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- Cape Canaveral's 6,000-mile Shooting Gallery 421
ALLAN C. FISHER, JR.
LUIS MARDEN, THOMAS NEBBIA
- Amalfi, Italy's Divine Coast 472
LUIS MARDEN



- Creatures of Hawaii's Coral Reefs PAUL A. ZAHL 510
- What We've Accomplished in Antarctica 526
REAR ADM. GEORGE J. DUFEK, USN
- America's Wonderlands*, The Society's 558
New Book on the National Parks
- The Swans of Abbotsbury MICHAEL MOYNIHAN 562
BARNET SAIDMAN

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THE NATIONAL GEOGRAPHIC MAGAZINE



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*Islands drowsing in the sun track flaming rockets
down the Atlantic Missile Range, a Space Age proving ground*

Cape Canaveral's 6,000-mile Shooting Gallery

By ALLAN C. FISHER, JR., Assistant Editor

With photographs by LUIS MARDEN and THOMAS NEBBIA
National Geographic Staff

RISING from the distant edge of night, the thin pencil of flame arched past the North Star and headed southeast. Then, quite suddenly, the heavens exerted their magic. Behind the racing flame shimmered an enormous tail of light, pearly, opalescent, for brief moments tinged faintly with green, a luminous veil miles long across the darkness and the stars.

East of my vantage point on Grand Bahama Island the cometlike tail streaked behind billowy clouds, lighting them eerily, only to reappear with undiminished brilliance. Yet its light seemed a delicate wraith of a thing, as weirdly beautiful as an aurora or the zodiacal light. Far to the southeast, a storm front extinguished the sight, and my companions and I turned away, feeling like men who had dreamed in color while yet awake.

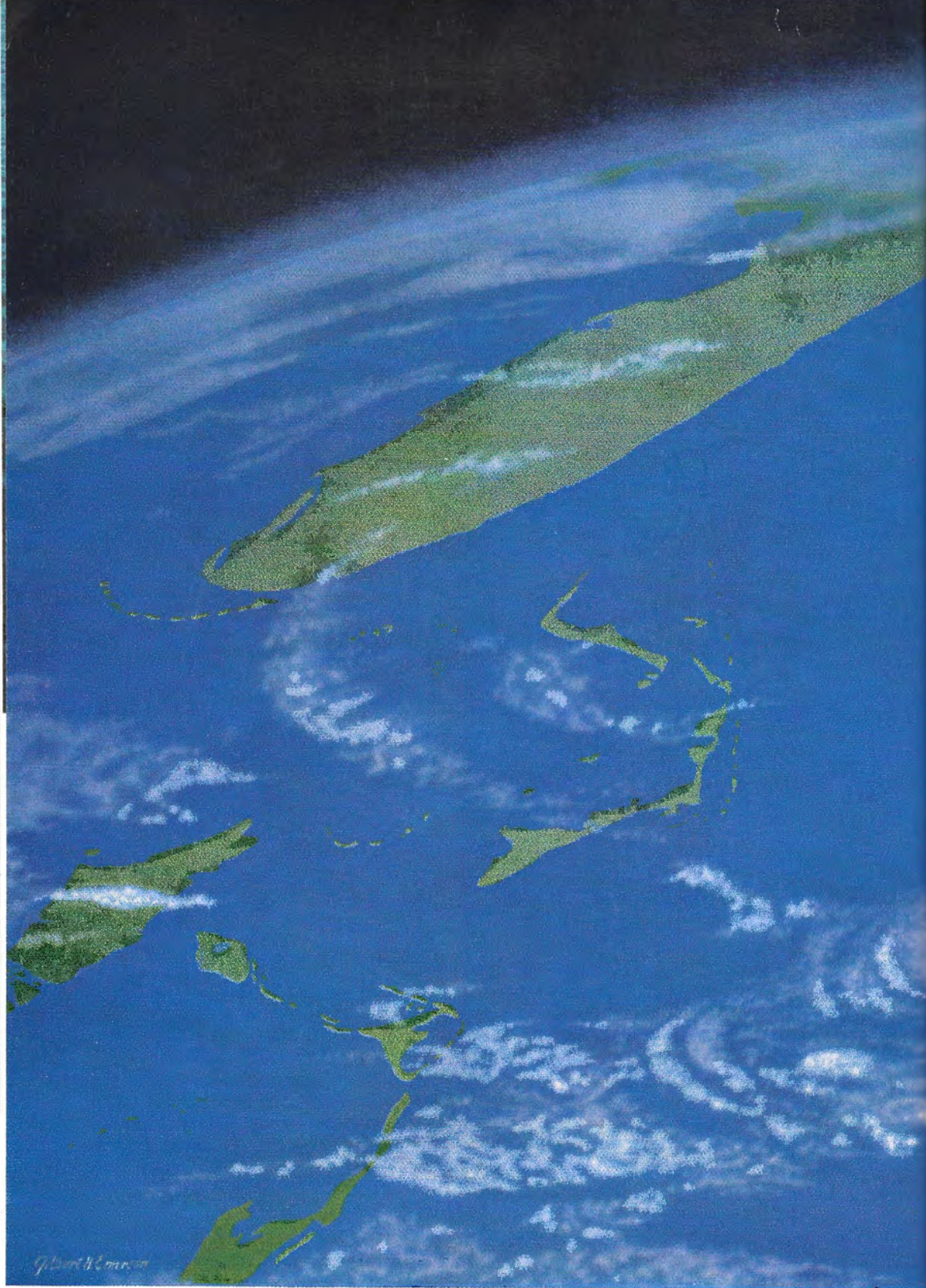
An intercontinental rocket, the huge Atlas, touched off that spectacular display. Vaulting into space from Cape Canaveral, Florida, just over the horizon, the missile hurtled past

Grand Bahama at 15,000 miles an hour en route to its death plunge off distant Ascension Island in the South Atlantic. Atlas's high, scorching passage through remnants of air built a wake, like that of a ship sailing a phosphorescent sea.

Ascension, 5,000 miles from Cape Canaveral, anchors the Atlantic Missile Range, a Space Age proving ground stretching across a quarter of the globe. Along the unique flyway lie island tracking stations where technicians, intent at powerful cameras, antenna consoles, and banks of electronic gear, record missile performance (map, page 434).

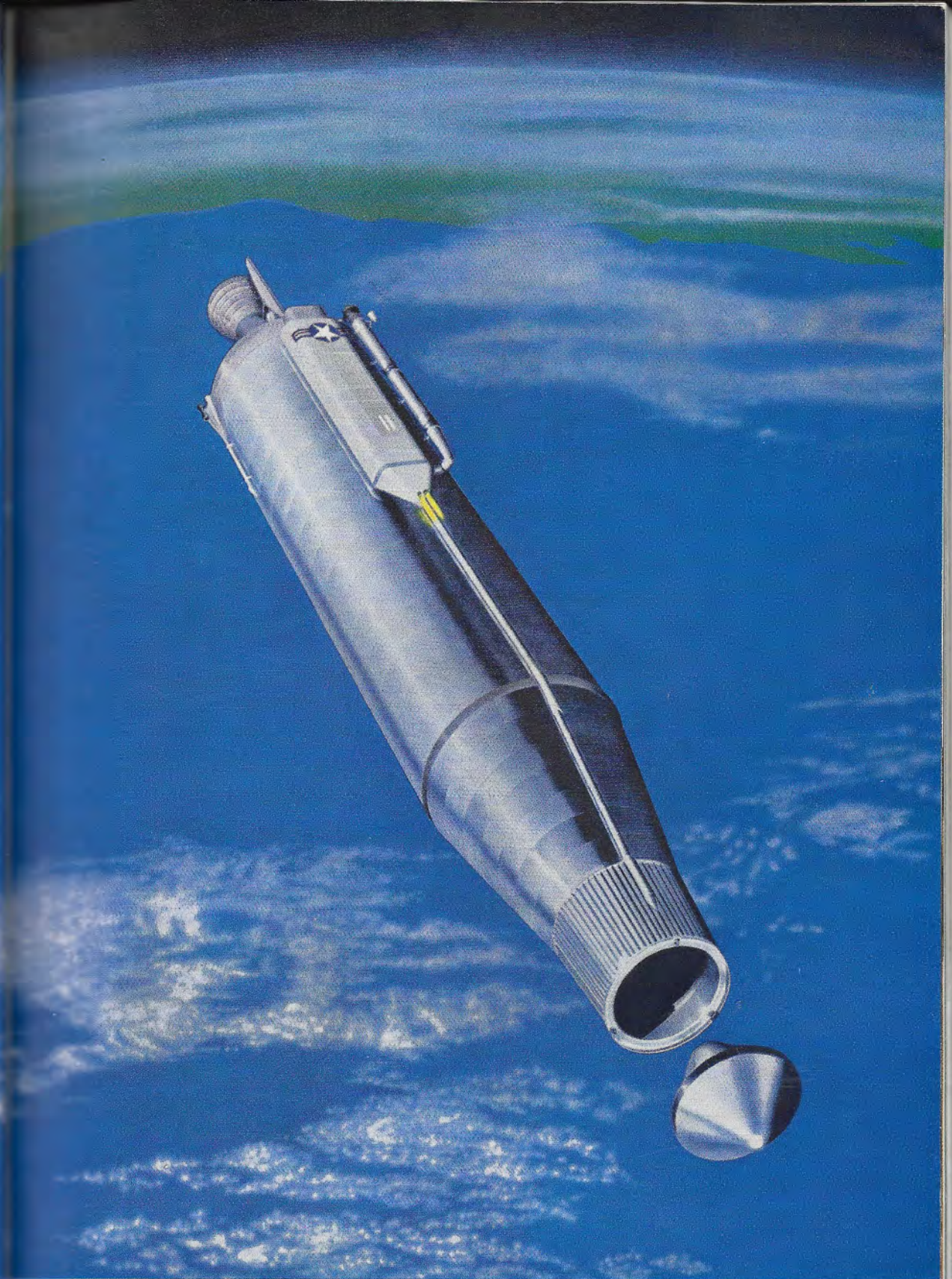
Grand Bahama is the first of 11 islands in the tracking chain. Musing in the soft subtropic night, I pictured Atlas's 6,000-mile journey down range: past the other Bahamas, dark smudges on the face of the sea . . . past the sleeping West Indies . . . high above the featureless Atlantic . . . and, finally, to a flaming, meteoric fall beyond terminal Ascension.

National Geographic photographer Tom



**Ocean-spanning Atlas Arcs Into Space
on a 30-minute, 6,000-mile Flight
From Cape Canaveral, Florida**

Seconds ago the Air Force's intercontinental missile exhausted its fuel. Now, speeding 15,000 miles an hour, the spent engine sheds its nose cone some 200 miles above the Atlantic. Small braking rockets flaring on Atlas's decapitated



PAINTING BY NATIONAL GEOGRAPHIC ARTIST GILBERT H. EMERSON © N. G. S.

body aid separation; in this near vacuum no wind brushes back the flames. A few thousand yards apart at journey's end, the cone and its trailing "tankage" will plunge seaward beyond Ascension Island like blazing meteors. But only the cone,

which carries data-recording instruments and their radio voice, will survive the torch of air friction. Storied subtropic isles—Grand Bahama, Great Abaco, Andros, New Providence, and Eleuthera—lie off Florida in this artist's conception.

Nebbia and I toured that island missile empire from its beginning to end, the only outsiders who have been privileged to do so. Luis Marden, a National Geographic veteran, accompanied us over most of the range. We spent three months at the task and logged a combined total of more than 40,000 wearying miles. At Cape Canaveral, officially Station No. 1, the all-important first link in the tracking chain, we saw a dozen missiles blast off in raging cataracts of flame.

The pyrotechnics above Grand Bahama, however, had been completely unexpected, an unusual display that typified for us the alien strangeness of space. Only a few rockets fired at night grow a tail, so to speak, and the cause of the phenomenon, though under study, remains mysterious.

Some scientists believe a ballistic missile may trigger a release of energy in the electrically charged ionosphere—provided condi-

tions 200 miles up and more happen to be just right. These experts theorize that the extreme speed and heat of an Atlas, for example, may strip electrons from vagrant air particles, causing the violated atoms to emit visible light.

Other scientists think the glowing wake may consist of a thin fog of exhaust gases, but they are at a loss to explain why some rockets and not others should create the effect.

Few Men Witness Glowing Wakes

Only men on the northernmost isles ever see the diaphanous tails of light, which cannot be viewed from Cape Canaveral and vanish when the rockets exhaust their fuel, usually off San Salvador. Most missilemen have never witnessed the sight or even heard of it.

Atlas's swift passage from Florida would last only 30 minutes, but I knew it had been carefully planned for months and had involved the work of 2,500 men in prelaunch preparations, firing, and tracking. Yet Cape Canaveral shoots many missiles of various kinds each month, and the complex teamwork has become routine.

The range's 18,000 workers subject that last and greatest frontier, space, to day-and-night assault. They strive, primarily, to perfect weapons, but these are men who believe that attaining the stars, one day, is not so wild a dream. So, with far-ranging probes, satellites,

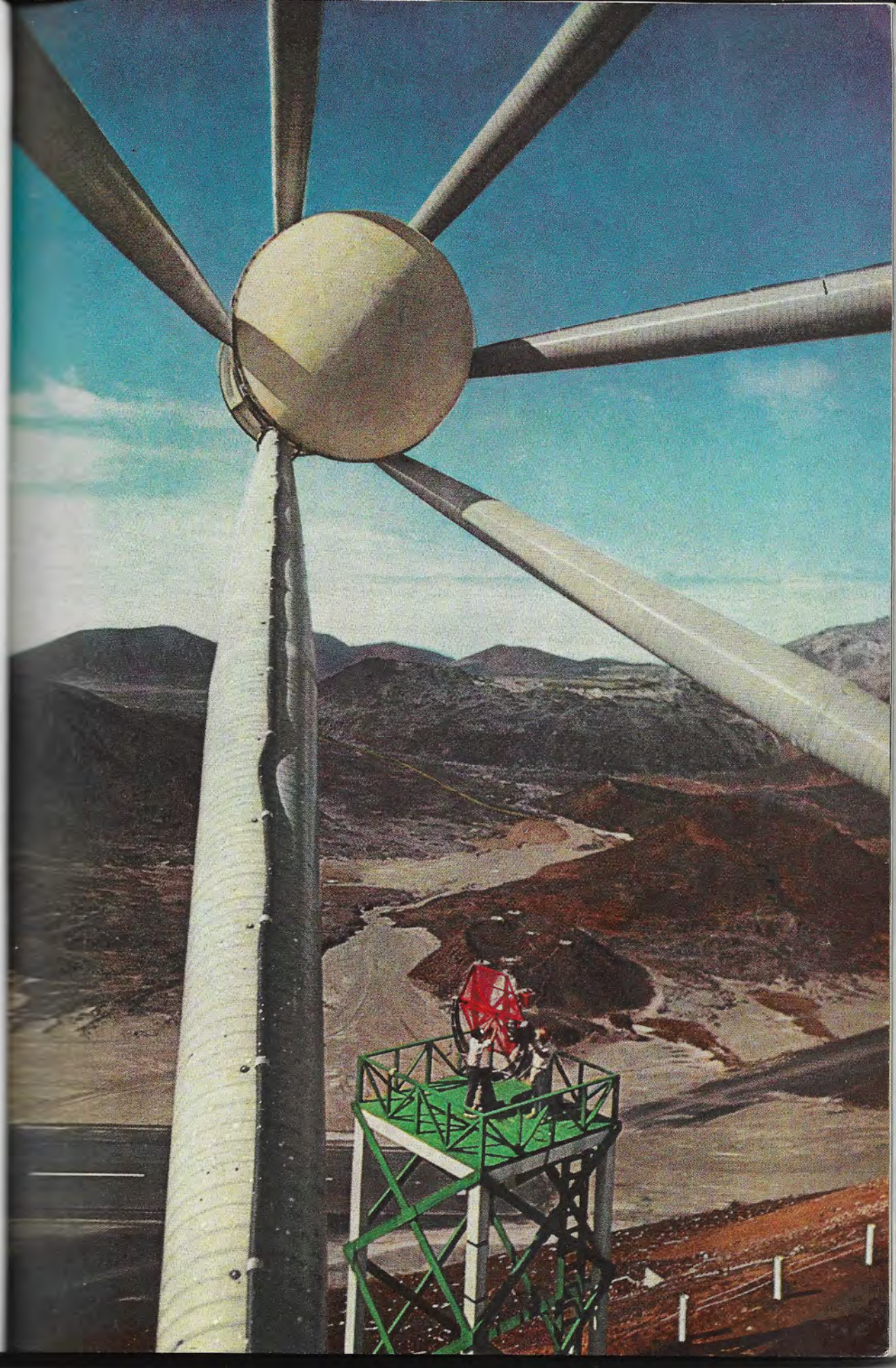


Bulbous Eye in Metal Spider Web Follows Missiles Homing Near Ascension

Giant arms support the sphere, an instrument package, before the face of a disk-shaped antenna 60 feet in diameter. Waiting 5,000 miles from Cape Canaveral, the antenna starts gathering Atlas's radio signal when the missile is still hundreds of miles distant. Instruments in the eyelike sphere break down the signal into many separate frequencies, each describing some phase of the rocket's performance. Trackers record the information, which is known as telemetry data.

Men on the tower check a smaller telemetry antenna overlooking Ascension Island's airstrip, ash-heap hills, and cinder cones (page 458). Bleak Ascension anchors the Atlantic Missile Range's chain of island tracking stations.

Identical 60-foot antenna shows its bizarre profile on Antigua, Station 9.1 in the tracking chain. Three of these powerful instruments, including one at Cape Canaveral, cover the length of the range. Each stands more than seven stories high.





NATIONAL GEOGRAPHIC PHOTOGRAPHER THOMAS NEBBIA

A Three-man Team From Air Force and Industry Runs the Missile Range

To date the Nation has invested \$500,000,000 in building and equipping the tracking system, which employs 18,000 workers. Pan American World Airways operates it under Air Force contract, and RCA Service Company records signals from the racing rockets. Maj. Gen. Donald N. Yates, the range's commander, accepts a Thor model from his principal aides, Kenneth M. McLaren, RCA vice president (center), and Richard S. Mitchell, Pan American vice president. Relief map shows Cape Canaveral.

rocket-riding monkeys, and other experiments, they also pursue the goals of peace.

Like Caesar's Gaul, the Atlantic Missile Range can be divided into three parts: a 15,000-acre testing and firing reservation carved from Cape Canaveral's scrubby brush; an administrative headquarters at crowded Patrick Air Force Base, 18 miles south of the launching sites; and the down-range stations on drowsy isles. Working together, one and inseparable, they comprise the largest and most important installation of its kind in the Free World.

Maj. Gen. Donald N. Yates of the Air Force, the range's commander, often refers to his charge as "a \$500,000,000 shooting gallery." This figure represents capital investment only; operating costs for fiscal year 1959 reached a whopping \$130,000,000.

But a shooting gallery that stretches between continents requires unusual services, many of them expensive. The range operates its own regularly scheduled, interisland airline and flies specially instrumented aircraft on

missile-tracking missions. The combined fleet totals 41 planes. General Yates also commands a navy—11 ocean-going tracking vessels, plus several smaller ships used in missile recovery and supply missions (page 467).

Traveling teachers, a chaplain, even an island-hopping barber, serve the various stations. The range has its own excellent medical corps and its own motion-picture service. Wisely, I believe, it spends \$100,000 a year on film rentals. Each station gives nightly shows in an outdoor theater, an essential morale builder at the lonely outposts.

Cape Transformed in a Decade

Imagine, for a moment, a desolate expanse of sand and snarled brush that juts out into the Atlantic like a bent elbow. Alligators bask in its swamps, snakes infest its undergrowth, birds of many species wing its air-lanes, and hordes of voracious mosquitoes drone in its thickets. Of human habitation, however, there are but few signs—a venerable lighthouse and several forlorn old houses.

That would be Cape Canaveral a decade ago.

Now visualize the Cape today, as I saw it from a low-flying aircraft. Along the ocean front, like robots in file, stand huge towers of skeletal steel—the missile gantries, or service towers. I count 15 major ones, each with its own concrete launching pad and, near by, a blockhouse for the launching crew. Many of these shelters, made of reinforced steel and concrete, look like massive igloos.

Gazing inland I see a broad ribbon—an airstrip—and beyond it a community of enormous buildings—missile assembly and check-out hangars. Here, there, seemingly everywhere, I glimpse smaller structures: bizarre, dome-shaped beehives housing tracking instruments, and squat buildings topped by strange-looking antennas. Paved roads, veins through the brush, connect the sites.

In the language of the military, a specialized tongue known as Pentagonese, the Air Force

has "cognizance" (supervision) of this Space Age laboratory and all its many dependencies. But a private company, Pan American World Airways, operates the range for the Air Force. A subcontractor, RCA Service Company, a division of Radio Corporation of America, provides technical know-how and the skilled "bird watchers," or missile trackers.

Instruments Track Rocket's Every Move

A ballistic rocket is one of man's most complex creations. Its electronics system alone may contain 37,000 items; these, plus several hundred thousand other parts, must function perfectly. If they do not, engineers must determine where the failure occurred.

RCA's bird watchers supply a host of clues to the mystery. Their complex precision instruments yield such information as missile temperatures, pressures, course, velocity, altitude—often more than 16,000 individual read-

Helen Mann Feeds Mathematical Data to an Electronic Brain

Mrs. Mann, employed by RCA, once confounded television's "What's My Line?" panelists, who failed to guess her occupation. Holder of two degrees in physics, she helps prepare complicated test data for analysis by computers. Here she issues instructions to FLAC (Florida Automatic Computer) at Patrick Air Force Base.

