2. Odd but Interesting Events Near the Sun

Of the major planets in the Solar System, only two can pass across the face of the Sun, at least as seen from the vantage point of Earth. Such a phenomenon is called a "transit," and the only planets that can accomplish this feat are the two so-called "inferior" planets, Mercury and Venus.

By the way, there is nothing discriminatory intended by calling these planets "inferior." All it means is that they are located between Earth and the Sun, "beneath" Earth's orbit with respect to the Sun.

Transit Tales: Regular and Weird

Venus

Transits of Mercury are the more common, but those of Venus are the more spectacular and have generated far greater scientific interest, especially during the earlier years of the Scientific Revolution.

It was the famous British astronomer Edmond Halley who first suggested, in 1716, that transits of Venus could be used as a means of more accurately determining Earth's distance from the Sun. This distance is known as the Astronomical Unit and is the main yardstick for the moderate distances found within the Solar System.

Back in 1619, Kepler worked out the *relative* distances of the planets from the Sun. Since that time, it was known that (for instance) Venus orbited at a mean distance of 0.72 that of Earth, Mars at 1.52, and so forth. But the *absolute* distances (the actual number of miles or kilometers) was only very roughly determined.

D.A.J. Seargent, *Weird Astronomy*, Astronomers' Universe,
DOI 10.1007/978-1-4419-6424-3_2, © Springer Science+Business Media, LLC 2011

This situation could be changed if some method of measuring Earth's distance from one of the nearer planets could be found. If the true distance between our world and (say) Venus could be determined, by already knowing what the relative distances are, our absolute distance from the Sun could be easily calculated.

Halley saw that the accurate measurements of transits of Venus could achieve this end.

How could observing transits do the trick?

Briefly, because of the phenomenon of parallax, two people viewing the same transit from two relatively widely separated locations on Earth's surface would see the transiting planet take a slightly different path across the face of the Sun. As Venus is relatively close to Earth, this difference is measurable.

Because the Sun is perceived as a disk, this also means that each observer sees the planet's track as differing slightly in length, and it is the accurate measuring of the difference in length that the value of the parallax is determined, and from this, the planet's true distance derived.

To achieve this end, Halley proposed that two widely separated observers accurately determine the time of first contact (the first appearance of the planet's limb against the Sun's surface), second contact (when the planet breaks free of the solar limb), and the third and fourth contact at the end of the event.

The precision of this method is, however, compromised somewhat by a phenomenon known as the "black drop," about which more will be said shortly. This made it all but impossible to obtain the required accuracy in the timing of the planet's "contacts" with the solar limb.

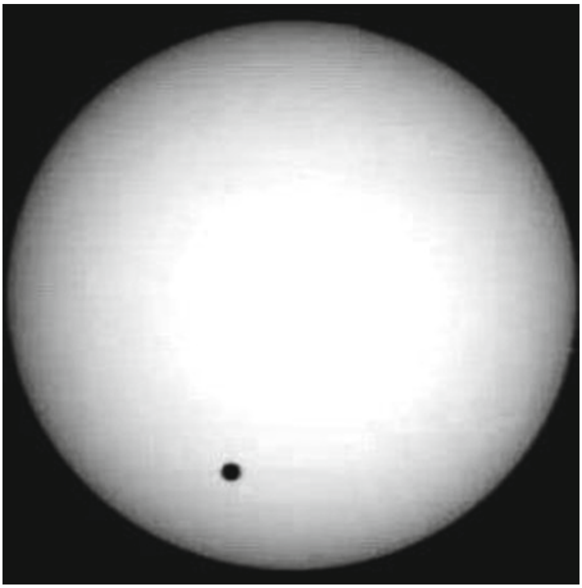
Nevertheless, the pursuit of these rare events proved a good stimulus for expeditions to remote parts of the world. It also inspired great voyages of discovery such as that by Captain James Cook.

Nowadays, the scientific value of transits has largely disappeared. But they are still worth observing simply for the wonder of seeing the black dot of Venus (visible – with adequate protection, of course – to the naked eye) cruising slowly across the face of the Sun.

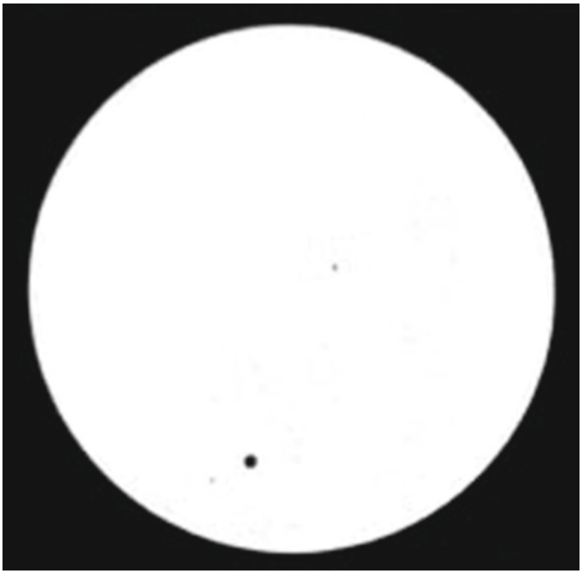
It is a pity that whole generations pass without having the chance to witness such an event. The transits actually happen in pairs, but with such long gaps between them that the observers of one pair have long departed this life before the next pair comes along. Actually, just seven transits of Venus have been observed since the invention of the telescope: on December 7, 1631, and December 4, 1639, June 6, 1761, and June 3–4, 1769 (Captain Cook's transit), December 9, 1874, and December 6, 1882, and, most recently, June 8, 2004. The next is due on June 5–6, 2012, after which there will be no more until December 10, 2117, and December 8, 2125. Notice that the entire twentieth century passed without seeing a transit of Venus.

At our time in history, transits occur in pairs according to a pattern that repeats itself every 243 years. A pair of transits separated by 8 years occurs, followed by a transit-free gap of 121.5 years, then a second event just 8 years later followed by a gap of 105.5 years.

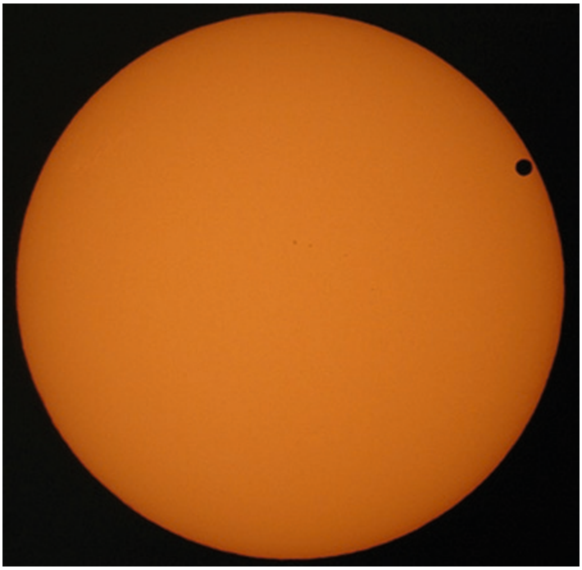
As mentioned, the black silhouette of Venus against the brilliant face of the Sun can easily be seen by the naked eye. Of course, the eye should never be completely "naked" when looking toward the Sun, and unless suitable protective measures are taken when viewing such an event, the penalty of carelessness will be blindness.



