Aden Meinel's official portrait at the University of Arizona College of Optical Sciences.

Aden Meinel

Astronomer, Optical Scientist, Founder and Scholar

Kristin Waller

Aden Meinel was the founding director of the University of Arizona Optical Sciences Center and the Kitt Peak National Observatory. With his wife and research partner, Marjorie, he also developed next-generation space-telescope concepts and pioneered the use of solar energy.

When Steve Jobs, cofounder of Apple Inc., died last year, millions mourned. Everyone who owned an iPod, iPhone or iPad took a moment to memorialize an innovative inventor who lost a long battle with pancreatic cancer.

But three days before Jobs died, on 2 October 2011, another innovative intellect breathed his last: Aden Meinel—astronomer, engineer and optical scientist—passed in his sleep in Henderson, Nev., U.S.A., at 89. Although fewer headlines noted Aden's death, anyone who has benefited from solar energy or marveled at a stunning Hubble-telescope image of the universe has been touched by his legacy.

Early life

Aden was born in Pasadena, Calif., on 25 November 1922. According to close friend James B. Breckinridge, the Meinels came from eastern Pennsylvania, with roots in Germany. A search for work brought the family to California. There, Aden's technically trained father, unable to find a position that utilized his skills, became a handyman and house painter to support the family.

Aden, the youngest of three stepbrothers, always took to mechanical things. He built his own toys with woodworking tools and was placed in advanced classes when he started school. In 1940, in an 11th grade accelerated math program at Pasadena Junior College, he started dating a smart, strong-willed young astronomer named Marjorie Pettit; she would, in time, become his coauthor, editor and partner in life.

At Marjorie's urging, Aden changed his college major from aeronautical engineering to astronomy, so they could share classes. Aden also volunteered with nearby California Institute of Technology's physics department, researched Venus' atmosphere alongside graduate students and served as an apprentice optician at Mount Wilson Observatory.

The Great Depression was waning, and World War II was driving research on any subject with military significance. As Breckinridge noted in a presentation on the occasion of Aden's 80th birthday, "there had been no more exciting time for applied sciences" since the Dark Ages. Meinel was fully immersed in it.

Don Cowen

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College, military service and beyond

Aden was admitted to Caltech in 1941 as a sophomore while Marjorie studied at the University of California, Berkeley.

Aden apprenticed at Roger Hayward's optical fabrication lab, where he learned to make aspheric plates for Schmidt cameras. This work would inspire him to study Schmidt plates for his doctoral dissertation.

However, after the United States entered World War II, Aden knew he would need to serve in the military. In the spring of 1942, he joined the V-12 Navy College Training Program, in which he worked under future Nobelist William Alfred Fowler.

He joined a highly classified rocket project and worked on training, timing, trajectories and fuses—including the time-delay fuses for what would become "the Gadget" at the first test detonation of a nuclear device. When Marjorie finished her master's degree at Claremont College in 1944, she joined him on the rocketry team.

In 1944, the pair married. Unfortunately, a draft notice was waiting for Aden when they returned from their honeymoon at Kapteyn Cottage, a guest house on Mount Wilson that was built for and named after a visiting astronomer.

Thus, Aden spent his 22nd birthday in Navy boot camp in San Diego. His group was scheduled to serve on the brand-new ship, the *U.S.S. Indianapolis*, which lay across the bay; they were excited at the prospect of clean bunks and regular showers.

Other orders came for Aden, though. He reported back to the Navy office at Caltech and was commissioned as ensign at the China Lake Navy ordnance research station soon after. A different fate met his friends on the *Indianapolis*; the ship was torpedoed on its way to Manila. Many of the explosion's survivors died of exposure, dehydration and shark attacks in the worst single loss of life in Navy history.

Barbara Meinel

Aden Meinel on Table Mountain, 1941.

