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COVER: *Rare roseate spoonbill, seen only in the Americas, guards a nesting colony on the Texas coast* (*page 274*).

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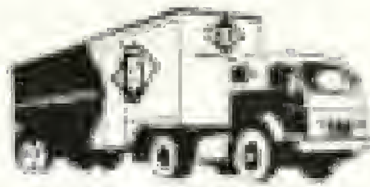

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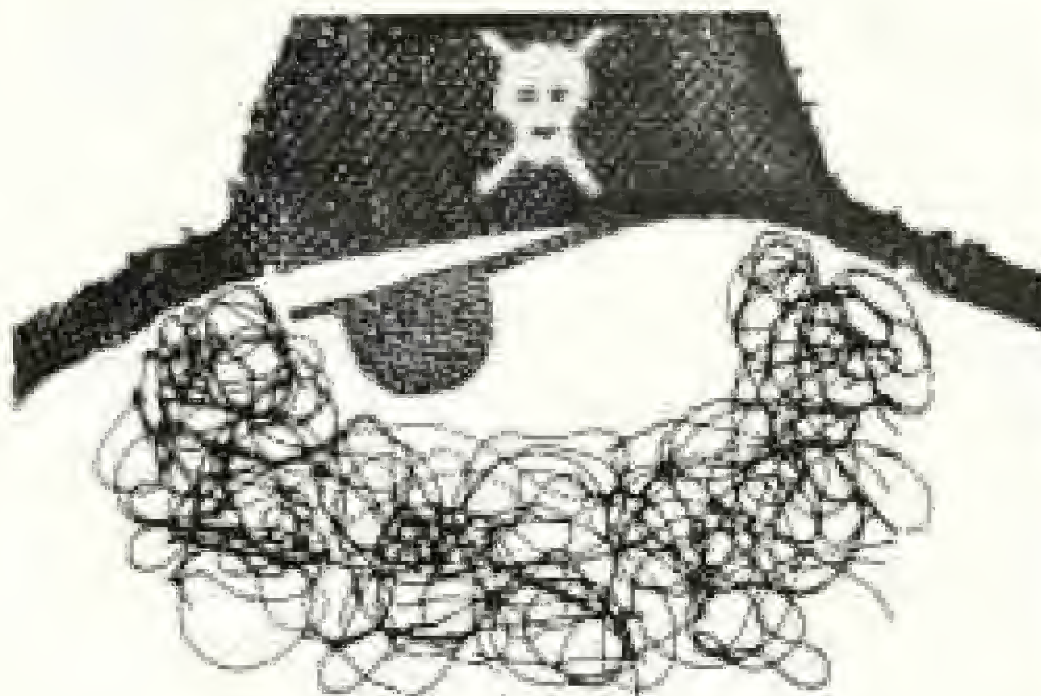

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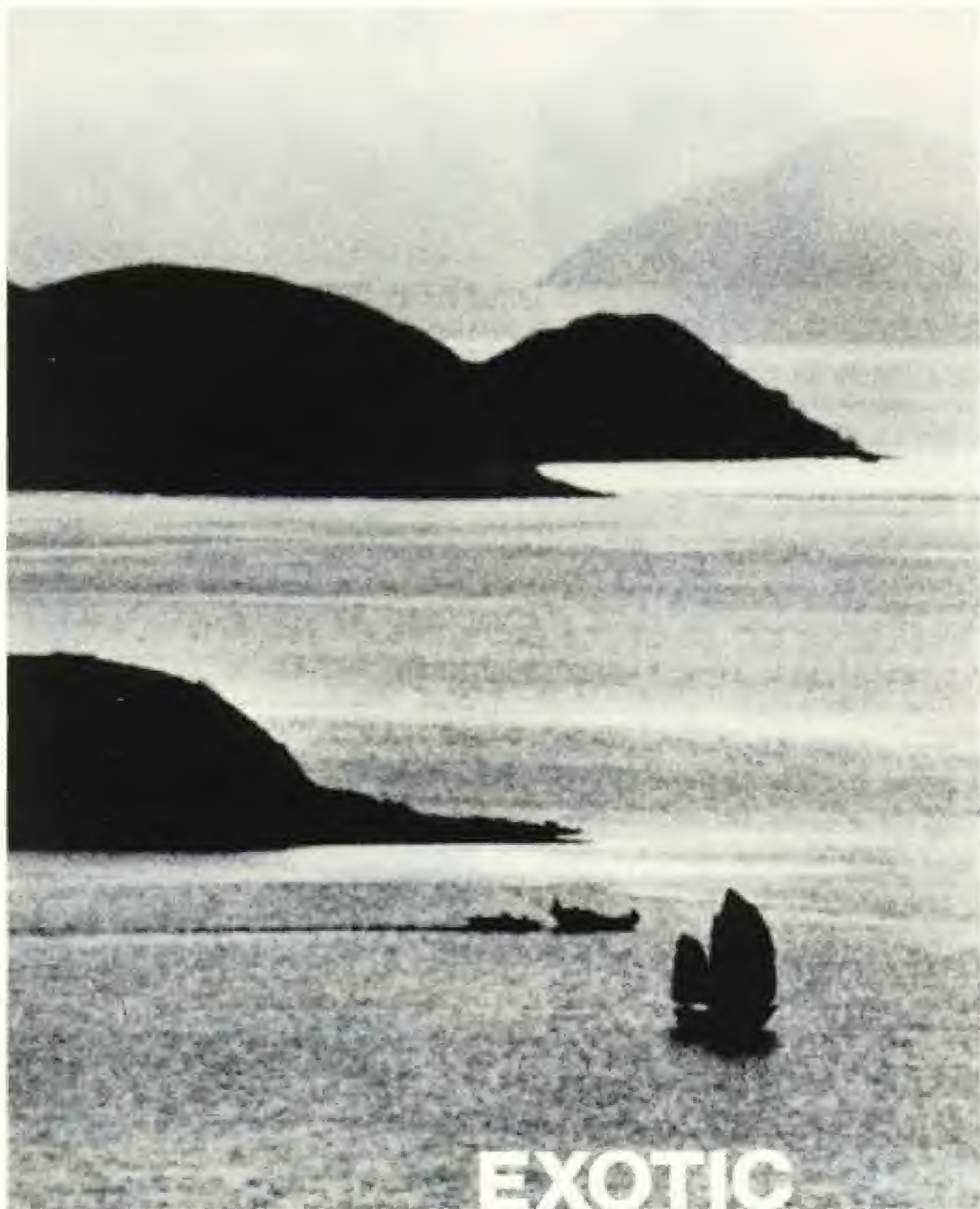

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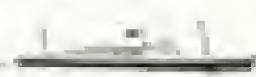
BY CUNARD TO BRITAIN BY UNION-CASTLE TO AFRICA 

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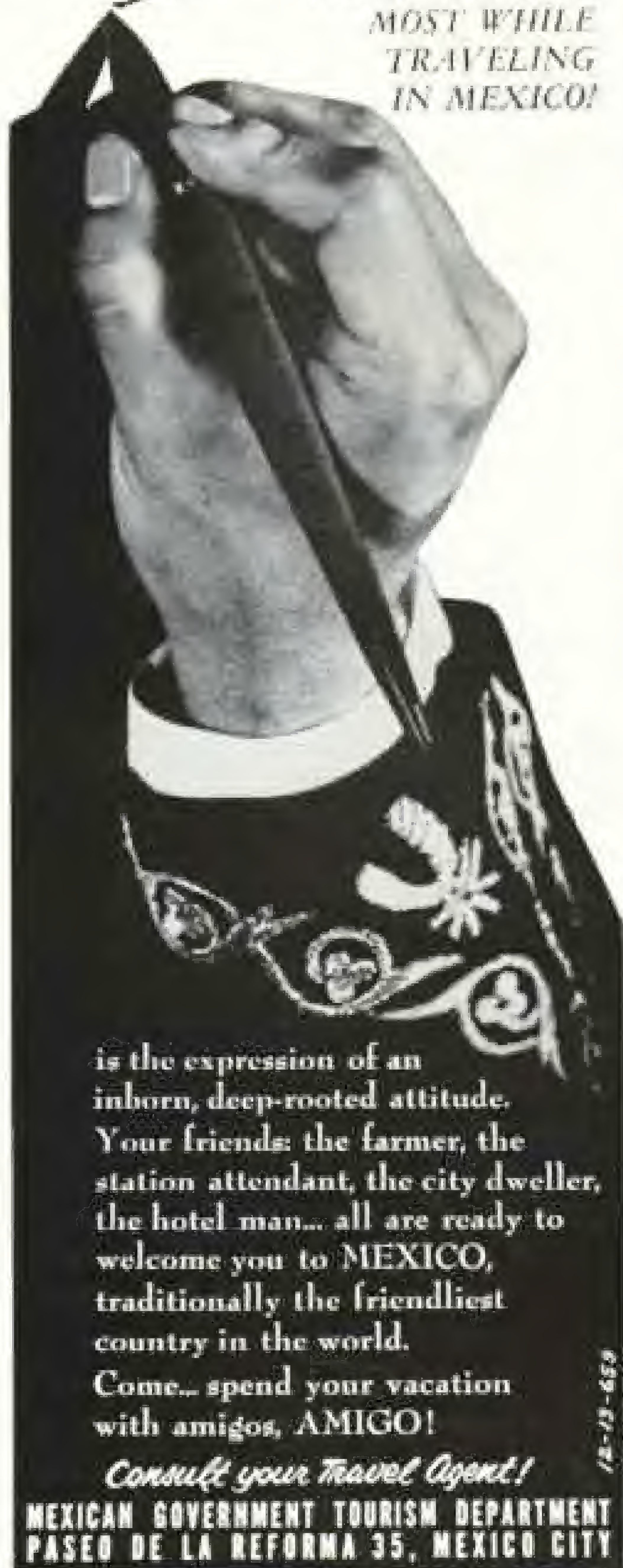

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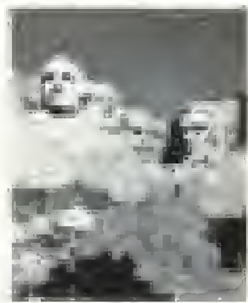

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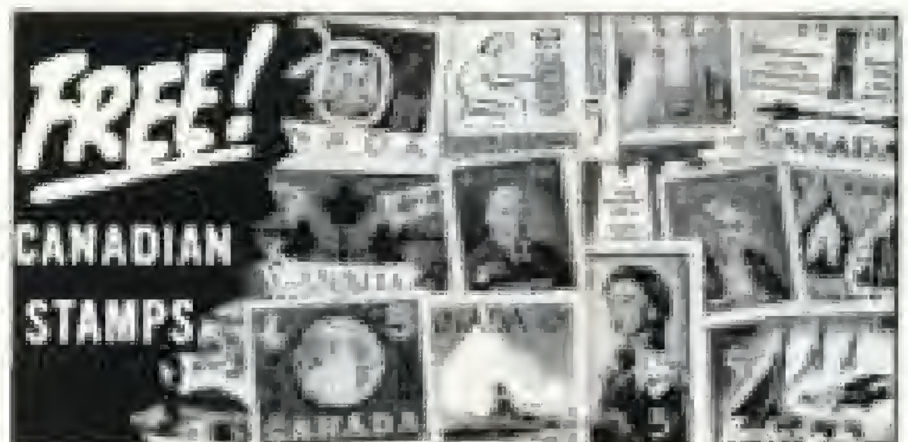

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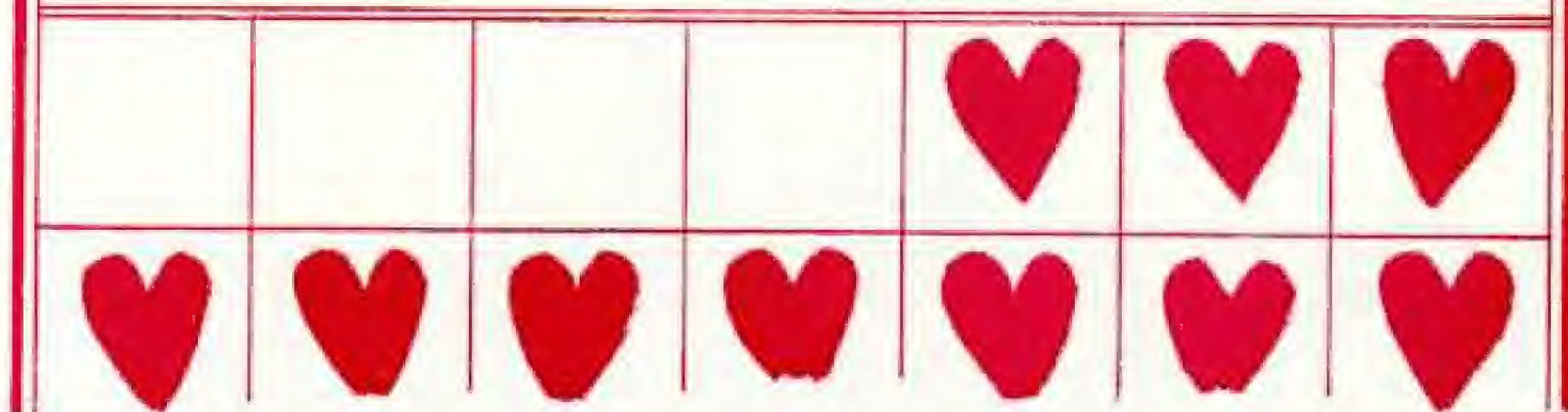

February's quiz about your heart

February is "Heart Month"—a good time to consider some questions and answers that could make the difference between a heart that will carry on efficiently for a long time or a heart that may falter too soon.

Q. What does overweight do to the heart?

A. Excess pounds put a constant and needless strain on the heart. Eventually its ability to meet the regular demands placed on it is impaired. To help keep your heart healthy, *keep your weight down—permanently.*

Q. Is there any special diet that will protect the heart and blood vessels?

A. There are still many unsettled questions about the relation of diet to diseases of the heart and blood vessels. Authorities generally agree, however, that some limitation on the kind and amount of fat in the diet is desirable. But a healthy person probably should not make drastic changes in his diet without medical advice.

Q. Do stress, strain and tension harm the heart?

A. Anyone who is under constant emotional stress many hours of the day probably runs a greater risk of diseases of the heart and blood vessels than the individual who takes things in his stride. All excesses — emotional and otherwise — certainly do the heart no good.

Q. Does exercise help the heart?

A. Many authorities now believe that the more active you are, the less likely you are to develop coronary heart disease. After middle-age, it is wise to avoid sudden or strenuous activities to which you're unaccustomed. But for your heart —and your health in general—some form of regular physical activity should be continued throughout life.

Q. How often should your heart be checked?

A. Even if you've never had any symptoms that suggest heart trouble, don't neglect a periodic health examination. If your doctor finds that all is well with your heart, think of the comforting assurance you'll have. If, however, something should be amiss, your physician—thanks to new drugs and new treatments — may spare your heart further damage and, with a few sensible restrictions, help you live long and actively.

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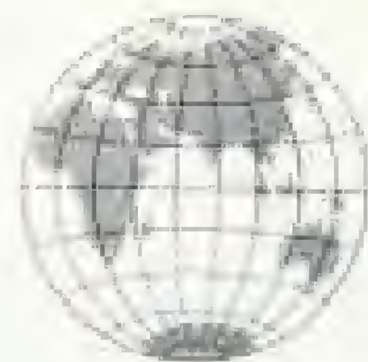

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VOL. 121, NO. 2 FEBRUARY, 1962

North Carolina, Dixie Dynamo

By MALCOLM ROSS

Illustrations by National Geographic Chief Photographer B. ANTHONY STEWART

BECAUSE we love to see the change of seasons, my family and I seven years ago began coming north from Florida each spring to a cabin in the Blue Ridge of North Carolina.

In time we came to know more of the State—and to see why such a noted American as Carl Sandburg, of Flat Rock, chose North Carolina as his home. There is something inspiring about the State at this point in the 20th century, something exciting, dynamic, and somehow youthful, though this is among the oldest of our States, one of the Thirteen Original Colonies.

Partly North Carolina's appeal derives from its varied resources and geography—a 500-mile-long slice of America sweeping west from the long, lonely beaches of Hatteras, ever upward to the mile-high crests of the Blue Ridge and the Great Smokies.

There is glamour, too, in its history. English colonists fought the wilderness here 20 years before the landing at Jamestown, Virginia—and vanished without trace.

Most important is today's "human geography"—the people whose composite energies make this a forward-looking, eagerly progressive State.

One day my car began acting up, and I stopped at a crossroads garage. A 17-year-old mechanic spent two hours under the hood.

"No charge," he said, as I slid behind the wheel. "I couldn't fix it." Then he brightened. "But when you find some one who knows what's wrong, stop on your way back and tell me. That's the way I'll learn."

Typical Tar Heel Eager for Knowledge

The young mechanic's remark seems to me to typify the search for knowledge that animates the whole State of North Carolina. For example, visit the State capital, Raleigh, and the first thing you hear about is the Research Triangle.

George R. Herbert, an Annapolis-trained engineer, spread out before us a map of the State. On it he traced lines connecting the State College of Agriculture and Engineering in Raleigh, Duke University in Durham, and the University of North Carolina in Chapel Hill (map, pages 146-7).

"Here are three pools of special skills," he said. "In the center of the Triangle are industrial laboratories and the North Carolina Research Triangle Institute, of which I'm president. Now—tie all these centers of study, industry, government, and finance into one working unit, and you get the total effect."

Mr. Herbert smiled. "It's like the Saturn missile: a lot of separate rockets, but put them together in a single booster and—well, you've really got something."

"But," I protested, "a lot of North Carolinians make their living in the old ways. What are all your modern methods to a man with a mule?"

"A chance to live where he wants to and still share in the new benefits," he replied. "Nearly 150,000 Tar Heels owe their jobs to a single result of basic research, synthetic textiles. The benefits spread out—well, not always to your man with a mule, but certainly to his son, who drives a tractor to break research-improved land for research-bred seeds.

"Take a swing around the Triangle yourself," Mr. Herbert concluded. "Look for the lines that lead from laboratories into lives."

I took his advice, and more. I traveled all over the State, everywhere asking people why North Carolina is changing so rapidly.

Research Triangle

Goggled student at Duke University compares the effect of fire-retarding chemicals. Untreated board at left blazes up quickly; flame merely scorches the treated wood at right.

Dedicated to new ideas, the Triangle underscores Tar Heel efforts to attract science and industry. Duke University in Durham, North Carolina State College in Raleigh, and the University of North Carolina in Chapel Hill form the Triangle. Their specialists advance the frontiers of knowledge.

Nuclear bombardment at North Carolina State College helps improve fibers for textiles. Here an instrument checks the radioactivity of wool yarn pelted by particles released by an atomic chain reaction; the reading tells if the fibers may be handled safely. Red lights show that the reactor in background is working.

Cancer experts at Duke inoculate chicks with a leukemia virus. By taking blood samples and magnifying them on the screen, the technician observes how the disease attacks healthy cells.

A Tar Heel electronics worker said the changes came with new black-top roads—which let a man work in town while still living on three-acres-and-a-cow up the hollow.

A college president said that the changes started about half a century ago with new schoolhouses for many a Tar Heel community.

An ex-paratrooper said it was a matter of spirit. "The spirit of North Carolinians is that they can do anything they want to do," he declared. "In education, industry, natural resources, agriculture—in all activities our goal is not to be the best in the South but the best in the Nation." The World War II combat veteran who uttered these confident words was Governor Terry Sanford (page 146).

Here You Can Choose Your Climate

From its lofty brow in the western highlands to the white chin whiskers curling up the sands at Hatteras, the Old North State wears many expressions. You glimpse one

KODACHROME BY NATIONAL GEOGRAPHIC PHOTOGRAPHER WINFIELD PARKS

EKTACHROMES BY B. ANTHONY STEWART

Promotes Progress

Molecular model of cobalt acetylacetonate symbolizes chemistry research at Chapel Hill.

Eyeball to eyeball: Dr. Ewald W. Busse examines a patient's eye at Duke's Center for the Study of Aging. Binocular microscope magnifies blood vessels that change as a person grows older.

Future architects at State College study a model of thin-shell concrete roof construction. The School of Design fosters forms suited to the South.

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KODACHROME BY NATIONAL GEOGRAPHIC PHOTOGRAPHER WINFIELD PARKS © N.G.S.

Soaring chapel with 50-bell carillon and 7,791-pipe organ dominates Oxford-like quadrangles at Duke University, Durham. The school enrolls six thousand students.

in the farming coastal plain, then lose it 100 miles west, where the waters of the Piedmont spill over the fall line; upstream the rivers turn industry's dynamos. Still farther west the Great Smokies rise, changed by every passing cloud.

Red spruce and Frazer fir abound above the 5,500-foot level in the southern Appalachian Mountains. Venerable live oaks, their massive crowns festooned with Spanish moss, flourish in the soft, warm air that the Gulf Stream breathes across the lower North Carolina coast. Pick whatever climate you want: The Tar Heel State has it.

Why was North Carolina nicknamed the Tar Heel State? Because the long-leaf pine forests of the coastal plain produced such an abundance of rosin, turpentine, and tar.

Columned cupola shelters the Old Well, landmark of the University of North Carolina, Chapel Hill. Opened in 1795, the institution was the first State university to admit students. The well on this site provided the school's original water supply.

Mortarboards and gowns honor President Kennedy and Governor Terry Sanford. They march at right in an academic procession at Kenan Stadium, Chapel Hill, where they received honorary degrees last October.

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Longest State in the East, North Carolina spans 500 miles. From the Appalachian highlands, the land slopes down to the Piedmont plateau, which supports much of the 4,600,000 population. The Outer Banks enclose sheltered sounds.

KODACHROME BY WINFIELD PARKS © N.G.S.

Former paratrooper who won a World War II battlefield commission, Governor Sanford sits on a Civil War mortar outside the Capitol in Raleigh. During the conflict, Confederates stored saltpeter in the rotunda. Statue honors three Presidents claimed by the Tar Heel State—Andrew Jackson, James K. Polk, and Andrew Johnson.

To learn not to say North Carolina is this or that, I had to travel the State from the Outer Banks to the Tennessee border, talking to menhaden fishermen and investment bankers, jet pilots and stonemasons.

My tourist eyes saw the Shackleford Banks as tawny gold dunes speckled with the silver of sand-drowned cedars. To our Outer Banks skipper, however, the sand was a shroud, burying the village where his kinfolk once lived so contentedly.

Much depends on your point of view—and the weather. I have seen North Carolina's 6,684-foot Mount Mitchell, highest point east of the Mississippi, in all its solid superiority. I have also watched it melt into the impalpable mists and into obscurity.

In Asheville a wild-flower enthusiast led me over his eight-acre garden. Across town was a warehouse, scented with bales of dried roots, bark, and leaves of the same plants that graced my gardener friend's hillside. One

group was for show, the other for medicine.

But if herb remedies seem old-fashioned, I found another atmosphere on the campus of North Carolina State in Raleigh. At its center is the cottage in which President Andrew Johnson was born. Nearby stands a classic-style building with modern additions, in which Dean Henry L. Kamphoefner and his School of Design are transforming Southern architecture. How? Well, take the titanic steel-and-glass building with cable-suspended roof outside Raleigh (pages 148-9).

"The State Fair Arena," the dean nodded, when I said I'd seen it. "Popularly called the 'Cow Palace.' In its centennial exhibition, the American Institute of Architects named the arena among ten buildings in the U. S. worthy of special attention."

I asked if the modern approach dominated Dean Kamphoefner's School of Design.

"What else?" He seemed almost shocked. "These are modern times. In the past ten years North Carolina has spent a quarter of a billion dollars on new school buildings alone. Should we have built fake colonial, when we have new techniques, new materials, and bright new minds to draw on?"

But North Carolina State College has other attractions, such as the first nuclear reactor ever installed on a college campus.

That was in 1953, but apparently this is the age of two reactors on every campus, for State already has its second nuclear pile. Both are devoted to research in nuclear physics, health

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The Author: Malcolm Ross, a native of New Jersey who has lived in the South for 35 years, retired as Chairman of the University of Miami Press in 1960. Former newspaperman and U. S. Government administrator, he has written four novels, as well as technical and sociological books. His summers in the North Carolina Blue Ridge resulted in a memorable article, "My Neighbors Hold to Mountain Ways," in the June, 1958, GEOGRAPHIC.

Conical skylight filters sunshine into Garinger High School library, Charlotte. Folded panels of translucent plastic, suspended on a steel frame, form the umbrella-rib pattern. Stacks surround the sunken reading room. Completed in 1959, the school serves as a showplace of the Charlotte-Mecklenburg school system, North Carolina's largest.

Saddle-shaped roof covers the J. S. Dorton Arena at Raleigh. Cables stretching between two 90-foot-high parabolic arches cradle the top, strong enough to bear the weight of a 60-inch snowfall. The glass-walled structure seats 9,500 for conventions, exhibits, and athletic events.

physics, metallurgy, agriculture, and chemistry, and to the training of students in the design, construction, and maintenance of nuclear installations.

Dr. A. C. Menius, head of State's physics department, said: "The nuclear harvest will come in the next ten years, when our alumni are serving industry, hospitals, and farms of North Carolina."

"Tell me," I begged, "one simple and homely use of these fabulous reactors of yours."

"Well," he answered, "how about irradiation of peanuts to produce better yields?"

A small matter, perhaps, until one realizes that peanuts go into the manufacture of hundreds of everyday products, from soap and textiles to the newest plastics.

In the nearby Textile Research Center I saw new investigations that might lead from the laboratory into North Carolina's lives.

"By means of nuclear radiation, we are able to impart new functional properties to old fibers," Dean Malcolm E. Campbell explained.

He pointed out that fibers such as cotton can be modified with chemicals under the influence of gamma radiation from a cobalt-60 source. The result: improved performance properties.

"This was the first research facility in the country for exploring the use of radiation in textiles alone," said Dean Campbell. He and his colleagues are working hard on synthetic fibers as well as on cotton. I asked where the "battle of the fibers" stood.

"Before synthetics," he answered, "cotton was 88 percent of U. S. fiber consumption. Now it is 65 percent. It seems to have leveled

KODACHROME (BELOW) AND EKTACHROME BY NATIONAL GEOGRAPHIC PHOTOGRAPHER B. ANTHONY STEWART © N.G.S.

off at about this figure in recent years, primarily because of great improvements in cotton fabrics. The battle of fibers still goes on, but the consumer is the winner."

The Textile Research Center's future is bound up with North Carolina's Triangle. "We're part of the Triangle," Dean Campbell said, "and the part is getting bigger all the time. We began the research center in 1949 with a staff of three. Now we have 61 workers and an annual budget of half a million dollars."

The North Carolina Textile Foundation helps finance the projects. Other industries, such as dairy farming, forestry, engineering, and architecture, have followed this pattern.

Wealth Built on Wood

At Duke University in Durham I switched from textiles to timber. In the School of Forestry, I learned that only textiles and tobacco outrank the products of wood in the State's industrial economy. In fact, North Carolina

KODACHROME BY NATIONAL GEOGRAPHIC PHOTOGRAPHER WINFIELD PARKS © N.G.S.

leads the Nation in the production of wood furniture and hardwood veneers and plywood. Its vast pine forests also supply a thriving pulp and paper industry.

Driving through the State, I had been impressed with the large, unbroken tracts of forest. Timber seems abundant almost everywhere. Therefore I was astonished to learn that there are actually shortages among plenty. Certain valuable hardwood species are in greater demand than supply.

Home is the heroine: Battleship *North Carolina* noses up the Cape Fear River on her last voyage. She won 12 battle stars from Guadalcanal to Japan; Tokyo Rose reported her sunk six different times.