Venus transit December 6, 1882 photographed by students at Vassar College.



Another image of the Venus transit December 6, 1882.



The disk of Venus near the solar limb June 8, 2004. © Gordon Garradd 2004.

Through a telescope (also adequately protected, of course) the event can be eerily spectacular. An unusual effect, visible especially when a low-power eyepiece is used for the observation, is the apparent tendency for the silhouetted planet to remain connected to the Sun's limb even after its entire disk has progressed onto the face of the Sun. This is the so-called "black drop," which proved such a menace to the exact timings required by those trying to refine the measurement of Earth's distance from the Sun. This phenomenon, by the way, owes more to the atmosphere of Earth than to that of Venus, as was originally thought. The effect has also been noted (though, by the nature of things, in a less conspicuous form) during transits of that smaller inferior planet, Mercury, which has no atmosphere worthy of the title and certainly none capable of giving rise to any phenomena observable during transits.

As we will see below, weird things have been reported from time to time in association with transits of Mercury. However, probably on account of the rarity of Venusian transits, few mysterious sightings have been reported during these events.

Nevertheless, the transit of 1874 did bring forth a couple of odd observations. For whatever reason, both of them came from observers located in New South Wales, Australia.

Thus, we have the observation by Mr. L. A. Vessey, who reportedly saw the planet during transit not as a black silhouette but

Venus in transit June 8, 2004 showing "*black* drop". NASA image.

as having a distinctly grey appearance, albeit with a black center. Also, during that same transit, Sydney Observatory astronomers H. C. Russell and H. A. Lenehan noted a bright spot of light near one of the planet's poles as it crossed the face of the Sun.

These two anomalies were probably not associated. The first may have been merely a contrast effect, but the bright spot is unlikely to be explicable in that way. It is difficult to say what it may have been, although if it was very near the dark rim of the planet, it might have been a high-altitude Venusian cloud forward scattering the Sun's light. At least, that *sounds* plausible!

They Missed the Transit but Found the Bird!

Arguably, some of the most interesting scientific results of Venus transits were those having nothing to do with astronomy at all! We have already mentioned Captain Cook and his voyages of discovery, but these were not the only serendipitous advances courtesy of Venus transits.

For example, as the transit of 1761 approached, the renowned French naturalist Charles Buffon found himself, in his capacity as head of the Acadamie des Sciences, in charge of sending astronomers and their equipment to distant observing sites. One of the more hazardous expeditions was reserved for the noted astronomer-monk, Alexandre-Gui Pingre, and his assistant Denis Thullier, to the remote island of Rodrigues; a 24-mile-long pile of basaltic rock in the middle of the Indian Ocean.

Buffon himself may have been a little envious of Pingre and Thullier, not because of the transit and certainly not because of the sea voyage to the ends of Earth, but (as a naturalist) he was intrigued about the flora and fauna of the strange place to which they were bound. So, just in case the transit was clouded out, he instructed the two astronomers on a contingency plan, providing instructions for a thorough collection of plant and animal specimens and the recording of all that appeared unique to the island.

Just as well, as it turned out!

Come Transit Day … and the sky filled with clouds. Realizing that observing the transit was a lost cause but anxious that the expedition would not be a complete waste of time and effort, Pingre put Buffon's "contingency plan" into action and began the biological survey of Rodrigues. The results of the survey, although never published as a book, are preserved in the Bibliotheque Sainte-Genevieve in Paris.

Included in this work is Pingre's account of a large flightless bird known, thanks to its seemingly unsociable nature, as the Solitaire (*Pesophaps solitaire*). This bird was actually a relative of the Dodo and, alas, has now gone the way of its famous cousin. Pingre apparently did not actually see the Solitaire with his own eyes, but he was assured by an inhabitant of the island that a small number still existed there at the time. This second-hand report is our only evidence that the bird existed on Rodrigues as late as 1761.

At the time, this was little more than a curiosity. Detailed knowledge of this avian oddity did not come until 1874; courtesy of another transit of Venus!

Gone the way of the Dodo. Alas! Illustration of the now-extinct Solitaire *Pesophaps Solitair.* From "Extinct Birds" 1907, Courtesy Wikipedia.

This time, an expedition of British scientists chose the island as a favorable spot to observe the transit and, just like their French predecessors, their interests extended beyond the astronomical. Sadly, by that time there were no living Solitaires – not even stories of living Solitaires – but the scientists did find bones. Solitaire bones aplenty. In all, 15 complete skeletons of the bird were finally assembled and the information gleaned from these enabled, for the very first time, the Solitaire to be established as a separate species of bird, something that had previously been the subject of debate. And all because of two transits of Venus!

But what of this second transit? Was it observed, and did it add to astronomical as well as to ornithological science?

It was observed, but scientifically it was disappointing. Little material of astronomical value was brought back by the Rodrigues expedition!

PROJECT 6
Observing the Transit of 2012

On June 6, 2012, the second and final transit of Venus in the present century will take place. Over a century will pass before the next one, so if you miss it, there will not be another chance to see one in your lifetime!

This map shows the region of Earth from which the transit will be visible. The Roman numerals denote first (I), second (II), third (III), and fourth (IV) contacts. First contact is when the disk of the planet reaches the Sun's limb, second when the planet's disk breaks free of the limb and its silhouette is fully on the solar disk, third contact is when the leading edge of the planet's disk touches the limb of the Sun as the silhouette begins to leave the disk, and fourth contact is the final exit from the solar disk.

The transit will be visible with the naked eye, although (it must be repeated) the eye must NEVER be completely "naked" when viewing the Sun. If you intend trying for it without optical aid, only use proper solar filters, *NEVER* smoked glass or even welding goggles. If directly viewed through a small telescope, even greater caution needs to be taken. Only recommended filters, *PLACED OVER THE OBJECT GLASS AND VERY SECURELY STRAPPED ON*, should be used.

2012 Transit of Venus

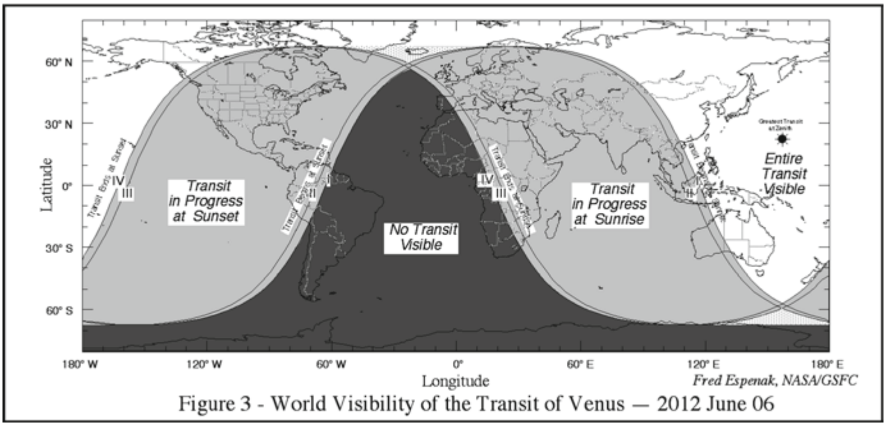


Figure 3 - World Visibility of the Transit of Venus — 2012 June 06

Map showing region of visibility of the Venus transit of June 6, 2012. NASA image.

