

STARS OVER

MAUNAKEA

Celebrating 50 years of
astronomy on Maunakea

Hawaii
Tribune  Herald

So much to be proud of

Some of the big questions generated by 20th century astronomy may be answered in the 21st century, and the Maunakea Observatories will be key to finding those answers.

Our knowledge of the origin and makeup of the universe is growing exponentially. A couple of decades ago, the only planets known to exist were in our solar system. Now we know that most stars have planets, and thousands of them have been detected directly, including from Maunakea.

Likewise, black holes were theoretical constructs throughout most of the 20th century. Now we know they are real, with some of the most compelling observations made to date coming from Maunakea.

What are some of the big answers that are potentially on the horizon stemming from the Maunakea Observatories? First, a closer look at Hawaii's only billion-dollar scientific research complex is needed to better understand how these answers will emerge.

Based upon the number and quality of publications, the Maunakea Observatories are collectively No. 1 worldwide in their scientific product. This is attributable to many things, including the exquisite nature of the site that produces some of the sharpest views of the cosmos on our planet.

It is also due to decades of investment by governments from around the world that sponsor pure research, like astronomy. The bulk of the \$70 million that is invested annually to operate the Maunakea Observatories passes directly into the local economy through the salaries of our local staffs.

Maunakea astronomy is an aggregator of innovation, new knowledge, clean high-tech jobs, educational opportunities, international funding, technology development, and global esteem in perhaps the most ancient and revered field of science.

Thanks to the 100-plus local companies that support the Maunakea Observatories, nearly \$100 million in annual economic impact is felt across Hawaii Island. Astronomy's economic impact statewide (\$175 million) is about half that of agriculture and forestry combined — a respectable contributor to Hawaii's economy by any measure.

With a 50-year legacy, the Maunakea

mana'o and timeless lessons connecting earth, sea, sky and spirit.

Though their wisdom, we are reminded of the sacred nature of this space, Maunakea, which links us to distant space. This ancient endeavor, astronomy, is framed today by Maunakea. It serves as a beacon to find our way home, a pristine portal on the universe, and in time, a symbol of peace. Nowhere else on Earth does this conjunction occur. Nowhere.

With that as background, what are some of those discoveries on our horizon when viewed from Maunakea?

Having helped establish how common planets are in our galaxy, next-gen research will focus on finding nearby habitable planets by dedicating sophisticated new instruments and large blocks of observing time to sweep the sky for the faint signatures of distant worlds.

If the Thirty Meter Telescope is built, biomarkers in the atmospheres of these planets stemming from life may be discovered, etching an accomplishment into the annals of history for Hawaii that will stand out for centuries. Having first proven that a massive black hole is lurking in the heart of our Milky Way galaxy, observations are being conducted worldwide (and, critically, from Maunakea) that will be used to capture an image of that black hole — another first.

Fantastically powerful new instrumentation under development now will be used to study and perhaps identify the nature of the dominant form of matter in the universe — dark matter. The recent Noble Award winning observations by the Laser Interferometer Gravitational-Wave Observatory of gravitational waves emitted from merging black holes has rekindled interest in the possibility that dark matter isn't some form of exotic particle, but countless primordial black holes created during the Big Bang. If true, in a startling sense, black holes may be critical for life.

Intrigued? Welcome to the frontier of new knowledge about the universe, about ourselves. We, the people of Hawaii, have so much to be proud of, including the beautiful Hawaiian culture that grounds our communities, and a legacy of discovery that in this century will help point the way for centuries to come.

Doug Simons is executive director of the 3.6-meter Canada-France-Hawaii Telescope and former director of the Gemini Observatory. This column was written at the request of the Tribune-Herald specifically for this publication.



Doug Simons

Executive director,
Canada-France-Hawaii Telescope

Observatories are connected to — and derived from — our community in countless ways. Community engagement and support, particularly of our keiki through education, is natural and central to the future of Hawaii astronomy. Key programs include:

- The Journey Through the Universe program that touches the better part of 10,000 students each year;
- AstroDays at the Prince Kuhio Plaza and Kona Commons that draw thousands;
- The Kama'aina Observatory Experience that provides monthly programs dedicated to the cultural, environmental, and scientific dimensions of Maunakea;
- The Akamai Intern Program that has trained hundreds of local college students in STEM fields;
- The Maunakea Scholars program that opens the doors to the Maunakea Observatories to high school students across the state to conduct their own research projects.

All of these impactful local programs demonstrate the commitment of the Maunakea Observatories to the community from which we come.

Of course, what makes all of this possible is the people of Hawaii, in particular those of the First Nation of Hawaii that first called these islands home centuries ago and created a lasting cultural treasure that serves as the foundation for Hawaii's future. None of this would be possible without their

STARS
OVER
MAUNAKEA

Credits

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The birth of an institute

How a bold idea a half century ago put Maunakea at the forefront of astronomy

By TOM CALLIS
Hawaii Tribune-Herald

The story of modern astronomy in Hawaii begins not on Maunakea, but on Haleakala.

In the early 1950s, Walter Steiger, then a physics professor at the University of Hawaii at Manoa, began thinking about building a solar observatory.

He wrote in "Origins of Astronomy in Hawaii" that

Mauna Loa, Maunakea and Haleakala were all considered. Mauna Loa was too volcanically active, and Maunakea, at the time, was too remote and lacked an access road.

It was Maui's Haleakala, translated as "House of the Sun," then that became home of Hawaii's first solar observatory in 1962.

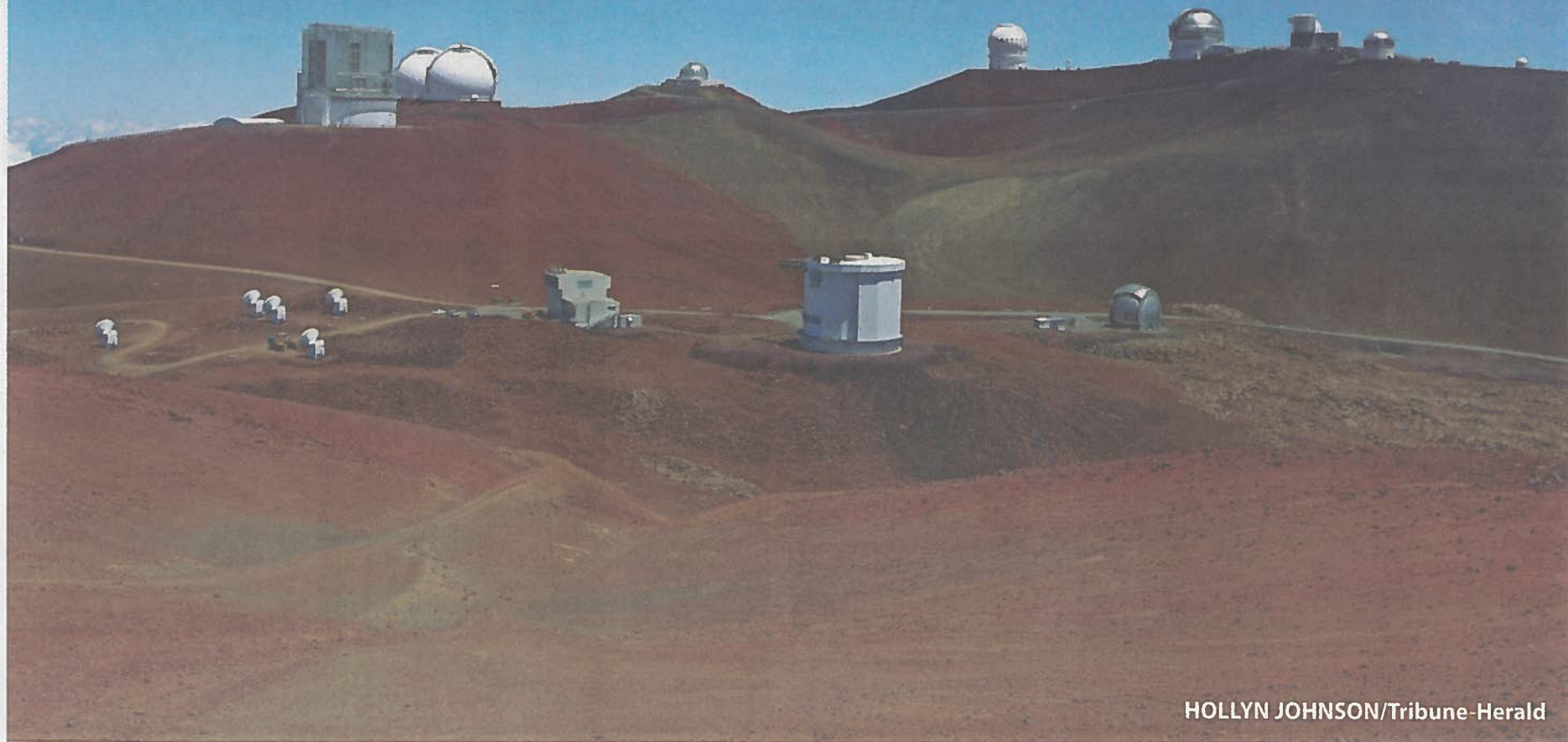
Conditions for observing on the mountain were extraordinary on most days, but, at 10,000 feet tall, Haleakala was not always high

enough to be above the clouds.

This became apparent to the world-renowned astronomer Gerard Kuiper, who was studying site conditions there following groundbreaking of the solar observatory with his assistant, Alike Herring. An even better location was not hard to spot.

"Looking across the channel to the Big Island, Kuiper could see the summit of Maunakea

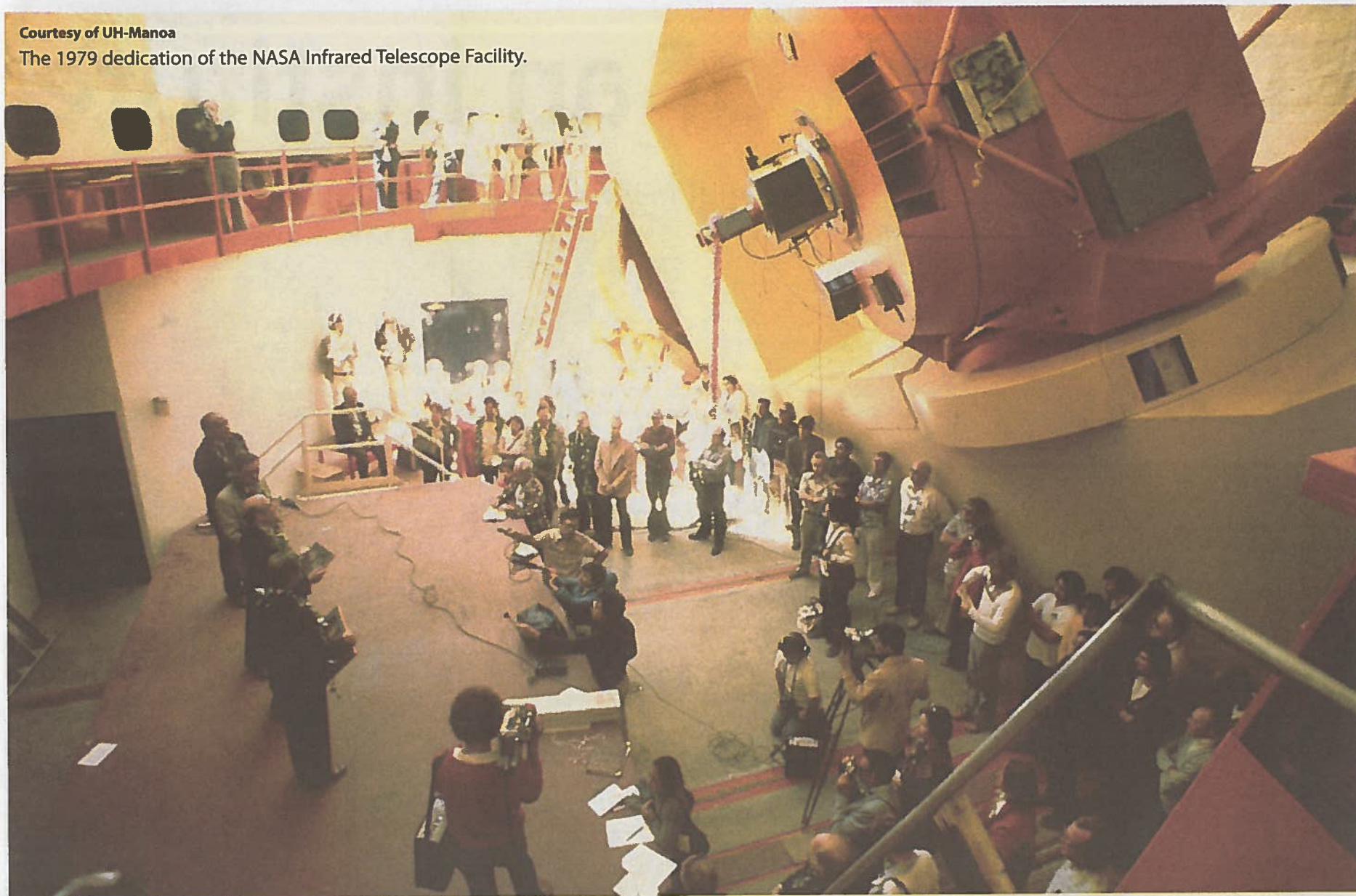
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HOLLYN JOHNSON/Tribune-Herald

Courtesy of UH-Manoa

The 1979 dedication of the NASA Infrared Telescope Facility.



INSTITUTE From page 3

high above the clouds and wondered if that peak might not be a better site," wrote Steiger, who died in 2011. He was not the only one thinking about Maunakea, which sits at 13,796 feet above sea level.

Following the 1960 tsunami that devastated Hilo, the Hawaii Island Chamber of Commerce began looking at astronomy as a way to boost the local economy. Mitsuo Akiyama, then the organization's executive director, invited Kuiper to come give Maunakea a look. "We wrote to about 1,000

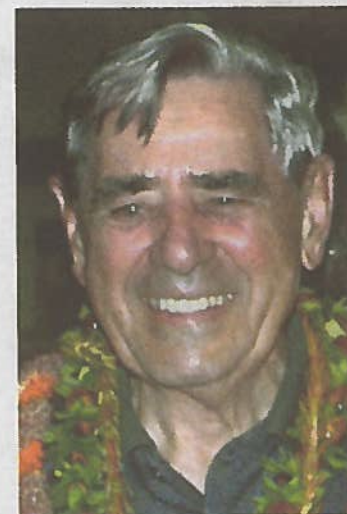
mainland universities and said, 'We have an empty mountain on Maunakea. Why don't you folks take a look at it and do something about it,'" Akiyama told the Tribune-Herald a year before his death in 2004. Kuiper was the only one to reply. Gov. John Burns was on board with the idea and released \$42,000 to build a jeep trail to the top. The road was complete in 1964, and a small dome with a 12.5-inch telescope was placed on Pu'u Poliahu to test the site.

Today, the only evidence that remains is a flat area

up top and a small piece of concrete, possibly part of the foundation, poking through the cinder. The pu'u, which would be restored under conditions of the proposed Thirty Meter Telescope, offers views of Lake Waiau and most of the existing observatories.

"It was more of a sight-seeing visit," recalled John Jefferies, who at the time was leading the solar program at UH's physics department. He would become the first director of UH-Manoa's Institute for Astronomy in 1967.

