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Spotting Venus

First transit of the sun since 1882

By Dan Falk, Globe Correspondent | June 1, 2004

In 1761, Harvard professor John Winthrop left Cambridge for a 13-day journey to Newfoundland, taking along two students, two telescopes, a pendulum clock, an octant, and other precision navigation instruments. As the French and Indian War swept across North America's European colonies, Winthrop undertook the first scientifi c research expedition in his continent's history.

The astronomer and his team lugged their equipment up a hill to their chosen observing site, and camped out. The skies were clear as dawn broke on June 6, and the months of preparation paid off.

At 4:18 a.m. the men became the only North Americans to witness the "transit of Venus," the rarer-than-twice-a-century event when the second planet passes directly between the Earth and the sun, and appears as a tiny black dot in front of the bright solar disk.

"We had the high satisfaction of seeing that most agreeable Sight, VENUS ON THE SUN, and of shewing it in our telescopes to the Gentlemen of the place, who had assembled very early on the hill to behold so curious a spectacle,'' Winthrop wrote in his log.

The transit of Venus has happened only three times since then – in 1769, 1874, and 1882 – but next Tuesday morning, for the fi rst time in 122 years, Venus will once again glide silently in front of the sun.

Such transits occur in pairs eight years apart, so there will be another transit in 2012, but then more than another century will pass before the planets align perfectly again. Back in the 18th century astronomers used the transit as a scientific opportunity to calculate the distance to the sun, and, from that, the distance to the planets. Today, the transit is of more interest to amateur astronomers than to professionals; many hobbyists are planning to travel thousands of miles for the best view.

The transit -- which will be visible through a telescope or binoculars (see sidebar on how to view the sun safely) in the Boston area from sunrise at 5:09 a.m. until 7:26 a.m. -- will tell astronomers little that's new about either Venus or the sun. There is still scientific interest, though, in the so-called "black drop effect," a complex phenomenon in which the second planet appears in the shape of a raindrop as it first passes in front of the sun, and later as it exits the solar disk.

Jay Pasachoff, an astronomer at Williams College, believes he's got the black drop figured out: It seems to be an interplay between the "point-spread function" -- a natural blurring of any image seen through an aperture such as a telescope -- and solar "limb darkening," the rapid decrease in the sun's brightness at the edge of its disk. He and a group of students will observe the transit from northern Greece -- where the entire duration of the event will be visible -- in the hope of studying and quantifying the black drop effect.

Like an eclipse or the passage of a bright comet, the transit is expected to trigger a renewed public interest in all things astronomical.

"We'll have the attention of much of the world on June 8," Pasachoff said recently. "So this is a great time for public education, and making people appreciate the value of science in

general and astronomy in particular."

The first transit of Venus known to have been seen by human eyes occurred in 1639, and only two people reported glimpsing it -- a young Englishman named Jeremiah Horrocks and his friend William Crabtree. By the time of the next transit in 1761, the alignment had been predicted well in advance and dozens of expeditions, including Winthrop's, set out to locations around the globe to record the event.

Winthrop, one of the brightest scientific minds of his time, sailed to Newfoundland because the transit wasn't visible from New England. "In his day he was one of the better mathematicians and scientists in North America," said Sara Schechner, curator of the Collection of Historical Scientific Instruments at Harvard, which still houses a number of Winthrop's instruments.

Besides equipment and manpower, Winthrop also needed "letters of safe passage" -- documents that would guarantee safe travel across French-controlled waters. The fact that the governor was willing to request these from the enemy -- and that they complied -- shows just how important all parties viewed the endeavor to be. England and France may have been trading cannon fire up and down the Atlantic coast of North America, but the pursuit of science was seen as being above such petty squabbles.

The next transit came in 1769, and again drew astronomers to the far reaches of the globe. Viewing the transit was James Cook's motive for his epic voyage to the South Pacific. Winthrop would observe this one, too -- this time from the comfort of Harvard Yard.

In the decades that followed, astronomers would combine the data from the two 18th-century transits to work out the Earth-sun distance with a remarkable degree of accuracy.

It boils down to a problem of triangulation. As seen from different locations on the Earth's surface, Venus takes slightly different paths across the face of the sun. If you compare those paths -- whose lengths can be calculated based on precise timing of the transit -- and if you know the distance separating the various observing sites, then, with a bit of geometry, you can work out both the distance to Venus and the distance to the sun. Using this method, astronomers eventually arrived at a figure within a few percentage points of the modern figure: 149.6 million kilometers to the sun.

The last time Venus passed directly between the Earth and the sun, Chester Alan Arthur was in the White House and the Brooklyn Bridge was under construction.

After the 1882 event, astronomer William Harkness mused on the long wait ahead: "What will be the state of science when the next transit season arrives God only knows," he told his audience. He could hardly imagine that far-off day when "the twenty-first century of our era has dawned upon the earth, and the June flowers are blooming in 2004." ■