Six months after he was drafted, Aden found himself in Hingham, Mass., at munitions school. Within a month, he was in Europe, assigned to Patton's 3rd Army as a rocket and optics expert. His job was to hunt out Germany's optical and ballistic technology, while also helping scientists and technicians from some of the world's best optics companies head to the West.

> For his dissertation, he designed the world's first solid Schmidt spectrograph, through which he viewed chemi-luminescence in the night sky.

Aden's childhood fluency in German served him well on the Western Front. In one foray, he found a note signed, "A. Hitler" that was written in what he described as "a nice script." The page, which he had found windswept in a burned-out director's office, was marked *geheime kommandosche*, or "top secret;" it held a list of the Third Reich's highest priority rocketry and guided missiles programs, one of which was called *schmetterling*, or "butterfly." Later, while exploring the Nordhausen rocket factory in Jena, Aden saw two big crates, both marked *schmetterling*, that held advanced cruise missiles.

Due to an administrative mishap, Meinel never received the awards he'd earned for his service under fire with the 3rd Army. In fact, there was no official record that he'd ever

A Wonderful Life

Aden Meinel's career lasted more than 70 years, taking him across the world while gazing at the stars.

1920

1922
Born 25 November in Pasadena, Calif.

1940

1942
Enters a classified Navy rocket program at Caltech

1945
Commissioned in U.S. Navy and sent to Europe to investigate rocketry and optical instruments

1949
Receives doctoral degree from Berkeley; designs and builds the first solid Schmidt spectrograph

1950

1950
Discovers hydroxyl emission bands in the night sky; they become known as the Meinel bands

1953
Becomes associate director of the Yerkes and McDonald observatories

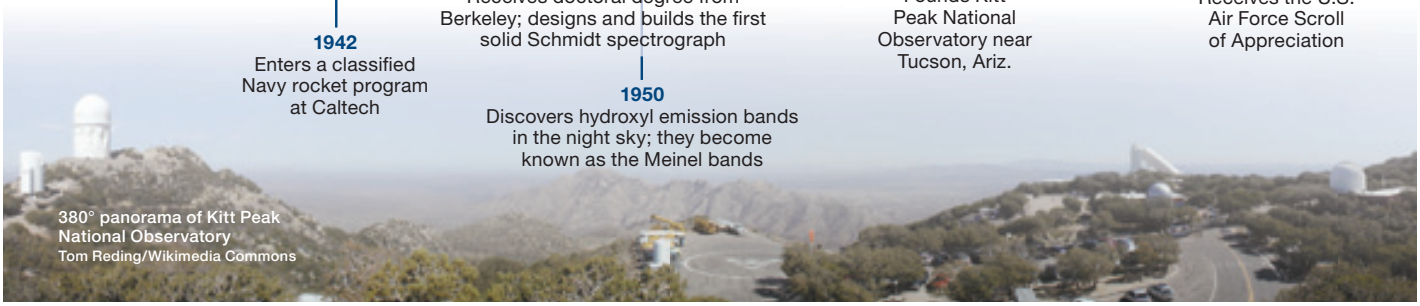
1958
Founds Kitt Peak National Observatory near Tucson, Ariz.

1960

1964
Founds the Univ. Ariz. Optical Sciences Center

1967
Receives the U.S. Air Force Scroll of Appreciation

1970



380° panorama of Kitt Peak National Observatory
Tom Reding/Wikimedia Commons

been to Europe. But "the bullets were real," he said. "I slept in bombed-out buildings out in the open just like any GI." Fortunately, upon his 1946 return, he did receive a large check for the per diem pay he'd accrued while on the front. It paid for the Meinels' first car.

Now back on familiar soil, Aden sought to complete his studies. Caltech wanted him to complete three more semesters before allowing him to start graduate school; the battle-hardened naval officer found a better deal at UC Berkeley. There, he was allowed to earn his bachelor's degree as soon as he finished the requisite tests.

Aden received his bachelor's from UC Berkeley in 1947, and then his Ph.D. in 1949—finishing his graduate studies after only two years. For his dissertation, he designed the world's first solid Schmidt spectrograph, through which he viewed chemiluminescence in the night sky.

