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JEREMIAH HORROCKS and the 1639 transit of Venus

ELI MAOR

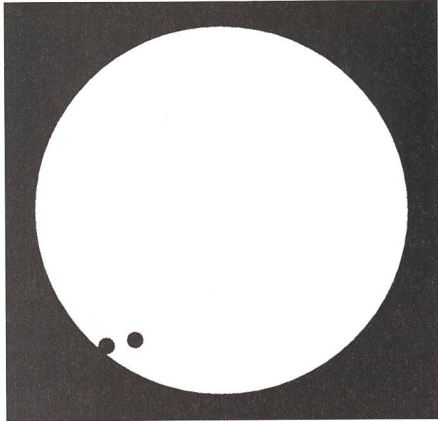


Fig. 1: The transit of Venus on December 4, 1639 as seen by JEREMIAH HORROCKS.

After a wait of nearly 122 years, the next transit of Venus is almost upon us! At 05:13 Universal Time on Tuesday, June 8 2004, a tiny black dot, the silhouette of the planet Venus, will slowly encroach on the Sun's southeastern limb, its first visit to the Sun since December 6, 1882. For the next six hours and twelve minutes the black dot will slowly make its way across the Sun's face in a west-southwest direction, until it leaves it at 11:25 UT, not to return again until June 6, 2012.

Transits of Venus are among the rarest of astronomical events, rarer even than the return of Comet Halley every 76 years. As far as is known, only five times have humans witnessed this event before: in 1639, 1761, 1769, 1874, and 1882. So we should consider ourselves privileged to live in a «double transit» period, giving us a good chance to see the event twice in our lifetime!

The story of this rare spectacle takes us back to the early seventeenth century. In 1627, three years before his death, JOHANNES KEPLER published his last major work, the long-awaited *Rudolphine Tables*, a compilation of celestial and terrestrial data that was hailed as the most accurate astronomical almanac to date. Based on the *Rudolphine Tables*, KEPLER predicted that Venus would be visible on the Sun's face on December 6, 1631, and he hastily sent out letters urging the astronomical community to observe this unique event. Only one astronomer heeded his call, the Frenchman PIERRE GASSENDI (1592-1655). Just one month earlier, on November 7, GASSENDI had ob-

served a transit of Mercury (also predicted by KEPLER), making him the first person ever to watch a transit. GASSENDI now hoped to repeat his success. He set up his telescope at his home in Paris, eagerly awaiting Venus's black shadow to be projected on a screen in his darkened room. But he waited in vain: the transit did indeed take place on the night between the 6th and 7th of November, but it was visible only from the Western Hemisphere. There is no record that anyone saw it.

KEPLER had further predicted that Venus would not pass again in front of the Sun until June 6, 1731. But when a young and unknown English astronomer, JEREMIAH HORROCKS, examined Kepler's tables, he realized that, unnoticed to KEPLER, a transit of Venus would occur on December 4, 1639, following the previous transit by just eight years. This was a startling discovery, and it showed that even the *Rudolphine Tables* were not free of error.

Very little is known about HORROCKS (or HORROX, as his name was then spelled). He was born in Toxteth, Liverpool, in 1618 or 1619 to a poor family. In 1632 he was accepted to Cambridge University as a Sizar, a student acting as a servant to senior students in return for an allowance to cover his college tui-

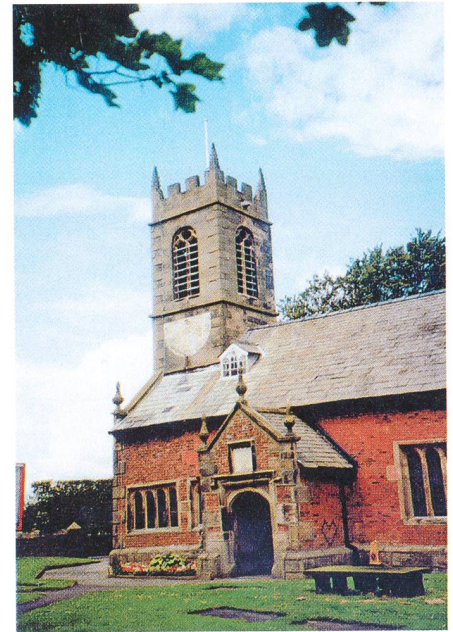


Fig. 3: St. Michael's Church, Much Hoole, England, where JEREMIAH HORROCKS had to attend to «business of the highest importance» on December 4, 1639.

tion. He spent four years at Cambridge, during which he studied, largely on his own, mathematics and astronomy (these subjects were not yet then part of the official university curriculum). He was the first scientist to study the Moon's motion in detail, in the course of which he became convinced of the superiority of KEPLER's *New Astronomy* over any other system. During this time he made friends with another young student, WILLIAM CRABTREE, a native of Manchester. The two shared a compassion for mathematics and astronomy. After

Fig. 2: A clock in memoriam of JEREMIAH HORROCKS, St. Michaels' Church, Much Hoole.





