Astronomy & the

Sun and shadow have finally pinpointed a moment of history and ruled out the widely accepted scenario for an iconic photograph.

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VJ Day — Victory over Japan Day, August 14, 1945 — marked the end of World War II. As rumors of Japan's surrender spread, Americans poured into the streets. Amid the celebration in New York's Times Square, Alfred Eisenstaedt captured one of the iconic images of the 20th century when he shot four photographs in quick succession of a sailor kissing a woman in white. Victor Jorgensen, standing just a few feet away, photographed the same kissing pair at the moment of Eisenstaedt's second frame.

We have recently used astronomy to determine new information about these famous photographs.

The questions of identity — who is the sailor? who is the woman in white? — have been a source of much controversy over the decades, in part because their faces are largely hidden. Glenn McDuffie, George Mendonsa, and Carl Muscarello are among the dozens of men who have claimed to be the sailor. Candidates for the woman in the white dress include Edith Shain, Barbara Sokol, and Greta Friedman (Greta Zimmer in 1945).

We have used the position of the Sun to solve a related mystery — at what time were the Kiss photographs taken? — and thus to rule out some of the candidates for the real sailor and woman in white.

Kiss After 7:03 p.m.?

After rumors and false alarms throughout the day, radio networks carried a brief statement from the White House at 7:00 p.m., and by 7:03 p.m. the moving electric sign on the Times Building displayed the long-awaited words: "OFFICIAL *** TRUMAN ANNOUNCES JAPANESE SURRENDER ***." The current Wikipedia page assumes that the Kiss followed shortly thereafter: "Eisenstaedt was photographing a spontaneous event that occurred in Times Square as the announcement of the end of the war on Japan was made by U.S. President Harry S. Truman at seven o'clock."

Sixty-five years later in 2010, a front-page *New York Times* story on the VJ Day anniversary expressed the same opinion: "For decades, the world has believed that the photographs were taken after — perhaps just seconds after — President Truman's announcement at 7:03 p.m."

Kiss Near 6 p.m.?

However, that same anniversary story went on to propose a scenario with an earlier time. The reporter interviewed Gloria Bullard, who identified herself as a figure in the background of the Jorgensen photograph. She gave an account of witnessing the famous Kiss and contradicted the conventional wisdom by implying that the event occurred not after 7:03 p.m. but instead "earlier — before the war was officially over."

Bullard, after leaving Times Square on VJ Day, spent a few minutes walking to 8th Avenue. She estimated that it then took two more hours to reach her home town of New Canaan, Connecticut, by bus and train. She noticed that dusk was settling and the streetlights were just coming on as she walked the final blocks near her home.

