Observation of the Transit of Venus-2012 with Old Refractor Telescope

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Latitude 41°51′00″ N, longitude 88°18′45″ W

Abstract. Here we present results of the observations of the June 5, 2012 Transit of Venus made with ca 1790-1800 Dollond achromat refractor telescope in Batavia, IL (USA).

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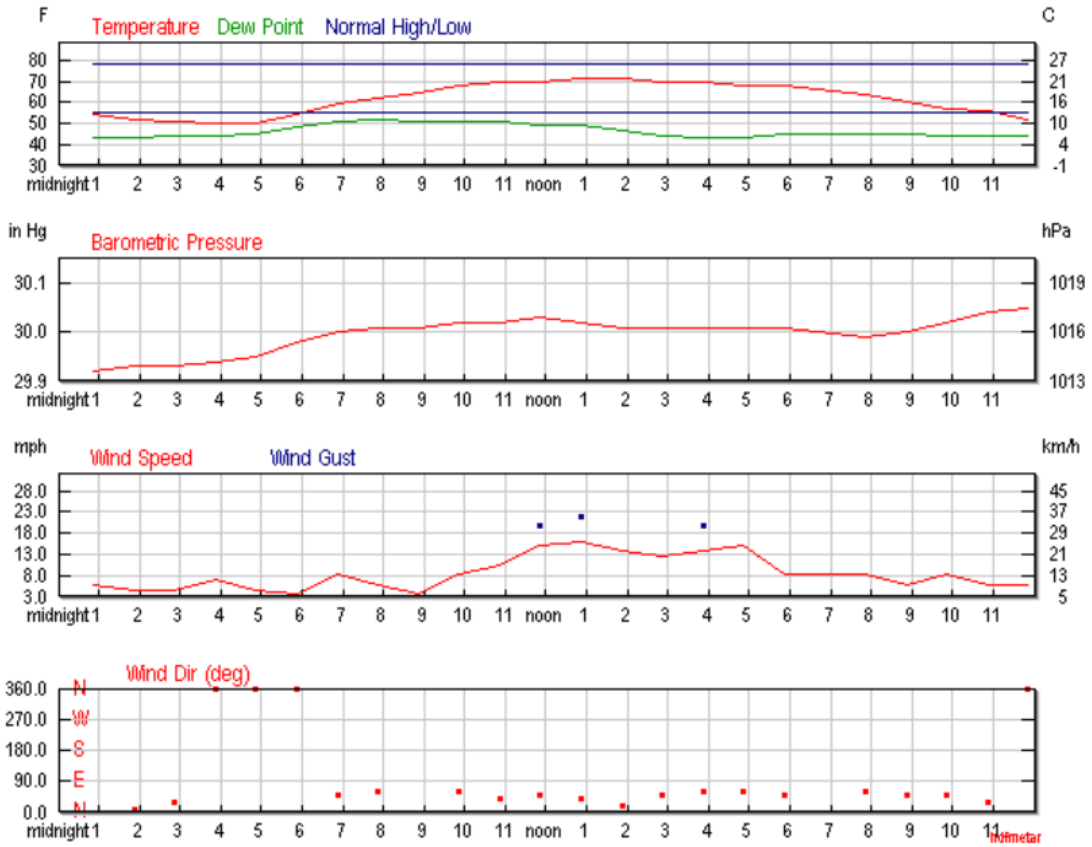
LOCATION AND CONDITIONS

The observations have been made at the backyard of the property on 602 Millview Drave, Batavia, IL, 60510 , USA; latitude 41°51′00″.0 N, longitude 88°18′45″.4 W. Elevation 696 ft (212 m).The sky was absolutely clear all the time of the ingress observations (visibility 10 miles, ~16 km), and remained such till the sunset. According to http://transitofvenus.nl/wp/where-when/local-transit-times/ , the times of the contacts (the local time in 24-hour format), Sun's altitude *h* and the azimuth *A* are given as the Table I below. The altitude is measured in degrees above the horizon. If the sun's altitude is negative, this means that the sun is below the horizon and, subsequently, the particular contact is not visible. The azimuth is the compass direction in degrees, measured westward from the south. Also the position angle *P* of Venus and angular distance *d* between the centers of Venus and the sun are displayed. The position angle of Venus with respect to the center of the solar disk is measured in degrees from the north towards the east. The distance between the centers is expressed in seconds of arc. The temperature was about 68°F (20 °C), slight wind – see full weather record in the Table II (data from http://www.wunderground.com/history/). "Sea level air" pressure was 30.00 inches.