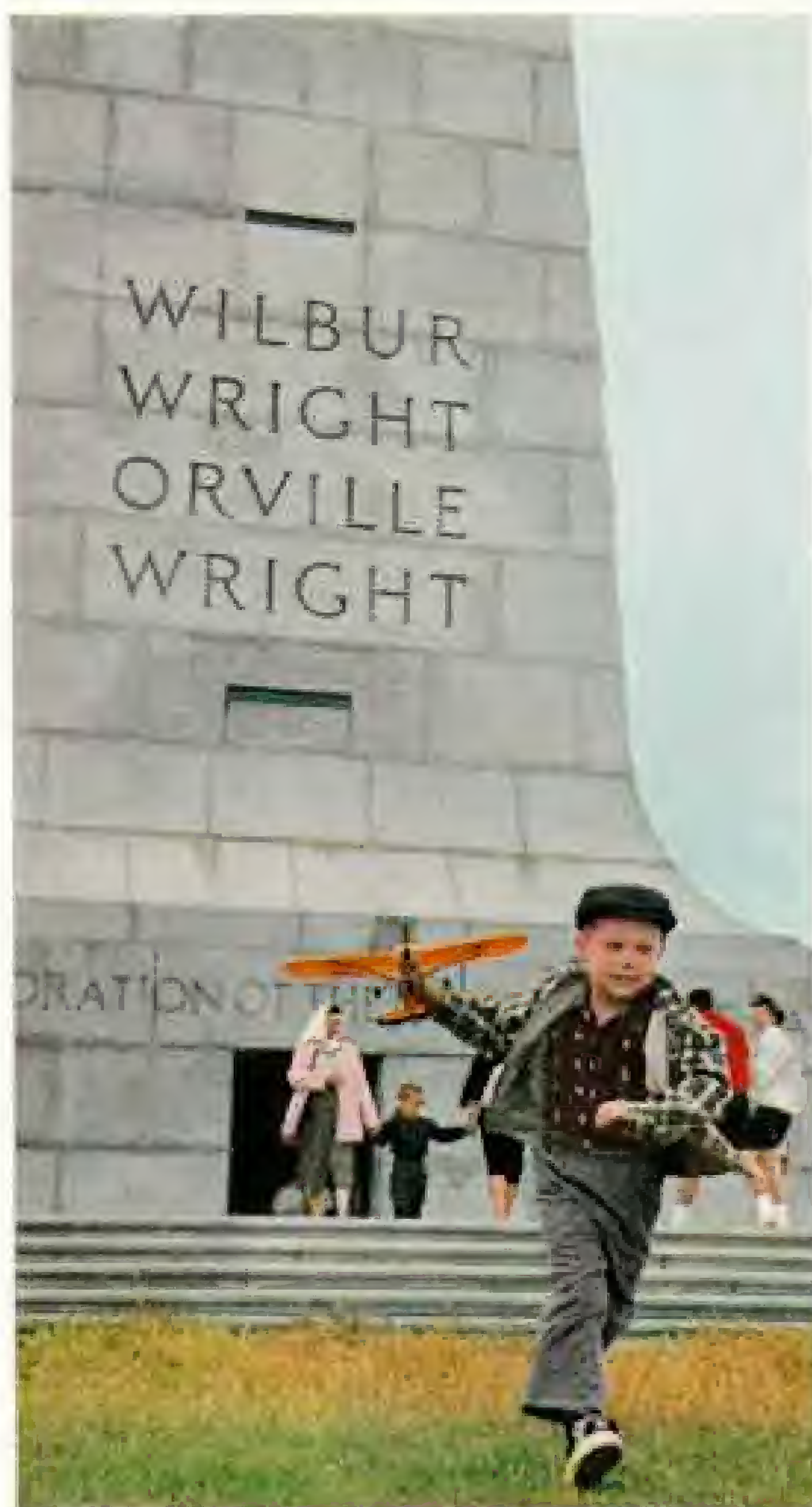
Tugs nudge the weary warrior past Wilmington toward a berth where the 35,000-ton vessel is now displayed as the U.S.S. *North Carolina* Battleship Memorial.

North Carolina's leading seaport, Wilmington served as a haven for Confederate blockade-runners during the Civil War.

Resources may be limited, but is resourcefulness? Not in North Carolina! The large quantity of solid walnut that was made into great-grandmother's dresser is now stretched to cover some twenty items of furniture, in the form of carefully cut and matched veneer sheets of undiminished beauty.

When we left the university buildings, we drove through the laboratory of the School of Forestry. New roads thread the 7,200 acres of the Duke Forest—an excellent training ground for forestry students, a refuge for game, and a year-round delight for local residents who ramble along its trails on pleasant afternoons.

Among Tar Heels and outsiders, Chapel Hill means primarily one thing—the University of North Carolina. Here, in 1795, it became



Soaring Stone Pylon on Kill Devil Hill Honors the Wright Brothers' First Flight

From the base of this hill near Kitty Hawk, Wilbur and Orville Wright made four flights on December 17, 1903. The longest, 852 feet, lasted 59 seconds. The Wrights built their flying machine and its 12-horsepower engine in their bicycle shop at Dayton, Ohio. Only two or three newspapers printed anything the next morning about their epochal achievement. Grass anchors the hill, which was a shifting sand dune in 1903.

Copy of a historic glider occupies the visitor center at Wright Brothers National Memorial. For three years before their powered flight, Orville and Wilbur experimented with gliders on Kill Devil Hill. In 1963 a reproduction of their first plane will go on display; the Smithsonian Institution's National Air Museum in Washington, D. C., exhibits the original.

Framed in a window panel, the Wright pylon crowns distant Kill Devil Hill.

the country's first State university to open its doors to students—though it was three months before the first pupil arrived on foot from Wilmington, 130 miles away.

The young university, born almost simultaneously with the Thirteen Original States, took its familiar name from a hill where New Hope Chapel stood. And almost at once Chapel Hill began weaving its academic way into the warp and woof of the State. The habit, I found, persists: Within minutes of my first Chapel Hill interview, the Research Triangle cropped up again.

Professor George L. Simpson of the Department of Sociology, the first director of the Research Triangle Committee, had just returned from New York, where he had explained to prominent industrialists the chief advantages of the Triangle area of North Carolina.

"Wooing them south?" I asked.

"Not wooing," Simpson smiled. "They will come only if it makes hard sense. We want them to think of the Triangle when they build a laboratory. Modern industry's biggest asset is its skilled researchers. Know any better way to keep them happy than by moving them to North Carolina?"

Everyone at Chapel Hill agrees with Simpson. Certainly one who does is President William Clyde Friday—Bill Friday to nearly everybody in the State—who, though still in his early 40's, heads the Consolidated University of North Carolina, including Chapel Hill, State College, and the Woman's College in Greensboro.

"Education," Bill explained over lunch at

Surf-pounded ruins of the *Laura A. Barnes* attest the violence of wind and wave along the Outer Banks. The four-masted schooner was driven ashore near Nags Head in 1921. Sailors dread shoals off Cape Hatteras as "the graveyard of the Atlantic."

the gracious Carolina Inn, "isn't a sometime thing—not in North Carolina, anyway. It's nothing new, this Tar Heel search for the different and the unknown. North Carolina history will tell you that."

North Carolina history indeed did. It was a long and fascinating course, and I began it with my wife Camille and our teen-age son David, on the Carolina coast, where Capt. Arthur Barlowe began the first chapter of the Tar Heel story in 1584. Sent by Walter Raleigh to explore the coast, Barlowe landed on Roanoke Island and found its soil "the most plentifull, sweete, fruitful and wholesome of all the world."

The soil is not all that "plentifull." Today the island town of Manteo, named after one of the Indian chiefs presented at Elizabeth's court, favors motels over crops. I suspect that Captain Barlowe warmed up his description a bit to persuade Queen Elizabeth to support Raleigh's proposed colony, as in fact she did.

Lost Colony Remains a Riddle

In 1585 Ralph Lane and his "Roanoke Hundred" reached the island and built Fort Raleigh. Reconstructed for the outdoor drama *The Lost Colony*, it stands today in the piny woods north of Manteo, where Lane attempted unsuccessfully to establish an English settlement in America. Here John White's group arrived in 1587.

When the next ship from England arrived three years later, the settlers, including Virginia Dare, first English child born in North America, had disappeared. How the colonists were lost is one of the great riddles of history. Did they march into the guns of Spanish marauders? Were they killed by the Indians?

Unspoiled beach near Nags Head conjures up memories of Blackbeard the pirate, who sailed this shore in 1718. The National Park Service preserves an 80-mile stretch along the Outer Banks as the Cape Hatteras National Seashore Recreational Area.

KODACHROME (ABOVE) AND EKTACHROME BY NATIONAL GEOGRAPHIC PHOTOGRAPHER WINFIELD PARKS © N.G.S.

Colonial kitchen in restored Tryon Palace, New Bern, charms visitors with shiny copper and dried herbs. Miss Gertrude S. Carraway, a former president general of the Daughters of the American Revolution, directed the restoration of the palace.

Tempest over tea accounts for a bronze teapot in Edenton. The emblem commemorates the Edenton Tea Party of October 25, 1774, when 51 women signed a protest against the British tax on tea.

Tryon Palace housed royal governors, then served as the statehouse until 1794, when the capital moved from New Bern to Raleigh. Fire razed the main building in 1798, but spared the wing at right.

Did they sail for England and perish at sea? Did they go inland and live with some friendly tribe? Only the sands or the woods near Manteo know.

We crossed the bridge from Roanoke Island to Nags Head, vacation center of that 300-mile-long wonder, the Outer Banks.* The Banks thrust a great sandy breakwater into the Atlantic along the North Carolina coast. Behind this rampart against the fury of the ocean lie the sheltered sounds: Currituck, Albemarle, and Pamlico; through them threads the Intracoastal Waterway.

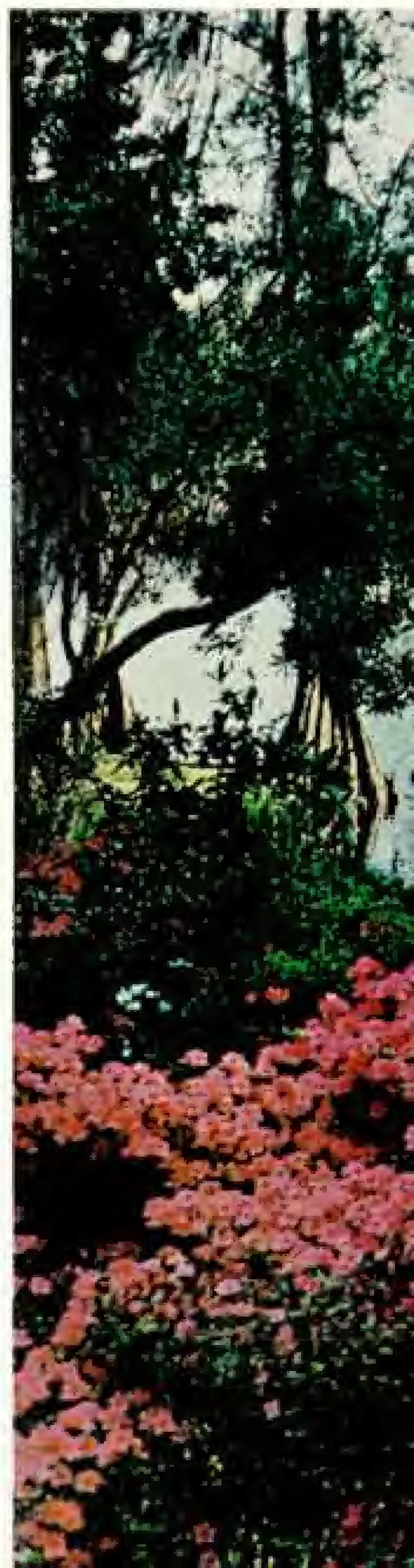
Summer on the Banks is gentle to the visitor, who, with the roads and ferries across the inlets, has at his command one of the world's great playgrounds—leagues of ocean beaches to seaward, as many gentler waters soundward, lagoons and ponds with ducks and terns. There are the inlets, where fish pass from sea to sound, and then give the fisherman a second chance when they move with the tide back out to sea.

Nags Head, when my wife and I first saw it eons ago while fleeing rice and old shoes, had one weathered

*See "October Holiday on the Outer Banks," by Nike Anderson, NATIONAL GEOGRAPHIC, October, 1955.

Flags flying, *Show Boat* carries sightseers around Greenfield Gardens, Wilmington. Motor-driven propeller powers the craft, modeled after old Southern riverboats; its motion turns the paddles. *Show Boat* seats 32.

Blanket of azaleas enhances Greenfield Gardens, Wilmington, a 210-acre municipal park enclosing a five-fingered lake. Bald cypresses stud the shallow water. A scenic drive winds around the lake. Wilmingtonians celebrate the Azalea Festival each spring when the flowers blossom.



Fluted columns grace this historic plantation house at Orton, near Wilmington. Dating from 1735, the mansion stands overlooking the Cape Fear River. Toward the end of the Civil War, Union troops used it as a smallpox hospital. Azaleas fill the foreground. Visitor admires a camellia.

hotel and a scattering of cottages. Now it is a motel main street, complete with glittering glass restaurants straight off the modern drawing boards.

But below Whalebone for 80 miles to the tip of Ocracoke, the first national seashore recreational area—a gift to the Nation largely from the philanthropist Paul Mellon—lets the wreck of a schooner bleach undisturbed and keeps the peace for those who like their beaches long and lonely (pages 154-5). About midway in those 80 miles stands Cape Hatteras Light, aged guardian of North Carolina's dread hurricane-swept graveyard for ships. My son David still has a piece of whalebone to remind him of that forlorn spot.

The same sea winds that helped to pile up the Banks bore aloft in 1903 a wood-wire-and-canvas contraption near Kitty Hawk—and changed man's life forever. We visited the memorial honoring those two Dayton, Ohio, bicycle makers, Wilbur and Orville Wright, near their first test site at Kill Devil Hill (pages 152-3). Camille and I sat in the car while teen-aged David climbed the great pylon, and we shuddered ten minutes later at

KODACHROMES © NATIONAL GEOGRAPHIC SOCIETY

the sight of a red shirt and blue jeans apparently poised for take-off from the pylon's tip. David got back—they always do—with some young father who had shouldered his infant up Kill Devil Hill and found a fellow Air Age enthusiast on the way down.

Fish and Tobacco Built Fine Homes

It was the English who, founding their first permanent colony in the New World at Jamestown in 1607, gradually extended their exploration southward and established a foothold in North Carolina.

Following their route, we came to that outpost, North Carolina's first town—Bath, on the Pamlico River. Bath seems to sleep in the memory of past grandeur. No traffic moves on its shaded main street at noontime, and veranda-rocking occupies a good part of everyone's day. Silence wraps a river harbor once crowded with colonial shipping.

Bath eventually gave way to Edenton on Albemarle Sound as a colonial center. Nearer to Virginia, and blessed with rich bottomlands, Edenton put up fine houses with money from the export of great barrels of shad and herring and from the tobacco that flourished on the plantations of the sound.

Southward, at the junction of the Neuse and Trent Rivers, we toured New Bern, the last colonial capital of North Carolina before the Revolutionary buff uniform replaced the British red coat. Governor William Tryon's Palace—capitol as well as residence—has been restored at a cost of some $3,500,000. The story is one of the determination of indomitable women, liberally mixed with luck.

The idea of restoring the palace was gradually conceived some years ago in North Carolina. The only part surviving a 1798 fire and the years since was the west wing. Forty houses had been built over the original palace square. The architect's plans had disappeared. Governor Tryon had taken his furnishings to New York, where fire destroyed them in 1773 at his home at Fort George.

But that didn't stop Miss Gertrude S. Carraway. She discovered the detailed plans in the New York Historical Society library.

Mrs. Maude Moore Latham, of Greensboro, began collecting period pieces—to furnish a palace that wasn't there! She established trust funds of $350,000. When she died in 1951, the residue of her estate was bequeathed for the palace restoration. In 1952 Governor Tryon's inventory of his books and furniture came to light in England.

North Carolina appropriated $227,000 to buy about one-third of the property now included in the restoration area. Thanks to Mrs. Latham's generous bequest, the rest of the site was purchased and deeded by the Tryon Palace Commission to the State, which maintains and operates the restored building.

Today, Miss Carraway is the restoration

Baskets of Bright Leaf Line Centre Brick Warehouse in Wilson

Nation's largest tobacco market, Wilson handles up to three million pounds of tobacco a day during the fall sales. Trailed by buyers, growers, and warehouse officials, a chanting auctioneer moves briskly from pile to pile. His singsong jargon and machine-gun rhythm proclaim bids submitted by the wink of an eye or the shrug of a shoulder.

North Carolina, the No. 1 tobacco State, grows two-fifths of the U. S. crop.

Transplanting tobacco near Rocky Mount, a farmer uses a cone-shaped device that simultaneously sets and waters each seedling. The woman feeds plants into the cone. Tobacco grows from seeds so tiny that it takes 314,000 to make an ounce.

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

director. She kindly escorted us through the great wrought-iron gate of a mansion that Don Francisco de Miranda, Spanish world traveler and contemporary of Governor Tryon, once called "the most beautiful in either of the Americas" (pages 156-7).

As I wandered through the stately paneled rooms and heavily beamed corridors, I could not help thinking that there are indeed still places for wood in architecture.

Jets Whine Above Ghost Town

From New Bern's quiet past we stepped into the supersonic future, by way of the United States Marines' 11,500-acre Cherry Point Air Station, down the Neuse River. There, Lt. Col. Gordon Gray took us for a close-up look at swept-wing Chance-Vought Crusader jet fighters, sleek Douglas Skyknights, and delta-wing Douglas Skyrays. Good recruiters, these Marines: David carried away an aerial photograph of Cherry Point's 35,000 feet of runways, inscribed, "To David, who would make a good pilot."

The Duke of Beaufort, lucky lord, had two charming American seaport towns named after him. South Carolinians pronounce theirs *Bew*fort; the Tar Heel version is *Bo*fort.

At "Bofort," then, we hired a boat for a family fishing trip off nearby Shackleford Banks. Our guide and companion was Miss Amy Muse, a devoted local historian.

We landed on the Banks near the ghost town of Diamond City—once a town of 300 people, now swallowed by the sand. Old bottles weathered to a smoky patina by sand and sea are a prize Shackleford find. Miss Amy dug up a beauty, but I settled for an armful of silvery cedar, smoothed to a satin finish by the same sand that killed the trees.

Another day we visited Fort Macon on Beaufort Inlet, whose protecting jetties were designed in 1840-41 by a young West Pointer, Lt. Robert E. Lee. Capt. Josiah Pender and 50 young Confederates seized it in 1861 and held it a year. Then, Union Gen. John G. Parke of Burnside's expedition took the fort and hauled down Pender's homemade Stars and Bars. Fort Macon never changed hands again in the war.

We moved fast after this visit. We stopped at Morehead City, which I remember fondly for a platterful of unbelievably tasty crab flakes in a waterfront restaurant. Of course the meal wasn't made any less enjoyable by the endless parade past the window of cabin cruisers with their swivel chairs and twin rigs to battle the fighting marlin, tarpon, and dolphin of those waters. Morehead City is famous for its sport-fishing fleet.

We followed briefly U. S. Highway 70, which parallels the old Atlantic and East Carolina Railway, not a very busy right of way these days, but still known from its

KODACHROMES BY B. ANTHONY STEWART © N.G.S.

Hosiery Undergoes a Torture Test in a Burlington Research Center

Machine in foreground stretches nylon hose. The stocking should withstand 5,000 flexings. A technician checks for signs of failure. Leg forms in background try on hose for length and fit. Burlington Industries, Inc., operates the laboratory. North Carolina produces more than half of the Nation's hosiery and a fifth of its yard goods.

Assembly-line methods turn out terry bath towels at a Cannon Mills Company plant in Kannapolis. Seamstresses at center hem one towel after another without stopping to snip the thread; clippers at right separate the pieces.

Orient comes to Leaksville, home of the Karastan Rug Mill. Using watercolors and drafting paper, the artist at upper left copies the pattern of a handmade Oriental carpet. Following her drawing, power looms will reproduce the design in a rug costing much less than the original.

lush seafood-carrying era as the Mullet Line.

I remember Southport for a young man who was dressed—and I'm not exaggerating—in peppermint-striped undershorts and a .45 automatic with live ammunition slung from his belt. He came ashore with some other men in a small green boat, and they marched past our oceanfront cafe.

"Survival unit," the Army lieutenant in command said cryptically. Later we learned that trainees are dropped on Cape Fear sands to live on oysters, mussels, and whatever their ingenuity turns up. I can't help thinking that our trainee in the peppermint shorts survived very well.

Our last coastal stop was Wilmington, the Tar Heel State's largest port. Since earliest times, the stretch of the Cape Fear River where shallow-draft plantation boats met deepwater vessels was the logical place for a seaport. Wilmington it became (page 151).

The tar, pitch, and turpentine of the 1700's have given way to seed potatoes and tobacco leaf, bound for Pakistan or Hamburg, Germany. Heavy gantry cranes tower above the docks. They lift unprocessed New Zealand sheepskins, which a North Carolina firm processes and reships as chamois. They lower away 450-pound bales of a dried wild coastal plant called deer tongue, destined for the flavoring in European cigarettes.

But Wilmington has more than commerce.

KODACHROME BY TOM WALTERS © NATIONAL GEOGRAPHIC SOCIETY

Tense moment at the Sedgefield Country Club: Mike Souchak strokes a putt in the Greater Greensboro Open. Golfers tee off on fine North Carolina courses from early spring to late fall; on many, as at Pinehurst, play goes on all winter.

It is blessed with wonderful ocean beaches and fishing grounds, attractions the city shares with other coastal centers such as Carolina Beach and a string of resorts all the way down the coast to Fort Fisher.

Wilmington streets are old and new, as befits a seaport that was briefly one of the Southern headquarters of Lord Cornwallis in the Revolution, the last ocean gateway of the Confederacy, and the modern center of big oil and tourist trades.

David and Camille somehow escaped the tempting Wilmington shops in what is known as good order, and we turned our backs on the ocean at last, bound westward into North Carolina's coastal plain.

Our travel followed the westward trail of the Highland Scots who emigrated from England after their defeat by George II in 1746 at Culloden, and who gave North Carolina an apt name for one of her counties—Scotland. A dozen citizens of the Scotland County seat, Laurinburg, insisted on showing us their proudest spots: the monument erected to a chalk-and-blackboard country schoolteacher, William Graham Quackenbush; the birthplace of the Tar Heel poet John Charles McNeill; a new watch factory; and the tiny brick hexagon where the "Richmond Temperance and Literary Society" was established in 1855 to keep Scots both sober and well read.

Today's great achievement in Laurinburg, though, is the recent completion of St. Andrews Presbyterian College. The new academic center unites what formerly were three widely scattered colleges: Flora Macdonald, Peace, and Presbyterian.

Old Farming Methods Yield to New

Around and about Laurinburg lie scientifically managed farmlands that are reshaping the life of the coastal plain. E. Hervey Evans gave us a grand tour of the McNair Investment Company's 31,000 acres. Evans's Confederate grandfather, John F. McNair, returned from war in '65 with nothing more in mind than guiding an ox-drawn plow. He died in 1927, the head of a rural empire centered on a great seed store.

In Raleigh my newspaper friend Jonathan Daniels told me how Hervey Evans reportedly met a classmate in New York whom he had not seen since Chapel Hill days. The classmate, now a prosperous man, asked Hervey Evans what *he* was doing.

"Oh," Evans replied modestly, "still clerking in my grandfather's store."

"This," Daniels concluded, "illustrates our State motto: *Esse Quam Videri*—'to be rather than to seem.'"

Farm research in Scotland County is a collective project of the United States and North Carolina Departments of Agriculture, university professors, and local scientists. McNair Farms' plantation shows what they can do.

For example, a gleaming tractor replaces Grandfather McNair's ox team. Fat white-faced Herefords crop pastures that not long ago were groups of tenant farms too small to be economical.

Other hints of change are the decreasing numbers of cotton gins and the disappearance of board shacks on stilts.

We stopped at a field mill where truckloads of sericea lespedeza, a research-improved strain of legume, arrived chopped into succulent bits. These climbed conveyer belts from the trucks into a giant baking oven and blew out in a green cloud of dehydrated powder. Another machine pressed the powder into green pellets that cattle, hogs, and poultry apparently find irresistible.

"Lespedeza," Evans told me, "will grow even in sandy areas, and it builds up the soil. It could mean salvation for the South's sandy and worn-out lands."

Our car crossed a field to the edge of a fenced-in woods. A tap on the horn brought an answering blast from the turkeys within the fence—thousands of outraged gobblers.

"We use the edge of the bays to fatten 'em

up," he said. "You know what Carolina bays are? Big and little circles—some of them miles across—scooped out by meteor showers. Peat and soil have built up in them over the ages. We are standing on plain sand. Inside that fence is the kind of ground turkeys like."

This seeming folk tale is a scientific theory, advanced after aerial photography of circles, ellipses, and heart-shaped bays set the geologists in the 1940's to testing for buried meteorites. They found magnetic anomalies in the southeastern ends of the bays, where they should be if the meteors came from the north-

Nylon mushrooms dot the sky above Fort Bragg. Swinging below swollen canopies, paratroopers of the 82d Airborne Division brace for the shock of landing. As soon as they hit, they roll up their chutes, break out guns and equipment, and advance.

The 82d stands poised to combat aggression anywhere, anytime. Key units of the division remain on 24-hour alert. During World War II the 82d fought in Sicily, Italy, France, the Netherlands, and Germany.

Fort Bragg, the division's home, takes its name from Confederate Gen. Braxton Bragg, a native North Carolinian.

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Buffalo herd in North Carolina grazes near Concord. Mounted on a palomino, owner A. B. Cooke inspects the beasts. Built up from a handful of animals obtained in the West, the herd numbers 25. A packing plant in Concord markets buffalo meat.

west. Sand ridges, possibly kicked up by the impact, line the southeast rims.

Mystery shrouds the origin of the bays, but many scientists now accept the theory that some time in the misty prehistoric past heavenly explosions peppered half a million meteorites into 25,000 square miles of coastal plain from North Carolina to Georgia.

"Queen City" Blends Work and Play

Charlotte, North Carolina, is called the Queen City because it took its name from Charlotte of Mecklenburg, wife of George III of England. Our entry into the city was accompanied by the billowing dust and frenetic roar of a stock-car race. All but blindfolding David to get him past the track, we telephoned Bud Cox, *Charlotte News* staff member and a good friend, to get our bearings.

In the evening, under Bud's guidance, we sat in the cool, dim interior of the great circular Charlotte Coliseum, where 11,600 people get an unobstructed view of the arena. The view that night was of a sheet of ice, on which couples skimmed, small-fry wobbled on moose-calf legs, and professionals twirled with enviable grace.

Charlotte's Independence Square is bounded by Tryon Street, named for the master of Tryon Palace, and by Trade Street, honoring a favorite Charlotte pursuit. Trade comes naturally to the city: Gold, for example, was minted or assayed there from 1837 to 1913. Until the '49 California gold rush, North Carolina and Georgia were the leading gold-producing States.

From Charlotte we headed eastward across the rolling sand hills, with forays into the winter sports country. Of course this was mid-August; the elegant resort of Pinehurst was sparsely peopled with visitors in casual hot-weather cottons and sport shirts. The huntsman's pink, the golf tweeds, and the dun jackets patched with pockets for carrying quail would lie mothballed until first frost heralded their season. Nearby Southern Pines, another golf resort, is attracting more and more people who have retired.

It was on our second visit to Raleigh that I saw Governor Terry Sanford, North Carolina's able 44-year-old chief executive. He had recently succeeded Luther H. Hodges, who now serves as President Kennedy's Secretary of Commerce.

We waited outside the State Capitol, I sedately on a bench and David exploring Capitol Square's statuary of Andrew Jackson, James K. Polk, and Andrew Johnson—all three Presidents of the United States claimed by North Carolina. In this distinguished company we received word that the Governor could see me.

Governor Sanford's quick smile and warm manner instantly put me at ease. Here was the man to ask about what seems a passion among Tar Heels—education.

"Won't your stress on being first in the country in education require a tremendous effort from your people?" I inquired.

