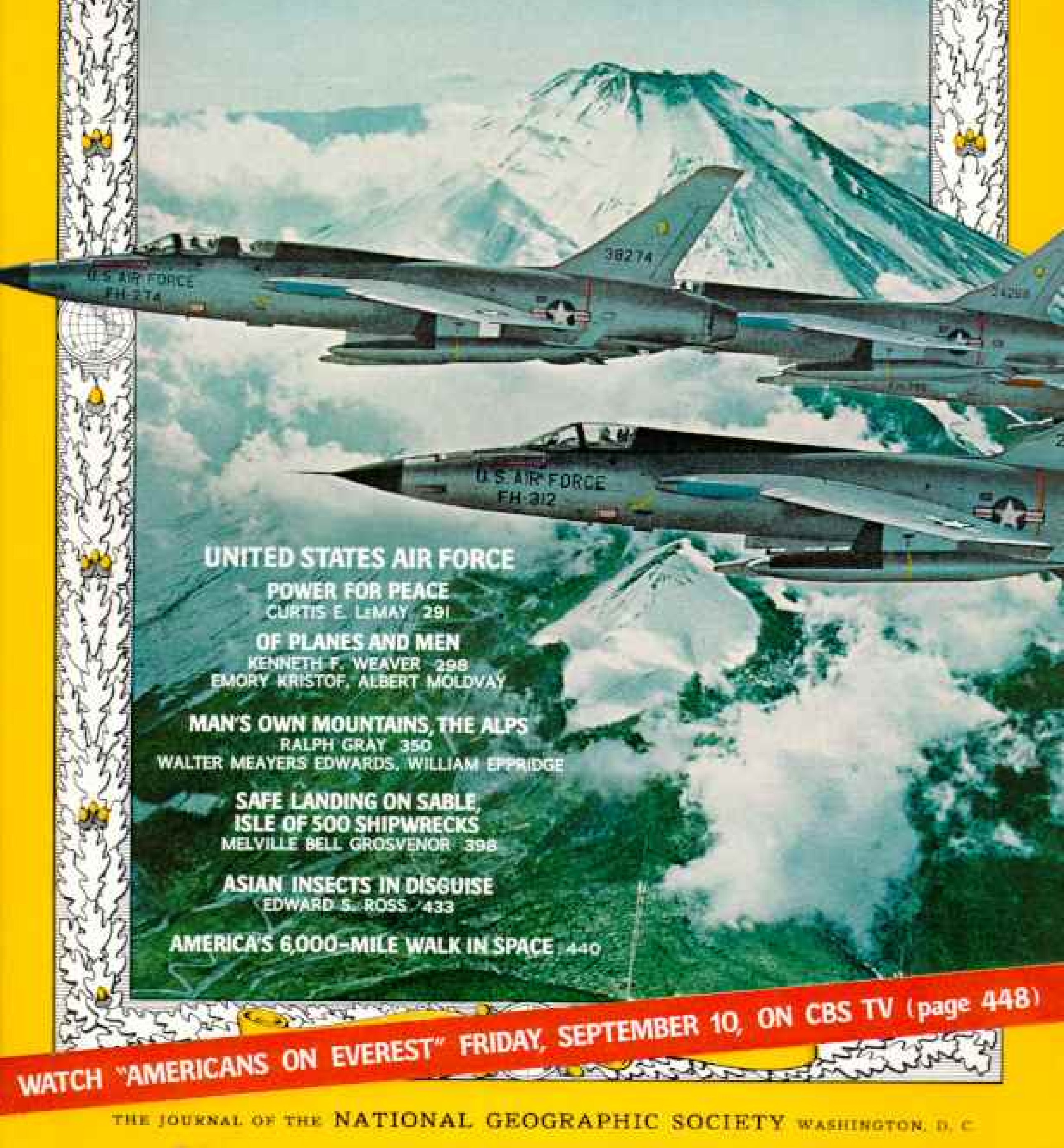
ATLAS MAP SUPPLEMENT: SWITZERLAND, AUSTRIA, AND NORTHERN ITALY (page 396)

VOL. 128, NO. 3 SEPTEMBER, 1965

NATIONAL GEOGRAPHIC



WATCH "AMERICANS ON EVEREST" FRIDAY, SEPTEMBER 10, ON CBS TV (page 448)

THE JOURNAL OF THE NATIONAL GEOGRAPHIC SOCIETY WASHINGTON, D. C.

NATIONAL GEOGRAPHIC SOCIETY

WASHINGTON, D.C.

Organized "for the increase and diffusion of geographic knowledge"

The National Geographic Society is chartered in Washington, D. C., in accordance with the laws of the United States, as a nonprofit scientific and educational organization for increasing and diffusing geographic knowledge and promoting research and exploration.

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Articles and photographs of travel, natural history, and explorations to far places are desired. For material used, generous remuneration is made.

COVER: F-105 Thunderchiefs streak past Fujiyama on their way to Yokota Air Base, Japan (pages 292-3).

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DATECHNURE BY BARON HUGO VAN LAWICK © NATIONAL GEOGRAPHIC SOCIETY

Geographic committee meets a research subject

FRIENDLY CHIMP in Tanzania's Gombe Stream Game Reserve calls on zoologist-in-residence Jane Goodall for a banana. With her husband, Baron Hugo van Lawick, she studies chimpanzee behavior in the wild; now the chimps accept them as fellow apes.

Dr. Leonard Carmichael (left), Chairman of the National Geographic Society's Committee for Research and Exploration, Dr. Melvin M. Payne, Executive Vice President of the Society, and Dr. T. Dale Stewart, Director of the Smithsonian Institution's Museum of Natural History, traveled to Europe and East Africa with other committee members for on-the-spot appraisals of this and other Geographic-sponsored programs. In Tanzania, Dr. Louis S. B. Leakey led a tour of his early-man digs at Olduvai Gorge. In Kenya, Cynthia Booth described her study of monkeys at the Tigoni Primate Research Centre. In Monaco, Jacques-Yves Cousteau outlined his undersea research.

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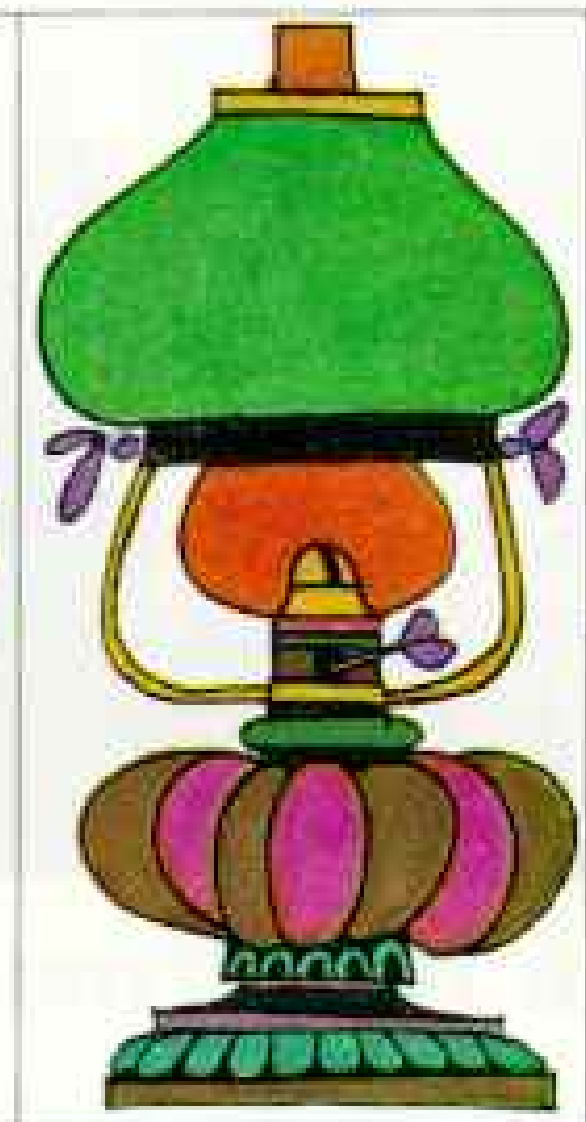

