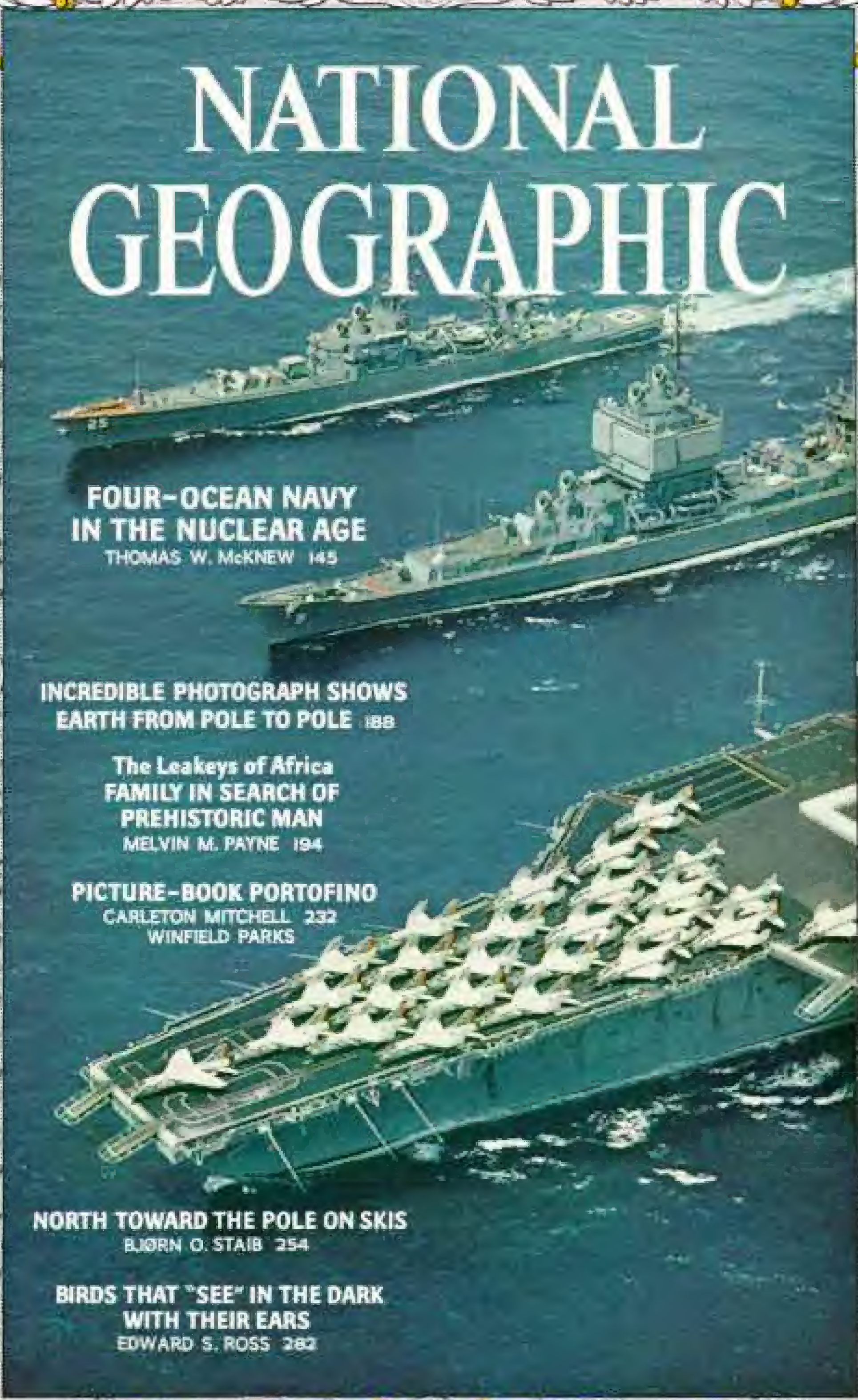


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FEBRUARY, 1965

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◀ COVER: Carrier Enterprise leads a U. S. nuclear-powered task force on a global cruise (pages 454-5).



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Strange safari stalks the Orient for rare insects

HUNTING IN SOUTHERN ASIA, Dr. Edward S. Ross (above) armed himself with nets, tweezers, bottles, boxes, and cameras. His catch: half a million insects and arachnids taken alive and on film.

Aided by a National Geographic Society research grant, Dr. Ross recently traveled 24,000 miles through India, Pakistan, and Southeast Asia. He found many a new twist to an old story. The Malayan spider at upper left captures the fly without using a web; instead, its yellow body and stamenlike legs, resembling the flower's sweet golden center, lure the victim to doom. Scarlet stinkbugs below

play ring-around their own empty eggshells, from which they obtain a supply of their mother's bacteria for digestion of plant juices.

During similar collecting expeditions in South America, this far-ranging California entomologist took time to explore cave homes of the little-known *guácharo*, or oilbird, a night-flyer that can navigate by echo like a bat and hover in mid-air like a helicopter. Dr. Ross's intriguing report on oilbirds begins on page 282 of this month's NATIONAL GEOGRAPHIC.

Every issue sparkles with such adventures in science and geography. You can share them by nominating your friends for membership.

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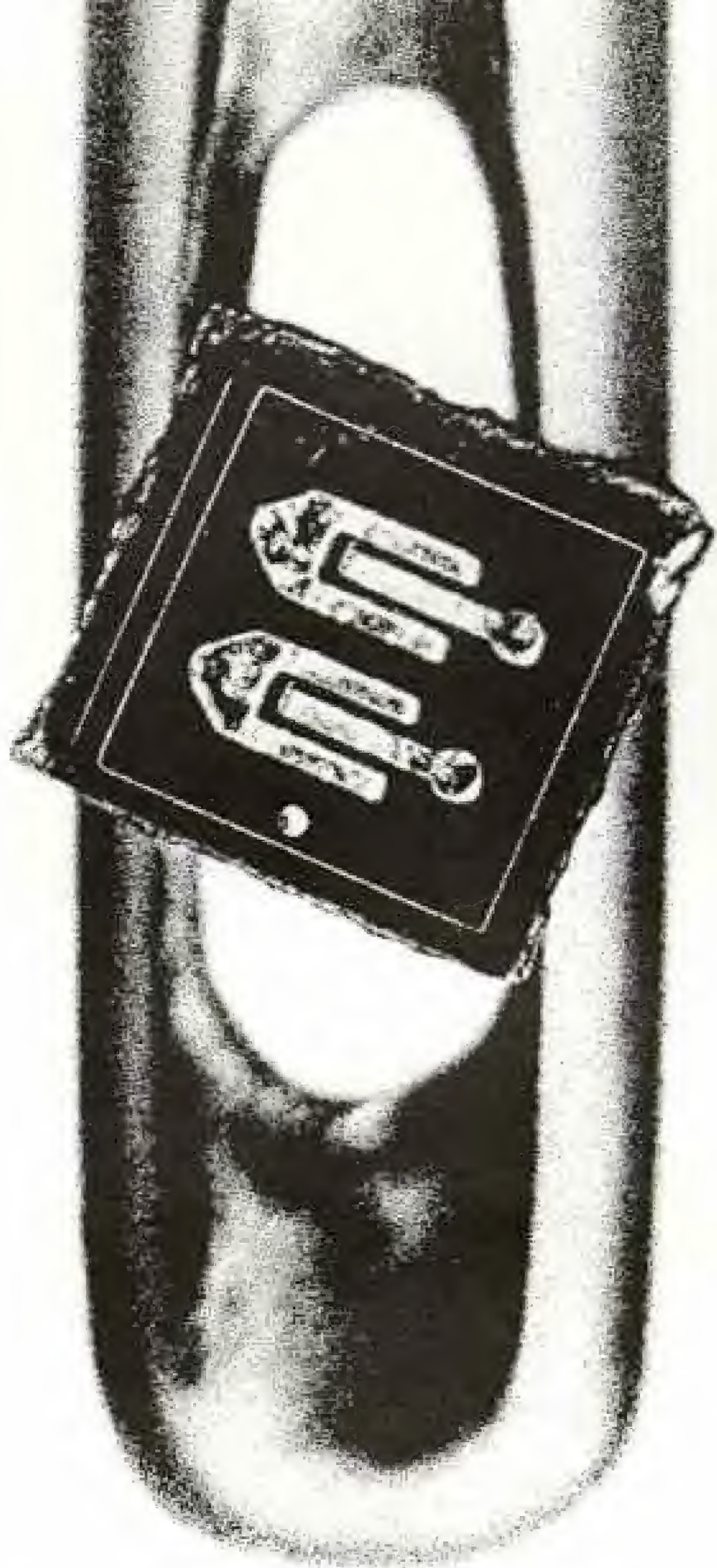
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Shown above: Chevella Malibu 4-Door 2-Seat Station Wagon

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You could spend your whole holiday relaxing. Once Bermuda's in your soul, however, a score of activities beckon. You find yourself playing

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Excitement after sundown. After dark, the island becomes a pleasure party. One hotel vies with another

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Rather listen to surf and the song of whistling frogs than a wild drum-



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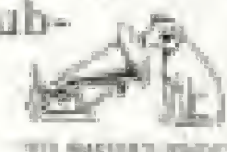
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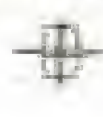


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Four-Ocean Navy in the Nuclear Age

*Revolutionized by the atom, far-ranging United States forces afloat
contribute unprecedented strength to the cause of peace*

By THOMAS W. MCKNEW

Vice Chairman of the Board of Trustees, National Geographic Society

CIRCLING US in the distance above the Mediterranean, the crippled jet fighter-bomber looked like a one-legged sea gull. In to roost came other planes of the United States Navy's nuclear-powered aircraft carrier *Enterprise*, howling down one by one, mission over. The wait was ending.

Rubber-tired tractors tugged the newly returned planes well away from the angled runway, and in two minutes the flight deck crew raised a nylon barricade across it.

Fire fighters in asbestos suits, foam nozzles in hand, ran to their posts. Men wearing red crosses stood by with wire litters. It was time for the injured Crusader to come home.

14-ton Plane Netted Like a Bird

With Adm. David L. McDonald, then Commander of the Sixth Fleet, I watched from the bridge of this largest and most powerful ship in the world. Now, on the intercom, the captain said, "Bring him in."

We could see the aircraft clearly, approaching *Enterprise* with one wheel dangling. It had been damaged in the catapulted take-off.

I stole a glance at the net stretched across

the runway six decks below. How could it possibly stop a 14-ton fighter-bomber?

Suddenly the Crusader roared life-size above the stern, then skimmed low over the flight deck, yawing slightly. The pilot brought her in at normal landing speed—around 150 miles an hour—and flew her straight into the barricade (page 159).

Before our eyes that 21-foot-high maze completely enmeshed the plane, yielded 500 feet, and stopped it dead. An incredibly strong web—thickness after thickness of heavy nylon strips fastened to hydraulically controlled cables—had halted the aircraft in the length of a football field.

And the pilot, uninjured, walked away.

His million-dollar, 1,200-mile-an-hour Chance-Vought Crusader would fly again, too. It sustained only minor wing damage.

This was the nuclear-powered, 100-plane carrier's first barricade engagement, as the Navy calls it, in thousands of plane recoveries. Launch, recovery, launch, recovery—day and night, this is the life cycle of the aircraft carrier. Each launch and each recovery represent the cooperative effort of the entire ship.

Catapult steam swirls across the deck of the nuclear aircraft carrier U.S.S. *Enterprise* as crewmen prepare to hurl aloft a North American A-5A Vigilante. The *Enterprise*, world's largest ship, keeps planes in the air around the clock when she cruises the world's oceans as a major weapon of the U. S. Navy.

ATTACHMENTS BY NATION



Above a fireball sun,
a Vigilante—the Navy's
biggest attack bomber—
begins its landing pattern.

GEOGRAPHIC PHOTOGRAPHER WINFIELD PARROTT, U.S. N.A.S.



Capt. Vincent Paul de Poix, then commanding *Enterprise*, had trained his 4,600 officers and men for this emergency, or any other.

A man's life had, indeed, hung in the balance for a few fearful seconds. But that night, logging the day's events in my journal, I realized that what we had witnessed was more than a dramatic slice of life at sea. This was the four-ocean United States Navy at its best, calmly meeting one more challenge.

It could have been a different challenge, and it could have happened half a world away—in Atlantic, Pacific, Indian, or Arctic Ocean. One such test occurred last August, for example, when North Vietnamese torpedo boats attacked two U.S. destroyers in the Gulf of Tonkin (see the National Geographic Society's new wall map, *The World*, distributed as a supplement to this issue).

But whatever the magnitude of the crisis, the Navy's reaction is the same: swift response, efficiently executed.

Nuclear Task Force Circles the Globe

Two years ago Adm. George W. Anderson, Jr., then Chief of Naval Operations, marked January 17, 1955, as the birth date of our nuclear Navy.* On that day Comdr. Eugene P. Wilkinson, commanding the attack submarine U.S.S. *Nautilus*, flashed his historic message to President Eisenhower:

"Underway on nuclear power."

Today our Navy has 53 nuclear-powered ships in commission besides the giant carrier *Enterprise*. Though mostly submarines, they

include the guided-missile cruiser *Long Beach* and the missile frigate *Bainbridge*. The missile frigate *Triton* has just been launched.

"Nuclear power marks the greatest advance in propulsion since the steam engine's invention," Admiral McDonald declared to me shortly after his promotion to Chief of Naval Operations, "and of all the armed services it most concerns the Navy. It is essential that we pursue its development."

His words came vividly home to me last June when I flew to the Mediterranean with staff writer Robert P. Jordan to see the world's first all-nuclear-powered surface task force of warships in operation. This unique force, teaming *Enterprise* with *Long Beach* and *Bainbridge*, patrolled the Mediterranean last summer as part of the Sixth Fleet. Then it took the long way home—around Africa, north to Karachi, south around Australia, across the Roaring Forties to Cape Horn, and finally north again to the United States—in a demonstration of high performance and great range (foldout, pages 153-5).

Enterprise, now commanded by Capt. F. H. Michaelis, carries more than 100 aircraft, from the 1,600-mile-an-hour McDonnell Phantom II jet fighters to the venerable Douglas propeller-driven Skyraiders. The offensive and defensive capabilities of "Big E" and her missile ships *Long Beach* and *Bainbridge* give this nuclear-powered task force a perform-

*See "Our Nuclear Navy," by Adm. George W. Anderson, Jr., USN, and "The Mighty *Enterprise*," by Nathaniel T. Kenney, NATIONAL GEOGRAPHIC, March, 1965.

ILLUSTRATION BY JOHN L. FURCHER © NATIONAL GEOGRAPHIC SOCIETY



The Author: Thomas W. McKnew (far left) has served the National Geographic Society for more than a third of a century. Executive Vice President and Secretary of the Society until 1962, he now is Vice Chairman of its Board of Trustees. Dr. McKnew holds the Distinguished Public Service Award of the United States Navy.

For this article, he traveled more than 80,000 miles to see our Navy in action throughout the world. Here, aboard the guided-missile cruiser U.S.S. *Providence* in Tokyo Bay, Dr. McKnew talks with Vice Adm. Paul D. Stroop, Commander, Naval Air Force, Pacific Fleet (center), and Adm. Thomas H. Moorer, then Commander of the Seventh Fleet and now Commander in Chief, Pacific Fleet. Gesturing in foreground is Vice Adm. John S. Thach, then Commander, Antisubmarine Warfare Force, Pacific Fleet, and today Deputy Chief of Naval Operations for Air.



Men who guide our global Navy confer at the Pentagon during the tense Gulf of Tonkin incident last summer. Left to right: Gen. Wallace M. Greene, Jr., Marine Corps Commandant; Adm. David L. McDonald, Chief of Naval Operations; and Adm. Horacio Rivero, Jr., Vice CNO. The Navy's far-flung fleets roam Atlantic, Pacific, Indian, and Arctic Oceans, serving as deterrents against the brush fires of international dispute.

ance and flexibility unique in naval history.

Operation Sea Orbit marked the first world cruise of a task force *without refueling or resupplying*. The ships covered 34,732 statute miles in 57 days at sea—averaging an easy 22 knots. Port visits took another eight days. They could just as easily have gone around the world nonstop, as the nuclear submarine *Triton* did four years earlier.*

Seventh of the big *Forrestal* class, Big E is the only carrier propelled by nuclear energy—as yet. The 77,000-ton *America*, just commissioned at the great shipyard at Newport News, Virginia, is powered with oil.

Congress has authorized still another mighty carrier, to be named *John F. Kennedy*. Its construction was held up more than a year while the Department of Defense made ex-

tensive cost-effectiveness studies. In the end, the department ruled that building should go ahead, but that the carrier would have conventional “fossil” power, not nuclear.

Thus the *John F. Kennedy*, like its oil-fired sister ship *America*, will not be able to challenge *Enterprise's* feat of steaming nearly 35,000 miles at an average 22 knots without refueling along the way.

Unfortunately, this ruling has halted, at least temporarily, the Navy's program of nuclear propulsion for major new combat surface ships. Yet in the few years since *Enterprise* was built, with its eight nuclear reactors, the Atomic Energy Commission and

*In the November, 1960, NATIONAL GEOGRAPHIC, Capt. Edward L. Beach, USN, described *Triton's* history-making cruise around the world submerged.





Exploding from the ocean depths, a Polaris A-3 soars skyward from Florida waters on a flight down the Atlantic Missile Range. The 31-foot bullet-shaped missile, unleashed from the submerged submarine U.S.S. *Eastel Boone*, will demonstrate its remarkable accuracy by striking an intrusively demarcated target area far down range.

Today the Navy has commissioned more than two-thirds of a planned fleet of 41 ballistic missile submarines, familiarly called Polaris after the missiles they carry. The entire nuclear-powered force will be operational in 1966. With almost unlimited range and endurance limited only by the crew, nuclear submarines cruise hidden in the ocean, their locations unknown to any potential enemy. And their deadly Polaris missiles, with a range of nearly 3,000 statute miles, can hit any spot on earth.

Aboard the U.S.S. *Andrew Jackson*, submariners monitor control panels adjacent to the 16 missile launchers that they call Sherwood Forest. Each Polaris vessel has two complete crews, the Blue and the Gold, of some 150 men each. Alternating patrols spend nearly two months of radio-silent submersion in assigned areas in both hemispheres.



PHOTOGRAPH COURTESY OF THE U.S. NAVY. ABOVE: POLARIS MISSILE LAUNCH; BELOW: POLARIS CONTROL ROOM.





OPERATION SEA ORBIT: A nuclear-powered task force led by Enterprise with the cruiser Long Beach (9) and frigate Bainbridge (25), both bristling with missiles, slices through the Mediterranean Sea at the start of a round-the-world cruise in mid-1964. Fifteen hundred seamen aboard the carrier spell out Einstein's famous equation: Energy equals mass times the speed of light squared, the formula that led to man's harnessing of atomic energy.

the Navy have developed reactors of much higher efficiency and with more than double the core life.

Fewer reactors would be needed to supply the same amount of power for a new carrier today, saving tremendously in space, weight, and cost. As I write this, a carrier with only two reactors—instead of eight—is being discussed. Rapid, indeed, are the advances in nuclear propulsion plants. Many authorities believe that tomorrow's reactors may never need refueling.

Navy Pioneers Tomorrow's Power

The great industrial power revolution of yesteryear followed the adoption of steam turbines by the Navy to propel its battleships and other warships. It is reasonable to assume that benefits in the industrial uses of atomic energy, far exceeding the cost of the nuclear power plants in naval ships, will result from the continued use and development of nuclear power in the Navy.

With nuclear propulsion, the Navy scores an advance whose vast scope is not yet fully realized. Here are some of its advantages: Virtually unlimited cruising range at high speed; greater maneuverability because of instant acceleration, deceleration, and back-down power; much less time to get up steam.

The cost of supplying conventional fuel is saved over the ship's lifetime. Gone is the need for frequent, time-consuming fuel replenishments, and the space saved by not using oil permits more aviation fuel to be carried.

The elimination of smoke on the flight deck makes flying safer; now pilots can land without having to fly through a burble of hot gases. Without these stack gases, corrosive to ship and planes, countless man-hours and dollars are saved.

No longer must upper decks and superstructure be cluttered with large air-passage spaces. Greater gas-tight integrity also safeguards the ship from atomic fallout and biological and chemical attack.

"The ship does not depend upon great draughts of air to sustain combustion, as do

the 'fossil-fueled' ships," Captain Michaelis explained. "The result is that radioactive contaminants can be excluded as the ship drives through an air mass contaminated by atomic air bursts."

I had seen much of the Navy before my cruises with the Sixth Fleet. I have found it dispersed throughout most of the world we live in, contributing its strength to the cause of peace everywhere. To update an old saying; the SUN never sets on the USN. It is ready for whatever may come, wherever it comes.

Aboard *Enterprise* and other Sixth Fleet combat ships, I have cruised thousands of miles. And not long ago I sailed and flew up and down the far reaches of the Pacific with our Seventh Fleet.

In recent years I have chilled at the sight of Russian trawlers, decks bristling with electronic listening and measuring equipment, steaming brazenly among our ships in maneuvers off Portugal. And I have ridden a plane down the Formosa Strait with the uneasy knowledge that the Chinese Reds were watching us on their radar screens. Such things are routine to our Navy men.

One Shot, One Hit in Missile Age

As a student of the Navy since my own bluejacket days nearly half a century ago, I have learned that the most constant thing about it is—change. The Navy has been in transition all its 189-year history. There was the evolution from sail to steam, and from wooden ships to steel. There was the advent of the sea-borne airfield. Today missiles and nuclear weapons have come to the fore.

Yet the Navy retains its flexibility, being "dual capable" and ready to use either conventional or nuclear weapons as required.

We used "garden-hose" warfare in World War II, spraying targets with relatively inexpensive bullets and shells. Now surface-to-air missiles like the Terrier and Talos are very expensive—and we perforce must have a different system: one shot, one hit.

The Navy today costs the U. S. taxpayer \$14,300,000,000 annually—roughly \$126 for

Mock War Rages on the North Carolina Coast as Marines Storm Ashore

Much like the human body, the Navy needs exercise to do its job at peak efficiency. Thus each year Navy and Marine units conduct more than a hundred major training operations. These air and ground forces of the Second Marine Division practice amphibious landings at Onslow Beach, near Camp Lejeune. Helicopters with combat-ready troops land behind the "enemy" lines in an enveloping maneuver.





Crippled Bird Coming Home to Roost

With the blast of catapult and the roar of jet, Lt. August Gandia, Jr., and his Chance-Vought Crusader (left) shot from the deck of *Enterprise* as the author watched. A wheel dangled, damaged in take-off. Lieutenant Gandia faced a moment of reckoning in bringing his jet back aboard safely.

He waited, using up fuel, as other planes came in and landed, leaving the deck cleared for the damaged F-8E Crusader. Then men raced out and in two minutes rigged a 21-foot-high net, like the one going up on the carrier *Constellation* (below).

PHOTOGRAPH BY JOHN L. WITTEBERG AND BY ENTIREWORKS OF WALTER B. VAN



Finds Safety in a Nylon Net

Swooping down, pilot Gandia hurtled straight into the barricade. The tough nylon web, held by hydraulically controlled cables, stopped the Crusader in the length of a football field. Gandia crawled out, unhurt.

Since her commissioning in 1961, *Enterprise* has experienced only two such barricade engagements, both successful.

STAFF PHOTOGRAPHERS U.S. NAVY



One-legged Crusader No. 201 lands at 150 miles an hour.



Like a trapped wildfowl, the Crusader flutters, slows.



U.S. NAVY PHOTOGRAPHERS

Beribboned with netting, the plane halts; the million-dollar jet aircraft, safely home, suffers only slight damage.



Split-second decisions are the specialty of a landing signal officer on *Enterprise*, the most respected "system" of the carrier's many landing aids. As each jet comes in to land, the LSO talks by radio-telephone to the pilot. Should the approach pattern be faulty or the deck not clear—"foul deck"—he squeezes the pistol-like device in his hand, and flashing red lights on the deck wave off the aircraft.

A flyer himself, the LSO knows that landing is an unforgiving business. It has to be right. Luminescent panels on coveralls help pilots spot him on the deck.

BY JAMES H. HARRIS



every citizen 21 years old and over. It is a bargain at any price.

At the time of Pearl Harbor the battleship was the backbone of the fleet. By the close of World War II the aircraft carrier had displaced it as the ship of the line, the ship around which the fleet is built.* Now the Navy's goal is nuclear propulsion for all future fighting ships of more than 8,000 tons.

Even the South Pole Knows the Navy

So I think it fair to say that the United States Navy of 1965 is like nothing any sailor any time and any place has known. One thing is certain about it, however: Its responsibilities are greater than ever.

To establish and maintain balances favorable to peace, it must exercise its strength

on all seas wherever free man is, or may be, challenged. It patrols the Atlantic Ocean, both north and south of the Equator; the Pacific from Alaska to Antarctica; the Indian Ocean and beneath the icy mantle of the Arctic Ocean; and most of the world's seas.

Carrying out this vast task are 670,000 officers and men, 870 ships, and 8,400 aircraft. The Navy is in its element on the water, above it, under it, or ashore. The United States Marine Corps, an integral part of the naval service, is tailored especially for amphibious assaults and landing operations.

Organizationally, the Navy is divided into four strong numbered fleets. The Sixth and Seventh are normally stationed in European

*See "New Queen of the Seas," by Melville Bell Grosvenor, *NATIONAL GEOGRAPHIC*, July, 1942.

and western Pacific waters respectively. The First is based along the west coast and the Second along the east coast of the United States (pages 164-5).

The Navy also has a number of overseas bases, most of them in the Pacific. I visited outposts on bleak Adak in the Aleutians, lonely Midway and Wake Islands, tropical Guam. I toured them in other countries—Japan, Taiwan, the Philippines.

Okinawa, scene of furious fighting in World War II, I found to be a great bastion of United States strength in the western Pacific.

In Western Australia the Navy maintains a

large communications center. More than 3,500 miles southeast, at Christchurch, New Zealand, stands the headquarters of the United States Antarctic Command. From there men, ships, and planes fan south to support naval stations on the rim of Antarctica and at the geographical South Pole.

Hawaii, nearly in the center of the Pacific Ocean, provides an ideal spot for headquarters of the over-all Commander in Chief, Pacific: Adm. Ulysses S. Grant Sharp, Jr. From Admiral Sharp's unified command post at Camp Smith, high in the hills above Pearl Harbor, Navy, Army, and Air Force units alike receive operational orders.

At Pearl Harbor, too, the Commander in Chief, Pacific Fleet, makes his headquarters. Adm. Thomas H. Moorer holds the helm of this Pacific Navy command, which includes both the First and Seventh Fleets.

On the other side of the world stands poised still more American naval power: the Atlantic Fleet, composed of the Second and Sixth Fleets, with headquarters at Norfolk, Virginia, world's largest naval base.

The Commander in Chief, Atlantic, now Adm. H. Page Smith, is also Commander in Chief, Atlantic Fleet, as well as Supreme Allied Commander, Atlantic, for the North Atlantic Treaty Organization.

From the London headquarters of United States Naval Forces, Europe, Adm. C. Donald Griffin directs the Sixth Fleet's operations.

Our largest concentration of naval strength guards the Pacific, where at present the greatest need for the Seventh Fleet's "Ready Power for Peace" exists. The Seventh consists of some 125 ships, 64,000 officers and men



Tail hook of a Douglas A-4C Skyhawk snags a cable stretched across *Enterprise's* deck; the plane jerks to a halt. At the moment of touchdown the pilot goes to full throttle, so that in case of a "bolter"—his hook missing all cables—he will have sufficient power to fly off again.

Human ballast, a flight crewman leaps onto the wing of a Skyhawk to hold it down in the face of a 35-knot wind whistling across the deck. The light, stubby-winged A-4C often needs this added weight to gain enough wheel traction for steering control.



(24,000 of them Marines), and more than 650 aircraft. Its responsibility stretches across 30 million square miles, from the Bering Sea to Antarctica, from 160° east longitude (approximately mid-Pacific) to the Indian Ocean.*

Admiral Moorer, the Seventh's commander at the time of my Pacific tour, put this vital mission in new perspective for me. With Dr. James H. Wakelin, Jr., then Assistant Secretary of the Navy, I rode aboard the carrier U.S.S. *Constellation* off Okinawa (page 181).

"We are face to face with Communism

here," Admiral Moorer said, "over the longest front in the world." He gestured seaward.

"We are watching the Communists from the Arctic to Southeast Asia. And," he added, "the Communists are watching us, too."

The Reds would be dismayed indeed, I thought, to see what Secretary Wakelin and I were viewing then and there. The sea flamed with streaking infernos of napalm. Guided

*See, in NATIONAL GEOGRAPHIC: "Pacific Fleet: Force for Peace," by Frank Sizer, Sept., 1959, and "Our Navy in the Far East," by Adm. Arthur W. Radford, Oct., 1953.



Television screen shows a Douglas A-3D Skywarrior's angle of approach to U.S.S. *Ticonderoga* as an aid to the nearby landing signal officer. Video-tape recordings of every touchdown allow pilots to study their own performances and correct mistakes.

Shimmering heat makes phantoms of men and planes as a Crusader shoots off *Enterprise's* runway. Its roaring jet washes the flight deck with shock waves of sound.



missiles blasted off; bombs, rockets, automatic cannon, machine guns—all cut loose in a frightful din. It was an awesome demonstration of firepower.

No Fat Men on a Carrier's Deck

Secretary Wakelin turned to me.

"I wish," he said, "everyone could see the Seventh Fleet as we are seeing it; then there would be a greater appreciation of the Navy's contribution toward maintaining peace throughout the world."

The activity on *Constellation's* flight deck, I kept thinking, was a kind of weird ballet. Each member of the crew was performing his duties with the speed, precision, and grace of a ballet dancer. Each had to

"The flight deck," said an officer at my side, "is an accident about to happen."

There are no fat men on a carrier's runways. The sailors who hook the catapult bridles to the undercarriages of jets screaming at full power—while lying on their stomachs—must scramble catlike to safety an

PHOTOGRAPHS BY JOHN LEE FERRY, LACED—THE GREAT FLYING—BY NATIONAL GEOGRAPHIC SOCIETY



AMERICA'S ★★★★★ FOUR-FLEET NAVY STANDS WORLD-WIDE WATCH



MAP NUMBERS SHOW BASES AND STATIONS SUPPORTING THE NAVY'S SEAGOING FLEETS

1. Christchurch, New Zealand, tethers the supply line of Naval Support Force that services U. S. scientific bases in Antarctica, including Amundsen-Scott station at the Pole.
2. Okinawa serves as headquarters for the combat-ready Third Marine Division, Reinforced, and as a training ground for counter-guerrilla and jungle warfare.
3. Iwakuni, Japan, provides home and headquarters for the First Marine Aircraft Wing and Navy Patrol Wing.
4. Yokosuka, Japan: the home port for the Commander of the Seventh Fleet.
5. Hawaii, hub of U. S. Pacific forces: headquarters of the Commander in Chief for the Pacific area (unified command of all U. S. services); of the Commander in Chief, U. S. Pacific Fleet; of the Fleet Marine Force Pacific; and of the Pacific Fleet Submarine Force, Antisubmarine Warfare Force, Service Force, and Barrier Force.
6. Long Beach, California. Pacific Fleet's Mine Force makes its headquarters here.
7. San Diego, California: largest naval installation on the U. S. west coast. The Commander of the First Fleet makes this his home port. Also headquartered here are the Pacific Fleet's Cruiser-Destroyer Force, Amphibious Force, and Naval Air Force. First Marine Division bases and trains at nearby Camp Pendleton; Third Marine Aircraft Wing flies from El Toro.
8. Newport, Rhode Island: headquarters for the Cruiser-Destroyer Force, Atlantic Fleet.
9. New London, Connecticut, serves as the Navy's largest submarine base and training area for submariners.
10. Washington, D. C.: U. S. Navy's nerve center.
11. Norfolk, Virginia, world's largest naval base, quarters the

Submarines crack through the polar ice cap on their trips across the top of the world.