Fig.4: A sundial with the inscription *Sine Soli Silio* («Without the Sun I am silent»), St. Michael's Church, Much Hoole.

leaving Cambridge, they would maintain their friendship by correspondence.

In 1635 the seventeen-year old HORROCKS began to compute astronomical ephemerides (future positions of the Sun, Moon, and planets) based on new tables by PHILIP VAN LANSBERGE (1561-1632), a Belgian astronomer who boasted that his were superior to KEPLER's tables. HORROCKS found this a vain boast: he found numerous errors in LANSBERGE's tables, throwing into doubt the very method of his calculations. But LANSBERGE's tables did show that Venus

would pass in front of the Sun on December 4, 1639, while according to KEPLER the planet would just miss the Sun's face. HORROCKS, confronted with the two conflicting sets of data, resolved to do his own calculations. After three years of hard labor he concluded that on this point LANSBERGE was right: Venus would indeed cross the Sun's face on that day.

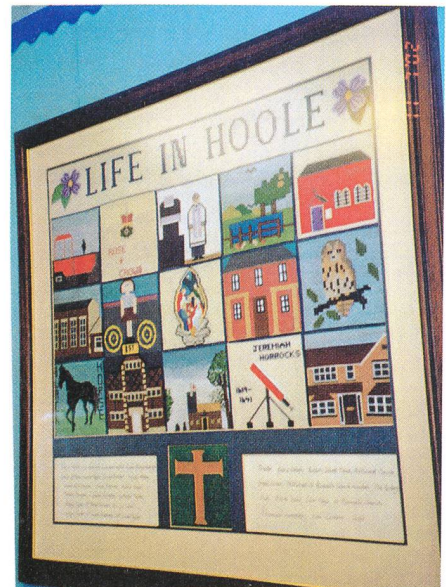
HORROCKS completed his calculations in October 1639, barely a month before the scheduled transit. He immediately alerted his friends, exhorting them to observe the rare event from different locations, so as to be «less likely be defeated by the accidental interposition of clouds, or any fortuitous impediment.» One «fortuitous impediment» of concern to him was that «Jupiter and Mercury seemed by their positions to threaten bad weather; for, in such apprehensions I coincide with the opinion of the astrologers, because it is confirmed by experiment.» Astronomy and astrology, in those days, were still on good terms, often practiced by the same person!

In that same year HORROCKS moved to the small village of Much Hoole in the district of Lancashire, some 60 kilometers northwest of Manchester. His exact whereabouts there are still being debated. Apparently he took up residence with the Carr family, a well-established family in the town, and may have tutored their children. He also got a teaching position at the local school, but he didn't find the job particularly exciting, describing it as «daily harassing duties.»

His real passion was astronomy, and he now put all his energies in preparing for the great event. He darkened his small room on the second floor, letting only a narrow shaft of sunlight pass through his small telescope. On the opposite wall he had a screen on which the Sun's image was projected.

According to HORROCKS's calculations, Venus would enter the Sun's disk at 3:47 in the afternoon on December 4; but just in case he might have erred, he began his vigil already on the day before. December 4 dawned: it was a Sunday. HORROCKS was at his telescope from 10 o'clock to noon, intently watching the Sun's image on the screen in front of him. The sky was overcast, but he got a glimpse of the Sun during brief breaks in the clouds. But except for a few sunspots he saw nothing unusual. At one in the afternoon his vigil was suddenly interrupted by «business of the highest importance.» What this business was he did not say, but from a brief biography of HORROCKS, written more than two hundred years later by the Reverend ARUNDELL BLOUNT WHATTON, we know that on that Sunday HORROCKS had the official duty of conducting divine services at his church.

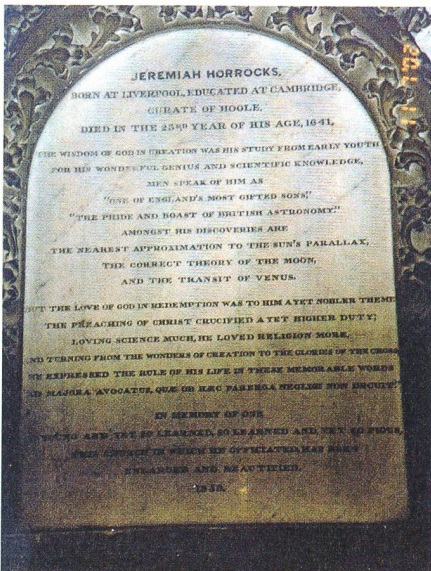
Fig.6: «Life in Hoole» - a quilt done by the pupils of the Hoole Church of England Primary School. One square is dedicated to JEREMIAH HORROCKS.