NATIONAL GEOGRAPHIC PHOTOGRAPHER THOMAS NEBBIA



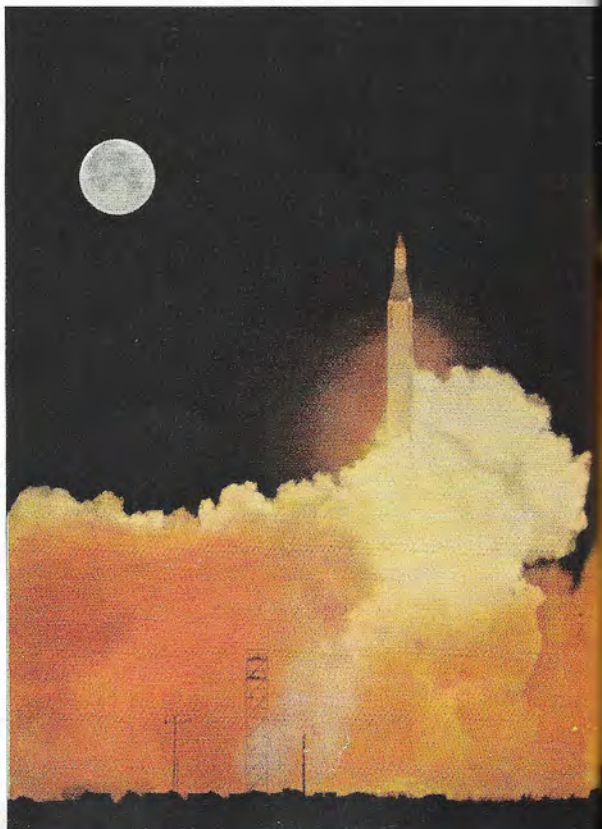


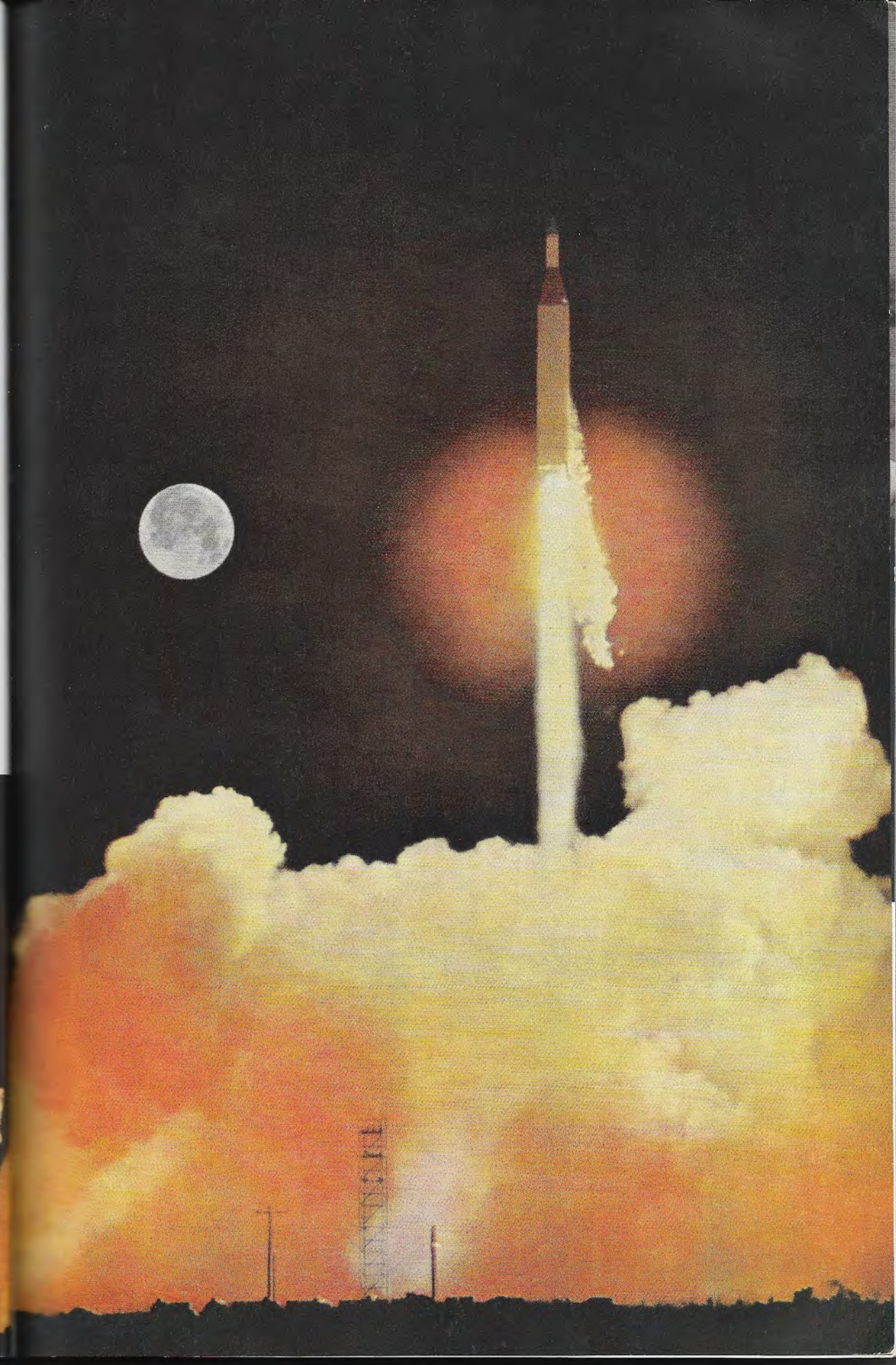
KODACHROME (ABOVE) AND ANSCOCHROMES © N. G. S.

Tension generated by a countdown reflects in the faces of men monitoring blockhouse instruments.

Pioneer IV Blasts Off on a Voyage Past the Moon

On March 3, 1959, this four-stage rocket roared up from Canaveral with a 13.4-pound satellite in its nose. Forty-one hours later the payload passed within 37,000 miles of the moon, then swung into orbit around the sun, where it may endure as long as the solar system. The moon was neither full nor visible at take-off time. Luis Marden photographed moon and rocket separately, creating symbolic double exposures on the same film. Billows of smoke at lift-off (below) characterize Army's Jupiter, *Pioneer IV's* first stage. Turbine exhaust (opposite) spews flame from the rocket's side.





ings for each minute of a 15-minute flight.

This intensive scrutiny begins before the rocket lifts from its pad. Consider, for example, one of the launchings I witnessed, that of a two-stage Thor Able designed, not as a weapon, but as a tool for long-range tests of missile nose cones.

Dismal clouds covered the Cape that night, and rain pelted me in gusts as I stood near a roadblock. T-time, the scheduled moment of firing, had been delayed more than an hour by range safety officers, who require a certain minimum ceiling of visibility for each test. But the countdown had gone well, and the rocket stood poised and ready for its journey past Ascension.

Minutes later the elements relented, a big hole opened in the overcast, and the Thor first stage, gushing incredible fire, pushed its burden up, up, up, while the lightning of its engine reflected blindingly from the surrounding clouds. I had witnessed other successful launchings, but, as always, the beauty and perfection of the sight moved me deeply and sent my imagination soaring.

Seconds before first-stage ignition, remotely operated cameras on the firing pad began taking pictures at a rate of more than 1,000 frames per second. As the rocket fled, cameras elsewhere on the Cape established its position to an accuracy of a few inches. Theodolites, accurate to 30 feet at ranges up to 15 miles, also eyed the sprinting missile.

Electronic Brain Computes Position

Big radars, powerful enough to follow the flight of a baseball 88 miles away, locked on to Thor Able. An intricate electronic device picked up its radio tracking beacon and fed it to a computer, which disgorged 10 position reports per second. Meanwhile, another radio signal provided telemetry data, a continuous stream of information on conditions inside Thor Able, where instruments monitored 175 separate functions.

Resurgent clouds soon covered the hole in the ceiling, but I knew Grand Bahama Island had joined the tracking. Successively, other islands would take over the job.

Guidance systems "program" all test missiles down range. The celebrated moon rockets, however, take a different trajectory. A special antenna at Mayagüez, Puerto Rico, is the only instrument on the range that tracks the payload (page 446).

An earlier article introduced NATIONAL

GEOGRAPHIC readers to these probes of deep space.*

At that time complete success could not be reported, but more recently, on March 3, 1959, *Pioneer IV* blasted off on a trip past the moon and into orbit around the sun (pages 428-9).

Luis Marden and I saw that historic launching. Later, during star-filled nights in the islands, Luis would shake his fist at those distant beacons, Mars and Venus, and exclaim jubilantly, "We'll get you both, you rascals!" Venus and Mars definitely are on the space probe agenda. The optimum time for a probe of Mars is October, 1960, and for Venus, January, 1961.

Be Careful of That Word "Failure"!

Sometimes the island trackers wait patiently for rockets, only to learn, after long "holds" in the countdown, that technical difficulties forced a cancellation. At other times they get word that their quarry met a flaming death above the Cape. Headline readers interpret the missile's destruction as a complete failure for the test—a natural, but mistaken, impression. In explanation, I can cite a revealing incident from my own experience.

Again I am at a roadblock. Less than half a mile away stands an Atlas, its golden flanks gleaming in the sun, oxygen vapor pluming from its sides. Suddenly flame stabs from its tail and waxes with furious energy. Ponderously the rocket moves upward. Almost immediately, however, while still climbing, it drifts to the south, where only five miles away houses begin. Fire blossoms along the missile's sides, engulfs it, and someone shouts, "She's coming down!"

An explosion, triggered by a radio signal from the range safety officer, rends the mortally stricken creature and fills a huge area of the sky with debris. Hastily, impatient at my fumbling fingers, I shoot pictures, take one last look at the flaming wreckage, now arcing nearer, and dive beneath a truck. Photographer Nebbia, true to the traditions of his profession, remains at his post, but our lanky escort, Capt. Thomas H. Burleson, joins me.

"Would you move over a bit, please?" he asks with drawing-room politeness. "I can't quite get under."

Luckily a strong wind carries the rain of

* See "Reaching for the Moon," by Allan C. Fisher, Jr., NATIONAL GEOGRAPHIC, February, 1959.



NATIONAL GEOGRAPHIC PHOTOGRAPHER THOMAS NEBBIA

Cape Canaveral Yields Tools of a Vanished Indian Tribe

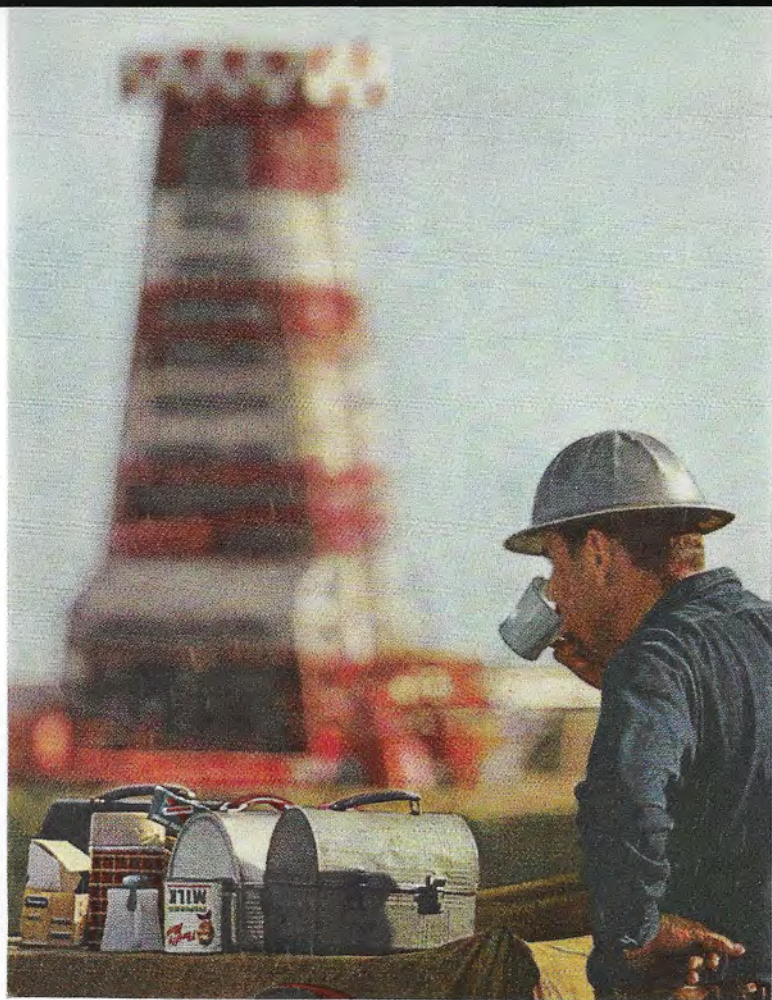
Bulldozers that cleared rocket firing sites unearthed abundant evidence of Cape Canaveral's early residents. Marvin H. Sears, a captain in the Cape's security police and an amateur archeologist, picked up hundreds of pre-Columbian artifacts from the disturbed earth. With his wife and daughters, he examines part of his collection. Many of his prizes are shell instruments for cutting meat, scraping skins, and opening clams and oysters. Others include bone awls, spear points, and stone arrowheads.

wreckage far down the road. There it touches off a number of brush fires, spectacular but soon extinguished.

This test happened to be one in a series of puzzling Atlas mishaps immediately after take-off. But a minute study of pictures made by the automatic pad cameras revealed a flaw. A complete test failure? Not from a missileman's point of view. It told him what he wanted to know.

The lesson is even more pointed in other instances. General Yates, who combats the "failure" impression with the zeal of an evangelist, explains:

"Actually, many successful tests terminate in so-called failures, either by design or accident. We may deliberately push a missile beyond tolerances for the purpose of determining the failure limit. Or perhaps some flaw terminates a test, yet we get 95 percent

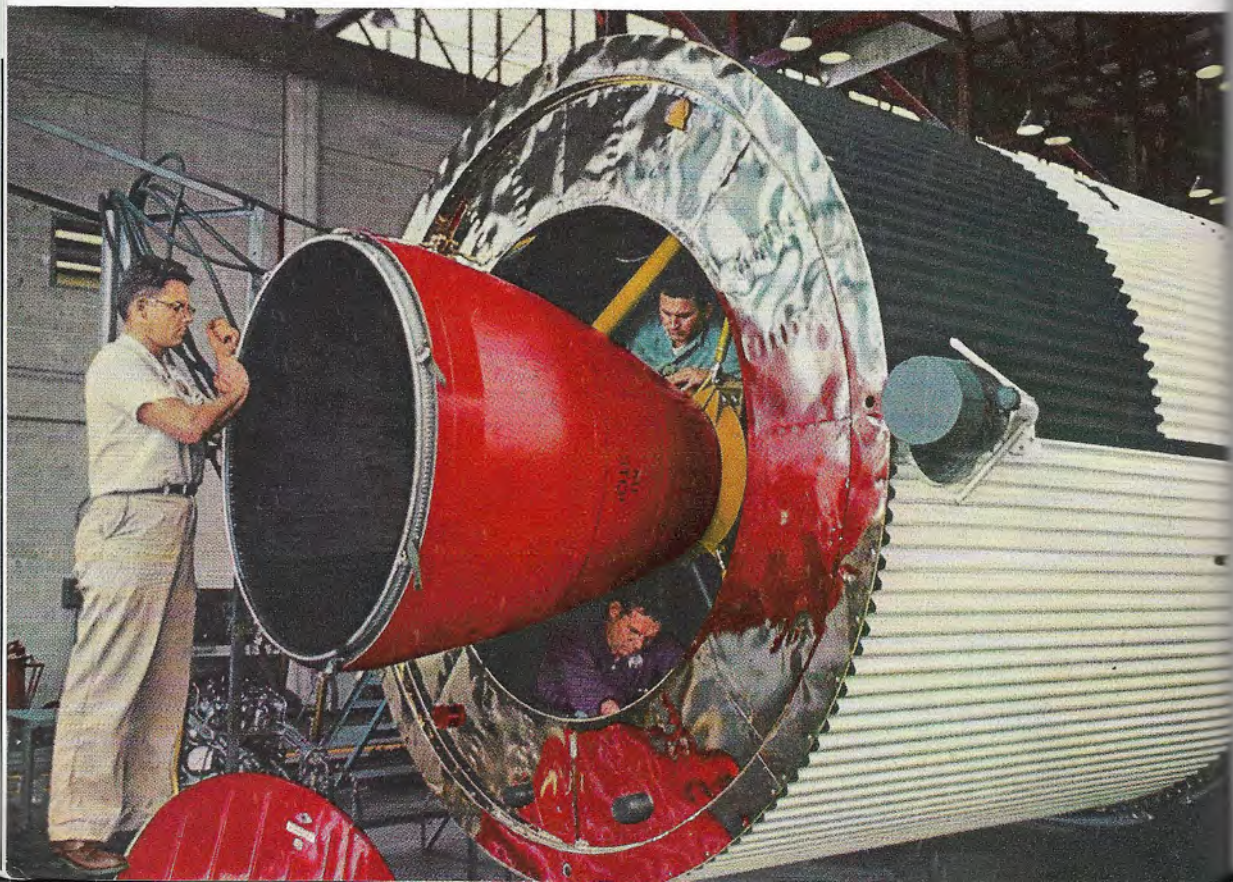


Missileland, Too, Has Its Coffee Breaks

This man, who works on the Titan project at Cape Canaveral, sips coffee near a candy-striped Atlas gantry.

Technicians adjust a red shield that protects the bell-like rocket nozzle of a Jupiter undergoing checkout procedures in the hangar. Delicate tubes hidden beneath the shield encircle the nozzle. Fuel, acting as a coolant, circulates through the tubes before entering the combustion chamber; otherwise temperatures exceeding 5,000° F. would melt the nozzle. A heat-reflecting, gold-plated flange encircles the casing.

432 KODACHROMES BY THOMAS NEBBIA (ABOVE) AND LUIS MARDEN, NATIONAL GEOGRAPHIC STAFF © N.G.S.



of the telemetry information sought. We regard the test as 95 percent successful."

Sometimes, however, internal performance data does not reveal the cause of missile death, requiring an autopsy of the remains. When debris falls off the Cape, a wiry swash-neckler named Louis Berger sends ships to fish it out for examination. Crews may trawl for wreckage or raise it with the help of divers. Berger's men are proud of a better than 90 percent record of success in recovering vital pieces desired by engineers.

Salvagers Memorize Missile Parts

Often the divers work in water too murky to see, so they must learn to recognize various missile parts by touch. Vernon Nealey, trapping young salvage master, takes the men to hangars, where they examine missiles, feel, heft, and memorize many parts. During one such session an engineer exclaimed with mock indignation, "We haven't even blown this bird, and you blasted undertakers are measuring it for a coffin!"

"Undertakers" the salvage men have been known as ever since, but they accept the title proudly. Evidence they brought to the surface revealed why the first lunar probe exploded and why the Vanguard failed repeatedly in early attempts to launch a satellite. Their work also has resulted in vitally important modifications to other missiles.

Sharks and foul weather plague the undertakers, but a more bizarre hazard ages Cape firemen when they recover missile debris from the brush. Fires set by showering fragments, such as those from the Atlas, drive dozens of rattlesnakes into the open. Booted firemen fight two battles, one against flames, the other against scorched, angry snakes.

Wildlife Still Claims the Cape

Despite Canaveral's metamorphosis, other wildlife remains in residence. Workers often see rabbits and armadillos. Occasionally someone sights a wary bobcat. Gulls, vultures, hawks, and pelicans still abound. For the past four years Florida members of the National Audubon Society have scored record 24-hour bird counts from stations just outside the Cape's south gate.

Several times, immediately following night missile shots, I have seen flocks of killdeers circling about in the searchlight beams, crying distractedly. But they won't leave. Even a few alligators cling to their old habitat.

Last year members of an Atlas launch crew found a 10-foot gator sunning itself in the entrance to their blockhouse. No one dared go in until those reptile specialists, the firemen, lassoed the intruder and carted it off for release in the near-by Banana River.

Much of the missilemen's enthusiasm for their work, their feeling of identity with a stirring future, rubs off on the private citizens of Cocoa Beach. This booming small town, Missileland's unofficial capital, lies between the launching area and Patrick Air Force Base. Along "Motel Row" spacecraft in glaring neon advertise such spots as the Vanguard, Polaris, Sea Missile, and Satellite. At another popular hostelry, the Starlite, one may dine spaciously, let us say, while gazing at large murals of the solar system, the moon, and Mars, all eerily illuminated by ultraviolet light.

I soon learned to affect a blasé air when merchants and barbers spoke knowingly of such things as "meco" (main engine cut-off) and "veco" (vernier engine cut-off). But, when a waiter used the word "clunge," I appealed to friends for a translation. It's slang for an impressive but crowded array of electronic equipment—"a real rat's nest."

Pan American Puts Experience to Work

Visitors to Missileland often think it curious that a commercial air carrier, Pan American, should operate testing facilities for intercontinental weapons. The overwhelming atmosphere of "wild black yonder" exploration and conquest makes it seem even more curious, visitors observe. I confessed a similar reaction to Richard S. Mitchell, vice president in charge of Pan American's Guided Missiles Range Division.

"We're often asked why we got into this," he said. "But we have many years experience operating stations in remote areas. You may recall that we opened up the Pacific to air travel with stations at Guam and Wake.

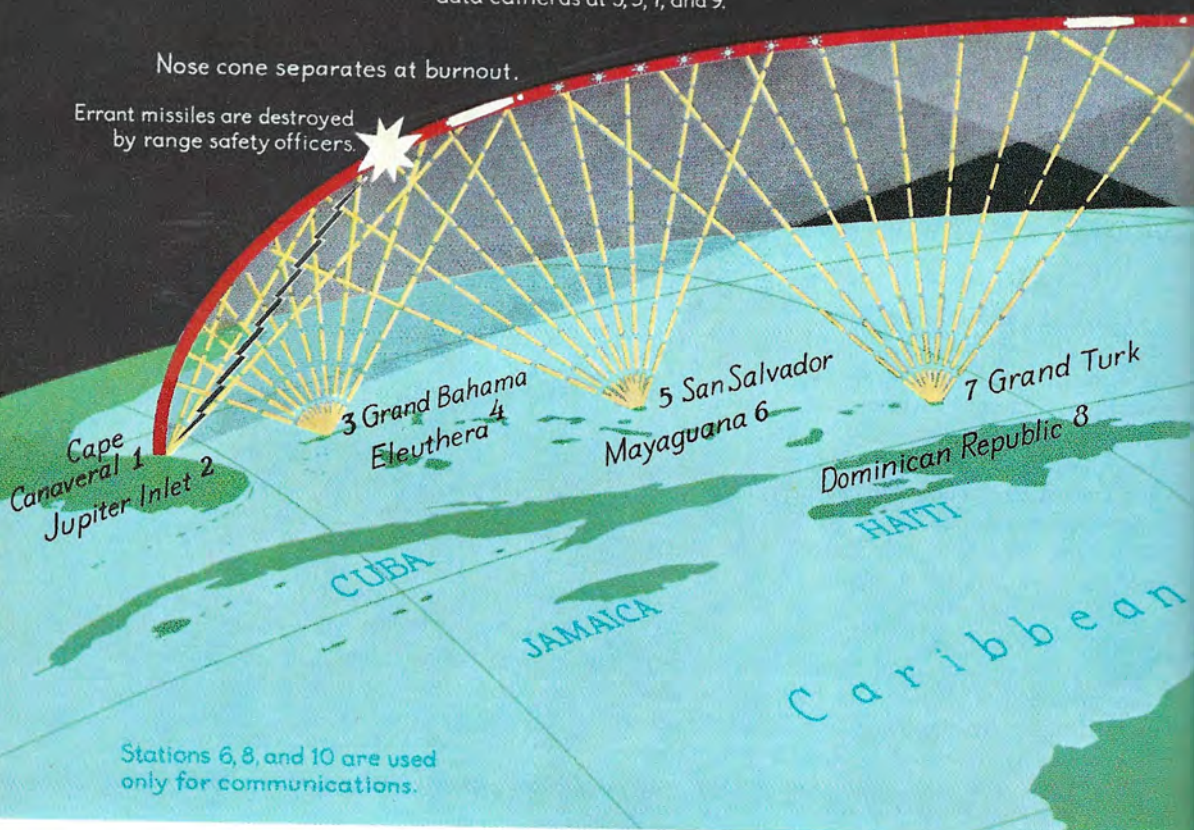
"Also, this work puts us in the vanguard of new techniques that eventually will be used by the airlines. For example, we understand missile properties and instrumentation. It's not too dreamy to think in terms of boost-glide transports; in other words, of liners that would take off and arch into space under rocket power, then glide to their destinations."