Table I : Transit of Venus – 2012 conditions for Batavia, IL, USA

Contact	Time	*h* / *A*	*P* / *d*
ingress exterior	Jun 5 17:04:25	34°.7 90°.5	41°.2 974″.7
ingress interior	Jun 5 17:21:54	31°.5 93°.3	38°.7 916″.9
closest approach	Jun 5 20:26:05	-0°.9 122°.1	343°.5 542″.7
egress interior	Jun 5 23:32:23	-22°.8 159°.9	291°.3 917″.0
egress exterior	Jun 5 23:50:16	-23°.9 164°.3	288°.9 974″.8
Sunrise	05:23:42		
Sunset	20:22:54		

Table II: June 5, 2012 weather conditions at Batavia, IL, USA



EQUIPMENT AND EXPERIEMNTAL TECHNIQUES

The observations reported here were made from the start to the end of the ingress (i.e. ended at about 17:26). The instrument used was Dollond (London) three-draw telescope, ca. 1790-1800. This telescope has a parallel mahogany barrel, laquered dark red (see photos). The objective lens is an achromatic doublet. It has three brass draws, a four-lens eyepiece, and a flared eyecup with a swivel cover. The segmented eye tube is signed "***Dollond, London***" with the eyecup to the right. The main parameters of the refractor are listed in Table III. The instrument is 100% identical to item T53 in the University of Arizona/College of Optical Science collection – see at http://www.optics.arizona.edu/antiques/telescope/Catalogue/T53/T53.htm . I was very impressed with the high quality of the telescope, sharpness of the images of the Sun, sunspots and Venus, almost all over the FoV (at least I mentioned no deterioration in sharpness within ± half of the FoV diameter - where I comfortably observed the ingress). The FoV was about 1 degree (about twice the Sun's angular size). I estimate the magnifying power to be 24±3.

Fig.1: a) (left) the Dollond achromat refractor; b) (right) two smoked glass filters (see the text)

Table III: The Dollond telescope parameters

Dimensions	English	Metric
Main Tube Length	8.7in	221mm
Main Tube Diameter	1.8in	45mm
Total Length	28.3in	718mm
Closed Length	9.3in	236mm
Objective Clear Aperture Diameter	1.6in	40mm

There were 4 filters prepared to the ToV2012 observations : #1 – Baader ND M5.0 filter (attenuation 100,000); #2 Baader ND M3.8 filter (6,000), #3 – hand-made smoked glass fit inside "15% Hirsch ND" moon filter (attenuation 600), #4 – hand-made smoked glass fit inside "30% Hirsch ND" moon filter (attenuation 500). Fig.1 b) shows the latter two filters, their attenuation was measured at 1000nm by Dr. Jinhao Ruan of Fermilab (J.Ruan, June 6, 2012). All the observations at ingress pictured and discussed below have been made with **filter #3**.

The choice of the filter was driven by following considerations: a) the first two had too strong of the attenuation to my eye, b) the image of the Sun looked "whitish" in them. The 18th century observers did not have such filters and used smoked glasses to observe the Sun. Also, Lomonosov (1761) mentioned that he used "not so-heavily smoked glass" (weak filter), so he needed to give his eyes some rest after some short observations time. During the ToV2012 observations I used the following technique: 1) target the scope; 2) give an eye a rest for 10 sec; 2) open it, see the Venus and try to see aureole; 3) wait till the eye adopts to the brightness of the Sun and I start seeing the sunspots; 4) close the eye and give it 10+ sec of rest or change the eye; 5) repeat the procedure (go to step 3). When the eye is first open, the Sun brightness was enormous (sunspots not seen for few seconds) but tolerable, at the same time the finer lower intensity details were seen. After the eye adaptation (step 3) the sunspots and other details were seen quite well, and the only concern was to keep the very bright yellowish Sun image in the eye for too long. Somehow I did not feel very comfortable with filter #4 – though after adaptation, I could watch the Sun without big problems, but the high brightness at the very first moments (onto rested eye) was worrisome. So, filter #3 was chosen as the most appropriate, was taped to the eyepiece and employed from 16:58 till 17:26 – as shown in Fig.1b).

