



Changes in Latitude, Changes in Attitude:

U. S. Naval Observatory Observations of the Transit of Venus 1874–2012



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Of the seven transits of Venus (ToV) for which unambiguous observations exist, four have occurred since the U.S. Naval Observatory (USNO) was established in 1844. With the Transit of Venus Commission, the USNO was heavily involved in observing the December 8, 1874, and December 6, 1882, events to establish an accurate value for the astronomical unit. In the 1960s, radar measurements began providing reliable Solar System distances. Scientific interest in these transits has now moved towards studies of the Venusian atmosphere and understanding transiting extrasolar planets, subjects in which the USNO is less active.

In 1874, American transit of Venus expeditions to Siberia, China, Japan, Tasmania, New Zealand, and the Kerguelen and Chatham Islands returned with 350 photographic plates. The 1882 missions collected 1,487 plates from Washington, DC; Florida; Texas; New Mexico; South Africa; Patagonia; Chile; and New Zealand. From the 1882 photographs, Harkness determined the astronomical unit to be $92,455,000 \pm 123,400$ miles ($148,790,000 \pm 198,600$ km).

On June 8, 2004, and June 5, 2012, the USNO hosted friends and family interested in seeing the transits of Venus. Both events were partially visible from Washington, DC while the Flagstaff station was only able to watch a portion of 2012 transit. The surviving 19th century equipment was returned to service to view this scientific curiosity. In 2012, one 5-inch (0.1-m) Alvan Clark refractor (#856) was able to observe its fourth transit of Venus from Washington despite clouds; it previous served Hall in Vladivostok, Siberia (1874) and San Antonio, Texas (1882). Between the two locations, approximately 570 people participated. Other USNO astronomers made personal trips west to Hawaii and Alaska to share the event with the public.

In 1882, Harkness mused on the scientific advances that had and would occur between transits of Venus. Like him, we can only wonder “What will be the state of science when the next transit season arrives” on December 11, 2117.



Captions: 1. 2012 ToV (HI); 2. Boys and Girls Club of Seward view 2012 ToV (AK); 3. Records of 1874 ToV Expedition to Chatham Island; 4. Memorandum Transferring ToV Commission Records; 5. Passerby observes 2012 ToV (AK); 6. 1882 ToV; 7. Old Naval Observatory c. 1880; 8. Equipment for 1874 ToV Expeditions; 9. Amateur views 2012 ToV (AK); 10. 2012 ToV (AZ); 11. 1883 Appropriation to Alvan Clark & Sons; 12. 1874 ToV Party at Old Naval Observatory; 13. USNO Visitors During 2012 ToV; 14. Essential Parts of ToV Photo-Heliograph; 15. J. Eastman; 16. 2012 ToV (AK); 17. Preparing for 2012 ToV (AK); 18. Calling cards in Hall Album on Hall Desk; 19. ToV Storehouse in 1928; 20. Astronomer views 2004 ToV Through Clark Refractor #856 (DC); 21. 19th cen. Transit of Venus Artifacts in Gilliss Library; 22. ToV Pendulum Clock by Howard Company; 23. Invoice for Western Union Telegraph Support During 1882 ToV; 24. Visitors observe 2012 ToV (HI); 25. W. Harkness; 26. Superintendent views 2012 ToV Through Clark Refractor #856 (DC); 27. Naval Observatory Flagstaff Station; 28. ToV Commission Records Bound in Red Tape; 29. Historic Telescope #856 During 2012 ToV; 30. ToV Photoheliograph; 31. Waldo ‘diary’ entry for 1874 December 9; 32. Display Label Describing Clark Refractor #856; 33. 1874 Map of Whangaroa Harbor, Chatham Island with ToV Observation Site; 34. Clark Refractor #856 on Display at Naval Observatory; 35. ToV Storehouse and Weather Station c. 1928; 36. Electrochronograph Tracings from 1874 ToV Collected from Chatham Island; 37. Clark Refractor #856 Inscription; 38. A. Hall; 39. S. Newcomb; 40. Adjusted Salary and Expenses for Dryer in 1882; 41. Naval Observatory; 42. Salary & Expenses for W. Bell in 1882–1883; 43. Orders for Bell to Report as Photographer to 1882 ToV Expedition to Patagonia

References: Dick, S. 2003, *Sky with Ocean Joined* (Cambridge: Cambridge Univ. Press); Harkness, W. 1882, *Nature*, 27, 114; Harkness, W. 1891, *The Solar Parallax and its Related Constants* (Washington, DC: GPO); IAU. 2012, Resolution B2 on the Re-Definition of the Astronomical Unit of Length; Newcomb, S. (ed), 1880, *Observations of the Transit of Venus Dec 8-9, 1874*, vol. 1 (Washington, DC: GPO) Newcomb, S. 1895, *The Elements of the Four Inner Planets and Fundamental Constants of Astronomy* (Washington, DC: GPO); Acknowledgements: Artifacts and historical photographs are from USNO collections. Barron, Chester, Riggleman, & Winter provided modern photographs. Barron & Winter participated in a 2012 ToV event organized by UH IfA & Friends of the IfA at Pacific Aviation Museum, Pearl Harbor. S. & V. Willet graciously hosted Bartlett, Riggleman, & Seward community during the 2012 ToV. This research used NASA’s ADS Bibliographic Services and Google Books.

For More Information

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