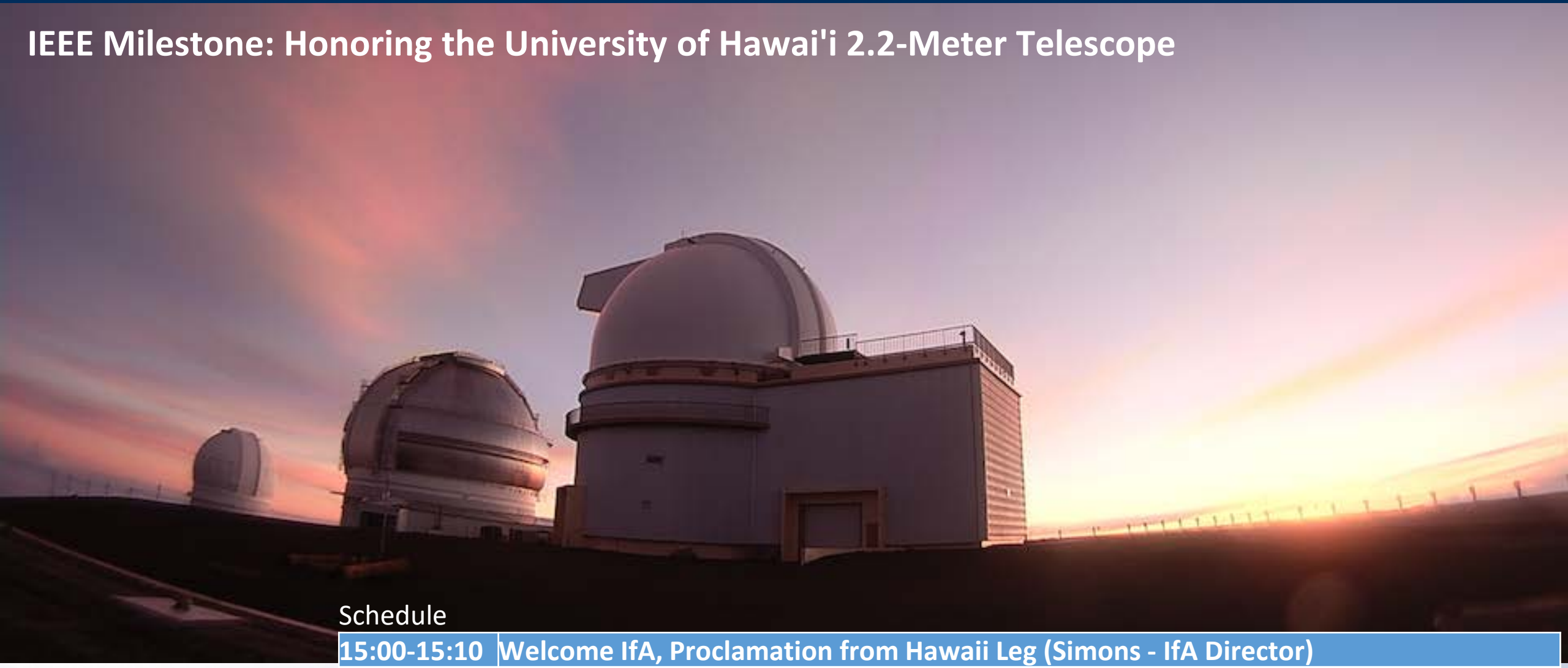
IEEE Milestone: Honoring the University of Hawai'i 2.2-Meter Telescope



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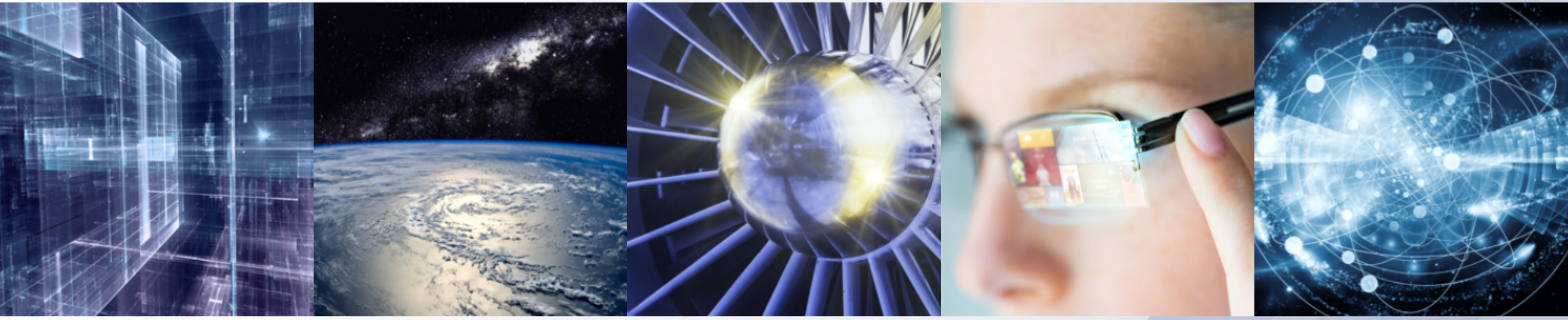


IEEE and Its Milestone Program

Brian Berg

IEEE Region 6 History and Milestones Chair

26 June 2025

IEEE
Advancing Technology for Humanity

Hi, I'm Brian Berg

- My background:
  - Consultant in data storage and flash memory
- IEEE Volunteer
  - IEEE History Committee: work on worldwide Milestones
  - Manage IEEE Milestones in Region 6 (12 western states)
  - Director: IEEE Consultants' Network of Silicon Valley

IEEE-CNSV
Consultants' Network of Silicon Valley

IEEE Region 6

IEEE: Inspiring a Global Community of Innovation

IEEE's Mission

To foster technological innovation and excellence for the benefit of humanity

IEEE's Vision

- Be essential to the global technical community
- Be essential to technical professionals everywhere
- Be universally recognized for contributions of technology and of technical professionals in improving global conditions

www.ieee.org

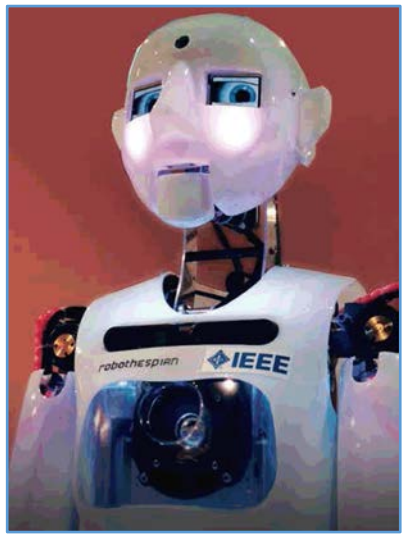
IEEE

IEEE at a Glance

- **500,000+** members in more than **190** countries
  - Over **189,000** Student members
  - **39** technical Societies
- **6 million+** documents in the IEEE *Xplore*® digital library, with **24 million+** downloads each month
- **1,079** active standards
- **1,000+** standards under development
- About **200** journals, transactions, and magazines
- **2,000+** conferences in **190** countries annually
- Continuing Technology Education Resources
- Global public policy and professional ethics
- International Climate Change engagement

Climate Change

IEEE: Enabling Innovation and Technology Solutions

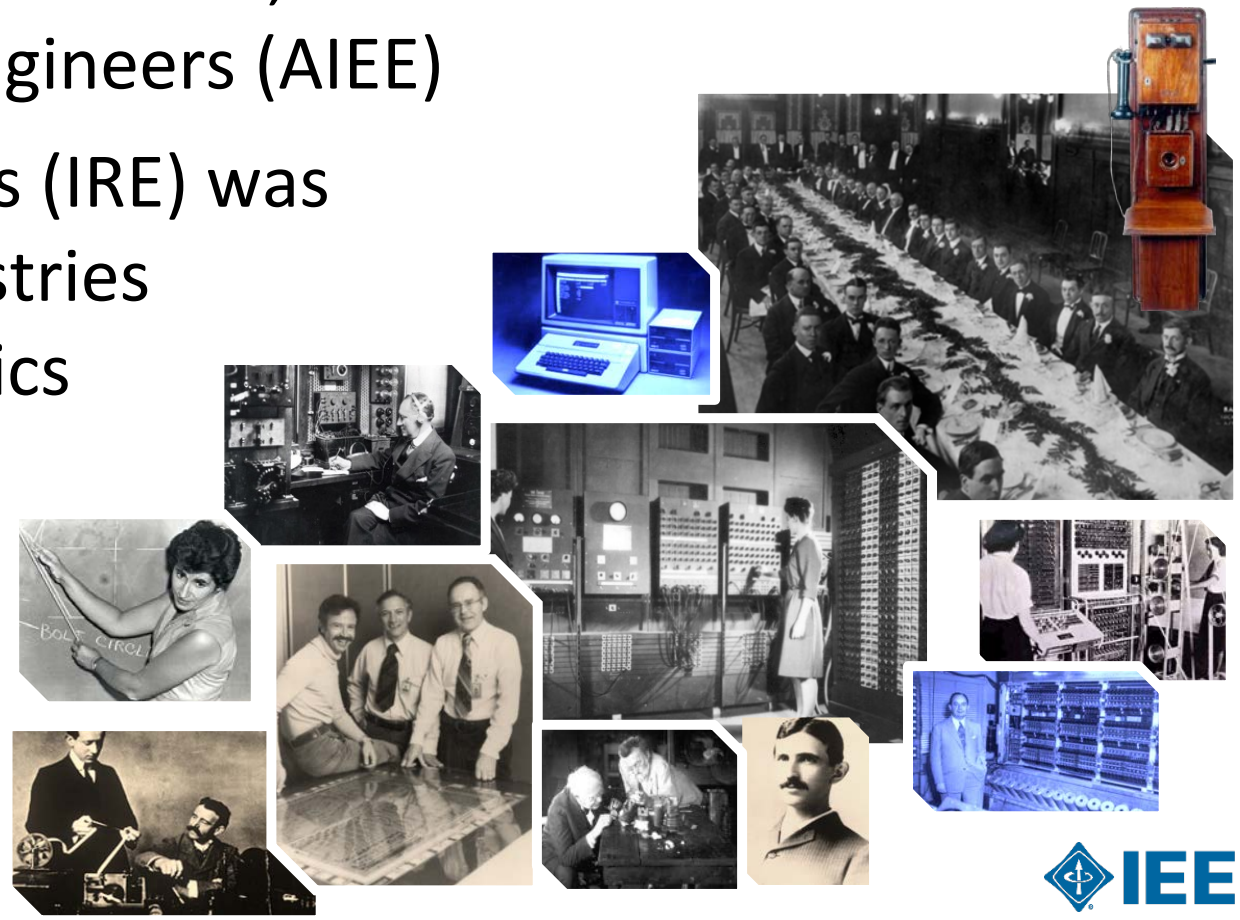


All figures as of February 2025

IEEE

IEEE Legacy: Innovation and Collaboration

- 1884: Thomas Edison, Alexander Graham Bell, and others founded the American Institute of Electrical Engineers (AIEE)
- 1912: the Institute of Radio Engineers (IRE) was formed with a focus on the new industries of wireless technologies and electronics
- 1 January 1963: AIEE and IRE merged to become IEEE
- *IEEE is now in its 141st year*



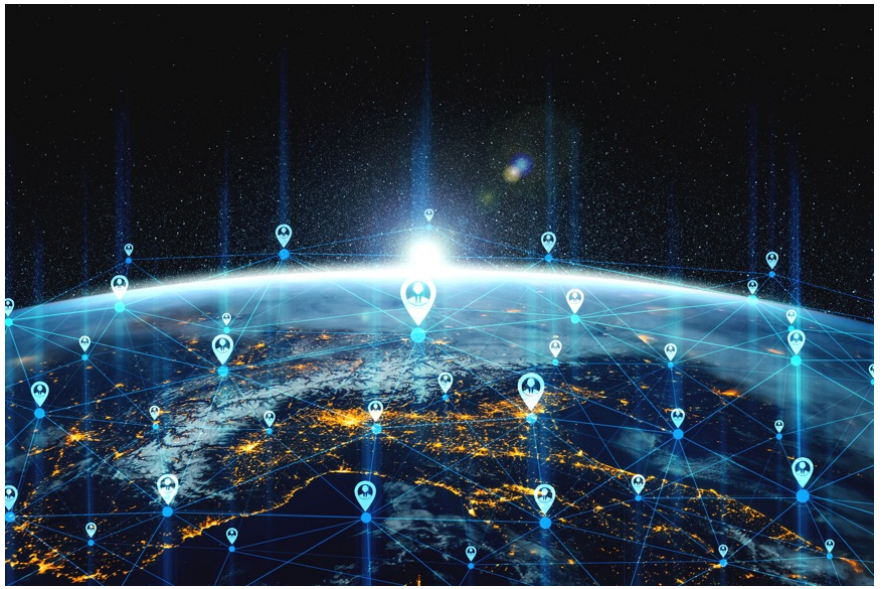
Technical Know-How that is Broad and Deep

- Electrical and electronic engineering, computer science, and beyond:

  - Aerospace
  - Biomedical Engineering
  - Broadcasting
  - Circuits
  - Communications
  - Computing
  - Control and Automation
  - Electronics
  - Environment
  - Industrial systems
  - Information Technology
  - Internet of Things
  - Life Sciences
  - Nanotechnology
  - Optics
  - Power and Energy
  - Robotics and AI
  - Semiconductors
  - Smart Cities
  - Smart Grid
  - Transportation and Vehicles
  - **And more…**

IEEE: The World's Resource For Technology Information

- **IEEE is the largest technical professional organization in the world**
- Members are involved in all aspects of technology creation and use
- IEEE research powers patents and IEEE creates many of the world's technical standards
- IEEE fosters efforts in future directions, technical roadmaps, and tracking megatrends
- IEEE can inform public policy and is a resource for technical discussions



The world's most successful technology professionals and organizations rely on IEEE information

Corporations

- 24 of the top 30 Semiconductor
- 8 of the top 10 IT Software and Services
- All top 10 Aerospace and Defense
- 8 of the top 10 Technology Hardware and Equipment
- 3 of the top 5 Consumer Durables (Electronics/Automotive)
- 8 of the top 10 Telecommunications

(Forbes Global 2000 Rankings, 2023)

Universities

- All the top 100 engineering schools in the US*
  (*U.S. News and World Report, Top Engineering Graduate Schools of 2023*, ranked in 2022)
- 98 of the top 100 Engineering and Technology Universities Worldwide*
  (*Times Higher Education*, Subject Ranking 2021-2022: Engineering & Technology)

* As of August 2023

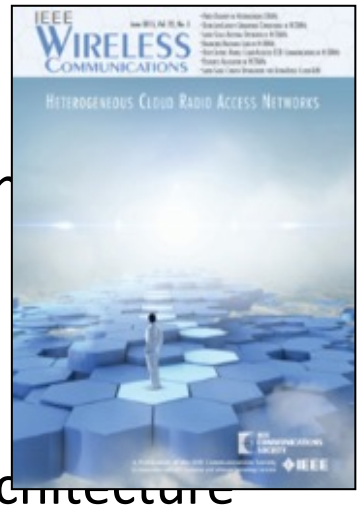
Government

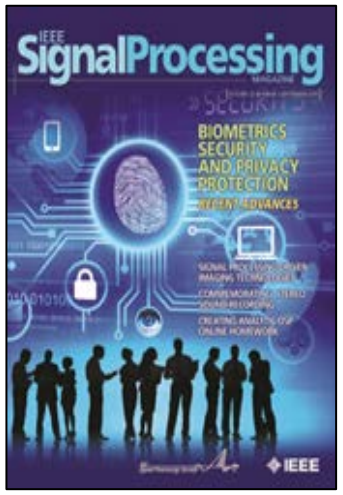
- Defense research and aerospace agencies
- Communications and energy labs
- Patent offices and scientific councils
- Government R&D centers in North America, Europe, Asia, and the Middle East

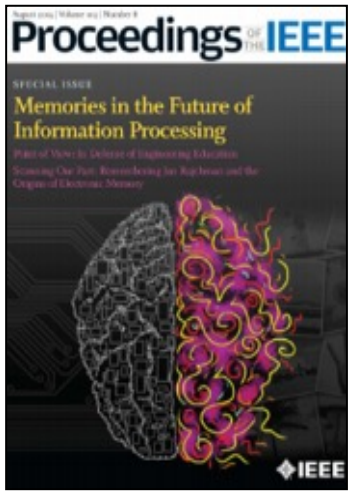
IEEE Publications Are Highly Respected Worldwide

IEEE Publishes:

- **8 of the top 10** journals in Electrical + Electronic Engineering
- **9 of the top 10** journals in Telecomm
- **3 of the top 5** journals in
  - Artificial Intelligence
  - Automation & Control Systems
  - Computer Science—Hardware & Architecture
  - Computer Science—Software Engineering
  - Cybernetics
  - Imaging







IEEE Xplore Digital Library

Top research organizations in the world rely on IEEE to fuel imagination and drive innovation

