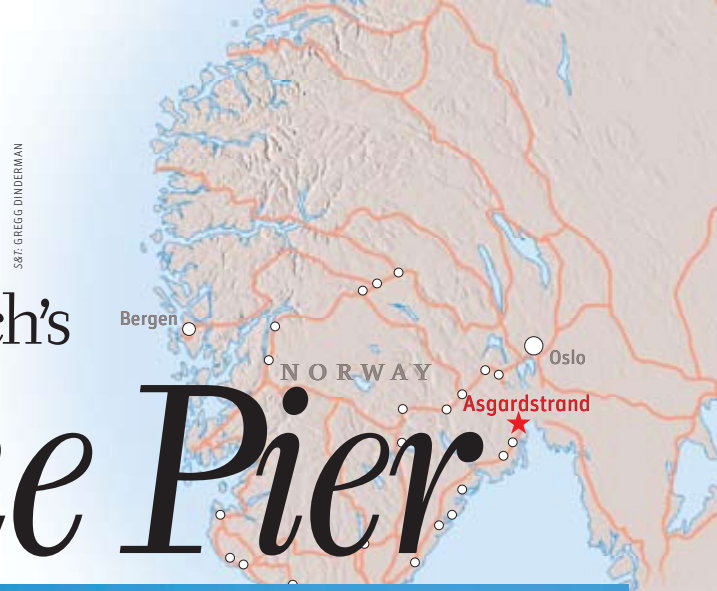
Is the yellow orb situated above the leftmost building the Sun or the Moon? And why doesn't it reflect in the still Norwegian fjord?



S&T: GREGG DINDERMAN

Reflections on Edvard Munch's *Girls on the Pier*

By Donald W. Olson, Beatrice Robertson, and Russell L. Doescher

DONALD W. OLSON

Facing page: Art historians consider this version of Edvard Munch's *Girls on the Pier* to be the earliest in a series of similar paintings, lithographs, woodcuts, and etchings. *Above:* The Åsgårdstrand, Norway, scene of the painting is easy to recognize in this May 2003 photograph looking toward the southwest from the modern stone pier.

Norwegian artist Edvard Munch (1863–1944) is best known today for *The Scream,* with its tormented figure under a blood-red sky, now identified as the depiction of a volcanic twilight caused by the eruption of the volcano Krakatoa (*S&T:* February 2004, page 28). But during his lifetime, Munch's most admired painting was a harmonious and tranquil landscape created in Åsgårdstrand, a summer resort village on the west shore of the Oslofjord. Jens Thiis, former director of the National Gallery in Oslo, wrote in 1933, "Munch's greatest and most famous masterwork is *Girls on the Pier."* Munch eventually created more than 20 versions of this scene in a series of paintings, lithographs, woodcuts, and etchings. *Girls on the Pier* has retained its popularity to the present day. The image appears on the covers of local guidebooks and on the Internet home page of the project compiling a complete catalog of Munch's paintings (www.munch-raisonne.com).

This painting holds a special intrigue for astronomers because of the yellow disk in the sky. Is this a rising or setting Sun, a rising or setting Moon, or perhaps a "midnight Sun"? We can rule out the last possibility because Åsgårdstrand lies south of the Arctic Circle and the midnight Sun doesn't occur there. However, the sky never gets dark during the so-called "light nights" near the summer solstice, when the Sun never dips far below the horizon.

Day or Night? Sun or Moon?

Thiis identified the painting's yellow disk as the Moon. In the catalog for the *Exhibition of Contemporary Scandinavian Art* (1912), he wrote: "Munch is first and foremost the portrayer of the northern summer night. No one has rendered as he the mystic suggestion of those light nights, with mighty tree tops swaying above slumbering white houses and the pale, blurred outlines of the surrounding country." Thiis's 1933 biography of the artist described *Girls on the Pier* as conveying "the essence of a summer night's twilight illumination. . . . The buildings disappear away in a dream under a small and pale moon." Modern art historian Ulrich Bischoff, in *Edvard Munch* (1993), agrees with Thiis that the "moon is visible beyond the mighty tree."

As part of a Munch retrospective, this canvas will be on display at New York's Museum of Modern Art through May 8, 2006, on loan from the National Gallery, Oslo, Norway.

The astronomical identification is less clear in an important modern exhibition catalog, *Symbols and Images,* at the National Gallery of Art in Washington, DC (1978), where one essay asserts that "the small, pale yellow moon tells us: it is a fair, Nordic summer night," while another commentary on the same canvas offers the contradictory statement that "we

see, indeed, the sun shining over the houses to the left." Also, a study in 1993 by Clément Chéroux argues that the painting must show a late afternoon scene, "as indicated by the placement of the Sun above the village."

On the other hand, some art historians have carefully avoided the debate. For example, Thomas Messer offers a composite theory, referring to the disk as the "yellow sun-moon" in his book *Edvard Munch* (1973), while *Edvard Munch: Theme and Variation,* the catalog for a major 2003 Munch exhibition at the Albertina Museum in Vienna, Austria, declines to favor either the solar or lunar theory, noting only, "The question of whether these works show the sun or the moon — a long northern summer day or a nocturnal scene — has been a recurring focus of discussion with respect to all of the different interpretations in the picture."