"North Carolinians," the Governor replied, "understand that education underlies both their chances to make a good living and the human values which give life satisfaction."

I recalled the story of the camp for underprivileged children that Terry Sanford had once run in Scotland County. It seems he would let the campers sleep late so that two meals—a midmorning breakfast and an early supper—could carry them through the day. I asked if it was true.

"It's a good story," he grinned. "While we were short of funds, it wasn't quite that bad.

"It's the same way with North Carolina," he said. "Education is worth a little austerity—it's the best investment people can make."

David and I invested the rest of our morning at the North Carolina Museum of Art in Raleigh, looking at works of Rembrandt and Rubens and other masters. With State taxes and gifts from the Samuel H. Kress Foun-

Gay in hunting pink, riders jog along a path near Tryon. Huntsman in foreground leads the pack, followed by the master and field. Hounds give tongue when they catch the scent of a fox. Sounding his horn, the huntsman leads the riders in pursuit. Pink coats identify male members and master of the Tryon Hounds; guests wear black.

EKTACHROME (LEFT) AND KODACHROME BY NATIONAL GEOGRAPHIC PHOTOGRAPHER B. ANTHONY STEWART © N.G.S.

Pinnacle Gap Overlook Beckons Travelers on the Blue Ridge Parkway

Designed for carefree, ride-awhile, stop-awhile driving, the parkway winds 469 miles from Shenandoah National Park in Virginia to Great Smoky Mountains National Park in North Carolina and

KODACHROME © NATIONAL GEOGRAPHIC SOCIETY

Tennessee. It forms an elongated park of its own, rich in folklore and breathtaking vistas. Trails and campsites lure nature lovers; overlooks offer scenic balconies for sightseers. Here the road skirts 5,892-foot Craggy Pinnacle (left foreground) before dropping toward Asheville 25 miles away. In North Carolina the Appalachian system pushes more than 200 mountains above 5,000 feet.

Hairy beardtongue, so named because of the whiskery tip displayed by one of its five stamens, blooms in June and July. Standing on its head, a katydid nymph explores a blossom.

Mountain laurel, a shrub that grows to a height of 15 feet in the Appalachians, forms virtually impenetrable thickets. Cocked stamens await an insect's arrival; triggered by a touch, they spring up and dust the visitor with pollen. Glossy evergreen foliage can poison livestock.

Exploding rhododendrons set 6,286-foot Roan Mountain ablaze with color. A cousin of Scotch heather, the vivid flower takes its name from the Greek: *rhodon*, rose, and *dendron*, tree.

Bumblebees and butterflies savor a thistle's sweets along the Blue Ridge Parkway. Despite their prickly flowers, thistles belong to the same family as lettuce and chrysanthemums.

dation, the museum has collected a handsome array of paintings.* Taxes have supported a State symphony orchestra for years.

Leaving Raleigh, we headed for High Point, "Furniture Capital of the World." Here in the Piedmont is an industrial counterpart of the Research Triangle: High Point, Greensboro, and Winston-Salem. North Carolina makes half the bedroom furniture for the Nation and more than a third of its dining-room furniture. Wood furniture, that is.

Prosperity Sets the Style

We discovered the origins of High Point's enterprise by knocking on a door in the Southern Furniture Exposition Building. Leo J. Heer, who presides over 23 acres of furniture exhibits set aside for retail buyers from all over the country, welcomed us.

"Nowadays, prosperity sets the furniture styles," Mr. Heer told us. "That's as it should be. During the depression it was cheap tables and chairs by the dozen."

Forty thousand Tar Heels, he said, turn out fine pieces, not only in High Point, but in Lenoir, Statesville, Drexel, Lexington, Thomasville, and other places.

"Why all this concentration in the Piedmont?" I asked.

"Virgin hardwood forests," Mr. Heer replied, "plus ample waterpower to turn machinery. The big factor, of course, was labor—plenty of sturdy, hardworking people.

"Mass production came in the 1890's," he continued. "The railroads opened up the forests, and folks had recovered from Civil War tribulations—they wanted something to sit down on."

In this modern revival I sensed the influence of research.

"Yes," admitted Mr. Heer, "we couldn't get on without our engineering and forestry schools. That's where technique is born."

Even among the Piedmont's great textile firms, Burlington Industries, Inc., with headquarters in Greensboro, is a giant (page 163).

*See "The Kress Collection: A Gift to the Nation," by Guy Emerson, in the December, 1961, GEOGRAPHIC.

Ladder-back chairs take shape in Mars Hill under the patient hands of Shadrack Mace. Handed-down skills such as his grew out of the mountaineer's isolation. What the pioneer needed, he made; by necessity he became a master craftsman.

It is the world's largest manufacturer of textiles – some 140 plants, 65,000 employees, and net sales of more than $866,000,000 a year.

From Burlington's diversified textile complex comes virtually every type of fabric and textile product. The company spins, knits, weaves, dyes, and finishes in modern plants located in 16 States and seven foreign countries – but almost half of its operations are located in North Carolina.

I had always thought mills just made plain cloth. But I discovered they are constantly thinking ahead to what girls, golfers, and even automobile seats and missile cones will be wearing a year from now.

"We must have the new or we'll die," a young executive told us above the roar of hundreds of tireless shuttles and the swirling of continuous ribbons of cloth through brilliant dye vats. "That's why we place particular emphasis on research and development – so we can come up with what people want almost before they want it."

Greensboro, second largest city in the State after Charlotte, is experiencing tremendous industrial growth and correspondingly large residential development.

Birthplace of short-story writer O. Henry, Greensboro has other claims to fame. Among its various educational institutions are two of the South's finest Negro colleges – the Agricultural and Technical College of North Carolina, and Bennett College. Nearby Guilford is the South's oldest Quaker college; it opened in 1837.

And the city remembers proudly that at the Battle of Guilford Courthouse, Lord Cornwallis suffered the Pyrrhic victory that proved to be the turning point of the Revolution in the South, paving the way for Washington's victory at Yorktown.

Winston Thrives on Tobacco

Research is vital to the R. J. Reynolds Tobacco Company at Winston-Salem, which has 27 Ph.D.'s on its research staff. They live and think tobacco, whose flat green patches on the coastal plain and rolling fields in the highlands brighten the landscape along many North Carolina highways.

Tobacco is a crop with several costumes: a white patch of cloth over a spring seedbed; the green pyramids crowned in summer with pink bouquets; and at last the rows of brown tepees of cut leaf in the fields.

Our guide at one of the R. J. Reynolds tobacco plants steered us through a stadium-sized room humming with the sounds of overhead conveyers moving among the rows of cigarette-making machines. Altogether these machines produce more cigarettes in a minute than all the cowboys in the world would roll during a roundup.

If Winston-Salem's eye is on the tobacco crop, it is also on the stars. A few miles from R. J. Reynolds are three Western Electric Company plants that make guidance systems or component parts for the anti-missile missile Nike Zeus, a vital weapon in the Nation's future defense arsenal. How Western Electric does this is a very well kept secret.

You will learn little from looking over the shoulder of one of the 800 engineers in the

plants or by following the nimble fingers of a pretty Tar Heel wire manipulator. You may think you're learning more from the friendly officials who parade you up and down aisles, quoting facts and figures with the utmost candor. But after two hours with the works manager and one of his assistants, I can only say that a modern Mata Hari would waste her time in Winston.

Western Electric at Winston, with 8,000 employees, is North Carolina's largest electronics supplier. Actually, Western Electric is the manufacturing arm of another giant, the American Telephone and Telegraph Company. In 13 major plants across the country, it produces most of A.T. & T.'s communications devices—telephones to missile brains.

Five minutes' drive from Western Electric brought us to Salem—meaning "peace" in Biblical language—dedicated in 1766. The hyphen joined Winston to Salem in 1913.

Winston-Salem is rich in this world's goods, important in banking and knitting as well as in tobacco processing and electronics production. It has Wake Forest College with its Bowman Gray School of Medicine, Salem College, the Teachers College for Negroes, nine trade schools, two Bible colleges, and a flair for cultural pursuits.

Moravians Built Salem in Wilderness

Salem was built by members of the Moravian Church, who came by way of Pennsylvania from what today is the southeastern corner of East Germany. Six men in 1752 trekked from Bethlehem, Pennsylvania, to survey the 100,000 North Carolina acres purchased from an Englishman, Lord Granville.

The following year 15 pioneers—a minister, a business manager, two carpenters, a tailor, doctor, shoemaker, baker, tanner, gardener, and three farmers—settled in the area. They had the skills to found industries in the wilderness, the sense of orderliness to plan well, and a piety which bound them in religious and civic unity.

Waiting for a nibble, a mountain woman wets her line in fast-flowing Little Rock Creek near Bakersville. Finding the Appalachian valleys crowded, settlers built their cabins in the high hollows. Here an individualistic people preserve the colorful speech, traditions, and self-reliance of their hardy forebears.

Forty of Salem's sixty original buildings still stand on the quiet streets near the public square: some houses of log and white clapboard, many of rosy brick with hooded doorways and eyebrow-arched windows. More than twenty buildings have been restored, and six of them are open to visitors.

The Moravians – United Brethren – believed in a respectable division of the sexes: "God's Acre," the old graveyard, has separate sections for the Brothers and for the Sisters.

Old Salem woke at the sound of a trumpet, sang the morning hymn for the day, sent the Sisters to sing at their spinning wheels, gave thanks in song for a top house beam put in place, and went to sleep to the watchman's conch-shell horn.

Beyond Winston-Salem to the west lie North Carolina's mountains. A pale-blue silhouette takes shape as a solid range, the incomparable Blue Ridge. The sun scatters bright patches in the dense shade and highlights flashing mountain streams. Vine and wild flower, moss and fern, live in a manner of their own choosing.

Mountains Magnetize Travelers

The serenity of these highland forests, and the sharp, winy air that bathes them, draw pilgrims from many parts of the Nation. Their reasons are the same: They feel at peace in the Blue Ridge.

Every traveler to the mountains faces a painful decision – what special part to make his own. Will it be Boone, Chimney Rock, Highlands, Franklin, perhaps Cherokee? This

Eagle dancers celebrate a victory in *Unto These Hills*, an Indian drama performed at Mountainside Theatre in Cherokee. The play recounts the trials of the Cherokees, most of whom were driven out of North Carolina in 1838. Feather wands simulate eagle wings.

Coonskin-capped Daniel Boone helps settlers find farms and freedom in the Blue Ridge. An excerpt from the musical drama *Horn in the West*, this scene is set on a prominent outcrop called Dog's Ears, near Boone. Close by runs Boone Trail, a stretch of U. S. Highway 421.

Sir Walter Raleigh reads poetry to Queen Elizabeth in the Elizabethan Garden on Roanoke Island. They stand near the open-air theater where they perform in *The Lost Colony*, which re-creates the ill-fated settlement founded on the island in 1587.

Inspired by French chateaux, Biltmore House enriches Asheville with Old World opulence. Visitors may view priceless paintings, tapestries, and statuary in some of the 250 rooms. A three-mile railway spur brought construction materials to the site.

Family portrait seen through a magnifying glass shows William, brother of George W. Vanderbilt who created Biltmore in the 1890's.

choice of a favorite place, multiplied by tens of thousands of visitors each summer, is a most important happening in the mountains of North Carolina.

The western highlands were practically unknown to lowlanders before the 1920's. True, there were a few resorts. In the 1890's, for example, the summit of Roan Mountain, reached by carriage from the valley railroad, had a wooden hotel from whose veranda spread out the world's most glorious display of rose-colored rhododendron (page 173).*

The hunting set found the thermal belt around Tryon most agreeable (page 169). Here and there were pillared hotels with links for the itinerant golfer.

But America on wheels awaited the bulldozer to carve a road over the mile-high peaks of the Blue Ridge and make corkscrew ascents into sweeping curves.

Along the Blue Ridge Parkway the Clan Ross headed for the annual Highland Games and Gathering of Scottish Clans, held in August, on that clannish slope of Grandfather Mountain known as MacRae Meadows. We were David and Angus and Sandy and Malcolm—and a Louisiana French import named Camille—but the preponderance of our Scottish first names got us nowhere in the kilted and bonneted company of the MacDonalds, the Morrisons, McBains, and more members of the clans Colquhoun, MacLeod, and Gregor than you could shake a claymore at.

Tar Heels Toss the Caber

The lassies danced distractingly. The pipers marched in review, and in the novice piping competition the winner must have made someone agonizingly proud.

There were running and wrestling and

*See "Rhododendron Time on Roan Mountain," by Ralph Gray, NATIONAL GEOGRAPHIC, June, 1957.

KODACHROME (ABOVE) AND © EKTACHROME © NATIONAL GEOGRAPHIC SOCIETY

jumping games, which culminated in the tossing of the caber, a not-too-miniature telegraph pole that a strong back, a stout thigh, and a great heave can sometimes force into arced flight. It looked to us like a series of guided-missile failures, but it was fun.

We were already friends with the guiding genius of the Games and Clan Gathering, Mrs. Agnes MacRae Morton, whose son Hugh owns Grandfather Mountain.

This mile-high summit commands a brilliant panorama. Hugh Morton inherited it together with the problem of what to do with 5,000 more-or-less perpendicular acres. His solution was to build a road to the top and string a bridge between Grandfather's nether and upper lips. So now you can stand dizzily on Grandfather's nose and see what appears to be the whole world beneath you.

"Tweetsie" at Blowing Rock is another attraction. Her name, onomatopoeic for the sound of a steam whistle heard over far hills, was bestowed long since by folk along the East Tennessee and Western North Carolina Railroad. Retired steam locomotives are now collectors' items, but a Blowing Rock businessman rescued Tweetsie from an outlander and set her to hauling three diminutive cars packed with delighted passengers around and around Roundhouse Mountain.

Highland Handicrafts Tempt Tourists

Mountains are great concealers. Seen from high above, their details smooth to velvet. In a valley road you cannot know what wonders may be just over the ridge. This trip we decided to follow the sign saying "Linville Falls." Here, in a part of Pisgah National Forest, we found paths over which the most short-breathed of us could climb to the verge of the Linville Gorge. There the breath catches hard, in awe at the grandeur and wildness.

It is hard to leave the Blue Ridge without taking something of it with you. Mountain artists offer samples of their skills at the Craftsman's Fair in Asheville each July. In defense of the family purse, I usually hide out at a coffee shop across from the city auditorium. But two whole floors of mountain wood carving, homespun, jewelry, pottery, pewter mugs, and hand-rubbed tables always draw me back, and we depart laden.

The mountains were settled about the time of the Revolution by homestead seekers who came with their worldly goods on their backs. In the 1880's the railroad pushed through to Asheville, and a second Northern invasion came by Pullman and private car.

George Washington Vanderbilt liked everything he saw and bought it. His 125,000 acres reached from the edge of Asheville beyond Mount Pisgah. While a thousand workers were engaged five years in creating a French chateau of 250 rooms called Biltmore House, Vanderbilt toured Europe in search of treasures of ancient Rome and the Orient, the Renaissance and later European periods up to his own times (pages 178-9).

For all that, Vanderbilt's contribution to the conservation of forest, field, and stream far outshines Biltmore's limestone walls and stately rooms. To plant, tend, and improve his huge private forest, Vanderbilt had the help of Gifford Pinchot, father of U.S. conservation, and Frederick Law Olmsted, one of the designers of New York's Central Park.

Today some of Vanderbilt's original acres form a generous section of Pisgah National Forest, the pride of every Tar Heel. In its 480,000 majestic acres wild animals have cover, trout swim in clear streams, and great trees stand guard.

Thanks to careful management, North Carolina's forest lands serve industry as well as wildlife. Take Champion Papers, Inc., at Canton.

Canton lies in a valley between

KODACHROMES © NATIONAL GEOGRAPHIC SOCIETY

Flying Boatmen, a Tennessee team, trace serpentine patterns on Fontana Lake. Drivers execute precision maneuvers at full throttle. Fontana Dam of the Tennessee Valley Authority backs up the mountain lake.

Chimney Rock, a 315-foot-high chip on the shoulder of Chimney Rock Mountain, overlooks Lake Lure. An elevator in a shaft punched through solid rock lifts sightseers to the top.

Clouds caress the Smokies as dawn breaks over North Carolina. Early risers

the Blue Ridge and the Smokies. There a pungent smell emerges from Champion's huge stacks. From the company's loading platforms 900 tons of paper roll away each day for worldwide destinations.

A company chemist led us through aisles of noisy chemical-mixing machines, vats, and gigantic paper-making machines wherein a pine log becomes a roll of paper. Logs tumble in the barking drums, get bitten into chips by rotating knives, are digested in alkaline cooking liquors and bleached to various shades of whiteness. On a fine-mesh screen belt they lay their cellulose fibers into a mat which miraculously comes through pressers and dryers as a king-sized gleaming sheet.

Champion is a child of the forest. Twelve hundred cords of pine and 600 cords of hardwood are daily digested. But the company pays it back: Champion has planted 50 million seedlings on its 300,000-acre holdings in the Carolina area.

We pushed on into the Smokies then, marveling always at nature's handiwork begun some 200 million years ago. That is when the Great Smokies were born, amid the upheaval and the twisting of the earth's crust under heat and pressure. Miracles were wrought: Impure clays turned to garnet- and mica-bearing rock. Sandstone was transformed

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

in Tennessee view the sunrise from a 6,593-foot grandstand on Mount Le Conte

into rocks of strange shapes. Then came the millenniums of erosion to carve the face of the Smokies into gorges, side valleys, and wrinkled slopes.

Ice Age glaciers never reached the Smokies, yet came near enough to grant them a legacy of northern plants and flowers. The Smokies today have a rich variety of trees, ferns, mosses, and flowering herbage (page 172).

All this we saw on our way to Fontana Dam, the highest dam in the eastern United States, whose 480 feet of concrete impound a 10,530-acre lake and produce electric power for cities far beyond North Carolina's borders.

The next morning we stood in Joyce Kilmer Memorial Forest, within a Tar Heel's wave of the Tennessee border—and our trip was done.

We had seen North Carolina from the sands of Hatteras to the lofty Smokies. We had talked, danced, eaten, and played with Tar Heels from Kitty Hawk to Cherokee—and loved every minute of it. Now it was time to go home and tell the story.

As we stood there, the cloud—or maybe it was mist—that blanketed our mountaintop drifted away, and the sun came out full and strong on the great trees, on the rocks, on the valley far below. North Carolina was bright with sun and promise.

Tracking America's

By KENNETH F. WEAVER, Senior Editorial Staff *Illustrations by*

As AMERICA'S ASTRONAUTS hurtle into orbit—one by one—each will, if all goes well, circle the earth three times. It will take the space traveler a little less than five hours, and during that suspense-filled period he will be the precious charge of the Mercury tracking network.

How superbly this worldwide team can function was demonstrated a few weeks ago when a swift and smooth "triple play" involving stations in Australia, California, and Florida brought the chimpanzee Enos to a safe landing after two orbits.

As the chimp passed Muchea, Australia, at nearly five miles a second, the station there detected undue rolling of his spacecraft and overheating of the cabin. This was reported by open telephone to Cape Canaveral on the other side of the earth.

Thirty-seven minutes later a controller at Point Arguello, California, on telephoned instructions

CANADA

POINT ARGUELLO, CALIFORNIA

UNITED STATES

GODDARD SPACE FLIGHT CENTER

New York

BERMUDA

ATLANTIC SHIP

GRAND CANARY ISLAND

London

Berlin

Paris

EUROPE

Moscow

Rome

Cairo

AFRICA

KANO, NIGERIA

ZANZIBAR

GUAYMAS, MEXICO

CORPUS CHRISTI, TEXAS

CAPE CANAVERAL

Five-hour flight ends near Grand Turk Island

SOUTH AMERICA

Rio de Janeiro

Equator

TRACKING STATION FUNCTIONS

Sends radio signal to bring spacecraft down

Talks to astronaut and receives radioed information (telemetry)

Tracks spacecraft by radar

Additional tracking stations not shown: White Sands, New Mexico, and Eglin, Florida

Painting by Robert W. Nicholson. Research by George W. Beatty. National Geographic Staff

© N.G.S.

120° 90° 60° 30° 0° 30°

Man in Orbit

National Geographic photographer ROBERT F. SISSON

from Canaveral, fired the capsule's retrorockets and brought it down to a successful recovery in the Atlantic south of Bermuda.

To get the story of that network and the fantastic work it does, photographer Bob Sisson and I have traveled the equivalent of several orbits.

Dr. Hugh L. Dryden, Deputy Administrator of the National Aeronautics and Space Administration (NASA) and a Trustee of the National Geographic Society, helped launch us on this survey. NASA directs Project Mercury, the man-in-space effort, and the race to put an American on the moon.

"If you take a look at all 16 Mercury tracking stations," Dr. Dryden suggested at lunch in the National Geographic Society's offices one day, "you'll not only see how our astronaut will be guarded, but you'll get the full story of the dedicated men who track the astronaut and record the flood

Mercury's first team: Astronaut John H. Glenn, Jr., (left), named for the first orbital flight, and backup pilot M. Scott Carpenter. Below: For the second flight, Donald K. Slayton (left) and backup Walter M. Schirra, Jr.

of data about his flight around the world."

With NASA's cooperation and the friendly assistance of the Western Electric Company, which supervised installation of the stations, Bob and I explored the Mercury range.

Island-hopping in three oceans and spanning three continents, we saw an astonishing variety of topography and landscape, from the rain-swept peaks of Hawaii and the soft pink beaches of Bermuda to the gravel-strewn outback of Australia; from the mud city of Kano, Nigeria, and the clove trees of Zanzibar to the sun-blasted coral speck in the South Pacific called Canton Island.

Electronic Wizards Plot Space Path

We were constantly amazed by the electronic wizardry of the range. Here is some of the world's most accurate radar gear. Superclocks synchronize timing around the network to an accuracy of one five-thousandth of a second. Computers in seconds can calculate and plot the orbit of a spacecraft halfway around the globe.

The range represents a diplomatic triumph as well. In Washington Dr. Dryden told us of the painstaking negotiations that resulted in agreements to permit our tracking stations on foreign soil.

"We went to great lengths to make clear that Mercury stations are purely for scientific, nonmilitary purposes," he explained.

With cooperation of the five foreign nations signing the agreements, the network was completed under heavy pressure in just two years at a cost of more than $75,000,000.

At its peak the project employed a thousand workmen, many of them local laborers using primitive tools and carrying dirt in baskets on their heads. It transported supplies ranging from structural steel to gold-plated electronic tubes the size of pigeon eggs.

Construction and staffing of the range has transplanted hundreds of Americans, some to island paradises, a few to posts so lonely that six months is regarded as a long tour.

When the astronaut's stainless-steel Atlas bursts from the sands of Cape Canaveral, it

Missile age archer with homemade bow and cane arrows patrols the Project Mercury tracking station at Kano, Nigeria. Audu, a Hausa tribesman, stands beneath an antenna that receives telemetry signals, channels of radio data about the performance of capsule and passenger. His teeth bear red stains from chewing kola nuts.

Poised on a Cushion of Flame, an Ice-coated Rocket Carries a Chimp Aloft

From this launching platform at Cape Canaveral, Enos, a five-year-old chimpanzee, began his two-orbit leap around the earth last November 29. Secure in a pressurized, air-conditioned cradle in his black Mercury capsule, Enos seemed undismayed by three hours of weightlessness. To win banana-flavored pellets and sips of water, he calmly flipped levers in response to colored lights. Flaming vernier rocket on the side of Mercury-Atlas No. 5 helps adjust its speed and direction.

On September 13, the first Mercury capsule to orbit the earth (MA-4) carried aloft a "canned man," a black box that breathed and gave off heat as would an astronaut.

EKTACHROME BY NASA (OPPOSITE) AND KODACHROME BY ROBERT F. SISSON, NATIONAL GEOGRAPHIC STAFF © N.G.S.

On a Rocky Finger in an Azure Sea, Bermuda Trackers Contact the Astronaut

Largest and most important of the overseas Mercury tracking sites, Bermuda contacts the capsule three minutes out of Cape Canaveral, 850 nautical miles southwest. When the rocket burns out and the capsule separates, technicians have but 30 sec-

onds to decide whether to continue the orbit or bring down the capsule. Here, on a jagged point of St. David's Island, stands the control building, which houses elaborate computer equipment. Like virtually all of Bermuda's structures, its roof catches rain for fresh water. A radar dish tops the boxlike building at left. In Castle Harbour (upper right), carefree vacationers swim and sail within sight of the antenna towers. Barely submerged coral heads kick up surf on all sides.

thrusts the Mercury spacecraft into a path that swings roughly 32° north to 32° south of the Equator. On a globe this path describes a circle; on a flat map it comes out an elongated S-curve (pages 184-5). The path is designed to keep the astronaut over water or over United States territory as much as possible in case of forced landing.

Each orbit traces a slightly different path over the earth because of the earth's rotation. The flight must end no later than the third orbit, for additional circuits would drop the astronaut outside the Atlantic recovery area where U. S. Navy rescue ships are waiting. Not until the 16th orbit, some 26 hours after launch, would the orbits again bring the astronaut within the recovery zone. The Mercury capsule as presently designed is not equipped with adequate cooling or electrical power for such long flights.

Beginning at Canaveral, the initial orbit arches northeast toward Bermuda, the first overseas tracking station. In mid-Atlantic it curves southeastward at about the point where a tracking ship holds station. The capsule streaks diagonally across Africa, within range of the sites at Grand Canary island, Kano in Nigeria, and the island of Zanzibar, and on past a tracking vessel in the Indian Ocean. Then it plunges across Australia, passing the stations at Muchea and Woomera.

Cutting northeast again, the astronaut watching through his periscope sees no land for thousands of miles except tiny Pacific islands. The station on Canton, just below the Equator, appears briefly, but Kauai, Hawaii, lies too far north to catch the first pass. So, too, does Point Arguello, California. They come into play on the second orbit.

On the American mainland, radars watch the orbiting satellite: at Guaymas, Mexico; White Sands, New Mexico; Corpus Christi, Texas; Eglin, Florida; and, finally, Canaveral again—about 100 minutes after lift-off.

Complex Network Links All Stations

Thus the global circuits involve 16 tracking stations. Two additional stations—the islands of Grand Bahama and Grand Turk in the Atlantic Missile Range—stand guard during Mercury's launch and recovery operations.

As Bob and I circled the globe, following on land and sea the route of the Mercury capsule, we caught glimpses of a communications web of submarine cables, telephone lines, and teletype circuits that, stretched end to end, would girdle the earth six times. All this monster network funnels through a master nerve center, the Goddard Space Flight Center at

Greenbelt, Maryland, and writes its ultimate message at the Mercury control room at Cape Canaveral (pages 216-17).

The communications network ties together the ring of outposts that will track each American who rides his black capsule into space. While an astronaut is within range, the stations are his only link with the world below. They study his physical condition and record every detail of what happens to him and to the capsule on which his life depends.

In addition—and most important—they *can control* the flight of a Mercury spacecraft by bringing the capsule to earth at a predetermined time and place. In this respect they do a more complicated job than most other U. S. tracking posts whose task is to keep tabs on unmanned satellites: the Minitrack network, Deep Space Probe stations, and the Smithsonian Astrophysical Observatory's optical tracking cameras. Only the Discoverer network also can bring down its satellites.

Does Russia need tracking stations for her cosmonaut flights? She does have stations

Rippled cloud canopy covers the Atlantic some 100 miles below the unmanned MA-4 capsule during its round-the-world flight last September. Through rifts in the white expanse, the automatic camera sees the Canary Islands (lower left) and the coast of Morocco (right). Seconds later the craft sped across Africa (pages 194-5).

Taking off from Cape Canaveral, the MA-4 orbited the earth in 109 minutes before landing in the Atlantic 160 miles east of Bermuda. The projected schedule calls for each of America's chosen astronauts to circle the earth three times and splash down near the West Indies.