Flags at Washington indicate the Secretary of the Navy, the Hon. Paul H. Nitze (white anchor); Chief of Naval Operations, Admiral David L. McDonald (four stars in a blue and white field); and Commandant, Marine Corps, General Wallace M. Greene, Jr. (red field). Four stars on a blue field designate full-admiral commands.

- ✈ Naval air station
- ⚓ Naval base
- ⚓ Polaris support facility
- ⚓ Naval area command headquarters
- ⚓ Navy yard
- ⚓ Communications station



London: Headquarters of the Commander, U.S. Naval Forces Europe, which includes the Sixth Fleet.

Navy divers live at a depth of 192 feet for 9 days in Operation Sea Lab off Bermuda, July, 1964.

Operation Amity: Ships of the South Atlantic Force call at African ports.

Normal home port of the Middle East Force that patrols the Persian Gulf and Indian Ocean.

SECOND FLEET patrols the western Atlantic. The Northampton and the Wright, two communications command ships, stand ready to serve the President as sailing White Houses in case of an atomic emergency. Ships and men of the Second rotate with those of the Sixth.

SIXTH FLEET guards the underside of Europe and, with no Mediterranean base, takes its supplies from the Atlantic Fleet Mobile Service Force. The Commander's flagship makes Villefranche its normal home port. The Sixth, called the "Friendly Fleet," holds the affection of thousands around the Mediterranean with its good-will acts.

MAPPING BY NATIONAL GEOGRAPHIC STAFF ARTIST JOSEPH E. BARRITT, JR. RESEARCH BY ROYAL W. BERRY © 1964

- 3. Mayport, Florida, bases Atlantic Fleet aircraft carriers.
- 12. Charleston, South Carolina, home base for the Atlantic Fleet's Mine Force, provides a support base for Polaris submarines and destroyers.
- 13. Mayport, Florida, bases Atlantic Fleet aircraft carriers. Their air wings fly from nearby Jacksonville.
- 14. Key West, Florida: headquarters for Caribbean Area Patrol.
- 15. Guantánamo, Cuba, harassed by Castro, carries on as the most important base for ship shakedown and crew training.
- 16. Panama acts as headquarters for the U. S. Naval Forces Southern Command, the Panama Sector of the Caribbean Sea Frontier, and the Western Sea Frontier.
- 17. Puerto Rico: headquarters for the Caribbean Sea Frontier. Naval base at Roosevelt Roads. Navy and Marine Corps conduct amphibious training on Vieques Island.
- 18. Bremerhaven, Germany, provides the European base for the Military Sea Transportation Service.
- 19. Naples, Italy, houses the Southern European headquarters of NATO, presently commanded by a U. S. admiral. Other activities centered here include the command of the Sixth Fleet's air support.



Flight-deck monitors aboard *Enterprise* spot aircraft models on a plotting table and relay instructions for planes taking off and landing.

On deck, a Skyhawk A-4C catapults into the night with bulletlike speed. Another trundles into launch position over a second catapult.

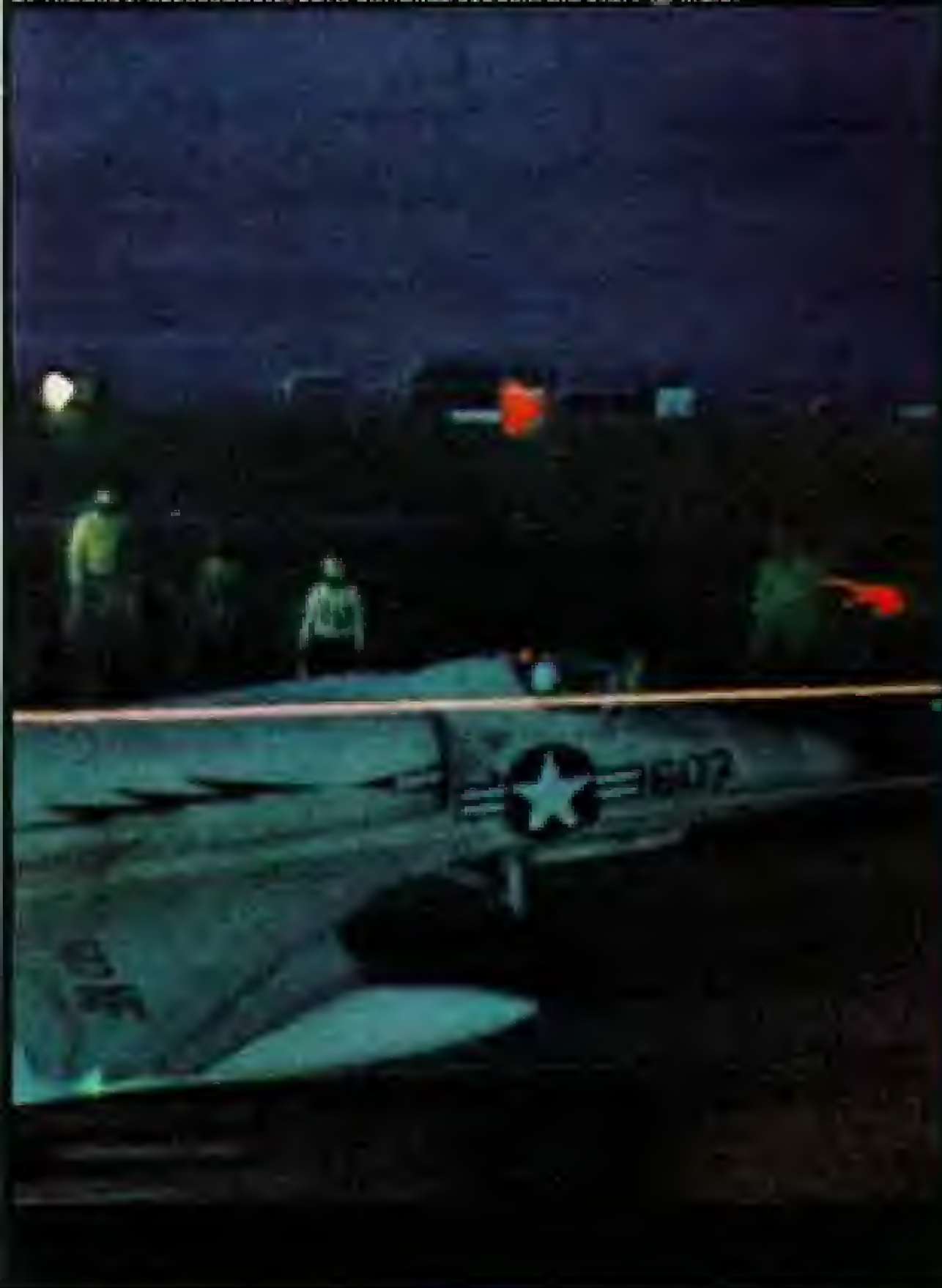
ENTACHROMES (LEFT AND RIGHT) BY WINFIELD PARKS AND BOBACHRON



Squadron of Phantom pilots studies orders in the ready room. Soft red glow helps them adapt their eyes to the hazardous job of night flying.



BY THOMAS J. ABERCHONNIE, BOTH NATIONAL GEOGRAPHIC STAFF © N.G.S.



instant before the launch signal. But constant training and vigilance keep the flight deck accident rate low.

From the standing, straining start, jet fighters and bombers leap airborne within 2½ seconds, in little more than 200 feet.

But the most hazardous part of carrier flight operations is the recovery, especially at night. It is literally touch and go. Sometimes a plane's dangling landing hook fails to snag one of the four or five arresting cables stretched across the runway near the stern. Then the pilot "bolts": He flies along the flight deck and off again.

To maintain flying speed, he has pushed the throttle wide open even as his hook touches the deck. This gives him enough power to get airborne again if his tail hook misses the cables, and a split second in which to make up his mind.

A heavy jet plane, pulling out cable against tremendous hydraulic resistance, takes 360 feet to stop. Propeller planes still in use on carriers, such as the old, highly maneuverable Skyraiders, stop in half that distance.

Five Landing Aids Guide Pilot

Science and technology have developed several remarkable electronic devices to help bring pilot and plane on board safely. There are no fewer than five technical landing aids in use during approach and landing.

Suppose a recovery involves 25 planes. They will rendezvous some 35 miles astern and come in for a landing at one-minute intervals during operations at night, 30-second intervals in daylight.

Deep inside the carrier in the darkened CCA (carrier-controlled approach) room, radar is tracking them, and high-speed computers are calculating the amount of fuel left in each plane's tanks. The controllers in CCA know how many minutes each plane can remain aloft, and which must be brought in first or refueled in the air from a tanker plane always stationed near the recovery area.

On the flight deck, the landing signal officer (LSO) and his team work with another radar device nicknamed SPIN, a speed indicator which tells them whether the plane is coming in too fast or too slow. Voice radio informs the pilot accordingly (page 160).

As the plane draws closer, PLAT (pilot landing aid television) picks it up and keeps it in constant view (page 162). Now the LSO team tries to keep the aircraft in the cross hairs of the TV screen. Running talk with the pilot keeps him in his proper glide path.



PHOTOGRAPH BY ROBERT W. BARNES OF NATIONAL GEOGRAPHIC SOCIETY

Heeling to starboard, the guided-missile cruiser U.S.S. *Boston* makes a sharp turn in the Atlantic. Her wake still froths beside the cutter that refueled her moments earlier. *Boston's* eight-inch guns can bombard targets more than 15 miles inland; two batteries of twin missile launchers aft, as well as anti-aircraft guns, strike attackers in the air.

Later, he will study his landing on TV tape.

Another aid is a system of signal lights, visible to pilot and LSO alike, that shows whether the plane is approaching too fast, too slow, or just right.

Finally, there is the famous Fresnel lens landing system, the carrier pilot's guardian angel. This is an arrangement of lights visible to the pilot to tell him whether he is on a proper path to the ship or not. When the pilot sees a large orange "sun" in the middle of a string of horizontal green lights, he knows his glide path is correct and calls out "meat ball." The LSO must acknowledge.

And if all these devices aren't enough, there is a glass-enclosed control tower high above the flight deck known as Pri Fly (primary flying control). Here the ship's air officer and

his assistant study the readings of the other systems; if anything seems amiss, Pri Fly directs a wave-off.

Pilots are quick to say that the most helpful aid of all is the LSO himself. They frequently refer to him as the "eyeball aid." From long experience the landing signal officer senses the attitude of plane and pilot. He can actually *predict* what the pilot is going to do. For example, he can give an incoming pilot a low signal before he actually goes low; he will tell the pilot just how much to increase his power and altitude as he comes on in.

Before the days of the angled deck, and that includes all of World War II, planes didn't take off and land simultaneously. Today planes land on the angled runway, which is canted from fantail to the ship's port side,

while others are sent skyward from the bow runway (see foldout, pages 153-5).

If a carrier is not recovering planes, it launches from all four of its steam catapults instead of only the two on the bow. Aboard *Constellation*, as Secretary Wakelin and I watched, four planes were launched within seconds, four more a minute later, and so on.

Since a jet plane about to be catapulted runs its engine at full throttle, the noise level becomes fantastic. Ear protectors must be worn. Heat generated by jet exhausts is so intense that one feels the hot blast even on the bridge, more than 40 feet above the flight deck.

The Seventh Fleet's attack carrier strike force may have from three to six aircraft carriers. Each is the core of a carrier task group, which also includes guided-missile cruisers, frigates, destroyers, and supply ships.

A carrier usually supports 60 to 100 planes: heavy and light bombers, fighters, radar scouts, reconnaissance and photographic aircraft. All can be airborne in minutes. They can fly around the clock, in any weather.

Flight Deck Becomes Eerie by Night

When flight operations ceased temporarily that day aboard *Constellation*, I walked about the deck and happened to look at the odometer of one of the tractors that move the aircraft. It had logged more than 8,000 miles, and *Constellation* then had been commissioned just a year.

Flight operations resumed that night. Red lights cast the only illumination; not only do they enhance night vision, but the ship is less easily seen from afar.

Peering at that baleful glare in the black-velvet night, punctuated by stabbing tongues of flame from jet tailpipes; following the grotesque shadows of nimble crewmen; hearing even through my earmuffs the high scream of the impatient jets—I felt as if in some hellish other-world.

Then I recalled what an Air Force exchange pilot serving in a carrier air wing had said when I asked him what he thought of naval aviation.

"I love flying," he replied. "This"—and he gestured around him—"is the closest you can be to aviation in all the world."

With supersonic planes flying from such highly mobile airfields, the Navy can, in an hour or less, strike a target as far inland as Chicago is from the Atlantic.

"I don't think that anyplace on earth today is beyond the range of attack from the seas," my old friend Rear Adm. Charles K. Duncan



U.S.S. MCCLOY

Onion-shaped sonar dome on the U.S.S. *McCloy*, here seen in drydock, probes ocean waters for enemy submarines. Detecting one, it relays findings to the destroyer's combat information center.

CAT-AND-MOUSE DRAMA *in the Atlantic. Beneath the waves lurks an American submarine, playing the role of enemy. On the surface and in the air, hunter-killer forces tighten the snare. Helicopter in foreground, its downwash ruffling the water, dunks a sonar device that pinpoints the target. Grumman S-2F Tracker flies between destroyers Samuel B. Roberts (left) and Charles S. Perry. A moment later, the second copter drops an exercise homing torpedo. Strike one sub.*

EXPLORER BY WILLIAM A. BURNS © NATIONAL GEOGRAPHIC SOCIETY

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SUBROC

NAVY'S DEADLY NUCLEAR TORPEDO adds punch to America's underwater arsenal. Its vastly increased range over conventional torpedoes deters the threat of hostile, missile-equipped submarines to the United States and her allies.

Booster-rocket propels 4,000-pound SUBROC at supersonic speed.

SUBROC breaks surface—
atmospheric flight begins.

Attack-type submarine fires SUBROC through standard torpedo tube.

Compressed air heaves SUBROC clear of submarine. Solid-fuel booster-rocket motor ignites under water.

once told me. "Almost three-fourths of the earth's surface is water," noted the admiral, who is Atlantic Fleet Commander of Cruisers and Destroyers. "Planes from carriers, missiles launched from ships on the surface or under it—these can reach anywhere."

All our fleets are designed, of course, to permit effective action on any level of a cold or hot war. Besides the attack carrier striking force, a fleet contains an amphibious force, mobile logistic support force, mine force, and patrol force. It also relies on an antisubmarine carrier group, known as a hunter-killer, or HUK, unit. Another important element is the airborne early warning force, sometimes called the barrier force.

Cruisers and destroyers operate with attack carrier and antisubmarine carrier groups. Besides providing air defense and protection from submarines, they carry long-range missiles and heavy guns for shore bombardment.

Each fleet also has numerous submarines. In training exercises, they often act as the "enemy" to furnish the edge of realism in fleet antisubmarine actions.*

The Navy lays great emphasis on its amphibious force of attack transports, attack cargo ships, landing ships, beach landing craft, and helicopter assault aircraft carriers. It can put Marines quickly ashore anywhere in the world—and sustain them.

How fast can the Marines move? Gen. Wallace M. Greene, Jr., Commandant of the Marine Corps, gave me a succinct answer: "From its Okinawa bases, the Third Marine

Division, Reinforced, with its artillery, tanks, and initial logistical support, can be on its way within 12 hours. Teamed with it in support will be the First Marine Aircraft Wing, also based in the western Pacific."

The mobile logistic support force, a vital outfit, keeps auxiliary ships at sea constantly throughout the world, carrying food, fuel, ammunition, and other supplies to the combat vessels (pages 178-9).

Operating in both Atlantic and Pacific, from land bases, the airborne early warning group sends out its long-range planes, with their powerful radars, to fill gaps of surveillance (page 180).

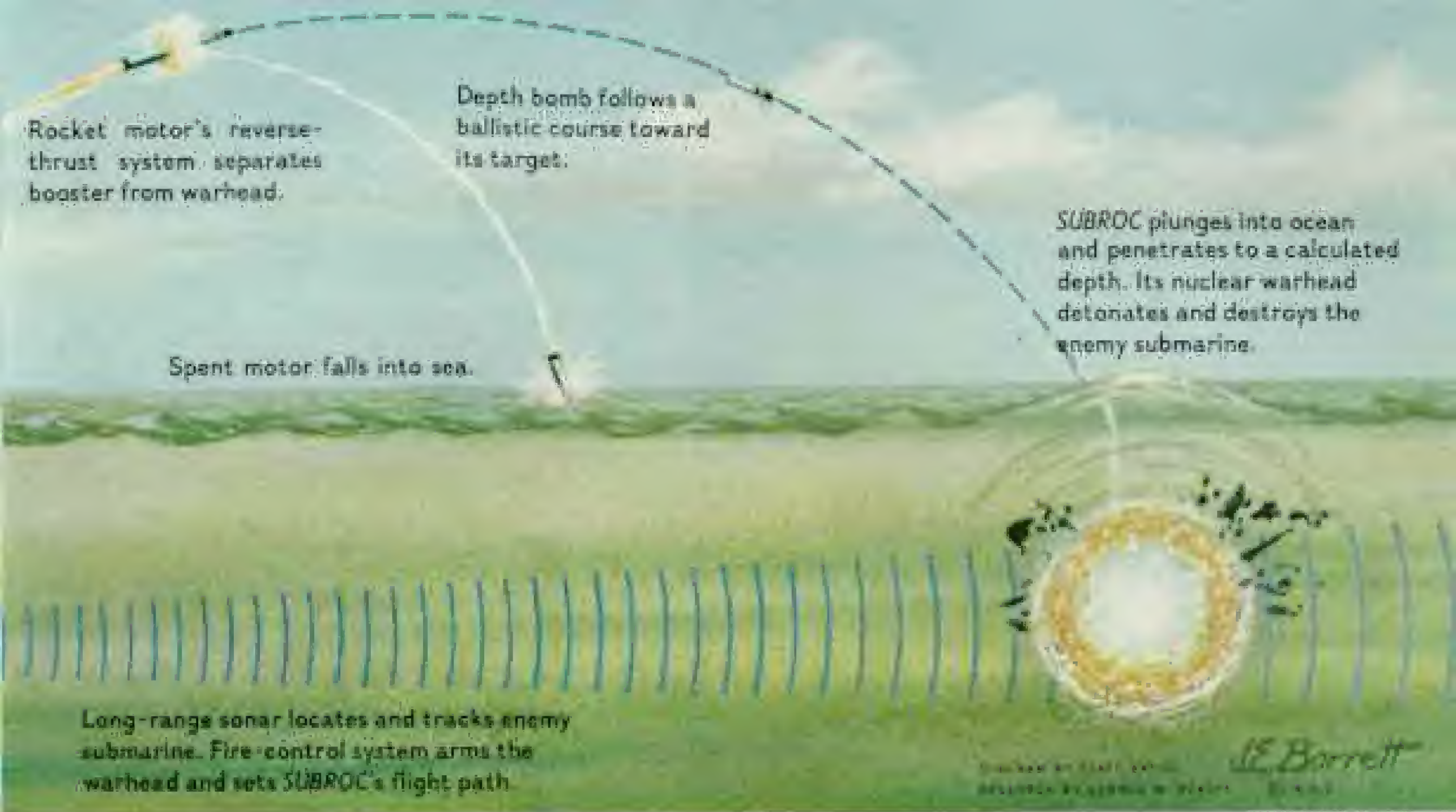
The mine force, especially important in shallow offshore waters, clears mined channels, while the patrol force conducts antisubmarine surveillance and search-and-rescue operations.

"Fighting Lady" Hunts Down Subs

To get a taste of antisubmarine warfare, I flew to the aircraft carrier *Yorktown*, then serving with ASW Carrier Division 19. The division was taking part in a Southeast Asia Treaty Organization (SEATO) exercise, called *Sea Serpent*, in the South China Sea.

We landed on *Yorktown* in a Grumman C-1A, the Navy's rugged, twin-engine personnel and mail-hauling "carrier on-board delivery" plane, or COD. I have set down in COD's on carriers many times; yes, and been

*See "Our Navy's Long Submarine Arm," by Allan C. Fisher, Jr., NATIONAL GEOGRAPHIC, November, 1952.



catapulted off carriers in them. Landing is worse, in my opinion.

Aboard *Yorktown*, I found that ASW work is as complicated—or as simple—as modern technology can make it. The carrier, World War II's famed "Fighting Lady," uses all manner of radar, communications gear, electronic countermeasure devices, and computers. Its Grumman S-1 Tracker planes, 24 of them, are equipped with devices known as Sonobuoy and MAD. Held in pods under the wings and dropped singly or in clusters into the water, Sonobuoys transmit penetrating sound impulses. The impulses bounce off the hull of a lurking submarine, and the Sonobuoy radios the echoes to the listening hunters.

MAD (short for magnetic anomaly detection) detects any large metal object down to almost any depth subs can go.

Yorktown also carries 18 helicopters. These hover over the area where a submarine is suspected and dunk sensitive listening sonar into the sea by cable.

Destroyers and destroyer escorts—the dashing cavalry of the Navy—also employ sophisticated sonar and other detection equipment. Their weapons include "hedgehogs," which can fire 24 rocket-propelled depth charges at once in a wide pattern, and ASROC, an antisubmarine, rocket-hurled homing torpedo similar to SUBROC (above). Another weapon is the DASH (drone

Lofty sail, or conning tower, with winglike planes cleaves Atlantic swells as the nuclear submarine *Shark* cruises off the Virginia Capes. Another nuclear sub, *Triton*, circled the globe submerged in 1960.

Illustration by Gary Wolfe © NATIONAL GEOGRAPHIC SOCIETY





PHOTOGRAPH BY THE OFFICE OF NAVAL RECORDS AND DOCUMENTATION

Charging across the green fields of Okinawa, Marines practice a bold concept of airborne assault known as vertical envelopment. Helicopters airlifted them from a carrier in the Pacific and set them down deep behind "enemy" lines. Third Division Marines train here for any possible landing in troubled Southeast Asia.

antisubmarine helicopter); controlled from its mother destroyer, it drops homing torpedoes or depth charges.

The Navy has nine antisubmarine carriers on duty. Their Douglas A-4C jets serve as interceptors against air attack.

In this SEATO exercise, units of the United States, Great Britain, Australia, New Zealand, the Philippines, Pakistan, and Thailand performed in near-perfect coordination. I spent the night listening to the submarine hunt, reported in laconic Navy jargon:

"This one's a sinker," comes the pilot's voice over the radio. "I've got a surface contact and he's going down."

A destroyer knifes through the sea at 30 knots to the contact area, and its sonar picks up the submarine. Now it begins dropping depth charges—small, harmless, practice ones—and brackets the pinned-down sub. Inside, her crew hears them exploding.

The submarine's commanding officer sends

up a green rocket; his ship is dead. Before the night is out, says *Forktown's* captain, we have killed all the enemy submarines.

"How about us?" I ask. "Did they score any hits on us?"

"We were sunk a couple of times," he says.

Nuclear Subs "Fly" While Submerged

I have nothing but admiration for our submariners. It goes back to the day I boarded the nuclear attack submarine *Skipjack* at New London, Connecticut, for a training cruise. I had been down before, but never in a nuclear sub, whose driving power could keep her under the ocean almost indefinitely.

I wasn't nervous as we submerged, perhaps because everyone else was so calm. *Skipjack's* operation soon engrossed me, and I was struck by the fact that a submarine has much in common with an airplane: It flies. The bow wave created by a surface ship restrains the vessel and affects its motion.

But the submarine has no bow wave; its streamlined hull actually permits it to go faster under water than on top.

Airplane-type controls direct the submarine. Push the wheel forward and the sub goes down; pull it back and it goes up. Two "planesmen" steer, sitting side by side like an aircraft's pilot and copilot.

Standing in the control space with Comdr. William W. Behrens, Jr., I marveled at *Skipjack's* maneuverability. We banked and turned so sharply that at times I had to hang on to straps—as if in a subway train.

Then it happened. The raucous alarm klaxon went off—always a dread sound at sea, and all the more foreboding deep beneath it.

"Fire in after storage locker!" announced a strident voice over the loudspeaker.

Sailors raced by on the double. The urgent voice kept repeating, "Fire . . . fire . . ."

A happy thought came to me: This must be part of the training exercise. Of course. I turned to Commander Behrens.

"It's a good idea to have a fire drill . . ." I began. He looked at me quizzically. "It's not a drill," he replied.

The captain of a ship does not leave the bridge during an emergency. We waited. Trained officers and men fought the blaze. It was soon out; they had confined it to some crates where it had started, origin unknown.

That night as *Skipjack* prowled the depths, I went to bed with new respect for the men who wear the dolphins of the submariner.

Polaris: Deadliest of Submarines

Attack submarines like *Skipjack* boast a double deadliness—vast range because of their nuclear engines, terrible striking power because of their nuclear torpedoes. But no submersible is as formidable as the fleet ballistic missile submarine—Polaris.

One cold, stormy predawn last winter several civilian observers, including NATIONAL GEOGRAPHIC Assistant Director of Photography Joseph B. Roberts and myself, boarded *Andrew Jackson*, then the newest Polaris submarine, at Norfolk, Virginia. This was a shake-down cruise; within minutes we would put out to sea to dive and fire two mock missiles.

Entering a submarine is easy—if you're an acrobat. You squeeze through narrow hatches and climb down steel ladders, deck by deck. It is like making your way arduously to the bottom of a well, and there finding a wonderful bustling city all about you.

As we got under way, an excellent break-

fast was served in the wardroom. The food appeared magically from a galley no bigger than a medium-size refrigerator. Then came the briefing: a calm recital of the startling Polaris facts of life given by Comdr. James B. Wilson, the skipper, and his officers.

All 41 Polaris submarines authorized by Congress, we were told, were already built, building, or under contract; as this is written, 29 are operational, and others are being commissioned at about one a month. Each carries 16 ballistic missiles; they can be zeroed in on a single target, or on 16 different targets, or any combination.

Powered by solid-fuel, two-stage rockets, these missiles have increased in range from the Polaris A-1's 1,380 statute miles to the A-3's nearly 3,000 statute miles. There are now three classes of Polaris submarines, each larger than its predecessor.

"You are aboard the most advanced class



PHOTOGRAPH BY THOMAS W. CLARK © N. G. S.

"I saw ferns move, but too late—I was already 'dead,'" said the author after encountering this Marine, "an enemy guerrilla." Dug into a foxhole in the Okinawan jungle, the sniper "wiped out" the passing patrol before it detected him.



Make-believe guerrillas ambush a Marine detachment on a lonely road in Okinawa. Troops in the rear of the convoy immediately crash off the trail to flank the attackers. Such training maneuvers teach Third Division Marines that only aggressive action can thwart enemy guerrilla tactics in the jungle. Torrid weather, poisonous snakes, and snipers dressed as farmers help toughen the men for conditions they would face in actual combat. And the war games pay dividends. "The Corps is in its best shape in history," Marine Commandant Greene said recently.

Jungle's lush beauty is wasted on a Marine platoon; their eyes are alert only to dangers concealed in the brush.



DETACHMENT BY THE FRONT © NATIONAL GEOGRAPHIC SOCIETY

of Polaris submarine," Commander Wilson told us. "*Andrew Jackson* is 425 feet long and displaces 8,000 tons when submerged and 7,000 tons on the surface. Her A-3 missiles—like the shorter-range A-2's and A-1's—all strike with uncanny accuracy."

Commander Wilson spoke from experience. His ship launched the first A-3, and later fired two of them, while submerged, down the Atlantic Missile Range (foldout, pages 150-52).

Directed by a self-contained inertial guidance system, these missiles cannot be aborted once they are on their way. Each Polaris submarine has more firepower than all the bombs dropped in World War II.

Fifty-four Days Under Water

I found *Andrew Jackson's* missile system an awesome sight. Here, through the entire mid-section of the ship, one sees the vertical launchers—two rows of eight tubes known in Polaris slang as "Sherwood Forest."

A-3 Polaris missiles stand 31 feet high, with a diameter of 4½ feet. The tubes are kept at constant air pressure and temperature.

"The guidance system is the missile's heart," Commander Wilson told me. "In the checkout, if we find a guidance system below standard, we can replace it in less than an hour."

"As to range, a Polaris submarine in the Atlantic 150 miles east of New York could fire an A-3 missile into the Pacific 150 miles west of San Francisco."

And what, I asked the skipper, of the 130 or so officers and men who live so intimately with these missiles? Each Polaris submarine

has two crews—the Blue and the Gold. In 1960, when the first Polaris went on station, alternating crews patrolled for 60 days each, never once surfacing. Now, with many Polaris ships coming on station, a patrol lasts about 54 days. A leave and retraining period follows, while the other crew is at sea.

On station, a Polaris submarine maintains complete radio silence. The ship, which can receive radio messages while submerged, listens continuously. It does not transmit, lest it give away its location.

Scheduled radio messages include condensed news and morale-building personal notes—some known as "familygrams."

"Naturally, the men miss their families," said the captain. "But their response and discipline are perfect. We have a fine library, and we show movies nightly. What really keeps them going, however—beyond the thought of returning home—is anticipating their next meal. The men love their food."

They should. It is the best in the Navy.

Now *Andrew Jackson* reached deep water in an area of the Atlantic proscribed to all shipping. Down we dived to launching depth, and Commander Wilson sounded battle stations. He had received a "war message"; he and his executive officer had verified it.

The countdown began. If all went well, the first Sabot, a training device used to simulate an A-3 missile but lacking rocket engines, would be "airborne" in minutes.

I did some mental arithmetic. Allowing time for the countdown and first missile launching, and for each successive firing,



Strung like a spider's web over Pacific waters, fuel lines from USS *Sacramento* (center) simultaneously replenish carrier *Midway* and an accompanying destroyer. *Sacramento*, a seagoing service station and supermarket, combines functions of oiler, ammunition ship, and stores dispenser. Its helicopter ferries supplies to the carrier.

Muscles strain as a rig crew heaves on a taut line aboard *Sacramento* during fueling.



Andrew Jackson could launch its sixteenth lethal bird before its first had slammed back down from space onto its far-distant target.

The countdown continued. Emotionless voices ticked off the checkpoints one by one, rapidly. Time was running out. Then it was down to three seconds . . . two . . . one . . .

Missile away! There was practically no noise—just a hiss. I felt a thud; a slight shudder coursed through the ship. That was all. Fascinated, I watched computers trace the theoretical flight. It was successful, and so was that of the second mock missile. Had they been actual Polaris missiles, I was told, the shock to the ship would have been no greater.

656 Arguments for Peace

We slipped back into Norfolk late at night. I kept saying to myself, "I don't believe it. It can't be true." But it is true. When all 41 Polaris submarines are at sea, 656 Polaris missiles can be brought to bear wherever their deterrent effect is needed.

I will not soon forget that Polaris cruise.

Another Navy man, as rugged as the submariner, is the Marine. I saw him in action recently on field exercises in both Europe and Asia. No service is tougher or more dedicated than the elite Marine Corps.



AMPHIBIOUS LANDING: AIRCRAFT BEING BY THE SHIP'S DECK. © NATIONAL GEOGRAPHIC SOCIETY

On Sardinia's barren south coast, I saw a practice landing of the Second Battalion, Sixth Marines. First, frogmen demolition teams cleared the beach of obstacles. Then, using amphibious craft, the battalion's 2,000 men brought tanks and artillery ashore.