The best method for watching the event is by projecting the Sun's image through a small telescope onto a white card. It is best to use a small refractor rather than a reflector. In general, reflectors are not suitable for any kind of solar work unless the mirror is left unsilvered, which of course makes it useless for anything else. Even refractors should be small, or they will focus too much heat. A 2 or 2.4 in. (50–60 mm) object glass is quite large enough, and anything over 4 in. (100 mm) or thereabouts should be stopped down to 2–2.4 in. An opaque cardboard cap over the object glass with a circular hole cut to the required diameter will be sufficient for this.

It is fascinating to watch the large black dot drift slowly across the face of the Sun. Watch out especially for the Black Drop effect and, of course, for the possibility of anything unexpected.

If you enjoy watching the Venus transit, don't despair that no more will occur in your lifetime. Although not as spectacular, remember that a transit of Mercury is due in 2016!

Mercury

These are less spectacular than transits of Venus and have never been held in the scientific esteem of the latter. Nevertheless, they can at least be watched with the knowledge that many observers of earlier events are still alive and well. I have seen a few myself, missed some others, and am still well under one century old!

The next transit of Mercury takes place in 2016. A full list of the remaining twenty-first century transits is given in Appendix D.

Being a smaller and more distant planet, Mercury's silhouette against the solar disk is much smaller than that of Venus and cannot be seen with the naked eye. A small telescope will suffice, however, and the safest way watching the progress of the tiny black speck is by projecting the image of the Sun onto a white sheet of paper. For my most recent observation of a transit of this planet, I found that the back of a letter from the local government authorities made an excellent screen for projecting an image from a 2.5-in. (6-cm) refracting telescope!

PROJECT 7
Observing the Mercury Transit of 2016

For the first time in nearly 10 years, Mercury will transit the Sun on May 9, 2016. The event will be visible from the Americas, Europe, Africa, and central Asia, and first contact is scheduled to occur at 14:57 h Universal Time.

Unlike Venus, Mercury is not visible with the naked eye when in transit, but may be seen as a very small black point through large binoculars such as 15×80 s. These must, however, be properly mounted, and the safest and easiest way of watching the transit with these instruments is by projecting the solar image onto a sheet of white paper.

For a larger view, a 2.5-in. (0.6-cm) refracting telescope (once again, properly mounted) at a magnification of 50–100 should be sufficient. Because the Sun is being observed, too much aperture means too much heat, so this is not a job for large telescopes.

At first contact, the limb of the planet first touches that of the Sun, and shortly afterward it becomes visible as a small notch on the solar limb.

Watch for any "black drop" that may occur as the trailing edge of Mercury breaks free of the solar limb at second contact. If you are viewing the event directly through a safe solar filter (CAUTION: Make sure that it really is a *safe* solar filter!), keep watch for any effect (real or illusory) similar to the bright spots and so forth occasionally reported at earlier transits. The chances are slim, but there is always a chance that something interesting might be seen, even if it is just an interesting optical illusion!

Unlike transits of Venus, the relative frequency and low scientific interest of Mercury's passages across the Sun's face has not inspired scientific expeditions to distant lands where bones of extinct birds might be found. These Mercurian events lack the romance of the Venus transits!

Nevertheless, odd things have been reported from time to time. In fact (undoubtedly because of the greater frequency of these events), transits of Mercury have managed to chalk up more anomalous observations than those of Venus!

Thus, during the transits of 1799, 1832, 1848, 1861, and 1868, a bright spot on the planet was noted by such eminent astronomers as Schroter, Harding, Kohler, and Professor Moll.

But what is to be said for haloes and rings seen surrounding the planet during transit?

Although a trace of atmosphere does exist, it is hardly worthy of that title and is entirely too rarefied to cause any such phenomena as haloes or rings of light. Nevertheless, just such a halo was reported during the 1707 transit by none other than the Assistant to the Astronomer Royal, and similar sightings were noted during the transits of 1753 and 1786. Then, in 1799, no less an astronomer than Schroter reported a halo "scarcely brighter than the surface of the Sun, but of another color" surrounding Mercury's silhouette. A similar ring was observed from the Royal Observatory during the transit of 1832 and described as having "a violet hue, the color being strongest near the planet." Then again, William Huggins noted a bright aureole – said to have been a little brighter than the Sun's disc, during the transit of 1868.

Curiously, according to a study by B. G. Jenkins published in 1878 (more will be said about this study below), when Mercury transits the Sun in May, dark and nebulous rings are reported, but when it transits in November, bright haloes are seen.

Most probably, the reported haloes were nothing more than simple contrast effects; a suggestion made as long ago as 1878 by an anonymous contributor to the *Monthly Notices of the Royal Astronomical Society*. This contributor had actually witnessed the halo effect himself. Describing his own observations of the transit of May 6 of that year, he noted that the planet appeared surrounded by a halo, much brighter than the surface of the Sun, and having an irregular outline. About the same time, E. Dunkin also observed a halo, albeit fainter than the surface of the Sun, that "appeared with radiating arms as in the solar corona." In agreement with the anonymous observer, Dunkin also explained this as arising from the contrast between the intensely black disc of the planet and the brilliant background of the Sun. Everything that has subsequently been learned about Mercury upholds this explanation. Still, these apparently anomalous observations of a Mercurial halo stand as reminders of how threshold visual observations can easily lead to the postulation of physical effects, which in the end turn out to be spurious.

Are the bright spots, to which we gave passing mention earlier, any more substantial?

In an article published in an earlier issue of the 1878 *Monthly Notices of the RAS*, B. G. Jenkins analyzed the reports of anomalous bright spots observed during earlier transits in the hope of finding patterns capable of predicting events associated with the forthcoming May 6 event. Summarizing his findings, Jenkins concluded that:

- During May transits, when Mercury is furthest from the Sun, a luminous spot appears on the planet's trailing hemisphere.
- The spot is never central but always south of the planet's equator.
- In some transits, two spots occur close together. At others, only a single spot is reported.

Comparing the "well observed phenomena" associated with the May transit of 1832 and those seen at the November transit of 1868, Jenkins found that in the first event a diffuse spot of light preceded the planet's centre but during the second transit, a sharply defined spot followed the center. He also found that a dark ring was reported around the planet in the first instance and a bright halo in the second.

From this, Jenkins concluded that the approaching May 6 transit should show a rather diffuse and ill-defined blob of light (not a point-like bright spot) "gradually sinking from a grayish-white to the dark color of the disc, situated a little in advance of the centre and to the south of it, and … the planet will be surrounded by a dark nebulous ring, not a bright one."

We have already seen that he struck out on the second prediction. Both Dunkin and the anonymous observer quoted above saw a *bright* halo on May 6, not a dark one!

So how did Jenkins fare with the other prediction?

No better it would seem!

The same anonymous observer who saw a halo brighter than the surface of the Sun (albeit explained by him as a contrast effect) also noted a "minute bright [spot]" very near the center of Mercury's disc. He went on to explain that the spot was "slightly diffused, but with a brilliant star-like nucleus" and, although almost centrally placed, was very slightly on the *trailing* side of the planet.

In other words, Jenkins' predictions were about as far from the mark as possible. If we wish to be very charitable, we might concede that he did at least get the diffuse appearance partially right, but this was more than undone by the far more conspicuous appearance of a bright point at the core of the "bright spot."