So which is it? What are the azimuth and altitude of the yellow disk, as seen from Munch's position on the pier? During the summer, does the Sun or the Moon appear in that part of the sky? We went to Norway to find out.

Making Our Way to Norway

Our photographs of the location of Munch's painting in Åsgårdstrand harbor were taken in May 2003 and show that the white fence, trees, and the houses are still easy to recognize. We determined that the pier extends into the water 27° north of east. So, for an observer like Munch looking toward the shore, the pier is aligned 27° south of west. But there's a complication — Frank Høifødt and Lasse Jacobsen of the Munch Museum warned us that the modern stone pier in Åsgårdstrand is in a slightly different location from the old wooden pier in the painting!

Fortunately, we found several old postcards and photographs showing the harbor in Munch's day. By measuring the "parallax shift" of the nearest corner of the white fence, relative to the buildings in the background, we calculated that the old pier must have been 18 feet (5.5 meters) north of the modern pier. We found confirmation of this at a local history Web site (http://borreminne.hive.no) that describes the old pier: "the site of Munch's most beloved work, *Girls on the Pier*. . . . The old landing pier lay on the north side of the new stone pier and went parallel with it." Our calculations also corrected for some changes to the roof of the house at the far left of the painting.

We finally determined that the artist painted the yellow disk low in the southwestern sky, near 63° south of west (azimuth 207°) and with an altitude of approximately 7° to 9°.

HORTEN AND BORRE LOCAL HISTORY ARCHIVE

This early postcard shows Åsgårdstrand harbor at about the time that the old wooden landing pier, the setting for Munch's famous painting, was being replaced by the modern stone pier. The painting is usually dated to 1899 or 1901, and this photograph was taken probably between 1904 and 1909.

Astronomical Evidence

Celestial objects in this part of the sky must have a declination of about –18° to –20° as seen from Åsgårdstrand, at a latitude of 59° 21′ north.

Therefore, the yellow disk cannot be the Sun, which reaches its most northern declination (+23° 26′) at the summer solstice in June and, therefore, remains north of the celestial equator during the entire summer season. The Sun reaches southern declinations matching the painting only during the third week of November and the last week of January, which are dates totally inconsistent with the depiction of a resort in the summer season.

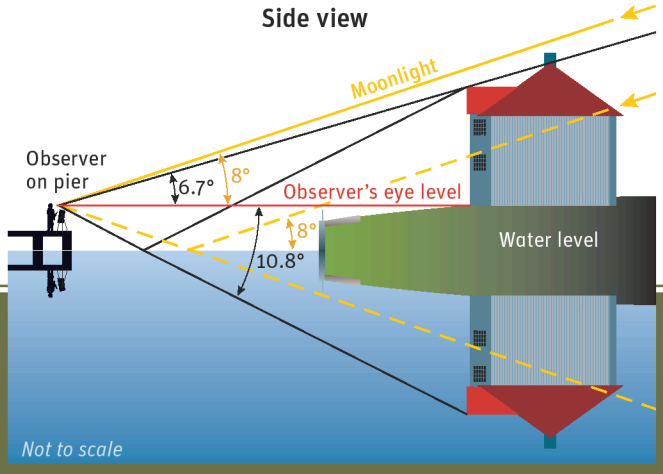
The full (or nearly full) Moon behaves more fittingly, reaching its most extreme southern declinations near the summer solstice. Such full Moons rise in the southeast, run low over the southern horizon, and then sink toward the southwestern horizon — exactly the position of the yellow disk in *Girls on the Pier.*

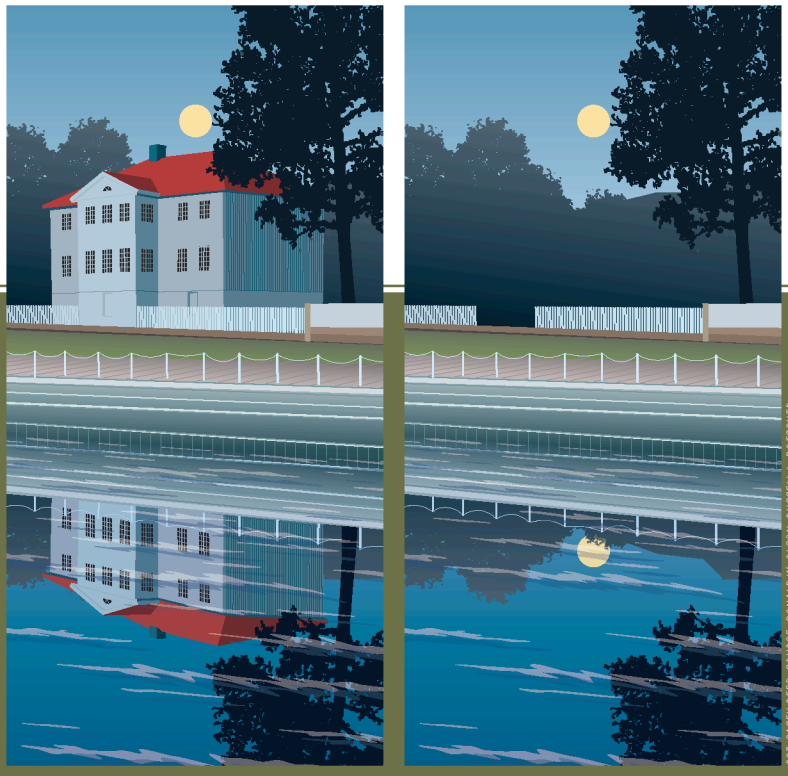
The "Missing Moon"