Camel takes traffic in its stride at the tracking station on Grand Canary. The Canaries got their name from *canis*, the Latin word for dog; early explorers found a ferocious breed here. Canary birds, in turn, were named for the islands.

across the broad Soviet land mass and on picket ships at sea, but apparently nothing like the life-preserving world ring the United States has set up.

As the capsule moves from west to east, it is picked up first by Bermuda. Although that sun-washed island is site of the largest and most important of the overseas tracking posts, it seemed to me incongruous for such an installation (page 188). The clean profiles of radar antennas contrast sharply with the soft outlines of pastel houses and whitewashed roofs and the profusion of oleander and hibiscus that makes the island a garden.

In this British colony engineers work at frantic speed to read and interpret information from the 17,500-mile-an-hour spacecraft, then drive home at a maximum legal speed of 20 miles an hour along winding, two-lane roads. Until World War II the island was innocent of automobiles. One bridge still bears the admonition, "Walk Your Horses."

Because car ownership is expensive and strictly regulated, some Mercury people travel by motorbike, exchanging a pair of headphones for a bulky helmet strapped firmly under the chin.

"Don't laugh," said one motorbike rider to me as he buckled on his hard hat. "These things are necessary if you ride a 'suicycle,' because of accidents. I've still got a 'road rash' from my last spill."

KODACHROMES BY ROBERT F. SISSON © N.G.S.

Turning the tables on photographer Sisson, a young Canary Islander aims a toy camera that has a lens with a face but no film.

Modern Buildings of Las Palmas Rise Above Boats and Bathers

A natural reef 200 yards offshore protects swimmers and sailboat skippers from pummeling by the Atlantic surf. A two-mile tiled promenade rings the crescent of Las Canteras Beach on the island of Grand Canary.

Water, oddly enough, is at once one of the island's joys and problems. Mercury people share the tourists' delight in Bermuda's azure seas and pink beaches. They soon become devotees of sailing and skin diving.

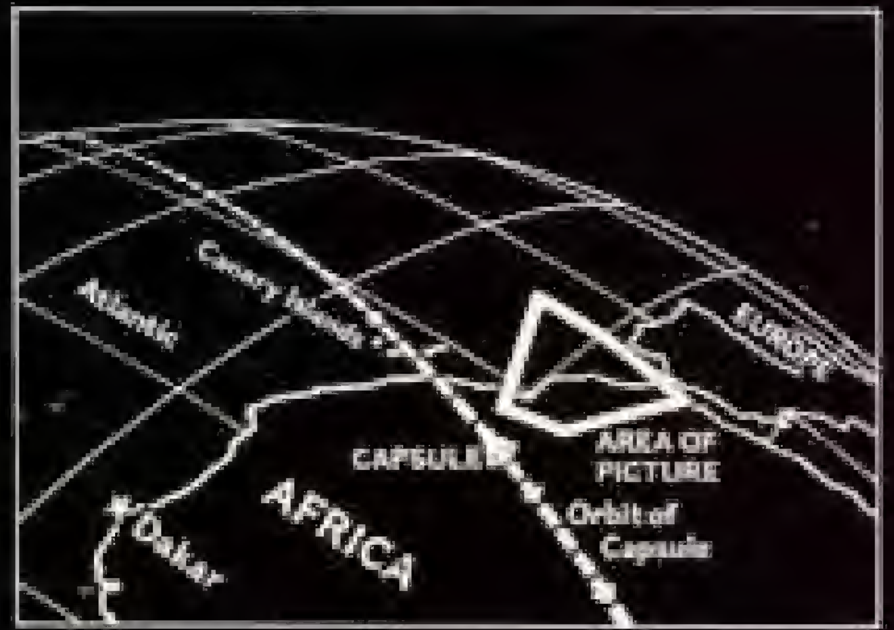
But fresh water comes chiefly from heaven; wells are scarce on this limestone isle.

The Mercury station, like virtually every house on the island, must catch rainwater on its roof to fill a nearby cistern. The station added 5,000 gallons to its supply during one night's rain while I was there.

Bermuda lies 850 sea miles from Canaveral. When an Atlas rocket and its Mercury capsule reach about half that distance, explosive bolts divorce the capsule from its booster, and small rockets known as posigrades separate the two pieces of flying hardware. Then the capsule automatically turns its blunt end forward and begins its lonely flight in space.

At this point the flight controllers back in the big control room in Canaveral, aided by computers at Goddard and Bermuda, must make the critical decision of "GO" or "NO GO." Their split-second reasoning determines whether the astronaut continues his flight or is started back to earth.

"We watch for three things," a Bermuda flight controller told me. "Is the flight path at the right angle? Is the capsule at the right altitude? Has it reached the necessary 17,500 miles an hour that will exactly counteract



SOARING ABOVE AFRICA, a Mercury capsule photographs the face of Morocco with the Anti Atlas Mountains lying in foreground. Clouds at left blanket the Atlantic shore. Map shows the area photographed and capsule's position 123 miles above the new nation of Mauritania. Less than a minute earlier the camera recorded the scene on pages 190-91.

ANSCOCHROME BY NASA

gravity and put it into orbit? Too much speed would thrust the capsule far out into space; too little speed would let it drop back to earth."

During one of the many Mercury tests I witnessed, a Bermuda engineer explained how they "find" an orbiting spacecraft.

"We know where to expect the capsule," he said, "so we point our antennas in that direction." As he spoke, the station's four-pronged antennas and the radar dishes all slued around in unison to face the western horizon in mute anticipation.

Stations Listen for Signal From Space

As word came from Canaveral that the launch had started, the engineer took me to a device known as the acquisition aid.

"This is the 'ears' of our station," he said. "It listens for the telemetry signal—the radio signal from the capsule that tells how the man and machine in space are performing."

About three minutes after the imaginary rocket and capsule had soared from the pad at Canaveral, the engineer pointed to a fuzzy band of pulsating yellow light on the acquisition aid screen. Suddenly it erupted in a steep yellow peak, flickering like a volcanic outburst (page 200).

"That peak tells us that the acquisition aid has caught the capsule's signal," the engineer said. "Now it will guide our radars. When they make contact, they will trigger answering signals from a device in the capsule known as a transponder. We can tell how far away the capsule is by measuring the time in millionths of a second from the moment our signal goes out until the response comes back."

Only ten minutes after launch, the man in space passes beyond the normal reach of Bermuda. But he has little chance to feel lonely. No sooner does he say goodbye to Bermuda than he begins talking to the Atlantic Ocean ship *Rose Knot*, station No. 3. Then, only 18 minutes after lift-off, he has already spanned the ocean and finds himself nearing the Spanish island of Grand Canary.

The Mercury station on Grand Canary lies just off the coast of Africa, so close that the sand dunes of the Spanish Sahara can be seen on its radar screen (page 190).

At the main city of Las Palmas to the north, an overcast sky often hides the sun. But 40 miles by coastal road to the south, brilliant sunshine bathes the Mercury station almost every

Decorative horns jut above sculptured mud walls of a house in Kano, an old caravan center in northern Nigeria. Sunbaked walls seem almost as hard as concrete blocks, but eroding rains necessitate periodic repairs.

Helter-skelter streets in Kano's adobe maze restrict automobile traffic; most residents travel by foot, donkey, or bicycle. In the distance, 40-foot pyramids of shelled peanuts await shipment to market. Green tarpaulins protect the mounds from rain.

KODACHROME © NATIONAL GEOGRAPHIC SOCIETY

© NATIONAL GEOGRAPHIC SOCIETY

Boldly patterned gown of a Kano labor contractor advertises his nation's independence, peacefully achieved in 1960.

Insect appetites forced the laying of metal-armored cable to replace 4½ miles of plastic-covered wire chewed up by termites at the Kano tracking station.

Calabash bowls laden with produce crown the heads of market-bound Kano women.

day of the year. There tomato fields in endless series fill the miles around the site, watered by stone-lined irrigation channels from the island's central mountains.

Few of the 350,000 islanders, I found, knew anything at all of the Mercury station. They seldom travel the long road to Maspalomas, where the station overlooks the Atlantic. Even the villagers nearby are too much concerned with getting each day's supply of goat's milk, fish, and *gofio* (parched corn ground to a powder) to care about travelers in space.

One Canary Islander, however, has seen his life revolutionized by the hungry Americans who work across the road from his tiny store-restaurant. Three years ago Antonio Vega Vega earned a meager living from the local farmers and the tourists who come to swim at Maspalomas. His floors were dirt; his windows had never known screens.

Lumber, screens, and paint donated by members of the Mercury crew have changed all that. Oilcloth now covers his tables. In his larder of canned goods I saw such delicacies as crabmeat, chicken, cocktail meatballs, Danish luncheon meat, salmon, potato salad. His cooler—the only locally owned electric refrigerator for miles around—holds a variety of European beers. Yet in his back room he still pumps wine, olive oil, and kerosene from three large barrels standing side by side.

From his restaurant profits Antonio has branched out into the transportation business. Each day I rode to and from Las Palmas with the Mercury crew in one of his Volkswagen Microbuses.

About half the Mercury men on Grand Canary have their families with them. One is Howard Gusa, a data-processing engineer, whose fourth child was born on the island.

KODACHROMES BY NATIONAL GEOGRAPHIC PHOTOGRAPHER ROBERT F. SISSON © N.G.S.

"The Las Palmas hospital even looked after *me* when the baby was born," he told me. "According to the local custom they moved a bed for me into the maternity ward!"

"Collarbone" Guards Empty Ocean

During a practice run one day at Maspalomas, I sat at the flight controller's console and listened to radio messages calling C-Y-1, the code name for the Canaries station.

"*C-Y-1, C-Y-1, this is Collarbone. Our status is GO.*"

"*C-Y-1, C-Y-1, this is Safe Haven. GO.*"

This cryptic language, I learned, came from two Navy rescue ships stationed in the Atlantic not far away.

"If Canaveral makes a NO GO decision and aborts the flight," an engineer explained, "those ships become very important, because the astronaut will come down nearby."

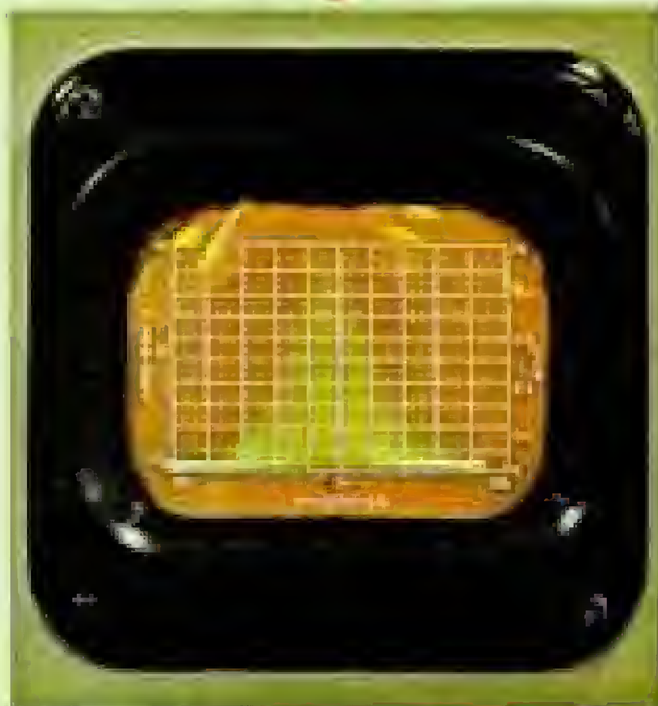
If the Canary Islanders know little of Mercury, the Space Age has made even less impact on Kano, Nigeria. A representative of the Mercury station at Kano illustrated the point as he drove me to my hotel.

"Our night watchman, Audu, carries a bow and arrows while he patrols the grounds out at the main station [page 187]. He sees nothing incongruous about his ancient weapons in a 20th-century world.

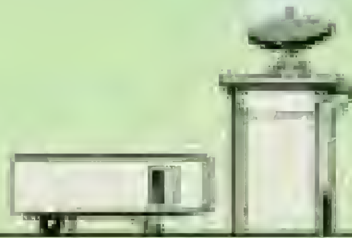
"Most of the people in these parts are Moslem, but many still believe strongly in spirits," he continued. "Some months back, when we were clearing the site, the local contractor found it expedient to call in the juju man to appease the spirit of a huge baobab tree before it was cut down."

I found Kano warm but pleasant, with peanut fields and Guinea corn bright green from the seasonal rains. But earlier in the year the

1 Ears of the tracking station, the acquisition aid locates the orbiting capsule by listening for its radio signal.



Acquisition aid scope shows only a fuzzy yellow line until capsule appears on the horizon. When capsule is "acquired", the line broadens into this pulsating peak.



2 Long-range eye, the Verlort radar, can see 700 miles. Its narrow beam, covering only 2½°, is guided by the wide-beam acquisition aid.

Verlort operator sees blips in his scopes as evidence that his radar signal has triggered the capsule's responding signal.

3 Pinpoint radar spots the capsule within half a degree at 500-mile range. Twelve-foot dish follows the capsule automatically.

Teletype circuits covering 100,000 miles rush radar information to stateside computers that calculate the capsule's exact orbit.

MERCURY TRACKING STATION
AND ITS FUNCTIONS

Computer on Bermuda supplements electronic brains at the Goddard Space Flight Center in Maryland.

Design by William N. Palmstrom,
Painting by John W. Lothers,
Research by George W. Beatty,
National Geographic Staff

© N.G.S.

4 Communications from the astronaut and all radio signals bearing information about man and capsule enter this telemetry and voice antenna. "Slaved" to radar receivers, it remains focused on the capsule during its six-minute pass from horizon to horizon.

Telemetry scope shows multiple peaks representing some 90 items of information carried by radio signal from the capsule to the ground stations.

5 Command antenna shoots signals to fire capsule's retrorockets and to bring spacecraft back to earth. An "alarm clock" in the capsule also fires the rockets as a safety measure. In an emergency the astronaut himself can trigger the rockets.

Displays

Telltale dials, gauges, and recorders describe the spacecraft's progress. Flight controllers talk to the astronaut.

Recorders

Wavy curves on a strip-chart recorder inscribe astronaut's heartbeat and respiration and the acceleration forces.

Astronaut's heartbeat shows up as a jagged blue curve on this oscilloscope. **Clocks** (right) tell how long capsule has been in orbit and when it will fire its retrorockets. Upper clock shows Greenwich mean time.

Mercury's outposts, marvels of electronics, can locate a spacecraft flying five miles a second; track it; talk to the man it carries; measure the performance of the astronaut and his vehicle; and by radio signals bring man and capsule back to earth.

monsoon had brought winds with gusts up to 120 miles an hour. During fall and winter, workmen told me, the harmattan, a cold wind from the northern desert, kept the air filled with powdery dust for days on end.

Native compounds built of Guinea cornstalks and mud dot the countryside. Several lie within an arrow's flight of the station. Youngsters from these villages often crowd along the fence to watch engineers at work on Mercury antennas. Most of them speak only Hausa, but they become adept mimics of the English-speaking visitors.

Emir of Kano Comes to Call

One employee of the Bendix Radio Corporation, which operates five Mercury sites for NASA, delighted in teaching the youngsters "The Eyes of Texas Are Upon You."

When he was transferred from the site, another Bendix technician, Carl Johnson from Wisconsin, stepped in to subvert the loyalties of the Texas converts. I stood with Johnson on an antenna tower one day and listened as his Nigerian friends below happily chanted in unison after him:

"Superior, Wisconsin . . . is the best city . . . in the United States . . . just like Kano . . . is the best city . . . in Nigeria!"

Mercury officials give warm praise to the Emir of Kano because of his stout cooperation with the project. On one occasion the turbaned ruler and 80 members of his retinue came to visit the site. They listened with keen interest to an explanation of how scientists on the ground can talk to a man a hundred miles and more above the earth, listen to his heartbeat, measure the temperature of his body, count the rate of his breathing, check the air he breathes.

I, too, found this explanation fascinating, especially during a test when I watched an astronaut's heartbeat appear as a jagged blue peak on an oscilloscope (page 201).

"Press that button," one of the flight controllers suggested, pointing to a black button on his console with a heart-shaped symbol beside it. Immediately I heard a representation of the astronaut's unhurried heartbeat in my headphones. It was not the usual *POM-pom, POM-pom* one would hear in a stethoscope, but rather an electronic note, a shrill, staccato *duee! duee!*

"All this information, along with some 90 other measurements of the performance of the astronaut and capsule, is broadcast to the ground by radio signal," the flight controller explained. "We call this process telemetry, from two Greek words meaning 'to measure at a distance.'

"The capsule can send as many as 90 items of information continuously on a single signal by using a device called a commutator. The commutator works something like the distributor in your car that sends electricity to each spark plug in a continuous rhythm. It swiftly samples each of the 90 measuring devices – instruments that show oxygen supply, battery voltages, temperatures, pressures, and so on."

He took me into the telemetry room where lights scampered across rows of tiny bulbs like an advertising sign on Times Square.

"This is our *de*commutator. It sorts out all the items of information and sends them through the proper 'gates,' represented by these 90 flickering lights. The entire series of 90 items is sampled every four-fifths of a second, so swiftly that each measurement seems to be coming in continuously."

Swahili Language Causes Confusion

If the astronaut were to come down in the Indian Ocean near Zanzibar, he would know where he was by the pungent odor of cloves blowing from the island. In this British-protected sultanate, with its narrow winding streets, its brass-studded Arab doors, and its *Thousand and One Nights* atmosphere, flying carpets seem somehow more appropriate than flying satellites. But ten miles out of Zanzibar city, near the crossroads of Tunguu, a Mercury station overlooks the sparkling waters of Zanzibar Channel.

The Mercury crew lives quietly to itself, ignoring the island's political ferment that occasionally erupts in street fighting and riots. The Americans' good intentions, I learned, have sometimes been misunderstood because of language. For instance, confusion over Swahili words that can variously be interpreted as satellite, missile, or rocket made it possible for opposition groups to charge that the Mercury tracking station was to be a rocket base.

Muchea (pronounced Moo-*shay*), in the southwest corner of Australia near Perth, stands out in my memory because of the breakfast headline that greeted me on my first morning there: "Russian Man in Space Lands Unhurt." That man was Yuri Gagarin.

Later, at the station, the crew told me

Mercury Men in a Ricksha Tour the Main Street of Zanzibar

An Arabian Nights flavor pervades Zanzibar, town of balconied buildings; labyrinthine lanes, and clove-scented bazaars. The Indian Ocean isle was a slave center less than a century ago.

Cloves are big business in Zanzibar, which together with its sister island of Pemba provides the bulk of the world's supply.

Clove harvester spreads pungent spice to dry in the sun. Cloves, unopened flowers of stately evergreens, are picked by hand twice a year.

KODACHROMES © NATIONAL GEOGRAPHIC SOCIETY

Pink clove buds, tiny bundles of compact petals, are ripe for picking. Some trees bloom for more than a century. An experienced harvester can gather up to 55 pounds of cloves a day.

Perth, Australia's Cinderella city of the west, lifts a glittering skyline above the Swan River.

philosophically that they had expected the news, and that it only made them more determined to be ready at the earliest possible moment to track the American astronauts.

This sense of urgency I found everywhere on the circuit. Installation crews worked uncomplainingly six and seven days every week.

Late last April everyone was keyed up for the first try to orbit an unmanned capsule.

"We sat there smoking our fingers for the last ten minutes of the countdown," one flight controller recalled. "When the Atlas failed and the mission aborted, some of us felt physically ill from tension and disappointment."

It was Muchea that first reported the malfunction of some of the equipment in the capsule bearing the chimpanzee Enos in the flight of last November.

Muchea is a radar and command station, in contrast to the basic stations at Kano and Zanzibar and on the Indian Ocean ship *Coastal Sentry*, which are equipped only to talk to the astronaut and to handle telemetry. Muchea is capable of hurling radio commands to the capsule to stop its flight.

"We're just halfway around the world from Canaveral, you know," an Australian engineer explained, "so we tie down the other half of the 'hoop.' If, during the first half of the flight, radar shows that the orbit differs from the early flight calculations at Cape Canaveral, Muchea can reset the retrofire clock in the capsule to compensate.

"It's a bit like resetting your alarm clock after you've changed your mind about when you have to get up.

Block and tackle hoist an Aussie technician aloft to repair spiral antennas on a Muchea transmitter.

Towers and antennas of Woomera station

KODACHROME (ABOVE) AND KODACHROMES BY NATIONAL GEOGRAPHIC PHOTOGRAPHER ROBERT F. SISSON © N.G.S.

The Mercury tracking station at Muchea lies 35 miles away in sandy bush country

"You know that before the capsule can come out of orbit it has to fire three braking rockets, known as retrorockets, to slow its speed and allow gravity to take hold. Those retros must be fired at precisely the right time—an error of a single second puts the spacecraft five miles farther away from the intended splash point. So our resetting of the 'alarm clock' is vitally important."

When installation teams first came to the sandy scrub country around Muchea, they were beset by large numbers of dugites, snakes whose bite is as deadly as that of a cobra.

"We lost two man-days," the Muchea site manager told me, "trying to get rid of a five-footer that crawled into one of our antenna pipes. We tried water, banging on the pipe, running wires through. Nothing worked until we poured in gasoline and set it afire."

More peaceable visitors, kangaroos, now come to nibble the grass under Muchea's antenna towers.

Woomera Blooms in the Desert

Of all the Mercury stations, Woomera is the most difficult to visit, for it lies in the "Prohibited Area" set aside for U. K.-Australian rocket and guided-weapon testing. However, officials of the Weapons Research Establishment of Australia's Department of Supply, which operates the two Australian Mercury stations, welcomed us.

We stayed at Woomera Village itself, surely one of the most remarkable communities in the world. This rocket town has sprung almost full-grown from the desert, complete

Pet kangaroo entertains an official of the Muchea tracking station and his neighbors in Perth.

survey a bleak, stony Australian desert

Test plane, equipped with Mercury capsule instruments, homes in on the tracking towers

with school, churches, and a fine hospital; playing ovals and bowling lawns; and even a "lolly water" (soda pop) factory. Yet its 5,000 people, including the Mercury crew, are dependent on water and supplies that must be piped and freighted in from several hundred miles away.

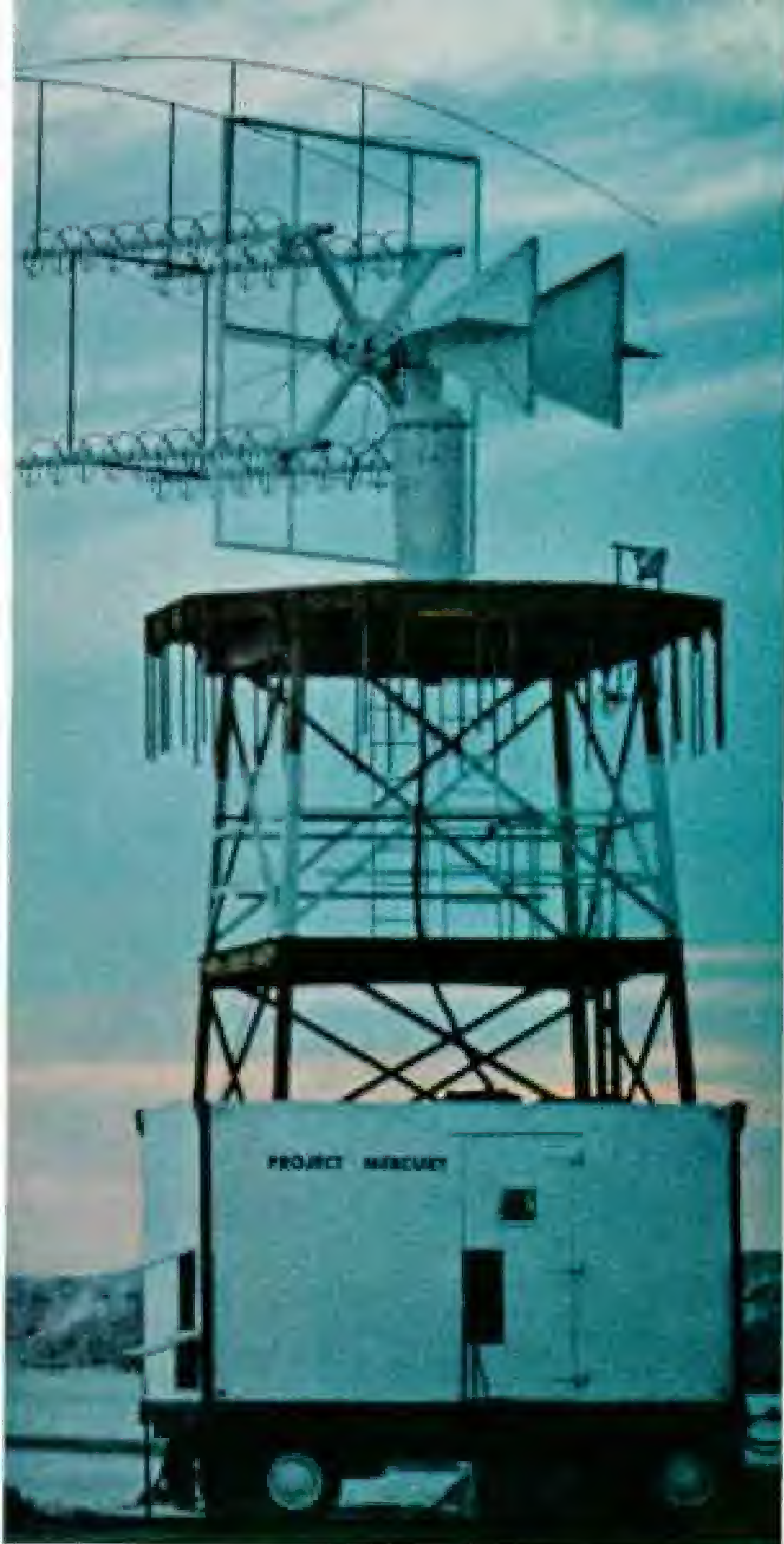
The Mercury station stands in the middle of endless gibber country (page 204). Gibber is the aboriginal word for the smooth brown stones that lie thick upon the land. Gibber rattled a machine-gun volley on our fenders and on the one-eighth-inch steel armor that protected our gas tank and crankcase.

"It's a savage country," the range security officer told us. "It will give you nothing unless you work for it."

Yet sparse clumps of saltbush and umbrella-crowned mulga trees manage to survive in this near-waterless terrain. So, too, do sheep that produce some of Australia's finest wools, and flocks of rose-breasted cockatoos with their unmusical screeching. And kangaroos that leap with magnificent speed but freeze with ears perked high at the sound of a sheepman's whistle, or stand in line back to belly in the thin shade of a telegraph pole during the heat of the day.

Their numbers have made necessary at least one road sign that warns: "Danger: Kangaroos abound on this road at night."

In the Woomera newspaper, appropriately named *Gibber Gabber*, I found advertisements for tanned kangaroo skins. I also saw this



of Canton Island in the South Pacific

notice under the heading "Lawn Mowing Made Easy:"

"One of the local sheep station owners has kindly offered to make available to Woomera residents a number of lambs as pets. Anyone requiring one of these automatic lawn mowers please contact the Woomera Board."

As at Muchea, the installation teams at Woomera faced a special problem. Here it was flies, hordes of black flies that at times infest this arid sheep country. We ran into these pests when we inspected one of the dry salt lakes that dot the desert.

"Imagine trying to work on equipment with insects bothering you like this," said John Kocik, the Western Electric site manager, as flies swarmed around our eyes and mouths despite our frantic beating. "We had to hang mosquito netting around our safety helmets to get any work done at all. Heat commonly reaching 110 degrees in midsummer makes mosquito nets something less than comfortable."

Until the orbiting astronaut passes beyond Woomera's grasp, he has never been more than five minutes away from radio contact with one of the stations. From Woomera to Canton Island he may fly in lonely silence for as long as ten minutes.

Beyond Canton on the first orbit he faces another lonely stretch of 11 minutes before the mainland picks him up. Perhaps this isolation is appropriate, for Canton is the loneliest of the sites.