Kenneth M. McLaren, the vice president who directs range affairs for RCA Service

Blinking missile lights are photographed against star background by precision data cameras at 3, 5, 7, and 9.

Nose cone separates at burnout.

Errant missiles are destroyed by range safety officers.



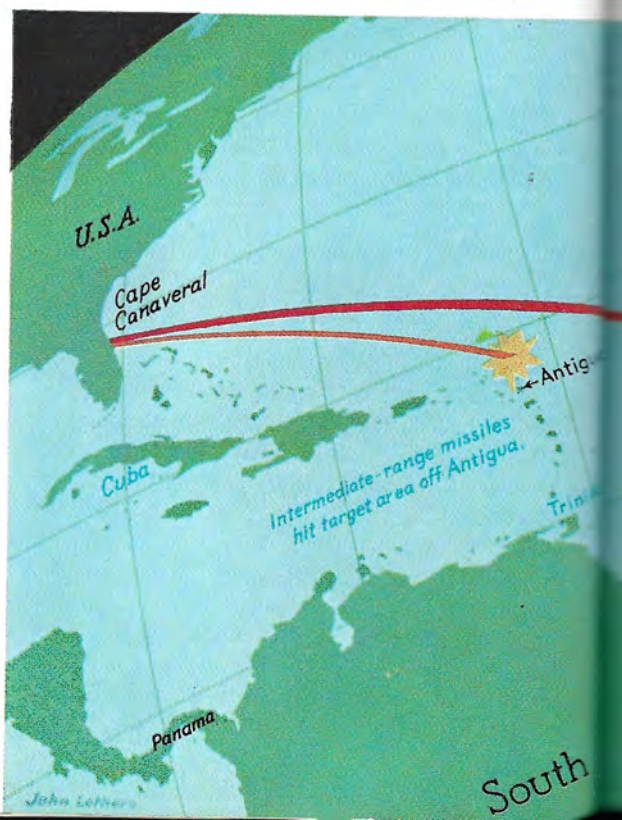
Atlantic Missile Range Spans a Quarter of the Globe

No other area in the world, experts have said, seems so well designed by nature for long-range missile testing. Open reaches of sea guarantee safety against mishaps. Sites in the Dominican Republic and on islands owned by British Commonwealth nations, Brazil, and the United States assure good tracking. A 15-minute flight may yield a quarter-million readings.

As a missile roars up from Canaveral, a complex electronic system picks up its tracking beam, plots its course, and predicts its impact point up to 6,000 miles away with lines moving on screens before the eyes of the range safety officer. If the rocket veers off course, the officer presses a button, a radio command flashes up, and the missile explodes.

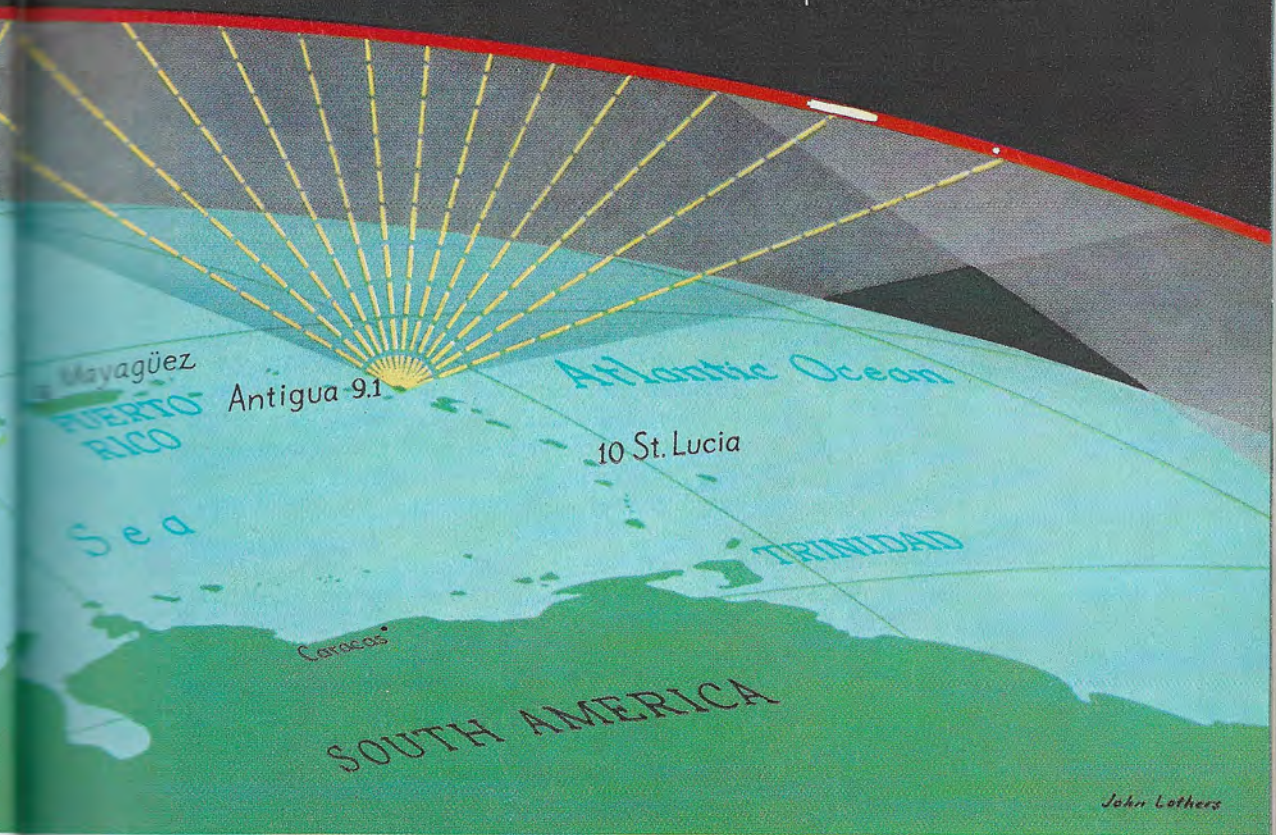
Diagram of the range's northern third (above) shows an Atlas in flight above the main tracking systems.

Ships and aircraft crammed with electronic gear fill gaps in the range's southern sector and at times extend coverage beyond Ascension.



Radar (yellow lines) tracks missiles and provides trajectory data.

Huge telemetry antennas at Canaveral, Antigua, and Ascension bracket entire range (blue shading), follow missiles automatically, and collect performance data.



Company, pointed out that the amiable partnership of two experienced contractors offers several advantages to the military services, which share use of the range.

"It relieves the military of a lot of business and administrative headaches and the need for putting uniformed men in jobs that can be handled by civilians," he said. "If you did use military men, you would have to ask yourself, 'Can I train them and keep them long enough?'"

Of the range's 18,000 workers, Pan American employs 4,900 and RCA 3,100. Most of the remaining personnel work for missile makers and other contractors or hold Civil Service ratings, but the Air Force assigns 1,800 of its men to supervisory and support jobs. As Mr. Mitchell puts it, "Pan American doesn't 'run' the range; we do exactly what the Air Force tells us to do."

Like newly hired employees assigned to the islands, the National Geographic team bared arms for numerous inoculations, studied rules and regulations for down-range conduct, and sat through orientation briefings covering the entire chain.

Three Bases Have Limited Jobs

Two stations, Mayaguana and St. Lucia, are on stand-by status, and a third, in the Dominican Republic, has but 12 employees. These stations serve as communication relay points but otherwise are unneeded because of changes in tracking requirements. Population of the other bases varies from 98 at Eleuthera to more than 200 at Grand Bahama and at Ascension, busiest points on the range.

An Air Force officer commands each station, though he is usually the only military man there. His principal duty, liaison with local authorities, often requires the tact of a diplomat and the astuteness of a Philadelphia lawyer; additionally, if on an island not a part of the British Commonwealth, he must speak the local language fluently. The Air Force hand-picks these men with great care.

At times the commanders, all career veterans, feel like doddering grandfathers in the company of bouncy RCA employees, whose average age down range is 28.6 years. Most of these employees learned a technical specialty during military service, then received additional training from their company. Base managers and other Pan American workers, who speak of their diverse du-

ties as "housekeeping," usually are older men, many with stateside families.

Employees of both companies must volunteer for island duty, and Pan American's large medical department, headed by Dr. Laurent P. LaRoche, screens them.

"To get away from one's wife is not considered a good reason for applying," Dr. LaRoche told me dryly, "although it is sometimes given in response to a question on our application forms. A quick stake is the big incentive."

Bonus and Tax Rebate Lure Workers

All but the Air Force commanders get a substantial monthly bonus over base salaries: 40 percent at the two most distant outposts, Fernando de Noronha and Ascension, and 30 percent elsewhere. Each man receives free room, board, and medical care, and Uncle Sam gives him an income tax refund if he remains out of the United States for 510 days during an 18-month period. Thanks to these inducements, employee turnover in the islands is not much greater than the normal rate on the mainland.

Trackers at Grand Bahama station, which lies only 180 miles from Cape Canaveral, delight in the climate but not in the island's terrain. Almost as flat as the sea, the rocky soil supports a green maze of thin pine trees, prickly undergrowth, and poisonwood, the latter a plant whose virulent touch makes poison ivy seem like balm. An American firm, Owens-Illinois Glass Company, reaps the pine to make paper containers, and rutted logging roads cut geometric patterns through the tangle. The isolated range base was carved from a woods on Grand Bahama's southern side.

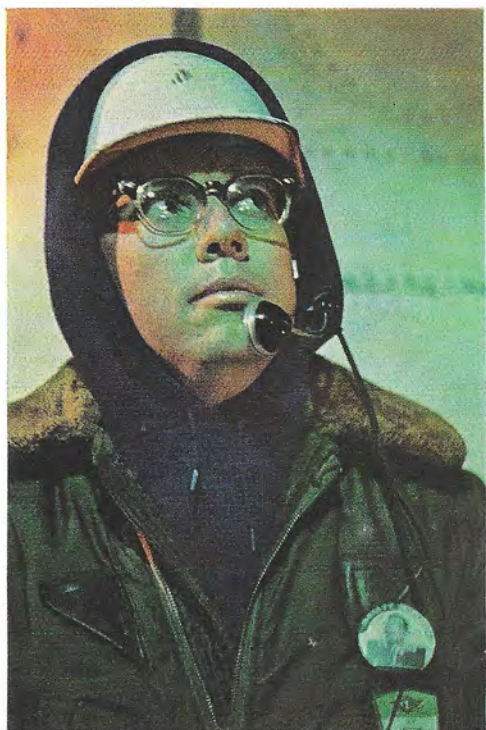
Grand Bahama Tracks All Missiles

Cape Canaveral's proximity guarantees plenty of work for personnel. Target drones hunted down by Bomarc's, for example, and some other missiles do not go very far down range, but Station No. 3 "sees" them all. Much of its equipment and instrumentation is standard for all stations.

Twin radars locked on the Atlas that staged the magnificent show above Grand Bahama, described earlier. A compact computer, housed in air-conditioned comfort beneath the rooftop radars, accepted their tracking data and fed split-second position reports to

(Continued on page 445)

Bundled up, Roy Merrow of the Thor Able project wears a heavy flight jacket and a wool scarf around his plastic safety helmet. His telephone communicates with other workers on an 11-story gantry at Cape Canaveral, where winter temperatures sometimes skid to the frost zone.



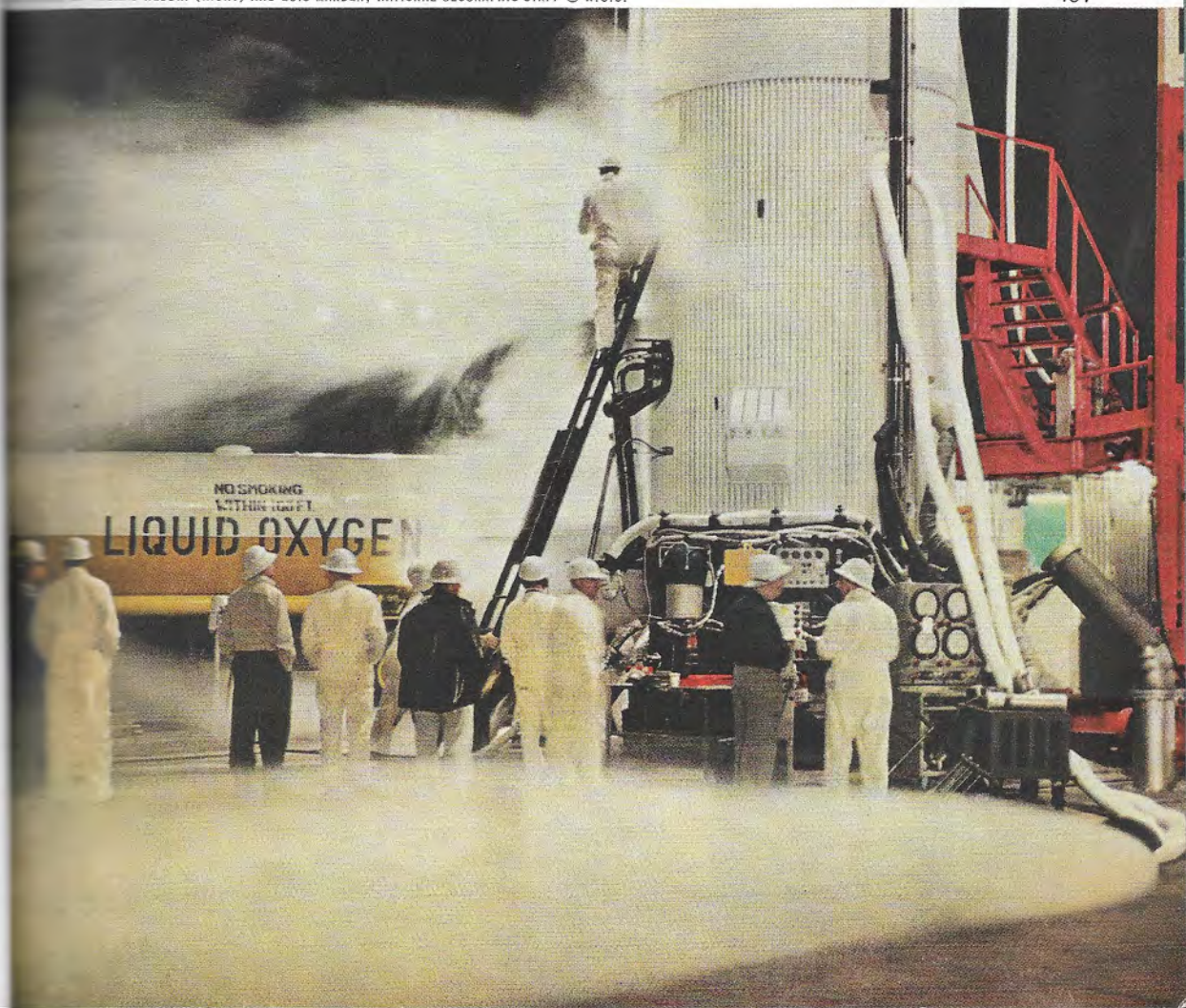
Pioneer IV Space Probe Exhales Chill Plumes of Oxygen

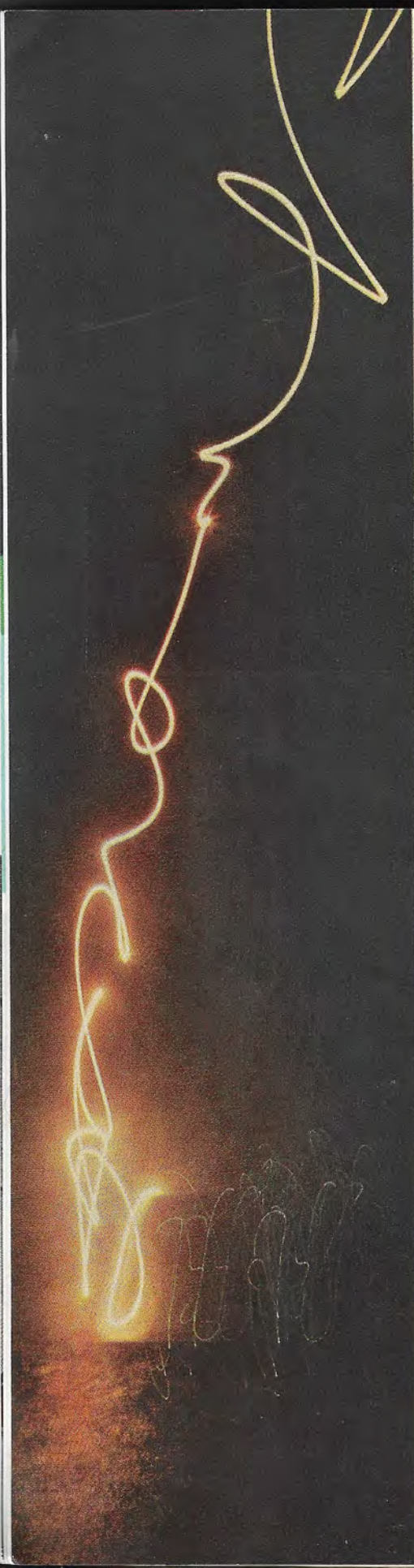
In the last hours of the countdown, *Pioneer's* launch crew pumped tons of liquid oxygen into the Jupiter first stage. This oxidizer, mixing with a derivative of kerosene, powered the booster rocket. Solid fuels propelled three later stages and sent the instrumented payload into orbit around the sun (page 428).

Until T-time, the moment of firing, Jupiter vents evaporating oxygen to relieve internal pressure. Striking air, the cold gaseous oxygen forms heavy clouds of vapor.

PHOTO BY THOMAS NEBBIA (RIGHT) AND LUIS MARDEN, NATIONAL GEOGRAPHIC STAFF © N.G.S.

437



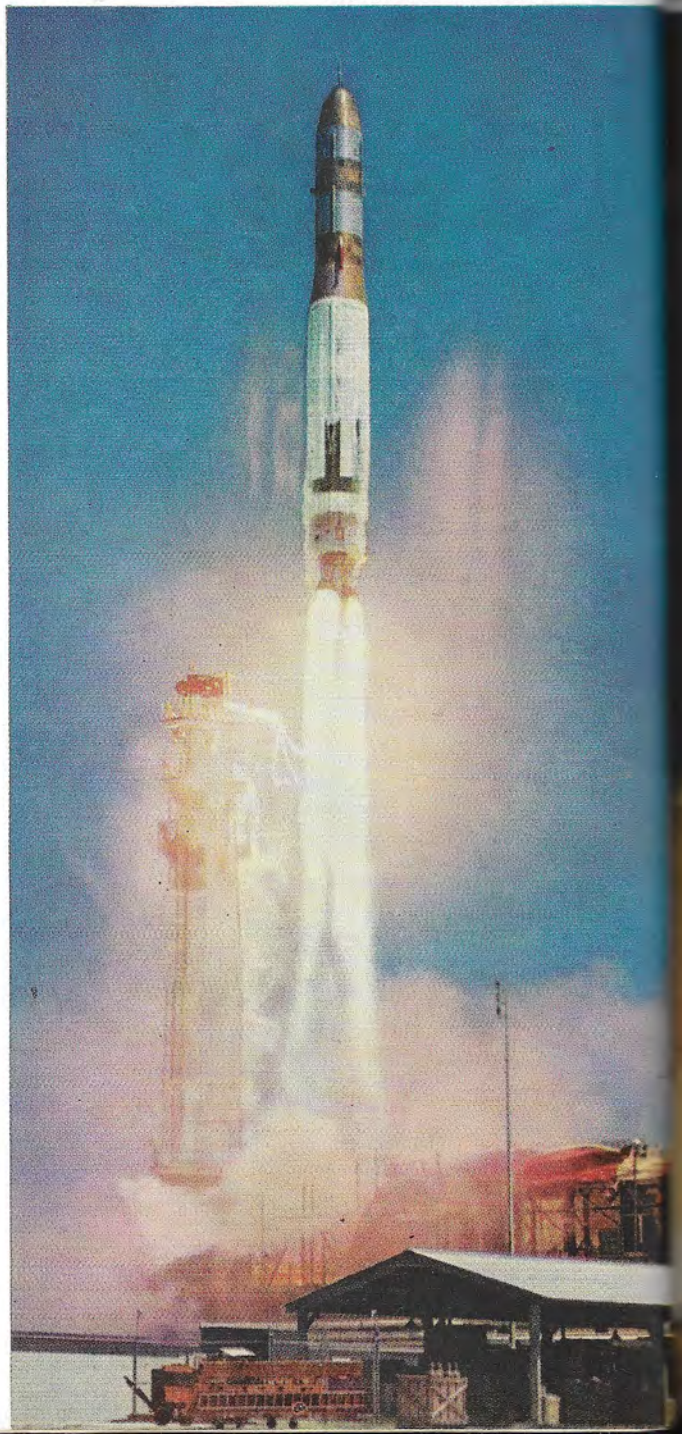


A rocket seemingly gone mad ties knots in its fiery track. Braced on the deck of a rolling ship, photographer Marden opened his camera shutter as a Jupiter took off from Cape Canaveral. The missile rose on course, but camera motion played tricks in this Kodachrome time exposure. Seen from $2\frac{1}{2}$ miles at sea, gantry towers trace thin loops of light at the lower right.

Intercontinental Titan blasts its launching pad with raging flame during a successful short-range test. This 90-foot Air Force rocket, larger and newer than Atlas, is designed to vault 6,300 miles. Liquid fuel powers its two stages.