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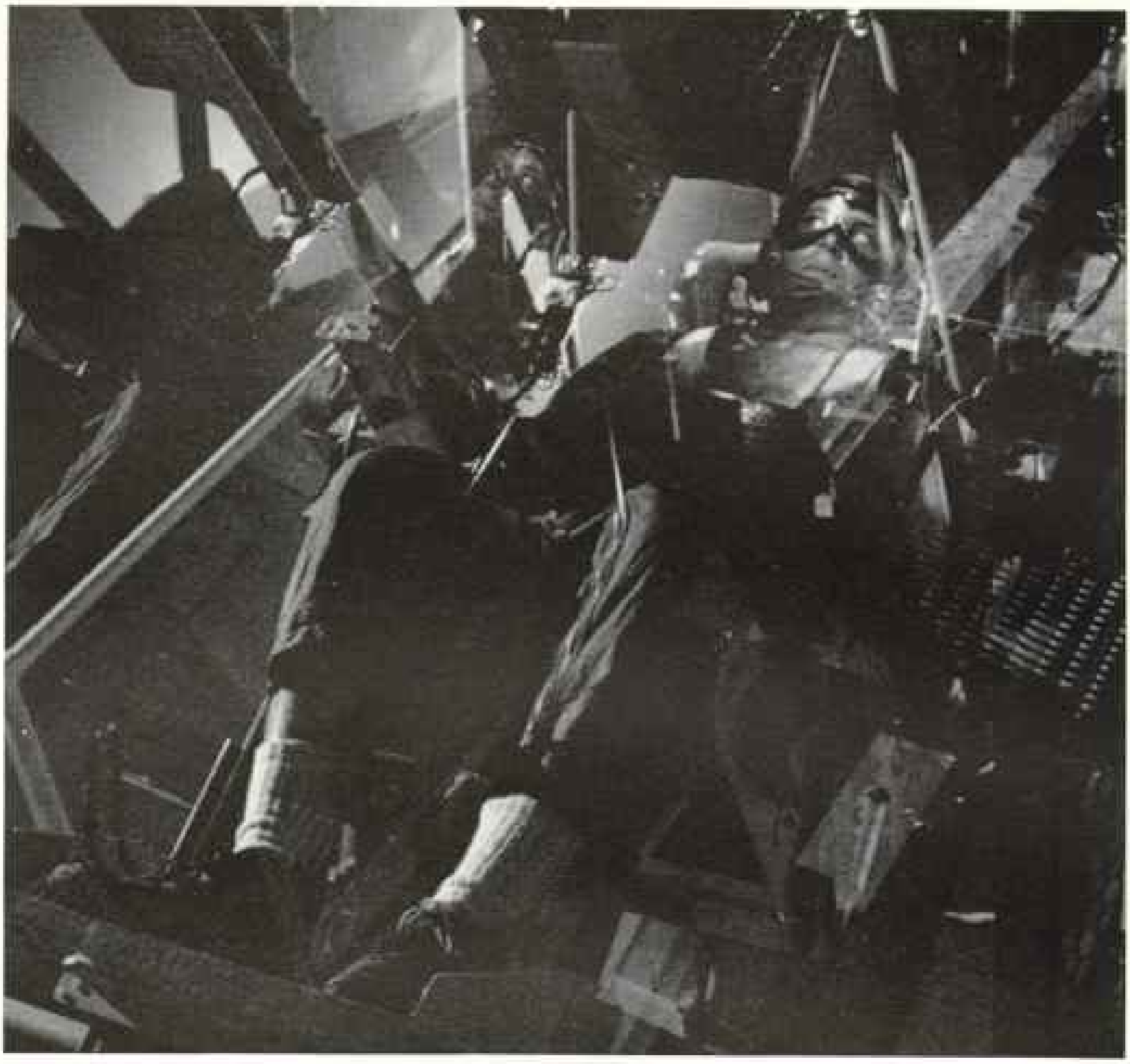

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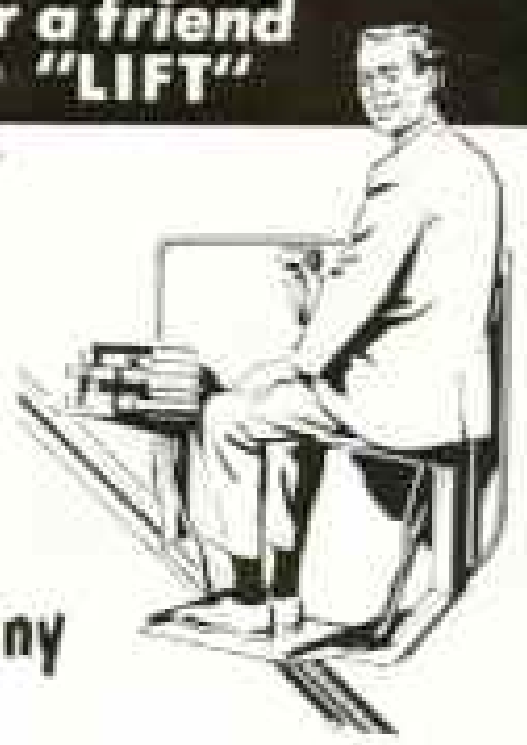

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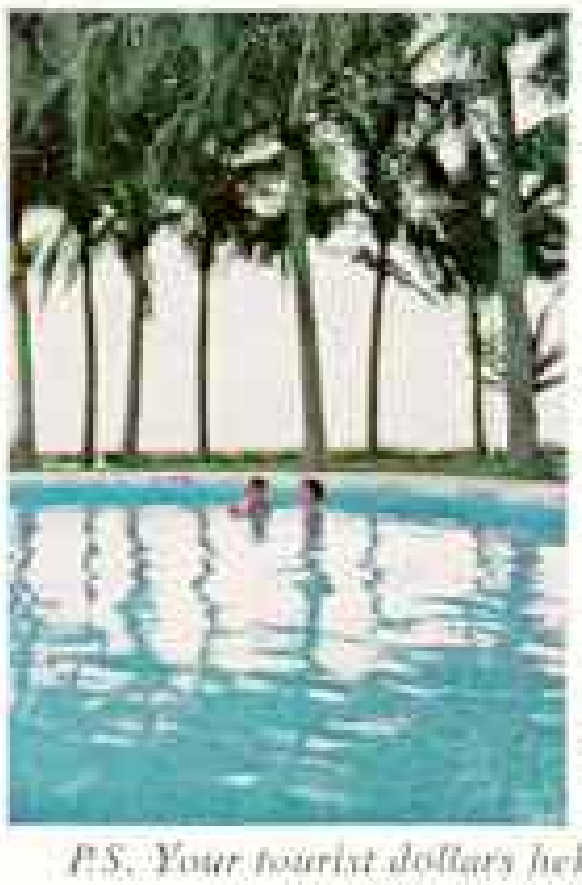

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September, 1965

NATIONAL GEOGRAPHIC

U. S. Air Force: Power for Peace

By GEN. CURTIS E. LEMAY
Chief of Staff, United States Air Force, 1961-65

IN 1910, scarcely more than half a century ago, a young Army lieutenant took flying lessons by mail from two brothers named Wright. Benjamin D. Foulois and 11 men, with a cracked-up biplane and a budget of $150 for four months, constituted the first United States "air force." *

The youthfulness of American military air power—and the efficacy of that correspondence course in flying—can be measured by the fact that Benjamin Foulois is still alive and active, retired as a major general and former Chief of the Army Air Corps.