When HORROCKS resumed his watch at 3:15 pm,

The clouds, as if by divine interposition, were entirely dispersed, and I was once more invited to the grateful task of repeating my observations. I then beheld a most agreeable spectacle,

Fig.5: Inscription in memoriam of JEREMIAH HORROCKS, St. Michael's Church, Much Hoole, England.



the object of my sanguine wishes, a spot of unusual magnitude and of perfectly circular shape, which had already fully entered upon the Sun's disk from the left, so that the limbs of the Sun and Venus precisely coincided, forming an angle of contact.

HORROCKS had thus missed the beginning of the transit, the very moment that during future transits would become critical in attempting to find the value of the Astronomical Unit, the Earth-to-Sun distance. This missed opportunity was, in the words of the nineteenth century astronomer SIMON NEWCOMB, «a circumstance which science has mourned for a century past, and will have reason to mourn for a century to come.» HORROCKS, however, did not waste time lamenting over what he had just missed. He immediately made a series of measurements of Venus's position and direction of motion across the Sun's disk. He had intended to record every detail of the rare apparition, fully aware that he was making history. Alas, it was December, the days were short, and at 3:50 pm the Sun set. He had been watching the historic transit for scarcely half an hour.

As far as is known, only one other person observed the transit on that day: HORROCKS's old-time friend CRABTREE. It was just a few days earlier that HORROCKS wrote him a letter, exhorting him to «attend to it diligently with a telescope and to make whatever observation you can, especially about the diameter of Venus.» CRABTREE heeded his friend's call and observed the transit from his home in Manchester, but he was beset by clouds during most of the event. He was about to give up when at 3:35 the Sun suddenly burst out of the clouds. CRABTREE was so awe-struck by the sight in front of him



Fig. 7: A mural by FORD MADOX BROWN at Manchester's Town Hall showing WILLIAM CRABTREE observing the transit of Venus on December 4, 1639.

that for a few moments he stood there transfixed, overcome with emotion. By the time he regained his senses the Sun had already set. The few measurements he was able to make agreed with those of HORROCKS, to the latter's delight.

HORROCKS now set about to write up his observation. The fact that the transit happened at the exact time he had calculated was a personal triumph for him. But equally important to him was the chance to measure the apparent diameter of Venus, a task that could only be attempted during a transit, when the planet's image is starkly projected against the Sun's face. He had predicted that Venus's angular diameter would be a mere one arc minute, whereas KEPLER had thought it should be 7 arc minutes, and LANSBERGE 11. HORROCKS's measurements

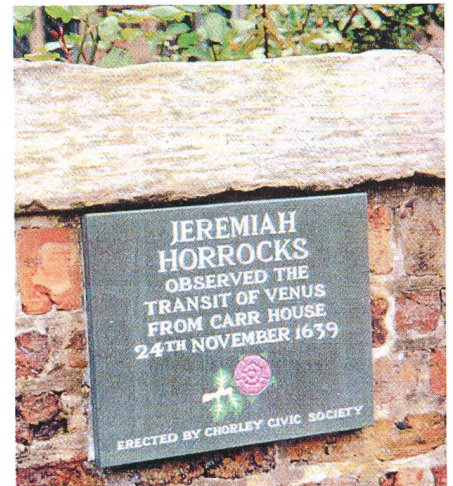


Fig. 9: A plaque at the entrance to the Carr House commemorating JEREMIAH HORROCKS' observation of the 1639 transit of Venus.



fully confirmed his prediction and are the first reasonably accurate estimation of the planet's apparent size.

HORROCKS was about to finish writing up his account, entitled *Venus in sole visa* (Venus visible on the Sun) and was making plans to meet CRABTREE in order to compare their observations. It would have been their first meeting since their Cambridge days, but it was not to be: on January 3, 1641, the day before their appointed meeting, HORROCKS suddenly died, not yet twenty three years old. The cause of death has never been determined. A tribute paid to him many years later described him as «a prodigy for his skill in astronomy; had he lived, in all

Fig. 8: The Carr House, from whose third floor JEREMIAH HORROCKS observed the transit of Venus on December 4, 1639.

probability he would have proved the greatest man in the whole world in his profession.» His good friend CRABTREE survived him by just three years: he reportedly was killed in the battle of Naseby during the English Civil War. Were it not for CRABTREE, who kept many of HORROCKS's papers, we would have never heard of HORROCKS. Many of these papers were destroyed during the Civil War; others went up in flames in the Great Fire of London. Of the papers that remained, many were taken by CRABTREE's brother and never returned. Fortunately, the surviving letters were bought by an antiquarian dealer and thus became preserved. His book *Venus in sole visa* was published by the German astronomer JOHANNES HEVELIUS in 1662.