- IEEE journals, conference proceedings and standards back to 1884
- More than 6 million documents, 24 million downloads per month, and over 8 million unique users
- Over 1.2 million articles from over 200 top-cited IEEE journals, magazines, and transactions
- Over 4 million conference papers from as far back as 1936, with up to 200,000 added each year
- More than 4,900 approved and published IEEE standards
- eBook collections covering emerging topics in engineering, computer science, telecommunications, AI and more

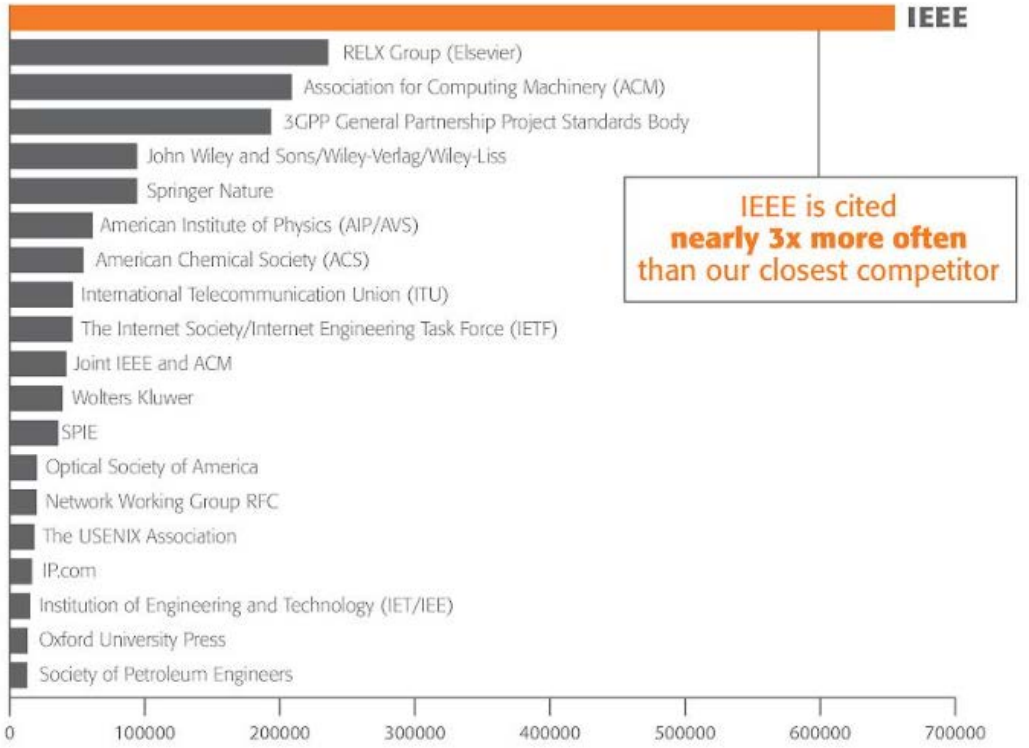
https://ieeexplore.ieee.org/

IEEE Research Powers New Patents

IEEE is the most-cited publisher in new patents from top patenting organizations

A study of the top 50 patenting organizations ranks IEEE #1 again

- Nearly 3x more citations than any other publisher
- Patent referencing to IEEE increased 864% since 1997
- Analyzed by discipline, IEEE is the #1 most referenced publisher in **AI, Blockchain, Computing, Cybersecurity, IoT, Power Systems, Semiconductors, Telecom and more**
- The importance of sci-tech literature in patents is rising
- IEEE research is increasingly valuable to innovators



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IEEE Standards Association

Consumers around the world enjoy the benefits of IEEE Standards:

- Provide the bricks and mortar for a globally level playing field for innovation
- Protect public safety, health & wellbeing
- Contribute to a sustainable future

COMPETITION
Influencing the competitiveness of industries & companies

CONFIDENCE
Demonstrating quality to customers by meeting expectations & requirements

INNOVATION
Providing an essential platform on which new technologies & processes can build

GROWTH
Facilitating trade & economic growth

PERFORMANCE
Fine-tuning performance and improving efficiency

SUSTAINABILITY
Making technology safer, interoperable and sustainable for the future

Networking is Key at IEEE

Interact with colleagues and collaborate on projects with leading experts—while taking advantage of specialized opportunities.

- **2,562 Professional Chapters** that unite local members with similar technical interests
- **39 Technical Societies**
- **580+ affinity and special interest groups** and growing, including **IEEE Young Professionals (YP), IEEE Entrepreneurship,** and **IEEE Women in Engineering (WIE)**
- **Tens of thousands of IEEE Members and Non-Members meet on IEEE Collabratec:** IEEE's online community
- **Convenient access** to IEEE products and services through the **IEEE App**

IEEE Collabratec

IEEE Women in Engineering WIE

IEEE youngprofessionals

IEEE

Technology Policy for the Public Good

Coordinated activities at the national, regional, and international levels

- Facilitate global collaboration between the IEEE and governments, regulatory, and other industry organizations to work together on important technical issues
- Provides independent and unbiased viewpoints
- Inform policy-makers, IEEE members, and the public of the benefits, risks, and social implications of technology
- Promote discussion of technology-related public policies
- Holds United Nations Economic and Social Council (ECOSOC) Consultative Status, Associate Member of World Federation of Engineering Organizations (WFEO)

WFEO / FMOI

ECOSOC
Economic and Social Council

Learn more at: globalpolicy.ieee.org

IEEE

IEEE Humanitarian Technologies

Engineering a Better World for All

IEEE Humanitarian Technologies

IEEE Humanitarian Technologies is a consortium of programs and initiatives-supported by a global network of volunteers and technical professionals-working together to **apply technology to solve the world's most pressing problems.**

IEEE HT provides the resources, partnerships, and tools for developing and deploying innovative solutions to **advance sustainable development globally** while achieving **social and environmental impact locally**.

EPICS IN IEEE
Engineering Projects In Community Service

EMPOWER A BILLION LIVES

IEEE SIGHT
Special Interest Group on Humanitarian Technology

MOVE
DISASTER RELIEF & OUTREACH
AN IEEE INTERNATIONAL PROGRAM

The IEEE HT consortium leverages the strength and reach of the IEEE network to make a difference in local communities around the globe. Get involved by:

- **Volunteering** time and skills to ongoing initiatives
- **Applying for funding** to deploy an innovation technology solution that solves a local challenge
- **Spreading the word** about IEEE HT and encouraging others to join our work

IEEE TECH4GOOD

IEEE smart village
Power a Village, Empower Community.

IEEE REACH
Raising Engineering Awareness through the Conduit of History

Learn more: ieee.org/humanitarian-tech

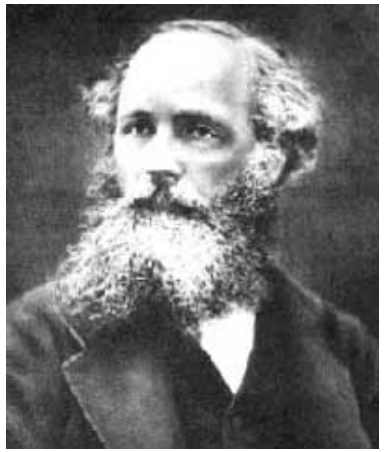
IEEE

The IEEE Milestone Program

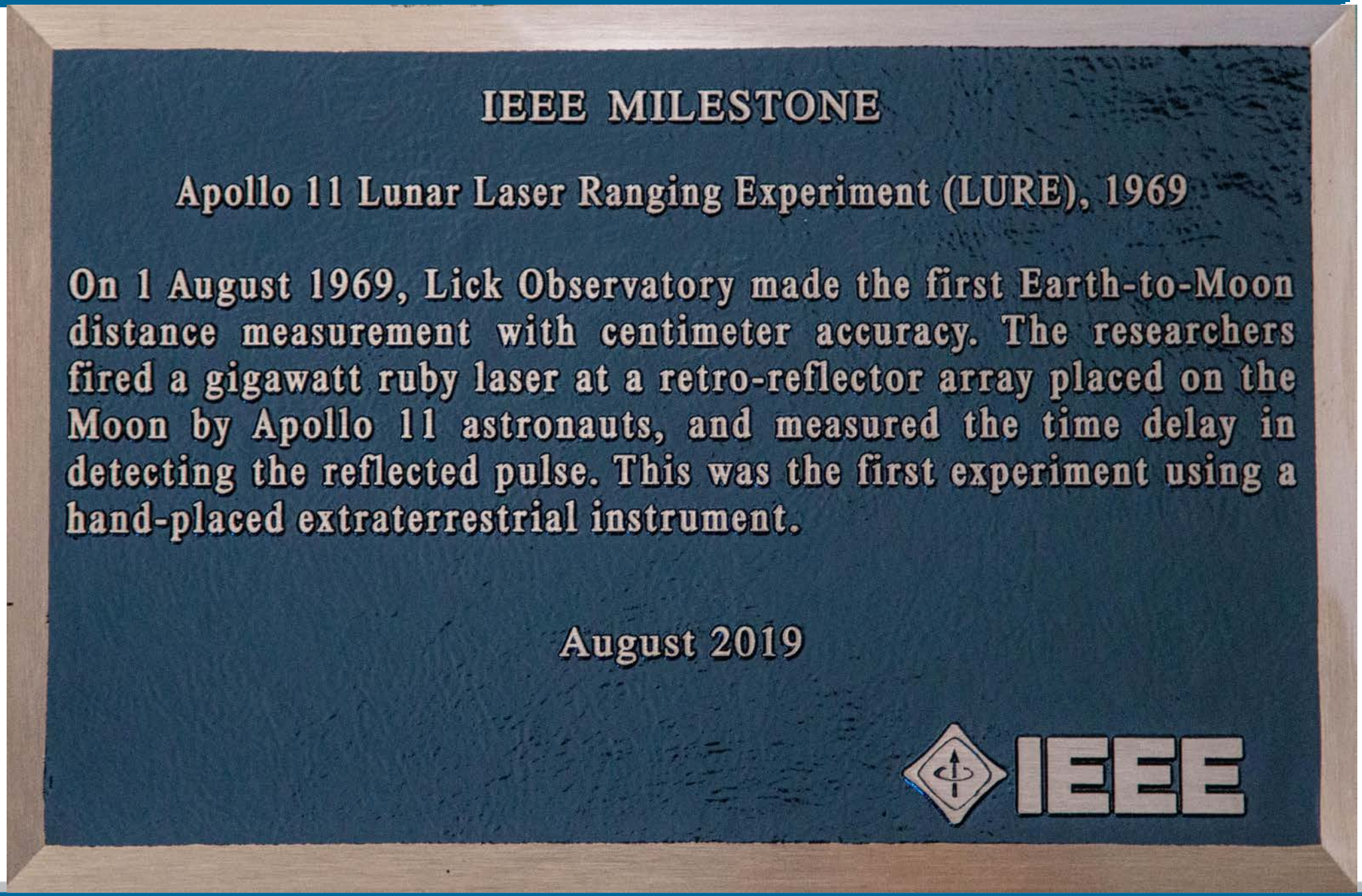
- Milestones honor an achievement, not a person or place
- The achievement must be at least 25 years old
- Here is the CDMA Milestone plaque at Qualcomm, San Diego

- This plaque greets visitors to Qualcomm's HQ

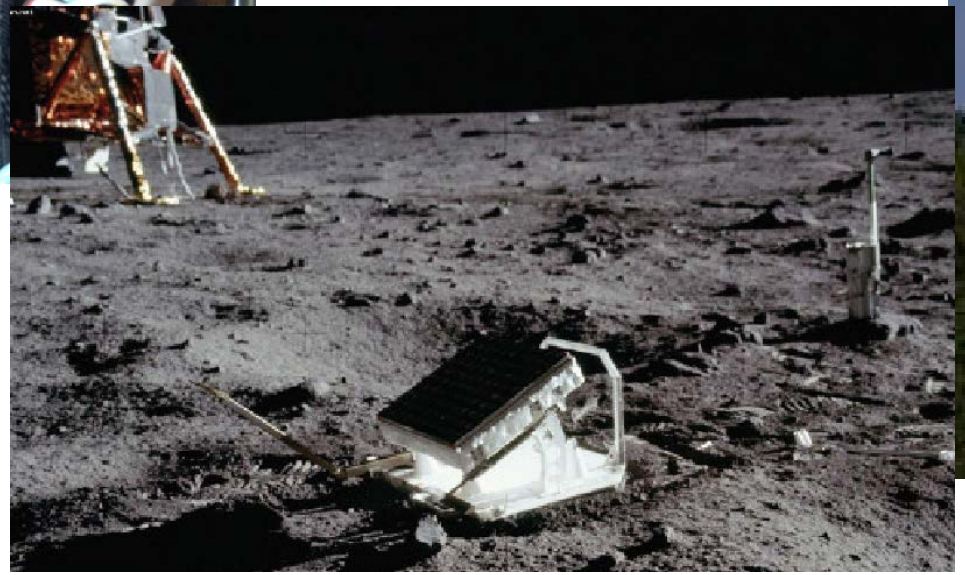
IEEE Milestones Around the World



- 274 Milestones dedicated since 1984, incl.:
  - Maxwell's Equations, 1860-1871
  - Stereo Sound Recording, 1931 (EMI Studios, later renamed Abbey Road Studios)
  - Bletchley Park Code Breaking, 1939-1945
  - CD Audio Player (The Netherlands), 1979
  - Bullet Train (Japan), 1964
  - Project Echo, Telstar, and Discovery of Cosmic Background Radiation, 1959-1965
  - Toyota Prius, the World's First Mass-Produced Hybrid Vehicle, 1997


IEEE MILESTONE
Apollo 11 Lunar Laser Ranging Experiment (LURE), 1969
On 1 August 1969, Lick Observatory made the first Earth-to-Moon distance measurement with centimeter accuracy. The researchers fired a gigawatt ruby laser at a retro-reflector array placed on the Moon by Apollo 11 astronauts, and measured the time delay in detecting the reflected pulse. This was the first experiment using a hand-placed extraterrestrial instrument.
August 2019
IEEE

Milestone: Lunar Laser Ranging Experiment (LURE), 1969 (using the retroreflector left by Apollo 11 astronauts)



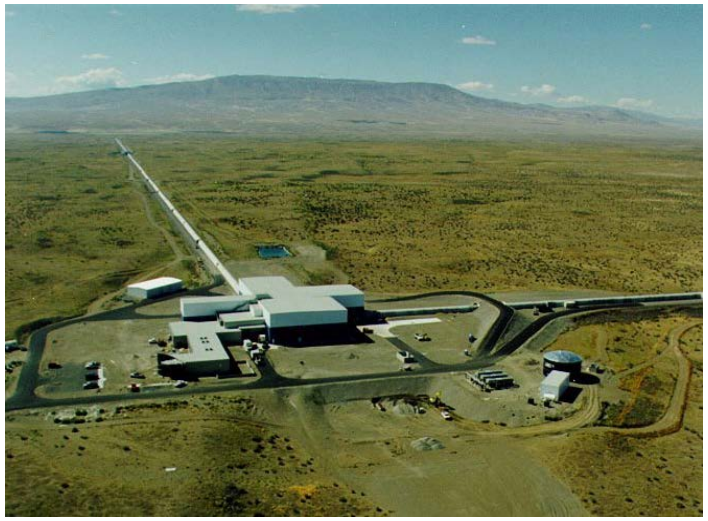
LURE was attempted at 3 sites:

- Haleakala High Altitude Observatory Site (Maui)
- McDonald Observatory (Texas)
- Lick Observatory (California)

LURE used a weapons-grade 1.2 Gigawatt laser

Dedicated at Lick Observatory on 1 Aug. 2019
(the 50th anniversary of first successful measurement to the moon)

3 Milestones: Gravitational-Wave Antenna, 1972-1989



LIGO: Hanford, Washington
with 4km long arms

LIGO: Livingston, Louisiana
with 4km long arms

Virgo Observatory: near Pisa, Italy
with 3km long arms

- Einstein's 1916 General Theory of Relativity:
  - He predicted the existence of cosmic ripples that traveled at the speed of light
  - These "gravitational waves" (GWs) carried information about their origin, and clues about the nature of gravity
- In 2015, GWs were detected at 2 LIGOs, as predicted by Einstein

Milestone: Mount Stromlo Solar Observatory, 1924

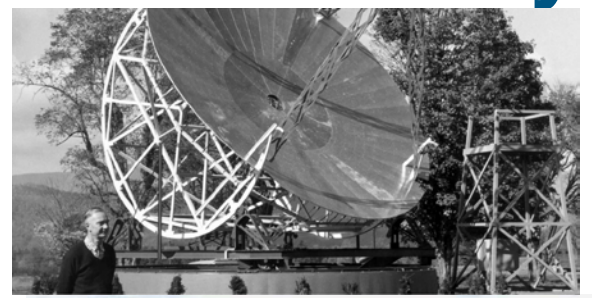
- Overlooks Canberra in southeastern Australia
- Early years: study of the Sun's atmosphere
- 1940s: earliest spectro-scopic classification of southern stars
- Until 1950s: largest telescope in the southern hem
- 1950s: work shifted to stellar and galactic astronomy
- Research continues in astronomy and astrophysics

Milestone: Deep Space Station 43, 1972-1987 (Australia)