Fledgling Corps Grows Into a Giant

My own memories do not go back quite so far—I became an air cadet in 1928. But I have seen transformations leading to the present Air Force that almost defy belief.

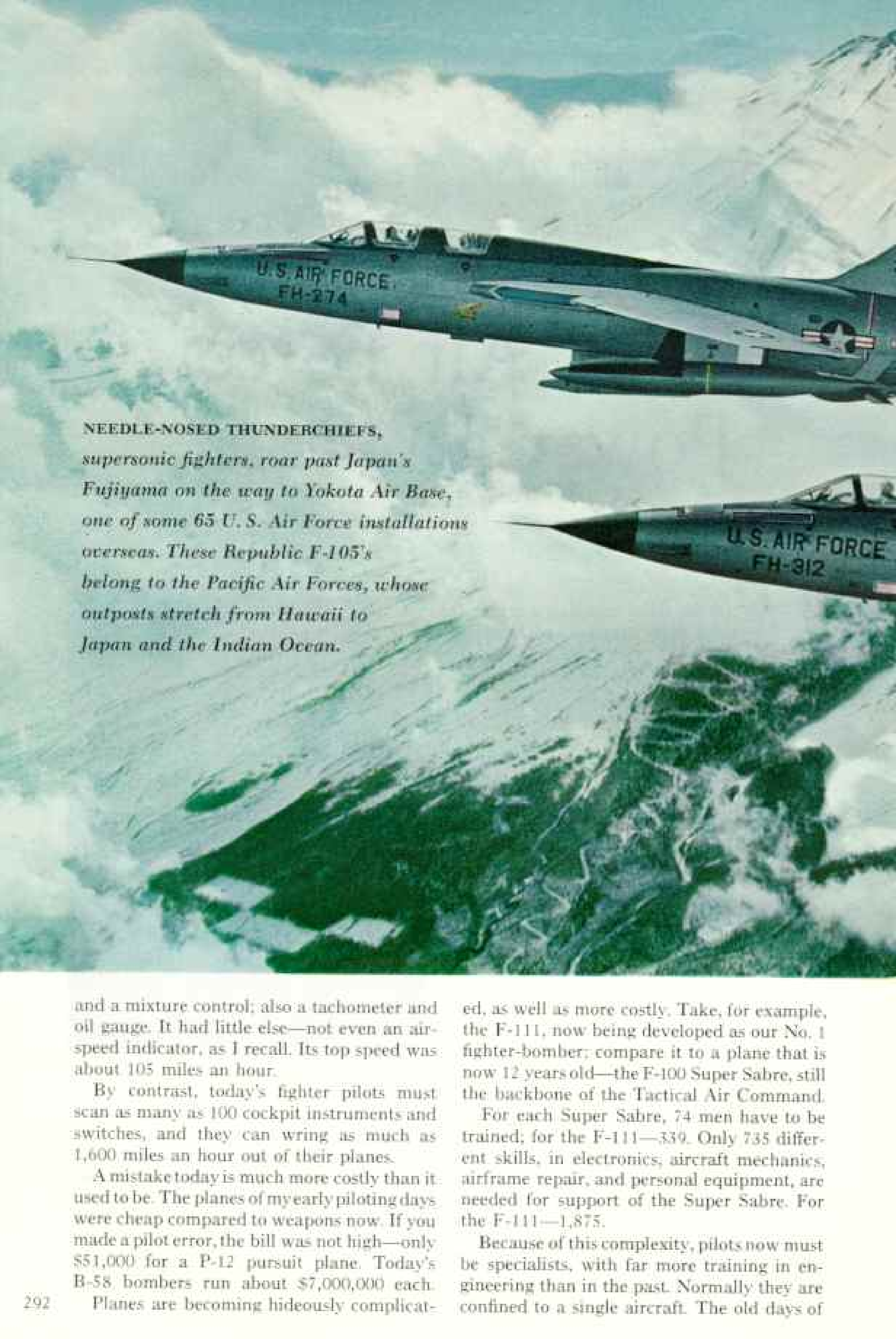
What General Foulois started in 1910 had grown by 1928 to an organization of some 11,000 men and 1,100 planes, and a budget of about $20,000,000. Since 1928, the Air Force has increased its manpower 75 times, its aircraft 13 times, and its budget nearly a thousandfold!

With this growth in size has come complexity. The first craft I flew, a training plane known as the PT-3, had a stick and throttle

*See, in NATIONAL GEOGRAPHIC: "Fledgling Wings of the Air Force," by Thomas W. McKnew, and "History Written in the Skies," both August, 1957; and "Fifty Years of Flight," December, 1953.

PHOTOGRAPH BY ROBERT S. OAKES, NATIONAL GEOGRAPHIC STAFF © N. G. S.

The Author: Gen. Curtis E. LeMay, here holding a model of the new F-111 variable-sweep-wing fighter, retired last February 1 as Chief of Staff, United States Air Force. Indomitable in his belief in peace through strength, General LeMay earned the Nation's gratitude by revitalizing the Strategic Air Command. He recounts a lifetime of distinguished service in *Mission With LeMay*, written with MacKinlay Kantor, to be published in November by Doubleday & Co. ($7.95). For 14 years he has served as a Trustee of the National Geographic Society.



NEEDLE-NOSED THUNDERCHIEFS, *supersonic fighters, roar past Japan's Fujiyama on the way to Yokota Air Base, one of some 65 U. S. Air Force installations overseas. These Republic F-105's belong to the Pacific Air Forces, whose outposts stretch from Hawaii to Japan and the Indian Ocean.*

and a mixture control; also a tachometer and oil gauge. It had little else—not even an airspeed indicator, as I recall. Its top speed was about 105 miles an hour.

By contrast, today's fighter pilots must scan as many as 100 cockpit instruments and switches, and they can wring as much as 1,600 miles an hour out of their planes.

A mistake today is much more costly than it used to be. The planes of my early piloting days were cheap compared to weapons now. If you made a pilot error, the bill was not high—only $51,000 for a P-12 pursuit plane. Today's B-58 bombers run about $7,000,000 each.

Planes are becoming hideously complicated, as well as more costly. Take, for example, the F-111, now being developed as our No. 1 fighter-bomber; compare it to a plane that is now 12 years old—the F-100 Super Sabre, still the backbone of the Tactical Air Command.

For each Super Sabre, 74 men have to be trained; for the F-111—330. Only 735 different skills, in electronics, aircraft mechanics, airframe repair, and personal equipment, are needed for support of the Super Sabre. For the F-111—1,875.

Because of this complexity, pilots now must be specialists, with far more training in engineering than in the past. Normally they are confined to a single aircraft. The old days of

one pilot flying three or four different kinds of plane are gone.