A slim coral ring enclosing a sea-water lagoon in the middle of the Pacific wastes, Canton has no water of its own. It supports little life other than stunted scrub growth and thousands of seabirds and hermit crabs.

Today's nonstop jets use Canton only for its radio beacon. The landing of planes is infrequent enough to bring out most of the little community. Even Bob Sisson and I found ourselves racing for the airstrip one day to see a plane come in.

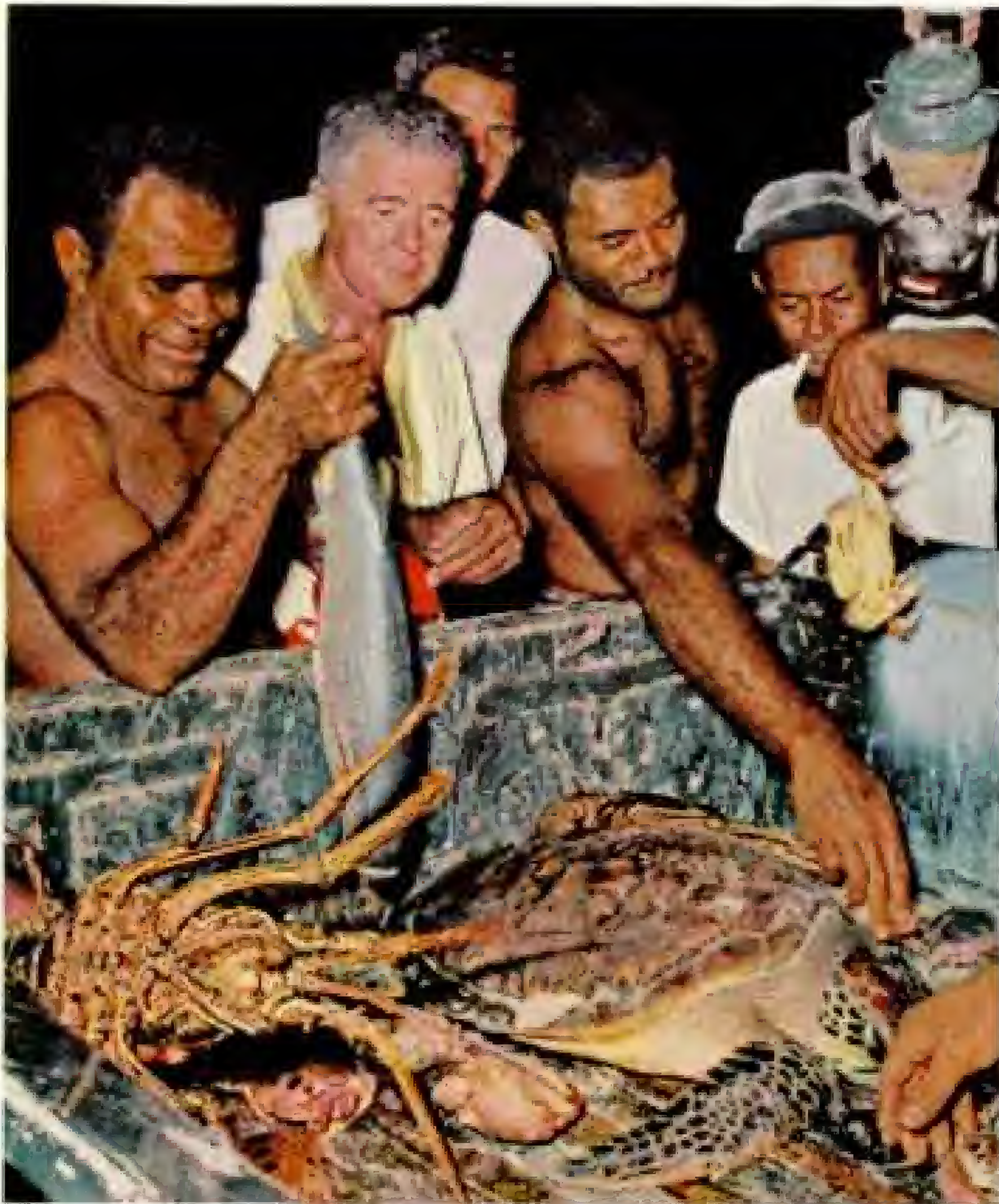
Mercury men all live a bachelor existence, sleeping in quonset hut apartments and eating at the Federal Aviation Agency (FAA) mess hall. Lacking newspapers, they crowd around the station's shortwave receiver each day for the noon newscast. They cannot even talk with Canaveral, as do a number of the larger stations, but must rely on teletype.

Crabs Move Like Shadows

It takes men of adventuresome spirit to stay for months in an isolated spot like Canton. But there are compensations. Sunsets on the long sweep of the Pacific are among the most exhilarating. And the fishing is superb. Only a hundred yards from the station I threw a line into the surf and within seconds had hooked a fighting three-pound bonefish. Waters beyond the reef teem with tuna, wahoo, and sea bass.

One night a large group of Mercury men took Bob and me on a turtle hunt. Our guides were a half dozen Fiji Islanders who work for Qantas Empire Airways on Canton.

We drove in trucks along a rocky beach, with coral plates clattering like breaking pottery under our wheels. When we reached a sandy stretch, we set off afoot so as not to frighten our quarry. Only a faint haze obscured the full moon. The Fijians and I moved ahead of the group, stretched out in



Fruits of the sea—fish, crabs, and 25-pound turtle—reward Fiji Islanders working on Canton. Mercury men inspect the catch.

Bamboo Batons Tap Out a South Seas Rhythm

Gilbert and Ellice Islanders who work on Canton chant and sway to clashing sticks during an evening of songs and dances in a palm-decorated clubhouse. Chief in red lava-lava, a wraparound skirt, calls the orders for the garlanded musicians. "The harmony was as beautiful as that of a trained choir," reports the author, a guest at the performance.

Hunting crabs, a lantern-bearing Fijian wades the shallows off Canton.

a line running inland from the water's edge.

Abruptly a large shadow swept along the beach to my right. It moved so swiftly that I thought it was the moon shadow of a bird.

"Did you see that?" I asked Saula, the Fijian nearest me. He shook his head.

Then another shadow flew across my path, and another. Suddenly I knew the answer. They were ghost crabs, silver wraiths that were hardly visible

except when they moved. Now we began to see many of them, running from our approach, scuttling so fast and dodging so adroitly that I could not catch them. What had been dozens became scores, scores became hundreds. I became a drover with a ghostly herd running before me.

We found no turtles along the beach, but later the Fijians waded out into the surf and captured a wealth of sea life, including a two-foot turtle.

The next morning, as Bob Sisson and I walked down a solitary road from our quarters to the mess hall, a man in a red lavalava approached us on a bicycle. He was one of the Gilbert Island natives who live on the British side of the island. (Canton Island is jointly administered by the United States and the United Kingdom.)

"Do you know a man named Sisson?" he asked. Bob acknowledged his identity, and the messenger handed him a cablegram.

"Congratulations! Your picture of an Algerian student won White House News Photographers Association Award, best color picture 1960." [Page 788, June, 1960, NATIONAL GEOGRAPHIC.]

Somehow in that moment Canton's isolation seemed to evaporate, and the distance between us and home seemed small indeed.

KODACHROMES © NATIONAL GEOGRAPHIC SOCIETY

Even paradises have flaws. I discovered this fact when I visited the station at Kauai, in the Hawaiian chain. Here I was charmed by the wealth of tropical flowers, by soaring overlooks, by lush green valleys and dazzling beaches, by the roar of the pounding surf and the happy cries of surfboard riders.

But a Mercury wife saw this idyllic picture through slightly different eyes. "Prices here are much higher than at home," she lamented. "And you think the roar of the surf is wonderful because it's new to you." She smiled. "It's not so wonderful when you're trying to hear TV!"

Roads are also a small problem on Kauai. The only access to the station is a 16-mile mountain stretch so rough and so sharply curved that tires may go to pieces in 4,000 miles. Precipices threaten the unwary, although they also offer spectacular views of Waimea Canyon whose half-mile depth and rich colors have earned it the title "Little Grand Canyon."

When we first traveled the road to the Kauai site, we were startled to find a large red stoplight in the middle of nowhere. It guards a sugarcane field crossing, where heavily loaded trucks rumble past in large numbers during harvest.

Doctor Checks Astronaut in Flight

At the station I learned about the role of the flight controllers, three men who become the most important figures at a station during a Mercury flight. They sit at three adjoining consoles in the control room, and their lives become tense indeed during the six minutes when the station is able to communicate with the orbiting capsule.

One is the capsule monitor, who keeps an eye on how well the capsule is performing.

Another is the capsule communicator, or

Technicians in sports shirts check electronic gear for long-range radar at the Kauai Island station in the Hawaiian chain.

Graceful hands tell a story about a star as dancers perform in a Kauai garden.

Like manicured lawns, pineapple fields terrace the slopes of Kauai. Roads accommodate trucks that spray, fertilize, water, and harvest the fruit. Iron oxide stains the earth red. Heavy gloves protect workers against the spiny plants.

"cap com," so called because he does most of the talking with the astronaut.

The third flight controller, the medical monitor, watches over the physical condition of the astronaut. Dr. Thomas R. A. Davis, a surgeon from Massachusetts who travels to one of the foreign stations for each Mercury flight, described his responsibilities.

"Other people look after the mechanical systems; my job is to keep an eye on the man," Dr. Davis explained. "On our consoles we monitor his pulse, his respiration, his body temperature. We warn him to use emergency measures if necessary. We watch his conversation closely, because his manner of speaking can give the first sign of danger."

I asked Dr. Davis about a rehearsal at one tracking station where teletype messages came through reading, "Astro is now delirious and singing to himself," and "Astro appears to have stopped breathing."

Davis laughed. "During our simulations with the astronaut, he is given a script and is prompted by a medical man on how to indicate various medical conditions. Some of these are quite unlikely to occur, but it is good training. When you consider that we have only about six minutes to 'diagnose by telephone,' you can understand why we literally sweat before the dials of the console and forget it is only a simulation."

I asked what actually could happen to the astronaut.

"If the oxygen pressure or cabin temperature went way out of ordinary," Dr. Davis answered, "or if the suit temperature jumped way up or down, we would have to decide if he should continue. We might test his condition by asking him to do certain things or reply to specific questions. If we find that the astronaut is confused or ill, we would strongly recommend that he come down.

"Actually," he concluded, "the astronaut will be quite comfortable, I expect."

It is not possible for you and me to visit a tracking station while a man is in orbit.

Battlemented city jail serves Guaymas, Mexico. Boys watch Otto Womick, NASA station director at the Guaymas station, as he adjusts his movie camera.

Earthbound satellites orbit around their Mercury parents on the beach of Bocochibampo Bay, Guaymas.

Mexican arcade charms Mercury visitors touring Alamos, whose silver mines built stately homes.

But come with me to the station at Guaymas, Mexico, on the Gulf of California. There, at the last stop on our global tour, you may enjoy a glimpse of what a Mercury flight is like.

It is long past midnight. Lights blaze in a large windowless room in the Guaymas telemetry and control building, where we have been sitting all night.

Around us a group of shirt-sleeved men wearing headphones hunch over electronic consoles, closely watching the blinking of colored lights, the quivering of needles on dials and gauges, the fleeting passage of wave forms across television-like screens.

We sit entranced. We are witnesses, as much as earthbound men can be, to the orbital flight of a Mercury spacecraft.

Tonight's flight is a full-dress rehearsal for the entire Mercury tracking network. But so skillfully is it simulated that in our control room we cannot tell the difference between rehearsal and reality.

More than an hour ago our headphones crackled with the familiar rocket countdown from Cape Canaveral, eastward across the continent; then the elated cry, "The bird's away!" Since then, one by one, we have heard the terse reports of Mercury stations around the globe as their radars traced the capsule that never was.

Now the spacecraft approaches Guaymas, and tension creeps through our control room. The hum of air conditioning, the clicking of clocks and relays seem unnecessarily loud. No one moves about except the silent messenger from the teletype room. The glass-covered plot board glows warmly, seeming to anticipate the moving pens that will trace the capsule's orbital path.

An hour . . . an hour and 20 minutes . . . an hour and 26 minutes after lift-off, and a faint spoken signal breaks the spell.

"Guaymas cap com, this is Mercury. Do you read me?"

The phantom man in the capsule is calling us. Blips on our radar screens show that we have locked on to the capsule. Dials and gauges jump from zero to vital readings: oxygen supply, 95 percent; cabin air temperature, 90° Fahrenheit; suit pressure, 5 pounds per square inch. All are normal.

Our medical observer, watching a paper tape recording the astronaut's simulated heartbeat, nods approvingly. Our capsule communicator queries the man in space and scribbles furiously, for the spacecraft passes overhead from horizon to horizon in only six minutes.

The fact that man and capsule are simulated scarcely detracts from the drama of this preview. Magnetic tapes provide the signals to operate our radar and data-gathering equipment. But the voices we hear are real people, manning their posts at Canaveral and Bermuda and other tracking stations, keeping vigil around the world just as we are doing at Guaymas.

Only the astronaut's voice is unreal: It is dubbed in by a technician in another room.

"What you see and hear tonight," an engineer remarks, "is almost exactly what will happen when the first American does orbit the earth."*

As each of the chosen American astronauts takes this whirlwind ride three times around the earth, we will have a mental picture of his route far above jungles, deserts, and empty stretches of sea. At that heart-stopping

*For previous GEOGRAPHIC articles on the U. S. space program, see, "The Flight of *Freedom 7*," by Carmault B. Jackson, Jr., and "The Pilot's Story," by Alan B. Shepard, Jr., both September, 1961; "Countdown for Space," by Kenneth F. Weaver, May, 1961; "Exploring Tomorrow With the Space Agency," July, 1960; and "Cape Canaveral's 6,000-mile Shooting Gallery," October, 1959, both by Allan C. Fisher, Jr.

[illegible] NATIONAL GEOGRAPHIC PHOTOGRAPHER [illegible] © N.G.S.

Mechanical arms that write as they move trace the path of MA-4 at Goddard Space Flight Center, Greenbelt, Maryland. On each orbital flight, data from the world network funnel through Goddard to Canaveral, providing a second-by-second log.

Radio Signals From Point Arguello Brought Enos the Chimp Back to Earth

Mercury's California tracking station lies within a 19,000-acre Navy facility 140 miles northwest of Los Angeles. A radar installation, as imposing as a fortress, crowns 2,159-foot Mount Tranquillon. Upon orders telephoned from Cape Canaveral, Arnold Aldrich, chief flight controller at Point Arguello, fired the MA-5's retrorockets to end the chimpanzee's trip through space.

EKTACHROMES BY U.S. NAVY (ABOVE) FOR NASA AND RALPH MORSE (RIGHT) © N.G.S.

MA-5 capsule carrying Enos the chimp swings aboard the destroyer U.S.S. *Stormes* after recovery in the Atlantic 220 sea miles south of Bermuda. Actual flight time: 3 hours, 21 minutes.

KODACHROME BY NATIONAL GEOGRAPHIC PHOTOGRAPHER OTIS IMBODEN © N.G.S.

Alone in space, yet not alone. When an astronaut soars skyward, earthbound scientists share his adventure. Here, during countdown on the MA-4, Canaveral's Mercury Control Center crackles with excitement. TV screens show the launching pad before lift-off. Flight controllers hunch over consoles. Wall map will trace the capsule.

Enos is A-O.K.! Astrochimp arrives at Canaveral for a second battery of tests two days after his 50,000-mile flight. Doctors on Bermuda had already pronounced Enos fit, though his pulse and heartbeat had risen during the second orbit.

moment when his shiny Atlas showers Cape Canaveral with thunder and flame, you and I will share the tension of men in remote places as they prepare to track his spacecraft and put to use the skills they have practiced for many months.

In our mind's eye, we will be again at a tracking station, listening in headphones to the capsule communicator as he talks to the astronaut; watching over the shoulder of the medical monitor; hearing with him the Mercury man's heartbeat.

A flight controller will reach up to lift a guard and throw a command switch marked "Retrofire." A trio of green lights will go on one by one, telling us that the capsule has fired the braking rockets in its nose. Speed slackened, the spacecraft will begin the long glide earthward that ends with splashing impact in the Atlantic some 3,500 miles and 15 minutes later.

The world will applaud, and men at Canaveral and Washington will politely bow. But as we cheer, we will tip our hats to the unsung men who have stood global watch to make that heroic flight possible.

Yugoslavia's Window on the Adriatic

Article and photographs by GILBERT M. GROSVENOR

National Geographic Staff

"DUBROVNIK WELCOMES YOU," cried a tousle-headed teen-ager as I crossed the moat to his walled town. "I, Ado Čimić, also welcome you; you now have the best guide in Yugoslavia!"

Grabbing my heavy camera case, he slung it over his shoulder, grinned widely, and continued talking without giving me a chance to interrupt.

"Now, first we'll visit the naval museum and then. . . ."

"Wait a minute," I protested. "I'm not sure I want your help."

"Every tourist needs a guide," he countered. "Now after the naval. . . ."

"I'm not a tourist; I'm a journalist. What I want. . . ."

"A journalist! Then I guide for free. Write how good I, Ado Čimić, guide you, then all tourists will ask for me."

Ado's offer of unpaid labor didn't interest me, but his enthusiasm did. We agreed to meet for a look at Dubrovnik's evening promenade, or *korzo*.

"See you later, alligator," he shouted as he faded down a winding street.

I was eager to see Dubrovnik again—this gem of the Adriatic. Twice before, over a six-year span, I had visited here. I have watched this beautiful coast become industrialized and have seen its cities swell in size. Along Dalmatia I was eager to renew friendships and to swim once more in warm Adriatic waters.

The Yugoslav korzo is a gay social affair. Daily at dusk old and young alike stroll along the main street (page 222). Men relax after a hard day,

Perched on a rocky balcony overhanging the Adriatic, the town of Dubrovnik epitomizes a land that long stood at the center of conflict. By wit and wile, Dubrovnik remained a republic for centuries, surrendering independence only after Napoleon had swept through Europe.

Today the town, once called Ragusa, takes hope for the future from expanding tourism. Sometimes called the Slav Athens, Dubrovnik offers music, theater, regattas, and tennis matches.

Here, beside one of the pebbly beaches that cling to Dalmatia's shores, Romana Milutin paddles her foldboat. Ado Čimić clutches the boat.

Miss Yugoslavia, Romana Milutin won the contest after submitting photographs taken by the author

women welcome relief from the summer heat and housework, and teen-agers meet their friends and kindle new romances.

Ado spotted me instantly when I joined the promenade. He introduced his friend Miro, a wiry lad. Like all youths, they waved to the passing girls. Ado greeted a particularly attractive young lady.

"Your girl?" I teased.

"No," he replied, "but she is my friend. You want to meet her?"

Before I could answer, he was off in pursuit. Triumphantly he returned.

"This is my American friend, Gil, who wants to meet you, Romana," he said to her.

I was embarrassed, but not so much so that I did not ask her to join us and my traveling companions, Maté Meštrović and his wife Jane, at a waterfront cafe. Maté is the son of the famed sculptor Ivan Meštrović (page 228).

Romana, a recent high-school graduate, works in an architect's office, but she hopes to study drama in Zagreb.

Both Miro and Ado are students at the Merchant Marine Academy in Dubrovnik. They will soon graduate as ensigns.

"I'll get a good job," Ado assured me in the excellent English he learned in school. "In

Dubrovnik's sun-bleached walls ring Renaissance treasures. Once the harbor

1945 our ships were on the bottom of the Adriatic. Today our growing fleet sails on all the seas."

"It's the best way to travel," he added. "I want to see how people live in America, England, and Canada."

I asked Ado about the stylish American-type shorts he wore. "A friend I guided from New York sent them," he said. "Miro's sport shirt comes from London. Unfortunately we won't get any more," he added.

"I might send some," I ventured.

"No, please don't," Miro requested. "The government just put a high tax on imported gift parcels, and we simply can't afford it."

"A tax on presents?" I questioned.

"The government wants to build up Yugoslav industries, so they have discouraged such gifts," Miro answered. "They want Americans to send us dollars, which would be exchanged for dinars so that we could buy our own products. The dollars are then used to purchase vital imports from abroad."

For days I roamed Dubrovnik. Surrounded by well-preserved, high thick walls, it nestles beneath Dalmatia's rugged mountains. Seaward, waves pound against sheer cliffs and thick stone walls (below and page 218).

sheltered powerful argosies that sailed the world; now pleasure craft abound

Twilight in Dubrovnik Invites a Promenade on a Car-free Street

Day's work done, townspeople seek the solace of companionship. Up and down the Stradun, a broad main street that permits no wheeled traffic, stream young lovers arm in arm, mothers leading children, elderly men seeking their friends. Some stop for a sip of wine or coffee at a cafe; others pause to pray in the Franciscan Church whose campanile (background) rose in the 1300's.

Some may take these moments of the dying day to remember Ragusa's high-noon glory. When most of Europe was just emerging from the gloom of the Middle Ages, this maritime republic endowed schools for all classes, abolished slavery, and financed a home for foundlings.

Merchant princes in Renaissance palaces dispatched caravans to Constantinople and sent ships foraging the seas for commerce.

Children trip down stairs of a street framed by age-mottled homes. Dubrovnik forbids within its walls new buildings out of character with medieval architecture.

ANSCOCHROME (ABOVE) AND EKTACHROME © NATIONAL GEOGRAPHIC SOCIETY

For many centuries the compact, tiny republic rebuffed foreign conquerors by skilled diplomacy and clung to its independence. Ragusa, as this town was formerly called, competed successfully in the 15th to 17th centuries with the great maritime power of Venice without armed conflict. The republic's galleys were always in demand because they were swift and reliable. So famous became "a vessel from Ragusa" that the word "argosy" still connotes treasure-laden galleons, adventure, and romance.

It took an earthquake, followed by fire, to topple Ragusa. On April 6, 1667, the quake killed 5,000 inhabitants and crumbled many buildings. Her treasuries were depleted repairing damage, and the republic slowly withered. In 1918 Ragusa became part of Yugoslavia. Dubrovnik's argosies are gone, but her mariners still captain Adriatic steamers.

My young Yugoslav friends proved remarkably similar to American youths. They like jazz, wear blue jeans or shorts and sports shirts, swim vacation days away, and dance by moonlight. But Ado was hardworking and eager to get ahead. Jokingly, I told him he had the makings of a good capitalist.

Unfortunately, not all my memories of Dubrovnik were pleasant. Last summer when I tried to look up a friend I met on a trip in 1959, I couldn't find him. His name was Vlaho, and his family owned a bakery. Daily he arose

at dawn, helped bake the day's pastry, tended the store, then swept it clean at night. He was 14, worked a 15-hour day, but always had smiles and free cookies for his friends.

Today his father no longer owns the bakery. The government seized the store, asserting that Vlaho's father owed a million dinars (then $2,500) in back taxes, which he denied. Finally I found Vlaho. He had become lazy, unkempt, and disillusioned.

Cities Swell as Farms Decline

The night before the Meštrovićs and I drove to Split from Dubrovnik, Ado, Miro, and Romana had a party for us. We enjoyed domestic salami, cheese, and Žilavka, a white wine. I regretted leaving these cheerful youngsters.

As we said good-night, Ado had a request: "Will you photograph Romana for us? We want to enter her in a beauty contest."

Later, Romana wrote to thank me. She had been chosen Miss Yugoslavia (page 219).

Dubrovnik is a magnificent town, and Split, its "neighbor" 145 miles north, is a beautiful, bustling port, but the road between is a nightmare. Punctured tires, rutted gravel roads, and dangerous blind curves combine with the stifling heat and summer dust to dishearten even the most venturesome tourist.

Except for isolated pockets of fertile soil cradled in the valleys of towering mountains, the geography of the Dalmatian Coast is stark and awesome: bold mountains, dressed only with sparse, burnt underbrush. Stone shells of ghost houses and rock walls, interwoven into small patterns across rocky fields, mark the graves of dead villages. The farmers have fled to the cities. Today only sheepherders with their flocks seek shelter among the ruins from the parching midday sun.

I recalled talking with Edo Jardas, then president of the district council of Rijeka, a city on the northern coast.

"Only about half the prewar peasant farmers remain in coastal villages," he told me. "By the thousands they are moving to the cities. Both Rijeka and Split are bursting at the seams—as you would say." His eyes twinkled when I smiled at idioms he had learned while in Canada.

"My country is industrializing as quickly as possible. We already have aluminum factories, canning plants for our fisheries, heavy-duty diesel-engine factories, and coastal oil refineries, as well as several shipyards with huge capacities," he told me.

"Are those ships Yugoslav-designed?"

"You bet they are," he roared. "Only the engines are from a foreign patent. But soon

Konavlje Farmers Pitch Hay Before a Towering Limestone Backdrop

Most Yugoslav farmers own their small farms, usually split into scattered tracts. Fewer than half own work animals and fewer still, tractors.

Prosperous farmers of the fertile Konavlje valley sell their vegetables, figs, grapes, and wine in Dubrovnik. Good drainage saves them from the overwhelming floods that turn many such valleys into springtime lakes. Ages of erosion have tumbled the mountain soil into the lowlands.

Wooden canteen hangs from the belt of a farmer sharpening his scythe. One of the Konavlje dwellers, he displays the straight and stalwart physique characteristic of these hardworking people.

we'll design the diesels, too. We want to build our ships down to the last button" (page 249).

"Have those former farmers adapted to city life?" I inquired.

"Yes, sirree!" Mr. Jardas replied emphatically. "And they have a living standard they never dreamed of before. Jobs are available for anyone. Right here in Rijeka we could employ another 2,000 workers if we had adequate housing. We're building 800 apartments in the suburbs and 1,200 in the town, but even then we'll need more."

Matě Meštrović interrupted with a candid query. "If conditions are so favorable," he asked, "why are so many young people fleeing Yugoslavia?"

Mr. Jardas hesitated a moment—long enough for me to think we might be asked to leave—then answered: "Young people are the same the world over. They expect fried chicken to fall from the sky."

Economy Depends on Highways

A familiar "wham" ended my reflections—the day's second blown tire. Luckily, I had two spares. Tire changing was systematic now, and, after rewiring the vibration-loosened muffler, we continued.

The Yugoslavs, well aware that their highway network is the key to their economic expansion, give roadbuilding top priority. Mr. Leo Mates, Assistant Secretary for Foreign Affairs and former Ambassador to the United States, had told me that "with great effort from everyone, including student summer labor and American aid, we'll soon convert from railroading to trucking."

I recalled how Mr. Mates had sketched Yugoslavia's plans: "Our highways will be like a central nervous system. A superhighway, the spinal cord, will stretch from Austria to Greece. The coastal road will run from Trieste to the southern border. Nerves will stretch northward to Hungary, eastward to Romania and Bulgaria, and westward to the sea. Our ports will then dominate the Adriatic." (See the ten-color Atlas Map, **The Balkans,** distributed to members with this issue).

I had asked Mr. Mates how the coastal highway was progressing.

"Unfortunately, blasting through solid rock is very tedious—and extremely expensive," he answered. "The coastal road is perfect from Trieste to Split. Soon it should reach as far as Dubrovnik."

I quickly rolled up the front and rear windows and slammed shut the sun roof as another truck roared past me trailing a thick

Soccer Fans in Split Perch on Billboards, Sit on Walls, and Pack Rooftops

KODACHROME BY ALBERT W. GROSVENOR, NATIONAL GEOGRAPHIC STAFF © N.G.S.

"Yugoslavs love sports," says author Grosvenor, "and appear to have the leisure to indulge their passion. Seemingly everyone in the city of Split tried to see this match against the Moscow Dynamos. Fans went wild when their Haiduks [in red-striped jerseys] upset the Russians 2 to 0." The Haiduk team takes its name from outlawed guerrilla fighters of the 16th century.

[illegible] EKTACHROME © NATIONAL GEOGRAPHIC SOCIETY

Meštrović Masterpiece: Psyche in Marble Adorns the Sculptor's Onetime Home

Ivan Meštrović ranks as Yugoslavia's premier artist. His statues in wood, stone, and bronze signaled the nation's transition from classic to modern art. With imagination, strength, and passion, the sculptor has won a generation of disciples and the admiration of the world.