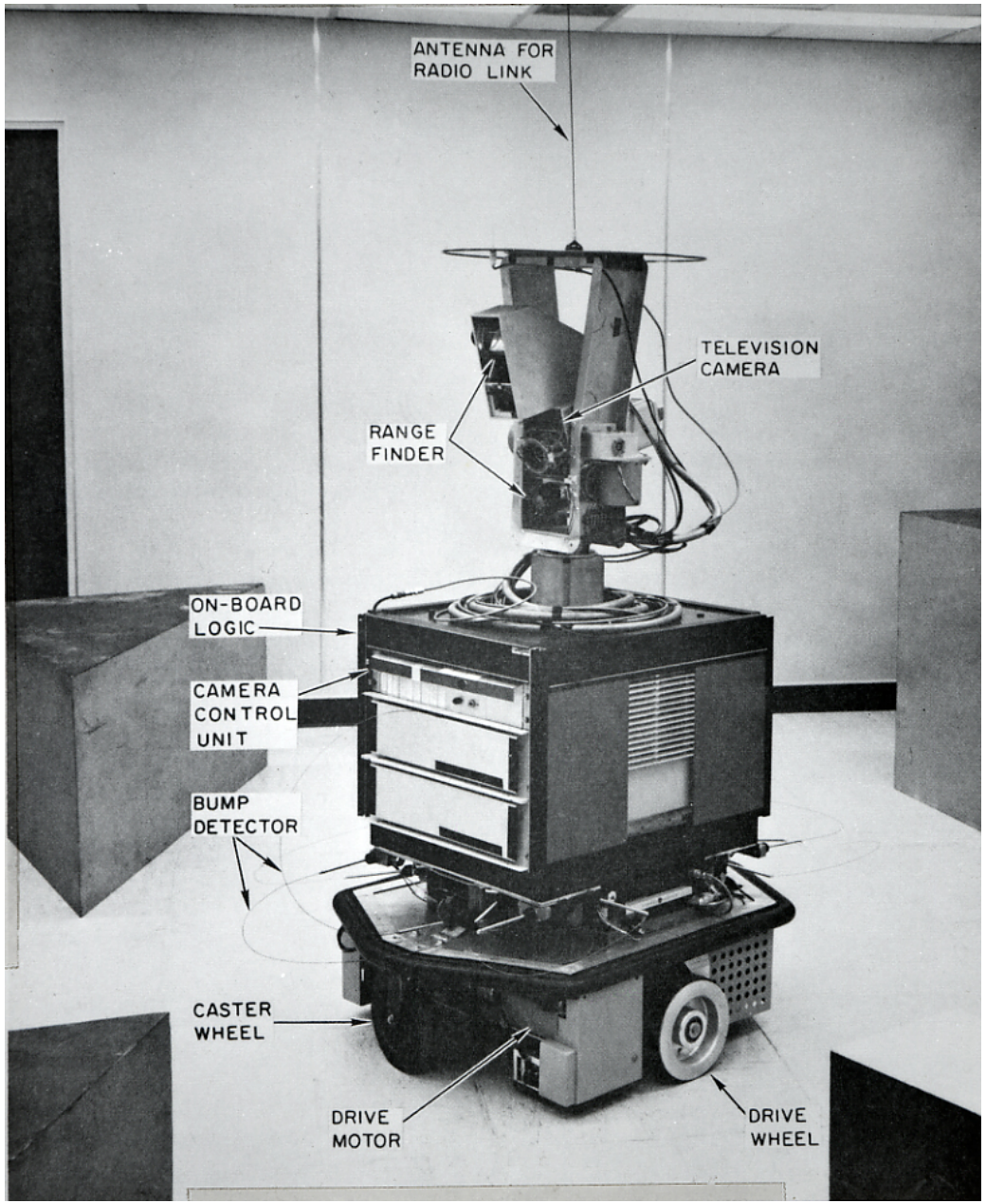
- First operational in 1972
- 70-meter steerable parabolic radio wave antenna
- Critical in NASA's Deep Space Network
- Supported the Apollo 17, Viking Mars landers, Pioneer and Mariner planetary probes, and Voyager's encounters with Jupiter, Saturn, Uranus, and Neptune.
- Only means to communicate with Voyager 1 and 2
- Milestone dedicated in March 2024

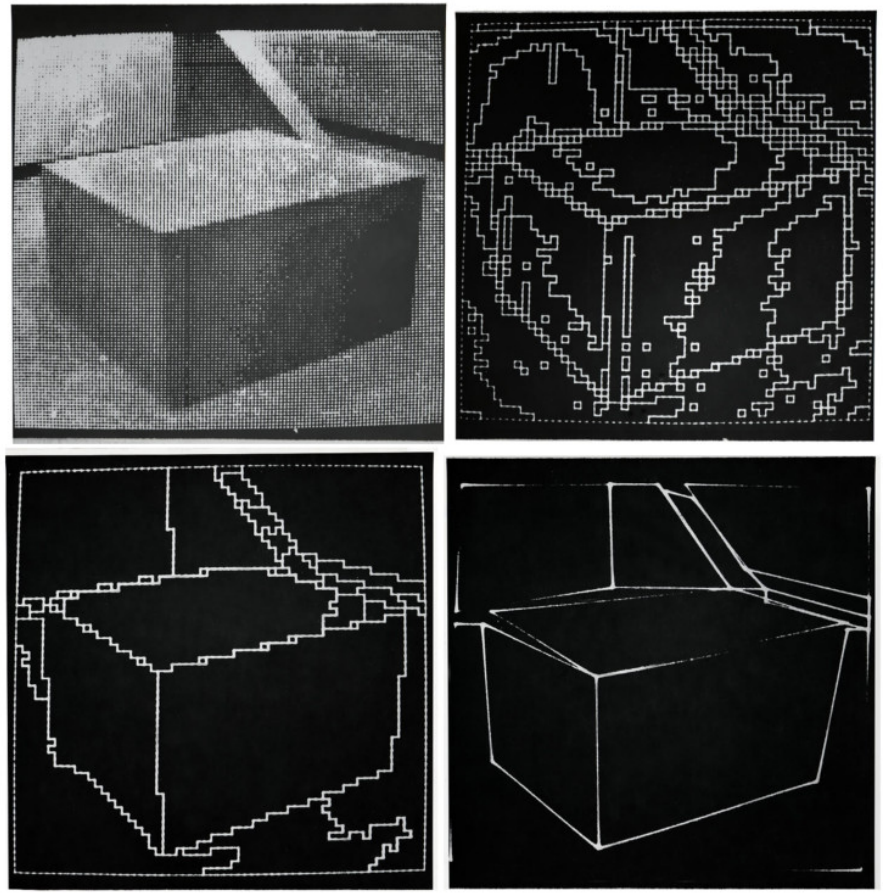
8 More IEEE Milestones Related to Radio Astronomy

- Bell Labs' First Radio Astronomical Observations (1933) (New Jersey)
- Project Diana: Start of radar astronomy with signals reflected off the moon (1946) (New Jersey)
- Principle of Self-Complementarity in Antennas and the Mushiake Relationship, 1948 (Japan)
- NAIC/Arecibo Radiotelescope, 1963 (Puerto Rico)
- First Radio Astronomical Observations Using Very Long Baseline 1967 (British Columbia)
- Parkes Radiotelescope, 1969 (Australia)
- Nobeyama 45-m Telescope, 1982 (Japan)
- Giant Metrewave Radiotelescope, 1994 (India)



Milestone - SHAKEY: The World's First Mobile, Intelligent Robot, 1966-1972





Developed at SRI, Menlo Park, CA

Funded by ARPA

Milestone: AMPEX Videotape Recorder, 1956

1946: Bing Crosby was the first investor in Ampex's audio tape recording system.

Crosby pre-recorded his radio shows and mastered his audio recordings

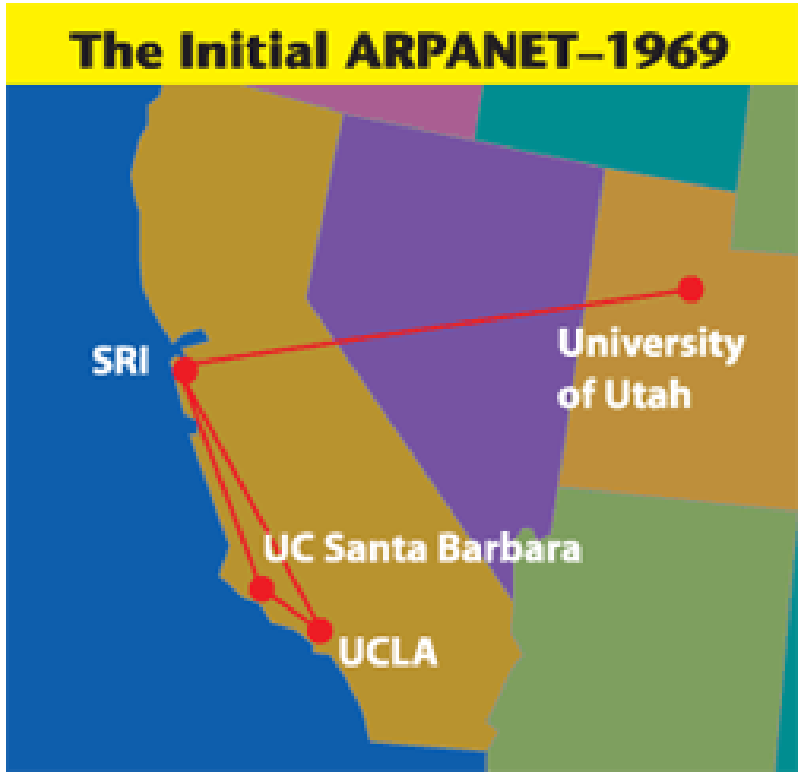
VR1000 1956

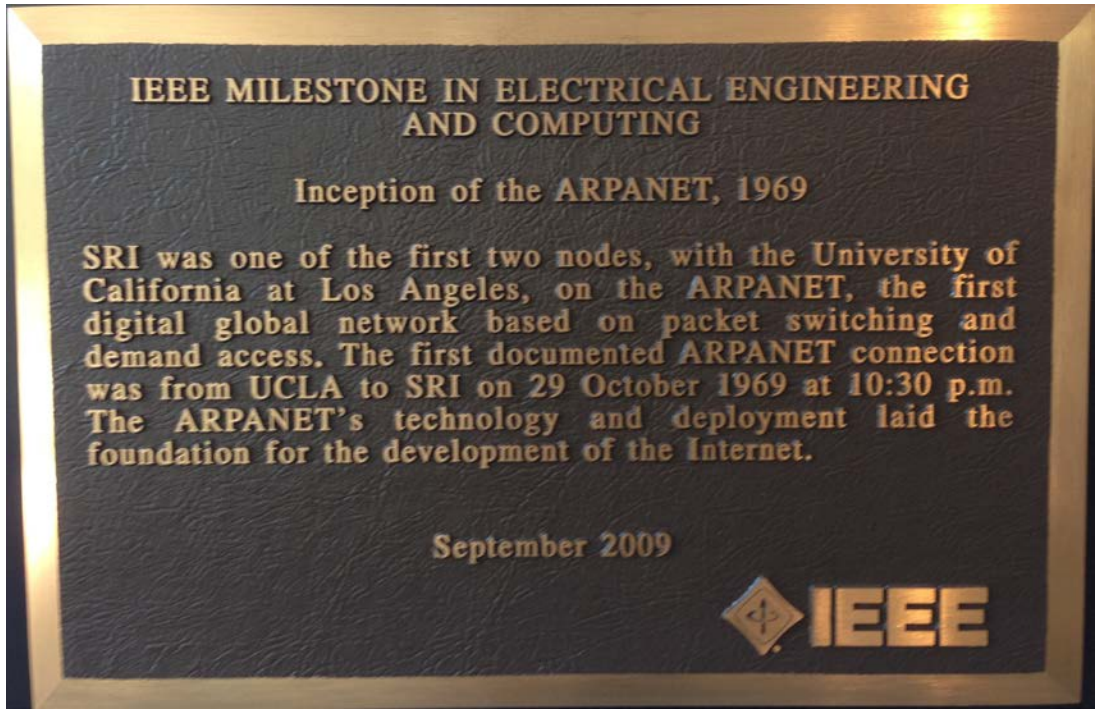
1957: Project Team with early version of the video recorder, and its Emmy Award (Ray Dolby is 2nd from left)

Ampex was in Redwood City, CA

Milestone plaque is on the Stanford Univ. campus

Milestone: First ARPANET Transmission, 1969 (from UCLA to Stanford Research Institute)





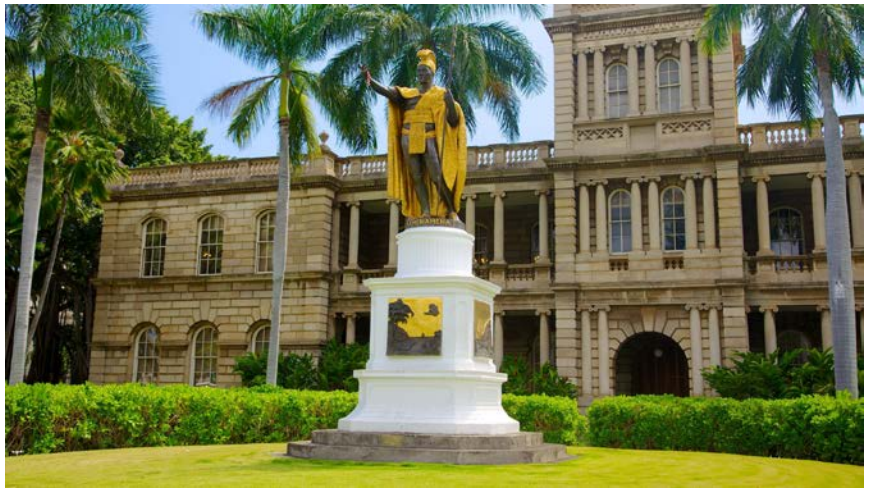
3 plaques in SRI's Visitors Lobby (including SHAKEY)

Dedicated in 2009 for ARPANET's 40th anniversary, in conjunction with IEEE's 125th anniversary

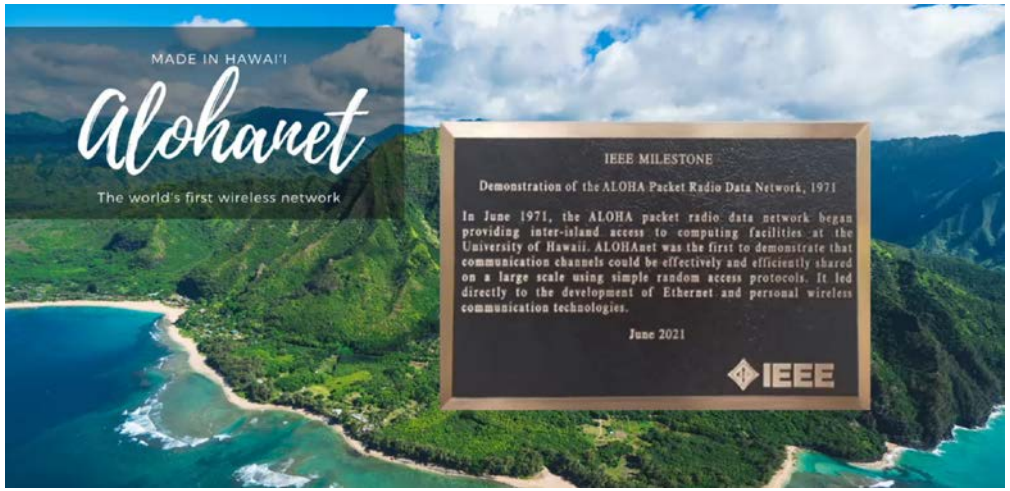
Hawaii's Milestones

- Hawaii currently has 4 Milestones
- Today we dedicate Hawaii's 5th Milestone

Opana Radar Site, 1941



Electric Lighting of Iolani Palace, 1886-1888



ALOHAnet Packet Radio, 1971

TPC-1 Transpacific Cable, 1964 (undersea coax connecting Japan to California via Hawaii)