So what are we to conclude from all of this?

Before we even try to reach any firm conclusion, it is well to remember that Mercury is a very small planet and that even when at its closest to Earth, it remains a miniscule dot in modest telescopes. When seen projected against the brilliant surface of the Sun during a transit, it is never more than a very small black spot. Trying to discern details on such an object under the conditions of a solar transit is, putting it mildly, not an easy task.

Moreover, it is worth noting that the evidence for bright spots on the transiting planet seems always to have come from early visual observations.

It is very difficult to understand how a bright spot could appear near the center of the transiting disk of Mercury. Accordingly, it seems that, like the halo reported to have sometimes surrounded the planet during transits, this phenomenon owes more to optical illusion than to any physical cause on the planet itself. Maybe someday a bright spot will be recorded by modern imaging, but in the meantime it seems that (in common with so many early anomalous details reportedly seen on other planets) the Mercurial spots must be placed behind the eyes of the beholder rather than located on the surface of another world.

Mercury progresses across the face of the Sun (Image 1). Note the conspicuous sunspot visible beneath the transiting planet.

Mercury progresses across the face of the Sun (Image 2).

Mercury progresses across the face of the Sun. Note the conspicuous sunspot visible beneath the transiting planet.

Mercury progresses across the face of the Sun. Note the conspicuous sunspot visible beneath the transiting planet. Images courtesy John Walker.

Some Transit Trivia

Before leaving the subject of transits, here are some pieces of trivia that the reader might find interesting. Remember them the next time a star party is clouded out!

When a planet passes in front of the Sun, the latter is dimmed by a tiny amount. A transit of Venus causes the Sun's light to drop by 0.001 magnitudes, one of Mercury by just 0.00003 magnitudes. Both amounts are far too small to be noticed.

See how many guests at your next star party know that one!

Or this one!

How often do grazing transits of Mercury occur? (A grazing transit is one where some regions of the world see only a partial transit of the planet, that is to say, it never becomes completely clear of the Sun's limb. All the while, the full transit is visible from other regions of Earth).

The answer is … not very often. The most recent occurred on November 15, 1999, but the previous one was as long ago as October 28, 1743. The next will be on May 11, 2391. Readers may wish to mark that on their calendars.

It is also possible for a transit to be only partial as seen from Earth, the full transit in these events missing our planet altogether. The most recent was on May 11, 1937 and the previous on October 21, 1342. Another will not happen until May 13, 2608.

Grazing transits of Venus also occur but (surprise! surprise!) only very rarely. One took place (according to calculations; nobody saw it) on December 6, 1631, but the next is not due until December 13, 2611.

Partial transits of Venus happen from time to time as well. There was one, so the mathematicians inform us, on November 19, 541 BC, and there will be another on December 14, 2854.

Now for something *really* rare. Simultaneous transits of both Mercury and Venus!

These do happen, but don't hold your breath waiting. A double-bill is predicted to occur on July 26 in the year 69,163 and another in 224,508. Although the two planets will not transit together, mark the date of September 13, 13,425 in your diaries for a pair of transits by both planets just 16 h apart.

The date of July 5, 6757 might also be worth noting, as an eclipse of the Sun will occur while Mercury is in transit. The event is predicted to be visible from eastern Siberia. This will also be a double transit of sorts – of Mercury and the Moon.

We have a longer wait for a transit of Venus to coincide with a solar eclipse. The next event of this type is predicted for April 5 in the year 15,232. There was, however, *almost* a Venus transit/ solar eclipse double in 1769. The day after the transit, on June 3, a total eclipse of the Sun was visible from North America, Europe, and the northern parts of Asia.

It is possible for a pairing of both Mercury and Venus transits to coincide with a solar eclipse, there is no known prediction as to when this will happen. Maybe the world won't last that long!

At the beginning of this chapter, we said that only two major Solar System objects can transit the Sun from the perspective of Earth. There are, however, minor objects capable of this feat.

In recent years, increasing numbers of asteroids passing within Earth's orbit have been discovered, and some of these must transit the Sun from time to time. All of these objects, however, are very small, and it is not surprising that no asteroid transit has been observed.

Likewise, many comets pass within the orbit of our planet, although most of these visit the inner Solar System only infrequently. Nevertheless, several were computed to have transited the Sun during the past 100 years, although most of these were not discovered until they emerged into the evening or morning twilight after the event had already taken place. Another (the Great March Comet of 1843), although seen before the transit, was not observed sufficiently well for an orbit to be calculated until after the event. It was only then that a transit was found to have happened. In only two instances (the Great September Comet of 1882 and Halley's in 1910) were attempts actually made to observe a transit, and in neither instance was anything seen against the face of the Sun. Significantly, the solid nucleus of Halley is rather large by cometary standards and was passing quite close to Earth at the time of the transit in 1910.

So, besides the rare transits of Mercury and those very rare ones of Venus, Earth's inhabitants are extremely unlikely to see anything passing across the face of the Sun – birds, airplanes, and balloons excepted!

But sometimes in the history of astronomy, the unexpected happens – or (at least) *seems* to happen. People *have* reported objects other than Mercury and Venus transiting the Sun! At one time, astronomers felt so sure that an intra-Mercurial planet existed that they even named it and listed it within the catalog of Solar System objects. Let's have a look now at the tale of the planet that never was.

The Little World that Wasn't There

How does that rhyme go?

> Late last night upon the stair
> I met a man who wasn't there
> He wasn't there again today
> O how I wish he'd go away!

Well, no one knows about the man who wasn't there, but the Solar System was once thought to have harbored a planet that wasn't there. In fact, there was a time when astronomers were so convinced that it *was* there, they gave it a name, calculated its orbit, and included it in descriptive surveys of the Sun's retinue!

Its name was Vulcan, and it was thought to orbit between Mercury and the Sun. Remaining so close to the Sun in the sky, the small planet was very difficult to see under normal circumstances, which explained why it had never been noticed in the morning and evening twilight. Nevertheless, it was considered potentially observable in transit across the disk of the Sun as well as during total solar eclipses under ideal conditions.

Today the very name "Vulcan" has a certain mythic (indeed, almost mystical) connotation as the home planet of *Star Trek's* Mr. Spock, but the Vulcan spoken about here is a very different world. So close to the Sun, it was expected to be hot enough to melt lead. Not even the indefatigable Mr. Spock could survive on *this* Vulcan!

But why should such a world be imagined in the first place?

Actually, in the middle years of the nineteenth century, there seemed to be extremely good reasons for believing in its existence, and it was this that raised speculation to the point of virtual certainty in the minds of many astronomers.

The chief reason was the orbit of Mercury or, to be more precise, the orbit's persistent refusal to conform to the predictions of Newtonian gravity. Nothing is more annoying to astronomers than a planet whose orbit seems to defy the laws of motion. Uranus had been such a planet, and it was the desire to bring it to heel that led to the discovery of the even more remote world that we now know as Neptune.

Mercury behaved in a manner not unlike Uranus, and it was both natural and logical to conclude that if the anomaly in the latter's orbit was due to the perturbing influence of another planet, the behavior of the former was most probably amenable to a similar explanation.