"I wanted to know what it looked like and how it



John Jefferies

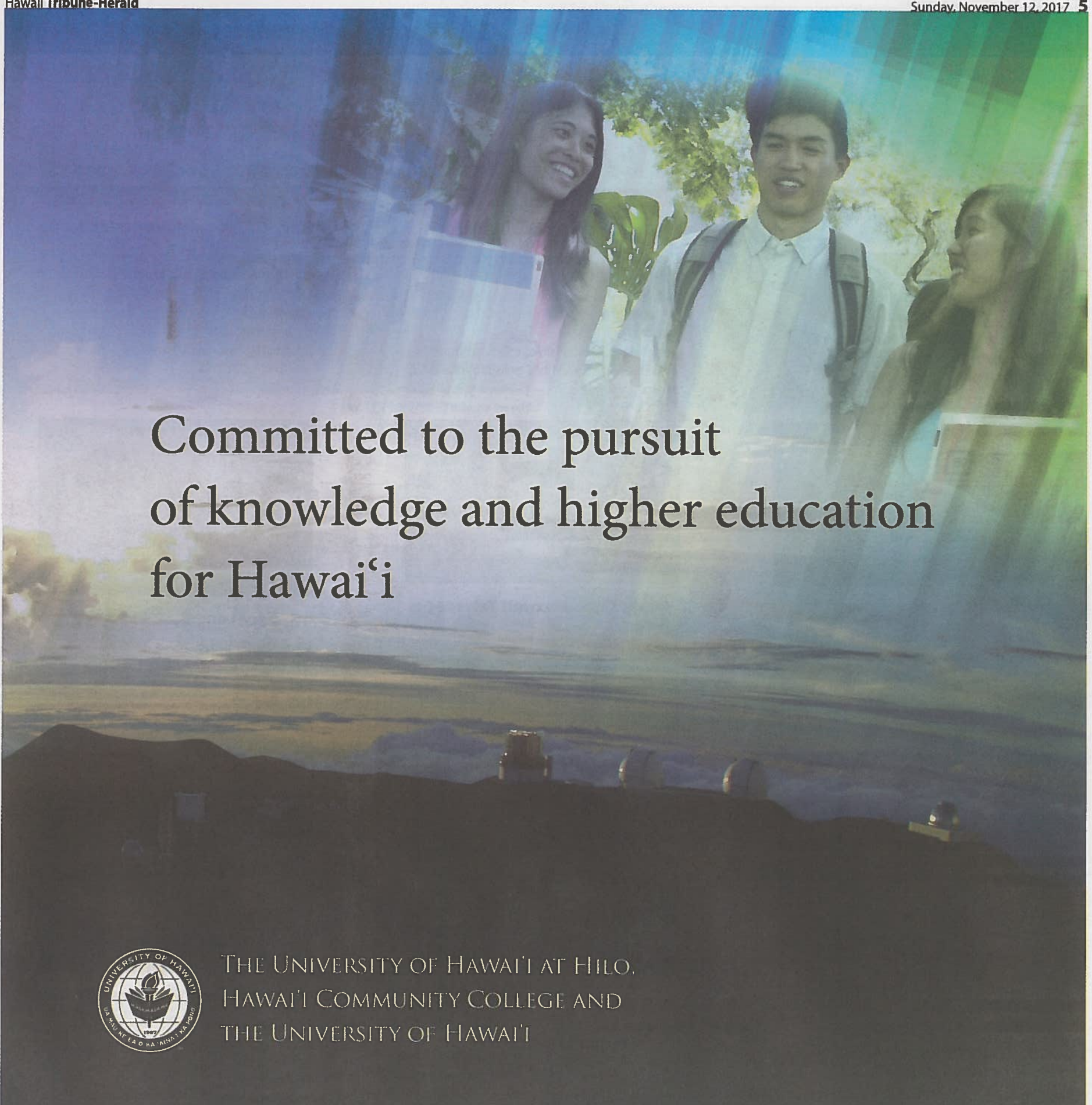
Former director, UH Institute for Astronomy



Walter Steiger

Former UH physics professor

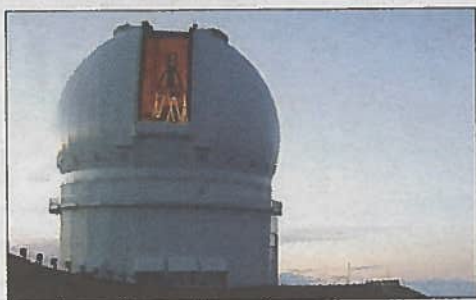
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Canada-France-Hawaii Telescope

Mirror size: 3.6 meters
Wavelength: optical, near infrared
First light: 1979
Employees: 47
Headquarters: Waimea
Operated by: The National Research Council of Canada, Centre National de la Recherche Scientifique of France and University of Hawaii.



Smithsonian Astrophysical

Mirror size: 8-by-6 meters
Wavelength: submillimeter
First light: 2002
Employees: 24
Headquarters: Hilo
Operated by: Smithsonian Astrophysical Observatory and Academia Sinica Institute for Astronomy and Astrophysics



United Kingdom Infrared Telescope

Mirror size: 3.8 meters
Wavelength: optical, near infrared
First light: 1979
Employees: 3
Headquarters: Hilo
Operated by: East Asian Observatory



Keck Observatory

Mirror size: Keck I (10 meters) Keck II (10 meters)
Wavelength: Keck I – optical, near infrared, Keck II – optical, near infrared
First light: Keck I, 1993; Keck II, 1996
Employees: 126
Headquarters: Waimea
Operated by: Caltech/University of California



James Clerk Maxwell Telescope

Mirror size: 15 meters
Wavelength: submillimeter
First light: 1987
Employees: 35
Headquarters: Hilo
Operated by: East Asian Observatory (Japan, China, South Korea, Taiwan). The United Kingdom and Canada are JCMT operational partners.



Very Long Baseline Array

Mirror size: 25 meters
Wavelength: radio
First light: 1992
Employees: 40
Headquarters: Socorro, New Mexico
Operated by: Long Baseline Observatory



Subaru Telescope

Mirror size: 8.3 meters
Wavelength: optical, near infrared
First light: 1999
Employees: 103
Headquarters: Hilo
Operated by: National Astronomical Observatory of Japan



University of Hawaii

Mirror size: 2.2 meters
Wavelength: optical, near infrared
First light: 1970
Employees: 6
Headquarters: Honolulu
Operated by: University of Hawaii



NASA Infrared Telescope Facility

Mirror size: 3 meters
Wavelength: optical, near infrared
First light: 1979
Employees: 25
Headquarters: Hilo
Operated by: Planetary Science Division for NASA



Gemini Northern Telescope

Mirror size: 8.1 meters
Wavelength: optical, near infrared
First light: 1999
Employees: 200
Headquarters: Hilo
Operated by: Association of Universities for Research in Astronomy



University of Hawaii

This UH-Hilo teaching telescope is not operational and is expected to be decommissioned.



Caltech Submillimeter Observatory

Mirror size: 10.4 meters
Wavelength: submillimeter
First light: 1987
Note: This telescope is in the process of being decommissioned.

Maunakea telescopes

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ASTRONOMY'S NEXT GENERATION OBSERVATORY

INSTITUTE

From page 4

compared with Haleakala," Jefferies said. "It wasn't really with the thought of transferring the observatories or initiating a new program on Maunakea. We had enough on our plate as it was."

But the results were clear as the sky above Maunakea: The conditions were the best Kuiper and Herring had seen.

After the success of the test site, Kuiper, who was then the director of the Lunar and Planetary Laboratory at the University of Arizona, approached the National Aeronautics and Space Administration for funding to build a telescope on the mountain.

But NASA decided to open the competition and invited UH and Harvard University to submit proposals, in addition to the University of Arizona, according to Jefferies.

"(Kuiper) wanted it for planetary studies," said Jefferies, 92. "Harvard wanted it for general astronomy studies to support their residency program."

He saw an "enormous opportunity" for UH.

"Here is a possibility for us to build an institute ... that would be world-class because the site was world-class," Jefferies said.

He proposed an 88-inch (2.2-meter) telescope, which, to Kuiper's dismay, received NASA's backing and \$3 million. The telescope was complete in 1970 and is still in operation.

"The opportunity, in fact, matured into the institute as it is today," Jefferies said.

Before the 88-inch telescope was complete, two smaller telescopes, both with 24-inch mirrors, were placed nearby, he said.

The first was built in 1968 on the current site of the Hoku Kea dome. The other, built in 1970 at the site of the Gemini telescope,



Courtesy of UH-Manoa

Canada-France-Hawaii Telescope groundbreaking on July 2, 1974. From left: Guy Vachon, Rev. Israel Kamoku, John Jefferies, Roger Cayrel, Kenneth Wright and John Hoag.

according to the Maunakea Outreach Committee's website, was later removed.

Still, there were skeptics about building telescopes on a such a tall mountain, where oxygen levels are 40 percent lower than at sea level.

"Some thought it was ridiculous at that height," Jefferies said. "They didn't think people would be able to operate."

An oxygen enrichment device was installed, but operators were able to work without it, he said.

Barracks constructed at about 9,200-foot elevation were later expanded to become the Hale Pohaku mid-level facilities, which provides housing and meals for construction workers, astronomers and telescope

operators. It also offers a place for them to get acclimated to the altitude.

The next astronomy facilities to be built on Maunakea were the NASA Infrared, United Kingdom Infrared and Canada-France-Hawaii telescopes in 1979.

But in the intervening years, the general feeling in the astronomy community was "wait and see," Jefferies said.

"We had a few people who came up there and decided that they wouldn't take the risk of going there and settled on lower altitude development sites," he said.

The French took less convincing.

Jefferies said France was looking across the world to build a telescope and visited

Hawaii after initially settling on a site in Mexico.

"I knew the people who were working on the telescope, they were good friends of mine, and I told them they were nuts not to look at Maunakea," he said. "It's clearly the best site in the world."

A team was sent to Hawaii to meet with him and Burns, who was "wildly enthusiastic" about it, Jefferies recalled.

"They looked at those images (from Maunakea) and about three days or a week later they returned to Paris," he said, and returned with a delegation to negotiate.

Those would be some of the last telescopes before Jefferies left IFA and moved to Arizona in 1983,

where he still resides.

By then, there had been some opposition, mainly from hunters who were concerned about sheep being scared away and Audubon Society concerned facilities would impact the palila bird, Jefferies said.

While former Hawaii County Mayor Shunichi Kimura, who held the office from 1965-1968 was supportive, Herbert Matayoshi, who was mayor from 1974 to 1984, was more critical, calling the telescopes "pimples" on the mountain.

Matayoshi was part of a group that proposed limiting telescopes to six, Jefferies said. There are now 13, though some are slated for removal.

While most people continue to support the observatories, he said his only regret is not reaching out more to the Hawaii Island community and making it more "part of the program" during his tenure.

"I thought having interaction with the mayor and the council was sufficient," Jefferies said.

"I thought that would be carried through to the public, but it wasn't."

At the time, he said cultural concerns with use of Maunakea weren't being expressed, though they would later become a significant source of opposition.

Looking back, he marvels at the telescopes' contributions to science and humanity's understanding of the universe.

"I always thought what we were doing, I think this is consistent with (Burns') thought when we first started out on this, was to build something that would be a source of pride for the people of the islands," Jefferies said. "It's something that contributes to human knowledge ... I still think that's the case."

Email Tom Callis at tcallis@hawaiitribune-herald.com.





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Keck Observatory Sr. Mechanical Engineer Sam Park and his daughter, Lilah, age 4



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A tour like no other

By **TOM CALLIS**
Hawaii Tribune-Herald

Kama'aina Observatory Experience gives the public a rare glance inside powerful telescopes

There are some questions that cut across languages and cultures: Why are we here? How was the universe created?

Those sorts of existential thoughts have guided science, art and religion for centuries. It's also the same curiosity that drives the research on Maunakea, and it's what Bill Healey, a former supervisor with the W.M. Keck Observatory, tries to instill in visitors who walk through the domes of some of most powerful telescopes on Earth.

"I don't care what your

beliefs are about how the universe came to be," he told a recent tour group. "It could have been created, it could have been some unexplained instant of physics. It makes no difference to us. ... It's there and we should all wonder" about it.

Healey leans slightly forward as he engages with the group on a Saturday in September at Keck, speaking sometimes with outstretched hands, but always with a healthy dose of enthusiasm.

"All you have to do is go out on a beach on a dark night and look at (the stars)," he said, when asked about

life on other worlds. "It goes on and on and on. So there's billions of galaxies and billions of stars, and just the odds are there's got to be something else up there."

The tour is part of the Kama'aina Observatory Experience, a free program that started in early 2016 to give Hawaii residents a better understanding of what the telescopes do on the mountain. The tour rotates between two observatories each month.

While the observatories have long sponsored

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Guests take photos on the catwalk of the Subaru Telescope in September during the Kama'aina Observatory Experience on Maunakea.

HOLLYN JOHNSON/Tribune-Herald

MAHALO

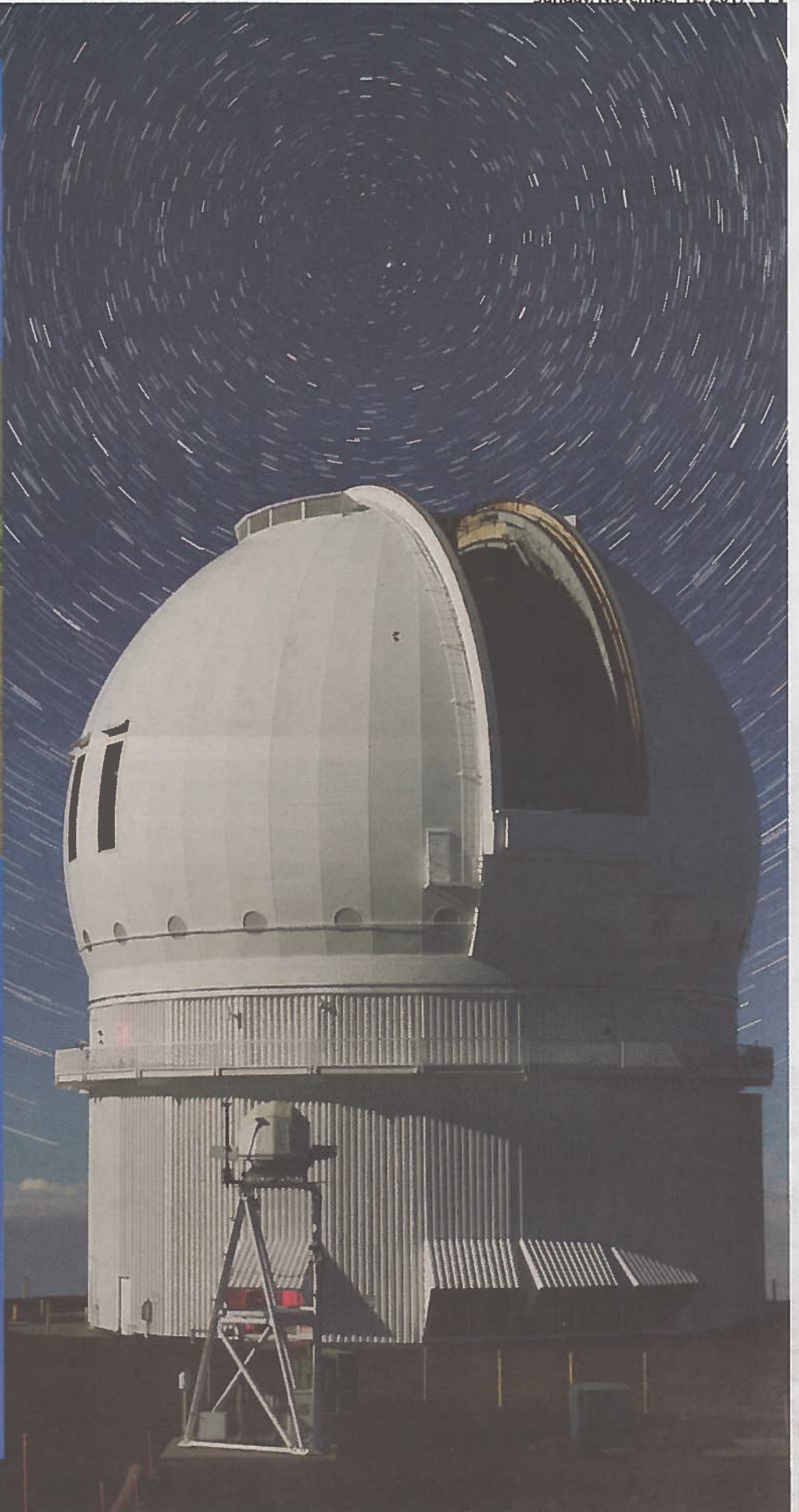
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TOUR

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different outreach efforts with the Hawaii Island community, they have never done anything quite like this.