Meštrović was once a shepherd boy carving wooden figures in Dalmatia. His genius flowered at an early age. When 30 years old, he had 29 exhibitions on display in Europe. He executed sculptures of presidents and popes. His memorials include one to the Unknown Soldier near Belgrade and to the American Indian at Chicago.

During World War II Meštrović suffered imprisonment as an Allied sympathizer, but intervention by the Vatican obtained his release. After accepting a professorship at New York's Syracuse University, he became an American citizen. In 1955, at the age of 72, Meštrović joined the faculty of the University of Notre Dame.

Deeply revered in Yugoslavia, the sculptor—a critic of Communism—waited until recently to revisit his home. Here, at Split, his son Maté shows Mrs. Gilbert M. Grosvenor through the Meštrović villa, which his father gave to the Yugoslav people.

dust cloud. How careless I had been to miss the subtlety of Mr. Mates's remarks: What he had been admitting was that roads around Dubrovnik were awful!

But once the coastal road is completed, vacationers can easily reach the southern resorts. Especially attractive is Miločer, once the summer palace of royalty. This hotel and its pebbled beach rank with Yugoslavia's finest. The hotel is set on the sea with beautiful shrubbery and gardens. Silvery-green olive groves climb the hillside. Miločer offers swimming, hiking, and boating.

I occupied the king's private suite. The porch faced the sea. I had a sitting room, a dressing room, and a huge tub in which I could easily have drowned. I began to feel a bit kinglike myself.

When I ordered chicken livers for breakfast, Maté warned me, "Don't get regal ideas, Gil. Remember, King Alexander was assassinated, and the royal family now lives in exile."

Whether you arrive in Split by automobile or ship, your first glimpse of the tall tower of the cathedral in Diocletian's Palace is a glorious sight.

Split Rebuilds Around Its Past

The city's industrial growth since the war is amazing. The shipyard is rebuilt; a modern plastics factory exports finished products to Egypt, Ethiopia, and the Sudan, and a cement plant operates around the clock. New apartments to house the mushrooming population dwarf Diocletian's Palace. But no modern concrete building can dim the glory of the past. Diocletian and his palace are still Split's most famous attractions (opposite).

Born in Dalmatia of humble origin, young

(Continued on page 233)

Aïda Sings Out Her Tragedy in the Courtyard of Diocletian's Palace

Roman Emperor Diocletian abdicated A.D. 305 at the age of 60 and retired to the splendor of a new palace in his native Dalmatia. When Slavic tribes invaded the area in the 7th century, the palace proved useful; refugees crept behind its walls, making houses out of rooms and adding lean-tos that clung like barnacles to a ship (page 232). Thus the city of Split was born. World War II bombs tore away part of the encrustation, and a movement to restore the palace began. These opera singers play Egyptians, from whom the Romans took a 3,500-year-old black sphinx still in the courtyard.

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Ghostly Warriors Haunt Trogir, Island Fortress of Medieval Battles

Founded by the Greeks in the 4th century B.C., Trogir suffered from plagues of conquerors. But she remembers moments of glory. In 1242 King Béla IV of Hungary took refuge here from invad-

KODACHROME © NATIONAL GEOGRAPHIC SOCIETY

ing Tatars. While clamoring hordes lay encamped on the mainland, Trogir refused to yield, and the enemy retreated. Battlemented Kaštel-Kamerlengo (right) rose during the 15th century. Auguste de Marmont, Napoleon's governor-general, played cards in the white-columned belvedere at the island's tip. Trogir Channel, which surrounds the town, served more than once as a protective moat.

(Continued from page 228)
Diocletian joined the Roman Army and won rapid promotion for valor in combat. When Numerian was murdered A.D. 284, Diocletian was proclaimed emperor.

Upon taking the oath, he vowed to restore the decadent Roman Empire to its earlier glory. However, his struggle proved futile, so Diocletian abdicated and retired to his homeland. He lived his last days in Split, where he built a luxurious palace.

In those distant times the walls of Diocletian's Palace faced on the water, and envoys from Rome docked there. Now a palm-shaded street runs along the quay.

Palace Becomes Apartment House

Tomo Marasović, a young archeologist in Split, showed us everything from recently excavated cellars to tiled rooftops.

"At first the people of the area sought protection within the palace walls from the invading Avar armies," he told me. "However, Yugoslavia always had invading armies; so the people settled here permanently. Today hundreds of apartments are crammed into Diocletian's Palace" (opposite).

Tomo insisted that Jane, Maté, and I dine at his father's home. Mr. Marasović, a prosperous contractor and builder before the war, now operates on a much-reduced scale, since he is permitted to hire only five men.

His three-story house sits high on a hill overlooking the city. Mrs. Maria Marasović does her own cooking. Maté had warned me: "Eat a little of everything, but don't eat much of anything. Otherwise, you'll never get through the meal."

Mrs. Marasović proved Maté a prophet. I managed the soup and rice pilau easily

Luxury to Laundry: Diocletian's Palace Becomes a Drying Yard

British architect Robert Adam arrived in Split in 1757 to inspect the city within a house. Lacking a plan of the palace, Adam painstakingly traced original walls concealed behind haphazard constructions. His imaginative but largely accurate drawings of the palace filled a book. Published in England, Adam's work inspired the best in Georgian architecture, a style that crossed the Atlantic and influenced the design of the White House in Washington, D.C.

ALL KODACHROMES BY GILBERT M. GROSVENOR © N.G.S.

Dalmatian handicrafts attract Romana. Decorated leather covers the bottles; elaborate chasing adorns a coffee urn. Old-time minstrel's one-string instrument, known as a gusle, hangs above the linen tablecloth and napkins.

Beauty wears a kerchief edged with the handmade lace for which the island of Pag is famed.

enough. Gingerly, I ate through a huge fish dish and potatoes, served with white wine. I faded badly on the pork course with beans, zucchini, beets, and salad. Only a strong constitution and Mrs. Marasović's wonderful hospitality kept me from passing up the peaches, ice cream, cakes, and liqueur.

In Split I met a schoolteacher named Vladimir Sunko, who invited me to sail with him. As a member of the local yacht club, he can sail the club's sloop.

"We can follow the regatta. It's the biggest one on the Adriatic. We have boats from all up and down the coast here this week," he told me as we bent on the sails.

The waters off Split are fa-

Old methods, new architecture: Shuttling headloads of plaster into an apartment building nearing completion, this Šibenik worker, like many Yugoslav women, helps relieve the housing shortage.

Rent is low but space is limited in the Vladimir Sunko family's state-controlled apartment in Split. A teacher of English and an artist, Mr. Sunko painted the wall scenes. His wife works in the post office. With two salaries they can afford luxuries such as the Italian tape recorder on the couch.

mous for sailing, and more than a hundred boats were racing: Stars, Snipes, Finns, and small cruising boats. I thought I was on Long Island Sound, until I heard a skipper yell for buoy room in Serbo-Croatian.

Vladimir insisted I come see his new apartment and meet his wife and son (below).

"Is the rent high?" I asked.

"It's incredibly cheap," he answered. "You see, the state controls nearly all of the new housing units being constructed today. In those developments the size of a person's apartment is determined by the size of his family."

Prices in Yugoslavia have skyrocketed in the past three years, but housing remains one of the cheapest items in the worker's budget. The big problem, of course, is to find a flat. Even with the all-out building program of the past years, housing is a serious problem.

I complimented Vladimir on his attractive apartment. "Thank you," he beamed. "My wife and I decorated it ourselves, but it is very expensive. For example, a board 15 feet long and 6 inches wide costs 1,000 dinars."

(The present rate of exchange for tourists is 750 dinars for a dollar. The rate was 600 in 1961, 400 in 1959, and 300 dinars in 1957.)

"But Yugoslavia exports wood," I objected. "It can't be that scarce."

"Yes, we do export wood," Vladimir agreed. "We need the dollars. We sell furniture, good fruit, fish, and wines for dollars to import the essential materials and machines."

"Is it difficult for a schoolteacher to make ends meet?" I asked.

"Not if your wife works in the post office," he chuckled. "Between us we earn 50,000 dinars a month, and I confess that my wife makes almost two-thirds of it. Taxes and pension deductions take a great deal."

He seemed content with his life. He loved teaching, had an attractive family, and found time to sail.

KODACHROMES © NATIONAL GEOGRAPHIC SOCIETY

Yugoslavia produces

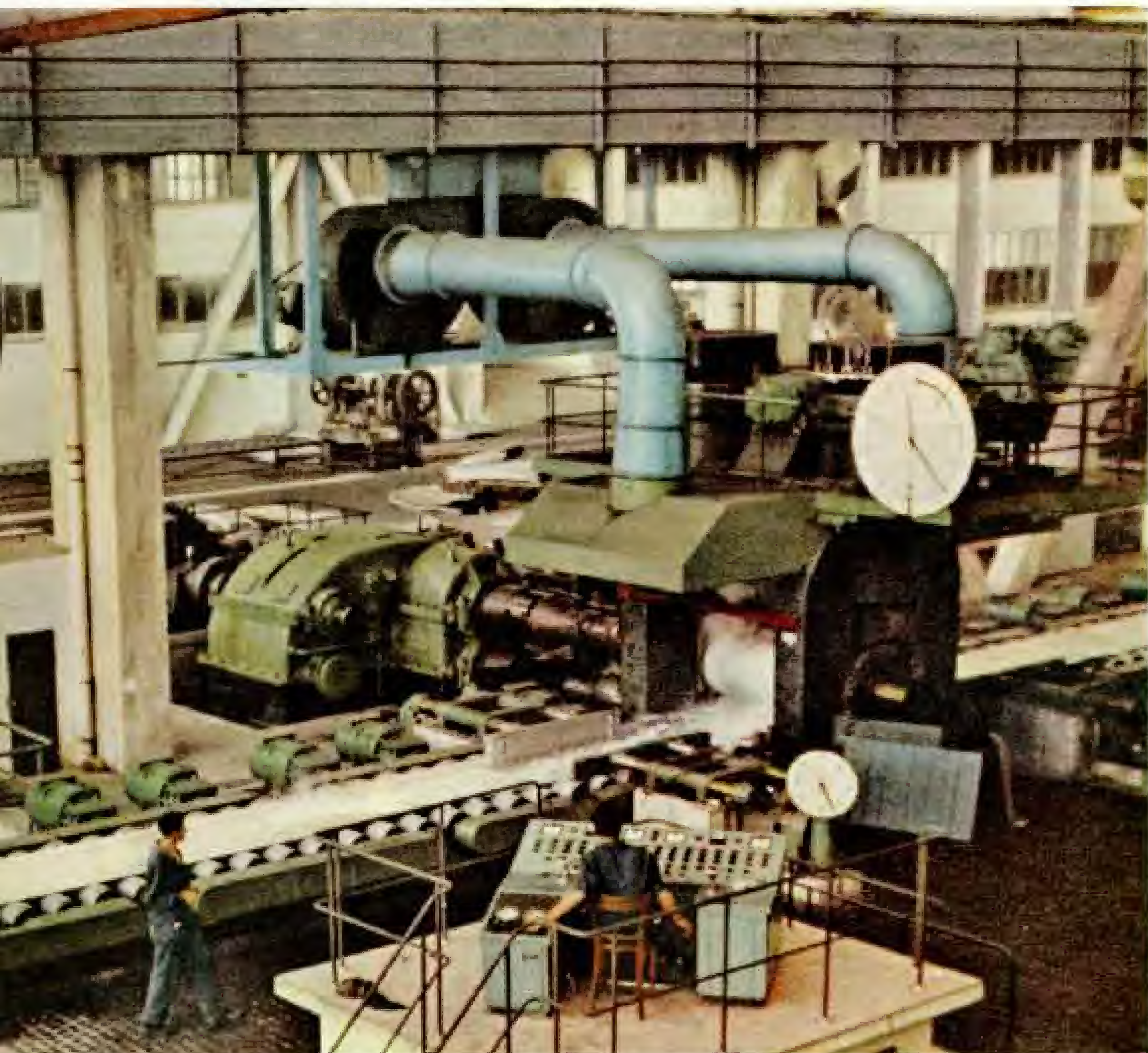
When I told Vladimir I planned to drive to Šibenik that afternoon to see the aluminum factory, he was very envious.

"I understand it's quite new and modern. I wish I were going with you," he said as he bade me goodbye.

The drive from Split to Šibenik is short, and soon I pulled into the flower-lined entrance to the Boris Kidrič aluminum plant, a complex of low, modern glass-fronted buildings.

"Has this plant been built since the war?" I asked, amazed at its vastness.

"Most Yugoslav industries are postwar," answered Mirko Rončević, the factory director. "During the war, everything was razed,



aluminum for America

terazed, and kept demolished. More than 820,000 buildings were destroyed. But we've rebuilt rapidly."

Metal chips "pinged" against protecting shields as giant lathes machined large aluminum cylinders into precise shapes for a customer across the globe. Overhead, coiled sheets of aluminum rumbled toward the loading platform, bound for New York (above).

Aluminum bars (left) were rolled back and forth until, under great pressure, they were squeezed into thin sheets.

"How could you afford to build this plant, and where do you get the technicians to run it?" I inquired.

"German reparation funds and Yugoslav bank loans," Mr. Rončević said. "The machinery and tools are German, but the workers and engineers are Yugoslav. More than 1,600 men and women came straight from the fields to the factory. It takes five months to train them. Since 1955 the nation has doubled aluminum production. In 1960 Yugoslavia turned out 25,000 tons—and showed a profit for workers and government."

In prewar Yugoslavia, bauxite was exported, and expensive finished aluminum was imported. Now Yugoslavs process their own aluminum and export semifinished products.

While the Yugoslav standard of living is at a record high, the people must work harder then ever. They dress attractively and eat

reasonably well. Although they grumble about inflation, low wages, and long working hours, there is little real discontent. But the fact that they *can* complain without fear indicates that the government is becoming more tolerant.

Many workers hold two jobs. Take Viktor Tadejević. Before the war, he farmed full time. Today, though he still cultivates his vineyard, farming is secondary.

"My shipyard job comes first," he told me. "I qualify for insurance, old age pension, and free medical care for my family. And I get a bonus for each child. Today, if you want security, you must work for the government."

Close to the soil, Viktor Tadejević supplements his income by cultivating grapes on generations-old terraces near Bakar (upper left), a northern coastal town.

Tilted vineyards depend on limestone walls to hold soil and moisture. The Bakar region produces a famous sparkling wine, Bakarska Vodica.

Coastal steamers, plying Adriatic waters at right, sail so close to the land, says the author, that "you can almost stand on deck and pick the grapes off the vine."

KODACHROME © NATIONAL GEOGRAPHIC SOCIETY

I asked how long he works each day. "The shipyard bus picks me up in the village about six in the morning and brings me home about three in the afternoon. Then I tend my vineyards until dark. On Sunday afternoons I take the family swimming. I work 12 to 15 hours a day."

Like most Yugoslavs, Viktor works at his job six days a week. His leisure hours are few, but he is content as long as he can feed and shelter his family and educate his three children.

"Perhaps they'll fare better," he concludes.

The Dalmatian fishermen, always admired for their seamanship but handicapped by antiquated equipment, have modernized. Diesel-powered steel trawlers equipped with two-way radios and nylon nets have replaced many of the wooden rowboats.

By night fishermen hunt sardines; by day they sleep in lean-tos on the shore near a narrow entrance to a bay and fish for tuna. In shifts, a fisherman sits atop an 80-foot ladder, angled over the crystal-clear water. When the tuna swim by, he shouts to rouse a slumbering shipmate who closes the net behind the fish, entrapping them.

Fishermen may earn more than 20,000 dinars a month. Unlike the farmers, whose stubborn opposition to collectivization forced the government to abandon it, many of the fishermen welcome it. Their pay, pensions, and other benefits put them in a relatively high income bracket.

In 1959 when Maté and I visited the small fishing village of Klenovica, we helped an elderly woman complete a U. S. social security form. Her husband, now deceased, had emigrated to America and worked in Detroit. For years he paid his social security tax. Now

his widow qualified for the benefits. Last year we revisited the woman. Her monthly social security from the U. S. amounts to 45,000 dinars—more than twice a fisherman's income.

War Left a Generation Missing

Everywhere along the coast I saw evidence of a missing generation of men between the ages of 35 and 50. In World War II more than 1,700,000 Yugoslavs lost their lives.

Unfortunately, divisive groups within the country hastened capitulation to Nazi forces and increased Yugoslav losses during the occupation. Serbs fought the Croats, both fought the Germans and the Italians, while some Montenegrins used the war as a pretext to settle generations-old blood feuds. At one point, 11 different armies roamed Yugoslavia, each stalking the other.

Hopes for the future were hindered by the legacies of the past. But Josip Broz Tito had united his underground Communist Partisans with a hard core of Yugoslav guerrilla veterans of the Spanish Civil War. The Allies supported the Partisans by air drops. Tito bravely led his band of Yugoslavs, which grew from squads to platoons to brigades and, by war's end, to many divisions. Women joined the ranks, carried rifles into battle, and gained equal status with the men.

Today thousands of these women have joined the labor force to increase Yugoslavia's manpower. They came from the fields with their families to work in the cities. I asked one country girl why she had left her coastal mountain village to work in a factory producing metal cans.

"There is no work at home," she told me. "The stones cannot be farmed."

A woman draftsman in a shipyard and a woman laboratory technician are recent university graduates. But women also tackle rugged manual labor. On the roads they wield picks alongside the men, and on construction projects they carry heavy loads of mortar and stone (page 234).

In industry, fishing, agriculture, even in government, the older men and the new labor force of women must fill the gap until the younger generation matures.

Today the future of that younger generation, like the destiny of all Yugoslavia, lies with President Tito.

Always an avowed Communist, Tito pre-

Industry lures women from farm and home

dictably gravitated to the U.S.S.R. in 1945. For three years, Russia successfully kept the Yugoslav satellite in orbit. But when the Soviets insisted on complete political and economic domination of Yugoslavia, Tito balked.

Dramatically, the Yugoslav satellite broke with Russia. At first the Yugoslavs suffered economically, but soon they gained.* A factory manager told me: "Initially the break with Russia set us back five years, but already we have jumped ahead ten years faster."

Private Shops Best Serve Travelers

"Stalinist" Communism was abolished and "Titoism" was born. Today it is still evolving to serve Yugoslavia's and Tito's needs. Like mechanics tinkering with carburetors, the Yugoslavs alter their constitution as conditions change. When they saw fallow lands, they levied exorbitant taxes on the owners. When urbanization outstripped apartment construction, the government penalized house owners who had unused spare rooms. When waiters became fat from tourists' high tips, they installed a maximum 15 percent service charge to be shared by all workers.

Today, the government permits limited private ownership of small businesses employing up to five workers. However, the private employer is harassed by such high taxes and compulsory employee benefits that many private businesses fail. Nevertheless, in privately owned shops the traveler is usually best served.

In Rijeka, for example, I drove into a tire repair shop just off the main street. The manager, not even bothering to inspect my tire, said: "Our patches aren't very good. But there's a small tire shop about three blocks away that might help you."

I followed his suggestion. When the second shopkeeper saw me wrestling the tire out of my car, he rushed out, snatched it away, and rolled it into the workshop.

"I'll have it fixed in thirty minutes," he told me as he removed it from the rim. The difference in attitude puzzled me.

"Why are the patches better here?" I asked the second garage man.

"Same patches," he assured me. "Only this is *my* store. The other shop is state-controlled. He makes no money repairing your tire."

*See "Yugoslavia, Between East and West," by George W. Long, NATIONAL GEOGRAPHIC, February, 1951.

Lacemaker on the island of Pag (opposite, left) still patiently plies her needle, but few girls elect to follow the trade. Shepherdess spins yarn as she tends her flock, but she represents a dying way of life. Today Dalmatia's young women swarm to the cities, fill the universities, and take jobs such as this one at a drafting table of a shipbuilding firm in Rijeka (below, left). Girl at right recently moved from her mountain home to work in a Rijeka can-making plant.

SUPER ANSCOCHROMES (BELOW) AND KODACHROMES BY GILBERT M. GROSVENOR © NATIONAL GEOGRAPHIC SOCIETY

Kotor, Encircled by Mountain Walls, Dwells in the Aura of a Shangri-La

War, plague, earthquake, and foreign occupation thrust the once-thriving port into the backwater of history. Kotor's deep gulf, linked to the Adriatic by the passage at upper left, attracts few ships today. Rocky ramparts limit winter sunshine to a few hours daily. Kotor lies in Montenegro, whose name means "Black Mountain." Switchback road at right leads to Cetinje.

In Yugoslavia the government and Tito are synonymous. Whenever I asked about the future of the country, the answer was always the same: "Ask Marshal Tito."

Seeing the President of the Federal People's Republic of Yugoslavia is difficult. I drove to Belgrade, made about thirty phone calls, and waited three weeks.

I spent the pleasant delay in Opatija, a

northern resort town. For days I floated in the warm Adriatic aboard my air mattress, soaking up the sunshine and making friends with Yugoslav, German, and Austrian tourists. Young children were especially friendly, which pleased me until I realized I owned the only available air mattress.

In Opatija I discovered an interesting Yugoslav free enterprise, and started one of my own. Several artists spent the day selling their canvases, then working well into the night painting new ones. They were shrewd bargainers, and I got nowhere until one of them noticed my Polaroid Land camera. I photographed his girl friend and immediately showed him the print. He was delighted. Quickly he opened his canvas case and withdrew an impressionist seascape I had ad-

mired earlier but found too expensive at 20,000 dinars.

"The picture and 10,000 dinars," he offered.

"Two Polaroids and 5,000 dinars," I said.

The painting now hangs in my living room.

Finally I was summoned to the island of Brioni, the summer retreat of Marshal Tito and important Yugoslavs. A luxurious speedboat carried Maté, Jane, and me from Pula to Brioni. In a horse-drawn carriage we toured the manicured grounds where deer, other game, and rare animals roamed.

Inside the presidential palace, polished marble floors were covered with exquisite Persian rugs, and walls were adorned with rich tapestries and priceless paintings. But to my surprise, President Tito does not live here. He prefers the smaller nearby island of Vanga. Again we sped across the water and docked at a small landing. We followed a flagstone walk through the dense foliage, which finally opened onto a small patio. Only President Tito's aide Nikola Mandić and an official photographer were present.

Suddenly the Marshal appeared from a partially concealed path. For an instant, he stood still, then briskly crossed the patio to shake hands. He was impeccably dressed in a white silk suit and white shoes. A large diamond stickpin graced his blue-and-white tie. He smoked continuously, using the long ivory cigarette holder that is his trademark.

The President was politeness itself, but it soon became obvious he had no intention of discussing his country's social or economic plans. I turned to photography.

Rather carelessly I opened my aluminum camera case, and my gunstock tripod tum-

Sun's fading gold tints the sky as fishermen begin a night's work near Novi. Kerosene lantern on the boat's bow lures fish, and a long-handled spear impales them.

Yugoslavia's leader, President Tito, ponders a question from the author (right). Attaining prominence as a guerrilla leader in World War II, Josip Broz Tito strives to industrialize his nation and modernize its agriculture. He received Mr. Grosvenor near Brioni, an exclusive island resort area. Mrs. Maté Meštrović acts as their interpreter.

bled out. Like a cat a waiter sprang to my side. Mr. Mandić leaped from his chair to shield the Marshal. When President Tito saw the cause of the excitement, he roared with laughter. "You almost ended badly," he said, as his protectors retreated.

He relaxed. "How does that thing work?" he asked. I explained how the gunstock steadies the camera for telephoto lenses. Expertly, President Tito squinted through the viewfinder and remarked, "Wonderful! You know, I take pictures myself."

"Yes, I know. I saw your pictures in a Yugoslav magazine taken on your Asian trip," I told him. "They were quite good."

His steel-blue eyes twinkled. "Show me what else you have in there," he said. Soon my equipment – Leica and Nikon cameras, various lenses – was scattered over the patio. He minutely inspected everything. The interviewer became the interviewed.

Yugoslavia Cherishes Independence

In my travels I saw evidence that the two-billion-dollar U. S. aid had helped the country: Natural resources are being worked; new industries thrive. Modern roads are being built; housing is under construction; and many hydroelectric plants are operating.

Yugoslavia's economic growth has been phenomenal (a greater percentage increase than either the Soviet Union's or the United States'); its important position in the neutral bloc of nations gives the government internal prestige; and the country has retained its independence. This is all important to the proud Yugoslav. After centuries of foreign domination, there is every reason to believe he would die fighting rather than surrender his hard-won independence.

The big question in Yugoslavia today is: "After Tito, where do we go?" Tito has a strong following. Many people told me that even if free elections were held today, he would almost certainly win. However, Yugoslavs remember with strong distaste their brief domination by the Soviets, and many are skeptical of Communism.

If Tito remains in power until Ado's generation matures, and if he continues to unite Serbs, Croats, Slovenes, Macedonians, and Montenegrins, the future could be bright.

But regardless of who rules, Yugoslavs can always take pride in their towering mountains rising majestically from the Adriatic; their thousands of beautiful tiny coves and inlets; their picturesque coastal villages; the walled town of Dubrovnik; the memories and traditions of the famous Diocletian, and the inspiring reality of his palace.

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Pula's Roman Amphitheater Once Rang With the Shouts of Gladiators

Built early in the Christian Era, the Adriatic colosseum remains one of the world's best preserved. Marble seats held 20,000 spectators at hand-to-hand fights and sea battles. Today Yugoslavia's film festival and musical dramas draw crowds on summer nights.

Box marked with a red cross serves as a first-aid station for visitors. A boy tosses a ball amid the amphitheater's broken columns and fallen pediments.

Restive Heartland: the Balkans

FOR CENTURIES the Balkan Peninsula has echoed to the tread of armies. Roman legionaries and Frankish Crusaders wound through its valleys to assault the bastions of Asia; Mongols and Turks swept in from the East to slash at Europe. Its name gave rise to a verb – balkanize – meaning "to break up into smaller ineffectual and frequently conflicting units."

Even today the Balkans are a source of trouble and unrest, as they were in past centuries. Across the upper right-hand corner of the latest map in the National Geographic Atlas Series, **The Balkans,** curves the Soviet border.* Among the nations shown on the map, political differences loom large, and geography plays a key role in this disunity.

Yugoslavia, for example, shares no common border with the U.S.S.R. Buffered by Hungary and Romania, the country has successfully defied the Kremlin for 14 years and now leavens its brand of Communism with capitalistic incentives. Tiny Albania, insulated by towering mountains, shrilly denounces both the Russian and Yugoslav styles of Communism and praises the Red Chinese.

In 1956 Hungarians rose in an anti-Communist revolt which was bloodily suppressed by Soviet troops. Romania and Bulgaria remain dutiful satellites of Russia, while Greece and Turkey stand firmly with NATO and the West. Black shading on the map shows the Iron Curtain boundaries between Communist and Free World countries.

The Danube River winds through the heart of this region. From the upper left corner of the map, it passes through Vienna, cuts southeast to bisect Budapest, snakes past Belgrade, and flows within 35 miles of Bucharest before emptying into the Black Sea. This river remains the great trade and commerce artery that it has always been.

Because of the large scale of the Atlas Plate – 34 miles to the inch – the counties of landlocked Hungary appear for the first time on a National Geographic map. (For legibility these counties are numbered in blue and named, with their capitals, at the right of the map.) Also shown are the areas administered by the so-called autonomous cities of Hungary and Romania. They still preserve a degree of local self-government over surrounding areas.

Pécs in southern Hungary is an example of such a city. Near it lies a recently developed major uranium field; virtually the entire output goes to the Soviet Union.

Largest and most populous of the Balkan nations, Yugoslavia with its 18½ million people fronts on the Adriatic Sea. Gilbert M. Grosvenor describes its "stark and awesome" coast in an article beginning on page 219.