The problem of Mercury's orbit was tackled in 1859 by Urbain Jean Joseph Leverrier, who applied the same method by which Neptune had been mathematically tracked down. It appeared to work, and on September 12 of that year Leverrier announced to the French Academy of Sciences that a new planet had been mathematically "discovered" in an orbit between Mercury and the Sun.

All that remained was for reliable observations of this new world to be made by astronomers. Incidentally, so confident were the astronomers of the day in the validity of Leverrier's solution that they did not wait for confirming observations to give the planet a name. "Vulcan" – from the Roman god of fire and metal forging – seemed a very good one for what must be a planet of infernal heat.

Remarkably, apparent confirmation was not long in coming. Just three months after Leverrier's announcement, news arrived that a certain Dr. Lescarbault – a physician practicing at Orgeres – had actually observed the transit of a planet-like object across the face of the Sun as far back as March 26, prior to Leverrier's presentation of his mathematical solution. Unaware of Leverrier's work, the doctor had kept his sighting to himself in the hope that he could find an independent, confirming observation before announcing his apparent discovery to the world.

Although no further observations were unearthed, publication of Leverrier's results seemed to provide confirmation of sorts, and Lescarbault finally made his sighting public.

Strangely, Leverrier welcomed the doctor's sighting with less than open arms. He actually took it upon himself to pay Lescarbault a visit, announcing with seeming lack of candor that he had come to determine "either that you have been dishonest or deceived."

What the doctor thought of this bombastic astronomer remains unrecorded (maybe just as well!), but it is clear that Leverrier was not exactly overawed by Lescarbault. Upon requesting to see his astronomical instruments, Leverrier was shown a "chronometer" consisting of a huge pocket watch with only hour and minute hands, a seconds-pendulum consisting of an ivory ball attached to a silk thread hanging from a nail in the wall, and a note pad consisting not of paper (of which the doctor was chronically short) but of a plank of wood on which all calculations were performed and, where necessary, erased with a wood plane. Leverrier was less than impressed!

Nevertheless, despite clearly getting off on the wrong foot, Leverrier slowly changed his mind about the doctor's observation and even used the results he obtained with his admittedly primitive instruments to calculate a rough orbit for the new body. He found that Vulcan orbited a mere 13 million miles (21 million km) from the Sun and had a "year" of just 19.75 days.

Nothing further was seen of Vulcan until March 20, 1862, when an English amateur astronomer by the name of Lummis noted a moving and very planet-like black freckle on the face of the Sun. He is said to have watched the supposed transit for 20 min before being called away by some unspecified (but presumably very important!) "official duties." These observations by Lummis enabled the French mathematicians Valz and Radau to compute an orbit which, encouragingly, came out very close to the one determined by Leverrier from Lascarbault's data.

On the face of it, this apparent agreement on an orbit by different mathematicians working, not just independently of each other but also using different sets of data from two independent observers, appeared to provide strong evidence for the reality of the planet.

Alas, such was not the case. It later transpired that at the time Lescarbault was watching the earlier transit, the French astronomer

Emmanuel Liais was also observing the Sun from Brazil, but saw nothing unusual.

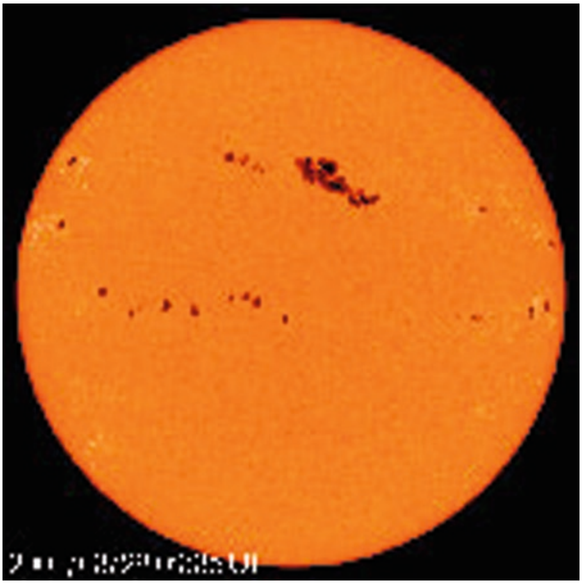
The second transit – that reported by Lummis – ended up faring no better. According to Professor C. H. F. Peters, the black dot that Lummis saw was none other than a small and very round sunspot observed at the same time by himself in America and also by Sporer in Europe.

A minute ago, we said that nothing was seen of Vulcan between Lescarbault's alleged transit observations of 1859 and that of Lummis in 1862. Actually, that is not quite correct, as there was a minor sighting on January 29, 1860, although the wider astronomical community knew nothing of it until the publication of a belated note in *Nature* by F. A. R. Russell in 1876 recounting his observation of something reminiscent of a planet crossing the face of the rising Sun 16 years earlier. As Russell recalled, the Sun shone through a fog so thick that it could be observed "as if through dark glass." He described the spot as being similar to Mercury when seen in transit and noted that the event was witnessed by four people, including himself.

Another observer claimed that he watched a transit of Vulcan (date unknown) while squinting through the (unfiltered) eyepiece of a telescope. Think about this for a minute. What would happen to the retina of somebody's eye while squinting through the eyepiece of a telescope pointed toward the Sun? Please, nobody try this one. Only assess the likely accuracy of an observation allegedly made that way!

It should be mentioned that reports of mystery transits did not wait until Leverrier's work on the orbit of Mercury. An anonymous contributor to the *Proceedings of the Royal Astronomical Society* in 1859 sought to bolster Leverrier's claim by listing reports of alleged transits dating back to early 1761, most of them observed by credible and knowledgeable observers. He actually lists eight events, in 1761, 1762 (two that year), 1764, 1798, 1802, 1819, and1820. The event of 1820 (February 12 that year) is interesting in that the observer claimed that the spot not only looked like a transiting planet but also displayed indications of an atmosphere!

Despite their planet-like appearance, we now know that none of these spots could have been a transiting planet. Presumably, they were simply sunspots. Some may indeed have been illusory.



A spotted Sun! Note how the smaller sunspots could be mistaken for the silhouettes of transiting planets. NASA image.

PROJECT 8
Spots on the Sun

Sunspots are easy to observe with only very modest equipment. A pair of tripod-mounted binoculars or small telescope projecting the Sun's image onto a sheet of white paper is all that is required, and on most days at least one spot will be visible.

Monitoring the increase and decrease of sunspots throughout the solar cycle is an interesting project in its own right, but the immediate interest here is to look for spots that may be mistaken for transiting planets. How frequently do spots occur that, in your opinion, might be mistaken for a transiting world? From your own observations of sunspots, do you think that many of the transit-of-Vulcan reports of earlier years might have been influenced by a level of wishful thinking? Have you seen anything that may have fooled *you*?

Nevertheless, not all alleged sightings of Vulcan came in the form of transits. There were also a small number of observations of bright objects seen close to the Sun during solar eclipses. Indeed, observations of this type, if taken at face value, suggested that there might be more than one Vulcan. As we will shortly see, at least one eclipse seemed to produce a pair of Vulcans!

Writing in the prestigious science journal *Nature* in 1878, astronomer J. R. Hind recalled how a group of people at St. Paul's Junction noted two unidentified objects during the total eclipse of August 7, 1869. The best attested object was described as "a little brilliant," a star-like point of light shining through the outer regions of the Sun's corona. This was apparently seen by four members of the group. Attempts to identify this with a known star were made; however, the stars suggested as possible candidates were simply too faint to have been visible under the prevailing conditions.

