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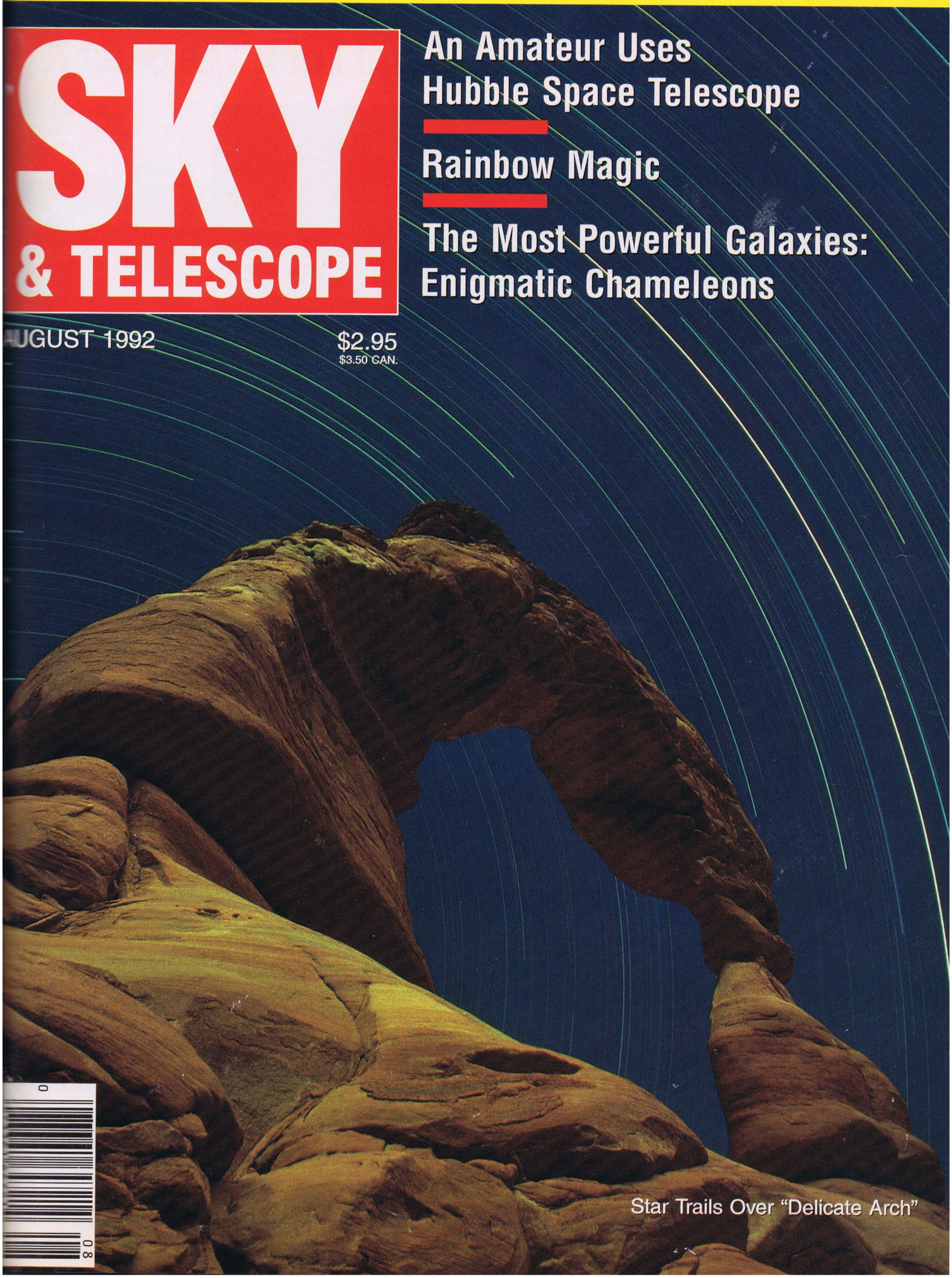