Yet, in another sense, a pilot must be far more than a specialist. Today an Air Force officer may find himself in a 1,600-mile-an-hour aircraft one day; in a staff planning conference another; in a laboratory the next day; and at a diplomatic conference the day after.

Historic Mission: "Find the *Rex*"

In my early days, instrument flying was unheard of. The crews controlled flight management. We ran out, jumped into a plane, and if it had gas, we took off. Today a pilot never climbs into a plane without detailed planning, and the planning takes more time than the flying.

In the early '30's, communications and operations took most of my time. I ran a navigation school for a while. When we got the first Boeing B-17's—bombers that later won fame in World War II (page 297)—we needed long-range navigational techniques, and adopted the bubble sextant, a modification of the shipboard instrument. It bounced around and gave false readings, so we had to take a number of readings and average them. We used slow shipboard methods of solving celestial triangles. We often needed 40 minutes to compute a line of position. (Contrast

that with today's automatic octant and computer that give a position immediately!)

But improvements came fast. In the spring of 1938, as an exercise during Army Air Corps maneuvers along the east coast, we received orders to find and intercept the Italian ocean liner *Rex*, some 700 miles out in the Atlantic.

Our fledgling air arm had been seeking just such an opportunity to demonstrate the capability of its long-range bombers. Three B-17's were detailed to conduct the search, and I was assigned as navigator in the lead aircraft.

We took off early on the morning of May 12, with little information about the position of the *Rex*. The weather was poor and rapidly becoming worse. This was at best a difficult mission, and pressure on the crew was not reduced by the fact that there was aboard my aircraft an NBC radio reporting team with a nationwide news broadcast scheduled for 12:30—based on my estimate of the time we would intercept the liner.

Perhaps you can imagine our state of mind. We were fighting for the recognition of air power as an instrument of national security. Suppose the *Rex* had been an enemy? Would we be able to find it? What if we failed?

The B-17's droned on. I figured and refigured our time of intercept.

Noon came and went. I revised the estimated intercept to 12:25. The minutes dragged by. Black clouds swirled all about us, more often than not obscuring the sea.

Finally, at exactly 12:25, we passed over the liner. A crew member's shout of "There she is!" almost blasted off our headsets, but no one cared. We had proved our point. We had shown that air power had the potential of protecting the Nation from sea attack.

More important, we had demonstrated the

Newly commissioned, Lieutenant LeMay wears the goggles and leather helmet that marked pilots of the open-cockpit planes of the early '30's. The man who took this picture misspelled the young officer's name.

In a B-29 bombardier's "greenhouse," Dr. Gilbert H. Grosvenor, then the Society's President and Editor, flies with Maj. Gen. Curtis LeMay, just back from Pacific service in World War II. They travel to Rapid City, South Dakota, for the 10th anniversary of the 1935 stratosphere flight of the National Geographic–U. S. Army Air Corps balloon *Explorer II*.

Historic mission achieved: With LeMay as navigator, Army Air Corps B-17's fly 700 miles over the Atlantic to find the Italian liner *Rex*, demonstrating that long-range bombers could carry out precise navigation over long distances. This feat in 1938 was accomplished with none of today's radar or advanced navigational instruments.

U. S. AIR FORCE PHOTOGRAPH

long-range bomber's capability for precise navigation over great distances—a capability that was to prove valuable a few years later, during World War II.

Recently, during the Cuban crisis of 1962, aerial reconnaissance was so good that within 24 hours of getting the go-ahead we had located and were keeping tabs on some 2,000 ships bound for Cuba or in its vicinity.

Air Force Power Exists for Peace

Aside from the phenomenal change in machines, I see a considerable change in the men of the Air Force. I think perhaps the biggest difference between Air Force officers now and 40 years ago is a sense of urgency. When I came in, we were at peace. We felt that if war threatened, there would be time to increase the size of the force and train new recruits.

The Cold War and modern weapons have changed all that. We no longer have time to prepare. We must be ready immediately.

Although the Air Force is geared for instant war, its mission is peace. The men of the Strategic Air Command, which I had the privilege of reorganizing in the late '40's, chose as their motto, "Peace Is Our Profession."

And they really mean it. All too many of the men in the Air Force today experienced combat in World War II and in Korea. They never want to go through anything like that again. That is why these men will accept so many hardships, why they will work 70 and 80 hours a week in the struggle for professionalism and perfection.

As you read the following article by NATIONAL GEOGRAPHIC senior staff writer Kenneth F. Weaver, you will see how the Air Force carries out its belief that the best way to maintain peace is to be stronger than any-

Summit of a career: General LeMay takes the oath as Chief of Staff from Air Force Secretary Eugene Zuckert. Observers at the White House include President Kennedy, Vice President Johnson, former Air Force Secretary W. Stuart Symington (extreme left), and two former chiefs of staff, Gen. Thomas D. White (upper right), and Gen. Carl A. Spaatz (second from left).

one else. It's as true today as it was when George Washington said, "If we desire to secure peace . . . it must be known that we are at all times ready for war."

Technology plays a vital role in maintaining that readiness. If you draw a curve on graph paper representing the performance of the airplane since it was invented about 60 years ago, the curve rises very slowly at first, then begins to soar at a steeper and steeper angle. Right now that curve is shooting straight off the paper. For example, the B-52's engines—and those of all other Air Force jets—have a ratio of thrust to weight of about 5 to 1; that is, the engines have a thrust in pounds five times as great as their own weight.

Backbone of the Air Force: Men

Although it may take ten years or more, our research and development program can now promise engines with a ratio of as much as 15 to 1. This will obviously mean huge increases in range and load. Contractors are already planning the C-5, a wonderful cargo plane that should be able to lift 100 tons from a short runway or carry as many as 600 troops.

Speed, too, is going up rapidly. Operational aircraft have been lagging about a decade behind the experimental rocket-powered X-15, which flies today at more than 4,000 miles per hour.* Therefore, in the decade ahead, we will probably be approaching the X-15's present performance.

When you get to such speeds, fantastic temperatures on the surface of the plane would soften aluminum airframes. New heat-resistant materials are needed, such as titanium, or other metals impregnated with boron fibers. The XB-70, which uses titanium, pipes its fuel on the way to the engine through high-temperature areas to help absorb the tremendous heat of supersonic flight.

We are now in the first crude, early stages of space exploration, about where aeronautics was in General Foulois's early days. No one then could foresee the fantastic weapons and materials we have today, and no one now can really foresee the most valuable things we will find and learn out in space. But we've got to get there and find out, and there's no doubt in my mind that we will.

This is exactly why we will always need manned systems—manned planes, manned spacecraft. Missiles are spectacular and they play their role, but they have no sense of loyalty; they can't think; they can't be recalled.

War is an art, not a science. No one today can say what the next war will be like, or where it will start. If there is a next war, we're going to be surprised. The enemy always tries to surprise you, to catch you off guard. Therefore you must have some weapon systems that are flexible, so that when you are surprised, you can do something about it. The missile is not very flexible, but a man can think and change his mind.

I have always believed strongly in what men can do if they are trained and motivated properly. I remember, during my days at tactical school, listening to a lecture on leadership and discipline. The teacher told of a conversation with a German officer after World War I. The German said that he couldn't understand Americans. They had no discipline. You had to give them orders, and then you had to explain why.

