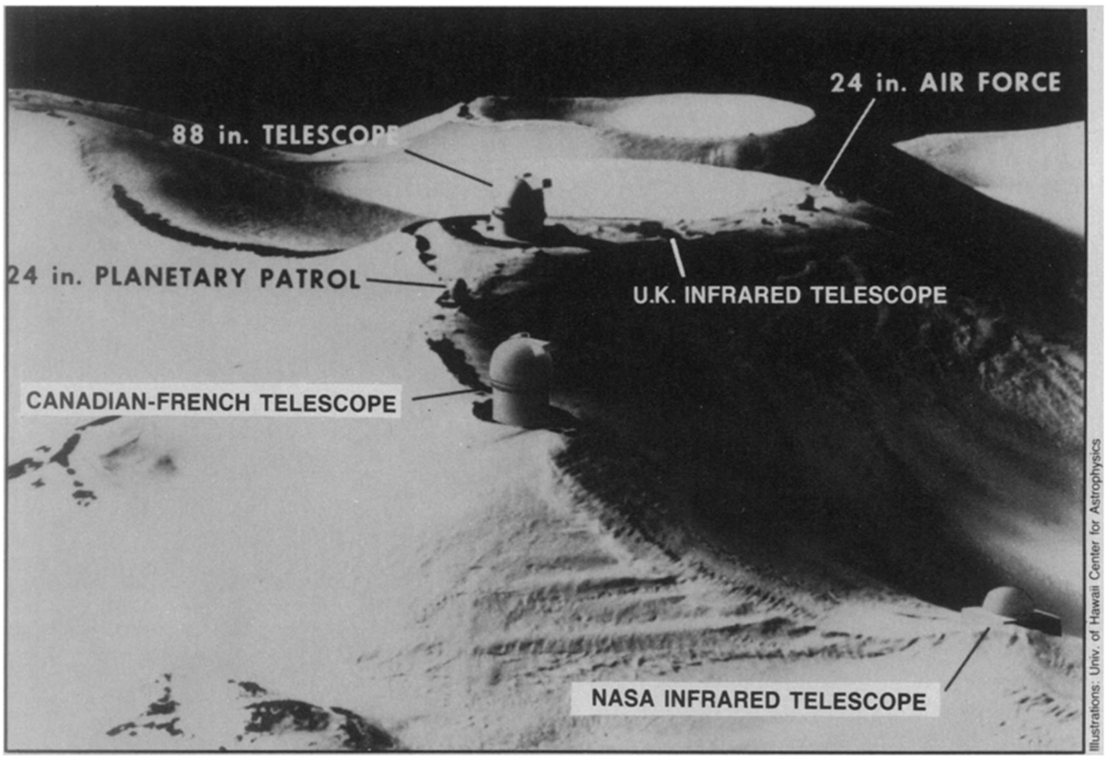
NEW EYES ON MAUNA KEA



Telescopes flourish in Mauna Kea's astronomically healthful climate, with the three biggest soon to bloom.

Three major telescopes, including the largest infrared facilities to date, are planned for Hawaii's tallest peak

BY JONATHAN EBERHART

The summit of 13,796-foot Mauna Kea, highest point on the island of Hawaii, is soon to become, for astronomers, one of the most exciting spots in the world. For in the year beginning with the summer of 1977, no fewer than three major new observatories representing four countries are expected to begin operations, including what will be the two largest infrared telescopes in existence.

Mauna Kea's lofty volcanic peak is a choice spot for astronomy, especially the infrared variety, for which the major obstacle in earth-based observations is the ocean of water vapor in the lower reaches of the atmosphere. Atop Mauna Kea, according to William Brunk, chief of planetary astronomy for the National Aeronautics and Space Administration, there is only about 2.5 *millimeters* of precipitable water vapor per year. This is one of the major reasons that NASA selected the site over the likes of Arizona's Kitt Peak and California's White Mountain (and even parched Baja California) as the location for its three-meter infrared telescope. The facility will be operated for NASA by the University of Hawaii, which last month received the $5.5 million contract covering most of the instrument's design and construction.

The other criterion, says Brunk, was a minimum of "sky noise." In infrared observations of faint sources, astronomers often must measure the intensity of the region of sky containing the desired source, then re-aim the telescope's secondary mirror to pick up an adjacent region with no bright IR emissions in order to measure the sky's background brightness, or noise. The intensity of the sky alone is then subtracted from that of sky-plus-source to yield the intensity of the source alone. For this technique to work effectively, the telescope has to be located such that adjacent areas of sky in its field of view have similar infrared intensities, or temperatures. Here again, says Brunk, Mauna Kea outshone its competition.

The long-sought facility has its official origins in a 1968 National Academy of Sciences summer study on planetary astronomy, whose final report specifically recommended construction of a large-aperture infrared telescope, suggesting a 120-inch size that is the equivalent of NASA's present three-meter design. Four years later, in a prospectus for astronomy and astrophysics in the 1970's, the Academy repeated its urging, stressing "a significant increase in support and development of the new field of infrared astronomy, including construction of a large, ground-based infrared telescope. . . ."