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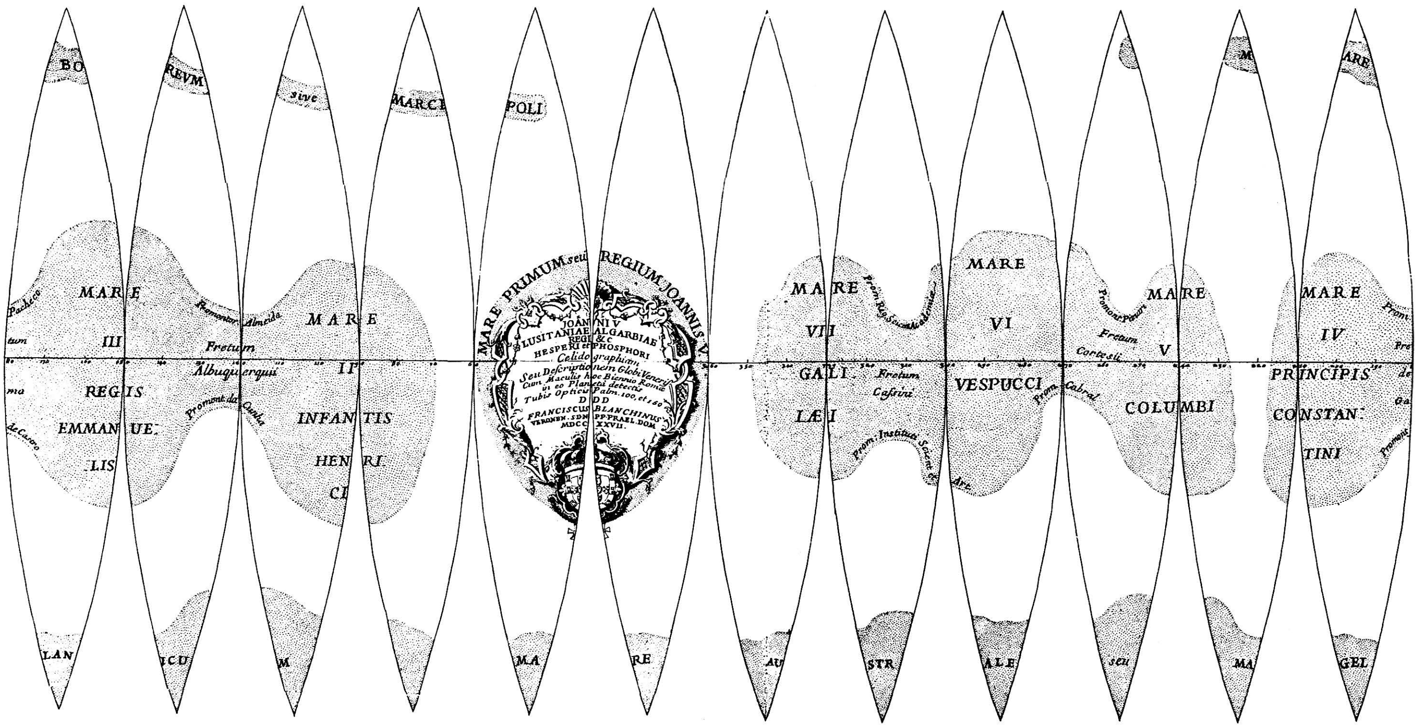


The Earliest Maps of Venus

What early astronomers saw through the telescope convinced them that Venus was a world much like the Earth. How wrong they were.

By Philip Stooke

THE MAGELLAN MISSION to Venus is revolutionizing our ideas about Earth's hellish neighbor world. Enormous volcanoes, extensive lava flows, cracked-eggshell terrain, crater "farms," and wrinkled mountains are all part of the new Venus emerging from Magellan's sharp, radar eye. It resolves features no more than about 400 feet across, a tenfold improvement over the Soviet Venera radar images taken less than a decade ago. And as more data flood back from the spacecraft, our maps of Venus will continue to change dramatically.

No doubt, the U. S. Geological Survey in Flagstaff, Arizona, will need to produce hundreds of maps showing the planet's geology, landforms, and elevations, to help geologists better study our sister world. But these and other maps drafted in recent years to help scientists plan the Magellan mission are far from being the earliest of Venus. In fact, Venus was the first solid body beyond Earth and the Moon to be represented cartographically.