Milestone “Wall of Fame” at Computer History Museum in Mountain View, CA

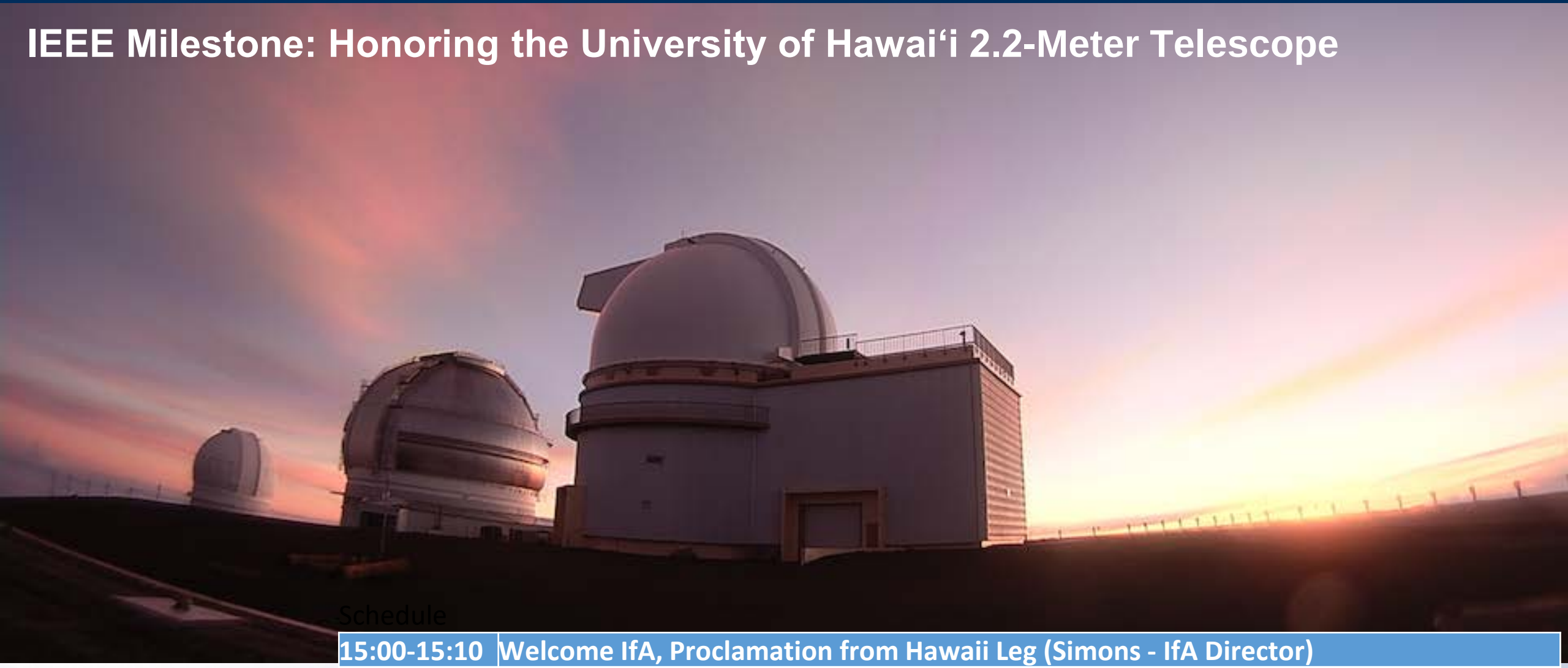
26 bronze plaques on the exterior wall

Largest collection of IEEE plaques in the world

Includes Duplicate of the ALOHAnet plaque

CHM Computer History Museum

IEEE Milestone: Honoring the University of Hawai‘i 2.2-Meter Telescope



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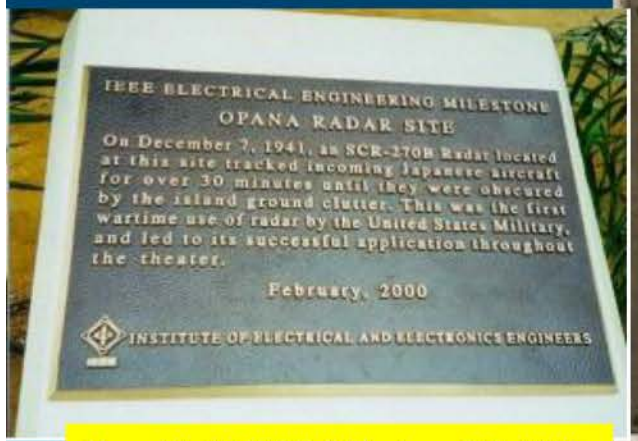
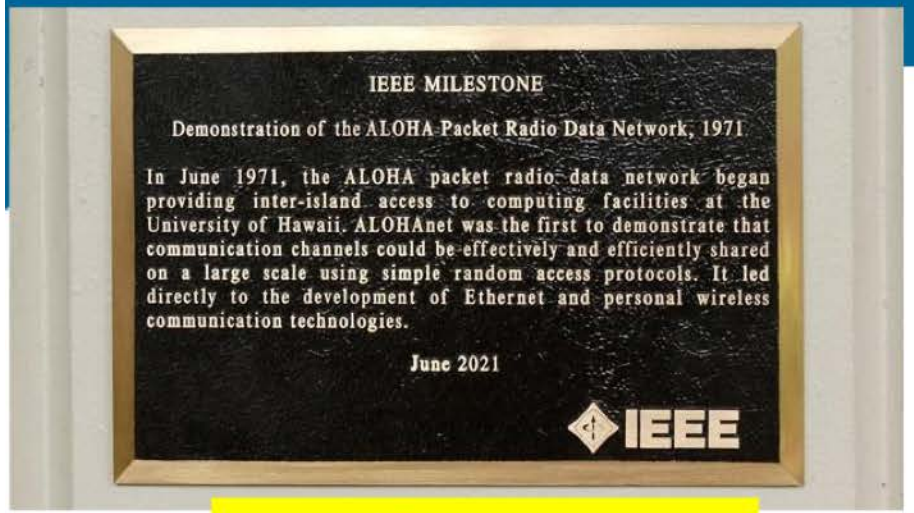
Hawaii IEEE Milestone Awards



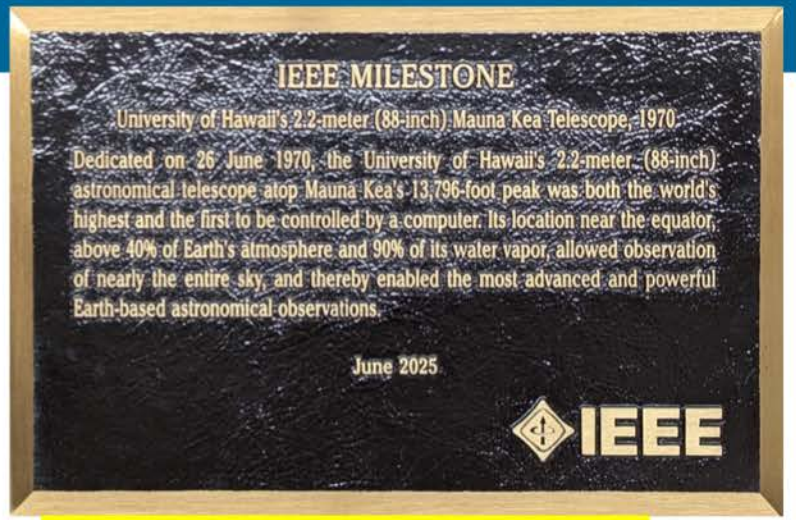
Hawaii's 1st IEEE-Milestone Feb 2000

Hawaii's 2nd IEEE-Milestone Nov 14, 2014

Hawaii's 3rd IEEE-Milestone March 23, 2018



Hawaii's 4th IEEE-Milestone Nov 2020

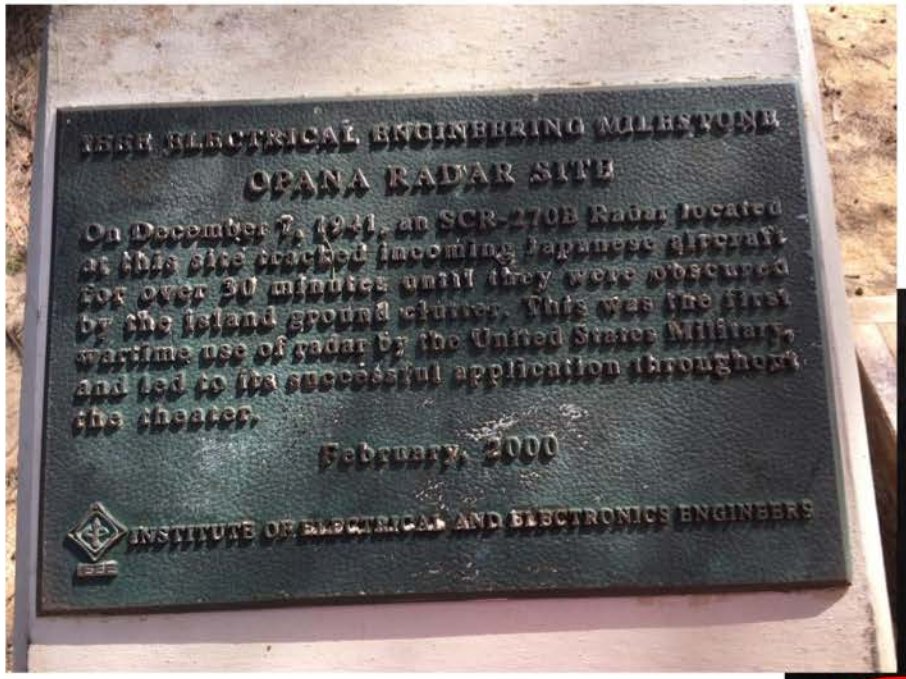


Hawaii's 5th IEEE-Milestone June 26, 2025

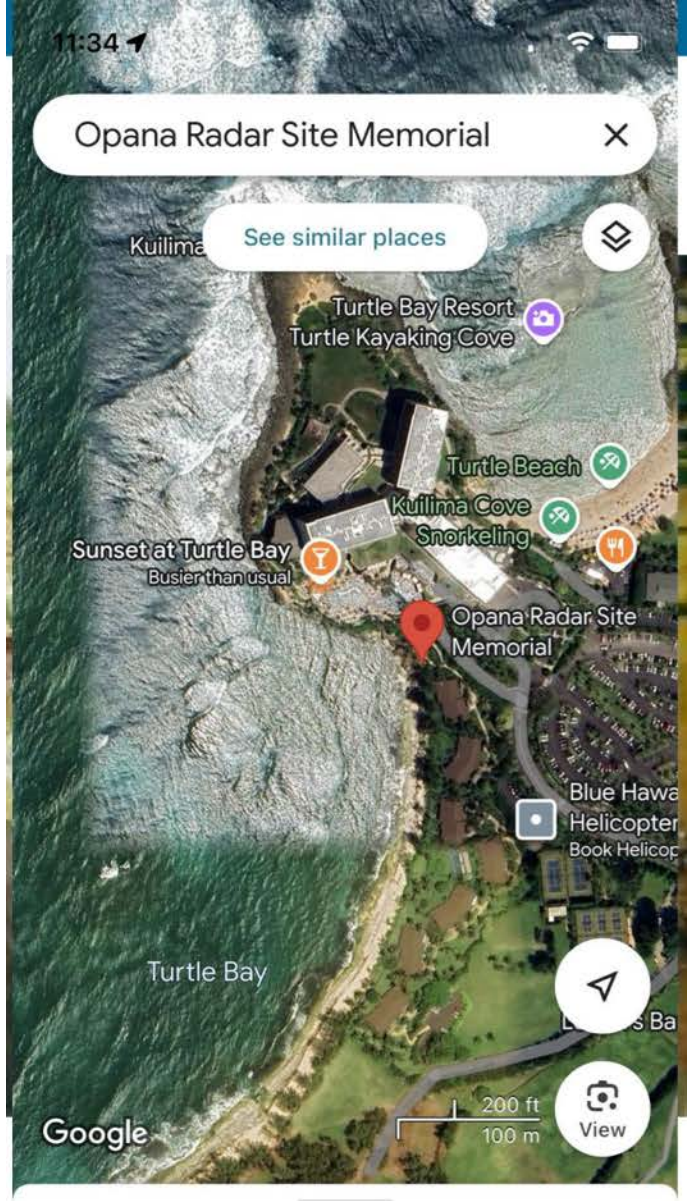
Celebrating Historic Achievements in Electrical Engineering and Computing

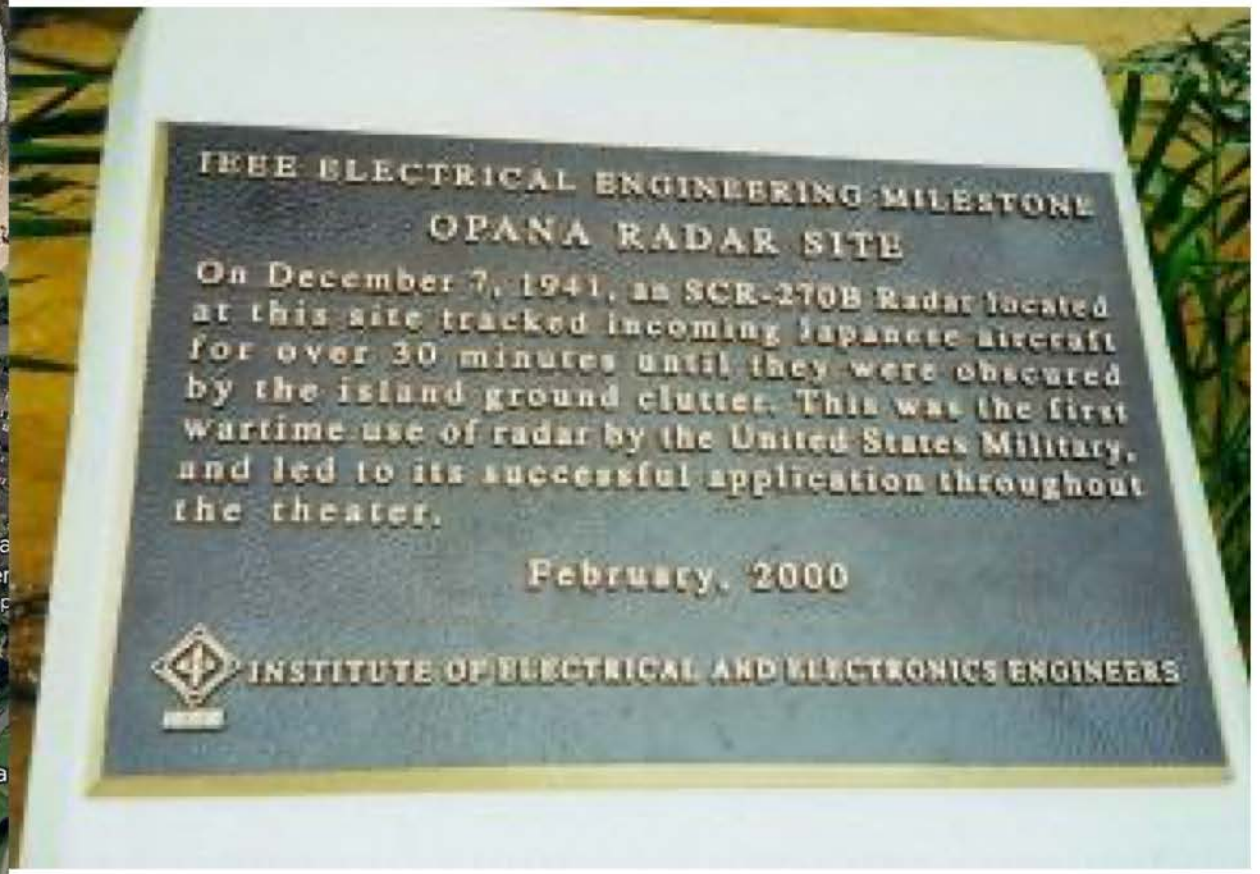
IEEE
Advancing Technology for Humanity

Hawaii's 1st IEEE-Milestone
Feb 2000: Opana Radar Site
(Dec 7, 1941)



IEEE Advancing Technology for Humanity





IEEE
Advancing Technology for Humanity

Hawaii's 3rd IEEE-Milestone March 23, 2018 (130th Anniversary)

Fig.2: Iolani Palace Throne Room with 72 electric lights on six chandeliers.

Located in the Gift Shop, Photo 6/24/25

IEEE Advancing Technology for Humanity

The historic timeline for this Milestone Award is listed below:

- 08/15/1881: On His Royal Highness (HRH) World Tour, King David Kalakaua visited the International Exposition of Electricity in Paris, France.
- 09/26/1881: King David Kalakaua visited Thomas Edison, inventor of the light bulb, in New York City for demonstration of DC electric light. HRH King Kalakaua was to decide if Honolulu should use gas or electricity for lamp/lighting.
- 07/21/1886: First demonstration of DC electric light in Hawaii-one (1) light at Iolani Palace, 1 light at Government building, 1 light on Richard Street and 2 lights on King Street.
- 11/25/1886: To celebrate King Kalakaua's 50th birthday, a Jubilee Ball with 10-arc lights of 2,000 candle power lit Iolani Palace grounds.
- March 1887: Three hundred twenty-five (325) incandescent lights were installed at Iolani Palace with 72 lights in the Throne Room and another 150 lights were installed at the Royal Hawaiian Hotel on Hotel Street.
- June 1887: The dynamo power plant located on Palace grounds provided power for the lights. [Four (4) years before the White House had Electric Lighting.]
- 03/21/1888: The Daily Bulletin Article "Honolulu Electric Works" energized dynamos for 50-arc lights and 12-arc lights. Dynamos and lamps were supplied by Thomson-Houston Co. of Massachusetts, [which eventually became **General Electric**].
- 03/23/1888:Town of Honolulu lighted by electricity on the evening of March 23, 1888, whenHer Royal Highness (HRH) Princess Liliuokalani turned on the circuit at the Nuuanu Electric Light Station. Two circuits run by a large and small dynamos at the Electric Light Station [hydroelectric plant] in the [Nuuanu] Valley. Long circuit is 15 miles and short is 6 miles on 46 poles.
- 1893: The electric plant was purchased from Kalakaua's estate by the Provisional Government who sold it the following year in 1894 to **Hawaiian Electric**. The plant was then moved into a larger building on the corner of Alakea and Halekauwila Streets.