The telescope was mounted on a combination metal-wood tripod - see Fig.2a) and d). A special hut/tent was set up to protect the telescope from direct sun, from the wind, to avoid additional exposure of the eye to sunlight and distraction by the general public (about 60 people attended the ToV observation session at my house that evening). The observer was laying on the ground inside the tent, well covered by linen set around the telescope – see Fig.2 b) and c). Some minor color distortions took place only at the edge of FoV, and I always tried to keep the North of the Sun (with Venus near it) close to the center of the FoV.

A wrist watch and a large dial alarm clock placed in the tent were set up within a second to precise local time, using http://24timezones.com/usa_time/il_cook/chicago.htm

Fig.2: The observation station set up.

RESULTS OF OBSERVATIONS

(Copy of the original hand-written notes taken at the time of the observation are given in the Appendix).

A. Seems that the 1st contact was missed by a bit - I has fully appreciated the leading edge of the Venus disc on the Sun at 17:05:05 (though had doubts for some time before that moment); for the next ~5 min the ingress progressed uneventfully
B. then around 17:11:00 I started to a little "fang" on the left (N) side of Venus expanding by less than 0.1-0.2 of its diameter off the Sun's disc. I did not believe my eye, and repeated the attempt again, and then with another eye. By 17:13:00 I realized it's not an artefact. The other (right side) of Venus did not have the fang, instead it sort of slightly bent the Sun's disc inward (by a little) – see Fig.3a below.

