fluid disk. Even then, it was not until 1895 that James Keeler confirmed the fact observationally, noting that spectral lines from the rings' inner portion were more highly Doppler-shifted than those taken farther from the planet, due to the greater orbital velocity of the closer-in particles. The three main rings, together with the Cassini and Encke divisions, were already recognized, and although conclusive evidence of additional material inside and outside the principal system was still decades away, there were already reports of a possible outlying ring. Estimated upper limits for the rings' thickness (now found to be as little as a few hundred meters) varied widely, but most were in the range of tens of kilometers.

Saturn's rings, photographed in 1929.

The existence of an atmosphere on Titan, Saturn's biggest moon and the only satellite known to possess such a blanket, was not confirmed until the work of Gerard Kuiper in 1943-44, even though its surface pressure is 50 percent greater than earth's. The possibility had already been raised, however, by such observers as Spain's J. Comas Solá, who reached his conclusion in 1908 after noting the disk of Titan to have darkened limbs and bright patches near its center.

URANUS, NEPTUNE AND BEYOND...

Even the "ancients" knew of Saturn, conspicuously visible to the naked eye. Planets farther from the sun, however, awaited deliberate telescopic efforts at discovery. Each new world pointed to the next, in a chain which, some astronomers believe, has not yet reached its end.

Uranus was discovered in 1781, and within a decade, observers were beginning to find that its calculated positions differed from its actual locations. Analysis of the discrepancies led to the 1846 discovery of Neptune, which not only failed to account for all of the Uranian perturbations, but also showed positional discrepancies of its own. A trans-Neptunian planet was sought unsuccessfully in the early years of the 20th century, and Pickering (in 1909, revised in 1919) and Lowell (in 1915) published calculations of where such an object ought to be. It was 1930 before Clyde Tombaugh, working at Lowell Observatory from those analyses, discovered Pluto—but it also became readily apparent that Pluto's mass was far too low to explain the strange behavior of Uranus or Neptune. Today, the search continues, as researchers from the U.S. Naval Observatory attempt to blend the orbital irregularities of three worlds into the location of a "planet X" that may have several times the mass of the earth.

Little was known in 1922 about Uranus and Neptune, so distant that they appeared only as near-featureless, greenish disks. The strange axial tilt of Uranus, canted 98° from the plane of the ecliptic, was inferred from the orbits of its four then-known moons, but most of the secrets of both worlds depend for the foreseeable future on the tenacity of the Voyager 2 spacecraft, bound to pass them in 1986 and 1989. Any Planet X is likely to be still farther away. □