438

USAF EKTACHROME AERO © NATIONAL GEOGRAPHIC

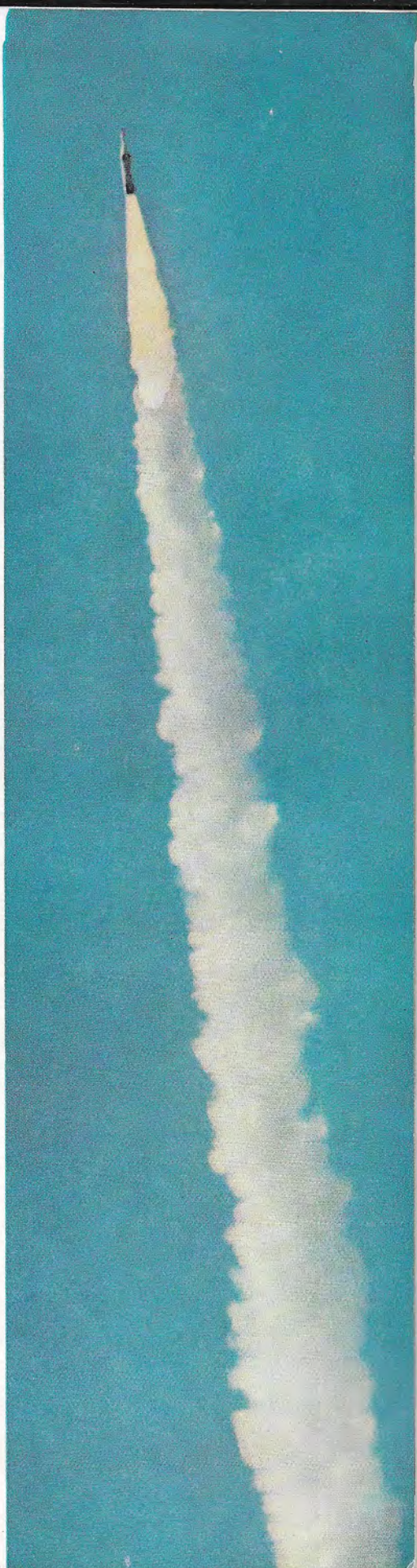
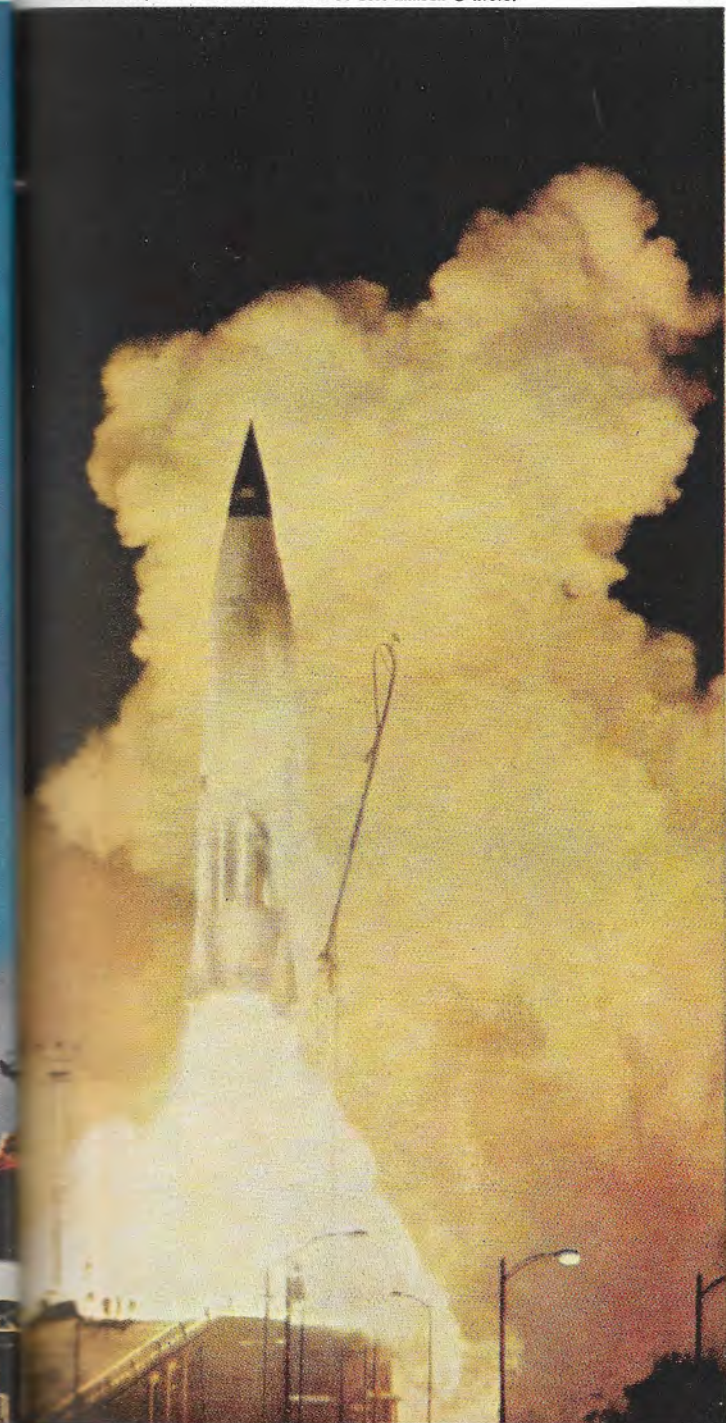


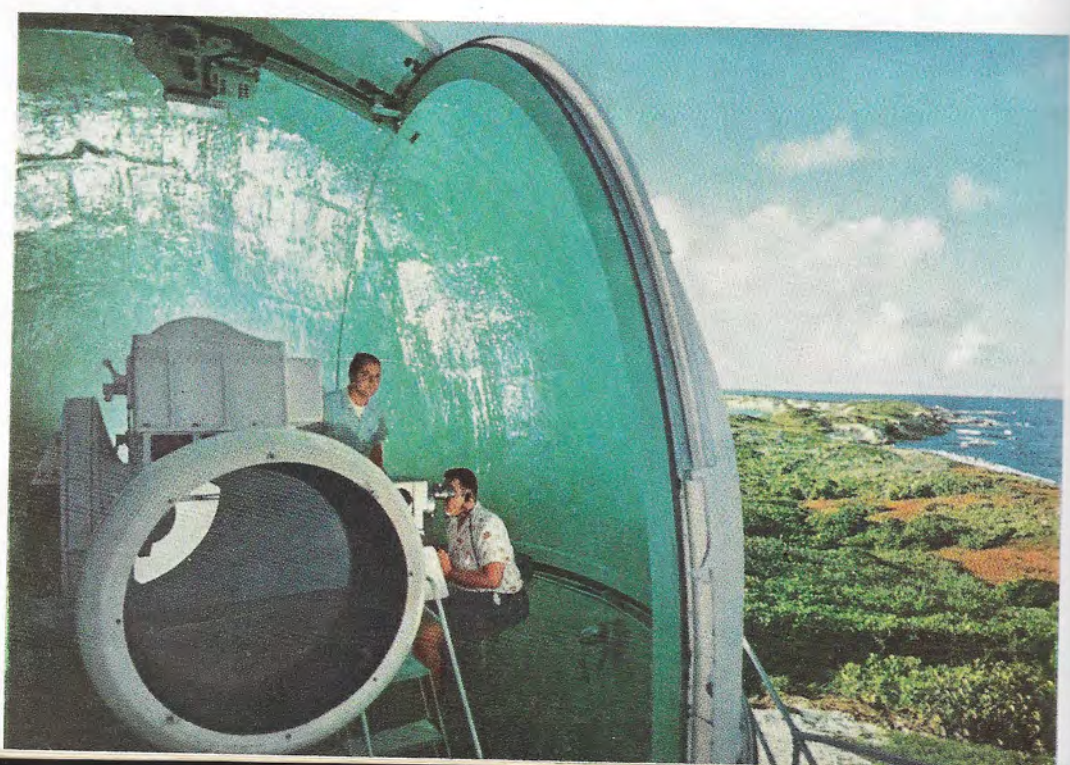
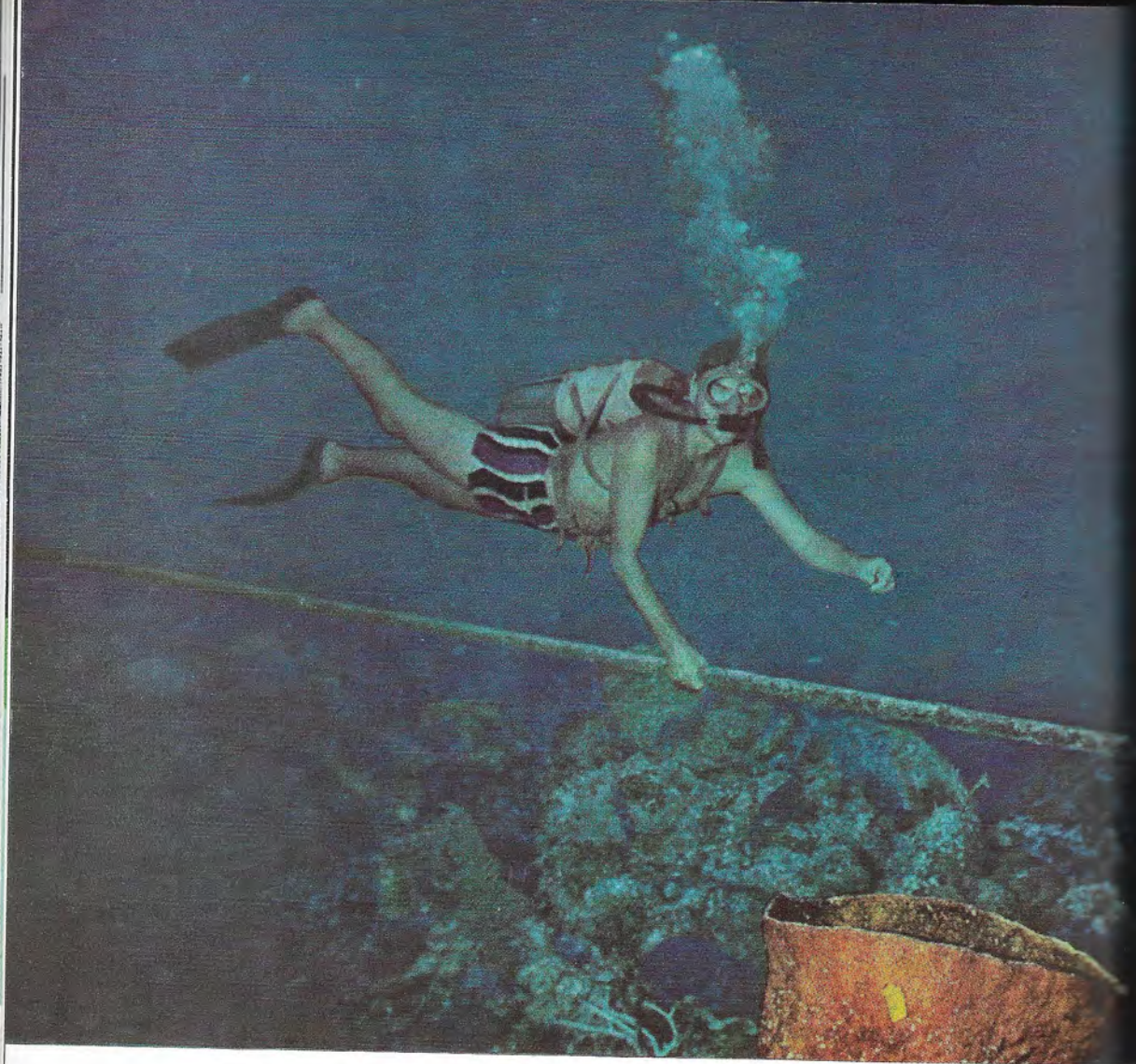
Navy's solid-fuel Polaris leaves a smoky wake as it streaks into a flawless Florida sky. Specially designed atomic submarines now being built will patrol the seas with Polaris, an intermediate-range missile that can be launched under water.

Atlas spews fire taking off November 28, 1958, on its first full-range flight of more than 6,000 miles. Other long-range rockets have two or more stages that fire in sequence. Atlas carries a main engine and a twin-chambered booster engine but only one fuel tank, enabling power plants to fire simultaneously and eliminating risk of ignition failure by a second stage miles above earth.

CHROME (RIGHT) AND SUPER ANSCOCHROME BY LUIS MARDEN © N.G.S.

439



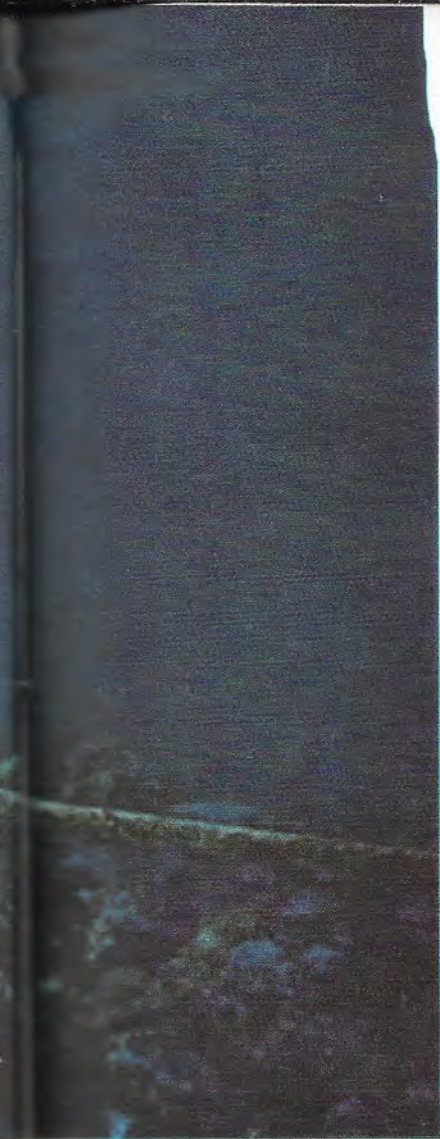


Goggled Diver in 90 Feet of Water Clutches a Submarine Cable, the Missile Range's Lifeline

Stations as far away as Mayagüez, Puerto Rico, share this submarine link with Cape Canaveral. Over the "pipe," as range personnel call it, flow voice and teletype messages and electrical impulses that translate into missile performance data. Now 1,300 miles long, the cable is being extended an additional 300 miles to Antigua.

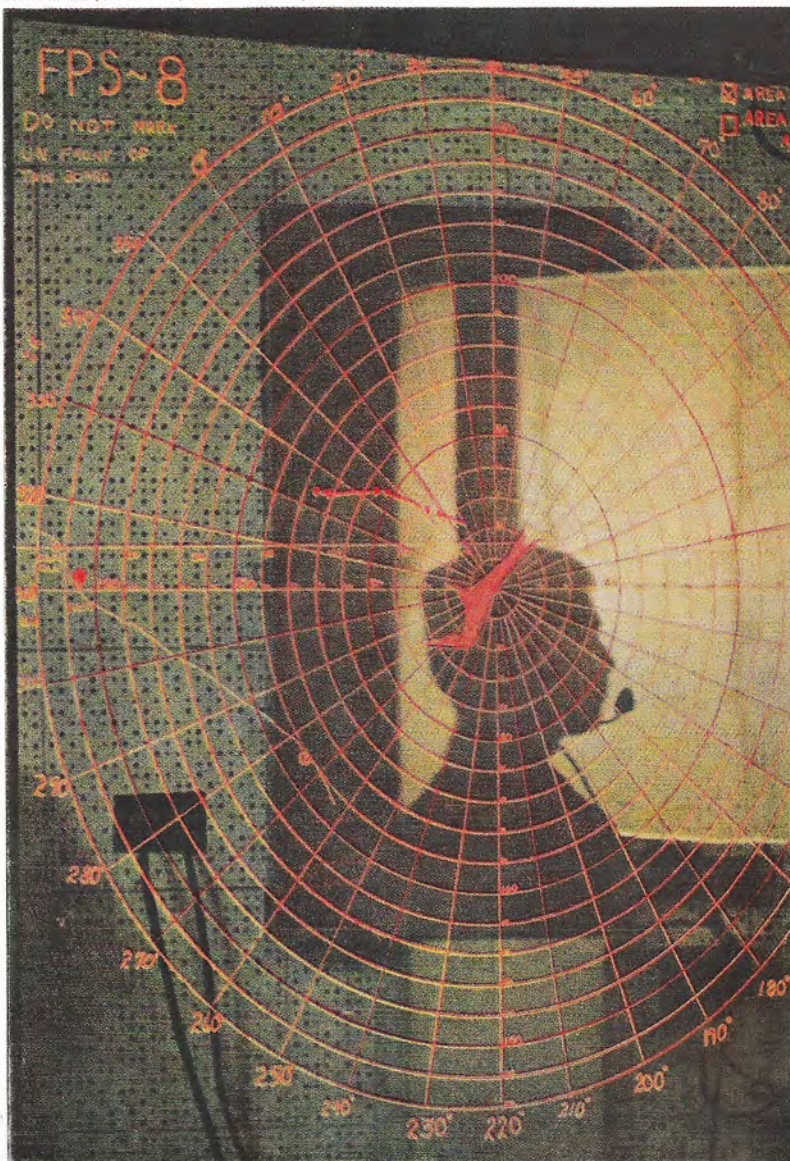
Here the cable leaves San Salvador. Not far away it snakes over a 300-foot cliff to a drowned ledge, then plunges 3,000 feet to the ocean floor. Russ Howard, president of the Water Wigglers, San Salvador's diving club, hovers above a coral head. Bucket-shaped orange object is a sponge.

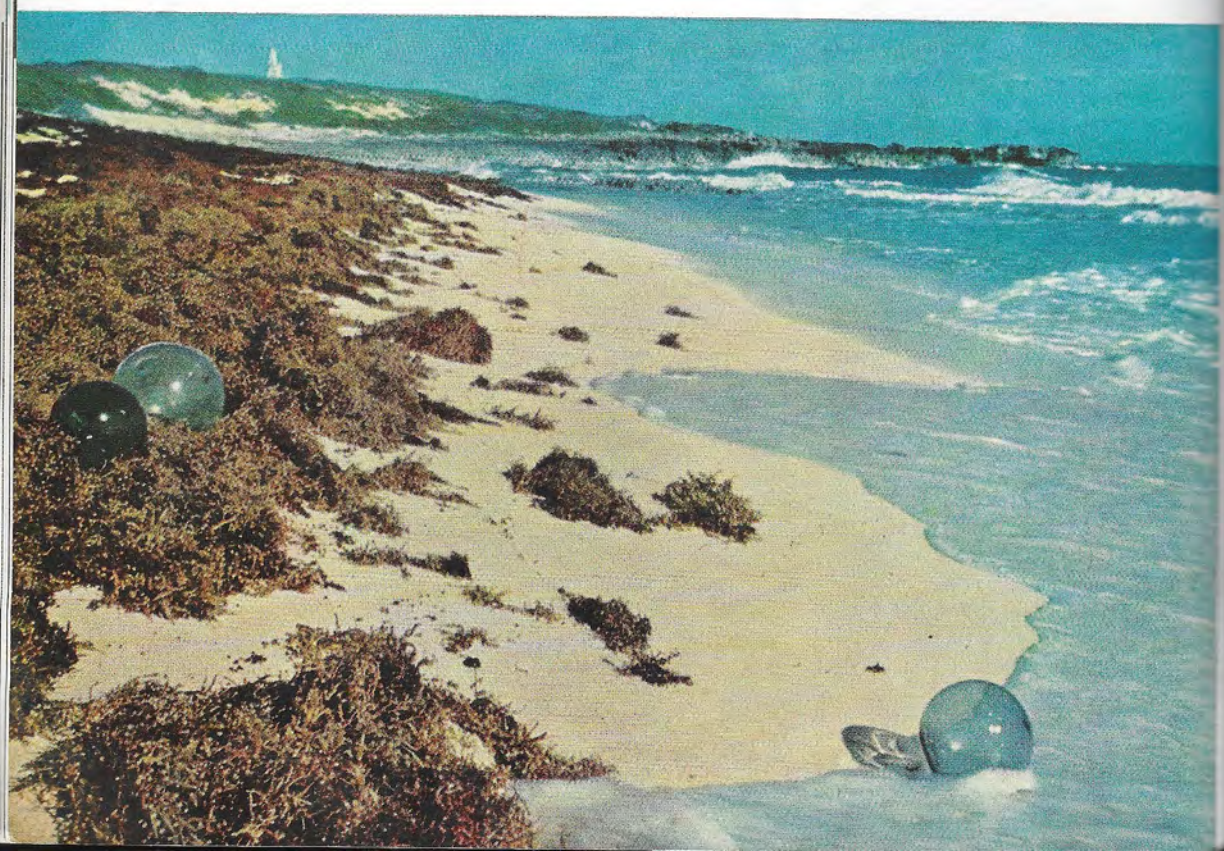
ANSCOCHROME (BELOW) AND KODACHROME (LOWER LEFT) BY THOMAS NEBBIA AND
KODACHROME (UPPER LEFT) BY LUIS MARDEN, NATIONAL GEOGRAPHIC STAFF © N.G.S.

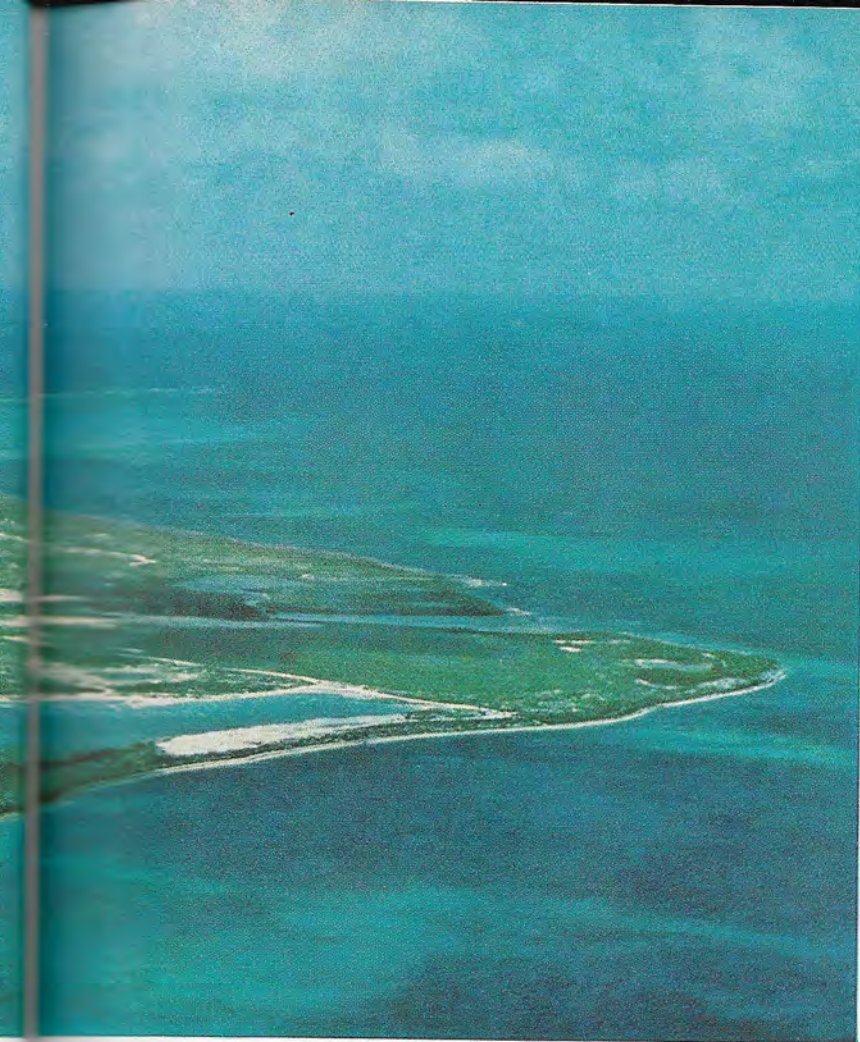


Huge telescopic camera on San Salvador takes motion pictures of missiles and satellites arching through space. The lens-and-mirror system, called ROTI (Recording Optical Tracking Instrument), gives the camera a focal length of 500 inches. ROTI can read letters four inches high at a distance of eight miles.

Transparent chart at Grand Bahama plots radar-detected ships and aircraft. Areas surrounding the island must be cleared before missiles are fired from Canaveral. The grid reflects the operator, microphone at his lips. Red line at center traces an approaching plane.