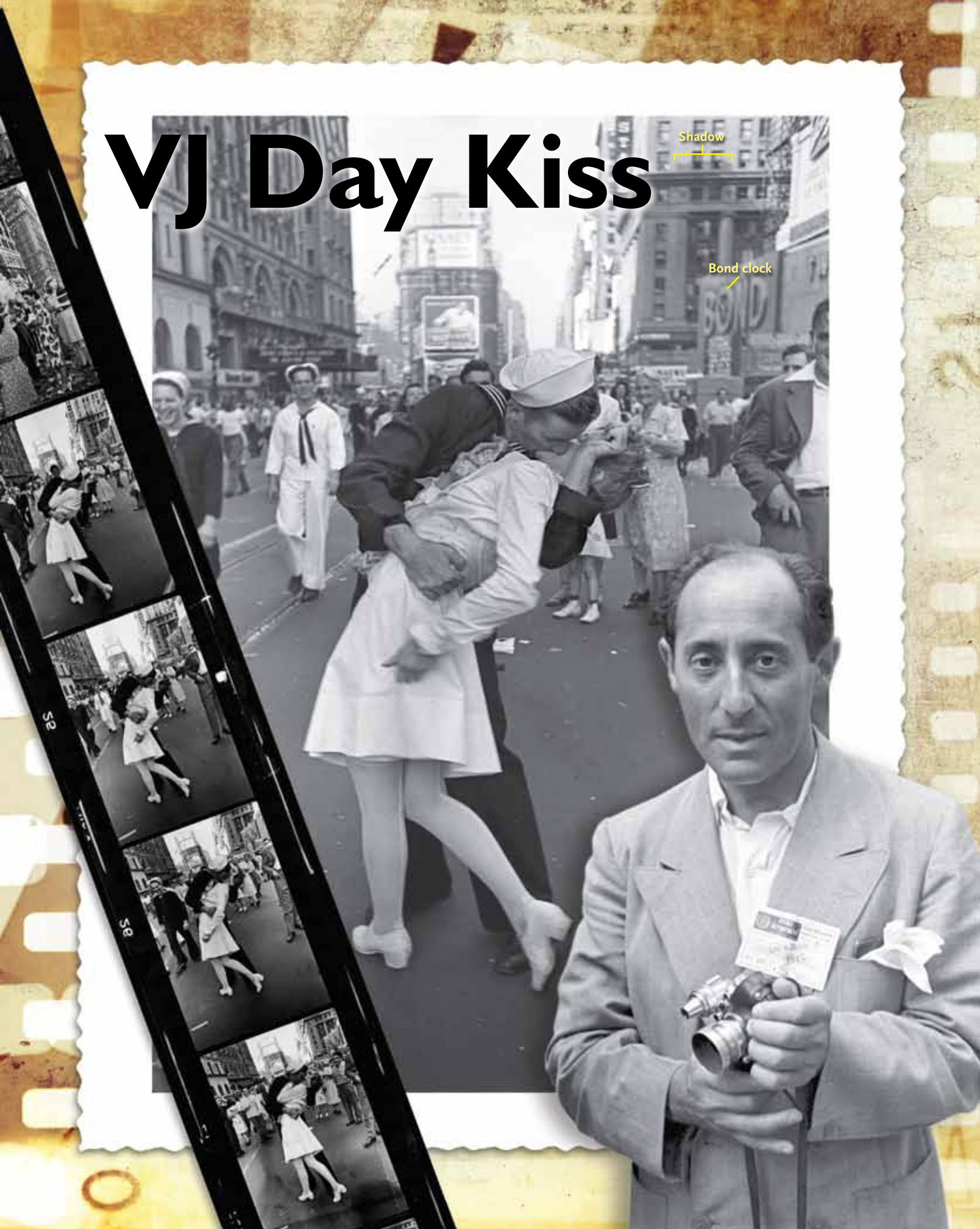
Here astronomy first enters. For New Canaan, we calculate that sunset fell at 7:54 p.m. that day and the end of civil twilight followed at 8:24 p.m., expressed in Eastern War Time, equivalent to modern daylight saving time. We can be certain that this is the correct time system in use because the *New York Times* that day listed Manhattan sunset at 7:56 p.m.

THE KISS Any collection of the 20th century's iconic images is likely to include this *Life* magazine photo taken by Alfred Eisenstaedt in New York's Times Square on the day World War II ended. The shadow on the Loew's Building (labeled) allows us to determine that he clicked the shutter at 5:51 p.m. An archived contact sheet from Eisenstaedt's roll of film shows the four Kiss shots to be negatives #24–27. The numbers are another smoking gun; the roll's earlier #10 and #11 are Eisenstaedt's Peace At Last images, which shadows reveal to have been taken around 5 p.m. — long after the 2 p.m. claim for the Kiss.

THE PHOTOGRAPHER This on-the-spot snapshot of Alfred Eisenstaedt was taken by William Shrout, another *Life* photographer assigned to cover the VJ Day celebration in Times Square.