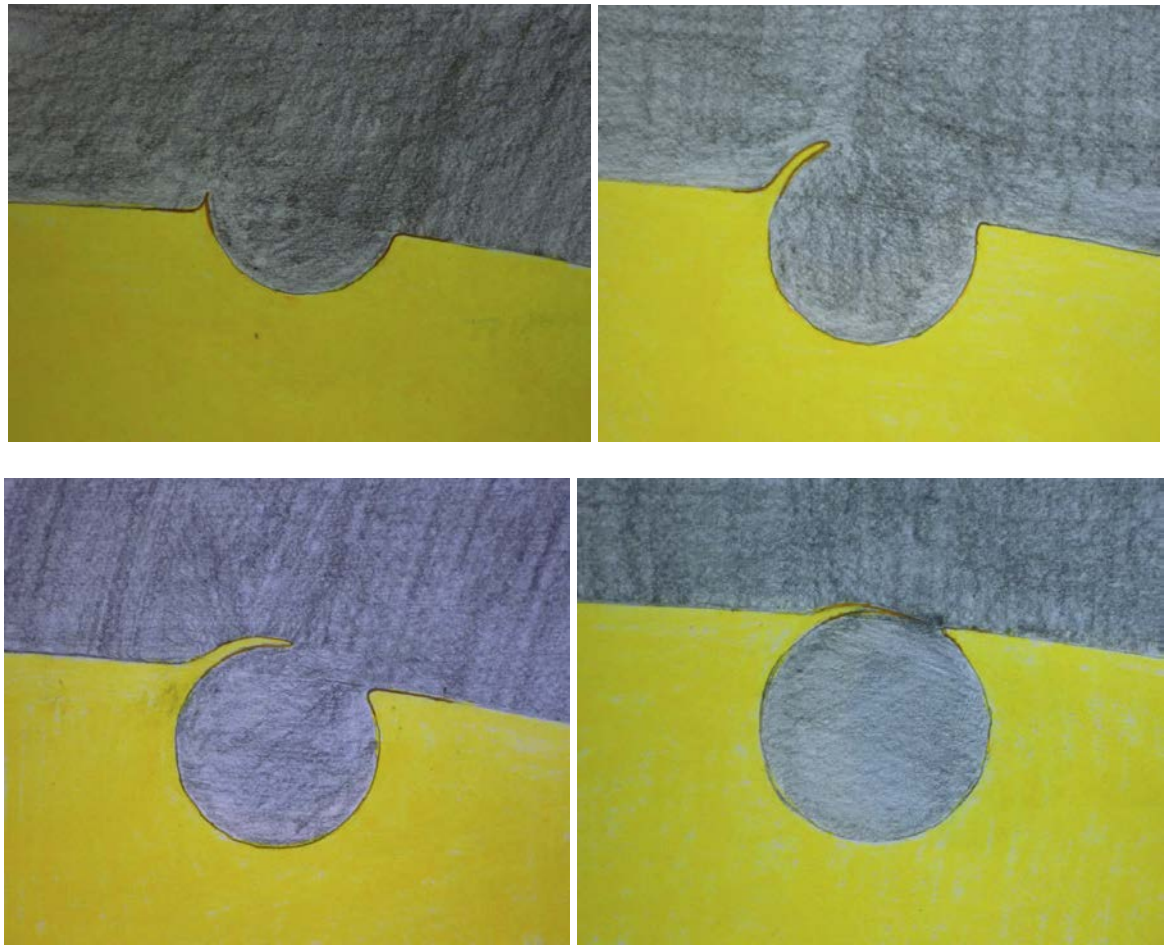


Fig.3: ToV at (a) ~17:11:00; (b) ~17:16:00; (c) ~17:19:00; (d) ~17:20:15

C. around 17:16:00, when Venus was ~half way on the Sun, the fang (part of arc) started to be reliably seen and somewhat increase in length till about 1/4-1/3 of the half of Venus disc circumference – see Fig.3 b).
D. around 17:19:00, the partial arc ("fang") was 1/3-1/2 of the "Venus limb arc off the Sun"-long; as before, it was on the right side of Venus, slight round ending remained at the right point of conjunction of Venus and Sun – see Fig.3 c).
E. I originally thought that I have not seen the full arc over Venus part off the Sun, and that left and right sides of the Sun connected over Venus at around 17:20:15, but the left-right asymmetry was still there – see Fig.3 d)
F. Until ~17:22:00 I saw the left-arc and right-arc in a sort of connected position with some kind of shady area between the disc of Venus and the darkness off the Sun 10. Only after 17:22:00 Venus and surroundings appeared as fully symmetric (left-right) round system – see Fig.3 e) below.

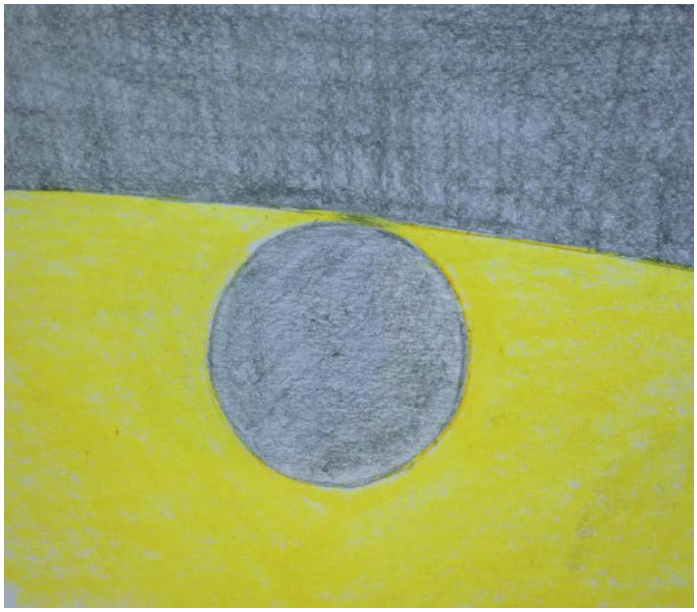


Fig.3 e): ToV as seen between 17:21 and 17:22.

G. After that, until ~17:25:00, nothing particularly exciting was happening (e.g., no "black drop effect"), the Venus went smoothly on and the observations with the old refractor have been stopped around 17:26:00.

DISCUSSION

Before 17:21:00 I clearly saw the partial arc ("fang") on the left (North) of Venus, around Venus disc, and that arc initially started small and did grow.

Checking the predicted transit times, I found that the end of egress in Batavia was at 17:22:00. On the other hand, between 17:20:15 and 17:22:00 I saw (not as bright as everywhere else but still) definite light connected all over the disc of Venus, and it was not clear to me

whether Venus fully on the Sun or still off it. I should also mention that around that time (17:21:00) I moved my body (I was laying all the time) and as the result, it ended in very uncomfortable position and I was forced to bring my head up (off the support) and keep it up in order to be able to continue observations. Keeping the head up all the time did not work well, and every so often I was giving myself some rest (to the muscles of the neck) and that may have compromised the consistency and quality of the last 1.5 minutes of the ingress.
So, was there “Lomonosov's arc” in the last 105 seconds before 17:22 or was it already image of "just after contact 2" (when two light arcs conjunct) – that can not be proclaimed with certainty.

After the first version of he report was written, I was told that program “TheSky6” gives 17:05:08 and 17:22:39 for the 1st and 2nd contact times.

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APPENDIX

Two pages of the original hand-written notes taken at the time of the observation.