In the quiet hours of the Norwegian "light night" Munch saw the trees and houses mirrored in the calm surface of the fjord. But why doesn't the painting show the Moon's reflection in the water?

Many commentators have addressed this point with symbolic or psychoanalytical interpretations. For example, David Loshak notes in *Munch* (1990) that "the moon has disappeared altogether" from the reflection and theorizes, "Discrepancies between the background and its reflection may point to the inaccuracy of memory." Likewise, Messer observes that the yellow disk "is subtracted from the mirror image" and wonders whether the artist chose to "eliminate a possible flaw in a carefully balanced emotional equation."

Instead, we realized that a physical reason based on simple optics easily explains the "missing Moon" in the reflection. A key point is that Munch's eye was about 11 feet above the surface of the water. In the landscape, the bottom of the nearest corner of the white fence is also 11 feet above the water, so Munch's "geometric horizon" ran along the bottom of the white fence.





S&T: CASEY REED, SOURCE: DONALD W. OLSON, RUSSELL L. DOESCHER

A long-standing mystery about *Girls on the Pier* is the absence of the yellow disk (the Moon) from the watery reflection. In this diagram the red line marks the ideal geometric horizon at the eye level of an observer on the pier. Because the Moon is effectively at infinite distance, the depression angle of the Moon's reflection in the water must equal the altitude of the Moon above the observer's horizon. Compared to the elevation angle of the actual nearby house, the observer sees the reflection of the house at a greater depression angle and is prevented from seeing the Moon's reflection in the water.

Our explanation relies on a well-known property of reflection (see the diagram above). The house just below the Moon was about 300 feet from Munch, and the top of its roof was about 46 feet above the water level; so from his position, trigonometry tells us that the artist would see the roofline at an elevation angle of 6.7° above his horizon. The reflected image of the roofline was 46 feet *below* the water's surface, but at his position 11 feet above the water, Munch would see the reflected roofline 57 feet below his horizon, and consequently at a much larger depression angle of 10.8°. The Moon, on the other hand, is effectively at an infinite distance. Therefore, if the actual Moon is visible in the sky at an altitude of roughly 8°, then the reflected Moon would have an equal depression angle of 8° below his horizon — a direction blocked by the reflected house.

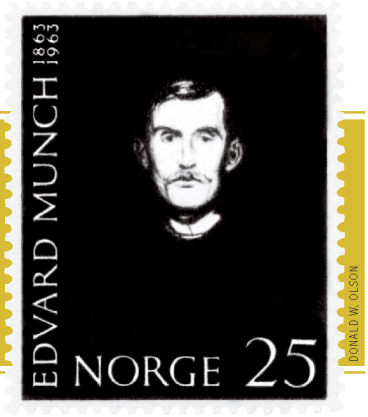
According to the principles of mirror optics, the reflected landscape appears as if viewed from a different vantage point or as though the observer's eyes were below the surface of the water. Marcel Minnaert, a pioneering authority on optics in nature, has described these phenomena in a section called "Differences between an Object and its Reflected Image" in his classic book *The Nature of Light & Colour in the Open Air*. This concept also helps explain why the actual roof and the reflected roof of the house under the Moon look different in Munch's painting.

Summer Night

After we had completed our analysis of *Girls on the Pier,* we were conducting a search of Munch's correspondence (much of which is unpublished) when Margaret Vaverek, a librarian at Texas State University, helped us locate two especially interesting letters. On March 8, 1902, Munch states that the "picture from Åsgårdstrand with the three young girls" had been promised to Olaf Schou, the collector who eventually donated the canvas to the National Gallery in Oslo. Ten days later Munch identifies this same painting as "Schou's Summer Night," confirming in the artist's own words that this is a night scene.

It's clear that Munch was accurate, not only regarding the position in the sky of a summer full Moon, but also in his observation and depiction of the "missing Moon" in the reflection. Just as Thiis did almost a century ago, we can admire the artist's skill as a "portrayer of the northern summer night." ✶

Don Olson *and* Russell Doescher *teach in the Physics Department at Texas State University, where* Beatrice Robertson *recently received her bachelor's degree in physics.* *The authors are grateful for research assistance from the American-Scandinavian Foundation.*



Edvard Munch (1863–1944) was honored with a series of stamps issued by Norway on the centennial of his birth. The design for this denomination is based on one of the artist's self-portraits, a lithograph, originally created in 1895.