Doug Simons, director of the Canada-France-Hawaii Telescope, and one of the tour organizers, said the idea came about with conversations with Stewart Hunter, the head of the Office of Maunakea Support Services, who noted how it's important to bring people in your home to create relationships.

"In this case, the 'houses' are the Maunakea Observatories, and the 'neighbors' are the people of Hawaii," Simons said in an email.

Before, tours were rare, with most of the telescopes offering them only to other scientists or important people in their field.

"We want them to know we are doing something that has some value," Healey said. "Because we've had some comments like, 'You guys spend a lot of money on astronomy, why not put it into cancer research?' Good question. But we can do both."

But the tour is not just about astronomy.

Hawaiian culture and perspectives also are weaved into the experience and presented during an orientation.

Leilehua Yuen, a cultural practitioner and former space journalist, starts the event off at the Hale Pohaku mid-level facility with an oli komo (welcome chant) and the opening of the Kumulipo, a Hawaiian creation chant, in addition to other mele reflecting love for Maunakea and how the island was born as a child

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Photos: HOLLYN JOHNSON/Trbune-Herald

ABOVE: Yuko Kakazu, Subaru spokeswoman, gives a tour of the Subaru Telescope during the Kama'aina Observatory Experience.

BELOW: Bill Healey, a former supervisor with the W.M. Keck Observatory, talks with guests in the control room.



TOUR

From page 12

of Wakea (the sky father) and Papahānaumoku (the earth mother).

"I think everyone is here today because of aloha for the mountain," she said, after welcoming the two dozen visitors. "Whether you're a cultural practitioner, a scientist ... we have mutual aloha for this island, this mountain."

While explaining the Kumulipo, she said Hawaiian culture counts genealogy from the time of creation, not just from parents or grandparents.

"We go all the way back to the beginning," Yuen said. "... That time when the entire cosmos was this wailing blackness and darkness that coalesced until finally it gave birth to light ... and all time was born."

She said that reminds them that they are a "little piece in this great big cosmos."

Another mele describes deities on Maunakea — Poliahu, the snow goddess, and others — that Yuen explained reflected a deep understanding of hydrology and other forces of nature on the mountain.

"Whether you believe in them as a deity or you want to use them for a metaphor of hydrology of the mountain, or whether you just enjoy the poetry, the changes these songs talk about is still extremely accurate," she said.

The tour started with 24 people a month, but has since been expanded to 48 to meet demand. Still, spots fill up in the first five minutes on the website, kamaa-inaobservatoryexperience.org. The only requirement is a Hawaii driver's license.

The tour's soaring interest comes as no surprise.



HOLLYN JOHNSON/Tribune-Herald
Leilehua Yuen is a cultural practitioner.

There's no shortage of chicken skin moments.

Sitting atop of 270 tons of steel, Keck's twin 10-meter mirrors are made of 36 hexagonal segments. They are the biggest optical

telescope mirrors in the world, next to the 10.4-meter Gran Telescopio Canarias in Spain's Canary Islands.

Keck was the first to use this method and the telescopes have proved to be an immense success, capturing distant exoplanets and the most distant galaxy to date.

The mirror's surface is as smooth as it gets, and it can be almost easy to miss. As the group walked in, the telescope was angled toward the dome's walls, creating such a flawless reflection that at least one visitor commented they thought they were looking through to the wall on the other side.

The illusion disappeared as the telescope effortlessly changed position.

When the dome opens at night, these 3-inch-thick segments together become a

large window to the universe.

Ed Hickey, summit tour host, explains the mirror segments are continually being refinished to keep them flawless.

"At the end of the year, they will get done with Keck 1 and then come back in January to do Keck 2," he said. "So, it's like painting the Golden Gate Bridge. You're never done."

The telescope works by reflecting photons to a secondary mirror, which focuses the light and sends it to a third mirror that directs it to one of the instruments.

Each telescope dome is chilled to that evening's forecast temperature, making them much colder than the rest of the facility, to eliminate any air disturbance in

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HOLLYN JOHNSON/Tribune-Herald

Ed Hickey, summit tour host, talks with guests in the control room of the W.M. Keck Observatory in September.

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the room when it opens.

"It's like stepping into a freezer at Costco," Hickey explained beforehand.

At both Subaru and Keck, visitors were taken into control rooms where workers operate the telescopes.

As it was a Saturday, many of the workers, most of whom are from Hawaii Island, were absent, tour guides noted.

But the control room at Subaru wasn't entirely empty. Hanging up were several *teru teru bozu*, ghost-like puppets made of tissue paper.

Yuko Kakazu, Subaru spokeswoman, said they are prayers for good weather. While Maunakea's skies are clear about 300 days a year, a single overcast night can ruin an astronomer's research plans.

"You are desperate when you have bad weather, right?" she said. "You just make *teru teru bozu* and you hang it."

While Keck has the largest mirrors on the mountain, Subaru boasts the biggest single-piece mirror at 8.2 meters.

It also hosts a unique instrument — the Subaru hyper supprime-cam — which specializes in widefield views of the universe and mapping the cosmos.

"That's why we build this telescope," Kakazu said. "If you want to map the universe, it's better to use

this camera instead of Hubble. "

Subaru is unique in another way — its telescope enclosure is more rectangular than curved.

Kakazu said its doors open horizontally like a Japanese sliding door, and the telescope "bows" as it is put into position.

Subaru also is the only observatory to have done regular tours, apart from Kama'aina Observatory Experience.

Cartoons from anime artists who have visited are drawn as signatures on a tool used to transport instruments.

Hunter, who helps lead the tours, said the program's purpose is to show "the wonder of Maunakea, in all aspects."

In that, visitors that day said they succeeded.

William "Wolfman" Gass, of Volcano, said he wished the program was started earlier.

"I think with all the controversy and stuff I think it's a pity this wasn't available for the past 10 or 15 years and got the local people out to see what's going on here and to take advantage of it all," he said. "I think we have a certain understanding of the importance of this location and how we have to achieve a balance between cultural issues and science."

Email Tom Callis at tcallis@hawaii-tribune-herald.com.



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'Blown away by their creativity'

Maunakea Scholars program puts massive telescopes in the hands of high school students

By **TOM CALLIS**

Hawaii Tribune-Herald

Titan, the largest moon that orbits Saturn, was long shrouded in mystery after being discovered in the 17th century.

Following the recent Cassini spacecraft mission, it's now known the moon, which is larger than Mercury, hides lakes and seas made of liquid hydrocarbons under its thick atmosphere, and that its surface temperature is a frigid minus 292 degrees Fahrenheit. On this world, it rains methane, though oceans of liquid water and ammonia are likely present below the surface.

That could make it a challenging place for life to develop, at least as we know it.

On a September evening atop Maunakea, three Honokaa High School students — Anika Wiley, Marie-Claire Ely and Kaitlin Villafuerte — sought to find out by using the NASA Infrared Telescope Facility.

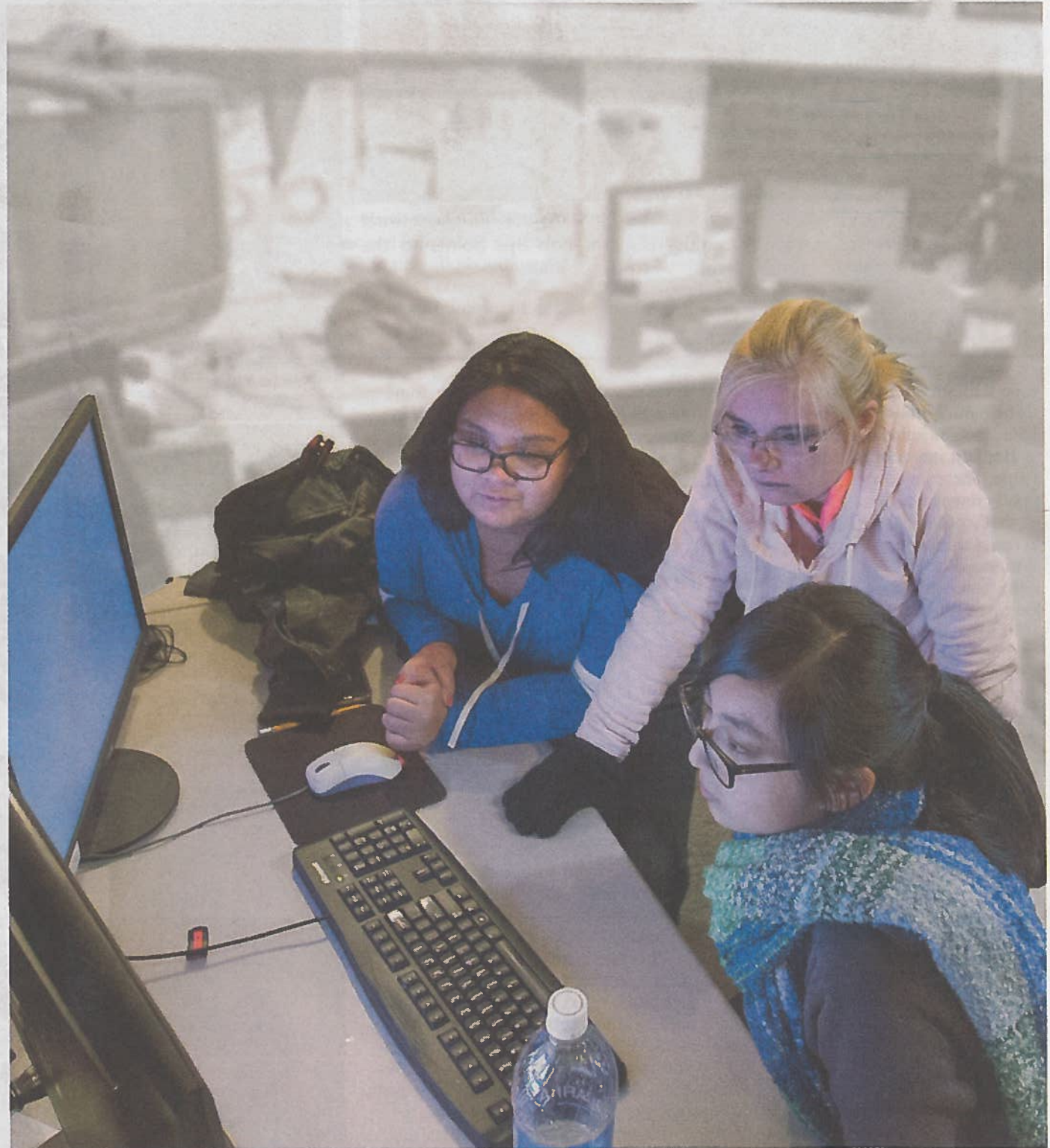
"We had a couple moons in mind and we narrowed it down to Titan mainly because of the atmosphere," said Marie-Claire, 15, a senior. "We're looking for something that can show us evidence there has been life."

Each are active in the school's astronomy club and jumped at the opportunity to use one of the mountain's telescopes through the Maunakea Scholars program.

These students are doing more than shadowing astronomers. They are doing the research and coming up with the ideas themselves, sometimes at PhD levels, said Mary Beth Laychack, outreach manager for the Canada-France-Hawaii Telescope and the students' mentor.

"We're continually blown away by their creativity," she said, noting that some research ideas have to be turned down because they would take years to conduct.

About 315 students, most of whom received school credit, have



HOLLYN JOHNSON/Tribune-Herald

Honokaa High School students, from left, Kaitlin Villafuerte, Anika Wiley and Marie-Claire Ely observe Titan with the NASA Infrared Telescope Facility.



HOLLYN JOHNSON/Tribune-Herald

NASA Infrared Telescope Facility Deputy Director Bob Bus points to the telescope's instruments.

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gone through the program from participating schools across the state since its launch in 2015.

But few step foot into an actual telescope. These days, a small crew is usually all that's needed to run a telescope at night, allowing astronomers to do their part remotely.

"I work from my kitchen table all the time down in Hilo," said Bob Bus, NITF deputy director. "You can actually get a PhD in astronomy without going to a telescope."

The students' trip to the observatory was the last night of three they spent viewing Titan and collecting data. The other two were done at CFHT headquarters in Waimea, Laychack said.

Built in 1979, the box-shaped NITF is one of the oldest on the mountain.

The building has a metallic-looking dome, the top of which rotates to allow the 3-meter telescope to find its targets.

The light is reflected from the primary mirror to a smaller secondary mirror at top of the telescope structure that sends the photons into one of the instruments attached at the telescope's base.

Before they begin their observing, which lasts about two hours, Bus

gives the students a tour of the dome as well as advice on how to work in the lower oxygen environment. (Tip: food helps, and doughnuts, which

they brought with them, taste better at higher altitude).

Bus said the telescope, owned by NASA but ran by the University of Hawaii at Manoa, was built to assist the space agency's spacecraft missions, a role it still fills to this day with the recent Cassini mission.

While the spacecraft provides the close-

ups, the ground-based telescope captures the baseline data of Earth's neighbors to help NASA understand what it is seeing.

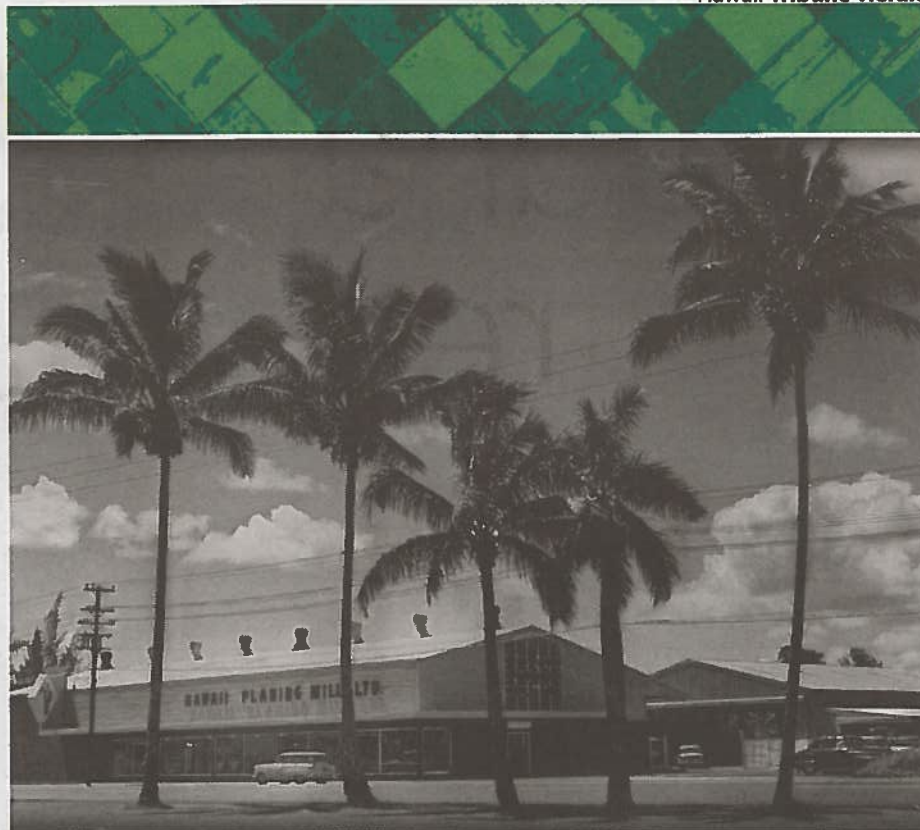
"It's like watching a really long soap opera for many, many years to put into context that one scene," Bus said, while describing the telescope's work. When it's not studying planets and moons, the observatory is discovering smaller objects, such as asteroids, many of which he gets to name.

Pictures of planets taken by NASA spacecraft line the walls of the telescope's control room,

"We had a couple moons in mind and we narrowed it down to Titan mainly because of the atmosphere. We're looking for something that can show us evidence there has been life."