IEEE Advancing Technology for Humanity

On July 29, 1891 *The Electrical Engineer, vol. 12* had an article on "Electrical Development In The Sandwich Islands" shown in Fig.3 below highlighting hydro-electric plants (dynamos driven by water-power) for electric lights and with foresight mentioned "submarine cable between the sandwich islands (Hawaii) and the American Continent" for communications which did not occur until 1964

ELECTRICAL DEVELOPMENT IN THE SANDWICH ISLANDS.

BY

As far as I am aware, little or nothing has ever been said about electrical development in the Sandwich Islands. I will therefore venture to tell the readers of THE ELECTRICAL ENGINEER, which is very well known in this part of the globe, what we have, what is needed, and what could be supplied with profit from the United States.

The Sandwich Islands are famous for their beautiful water-powers, and this power is being utilized for electrical work. The streets of Honolulu are lighted by 93 arc lights of 2,000 c. p. of the Thomson-Houston system, and the dynamos are driven by water-power. The same station furnishes 800 incandescent lights for residences and stores. This plant is the property of the Hawaiian Government. The Queen's Palace has a private plant of one Armington and Sims engine and two Thomson-Houston low-tension dynamos with a capacity of 600 lights. The Honolulu Iron Works have a plant of 75 lights, operated by a Mather incandescent dynamo. The Union Iron Works have an Edison plant of 75 lights. This enterprising concern have a Thomson-Houston motor in their pattern shop, and have now ordered a welding machine. The Oahu Railway has a private plant. The Waianae Plantation runs an arc system, not only out in the cane pieces but in the sugar mill. Nearly all the island steamers are furnished with electric light plants, annunciators, &c. The residences of planters on the other islands are also well supplied with the electric light.

Besides this, Mr. James Campbell, a wealthy land-owner, has installed at his Wikiki residence an accumulator plant furnished by the Edco Co., of Philadelphia; and Mr. Wilder, of the Wilder Steamship Co., has an accumulator plant at his residence. This is not a bad showing for the electric light.

The telephone industry is also in good condition. Honolulu itself has a population of 22,000 and a telephone system of 1,200 subscribers. On the island of Hawaii there are two telephone companies—the Hawaii Telephone Co. and the Hilo Telephone Co. The Maui Telephone Co. is on the island of Maui, and the Kani Telephone Co. is on the island of Kaui. The telephones in use are from the American Bell Telephone Co., of Boston. The large plantations have also extensive private telephone service of their own. All telephone instruments and material are free of duty when entered by the company itself, giving the company an advantage over the merchants in the importation of electrical goods. Copper wire is extensively used in the construction of telephone lines, because of the salt air. A No. 12 iron wire circuit 9 miles long has been known to fall to pieces in less than two years [illegible] action of salt water spraying on t[illegible]

Nov 2014 Milestone

There is also a general use of the telegraph in the island, and one hears a great deal about submarine cables between the Sandwich Islands and the American Continent. The great need of the kingdom is inter-island cable communication.

I might add that THE ELECTRIC[illegible] well-filled pages of electrical knowledge, [illegible] tisements, is a familiar periodical, found on every island of the group, in the workshop and the plantation, in government offices and in the importing houses of merchants, through whose agencies a large quantity of electrical goods is imported.

Nov 2020 Milestone

Hawaii's 2nd IEEE-Milestone Nov 2014 (June 19, 1964)

IEEE
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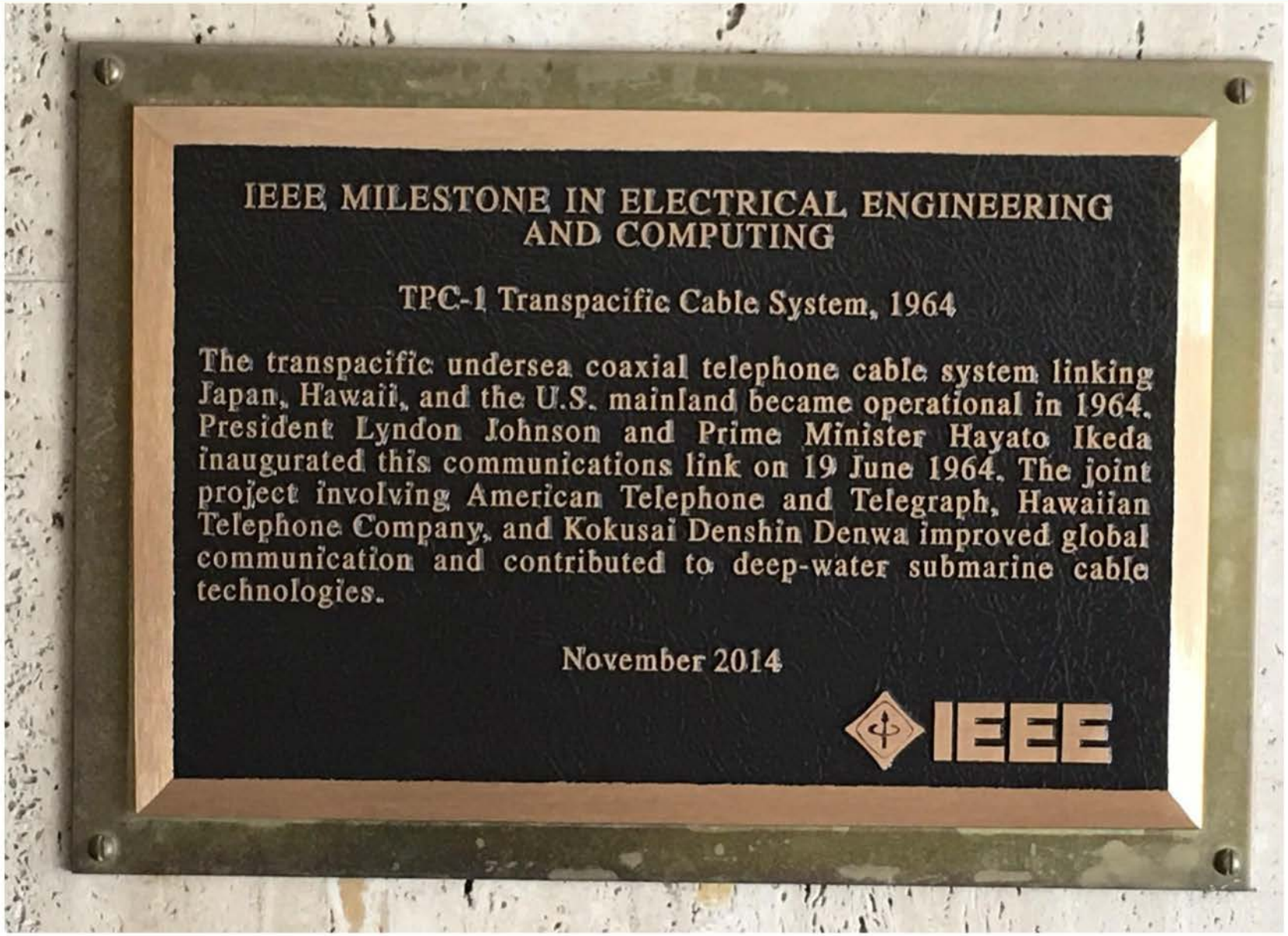
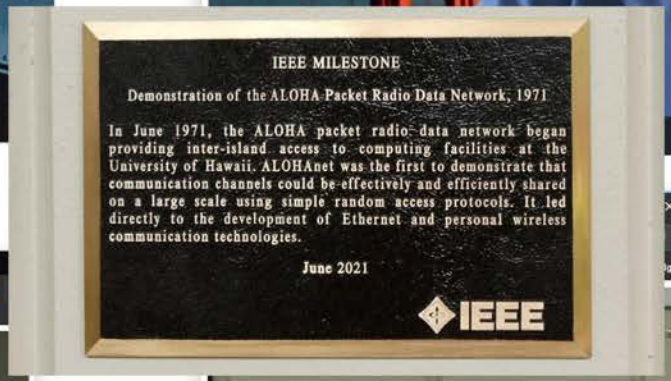


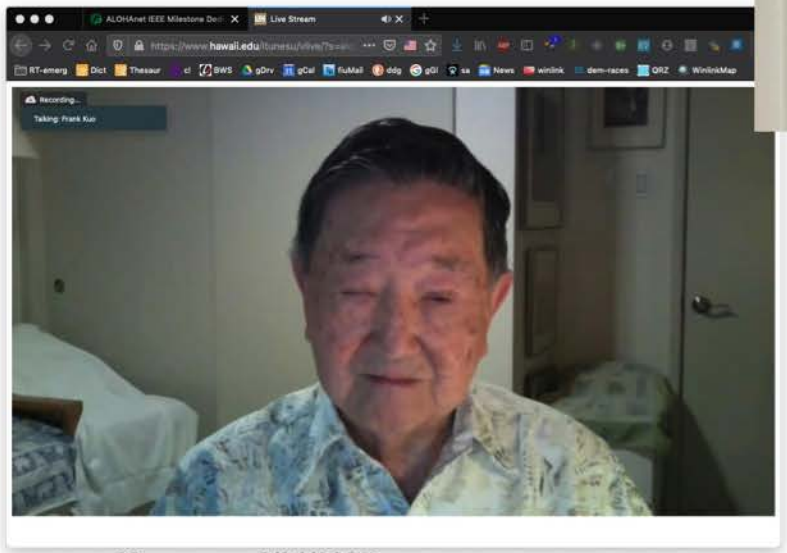
IEEE Advancing Technology for Humanity

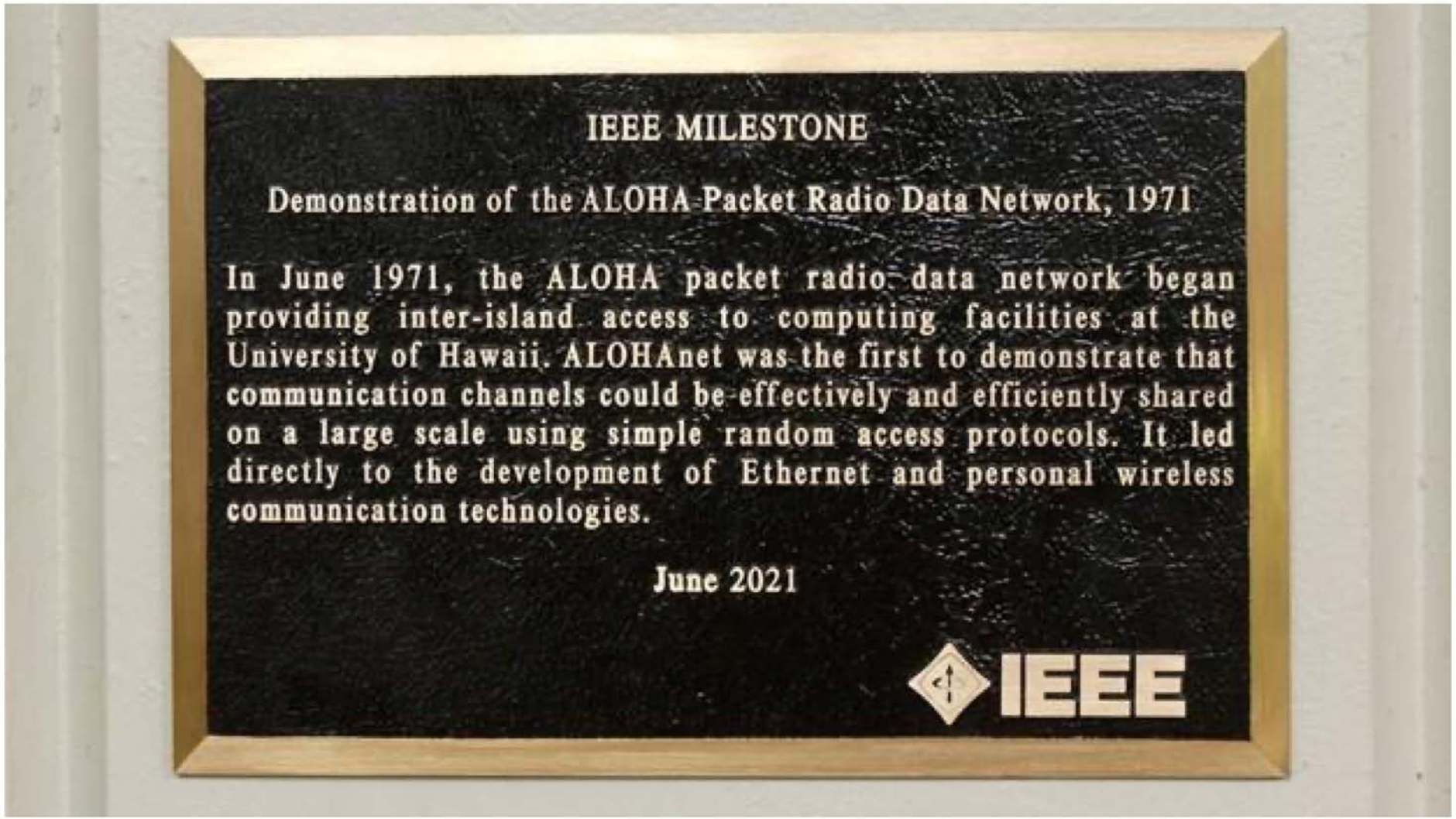
Hawaii's 4th IEEE-Milestone Nov 2020 (50th Anniversary)

Photo: Norm Abramson/University of Hawai'i at Mānoa

This user is operating the ALOHAnet hub machine, which used a random access protocol to transmit packets over a shared channel.






IEEE MILESTONE
Demonstration of the ALOHA Packet Radio Data Network, 1971
In June 1971, the ALOHA packet radio data network began providing inter-island access to computing facilities at the University of Hawaii. ALOHAnet was the first to demonstrate that communication channels could be effectively and efficiently shared on a large scale using simple random access protocols. It led directly to the development of Ethernet and personal wireless communication technologies.
June 2021
IEEE

Next?

First Wireless Communication Between Hawaiian Islands 1899

Marconi Kahuku Wireless Telegraph Station Creates Global Communications Around the Earth in 1914

In 1914 the Marconi Kahuku wireless telegraph station was the world's largest wireless communications center and is a registered national historic landmark. It played a critical role in providing the Hawaiian Islands with worldwide wireless telegraphic and later telephonic communications. The Hawaiian government learned that in March 1899 Marconi transmitted the first wireless messages across the English Channel between France and England and wanted it for transmitting messages between inter-island due to the failure of inter-island cable communication due to the deep ocean waters between islands. Marconi wireless telegraph stations were brought to Hawaii in 1899 forming Inter-Island Telegraph which later became Hawaiian Telecom Company. In June 1900 the first message was sent four miles from Iolani Palace to the Kaimuki station and was the first wireless transmission west of the Rocky Mountains. Five of the Hawaiian Islands were connected for the first time and the Kahuku station was constructed on the north shore of Oahu. For long range wireless telegraph signals, in 1912 the Marconi Corporation proposed "A Wireless Gridle around the Earth" using Kahuku station to connect stations on the US mainland with Japan/Asia. On Sep 24, 1914 the Kahuku long range station sent its first message to the President of the United States, Woodrow Wilson and by 1916 it was transmitting to Funabashi Station in Japan connecting Japan to the US mainland with wireless communication. In 1917 the US government took control of all wireless communication stations and after World War 1, RCA took control. Rapid development of Radio Technology made the station obsolete by 1919 and called "Junk".

IEEE Advancing Technology for Humanity

My motivation, Borland invited to give a half day seminar at Universidad de La Laguna on Tenerife, Canary Island, Spain Sep 19, 2019. Visited Teide Observatory

IEEE Advancing Technology for Humanity

First Meeting to Discuss Telescope Milestone Proposal Feb 2020

Subject:	**IEEE Milestone for our telescopes & related technology**
Date:	3/4/2020 10:48:59 AM Hawaiian Standard Time
From:	schoi@hawaii.edu
To:	smina002@fiu.edu, ekishore@gmail.com, johnoborland@aol.com
Cc:	baranec@hawaii.edu

Aloha e Steven, Kishore, John:

I wanted to update you on the discussion that we had at our last IEEE meeting regarding assistance to our astronomy counterparts.

Let me begin by introducing you to Dr. Christoph Baranec, who works on the adaptive optics at UH IfA. He has suggested several possibilities for a potential milestone recognition as one of our telescopes, the 2.2 meter one, is going celebrate its 50th this year.

I think there may be several paths to approach this, so let's start a conversation with Christph, and we can carve out the appropriate strategy to assist... Thanks.