In 1726 and 1727, six decades before William Herschel produced the initial crude map of Mars, Francesco Bianchini of Rome made numerous drawings of Venus. From these observations he prepared a map that was published in his 1728 book *Hesperi et Phosphori Nova Phaenomena sive Observationes circa planetam Veneris.* The title refers to Venus not just by its present name, but also as Hesperus and Phosphorus, the morning and evening stars respectively.

Bianchini mistook the markings for permanent surface features, from which he erroneously determined the length of Venus' day, as well as the orientation of the planet's rotational axis. His results are surprising. Not only is the day the wrong length — he took it to be 24⅓ days — but he placed the rotational axis almost in the plane of the planet's orbit, the same orientation that Uranus has.

In 1726, as his sketches on the next page show, he recorded dark patches that appeared to be carried by rotation along the terminator, while in 1727 he believed that he was looking straight onto the pole with the planet slowly spinning about the center of the disk.

From these observations Bianchini plotted three maps. The most impressive is a chart of the planet in gores, intended to be cut out and pasted onto a ball to make a globe, though I don't know if one was ever constructed. On it Bianchini named the dark markings, which he thought were seas, and some of the promontories that separated them. The names commemorate a curious assortment of explorers, monarchs, astronomers, and even scientific

***Above:* Francesco Bianchini, an 18th-century Italian observer, intended this Venus chart to be affixed on a sphere to make a globe. He believed that the dark markings were "seas."**

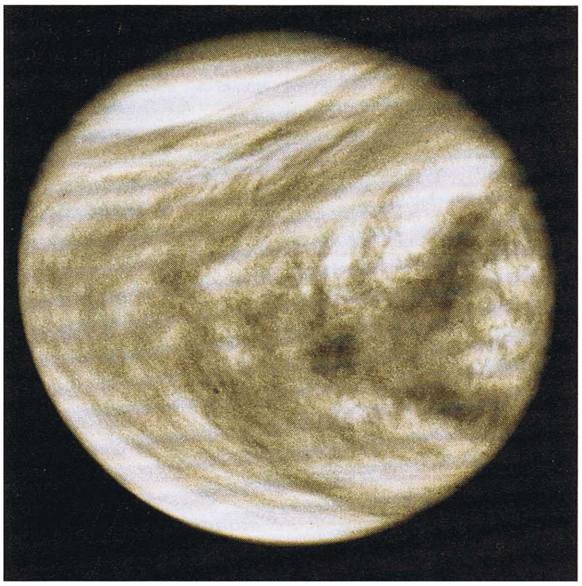
institutions in Paris and Bologna. A "sea" at the south pole, for instance, is named for Magellan.

Bianchini also prepared a couple smaller charts that show more clearly his concept of Venus' geography. One is a cylindrical projection, and the other is azimuthal. The gores are reproduced at the top of the facing page.

To my knowledge, almost 200 years passed before anyone else attempted to map the planet. Perhaps observers had difficulty in reliably observing features on the disk. More likely, it was the complete inability of astronomers to agree on the rotational period. One popular estimate was 24 hours, and a map based on this period appeared in Belgium in 1891. The other commonly supposed period was 224 days and 16.8 hours, which matches the planet's orbital period. This startlingly close estimate to Venus' true rotation period of 243 days was first suggested by the Italian astronomer Giovanni Schiaparelli. But he also believed that Mercury rotated synchronously; furthermore, at that time the only satellites with known rotation periods were synchronous.

Observing from Flagstaff, Arizona, in the late summer and fall of 1896, Percival Lowell immediately saw distinct markings on Venus, which enabled him to confirm synchronous rotation. The markings, he said, were "long and narrow; but, unlike the finer markings on *Mars*, they have the appearance of being natural, not artificial."

Lowell prepared a chart of the planet, together with a set of feature names relating to Venus in mythology. The map reproduced on the next page appeared in *Popular Astronomy* for December, 1896.