Grand Turk Sleeps in a Turquoise Sea

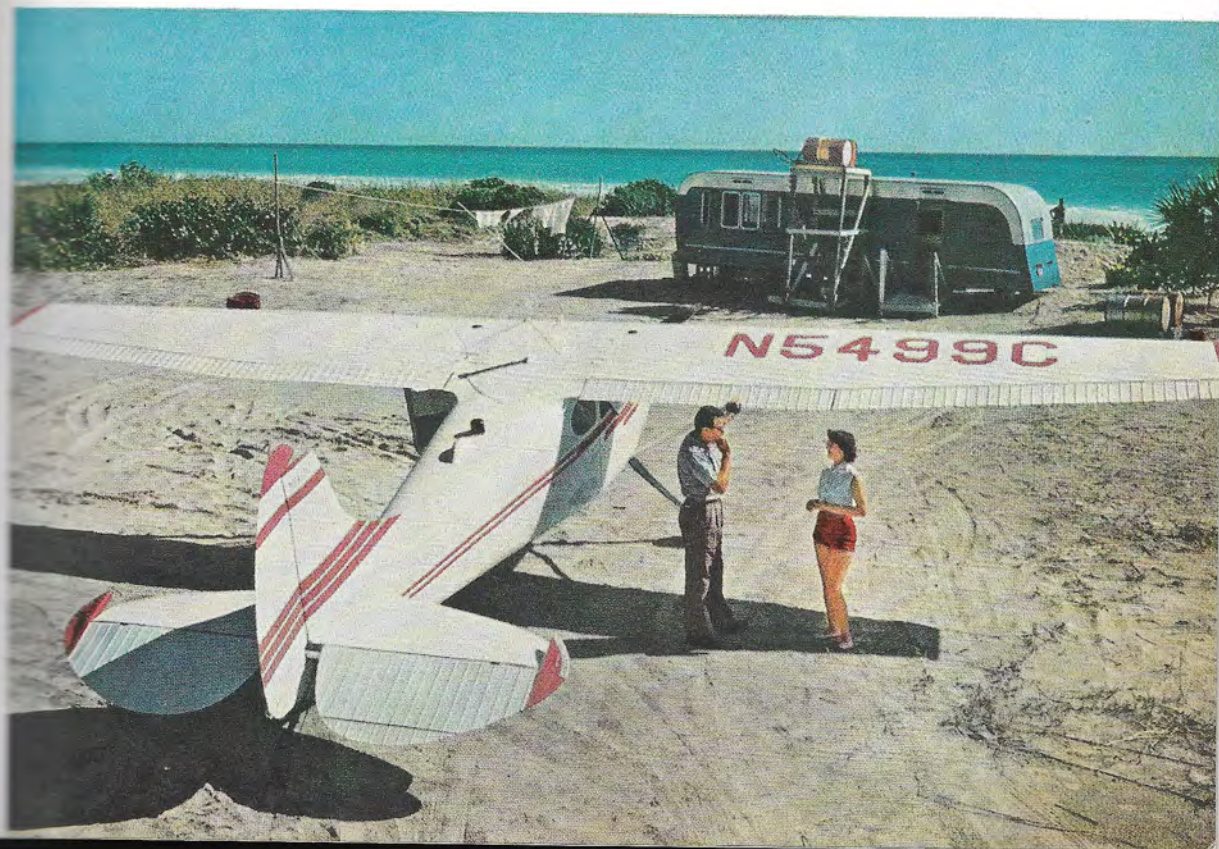
This island, which has but one village, extracts salt from sea water by evaporation. The U. S. base lies to the left of the large salt pan at the near end.

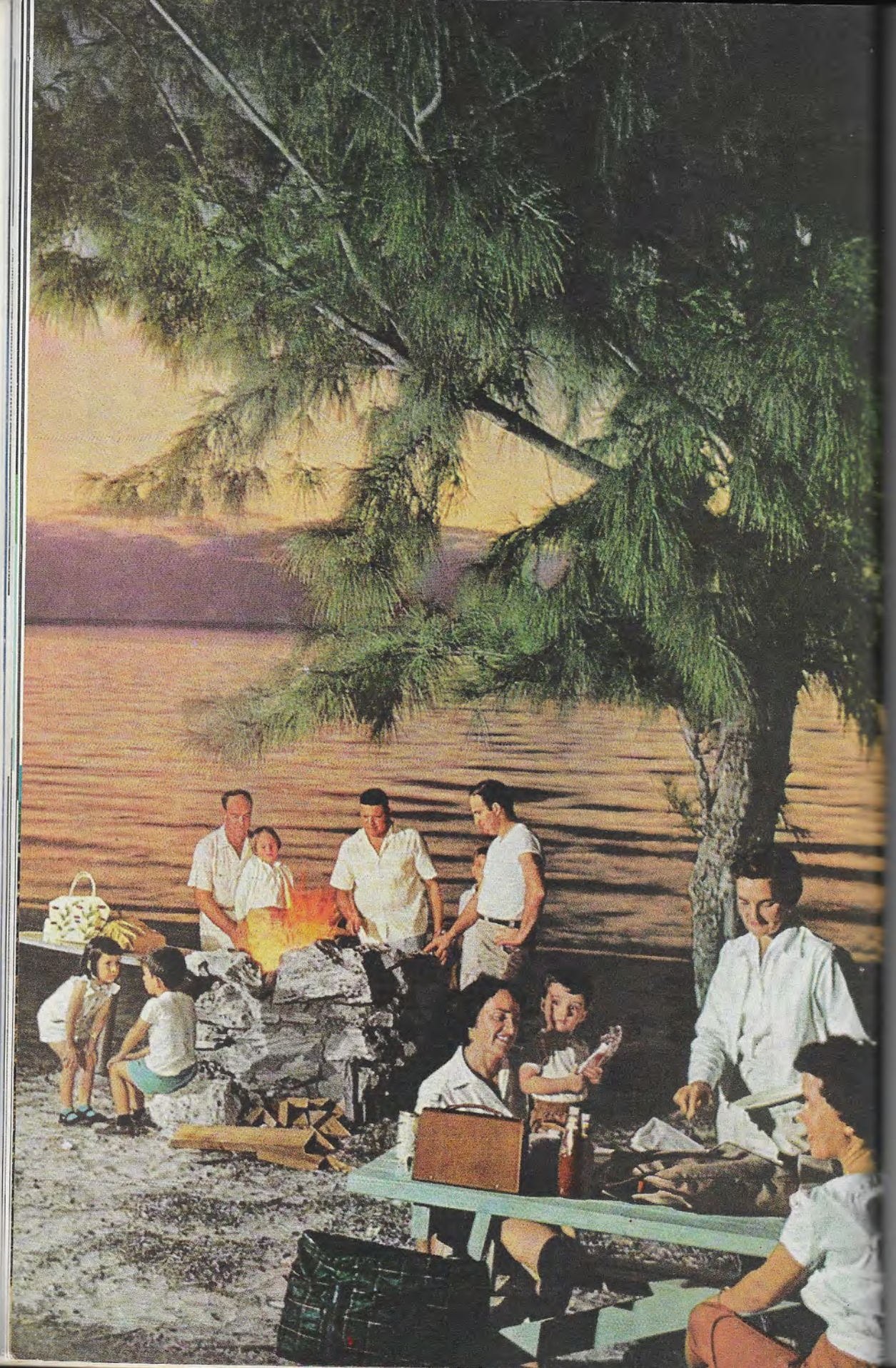
Glass balls, bedded in sargassum weed on San Salvador, drifted from Portugal, where fishermen used them as net floats. Prevailing winds and currents that wafted them also influenced Columbus's first landfall, believed by many to be San Salvador. Distant monument honors him; the *Chicago Herald* erected it in 1891.

Wives may join missile-tracking husbands on some of the islands. David Donaldson, RCA manager at Grand Bahama, and his wife live in this beachside trailer. Here she talks to Stan Monfette, who, with Donaldson, owns the light plane. They frequently fly it to Miami.

KODACHROMES BY THOMAS NEBBIA
(LEFT AND BELOW) AND LUIS MARDEN,
NATIONAL GEOGRAPHIC STAFF © N. G. S.

443





plotting boards, where automatic pens traced Atlas's course. At other sites sensitive helical spirals of telemetry antennas tuned in the missile as it narrated its own performance. On tiny near-by isles cameras with powerful lenses photographed its tail flame against a backdrop of stars, whose known locations helped in pinpointing Atlas's position.

Some of the information flowed instantaneously back to Florida on the range's submarine cable, which links stations as far south as Mayagüez and carries a time signal that synchronizes their instruments (page 440). Tapes and graphs made a permanent record of thousands of readings. Aircraft whisked this raw data, together with records and photographs from other stations, back to Patrick. There the Technical Laboratory, after analyzing the information with the aid of huge computers, issued a test report almost as thick as a big city telephone directory.

Hobbies Occupy Idle Hours

During off-duty hours the men at Grand Bahama, as elsewhere, can swap yarns in a pleasant club built with their own money, shoot pool, war at ping-pong, or play outdoor sports with equipment provided by Pan American. Yet time often weighs upon a man, and his capacity to resist boredom, supervisors told me, may depend upon his hobbies.

Ken Waltz, RCA communications manager at Grand Bahama, heads a group that builds and launches model rockets. Unluckily, I visited the island between shots, but Ken showed me part of a beautifully fabricated casing for his next creation. Stuffed with solid propellants, such as zinc and sulphur, the models erupt with a gratifying racket and often climb thousands of feet.

A young technician, giving a hammy imitation of a German rocket scientist, confided to me in a stage whisper: "Vee call ziss leader of ours Doktor Kenneth von Waltz. Der Cape fires rockets at us; vee fire der rockets back, ja!"

Waltz, who has worked on the range more than five years, also collects "thunderbolts," artifacts of greenish stone that the island's

prehistoric Indians used as club heads and scrapers. Made of basaltic rock, they are unlike all other stones on the island; migrant hunters or war parties probably brought them from South America. Waltz bartered for these trophies with island inhabitants—"locals" in range parlance—and he took me along on one such expedition.

We jeoped ages, it seemed, through sand, brush, and narrow trails that might have given pause to a goat, arriving finally at the cabin of kindly old "One-armed Joe." Joe, who had lost a bout with a shark in his youth, gave Ken several of the stones, then told me with a wrinkled grin how they got their name. "Lightning it hit pine trees, go down in ground and form stones—t'underbolts. They come to surface zactly seven years later; we pick them up."

This pleasant fable, I later found, is universal in the islands, where many such celts are discovered.

Grand Bahama does contain one recreational oasis, the plush Grand Bahama Club, a hotel some 40 jolting miles from the base. Veterans, inventing a fiction for young single workers, occasionally spread a rumor that the "Nassau Nurses Association" or the "Florida Secretaries League" is convening at the hotel. The prank always works with some of the newer youngsters, who expectantly beeline for the hotel as soon as duties permit. Pretty girls do vacation there, enough of them to keep hope springing eternally in the base's lonely hearts.

Family Life Difficult at Bases

Some married men live with their families in trailers near the base (page 443). But Edward J. Jones, Pan American manager, told me that neither his firm nor RCA gives any help to men who want to bring wives and children. Indeed, the companies discourage the men from taking families to San Salvador, where conditions are primitive, and forbid families at remote Fernando de Noronha and Ascension. Housing, medical care, and schooling for dependents prove troublesome—and then there is the problem of babies.

Missile Families Call Eleuthera the Country Club of the Range

Green and fertile, with long stretches of gleaming beach, the island supports luxury hotels, an exclusive golf club developed by wealthy Americans, and many attractive private homes. Twenty-one missile-tracking families now live on Eleuthera. This group picnics at sunset beneath a casuarina tree near the United States base.



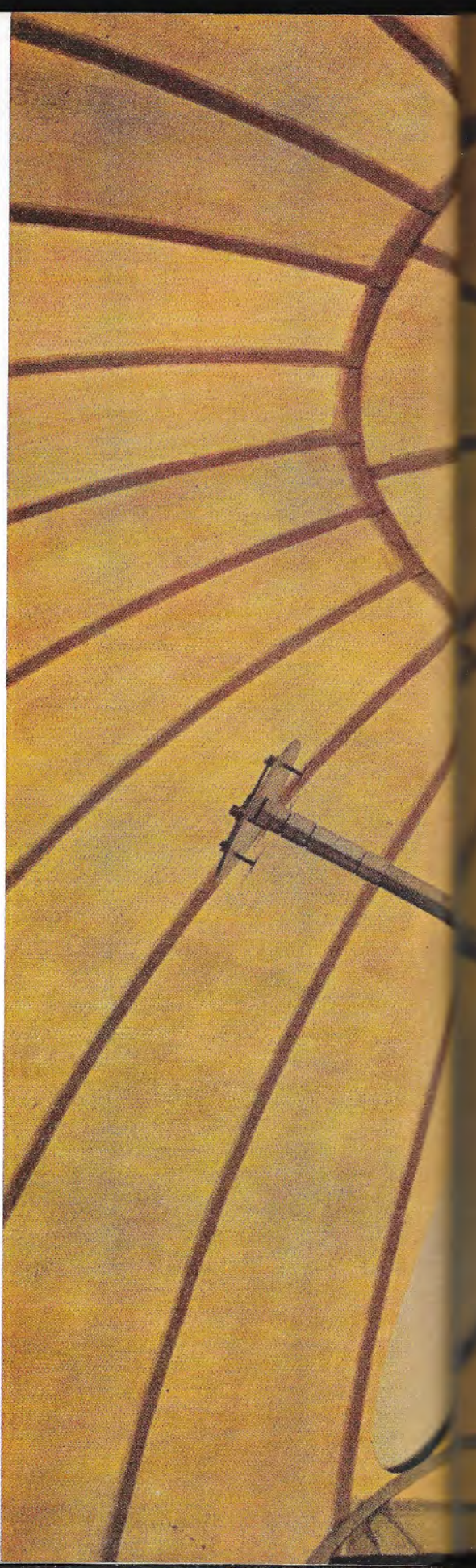
Nylon dome transparent to radio waves houses an ultrasensitive receiving antenna at Mayagüez. The antenna tracked *Pioneer IV* 104,000 miles toward the moon.

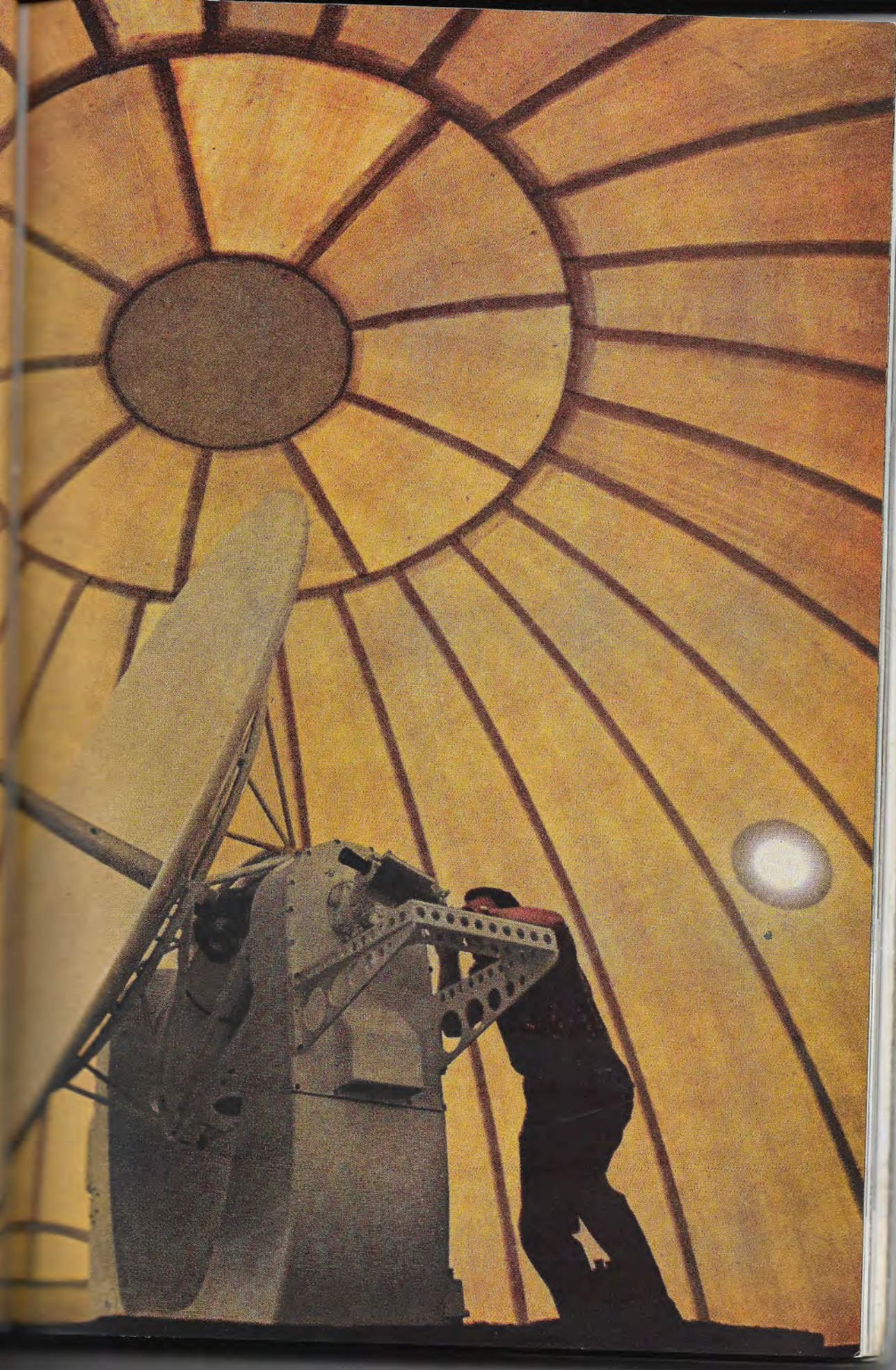
Within the dome, air pressure supports the girderless structure as it would a balloon. Men enter through an airlock.

The 10-foot dish gathers radio signals that yield position and performance data. Unique on the range, the instrument is operated by the National Aeronautics and Space Administration as part of its worldwide probe-tracking network.

Sighting a target through a porthole, the technician aligns the antenna's optical and electronic axes; he leaves the device unattended while it is operating.

Youth is accented down range. Rawleigh Tremain, Jr., works at Mayagüez.





Jane Donaldson and her husband, RCA instrumentation manager at Grand Bahama, once had to bundle a prematurely expectant wife aboard their private plane and race the stork to Miami. They landed in the early morning, only to be held up by a customs inspector, who thought their blanket-swathed cargo looked suspicious.

"Those forms of yours always ask where people were born," snorted Jane. "Well, you're going to know precisely where that lady's baby was born if you don't let us go."

Visibly shaken, the inspector hastily released them, and they beat the stork to the hospital.

Eleuthera, Station No. 4, contrasts sharply with Grand Bahama, both in beauty and in conveniences for families (page 444). Seldom have I seen an island so lovely. It is now experiencing a resort boom that, the British confidently expect, will make it "a second Nassau."* A retired Broadway actor, Craig Kelly, built French Leave, a luxury hotel; Arthur Vining Davis, Miami multimillionaire, backed the posh Rock Sound Club; Juan Trippe, Pan American's boss, headed a group that recently bought an exclusive golfing resort at Cotton Bay.

With money pouring into the island, lots facing the blue-green sea now sell for \$95 to \$200 a front foot.

Base Commander Creates Good Will

The base itself stands on a breeze-swept knoll overlooking the sea. It was established to track jet-powered Matador and Snark missiles; now, with the range emphasizing ballistic rockets, such as the Atlas, it is not very busy, although a new missile test program soon will increase its responsibilities.

Capt. Robert H. Reynolds, the commander, a gregarious soul, roams the island in his spare hours, visiting, chatting, making friends for his colleagues and his country. Roads near the base need repair? He will ask the Air

Force to authorize help. St. Patrick's Anglican Church is raising funds for a parish hall? Yes, it's okay to use the base's big recreation room for a charity dance. You fellows are building a chicken coop? Well, we have some big packing crates we can't use.

I spent one of the most pleasant hours of my trip swapping tall yarns in the back room of a country store with Reynolds and George Thompson, mayor of Gregory Town. George, a man of flashing wit, likes Reynolds, and he helps the base at every opportunity. Celebrities visiting Cotton Bay frequently drop by the back room to enjoy the cracker-barrel philosopher's colorful speech and irrepressible good spirits.

"Man, we redden the sky!" George laughed. In more serious vein he told me: "A man needs two things, freedom and happiness. If you've got them, what more do you need? Come back and stay awhile. We'll share them with you."

Time Stands Still on San Salvador

At San Salvador a marked contrast in islands again occurs. Except for the base and a single town, San Salvador remains virtually as undeveloped as when Columbus's three little vessels hove into view and joyously welcomed it as their first landfall.

Actually, some authorities—a small minority—credit that honor to one of the Caicos Islands, and men at the base debate the question endlessly. Their little newspaper, the *San Fly*, not given to crusades, says "presumably" it was San Salvador.

Three relatively small monuments, widely dispersed, yet each claiming to be the spot where Columbus landed, stand on the island's shores. The crew of a visiting yacht erected one, and a Chicago newspaper another (page 442). The third, a handsome white cross, is the handiwork of a group led by a New

* See "The Bahamas, Isles of the Blue-green Sea," by Carleton Mitchell, NATIONAL GEOGRAPHIC, February, 1958.

Antigua's Historic English Harbour Sheltered Horatio Nelson's Warships

For more than a century and a half British men-of-war used this landlocked finger of water as hurricane shelter, dockyard, and principal naval station for the Leeward Islands. Here, in 1784, came 26-year-old Captain Nelson for a three-year tour of duty. On near-by Nevis he wed a comely widow, Mrs. Nisbet, who was given in marriage by Nelson's comrade, William Henry, the sailor prince who became King William IV.

Restored, English Harbour now serves as a yacht basin. Men from Antigua's tracking station visit the site, rent boats, and explore its storied waters. The 134-foot schooner *Te Vega* sails toward the harbor entrance at old Fort Berkeley (foreground).