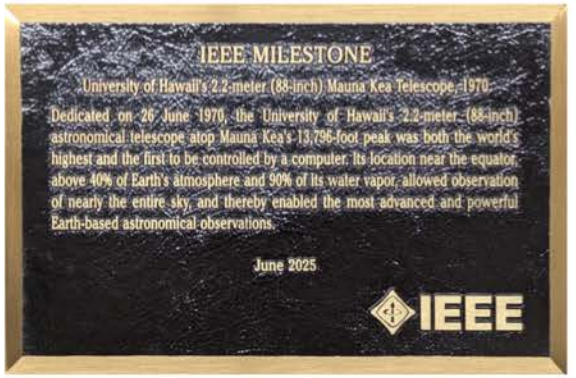
Aloha e Christoph,

Please meet the current, Mr. Steven Minikami, and past chairs, Dr. Kishore Erukulapati and Mr. John Borland, of IEEE Hawaii Chapter. We recently completed a milestone for Iolani Palace and electricity and working on the Aloha.Net and UHM one. I think we can try something similar to get/give recognition to astronomy and engineering in Hawaii. Hope we can start this conversation to get something generated. Thanks.

Aloha a me Mahalo Nui Loa,

Song

14



IEEE
Advancing Technology for Humanity

IEEE Milestone:

University of Hawaii's 2.2-Meter (88-inch) Mauna Kea Telescope, 1970

In 1964, Gov Burns of Hawaii, bulldozed a crude road to allow Gerard Kuiper, Director of Lunar and Planetary Laboratory, University of Arizona, access to the top of Puu Poliahu cinder cone on Mauna Kea for seeing tests. Kuiper concluded Mauna Kea was the best site in the world for ground-based astronomy. Due to the site elevation 13,796 feet (4,205 meters), it is above 40% of Earth's atmosphere and nearly 90% of atmospheric water vapor, which absorbs infrared wavelengths important for planetary surface characterization. Located near the equator, it enables observation of almost all the sky. Dedicated on June 26, 1970, the University of Hawaii 88-inch computer controlled, astronomical telescope became the world's highest. Providing much useful data in support of the Apollo missions to the moon in the 1970s and planetary missions, as well as stellar and galactic observations. In 1992, the discovery of the Kuiper Belt, distant objects beyond Neptune, led to the demotion and declassification of Pluto as a planet. The platform was also used to develop new tools for telescopes that are now industry standard on telescopes around the world including the Mauna Kea Keck observatory completed in 1992. The 2020 Nobel Prize award acknowledged the prestigious Mauna Kea Keck facility pioneering discovery that our galaxy has at its center a supermassive black hole (Sagittarius A) led by Andrea Ghez of UCLA. Today, it is fully automated with robotic remote control from UH-Hilo.

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What is the historical significance of the work (its technological, scientific, or social importance)? If personal names are included in citation, include justification here. (see section 6 of Milestone Guidelines)

In the late 1950's the space race started between the United States and the Union of Soviet Socialist Republics (USSR), leading to a great increase in interest in geophysics and planetary exploration. The University of Hawaii (UH) received funding from the National Science Foundation in 1961 to establish the Hawaii Institute of Geophysics (HIG), and one of the projects of this new institute was to build a solar observatory near the summit of Haleakala on the island of Maui. Haleakala reaches 3055 meters elevation and has a paved road enabling easy access to the peak.

Gerard Kuiper, Director of the Lunar and Planetary Laboratory at the University of Arizona, came to Hawaii to investigate the suitability of high-altitude sites for astronomical observatories. He visited the Haleakala site with his Native Hawaiian assistant, Alika Herring. Kuiper recognized the particular advantage of high-altitude sites as being above a significant amount of the earth's atmosphere and in particular, almost all of the atmospheric water vapor, which strongly absorbs infrared radiation. They found conditions on Haleakala "excellent", but subject to clouds and occasional fog. In the distance across the Alenuihaha Channel they could see the summit of Mauna Kea on the Big Island of Hawaii at 4,207 meters, and they noticed that it stood above the clouds almost all of the time.

At the invitation of Mitsuo Akiyama of the Hawaii Island Chamber of Commerce, Kuiper visited the Big Island in 1964. He traveled to the end of the road at Hale Pohaku, at the 2800 meter elevation where conditions seemed promising, but travel beyond this point was only possible on foot. Kuiper then met with Hawaii Governor John Burns who agreed to fund a bulldozer to cut a dirt road to Pu'u Poliahu, a peak next to the summit. By April that road was finished and a small concrete slab was poured to make up the foundation for a dome, and there a 12.5 inch reflecting telescope was placed. In June of 1964, Herring began measurements of atmospheric clarity (called "seeing") and of water content. Herring reported to Kuiper that on a scale of 0 (very poor) to 10 (perfect), many nights rated 9 or 10.

As was ultimately obvious to both Herring and Kuiper, the challenges of the location (addressed further below) were worth the cost and effort because of the quality of the viewing from the Big Island location. Being above the clouds is significant, but in addition being above the atmosphere in general reduces the impact of the air mass thermal instability on resolving power (how much can be clearly viewed). The air at lower elevations creates a scintillation effect on the images gathered, and this blurs content.

Kuiper proposed that NASA fund the relocation of a 28 inch telescope from the Lunar and Planetary Laboratory (LPL) to the top of Mauna Kea, which LPL would manage from their Tucson, Arizona location. As NASA administrators were concerned that LPL could be overextended, they solicited proposals from Hawaii and Harvard. At the time, the University of Hawaii didn't have an astronomy department – just a few solar astronomers led by John Jeffries at HIG. Jefferies enlisted UH President Thomas Hamilton to lobby the Hawaii State government, to provide roughly 3 million dollars for infrastructure . With Governor Burns' enthusiastic support, this funding was included in the UH proposal to NASA. On July 1, 1965, NASA awarded the contract to the UH.

At a June 26, 1970 dedication ceremony of the new observatory, Kuiper proclaimed "This mountaintop . . . is probably the best site in the world – I repeat – in the world, from which to study the Moon, the Planets, the Stars . . . It is a jewel! This is the place where the most advanced and powerful observations from this Earth can be made."

What obstacles (technical, political, geographic) needed to be overcome?

The largest problem was dealing with the location. The original dirt road was lengthened by adding some switchbacks, but was still unpaved and steep in sections. Travel time from concrete plants on the island was too long, and concrete would begin to set up in the trucks. To deal with this, a "batch plant" was set up below the summit cinder cone. Cement, sand, aggregate, and water were trucked up to the plant and mixed there, where it could be delivered to the construction site in a fraction of an hour.

The telescope itself was built by Boller and Chivens, a telescope manufacturer in Pasadena, California. Everything had to come up the long road to the summit site, and the telescope had to be designed for self-sufficiency. The observatory dome included a "horn" – an extension added near the top of the dome – that carried a crane, so the 88 inch mirror could be lifted out of the telescope and lowered into a wing of the building. There it could be placed in a large vacuum chamber where aluminum vapor could be deposited on the mirror to renew the reflective surface. Workers had to acclimatize to the altitude at the summit, and they lived in a temporary building at the end of the paved road at Hale Pohaku (Stone House) when not working. When completed the telescope was the first to be controlled by computer, an IBM 1800.

To be clear, light gathering systems are defined by a physical limiting function that has three parameters:

1. Wavelength

2. Distance to target

3. Aperture diameter

The relevant equation defines a direct relation between the diameter and the resolution (clarity) one can achieve with a system. Several smaller telescopes can only add up to one if they are fully coordinated down to the nanometer level, which was impossible in the 1970s, and which is still exquisitely expensive/difficult even in the 2020s (this coordination process is called phasing). By doing the extra work to build out the larger primary aperture, the value of the collector was improved dramatically.

It should be noted that the logistic difficulties in building this site in Hawaii were some of the most significant ever for the development of a scientific research location. These difficulties are greater only in Antarctica. Ultimately, the decision to build at the site was vindicated by the degree of collection success.

What features set this work apart from similar achievements?

Significance of the Technical Achievement and Historical Content:

1) In 1970, this was the world's highest computer-controlled astronomical telescope (UH News 6/26/2020).

2) In the 1970s, data collected was used to support Apollo missions to the Moon.

3) In the 1980s, the site studied and discovered dozens of Pluto-like objects (UH News 6/26/2020).

4) 1992 discoveries include the Kuiper Belt and distant objects beyond Neptune and this led to the demotion and declassification of Pluto as a planet. (UH News 6/26/2020).

5) The platform was used to develop new tools for telescopes that are now industry standard around the world (UH News 6/26/2020).

6) In 1992 the Mauna Kea Keck observatory was completed, and the 2020 Nobel Prize award acknowledged the prestigious Mauna Kea facility pioneering discovery that our galaxy has at its center a supermassive black hole (Sagittarius A). This effort was led by Prof Ghez of UCLA (Midweek 2/3/2021). The site became fully automated for remote robotic control from UH-Hilo (work done by Christoph Baranec).

As to the uniqueness of this site, there are only six other major observatories for astronomical collection:

1. Palomar (California)

2. Lowell (Arizona)

3. Haleakala Maui Scopes (Hawaii)

4. Aricebo (Puerto Rico)

5. Hubble (Space Telescope I)

6. Keck (Space Telescope II)

The great majority of the astronomical discoveries that define our cosmological understanding were made at these sites.

Supporting texts and citations to establish the dates, location, and importance of the achievement: Minimum of five (5), but as many as needed to support the milestone, such as patents, contemporary newspaper articles, journal articles, or chapters in scholarly books. 'Scholarly' is defined as peer-reviewed, with references, and published. **You must supply the texts or excerpts themselves, not just the references**. At least one of the references must be from a scholarly book or journal article. All supporting materials must be in English, or accompanied by an English translation.

1) University of Hawaii (UH) News article 6-26-2020: "Maunakea's First Large Telescope Celebrates 50 Years of Science".

a. UH's 88-inch (UH-88) telescope celebrated it's golden (50th) anniversary on June 26, 2020. Dedicated June 26, 1970, it was the 8th largest in the world. Today it is the smallest operational telescope on Mauna Kea. b. Decades of incredible scientific output, and unparalleled astronomy from Mauna Kea, the observatory continues to modernize and pave the way for others. c. Before digital cameras, astronomers manually guided the telescope using photographic plates and later analog electronic detectors. Today it is fully robotic with automated control systems with multiple cameras. d. It is the only telescope on Mauna Kea dedicated to UH astronomers. e. UH-88 was used to make important discoveries and develop tools that astronomers use at telescopes around the world and in space. i. Mark Rognstad Input: 1. In the 1970s, the UH-88 was used in support of the Apollo missions tracking the Moon landings sites. 2. In the 1980s, the UH-88 was used for robotic missions tracking deep space probes. ii. Starting in the 1980s the UH-88 was used to search for Pluto-like objects and found dozens. In 1992, discovered the Kuiper Belt, distant objects beyond Neptune. This led astronomers to realize Pluto was one of these large objects in the Kuiper Belt, which resulted in the demotion of Pluto from a planet. iii. New tools like "HAWAII" series of infrared imaging detectors (HgCdTe Astronomical Wide Area Imager). HAWAII arrays are now industry standard on many telescopes around the world. iv. In 2008, UH-88 was the first telescope on Mauna Kea to switch to fully automate remote observing.

2) Honolulu, Hawaii Midweek article 2-3-2021: "Starring Role: In Claiming the 2020 Nobel Prize in Physics, Astronomer Andrea Ghez Sheds New Light on Black Holes and Their Intimate Connection to the Evolution of the Milky Way". a. At the W.M. Keck Observatory on Mauna Kea, Prof Ghez made the pioneering discovery that our galaxy has at its center a supermassive black hole known as Sagittarius A (A-Star). b. 27 year-long effort leading up to the discovery of A-Star earned her the Nobel Prize and she's happy to share with Hawaii's prestigious Mauna Kea facility (Keck).

3) Christoph's e-mail dated 10-18-2022 showed current plaque on UH-88 site: NASA and NSF provided significant funding support for the UH-88 for Solar System Astronomy. See photo of site dedication plaque June 26, 1970 mentioning funds from NASA and NSF.

4) Partial transcript from John Jefferies interview 7-29-1977:

> a. At the end of 1963, after a site visit to Haleakala which had many other installations and was crowded, Kuiper also visited Mauna Kea, which was inaccessible to motor transportation. He liked what he saw better than Haleakala and put up a site testing dome.

b. In early 1964 after Gov Burns bulldoze a crude road to allow Kuiper access to the top of Puu Poliahu cinder cone, he installed a little U of AZ dome with a 10-12 inch telescope for seeing tests. Kuiper concluded Mauna Kea was the best site in the world for ground-based astronomy. c. In 1964 two groups, the Univ of Arizona and Harvard University had competing telescope proposal designs for NASA's $3M grant. d. On July 1, 1965 UH announced an award of $3M contract to build the UH-88. e. The primary "trouble" was with the control system, programmer working on the IBM 1800. This was one of the first computer-controlled telescopes if you include the Defense Department instruments that were computer controlled at the time. Integrating a telescope drive mechanism with the IBM 1800 computer involving instrumentation, electronic control, and electronic data acquisition system. Also, UH-88 needed electronic engineering in-house.

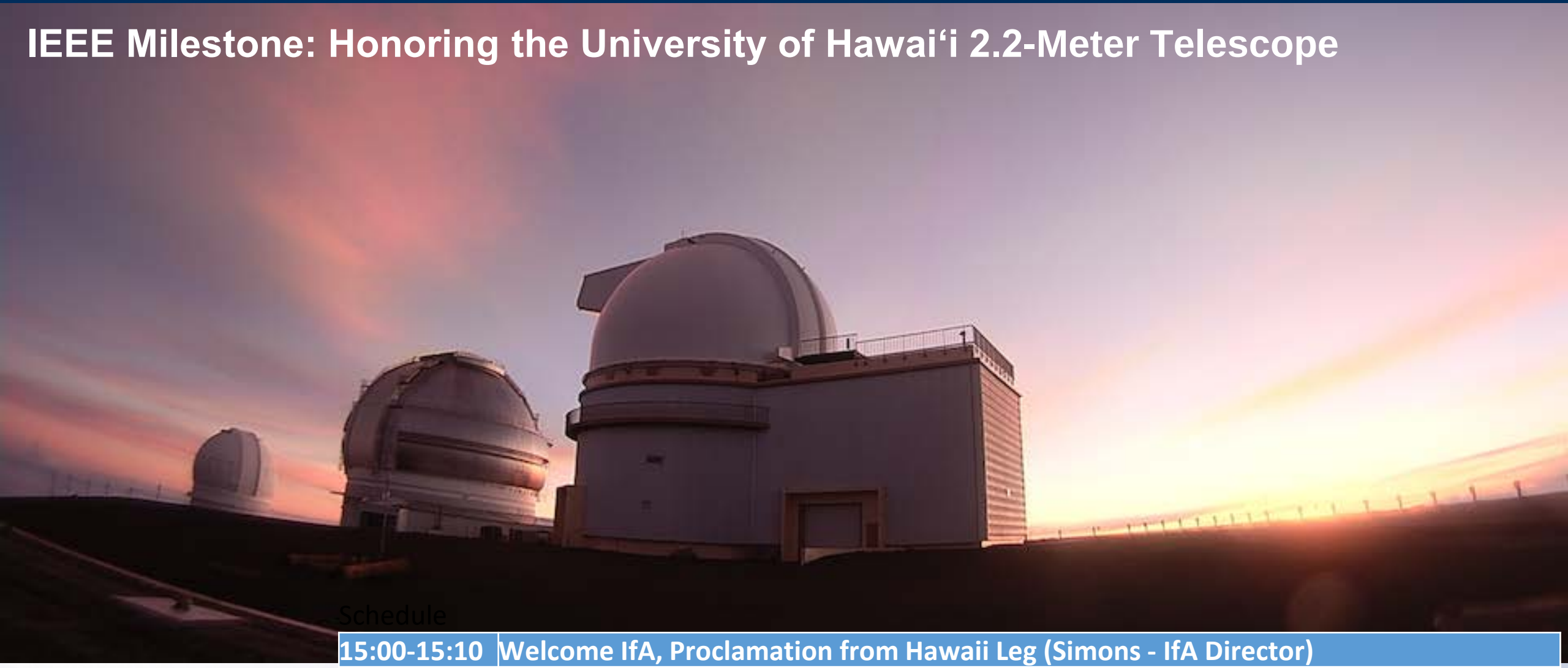
5) Encyclopedia Britannica report updated 2-12-2024: "Mauna Kea Observatory". See detailed report.

6) A Gentle Rain of Starlight: The Story of Astronomy on Mauna Kea Paperback – October 15, 2005by Michael J. West (Author).

7) A Sky Wonderful with Stars: 50 Years of Modern Astronomy on Maunakea (Latitude 20) Hardcover – Illustrated, July 31, 2015 by Michael J. West (Author).

8) Mauna Kea: A Guide to Hawaii's Sacred Mountain Paperback – November 15, 2013by Leslie Lang (Author), David A. Byrne (Author).