As far as we know, HORROCKS and CRABTREE were the only humans to witness the 1639 transit. It would be nearly 122 years before Venus would again visit the Sun's face. When the day finally came on June 6, 1761, hundreds of astronomers would be waiting at their telescopes all around the world to greet her.

In July 2002 my wife and I went to England to visit the places associated with the 1639 transit. Our pilgrimage began at Manchester's Town Hall, a huge impressive Victorian building. Here, in the stately reception hall, there is a large mural, painted by the 19th century artist Ford Madox Brown, showing CRABTREE staring in awe at the tiny black image of Venus in front of him, while his wife stands behind holding their child. Brown has obviously romanticized the event, making CRABTREE appear much

older than his 21 years at the time, but it was still moving to see the historic event memorialized on a grand scale.

Next we traveled to Much Hoole, some 10 miles west of the town of Preston in the Lancashire district. The small, sleepy village lies amidst open fields and low hills. We walked for a while along empty streets until we finally saw a pedestrian walking his dog, so we stopped him and asked for directions to St. Michael's Church. We could read the puzzlement on his face: why would visitors from the US come to this small place? So we just said we were after an astronomical event that happened here several centuries ago, upon which he said, «You mean the transit of Venus?» We soon found out that HORROCKS was a household name here.

When we arrived at the church, we first paid a visit to the adjacent St. Michael's primary school, where we were received with much honor. The headteacher, Mr. DAVID UPTON, introduced us to his classes. The pupils, he explained, have studied about the astronomical event that took place right here over 350 years ago, and they are planning to watch the 2004 transit from their school yard, hoping and praying for clear skies when the moment finally arrives early on the morning of June 8. In the hallway there was a large quilt entitled «Life in Hoole» made by the students; one square showed a telescope with JEREMIAH HORROCKS's name next to it.

Mr. UPTON then telephoned the Rector of St. Michael's Church, Reverend STEVEN HUGHES, who arrived within min-

utes on his bicycle. He kindly allowed us to tour the church, the very place where HORROCKS had to attend to his «business of the highest importance» on that winter day in 1639, which prevented him from seeing the beginning of the transit. Several artifacts commemorate the event, and an inscription engraved in marble tells HORROCKS's brief life. Above the church's entrance on the outside there is an impressive sundial with the inscription *Sine Sol Silio* («Without the Sun I am silent»). The opposite wall features a modern clock with the inscription «In memoriam Horrocii 1639-1839,» erected there on the 220th anniversary of the historic transit.

We ended our trip by walking the mile or so to Carr House, which, we learned, was up for sale (obviously this was big news in the village, as it must be the most expensive piece of real estate in town). The house, an impressive brick structure with a beautiful garden, was closed to visitors, dashing our hopes to be allowed in by posing as potential buyers. We had to do with watching it from the outside and letting our imagination do the rest. A plaque at the entrance briefly tells of the event in whose wake we had come. We left deeply moved, being transported back in time to that wintry day in 1639 when two young friends were privileged to be the first humans to watch one of astronomy's rarest events.

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SAG - Kolloquium 2003: Astrofotografie

Termin: Samstag / Sonntag, 21./22. Juni 2003

Ort: 15:00 Uhr, Schulungsraum Feriensternwarte Calina in Carona

Referenten: HUGO BLIKISDORF, HUGO JOST, JOSEF SCHIBLI

Programmübersicht

Samstag, 21. Juni 2003, 15:00 - 18:00 Uhr

- Geschichte der Astrofotografie gestern - heute - morgen aus der Sicht der Profis und der Amateure (HUGO JOST).
- Klassische Fotografie mit der Maksutov Kamera (HUGO BLIKISDORF).

Sonntag, 22. Juni 2003, 09:30 - 12:00 Uhr

- Web Kameras versus CCD Kameras (JOSEF SCHIBLI).
- Was CCD-Kameras sonst noch alles können (JOSEF SCHIBLI).
- Bildverarbeitung mit dem PC (HUGO JOST).

Anmeldung:

Hugo Jost-Hediger, Lingeriz 89, 2540 Grenchen, Tel. 032 653 10 08, email: hugojost@bluewin.ch
Anmeldungen bitte bis spätestens 1. Juni 2003

Übernachtung in der Sternwarte Calina:

Anfragen bitte an Frau Susanne Brändli, Casella postale 8, 6914 Carona, Tel. 091 649 51 91