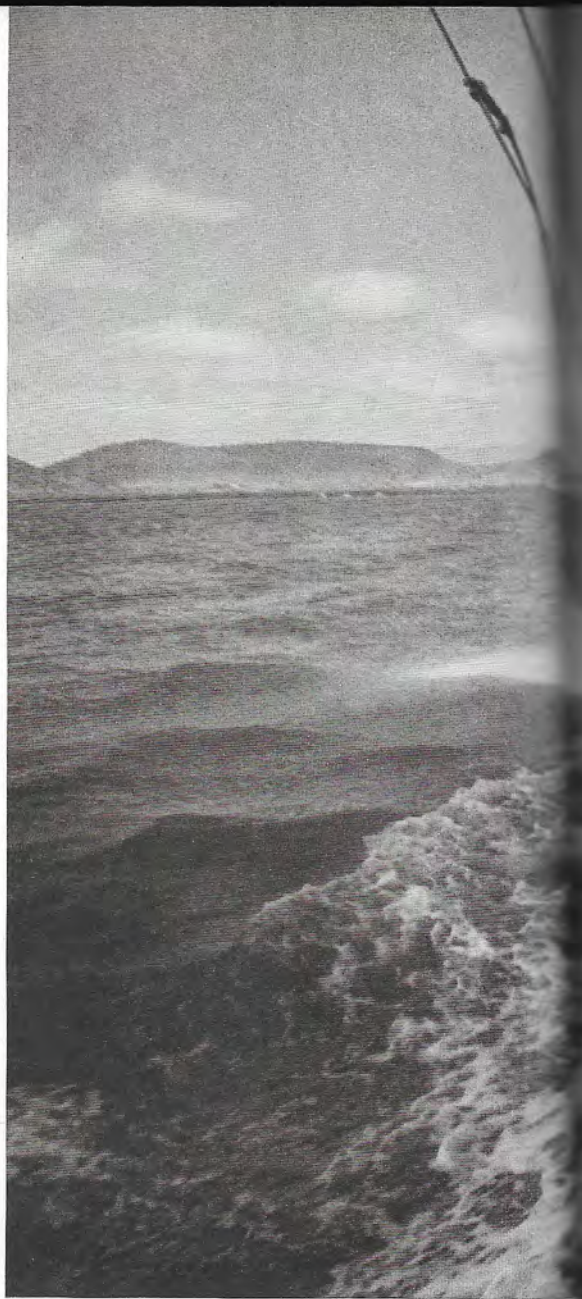
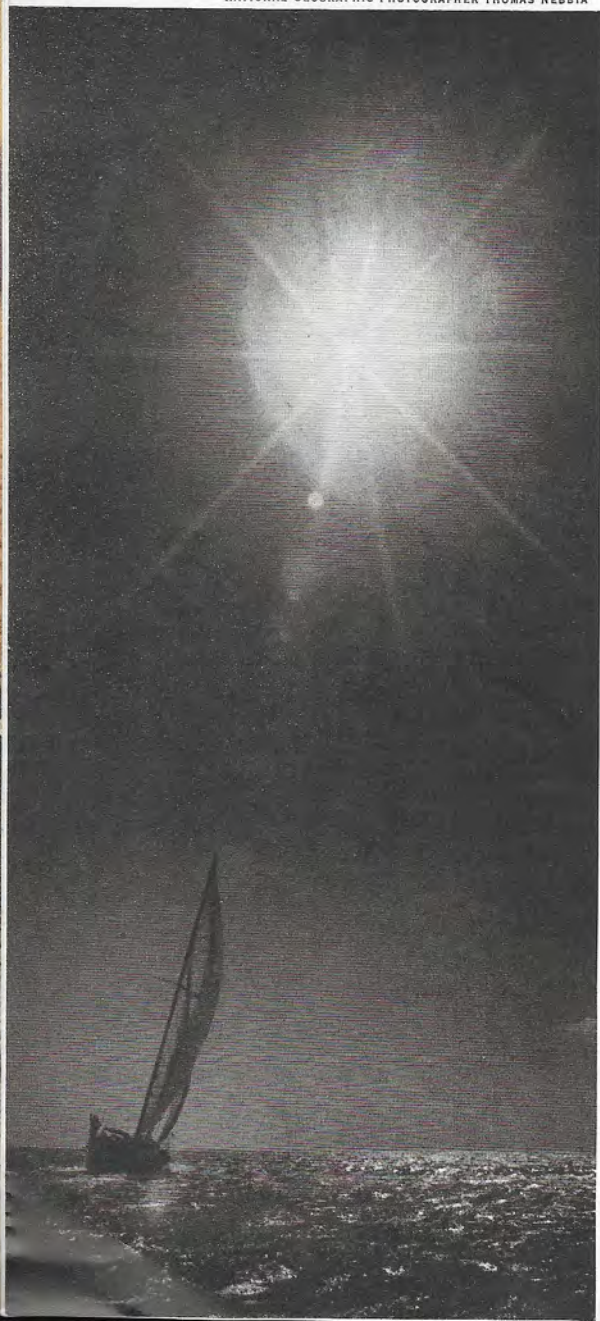


Missilemen Brace on the Heeling Deck of a Schooner off Puerto Rico

Feet against the lee rail, Sunday sailors enjoy a family outing aboard the 60-foot stay-sail schooner *Fairwind*, here driving close-hauled. Mrs. Henry Milstrey, wife of *Fairwind*'s owner, is the mother of a missile tracker formerly stationed at Mayagüez.

The sun scintillates in the camera lens as *Fairwind* cleaves a sparkling sea.

NATIONAL GEOGRAPHIC PHOTOGRAPHER THOMAS NEBBIA



Yorker, Mrs. Seymour Wolper, who maintains a home on San Salvador.

Reaching the monuments by jeep, with Capt. Roy Lefstad, challenged both spine and nerves, as did the uphill trip to stone ruins where, local legend maintains, once lived buccaneer John Watling. John, who began his career as an able-bodied seaman, thought his captain should observe the Sabbath, so he incited a mutiny and clapped the skipper in irons. After leading the crew in devout prayers, he sailed happily off under the Jolly Roger.

Boredom strikes quickly on San Salvador. To combat it, many of the men sign up for schooling under one of their Pan American colleagues, Adolph C. Risko, a remarkably versatile University of Chicago graduate. He



conducts evening classes in college algebra, analytical geometry, German, Russian, symbolic logic, modern mathematical group theory, and physics.

At San Salvador, as at other stations, the men look forward to work-connected instruction by visiting teachers. RCA's Technical Training Office employs 16 of these traveling pedagogues. I met one of them, Joseph Shoebert, at Grand Turk, where he lectured to a packed house on astronomy and its relation to the optical tracking of satellites. Pan American also sends men down range occasionally to give management training courses.

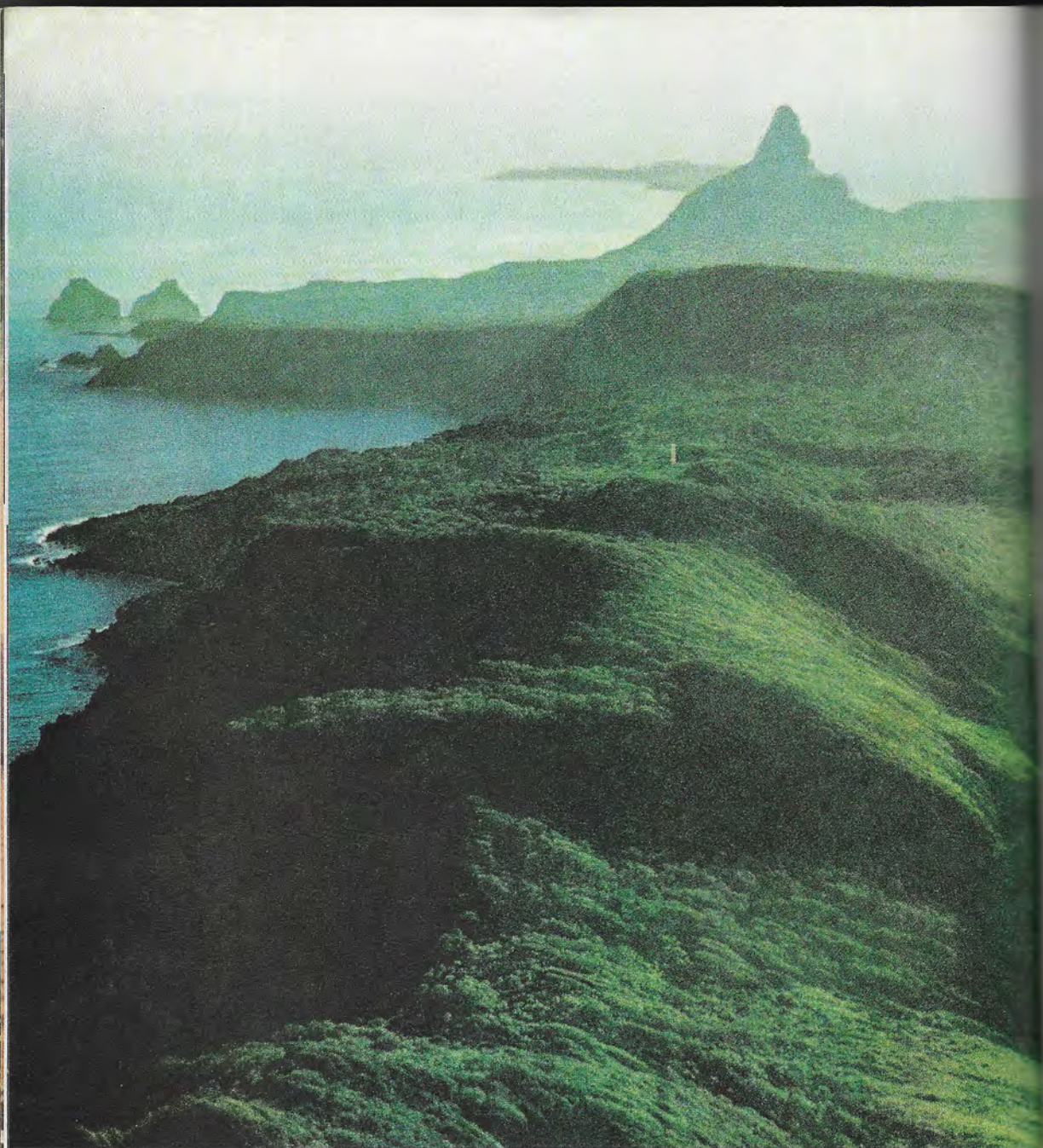
Both companies assist employees in planning correspondence school courses. If an RCA man takes a subject that will help in

his work—and passes it—his company foots the bill. Similarly, it pays tuition for employees on the mainland who enroll at colleges for spare-time study. Approximately 580 RCA men have signed up at correspondence schools and 780 at colleges.

Grand Turk Slumbers in the Sun

On San Salvador I had noticed many workers who seemed withdrawn and introspective, and the same thing proved true on sun-bleached Grand Turk (page 443). It, too, has but one town and offers little after-hours diversion. Islanders wrest a precarious living from the sea by reclaiming its salt and by fishing; they also raise a little livestock.

Grand Turk's missilemen, however, count



KODACHROMES BY NATIONAL GEOGRAPHIC PHOTOGRAPHER THOMAS NEBBIA © N. G. S.

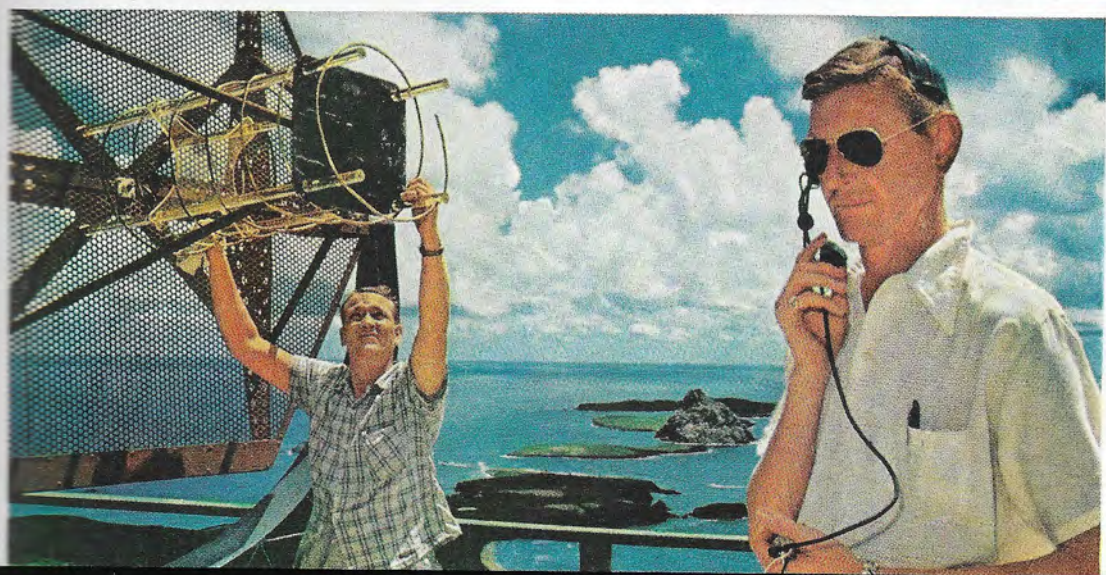
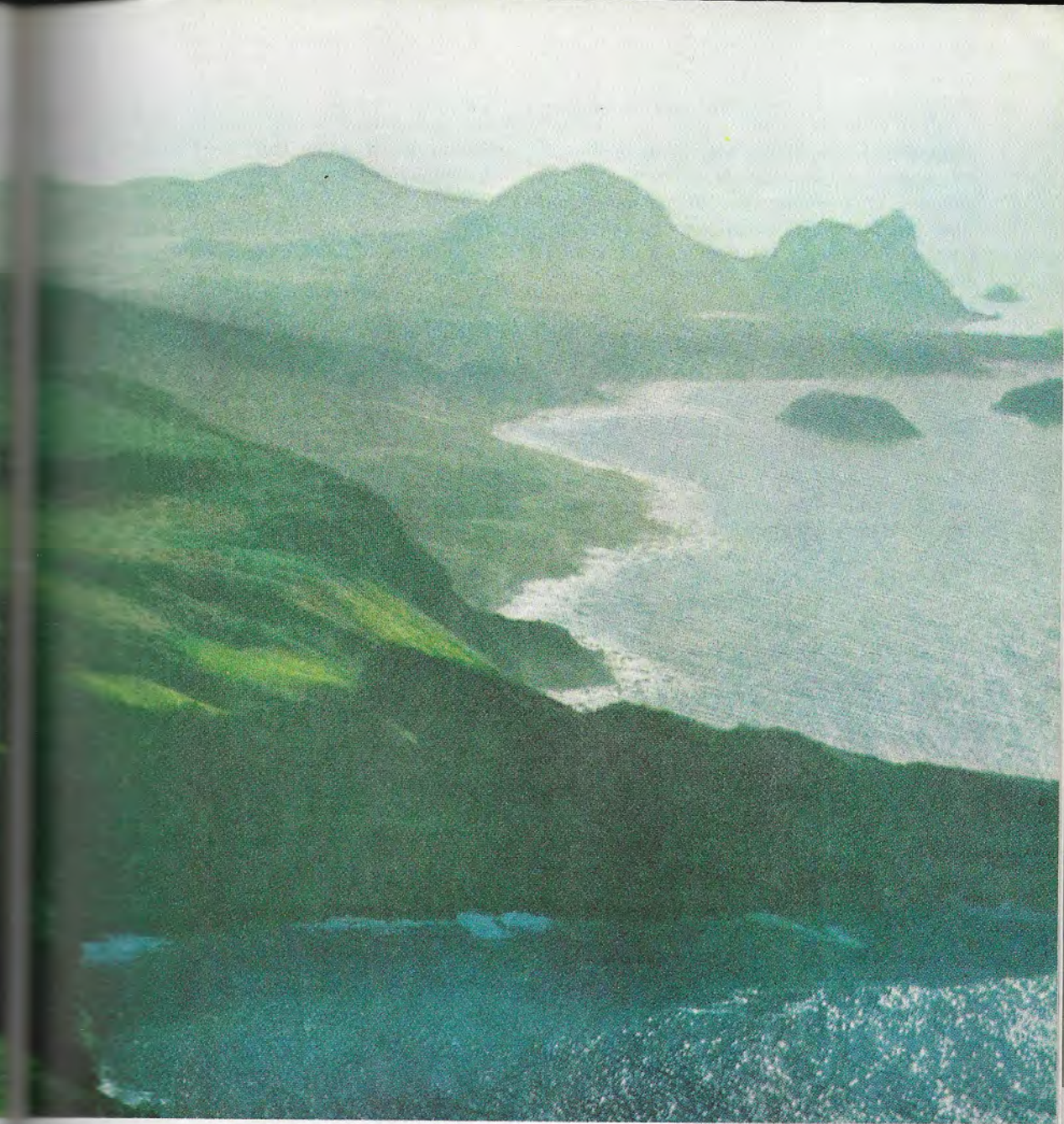
Morning Sun Burns the Mist From Emerald Fernando de Noronha

This lovely Brazilian island, lying 340 miles northeast of Recife, has long been closed to casual visitors. Until 1942 authorities used it as a penal colony. Today Brazilian armed forces garrison the isle and cooperate closely with United States missile trackers. The author, who visited Fernando de Noronha with photographer Nebbia by special permission, thought it "a place of dreamlike beauty."

In the distance rises the island's "little Sugar Loaf," a 1,053-foot spire. Officially it is known merely as Pico (peak). At its foot lies the United States base (page 454). White lighthouse in center stands in lonely isolation on a verdant hill.

Majestic seascape off Fernando de Noronha fails to distract range employees preparing telemetry equipment to track a missile.

Technician Fred Teague examines the antenna's helical coils, and RCA engineer John Anderson telephones to men at a near-by post.



themselves lucky to have near by a number of Britishers, who man the island's cable station. Geoffrey C. Guy, the British commissioner, likes Americans, frequently entertains them at parties with his own nationals, and is on a friendly first-name basis with the station commander, Capt. Sheril D. Huff.

"We borrowed a lot of vaccine and needles from the base to combat a typhoid epidemic," the commissioner told me appreciatively. "Since then we have carried out a full-scale vaccination campaign and have improved the water system and made certain, of course, that the water is safe."

The islanders depend upon trapped rainfall. To a lesser extent, so does the base, but it also has a distillation plant that converts sea water to fresh.

Parish Spans Fifth of the Globe

On Grand Turk I met perhaps the best liked man on the range, the Reverend Joseph Keiper, traveling chaplain. Joe, as he is known to many, logs 125,000 miles each year island-hopping from Grand Bahama to Ascension. "I guess I have the longest parish in the world, 5,200 miles," he said.

Stocky, balding, clad for comfort in T shirt, shorts, and sneakers, he looked more like a missileman than what he really is, a dedicated Methodist minister, and the trusted confidant of lonely men. Mr. Keiper spends about a week at each base, where he holds nondenominational services and, if the island lacks a Catholic church, arranges visits by priests. Much of his time is spent counseling men who bring him problems.

"They have a need for understanding," he said, "without criticism and expressions of sympathy. Don't get the idea many of the men are troubled, but, of the ones who come to me, most are running away from something. I try to convince them that they are probably carrying the problem with them and must face it.

"If a man tells me his marriage is in jeopardy, I advise him that his marriage is more

important than any job. Pan American always backs me up on this and will send me to visit the family of the man on the mainland, if I think that will help. No, I never tell the company the name of the family involved, and no one ever asks.

"When I took this job, Pan American officials, quite literally, gave me but one instruction: 'Go down there and do what the Lord tells you to do.' That's the approach we have taken, and I really feel I was led into this work."

Another well-liked personality is young Dick Langley, the traveling barber, who serves the range as far south as Grand Turk. Beyond that point the men shear one another or wait until they can visit a barber. While getting a rapid but skillful haircut, I asked Dick how he got his job.

"I used to work in Florida and ran into a



Fernando de Noronha's Peak Lifts Its Granite Head Above the U. S. Base

Comfortably furnished quonset huts house personnel, whose tracking sites lie elsewhere. Paved area behind the base traps rainfall. Distillation units provide additional fresh water, which is stored in the hillside tanks. The Brazilian farmer inspects his crop.

couple of guys from Grand Turk who told me the job was open. I applied and got it the same day. I guess it wasn't very hard to get," he added thoughtfully.

Dick spends three or four days at each base, then returns to Florida briefly before beginning the round again. He could have used a haircut himself. But, when I suggested one of his friends might clip him, he replied scornfully: "I've seen some of the work of these guys, and I don't want to carry any of it back to the States."

Wisely, both Pan American and RCA give their employees generous leave time. Each man can take several week-long special leaves each year, plus 30 days' vacation. Rather than endanger his income tax rebate by returning to the United States, he may ride a range airliner to Ciudad Trujillo, capital of the Dominican Republic, where he enjoys special rates at

luxurious hotels owned by Pan American and can take his pick of restaurants, clubs, and sightseeing tours in a large modern city.

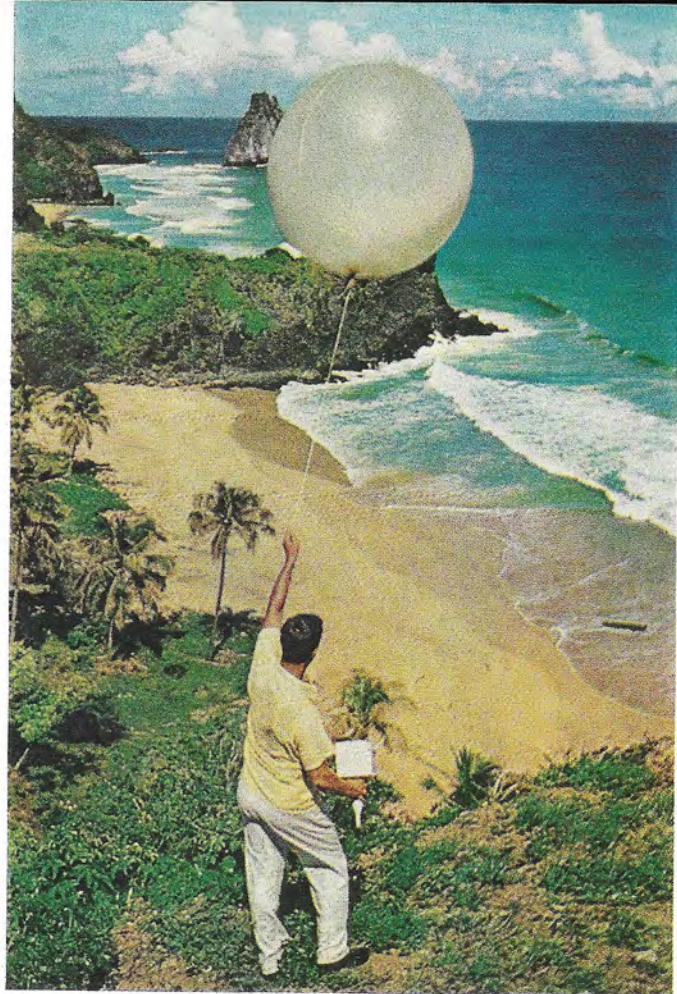
The range station in the Dominican Republic lies near the Atlantic at Sabana de la Mar, 50 miles northeast of Ciudad Trujillo. Not very active now, it serves only as a cable station and communications link. On the shore of beautiful Samaná Bay, near by, Columbus's men skirmished briefly with Indians in the *Batalla de las Flechas* (Battle of the Arrows).

Wedding Bells Ring for 19 Men

In one respect the Dominican station is most active. Since it was established, 19 employees have married dark-eyed local señoritas. A number of these couples gave a barbecue in our honor and proudly displayed plump babies in carriages and strollers.

At the time of our visit, Maj. Byron J.





Leashed Balloon Strains to Probe the Stratosphere

Twice daily each range station sends aloft radiosondes, small instrument packages that transmit data on barometric pressure, temperature, and humidity. These atmospheric variables determine the amount of refraction, or bending, undergone by radio beams from missiles.

Since trajectories are computed from the beams, engineers use weather reports to determine the degree of refraction, an essential correction factor in their calculations. The reports also aid Air Force weather forecasters.

Technician Bill Freese, on Fernando de Noronha, holds a balloon that will ascend some 100,000 feet.

Off-duty technicians fish for snappers and groupers from a wave-lashed ledge at Fernando de Noronha.

Range employees here enjoy some of the world's finest fishing.

456

KODACHROME (ABOVE) AND ANSCOCHROME BY NATIONAL GEOGRAPHIC PHOTOGRAPHER THOMAS NEBBIA © N.G.S.