IEEE Milestone: Honoring the University of Hawai‘i 2.2-Meter Telescope



Schedule

15:00-15:10	**Welcome IfA, Proclamation from Hawaii Leg (Simons - IfA Director)**
15:10-15:20	IEEE and Its Milestone Program (Brian Berg)
15:20-15:40	Hawaii IEEE Milestones (John Borland)
15:40-16:10	Panel/Pictures/Stories (Ann Boesgaard, Alan Stockton, Bob McLaren, Mark Rognstad)
16:10-16:20	The Plaque Dedication
16:20-16:30	Closing Remarks (Mark Chun)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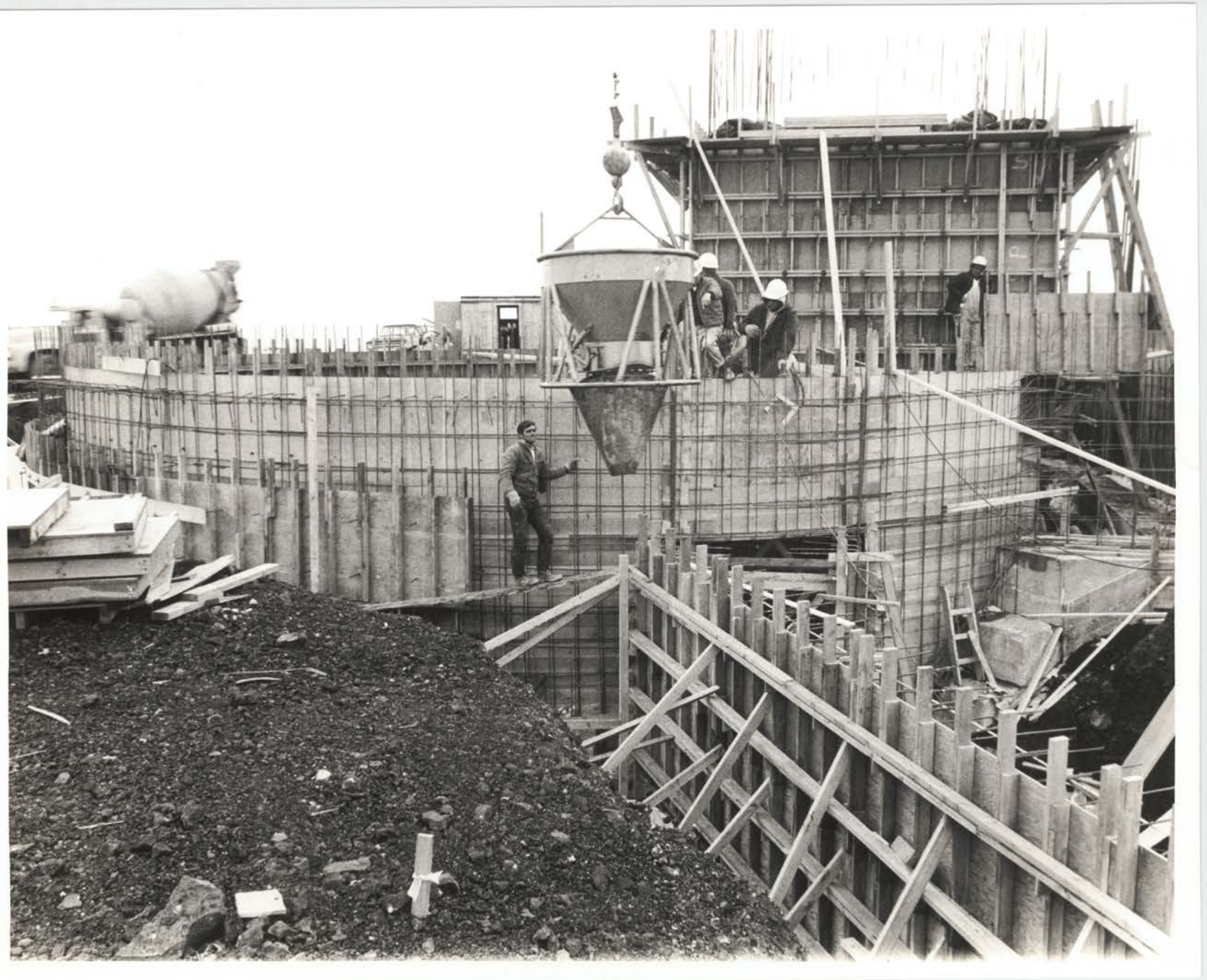
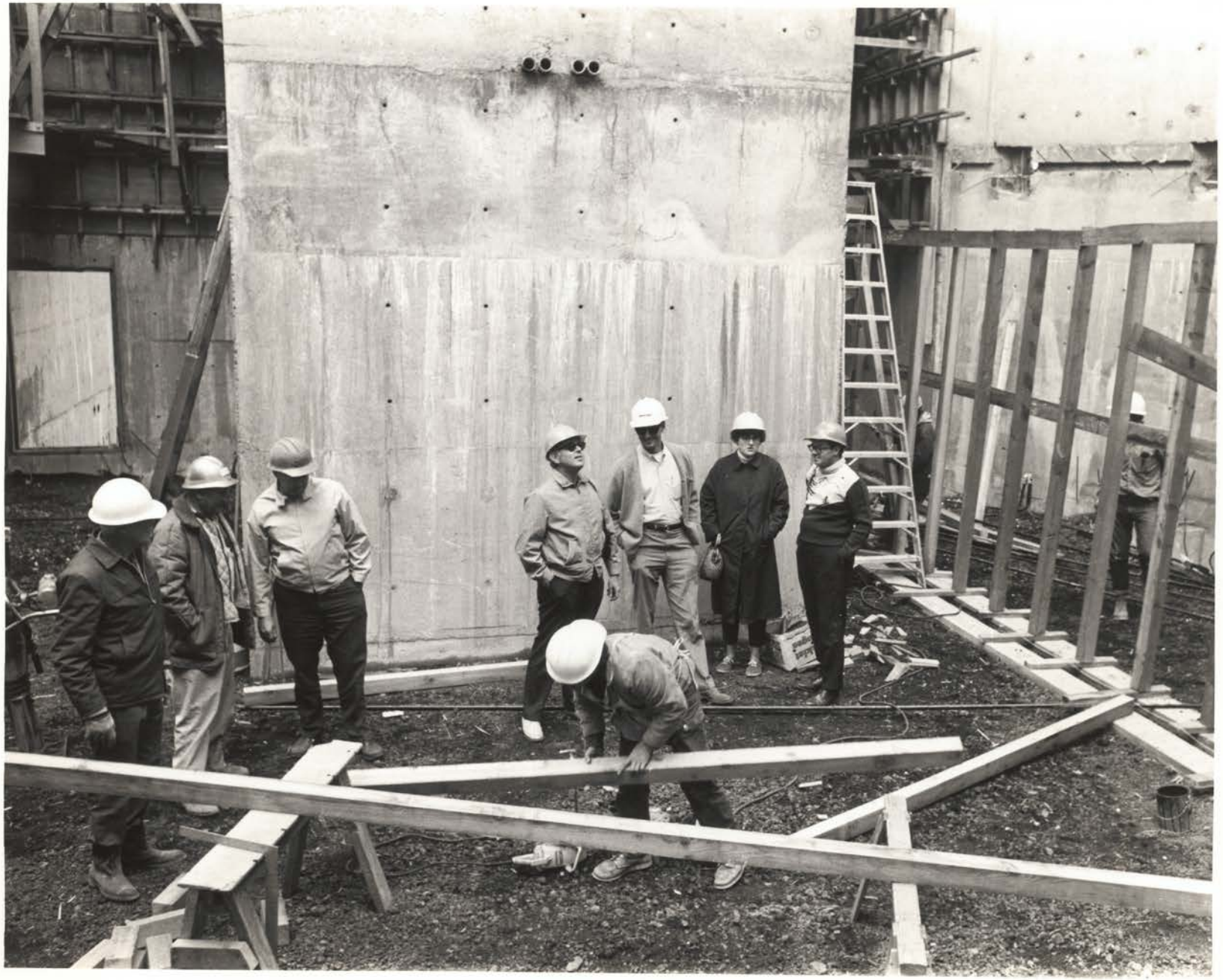
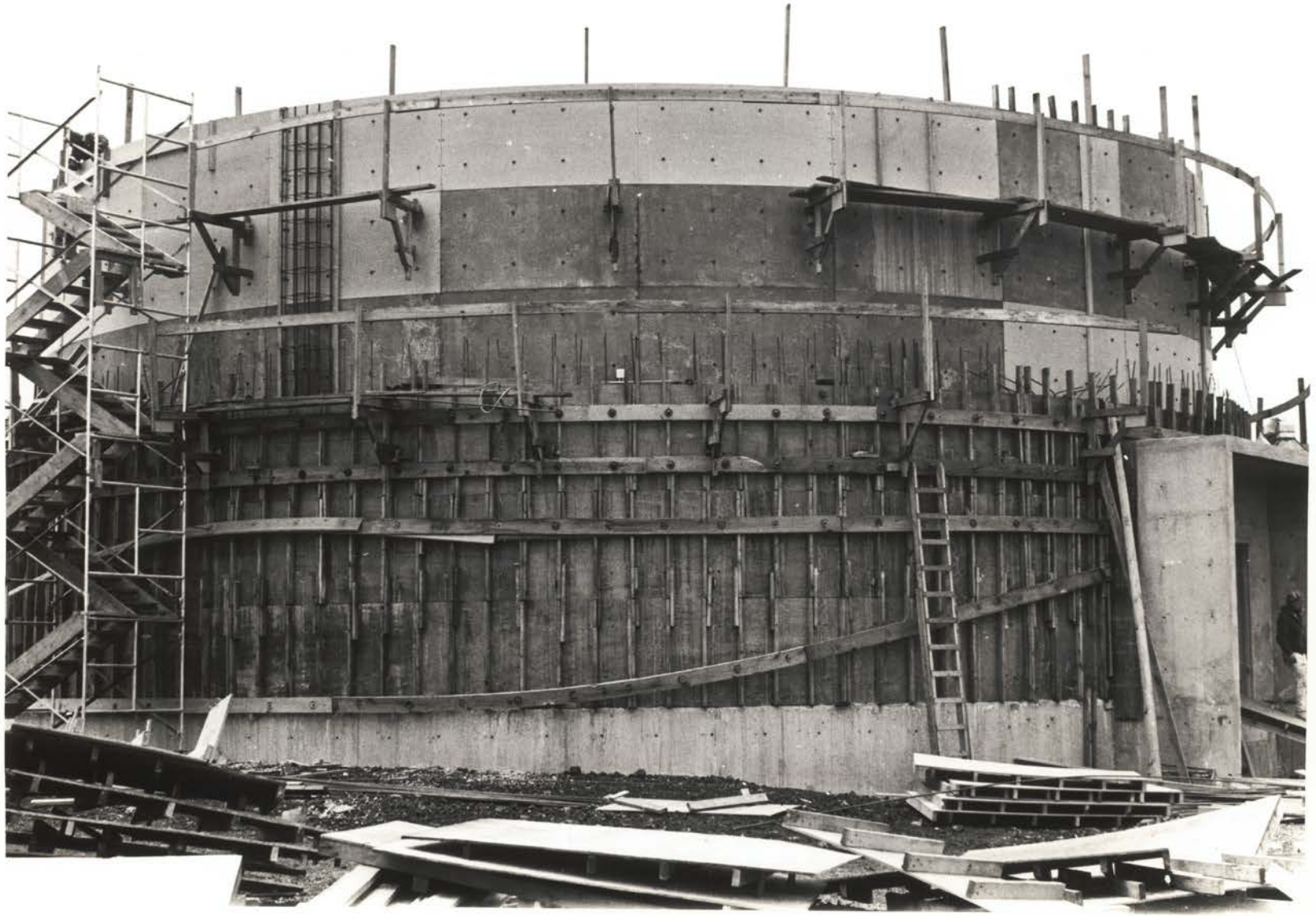
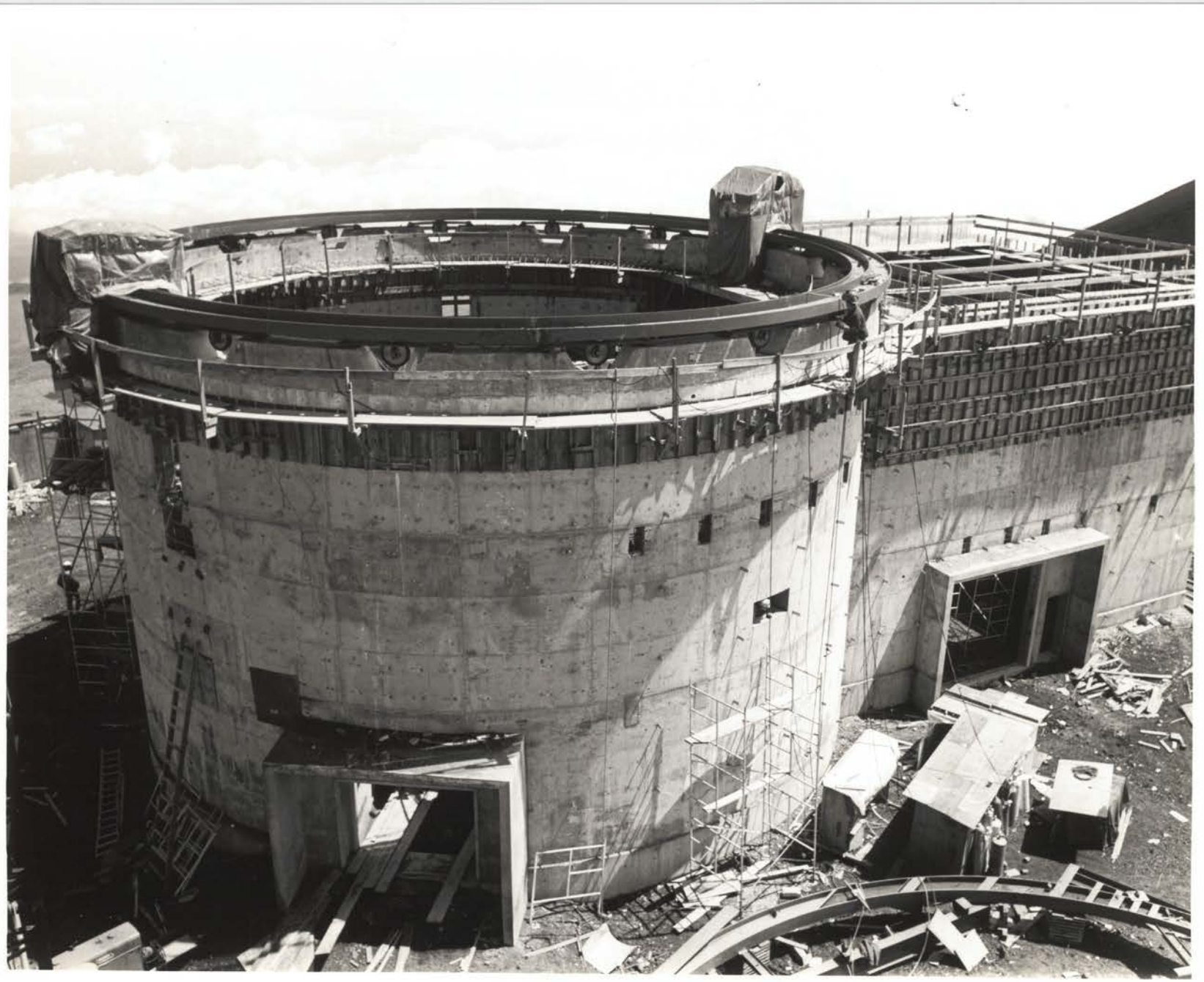
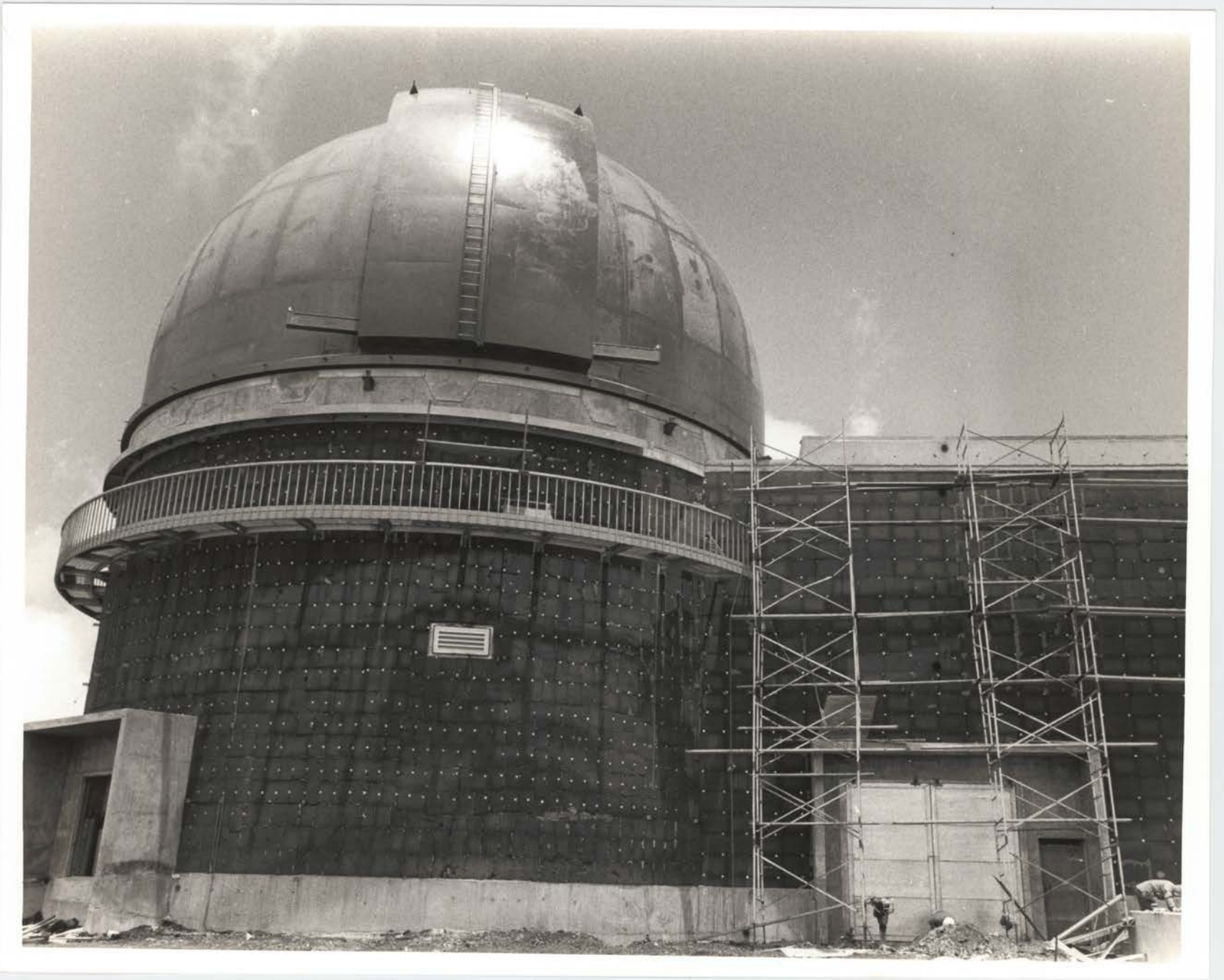
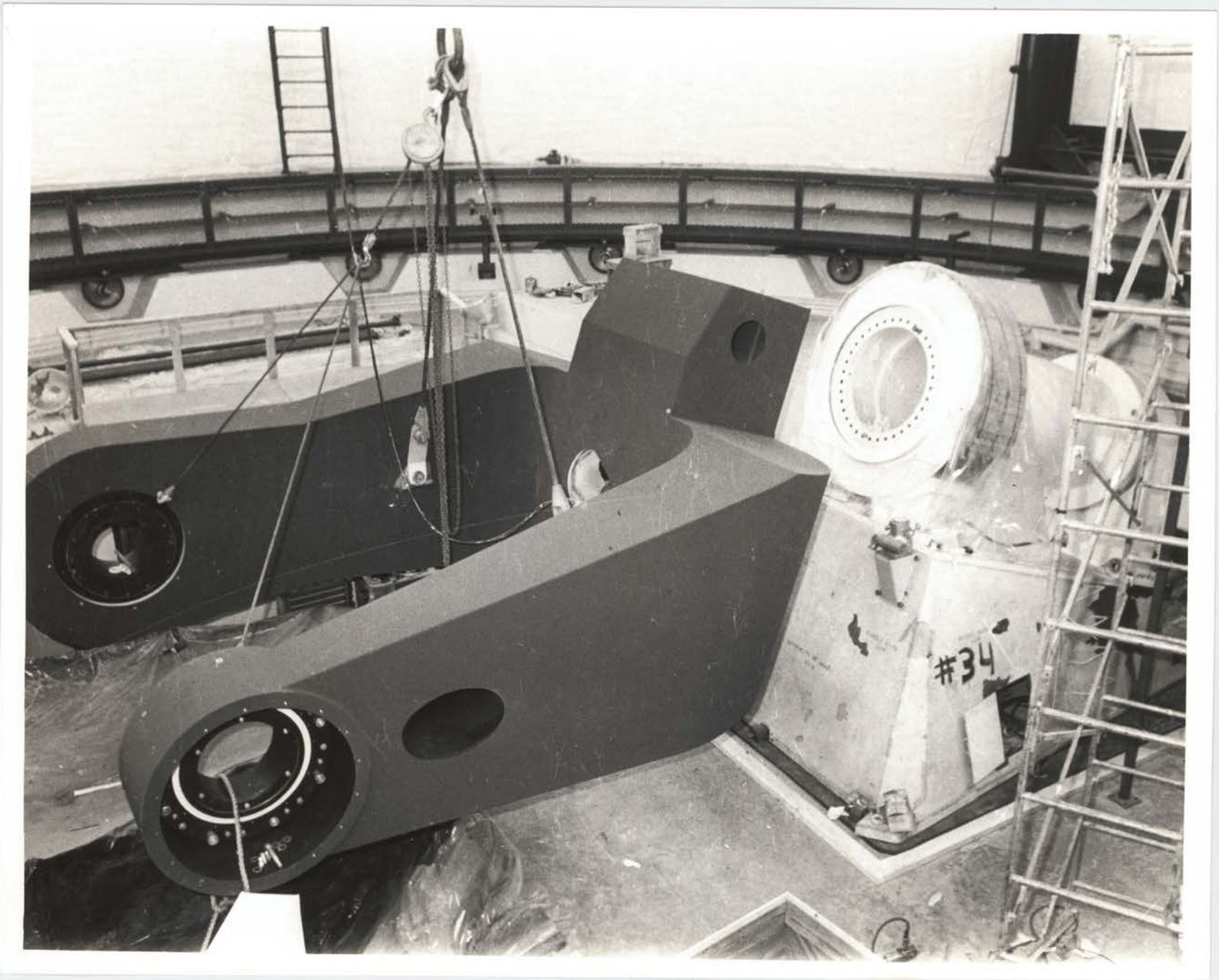