— Marie-Claire, senior

See **SCHOLARS** Page 18



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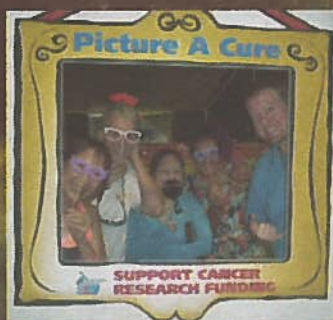


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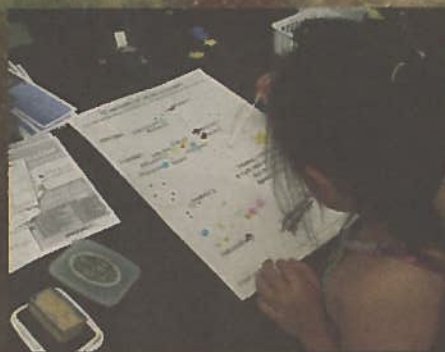
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SCHOLARS

From page 16

where the students work alongside the two telescope operators, who help get the mirror into position.

But it's up to the students to run the instruments, control the telescope's exposure to ensure as many photons are collected as possible, make sure the telescope stays on target, as well as document their steps.

If a step is missed or delayed, that means less light is collected, and Bus is there to make sure not a second of science is wasted.

"I tend to be a task driver," he said. "I'm trying to instill that a little bit."

Saturn averages about 886 million miles from the sun — more than nine times Earth's distance. Depending on positions of both Earth and Saturn, it takes the photons roughly 174 minutes to leave the sun, bounce off Titan's

atmosphere, reach the telescope, and show up on their computer screens, Bus said.

To ensure they are getting the best data, the telescope shifts between Titan and what's known as a "guide star." Laychack said they use the star, this one located near the constellation Scorpious, also known as Maui's fishhook, so they will know if their instruments are working correctly.

Once they switch to Titan, the moon appears on one of their computer screens in the infrared. What they see is more of a gray smudge than the colorful pictures captured by Cassini.

But they're not here to get the prettiest picture. What they're after is to capture and analyze the spectrum of light reflecting off the moon's atmosphere.

That shows up as lines



Mary Beth Laychack
Canada-France-Hawaii Telescope

bending across one of the student's screens.

It might not look fascinating, but this type of data can tell researchers what's going on in Titan's atmosphere, including what type of chemicals are most abundant. That could give clues to the presence of life.

"All these bumps and wiggles are tied to molecules," Bus said, as he points out ridges and troughs in the lines.

It's essentially the barcode of the moon's atmosphere and gives a snapshot in time of what's happening on our distant neighbor.

It's the same technique astronomers will use to find planets in far-off solar systems that could harbor life.

While they may not have found evidence for new lifeforms that night, the research will provide data that could be cited one day in a scientific paper.

"By allowing different groups to observe many times, you can get what's called time-domain astronomy," Bus said. "Many things aren't constant. In fact, the data they are taking right now could be used by a larger scientific project that is being carried

out right now by a scientist from Cornell (University)."

After returning to Hale Pohaku, the students grabbed cups of hot chocolate and reflected on their evening.

"I still feel like a kid playing with a telescope," said Kaitlin, 16, a junior. "At least I know I could do it if I wanted to."

Laychack said the program's goal is not to create the next generation of astronomers, but to inspire keiki to seek careers in any field of science, technology, engineering or mathematics, commonly known as STEM.

Asked what this would have meant to her if she had a similar opportunity in high school, she said: "I would have died. It would have meant the world to me, and I know it means the world to them."

Email Tom Callis at tcallis@hawaii-tribune-herald.com.

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Take a Journey Through the Universe

By **TOM CALLIS**
Hawaii Tribune-Herald

Journey Through the Universe has entered more than 300 classrooms in the past 14 years, according to Gemini Observatory outreach manager Janice Harvey.

The Gemini-led program sends more than 80 observatory professionals to talk with students about the cosmos and share their passion for science.

But it wasn't guaranteed it would last this long.

Hawaii Island's Journey Through the Universe was initially one of several around the country, but their funding ran out in the second year, Harvey said. She said local businesses and organizations have stepped in to provide the money to sustain and grow the effort.

Harvey said it started in the Waikeala complex schools but now is nearly an islandwide program.

"We decided as a community we



Andre-Nicolas Chene of the Gemini Observatory tells third-grader Dazlyn Urbano-Alves about the distances between stars in 2015 during the Journey Through the Universe program.

HOLLYN JOHNSON
Tribune-Herald

were going through with it," she said.

Harvey said the observatories see it as part of their "moral obligation" to the island that supports them.

"It peaks their interest" in science, she said. "It's about much

more than astronomy."

The program visits classrooms from kindergarten through 12th grade.

For students who want to pursue a job at a telescope, there's the Akamai Internship Program.

Austin Barnes, program manager, said they place college students at observatories and other high-technology businesses in the state. They are set up with mentors and gain valuable real-world experience in fields of science, technology, engineering and mathematics, commonly known as STEM.

The program started in 2003 and has helped more than 350 Hawaii students.

Barnes said it helps many find careers in Hawaii when they may think that's not possible in their fields.

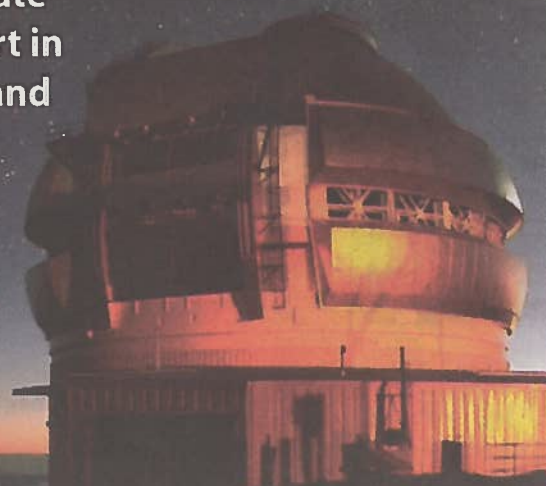
"I was of the mind I would have to leave like a lot of people are," said Barnes, a former intern.

Akamai is funded by the Hawaii Community Foundation, Thirty Meter Telescope, Air Force Office of Scientific Research, National Science Foundation, Daniel K. Inouye Solar Telescope and National Solar Observatory.

Email Tom Callis at tcallis@hawaii-tribune-herald.com.

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ARE WE ALSO

Maunakea telescopes at forefront of search for planets, life outside



This artist's rendering shows a view of the surface of the planet Proxima b orbiting the red dwarf star Proxima Centauri, the closest star to our solar system.

Photo: European Southern Observatory via AP

NE?

e our solar system

By TOM CALLIS

Hawaii Tribune-Herald

When the discovery of an exoplanet — a planet orbiting another star — was announced in 1995, it represented an earth-shattering moment for astronomy, recalled Claire Moutou.

Suddenly, a whole new era of research was born, and with it, the possibility of finding life elsewhere in the cosmos.

“The impact was tremendous because no one was really working on exoplanets at the time in the '90s,” said Moutou, a resident astronomer with Canada-France-Hawaii Telescope atop Maunakea.

That changed overnight as researchers raced to find more. Like others, Moutou, who was a student in France at the time, jumped on board. Instead of focusing on interstellar dust, as she had intended, Moutou became a planet hunter, and she hasn't stopped since.

“What we have found so far is much more diverse than what we have in the

solar system,” she said. “That is exciting.”

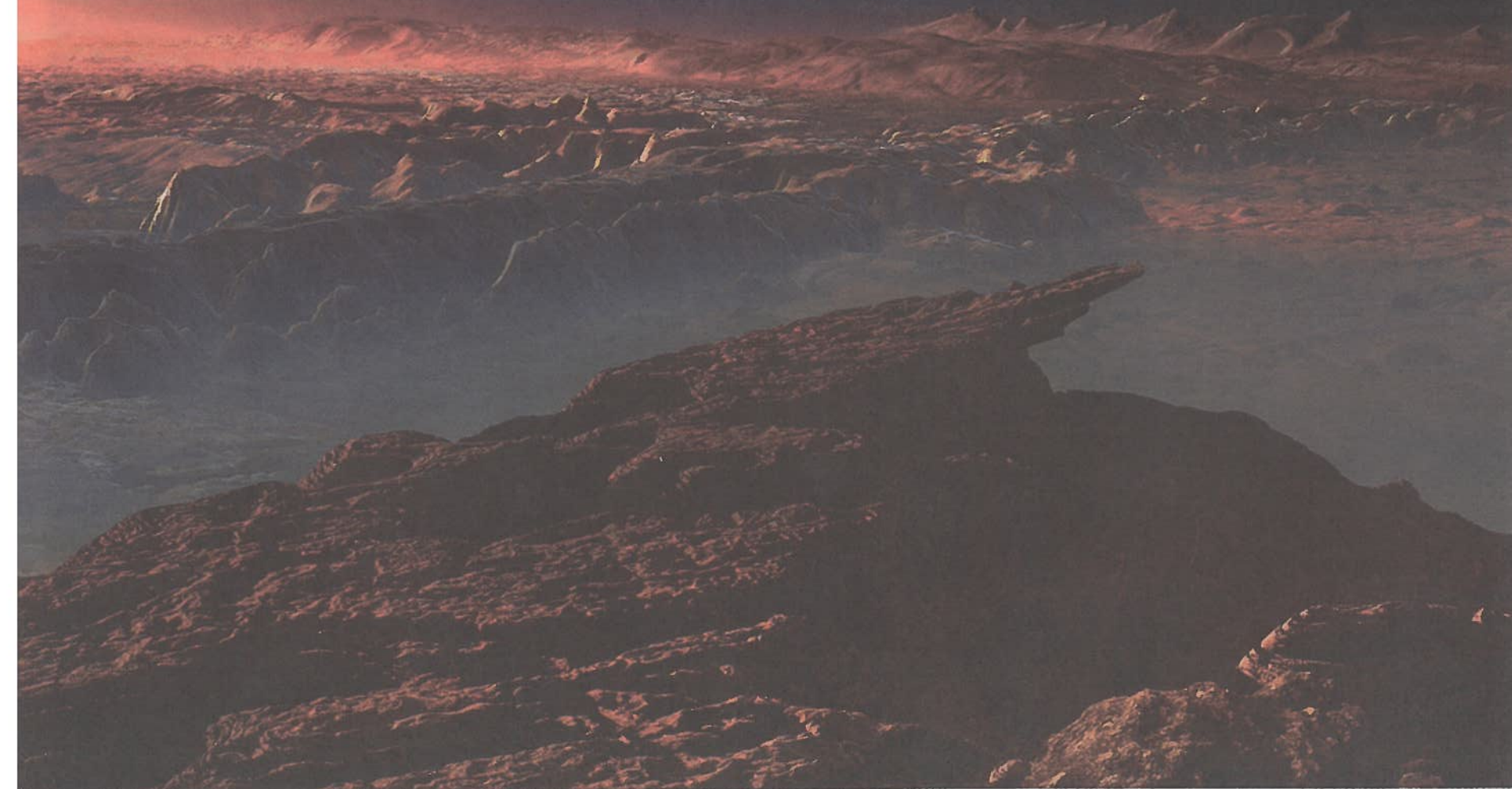
So far, about 3,500 exoplanets, many orbiting too close to their star to host life, have been discovered. Planet hunting is a team effort usually involving multiple telescopes.

Moutou said that makes it hard to estimate how many she has helped discover. “It's nothing that I consider mine,” she said. “It's teamwork.”

One of the discoveries she worked on was Corot-7b, located 489 light years away in the constellation Monoceros. About 70 percent larger than Earth, the planet was the smallest to have been measured until Kepler-10b was found in 2011. Both are scorched worlds, with surface temperatures that exceed that of lava on Earth.

Exoplanets are discovered in two ways: radial velocity, which measures the gravitational tug a planet has on its star, and the transit method. For the latter, astronomers search for dips in a star's light caused by the planet passing in front of it.

See EXOPLANETS Page 23





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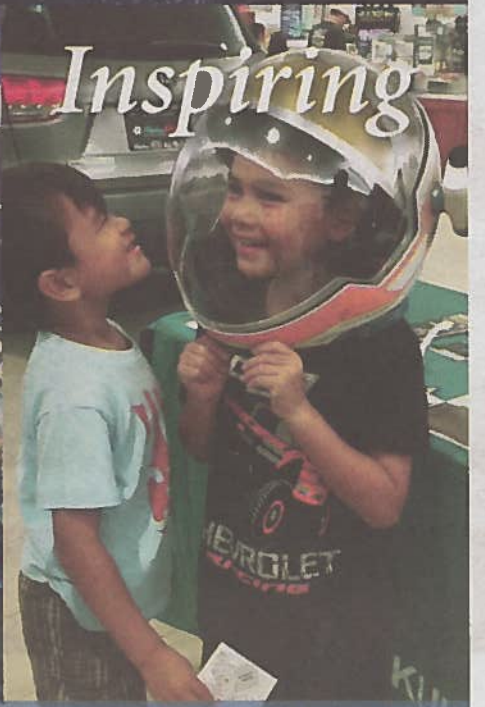
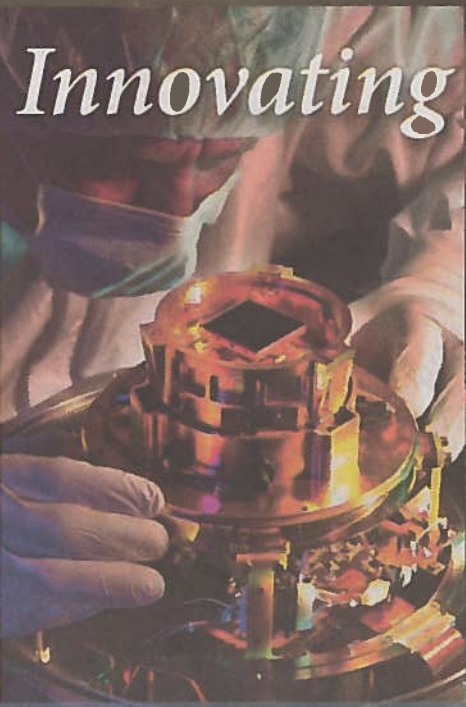
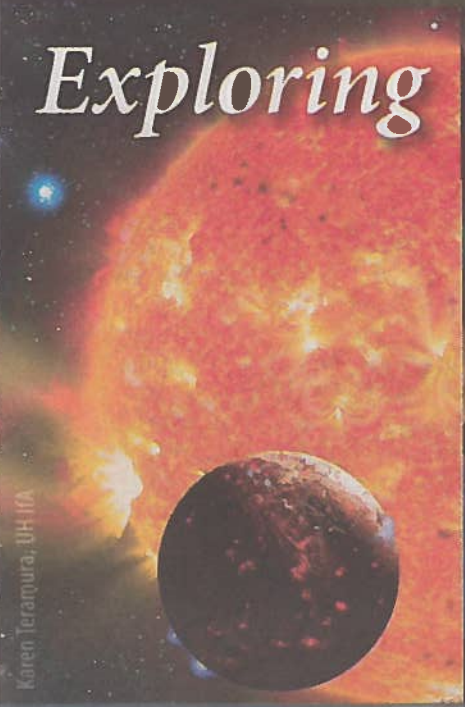
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“ Are we alone? You can't imagine humanity hasn't asked that question from the very beginning looking up at the stars. It's kind of the ultimate question: What else is out there? ”

Peter Michaud | Gemini spokesman

EXOPLANETS

From page 21

The former was pioneered at CFHT in the 1980s, Moutou said.

“A few dozen planets were searched for and it was 10 years before the first one was discovered,” she said. “They missed it by that much.”

The credit for finding the first exoplanet around a sun-like star goes to Swiss astronomers Michel Mayor and Didier Queloz, who announced the discovery of 51 Pegasi-b in 1995.

They found the needle in the haystack that everyone else missed.

“At the time, they thought it was due to stellar rotation and not planets,” Moutou said, regarding earlier observations. “... You have to break that wall and say, ‘That’s a discovery.’”

The planet, a “hot Jupiter,” is a gas giant with an orbit tighter than Mercury’s, making the gravitational dance it has with its host star more pronounced and easier to detect. On this world, a year lasts a mere four days.

It technically wasn’t the first exoplanet. A few years before, planets were detected orbiting a dead star known as a pulsar, leaving the possibility that the planets were a byproduct of the star’s supernova.