Greene commanded the station and also held the job of Air Force liaison officer in Ciudad Trujillo, where he had an office. Greene met every range airliner, shepherded hundreds of men through customs each month, served as their adviser and translator, and maintained a close and cordial relationship with Dominican officials. Both the Americans and their hosts often referred to him as "the ambassador without portfolio."

Greene, happily, represents a type one meets with increasing frequency in the services: a specialist, well schooled in languages, who smooths relationships for the United States military in a non-English-speaking country.

Station 9 in Puerto Rico, our next stop, commanded a magnificent view of verdant slopes and distant sea from a hilltop outside Mayagüez. The only island station on United States soil, it rates as one of the choicer assignments among married men, who can maintain families in comfort in the city below. The range calls its commuting married men "brown-baggers," for frequently they bring their lunches in brown paper bags. On some weekends families may dine in the base cafeteria. Food at each station is so good and so plentiful that it balloons many a waistline.

Bachelors find Mayagüez, a quiet, home-loving city that clings to Spanish ways, a little sedate; cosmopolitan San Juan, the capital, becomes their mecca.

Blazing Missiles Fall off Antigua

For weeks our group had eagerly anticipated the island of Antigua. Off its shores intermediate-range Thors and Jupiters flash back into the atmosphere like meteors, while their vital data capsules and nose cones, also blazing brilliantly, hurtle toward the sea for recovery by ships. With luck we might see from Antigua a missile's final dramatic, friction-tortured plunge—something no other journalists had witnessed, the Air Force told us.

We had been well briefed on what to expect. The spent rocket slams into the air like a bullet into a well of feathers, and friction consumes it. The nose cone, previously separated from the rocket, fares better. It bears a special coating designed to absorb heat and peel off in fiery streams, thus protecting the inner cone and its payload. A layer of ionized air grows around the projectile, however, disturbing radio transmission from its instruments. For some tests engineers encase the instruments in a protective plastic ball.

Ejected from the cone, the ball, or data capsule, falls separately.

The prospect that we might capture a missile entry on film seemed to intrigue Antigua's base, and many men offered advice and help. Fortunately the schedule called for a night Thor shot in three days. Luckily, too, a tracking vessel, the *Sword Knot*, lay briefly at Antigua. Tom Nebbia sailed on her, hoping to shoot the Thor from a ringside seat. Since *Sword Knot* might remain weeks at sea, Luis Marden and I decided to remain on the island and chance seeing the show from there.

We found the perfect vantage point: a tower overlooking the base's high-gain telemetry antenna, a giant steel skeleton resembling a radio telescope. The Thor would streak through the sky just to the right of the antenna, trackers assured us.

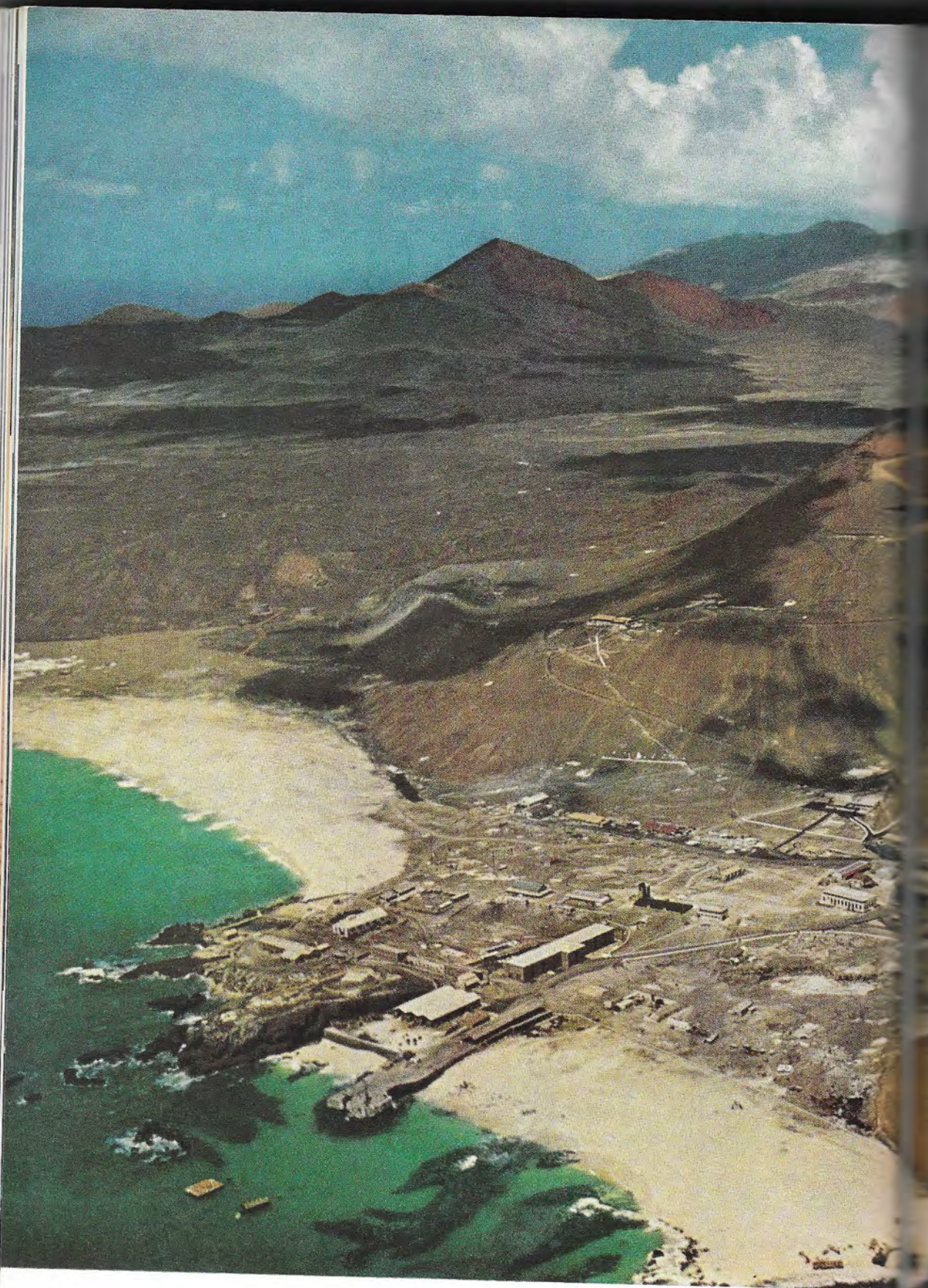
Cameras Wait in Vain for Thor

Then fortune turned capricious. On the scheduled night Luis and I huddled hours atop the wind-swept tower, only to have the shot canceled. Two nights later we resumed our post; showers plagued us, delay followed delay, and once more the shot was "scrubbed." This time, however, it would not be rescheduled for five days.

But no enforced stay on Antigua seems irksome. Like Eleuthera, it is a lovely, smiling place with sun-washed beaches, luxury hotels (six already built, eight more planned), and flower-fringed homes. On Exchange Bay lies the exclusive Mill Reef Club; there, in a 1,400-acre private domain, members have built 42 spacious homes. The club's roster reads like *Who's Who*, listing such men as poet-playwright Archibald MacLeish, publisher John Cowles, Pittsburgh's Paul Mellon, and Philip Reed of General Electric.

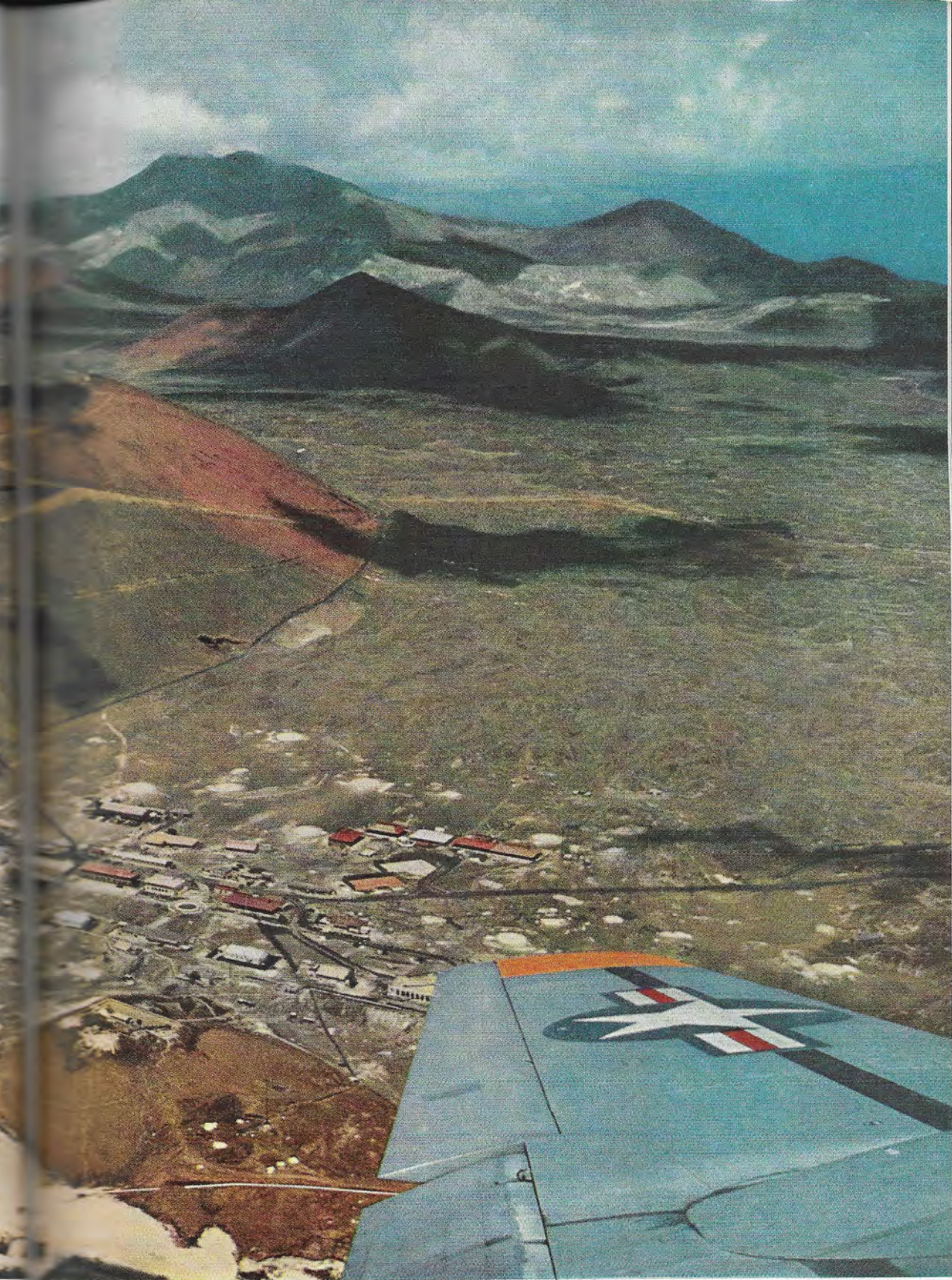
English Harbour, hallowed by association with Great Britain's premier naval hero, Horatio Nelson, reigns as the island's No. 1 tourist attraction (page 449). Its recently restored buildings, locally known as "Nelson's Dockyard," include a museum. Among its treasures I spotted one of those mysterious "thunderbolts." A card identified it as a Carib Indian adz and appended this observation, attributed to an unnamed early historian, about the cannibalistic Caribs:

"They have tasted of all the nations which frequented them, and affirm that the French are the most delicate, and the Spaniards the hardest of digestion."



**Georgetown Thrusts a Foot Into the Sea
From Its Cinder Heap, Ascension Island**

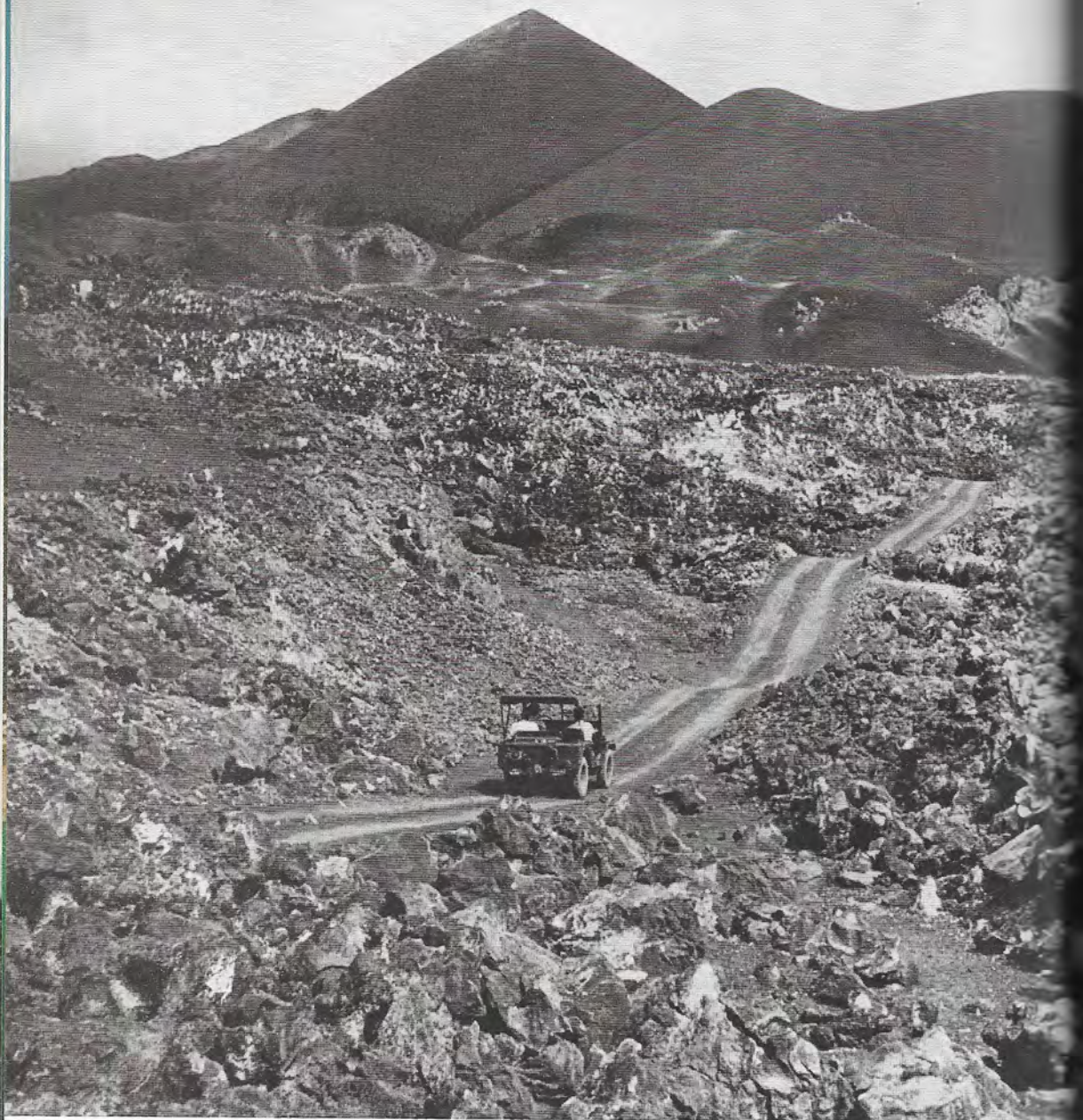
Ages ago volcanic fires spewed torrents of molten rock and glowing ash above the surface of the South Atlantic to create Ascension, one of the most barren, isolated spots on earth. Here United



KODACHROME BY NATIONAL GEOGRAPHIC PHOTOGRAPHER THOMAS NEBBIA © N. G. S.

States engineers track nose cones plunging into the sea. The road to their main tracking site snakes up Cross Hill, the ancient cinder cone in center. Clouds bathe distant 2,817-foot Green

Mountain, the only spot that receives enough moisture to support vegetation (page 462). British residents of Georgetown operate a transatlantic relay station for Cable and Wireless, Ltd.



Since the subtle French cuisine is universally esteemed, and its tenderizing effect upon the anatomy can be readily imagined, I thought the Caribs' conclusion most perceptive. Ian G. Turbott, Antigua's administrator, had been guiding me about, and he agreed—but we could not imagine why the Caribs should be any more critical of a Spaniard than, let us say, an Englishman or a Portuguese.

On the night of the rescheduled shot, Luis Marden and I once more climbed the tower. Our spirits, however, were far lower than our vantage point. *Sword Knot*, with Tom Nebbia aboard, had been ordered back to her home port at Trinidad, and another ship

had taken her place. Moreover, an unremitting wind endangered our own prospects, blowing so fiercely that we had to lash trembling cameras and tripods to steel girders.

But periodically the high-gain antenna crew shouted to us that the countdown went well. Then came word, "She's off!"

Nervously we counted the minutes. When a dozen had ticked away, we gazed fixedly, expectantly, to the right of the handle of the Big Dipper. For long moments only the stars stared back. Then, at a spot where there had been nothing but blackness, a light flashed on, growing immediately into a racing, brilliant meteor.

Luis Marden's remarkable photograph on



NATIONAL GEOGRAPHIC PHOTOGRAPHER THOMAS NEBBIA

page 464 captures that man-made falling star; yet, because of the necessary time exposure, it could not record all that the eye saw. Briefly, fleetingly, I glimpsed three separate streaks of light, one less vivid than the others, all arcing downward in the same trajectory. Then they seemed to coalesce into a single stream of fire that vanished abruptly, low on the horizon. Presumably, experts later told me, I had seen rocket, data capsule, and cone, and the capsule had been the fainter light.

Viewed close up from tracking aircraft, these night displays are blinding in their brilliance. Maj. M. E. Griffith, Thor Able project officer, told me of one that occurred

Road Through Chaos: a Vulcan's Dump Broils in the Sun on Ascension

This jeep track near Comfortless Cove cuts through gritty clinkers spewed during an ancient eruption. Men who explore the grim jumble afoot soon find their shoes slashed by the rocks' razor edges. Even the slightest cut sustained in a fall proves troublesome, for embedded cinders make healing difficult. Bald, humpbacked cones line the horizon.

so suddenly, and with such intense light, he thought for a moment a crewman had fired a flashbulb in the cockpit. Occasionally someone gets a fleeting look at a missile's daylight plunge. Vernon Nealey, salvage master of the "undertakers," saw from a plane a tremendous geyser raised by the cone of a Redstone. To the north great clouds of steam, visible for 20 miles, erupted when the rocket, not entirely consumed, also plummeted into the sea.

Jupiter Dies Above Recovery Ship

Crews of recovery ships, who have an unobstructed sweep of the horizon, often get the best view. Capt. Edwin S. Church, skipper of the *Sword Knot*, described one instance when the view seemed too good.

"It was a Jupiter," he recalled, "and it looked like a very bright comet zooming directly toward us. That thing lit up the sea all around the ship, and I thought it was going to come right down our stack."

Actually the cone hit 10 miles away, zeroing in perfectly on its target area. But a sonic boom hurtled down from the outraged air and struck the ship like a thunderclap.

Pan American's Marine Department directs *Sword Knot* and other tracking ships from bases at Trinidad, in the West Indies, and Recife, Brazil. Suwannee Steamship Company, a Florida firm, operates most of the vessels. In addition, the Army converted an old Liberty freighter into a floating station, and Navy ships sometimes assist in recovery operations.

We had now reached that point on the range which trackers call "the water gap." The next active station, on Fernando de Noronha off the bulge of Brazil, lay more than 2,400 miles from Antigua. We would reach it circuitously, however, flying by Military Air Transport Service from Trinidad to Recife, thence to the island. Everyone cheerfully assured me that the flight to Recife alone would last 11 nonstop hours, since MATS follows the South American



coast and skirts the vast Amazon jungle.

But Fernando de Noronha lured us as compellingly as did Antigua, though for a different reason: it had an intriguing reputation as an isle of mystery. For many years Brazil's State of Pernambuco operated the island as a penal colony; later, until 1942, the Federal Government put it to the same use. More recently the Brazilian Air Force and Army had garrisoned Fernando de Noronha as a strategic outpost, and no journalist in modern times had visited it with official sanction.

Range Ships Sail Despite Strike

Earlier, General Yates had told me frankly that he doubted the Brazilians would permit our visit. But, through diplomatic channels, the National Geographic Society asked approval for its representatives, and it was graciously and speedily granted.

In Recife the Air Force stations another of its specialists in diplomacy, Maj. William F. Sandusky. When we arrived, he was preoccupied with the problem of getting Pan American tracking vessels out of port despite a dockyard strike that had made hundreds idle. Again I saw how the Air Force's carefully tended liaison with a host government pays dividends. Sandusky appealed to the Brazilian Army and Navy, and they eased the range ships out of their berths and shepherded them to sea in time for an important test.

Nothing I had read or been told prepared me adequately for the beauty of Fernando de Noronha. Viewed from the air, its majestic humps and spires, its green slopes and wave-lashed cliffs rose from the sea like an improbable dream (page 452). Despite its limited area, only 10 square miles, ruggedness and a serrated coast gave the island an arresting sweep and grandeur.

Still bemused by the air view, I was the last passenger to quit the plane after it landed. Yet, curiously, a number of men turned to stare at the door of the empty plane after greeting me, and expectant smiles

wreathed their faces. Finally one of them asked:

"Where's Louise?"

"Louise?"

"Yes, didn't she come with you?"

Completely bewildered, I explained that, while feminine companionship would have been delightful, only Tom Nebbia and Air Force officers had accompanied me. Luis Marden, scheduled to come, had been recalled to Washington for another assignment.

My questioner, suddenly crestfallen, offered an explanation which I received with hoots of laughter. A message had been sent the base listing our names. Apparently "Luis" had been garbled in transmission, emerging as "Louise."

Word of that message had flashed with rocket speed around the womanless base, touching off much speculation. Supervisors, however, worried about proper housing. They solved the problem by assigning "Louise" solitary quarters in the infirmary, and several stout fellows of good character drew the job of guarding her maidenly slumbers.

Luis Marden will not learn of his celebrity on Fernando de Noronha until he reads this article. I hope our friendship survives.

Peaks Guard Fernando's Coast

Viewed from the ground, the island seemed just as lovely as it did from the air. Its dominant feature, Pico, a precipitous 1,053-foot spire, stands like a sentinel on the north coast. Near its foot nestles the missile base, a group of comfortable quonset huts. United States Navy forces, who shared with Brazil the island's defense in World War II, planted an aircraft warning beacon atop Pico. Long ago it ceased to operate, and no one has attempted repairs. I could see why, for scaling the peak is a job for human flies.

Many smaller spires rise from the surf along the north coast, and hills of softer contour line the island's southern end. Between stands a central table, the Quixaba Plateau, which falls off abruptly to the island's single valley, site of the airstrip.

Water-trapping Concrete Paves a Hump on Ascension's Green Mountain

Peter Critchley (left), a former RAF fighter pilot, shares an idle hour with Air Force Capt. Edward Duch, commander of the United States base. Critchley, who manages a farm atop the island's summit, supplies Ascension's British subjects with fresh vegetables, milk, and meat. This lush Shangri-La taps moisture from clouds that frequently shroud the mountaintop. Rainfall from the catchment basin is piped down to dry and cindery Georgetown, which has no other source of fresh water.