#34

By Ted Pollard
Journal Staff Writer

Middletown native Harold Allan Gray is helping the world keep an eye on the universe.

Gray, a graduate of Middletown High School and the son of a retired Middletown police officer, is currently project engineer on the instrumentation for Hawaii's relatively new University of Hawaii Mauna Kea observatory telescope, the highest astronomical facility in the world.

Three years ago the university and the National Aeronautics and Space Administration (NASA) completed an 88-inch (in diameter) telescope atop Mauna Kea mountain whose summit is over 13,700 feet. Mauna Kea is on the Big Island (Hawaii).

Gray was in charge of the installation of part of the computer interface equipment on the project, the optical analyzer system and other technical systems on the telescope.

And now, according to Gray's father, Harold, his son is now in charge of similar technology on an even newer development on Mauna Kea. (The former police lieutenant and head of the detective bureau retired from the force seven years ago. He has visited the Hawaiian islands several times since his son has been based there.)

The new development is a $20 million 120-inch infrared telescope that will be the primary viewing unit at Mauna Kea.

"Allan writes that the mirror (144-inches in diameter) will weigh some 15 tons and is being ground now in British Columbia," says Harold. The job of grinding the mirror, which began last summer, won't be completed until the end of next year.

The altitude of the

HAROLD A. GRAY
Project Engineer

telescope site is so lofty, says Harold. (he has been there but was there at the wrong time of the day to star gaze) that the younger Gray and his associates can only work for limited time periods because of the altitude which is above timber line. And while on site they can only work at 80 per cent efficiency.

After about three hours at the over-13,000-foot altitude, the men break for lunch in a specially conditioned room at the observatory, then early in the day they come down to a base camp at 9,000 feet for dinner, recreation and a night of sleep. (Harold Jr.'s home is in Kailua on the island of Oahu.)

The men spend about three weeks at a stretch on Mauna Kea.

THE NEW infra-red scope is being built with National NASA funds (NASA will also operate the facility) and the viewing time will be shared largely by Canada and France which shared the costs of the mirror. A smaller portion of viewing time will go to the University of Hawaii which, according to the university president, "is now certain to be one of the major international astronomic centers."

The younger Gray and his wife, Eleanor, and two sons have lived in Hawaii now for the past five years, a result of his work on the Mauna Kea project. Until 1969 he was biomedical instrumentation engineer with an aeromedical research laboratory at Holloman AFB, N.M.

A recent addition to the Marquis's Who's Who in the West, Gray received his bachelor's degree in electric engineering from Ohio State University where he also took postgraduate studies in astronomy, laser and electrical engineering. He is a 1953 MHS graduate.

He is expected to return to the United States later this year for more postgraduate studies at MIT.

Franklin business

enforcement of 2-

By Eric von Klinger
Journal Staff Writer

FRANKLIN — The Franklin downtown business association this morning voted in favor of strict enforcement of the two-hour parking limit on Main Street from Second Street to Sixth.

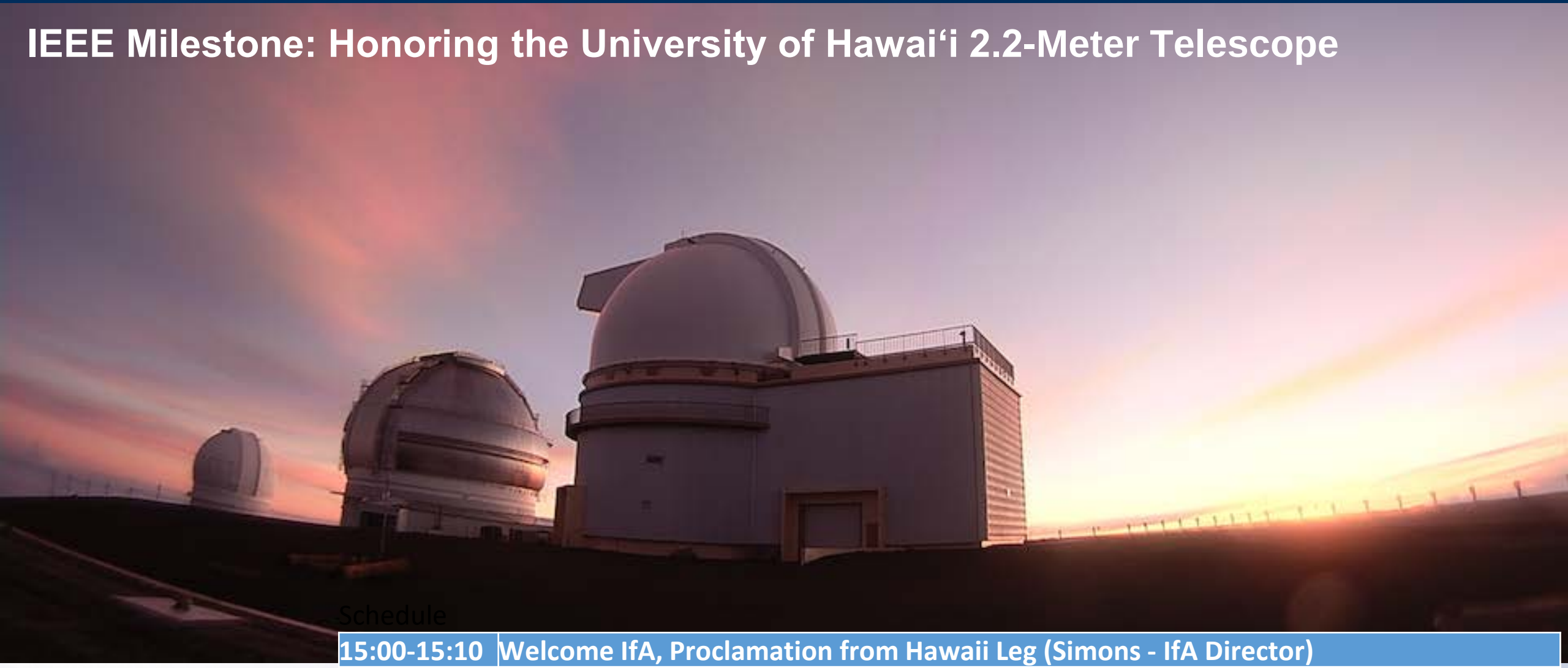
The group agreed to request that the city issue warning tickets for 30 days, then crack down on violators.

Gerald Miller of Miller

Franklin drill team wins contest

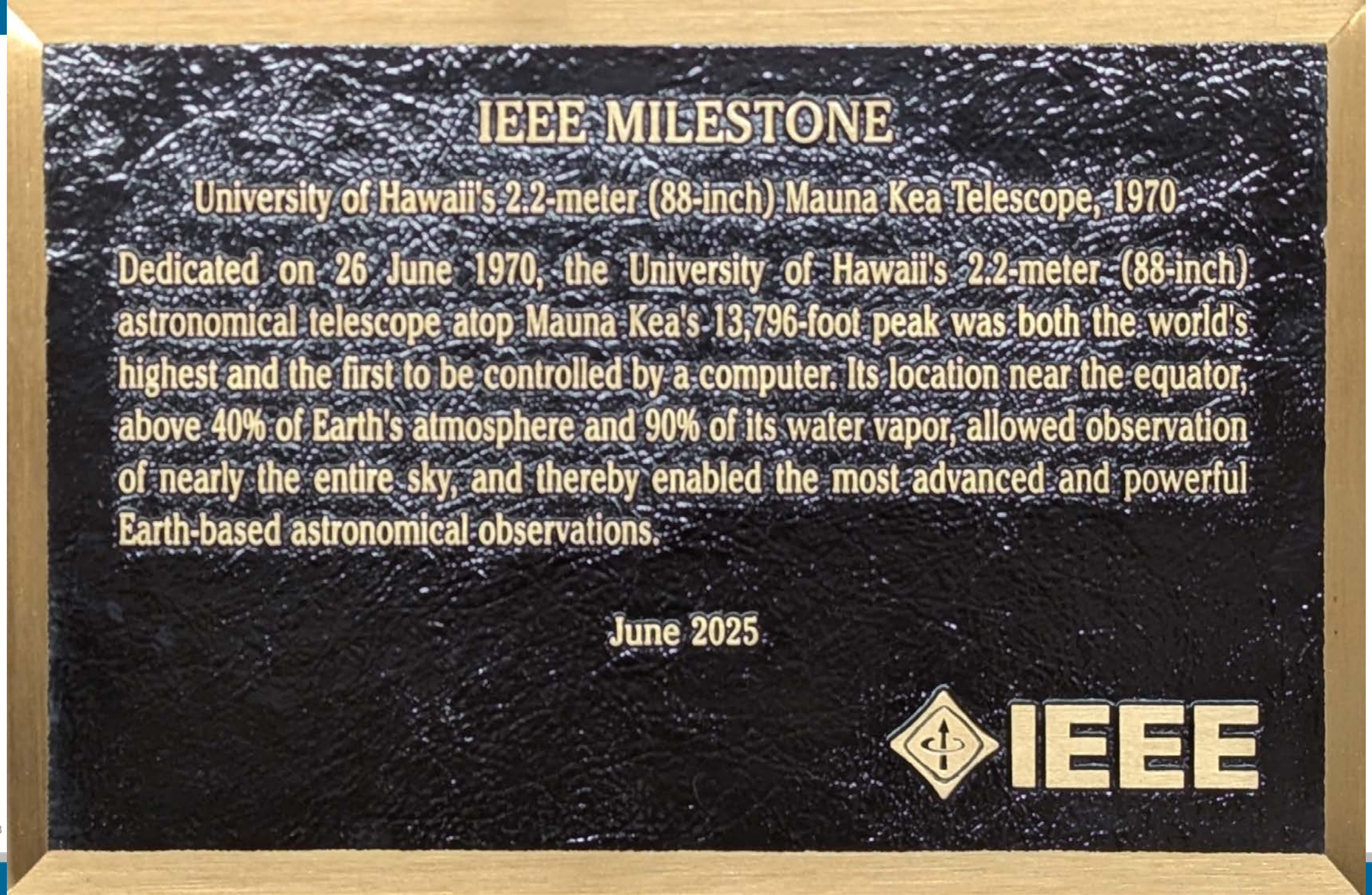
FRANKLIN — The 20-member "Franklinettes" drill team won first place honors in the Class B recorded music category,

IEEE Milestone: Honoring the University of Hawai‘i 2.2-Meter Telescope



Schedule

15:00-15:10	**Welcome IfA, Proclamation from Hawaii Leg (Simons - IfA Director)**
15:10-15:20	IEEE and Its Milestone Program (Brian Berg)
15:20-15:40	Hawaii IEEE Milestones (John Borland)
15:40-16:10	Panel/Pictures/Stories (Ann Boesgaard, Alan Stockton, Bob McLaren, Mark Rognstad)
16:10-16:20	The Plaque Dedication
16:20-16:30	Closing Remarks (Mark Chun)


IEEE MILESTONE
University of Hawaii's 2.2-meter (88-inch) Mauna Kea Telescope, 1970
Dedicated on 26 June 1970, the University of Hawaii's 2.2-meter (88-inch) astronomical telescope atop Mauna Kea's 13,796-foot peak was both the world's highest and the first to be controlled by a computer. Its location near the equator, above 40% of Earth's atmosphere and 90% of its water vapor, allowed observation of nearly the entire sky, and thereby enabled the most advanced and powerful Earth-based astronomical observations.
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