ALFRED EISENSTAEDT / WILLIAM SHROUT / *LIFE* © TIME INC.). S&T PHOTOILLUSTRATION: PATRICIA GILLIS-COPPOLA

VJ Day Kiss



U. S. NAVY PHOTOGRAPH / NATIONAL ARCHIVES

2 P.M. RULED OUT Victor Jorgensen took this photo at almost exactly the instant of the second of Eisenstaedt's four images. He was standing just to Eisenstaedt's right. They cannot have been taken near 2 p.m. because Jorgensen reached Manhattan on a train that arrived at 3:00 p.m. Gloria Bullard has identified herself as the nurse in the far background, under the "W" of "Walgreen Drugs" at the extreme left edge.

We checked 1945 rail timetables and found that relatively few trains ran on the New Canaan branch. The train best matching Bullard's description reached her hometown station at 8:12 p.m. Bright twilight prevailed then, with the Sun 4° below the horizon, and the twilight would have been deepening as she walked home.

Subtracting somewhat more than two hours from Gloria's arrival time in New Canaan suggests that the Kiss in Times Square would have occurred about 6 p.m.

Kiss Near 2 p.m.?

In their recent book *The Kissing Sailor* (Naval Institute Press, 2012), Lawrence Verria and George Galdorisi propose that the Kiss photographs were taken much earlier in the day, around 2 p.m. The authors also offer detailed arguments supporting George Mendonsa and Greta Zimmer as the kissing pair.

According to the book, George Mendonsa attended a 1:05 p.m. movie at Radio City Music Hall. After only a few scenes had played, theater employees interrupted the show with the dramatic announcement of the war's impending end. Mendonsa left the theater and made a brief stop for some drinks. The authors deduce that he reached Times Square and kissed a woman in white about 2 p.m.

Greta Zimmer in 1945 worked as a dental assistant in a white uniform resembling a nurse's. According to her account of VJ Day, the dentists returned from their lunch at about 1 p.m. She then took a late lunch hour and began walking from the dental office on Lexington Avenue to Times Square, to see if she could confirm the rumors she had heard from the morning's patients. She was reading the messages on the animated electric signs when a sailor grabbed and kissed her without warning. Greta returned to the dental office and reported the news from Times Square. The doctors then told her to cancel the rest of the afternoon's appointments and close the office.

These details are entirely inconsistent with both the 6 p.m. and 7:03 p.m. times theorized for the Kiss. The accounts of George Mendonsa and Greta Zimmer appear to mesh consistently only with a time near 2 p.m.

The Kissing Sailor received much favorable media attention that treated the book's scenario as a definitive answer at last. David Hartman, longtime host of ABC's *Good Morning America,* wrote the book's foreword and stated that its authors had "finally revealed, with certainty, what millions have wanted to know for decades." Photographer David Hume Kennerly wrote a jacket endorsement and called the book a "whodunit that provides once and for all the identification of the world's best-known smoochers." NBC journalist Tom Brokaw also wrote jacket copy for what he described as a "wonderful detective story." *Publishers Weekly* judged that the "authors deliver a convincing conclusion."