I think the German officer missed the point. It has been my experience that if you explain *why* to an Air Force man, you don't have to give an order. You just get out of the way and let him get on with the job! * * *

His cigar a hallmark, General LeMay attends a reception following retirement ceremonies. One of the Nation's most honored military men, he holds decorations of 20 lands.

Rain of destruction: B-17 Flying Fortresses drop salvos of 500-pounders during a saturation bombing of Hitler's Europe in 1944. In waves of hundreds, Allied planes shattered Nazi war strength with bombing techniques—close formation and simultaneous drops—pioneered by LeMay.

*See "I Fly the X-15," by Joseph A. Walker, NATIONAL GEOGRAPHIC, September, 1962.

Of Planes and Men

U. S. AIR FORCE WAGES COLD WAR AND HOT

By KENNETH F. WEAVER
National Geographic Senior Staff

Illustrations by National Geographic photographers EMORY KRISTOF and ALBERT MOLDVAY

A MILE BELOW ME the red lights of helicopters winked fitfully, like fireflies, in the Vietnamese darkness. Suddenly a parachute flare cut through the night with the glare of a million candles, mirrored in the twisting waterways of the Mekong Delta.

We could just make out the lonely outpost below, but not the stealthy figures of Viet Cong insurgents attacking it. Now fighter planes, guided by the flare, swept across the scene to rain explosives and shells on the guerrillas. An explosion's concussion nudged our plane; I saw an awesome yellow "rose" bloom along a bend in the river. Dashed lines of fire—streams of tracer bullets—stabbed

ENGINES STRAINING, *an Air Force C-123 leaps from a short runway at Khe Sahn, northernmost U.S. outpost in Viet Nam. Guard watches for Viet Cong snipers. Going aloft for the first time, Vietnamese troops (opposite) gasp at the sudden liftoff.*

venomously from the fighters to the ground, and answering streams rose skyward. Some probed toward us, fading out like spent Roman candle balls.

The attackers melted away, but for more than an hour our United States Air Force plane—code-named Smokey Red—circled, dropping 70-odd flares to keep the embattled fort alight (next page). At one o'clock in the morning, our fuel nearly exhausted, we turned the flare mission over to Smokey Blue and headed back to Tan Son Nhut Airport near Saigon, where our patrol had taken off at dusk.

The Fairchild Hiller C-123 Provider in which I was riding is one of the smaller Air

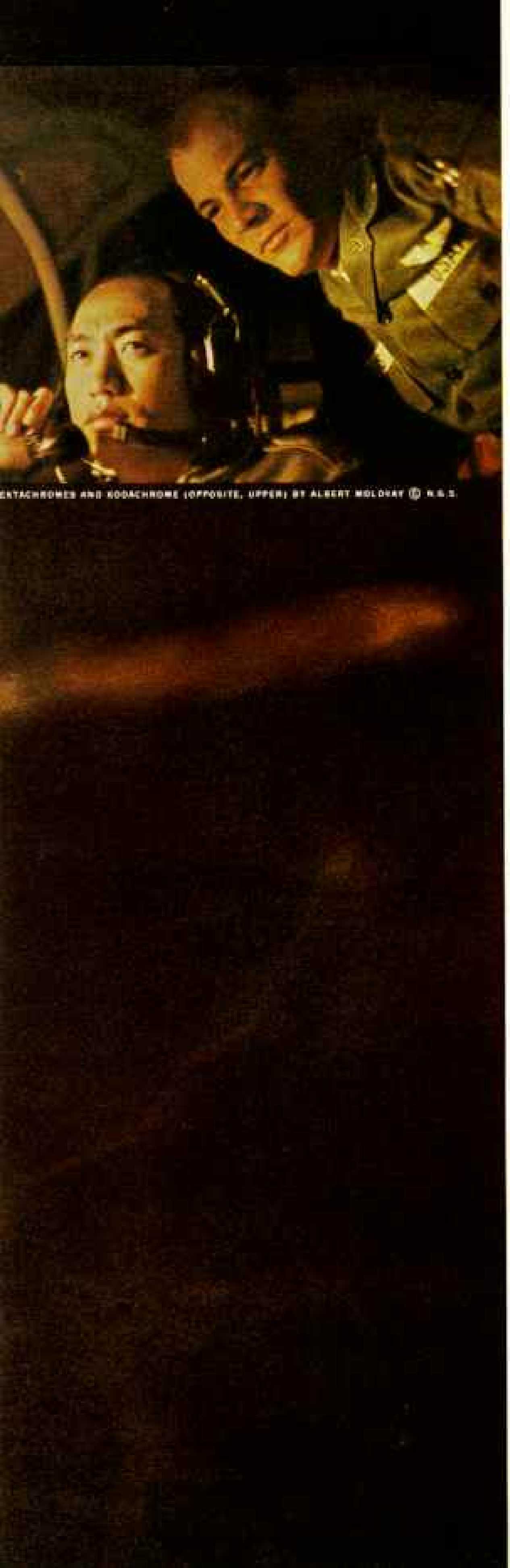
ANSCHÜTZ (ABOVE) AND KODACHROME BY ALBERT MAYSLES © N.G.S.

Night strike over Viet Nam

DRIFTING PARACHUTE FLARES *light a small but deadly battle in South Viet Nam's Mekong Delta. Faint trails lead to a fortified hamlet; its fuel dump, fired by Viet Cong mortars, glows at far right. Streaking tracer bullets from diving Skyraiders zero in on the foe.*

A mile above the battle (left) C-123 crewmen load flares into chutes to be shoved out at the pilot's signal. The magnesium torches, each with a million candlepower, reveal guerrilla moves.

"Where's the enemy?" asks the Vietnamese navigator in the flare plane (right). He radios defenders to learn Viet Cong strong points. U. S. officer directs the Skyraiders.



EKTACHROMES AND KODACHROME (OPPOSITE, UPPER) BY ALBERT MOLDVAY © N.G.S.

Force cargo planes; its twin propellers can drive it no more than 245 miles an hour. And the sturdy Douglas Skyraiders we had watched hurling destruction at the Viet Cong are aging one-engine propeller craft—quite a contrast to today's enormously sophisticated and powerful jet warplanes.

How paradoxical, I thought, that the world's most powerful military organization, possessing nine-tenths of the non-Communist world's striking force, should be fighting so old-fashioned a war, with equipment and techniques that suggest World War II.

And yet that paradox is the most striking fact about the Air Force today. It is—and must be—prepared to wage the entire spectrum of combat, from brush-fire wars, like South Viet Nam's, to global nuclear conflict.

Just how well the Air Force is prepared I have learned in recent months visiting bases in 20 states and nine foreign countries. I logged more than 200 hours in every kind of craft, from supersonic jet fighters and bombers to fire-fighting helicopters.

The Air Force I have seen is a superbly trained fighting organization of men, 828,000 in uniform, and of machines—14,500 aircraft of all kinds, an estimated 800 of which are carrying out missions at any given moment. It operates some 200 installations, a third of them overseas, and spends almost 20 billion dollars a year.

"Teeny-weeny" Line Uses Armored Planes

Among its 20 components, the best known are the four combat commands: SAC, the Strategic Air Command, whose nuclear-armed bombers and missiles deter enemy nuclear attack; ADC, the Air Defense Command, charged with protecting North America from aerospace attack; TAC, the Tactical Air Command, a combat-ready force prepared to respond to any type of hostility; MATS, the Military Air Transport Service, whose fleets of cargo craft can lift men and supplies around the globe. Four theater commands maintain forces in the Pacific, Europe and the Middle East, Alaska, and the Americas (map, pages 314-15).