Even more puzzling were reports by two further members of the group that a crescent-shaped object was also spotted somewhat further from the eclipsed Sun. At least one person claimed that this crescent was observed through a small telescope just before totality and again as the Sun emerged from the total phase of the eclipse. It is not known whether this observer tried to see it during totality, but it is probable that his attention was directed elsewhere then!

A crescent shape is interesting, as an intra-Mercurial planet would go through phases similar to Venus and Mercury itself, but one must also wonder if internal reflection in the telescope (perhaps a ghost reflection of the partially eclipsed Sun itself?) might account for the crescent.

Ultimately though, the mystery of the two objects of 1869 remains unsolved.

The reason why Hind recalled the incident in 1878 is, however, not hard to find. That year also witnessed a total eclipse of the Sun, on July 29, which raised the Vulcan issue in grand measure, as we will shortly see.

Unlike the 1869 incident, the chief players in 1878 were very well known and highly experienced astronomers – no less than Lewis Swift, Professor James Craig Watson, and G. B. Airy, who independently undertook searches of the Sun's immediate vicinity for any signs of intra-Mercurial planets.

They were not to be disappointed, with each astronomer reporting unidentified star-like objects close to the Sun. Indeed, Watson reported finding not one, but two, such objects!

Now, one Vulcan might be acceptable, but *two* of them? Needless to say, this interpretation was hotly debated.

Maybe the rather rushed conditions under which these observations were made, plus the drama and excitement of the event itself, plus the inadequacy of the portable equipment used, all conspired to render the positions of the suspected objects less than accurate. For instance, Professor Peters argued that a small error in the reading of Watson's instruments would bring both his objects into line with two well-known stars.

On the other hand, Swift's object may not be so easily explained.

Like Watson, Swift also saw two objects, and apparently identified one of them with a known star (Theta Cancri). However, the second object corresponded to nothing on the charts. At the time of this observation, Swift knew nothing of Watson's sighting, and when he learned of this the following morning, he saw it as confirming his own results.

According to Swift, the two objects (star and unidentified) were of the same brightness and, from his description, were apparently aligned to the southwest. He described them as red in color.

The sighting by Watson may not actually have been confirmatory, if Peters' corrections (?) were, indeed, *correct*. But another sighting seems to have corfirmed Swift's results!

About the same time, the third independent observer, G. B. Airy, in his own words, "devoted myself to a search for an intra-Mercurial planet." As if to avoid the type of criticism leveled against Watson by Peters, he specifically noted that "In order to expedite the record of position, I placed disks of cardboard on the circles of the equatorial, and marked the pointings by means of a sharp pencil and a pointer. All danger of error from wrong circle-readings is in this way avoided."

The search appeared to pay off, with the discovery of an uncharted object a little further to the east of Theta Cancri, the same star that Swift determined lay close to *his* own mystery object. Like Swift, Airy described the color of his object as reddish but, unlike Swift, noted that it was "very much brighter" than Theta Cancri. He also added the very interesting comment that it "had a perceptible disk" under a magnification of 45 power.

Airy took such great care in determining the position of the object that there hardly seems room for error, especially as the perceptible "disk" would seem to preclude any possible confusion with a star. Although Airy thought it "highly probable" that this was indeed the elusive Vulcan, he did allow that it may actually have been a comet, as "when the tail of a comet and the small appendages of its head are invisible [against the bright sky], the nucleus is usually circular." This alternative possibility now seems the most likely explanation for the object seen by Airy and Swift.

Intriguingly, the position given by Airy is quite close to that of a member of the so-called Marsden Group of comets identified in images from the SOHO spacecraft launched in 1996. These tiny objects are closely associated with another SOHO comet group – the Kracht Group – and several meteor showers. The comet groups are named for Brian Marsden and Reiner Kracht, who first identified them.

The present writer appears to have been the first to note an apparent similarity between the orbits of the Marsden Group comets and those of the June Arietid meteor stream, which in turn is associated with the Southern Delta Aquarid meteor shower of July and also, possibly, the Quadrantid meteors of January. All of these have been linked together with the short-period comet 96P/Machholz (or Machholz I, as it is also known), which appears to be the parent body of the entire complex. Not surprisingly, the system has become known as the "Machholz Complex."

According to comet expert Maik Meyer, the position reported by Airy is not *quite* in agreement with a Marsden comet, but it is quite close and is consistent with an outlier of the group or an object within the broader complex. Unfortunately though, the meager records do not allow the motion of the object to be determined and without this, any further speculation as to a relation with the complex is no more than an intriguing possibility.

By the way, comets of the Marsden Group can make very close approaches to Earth, and some may even by capable of colliding with us. But don't worry. These are such small and fragile objects that they would almost certainly break up into very small fragments after entering the atmosphere.

Despite the trickle of observations of tiny round spots on the Sun and unidentified "stars" seen at solar eclipses, no proof of "an intra-Mercurial planet" managed to stand the test of time. Transiting black dots could never be satisfactorily distinguished from small round sunspots, and the bright objects allegedly seen near the Sun during the 1869 and 1878 eclipses failed to show up in more detailed searches made during subsequent events.

The strongest evidence, in the absence of definitive observations, remained the departure of Mercury's orbit from strictly Newtonian mechanics. At the beginning of the twentieth century, the only explanation appeared to be the existence of a significant mass between Mercury and the Sun, but whether this was in the form of a single planet (which appeared less and less likely as the years passed), a ring of asteroids, or even cosmic dust (possibilities which Leverrier himself raised at the very beginning of the Vulcan saga), was debatable.

Then, in 1916, Albert Einstein published his Theory of General Relativity – in effect, a new theory of gravity superseding that of Newton. When Mercury's orbit was computed using the new theory, it was found to fit perfectly with observational data. The problem of the planet's orbit had finally been solved, not by the discovery of a new planet but by the discovery of a new physics!

How did Einstein's new theory solve the problem?

To answer this, let's take a look at what the problem was really about. What, after all, was so wrong with Mercury's orbit to cause all this fuss about planets hugging the Sun?

Briefly stated, the point in the planet's orbit lying closest to the Sun (perihelion) slowly drifts. In a sense, Mercury does not come to quite the same point in space at each orbit, although the difference is so slight that it takes many orbits for this to become apparent.

As it stands, that is not necessarily a problem. Thanks to the gravitational perturbations of the other planets and even the slight deformation in the Sun's shape caused by its rotation, the perihelion of Mercury was predicted (on strict Newtonian theory) to shift slightly. In fact, the perihelia of *all* the planets show this effect, which is technically known as *precession*.

The problem was, Mercury's rate of precession was too large. Using Newton's Theory and taking all known perturbing influences into account, Mercury's rate of precession was predicted to be 5,557 s of arc per century. But the actual measured value turned out to be 5,600 s of arc per century. The discrepancy of 43 s of arc per century, though it might not seem very large, is still far too great to be brushed aside, and the most reasonable explanation prior to Einstein seemed to be the gravitational influence of some massive object or objects orbiting on the inside of Mercury's orbit.