The notion that Venus displayed visible surface features persisted until the dawn of the space age. Yet the planet's surface is perpetually shrouded in clouds, as this Pioneer Venus ultraviolet-light image shows. It is possible, however, that Earth-based observers did see subtle brightness differences in the clouds and mistook them for permanent markings. For example, the chevron pattern at the planet's equator does form repeatedly as the planet's cloud deck rotates from left to right (south is up in this image) every four days.

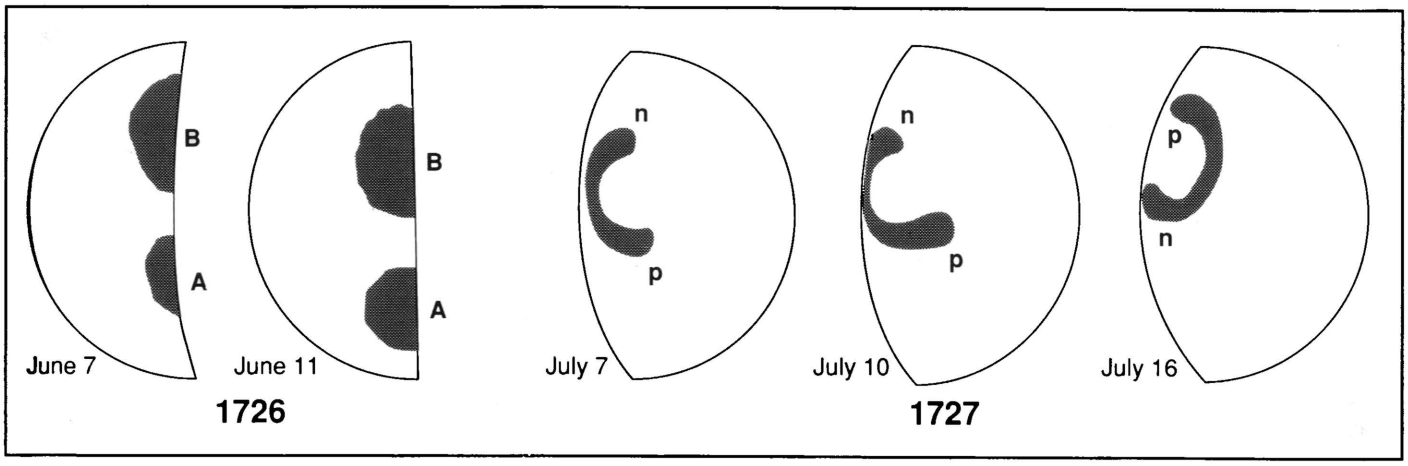
A redrawn version was reproduced in the *Monthly Notices* of the Royal Astronomical Society the following year, but its lettering is less clear. This has resulted in some confusion regarding Lowell's nomenclature. For instance, the sketch of Lowell's map in Patrick Moore's 1956 book *The Planet Venus* contains many misplaced names.

Most of Lowell's linear features appear to radiate from a central spot, *u*, which he called Bilit. The faint marking *w* (Libentina Regio), running roughly northeast to southwest near the map's right-hand edge, is an afterthought and is missing from an earlier version, which appeared in the 1896 book *A New Astronomy* by David Todd. It is only lightly sketched in on the map reproduced here, but it is more definite in the *Monthly Notices* version.

Also noteworthy are three arcs protruding from the right-hand edge of the map. Lowell believed these to be mountains, seen not on the limb as the map seems to suggest but as irregularities on the terminator. He thought the one near the top was identical with a mountain reported by Johann Schröter in 1792.

Lowell and his colleagues at Flagstaff also recorded linear features on Mercury, Mars, and Ganymede, and they were mistaken in every case. These lines tend to connect faint and fuzzy markings near the very limits of visibility. As for the linear markings on Venus, contemporary observers were unanimous in denying their existence. Neither E. M. Antoniadi in France nor E. E. Barnard at Lick Observatory could see anything of the kind, and they said so quite forcefully. In later years only a handful of observers reported similar lineations.