The remaining groups fill support roles, such as supply and maintenance, training, and weapons development. Without them, the Air Force could not function as the world's strongest peace-keeping force.

Keeping the peace has come more and more to mean "counter-insurgency"—the term for limited-scale action against guerrilla insurgents. As I saw when I went to Viet Nam,

these "barefoot wars" seem strangely primitive in an age when men are about to set foot on the moon.

At Da Nang, 380 miles north of Saigon, long lines of Republic F-105 Thunderchief and North American F-100 Super Sabre jet fighter-bombers stood in sandbag revetments, poised for strikes against North Viet Nam. But the airstrip nearby was busy with the coming and going of C-123 Providers. These versatile, rugged cargo planes are the backbone of the airlift in Viet Nam, dubbed the "Teeny-weeny Airline" (pages 298-9).

Lt. Col. Harry G. Howton, commander of the 311th Air Commando Squadron, talked to me in an office of wooden planking decorated with a spear and crossbow of the Vietnamese *montagnards*, or hill people.*

"My men get in six or eight sorties a day," he told me. "In most cases our 123's are the only means of supply for the Special Forces camps in the jungle. We use airstrips where we can; otherwise we airdrop everything we carry—from barbed wire to pigs, ducks, and even cows.

"The 123 handles about 11,000 pounds of cargo—rice, fuel, and ammunition are our big items. Or we can move 80 men at a time. Once they've tried it, the Vietnamese love to fly. We often find them as stowaways."

*See "American Special Forces in Action in Viet Nam," by Howard Sochurek, GEOGRAPHIC, January, 1965.

Sandbag revetments, shields against sniper and mortar fire, serve as stalls for two camera-carrying F-101 Voodoos (foreground) and F-102 Delta Dagger interceptors at

Colonel Howton showed me the armor plating beneath and along the sides of the cockpits, and the flak vests he and his men wear. They get shot at every day, especially when bad weather forces them to fly low. The Viet Cong often fire on planes only two miles from the end of Da Nang's runway.

I flew on a supply mission out of Saigon's Tan Son Nhut Airport with Maj. Philip H. Maxey, operations officer for the 309th Air Commando Squadron. Maxey is an expert on this kind of war. He wrote his thesis at the Air University, Maxwell Air Force Base, Alabama, on "Air Power and Its Uses in Counter Insurgency."

"I try to fly every day," Maxey told me. "Our line pilots average 14 to 16 working hours a day; yesterday it was 18 hours. We aim to give a man a day off once a week, but usually he's in here pounding the counter and asking for a flight."

"Controlled Crash" Thwarts Snipers

Twenty minutes out in the Mekong Delta our C-123 reached a Special Forces installation called Vinh Long, where we were to deliver our load of rockets and ammunition. Strapped in the navigator's seat, with a powerful new M-16 rifle by my side, I experienced an assault landing. Maxey made a steep final approach, hit down hard on a red dirt strip, set his brakes and reversed his props with

Saigon's airport, Tan Son Nhut. Armed guards, observers in the control tower, and roving helicopters protect against the ever-present threat of sneak attack by the Viet Cong.

Ordered aloft for a retaliatory strike, fliers lug parachutes and helmets to a Skyraider on Bien Hoa's flight line. Only hours earlier the enemy had downed two U. S. helicopters in the Mekong Delta south of Saigon. The American pilot serves as instructor for the Vietnamese copilot, who received his basic flight training in the U. S. Their stubby fighter plane carries napalm (jellied gasoline) and phosphorus bombs, 500-pound demolition and 260-pound fragmentation bombs. These, plus cannon, provide a bigger load of destruction than that packed by the B-17 of World War II.

"That's a bullet hole?" NATIONAL GEOGRAPHIC photographer Albert Moldvay (left) learns from Col. William E. Bethea that a .50-caliber bullet punctured their plane during the low-level strike in the Mekong Delta (above). Moldvay recalls the raid: "With a sharp lurch, we slid out of the blue and plummeted in a parallel dive with the lead attack plane. Suddenly we were down low above the trees, and the exploding fireball of napalm bloomed like a huge volcanic eruption. The plumes of white phosphorus arched over the target. Then we were through the smoke and fire, and my back hit the seat with a smack as we hungrily roared up into the clear sky. We had struck back at the enemy and evened the score. And I had been so busy with the camera, I wasn't aware they were shooting at us."

EXTREMELY LARGE AND HIGHLY DESTRUCTIVE EXPLOSIVE STRIKE BY SKYRAIDERS BY LT. COL. FRANK CAMPBELL © U.S.A.

Flame sears a jungle stronghold of the Viet Cong after Skyraiders bombed and strafed it.

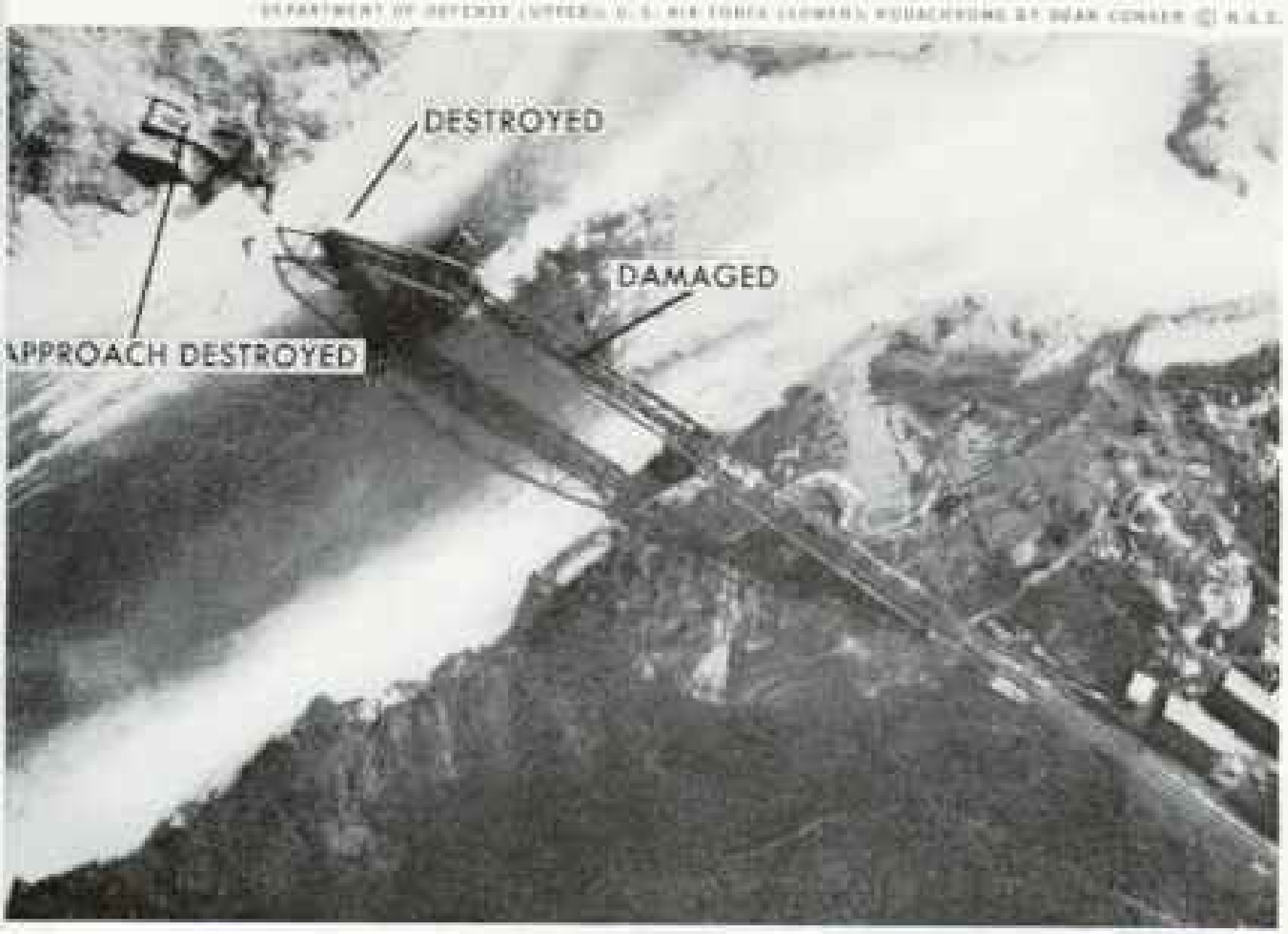
a terrible burst of sound and the smell of burned rubber. We stopped in a cyclone of red dust only 500 feet from the touchdown point.

