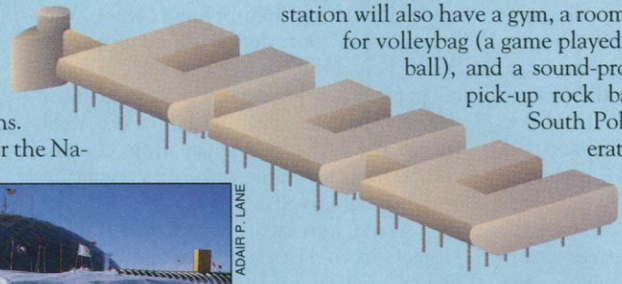
A Design for Life in the Freezer

For an architect, drawing up a blueprint for a new station at the South Pole is about as tough a challenge as terrestrial design gets. Eight inches of snow accumulates every year and never melts. A steady wind creates drifts that can bury low-lying buildings in months. Temperatures routinely hit minus 100 degrees Fahrenheit. The "ground" itself—really a glacier almost 2 miles deep—slides an average of 33 feet toward the sea each year, and adjacent spots can move at different speeds, ripping apart structures. And then there's the task of designing facilities that will help the station's two dozen or so winter inhabitants endure near-total isolation from the outside world during 6 sunless months.



SOURCE: FERRARO, CHOI & ASSOCIATES

Given those challenges, it's no wonder the National Science Foundation (NSF) has spent 4 years chewing over more than a dozen different configurations to replace the current station, built in 1975. Proposals, fluctuating between the aesthetic and the practical, have ranged from half-buried mounds to a globe on stilts. But the first solid design is finally emerging from the cloud of half-formed ideas.

ADAIR P. LANE

(N)ice and comfortable. The proposed South Pole station *(right)* would result in more science with less maintenance than the current structure *(above)*.

This week, NSF is expected to propose a structure consisting of three horizontal U-shaped modules on stilts, connected by flexible enclosed walkways. Each of the elevated modules will have two floors; some will contain sleeping and personal space, others will have lab areas, recreational rooms, a cafeteria, and conference rooms. At 120,000 square feet, the new station will be some 33,000 square feet larger than the existing dome and underground arches that comprise the current station. It will be able to house 150 people in summer—25 more than the current overcrowded accommodations—and 50 in winter, compared with the current overcapacity of 29. But the biggest difference is in the way each person will be housed: Individual rooms and workspaces, windows, and a mix of common and team space will allow for efficient working conditions even during the depths of winter.

The design is dominated by the need to prevent the relentless drifts from burying the station. Today, bulldozer crews spend nearly the entire summer digging the current dome out from its winter accumulation; to avoid a "bowl" effect, they now have to push the snow nearly a mile away. The new station will be almost maintenance free, with each module perched on legs above the ice. The raised modules will have their leading edges sloped to deflect a nearly constant 10- to 15-mph wind and accelerate it underneath the structure, thereby reducing the accumulation of snow. Because some drifting is inevitable, the modules are designed to be raised when the "ground" gets too close. Likewise, because the ice sheet on which the new station will be built is moving, the walkways that connect the modules are flexible.

Inside the station, quarters will seem luxurious compared to the existing berths, where welders' curtains often provide the only privacy and metal lockers the only personal storage. The station will also have a gym, a room with a ceiling high enough for volleybag (a game played with a beanbag instead of a ball), and a sound-proofed practice room for the pick-up rock bands that have become a South Pole tradition. NSF's polar operations manager, Erick Chiang, hopes the new station will feel "like a reasonably good motel," with at least one special feature: a 3000-square-foot area in which treated sewage fertilizes vegetables and perhaps some fruit.

As for working conditions, laboratory space will consist mostly of flexible work stations, open areas, and a machine shop. Power will be provided initially by the same sort of diesel-electric power plants that provide heat and electricity for the current station. But NSF is also planning on some passive solar heating—during the summer months, the pole is the sunniest spot on Earth—as well as exploring photovoltaics and wind turbines for supplemental power. To ease fuel consumption, the new station will be insulated to a value nearly five times that of the average U.S. residence.

Outside, the surrounding ice will be divided into science sectors: "Dark" for astrophysics; "Quiet" for seismology; "Clean air" for atmospheric sampling; and perhaps a balloon launch sector as well. A fifth sector is the actual pole, a significant geopolitical feature as well as a tourist attraction.

Symbolism is important when redesigning South Pole station, says Joseph Ferraro, with the Honolulu firm of Ferraro, Choi & Associates, Ltd., the proposed new station's chief architect. "NSF wants a really impressive shape," he says, as well as a way to clean up the surrounding area, now littered with crates and temporary scientific structures. One option would give the station the look of a wing by connecting the modules with a flexible mesh.

One symbol that is not expected to survive the redesign is the familiar dome. Although the dome will be used to house the estimated 80 workers and their equipment during the 8 years of construction, it will be taken down when the new station is finished. Not only would the dome continue to present a drifting problem, says Chiang, but "we just didn't feel it would be right to turn this symbol into a shed."

–Christopher Anderson

people to the winter-over crew, it provides better working conditions for scientists affiliated with the center. As a consequence, when Stark makes his fourth visit to the pole in November, he'll be stepping into comparative luxury. Instead of lugging a low-budget prototype with him, he'll meet up with a $3-million, 10,000-pound Antarctic Submillimeter Telescope and Remote Observatory (AST/RO), which was built, assembled, and calibrated in Boston and shipped across the Pacific by boat. Instead of toiling outside, Stark will use the telescope to map star-forming regions of the galaxy from inside a well-heated building. And when the austral summer ends, AST/RO will be tended by a graduate student who will winter over and operate the observatory until Stark returns in November 1995.

This fall, construction crews will complete work on a second building that will be a permanent home for two other CARA instruments currently occupying AST/RO's quarters. One, called Python, is a microwave telescope measuring the temperature of the early universe (*Science*, 25 March, p. 1683). It's operated by a team led by Dragovan, who's in the process of moving to Yerkes from Princeton University. The second, called SPIREX (South Pole Infrared Ex-