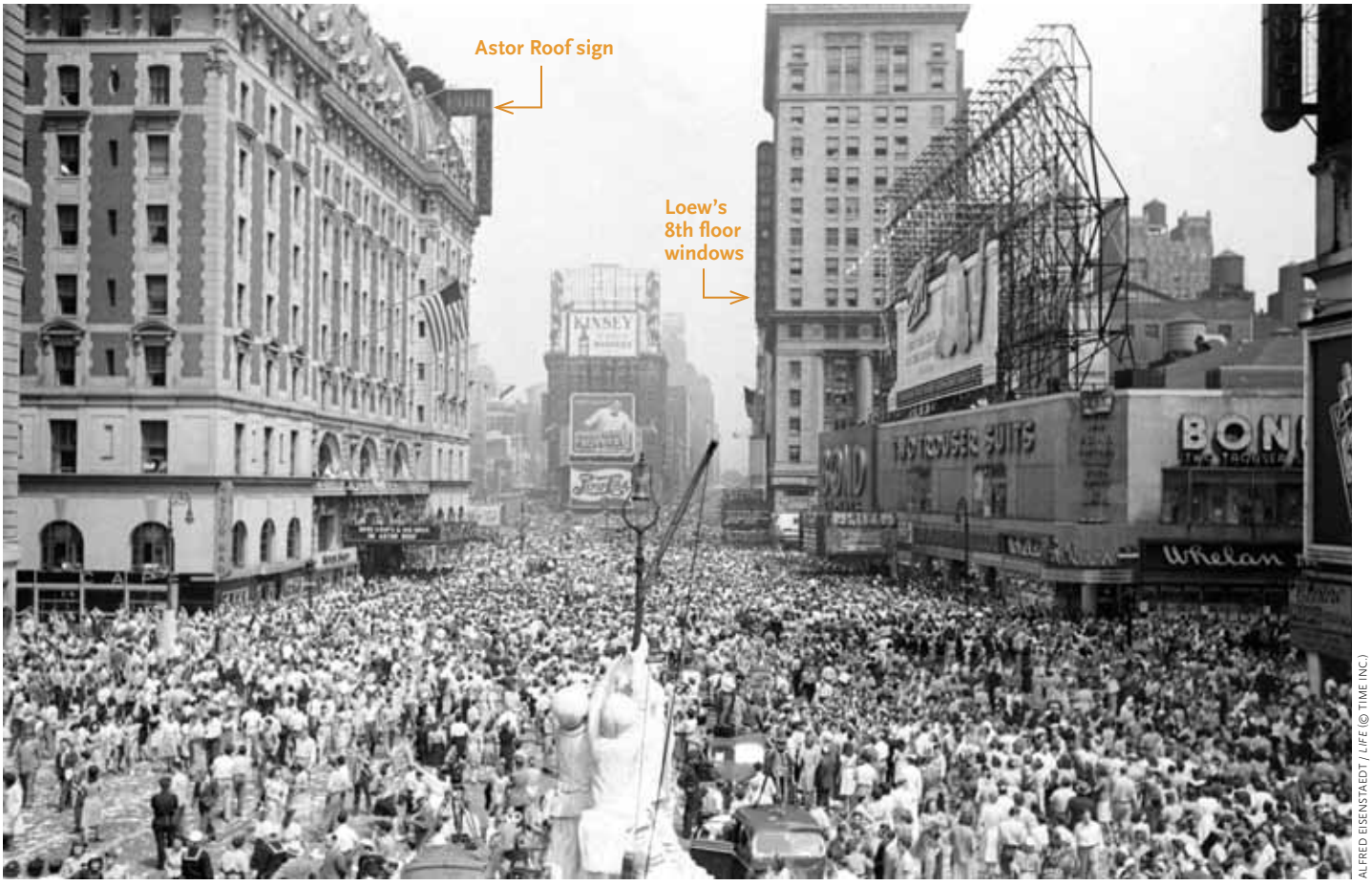
So, which is it? Did Eisenstaedt take his Kiss photographs near 2 p.m., near 6 p.m., shortly after 7:03 p.m., or at some other time?

The Bond Clock

The *New York Times* online version of the story about Gloria Bullard drew 144 comments, with much debate

COLLECTION OF DONALD OLSON

THE BOND CLOCK By coincidence, this amateur VJ Day photo of the Bond Clothes clock shows the exact time of Manhattan sunset, 7:56 p.m. Unlike the prominent minute hand, the short hour hand of the Bond clock is hard to make out in the oblique views of Eisenstaedt's Kiss series.