"That's really a controlled crash," Maxey explained casually. "We've got to do it that way because the Viet Cong lie in wait just off the ends of the runway and try to pick us off. If you come in under a thousand feet, you can count on getting shot at."

Bien Hoa Air Base must watch for snipers too. Here, only a 45-minute drive from Saigon, red bougainvillea gaily festoons the barbed-wire coils that fence the administration buildings. Earthworks with firing ports protect the perimeter of the cantonments, for the Viet Cong may be within rifle shot at any time. The jungle hat with turned-up brim and the pistol on the hip give this place the atmosphere of a frontier outpost.

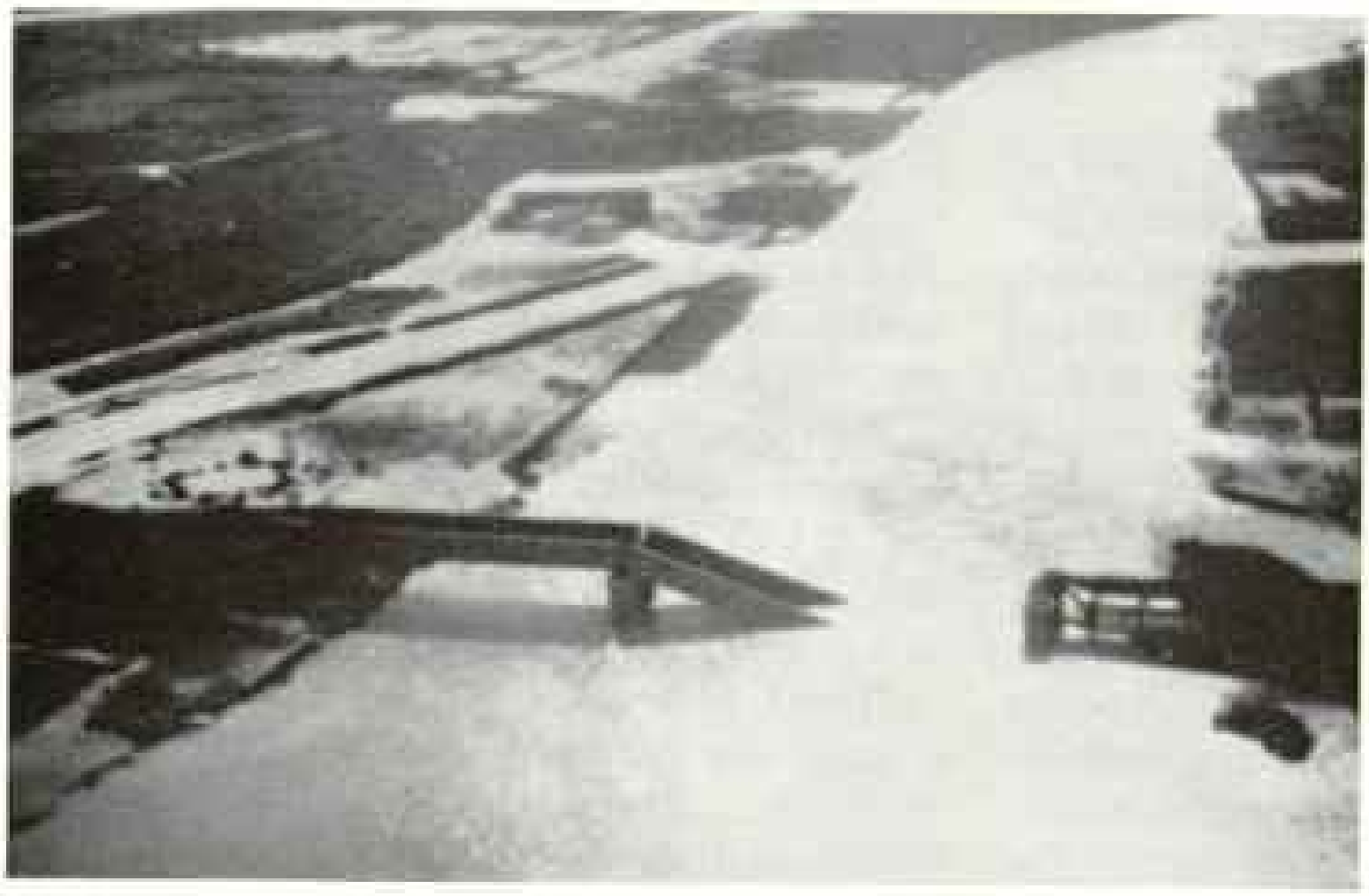
Here Air Force men train Vietnamese pilots, and the tough counter-insurgency fighter, the A-1 Skyraider, wedges into every available space, its wings folded in reminder that it was designed as a Navy carrier plane.

"Don't let anyone tell you this plane isn't a good one for our purposes," Col. William E. Bethea, commander of the 34th Tactical Group at Bien Hoa, told me (opposite). He



The price of war: Shattered bridges and highways, ruined barracks and staging areas repay North Viet Nam for her guerrilla attacks on South Viet Nam. The 67th Tactical Fighter Squadron out of Da Nang cut these railroad bridges at Trai Hoi (above) and Dien Chau (below) last April.

Air Force Cross sparkles on the tunic of Lt. Col. Robinson Risner, first living recipient of the award. He won it for leading the 2½-hour bridge-destroying strike by the 67th Squadron. The decoration, first bestowed in 1964, is the Nation's second highest award for valor.



Anxious wait: A rescue helicopter orbits Da Nang Air Base in South Viet Nam, ready to help fighter jets returning from a strike.

Crews of these HH-43B Huskie crash-fire-rescue craft, stationed at most U. S. air bases, daily perform deeds of valor, finding downed airmen and rescuing pilots from blazing planes (page 343).

Counter-rotating rotors, which make this craft especially stable, drive it at more than 110 miles an hour to altitudes as high as 25,000 feet.

CRYSCHROME BY ALBERT MOLDVAY © N.G.S.

praised its maneuverability, its ruggedness, its bomb load.

As we watched flights of propeller-driven Skyraiders coming in from a strike, their bomb racks empty, I asked Colonel Bethea if there was a lot of sniping at the base.