Within an amazingly short time they had set up headquarters, ammunition depots, a fully equipped field hospital, an airbase for their helicopters, and a communications net in touch with the fleet at sea.

Amphibious operations like this recall World War II to Marines—but they might boggle at a tactic I saw called vertical envelopment. This sort of airborne assault uses a special kind of aircraft carrier, the amphibious assault ship or LPH (landing platform, helicopter).

The LPH brings combat-loaded Marine helicopters to a designated point at sea. Then the choppers lift the Marines to the rear of the enemy and set them down (page 174).

Marines in troubled Viet Nam are using the training they received at the Guerrilla and Jungle Warfare Schools in Okinawa.

Not long ago, NATIONAL GEOGRAPHIC photographer John E. Fletcher and I helicoptered to each school—and decided that when a Marine completes this training he can

handle anything the jungle or the guerrillas, or both, may toss at him. When we arrived at the Jungle Warfare School, we were greeted by Maj. Charles G. Cooper, its commander, who is now an aide to Admiral McDonald, Chief of Naval Operations.

"We've got a patrol going off through the jungle," he said. "We're holding it for you."

Marines Train for Instant Action

I brought up the rear, stumbling against the current of a muddy stream, wading knee-deep at times, trying to be as silent as possible. Silence is the price of life in the jungle. Single file ahead of me, members of the patrol used only hand signals.

Then, on my right, a man's figure loomed up out of nowhere. Even as I noticed him, he went down full of bullet holes.

Fortunately, "he" was only a dummy, triggered upright by the sergeant training the patrol. But it was live ammunition the patrol leader put into him. "Helps keep the men on their toes," the major explained.

On we slogged through green and humid swamp, easing past ferns and other tropical plants growing lushly along the stream. Behind me, out of the corner of my eye, I saw a clump of ferns move.



Illustration by the artist, showing the plane in flight over the water.





Then I spied what was behind it: the muzzle of a guerrilla's gun, poking at us from a foxhole dug into the bank (page 175).

The guerrilla turned out to be a Marine dressed in Oriental clothes. The patrol and I continued—theoretically wiped out.

Now the Marine next to the patrol leader slipped on the jungle path. The sergeant grabbed him and pointed wordlessly to a camouflaged hole he had just missed. On a real patrol, it might well have been lined with razor-sharp bamboo stakes.

On we went, the patrol stealthily blending into the jungle, its members alert to so much as the snapping of a twig. All the while I kept an eye out for the habu, a poisonous pit viper at home there on the ground, in the water, or in foliage overhead.

Finally we found ourselves blocked by an almost vertical cliff at least 50 feet high. Using ropes, the Marines scaled it.

But I was a weary senior citizen, not a Marine. Major Cooper, smiling, mercifully showed me a hidden path around the cliff.

Fleets Replenish Stores Under Way

Marines, submariners, the men of the destroyers whose ships know every mood of the sea—all think their particular branch of service is best. But taken as a whole, the Navy I saw proved much the same everywhere.

One thing, however, sets the two overseas fleets apart: The Sixth has no shore bases. It patrols the underside of Europe constantly as a transient organization, mobile and self-sustaining, making several complete trips around the Mediterranean each year.

Thanks to its service force of fuel tankers and repair, ammunition, supply, and provision vessels, the Sixth can stay at sea indefinitely. Its support comes from the Atlantic Fleet on the east coast, with which its men and ships rotate every four to six months.

The Seventh, on the other hand, has many shore bases, shipyards, and dry docks. Its ships undergo major repairs without returning to the United States. Some 55,000 Japanese work on our vessels at the great naval bases of Yokosuka and Sasebo. Seaplanes of the Seventh's patrol squadrons, similarly, are overhauled at Japanese aircraft plants. "Repairs are made in less time and at considerably less cost than they would be if sent back to the United States," said Vice Adm. Paul D. Stroop, Commander, Naval Air Force, Pacific Fleet.

All our fleets have one outstanding characteristic: long, sustained, mobile staying power. They can be completely independent of overseas bases on foreign soil. Underway replenishment, a Navy system



Departing Midway at dawn, a radar-equipped Lockheed C-121K Warning Star heads toward the Aleutians to scout unidentified missiles or planes.

Phantom II jets in the North Pacific escort a Russian Badger long-range photo-reconnaissance plane as it flies near the carrier *Kitty Hawk*.

On a Pacific tour in 1965, James H. Wakelin, Jr., then Assistant Secretary of the Navy for Research and Development, boards the *Constellation* with Adm. Thomas H. Moorer. Dr. Wakelin serves as a member of the Board of Trustees of the National Geographic Society.





DETACHMENT LAYTON AND BUSHMAN





BY WILLIAM S. ALLEN © NATIONAL GEOGRAPHIC SOCIETY



developed in World War II, provides all essential supplies while ships are steaming ahead.

I have seen many replenishments, day and night, good weather and bad. A typical one finds the supply ship under way at 15 knots with a destroyer, say, on one side and perhaps a carrier on the other. Many supply lines link the center ship to the others: Fuel oil and aviation gas course through heavy black hoses; mail, movies, and other items are transferred along highlines (pages 178-9).

Fuel is taken on most often. Skippers begin worrying about their next refueling when their tanks are down to about 85 percent full. I once asked a captain why.

"I want my ship ready instantly to carry out any mission," he answered. "We never know how long the chase may be."

"Stand By for Emergency Breakaway"

One replenishment I shall long remember. Midway across the Atlantic, the 17,000-ton guided-missile cruiser *Boston* steamed alongside the fleet oiler *Chukawan*, taking on fuel. It was Sunday. I had gone to the bridge about 5 a.m., joining Capt. Richard G. Colbert, *Boston's* commanding officer.

The sea was alive with ships. Even in the half-light I counted two carriers, two cruisers, 12 destroyers, two oilers, and an ammunition ship.

Most were rotating to the Sixth Fleet, when the fueling was completed, they would spread out over a front of as much as 100 miles. For reasons obvious since Pearl Harbor, our ships no longer operate in large formations, except very briefly.

Chukawan plunged through heavy seas about 80 feet from us, pumping oil into our tanks. Then I witnessed something that makes a captain old early in life.

A telephone line ran between the bridges of the ships. Over the phone suddenly came the word, "*Chukawan's* steering engine has failed. She has lost steering control."

Out of control and loaded with highly combustible aviation gas as well as oil, and only 80 feet away from us!

"Stand by for emergency breakaway," I heard Captain Colbert direct. "Execute!"

Vapor trail of a Terrier missile (above) draws a map in the sky as it zeroes in on its target, a drone jet streaking in from left. Destroyer *Dahlgren*, which fired the missile, employs two radar beams—one to find the target, the other to guide the Terrier. A deliberate near miss squares the costly drone.

Like a Fourth of July rocket, a Talos anti-aircraft missile blasts off its launcher on the cruiser *Little Rock* to seek out a target drone.

I looked down at the deck where two six-inch hoses were joined to the ship's fueling connections. Abruptly they parted and went snaking overboard into the roiling water, spewing oil as they went.

Captain Colbert took over from the young officer of the deck. "Left 10 degrees rudder," he commanded. Then—"Left 20 degrees rudder . . . left 30 degrees rudder." And then—"All engines ahead flank."

We turned sharply to port and pulled away from the helpless, wallowing tanker, which was sheering toward us. Our deck was covered with oil where the hoses had been disconnected, and the sailors were thoroughly splashed by it. But there wasn't one of us who didn't feel like cheering.

Later that Sunday, I saw another kind of replenishment—the spiritual kind. After our chaplain conducted religious services for our 1,500 officers and men, *Boston* sent him out to the smaller ships. That day he would conduct six or more services, transferring from ship to ship by highline.

Emerging into an Arctic world of eerie silence and icy beauty, the nuclear submarine *Skate* shatters the polar pack in March, 1959. Her skipper, Comdr. James F. Calvert, made the picture 300 miles from the North Pole at one of numerous "skylights" of thin ice in the 17-foot-thick frozen cover. On the historic voyage, *Skate* surfaced 10 times—once squarely at the Pole.

Navy icebreaker *Atka* smashes through frozen Antarctic seas, sculptured by raging winds into fantastic crags. She keeps channels open in the summer season (September to March) to support Americans quartered at the bottom of the world.





PHOTOGRAPH BY JOHN P. JACENTZOFF, U.S. NAVY, COURTESY OF THE U.S. NAVY ARCHIVE

Whether in the Mediterranean or the western Pacific, our Navy is a powerful instrument of peace and friendship. Its ships and men are constantly making friendly visits to foreign ports and building good will.

Of the 30,000 officers and men in the Sixth Fleet, and more than twice that many in the Seventh, every one is an ambassador, and a good one.

Our "white hats" make friends and build good will by the interest they take in the countries they visit. I say "countries" rather than ports because their liberty sometimes extends four or five days—time enough to permit sightseeing far inland. Each fleet has its favorite ports. Sixth Fleet sailors mention Barcelona and Cannes. Most men of the Seventh vote for Hong Kong (next page).

Time and time again I saw American sailors give up their liberty in port to build playgrounds and paint hospitals and orphanages. I watched them receive something in turn—the love and affection of children.

The cruiser *Boston*, for example, carried all types of hospital equipment. It had medicines and it had toys—donated by hospitals of the cruiser's namesake city and by major American drug and toy manufacturers.

Literally tons of these gifts were crammed

into every available space aboard, and as we visited ports around the Mediterranean, *Boston's* men distributed them where most needed. The recipients will not soon forget the U. S. Navy, or these sailors.

Technology Takes Over the Navy

The enlisted men of the United States Navy follow dignified and honorable careers, and they hold positions of real responsibility.

In days of sail, Navy ships were manned by grizzled "salts." With arrival of steam, firemen and enginemen were added to the list of ratings. Today, of course, the ship's company still must handle the ship, do its housekeeping, and stand many and varied watches. But there the similarity ends. Even the men of the fireroom and engine and machinery areas must have technical training. This is the day of the specialist.

With the advent of radar and sonar, there is an entirely new breed in the Navy—the highly trained enlisted technician. Many are employing their skills on multimillion-dollar equipment while not yet old enough to vote. Petty officers are usually high-school graduates—and they have spent additional months and years in specialized training. Many have gone to college.



Favorite liberty port, Hong Kong spreads below Seventh Fleet sailors sightseeing atop Victoria Peak. Kowloon, hugging the mainland of Red China across the harbor, faces

Technology is ever changing the Navy and its men. Now science increasingly investigates the sea itself. Oceanography embraces the last geographical frontier on earth.

What changes will tomorrow bring? Will technology change the nature of the surface Navy, its air arm or submarine service? What does the Polaris missile portend?

Some believe that the Polaris submarine and NATO's projected multilateral surface fleet of Polaris-carrying ships mean the carrier's day is waning. Most experts do not agree.

Polaris is a total weapon to be used in total nuclear war and therefore, hopefully, never. Polaris gives the Nation additional nuclear deterrent beyond the dreams of just a few years ago. The fact that it exists is the protection it affords.

But Polaris will not deter or prevent the "brush fire," or limited, war. This kind of war

is the order of today and probably tomorrow. To deal with it, the aircraft carrier remains vitally necessary. A reduction in this conventional warfare capacity is a reduction in our total capability.

What was the first thought when we were confronted with the problems of the Formosa Strait, Lebanon, the Dominican Republic, Cuba, and the Gulf of Tonkin? The attack carrier strike force.

In the Gulf of Tonkin incident last August, when North Viet Nam PT boats attacked the U.S. destroyers *Maddox* and *C. Turner Joy*, which were patrolling international waters, the planes from a Seventh Fleet carrier attack force were able to strike back, damaging or destroying 25 patrol boats and 90 percent of the fuel oil depot that supplied their bases. This instant but restrained retaliation won us new respect in Asia.



its sister city of Victoria on Hong Kong Island. Carrier *Hornet* and supporting ships lie at anchor. Busy Kai Tak Airport pokes a finger into the blue bay beyond Kowloon.

The Navy today has fifteen attack carriers, nine operating in the Pacific Ocean and six in the Atlantic. Much has been said about the ability of enemy planes to find these aircraft carriers at sea.

Soviet bombers modified as reconnaissance planes have indeed flown near several carriers in the Pacific and in the Atlantic. But each flight was intercepted far from the carrier by its own aircraft, which then flew alongside as long as the Soviet planes were in the carrier's steaming area (page 180).

Peace Depends on Readiness for War

In time of war, Navy experts say, few enemy bombers would get near our ships, not only because of our defense net and interceptions, but because of the speed and maneuverability of the attack carrier and its ability to evade detection.

The carrier, like the submarine, has almost total immunity to enemy ICBM's; the carrier's real enemy is the submarine. A large segment of our naval strength is directed to the capability of seeking out, pinning down, and killing enemy submarines.

History has witnessed great struggles between land armies and between large surface fleets. World War II and the Korean War saw many pitched battles high in the skies. If ever there comes another total war, furious struggles may take place hundreds or even thousands of feet deep in the seas.

To preserve the peace, it is necessary to be proficient and powerful in the art of war. Control of the seas has determined the fate of nations throughout history. It still does. And that control is in able hands—the hands of the global United States Navy.

THE END

Changing World Sits for a New Portrait

THE SOUTH AFRICAN Surveying Ship *Natal*, plying a zigzag course, was taking soundings in the Indian Ocean. Her echo sounder told depths in hundreds of fathoms.

"Then, without warning," reports NATHANAL GEORAGIANTIC staffer Samuel W. Matthews, covering the International Indian Ocean Expedition, "the line on the recorder rose almost vertically, up, up, until scarcely 10 fathoms—60 feet—were indicated."

He had witnessed, 450 miles south of Madagascar, the discovery of a major undersea mountain, its jagged peak a potential danger to deep-draft ships. An international message warned mariners to mark the mount, later named Walbers Shoals for *Natal's* captain, on their charts.

The National Geographic Society also paid heed; the new seamount appears in square N-32 on its completely new wall map of **The World**. As a supplement to this issue of the magazine, the new 14-color, 42½-by-29½-inch map goes to 4,475,000 Society members, two million more than received the last such map in 1957.

Between the two editions, the earth has changed literally from A to Z. Aden Protectorate has become the Protectorate of South Arabia; Zanzibar has merged with Tanganyika, and the new nation has been named Tanzania. In that brief span of time, 27 African countries have gained independence; a 28th—Britain's tiny Gambia—is due for similar status this month.

Events that have shaped history are reflected on this map. In the Soviet Union, Josef Stalin was discredited, and the city of Stalingrad be-

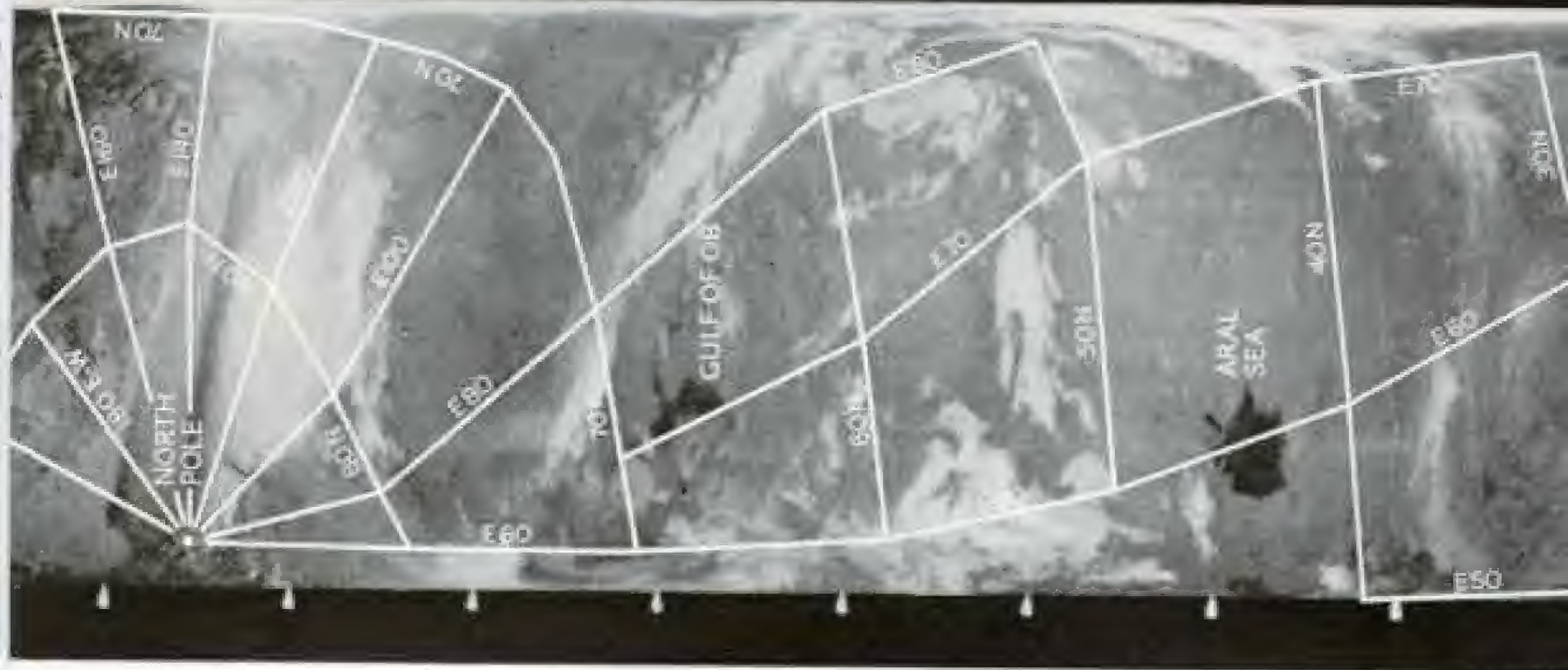
AS ENLARGED version of **The World** (68 by 47 inches) on heavy chart paper may be obtained from the National Geographic Society, Dept. 212, Washington, D. C. 20036, for \$5.75, postpaid. Additional copies of the supplement map mailed with this issue may be ordered at \$1.00 on paper, \$2.00 on fabric. A new physical wall map of the world is available on paper at \$1.00. Mural-size (11¼ by 8½ feet) political and physical world maps, 1964 editions, \$85.00 each, shipped express collect in four sections.

map, many in Arctic waters were recorded by United States vessels. But ships of many flags, such as those participating in the 25-nation Indian Ocean Expedition, 1962-65, have contributed to the map's oceanography.

Earth constantly springs surprises on the cartographer; one was the birth, in late 1963, of a volcanic island, Surtsey, off the coast of Iceland (below). Another was the growing pains of Sicily's 10,958-foot Mount Etna, which during recent eruptions has added 253 feet to its summit.

Predictable to geographers, but still surprising to the layman, are the wanderings of the magnetic poles. Since National Geographic's last wall map of the world was published, the North Magnetic Pole has leaptfrogged Viscount Melville Sound, moving from Prince of Wales Island to just off Bathurst Island. The South Magnetic Pole, drifting to the northwest about eight miles a year, has shifted from the continent of Antarctica into the sea.

In the Arctic inset, red dashes trace the early



came Volgograd. In the United States the martyrdom of a President changed Cape Canaveral to Cape Kennedy.

Malaysia came into being when Malaya, Singapore, Sabah (North Borneo), and Sarawak federated on September 16, 1963. Netherlands New Guinea was transferred to Indonesia and renamed West Irian; its capital, Hollandia, has been renamed twice—Kotabaru, now Sukartipura. Another rechristening occurred on the southernmost continent: the United States and Britain agreed to the new name of Antarctic Peninsula for an area they had called, respectively, Palmer Peninsula and Graham Land.

Members can follow world crises on the new map. Elements of the U.S. Sixth and Seventh Fleets recently sped toward tension spots in Cyprus, in the Mediterranean, and in the Gulf of Tonkin (see "Four-Ocean Navy in the Nuclear Age," by Thomas W. McKnew, page 145). Of the several hundred new soundings on the

warning lines for defense; in the Antarctic inset, red-circled dots pinpoint scientific research stations. Insets at the bottom of the map show international time zones, the pattern of the world's vegetation, distribution of population, and United Nations members—up 35 in eight years to 115 as of December, 1964.

Near the margins are listed the world's largest and most populous countries and cities. And at the top, a table of geographical equivalents reveals that *do, vy, jina, o, ostrov, øy, and østima* all mean the same thing: island.

On the continents of Australia, North America, and Africa, and on far-flung islands appear fish-shaped radar symbols—manned space-flight tracking stations that ring the globe. At major harbors around the world, boxed figures tell channel depths in feet.

Last-minute information—a boundary shift in the U.S.S.R., a new seamount in the Pacific, a name change in Africa—kept Geographic cartographers at drawing boards up to press time. As a result, the new map of the world ranks as one of the most timely and important reference works published by your Society.



Bumping volcano creates an island off Iceland. Ocean waters, boiling from the gaping crater, send scalding white clouds 5½ miles high. Called Surtsey after a legendary giant who ruled the fire-world, the infant isle grew almost a square mile in nine months. In the Indian Ocean (right), the South African Surveying Ship *Natal* drops a coring tube onto a new-found seamount that soars 2,000 feet in less than a mile, its peak lying only 60 feet beneath the surface of the sea.



STUDIED BY SAUNDERS, W. PHOTOGRAPH BY GUY LAWRENCE/GETTY IMAGES



Extraordinary Photograph Shows Earth Pole to Pole

Born North and South Poles show in the astounding picture at right, taken without light and radioed 500 miles from space. Made by the weather-watching satellite Nimbus I (left), it shows landmarks and cloud formations on the night of September 6, 1964.

During a 50-minute pass from Pole to Pole, Nimbus scanned the terrain like a finger reading Braille, although it "felt" not raised dots, but heat. Warm areas register dark; cold areas, light. Nimbus's sensor, an infrared radiometer, took rapid-fire readings of successive five-mile squares as it made 1,500-mile-wide sweeps. Each side-to-side sweep was completed in 1.34 seconds. By then, the satellite's forward movement had brought it into position for the next.

The heat readings, flashed as radio signals

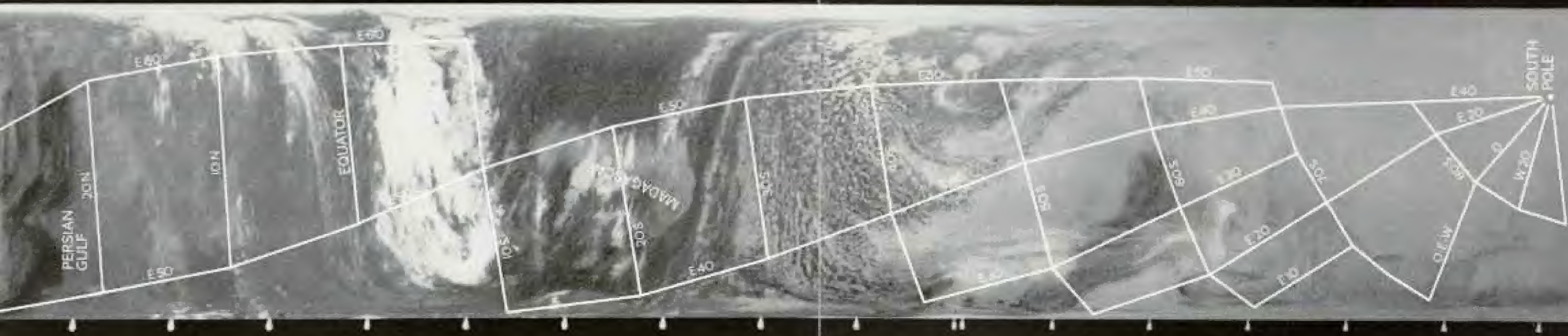
to a ground station near Fairbanks, Alaska, were then projected as dots of varying shades of gray on film. Faint diagonal lines mark radio-frequency interference.

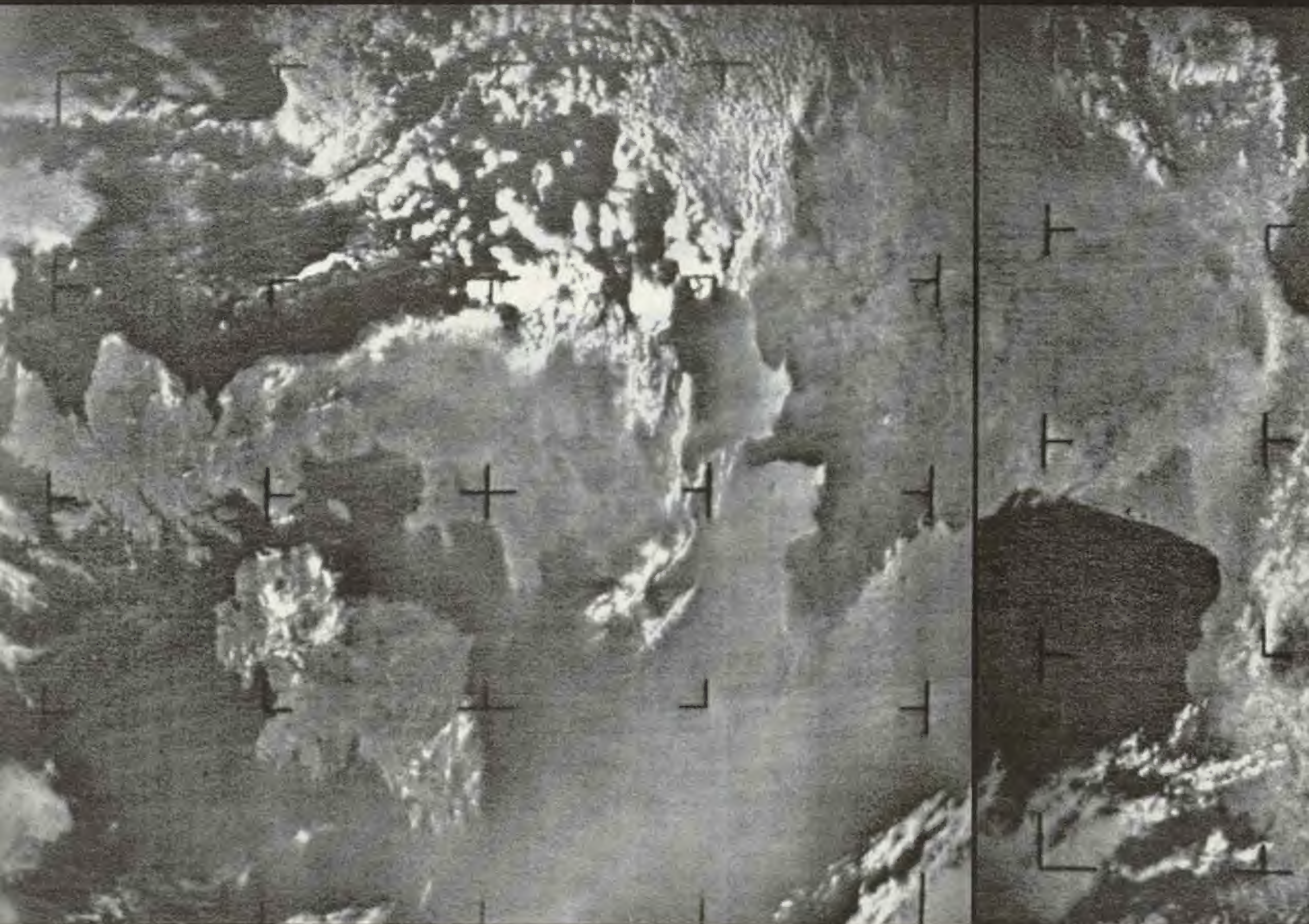
A swirling storm pattern brews to the south of Madagascar, here enjoying almost clear weather. Between Madagascar and the Equator, cold white clouds indicate a slight disturbance.

The Soviet Union's Aral Sea, giving off heat it absorbed during the day, appears dark. Just to the north of the Gulf of Ob, also in the U.S.S.R., clouds mark the boundary between warm and cold air masses.

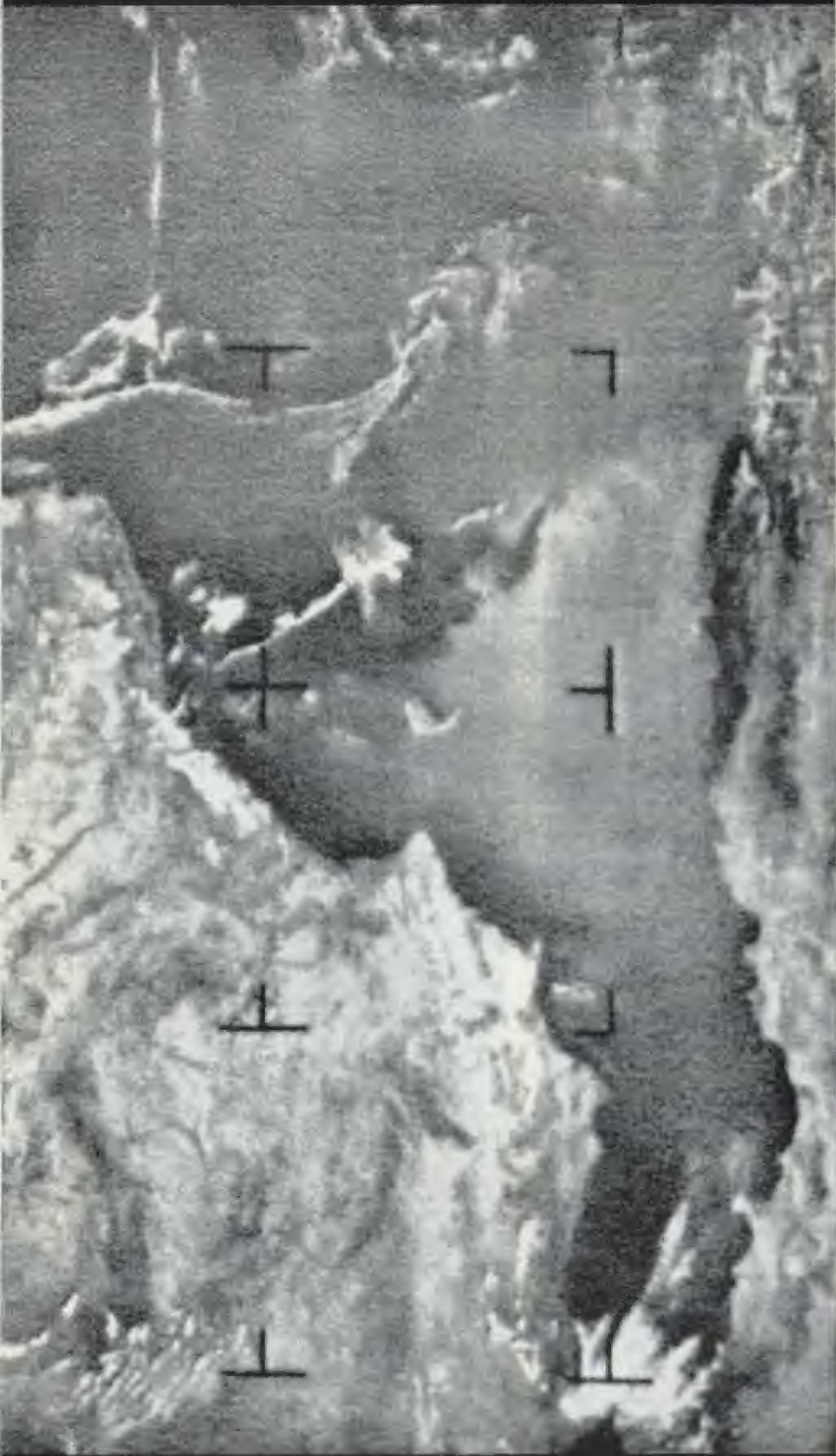
Although too coarse to help with conventional mapping, Nimbus strips have many other uses in addition to their value as global weather reports; scientists believe they have only scratched the surface of their potential.