ALFRED EISENSTAEDT / *LIFE* (© TIME INC.)

about the time of day depicted in the Kiss photographs. One of us (SDK) was apparently the first to notice that the Eisenstaedt photographs include, in the background, a large clock on the Broadway façade of the Bond Clothes store. He suggested that the time it displays might be either 5:50 or 6:50, with the uncertainty due to the oblique angle of view from Eisenstaedt's location.

A later commentator was more certain that the clock showed 5:50 p.m., while another opted for 4:50 p.m. on the clock face. The Bond Clothes clock had a prominent minute hand but an unusually short hour hand, adding to the difficulty of reading the time from the photo.

Half a dozen online comments to that same article made the intriguing point that a prominent shadow appears on a building in the background. Analysis of the Sun's position might thus determine the time of the photograph.

We pursued this suggestion and have obtained a precise result.

Buildings as Sundials

Every tall building in Manhattan acts like the gnomon of a sundial. But how to read its face? Our Texas State University group has experience using the astronomy of sunlight and shadows. For Ansel Adams' photograph "Moon and Half Dome," the shadow of a ledge helped to fix the precise date and time of this iconic Yosemite image (*S&T:* December 1994, p. 82). Mountain shadows played a similar role in our dating of Ansel Adams' "Autumn Moon" (*S&T:* October 2005, p. 40).

GNOMON AND SUNDIAL Earlier on VJ Day, Eisenstaedt shot this northward view. The Hotel Astor with the Astor Roof sign appears at left. Just left of the sign are bushes lining the Roof Garden. The 16-story Loew's Building is on the right. Intruding diagonally across the Times Square crowd from right toward center is the shadow of the Hotel Claridge, matching the Sun's position at 12:30 p.m.

We studied hundreds of photographs from the 1940s to become familiar with all buildings in and near Times Square in 1945. We also collected vintage maps from the Sanborn Map Company and the G. W. Bromley & Co. Manhattan Land Book series, and photographs taken by the Hamilton Aerial Map Service.

From this topographic evidence we could see that the prominent shadow in Eisenstaedt's photos was on the 45th Street side of the Loew's Building, home to the theater known as Loew's State. The top of the shadow runs horizontally along the center of the windows on the 8th floor. From the known dimensions of the 16-story Loew's Building, we determined that the shadow stands 94 feet above street level.

Now we needed to identify the building casting the shadow. We first considered the Hotel Astor, across the street to the west. The shadow on the Loew's Building has a flat top only about 16 feet wide, so our thought was to search old photographs and blueprints to find a flat-topped water tower on the Astor roof. This theory immediately foundered because we learned that the summit of the Astor Hotel held no standard water tanks at all! Instead, the top was known as the Astor Roof Garden, an elegant site for music, dining, and dancing.

But we were able to rule out other buildings one by one: the Paramount Building, the Hotel Lincoln on 8th Avenue, the Times Building. A Schlitz Beer sign on the roof of the Bond Clothes building was too short to cast a shadow of the length in the Kiss photographs. Nothing fit.

Astor Roof Sign: 5:51 p.m.

The breakthrough came when we looked at vintage photographs of the Hotel Astor with its elegant roof garden. The hotel had a sign in the shape of an inverted "L" projecting a little above roof level, advertising the Astor Roof. Blueprints preserved at Columbia University show that the vertical arm of the sign was 40 feet high, its horizontal top was 18 feet wide, and the top edge stood 150 feet above street level.

Measurements on old photographs and maps established that the top of the sign and the top of the shadow on the Loew's Building had a horizontal separation of 134 feet and a difference of 56 feet in height above street level. A line from the shadow on the 8th-floor windows of the Loew's Building to the Astor Roof sign would point to the upper limb of the Sun being at azimuth 270° (exactly due west) and at an altitude of +22.7°. As seen from the Loew's Building 8th floor, the solar disk was disappearing behind the Astor Roof sign at 5:51 p.m. Eastern War Time.