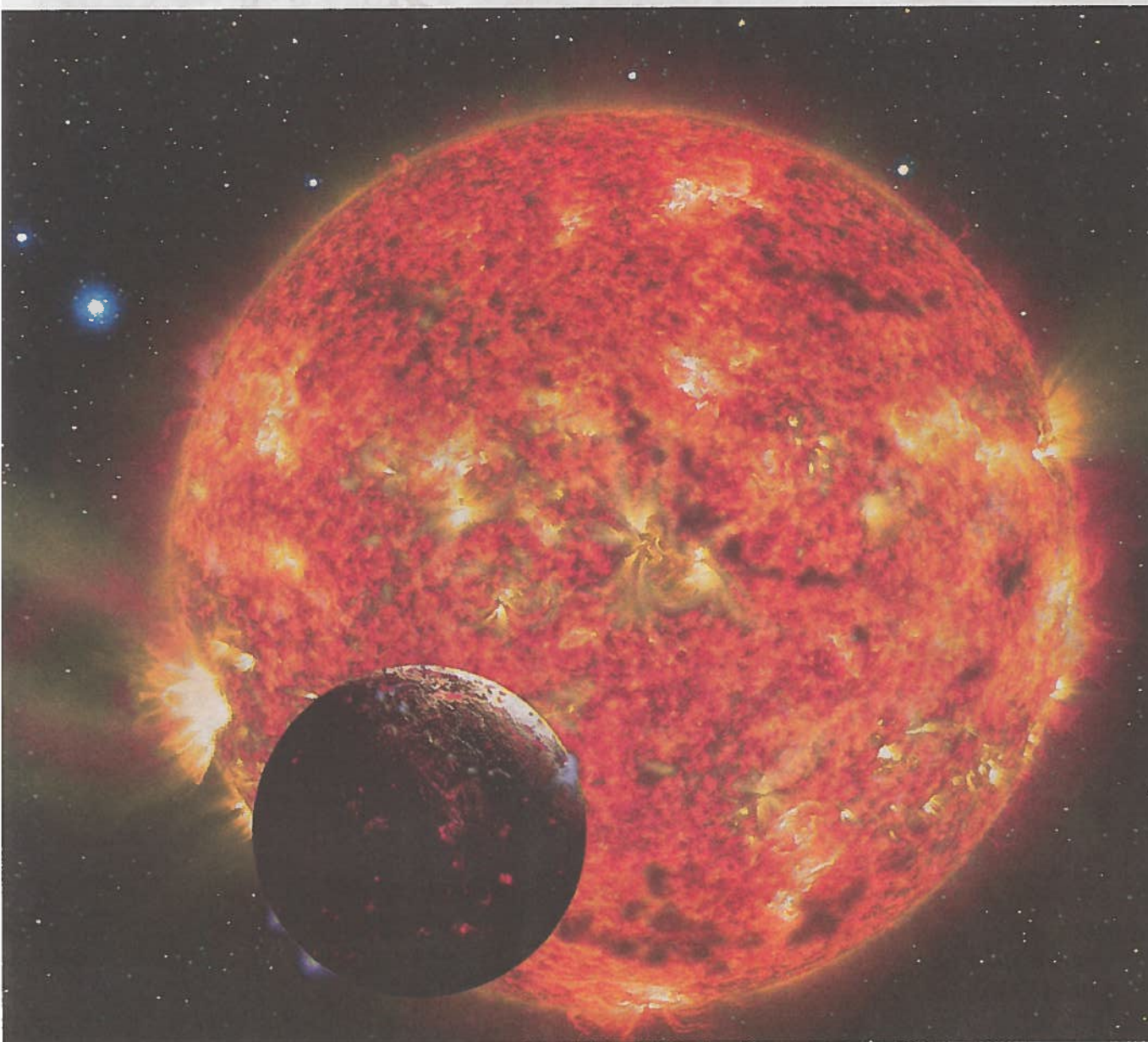
What made the ‘95 discovery significant was that the planet orbits a sun more similar to our own. And that opened the floodgates.

“Maybe not all of them, but most of them have a planetary system,” Moutou said regarding stars in the galaxy.

“Many of them have several planets.”

In the field of exoplanet discoveries,

See **EXOPLANETS** Page 24



An artist's rendering of Kepler-78b, an Earth-sized rocky exoplanet discovered by Roberto Sanchis-Ojeda with the Massachusetts Institute of Technology, using Kepler Space Telescope data, and confirmed by Andrew Howard with the University of Hawaii's Institute for Astronomy, using the W.M. Keck Observatory atop Maunakea.

EXOPLANETS

From page 23

Maunakea has made several firsts.

In 1999, W.M. Keck Observatory made the first detection of an exoplanet transiting its host star.

The first direct images of exoplanets came in 2008 when the Gemini and Keck telescopes captured four planets in orbit around a star known as HR 8799. Each are more massive than Jupiter.

Peter Michaud, a spokesman for Gemini, said a direct image of a planet in another solar system was long seen as the "holy grail."

"The new challenge is to image smaller and smaller worlds," he said.

Michaud said the discovery was possible because of the observing conditions on Maunakea.

"You need to have a fairly bright star, you need the technology like adaptive optics, but you really need the exquisite atmospheric conditions to be able to use it effectively," he said.

After a quarter century of exoplanet research, a major question



HOLLYN JOHNSON/Tribune-Herald

Claire Moutou, resident astronomer at Canada-France-Hawaii Telescope, sits in her office in Waimea.

remains: Do any of them have life?

The mere numbers suggests so.

But the proof is in the pudding.

"We are not in the age of

spaceships where we can travel and take a look at the soil," Moutou said. "We still have to rely on the light which travels from

there to here and the study this light and interpret what it is."

She was referring to spectroscopy, the method of analyzing light reflected off an object to determine its characteristics.

"Chemicals or molecules in the atmosphere absorb some of the light," Moutou said. "And so we can have the spectrum of the atmosphere of the planet."

Those show up as lines on the light spectrum, representing a barcode of sorts for the planet.

Such data has been recovered from a few exoplanets that orbit too close to their star to be in the habitable zone.

While life might take different forms on different worlds, Moutou said what astronomers want to generally look for is an imbalance of gasses, such as an abundance of oxygen; water molecules and light wavelengths that could be produced from photons reflecting off a surface covered in vegetation.

"Life which is everywhere, which has a common signature, and which has impacted the atmosphere

See EXOPLANETS Page 25

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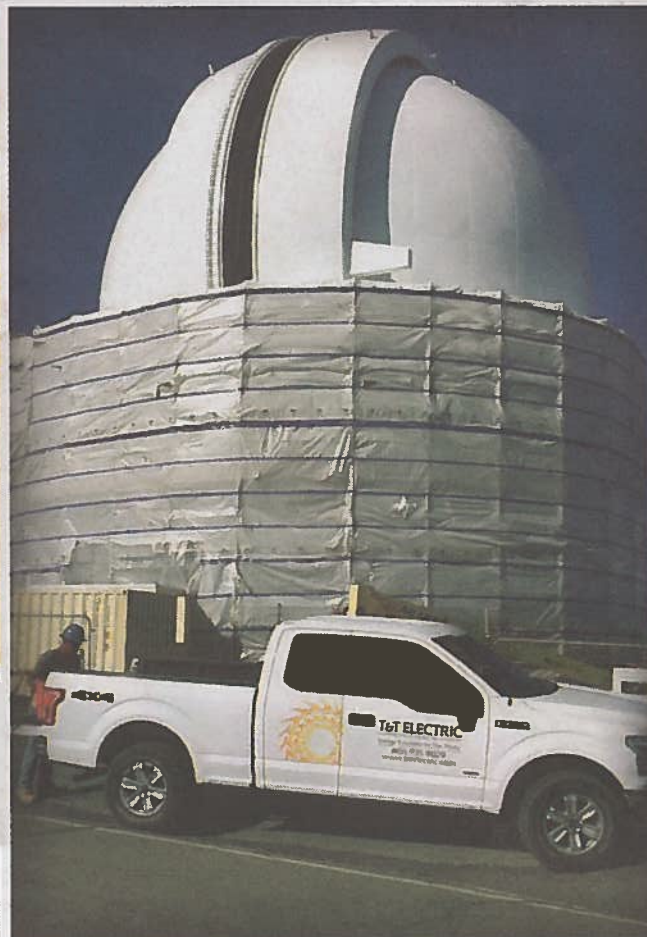


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EXOPLANETS

From page 24

of the planet will be recognizable from Earth," she said.

So far, scientists have used spectroscopy to confirm life on only one planet, and it's one with which we're quite familiar.

In the early '90s, famed cosmologist Carl Sagan proposed the Galileo spacecraft turn its instruments toward Earth as it traveled to Jupiter to test whether such methods could be used to find signs of life. That was done successfully.

"In its December 1990 fly-by of Earth, the Galileo spacecraft found evidence of abundant gaseous oxygen, a widely distributed surface pigment with a sharp absorption edge in the red part of the visible spectrum, and atmospheric methane in extreme thermodynamic disequilibrium; together, these are strongly suggestive of life on Earth," Sagan and his co-authors wrote in the journal *Nature* in 1993. "Moreover, the presence of narrow-band,

pulsed, amplitude-modulated radio transmission seems uniquely attributable to intelligence."

Those measurements were taken within our own solar system. To do the same for planets millions of light years away, and especially those in a habitable zone, will require bigger telescopes, Moutou said.

Existing telescopes on Maunakea aren't giving up on the hunt.

Several, such as CFHT, Keck and Gemini, are planning new advanced instruments to find more exoplanets.

While new space telescopes are being launched, Moutou said ground-based telescopes will continue to play an essential role. One of the limitations of space telescopes is their instruments can't be replaced.

"We can do that from the ground and it's much more expensive to send satellites with these," she said. "Ground-based telescopes are very much important as a synergy with space telescopes to measure and catalog the planetary systems we are about to discover."

With bigger and better telescopes and instruments on the way, it's hard not to feel like astronomy is on the cusp of a major discovery.

But asked how soon might another world with life be confirmed, Moutou hesitates. It could be within the few decades, she suggests.

One thing is known, though. The impact of finding another world with plants or creatures, no matter their form, would be enormous.

"There have been a lot of revolutions like that in recent history of humanity," she said, citing the realization the Earth is not the center of the universe as an example. "Knowing Earth is just one earth of millions and billions of earths in the galactic neighborhood may change our view of ourselves. It may make us more humble. I think it will be a very positive impact."

Michaud agreed.

"Are we alone? You can't imagine humanity hasn't asked that question from the very beginning looking up at the stars," he said. "It's kind of the ultimate question: What else is out there?"



HOLLYN JOHNSON/Tribune-Herald

Peter Michaud, Gemini Observatory public information manager, sits in the lobby at Gemini headquarters in Hilo.

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Ready for anything

Operating in a dangerous environment, rangers and road crew help protect visitors, staff — and Maunakea itself

By TOM CALLIS
Hawaii Tribune-Herald

Scotty Paiva has worn many different hats over the years.

He's been a police officer, fireman, Coast Guard reserve commander, and even a nighttime telescope technician.

What connects most of them is a desire to help others. But he says few jobs can compare to his current role as the Office of Maunakea Management's chief ranger.

It's what keeps the 60-year-old Hilo resident out of retirement, and one that makes him responsible for the well being not only for the thousands of visitors each year — including tourists, observatory workers and Hawaiian cultural practitioners — but also the mountain itself.

"There's no place like this," Paiva said, as he drove on the Maunakea access road far above the clouds in a Toyota 4-Runner. "We want to keep it as best as we can so my grandson's grandson's grandson can enjoy this place."

Paiva is one nine full-time rangers who are employed by the University of Hawaii at Hilo to assist visitors and protect the mountain's natural and cultural resources in the Maunakea Science Reserve. The university created the rangers program following the formation of OMKM in 2000, a move intended to increase local management of the mountain.

Despite the title, being a ranger doesn't come with a lot of authority. Rangers don't carry firearms and can't make arrests or issue citations.

Maunakea rangers

What makes them effective, Paiva said, is showing aloha for others while also asking them to show the same respect for the place they're in.

"We want people to leave here better than they came," he said. "Come up, have a nice time — it's a wonderful place — and leave feeling better. So our guys are trying to be the ambassadors of aloha."

Paiva said most people want to do the right thing, but he pauses to knock on a wooden table for good luck.

After all, accidents happen.

Vehicles, especially those without four-wheel drive, sometimes lose their brakes as they descend down the winding road from the summit. Hikers or bicyclists — yes, there are people who ride bikes from sea level to the summit — get caught in bad weather, and, most commonly, visitors just aren't prepared for lower oxygen levels as they ascend to nearly 14,000 feet.

That means the rangers must be prepared for just about anything. No matter what happens, they're the first on the scene, and additional help, whether by

ambulance or police car, is up to an hour away.

Paiva said each ranger carries medical gear in their vehicles, including oxygen tanks, as well as extra water, juice and snacks for those who find the altitude not agreeing with them.

"You never know what's on the other side of the hill," he said, as he drove down from the summit as part of a routine patrol.

About 20 minutes later, Paiva stopped his vehicle as he saw a woman and man hiking up the road, mostly wearing light clothing.

"How are you guys doing?" he asked. "You got enough water?"

See RANGERS Page 27



Maunakea rangers Duwayne Waipa, left, and Scotty Paiva stand atop the mountain.

HOLLYN JOHNSON/Tribune-Herald

RANGERS

From page 26

The young woman says yes and points to a water pack she's carrying.

"OK, OK, good,"

Paiva responded, before warning them about the weather. It was sunny at the time, but that can change, he told them.

"Some clouds might be coming in soon so just keep an eye on the weather," Paiva said, "because you don't have very heavy clothes, it might get cold later on if it gets cloudy, misty and windy."

The hikers carry on and Paiva puts his vehicle back in gear.

Those contacts occur several times a day, he said, noting he's seen more hikers, and even the occasional jogger, over the years.

While he was growing up, Paiva said he spent most of his time on the mountain hunting. Out of respect for the place, he said he was raised not to see it as somewhere to play or "holoholo."

"If you didn't have a reason to come up here you don't come up here," Paiva said his parents told him. "You don't come up here to play; this isn't a recreation area. You come up for some kind of business."

Making sure visitors have the least impact to the mountain is part of the job.

While driving more than 10,000 feet above sea level, he points off to the left side of the road, where remnants of a Hawaiian adze quarry can be seen.

The rocks, hardened by lava contacting glaciers during the last ice age, were prized for tool making.

Paiva said a ranger once caught people carrying adze chips out in backpacks.

"We reported it to DOCARE and they made a case," he said, referring to the state Department of Land and Natural Resources' enforcement division.

"One guy dropped

what he had and left it."

Cases of bad behavior are rare, Pavia said. Sometimes people do things they don't know are wrong or offensive.

He referred to one incident where a couple people were found kayaking on Lake Waiiau, a sacred spot to Hawaiians.

A ranger saw the vehicle driving up with the kayak, only to find it parked at a trail head without it.

"So he walks in and they're on the lake," Paiva said. "So, again, we're the eyes and ears of DOCARE."

At the summit, rangers will check on the observatories and Hawaiian shrines in the area, and ask visitors to not walk up Pu'u Wekiu, Maunakea's tallest point and another spot used by Hawaiian religious practitioners.

When snow falls on Maunakea, rangers are up at 3 a.m. to do their weather checks, Paiva said, and are on the mountain before sunrise. Once the road is free of snow and ice, they will open it to the public.

Pickup trucks full of snow and boogie boards as stand-ins for sleds become a common site.

Paiva said the rangers don't stop people from playing in the snow. But they try to warn of the dangers of sledding down the cinder cones.

"You know how you gonna stop? Lava rocks," he said.

Overall, Paiva said he enjoys most working with people of all types and backgrounds who use the mountain, from astronomers to the many visitors with which he interacts. The view also is hard to beat.

"It's beautiful up here," he said. "I get a neat kind of inner peace when I'm up here."

Paiva adds, "We're here for everyone. Everyone who comes up is our guest."



Alika Toledo and Tracy Miyashiro change the tire on a road grader in September at Hale Pohaku on Maunakea.