As the idea that Venus was permanently shrouded in clouds gained ground, most astronomers gave up trying to map the planet. The exceptions were mostly in France, where the most notable work was done by Audouin Dollfus in the 1940s. In the view of Dollfus and others, some faint markings were real surface features occasionally glimpsed through thick clouds. If you watched long enough, they said, surface markings, or parts of them, could be distinguished from transient clouds. The pattern pieced together from such frag-



These drawings, based on observations by Bianchini, show apparent surface markings on Venus. Bianchini believed the pair at left revealed how equatorial features were being carried by rotation along the terminator. The three drawings at right show the alleged rotation of his so-called Marco Polo Sea about the planet's north pole, which he placed almost in the plane of the planet's orbit. Although he wrongly interpreted the movement of Venus' markings, Bianchini might have recorded actual clouds, as seen in recent spacecraft imagery. All illustrations were supplied by the author.

mentary observations was vaguely radial, resembling Lowell's streaks radiating from Bilit. So while most astronomers did not hesitate to reject the sharply defined features claimed by Lowell, there was continued support for a faint radial pattern on the clouds.

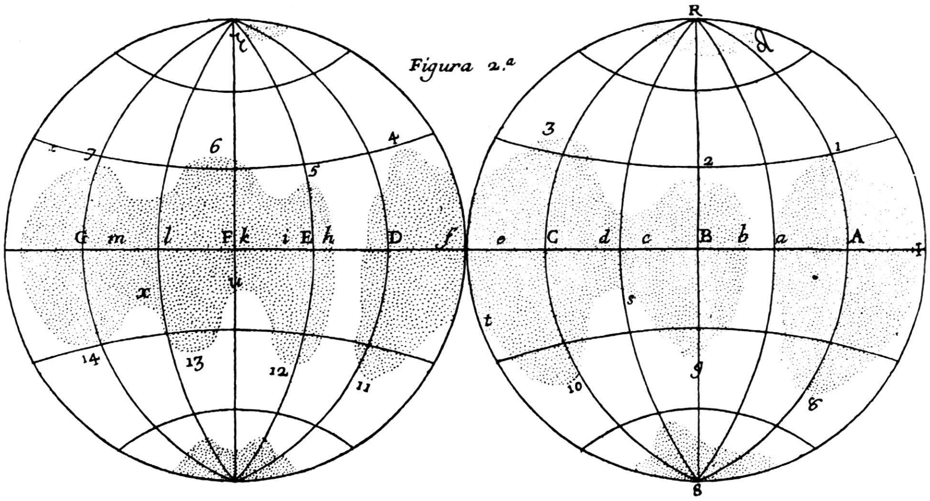
Ironically, Lowell's streaks on Venus were rejected more vociferously than were his "canals" on Mars. Yet it is quite possible that the former were more reliably rendered. If we compare Lowell's drawings of Venus from 1896 with a Pioneer Venus image of the clouds, a distinct similarity is apparent. Venus' clouds *do* display a characteristic, crudely Y-shaped pattern in the clouds opening to the west. Made up of broad streaks and bars, this feature is most apparent at ultraviolet wavelengths but can sometimes be faintly seen in visible light. The central node of the Y could correspond to Lowell's Bilit.

One could argue that Bianchini's individual drawings were similarly accurate but his interpretation was wrong. Both Bianchini and Lowell certainly never understood what they were seeing. Yet it is quite likely that Lowell saw at least parts of the Y-shaped marking and incorporated them into his map almost a century ago.

Both Bianchini and Lowell certainly never understood what they were seeing. Yet it is quite likely that Lowell saw at least parts of the Y-shaped marking.

Place names on Venus are now reserved for women, with the exception of Maxwell Montes. It is named for James Clerk Maxwell, whose pioneering work on electromagnetic radiation led to the creation of the radio telescopes that first revealed Venus' surface to us. It's unfortunate that Bianchini, the pioneer cartographer of Venus, cannot be commemorated, though this might be possible if a female namesake can be found to smuggle his name onto the planet. I am aware of only one appropriate person, the Italian composer Emma Teresa Bianchini (1890-1929), but others might be found. If not, all is not lost. Bianchini's name has been given to a lunar crater near Sinus Iridum, not far from the spectacular Alpine Valley, which he discovered in 1727. A beautiful engraving of the valley can be found in the same book that contains his maps of Venus.