City Where World War I Began

A red airport star near the center of Yugoslavia marks a city whose name still has a sinister ring after almost half a century: Sarajevo, where an assassin's bullet killed Austrian Archduke Franz Ferdinand on June 28, 1914, and sparked the flames of World War I.

The map records the new official spelling of Ploieşti – formerly Ploeşti – for Romania's gigantic petroleum complex just north of Bucharest. During World War II, Ploieşti supplied a third of Germany's liquid fuel. In one of the war's most daring operations, 177 American bombers raided Ploieşti from Libya on August 1, 1943. At a cost of 54 aircraft and 532 airmen, the bombers destroyed almost half of Ploieşti's refining capacity.

Scars left by that massive raid have been erased. But today Ploieşti supplies only 35 percent of Romania's oil output; new wells have been brought in elsewhere. Romania is again Europe's largest oil producer. All but a trickle of the black gold flows to Communist states.

*The Balkans, twenty-ninth in the series of uniform-sized maps issued as magazine supplements in the past four years, becomes Plate 39 in the Society's Atlas Series. To bind their maps, a quarter-million members have ordered the convenient Atlas Folio, at $4.85. Single maps of the series, at 50 cents each, or a packet of the 28 maps issued in 1958-61, at $11.00, may be ordered from the National Geographic Society, Dept. 97, Washington 6, D.C. A combination of the 28 maps and folio is $15.25.

Berthed in Dry Dock, a Yugoslav-built Ship Gets an Overhaul in Rijeka

Reconstructing bombed-out facilities with the aid of German reparations after World War II, Rijeka today hums with one of Yugoslavia's biggest industries, shipbuilding and repairing. Here some five thousand workers fill orders from a dozen countries.

KODACHROME BY GILBERT M. GROSVENOR, NATIONAL GEOGRAPHIC STAFF © N.G.S.

Exploring Antarctica's Phantom Coast

By CAPT. EDWIN A. McDONALD, USN

U. S. Navy Task Group Commander
Bellingshausen-Amundsen Sea Operations

Photographs by W. D. VAUGHN

THE ENEMY WIND blinded and deafened us. Eight-inch hawsers holding our two ships to the ice snapped; yet we heard nothing above the shrieking gale. The blizzard engulfed our pilothouse; looking outside was as futile as peering through a quart of milk.

Our icebreakers, U.S.S. *Glacier* and U.S.S. *Staten Island*, were hard put to keep bows nudged against the solid sheet of ice in the 100-mile-an-hour Antarctic winds. Both the ice-anchor lines and the six mooring lines that held the two ships together had long since parted. Now *Staten Island* and *Glacier* were fighting their separate battles. Although we could see nothing, the radarscopes showed a score of bright blobs astern—treacherous icebergs. In the wind's teeth we could hold our own only by steaming full speed ahead.

Our position was dangerous, but something else worried us more. Joel Langhofer, a topographic engineer from the U. S. Geological Survey, put into words the thought that chilled us all: "Commodore, how do you think our men are doing?"

Four of our fellow explorers were out in the white hell, some 75 miles away. They had no shelter except two small tents, and the wind would make short work of those unless they were pitched in a protected place, not an easy thing to find in the Antarctic.

Neither the shore party nor the ships could move; helicopters could not fly. Nothing to do but wait and worry. The sheer frustration of our situation, the inability to act, weighed heavily upon me. As leader of the task group, bearing the customary title of commodore, I was responsible for the safety and well-being of those men and all the others I had led into this savage white wilderness.

Ice Pack Defies Exploration

We had ventured here—504 men aboard two ships—because no one else had ever been here before. We had battered our way into the ice-locked Bellingshausen Sea to explore the Eights Coast, one of the least known parts of Antarctica—the stretch which Adm. Richard E. Byrd long ago dubbed the "Phantom Coast." It lies between the Palmer Peninsula and what was called the Thurston Peninsula until our 1961 expedition, when we confirmed an aerial scouting report and our own observations of the previous year: The "peninsula" was really an island (map, pages 254-5).

For nearly two hundred years the Antarctic ice pack had defied all efforts to reach this coast. One ship, *Belgica*, under Belgian leader Adrien de Gerlache, had been locked in its ice fields for over a year in 1898-99 before freeing herself. Now this realm of ice and snow was living up to its formidable reputation.

By helicopter the four men had been flown ashore in a mild spell of weather two days previously, February 12. They were to stay 24 hours, taking sun sights to help chart the area and gathering samples of rock and lichens a thousand miles from the South Pole.*

The weather alone was giving them plenty to observe. Hardly had the helicopters returned, when a fierce storm hit suddenly. Our own plight was bad enough. How much worse must be the plight of men exposed to the full fury of those raging, ice-laden winds!

Finally, on the third night, winds eased to 25 miles per hour, and we could prepare to launch our copters in the growing light of a new "day," shortly after midnight.

Two large copters spun away for the rescue. A small one followed as a communication relay at the halfway point. I rode the small craft and soon heard a burst of radio talk.

"All four of them are here," a voice said. "They're trying to get aboard before I can sit down. They look all right to me." I relayed the good news to the ship.

A short time later, however, we got an indication of the privations suffered. Reversing his first hurried appraisal, the pilot requested that a doctor examine the quartet on arrival at the ship. "They don't look so good," he radioed tersely.

When they stepped out on *Glacier*, the strain was recorded in their black-rimmed eyes and cracked hands (page 256). Fortunately, our doctor found nothing wrong that warmth, food, and rest wouldn't cure.

Over coffee they told us their experiences. Trouble began half an hour after the first two men landed. Lt. Comdr. James Peeler, USN, and Larry Lepley of the Navy Hydrographic Office, lighted their oil-burning stove. It developed a flaming leak. In less than 60 seconds, the nylon tent was consumed.

Gales Batter Shore Party

A canvas windscreen shielding the surveying instruments was guyed to a pair of ice axes sunk into the ice. A blast of wind snapped both handles. It also knocked Peeler flat—and out—for a few minutes.

The only one in the party with previous Antarctic experience was Dr. Brian Roberts, a British observer with the expedition.

"Let's build a wall of loose stones," said Roberts. "Looks like we're in for it."

"Right then," Peeler declared, "we decided

*See, in the NATIONAL GEOGRAPHIC: "What We've Accomplished in Antarctica," by Rear Adm. George J. Dufek, October, 1959; "Man's First Winter at the South Pole," April, 1958, and "We Are Living at the South Pole," July, 1957, both by Paul A. Siple.

◀ **Sun burnishes sea** as the icebreaker U.S.S. *Staten Island* cruises along the Eights Coast, the "Phantom Coast" of pioneers. On this 1961 voyage the U. S. Navy charted frozen frontiers and made discoveries that altered the map of Antarctica (page 254).

Helicopters Rendezvous Above Icy Wastes of the Bellingshausen Sea

Aircraft from U.S.S. *Glacier* and *Staten Island*, both under the author's command, shuttle cartographic teams to McNamara Island. Photographer's foot appears to skim an iceberg as he leans from the cabin. Fire later destroyed the Sikorsky in background.

KODACHROMES BY W. R. [illegible] © NATIONAL GEOGRAPHIC SOCIETY

100°

Pack ice

Pack ice, composed of blocks as thick as 10 feet, may be blown tightly together by a north wind, or turned into loose chunks by a south wind, leaving gaps of relatively open water

71°

After making rendezvous north of the pack, Glacier and Staten Island fought their way through the ice, with Glacier in the van

Expedition spots black iceberg

U.S.S. GLACIER's course through the pack ice

Cape Braathen

Cape Palmer

Dyer Point

Cape Davies

Noville Peninsula

Evans Peninsula

Glacier recovers tattered remains of U.S. and N.G.S. flags left by her crew on the 1960 voyage

3100

3000

72°

Cape Flying Fish

THURSTON ISLAND

Walker Mountains

Mt. Hawthorne 3400

Seraph Bay

Shelf ice

Demas Ice Tongue

PEACOCK SOUND

Sherman Island

Ship-based helicopters search out land and ice

Shelf ice, overlying deep water

Shelf ice

73°

King Island

Burke Island

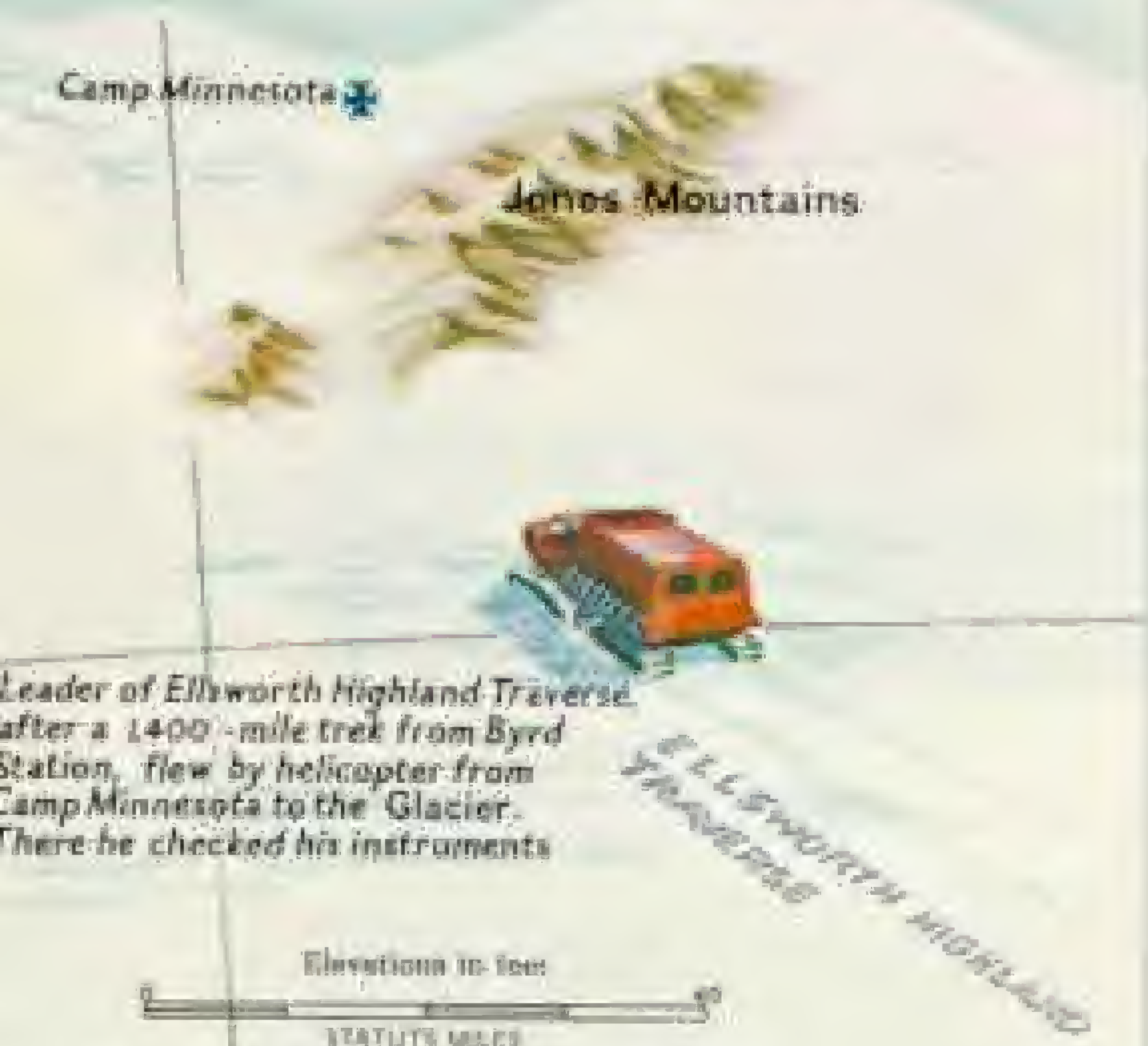
Uncharted area

AMUNDSEN SEA

74°

Voyage of Discovery:

Penetrating farther than any previous ships into the ice-armored Bellingshausen Sea, the U.S. Navy icebreakers Glacier and Staten Island stripped some of the mystery from Antarctica's "Phantom Coast." Aerial reconnaissance confirmed that Thurston "Peninsula" (left) is really an island (above)



Dr. Roberts would give the orders and we'd take them."

The wind was so strong it was hard to stand erect, but the four managed to construct a shelter of rocks, using the canvas screen as a roof. Thereafter they kept to their sleeping bags, unable to eat. They attempted to keep warm in the −20° cold by huddling together.

The next day they managed to build a small annex of stones, like a sleeping porch. Peeler slept in it with the idea of rescuing the others if snow caved in the main shelter. This was shelter in only the crudest sense. The blizzard sought out every crack in the walls, leaving a thick white layer on the sleeping bags.

"Early this morning," Dr. Roberts said, "with the winds dying somewhat, I decided we should erect our tent. But when we tried to step outside, we found ourselves so cramped and weakened we fell flat on our faces. Our gloves were frozen so hard we couldn't work in them. We were forced to crawl back into our shelter."

Wind Snuffs Out Rescue Flares

An hour later they heard engines and saw two beautiful helicopters.

"Those pilots did an incredible job," said another member of the party, Avery A. Drake, Jr., a U. S. Geological Survey geologist. "We lighted flares in an attempt to show them wind direction, but the winds were still so strong the flares burned out uselessly. The

Storm-lashed Scientists Return to *Glacier* From Unexpected Exile on the Eights Coast

Trapped by 115-mile-per-hour gales that balked helicopter rescue, the shore party suffered three days of hardship and sub-zero cold in the makeshift shelter below.

Toppled tent roofs a lair of stones where the scientists lay cramped and frostbitten beneath screeching polar winds. Before digging in, the men obtained information that contributed to the accurate charting of Eights Coast.

Survivors of a helicopter fire swing to safety aboard a rescue craft. Black-nosed copter at water's edge burned while flying a salvage mission over McNamara Island. Four occupants, including the photographer, escaped injury when the copter fell 10 feet.

copters would touch on icy patches of the outcrop, slip downhill, and touch again until they were able to get us aboard."

I asked Dr. Roberts how this experience matched others he had had in the Antarctic.

"This was unquestionably far worse than any I've ever had," he replied with conviction. "Winds were well over 115 miles per hour, I'd judge. I shouldn't like to repeat it soon."

Marooned men and ships, however, were nothing new to *Glacier*. During the voyage of the previous year – when we had made our first successful penetration of the Bellingshausen Sea – our ships had been called away from exploration to rescue two vessels trapped in the ice 1,000 miles away: the Argentine icebreaker *General San Martin* (which fought clear the day before we reached her) and the Danish *Kista Dan*, which carried Sir Vivian Fuchs, the British leader who guided his party across Antarctica in 1957-58.*

Now, once more, we were back in Antarctica, assigned to explore both Bellingshausen and Amundsen Seas. With high hopes of success, we had rendezvoused with the smaller icebreaker *Staten Island* near the Amundsen Sea and headed south toward the ice.

Ship Rolls 60 Degrees

It may seem strange to a landlubber, but our men look forward to the ice because sailing there is calmer – at least for an icebreaker – than in the open sea.

These ships are designed primarily to smash polar ice. Their hulls beneath the waterline are rounded, with no keels to help keep them upright. Even in a light sea such vessels react much in the fashion of a log in a millrace. In a rough sea 50- and even 60-degree rolls are not uncommon.

When your world rolls like this, the simplest actions become difficult. Eating is tough; you do it with one arm around a stanchion, balancing a cup of soup or a sandwich in the other hand. Everything is lashed down – but something is sure to get away and roll around in the cabin or on deck.

You can't sleep much because you must hold onto the bunk. En route to the rendezvous, many of our new crew members were seasick, and I doubt they felt the proper sympathy for the captain and executive officer of *Glacier*, who were both thrown out of bed. The captain suffered a gashed head that called for 13 stitches.

We saw our first iceberg of the trip on February 1, 1961. During the next two days we saw larger bergs and more of them. When 200 miles from the Antarctic Continent, we encountered what we call eight-tenths ice – 80 percent ice, 20 percent open water.

Each mile we moved forward disclosed new, and thicker, patterns of floes and icebergs that made progress increasingly difficult. Like great sugar-frosted pancakes, the floes soon covered all but a few patches of sea, giving the impression of a white desert on the surface of the moon. *Glacier* led the way, seeking leads of open water and cracking through ice where no leads showed.

***Glacier* Escapes Ice Trap by Heeling**

Newspapermen aboard were surprised to learn how an icebreaker does its job. They had thought we would cut our way through with sharp prows. Instead, we put the ship's tonnage to work. When ramming a floe, the ship's bow rides up on the ice, then crunches down and through by sheer weight. If the floe doesn't give, you're in trouble.

In the yellow rays of the low sun, the ice looked delicate and harmless. Actually far from weak and innocent, it was quite capable of wrecking our screws and crumpling the ships themselves.

I was in "aloft conn," the 100-foot-high pilothouse on *Glacier*'s hollow mast, when the ice grabbed us. The officer of the deck, Lt. Ross Hatch, was conning the ship. Ahead two floes had come together – one about half a mile across, the other 400 feet wide. Hatch aimed for the seam.

As he pushed the engine control levers all the way forward, the diesels thundered with 21,000 horsepower, and the ship charged ahead. She reeled under the impact, bucked forward, slowed, and came to a shuddering halt, propellers churning futilely.

Hatch pulled the controls all the way back, reversing the 17½-foot screws. The ship trembled like a palsied whale but couldn't wrench free. Heavy, snow-covered ice had yielded only enough for the bow half of the vessel to enter, and it held us fast, despite repeated engine reversals at different rudder positions.

Grabbing a phone from the bulkhead, Hatch spoke briskly: "Engine room, this is the officer of the deck. Cut in the heeling system. Tell me when you've got it working."

*See "The Crossing of Antarctica," by Sir Vivian Fuchs, NATIONAL GEOGRAPHIC, January, 1959.

Hatch proposed to "sally" the ship—to rock it from side to side to break the ice's grip. In the old days of Arctic and Antarctic exploration, sallying ship was accomplished by having the crew run back and forth across the deck. *Glacier*, of course, is much too heavy for that. We heel her by taking in 250 tons of sea water and pumping it from starboard to port tanks and back.

The engine room buzzer sounded. "Heeling system working, sir."

Glacier shook and slowly listed to port. Her twisting motion loosened the clutch of the ice so she could shudder backward. "Full ahead!" We rammed the pack again, then broke free by heeling to starboard. Smashing and twisting, we crashed our way through.

Antarctic ice offers a believe-it-or-not variety. There are bergs of every shape imaginable: large, small, square, round, solid, hollow. Some look like castles. I saw one that was the shape of a dry dock—and large enough for us to sail into for overhaul. Others have enormous caves at the waterline; we call them "whale hangars."

Iceberg Wears Black Coating

We even saw a black iceberg! About two miles away, it rode in the water beside a large floe, looking as if it had a load of coal dumped on it. A helicopter landed me on the floe. Cautiously I walked to the edge, near enough to reach over to the berg. It was covered with stones and gravel.

This was moraine, rock that had been ground up by the advancing glacier and held

Glacier, **leading, and** *Staten Island* **break out of a straitjacket that imprisoned them four days.**

in the ice until the edge broke away as a berg. Since Antarctica's basic geography is that of a broad hump, glaciers move outward from the South Polar region—an ice plateau 10,000 feet high—toward the lower coasts. The slow pace of the glaciers makes it probable that the stones were picked up many hundreds of years ago, perhaps even before the birth of Christ.

Fathometers Find Undersea Peaks

Drake pronounced the samples I brought back metamorphosed sedimentary rock, quite different from rocks we had collected along this coast in 1960. So the black berg had drifted from some unknown shore.

Late that afternoon our ships broke into ice-free waters adjacent to the coast. We were approaching the Thurston Peninsula in wonderfully calm seas. Our fathometers clicked out a profile of the bottom, showing many underwater pinnacles.

Our orders read that on sighting the peninsula we were to turn west and penetrate the Amundsen Sea. But that could wait. To the east, into the Bellingshausen Sea, there opened an inviting expanse of water. A quick trip there, we reasoned, would allow us to retrieve a "grasshopper" automatic weather station we had planted ashore the previous year. It had sent out weather data for two months before its batteries died. (In the explorations going forward as this article is published, we are taking an atom-powered grasshopper that is capable of broadcasting for ten years.)

Helicopter scouts for ice leads opened by changing winds in the frozen Bellingshausen Sea

KODACHROME BY W. D. VAUGHN © NATIONAL GEOGRAPHIC SOCIETY

By retracing some of our earlier route, we could also check the condition of the two flags, the United States ensign and the National Geographic Society flag, which we had raised the year before on this coast.

So, turning east, we began our "quick trip." It was to result in much new knowledge of geography, outdating all the world's charts of the coast. It was to threaten us with death in the storm and capture by the ice.

Soon we confirmed one of our major theories. From a helicopter flying at 5,000 feet above Seraph Bay in perfect visibility, we sighted shelf ice extending unbroken and without a rise for some 95 miles to the southwest. This cut across the base of Thurston Peninsula past a point we had seen in 1960 from the other side. Now we knew that Thurston Peninsula was no peninsula at all! Future charts would call it Thurston Island.

Ice Cover May Diminish Sea's Fertility

As we cruised along, snow-mottled peaks, capes, and bays seen the previous year loomed from the mists like old friends, most of them now charted with names of our expedition members.

Our oceanographic work continued without letup. Scientists sampled sea water at all depths and took cores, or samples, from the bottom—routine-seeming work that may greatly affect the future of mankind. Antarctic seas, as science has known for some time, are potentially the richest food-producing areas, acre for acre, in the world. They contain an abundance of plankton on which many fish feed. Testing for organic carbon present in these seas, therefore, is a vital step toward their use. Someday, a world of vanishing resources may turn to this area for food.

We found that the Bellingshausen Sea, however, is an exception—its waters proved relatively poor in food potential. The heavy ice cover may cut off so much sunlight that the basic food-making process, photosynthesis, is retarded. The paucity of seals and penguins was strong evidence of this fact.

Transparent Chart Webs a View of *Glacier*'s Pulsing Nerve Center

Sailors huddled over a plotting table in the combat information center track navigational hazards by radar and report them to the conning officer. Meridians and parallels on the large acetate disk enmesh Antarctica. Banks of lights, glowing at low intensity, permit seamen to read illumined instruments with ease and accuracy.

Our experts studied the temperatures and cloudiness of the waters, and terrestrial magnetism. This last science is closely related to communication difficulties in the Antarctic, where radio is short-circuited by every solar storm. If we can someday find a means of communication that will be free from interference by sun spots and flares and disturbances in the radio reflecting layer above the earth, Antarctica will be a much safer place.

Scientific activities continued 24 hours a day. Though our hardworking men had no way of knowing it, they were setting a record in polar oceanography: The *Staten Island* made more scientific observations in the Antarctic in this field than any previous United States vessel.

One hundred and twenty miles from Thurston Island's tip at Cape Flying Fish,

Sighting a theodolite, a Navy officer

Slashed by Antarctic winds, members of a surveying team sink a flagged marker in the rock of McNamara Island—a scene that calls to mind the U. S. Marines who raised the American flag on Iwo Jima.

we had turned back during our 1960 voyage. At that time, heavy ice had barred us from further penetration.

Now our lookouts reported an ice-free lane as far as they could see. But we were supposed to be in a different sea, the Amundsen. The foray into the Bellingshausen had been designed only for a quick look.

On the other hand, new discoveries, surely, awaited us just beyond the horizon. Here was a chance to contribute greatly to the United States' scientific objectives in the Antarctic, as outlined by the National Science Foundation. It might be years before this area was open again.

The temptation was overwhelming. We steamed ahead.

On our charts the shoreline was marked with a dotted line, meaning "true boundaries unknown." Now our expedition was changing that dotted line to a new, solid one.

Helicopters sailed out over the blue water toward the white snow cliffs with their occasional outcrops of brown rock. They carried shore parties to the coast, where the men could determine their positions accurately by solar sightings and could collect the revealing rock and lichen samples.

We soon found that this area, named the Eights Coast after an early American Antarctic naturalist, James Eights, was not a coast at all. Instead, we had encountered an archipelago of small islands.

Flying over the blue-white expanse, our helicopters approached the chocolate ramparts of a mountain range. In the cold, clear atmosphere, we could see at least five separate peaks. At the base of one mountain we glimpsed a square blot on the snow. Circling closer, we found that it was a Jamesway hut,

determines his precise position. His companion records observations behind a windscreen

KODACHROMES © NATIONAL GEOGRAPHIC SOCIETY

the canvas version of the quonset, with a sign: "Minneapolis, Minn., 8,140 miles."

Checking with U. S. Antarctic headquarters at McMurdo Sound by radio, we learned that a party led by Dr. Campbell Craddock, a geology professor from the University of Minnesota, had been surveying the mountains after a 600-mile flight from Byrd Station. They had evacuated the camp by plane about a month earlier.

Another American group, the Ellsworth Highland Traverse party, was already crawling toward it by tractor. Its members were to be flown out from Camp Minnesota. The proposed name for the range, we learned, was the Jones Mountains, honoring Dr. Thomas O. Jones, head of the Office of Antarctic Programs, National Science Foundation.

Ice Explorer Scorns Hot Shower

Later, as we circled the camp by air, we saw men and vehicles (page 268). The traverse party had arrived. We landed and met the leader, Dr. Charles R. Bentley of the University of Wisconsin. Bearded and lean from the 90-day journey by Sno-Cat from Byrd Station far in the interior, the six-man party was in high spirits—perhaps because planes were to pick them up in 24 hours.

There were other reasons, too. Their seismographs had proved that a large chunk of the Antarctic Continent was not continent at all. They had found that the land beneath the ice over which they traveled was mostly below sea level, indicating that perhaps the area between Bellingshausen, Weddell, and Ross Seas is, like the area that lies off the Eights Coast, a group of islands.

I invited Bentley to fly aboard *Glacier* for a shower and a hot dinner—both luxuries in the Antarctic. "I'll be glad of the dinner," he smiled, "but as for the shower, I haven't had these clothes off for weeks and I couldn't bear to put them back on."

After the Bentley party was flown out, the Phantom Coast was all ours once more. We continued our mapping and measuring, our sampling and dredging, our balloon-borne examination of the upper atmosphere.

Then began the storm I have already described, and our work came to a howling halt. After the rescue of the marooned shore party, we found solid sea ice blocking any further penetration to the east. The season was advancing; it was high time to sail back west, toward the Amundsen Sea.

But first we had to pick up the equipment that the shore party had been forced to abandon. Four men set out in a copter to get it.

While they cruised 3,000 feet over an ice-clad island, the engine began making weird noises. Black smoke poured from the exhaust. The pilot, Lt. (j.g.) R. N. Franks, reduced speed and started looking for a place to land.

Weather balloon tugs for take-off from *Staten Island's* flight deck. Suspended instruments transmit data on temperature, humidity, and wind velocity. *Glacier* looms like a shadow in the mist.

Conical nets fluttering above *Glacier's* ventilation blower scoop the winds for insects. Canadian entomologist Robin Leech found no insect life among the islands off the Eights Coast.

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

CB 4

Wind-tortured floe frames Glacier's *bow as she moors to the ice 12 miles farther south in the Bellingshausen Sea than any previous ship. Men scramble overside to stretch their legs.*

The ice below was fissured with deep crevasses, but he found a likely spot and headed toward it. When he had come down to ten feet above the ice, his number two cylinder exploded, blasting metal fragments through the nose, and the helicopter dropped to the ice. Flames enveloped the engine. The landing was on a slope, and the burning aircraft slid 300 feet toward the sea while the four men jumped out—miraculously unhurt.

The only possible rescue was by other helicopters (page 256). We flew the men back to the ships, then salvaged what parts of the wrecked aircraft we could. We had to leave her hull on the ice—a bright red-orange spot in the eternal blue-white.

We sailed northwestward then, hoping to get to the Amundsen Sea, but the ice would not have it so. After 30 miles of open water, we were forced to steer into narrow leads. The best we could do in the last 24 hours was a single mile along the base course.