Infrared patterns, for example, could locate open water in the Antarctic ice pack, a boon to polar investigators, and ocean currents of varying temperatures could be plotted for navigators.





THIS PAGE FOLDS OUT



THIS AND OTHER PICTURES BY TELEVISION SATELLITE SPATIAL RESEARCH © 1964

Two televised pictures overlap to show generally clear weather all the way from Africa to the tip of Scotland. The North Sea and Northern Ireland lie under cloudy skies, but the English Channel and France are clear. Bare mountains and dry plains on sunlit Spain suggest a cloud pattern. Except for coastal areas, Great Britain also basks in the sun. This was the weather map of western Europe on August 31.

**Living Map of Western Europe:
Nimbus I Shows British Isles,
France, and Spain
From 500 Miles Aloft**

1964, as seen by Nimbus I during a daylight pass with a camera similar to those that made Ranger VII's historic close-ups of the moon. Pictures from this weather satellite have revealed the births of hurricanes and lesser storms. In 26 days, Nimbus I returned more than 27,000 pictures, often faster than meteorologists could interpret them. A second Nimbus is scheduled to be launched late this year.

The Leakeys of Africa

FAMILY IN SEARCH OF

Probing the mysteries of Africa—past and present—absorbs Mary and Louis S. B. Leakey and their three sons. Below: Richard examines a lizardskin harp made by pygmy friends in Uganda. Mary Leakey, carrying Simon, a pet Sykes monkey, searches for fossils in Olduvai Gorge, Tanganyika. Dalmatians warn of leopards, lions, or other dangers. Jonathan, a herpetologist, pets a giant python and shows its lidless eyes to a fascinated young friend at Songhor, Kenya. Tame tree hyrax crouches on the arm of Philip. Dr. Leakey displays the broken molar of a dinotherium and, on his hat, a million-year-old elephant tooth discovered at Olduvai.

FOR THREE YEARS, a steady stream of letters and reports from Nairobi had been crossing my desk—brilliant, fascinating documents chronicling a National Geographic Society-supported search for the remains of earliest man at various sites in East Africa. All were signed by Dr. Louis S. B. Leakey or his wife Mary Leakey; all fired me with a desire to visit these dedicated scientists and see their work firsthand.

Powerfully built, white-haired Louis Leakey had flown to Washington twice, to report personally to the Society's Committee for Research and Exploration and to lecture on



By MELVIN M. PAYNE, Sc.D.
Executive Vice President and Secretary, National Geographic Society

PREHISTORIC MAN

his revolutionary discoveries to Society members in Constitution Hall. During these visits I had listened enthralled to his discourses, both formal and informal, on his native Africa—on prehistoric man and today's colorful tribes and magnificent wildlife.

A Man of Broad Horizons

Dr. Leakey impressed me then, and still does, as a modern counterpart of the Renaissance's "universal man." He is an anthropologist and a paleontologist; he is skilled in zoology, archeology, and anatomy; he conducts a medical dispensary for African tribes-

men when in the field. In addition to his numerous publications on prehistory and anthropology, he is the author of a grammar of the Kikuyu language.

Above all, however, Louis and Mary Leakey—aided by their three sons, Jonathan, Richard, and Philip—are fossil hunters who have pushed back the horizons of prehistory by hundreds of thousands of years.

Some 40 years ago, when Louis first began to prod the harsh soil of East Africa with his trowel, few authorities believed that man could trace his existence back as much as 100,000 years. Today, owing in part to the



ARRANGED BY MELVILLE BELL COLEMAN (LEFT); DAVID S. BATES (RIGHT); AND BRUCE HUGHES (TOP RIGHT) © N.G.S.



fossils unearthed by the Leakeys—*Proconsul*, *Kenyanthropus*, *Zinjanthropus*, *Homo habilis*—we know much more about the dawn of humankind on this planet than we did only a few years ago.

So rapid and so significant are these contributions to knowledge that they have virtually outstripped the printing press. Last year in his Washington, D. C., press conference announcing discovery of *Homo habilis*—a creature almost two million years old that many scientists now believe to be a direct ancestor of modern man—Dr. Leakey observed that it made every existing work on prehistoric man obsolete, “including a new book of my own presently at the printer’s.”

I once questioned Louis concerning the wide area of disagreement among scientists engaged in prehistoric research.

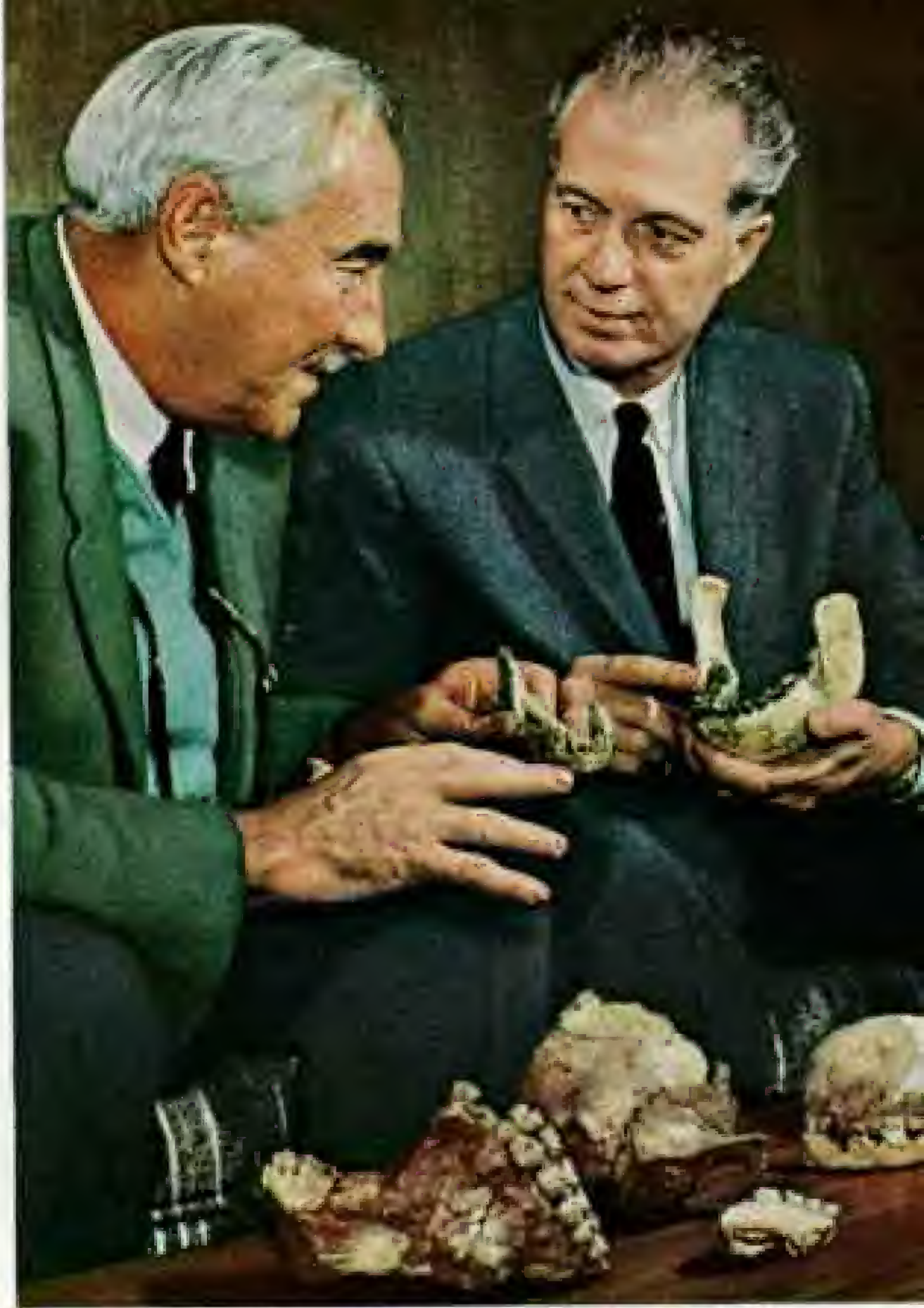
He replied: “Theories on prehistory and early man constantly change as new evidence comes to light. A single find such as *Homo habilis* can upset long-held—and reluctantly

discarded—concepts. A paucity of human fossil material and the necessity for filling in blank spaces extending through hundreds of thousands of years all contribute to a divergence of interpretations. But this is all we have to work with; we must make the best of it within the limited range of our present knowledge and experience.”

Scientist Grew Up a Kikuyu

Louis Leakey deprecatingly ascribes the incredible achievements of his family to “Leakey’s luck.” I think, though, that destiny has played an overriding role. For everything in the lives of Louis and Mary has pointed them toward their rendezvous with man’s distant past. Had Mary Leakey not been introduced to paleolithic caves by the Abbé Lemozi of France when she was 11, had not Louis Leakey been born in Africa and brought up among warriors of the Kikuyu tribe, the remains of *Zinjanthropus* and *Homo habilis* might still sleep in the lonely gorges of the





PHOTOGRAPH BY NATIONAL GEOGRAPHIC PHOTOGRAPHER
 MERVIN M. PAYNE AND JOHN R. FLETCHER © N.G.S.



Trophies of a fossil hunt. Dr. Leakey holds a jaw of *Homo habilis*, believed by many scientists to be the earliest known direct ancestor of modern man. Author Melvin M. Payne, the Society's Executive Vice President, holds a massive jaw of *Zinjanthropus*, another prehistoric hominid. Society grants enabled Dr. Leakey to unearth these and most of the other bone fragments shown.

Hubbard Medal awarded by the National Geographic Society for scientific achievement honors Dr. and Mrs. Leakey for "revolutionizing knowledge of prehistory."

Mud-walled bungalow in Kabete, Kenya, witnessed Louis Leakey's birth in 1903. His mother, Mary, sits with the newborn son; his sister Julia stands beside them. Another sister, Gladys, clasps the hand of her father, Harry. Dr. Leakey's parents met and married in England and came to Africa as missionaries. When the thatch on their first home failed to keep out torrential rains, the Leakeys covered the roof with tarpaulins.



Magic-lantern slide preserves the image of Kikuyu warriors before the Leakey home at Kabete, about 1903. Calico cloaks reddened with ochre clothe the youths, who carry long-bladed spears and sheathed swords. Workman behind them renews thatch on the veranda roof.

Serengeti Plain in Tanganyika (map, pages 206-7).⁶ Science—indeed, man's knowledge of his own beginnings—would be the poorer.

To understand Louis S. B. Leakey, one must forget that he is British—as most Africans have long ago forgotten. "We call him the black man with a white face," the tribal chief Koinange once explained, "because he is more of an African than a European."

Four Sisters Set Forth for Africa

I came to appreciate this statement fully when my post as Vice Chairman of the Society's Committee for Research and Exploration necessitated a trip to the dig at Olduvai Gorge.

By Land-Rover, Olduvai lies a long day's journey from Kenya's bustling skyscraper-studded capital, Nairobi. Louis himself was on hand to drive my wife Ethel and me to the Leakey camp; new short cuts had reduced the distance to 314 bone-jarring miles. En route, as we jounced across the clear and endless

savannas, I asked him how long his family had been in East Africa.

"Well, my mother, Mary Bazett, decided to come here in 1892," he answered, swerving the Land-Rover to avoid a deep rut. "She was one of 15 children of a British Army colonel living in Reading, a quiet town not far from London. She and three of her sisters, Louisa, Nellie, and Sybella—all of them under 24—couldn't abide life in Victorian England. They volunteered for missionary work in Africa."

Thus, barely 24 years after two men named Stanley and Livingstone met on the shores of Lake

Tanganyika, the Bazett sisters set out from London. Their ship voyaged under sail when the winds were favorable, under steam when they were not. Amenities? Passengers who wanted bedding simply brought their own.

Days passed into weeks as the vessel, alternately sailing and chugging, rounded the Cape of Good Hope and crept up the eastern coast of Africa. Finally, three exhausting, storm-tossed months out of London, the girls reached Mombasa.

"To the best of my knowledge," Louis said, "they and one other passenger were the first unmarried white women to land there."

Louisa continued on to Tanganyika, while Mary and Sybella remained in Mombasa. There they made the rounds of Moslem houses to teach cloistered women reading and writing—and, incidentally, to spread the gospel.

⁶Tanganyika, which merged with Zanzibar in April, 1964, officially adopted a new national name, Tanzania, in October. The change appears on the new National Geographic World Map distributed with this issue.

Oiled goatskins, beaded head ornaments, and coiled copper arm- and wristbands adorn Kikuyu women; shell disks at the throat indicate they are married. Here, about 1923, they spread coffee beans to dry on a Kenya plantation. Missionaries introduced coffee to British East Africa at the turn of the century.

Everybody smile! Dressed in their best, the Lenkey children face the photographer. Louis, eight years old, sits in front of Gladys, Douglas, and Julia.

Young Louis grew up romping with Kikuyu playmates. Tribesmen taught the boy how to coax a swarm of bees into a hive and how to trap animals for European zoos. Later, in 1937, Kikuyu elders initiated him into the tribe.

Today an internationally known scientist with notable publications behind him, Dr. Lenkey sometimes thinks and often dreams in Kikuyu.



BERNARD T. COHEN'S PAPERS AND LENKEY FAMILY COLLECTION



Nellie, however, determined to push on some 700 trackless miles into Uganda. Old-timers in Africa shook their heads, and the alarmed British commissioner put her off repeatedly. Eventually Nellie told him flatly, "I want to go *now*."

"I am very sorry," he replied with exquisite courtesy, "but you cannot."

The girl left in a huff, and the commissioner heard no more of the affair—until one day a young assistant burst into his office: "Terrible news! Miss Bazett has hired porters and set out for the interior. We must overtake her."

"No," smiled the commissioner, wise in the ways of Africa. "We shall leave her alone. In a day or two she'll be back. And our little problem will be permanently solved."

He never saw Nellie again. Six months later she arrived in Uganda.

Alarm Clock Frightens Away Lions

"Aunt Nellie," reminisced Louis, "always maintained that her only weapons on the safari were an umbrella and an alarm clock. She'd set the clock at two-hour intervals throughout the night. She reckoned that a prowling lion would require at least two hours to reconnoiter before entering the camp, at which time the clanging of the alarm would frighten him off. All the way to Uganda, she slept in two-hour naps."

In time Mary Bazett, making her rounds in Mombasa, fell ill. The doctor who treated her was firm: She must leave at once for England and never return. Africa would surely kill her if she stayed.

"She did what the doctor ordered," Louis told me. "She went back to England, where she soon regained her health and married another missionary—my father. In 1902 they both came back to Africa. She lived in Kenya until she died fifty years later."

Through the dazzling afternoon heat, as our vehicle coursed across the East African uplands, leaving a smoke screen of yellow dust, the Leakey family saga unfolded.

Louis's parents, Harry and Mary, took over a Church of England mission at Kabete, eight miles from a tiny upcountry settlement called Nairobi. There they began to work among the Kikuyu, Kenya's largest tribe. And there, on August 7, 1903, was born their first son—Louis Seymour Bazett Leakey.

Word of his birth spread quickly, and the Kikuyu tribal elders called. They gathered solemnly about the cradle and spat on the new child as a gesture of trust.

"The Kikuyu," Louis explained, "believe

that to possess part of another person—a fingernail, a lock of his hair, even his spittle—gives one the power to work deadly black magic against him. Symbolically, the elders were putting their lives in my hands.

"The elders," he grinned, "made me the best-washed baby in East Africa."

The British youngster grew up a Kikuyu, speaking Kikuyu, thinking in Kikuyu, even dreaming in Kikuyu—a habit he professes to this day. While his parents saw to his formal



On a dinosaur dig in 1924, during his first scientific expedition in Tanganyika, 20-year-old Louis Leakey holds a lightweight pick he designed and still uses.

Stone-ax Storehouse Shows Wares Manufactured 200,000 Years Ago

A near-fatal step in 1929 led Dr. Leakey to the first known living site of hand-ax man. At Kariandusi, Kenya, he shows Mrs. Melville Bell Grosvenor where he almost stumbled over a cliff and clutched at bushes to save himself. Peering over the edge, he spied an ax embedded in the wall. Digging uncovered some two thousand tools of black volcanic glass. The Kenya government maintains the site as a field museum.



education, the Kikuyu saw to another kind. They taught him to throw his spear through a rolling hoop made of twigs, to fashion snares for game, to creep close enough to small animals to touch them with his hand.

By the time he was 13 years old, he had built his own thatched hut with the aid of his Kikuyu "brothers" and lived in it whenever his parents allowed.

Secret Oath Protects Tribal Rite

Louis's boyhood introduction to tribal life has colored every aspect of his existence. Later Mary Leakey told me the name the Kikuyu had given him when, at 13, he became a member of the tribe: Wakaruigi, "Son of the Sparrow Hawk."

But even Mary doesn't know the details of his initiation into manhood. "They made him swear an oath of secrecy," she said, "and even during the years of the Mau Mau troubles in Kenya, when it wasn't very popular to be

identified with the Kikuyu, Louis kept his word and never described the ceremony. As far as I know, he's still the only white member the Kikuyu tribe has ever had.

"Of course," she smiled, "he's no longer a warrior. He's become an elder now."

But elder or no, Louis still remembers clearly that long-ago boyhood, still remembers the green, wild days in the bush with an old hunter of the Dorobo tribe, Joshua Mubia, who taught him how to stalk game. In the sure, careful way of Africa, the lore of centuries passed from graying man to eager boy. Since the Dorobo hunt with short-range weapons—clubs, arrows, stubby spears—success hinges upon the undetected approach. And to reach striking distance, the hunter must know his quarry well.

Consider a duiker grazing among the trees. Joshua tells the boy that, as with many animals, this small antelope does not easily distinguish motionless objects. Therefore, the



Hand axes and bolas stones, missiles hurled by prehistoric hunters (page 220), lie exposed in a demonstration dig at Olorgesallie, Kenya. Editor Grosvenor crouches to hear archeologist Glynn Isaac tell how Acheulean men for thousands of years camped here beside a long-vanished lake. Their axes represented a tremendous advance over the crude pebble tools of earlier days. Broad on one end, pointed on the other, the improved ax served as chopper, pick, or shovel and remained in style for tens of thousands of years.

Rickety catwalk takes Dr. Leakey (center) and his visitors across the original find at Olorgesallie, which lies just as the Leakeys first saw it in 1942. Hand axes by the bushel rest on the surface. Sign and dark wooden arrows point out the layers of clay from which the tools were washed by torrential African rains.



Grasped by its end, a handleless ax made an efficient chopper for Stone Age African hunters.







hunter camouflages himself with boughs and leaves to break up the outline of his body. Then, from downwind, he commences his cautious approach. He advances from an oblique angle; a direct stalk would send the duiker darting into the underbrush. Slowly . . . slowly, inch by inch, the man draws near.

Joshua freezes as the animal abruptly raises its head and stares at him. What do those eyes register? A bush? A small tree? Reassured, the duiker lowers its head once more.

Joshua waits. Then he moves forward a slow step . . . another. His hands are tight against his sides; always he conceals them, for to wild creatures hands spell man. No bush, no tree possesses those twin instruments of death, and the sight of them provokes terror or rage among Africa's wildlife.

Silently, gradually, the tree that is Joshua nears the duiker. Thirty feet . . . twenty-five . . . twenty. Then, a lightning movement.

Too late—the duiker sees the telltale hands upraised. A spear flashes. And the hunter will eat meat this night.

Kikuyu Lessons Help a Scientist

Louis remembers, too, the long evenings in front of the Kikuyu huts. As fires burned low, the old men would spin the old tales to Louis and the boys of his age group. Amusing tales, yes, but not idle. For each taught its lesson, each had its moral.

What, I asked, had Louis's Kikuyu boyhood contributed to his success as a fossil hunter?

"Two things," he responded promptly. "Patience—especially patience—and observation. In Africa, survival depends upon your reaction to irregularities in your surroundings. A torn leaf, a paw print, a bush that rustles when there is no breeze, a sudden quiet—these are the signals that spell the difference between life and death.

"The same instant recognition of something different—a glint of white in the face of a cliff, an odd-shaped pebble, a tiny fragment of bone—leads to the discovery of fossils.

"And patience. I can still hear the Kikuyu elders telling the boys of my age over and over: 'Be patient, be careful, don't hurry. Try again and again and again.'

"I remember when Mary discovered the 25,000,000-year-old skull of *Proconsul* on the island of Rusinga in Lake Victoria in 1948. We had combed that particular site at least seven times—both of us—without results. But we kept going back, and on the eighth try, Mary found it.

"Some scientists would make two or three



On the track of earliest man, Leakey-National Geographic expeditions have ranged both Kenya and Tanganyika. Fossils of prehistoric men and animals have turned up on rocky hills and in barren gorges. Olduvai Gorge (lower center) yielded *Homo habilis* and the skull of *Zinjanthropus*. A Zin jaw was found at Peninj, near Lake Natron. *Kenyanthropus*, regarded by Dr. Leakey as a 14,000,000-year-old stage in man's ancestry, came to light at Fort Ternan (upper center). The Leakeys found apelike *Proconsul* on lake Victoria islands, and Stone Age man at nearby Kanam.

Pathfinder on wheels, this truck carried Dr. Leakey's first expedition to Olduvai in 1931. Roadless plains and frequent stops to cool the engine slowed the pace to five miles an hour. Driver Donald MacInnes rests behind the wheel at a small trading post in Kenya; Dr. Leakey stands on the far running board. In the dry season, Olduvai's explorers had to go far afield for water; even today, the nearest reliable source lies about 30 miles away from the excavations.





The pioneers: Prof. Hans Reck (second from right), who explored Olduvai in 1913, turns the site over to his successor, hatless Louis Leakey (center), in 1931. Others (from left) are Vivian Fuchs, who later traversed Antarctica, Dr. Arthur T. Hopwood, Sir Edmund Teale, and Donald MacInnes.

Stone tools and fossil bones crowd the table in the thatched work shed at Olduvai Gorge. Mrs. Leakey shows Mrs. Grovenor (left) part of a three-foot tusk of an extinct pig. Horned skull of a modern hartebeest overlooks the worktable.

Immense bones of a prehistoric elephant, coated with protective plaster, await shipment at Olduvai Gorge in 1935. P. E. Kent, now an oil geologist, and a young student, Mary Nicol—the future Mrs. Leakey—flank Dr. Leakey.



attempts, then move elsewhere. But my Kikuyu training taught me this: If you have reason to believe that something should be in a given spot but you don't find it, you must not conclude that it isn't there. Rather, you must conclude that your powers of observation are faulty."

Louis had learned his lesson well, for I remembered that he and his wife had worked at Olduvai for more than 20 years before finding their first human fossils.

Olduvai: Storehouse of Prehistory

Dusk was gathering as we drove into the camp near Olduvai Gorge. This weathered gash (pages 204-5), now a landmark of prehistory, scars northern Tanganyika's Serengeti Plain for 35 jagged miles on the flank of the Great Rift Valley (map, page 207). Strange and wonderful animals once roamed this region, until overwhelmed by the dark doom of extinction. For two million years man and his cousins have camped, hunted, and died here. Their fossil record, painstakingly sifted from the soil by the Leakeys, reads like a biography of time itself.

At camp the day's field work was done. After washing, we joined Mary Leakey for dinner in a three-sided thatched shelter overlooking the gorge itself. We sat at a rough wooden table, while a gasoline lamp flared from the roof support. Food at Olduvai is simple but good. That evening we dined on beef brought down from Nairobi, canned vegetables, tea, and freshly baked bread. The Leakeys, passionately devoted to the preservation of wildlife, do not shoot game for food. You will never find it on the Olduvai menu.

On the other hand, you will find a raucous menagerie of orphaned wildebeest calves (page 219), abandoned antelopes, dogs, monkeys, fowl, cats, baboons, jackals, and field mice—all living in harmony.

"The remarkable thing about animals," Louis said, "is that natural enemies, those that hunt each other in the wild, live side by side quite peacefully in captivity."

The Leakeys' concern for the fate of Africa's unique wildlife led them to champion the cause of conservation long before it became the matter of world-wide concern it is today. As far back as 1938, Louis was serving on a





Beneath the battlements of the red-banded Castle at Olduvai, Mrs. Leakey carefully retrieves a fossil protruding from the eroded cliffside. Moments earlier, Dr. Grusvenor had spotted the relic, a tooth of a giant prehistoric elephant, *Elephas antiquus nicki* (right and page 195).

As nowhere else in the world, Olduvai preserves a succession of stone tools of ever-increasing complexity and utility. Animal fossils abound in the strata. Scientists thus gain an accurate view of man's rise toward civilization and of the beasts he knew.

committee to establish effective game reserves in Kenya. The eruption of World War II postponed action, but 1946 saw the inauguration of an outstanding national park system—with Louis as a founder-trustee—devoted to sheltering the fast-dwindling animal population.

Scientist "Reads" a Big Cat's Mind

This long association with animals has given him striking insight into their behavior. He can, for instance, "think lion."

NATIONAL GEOGRAPHIC staff man Bill Graves reported a drive with him through Nairobi National Park: "Gradually Louis fell into a habit I had noticed before. He began to speak for the animals we were watching, verbalizing what seemed to be in each one's mind. He was so absorbed in interpreting their thoughts that he forgot my presence completely. Soon I felt I was actually listening to the animals themselves.

"By great good luck we came upon a lioness on the hunt, something I had never seen before. Louis cut the engine, and we drifted silently behind the huntress who was padding toward a cluster of unsuspecting zebras.

"'There they are,' Louis picked up her stream of consciousness, 'but I must be careful . . . take to the ravine, quickly, that's it . . . slowly now . . . they're looking up . . . all right, get behind that clump . . . there . . . a few yards more and—'

"Just at that moment another car came in sight, and the driver blew his horn. The zebras bolted in a blur of stripes, and Louis spoke once more for the lioness—a short, sharp monosyllable of disgust."



How does Louis Leakey do it?

"Growing up in constant contact with animals," he explains, "you develop an almost subconscious interpretation of their every movement. A quiver of the paw, a change of facial expression, a ripple of the muscles can mean that an animal is going to rise. Another signal announces a change from a walk to a run. And any lion, before he charges, will roar and twitch his tail violently.

"Here at Olduvai we must know these things to survive. We're never armed. If we weren't always subconsciously alert to animals and their ways, we probably would have been dead long ago. You only stumble across a lion with its kill once. Or a touchy rhino shepherding its young."

After dinner Louis and I sat gazing across Olduvai. Beyond the raw slash of the gorge rose a series of magnificent rolling hills. Recent rainfalls had freshened the usually parched vegetation, and now the dying sun picked out shifting shades of green—here bright emerald, there a deep, smoldering olive.

It was that magic hour of peace, that mo-

ment of suspended stillness that presages the African night. The creatures of daylight were quietly bedding down; the prowlers of darkness were not yet abroad. Even the insects seemed to observe a short-lived truce.

Sitting in the silence, I felt an almost physical sense of the past. The brooding gorge before me was a link to the dim, far eons when bizarre creatures roamed the earth. And of all that strange long-perished company whose remains lie entombed in Olduvai, one seems to have been destined to give rise to man.

Ancient Tools Whet a Boy's Interest

"Tell me, Louis," I asked, caught in the spell of the moment, "what led you to study prehistory?"

"It all started when I was a boy," he said. "Ornithology was my first love, and, while seeking out birds, I used to find stone arrowheads and tools—generally after heavy rainstorms. Rain, of course, turns them up by eroding covering layers of soil or washing them into gullies.

"The Kikuyu called them 'spirit's razors,'"



Bantam rhinoceros left its jaw at Fort Ternan, Kenya, fourteen million years ago.

Animal graveyard at Fort Ternan entombs the bones of thousands of beasts. African assistant Joseph Mutaba expertly cleans an antelope backbone with a dental pick and soft brush before labeling individual bits for reassembly. How did the mass slaughter occur? Perhaps gas from a natural vent near a water hole poisoned the animals as they came to drink. Today the graveyard forms a rock outcrop on an orange farm.





"My knees get pretty sore, and so do my arms," confesses Dr. Leakey. He spends hours with his eyes close to the earth, laboriously inching over ground as rough as a nutmeg grater.

Small rodent and bird bones show what men and manlike creatures ate at Olduvai Gorge more than a million years ago.



Mary Leakey's African crew sifts

he added, "believing that the storm spirits actually hurled them from the sky.

"From my reading, I knew that they had to be prehistoric tools. Yet most prehistorians dismissed East Africa as a potential site of human fossils. Their attention was then focused almost exclusively on Asia because of the turn-of-the-century discoveries in Java of *Pithecanthropus*—an extinct primate with certain human characteristics.

"However, even then I believed Darwin's theory: that the mystery of man's past would be unraveled here in Africa. So, long before my parents packed me off to school in England, I had abandoned birds and prepared myself to hunt here on my home grounds, not only for prehistoric man but for the complete picture of his world."

I already knew something of Louis's colorful scholastic career. He was 16 when he entered public school in England; two years later he gained admission to Cambridge University. There, as a first-year student, he was barred from specialized courses in prehistory. So he proposed to take modern languages, listing as his specialties French and Kikuyu, which he had spoken from infancy.

Student Chosen to Examine Himself

French presented no problem to the university, but Kikuyu was another matter. The authorities pointed out the requirement that his second choice must also be a current language spoken by a large body of people. Louis replied that half a million East Africans spoke Kikuyu. The university capitulated.



LOUIS LEAKEY (RIGHT) WITH LOCAL ASSISTANTS (LEFT) AND OTHERS AT OLDUVAI. © NATIONAL GEOGRAPHIC SOCIETY

a dry wash at Olduvai for precious bits of a skull trampled by the Masai tribe's cattle.

Weeks passed before it was realized that Leakey was not attending classes or receiving instruction in Kikuyu, because no one was qualified to teach him. So Louis was assigned to teach Kikuyu to a professor who already spoke Luganda, a similar African language.

The university was also aware that it would require two scholars to examine Leakey at the end of the year. A letter to the University of London requested the services of its examiners, if any.

Receiving assurance that two qualified men were indeed available, they permitted Louis to finish the course. The London institution eventually forwarded the names of the examiners: a retired missionary named G. Gordon Dennis and Louis S. B. Leakey!

In the end, Louis's professor-pupil helped

to prepare the examination—probably the first and last time in the history of Cambridge that a student was examined in a subject he had taught his professor.

At the beginning of Louis's second year at Cambridge, a head injury suffered in a Rugby game interrupted his studies. Blinding headaches made reading impossible, and the doctors recommended a leave of absence. Louis joined a British expedition bound for his native East Africa to search out fossil reptiles. Here, too, Leakey's luck held good, for the leader of that expedition was the Canadian paleontologist W. E. Cutler, a prominent fossil collector of the time.

"From him," Louis recalled, "I learned skills and techniques—particularly those dealing with field preservation of fossils that

Mary and I still use. Prior to Cutler, crumbly specimens or those in poor condition were often scrapped or ruined through handling. But he used shellac and plaster of Paris in a new way to preserve even the poorest fossils.

"Cutler never completed that expedition. A combination of typhoid, dysentery, and malaria killed him in Tanganyika. But he managed to pass on his knowledge."

Returning to Cambridge, Louis completed the requirements for his degree by passing examinations in archeology and anthropology. Then, academic work behind him, he proposed an expedition to search for early man and early culture. He told me the story.