Philip Stooke teaches at the University of Western Ontario. His research includes cartography of nonspherical worlds, history of planetary cartography, and geology of the planets.



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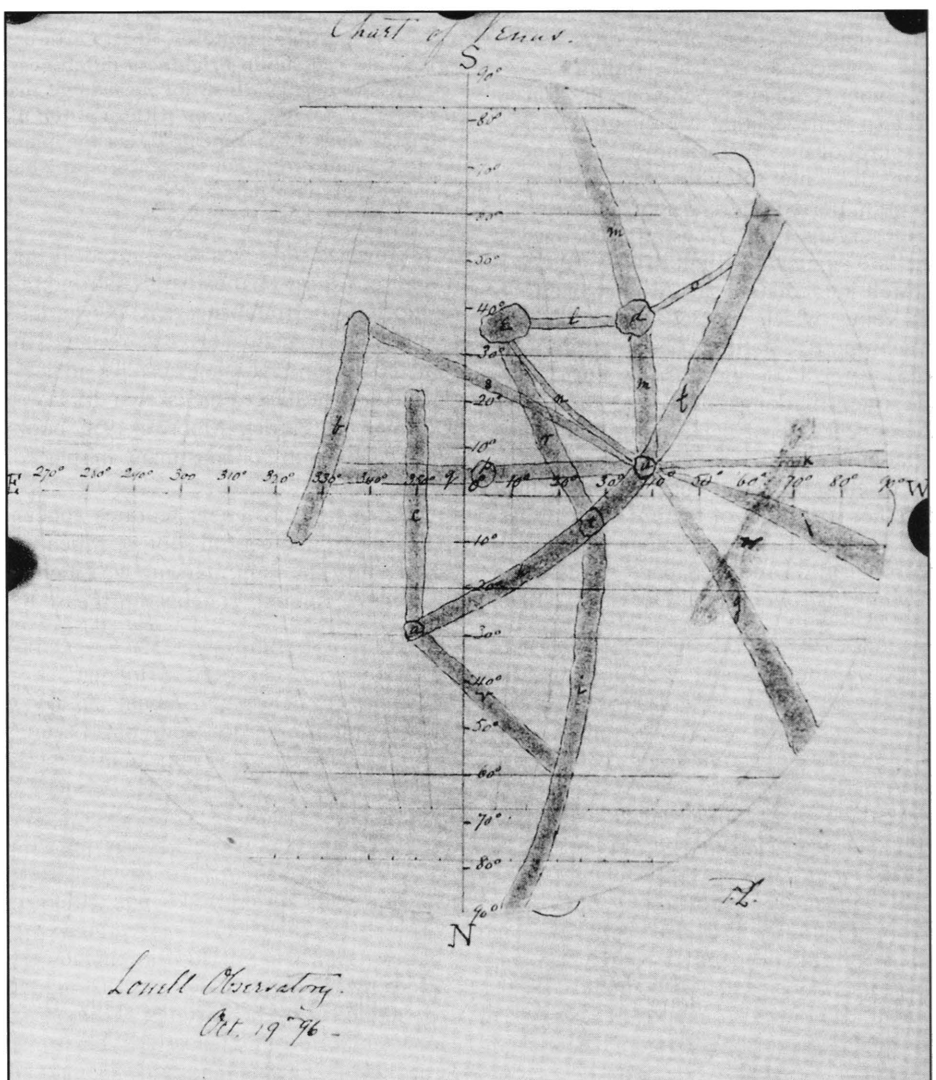

Top: **Bianchini's small chart of Venus was made on an azimuthal projection. The table gives dates when a certain meridian (running between points *R* and *S*) crossed the center of the disk during the two years of his observations. *Above:* Percival Lowell's chart of Venus, as published in *Popular Astronomy* for December, 1896, shows supposedly permanent linear features radiating from a central node he called Bilit (marked *u*) on the equator.**