Because the Sun's disk has a finite size, with a diameter of 31.6′ on August 14th, the 18-foot-wide top of the sign would project an umbral shadow about 16 feet wide at the distance of the Loew's Building, also in good agreement with the shadow in Eisenstaedt's photographs.

Our topographical analysis ruled out every other tall structure in or near Times Square. Only the Astor Roof sign could cast the photographed shadow, and it did so at exactly 5:51 p.m.

We then checked our mathematical results by building a scale model of the buildings, including the L-shaped sign. A large, flat mirror allowed us to project the Sun's rays onto the model from any desired altitude and azimuth. The location, size, and shape of the shadow on our model Loew's Building exactly matches the shadow in Eisenstaedt's Kiss photographs.

Confirmation: Pennsylvania Railroad

Victor Jorgensen took his Kiss photograph at the same time as Eisenstaedt's second of four frames. Two days later, Jorgensen's wife wrote a letter describing how on VJ Day they had traveled up to Manhattan on a train departing Washington, D.C., at 11:00 a.m. Railroad timetables show this train arriving at New York's Penn Station at exactly 3:00 p.m. Allowing some time for checking into a hotel, where Jorgensen dropped off some photographic gear, and then proceeding to Times Square, Jorgensen cannot have reached Times Square until at least 3:30 p.m. and perhaps even after 4:00 p.m.

Thus Jorgensen's train trip provides additional evidence to rule out the proposed 2 p.m. time for the Kiss photographs, but it's consistent with our calculated time of 5:51 p.m.

Confirmation: "Peace At Last"

Two more Eisenstaedt VJ Day photographs, known as Peace at Last, show a couple looking up at the Times electric news sign. In the background, the shadow of the Times Building falls onto the last word in a sign reading "PUBLIC TELEPHONE CENTER for the ARMED FORCES." Vintage photographs and maps show that this

ALFRED EISENSTAEDT / *LIFE* © TIME INC.)

ON THE SAME ROLL This Eisenstaedt VJ Day photograph, known as Peace at Last, shows a couple looking up at the moving electric news scroll on the Times Building. In the background, the shadow of the Times Building on the façade of the Public Telephone Center for the Armed Forces (the shadow's edge crosses the R in "Forces") allows us to determine that this image was captured near 5 p.m. Eisenstaedt's roll of Kodak Plus-X film includes Peace at Last, then a dozen other scenes, and then the famous Kiss series.

shadow corresponds to a solar azimuth of 261° (9° south of due west) and a time of 5:00 p.m.

The connection? In the archives of *Life* magazine, a contact sheet for a roll of Kodak Plus-X film includes Peace at Last (negatives #10 and #11 at 5:00 p.m.), followed by a dozen other photographs (#12–23) of revelers on the west side of the Times Building and near the New York movie theater, and then the famous Kiss series (#24–27, shown on page 31). This sequence is consistent with our result that Eisenstaedt and Jorgensen took their Kiss photographs at 5:51 p.m.

On another roll of film, Eisenstaedt's last VJ Day photographs look down from high positions onto the denser crowd packing Times Square after the 7:03 p.m. official announcement of the war's end. Several of these images include the large Toffenetti Restaurant clock showing times between 7:40 and 7:47 p.m. Eisenstaedt later recalled that he turned in his film to the *Life* office at about 8 p.m.

Who Is the Sailor? Who Is the Woman in White?

The widely accepted scenario placing the Kiss photographs near 2 in the afternoon doesn't stand up. We also point out that the identities of the kissing pair became a public controversy only after August 1980, when *Life* magazine published an article about the identity of the nurse and asked: "Now, if the sailor can recognize himself, would he please step forward?" This brought forth dozens of candidates for the sailor and several more for the woman in white.

It's possible that most of these claimants were present in Times Square and that each kissed someone. Which are in Eisenstaedt's photos? Maybe none. The actual subjects may not have read the August 1980 issue of *Life* or, indeed, even been alive in 1980.