"Where do you plan to go?" a Cambridge professor asked.

"To East Africa," Louis answered.

"Don't waste your time," the professor advised. "There's nothing of significance to be found there. If you really want to spend your life studying early man, do it in Asia."

"But," Louis recalled, "I was pigheaded.

I said: 'No. I was born in East Africa, and I've already found traces of early man there. Furthermore, I'm convinced that Africa, not Asia, is the cradle of mankind.'

"The professor laughed, of course. So did all his colleagues. But, in 1926, I mounted my own expedition and enlisted the aid of a former fellow student. I managed to raise enough money for two third-class steamship fares to East Africa.

Young Scientist Makes First Finds

"With our remaining funds we bought tents and hired workmen to help us. We dug on a farm near Lake Nakuru in Kenya and—another stroke of Leakey's luck—uncovered a Stone Age burial site. Nothing terribly exciting, but a good beginning."

Then came years spent combing the valleys of East Africa in search of man's past. For six months Louis and his assistant made their headquarters in the abandoned pigsty of a sympathetic farmer.



Discovery of

DEEP in the distant past—nearly two million years ago—a manlike creature roamed the shores of a now-vanished lake. He killed small animals for food and fashioned tools, Dr. Leakey feels, with hands that had a grasp approaching ours. With death, his bones lay embedded in the earth until their discovery in Olduvai Gorge.

The anthropologist named the new species *Homo habilis*, or "man with ability," and considers him a direct ancestor of modern *Homo sapiens*—a belief fostered by study of fossil fragments, including the two incomplete *habilis* jaws seen in picture (opposite) at upper left and upper center. The latter jaw

Workers sift Olduvai soil in search of bone fragments; here *Homo habilis* lay buried hundreds of thousands of years.

"Oh, we cleaned it out," he recalled, "and we strengthened the walls, but the wind kept whistling through."

Leakey's luck, however, struck again. In 1929, striding through thick bush at a place called Kariandusi, in Kenya, he almost stumbled over the edge of a hidden 50-foot cliff. Peering down, he spotted a hand ax jutting out of the cliff face. An excavation uncovered a living site—the first ever recognized of hand-ax man, a paleolithic nomad who flourished some 200,000 years ago.

The owner of the site presented it to the public, and it has since been converted into a field museum where visitors can see the fossils and hand axes lying exactly as they came to light (page 201).

Searching the scientific literature, Louis noted that the animal fossils unearthed among the stone tools at Kariandusi resembled those found in Olduvai Gorge in 1913 by a German geologist, Prof. Hans Reck. He dispatched a letter to Reck immediately, inquiring if he

too had found stone tools. Reck replied that although Olduvai doubtless contained a wealth of animal fossils, it was the wrong place to seek prehistoric man. He himself had searched intensively for signs of human culture, he said, but without success.

But the young fossil hunter remained unconvinced. Adding together small contributions from several British learned societies, Leakey financed a large-scale expedition to Olduvai. Members included Reck himself and V. E. Fuchs—now Sir Vivian Fuchs—who was to gain fame in 1958 as leader of the first expedition to traverse Antarctica (page 208).*

"At that time," Louis said, "Olduvai was all but inaccessible. It required seven solid days to reach it from Nairobi. Within eight hours of getting there, though, I'd found hand axes. All told, we stayed three months, locating some of the most important sites we've since worked in the gorge."

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

Homo habilis: Prehistoric jaws tell a tale

belonged to a young adult female whom the Leakeys nicknamed Cinderella. She appears to have been short-statured, small-brained, and of light weight.

Cinderella lived about 800,000 years ago, whereas the owner of the warped jaw on the left, a *Homo habilis* child, preceded her by about one million years.

The size, shape, and wear of the teeth suggest that *Homo habilis* was a meat eater. *Habilis* may have been able to speak, Dr. Leakey believes, since the broad, U-shaped inner curve of the jaw would have permitted free movement of the tongue.

The largest jaw belonged to *Zinjanthropus*, a near-man who lived concurrently with *Homo habilis*. Zinj's massive, heavily worn molars, like those of some of its kindred South African near-men, or australopithecines, point to

a diet of rough vegetation. For contrast, a modern human jaw lies below.

A skull of *Zinjanthropus* 1,750,000 years old came to light at Olduvai Gorge, where the Leakeys later found *Homo habilis*. The much younger Zinj jaw came from a cliff

near Lake Natron, 63 miles away. Its sharp V shape indicates that this hominid could not move its tongue freely.

Eventually *Zinjanthropus* vanished, the Leakeys theorize, whereas *Homo habilis* survived to become one of the ancestors of modern man.

ILLUSTRATION BY BRUCE GILLER FOR NATIONAL GEOGRAPHIC



The twenty years that followed witnessed a continuing exploration of Olduvai's riches. In 1945 Louis became curator of Nairobi's Coryndon Museum, and the post allowed him little time for field work. Always short of funds, always short of time, Louis—first with others, later accompanied by Mary—still contrived to spend a few weeks a year at the gorge. They covered it foot by painstaking foot, analyzing, speculating, charting.

Not until 1952 did they begin to dig in earnest. And not until the sensational discovery of *Zinjanthropus* in 1959 did Olduvai fully

repay the long harsh years of exploration.⁹

"Now, here we sit," concluded Louis. "And thanks to the National Geographic Society, we at last have enough money to finance a respectable campaign of excavation."

He glanced at his watch. The luminous dial glowed in the darkness. "Nine o'clock. Our day begins early here. Best to turn in. If you hear any animals sniffing or snorting around your tent during the night—or even

⁹See "Finding the World's Earliest Man," Sept., 1960, *Geographic*, and "Exploring 1,750,000 Years Into Man's Past," October, 1961, both by L. S. B. Leakey.

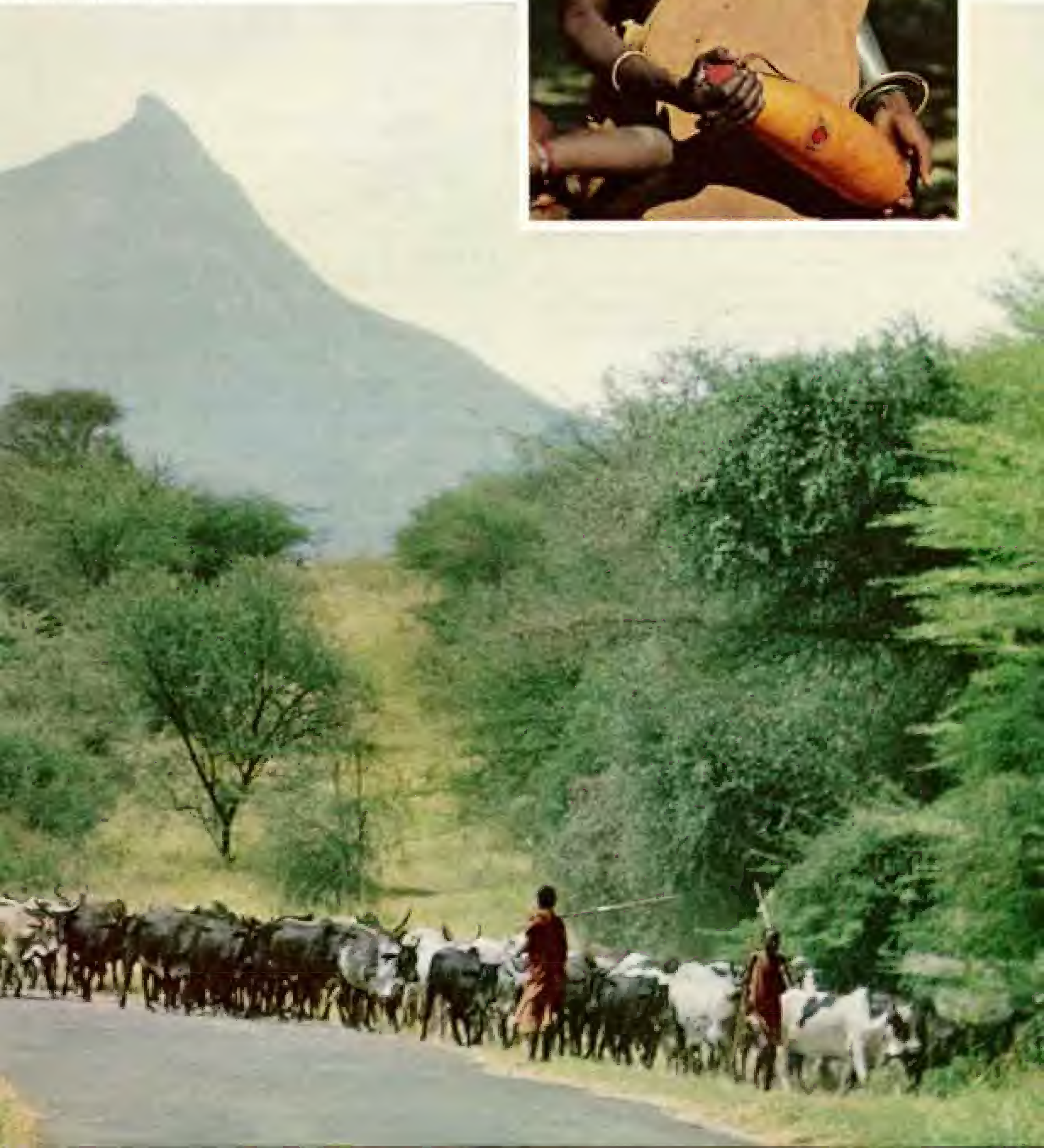


Head shaved, a Masai woman at Olduvai shakes a gourd of cow's blood and milk—the staple diet of the tribal elders.

**Masai Spearmen Drive Cattle
Across a Road Near Olduvai Gorge**

Proud Masai amass cattle as investors collect stocks and bonds. Herds spill over onto the grazing lands of African wildlife. Masai cattle, pouring down into Olduvai Gorge for water in 1963, trampled into pieces a very early hominid skull. The Leakeys, still fitting the fragments back together, consider the skull one of their most significant finds.

PHOTOGRAPH BY GUY LAWRENCE © 1988



if a lion should pay us a visit and make a lot of noise—just stay in your blankets and be quiet. He's really not looking for you and won't bother you if you don't bother him."

I wondered!

Next morning, in the predawn chill, Ethel and I were awakened with a cup of steaming tea. After a brisk wash in icy water, we gathered for breakfast; then, wasting no time, we rode a Land-Rover down a steep, rutted trail to the floor of the gorge. The track had been pioneered by then-12-year-old Philip Leakey, "the finest Land-Rover driver in East Africa," according to his father.

Philip's jobs include driving work teams to remote sites in the gorge, making the 60-mile round trip for drinking water with a two-ton tank trailer, collecting truckloads of firewood, and occasionally blazing car trails to new fossil excavations. Virtually since birth, Philip has accompanied his parents on their scientific safaris. He has, in addition to this apprenticeship in prehistory, also become a specialist in African orchids.

"He's planted some 176 types in my garden," Louis told me, "and he knows the Latin names as well as the peculiarities of each."

Skilled Africans Aid Scientists

When our Land-Rover halted on the floor of the gorge, most of the Leakeys' assistants were already hard at work. European and African, they numbered more than two score. Louis and Mary are particularly proud of their African foremen. Highly trained in the art of fossil hunting, they share with Louis the virtues of unflagging alertness and inexhaustible patience. One of them, Heslon Mukiri—a member of the team for 38 years—discovered a fragment of jawbone near Fort Ternan in Kenya that proved to be the first relic of fourteen-million-year-old *Kenya-pithecus*.¹

What is it like to hunt for fossils? After a day in Olduvai Gorge, I can wholeheartedly echo Louis's description in the September, 1960, *GEOGRAPHIC*: "It consists," he wrote, "of crawling up and down the slopes of the gorge, eyes barely inches from the ground [page 212], stopping at the slightest fragment of a fossil bone or stone implement. . . ."

But to the inexperienced eye, as I soon learned, fossil bones, stone tools, and plain rocks can sometimes look distressingly alike.

The blazing sun of noon drove us back to the shelter of the camp. Before the afternoon return to the dig, Ethel and I attended Mary's

clinic. Every day she or Louis treats the Masai warriors, elders, and their families who appear at the camp with wounds, fevers, and a variety of other ills (opposite, below).

We marveled at the way Mary—so slight and normally so soft of voice—scolded, advised, and dosed the towering plainmen with their fearful spears.

"They simply will not take care of themselves," Mary complained as she painted cuts, dispensed drugs, and swabbed the infected eyes so common among the tribesmen.

"These ills are nothing." She gestured at the morose patients. "We can take care of this sort of thing. But occasionally the warriors come in horribly mauled by lions. They hunt them with spears."²

Rock Paintings Shape a Career

The fascinating story of the Leakeys came to light bit by bit during our stay in their camp. What, I wondered, had brought Mary Leakey—now as much a part of Africa as her husband—to this distant and desolate gorge? What twists of fate had conspired to unite them for a tireless assault on the murky ramparts of the past?

Unlike Louis—outgoing and quick of speech—Mary is quiet to the point of reticence. And, quite aside from her partnership with her husband, she is an outstanding prehistorian and one of the world's foremost draftsmen in the art of representing stone tools.

Her artistic talent, I learned, was inherited from her father. A successful landscape painter named Erskine Nicol, he had traveled throughout southwestern France. He loved to work in that land of green fields and lucid skies, and his young daughter invariably journeyed with him.

"The area is full of prehistoric caves," Mary said. "Both my parents were interested in them, and I scraped around the caves while father painted. At one place called Cabrerets, a priest, the Abbé Lemozi, had discovered ancient rock paintings, and he encouraged me to work with him on them. The abbé kindled my interest in prehistory and also gave me a very sound groundwork in excavating. After that, I don't think I ever really wanted to do anything else."

Like art, archeology was also in the family

¹See "Adventures in the Search for Man," by Louis S. B. Leakey, *NATIONAL GEOGRAPHIC*, January, 1961.

²Such hunts were described in "Spearing Lions With Africa's Masai," by Edgar Monsanto Queeny, *NATIONAL GEOGRAPHIC*, October, 1954.



Skittish young wildebeests, orphaned by marauding lions, greet foster parents Dr. and Mrs. Leakey for the first time. Within hours after this meeting, the gnus mingled freely with other motherless animals in the Leakey household above Olduvai Gorge.

Free clinic for Masai friends. Dr. Leakey treats minor ills of nomadic tribesmen. Serious ailments may require a 42-mile ride to the hospital at Oldeani. Red-hatted Masai, resting foot against knee, may stand like this for hours.





tradition. Mary's great-great-grandfather, John Frere of Hoxne in Suffolk, first recognized Stone Age tools for what they were—the work of man. Before his time, scientists had taken it for granted that nature had shaped these strange bits of flint.

At the University of London, Mary prepared for the future with courses in geology and prehistory. She also worked in the field, excavating several early sites in the English countryside. Undertaking a dig near Clacton with some fellow students, she unearthed the site of a Stone Age settlement.

Lecture Leads to a Life in Africa

In 1933 Mary Nicol attended a dinner in London given by a group of people interested in archeology. "It sounded like a very stuffy affair," she recalled, "and I didn't really want to go." She did, however, and the lecturer of the evening proved to be an energetic man from East Africa named Louis Leakey, who spoke on his work at Olduvai.

"Our association began at that moment," Mary said. "Within two years I went to Olduvai with Louis as one of four students on his staff." Soon the association became a partnership—Louis and Mary were married.

I asked her if she ever regretted coming to Africa. She laughed. "Hardly. My only disappointment is that I didn't get here sooner."

Louis had once told me of his bride's first serious encounter with African wildlife: "We were exploring a region of Tanganyika called Laetoli, and Mary walked around a small hummock. Neither of us had seen the lioness behind it. The first thing I knew, Mary was sprinting for dear life in one direction, while the lioness—luckily as surprised as she—was running in the other."

But familiarity soon bred confidence. During World War II, when Louis's intelligence work made fossil hunting all but impossible, Mary once packed off with Jonathan—then two years old—for a lonely month of digging at Olorgesailie, southwest of Nairobi. By then she was an old Africa hand.

Thongs and balls of the bolas, whirled about the head and released, can entangle the legs of fleeing game. Acheulean man developed the missile some 250,000 years ago. To make this one, Dr. Leakey used a set of three stone balls laboriously rounded by prehistoric Olduvai hunters. He cut the skin for strips and casings with stone tools from the gorge.

"Nothing out of the ordinary happened," she recalls. "A pride of lions used to sleep in a gully about 150 yards from our tent, but we didn't seem to disturb them, and they didn't mind us. Once they came strolling through the camp, and Jonathan was very excited. But then you always have lions in that part of the country."

At Ologasalie the Leakeys discovered the world's most important deposit of late hand axes. It happened one weekend in 1942. Louis had obtained a three-day Easter leave from his wartime duties with British military intelligence, and he and Mary spent the whole of it combing Ologasalie. On Easter Saturday, just as Louis stumbled upon some exposed axes, Mary called out from a point several hundred yards away.

Louis answered, crying, "Mary, come here! I've found the site we want. There are hundreds of them!"

After a further exchange of shouts, Louis reluctantly abandoned his own find and hurried over to Mary. The sight that met his eyes staggered him. There were not just hundreds of hand axes at Mary's site; the final tally came to more than 5,000.

Tool Factory of Stone Age Man

Today Ologasalie, like Kariandusi, is a field museum (pages 202-3). Dr. Melville Bell Grosvenor, the National Geographic Society's President and Editor, recently visited it.

"I'll never forget that incredible wealth of artifacts," he told me. "An elevated catwalk extends across the area—perhaps three times the size of an average room—and as I walked around it, I had the feeling that I was visiting a kind of Stone Age tool factory. One day, uncounted centuries ago, the artisans had closed shop and moved away. But here, defying time, lay the products of their skill."

Exciting as this find was, Mary's most significant contributions to prehistory still stand as the uncovering of *Zinjanthropus* at Olduvai in 1959 and the 1948 discovery of the skull of *Proconsul* at Rusinga.

In the afternoon of our second full day at Olduvai, the Leakeys' two elder sons arrived in camp. Jonathan has carved out a career as a herpetologist; in fact, he makes his living collecting Africa's deadliest snakes, extracting poison from them, and selling it to laboratories in South Africa and elsewhere engaged in research on antivenin (page 195).

Richard now operates safaris out of Nairobi—but safaris with a difference. His clients use cameras, not high-powered rifles, and



Wig of Greenery Disguises a Hunter in the Balhal Depression

Submerged to his mouth in a rain-filled lake, Phillip Leakey perfects his skill at a sport taught him by his father. Hoping to pass as a moss-covered stump, he wades stealthily toward a flock of floating ducks. When close enough, he will grab one by the legs. Such youthful pastimes schooled Louis Leakey in the patience his profession demands.

Razor-sharp stone knife, chipped from chert, helped prehistoric Oldowans dress game. Dr. Leakey, using similar tools that he himself shapes, can skin and disjoint a sheep in 20 minutes.





Stately bull elephant, strolling the banks of the Kazinga Channel, keeps cameras clicking as a water safari winds through Queen Elizabeth National Park in Uganda. Pipe-smoking Richard Leakey has spent most of his life in the East African bush. A wildlife expert, he conducts photographic and study trips to give visitors close-ups of every kind of animal, from belligerent rhinos to wary impalas. He permits no kills.

Army on the march, a black streak of safari, or driver, ants crosses an African road in search of food. Richard Leakey shows Mrs. Gilbert M. Grosvenor how soldiers of the colony stand guard on either side of the procession to protect workers. Scouts go ahead of the main force, find young or helpless animals, and call the troops to attack. Workers bite off small chunks and haul them back to the nest.



Tenacious jaws of a soldier ant grip Richard Leakey's thumb as he demonstrates how Africans use the ants to close cuts. Drawing the gaping skin together, a man allows an ant to bite the flesh; jaws penetrate both sides of the wound. When the patient nips off the body, the head forms a perfect stitch.

they see aspects of Africa undreamed of by the average tourist (opposite).

"Most people come here to look at the big game," Richard said, "and leave knowing little or nothing about our incredible small-animal population. I attempt to present a complete picture, including the rarer mammals, birds, and insects. We have hundreds of species that exist nowhere else."

Richard was guiding a crew of National Geographic motion-picture cameramen filming a television documentary on Africa. They were photographing areas of the Serengeti

Plain, probably the most magnificent game reserve on the entire continent.

Jonathan, too, arrived with company. He had been at his snake farm, then at Songhor, near Lake Victoria. His passenger was four feet of malicious temper known as a puff adder. Jonathan, who has an affection for all snakes, might take exception to that description. But then Jonathan's friends are not mine!

We cleared a table in the center of camp for Jonathan to demonstrate the technique of milking a snake for venom. With the help of a slender forked rod, he deftly drew the



PHOTOGRAPH BY BRUCE WELLS FOR LOOKS OF NATIONAL GEOGRAPHIC SOCIETY

puff adder from its sack, grasped it firmly, and pinned it to the table beside a dish.

Hooking the cruelly curved fangs over the dish, he massaged the snake's head just above the hinges of the jaw. The membrane covering the fangs gradually retracted, baring thin, wicked hypodermics more than an inch long. Then the venom—like watery gelatin—splashed into the dish in slow drops. It was over in less than two minutes.

I asked Jonathan how many snakes he milked in an average day.

"About 60 or 70. I don't like to do more

because I tend to become automatic—and that could be dangerous."

Danger, in any case, lurks in every fang. Once, in Nairobi, Jonathan was milking a small but deadly viper—*Echis carinatus*—when the snake suddenly twisted in his hands and struck his finger. The venom of this particular species kills within minutes, but Jonathan immediately slashed the wound, squeezed out blood, gave himself an injection of antivenin, and applied a tourniquet. This instant first aid—administered even as he was collapsing—saved his life.

Fortunately, a visitor happened to be with him at the time and called his father. Louis told me the story: "When I got to the laboratory, Jonathan was lying on the floor, very faint. But he was making shaky notes all the time on his reactions. He was growing progressively weaker, though, and he asked me to come with him in the ambulance to record his sensations.

"You see, the literature contained nothing by a victim about the reactions to the bite of this particular snake. So I went with him to the hospital and wrote down everything he said. Things like 'my heart's beating very fast... faster still. The headache is much worse. Now I feel dizzy.' He wanted to be

sure that his reactions were recorded at the time and not from later memory."

Both Jonathan and Richard are graduates of the Olduvai team, and both still spend several weeks each season hunting fossils with their parents. Jonathan discovered the jaw and teeth of *Homo habilis* in 1960; Richard, in January, 1964, led an expedition which found the only known lower jaw of *Zinjanthropus* during a reconnaissance west of Tanganyika's Lake Natron (map, page 207). Excavations in the rugged terrain at Peninj, directed by Richard and Dr. Leakey's chief assistant, Glynn Isaac, continue with National Geographic Society support.

To my delight, Richard invited my wife

Two-horned rhino lumbers through Amboseli-Masai National Park, Kenya. Oxypeckers on his



and me to accompany him and the photographic crew on a nighttime expedition to the Serengeti. By setting out a wildebeest carcass, he hoped to lure hyenas—slinking scavengers everlastingly torn between greed and fear—within close camera range.

Hyenas Gather for a Feast

In the chill blackness of 3 a.m. we climbed into Land-Rovers for the eight-mile drive. Our headlights splashed the moonless night, and vague animal shapes darted off the rough track at our approach. Occasionally, just beyond the glare of our lights, luminous eyes watched us unblinkingly—live coals scattered across the plain.

Finally the vehicles halted behind a clump of bushes in a little gully. Nearby a solitary knoll rose out of the flatness. At its crest Richard had staked down the carcass, to prevent the hyenas from dragging it away.

Ethel and I sat on the side of the gully, about 50 feet from the dead animal, as the cameramen set up their equipment. They planned to start filming at first light.

After a while, when my eyes adapted to the darkness, I could see several big hyenas dimly silhouetted against the sky. They paced nervously; occasionally one would approach the kill, only to skitter away. More appeared out of the dark. At one point I counted 17.

Sometimes they virtually surrounded us,

back rid him of parasites.



Leopard at leisure straddles a bough on the Serengeti Plain and guards a half-eaten meal. Tanganyika law prohibits leopard hunting in the national parks, but poaching for fur coats threatens the species.

Culping fish, an African wood ibis ignores a crocodile on Lake Baringo





Wary of intruders, zebras, impalas, and oryxes interrupt their grazing in Tsavo



PHOTOGRAPH BY GUY A. LAWRENCE FOR NATIONAL GEOGRAPHIC MAGAZINE

National Park, Kenya. Rare fringe-eared oryxes are seldom photographed.

trotting restlessly, sniffing the air, then halting to stare at us with sinister eyes that glowed yellow-green.

As the night wore on, greed occasionally conquered fear, and several of the hyenas sidled close to the kill for a snap at the meat. But Richard dashed toward them with a flashlight, driving them back into the surrounding darkness.

Sentinels of Death Gather

When the first gray hint of dawn streaked the sky, Richard let the hyenas close in unmolested. As the cameras whirred, the hideous, ungainly beasts tore at the carcass with wild gluttony. I could hear the sound of flesh and hide being ripped and the crunching of thick bones.

The hyenas stuffed themselves until their bellies distended visibly. Occasionally one would tear off a chunk of meat and trot away toward an escarpment to the southeast, where

the hyenas' dens and their hungry cubs lay.

In the growing light I noticed a dead thorn tree farther back on the knoll; its tortured limbs sagged with vultures, Africa's sentinels of death. More flapped out of the semidarkness to settle on the knoll with a flurry of great brown wings.

Gradually the hyenas—glutted now—began to drift away, until only three or four remained. Suddenly all lurched off at full run and, with another great beating of wings, the vultures lumbered skyward. Almost simultaneously a Masai warrior appeared at the top of the knoll, his spear poised. This, of course, ended the animal photography.

Richard and I walked over to where the Masai stood alone on the skyline. The tribesman explained in Swahili that he was guarding his cattle nearby. He had seen the hyenas and vultures. Fearing that they signaled a lion kill, he had come over to drive the lion away from the vicinity of his herd.



ILLUSTRATIONS BY RICHARD H. ELLIS (LION), AND KAROL FINE (SEE LION) © NATIONAL GEOGRAPHIC SOCIETY

High-stepping and haughty, ostrich parents marshal their chicks in the Ngorongoro Crater. Of 30 to 40 young hatched at a time, only four or five may reach maturity; predators snatch straggling chicks despite adults' lusty kicks.

Frisky calf and its mother show the lanky grace of the giraffe. Hide patterns differ even in a single herd. This pair runs across the Serengeti Plain near Olduvai Gorge.





Baboons frolic about Dr. Leakey's Land-Rover as he shows Nairobi National Park to Dr. Leonard Carmichael, Chairman of the National Geographic Society's Committee for Research and Exploration. Both men cautiously keep doors closed to prevent the high-spirited animals from suddenly leaping into the car.

Young baboon bites playfully on the rear-view mirror. Photographer's reflection shows in the glass.

PHOTOGRAPH BY MARK WING FOR LIFE'S JOURNAL
 1970 (11) FROM NATURE'S WORLD



King of Amboseli-Masai Park, a magnificent lion takes his regal ease before Kilimanjaro's snowy crater. Wear and tear from the thick brush keeps his mane neatly trimmed.



The Masai coldly eyed us and our elaborate camera equipment. Then, with an arrogant sweep, he threw his ocher cloak across his shoulder and, using the spear as a staff, walked back toward his herd. His strides were long and smooth, and his destination could have been the end of the earth.

The pride of his bearing, his aristocratic profile, and that long spear glinting in the first sunlight struck me with dramatic force. The sight of that warrior striding into the dawn will always remain among my most vivid memories of Africa.

Leakeys Still Carry On Their Search

Back at the Leakey camp, Ethel and I packed our things for the long journey to Nairobi. For Louis and Mary, the new day was bringing another foray into the past. The

sun shone brassily from an empty sky, and the air already held the promise of heat as the fossil hunters headed into the gorge. Ethel and I stood beside our vehicle, watching them disappear into the shadowy depths—Louis and Mary and Philip, supplemented that day by Jonathan and Richard.

I remembered, as we waved our last farewell, the occasion in the previous year when the National Geographic Society had conferred its Hubbard Medal on Louis and Mary for their achievements.

In thanking the Society for its support, Louis had said: "This medal belongs not to two Leakeys, but to five. Whatever we have done, we have done together."

It seemed at the time merely a gracious tribute from a man to his family. Olduvai Gorge taught me otherwise. THE END

ILLUSTRATION BY WALTER W. WOOD, F. R. S. (1964). COURTESY, NATIONAL GEOGRAPHIC SOCIETY



WHEN I FIRST sailed into Portofino from the sea, it was like coming into a theater after the curtain had gone up. As my 38-foot ocean racing yawl *Finisterre* drew closer, a cloud drifted over the Golfo Marconi, muting the usual brilliant Mediterranean colors. But when I rounded the point and entered the harbor, sunshine shafted down like a spotlight. The white topsides of moored yachts jumped into bold relief, while the encircling houses seemed pastel cardboard cutouts against the backdrop of dark green pines running up the mountainside.

I stood holding the mizzen shrouds, steering with a foot, my heart and brain flooded with an almost painful consciousness of beauty. An excursion boat bound for Santa Margherita Ligure nearly ran us down, and I shamefully failed to give right of way to a small sloop on the starboard tack, but still I stood transfixed.

Since then I have come to know Portofino well, from the decks of boats along the quay and from a room in the tiny Hotel Nazionale, whose shutters open over the town square—a picture window in the truest sense of the word. Between visits I have ranged far, but always tucked away in my memory lies a vision of this former fishing village in the heart of the Italian Riviera, and always I come back.

As the rest of the Riviera—indeed, the rest of the world—modernizes and changes, Portofino continues to look the way it has for centuries. This is no accident, as my friend Beppe Croce explained to me one day.

"Tourists began arriving here in the 1920's," he said as we sat

Time Turns Back in Picture-book Portofino

By CARLETON MITCHELL



*Illustrations by National
Geographic photographer
WINFIELD PARKS*



REACHING THE LEAVES AND THE MOON © W.P.S.



*POCKET PARADISE of the Italian
Riviera draws pilgrims from the ends
of the earth. Flash of white sail . . .
verve of youth . . . ease of age. By day
Apollo, god of the sun, sets the pace.
By night Diana, goddess of the moon,
holds sway above Castello Brown.
The castle, a landmark for passing
ships, overlooks the village.*



PORTRAIT OF PORTOFINO: *Artist's palette of pastels against a green canvas – all framed*



EXHIBITION OF ARTISTS, COURTESY PHOTOGRAPH BY STEVE PERRY © A.S.S.

By blue sea. Yachts cluster before the masterpiece, a national monument of Italy.

on the terrace of his villa, with the multicolored water of the harbor spread below. President—equivalent to commodore elsewhere—of Yacht Club Italiano, and organizer of sailing events in the 1960 Olympic Games, Beppe is not only one of Italy's most prominent yachtsmen, but also a leading Portofinese.

"Some of us saw that what was happening to other towns along the coast would happen here next: big hotels, tiers of villas up the mountain, the old houses pulled down to make room for shops and apartments. So, in 1955, the government was persuaded to make Portofino a national monument. Anything altering its appearance must be approved by a committee."

"Is permission often granted?" I asked, knowing he was vice chairman of the official body that protects Portofino.

Beppe smiled as he gazed across to the ancient battlements of Castello Brown atop the opposite hillside (page 233). "If you asked to build a new villa or to change that one over there, we would politely tell you to draw up the plans, and maybe request you to make alterations in the plans. But we would know inside that we will sooner or later say 'no.'"