Then, under the pressure of a strong northeast wind, all leads closed, forcing us to a halt; we were beset.

Contrary to what you might think, it is not primarily the thickness of the ice that traps ships, but the pressure. A steady northeast wind had pushed the floes and bergs into a tight mass. As long as the wind "leaned" on the ice, there was little we could do. If we tried to break through, the ice we smashed would have no place to go. It would close again behind us, and we could not back off to get a run at the pack. We could easily lose a propeller.

For four 24-hour days we couldn't budge. We were in almost continuous daylight; the passage of time was marked only by the growing trash and garbage piles around the ships, and by the "nightly" movie.

Men Prepare for a Black Winter

All hands grew restless. The Navy runs on schedule: Ships sail at a certain hour; they arrive at specified times. But now, suddenly, time seemed wiped out.

There is an axiom that if you wait long enough, the ice, which is constantly shifting, will open enough to let you out. The catch is in the "long enough." It is quite possible to be beset all winter long.

"Do you think we'll spend a year stuck here?" The words were mostly in a jocular

Abandoned Camp Minnesota, set up by geologists probing the Jones Mountains near the Eights Coast, stirs anew as members of the Ellsworth Highland Traverse party trek in. They arrived in three Sno-Cats after creeping for 90 days across 1,400 desolate miles, starting from Byrd Station.

Before being flown out, the team put scientific equipment and sleds in cold storage in a Jamesway hut and mounted a tall marker to guide future expeditions to the cache through accumulated snows.

Navy pilots from McMurdo Sound, landing supplies to earlier tenants at the outpost, logged the longest logistical flight in Antarctic history: a 3,000-mile round trip.

vein. Comdr. Philip Porter, commanding officer of the *Glacier*, with two years of Antarctic ice experience behind him, was reflecting the opinions and worries of his men. Nor was I sure that the pack would let us out before the next summer.

Hummocked floes, like masses of jumbled concrete, hid any sign of water. The wind-pushed pack held our ships as mortar holds a brick. Clearly, our only hope was for a change of wind.

Each day we hoped. Each morning I would roll out of my bunk, dress, and climb expectantly to the bridge, knowing full well that if ice conditions had improved, the officer of the deck would have called me earlier.

It was always the same. At first the glare of sun on ice would blind me. As my eyes adjusted, I could see there had been no change. It meant another day of staring at the same floes and bergs. If strong language could melt ice, our ships would have been free long since!

Just for something to do, we said, the officers started making tentative plans for a winter in the ice, deciding how best to conserve our fuel oil supply. We might move all personnel to one ship and winterize the other.

Woolly hair and ruddy face reflect the rigors endured by a member of the Ellsworth Highland Traverse party.

EKTACHROME © N.G.S.

Ice-locked *Staten Island* lies trapped in the Bellingshausen Sea. Several times the more powerful *Glacier* plowed furrows in the floes to free the smaller ship.

Distilling salt water into fresh, sailors check gauges that control evaporation. Poster girl inspires them.

Baker prepares doughnuts for a coffee break, a U. S. Navy institution.

KODACHROMES BY W. D. VAUGHN © NATIONAL GEOGRAPHIC SOCIETY

Strumming his guitar, a *Staten Island* seaman entertains shipmates in the boatswain's storeroom. Overheads burgeon with nautical gear and the souvenir saddle at left.

Parts of the ship's machinery could be sealed off. We had enough food to winter through on short rations.

Worries and rumors were, of course, rife in the crew's quarters. Church attendance that Sunday jumped 400 percent. The rumor mill ground out some beauties: The real reason we were stuck was that the starboard propeller was frozen in a big block of ice; the Navy was going to send a carrier to the edge of the ice and have long-range helicopters fly out whoever wasn't needed for wintering the ships over; an atomic submarine would rise through the ice at any minute to help us.

One night Commander Porter spent an hour and a half in the crew's mess answering questions about such rumors. He did his best but came away with the uneasy feeling that he had accomplished little.

Every man fought boredom in his own way. I played the accordion. Bingo games were held. The hobby shop was full of men turning out belts, billfolds, model planes and ships. About half the crew had beards that received intensive currying. The movie situation was excellent for a winter in the ice.

We would normally carry 60 features; by luck we had 1,000, part of a shuffling of films among various Antarctic stations.

Aboard ship you can always scrape up an impromptu stage show. We had music, and, of course, a comedian. We also had a ham radio station, by which the men could talk to their families at home. This stirred things up considerably, we later learned.

Conversations went something like this:

"Hi, honey! How're you doing?"

"I'm fine, and the kids too. We miss you. What are *you* doing?"

"Mostly nothing. We're stuck in the ice. Don't know when we'll get loose. Maybe not till next year."

After such messages, Congressmen probably began hearing from constituents—and the Navy began hearing from Congressmen.

For three days the wind blew mercilessly, without letup or change. On the fourth day the wind shifted to southwest, but lacked strength to help us. From a helicopter, late in the afternoon, I saw some evidence of the floes separating, and small areas of water showed. But these were without pattern and of no use to us.

Next morning, once more aloft in the helicopter, I saw it—a jagged black lead stretching out from the corner of a huge tabular iceberg. Ice-free water reached ahead to the northwest as far as the happy eye could see.

The whole area was loosening up, offering more water between floes and giving us room to maneuver.

Ships Break Out to Open Water

Immediately, I radioed the captains of both ships: "Prepare to get under way!"

Back through the cold air came two delighted shouts: "Roger from *Staten Island!*" . . . "Roger from *Glacier!*"

When I landed on deck, *Glacier's* diesels were already warming up. With their throbbing, life returned to the ships, the men and officers relaxing into familiar jobs.

We battered through the neck of ice that lay between us and the lead (page 258). Con-

Informal guests at a full-dress party, author McDonald (left) and Robin Leech visit a rookery of gentoo penguins on Palmer Peninsula. International groups urge protection of the birds from raids. Captain McDonald for three years has served as Deputy to Rear Adm. David M. Tyree, Commander of Operation Deep Freeze.

En route home, *Glacier's* helicopters stop to collect cargo at González Videla base, Palmer Peninsula. Chile, one of 12 nations that signed the Antarctic treaty, maintains the installation.

ditions improved steadily as we went forward. By nightfall we had logged 40 miles.

On March 2 we reached our goal—Evans Peninsula at the northeast corner of our newly named Thurston Island. Now we were safe, and in familiar territory.

But the ferment back in the States was apparently still bubbling. That afternoon a radio operator rushed in to announce dramatically, "Sir, we've just had an operational-immediate [message], telling us to come up at once on the single side-band radio with Washington."

When contact was made, the words came loud and clear: "How are you doing? We've had inquiries from all the way up to the White House. What's the story down there?"

The timing couldn't have been better. A few hours earlier, I would have had to answer quite differently. Now I rapidly told the good news.

We were to be stopped one more time by solid ice, but by March 7 we were free.

By then the season was too far advanced for any lengthy exploration of the Amundsen Sea, yet we did have some other unfinished business. We searched the shore for our automatic weather station, but the snows had covered it beyond tracing. The two flags were a different matter. A few shreds still clung to the strong pipe we had erected—although the pipe itself was bent to a grotesque angle by the bitter winds.

With the weather getting colder, it was high time to point our bows north. As we steamed away, I noticed parka-clad officers and men checking their dress-white uniforms. They would need them on the warm beaches of Montevideo, Uruguay, where we could bake the long chill out of our bones.

Luxuriant beards would be neatly trimmed—most of them into extinction. After a long, warm leave in the bustling city, you wouldn't know us from anybody else.

But for months and perhaps years, the chart makers, oceanographers, and other scientists would benefit from our voyage to the Phantom Coast.

Roseate Spoonbills

RADIANT BIRDS OF THE GULF COAST

By ROBERT PORTER ALLEN

Photographs by
FREDERICK KENT TRUSLOW

AN EXCITED TOURIST, driving along the Overseas Highway between Miami and Key West, pulled out of traffic and stopped beside a gasoline pump.

"Say," he exclaimed to the attendant, "I didn't know there were wild flamingos here in the Florida Keys!"

With the air of one who has superior knowledge, the attendant began unlimbering the gas hose. "Mister," he said with authority, "those pink birds you saw weren't flamingos. They were *rosy-ate* spoonbills!"

Such an incident could hardly have happened ten years ago. There were very few spoonbills in the Keys at that time; besides, the average local citizen wouldn't have known the difference between a roseate spoonbill and many another bird.

Today it is a different story. Photographs of the resplendent pink-and-white birds take their place alongside bathing beauties,

Bobbing their heads in offbeat rhythm, hungry fledglings on a Texas coastal island signal a parent for mealtime service. Until weaned, young birds feed on predigested morsels siphoned from an adult's throat.

Spoonbills have increased in Louisiana and Texas but recently declined in Florida.

KODACHROME © NATIONAL GEOGRAPHIC SOCIETY

sailfish, and palm trees in Florida Keys brochures. One of the local Girl Scout troops has chosen the roseate spoonbill as its official emblem. And from far and wide, people come each year on Audubon tours for a brief sight of this lovely bird. The only people who can't tell a spoonbill from a flamingo are rank outlanders—and even they are learning.

Most of the credit for this enlightenment must go to the spoonbills themselves, for they staged a remarkable comeback in recent years, after having been virtually wiped out in the United States by the plumage trade of half a century ago. From a single tiny colony of 15 pairs in 1939, the Florida nesting population increased to a peak of eight colonies and more than 400 breeding birds in 1955-56.

The Author: Robert Porter Allen, formerly Research Director of the National Audubon Society, has spent years observing shore and upland birds. He has become an authority on such species as the roseate spoonbill, whooping crane, and flamingo. His description of the whooping crane's fight for survival appeared in the November, 1959, NATIONAL GEOGRAPHIC, illustrated, as is this article, by the remarkable photographs of retired business executive Frederick Kent Truslow.

Since then, however, encroaching real estate developments have decreased spoonbill numbers to about 250 in three colonies—at Nest Keys, Cowpens, and Porjoe Key.

There are six distinct species of spoonbills on earth, but only *Ajaia ajaja*, our New World species, is brightly colored. The others—native to Europe, Asia, Africa, and Australasia—are chiefly white and have crests of long, stiff feathers growing from the nape of the neck.

Identical Plumage Adorns Both Sexes

In our species the head of the adult is bare. But the general plumage pattern—pinks and whites, set off by startling patches of carmine, saffron, and orange yellow—more than makes up for this baldness. The bald head itself has moments of beauty. Its crown, normally dull green, takes on a soft tinge of gold at mating time. Oddly, male and female have identical plumage, even to the golden heads.

The roseate spoonbill is essentially a tropical bird, ranging from the West Indies and Mexico southward to Argentina and Chile. In the United States it nests only in southern Florida and along the Gulf Coast of Louisiana

Breakfast-bound Pinks Erupt From Their Private Texas Lagoon

Rainbow tails flash saffron and scarlet against an azure sky as spoonbills start their morning search for food. Driven from nearby rookeries by nesting birds, these unpaired adults and immature members of the flock summer in solitude amid salt cedars on coastal islands.

Gulf Coast sanctuaries aid the birds' fight for survival. Roseate spoonbills find refuge in coastal fringes of Texas, Louisiana, and Florida. Members of this species, *Ajaia ajaja*, dwell also in South America and in the West Indies. In 1961 Hurricane Carla damaged rookeries in Galveston Bay, but author Allen believes the birds will return.

THE ROSEATE SPOONBILL

Nesting sites •
Migration routes —

Map by H. L. Peacock and S. Stefanoff

and Texas. Here, at the northern edge of its range, the spoonbill receives the most active protection (map, page 277).

Texas and Louisiana spoonbills, flying up the coast each spring from Mexico, establish their nesting colonies in April and May. But the pink birds of Florida constitute an altogether distinct population group that wings across the Gulf Stream from Cuba in September and October. In November they start nest building on mangrove islands in Florida Bay. Generally, their pink-and-white chicks hatch just before Christmas.

The birds reach the peak of their annual cycle – so far as beauty of plumage and nesting activity are concerned – at the height of the winter tourist season. No Florida resident could be more cooperative!

Chicks Heard But Not Seen

Because of the heavy cover of red mangrove on their island rookeries, spoonbills are hidden for the first six weeks of their lives. Their thin, cheeping notes can be heard, but they cannot be seen by the visitor unless he goes ashore and approaches the nests. The law, however, forbids this, for such interference would panic closely packed nesting communities. Many young birds would tumble from the nest and get lost.

For years my wife Evelyn and I have observed the behavior of the adult birds from a vantage point aboard the Audubon Society's research boat *Pink Curlew* – a local nickname for the roseate spoonbill. In this way we have learned the approximate dates of mating, incubation, and hatching. Week after week we have watched and waited impatiently for that red-letter day in the life of any dedicated spoonbill watcher – the first appearance of brand-new young.

I well remember one such day, when we were anchored close to the Cowpens nesting site in Florida Bay. I had noted down that if hatching had occurred on December 15, as we suspected, some of the youngsters would now be six weeks old and should be making an appearance today – January 26 – in the treetops.

At 9:30 that morning an adult spoonbill glided toward us and landed in the top of a mangrove tree. There was a great waving of its colorful wings, followed at once by the movement of other wings that were pale pink with dark tips. The adult bird was feeding a young spoonbill, while a second youngster begged from the sidelines.

When the parent had fed both its young, it flew away. The two new recruits were then emboldened to poke their white-feathered heads clear of the topmost branches. During the morning other youngsters raised their heads above the canopy of glistening green leaves. To us they looked bright and shiny and new, the hope of the spoonbill race.

That night there was a mild norther, but at sunup the next day the wind dropped, and we resumed our watching. At 7 a.m. many more young started to appear. One by one they tried their wings, flying awkwardly from branch to branch until they reached the treetops. There they sat, content to look out at the world at large and wait for their parents to deliver food.

When an adult spoonbill flies up and away, it displays colors that are breathtaking in their brilliance. The bright pink of the wings and tail coverts would seem to be enough; but in addition, a wide band of deep carmine splashes across each wing. The tail, glowing with a wholly improbable shade of rich orange, adds a final touch of rare tropical beauty (opposite).

Cubans call the spoonbill *sevilla*, probably because its reds, whites, oranges, and yellows recall the banner of old Seville.

Peregrine Falcon Buzzes a Rookery

We had been watching for just half an hour when a peregrine falcon – a male, I would judge from its size – zoomed in and dived with great speed and dash at the adult spoonbills that were flying in and out of the colony. His passes seemed half in play, for he never actually struck one of them. But when he went after the young, it was different. Starting at one end of the colony, he raked its entire length, sweeping lower each time he approached a young spoonbill.

Suddenly we found ourselves shouting, "Down! Down!" as if the young birds could understand us. "Get your heads down, you young idiots! Take cover!"

But the youngsters did not need our warnings. After the peregrine had made a couple of unsuccessful sweeps over them, not a white-feathered head could be seen. Abruptly the sleek intruder abandoned the mangroves and began to chase other shore birds over the mud flats in the vicinity.

Almost immediately the heads of young spoonbills began to reappear out of the treetops. They looked like the white blossoms

KODACHROME © NATIONAL GEOGRAPHIC SOCIETY

Bowing like a ballerina, an adult balances atop a favorite perch. Male and female display identical markings; they share the three-week task of incubating eggs. In the United States spoonbills number some 1,400 nesting pairs.

of some exotic plant that blooms all at once, as if on signal.

The peregrine falcon takes a newly fledged spoonbill now and then. And I have watched, somewhat in dismay, as our national bird, the bald eagle, dined on a young pink which he had captured on the ground. But such incidents are the exception, not the rule.

Given the opportunity, raccoons eat the eggs. Hurricanes, droughts, and unseasonable cold spells all take their toll of the young as well. But none of these natural enemies threaten the ultimate survival of the birds within our borders. The chief enemy, although a well-intentioned one, is man himself.

Every year more and more people come to live on the Florida Keys. They like the balmy, frost-free climate, warm turquoise waters, superb saltwater fishing, and the relatively unspoiled tropical scenery of such nearby areas as Everglades National Park.

Yet every new land-clearing job and real

estate development, every filling and bulldozing of a tidal slough or mangrove pond, reduces the natural beauty and charm of the Keys. At the same time, feeding and breeding areas essential to such wildlife as the spoonbill are destroyed. If the trend continues, there won't be enough natural areas left where the birds can nest and find food.

Test of New Rocket Endangers Birds

One Florida feeding ground lies dangerously near the towering rocket gantries at Cape Canaveral. Just before the launching last October of the Saturn, mightiest of U. S. rockets, local staff representatives of the National Audubon Society appealed to the National Aeronautics and Space Administration to alert the birds lest they be incinerated. NASA complied and, minutes before the blast, sent military police cars into the area, their sirens screaming. The spoonbills as well as all other birds in the danger zone flew away to safety. Later they returned.

The spoonbill eats a great variety of foods: killifish and other small fry, crustaceans, aquatic larvae, insects such as water boatmen and back swimmers, and a little vegetation. All the food animals are small, many minute. A great number of each kind must be taken to make a meal for two or three young.

The bird's broad spoon-shaped mandibles, rare among birds, are wonderfully adapted for gathering such food. Wading forward, the bird swings its partly opened bill from side to side in a sweeping 180-degree arc, feeling for its prey through a curtain of water and mud. When nerve endings along the inner lining of the bill signal contact, the spoonbill traps the prey between its wide mandibles with a quick upward toss of its head.

Young birds swing their bills this way the first time they wade in the shallows. In captivity they do the same, for this is an instinctive action. Offered live killifish or shrimp in a large basin of clear water, they continue to feel for them blindly, even though they can see them perfectly well. But don't be misled by this behavior—or by the bird's mild and somewhat tomfool expression—into thinking that the spoonbill is a dullard.

Eggs turn sunny-side down at a touch of the beak. Egg rolling encourages proper development of the embryo. When the sun is hottest, parents shade the eggs to prevent overheating.

ALL KODACHROMES BY FREDERICK KENT TRUSLOW © NATIONAL GEOGRAPHIC SOCIETY

Not twins, just neighbors. Although the Texas islet provided ample elbowroom, these spoonbills nested and raised their young within pecking distance of each other. Reports photographer Truslow: "They quarreled all day long."

Powder-puff plumage cloaks rosy chicks three hours old. Predators, parasites, and preflight accidents plague nestlings like these life-size twins. Beaks, blunt at birth, start splaying into banjo shape after two weeks.

Spoonbills Feeding Their Young Appear to Swallow Them Whole

Home from a fishing trip, the big pink at left fetches food in its throat for a clutch of helpless nestlings. A day-old infant struggles to sample the menu.

Frederick Truslow made this series of pictures in Texas, while the temperature in his blind hovered around 138° F.

Outside, the brooding spoonbills fared far better. Dousing themselves frequently in nearby shallows, the parent birds returned to their nests to cool their chicks with water-drenched wings.

Eager for a snack, a nestling offers no resistance as an adult brings it into feeding position with a gentle gobbling action. Reaching for a firmer beak hold, the parent propels the baby bird toward the gullet. Young appetites demand constant attention.

ALL KODACHROMES BY FREDERICK KENT TRUSLOW © NATIONAL GEOGRAPHIC SOCIETY

Going up! Clamping a weak and wavering chick firmly in its forceps-like bill, a parent steadies the youngster for a lift to the larder. After a week of spoon-feeding, new birds attain strength to reach the throat without assistance

© NATIONAL GEOGRAPHIC SOCIETY

A friend of mine, after hours of observing spoonbills at close range, remarked: "You can look 'em between the eyes and tell they haven't got any dern sense!"

So I told him about my experience with the painted sticks. A few years ago I was studying the nesting behavior of black-crowned night herons. As a means of marking the adult birds, I smeared the rims of several nests with red paint. When the birds returned to settle on their eggs, their white breast feathers were stamped with individual patterns of bright red that could be easily recognized.

Tidy Male Rejects Painted Sticks

Later, when I was working with roseate spoonbills on the Texas coastal islands, I tried the same technique, using blue paint. At daylight one morning I hastily daubed the rim of a nest, then retreated to my blind.

Soon both nesting birds returned. One, which I took to be the male, stood on a supporting branch and looked intently at the paint. Then he dropped cautiously into the nest and turned the eggs with his bill.

For a few minutes he stared at the paint-smeared twigs at the rim of the nest. Then he reached out with delicate deliberation, spooned up one of the painted sticks by its unpainted end, and dropped it to the ground.

Ultimately, he had removed every stick and twig that showed the least vestige of paint. Only then, with a satisfied air, did he settle on the eggs. *I* felt like the tomfool!

The Texas spoonbills have been under surveillance for many years. In 1931 a party from the Houston Outdoor Nature Club visited the Vingtune Islands in Galveston Bay and found roseate spoonbills nesting there among a colony of herons and egrets. Later that season thoughtless visitors killed many of the pink birds and broke up their nesting. To prevent

Beautiful yet bizarre, adult spoonbills preen and bathe on a Texas oystershell beach;

a repetition of such vandalism, the National Audubon Society has guarded the colony since 1932.*

The National Audubon Society does not permit visitors to enter its sanctuaries during the nesting season. Close observation or photography can cause mortality of eggs and young, and desertion by adults. The society granted special permission to Fred Truslow to photograph on certain of its sanctuaries, for the NATIONAL GEOGRAPHIC, under the supervision of its wardens, knowing that the methods he would use would cause no harm and that his pictures would contribute to the appreciation and preservation of the birds.

When Fred visited the Vingtune Islands in 1960, they harbored the largest spoonbill colony in the United States, an estimated 600 pairs. Vigilant protection has paid off, even though the biggest of these islands has now eroded so badly that there is no more than a rim of nesting cover around a central lagoon.

In Texas the pinks build their nests in low bushes—salt myrtle, salt cedar, mesquite, and other plants typical of the State's coastal islands. Here Fred was able to make photographs that would have been impossible to obtain in the dense mangrove habitat of Florida Bay. These pictures, besides being extremely beautiful, are a real contribution to spoonbill studies.

Helpless at birth, spoonbill chicks appear too fragile and weak to survive. Almost embryonic in appearance, they are soft pulsating sacks of pink flesh and sparse white down. At first sight, you wouldn't give a plugged nickel for their chances (pages 281).

But this sad appearance is misleading. Na-

*See, in the NATIONAL GEOGRAPHIC: "Saving Man's Wildlife Heritage," by John H. Baker, November, 1954; and "The Pink Birds of Texas," by Paul A. Zahl, November, 1949.

arched wings reveal the vivid raiment that gives the roseate species its name

KODACHROME © NATIONAL GEOGRAPHIC SOCIETY

Knee-deep in dinner, a young spoonbill stares at killifish roiling a Florida lagoon. Emulating their elders, juveniles wade the shallows and grope for food with bills submerged.

Young adult combs flaming feathers with broad bill. Plumage will attain full brilliance after the next molt.

Casually balancing on one pink leg, a Florida bather uses the other to scratch an itching neck.

ALL PHOTOGRAPHS BY FREDERICK KENT TRUSLOW © NATIONAL GEOGRAPHIC SOCIETY

Juveniles Shatter the Quiet of the Florida Mangroves

Known locally as pink curlews, Florida spoonbills may vanish as land development destroys the environment in which they breed and feed. Observing the slow growth of breeding colonies in the Keys and the large number of juveniles there, author Allen concludes that many of these birds are not bred in Florida but migrate there from Cuba and Hispaniola.

One young bird washes its wings. The other flees an unexpected bubble bath.

ture has anticipated the chicks' helplessness and made every possible provision for them. The young birds' first need is protection from the elements; at this stage the parents provide constant shelter. Another vital necessity for the nestlings is food—food, food, and more food. And nature has provided for this too.

When hungry, the chicks utter a thin, cheeping sound, and the parent responds by feeding them predigested food. Gently grasping the head or bill of the young bird, the parent brings it into a position where feeding is possible, as Fred Truslow's remarkable photographs show (pages 282-3).

By the time these spoon-fed youngsters are a week or ten days old, their down has become thick and woolly and their bellies satisfyingly fat. They grow rapidly, and during their third and fourth weeks of life they begin to crowd one another in the nest. If disturbed, they scramble to nearby tree limbs and may fall to the ground, where they face death from starvation or predators.

By their fifth week the young move about quite freely, trying their wings and flapping from the nest tree to the shallows beneath and back again. But it is not until they are six weeks old that they finally poke their heads through the tops of the trees and look out for the first time. At this stage, each parent bird probably continues to locate and feed its own offspring.

Within a few days the young start to come to the shore of the nesting island. There are so many of them together, all vigorously demanding food, that an adult returning from the feeding ground may be pursued by a dozen hungry youngsters at once. As a result, the most persistent one usually gets fed, regardless of its parentage.

Between feedings, the young birds probe experimentally for food on their own. Their nestling voices begin to change, and although they still bob their feathered heads and cry in a high, thin treble, the reaction of the parent birds soon changes too.

Hungry Young Harass Elders

A mob of noisy, scrambling youngsters shoves all around the old bird, wings flapping as each applicant struggles to get close enough to be fed. But now the adult pulls its head away, mandibles tightly closed.

Sometimes the adult eventually gives in, as if simply for the sake of peace and quiet, and reluctantly feeds the most aggressive young. But within a few days even the most violent entreaties leave the adult unmoved. The young must learn to fend for themselves.

Taking off, the parent bird flies in wide circles over the nesting key, followed closely by a bevy of hungry youngsters. Around and around they go, the more advanced young keeping close to the adult's tail.

Then the old bird peels off and heads straight for the nearest feeding grounds. One or two of the strongest youngsters may follow for a short distance, but it is several days

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Streamlined in flight, a majestic spoonbill sweeps across the Florida sky. No longer hunted for food and feathers, the species revives slowly in the U. S. All flocks may flourish again if fishing grounds as well as nesting areas receive protection.

before they develop enough confidence to go all the way. When at last they can do this, young spoonbills are close to independence.

Soon every young bird that has learned to navigate has been taken to the feeding grounds and left there, fully aware of what every young spoonbill should know. Only then do the adults start to disperse, their job of raising a family completed.

Building Boom Threatens Spoonbills

When Hurricane Donna swept through Florida in early September, 1960, it devastated most of the mangroves on the spoonbills' breeding site at Cowpens.

When the spoonbills arrived in October, we feared that the damage to their nesting place might cause them to leave. To our relief, they not only stayed but began nesting operations almost at once – building in the dead trees, with none of the usual cover of heavy mangrove leaves over them. Fortunately the weather was mild. The spoonbills had one of their best seasons, producing between 175 and 200 young.

But despite such encouraging adaptability to nature's ways, Florida's spoonbill population has decreased from 215 to 125 pairs during the past five years. The future of these lovely birds is clouded by the unprecedented building boom on the Keys, for spoonbills just don't seem to be able to coexist with draglines, bulldozers, insecticides, and the like. The pressures of an expanding human population are also apparent on the Texas coast, where the roseate spoonbills have been doing well.

With an eye to the future, we should try to preserve in a permanent and inviolate status all the nesting and feeding areas the spoonbills require to survive. In one such enlightened transaction, Florida recently placed the Cowpens rookery under the State Board of Parks and Historic Memorials. The National Audubon Society has negotiated with the board a land management contract that will protect the spoonbills nesting there.

The people of Florida, Louisiana, and Texas are justifiably proud of their roseate spoonbills, and I am sure that they will take whatever steps are necessary to ensure the survival of these beautiful neighbors.

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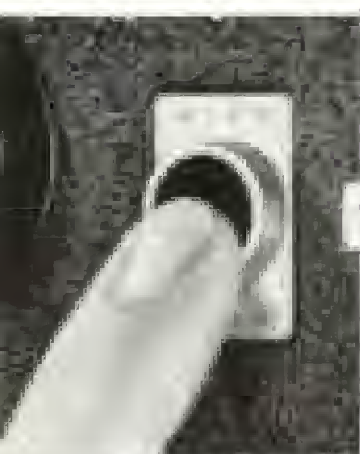

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