Some mysteries are beyond the reach of astronomical calculations, but the August 14th late-afternoon shadows provide the key to unlocking at least some of the secrets of the iconic VJ Day images. ✦

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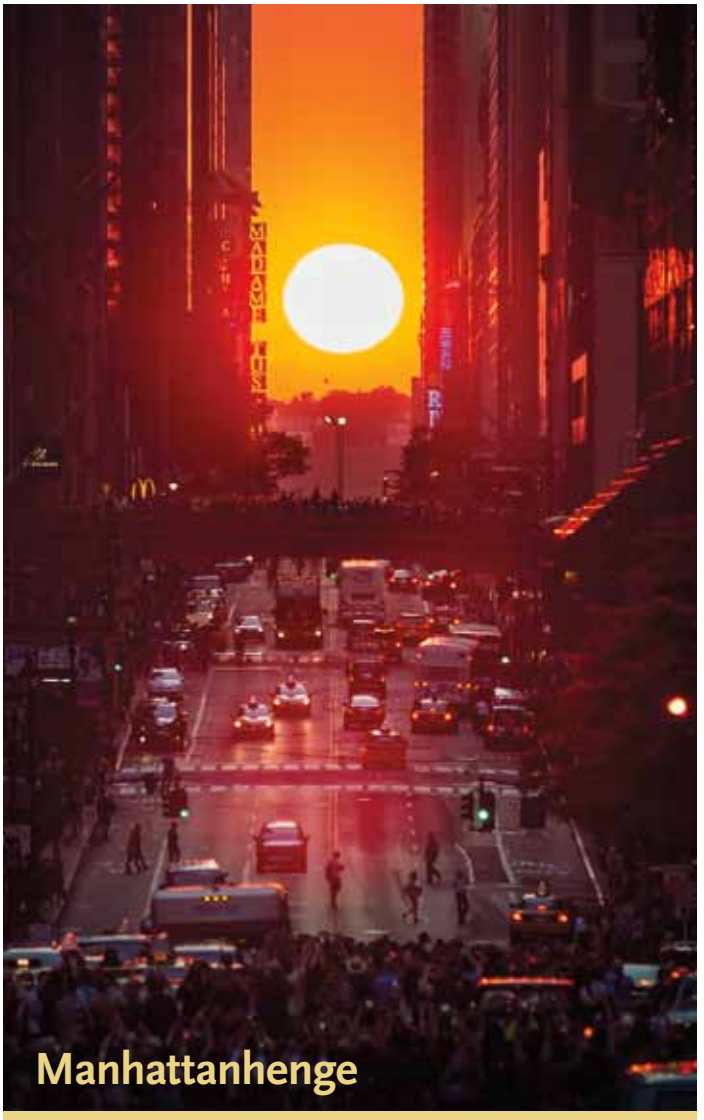

EDUARD MOLDOVEANU PHOTOGRAPHY

Manhattanhenge

Maps of Manhattan often show the avenues running vertically and the numbered streets running horizontally for convenience, but the Manhattan street grid is actually tilted 29° clockwise from true north. Knowing the correct azimuths of the streets and avenues was essential to our VJ Day shadow analysis.

The tilt of the street grid also determines the dates of the phenomenon known as "Manhattanhenge," popularized since 2001 by Neil deGrasse Tyson, director of New York's Hayden Planetarium. New Yorkers see the setting Sun aligned with Manhattan's numbered streets not at the spring and fall equinoxes, but rather for a few days near May 30th and July 12th, when the azimuth of the setting Sun is near 299° (that is, 29° north of due west). The steel, glass, and concrete towers lining the Manhattan streets make this sunset phenomenon especially spectacular.

COSMIC ALIGNMENT **Unlike Stonehenge, Manhattan wasn't built to align with the Sun on particular dates; it just does. On July 11, 2014, a crowd gathered at 42nd Street to witness the celestial event popularized by Neil deGrasse Tyson.**