Since those days, however, although the size of the planned instrument is still the same, there has been a significant increase in the quality of infrared detectors, the devices that take the place of cameras and other direct-imaging equipment in IR studies. (Since most infrared astronomy is done at wavelengths too long for most IR film, the light collected by an IR telescope is usually focused on a detector such as a photovoltaic device, either singly or in arrays, or else directly into an instrument such as a spectrometer.) The result has been that the telescope's planners have set higher goals for themselves, including a more demanding role for planetary, as opposed to stellar, astronomy.

A substantial part of the Hawaiian facility's work will be on stellar sources—exploding galaxies, interstellar dust, galactic nuclei and so on. But the real impetus for the project, including the deadline for its summer 1977 opening, has come from planetary plans, notably including the scheduled August 1977 launch of two Mariner space probes to Jupiter and Saturn. The observatory's Coudé room, for example, which receives light from the source at a fixed point regardless of the telescope's position (thus facilitating the use of heavy, permanently mounted instrumentation), will be made unusually large to accommodate as many as four separate interferometers for studies of planetary atmospheres in different spectral ranges. Similar studies with smaller instruments (the largest at present are 60-inchers, Brunk points out) have already made valuable contributions, such as Stephen Ridgway's discovery of various constituents in the atmosphere of Jupiter. The Mariner Jupiter-Saturn probes will also each carry a 50-centimeter IR telescope equipped with interferometer and radiometer, enabling comparisons between earth-based and space-borne observations. The spacecraft should reach Jupiter in the spring of 1979 and Saturn in the summer of 1981.

Pointing accuracy is of particular concern for the ground-based telescope, especially since much of the Mariner probe's work will focus on the moons of Jupiter and Saturn, and the Mauna Kea instrument should be able to effectively support it. NASA's requirements call for a spatial resolution of 2 seconds of arc—about one twentieth of the disk of Jupiter—but in addition, because some of the targets will be so small, it must be possible to center the telescope even more precisely than that. The optimum way to mount the huge instrument is still being discussed, since its planners want to be able to move it through a 20-degree arc and end up within one arc-second of the desired spot in order to use angularly distant visible objects as reference points to locate IR sources.

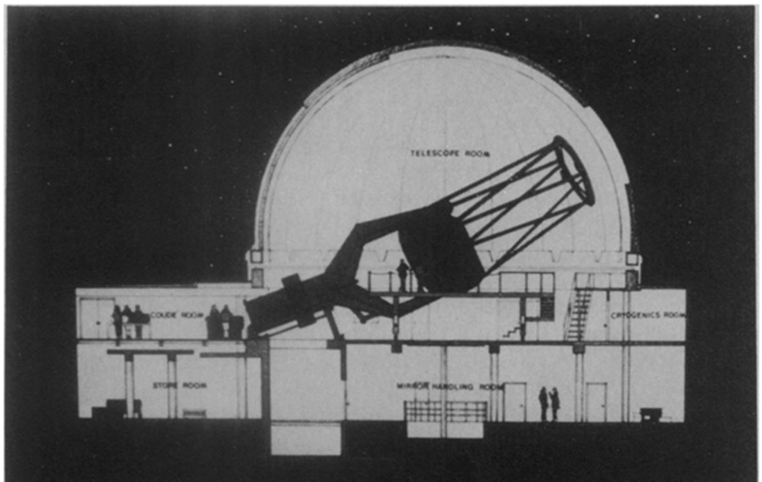
As little as six months after the NASA telescope assumes the infrared crown, a still bigger one may join it on the mountain top. (The actual opening date may depend on the resolution of environmentalists' concerns about the scenic peak, a gauntlet through which the NASA 'scope's planners are also running.) This will be a British facility, with a 3.8-meter (150.inch) mirror that became available, says Brunk, simply because the mirror supplier decided to try casting a larger one, and British researchers decided to take advantage of it. This instrument, however, will be used largely for stellar astronomy, because although it will have more light-gathering power than the NASA telescope (valuable for distant sources), it will have only about five arc-seconds of spatial resolution. About half a dozen people from the University of Hawaii will support the British facility, with a similar number added from the United Kingdom. (NASA will provide support for about 10 for its own facility, to be hired by the University of Hawaii.)

The advantages of Mauna Kea are not confined to the infrared, however. The remarkable "seeing" afforded by the peak is important to visible-wavelength observers as well. For sky features as small as one arc-second to be seen without crippling atmospheric distortion is considered excellent, and Mauna Kea has recorded seeing as sharp as one-half second of arc. In fact, Brunk says, the Hawaiian site offers about three times as many "one-second nights" as does, say, Kitt Peak.

Thus the third super-scope, a 3.6-meter (142-inch) visible-wavelength instrument, already under construction as a joint Canadian-French project. The footings for the telescope were poured last year, although it may be 1978 before the facility is in operation. The largest telescope now on the mountain is an 88-incher.

But there are other large visible-light observatories in many parts of the world. It is the infrared astronomers who have the most to gain from Mauna Kea's high and dry environment. In fact, according to Brunk, with the three-meter NASA instrument still two years from its grand opening, there are already thoughts of a still larger IR telescope, whose primary mirror would be a titanic five meters across.

Whole new fields of astronomy are being developed by orbiting observatory satellites. But there is still plenty of excitement to come on the ground. □



Large, instrument-filled Coudé room will aid planetary studies at NASA's infrared observatory.