Einstein's Theory of General Relativity, however, predicted the planet's precession rate exactly. The reason has to do with the way in which a massive body such as the Sun modifies the shape of the space-time continuum. To use a two-dimensional analogy, it is like taking a flat piece of paper, cutting out a narrow wedge from the center, and then rejoining the sheet to make it slightly cone-shaped. If an ellipse had been drawn on that sheet of paper, we would find that it no longer joins up correctly. If continued, it would not repeat until slightly after going all the way around the periphery. The "meet-up point," in effect, would have moved. Although impossible to picture, a 4D version of this (in three spatial dimensions, plus one temporal) is what Einstein's equations describe.

Being deep within the Sun's gravity well and having an unusually eccentric (strongly elliptical) orbit, this relativistic effect is quite pronounced for Mercury, whereas in the case of the other planets, it is too slight to have made their departure from Newtonian predictions obvious.

Finding a solution to the Mercury problem in terms of revised theory did more than eliminate the need for a large mass between that planet and the Sun. It effectively placed an upper limit on the amount of matter permitted to reside there. In other words, if the motion of Mercury as it orbits the Sun can be completely explained without recourse to the pull of unseen matter, the quantity of matter inside its orbit must be too small to have any significant influence on its motion.

That does not necessarily mean that *no* matter exists there. It just means that if anything does lurk there, its total mass must be much, much, less than that derived for the classical Vulcan.

But Is There Room for Mini Vulcans?

During the last half of the twentieth century, the Vulcan idea was revived in a greatly modified form, most notably by Henry C. Courten of Dowling College, Oakdale, New York. Courten had photographed several total solar eclipses since 1966, and some suspicious images had been noted. The most striking results came from the eclipse seen in Mexico on March 7, 1970, when at least ten faint unidentified images were recorded on Courten's photographs. Some of these may well have been artifacts on the photographic plate, but Courten felt that at least seven were real objects. He based this conclusion on the results of sensitive computer analysis, crosschecking images on separate plates. Moreover, some of the objects were apparently confirmed by another observer in North Carolina, and one image seemed to correspond to an observation made by a third person in Virginia.

With the launch of *Skylab* in 1973, Courten hoped to find confirmation of his suspicion that an asteroid, or even a belt of small asteroids, orbited the Sun at a distance of about one quarter the diameter of Mercury's orbit. As a grant investigator of *Skylab* white-light coronagraph data, he searched for telltale images, but without success.

Since *Skylab,* more sensitive coronagraphs have been launched into space, but no "vulcanoids" (as hypothetical small intra-Mercurial bodies have been named) have as yet been recorded. The SOHO spacecraft has been examining the Sun and near-Sun space since 1996, regularly recording stars near the corona as faint as those seen close to the limit of 7×50 binoculars on a dark night, but nothing orbiting between Mercury and the Sun has turned up. More recently, since early 2007, the twin STEREO spacecraft maintain an even finer scrutiny of the Sun and its immediate environs. Stars down to around 250 times fainter than the dimmest seen by naked eyes on dark nights are accessible to this project, but as yet no vulcanoids have turned up in the data.

What these extraterrestrial coronagraphs (most notably SOHO) *have* found, however, are myriads of tiny comets. As of mid-2008, SOHO had chalked up some 1,500 of them, sometimes several being visible in the same image. Many of these appear as simple points of light or small disks, and it is very possible that similar objects could have accounted, not just for Courten's images, but also for earlier "Vulcan" sightings. As already remarked, the object found by Airy and Swift seems particularly open to this explanation, as Airy himself admitted.

This is not to say that nothing apart from comets venture inside Mercury's orbit. The asteroid Icarus has long been known to fly closer to the Sun than this planet, and several other Sun-approaching asteroids have been found in more recent years. But none of these remains within the orbit of Mercury and as such cannot qualify as a genuine Vulcanoid.

So are there any Vulcanoids?

Such things probably do exist, but it is also likely that they are very small and comparatively few in number.

Mercury is a small planet with a weak gravitational field, and its cratered surface bespeaks of many impacts in ages past. Even today, while only a small number of asteroids continue to cross its path, large impacts must occasionally happen. Sizable chunks of rock presumably get hurled out into the surrounding space every now and then. Just as chunks of our Moon are known to orbit close to the Earth/Moon orbit, similar rocks probably trail Mercury around the Sun. Some of these may well orbit on the solar side of the planet. In addition, some asteroid fragments may have migrated into intra-Mercurial orbits from further out in the planetary system.

By definition, such would be Vulcanoids, even though they may only be a few yards in diameter and very, very, faint.

Maybe someday, they will be found.

Bright Lights in the Sunshine

Not every mystery object seen close to the Sun was assumed to be Vulcan. Over the years, some truly brilliant points of light have turned up very close to the Sun and shone so brightly as to be seen with the unaided eye in very bright twilight or even in broad daylight. Far too bright to be confused with an intra-Mercurial orb, these observations belong in a different category from the relatively faint and elusive bodies of the previous section.

Reports of bright star-like objects seen close to the Sun in daytime hours go back to before the time of Christ. Typically, these are no more than brief mentions of "a star was visible during the day" or something similar, and it is not always clear whether the object was a fleeting meteor, a sighting of the planet Venus by day, or something else.

For instance, what can be said about the "blazing starre seen near unto the Sonne" on Palm Sunday in the year 1077? Eighteenth century astronomer G. Pingre opined that this may have been Venus near inferior conjunction, while others suggested a comet very close to the Sun. A meteor is not likely in this instance, and the possibility of a bright nova is remote. Galactic supernovae are probably the least likely explanations for any of the day stars, as the extended duration of these titanic stellar explosions is too great to explain something seen so briefly.

In more recent times, we have the strange instance of a number of folk at Broughty Ferry in Scotland seeing a star-like object not far from the Sun on December 21, 1882. According to the witnesses, this "star' had "a milky appearance" with the naked eye, in the sense that it was not bright and clear like a star seen during the night. Through a "glass," the object was said to have been crescent shaped. Opinions soon divided as to whether this was our old friend Venus or a bright comet near the Sun. By the way, 1882 saw two comets visible in full daylight close to the Sun (one telescopically, the other naked eye) and a third visible almost within the corona during a total solar eclipse. The suggestion that the Broughty Ferry object was of a similar nature seems quite logical.

On the evening of June 26, 1915, Anna Caroline Brooks (daughter of famous astronomer William R. Brooks) noticed a very bright point of light about 5° above the spot on the western horizon where the Sun had set just 10 min earlier. She compared its brilliance with that of Venus (although it certainly was not that planet) and pointed it out to three of her companions, who also had no trouble seeing it. After about 2 min, a cloud covered the object, and it was not seen again. Both Anna and her father searched for it on the following evening, but to no avail.

Soon after his (negative) observation on the second night, William Brooks wrote a brief report in *Popular Astronomy* placing the observation on record "in view of future developments," but, alas, there appear to have been no such "future developments," and Anna and her three companions remain the object's only witnesses. Brooks himself suggested that the object was probably "the nucleus of a bright comet, the tail being invisible from the overpowering light of the sky."

Just 6 years after the Brooks' sighting, there occurred one of the best known of all "bright objects near the Sun" events. This one was especially interesting in so far as the principal observers included gentlemen who must be numbered among the more prominent astronomers of the day.