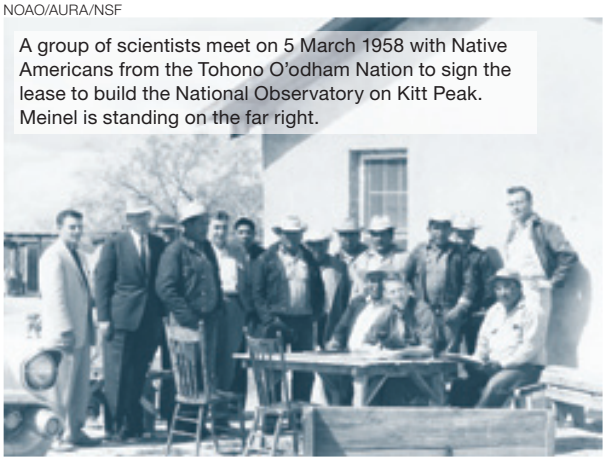
After Berkeley, the Meinel family moved north. Aden served as a research associate at the University of Chicago for two years before he became an associate professor. In 1953, he was named associate director of Yerkes and the McDonald Observatory, a position he held for three years. He recorded, analyzed and explained hydroxyl emission bands in the night sky, now called Meinel bands, while working at Yerkes.

Establishing an optics center in the Southwest

In 1957, Aden was tapped by the National Science Foundation to find a site for a national optical observatory. His search led him to southern Arizona, where he helped to identify the 6,800-ft. Kitt Peak—known as Iolkam Duag to the local Native Americans—as the ideal location. He led the scientific survey to ascertain its fitness and worked with the Tohono O'odham Nation to secure a lease for the space. He was named the observatory's founding director.

In a March 1983 article in *Sky and Telescope* magazine, Leo Goldberg, Aden's eventual successor as director of the Kitt Peak National Observatory, wrote, "the contribution of Meinel, the first director, cannot be overestimated. His enthusiasm, immense energy and scientific creativity were applied with great success, both to the survey and to the 36- and 84-in. telescopes."

NOAO/AURA/NSF



A group of scientists meet on 5 March 1958 with Native Americans from the Tohono O'odham Nation to sign the lease to build the National Observatory on Kitt Peak. Meinel is standing on the far right.

By 1961, Aden had moved on to the University of Arizona, where he was hired as a professor of astronomy and the third director of the Steward Observatory.

He was in the director's chair for a month when OSA called. Sadly, Van Zandt Williams, chair of the U.S. Needs in Optics committee, had just passed away. Might Aden be interested in taking the job?

"Unfortunately," Aden later recalled, "all my life I have never been able to say 'no,' when these interesting challenges arrive." And the idea of running the committee aimed to assess the country's educational offerings in the optical sciences … well, that sounded like an interesting challenge to Aden.

The committee unanimously decided that the United States needed another optics center in addition to the well-established program at the University of Rochester in New York. Now came the task of finding an appropriate venue. Aden decided to spearhead the effort.

In 1964, he was given six weeks to create a proposal for "the design, construction and equipping of the laboratory and research areas required for an Optical Sciences [Center] at the University of Arizona." He felt that the center should be placed near the clear skies and established astronomy community in Tucson.

1980

1973 Serves as president of OSA

1980 Receives the OSA Frederic Ives Medal

1982 Starts working at the Jet Propulsion Laboratory with his wife, Marjorie

1985 Retires from the Univ. of Ariz.

1990

1990 Receives honorary doctoral degree from Univ. of Ariz.

He and his wife help diagnose the problem with Hubble's telescope assembly

2000

2002 He and his wife publish their last coauthored paper, "Optical phased array configuration for an extremely large telescope," in *Applied Optics*

2010

2008 Publishes final paper, "Evidence of a magnetic sheath around a jet from NGC 6543," with daughter Barbara

2011 Dies 2 October in Henderson, Nev.

The University of Arizona College of Optical Sciences

Marjorie and Aden Meinel celebrate the publication of their second book, *Applied Solar Energy* (c. 1976).