HOLLYN JOHNSON/
Tribune-Herald

Maunakea road crew

By TOM CALLIS
Hawaii Tribune-Herald

After 32 years working on Maunakea, Tracy Miyashiro knows the access road like the back of his hand.

From the Hale Pohaku mid-level facilities, the road snakes its way up the mountain, gaining more than 4,000 feet in elevation and covering 8.5 miles before it reaches the observatories atop.

About half is unpaved, and it's up to Miyashiro and other road maintenance operators with the Office of Maunakea Support Services to keep it open. That means grading it several times a week and removing snow in the winter, on slopes that range from 10 percent to 15 percent.

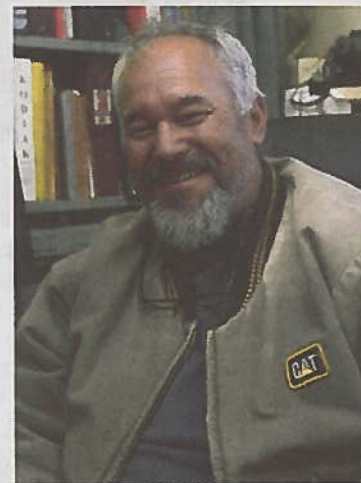
"It's challenging up here just dealing with the weather," said Miyashiro, of Hilo.

Then there's the lower oxygen levels, an issue anyone working on the mountain has to face. He said the altitude doesn't bother him much anymore, though he's learned it's best to pace himself.

In their baseyard just above Hale Pohaku, sits the only snowplows in the state.

Miyashiro said he did some snow removal while in the U.S. Army, but none of that compares to the hazards of Maunakea.

"Safety is a big concern," he said. "Because if something happens with us it's just us up there.



Alika Toledo

Maunakea Support Services utilities and maintenance supervisor

We have to rely on each other to make sure everybody is safe."

Miyashiro said they see a major snow storm every 10 years or so, with the worst occurring in 1991.

That was when 14 feet of snow covered what's known as Goodrich Pass, not far below the summit.

"We had a D-9 dozer pushing snow, we got tracks on it, and the thing just started sliding and you ain't stopping 80,000 pounds," Miyashiro said.

"You ain't stopping that until you hit something. So that was a learning experience."

If the grader starts sliding because of icy conditions, he said the best thing to do is to get in a higher gear so the tires can catch up.

"You lift the blade up, you get it up to speed with the ground," Miyashiro said, "and kind of hopefully from there try to slow it down. That's the best thing you can do."

According to MKSS, the road costs about \$550,000 a year to maintain, plus another \$125,000 for removing snow. Costs are covered by the observatories.

But it's not just telescopes that benefit.

In 2016, 35,511 vehicles went up the mountain, according to MKSS. Of that, 13,396, or about 37 percent, belonged to observatory crews or permitted tours. The rest was attributed to the general public.

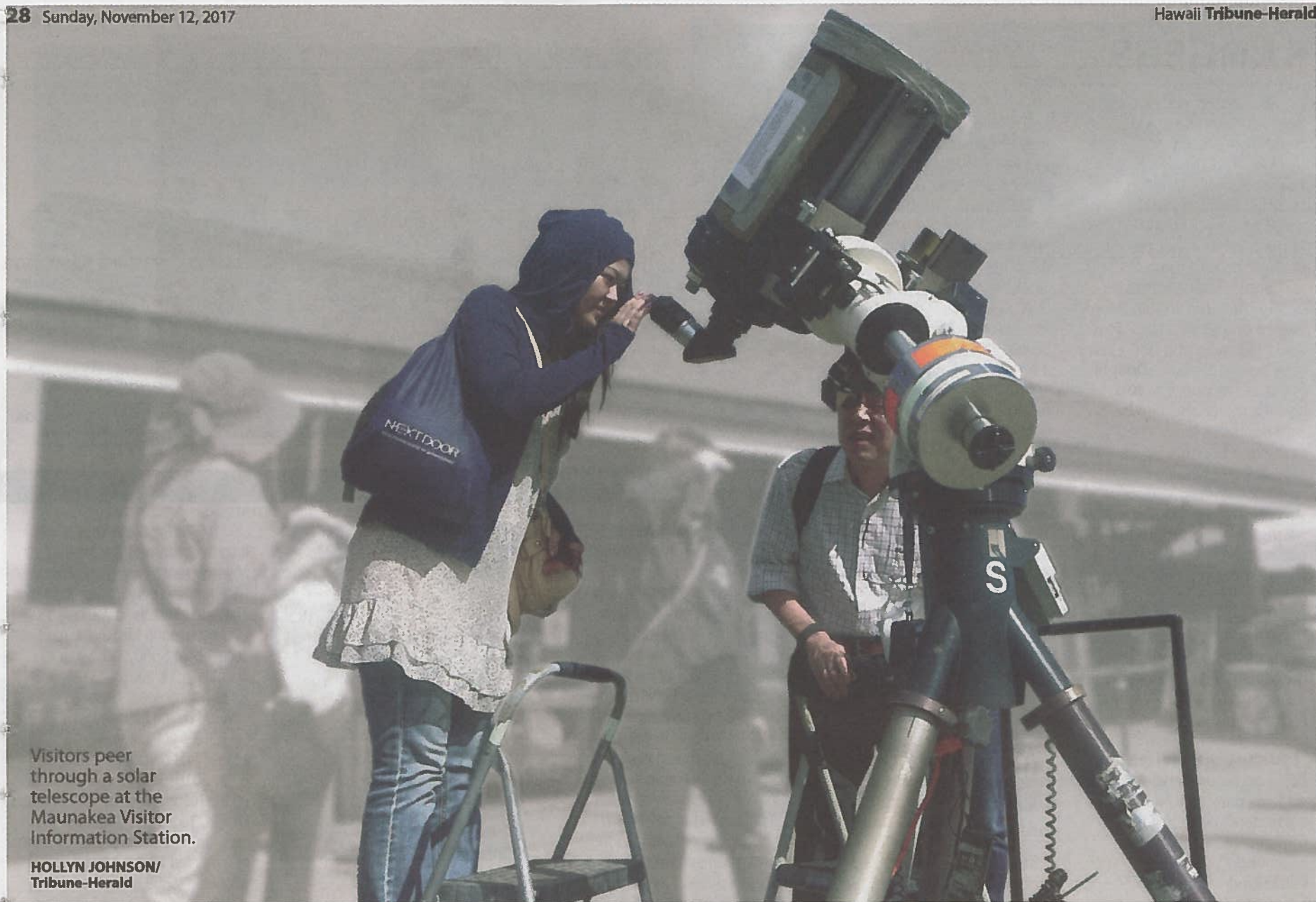
The utilities division, which he works for, also is responsible for maintaining about 30 vehicles and the Hale Pohaku mid-level facilities, where telescope workers eat and sleep.

"It's definitely a full plate around here," said Alika Toledo, utilities and maintenance supervisor. "We try to do as much as we can ourselves."

One project is adding more ice detectors along the road, which would be used to update the Maunakea Weather Center website. Toledo said that would give the public a better sense of conditions before they head up.

Toledo, a Hilo resident and former operating engineer, said he wouldn't want to be anywhere else.

"I was born and raised here," he said. "I grew up hunting on this mountain. It's definitely a special place to be."



Visitors peer through a solar telescope at the Maunakea Visitor Information Station.

HOLLYN JOHNSON/
Tribune-Herald

Gateway to the STARS

Visitor Information Station helps public experience 'amazing' views of space

By TOM CALLIS
Hawaii Tribune-Herald

The Maunakea Visitor Information Station has served as the gateway to the mountain for more than 30 years.

It offers a place to rest and get acclimated before ascending the steep, winding road to the summit, a small retail shop, as well as free stargazing tours several nights a week.

But as the popularity of the mountain as a tourist destination increases, so has the pressure on this humble 1,700-square-foot

building, situated about 9,000 feet above sea level.

"It's become a tourist destination when that's not what the goal was," said Janno Scheer, VIS manager.

UH's Office of Maunakea Support Services operates the VIS with a staff of 13 full-time and part-time workers and numerous volunteers. It costs about \$2 million a year to operate, with funding coming from the observatories, permitted tour operators and retail sales, according to Stewart Hunter, MKSS general manager.

Hunter said the VIS' role remains ensuring the safety of visitors and educating them about the mountain, including the cultural and natural resources.

But the increasing popularity of the mountain does make that a challenge, he acknowledged.

"We rival (Hawaii Volcanoes National Park)" on travel sites, Hunter said.

He said traffic has increased significantly following improvements to Saddle Road, which prompted rental car

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GATEWAY From page 28

companies to remove their restrictions from using the cross-island route, and the rise of social media.

In 2014, MKSS estimated about 750 people a day went to the VIS, though some were counted more than once if they went up to the summit. During the summer nights, stargazing events can attract 450.

The popular events allow visitors to peer through some of its seven telescopes, which range in size from 4 inches to 16 inches. Stargazing is held from 6 p.m. to 10 p.m. Tuesday, Wednesday, Friday and Saturday. Volunteers also provide talks on constellations and Hawaiian navigation. Parking is limited.

The VIS opens at noon.

"We look at things millions of years away from us, as far as light travels," said Margaux Mellott,

VIS interpretive guide.

There's also an "amazing" view of the Milky Way, she said.

Despite limitations, Scheer said 98 percent of people leave happy, which she credits her staff.

"I think we're all here for the same purpose," she said. "We like being on the mountain. We like to provide support and services to the public."

Visitors come from countries all over the globe, with an increasing number from South Korea and China, Scheer said.

That means staff have to answer questions in multiple languages.

Most commonly, they want to know where is the restroom. Occasionally, they'll get asked about where the restaurant or bar is located.



HOLLYN JOHNSON/Tribune-Herald

Margaux Mellott, Maunakea Visitor Information Station interpretive guide, explains the capabilities of the different telescopes kept at the VIS on Maunakea.

While they can't offer the latter, Scheer said they do try to keep the VIS stocked to meet visitors' needs.

That includes a small selection of beverages

and sandwiches. For the adventurous, there's freeze-dried ice cream called an "astrosandwich"

But since most don't pack winter clothing for a trip to

Hawaii, the most popular items are no surprise. At the VIS, temperatures can be near freezing at night.

"Sweatshirts are our No. 1 seller," Scheer said.

"Then zipup shirts and sweatpants. Socks have been an amazingly effective seller."

Hunter said they try to source local and avoid items that might look gimmicky.

"(Sales) help the VIS but it's not our focus," he said.

Working on the mountain is about more than just a job for Scheer. It's also a chance to enjoy the peace it offers.

"For me, coming up here, is more of a spiritual thing for me," she said. "Just because when you're up here at 6 o'clock on the morning, there is nothing happening ... and if you go up to any of the pu'us or you go to the summit, it's quiet and you can just breath and nothing else matters."

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Photos: HOLLYN JOHNSON/Tribune-Herald

Telescope workers grab dinner at Hale Pohaku.



Flags of the countries working with the Maunakea telescopes line the lobby of Hale Pohaku.



Telescope workers eat breakfast at Hale Pohaku.

An international 'hotel' at 9,200 feet

Warm meals, cozy rooms await astronomers at Hale Pohaku

By **TOM CALLIS**
Hawaii Tribune-Herald

In a state known for its diversity, perhaps no place is more cosmopolitan than Hale Pohaku.

The mid-level facilities at about the 9,200-foot elevation houses and feeds astronomers and telescope workers from Hawaii Island and across the globe.

In the lobby, flags represent the dozen or so countries that take part in astronomy atop Maunakea, some of which, like China and Taiwan, aren't on the best diplomatic terms.

But they come together here just above the inversion layer.

For the facility's cooks, that gives them a good excuse to try new things.

"We have all-around-the-world food," said Alan Hara,

food and lodging manager. "If it's a hit, we keep the recipe."

Most of the telescope crews are from the island, so meals often skew toward local tastes. But he tries to introduce food from elsewhere on a monthly rotation that visitors will find familiar.

"In fact, before they come, they will give me recipes if they want," Hara said.

They will serve about 200 meals throughout the day, either in the cafeteria or up at the summit.

That starts at about 6:30 a.m. with the first rush from telescope workers.

By the time lunch rolls around, they will have meals ready to be delivered atop the mountain, where they are served in a former utility room, as

See HALE Page 31



Wade Yoshizumi, cook, preps food for the telescope workers at Hale Pohaku.

HALE

 From page 30

well as in the Hale Pohaku cafeteria.

What matters most, he said, is keeping their stomachs full at such high altitude.

"I've heard all kind of things," Hara said, regarding what food is best for the summit. "I think some people, greasy food doesn't affect them at all. Some say greasy food is not good. Some people, no problem, they have no problem. The main thing is their stomach is full. If their stomach is empty, they don't feel too good."

Cooks will continue working through dinner. For anyone who misses a meal, they can make sandwiches or a bowl of soup in the cafeteria, Hara said.

He has worked in the hotel and food industry for 19 years, but said there's nothing like working at Hale Pohaku.

The facility offers 78 rooms, which he described as a "comfortable small hotel room," as well as a recreation room with pool tables.

Hara said they used to average 50 to 60 people a night, but with telescopes switching to remote observing, that is down between 20 and 30 most nights.

Rob Hayes, a housekeeper and assistant cook, has worked on the mountain for the past 10 years.

He said he has to be a bit of a jack-of-all-trades and enjoys making people feel comfortable at the high elevation.

"The first day I felt a little woozy," Hayes said, because of the thinner atmosphere. "After that, I'm fine."

Some are not so lucky.

"I've seen people walk through the door and collapse," Hayes said. If that happens, they are trained to administer oxygen.

During his first year, he said they saved the life of an infant who was brought up the mountain by their family, who were on vacation from Japan.

The baby was unconscious when they pulled into their parking lot seeking help.

"We ended up saving it by putting it on oxygen," Hayes said. "There were three of us in the kitchen. We couldn't understand what they were saying, but we knew" what was wrong.

Email Tom Callis at tcallis@hawaii-tribune-herald.com.



Alan Hara, Hale Pohaku food and lodging manager.



Telescope workers have the option of getting meals in a break room on the summit of Maunakea.



Rob Hayes, a housekeeper and assistant cook, preps food for the telescope workers in September in a break room on the summit of Maunakea.



A van is kept on Maunakea for medical emergencies.

The telescope whisperer

John White's job: To keep Gemini's sophisticated instruments working

By **TOM CALLIS**
Hawaii Tribune-Herald

To get the best pictures of the universe, observatories need a large "light bucket," as astronomers sometimes call their primary mirrors, to collect as many photons as possible.

But they also need sophisticated instruments to take the images and collect data so they can really understand what's going on billions of light years away.

That's where people like John White come in.

The 58-year-old Hilo resident is the senior instrument engineer for the Gemini Observatory atop Maunakea.

His job is to be a troubleshooter of sorts. It's up to him to ensure the instruments work as they should when they're needed so that a night of observing doesn't go to waste. That requires him to work not just with electronics, but also the cryogenics that chill the instruments to keep out interference.

"Whenever you find a solution to a problem, that's always a really great feeling," said White, who has worked for telescopes on Maunakea for 28 years.

It's a job he said he still finds rewarding and challenging to this day. But he almost fell into it by accident.

White, who was born in Honokaa and raised in Waimea, said he initially wanted to be an architect. Noticing that computers were making drafting obsolete, he studied business in college instead.

Then he graduated and a recession hit. Nobody was hiring, he said.

White came back to Hawaii Island, where he enrolled at Hawaii Community College in Hilo to study electronics.

At the time, he didn't know anything about it. But he figured that would give him a foothold in another career. He expected to return to the mainland in search for work.

But then White landed a part-time job as an electrician for the Joint Astronomy Centre where he found a mentor who taught him things he was told not to worry about only a few months before in college.

"He was using a piece of equipment called a logic analyzer," he said. "... This is one of the things with electronics class we were told don't bother, you won't see it."

That sparked his interest, and he has been at it ever since.

"Electronics here in Hawaii

is limited to a few things," White said, noting he feels lucky to have a career here.

And a lot has changed during the past three decades.