Late in the afternoon of August 7, 1921, a group of people including Professor H. Norris Russell, Major Chambers, Captain Rickenbacher, Lick Observatory Director Professor W. W. Campbell, and Mrs. Campbell were sitting on the porch of the Campbells' residence at Mt. Hamilton watching the setting Sun when, just as the Sun was about to sink out of sight, Major Chambers spied a bright star-like object a little to its left. Captain Rickenbacher then admitted that he had been watching the object for several minutes, but presumed that it was something known and had not bothered mentioning it. Professor Campbell then retrieved a pair of binoculars from inside the house and managed a quick glance of not more than 2 s before the "star" set behind a layer of horizon cloud. As well as Campbell could determine, the object appeared equally star-like through the binoculars. The object clearly shared the diurnal movement of the sky and must therefore have been a true astronomical body rather than something in Earth's atmosphere catching the waning sunlight.

Although the Lick observers made careful searches on following nights, the mystery object was not relocated. To place the incident on record and, hopefully, elucidate sightings from elsewhere, the observation was distributed telegraphically on August 8 and printed in a *Harvard Observatory Bulletin* (at that time, the official announcement circular for astronomical discoveries) on the ninth.

Not unsurprisingly, these announcements did indeed uncover several sightings of bright objects deep in twilight or in daylight during early August. Equally unsurprisingly, nearly all of them could be explained as Jupiter or Venus. A report from Germany, for instance, if actually referring to the same object, suggested a motion of 27° in just 8 h, placing it as close as twice the distance of the Moon! On closer examination, however, the position of the German object came in very close to that of Jupiter, and there can be little doubt that it was, indeed, the planet that was seen.

Two observations from England looked more promising. Also around sunset on August 7, but 7 h earlier because of the difference in longitude, a bright object was noticed by Lieutenant F. C. Nelson Day and several other people at Ferndown in Dorset. Around the same time, a Mr. S. Fellows also noticed it from Wolverhampton and noted that through binoculars it appeared reddish in color and elongated in the direction of the Sun. Fellows estimated its distance from the Sun as 6° while the Lieutenant gave it as 4°. Despite this discrepancy, both observers made it somewhat further away than the Lick group, who measured it as distant "three degrees east, one degree south" of the Sun. Also, whereas this group estimated its brightness as "brighter than Venus," Nelson Day's estimate was closer to the brightness of Jupiter, although too much weight shouldn't be placed on this.

In the initial announcement from Lick Observatory, the object was suggested to have been the "nucleus of a bright comet, less probably a nova." According to J. A. Pearce, writing in the *Journal of the Royal Astronomical Society of Canada*, the distance from the galactic plane "would almost certainly rule out" a nova. We might also add that the coincidence of having one of the brightest nova on record (apart from galactic supernovae, which it certainly was not) appearing almost directly behind the Sun is highly improbable, to say the least. Moreover, no star in the vicinity shows a light echo or gives any evidence of having recently been an unusually close nova.

On the other hand, a comet is very probable, as it is for the similar but less well observed object of 1915. Comets brighten as they approach the Sun, and one reaching a very high brilliance in its immediate vicinity is not at all unusual. Moreover, the hint of movement between the English and Lick observations are consistent with a comet moving toward the Sun and the object's apparent elongation as reported by Fellows might hint at dust being swept back from the nucleus and into the tail (the latter being invisible against the bright sky). On the other hand, the departure from a star-like appearance may have indicated nothing more than imperfect optics in Fellows' binoculars!

Why were the purported bright comets of 1915 and 1921 not seen in the night skies?

Picture a relatively small comet approaching the Sun from the region of the Solar System opposite Earth. From our perspective, it would stay close to the Sun in the sky (i.e., deep in twilight) and beyond it. If the comet was not especially bright intrinsically, it would be difficult to find against the bright sky.

Suppose, further, that the comet moved in an orbit that brought it very close to the Sun (well within the orbit of Mercury?) and that, at its closest approach, it actually whipped around more or less in front of the Sun – though not *directly* in front – as seen from Earth.

Now, we know that comets normally brighten greatly as they approach close to the Sun, but another very interesting effect may have come into play as well. Have you ever noticed pieces of thistle-down and lengths of spider web (and spiderlings themselves for that matter) brightly illuminated as they pass in front of the Sun on a clear and windy day? Within a few degrees of the Sun, they shine bright and silvery, but fade to invisibility as they move just a short distance away.

This is an example of a phenomenon known as forward scattering of sunlight, and it applies as much to the dust particles surrounding a comet's nucleus as to thistle-down and spider webs blowing about in our atmosphere. In fact, if a dusty comet passes very close to the Earth/Sun line of sight, it is possible for its brightness, as seen from Earth, to increase by a factor of several thousand. But only while the Earth/comet/Sun angle is large. Although the effect peaks near 180°, it already becomes detectible at angles of about 110°.

Now, back to the objects of 1915 and 1921.

Assume that these objects were, indeed, comets, and further assume that each spent only a short time on the earthward side of the Sun. This geometry would have occurred about the time the comet was passing closest to the Sun itself, and the combined effect of this proximity and forward scattering may well have caused its apparent brightness to surge by at least several hundred fold, albeit for only a short period of time (the actual length of time depending to a major degree on how close the comet actually approached the Sun). From obscurity, it suddenly blazed out in full brilliance, only to whip back behind the Sun again and out of forward-scattering geometry. With brightness falling as fast as it surged and the comet pulling away behind the Sun, it rapidly faded to obscurity in the twilight.

This may be the most likely explanation for the 1915 and 1921 objects, and maybe for that of 1882 as well. But it was clearly not the explanation for a bright object seen during the total solar eclipse of June 30, 1973, which we will take a look at now.

From an observing site in Kenya, several photographs taken by more than one camera recorded what appeared to be a bright star-like object close to the eclipsed Sun. It was estimated to have been almost as bright as Jupiter and apparently remained stationary through the time taken to secure the photographs.

From that information alone, it may appear justifiable to conclude that this was yet another instance of the type of object seen in 1915, 1921, and possibly 1882, presumably either the nuclear region of a comet near the Sun or a very bright nova. Because it appeared close to the Sun and because no fading nova was recognized when that region of sky later became visible before dawn, a comet would once again seem the most likely culprit. This seems a logical conclusion – except for one small problem. Photographs taken from other sites during the same eclipse failed to show any sign of the mystery object!

Its appearance on multiple photographs taken with more than one camera presumably established it as a real object and not simply a ghost image or such like. But if it was only visible from a single site, it can hardly have been at astronomical distances.

What, then, could it have been?

Really, we don't know. Someone suggested that it may have been a weather balloon high in the atmosphere. This suggestion, or some close variant of it, is probably about the best that we can do. Some reflective object floating in the air and catching the light of the Sun's corona may indeed explain this mystery object.

On that somewhat unsatisfactory note, we leave the realm of mystery objects near the Sun and direct our gaze in the direction of our neighboring planets – into the realms of Mars and Venus and the odd and interesting things that have been reported there over the years.

Springer

http://www.springer.com/978-1-4419-6423-6

Weird Astronomy
Tales of Unusual, Bizarre, and Other Hard to Explain Observations
Seargent, D.A.J.
2011, XIII, 304 p. 46 illus., 18 illus. in color., Softcover
ISBN: 978-1-4419-6423-6