Marjorie Pettit Meinel: Love of Aden's life

On the seventh floor of the Tucson building named after Meinel, Aden's official portrait hangs next to those of his successors as director of OSC, which is now called the College of Optical Sciences. The painting, which is shown on p. 38, is imposing, but Meinel's hands are casually clasped at the knee, with his wedding ring clearly visible on the left.

How apropos that even a solitary portrait of the man holds a gentle nod toward the most important person in his life. Marjorie was his partner in all things, from home to society to academia. As Robert Shannon said in an interview, "The two of them supported each other extremely deeply—they thought for each other."

Marjorie came from astronomy royalty. Her mother, Hannah Steele, was the first woman to graduate from the University of Chicago with a doctorate in astronomy in 1919. Marjorie's father, Edison Pettit, earned his Ph.D. from Chicago in 1920; he and Hannah both used Yerkes Observatory's 40-in. telescope for their degree work.

The work that Edison Pettit did in solar astronomy at Mount Wilson became widely renowned. Dr. Hannah Steele Pettit, however, was less welcome; no women were permitted in the observatory. As Breckinridge stated in a 2002 presentation, "A productive research scientist, who [had] used the world's largest refractor for her dissertation, was denied the tools to continue her career."

After her mother became ill and was confined to bed, Marjorie became her father's backyard research assistant. Together they made the first time-lapse movies of eruptive solar prominences. By age 16, Marjorie was finishing up high school and taking math and physics courses at Pasadena Junior College—where she met Aden in the fall of 1940.

Marjorie stayed in step with Aden throughout his career, even as she raised their seven children. They shared trips, ideas, awards and bylines, travelling from Pasadena to Chicago to Tucson, and anywhere else that their combined passions for the sciences took them.

The U.S. Air Force approved the proposal for the Optical Sciences Center (OSC). As ground was broken on the building, Meinel laid the foundation for a robust and rigorous research and educational program.

He pulled in Roland Shack, Robert Noble and Stephen F. Jacobs from Perkin-Elmer; Robert R. Shannon from Itek; and William Wolfe from Honeywell, firmly grounding the center in both the optical engineering experience that the Air Force so strongly encouraged as well as the pure physics of quantum optics.

But as Jacobs described it, "Aden's greatest attribute was as builder, not director." In 1973, Aden stepped down from the directorship of OSC, where he continued to serve as a professor until 1985. "I wasn't director very long," he said. "I always turned over the director [position] to more competent people."

He accomplished a great deal in just a few years. "Aden was a fountain of creativity," said Steve Jacobs. His work ethic and enthusiasm are "hard to match in modern times." OSC's first graduate, James Mayo, deemed him "a man of true scientific genius, prodigious energy and organizational ability far beyond anything I had ever imagined." John Lytle called him "the consummate cool guy ... just so capable in so many fields." Suffice to say, he made a considerable impression on everyone he met under the desert sun.

After OSC

The Arizona sun made a considerable impression on Aden. After resigning the OSC directorship, he and Marjorie threw their attention into exciting new projects, including exploring solar energy.

Quite literally, they wrote the book on it—actually, two books. In 1971 came *Power for the People*, which followed the history of solar power from 212 B.C.E. to the modern 1970s energy crisis. The last half of the book provided possible solutions to the problem, including Peter Glaser's orbiting solar power station and their own national solar power facility.

In 1976, they published *Applied Solar Energy: An Introduction*, which was used across the United States to teach the basic premises and techniques of collecting solar energy.

A wall of solar panels heats the Meinels' swimming pool in 1974.

Boyd Norton / U.S. National Archives

Their own swimming pool was heated with solar energy, with a linear parabolic reflector setup captured in 1974's DOCUMERICA—a program sponsored by the Environmental Protection Agency that described alternative energy efforts in the desert Southwest.