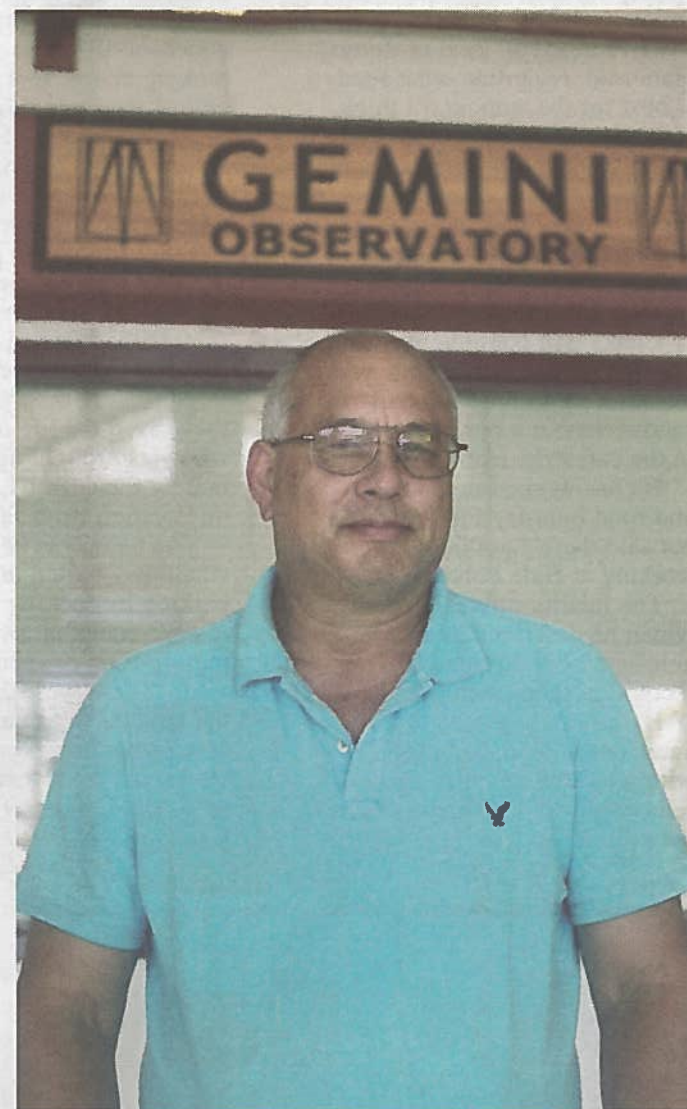
He recalls using floppy disks to store data when he first started. Now, he can use a webcam in the control room in Hilo to solve problems with workers on the summit, something Gemini introduced almost from the start in 1999.

Working with astronomers might not be the most important job in the world, he said, but it does help give him a different perspective.

"If it has taught me anything, it's how incredibly huge the universe is," White said. "The distances are unimaginable, simply unimaginable. And to think that we are on a little tiny blue marble, as someone once said, amongst tens of billions of marbles, bright marbles, with maybe marbles around it. And there is nothing out there that we know of that comes close to the life here on Earth."

For those interested in a similar field, he advised them to keep an open mind.

"You never know what door will open," White said. "You never know what opportunity will pop up. If it's interesting and it interests you, then you should pursue it."



HOLLYN JOHNSON/Tribune-Herald

John White of Gemini Observatory.

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Kalepa Baybayan, left, Ka'iu Kimura, center, and Yu Yok Pearring stand near a Polynesian canoe exhibit at 'Imiloa Astronomy Center.

HOLLYN JOHNSON/Tribune-Herald

'Big Bang versus Kumulipo'

'Imiloa Astronomy Center strikes unique balance between science, Hawaiian culture

By **TOM CALLIS**
Hawaii Tribune-Herald

Growing up in Waimea, Ka'iu Kimura didn't know much about the work astronomers did on Maunakea or about those who lived in the small community.

"I think when astronomy began it was all about the research and accessing Maunakea as the best place on Earth to study the universe from," said Kimura, director of the 'Imiloa Astronomy Center. "And I think as the years moved on, as the decades moved on, the community became more involved, more concerned with what was happening on Maunakea. And out of that conversation

came this idea to build an education center that would have these perspectives."

That place became 'Imiloa, which opened in 2006 with the mission of bringing modern astronomy and the Hawaiian culture together, and better communicating benefits of the research on the mountain to the public.

Sitting at the University of Hawaii at Hilo, the 40,000-square-foot center includes three titanium cones representing the island's largest mountains, easily setting it apart architecturally from other buildings on campus. Inside, it hosts a 3-D planetarium and exhibits on astronomy and Hawaiian culture, including those highlighting traditional Hawaiian navigation.

In the last fiscal year, the facility welcomed 61,000 people, according to 'Imiloa.

"Our mission is to provide a balanced perspective between astronomy and culture," said Kalepa Baybayan, 'Imiloa's resident navigator. "For example, the idea of how the universe came together, we have the Big Bang theory and we have the Kumulipo (a Hawaiian creation chant). It's shared space."

Baybayan, a master navigator and Hokulea captain, said he sees a "metaphoric relationship" between traditional Hawaiian navigation and astronomy on Maunakea.

"We are both very interested in celestial bodies," he said.

See 'IMILOA Page 34

'IMILOA

 From page 33

Kimura, who studied Hawaiian language and literature at UH-Hilo, got involved in the discussions to form 'Imiloa in its early stages following the new millennium. She became deputy director after its opening and executive director in 2010.

"I saw it as an opportunity to advance our Hawaiian language, to advance our Hawaiian worldview," she said. "And I thought by bringing that together with science, modern science, it could really empower both science and our cultural revitalization efforts by coming together to forge new ways of understanding."

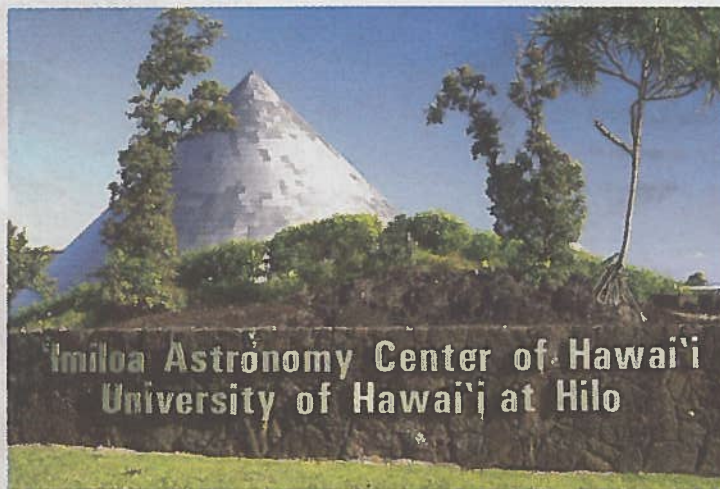
During the planning stages, Kimura said they created about 200 new Hawaiian words to describe phenomenon and objects in space not visible to the naked eye, such as black hole and nebula.

"You got to understand deeply what those concepts are, and you got to understand deeply how to create that same sort of understanding in a totally different language," she said.

While everyone agreed on the mission, there was some clashing of perspectives on how to do that. Kimura said that was a healthy process to go through.

"In that process, I saw people who could not agree at all, on Big Bang versus Kumulipo," she said.

"That the validity on either one, they couldn't agree. I saw they were really transformed through the process of having to work very closely together, explaining one another's perspectives very deeply because they had to create a product that was usable for the general public walking through 'Imiloa."



Courtesy photo

The 'Imiloa Astronomy Center of Hawaii is located at 600 Imiloa Place in Hilo.

Over the years, Kimura said the astronomy community significantly has increased its engagement with the rest of the island, creating new opportunities for children to get involved and feel connected to the work they do. And 'Imiloa is often there, too, helping to support programs

like Journey Through the Universe and Maunakea Scholars, and provide them with cultural education.

There is still tension and conflict over use of Maunakea for astronomy, as seen with the protests against the proposed Thirty Meter Telescope.

Kimura said she hopes

'Imiloa can still serve as a place for dialogue.

She said she also is looking to include that conflict in an exhibit that could be ready by the end of 2017.

Kimura said it will give a historical overview of Maunakea from different dimensions, including astronomical, natural, social-political and management.

"So this issue with TMT has given us the opportunity, made us realize that we need to step up to that and be this resource for the community to learn about the historical development on Maunakea," she said. "That's one way we are responding to the current issues."

'Imiloa is open from 9 a.m.-5 p.m. Tuesday through Sunday at 600 'Imiloa Place, Hilo.

On the web: www.imiloahawaii.org.

Email Tom Callis at tcallis@hawaiitribune-herald.com.

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The Kona-Kohala Chamber of Commerce bestowed its 2017 Pualu Cultural and Heritage award for OMKM's "implementation of its Long-Term Historic Property Monitoring Plan" that "specifically enhances cultural stewardship on Maunakea and preserves our island's cultural heritage."

OMKM was established to oversee the Maunakea Science Reserve. It works closely with the Maunakea Management Board, Kahu Ku Mauna, a council comprised of Hawaiian cultural resource persons, and the community at large.



malamamaunakea.org



HOLLYN JOHNSON/Tribune-Herald

Hoku Kea director Pierre Martin takes the manual mirror cover off of the new telescope in February at University of Hawaii at Hilo.

UH undergrads share telescope time with astronomers

By TOM CALLIS
Hawaii Tribune-Herald

A graduate degree is no longer required to use some of the best telescopes in the world.

In 2016, the University of Hawaii agreed to share some of its viewing time on the Maunakea telescopes with undergraduate students in Hilo.

Pierre Martin, astronomy associate professor at UH-Hilo, said in an email that the program started in February 2017, noting it is working well except for some lost time due to bad weather on the mountain.

Research proposals are submitted by UH-Hilo faculty members but they include an educational component.

"To my knowledge, no other undergraduate program has access to such a large panoply of observatories," Martin said.

"The opportunities to conduct research here and learn about modern techniques of astronomy are rather amazing, really."

UH-Hilo's astronomy program includes five tenured or tenured-track professors and about 40 students. Another 15 were in the physics program in fall 2017.

UH-Manoa, which hosts the Institute for Astronomy, receives between 10 percent and 15 percent of the viewing time at telescopes on Maunakea.

Through the program, up to 16 nights a year will eventually go to UH-Hilo faculty and students, with six nights a year during the first five years.

Martin said UH-Hilo's focus is on observational astronomy.

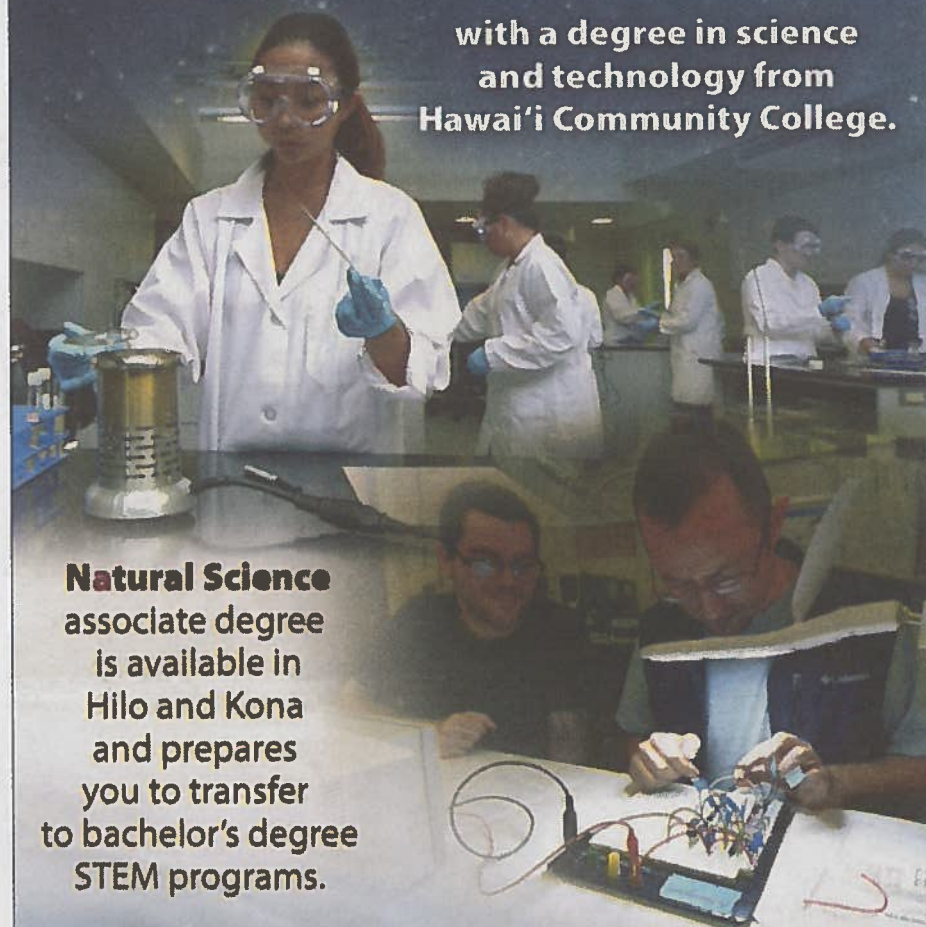
The undergraduate program has seen some setbacks.

The site of its Hoku Kea teaching telescope has been selected for decommissioning. As of October 2017, UH-Hilo was still searching for a new site for a replacement 28-inch telescope and dome.

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HAWAII ASTRONOMY DISCOVERIES AND TECHNOLOGICAL ADVANCEMENTS

Relics of our Solar System Discovered on Maunakea

The Kuiper Belt was discovered in 1992 and observations from the UH 88" were critical to this accomplishment. This region of our solar system, which extends from roughly the orbit of Neptune to about 50 times the earth-sun distance, contains an enormous number of small icy bodies thought to be remnants from the formation of our solar system. Pluto is a member of the Kuiper belt, which sources many of the short period comets that traverse the inner solar system and we see from earth.



Kuiper Belt Objects

Laser Adaptive Optics Developed on Maunakea

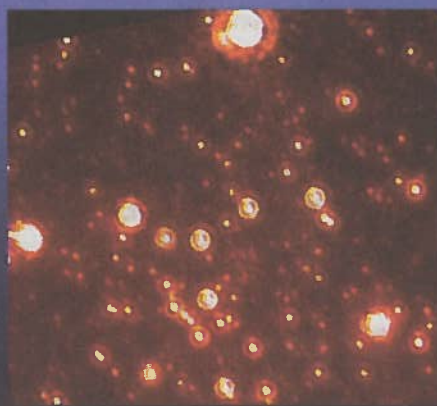
In 2003 Keck released for use an ambitious laser adaptive optics system that has over the years developed into the most scientifically productive laser AO program in the world. Keck helped pioneered laser AO for astronomy, providing some of the highest resolution images of celestial objects ever recorded.



A first light image recorded with the Keck laser guide star system. The object above is an edge-on proto-planetary nebula, with dust forming the dark band.

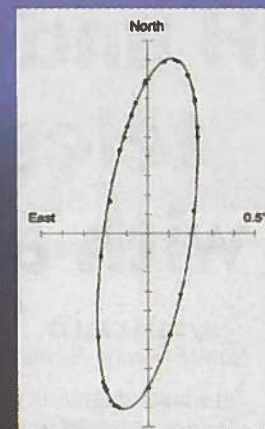
Facility Class Adaptive Optics Arrives First on Maunakea

1997 yielded the first image of the Galactic Center with facility class adaptive optics (from CFHT) seen here at near infrared wavelengths. The increase in resolution is stunning and diffraction rings adorn stars, an indication that the image is approaching its theoretical maximum resolution.



Distant Worlds and Exquisite Measurements from Maunakea

Precise observations made at the UH 88" played an important role in measuring the bulk properties of Pluto and its largest satellite Charon, demonstrating that each has large surface feature variations and that Pluto has a rocky core surrounded by an icy mantle. These results were published in 1987 and derived from careful measurements of the orbit of Charon around Pluto. They were crucial early steps in research about Pluto, leading to the recent New Horizons Pluto mission.