**A Blazing Thor Streaks Antigua's Sky
Like a Meteor From a Shattered Planet**

Twelve minutes and 1,500 miles after its launching from Cape Canaveral, the missile dives seaward at 10,000 miles an hour. Photographer Marden waited 10 days to catch this spectacle, which



KODACHROME © NATIONAL GEOGRAPHIC SOCIETY

lasted only 18 seconds. His multiple time exposure records Thor's incandescent trail, an estimated 150 miles from the island. In the tail of the track, the spent rocket bursts into flame.

Miles ahead, the nose cone slashes the night sky, but its light ebbs as a ribbon parachute brakes the fall. Powerful antenna at left, similar to a radio telescope, picks up the cone's signal.

It can truthfully be said of Fernando de Noronha that "every prospect pleases." I have seen the rocky coast of Maine and the seascapes of Nova Scotia and southern California, but none quite matches the beauty of this onetime prison isle.

Like most Edens, however, it has a flaw. Rainfall during the dry season, August to January, averages only four inches. Much of the year the low vegetation looks sere and brown, not the lush emerald green we remarked from the air. Authorities humanely permitted prisoners to bring families to the island, and several hundred of their descendants still farm the land, though lack of moisture restricts crops.

Governor Served With U. S. Troops

Brazil has placed in command of the island, as military governor, a staunch friend of the United States, Lt. Col. José Francisco Costa. Colonel Costa, who speaks excellent English, trained with U. S. forces during World War II at Fort Sill, Oklahoma, and later fought in Italy under Gen. Mark Clark, as did many Brazilians.

Major Sandusky, whose liaison duties frequently bring him to the island, took us to call on the governor at his headquarters, a huge, cool building, gleaming white, that commands a hillside in the only village.

"Americans and Brazilians have gotten along very well on this island," the governor told me. "We are good companions, good friends. Mutual confidence—that's the important thing, that's what Major Sandusky and I work for."

The governor, we found, had a most attractive partner in his duties—Mrs. Costa. She administers social services, directs reforestation (the island once had many trees), and supervises restoration of an old fort built by the Portuguese in 1772.

Proudly the couple showed us the island's modern school, named for the governor and attended by 210 youngsters, and its spotlessly clean, well-equipped maternity clinic, where a woman pays a single chicken as the price for delivery of her child.

When, regretfully, we left the island, its

"mystery" had been dispelled, and young Tom Nebbia could say, and mean it: "It's too bad they no longer keep prisoners there; I'd like to sign up for a year's sentence."

Wholly different was our last stop. As our escort, Capt. Tom Burleson, pointed out, if one cannot go to the moon, "the next best place" is that dead caldron Ascension Island.

Volcanic Ascension, with its dark, brooding cinder cones, ancient lava flows in tortured shapes, and monstrous chunks of slag, all coated with gritty dust and cinders, does resemble the moon's ravaged face (page 460). It can also be likened to another celebrated world, infernal rather than celestial, as indicated by these names given some of the island's grimmer features: Devils Inkpot, Devils Ashpit, Devils Riding School, Deadmans Beach, and Comfortless Cove.

A Portuguese, João da Nova, discovered the isle in 1501 on Ascension Day, hence the name. Later voyagers treated it with understandable indifference, though occasionally they found it a fitting place to maroon some sinful sailor. When the British put Napoleon on St. Helena in 1815, they decided to occupy Ascension, lest it be used as the base for an attempt to free him. The indefatigable British have remained ever since, and today their community, Georgetown, maintains a vital transatlantic cable and radio station (page 458).

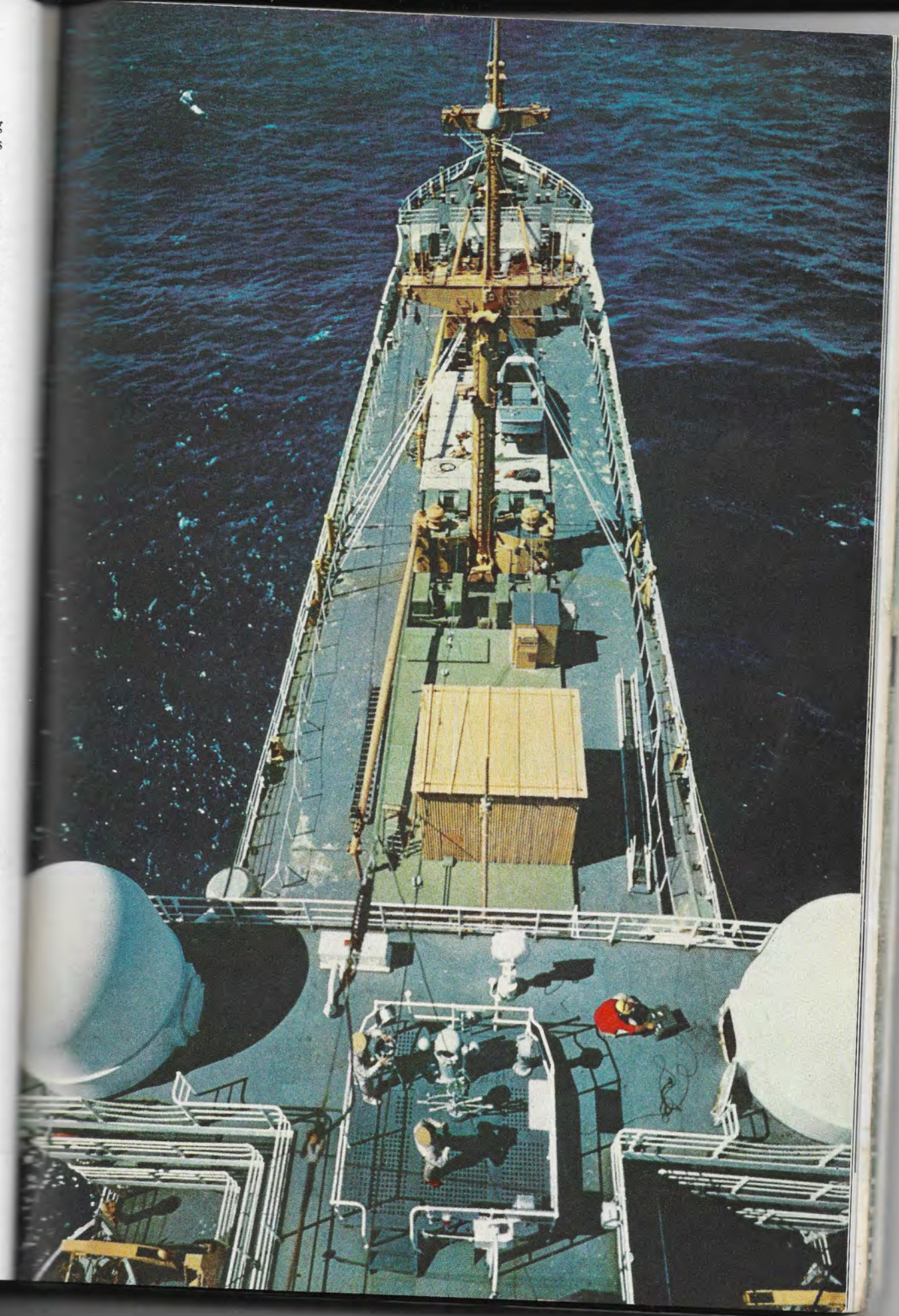
Limited Housing Plagues Base

Missile-tracking antennas, reached by giddy, serpentine roads, rise from the tops of several widely scattered cones. The main base, with its comfortable dormitories, cafeteria, and offices, lies a mile and a half from Georgetown. Built to accommodate 194 people, it had squeezed in 281 at the time of my visit, and supervisors were concerned, feeling that life on Ascension is difficult enough without crowding.

Except for a few plants near the dormitories, set out and carefully watered by the men, no green vegetation exists around the base, and the view of bald, scabrous hills and gullies inevitably dampens spirits. The island's remoteness and its lack of outside

A Missile Range Station Afloat, *Sword Knot* Awaits a Voice From Space

This converted freighter is one of a dozen vessels that fill in the range's gaps, extend its operations, and recover nose cones and data capsules. Ship's officers between guard rails in center take position sights. Red-shirted technician tests receiving antennas housed in the dome-shaped Fiberglas huts on *Sword Knot's* bridge deck.





NATIONAL GEOGRAPHIC PHOTOGRAPHER THOMAS NEBBIA

Sword Knot's Trackers Keep Intent Eyes on Banks of Telemetry Equipment

recreation, popularly known as "goofing-off facilities," also tend to create a certain mental jaundice.

Dr. N. H. Allen, the base's Iranian-born physician, works on morale problems in his role of medical-recreation director. Skilled medical technicians fill that post at each of the other bases, but Ascension, because of its remoteness, requires a physician.

"One troubled young fellow from South Carolina came to me recently," Dr. Allen recalled, "and confided that he missed trees. 'I just can't stand it without trees,' the boy said, and I had to send him home."

But, Dr. Allen emphasized, such incidents are not typical. Carefully selected, the men are physically and mentally well balanced. They serve on the island only six months and usually cure their blues with such diversions as the island offers.

The fishing, for example, is superb. At a

beach picnic I saw Air Force flyers pull dozens of groupers from the surf. Only one thing troubled these blithe young men: the possibility that hordes of sharp-toothed blackfish might attack their catches before they could be reeled in. The problem was solved by tossing into the surf fish entrails, which the blackfish devoured, ignoring the struggling groupers.

Fish Lost to Marauding Sharks

Boating parties take many game fish, such as wahoo, dolphin, and tuna. All too often, however, sharks tear the hooked fish. These marauders so infest one off-shore area that it has been named "Shark Alley."

Because of the many barracuda and sharks, British authorities forbid swimming, except in one protected cove.

But Americans enjoy Georgetown's golf course, locally acclaimed with pride as the

world's worst. Having seen it, I will not dispute its right to the title. The nine-hole layout, unblemished by so much as a single blade of grass, zigs about in a field of big clinkers, and its ashy fairways would be nightmare roughs anywhere else. I mistook the greens, made of sand, for sand traps, and the gritty traps looked as deep as craters.

A. R. Harrison, island magistrate and manager of the cable station, pointed out that the course does boast one advantage.

"You know the problem of divots—digging up the turf when you swing?" he asked. I confessed a deplorable familiarity with the problem. "Here no one has to give it a thought," Mr. Harrison beamed. "The problem is how to keep from breaking your club."

Though the base is short of vehicles, a group sometimes gets a truck or a jeep and drives in ever-ascending twists and turns to the mist-shrouded top of Green Mountain. There they find a compact farm, green and delightful, an almost unbelievable contrast to the rust-colored desolation below (page 462). The secret is moisture; Green Mountain draws it from the faithful cloud cover, making possible vegetable gardens, pasturage for livestock, and groves of sweet-smelling eucalyptus and other trees.

Cable and Wireless, Ltd., maintains the farm to feed its employees. The base sometimes buys surplus vegetables, but most of its excellent fare comes from the United States by plane and an occasional ship.

Alien Trees on Mountain's Summit

United States troops occupied Ascension during World War II and grew vegetables by hydroponics, the soilless culture of plants in chemically treated water.* But this method is difficult and uneconomic. Today there is little trace of the GI occupation.

One must hike to reach Green Mountain's actual summit, where a bamboo forest, its slender, close-packed trunks endlessly clattering against one another in the wind, awaits the sure-footed and the spry. The British Navy planted this alien but delightful forest many years ago, and it flourishes in the almost perpetual mist. Mr. Harrison and his wife, both tireless climbers, guided me to it at an apoplectic pace. Then, by holding out the lure of a cooling drink, they persuaded me to venture down a dizzying track to their lodge on a flank of the mountain.

Most of the men seldom get a chance to visit

Green Mountain's lush oasis, but they bear their surroundings stoically, even with humor. A group conversing in the club may suddenly stand and bellow in unison, "I hate this blasted island!" Then the men resume their talk, as if nothing had happened.

Many collect pin-up pictures of movie starlets and models. I had thought some of the wall displays on other islands sensational, but Ascension has no peer in this endeavor. One young bachelor ceremoniously intones, "Farewell, darling," to his favorite blond pin-up each time he leaves his room.

Specialists Arrive for Test Series

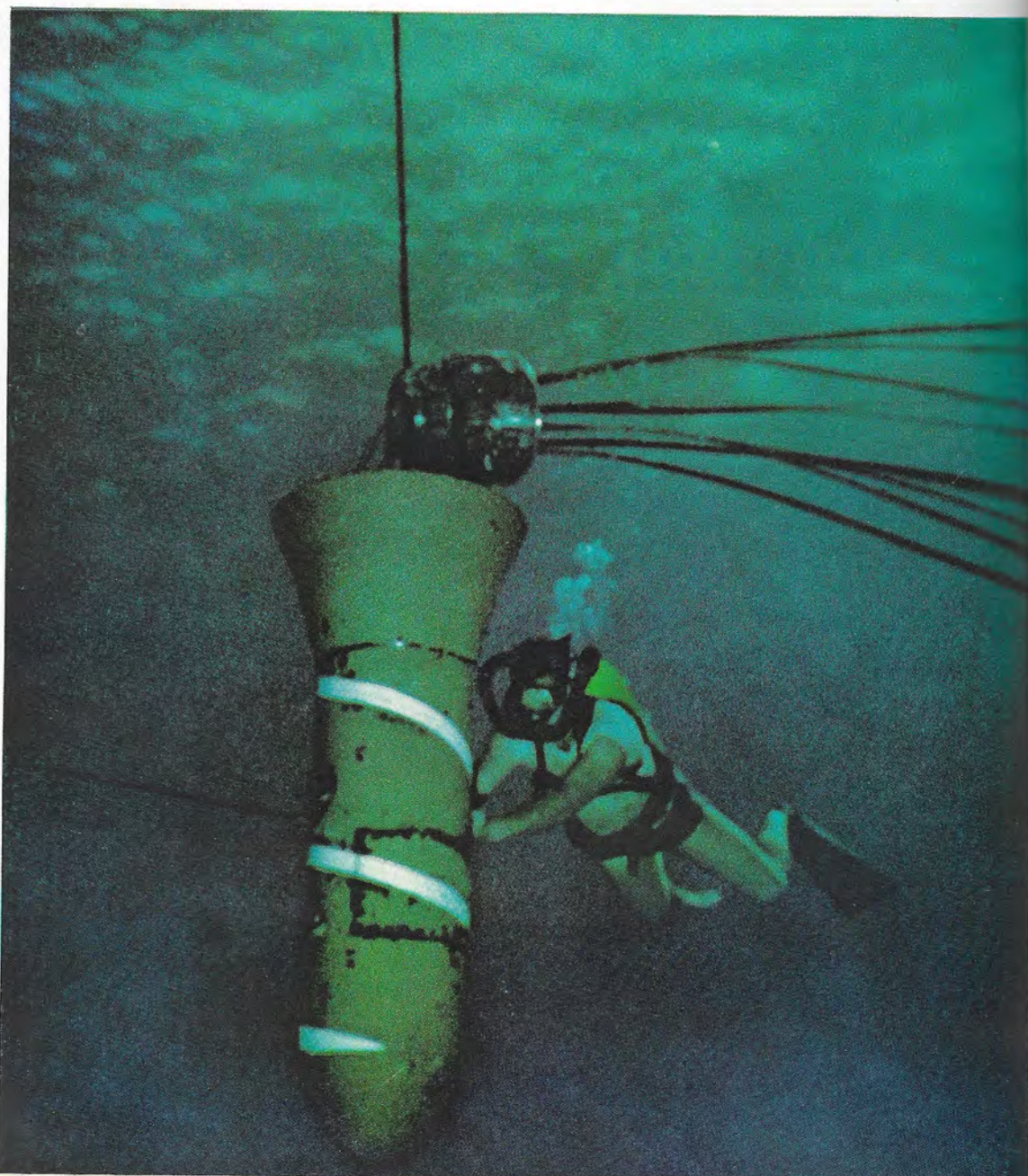
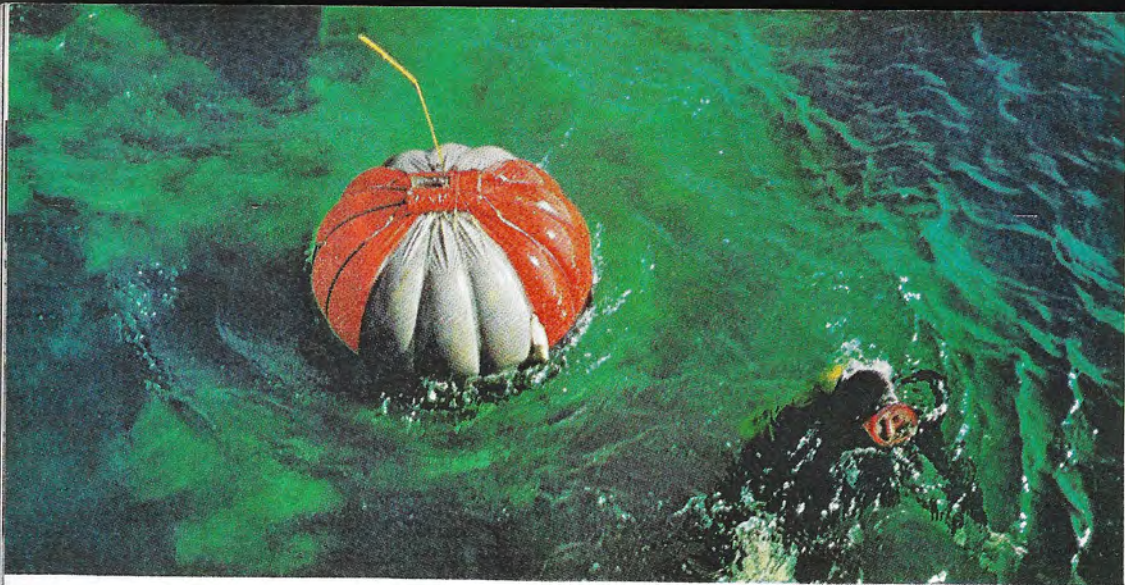
But the best antidote for loneliness and isolation is work, and Ascension gets plenty of it. There, at the end of the line, fall the elite of Cape Canaveral's missiles, the intercontinental rockets. Their terminal plunge is a supremely critical test for trackers, who must not only get performance data, but, frequently, must spot and retrieve the cone. These days the base often finds its regular personnel suddenly augmented by visiting scientists, engineers, technicians, and aircraft crews, sent to lend their talents during a series of critical tests.

One such test coincided with my visit. Canaveral had scheduled a Thor Able, and its vitally important cone of advanced design would contain experimental material. Three planes from the 6550th Operations Squadron, based at Patrick Air Force Base, stood by at Ascension to track it. Scientists of Avco Research Laboratory and Aerojet-General Corporation had joined the plane crews.

These two companies, together with Barnes Engineering Company, form a private industry team cooperating in Operation Gaslight, a study of missile entry problems. With special cameras and spectroscopic devices, the civilian contractors record the holocaust that envelops falling cones.

In the last split seconds of their plunge, these man-made meteors cannot be tracked by Ascension's instruments or those aboard ships. But designers want telemetry information right up to "splash," or impact; planes, with a downward view unimpeded by earth's curvature, obtain that data, as well as optical coverage.

* See, in the NATIONAL GEOGRAPHIC: "Ascension Island, an Engineering Victory," by Lt. Col. Frederick J. Clarke, May, 1944; and "Greens Grow for GIs on Soilless Ascension," by W. Robert Moore, August, 1945.



Mental tension seemed a tangible thing around the base on the day before the shot, and for a good reason. Ships had recovered cones off Antigua, but none fired long range had been retrieved off Ascension. Mysteriously the Atlantic swallowed them without trace.

Luis Marden, at the request of another contractor, General Electric's Missile and Space Vehicle Department, had photographed the underwater behavior of a cone dumped overboard from a ship (opposite). Diving repeatedly into the twilight depths with movie and still cameras, Luis recorded the cone's bobbing gyrations. His pictures showed that the movement was not too severe and that the strap tying cone and bag together definitely seemed strong enough. He also reported—and his pictures confirmed—that the strap was not snarled or chafed by the large ribbon parachute that each cone releases to brake a seaward plunge.

Puzzled designers could only surmise that, if the cone had been subjected to an actual atmospheric entry, its recovery aids might not have functioned. Perhaps the float's transmitter, which beeps out a "come-get-me" signal, could not survive the shock of air resistance, thereby handicapping searchers.

Dye Marker Aids Cone Recovery

Long before daybreak I heard the tracking aircraft rev up on the airstrip below my quarters, and I wished each one good hunting as it roared overhead. Tom Nebbia and I turned out just before dawn, hoping to see the entry from a tracking site. But, stare though we would at the slowly red-ening horizon, nothing flamed in the blank vault. The missile had entered far away, visible only to electronic eyes.

Seemingly endless hours of waiting followed. Then word flashed about the base, "It's found!" None of the searchers had picked up radio signals from the cone's float, but an Avco man in one of the planes had spotted a dye marker just as hope began to wane. All floats emit dye, but it is ex-

remely hard to find in the immensity of the Atlantic.

For three hours aircraft orbited the tell-tale discoloration; then ships reached the scene and picked up the heat-blackened cone.

When the planes returned, their crews had been 12 stressful hours in the air and should have been exhausted. But seldom have I seen a more jubilant group of men. In conversations they relived each moment, and a party in their honor at the club continued until early the next morning.

Recently missilemen have fished out other cones off Ascension, for recovery techniques have been improved; yet, among the men who were there at the time, no subsequent success could approach the thrill and the gratification of that first lucky find.

Mercury Astronauts Will Use Range

With the privilege of a comparative elder, I excused myself from the merrymaking and took a solitary stroll under the stars. In the clear, ocean-fresh air they blazed with an almost unwinking brilliance, and my thoughts, as well as my eyes, lifted toward them.

In a sense, that expression of a people's faith and will, Cape Canaveral, and the many isles we had trod might be termed stepping-stones toward those distant stars. Man has a rendezvous in space, and historians of a later age will say that he took some of his first modest strides from the range we had traversed. As early as next year, for example, one of the Project Mercury astronauts, a man instead of a monkey, may ride a capsule down range. By 1961 a rocket fired from Canaveral may carry an astronaut into orbit around the earth.

The moon, the planets, and eventually that strange dimension, time itself, will yield to the challenge of man's mind and heart. But a certain enthusiast must remain a yearning on-looker while early pioneers in increasing number go out to meet their high destiny. Sadly, I dwelt upon the thought that I had been born 20 years too soon.

Fish Men Salvage a 600-pound Nose Cone Bobbing Beneath the Sea

As it strikes water, the cone releases a self-inflating nylon float (upper). Fluorescent dye stains the waves, and the float's waterproof radio, topped by a small antenna, beeps out a signal to searchers. Suspended from the bag by a nylon strap (lower), the cone dangles 40 feet below the surface. Shroud lines of its ribbon parachute, which serves as a brake during atmospheric entry, stream in the current. Diver attaches a cable for hoisting the cone. High-visibility spiral stripes aided underwater observations during this test of recovery techniques off Grand Bahama.