In 1985, they returned to Pasadena, eager to explore new frontiers. Breckinridge, who had studied under Aden and Roland Shack back at OSC, was more than ready to oblige them by hiring the pair as senior scientists, and later distinguished visiting scientists, at the NASA Jet Propulsion Laboratory (JPL) at Caltech.

Sunsets

After retiring from JPL in 1992, Aden and Marjorie continued to research, publish and engage with the scientific community. The next year, they traveled to Tucson to celebrate with OSC as its building was renamed in their honor.

Retirement didn't keep them from their research. When the Hubble Space Telescope transmitted its first blurry photographs, Aden, Marjorie and several OSC colleagues were among the top minds that helped diagnose, and then treat, its spherical aberration.

Post-retirement, Aden's more memorable projects included the design and engineering of the interferometer optomechanical layout used in the two 10-m telescopes at the W.M. Keck Observatory in Hawaii, as well as innovative optical testing methods for off-axis aspheric segments.

As the 19th century ticked over to the 20th, however, the brilliant spark within Marjorie Meinel started to dim. She was diagnosed with Alzheimer's disease, and though Aden initially cared for her in their Santa Barbara home, additional assistance became necessary in time. They moved to Henderson, Nev., just outside Las Vegas, where their son David served as a pastor.

The pair's last coauthored paper came in 2004; it was titled "Optical Phased Array Configuration for an Extremely Large Telescope."

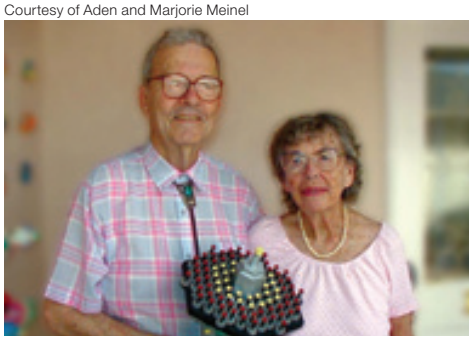
On 24 June 2008, Marjorie passed away. She was 86 years old; she and Aden had been married for 64 years. In keeping with Marjorie's wishes, Aden scattered her ashes in the desert.

Aden continued to contribute, not only with research and outreach, but also with chronicling some of the remarkable history from his long career. His work spanned from the 1930s into the 20th century—he spent more than 70 years as a productive physicist and engineer.

He returned to southern Arizona in 2010 to celebrate the 50th anniversary of the Kitt Peak National Observatory's founding. On 22 March, he gave a talk titled "Why Kitt Peak?" in the Steward Observatory. He took a tour of the newly expanded Meinel Building at the College of Optical Sciences the next day.

Meinel died quietly, late on the night of Sunday, 2 October 2011, and the scientific community bid farewell to one of its greats.

Courtesy of Aden and Marjorie Meinel



Aden and Marjorie Meinel pose with a model of an extremely large sparse aperture telescope.

Meinel's legacy

The street address listed on Aden Meinel's last professional publication, a 2008 article on cosmic rays published in the *Proceedings of the International Astronomical Union*, is Eclipsing Stars Drive in Henderson, Nev.—an appropriate place for a man so revered in astronomy and optical sciences to spend his twilight years.

> John Lytle called him "the consummate cool guy ... just so capable in so many fields."

He is one of only two people to have ever won both OSA's Adolf Lomb Medal (for outstanding achievements under the age of 35) and its Frederic Ives Medal (the highest award for lifetime achievement), in 1952 and 1980, respectively. OSA also named Aden a Fellow and elected him as president in 1972.

The list of Aden Meinel's recognitions goes on for pages. He gave us new ways to see the stars and founded institutions that would go on to do world-changing research. And he kept curious, busy and engaged every moment.

Special thanks go to Barbara Meinel, James B. Breckinridge, Robert Shannon, Stephen F. Jacobs, James C. Wyant, Dale Karas and Gary Esham.

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