"And what if someone wanted to put up a neon sign, or open a nightclub with a jukebox?"



BURNISHED BY THE SUN, his strength undiminished by age, Mario Buffa takes a morning turn about the harbor. Though he owns a cantankerous motor, this honorary commodore of Portofino boatmen prefers stout oars and muscle.

SYMBOLS OF THE SEA—dolphin, trident, and compass—pebble the terrace of the Church of San Martino. Stones as blue as the Mediterranean and as white as its foam compose the mosaic for mariners. Romans named this important harbor Portus Delphini, or Port of the Dolphin.

He gave an expressive shrug. "For that we already have waiting the paper saying 'no.'"

Thus the clock stopped for Portofino 30 years ago, before the pressures of modern tourism, leaving the village as it was in previous centuries. Not even a shutter can be repainted until the committee is shown samples guaranteeing an effect approximating the original.

High behind the town stands a single deluxe hotel, while two



small *alberghi* face the piazza, so only a few travelers can find rooms. Others must seek accommodations elsewhere. These park their cars at the end of the road and walk the rest of the way, for except between the hours of 7 and 10 in the morning, when deliveries to stores and restaurants are permitted, a padlocked chain stretched between stone posts bars wheeled vehicles from the town (opposite).

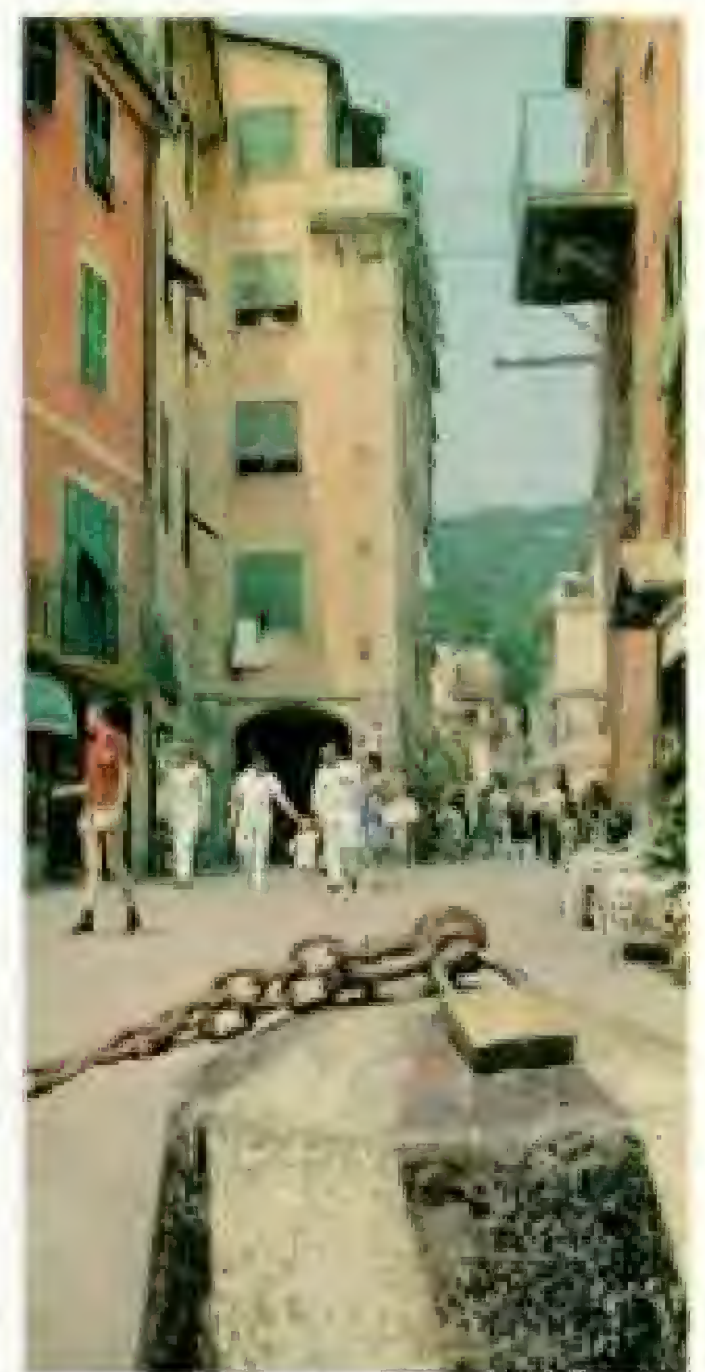
As I have come to know Portofino, I have become aware of the actors as well as the stage. For besides esthetic considerations, this experiment in halting progress has interesting sociological aspects. Had Portofino grown like other villages, what would have happened to the people, those descendants of simple men and women who had lived for generations in the houses overlooking the harbor—the boatmen and the lacemakers and those



whose livelihood comes from the tiny shops under the ancient Genoese arches around the piazza? In all the involved financing, in all the squeeze for space, where would they have gone, and what would they have ended doing?

There can be no certain answer to those questions. But it is sure that the townspeople would not be living very much as did their ancestors. Yet they do. Portofino behind its façade remains a simple Italian village. Watching, I have often been reminded of an ocean pool. Visitors stream in during the late morning and out again at night; and while the tide may sometimes flood almost to overflowing, when it ebbs the pool is the same.

Stay with me a day in Portofino, a day similar to many I have spent over the past eight years, and I will try to show you the life of this village as I know it.



ILLUSTRATIONS BY R. A. S.

GUARDING THE JEWEL, chain and lock keep out cars. Visitors who travel the cliff-hanging highway from Santa Margherita Ligure must park on the outskirts of Portofino and wander its winding streets on foot.

PENDANT on the necklace of villages that rim the Riviera di Levante, or Coast of the Rising Sun: Portofino in a fish-eye-lens view (opposite) from Castello Brown.





I arise early because the town does. The sky is lavender, the clouds pink. Choosing a seat at a table in the corner of the piazza, I watch the first rays of the sun gild the toy ramparts of Castello Brown, while night still lingers on the slopes behind me. Yachts along the quay are like sleeping sea birds. Then the sun fingers through the entrance of the harbor, touching the ancient stones and faded plaster with the magic of renewed youth.

Old Mario Baffun is the first of the *marinai*, the boatmen, to appear (page 236). He is the dean of the Portofino waterfront, famous and respected as the great Don Juan of his day. His walrus moustaches have now gone white, but without dimming the twinkle in his eye.

"*Buon giorno, signore,*" he calls in greeting. We have been friends since 1956, when he acted as my water taximan between *Finisterre* and the quay. Now he pauses. Lesser sailors wear blue trousers and jerseys, topped by a peaked cap as a badge of office, but Mario asserts his station with an undershirt and usually a floppy white tennis hat.

"How goes it?" I ask.

"The motor," he mutters, and makes a vendetta gesture with a gnarled finger across the throat. Mario prefers the ancient and honorable Mediterranean method of rowing with heavy sweeps, standing up and facing forward, to an undignified crouch over an outboard mounted on the stern. He regards the motor as a deadly enemy, and it responds by frequently going on strike. As he walks away, his bare feet make tiny plopping sounds on the cobbles, worn smooth through the centuries.

AT THE SAME TIME, the shutters of the shops begin to swing open. Beyond the cafe tables of the Trattoria Navicello, trays of vegetables and fruit are being arranged in front of a small grocery. No mass production and distribution here! Each pear-shaped tomato, waxy red and luscious, is individually laid in place. A zucchini squash is polished the dark green of jade before becoming part of the arrangement. The licorice-flavored fennel called *finocchio*, the *rughetta* and other salad greens, the herbs, the almonds snug in their pale velvety hulls, all get the same loving attention. So does the fruit: rose-yellow peaches bedded on green leaves, boxes of raspberries, miniature melons, ripe figs, and *fragole*, tiny wild strawberries.

Other *marinai* have begun working on their boats alongside Mario, men stained chocolate brown from a lifetime on the Mediterranean, readying lovely double-ended little craft of a type stemming back to the days of the far-sailing Phoenicians and perhaps beyond. Now the catch is tourists instead of fish, but everything else is the same.

One after another the boats are skidded down the slope from the piazza into the harbor, a community effort that attracts clusters of small boys, tugging beside their fathers, dreaming of the day when they, too, may go out on the dancing waters.

At seven a *carabiniere* in uniform, key in hand, ambles along the narrow street bearing the imposing name of Via Roma. He opens the padlock and drops the chain. Portofino is officially



THE FORTUNATE FEW—those who live here. *Giulberto Rocchi*, a sculptor recently commissioned to do a bust of President Lyndon B. Johnson, captures the mute eloquence of Napoli, the clothing vendor (opposite page, top). The fishmonger, more vocal in her selling technique, attracts customers and cuts to her cart. A sweeter melody is heard from guitarists who saunter beneath the street lamps every evening. An artist in her own way, a fruit merchant displays grapes to catch the eye of a child with the same care that painter *Lino Selvendy* (above) gives to a new canvas.





CATERING TO THE CAREFREE, *shore-side waters see sleek power boats and graceful sailing yachts serving as diving boards and sandecks. Sheer face of the coast makes it possible for the largest boats to ride at anchor close to shore.*

In the froth-flecked wake of a speedboat, a lithe young figure on skis skims the water outside the harbor.



awake. Church bells ring. Small trucks, some tricycles, roll onto the piazza. Bent old ladies in black stop to gossip, putting empty market baskets down on the stones to gesture with both hands. As they talk, they make way for Genio, the street sweeper, who has already begun his morning task of cleaning the cobbles with a medieval broom of stiff twigs bound to a staff.

As I eat a breakfast of coffee and rolls, there is a clip-clop of hoofs from Via Roma, and the morning mule train appears from the mountains above. It is the only way heavy supplies can be taken to villas perched high over the town, for no roads lead up the steep slopes.

At the same time, a chant sounds from the twisting mosaic path below the Church of San Martino (page 237). I recognize the strong, clear voice of Maria, the fish peddler. "Pesci! Pesci!" she singsongs in the dialect of Genoa: "Bughe! Ancine belle vive!" ("Fish! Fish! Boggles! Anchovies beautifully fresh!") Now she appears, pushing her cart and followed by cats like a Pied Piper as she crosses the piazza to the shaded alley beside Ristorante Delfino (page 240).

Upper shutters have been swinging back. Bedding is spread on window sills and laundry clipped to lines underneath—a practice not approved by the town fathers, but some habits go back too far to break. Portly ladies fold their arms comfortably in the warm morning sunshine and lean out of windows to talk to neighbors or call down greetings to passers-by.

From previous visits to such centuries-old houses I picture the interiors, hidden from the casual visitor. I remember climbing narrow steep stairs, almost like ladders. Blinded by the transition from the brilliance of the piazza to the gloom within, I slid my fingertips along the smooth plaster on either side until I reached a landing, where my questing fingers touched the wood of a door.

Inside the apartment it was still dark. Because houses huddle together medieval fashion, shoulder to shoulder, there are no side windows. Light enters only at front and back. Electricity and plumbing are recent innovations, therefore regarded as luxuries and used sparingly. Heavy dark furniture makes the dwelling more somber, relieved only by religious prints on the walls.

IN THESE APARTMENTS—for the houses are divided one family to a floor—size is measured by the number of windows overlooking the piazza. "A 'one-window' house is usually about 11 feet wide," Beppe Croce once told me, "and a 'two-window' house twice that. So you can see that a one-window apartment is like a narrow, deep cave. That's why the ladies spend a lot of time looking out."

I remember also a visit to the rooms of Milan industrialist Franco Mazzucchelli and his beautiful wife Bruna, who converted a fisherman's dwelling into an apartment. Thick walls and random floor levels echo the past, but yachting trophies and photographs enliven the walls, while gleaming kitchen appliances replace smoke-stained cupboards. Scattered magazines, a hi-fi system, and comfortable furniture betoken the amenities of modern living. But overlooking the piazza there is also a wide window

NEW DESIGNS AND OLD *lure customers in Portofino. A mirror ringed with 14 convex moons reflects a sale in a shop on the Via Roma—and reveals the photographer, too. The store displays Italian clothes of brilliant silks and soft leathers.*

An individual artisan, lace-maker Rosita Lodi (below) makes her bobbins fly while sitting in her harborside



doorway. Fingers still nimble at 92, she traces the patterns of her ancestors. England's Queen Elizabeth I, among many, prized such lace from northern Italy.

seat, and here Bruna spends much of her time, like the other ladies of Portofino, gazing down on the scene below.

Again from Via Roma sounds the ring of iron-shod hoofs on stone, and the dripping cart of Pippo the iceman begins its rounds while the town undergoes its morning transformation. The Portofinesi have no intention of neglecting fire arriving in the pockets of the visitors. Umbrellas sprout around the quay, and waitresses spread gay tablecloths.

On the doors of shops are draped the creations of Pucci and other Italian designers, a carnival touch of gaily printed silk blouses and slacks. Postcard stands are set up. Counters are washed in the little shops selling ice cream in its endless varieties, while the vendor of *frutti di mare*—fruits of the sea—rolls down his blue awning and in the shade arranges mounds of mussels and spiny sea urchins and tiny clams.

Nearby lounge the marinai, gossiping and perhaps splicing a length of rope, waiting for what the incoming buses and automobiles will soon bring.

"Boat, mister? *Bateau, monsieur? Barca? Båt? Boot, mein Herr?*" they will then ask softly, infallibly matching the language to the nationality of the visitor. "A boat for San Fruttuoso?"

AS I SIT BLINKING, the captain of the port goes by, crisp in a white uniform festooned with gold at the shoulders. He is a true autocrat, who usually directs the destiny of the port from a lookout at the entrance, blowing whistles and calling orders through an electric megaphone. Now he has urgent business on the far side of the harbor, nodding only a brief *buon giorno* in passing. The captain's hurried look comes from trying to find space for visiting yachts that converge on Portofino flying the flags of every nation of Europe, plus a few with the Stars and Stripes at the stern.

His problem is made greater by a resident fleet headed by the towering *Quadrifoglio*, a contender in 1930 for the America's Cup as Sir Thomas Lipton's fifth *Shamrock*. Lucky indeed is the roving vessel that can find space along the quay, for the local yachts voyage neither often nor far, as though content to remain forever in the fairest harbor of all.

As I watch the captain stride along, I am almost blinded by the glitter of brass and chrome on the boats, brought to a high polish by the crews. Soon the sailors will retire to breakfast on red wine, bread, and cheese, their most arduous remaining chore of the day being to shift the awnings from one side of the boat to another as the sun passes overhead at noon.

Around me tables fill, as local customers sip a final morning coffee before the flow of sightseers begins. Signor Salvator Gotta arrives, a journalist and author of several books, and I ask him to sit so I may learn more of the history of the area.

"The origin of the name Portofino?" he repeats. "It stems from the Roman 'Portus Delphini,' which later in Italian became 'Porto del Delfino,' or Port of the Dolphin. Some think such fish were once caught here. But I have a different theory."

Taking a pencil, he sketches on the tablecloth. "Regard. Here

AWASH IN A RED-GOLD TIDE, the tranquil harbor hears only the lapping oars of a lone fisherman quietly trying his luck at sunrise.

But the world intrudes on another early riser who scans the news at a sidewalk cafe while waiting to breakfast on coffee and rolls.

1976. ILLUSTRATION BY WIMPELLE. PHOTO © R. A. G.





is the shape of the peninsula that forms the harbor. This end is Castello Brown; the other end is there, under the Church of St. George. You see, the land has exactly the curved form of a dolphin leaping from a wave under the bow of a ship."

He finishes his coffee and rises. "Would you like to walk up to the church? You can see it better from above."

We pass the alley where Maria's fish have now attracted customers as well as cats and climb a steeply sloped path, shaded and patterned by purple bougainvillea. At the top is a small piazza in front of a tiny stone church. One side overlooks the town; the other drops sheer to the Mediterranean. Lazily lifting in the breeze from a staff over the sea is a white flag bearing the blood-red Cross of St. George.

"Sailors from Portofino brought back some bones thought to be those of St. George from the Holy Land during the Crusades," explains Signor Gotta. "The relics are still here. Each April the reliquary is carried through the streets, followed by the marinai, praying for protection."

Inside the church are testimonials showing the concern of the town's patron saint for men venturing forth on the sea. Paintings on the walls depict square-rigged sailing vessels and paddle-wheel steamers beset by mountainous waves or among cruel rocks. In each painting St. George on horseback looks down from a cloud, symbolically slaying the dragon of evil with his lance as he smooths the stormy waters in answer to prayers.

"Why does the Royal Navy of Great Britain use almost the same flag?" I ask Signor Gotta.

He shrugs. "Some Genoese say because there were Ligurian sailors in the fleet of Richard the Lionheart, who stopped in Portofino on his way to the East. Or perhaps it was because Genoa was a great maritime power when England was beginning to develop. No one lightly attacked the Cross of St. George in Mediterranean waters. Others believe it was part of a commercial agreement, as the Genoese were great traders and bankers."

England, of course, has its own version of the story.

AS HE TALKS, we stroll the piazza in front of the church. Despite my guide's efforts, I am unable to see any resemblance between the shape of the peninsula and a jumping dolphin. Reluctantly Signor Gotta returns to his office, while I climb the path to Castello Brown, pausing at a high stone wall.

The outer gate is locked. My knock echoes.

Finally a dog barks, and a woman swings back the door a crack. She explains that the castello is not open to visitors, but admits me when I show a note from Signor Gotta. I find a jewel of hewn stone in a setting of flowers.

Once part of a chain of fortresses protecting Genoa against surprise attack, the tower was made into a dwelling by an Englishman in the 1880's. His name was Brown, and it has ever since been called by the odd Italian-English mixture of Castello Brown.

Once inside I find the usual hospitality of the Italian. My guide tells me she is the widow of Guido Garbarino, whose family have been custodians of the castle for three generations.





PLEASURE IS A PLACE called Portofino. Some know it only for a day. Arriving by sightseeing boat, they jostle in a like-minded crowd, exploring the byways of a village mellow with the patina of the past. Others know it as a stroll with one's beloved, barebacked in the sun. Older citizens find joy in the laughter of a child.



PHOTOGRAPHS AND ILLUSTRATIONS BY W. H. W.



APRIL 1965 © J. M. S. S.

FAIR WEATHER OR FOUL, no one hurries. Caught in a sudden shower, a couple share an umbrella along the waterfront. A housewife trudges a crooked line past walls washed with the tints cherished by artists. Italian law forbids altering the outward appearance of the village; residents wishing to paint their houses must submit color samples to ensure duplication.

"I came to the gatehouse as a girl bride 30 years ago, and I never want to leave," she tells me as we stroll a path bordered by oleander. "But my son plays clarinet in an orchestra in Rome, and my daughter is married to an aircraft technician. They do not wish to become *custodi del castello*, so perhaps I must go."

As we pause to look out over the shimmering water, I sympathize, remembering a story told by Signor Gotta of a retired Englishman forced by circumstances to sell a nearby villa and take a smaller house behind. Unable to bear the thought of parting forever from the view he thought the most beautiful in the world, he had a clause inserted in the sales contract granting him "the right of sunset." Thus at the close of each day, as long as he lived, the Englishman was able to stand on his former terrace and watch the sun sink into the sea.

I walk through high-ceilinged rooms almost bare of furniture, for since the castle was bought by the municipality of Portofino to use eventually as a museum, no one has lived here. Floors are bare stone, and the windows reveal the thickness of masonry walls built to withstand siege.

Then suddenly I am on a terrace overlooking the whole of the Golfo Marconi, a sweep encompassing the towns of Santa Margherita and Rapallo and the amphitheater of mountains forming one of the loveliest panoramas of the Italian Riviera. I see Beppe Croce's villa on the opposite point, while below the harbor and town look more than ever like a stage set (page 238).

WHEN FINALLY LURED back to the piazza by thoughts of luncheon under the umbrellas, I find the tide of visitors in full flood. Excursion boats shuttle to San Fruttuoso, a smaller edition of Portofino around the corner of the peninsula, or to Santa Margherita. Shops are busy. Waitresses dart back and forth carrying steaming platters of *lasagne al pesto*, flat pancake-size squares of freshly made pasta covered with a dark green sauce of herbs, cheese, olive oil, and crushed pine nuts.

Crowds flow around the quays, looking, buying, eating, photographing, all with a vivacity and abandon that could exist only in Italy. As a friend once commented, "There is something in the air that makes everyone behave like an opera singer."

After lunch, the press of visitors thins. I see the pink shirt of Napoli, the itinerant haberdasher, moving among the tables (page 240). From a bundle over a shoulder he is able to produce an endless variety of fishermen's-style clothes. I signal him over, not because I need another shirt, but because his gestures and sales talk in mixed languages should not be missed.

Napoli is not old Portofinese, having arrived only after the last war, but he has become part of the local cast. After 20 years his nickname remains Napoli while his real name is forgotten, a reminder that his home city is Naples, and that like the daily tourist influx, he, too, is an outsider.

Not so Rosita Lodi, who has lived for 85 years in the house on the far quay, the same house occupied by her family for more generations than anyone can remember. Sitting on the quay beyond the floating aperitif barge called *La Grilla*, she makes her



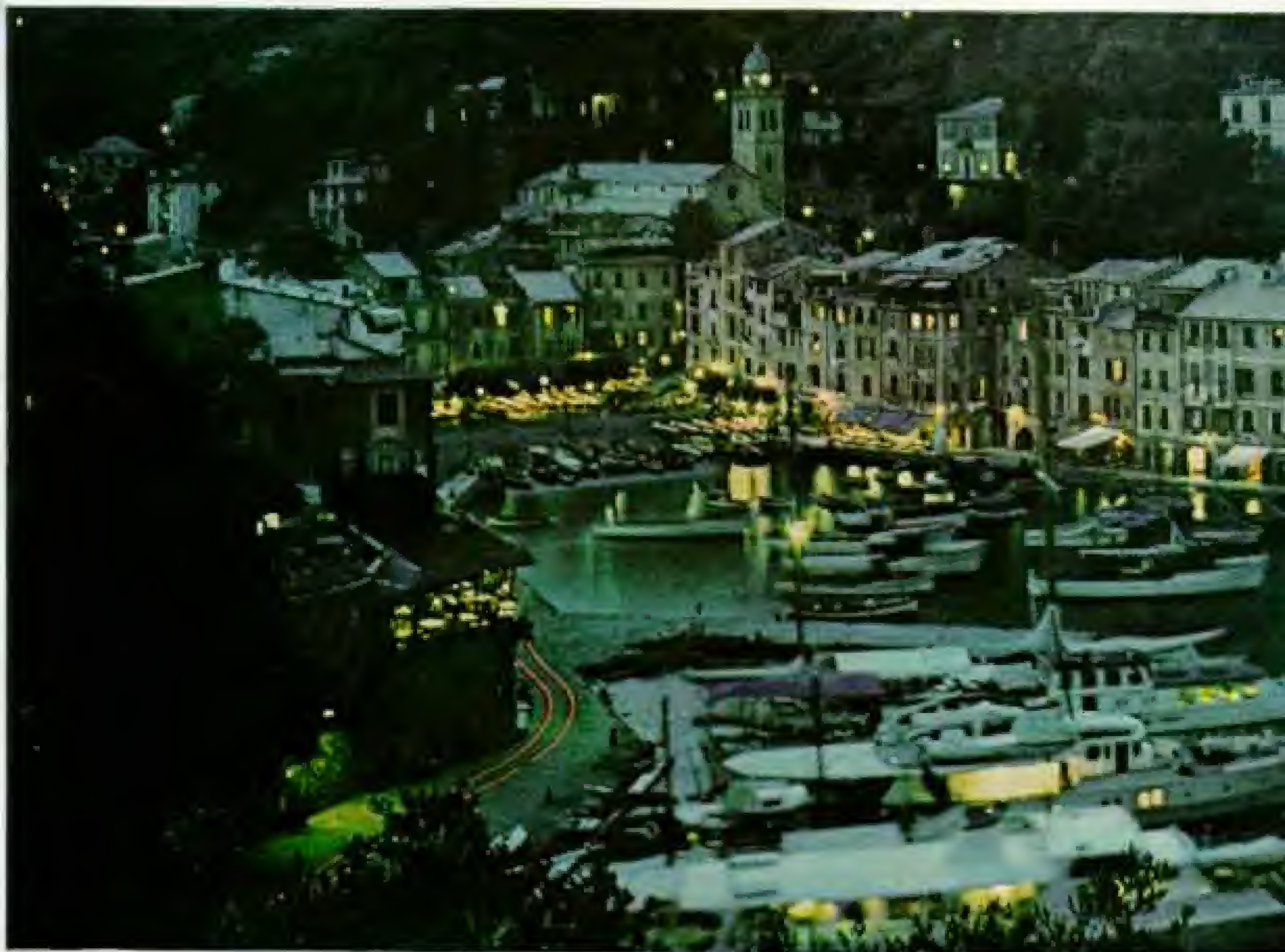
92-year-old fingers fly among intricate clusters of pins and bobbins to produce exquisite lace (page 245).

I stop to talk to her with Umberta Croce, wife of Beppe, one of the few people for whom Rosita will pause in her work. She ducks her head in greeting and lifts a length of lace for inspection.

"Beautiful!" exclaims Umberta. I take the gossamer threads in my hands and marvel at the complexity of the design, a pattern of knots almost invisible to the eye.

Umberta inquires about the Lodi family, and finally I ask Rosita about the changes she has seen in Portofino during her lifetime. She reflects, the pale old eyes scanning visions of the past.

"The men don't fish any more," she answers simply, "and there



are many more people on the quay by the harbor every day."

Her reply sums up a great deal. I return to a front-row seat at a cafe table, while almost imperceptibly Portofino becomes itself again. The marinai are the first to return to a village life. As the sun lowers, the boats are skidded back up on their ramp facing the piazza. Afterward the sailors sit like gulls along the wall of the quay, smoking and gossiping. The souvenir stalls are folded and put away. Iron store shutters begin to swing shut. The cafe tables refill with local folk, parents having coffee or a predinner

ice cream while children play games on the square, hiding among the boats.

The glare of the day is gone, and the sky softens through successive shades. If I am lucky, a moon will rise over Castello Brown as the sun drops behind the vineyards of Camogli. Unobtrusively the two guitarists, whose first names both happen to be Oreste, wander from cafe to trattoria, and equally unobtrusively the single flower girl permitted by town regulations makes her rounds, carrying a tray of fragrant gardenias. Bottles of wine shuttle along the restaurant tables. Strollers move more slowly. Yachtsmen loll comfortably on the afterdecks of the immobile fleet.

Before midnight the last outsiders have departed. Now lights



LIKE STARS mirrored in a pool, lights of the village signal the end of day. Visitors and residents draw close on this fringe between darkening mountains and the void of sea. Boats nestle in their berths, while music drifts across the cove.

Young guest aboard the yacht Wanderer feels a sense of homecoming to Portofino.

wink out, except for a few which cast long shimmering spears across the mirror of the harbor. A cat wanders across the deserted piazza, stopping in the center to preen. Then a waiter begins to fold the tablecloths of the Excelsior, so I take the hint and walk to the Nazionale, with my footsteps on the cobbles sounding loud in the silence of the sleeping town. I take a final look from my bedroom window before swinging shut the shutters. Nothing has changed. The scurrying hands of the twentieth-century clock have indeed stopped for Portofino. THE END

North Toward the Pole on Skis

By BJØRN O. STAIB

*MEZZLES DOWN, PAWS CHURNING, Greenland huskies
inch a toboggan over jagged ice in an attempt
to cross the Arctic Ocean last spring.*

PHOTOGRAPH BY JAMES WILSON FOR THE NATIONAL GEOGRAPHIC MAGAZINE



GIANT ARCTIC FLOES on the move make an eerie, creaking sound. As they grind together in the grip of wind and current, the ice builds into a pressure ridge; huge blocks rear 40 to 50 feet into the air. Minutes later, this structure, seemingly tough as steel, may snap and crumble onto the ice below with devastating force.

For weeks we had lived with the sound, sometimes nearby, often a mere rumbling on the horizon. Now, from inside our tent, we caught a new note—as of a vast artillery barrage creeping toward us.

Although the ice can be 9 to 12 feet thick, the mantle on the Arctic Ocean resembles a thin layer of dust on a bucket of water. Reaching depths of 12,000 feet, the ocean unleashes enormous momentum when stirred by currents or wind. These gigantic forces mash the ice together, grind tens of thousands of tons of sea ice into fantastic ridges and formations. We faced the classic problem: where to go when all the surrounding ice erupts?

As I crawled from the tent, the pressure wave struck, tilting our camp and its small floe like a child's seesaw. Everywhere around



us the ice writhed, great slabs the size of freight cars grinding, rearing, tumbling. The effect was of an earthquake, yet with a single difference—land lay 100 miles away.

We had pitched our camp on April 25, far to the north of Canada's Ellesmere Island, on a heading for our objective, the North Pole (map, opposite). In the raging, churning ice world around us, there could be but one hope of refuge: some slab that might withstand the fearful force of the sea.

Icequake Forces a Retreat

Without the Arctic sun flooding the spring night, escape would have been impossible. Scrambling across the heaving floe, we slipped the dogs free of their anchoring lines as ice boulders tumbled toward them.

Packing the sleds in the roaring maelstrom was like loading dories in a gale. Tents, sleeping bags, stores, all landed together in the heaving sled cradles. The cannonade of shifting floes drowned out all words; the six of us worked automatically.

Finally we were ready to retreat. But where? The movement of the ice seemed to come from the southwest, so we chose north.

Our floe, no more than 60 by 100 feet, clearly was going. The edges had crumbled badly, and the tilting continued. Once it slipped down among the neighboring blocks, it would be ground to porridge in an instant.

Straining at the ropes, we hauled the sleds to the northern edge of the floe, now angled 10 feet above



WINTERKING, LARSEN, AND STAB (CLOCKWISE FROM TOP LEFT) WERE THE POLAR PARTY'S LEADERS.

Frostbite mask camouflages the expedition leader, 26-year-old Björn O. Stab. He fashioned the sheepskin guard after developing severe frostbite in the polar wind, which scientists estimate increases the effect of cold by one degree of temperature or more for every mile per hour of velocity.

Reluctant sledge balks atop an ice ridge. On the downhill, drivers unhook traces to safeguard dogs from being crushed by a runaway load. Once freed, this sledge will slide down under its own momentum.



the neighboring block. That block itself had already begun to submerge; only hummocks rose above the slush. Jumping and hauling, we worked the sleds from hummock to hummock and onto higher floes beyond.

We maneuvered desperately. Several times it seemed a sled might be ground to splinters or drop into the icy blackness between floes, but each time we managed to save it. I envied the dogs with no sleds to pull; they leaped nimbly from perch to perch like lumbermen rafting logs on a river.

At last, with luck, we found a large floe that seemed solid and likely to survive. We gathered the dogs, unloaded the sleds, and pitched our two tents. For an hour after we lay down in the orange glow of sunlight through the tents, the ice continued to crack and thunder.

Long afterward the sound drifted away to the north, leaving only stillness.

Four weeks before, we had put land behind us at Alert, a small weather station (and the Western Hemisphere's northernmost permanent settlement) on the icebound rim of Ellesmere Island.

Northward in Robert Peary's Track

Our plan was ambitious. Striking across the frozen Arctic Ocean in late winter by ski and dog sled, we aimed for the North Pole itself. In more than half a century, no man had ventured there on foot, not since the American, Robert E. Peary, had telegraphed his famous message from Labrador on the return journey in 1909—"Stars and Stripes nailed to the Pole."