Charon's orbit around Pluto

Large Telescopes Meet Large Cameras at Subaru

In 2000 Subaru ushered in the era of wide field imaging with a large format telescope using Suprime-Cam. A first and a feat that has not been repeated since. This capability stems from Subaru being the only 8-10 m class telescope in the world that supports a prime focus instrument complement. Today the mammoth Hyper Suprime Camera is used regularly, offering 1.5 deg wide fields of view using 870 million pixels in its digital focal plane.



The new Hyper Suprime Camera at Subaru Telescope is the only large format camera on an 8-10 m class telescope



The Field of Exoplanet Discovery Through Transits is Opened

In 1999 the first exoplanet transit was measured at Keck observatory. As this gas giant passed in front of its host star (HD209458), a faint drop in the star's brightness heralded the age of detecting and measuring exoplanet properties through such transit measurements. The planet circling this star completes an orbit in only 3 days, is nearly as massive as Jupiter, and has a surface temperature of about 1000 C. Since this discovery thousands of exoplanets have been detected using this technique.

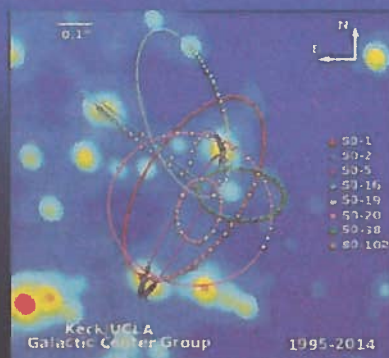


Astronomy Picture of the Day (APOD) – an artist's rendering of how the exoplanet orbiting HD209458 might look during a transit.

HAWAII ASTRONOMY DISCOVERIES AND TECHNOLOGICAL ADVANCEMENTS

A Black Hole Lurking in the Heart of our Galaxy is Confirmed

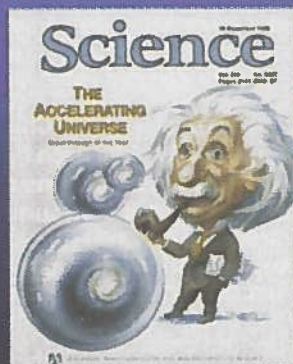
In 2000, observations conducted at Keck were published stemming from years of high resolution images of the Galactic center region. These measurements were used to derive the orbits of stars around the massive black hole in the center of our galaxy. They proved, beyond the shadow of a doubt, that black holes exist and shed "light" on the nearest massive black hole in our neighborhood that we can study.



Orbits of stars around an invisible objects are shown. Today we know that object is a massive black hole.

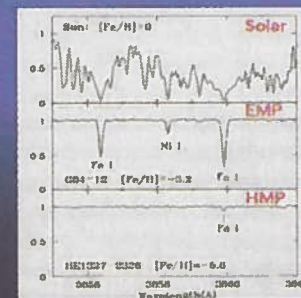
The Largest Form of Energy in the Universe is Discovered

In 2005 an announcement that startled the international science community was that the expansion of the universe isn't slowing down, as expected because of gravity, but accelerating, due to an unknown energy field pervading the universe. A number of Maunakea observatories played an important role in this discovery including CFHT, Subaru, Gemini, and Keck. The discovery of Dark Energy earned the Noble Prize in physics in 2011 for Adam Riess, Brian Schmidt, and Saul Perlmutter.



In Search of the First Stars Formed After the Big Bang

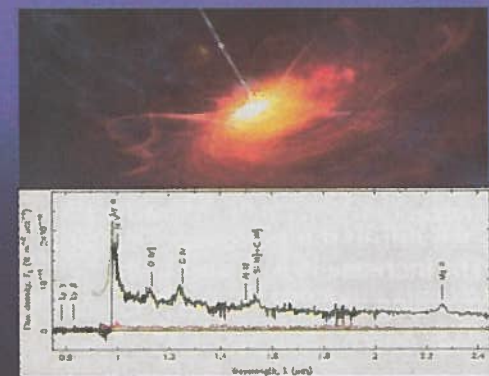
Subaru telescope was used in 2006 to find some of the most metal deficient stars ever identified, having chemistries consistent with stars made from truly primordial material from the Big Bang, not "recycled" material from previous generations of stars. These stars were real "needles in the haystack" and are extremely rare. They provide insight into the physics of the first stars born after the Big Bang, which were made almost entirely of hydrogen and helium, lacking heavier elements that create absorption lines in stellar spectra.



The top spectrum is of our sun, which has a fairly normal chemical composition leading to lots of absorption lines in its spectrum. Extremely Metal Poor and Hyper Metal Poor stars were discovered at Subaru, essentially free of any contamination from previous generation stars.

Maunakea Telescopes Team Up to Identify the Most Distant Quasar

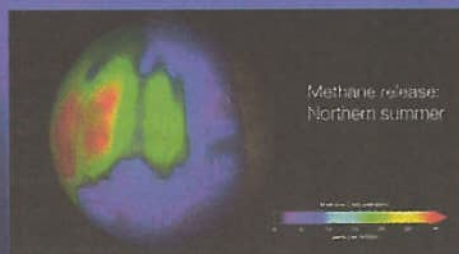
In 2011 the most distant quasar ever discovered was detected at UKIRT and confirmed at Gemini-North, on Maunakea. The light from this quasar is actually being emitted from a super massive black hole lurking at its core with a mass 2 billion times that of our sun. The light measured now was emitted just 800 million years after the Big Bang. The formation of such massive black holes, so quickly after the Big Bang, remains a mystery.



Above, an artist's concept of what the most distant quasar ever discovered might look like. Below, a spectrum of the light from this quasar, measured by Gemini-North, proving its enormous redshift (distance).

Mars + Methane = Life?

In 2005 observations made by the NASA IRTF on Maunakea (and later confirmed at Keck Observatory) proved that methane is being replenished in the atmosphere of Mars. The source of this gas, which is chemically volatile and breaks down easily, remains unknown but the two most likely sources are either geologic or biologic processes. On earth, microbes produce large amounts of methane and this discovery opens the possibility of similar biological activity on Mars.



A map showing the distribution of methane in the atmosphere of Mars.

The First Image of an Exoplanetary System was from Maunakea

In 2008 astronomers announced the discovery of an entire exoplanetary system around the star HR 8799. The white dots surrounding the host star, imaged by Gemini and Keck, were unprecedented and will be reproduced in astronomy text books throughout the 21st century. These images are a testament to the exquisite observing conditions on Maunakea and the technologies used at the Maunakea Observatories

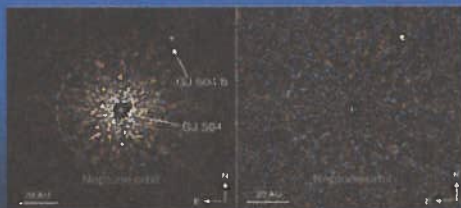


Top – the first image of an exoplanet system using adaptive optics on Maunakea telescopes. Bottom – an artist's concept of how HR8799 might look up close.

HAWAII ASTRONOMY DISCOVERIES AND TECHNOLOGICAL ADVANCEMENTS

A "Second Jupiter" is Discovered

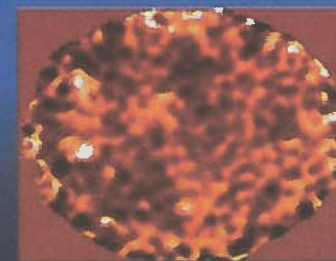
In 2013 the lowest mass exoplanet ever directly imaged was detected by Subaru Telescope. This planet (GJ 504b), which has a mass comparable to that of Jupiter, was detected through the use of innovative coronagraphic imaging and adaptive optics at Subaru. Direct imaging allows direct measurements of planetary orbits, masses, and luminosities. GJ 504b is further from its host star than Neptune is from our sun and challenges models of planet formation, which do not easily explain how Jupiter-like planets can form so far from their host stars.



Direct imaging of exoplanets yields a wealth of information about these objects, including a direct measurement of their masses. These images from Subaru Telescope are of an exoplanet with a mass comparable to Jupiter's – a first in astronomy.

A New Class of Distant and Previously Invisible Galaxy Discovered

In 1998 JCMT's instrument SCUBA was able to take full advantage of the extraordinary conditions on Maunakea to conduct observations at microwave frequencies to detect ultra-luminous dusty galaxies, a previously undetected class of distant galaxies. These objects emit copious amounts of radiation but are so heavily enshrouded in dust that they are rendered invisible except at far infrared and radio wavelengths. They are so bright at radio wavelengths that they emit as much radio energy as all optical light in the early universe. This discovery challenged theories on star formation in the early universe.



Bright knots in this ultra deep microwave image of the distant universe are never before detected incredibly luminous galaxies. They are so heavily enshrouded in dust that they are not detected at optical or infrared wavelengths.

Where Did the Elements Come From?

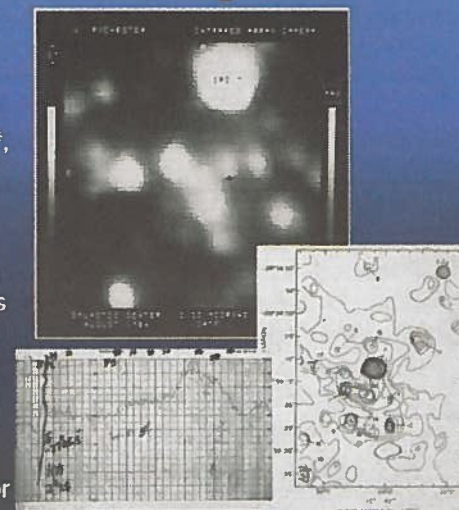
Understanding the origin of matter provides incredible insight into physical processes that make life and the world we know possible. One such mystery was substantially solved by Subaru Telescope in 2015 when observations of Nova Delphini 2013 showed large amounts of lithium being produced by nuclear reactions in the immediate aftermath of this explosion. The third lightest element, with only trace amounts produced during the Big Bang and other mechanisms, lithium's production has been the subject of astronomical research for decades. Thanks to observations made at Subaru, we have a much better understanding of where the element that powers modern batteries, computers, cell phones, etc. comes from.



An illustration of the beginning of a nova is shown. Material from a star spiraling onto a nearby white dwarf overtime accumulates enough to trigger an explosion. This process can repeat many times in such systems.

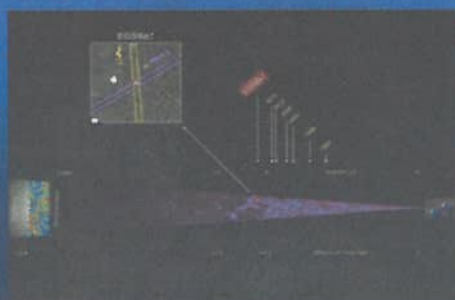
Hawaii Helps Revolutionize Infrared Astronomy

First image (above) of the Galactic Center recorded in 1986 from Maunakea by a 32x32 infrared array. The small + denotes the location of a mysterious radio source, called SgrA*, previously detected and suspected of being a black hole lurking in the core of our galaxy. The raster scan (below right) made with a single element infrared photometer, represented the state of the art in imaging prior to this remarkable first digital image of the core of our galaxy. Prior to that, a crude strip chart recording was the first evidence of an infrared source in the heart of our galaxy. Technology development has been one of the hallmarks of Maunakea astronomy, for decades.



Hawaii Astronomy – A Legacy of Pushing Further Back in Space and Time

In 2015 the most distant galaxy ever detected (named EGS8p7) was confirmed via observations made at Keck observatory. The universe was only about 600 million years old when this galaxy formed. Modern cosmology predicts that the universe was filled with atomic hydrogen in that period, which would absorb the ultraviolet radiation from stars. Surprisingly an ultraviolet emission line was detected at Keck from this incredibly distant object, leading to reconsideration of the conditions in the early universe.



A timeline showing the discovery of ever more distant galaxies.

A New Technique to Map the Location of Dark Matter Across the Universe

In 1986 the first image of a "strong" gravitational lens was recorded at CFHT. The mysterious arc of light was at first misinterpreted but eventually correctly shown to be the result of a powerful gravitational field created by dark matter in the midst of a galaxy cluster. What makes this important is that this observation paved the way to using gravitational "lensing" to map the distribution of the dominant form of matter across the universe – dark matter.

Nearly 20 years later Hubble Space Telescope recorded this image



CFHT's 1986 image of Abell 370's powerful gravitational lens heralds the beginning of mapping dark matter across the entire universe.

Mahalo, Maunakea

For over a thousand years, Maunakea was treasured as a beacon to guide fearless seafarers into safe refuge. They were the best astronomers of their age, able to pinpoint their location on a spinning sphere, orbiting a distant sun, using the stars visible at night and connections to the wind, currents and signs of the sea to navigate a vast ocean.

Once ashore, Maunakea was revered as a source of water and food needed to sustain thousands of people. Maunakea was a giver of life itself. This majestic mountain was also revered as a portal to Wakea (sky father) and Papahānaumoku who brought forth all things from po, a vast sea of empty darkness. Captured in the Kumulipo or creation story, this genesis of life has always intrigued

me as an astronomer in the 21st century who has spent most of my life in the graces of Maunakea's shadow.

Today's astronomy depicts a genesis of all things that started in a Big Bang, which emerged from an infinite vacuum — a vast sea of infinite darkness. This intersection of origins — in what Hawaiians believed for centuries and we have discovered using sophisticated techniques from Maunakea and beyond — is perhaps the intersection of our collective future.

Tonight, the most powerful collection of telescopes in the world will harvest ancient light from distant reaches of our universe to answer ancient questions. They are part of an epic quest to unravel the nature and genesis of all matter, energy and life in the realm we call the universe.

The tallest mountain on Earth, and the second largest shield volcano in our entire solar system, Maunakea is arguably the best site on our planet for observing the cosmos.

Surrounded by a flat ocean surface on all sides for thousands of miles, the placid topography of Maunakea minimizes turbulence in the air that is gently blown up and over its summit, leading to exquisite clarity in our views of distant nebulae and galaxies.

From Maunakea, we see our origins reflected in the night sky above. The unique attributes of Maunakea, including some of the darkest skies anywhere and its high altitude, leaving most water vapor far below, make it a treasure for studying the universe, and for studying ourselves. From that vantage point, today's

astronomers have made some of the most startling discoveries in history, including a behemoth black hole lurking in the heart of our Milky Way galaxy, and the existence of the greatest form of energy in the universe — so-called Dark Energy — that pervades all space, including that between the molecules in our bodies. Maunakea is a key to unlocking the mysteries of our existence. It is a sacred and timeless place of peace, reverence, knowledge and guidance.

We all ride a wave of life that crests in our time. For the Hawaiians that came before us, and the generations that will follow, Maunakea helps sustain that wave of life.

This special section of the Tribune-Herald celebrates some of the many stories of the Maunakea Observatories as they too

ride that wave of life.

One of those stories is about high school students from Honoka'a who are among the first teenagers in the world to use the most powerful telescopes in the world to probe their chosen piece of distant space.

They are among the first of many 'opio that, with powerful time machines at their fingertips, will explore ancient space and connect that to modern space. In the near future, young Maunakea Scholars will participate in a fantastic search for nearby terrestrial class planets that, once discovered, they will name for posterity.

These may be among the planets that a future generation will send the first interstellar probes, in the search for life beyond the confines of island earth.

Think of it: In a century or two, our species may reach out to touch life on a distant world, named by a child in school now, in our midst, in Hawaii. It's not that far-fetched.

The story that began a thousand years ago by brave seafarers who relied upon Maunakea to signal home, continues today as we search for distant islands afloat in space with the goal of improving the lives of future generations.

This multi-generation cascade of discoveries is our legacy in Hawaii. When Maunakea was discovered by the first Hawaiians centuries ago, it wasn't the end of a voyage. It was the beginning of an incredible journey that we are just starting to recognize.

— Doug Simons,
on behalf of the

Maunakea Observatories.

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— Plato
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Mahalo to Our Community



Over the past half century, the Maunakea Observatories have created well over a thousand green high-tech jobs, provided education opportunities for tens of thousands of students, and sourced well over a billion dollars in investment in Hawai'i.

To our neighbors, friends, families, colleagues, and partners in this journey, mahalo nui loa for making all of this possible.