Bicycling to nowhere, expedition members undergo physical endurance trials in an Oslo laboratory prior to the polar trek. Norwegian Air Force 2d Lt. Emil Vikari (above) cycles furiously while breathing into a mechanism that measures respiration rate and oxygen consumption. Civilian trapper Hans Odjvick (left) gets a final check by a young technician. Tests before and after the expedition revealed only a slight drop in the men's physical condition because of their six-week ordeal.

In the beginning our hopes had reached even beyond the Pole. With luck, we envisioned a truly historic trek—a complete traverse of the Arctic Ocean from Ellesmere across the Pole to the Soviet Arctic island of Severnaya Zemlya or to Norway's remote outpost, Spitsbergen. I estimated the total distance at more than 1,300 miles, and the time to cover it at roughly three months.

Lying in my sleeping bag that night after the icequake passed, I conceded that our hopes had dimmed—hopes not only for making the traverse, but even for reaching the Pole itself.

In a sense, I had spent years reaching that small camp on the floe—years stretching back to my boyhood in Norway, when I studied the lives of great figures in Arctic exploration

Fridtjof Nansen's account of crossing Greenland in 1888 had inspired my first Arctic expedition. In 1962 with a friend, Bjørn Reese, I had traversed Greenland's icecap on skis in 31 grueling days.*

Flight Gives Preview of "White Desert"

After Greenland, my thoughts turned to the true Arctic, that vast reach of trackless water and ice forever reshaped by wind and circular polar currents. This was the perilous world I longed to challenge. But a transpolar expedition takes a great deal more money, time, and men than a Greenland adventure. In the summer of 1963 I began the search.

Men were the most critical item. Here I was lucky, for Norway is blessed with a people born to the outdoors and to endurance.

Yet endurance counted as only one requirement. Crossing the constantly shifting polar pack also called for great skill in navigation, expert radio communication, and a knowledge at least of first-aid medicine.

I assembled a team of eleven young but experienced men, including that all-important part of any sledge expedition, dog-team drivers.

Then I sought advice and support. Some of the best of both came from my friend Max Brewer, Director of the Arctic Research Laboratory at Point Barrow, Alaska. The laboratory, a civilian arm of the United States Navy, supports the vital ice-island research stations—T-3 and Arlis II—that drift endlessly in the polar pack and provide manned platforms for Arctic observations.

In the spring of 1963, I flew to T-3 and Arlis II in one of the laboratory's single-engine Cessna 180's for a stay of several weeks. It was my first chance to see the type of ice we would encounter—an unimaginably vast and ghostly white desert, pocked by ridges beyond count, veined by the ominous dark coils of leads—jagged fissures that occur in the ice, revealing the cold, deep, restless ocean beneath (page 272).

*The author described his 1962 expedition in *Across Greenland in Nansen's Tracks*, George Allen & Unwin, Ltd., London, 1963. Mr. Staib's new book, *Northward on Skis Toward the Pole*, is soon to be published by Doubleday & Company, New York, and also in London.



EXTENDING BY JOSEPH J. SCHNEIDER © ARTHUR LEONARD GILLET

Shakedown cruise in Oslo Fjord tests men and kayak-like plastic boats designed to ferry the expedition across stretches of open Arctic water in the final stages of the polar traverse. But the boats never saw action.



Frozen obstacle course, the fearfully pocked and ridged ice north of distant Ellesmere Island, doomed the expedition's hopes by holding progress to a mile or two a day during the first three weeks.

On the flight deck of a U.S. Air Force C-130 cargo plane (left), Staih surveys the team's first challenge. Ice ridges in foreground, seemingly inches high, rise 30 to 40 feet over the pack. Peaks of the United States Range loom beyond.



On my take-off for home from Point Barrow, Max made me an offer I was to recall long afterward:

"You'll have a rugged trip—but it should be a good one. Let us know if we can help."

As the starting time for the expedition, I chose early March of 1964. Two factors dictated the choice: In deep winter, the polar pack is at its most solid and traversable state. As spring with its storms and higher temperatures creeps northward, open leads in the ice increase—and the dangers of surface travel increase with them. But spring also brings the gift of sunlight and an end to the long polar night. We hoped to profit from solid ice with-

out sacrificing the advantage of daylight.

The National Geographic Society offered us a generous grant, as did *Aftenposten* of Oslo, Norway's leading newspaper, and *Expressen*, the Swedish daily in Stockholm. Although our purpose was largely one of adventure, we had a number of scientific objectives. Research organizations in Norway and the United States asked us to observe such polar conditions as ice formations, temperatures, problems of communication, and the effects of those conditions on our bodies, minds, and performance.

As March approached, we made final plans. Equipment amounted to thousands of items,



ranging from tea bags to plastic sled-borne boats I had designed for ferrying the expedition across open water (page 259). For sleds I chose the light but durable design of wooden frame that Nansen—and later my companion and I—had used successfully on the Greenland traverse.

Our diet was to be simple. Once in the ice, we would have two hot meals a day. For breakfast we would stoke up on heavily sugared oatmeal porridge with powdered milk, and a ration of raisins. At dinner we would have pemmican—that incredibly nutritious and unappetizing concentrate of dried meat and seal blubber—and tea laced with sugar. For noontime under way we had high-energy chocolate bars and substantial biscuits.

For clothing we chose roughly the same as that worn by Norwegian ski troops—wind-break ski trousers and fur-trimmed parkas over heavy jerseys and woolen undersuits.

During our last days in Oslo, expedition members underwent tests designed by Professor Kristian Lange Andersen of the Institute of Work Physiology of Norway's Ministry of Labor. The tests were to measure our resistance to cold and our fitness for heavy work, both before and after the expedition (page 258). One of these involved holding one's hand in a bucket of ice water. After some



time, the pain becomes excruciating. Emil Vikari, one of our navigators, summed it up.

"I don't mind freezing my hand off," he told the technician, "but let's wait till I get to the Arctic."

We left Oslo on March 2. At Fornebu Airport we boarded a Douglas DC-6 appropriately named *Norse Explorer*. Altogether we weighed nine tons, counting men, supplies, and ten sled dogs. The main body of 87 more Eskimo sled dogs awaited us at the U. S. Thule Air Base in Greenland (map, page 256).

After an overnight stop at Keflavik, Iceland, we crossed Greenland's glacier-fingered east coast. In the next hour we spanned the same distance that had once cost me a grueling month on skis. Then, in the eerie lavender haze of a Greenland winter afternoon, the lights of Thule's vast runway rose to meet us, and we were down at last in the Arctic.

Doglift Gives Americans a Furry Cargo

I cannot say enough for the officers and men of Thule Air Base, who helped us on our way. Without their aid, and that of the U. S. Air Force behind them, our story might well have ended in Greenland.

The flight from Thule to Ellesmere Island was more doglift than airlift. Two enormous U. S. Air Force ski-equipped C-130 cargo planes took us on the final 425-mile leg. One aircraft carried all the equipment and most of the men; the other lifted some 100 yapping, perplexed huskies. The dogs' breath in the chill of the cargo hold raised such a cloud of fog that the crewmen could hardly see one another (opposite). As we got the last of the yammering, fidgeting pack settled, the aircraft loadmaster shook his head.

"The recruiting sergeant never mentioned this," he said grimly.

At Alert, on Ellesmere Island's northern

Arctic veteran, Greenland Eskimo Krak-ochek adds lashings to a sledge at base camp on Ellesmere Island. His quilted jacket and homemade polar-bearskin trousers ward off all but the deepest cold.

Vapor cloud of breath envelops nearly 100 sled dogs in the cargo hold of the C-130. They await an airlift from the U. S. air base at Thule, Greenland, to Ellesmere Island. Uneasy on take-off, the dogs soon settled down like veterans for the 425-mile flight.

PHOTOGRAPHS BY GUY LAWRENCE AND GUY LAWRENCE
AND GUY LAWRENCE (PHOTOGRAPHY), GUY LAWRENCE



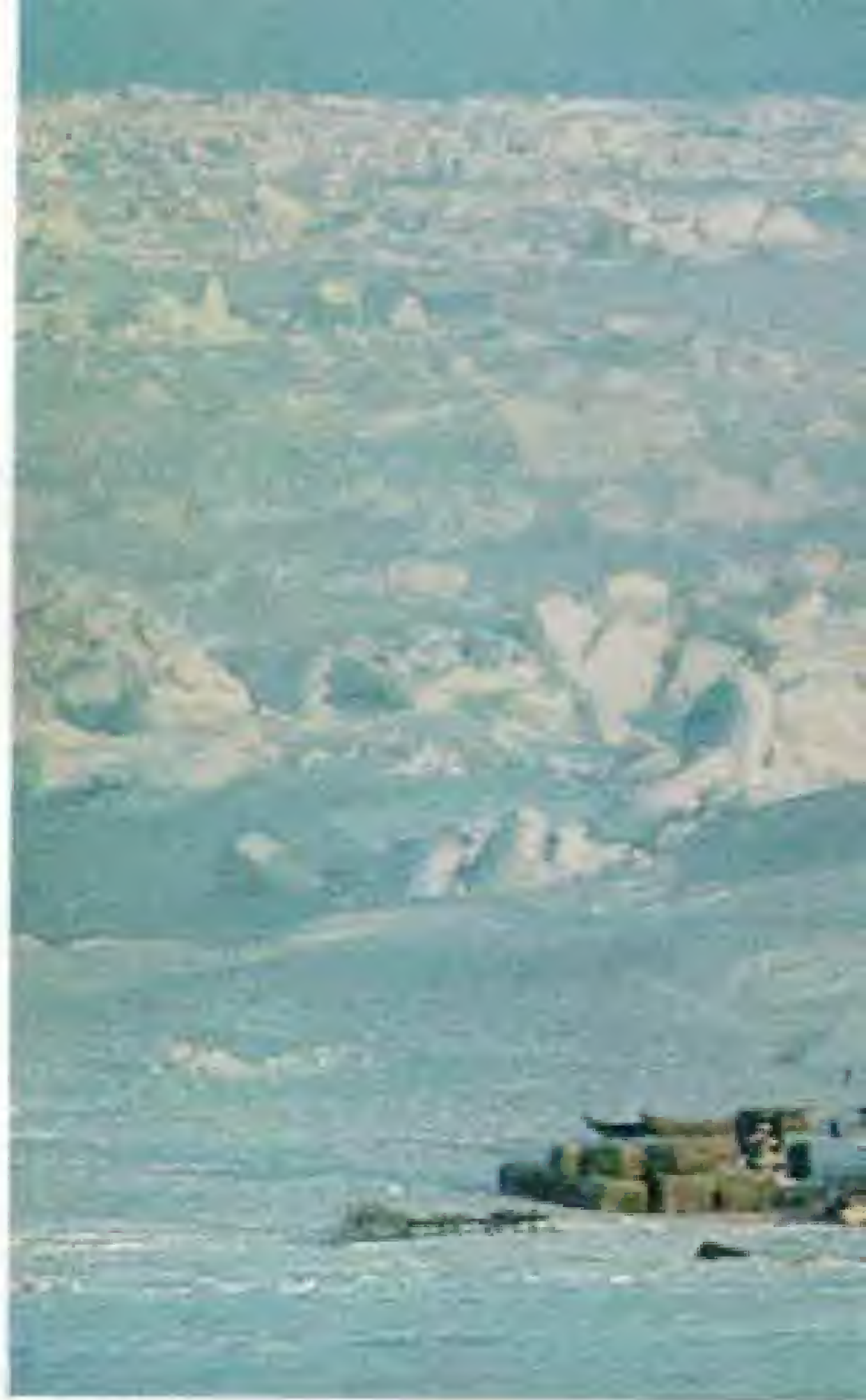
tip; the Canadians met us with snow tractors. In a few hours they hauled our tons of supplies to the coast, so that our base camp stood at the edge of the polar pack (right).

It was our first face-to-face view of the enemy we had challenged, and the shock was undeniable. Where the land sloped down to meet the frozen sea, there began a nightmare jumble of tortured ice, ranging from blocks as big as houses to gravel-size chips. All had been hammered and crushed together by the rams of wind, tide, and current until there seemed hardly a flat surface as far as the horizon.

"Not exactly a soccer field," Sivert Fløttum, one of our radio operators, said wryly.

The frightful cold surpassed any I have ever known—the first week we recorded minus 65° F. Even inside the base camp tents, with their kerosene stoves, medicinal brandy froze brittle in the bottle. We found no real escape from the cold's knife-edge probe, even inside our sleeping bags. Gradually we accepted pain as a constant companion, always to be respected, never ignored.

Boots and mittens festoon a tent at Alert, the expedition's base camp on the rim of Ellesmere Island (right). Expedition navigator Steinar Laugen and an Eskimo helper repair a Norwegian-type sled.





PHOTOGRAPH BY GUY LAWRENCE FOR NATIONAL GEOGRAPHIC MAGAZINE

Ghostly blue of Arctic dusk haunts the Alert base, where the expedition started on March 29. Within two weeks, the sun shone nearly 24 hours a day.

Jumble of equipment surrounds packers during final preparations. Six-man dash group and its support party began the trek with 50 dogs.





Off at last, but not to a running start. Fan of huskies, harnessed Greenland fashion, strains to squeeze a sled through a narrow corridor in the tumbled maze of ice; drivers tug as well. Such an agonizing pace, in temperatures that fell to 65° below zero, robbed the men of time needed to attain their goals.



PHOTOGRAPH BY BARRY SHAPIRO, GREENLAND EXPEDITION, U.S.A.



Ice, not age, whitens the beard of radio operator Sivert Flottum, whose hat carries his expedition number, 12. Condensation of his own breath in a day of struggle provides the frosting.

Coupled with the cold was a desperate loneliness—all life seemed to shun this world. Occasionally we saw tracks of polar foxes, and once, as I chopped seal meat for the dogs, I saw a solitary wolf outlined on a hill against the sky. As I watched, he turned and trotted over the ridge, a wraith in the eerie twilight.

We began reconnaissance runs into the ice pack. Almost at once we met with disaster—our light Nansen sleds simply disintegrated under the battering of the ice. The only choice was to abandon them all and build something sturdier on the spot.

Our two Greenland Eskimo helpers, Krakochek and Peter, grinned at each other: "Build Eskimo sled." With their help and with lumber supplied by the Canadians at Alert, we fashioned three Eskimo-style juggernauts of heavy pine timber with iron-rimmed runners that could stand any amount of punishment. The finished products, similar to the ones that Peary took to the Pole, resembled old-fashioned horse-drawn sledges (next page). The weight of the sleds cut speed and load cruelly, but Krakochek only shrugged his shoulders: "Eskimo never in hurry."

March 23 brought us tragedy and loss—Torstein Raaby, our base camp radio consultant, who had served as radio operator aboard Thor Heyerdahl's famous transpacific raft, *Kan-Tiki*, died of a heart attack. Our shock was deep, as we knew all Norway's would be.

The Canadians and the U.S. Air Force

arranged for Torstein's body to be flown home. With a great sense of loss, we set out from Alert on March 29 for the Pole, some 500 desolate miles to the north.

A brief aerial reconnaissance during the flight from Thule to Alert had revealed our first—and perhaps greatest—obstacle. In the winter of 1963-64, since judged the worst Arctic winter in decades, an enormous ice island eleven miles long had blocked the normal flow of ice southward between Greenland and Ellesmere Island. A gigantic ice jam, the great saw-toothed barrier that began only yards from our base camp, reared all along Ellesmere Island's northern coast.

This fearful rampart had to be breached before we could hope to find the smoother sea ice beyond. Our survey had shown that the barrier stretched seaward for 25 or 30 miles. Beyond, the going had looked easier, but still rough for 120 miles.

Our six-man dash group took to the ice, temporarily augmented by a support team of four to help carry provisions the first 10 days. Our first day, and for many days afterward, skis proved useless. The straining and hauling of cumbersome

Hacking a passage by hand, Arctic trailblazers struggle through a nightmare labyrinth formed when flat floes buckled into house-high blocks under pressure of ocean current, wind, and tide. Pick-and-shovel work in the early stages often earned only 15½ miles a day. On smoother sea ice, men and dogs averaged better than 10 miles daily.

Stalled again, men struggled to lift an Eskimo-style sled over an ice boulder. The cumbersome vehicles, useful on the punishing trek through coastal ice, bogged down later in deep snow. Then the expedition shifted to lighter toboggans, air-dropped by Americans from the Navy's Arctic Research Laboratory at Point Barrow, Alaska.





PHOTOGRAPH BY KAREN WILSON. WOODS HOLE OCEANOGRAPHIC INSTITUTION. © NATIONAL GEOGRAPHIC SOCIETY

sledges over the barrier ice could only be done in boots.

Our 50 dogs, the pick of the lot from base camp, were in top condition from a rich diet of seal meat, blubber, and dried fish. Yet alone they were no match for the ice. Time after time the sledges came to a halt against massive blocks or in dead-end corridors, and then it was men and dogs together, heaving to break free or backtracking on a detour.

Whenever possible we bypassed the towers and ridges looming 20 and 30 feet above us. Often the only choice was to chop a passage (above). Sometimes on a single obstacle we hacked our way through many cubic yards of ice. At such moments, I could only echo the grim humor of Steinar Laugen, our navigator—"I came to the Arctic to explore, not to join a road gang." But hatchet and pick were the only way through.

Despite the fearful temperature, we had to guard against perspiration. Wherever moisture soaked through the woolen jerseys we

wore, it turned instantly to ice. During rests, we slipped our parkas back over the sweaters to guard against dangerous chill. An observer would have had no difficulty spotting us among the canyons and towering ridges: The heat from our bodies and from the dogs raised a cloud of fog that hung above us in the knife-like cold like a balloon.

Fourteen Hours to Make One Mile

I called a halt late the first evening, after we had struggled for 14 hours. We had edged the sleds over a final high ridge and lowered them gingerly with ropes while the dogs lay safely staked at a distance. Within an hour we had pitched our small orange tents, fed and bedded the dogs, and set our tea and pemmican to simmering on the Primus stoves.

I could not rest after dinner. By my estimate, we had covered little more than a mile in the entire first day's struggle. We felt little need to make radio contact with Tor Lundström, our base camp operator—we could



Sighting the sun with a sextant, navigator Steinar Laugen plots the expedition's course through the constantly moving ice park.

Six-man dash team bids goodbye to the support group that helped carry provisions for the first 10 days. From this point, some 15 miles from land, the six braved the frozen Arctic Ocean alone, completing the 300-mile trek from Ellesmere Island to Arlis II in 41 hazardous days. Left to right: leader Staib, Hans Oddvik, Sivert Fløttum, Steinar Laugen, Eil Selnes, and Staib's brother Terje.

almost yell back across the ice to him. At such a rate, a mere mile or so a day, I knew we could lose all hope of success very quickly. With 500 miles of unyielding ice between us and the Pole, we were racing our deadliest enemy, spring, and its partner, open water.

Grudgingly, in the lifeless glow of the evening sun, I reconnoitered the next day's route. After an hour I turned back. For days ahead we faced the same backbreaking task of hauling, detouring, and hacking.

As I crawled into the tent, all eyes turned toward me.

"Did you find any pleasant surprises for us?" Hans Oddvik, one of the dog drivers, asked, only half joking. I shook my head.

"If there's a short cut to the Pole, I didn't find it. We have a lot of road work ahead of us."

In the end the work lasted three weeks—and

gained us only 25 miles. We developed a routine and stuck to it doggedly, rising at six, breaking camp in an hour, inching our way desperately for 14 hours; then camp, food, and the sleeping bags again, all in the never-ending daylight.

We came to know the sounds of ice and snow, the high-pitched singing of hard-packed drifts underfoot,



the echoing thunder of restless floes, the unearthly screech of ice block against ice block—one giant whetstone against another.

Endless Battle Against the Cold

We learned to live with cold, never to conquer it. On the trail, we searched one another's faces for the innocent-looking, painless white spots that can appear in minutes and develop into dangerous frostbite.

Cold followed us even into the sleeping bags at night, where condensation from our breath froze to the air vents. To protect the bags and our clothes, we wore canvas bibs around our necks. Overnight the napkins absorbed the condensation, and by morning they were like breastplates of steel.

Condensation froze on the insides of the two tents, coating them with layers of ice crystals. Then in the night, when the wind







PHOTOGRAPHS BY GUNNAR JENSEN WITH JOHN ROBERTSON © NATIONAL GEOGRAPHIC SOCIETY



picked up, the tents would shudder, pelting us with a miniature ice storm.

Leaving the sleeping bags in the morning was a minor agony; each man developed his own system for dressing. I learned not to lace my ski boots until after breakfast. When I first put them on, they were frozen stiff as Dutch clogs, but in 15 minutes my feet had thawed them enough to tighten the laces.

Homemade Sleds Become Snowplows

At the end of three weeks, with 25 harrowing miles behind us, at last we broke through our barrier. Threading the worst of the coastal pack, we reached the smoother sea ice.

Our support team had left us and turned back to Alert, and now we were six in the ice: myself and my younger brother Terje, our medical corpsman; dog driver Hans Oddvik, Egil Selnes and Sivert Fløttum, our two radio operators; and Steinar Langen, navigator (pages 270-71).

Delay had cost us heavily in schedule and provisions, and our first goal was now the ice island Arlis II. Arlis lay some 250 miles north of our position, close on the route to the Pole, though of course the island shifted constantly with the Arctic pack (map, page 256).

When the shift to the heavy Eskimo sleds at Alert had cut our carrying capacity, we had taken a calculated risk—we had trimmed provisions so that they would last us only as far as Arlis II, and left the plastic boats behind.

While we had fought our way through the terrible coastal ice, Tor Lundström, the base camp operator, had hitched a ride with a U. S. Air Force supply flight to Arlis II. With him he had carried the base camp radio, a vital cargo of extra provisions, and our plastic boats.

Ice-floe raft ferries a man across a lead, or fissure, in the solid cake. Skis serve to jockey the improvised craft to a landing. Although the expedition gained speed on this smoother terrain, danger increased as spring thaw widened the watery aisles. Toward the expedition's end, the group spent a hazardous 48 hours marooned on a floe in the middle of a broad lead. At any moment during that time a storm could have overturned or pulverized their floating platform.

Frigid dunking fails to halt huskies crossing a narrow lead. Dogs survived immersions without harm if run briskly for the next hour to speed circulation.



ILLUSTRATION BY GARY FINE WITH PHOTOGRAPHY BY NATIONAL GEOGRAPHIC SOCIETY

Comfort of contact with the outside world comes to men in terrible isolation near one end of the earth. Fløttum (left) prepares to crank the radio generator for Selnes to broadcast expedition news to their colleague Tor Lundstrøm at Arlis II. Stations as distant as South America picked up reports relayed by Lundstrøm.

We reasoned that in the first few weeks of deepest cold we would encounter little open water. When we reached Arlis II—if indeed we could find it—the boats would be available for the dash to the Pole in the face of the gradual spring breakup of the Arctic pack.

Now, during our regular radio exchanges with Tor, we could hear his cheerful voice coming from ahead of us at Arlis II, urging us on. And then suddenly Arlis II seemed beyond our reach—the Eskimo sleds failed us.

Digging and hacking our way through the coastal ice, we had found snow only a minor problem. Now, when the smooth sea ice stretched before us with the promise of speed, our sleds suddenly became snowplows that refused to budge. The ice was covered with a fluffy snow blanket often knee-deep.

Over a grim and wordless dinner eaten while we huddled in the sleeping bags that night, I recalled Max Brewer's offer at Point Barrow from the spring a year before—"Let us know if we can help." Within an hour I

was on the radio to our colleague Tor Lundstrøm at Arlis II.

Thus, a day or so later, an Arctic Research Laboratory twin-engine Douglas DC-3 Skytrain, one of the famous World War II workhorses, with a cargo of light plastic toboggans aboard, sought our position in the sea ice.

1,500-mile Message to Plane 5 Miles Away

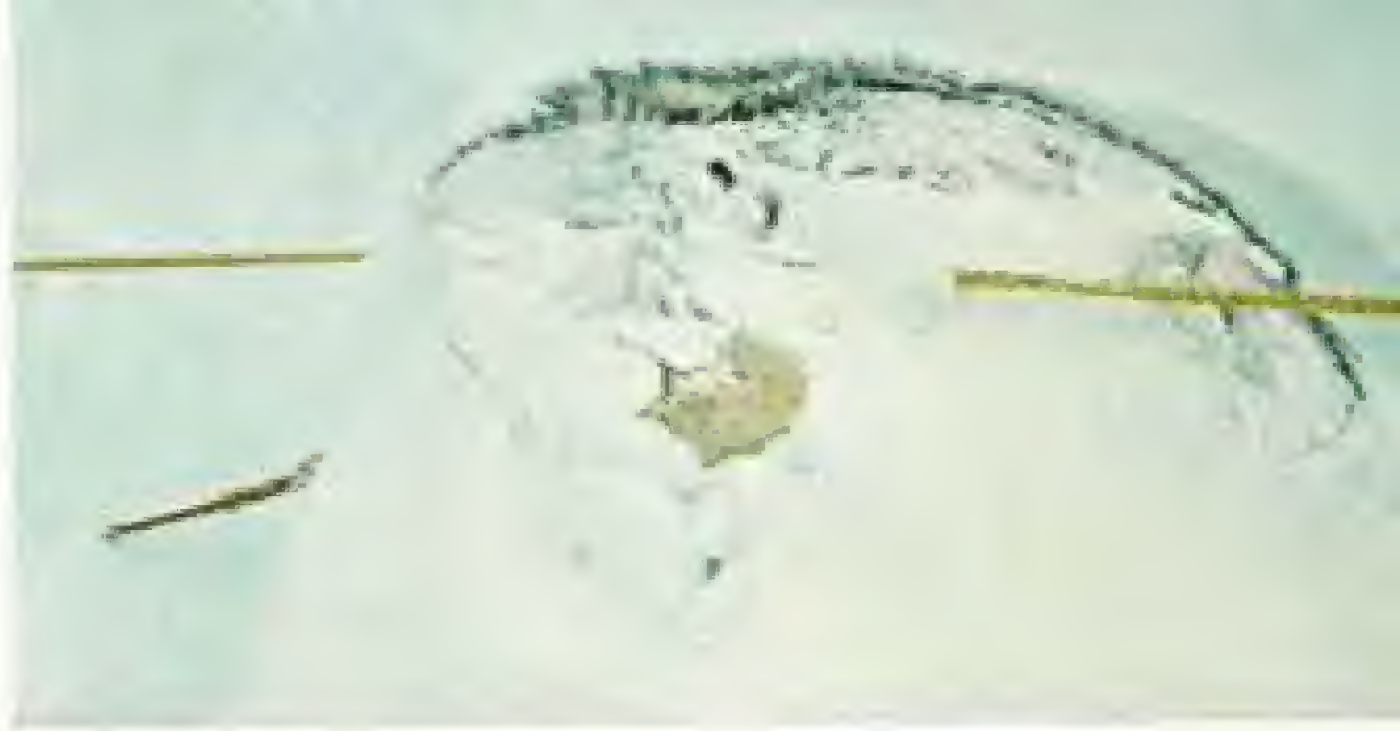
Finding a small camp in that endless expanse of blinding white is a major achievement. Because the DC-3's radio operated on an aircraft frequency, we could not talk directly to the pilot. Instead, we beamed directions by what may well be the longest detour in the history of Arctic communications.

In the clear polar sky, we sighted the aircraft at a distance of six or eight miles, long before the pilot saw us. As he groped blindly for our pinprick of a camp, Sivert Fløttum began transmitting on our radio to Tor Lundstrøm at Arlis.

"Tell him to turn south about 80 degrees."

Snow blankets a sleeping husky, tightly curled against the cold. Animals managed the extreme temperatures well, despite Eskimo predictions that they might die.

Mess call for pemmican brings rapt attention along the stake-out chains. As provisions dwindled, expedition members reluctantly fed teams on the remains of several dogs destroyed because of crippling injuries.



DOG CHAINS, TOP, AND SUPPLYING AN ARCTIC STAFF WITH SUPPLIES FROM THE AIR

Tor, too, was unable to talk to the DC-3 directly, so he relayed our message to the Arlis operator in the hut next door. Arlis's transmitter, likewise unable to reach the plane directly, raised its sister ice island, T-3, some 700 miles to the southwest—"Tell the pilot, south by 80 degrees."

T-3, on its direct frequency with the DC-3, then flashed the signal back eastward 700 miles to the pilot—"South by 80 degrees."

And the plane—now scarcely five miles from our camp, yet following directions that had flickered across 1,500 miles of frozen Arctic wastes—turned south by 80 degrees!

Within minutes the precious toboggans were floating down toward our camp under ballooning green or white parachutes. With them came a hastily scrawled note from our friend Erik Lande, the *Aftenposten* correspondent, who had hitched a ride on the DC-3 to survey the ice for us.

"You are past the worst of it," we read with relief. "Things better northward. See few



Trailside siesta: A husky naps during a noonday pause. Expedition members fitted dogs with harnesses made from military belt webbing. This dog now serves with the Arctic Research Laboratory at Point Barrow, Alaska.

"*Huk, huk!*—Go, go!" Drivers start a team with the Eskimo command. Leaving a smooth, newly frozen lead, they tackle a snow-covered ice ridge. To handle the huskies, the Norwegians learned the commands from original owners in Greenland.

Despite identical training, sled dogs varied greatly, some straining at the first command, others constantly lagging or veering aside. Older dogs proved best.

"Young dogs," the author explains, "wore themselves out early by overpulling. But the wiser ones, like good long-distance runners, paced themselves and ended the trek still strong."

Black lead dog (left foreground) was called "Barnse," Norwegian for "bear," because of his enormous strength.

For speed and as a precaution against dangerously thin ice, the men wore skis whenever possible. Only in the hopeless jumble of pressure ice or while straightening snarls in traces did they work in boots.

Four weeks and some 100 miles out of Ellesmere Island, the Pole party, now hopelessly behind schedule, shifts its sights to Arlis II.



open leads. Arlis planning steak dinner for your arrival."

The steak dinner was still 250 miles to the north, but the toboggans brought it within reach. With new heart we shifted the loads from our now useless Eskimo sleds to the featherweight toboggans.

On skis at last, we shouted the Eskimo command to the dogs. "*Huk, huk!*—Go, go!" The teams, sensing freedom at last from their wooden monsters, set off in a shower of ice crystals.

The first day on skis and with the toboggans we covered more than 10 miles, the same

distance it had taken us a week to travel in the coastal ice. If we grew confident, the feeling was short-lived, for a few nights later in camp we encountered the terrible icequake. The following day, April 26, we were pinned down by a howling blizzard.

Swirling Snow Stalls Expedition

High wind, with its swirling snow, or occasionally a dense fog, can immobilize an Arctic expedition. The sensation is eerie, as if the traveler were wrapped in an enormous cocoon of white gauze. Even ski tracks at one's feet become hopeless blurs or faint shadows to the



PHOTOGRAPH BY HARRY WARD NORTH POLE EXPEDITION. © NATIONAL GEOGRAPHIC SOCIETY

eye. At such times it is suicide to stray far from a tent, let alone reconnoiter in shifting ice.

"Half rations until it lifts," I announced before breakfast, and instead of the luxury of oatmeal porridge and milk, we sipped hot tea, trying to make it last.

Our quarters, desperately crowded at the best of times, became unendurable prisons. Jammed shoulder to shoulder in the sleeping bags, we could move or turn over only by arrangement with our neighbors.

Looking back, Steinar Laugen recalls how he fought the terrible monotony. "I thought up problems for myself, and then I argued

one side against the other. Sometimes I even managed to work in a third party, and that helped to make the argument last longer."

While the snow fell, my brother Terje took automobiles apart in his mind and put them back together. Hans Oddvik, the unquenchable Hans, outdid us all—he dreamed up expeditions.

When the blizzard died, we got under way once more—still 200 miles to Arlis. Now a subtle change began to take place in the ice pack: Each day we sighted a few more leads than on the day before.

Once I spied a seal in a lead. In a second



Forty-one days and 300 miles of polar ice

the rifle was in my hands. Even as I sighted, I knew it was hopeless. At that season, with little winter fat left on him, he would have sunk the instant I killed him.

The last days of April came—we had spent a month in the ice. Now we rationed our provisions severely. Pemmanic for the dogs was in shortest supply, and were it not for injuries to the animals themselves, it might have disappeared. Crippling wounds on the trail—from accidents and dogfights—are unavoidable. One cannot abandon a disabled dog—it is heartless to leave him to starvation or the polar bears. One can only shoot him mercifully and, when food is so scarce, feed the meat to the hungry survivors.

I sometimes think of the Arctic as a great, formless creature, waiting grimly and patiently for man to make a mistake that will betray him. One day I made such a mistake, though luckily it cost me only severe frostbite instead of my life.

I had moved out ahead of the toboggan teams to reconnoiter the trail on skis. After an hour or so I suddenly realized that I had gone too far—I could hear not even the faintest sound of men or dogs. The wind, which blew so often out of the southwest behind us, should have carried the sounds more than a mile. I turned into the wind and began to

Wind-frayed Stars and Stripes and welcome handshakes greet the author beside the radio mast at Arlis II. But the expedition arrives too late. Threat of spring storms and breakup of polar pack forces the turnback 200 miles short of the Pole. United States Air Force supply planes flew the assault team back to Greenland.





BACKGROUND BY SIGMUND STRAIN NORTH POLE EXPEDITION © NATIONAL GEOGRAPHIC SOCIETY

behind them, expedition members trudge at last over the snow blanket into Arlis II.

backtrack, and then suddenly a screen of swirling snow enveloped me. My earlier ski tracks in the light snow blanket over the ice had been swept away, and I could only crouch low, searching for the small pits in the ice made previously by my ski poles.

I needed both hands on my poles to steady myself and fight the wind, which now caught me full in the face. The frostbite on my face grew worse, a firebrand drawn across my cheeks and nose. But I could spare neither a hand nor time to protect myself.

Finally, through the cotton-wool screen of fog and flying snow, I heard the dogs yapping across the ice ridge that had halted the expedition. I was safe, but I was to wear the mark of my error for weeks—a painful and outlandish green-and-black nose.

Sea Ice Begins to Break Up

Arlis II was now less than 100 miles away, and at last the leads caught up with us. One morning we came to an innocent-looking sliver of water.

I crossed it easily on skis, but then it turned "active," opening and closing with the force of the wind and currents. It began to widen, and I got back just in time, skiing over small ice floes that formed steppingstones in the dark open water.

As the men came up, the lead widened farther, forming a half-mile-wide water barrier stretching out of sight. Without the plastic boats, we had no hope of crossing. We could only camp until the lead closed or froze over.

"Half rations again," I announced wearily, and we settled down to outwait the big lead.

We camped 24 hours. Then the lead began to close. The icy jaws met at last with a sound like a thunderclap.

"*Huk, huk!*" we shouted to the dogs, and in a moment were safely on the other side—or so we thought. Only when I rounded a small ridge in front of us did I realize that the ice had trapped us—we had merely stepped onto a large floe now drifting into the center of the still-widening lead.

The worst dangers are those about which one can do nothing. For two days we drifted helplessly on the floe. Had a sudden storm come up, it could have capsized our ice raft or ground it to grael beneath our feet.

Dogs can take such a dunking at 40° or 50° below zero and recover if run at a brisk pace. But with a man, the only hope is to pitch camp at once, change clothes, and take refuge in a sleeping bag. If tents and bags get a soaking, too, they become solid lumps of ice—and so, very quickly, does the man.

At the end of our two-day vigil, the floe headed for the northern shore of the lead. As it touched, we yelled once more to the dogs. They were afraid at first and fought our efforts. Some took a painful plunge in the slush. At last we picked up speed and went skimming over newly formed ice hardly thicker than heavy plate glass.

Our speed provided the margin of safety; a moment's stop would have brought disaster. Several times I glanced behind me and saw the ice actually sagging beneath the weight of a man and his team, so that their feet were all but hidden from my sight.

The day came when we should sight Arlis II, if Steinar Laugen had calculated correctly. We were prepared for a miss. If we did not sight the ice island by evening, we would begin a methodical crisscross of an area of about ten square miles. What we were searching for in the flatness of a gray Arctic day



End of the trail for the expedition, remote Arlis II supports the Western Hemisphere's northernmost outpost. Pennant at right marks the drifting ice island's highest point, 41-foot Black Flag Hill. Lowell Thomas, Jr., put down his rifle (left) while he made this dramatic photograph during an Arctic assignment for NATIONAL GEOGRAPHIC in the

was not technically a floe but a larger, much thicker expanse of ice that had broken from a continental shelf, perhaps a century ago, and had been adrift in the Arctic Ocean ever since. We would recognize it by the few snow-bound huts on its surface, homes for a dozen scientists and men.

Over the radio the night before, Tor Lundstrøm had promised to fire a signal flare every hour on the hour, beginning at noon. As each hour approached, we climbed towering ice blocks to search for a flare on the horizon—nothing. Our hopes of a direct hit began to dim.

At six o'clock that night Egil Selnes and I stood on a small ice peak, scanning the horizon. The hour passed again, with no welcoming rocket. I climbed down, grimly determined to begin the painful crisscross search. As I reached the bottom of the ice tower, the overcast suddenly parted, and sunlight flooded

the ice for a mile around us. Egil danced on the peak above me, threatening to tumble 20 feet straight down.

"There it is—I see it! Arlis II!" Egil belted, and we all scrambled up beside him. And there it was indeed, not a cluster of huts but the splash of orange on a parked plane. As we watched, the overcast closed in again, and the fleck of color vanished. No matter now. I had a compass bearing. After 41 punishing days in the ice, Arlis II was ours.

Cook Grumbles, But Keeps His Promise

We arrived that evening, May 8, at ten o'clock, and the Arlis crew welcomed us warmly. Ben Pedersen, the Arlis cook, who had promised us over the radio to have a steak dinner waiting, was not to be denied a chef's right to grumble. "Where have you been?" he asked, shaking my hand reproach-



REAR VIEW © NATURE SCIENCE SOCIETY

winter of 1962. By the spring of 1964, the island had drifted nearly 1,000 miles across the top of the world, from the East Siberian Sea to a point north of Greenland (map, page 156). Boulders in foreground traveled with the ice since it broke away from a distant coast, perhaps Ellesmere Island, as much as a century ago.

fully. "Dinner's been waiting for two hours."

We had reached $86^{\circ} 31'$ north latitude, farther north than Fridtjof Nansen on his polar trek, and farther north on foot than anyone we know of since Robert Peary, but we could not go on. Spring had broken winter's grip on the Arctic, and great stretches of open water lay between us and the Pole. To make a dash for it now would endanger not only ourselves but those who might have to rescue us. Our old friends the U.S. Air Force flew us from Arlis to Thule, where we caught a commercial flight home.

Now that it is over, what have we learned? Were we realistic in our hope that men could challenge the icy chaos of the Arctic by traveling on foot from one hemisphere to the other across the top of the world? The answer is yes—it can be done.

Will it be done? Again, I believe so. Even

for the indomitable Peary, success lay only in a long sequence of efforts, each of which held its valuable lessons. For our part, we learned that over smooth sea ice, skis outdo snowshoes for speed and safety. The terrible coastal ice at Ellesmere Island taught us other lessons: patience—the patience to wait for an ideal winter—and the wisdom of an early start.

Why challenge the Arctic Ocean on foot at all, when aircraft and nuclear submarines effortlessly explore its vast reaches? One might answer with another question: Why set foot on the moon, when telescopes and space probes can map its surface? The key to both questions, of course, is man's restless urge to go and see for himself.

Whether one succeeds or fails, the urge remains, and of one thing I feel certain—one day it will lead man on foot across the top of his world.

*South American oilbirds navigate by echo
in the blackness of their cave homes*

Birds That "See" in the Dark With Their Ears

By EDWARD S. ROSS, Ph.D.

Photographs by the author

WE HEARD THE CAVE before we saw it. Climbing hand over hand up a towering cliff in the Peruvian rain forest, we were met by a wild, undulating chorus punctuated by demonic screams.

Had we not been braced for the fiendish din—this was a follow-up to a visit I had made here 10 years earlier—we might have beat a terrified retreat. As it was, I watched with amusement the surprise and alarm on the faces of my 14-year-old son Clark and my longtime friend H. Vannoy Davis. The racket, I assured them, was the normal domestic pandemonium of our quarry, the unique *guácharo*, or oilbird.

Its scientific name, *Steatornis caripensis*—in translation, "the oilbird of Caripe"—was bestowed by the celebrated German naturalist-explorer Alexander von Humboldt, who encountered the noisy species in 1799 in a cave near Caripe, Venezuela. The local name, *guácharo*, is a Spanish word meaning "one who cries and laments."

The Author: Though his subject here is a fascinating bird, Dr. Edward S. Ross is best known as Curator of Entomology at the California Academy of Sciences in San Francisco. His specialty, a little-known order of web-spinning insects, the Embioptera. On expeditions supported by your Society to Africa, to India and Southeast Asia, and to Australia, he has discovered hundreds of species of embiids previously unknown to science.

On a wide-ranging insect-collecting trip through South America, we had driven across the Andes to the upper reaches of the Amazon River. We could not pass up the chance this gave us to visit the misnamed Cueva de las Lechuzas—the Cave of the Owls—overlooking the Monzón Valley near the remote Peruvian town of Tingo María (map, page 284). Natives of the region erroneously call the noisy oilbirds owls because of their large eyes and nocturnal habits.

Birds Give Indians Oil for Cooking

Actually, the long-whiskered oilbird is an outsize and distant relative of whippoorwills and goatsuckers. But unlike its insect-eating kin, the *guácharo* feeds only on the fruits of forest trees, chiefly palms and laurels. This diet gives the young birds an exceptionally high body-fat content.

Despite protective efforts, most known oilbird caves are regularly raided by Indians or local farmers, who rob the nests of young *guácharos*. They boil the squabs to render fat for cooking—hence the name oilbird.

The *guácharo* gathers its fare in long nighttime forays across the jungle. With its strong curved beak, the bird snatches fruit while fluttering before laden branches. With crop full, the adult may fly back to its nest four or five times during the night to regurgitate food into the mouths of the young. Before dawn,

Wings a Halo, Tail a Fan, an Oilbird Hovers in Mid-air Like a Helicopter

Hawk-size *guácharos*, as oilbirds are known in South America, possess a smug sense shared among known birds only by Southeast Asia's swiftlets, though common among bats. Cave dwellers, they bounce echoing clicks from rock walls to help them navigate in the ink-black vaults where they nest by the hundreds. A three-foot wingspread makes them masters of flight maneuverability, capable of a quick lift, a short turn, or a stationary flutter, as this bird shows. Such power enables oilbirds to fly slowly and carry large quantities of palm and laurel fruit, their principal diet.





Owl-like eyes help the nocturnal oilbird see in the darkness of its cave home and on food-gathering forays in the jungle night. Long whiskers projecting ahead of the hooked beak may aid the bird's sense of feel.

Stygian lair of the oilbird: the Cave of the Owls near Tingo Maria, Peru. Water oozing from the ceiling created the draperies of stalactites. Broken pottery and stone axe-heads reveal that man has known this grotto for more than 3,000 years.

Inside the cave, birds swoop and wheel amid continual screeches. They sound like "a thousand mud ducks shut up in an iron boiler," says the author. At dusk, birds pour forth, returning with food for the young.

Avian denizens of the dark inhabit mountainous areas of South America and Trinidad.

ARTIST: ILLUSTRATION BY JIMMY J. SMITH AND TERRY LUTZ



all the birds have returned to the blackness of the lonely caves where they roost and nest.

Scrambling over huge boulders, we reached the cave's vine-draped mouth and entered the high-vaulted outer room. Flocks of small green parrots complained loudly as they flew from nests hidden in rocky niches overhead. With the alarm, the oilbird chorus grew even more shrill, yet still we saw none of the birds themselves.

"It sounds as if all the foxes in the world were chasing all the hens," said Van Davis.

Beyond, deeper within the cave, our boots crunched on a thick bed of dry seeds. The cavern was like a mighty horn of plenty, spewing forth great drifts of fruit kernels. Obviously these were the seeds, or pits, cast aside by generations of guicharos.

Only the thin outer flesh, or pericarp, of the fruit is eaten, and one by one the seeds are



expelled from the birds' exceptionally large mouths.

The accumulation literally crawled and pulsated with life. The molelike burrowing of four-inch-long cockroaches, some of the largest in the world, caused the surface to surge before our eyes. Uncountable hordes of beetles, larval and adult, busily gnawed at the seeds. Skittish tailless whip scorpions used their 18-inch span of antennalike front legs to track down their favorite prey, an abundant cave cricket.

Cave Sheltered Man for 3,000 Years

Amid the cave-floor debris we spotted abundant relics of ancient human occupancy. During my earlier visit, we had picked up a small collection of pottery fragments and several stone axeheads. Dr. Donald W. Lathrap of the University of Illinois and a colleague, Lawrence Roys of Moline, Illinois, made a

study of these finds and others collected from the cave.

The scientists reported that the materials provided a rare link between ancient highland and lowland Indian cultures. The pottery was related to two separate periods, 1500 B.C. and after A.D. 1000.

Our light threw weird mobile silhouettes on the cavern walls. Climbing a great mass of fallen rock, we came upon ghostly stalagmites rising from terraced pools of clear water.

At this point we saw the first oilbirds—brown, broad-winged creatures wildly swooping out of the darkness, wheeling in the dim light, and vanishing into the gloom. As they turned, they shrieked and squawked, but in direct flight they voiced evenly spaced clicks—sharp, snapping sounds.

These peculiar clicks serve as navigation echo guides, much as ultrasonic chirps aid the flight and food gathering of most bats.





The birds bounce the sounds off confining walls, gauging clearance by the time of return to their ears. While the chirps of bats are usually inaudible to man, oilbirds' clicks are well within the range of human hearing.*

The guácharo is one of only two birds known to use this sonarlike echolocation technique; the other, more recently studied, is the Southeast Asian swiftlet, genus *Collocalia*, whose nests are prized for bird's-nest soup.

To prove that sound reflection is indeed the means by which oilbirds guide their flight in the dark, Donald R. Griffin, then of Cornell University, and William H. Phelps, Jr., of Caracas, Venezuela, once captured several birds from a Venezuelan cave, allowed them to fly about in a dark enclosure, and noted that they never collided with the walls.

Then they plugged the birds' ears. The guácharos became completely disoriented and continually bumped against the walls.

As we worked our way deeper into the cave, the squawking and screeching became almost deafening. The cavern suddenly expanded into a huge room. The stale air moved refreshingly, stirred by the beating wings of the birds and of bats that share this underworld. We tilted and turned our lamp. What

* See "How Bats Hunt With Sound," by J. J. G. McCue, April, 1961, *Geographical*, and "Mystery Mammals of the Twilight," by Donald R. Griffin, July, 1946.

Crevice in a cliff provides a nesting site. Birds jealously guard such ledges, which are relatively scarce for the large population of the cavern.



we saw exceeded our wildest expectations.

We stood as dwarfed intruders in a huge circular, rock-walled auditorium more than 200 feet across and perhaps 100 feet high. The cave was filled with sound and confusion. While scores of birds spiraled high above, hundreds more squatted contemplatively on high nesting ledges.

On the ledges the birds moved in a crouched, rather awkward diagonal or sideward waddle. But in flight the guácharos were artists. With skillful use of their wings and tails, they wheeled in tight circles or fluttered in one place (page 290).

Before getting to work, the boy in us caused us to let loose Indian war whoops to see what would happen. Bedlam ensued. Beating wings added to the din of the birds' cries, and our upturned faces were splashed with droppings and pelted by seeds swept from the ledges as birds took off.

"How in the world do we get up to the nests?" asked Clark.

No nest or perch was accessible from the floor. Those within reach of crude log ladders set up by the Indians were not worth visiting: Repeatedly robbed of squabs, they had been abandoned by their occupants.

But a decade ago I had pioneered a route that ascended the great fall of ceiling rock blocking the end of the cave. Now we found it—a series of precarious toe- and handholds leading up the 80-degree slope.

As we climbed, we tried not to think of our plight if our single lantern should slip from grasp and shatter down the cliff, leaving us marooned on the ledge in total darkness!

"Secret" Route No Secret to Indians

Eventually we found ourselves uncomfortably perched like oilbirds almost 100 feet above the cave floor. We could look across narrow chasms to nesting ledges and balconies. But what I saw dismayed me.

Ten years ago the eyes of myriad nesting birds had gleamed back at me, ruby red in the lantern light. In temporarily vacated nests I had seen naked nestlings or the normal clutch of two to four white eggs.

A chief reason for my return visit was to rephotograph the guácharo and its extraordinary cave home in color. The earlier trip had been recorded only in black and white.

Imagine my chagrin and disappointment now to discover that my formerly "private" access to the nests had been found by the

Cockroach feasts on seeds in the Tingo Maria cave, whose roaches, up to 4 inches long, rank among the world's biggest. After gobbling fruits on night flights, oilbirds return to their cave to digest fleshy parts and regurgitate the seeds. Decaying refuse rises in huge drifts on the cave floor and supports a host of insects.

Fringed mushrooms grow beside an oilbird eggshell in the cave's uniform 68° F. temperature and high humidity—ideal conditions for raising fungi.

Doomed forest of palm and laurel rises from seeds dropped by oilbirds. For a time, they thrive on nutrition stored in the kernel. But deprived of sunlight, the plants soon wither and die. Here the author photographs the webbing of tiny spiders.





Agate-eyed in Camera's Flash.
Otilbirds Hoost Amid Palm Seeds

Male and female take turns incubating eggs and stuffing fruit into insatiable young. Nestlings may weigh half again as much as their parents by the 70th day, then begin to slim down.

PHOTOGRAPHS BY NADINE E. DEWEE AND SA





Indians raid nests and boil squabs for fat; thus the name oilbird. Peru now protects Tingo Maria's cave.



Indians. The chasms were bridged by logs, and the birds' sanctuary had been recently robbed. Only empty, eroded, cuplike nests remained.

Inviolable nests were within sight at a little distance, but out of range of our flash equipment. For this reason, many of the accompanying photographs were made in another cave, a smaller one we visited in Trinidad, at the northern limit of the oilbirds' range (map, page 284). The guácharo, wherever found, is the same bird. There is only one species, and it occupies a genus and family all its own in the order Caprimulgiformes.

The oilbird remains the subject of many questions. Ornithological literature records only a few, often widely separated cave homes from Peru and Colombia to Venezuela, British Guiana, and Trinidad. Its Andean range is largely unexplored, and doubtless there are many unrecorded colonies known only to the Indians. Some, we may hope, are forever unreachable by man.

Slip in Darkness Brings a Near Tragedy

Despite the inroads we discovered in the Cave of the Owls, there seems little danger that its oilbird colonies will be completely exterminated. Most of the nesting ledges are at inaccessible heights, probably permanently out of reach of the Indians.

For us, our watches gave warning that it would soon be as dark outside the cave as in. Apprehensively, we began the descent of the bare, slick cliff. As we backed down in our own shadows, young Clark, being the most agile and sure-footed, led the way. I took the middle, and Van Davis followed. Not a hand moved from crevice or crack until a foothold was firm.

Suddenly the worst happened: Van Davis's feet slipped and down he slid, falling past me on his way to almost certain death.

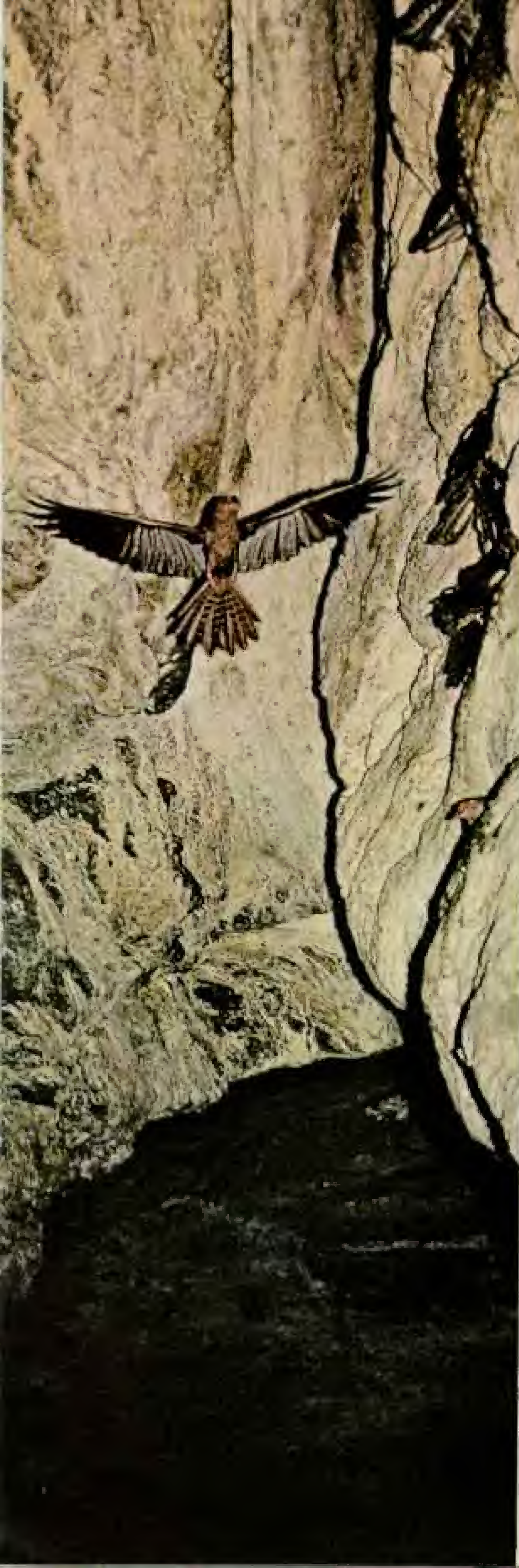
"Oh, no!" "Watch out, Clark!" Van's exclamation and my warning to my son below rang out together.

I happened to have a pretty good grip with my left hand on a thumblike stalagmite. Van instinctively caught my extended right arm. Both of us were on the brink of tumbling down the cliff together. But my footholds and hand-grip held, and Van stopped.

Clark guided Van's toes to a crack and, after pausing for breath, we made it the rest of the way down.

Outside the cave, in the late afternoon light, all of us were dazzled by the beauty of a great forest tree in full red bloom. We felt as prisoners must feel when released from a dungeon.

We ended our day watching the evening flight of the oilbirds from their cave. Already at 5:30 the birds were stirring about the outer room. As twilight dimmed, a few darted out of the cavern, as if to test the light, and then returned. Then emerging bats started to whiz by us in great numbers. By 6:00 the oilbirds began to leave the cave en masse, continuing for a full half hour. Hundreds of birds passed overhead. As soon as they were clear of the rocky entrance, the guácharos' sonar clicks ceased, and the birds became silent silhouettes darting out over the forest.



Adroit aerialist, an oilbird hovers in a rocky crypt in Trinidad, also visited by the author.

Oscillograph squiggles show the clicking sounds made by a bird flying in darkness. Four clicks, shown by elongated lines, occurred in $\frac{1}{100}$ th of a second; this many clicks in so short a time indicate that the bird is nearing an obstacle. When scientists experimentally plugged birds' ears with cotton in a dark room, they crashed into the walls.

REPRODUCTION BY EDWARD L. BOES; DONALD R. BRITTON (LEFT) © N.A.S.



Back at the village hotel, Clark said, with a touch of youthful bravado, "Well, I wonder who will be first to come down with Tingo Maria fever."

This is the local name for a debilitating, painful malady contracted by many visitors—local and foreign—to the oilbird cave. During our first visit, my wife entered the cave only briefly. A month later she fell victim to a strange fever accompanied by severe chest pains. Fortunately she recovered promptly.

Soil samples from the cave studied by medical investigators yielded cultures of *Histoplasma capsulatum*. This fungus causes histoplasmosis, a disease prevalent in other regions, including parts of the United States. The fungus has been isolated from soil contaminated by starlings and chickens. Humans contract the disease by inhaling dust containing histoplasma spores. In serious cases, it produces lung involvement resembling tuberculosis. Some individuals—and I seem to be among the lucky ones—show less reaction or none at all, perhaps through resistance developed after an undiagnosed encounter during youth.

Luckily, none of us on the second trip caught the fever. Nevertheless, the risk of disease is the price one must pay to see and hear the oilbird. We who escaped thought the strange show—played out amid shrieks and shadows—well worth the price of admission.

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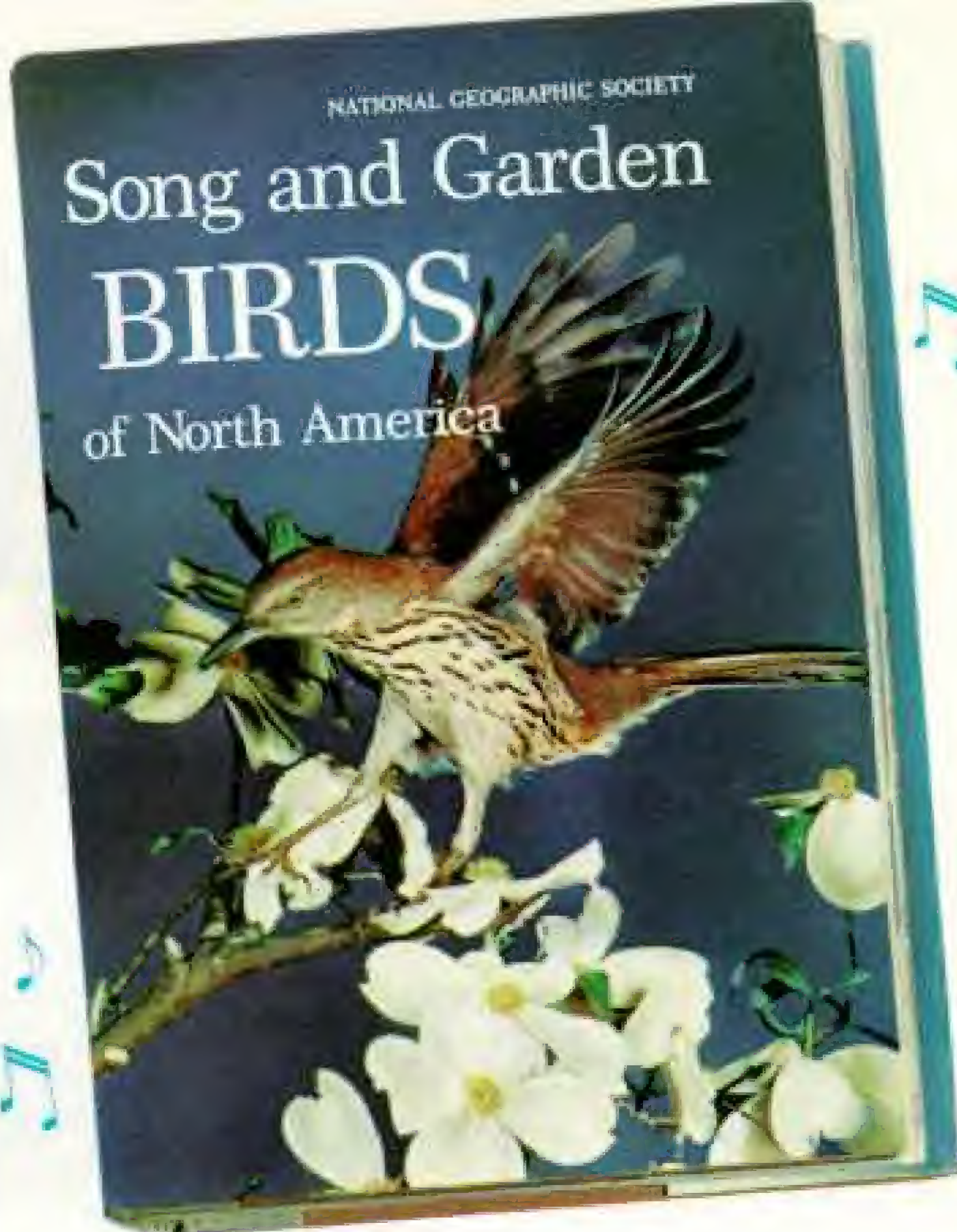
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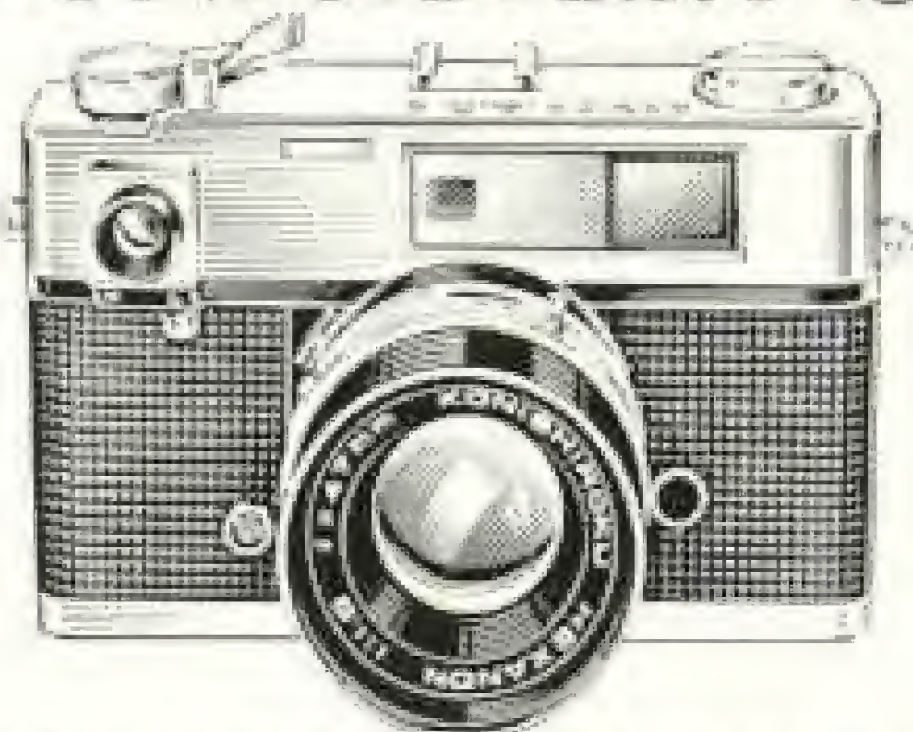
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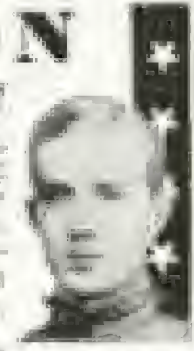
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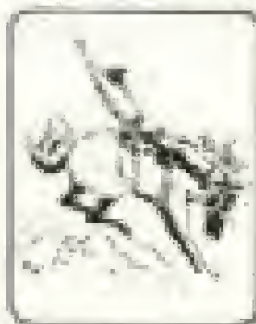


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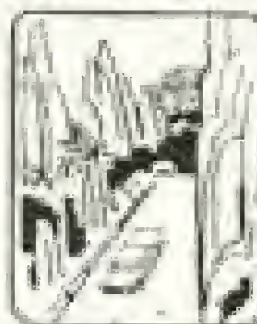
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