"Well," he said offhandedly, "I don't believe I've had an airplane hit on the taxiway by sniper fire since yesterday afternoon."

Patched-up bullet holes are common enough in any Air Force craft in Viet Nam, but they appear with special frequency in a little butterfly of a plane called the Cessna O-1F; it is used in Viet Nam by scores of pilots known as forward air controllers. These onetime jet jockeys live with the ground troops and direct the strikes of fighter planes in their area.

They fly at the vulnerable speed of 90 miles an hour, watching for unusual activity that spells Viet Cong. When they find a target, they mark it with smoke rockets and loiter nearby to report to the fighters by radio on the success of their efforts.

SAC Wields Nuclear Might

Flushing small groups of guerrillas from a Vietnamese jungle is one kind of war. SAC, the Strategic Air Command, stands constantly poised to unleash another. Largest of the Air Force's commands, with nearly a quarter of a million men in uniform, SAC has also been the most glamorous, with its huge fleets of nuclear bombers and ICBM's—intercontinental ballistic missiles.

SAC's emblem is a mailed fist brandishing thunderbolts and an olive branch. The symbolism is appropriate, since SAC's ability to

REDACHROME BY ALBERT MOLDVAY © N.G.S.

Air Force high command weighs plans for deployment of U. S. men and planes: Gen. John Paul McConnell, Air Force Chief of Staff (right); Air Force Secretary Eugene M. Zuckert; and Gen. William H. Blanchard, Vice Chief of Staff. In the background picture, SAC alert crews on Guam race to their B-52's for a practice scramble.

inflict instant nuclear retaliation is the world's best guarantee at the moment that nuclear war will not begin.

But for me, SAC's characteristic symbol will always be the Boeing B-52 Stratofortress, largest plane in the Air Force inventory (pages 327-9). I never tire of watching it thunder down the runway, its eight jet engines spewing black smoke. Heavy with fuel, its enormous wings span 185 feet and droop like those of an angry mother hen sheltering her brood. As the 244-ton plane—heavier than the Statue of Liberty—takes to the air, the wings straighten, then bow upward. In flight they flex as much as 20 feet at the tips.

I first saw the B-52 close up at Ellsworth Air Force Base, near Rapid City, South Dakota. If I had entertained any thought that these last-resort bombers stand around gathering cobwebs until an emergency threatens, I soon learned otherwise. So heavily scheduled is each plane for maintenance, modification, repairs, training flights, and alerts that it is difficult to find time to launder it. But its curiously wrinkled skin—stretched by the stresses of high-speed flight—must be washed, for a dirty plane does not perform well.

The master crew chief for one of Ellsworth's B-52's, T/Sgt. Verle L. Wagner, explained that it takes two years for a maintenance man to learn this complex plane. Before every flight, he said, his crew checks 1,250 items in an examination lasting four and a half hours.

Alert Crews Sleep in Flying Suits

By Presidential order, half of SAC's 880 bombers must be constantly ready for takeoff within 15 minutes. The Ballistic Missile Early Warning System (BMEWS)—radar detection and tracking stations at Clear, Alaska; Thule, Greenland; and Fylingdales Moor, England—can give SAC that much warning in case enemy ICBM's are ever launched across the top of the world.

SAC's alert planes have been completely checked out, their switches set. They are "cocked" and ready for swift starting. Ropes, armed guards, and sentry dogs keep intruders away and prevent tampering (page 345).

For every B-52 on alert, six crewmen and three ground-crew members must live for three to seven days at a stretch in an "alert pad" in guarded, fenced seclusion near the runway. Attractive quarters and underground bedrooms (to cut down on jet noise) help make this isolated life tolerable. But the men must live and sleep in flying suits, with zippered boots that can be pulled on in seconds.

"If the klaxon sounds while we're here," Lt. Col. John B. Voss advised, "get out of the way fast, or you'll be run over. It's a matter of pride—as well as national security—to get those planes off the ground in the fewest seconds possible, and they can do it in lots less than 15 minutes."

During practice scrambles, B-52's take off only 15 seconds apart, staggering in the hot, turbulent jetwash of the planes ahead.

SAC's crews work an average 74-hour week. Even on alert they put in full days studying, practicing in simulators, planning the endless details of practice bombing runs, and memorizing target data. Each radar-navigator must be able to draw from memory what his assigned target looks like on radar. Each pilot must know his route like a taxi driver; every day he is briefed on the weather along the way.

Night Mission "Bombs" U. S. City

Few Americans know it, but many of our cities are "bombed" at night by SAC crews whetting the fine edge of their readiness. I flew on such a mission with a B-52 crew of the 28th Bombardment Wing at Ellsworth.

Our aircraft commander (that's what the Air Force calls a pilot these days) was 28-year-old Capt. Thomas R. Ferguson, Jr.—astonishingly young, I thought, to bear responsibility for a $6,000,000 plane, the lives of half a dozen men, and, when on alert, the equivalent in nuclear bombs of millions of tons of TNT. Ferguson shows all the crisp ability to command and the self-assurance of older SAC colleagues, who average 34 years of age and 3,200 hours of flying.

Bathed in floodlights, our B-52 looked even bigger than it was as I climbed the ladder through a trap door near the nose. I found the six-man crew already strapped in their seats going through the long checklist ritual, testing electric and hydraulic systems, warning lights, and controls.

Satisfied, Captain Ferguson took the huge bird smoothly down the runway. We climbed swiftly. The sensations were not unlike those in a commercial airliner, except for the two-mile run on the ground and the hemmed-in feeling in this almost windowless plane.

A mixture of air and oxygen fed steadily through a flexible green hose into my face mask. Helmet and earphones reduced the plane's heavy roar. I could clearly hear members of the crew and the controllers on the ground in frequent communication as we droned on through the night.

I became aware of a muffled, rapid bang-bang-bang-bang. "It's just our radar in the nose, sweeping back and forth," Ferguson reassured me. Soon a blip showed on the radarscope. Another plane, our tanker, was making rendezvous with us.

Planes Lock Together for Refueling

Presently, just ahead, I saw moonlight glinting on the silver fuselage of a Boeing KC-135, the big jet Stratotanker that enables SAC bombers to go anywhere in the world and return without landing.

As we gradually closed, a long boom under the tanker's tail dropped down and extended 30-odd feet toward us. Two small vanes helped the operator "fly" the boom into position.

Now Ferguson and his copilot hunched forward in their seats, intent on lining up with a row of lights on the tanker's belly, while the "boomer" in the tanker called off the distance. The boom waved slightly; for an instant I thought it would plunge through our cockpit window, but at the last moment it rose gracefully and passed over.

"Stand by for contact," the boomer's voice crackled; with a sharp thunk the boom's nozzle locked in its receptacle just behind us. Now we drank in fuel at more than 6,000 pounds—nearly 1,000 gallons—a minute.

For more than 10 minutes these titans roared along at 300 miles an hour, five miles high, as though welded together. Only by the pilot's constant adjustments in throttles and yoke could I appreciate how tricky and dangerous this operation can be, especially during turbulence. Yet, on the average, every 4.7 minutes around the clock an airborne SAC bomber refuels somewhere in the world (pages 316-17).

Through the night our B-52 zigzagged hundreds of miles across the Dakotas, Nebraska, and Wyoming. About 2 a.m. we began a high-level bombing run at 32,000 feet. I wormed my way down to a windowless cubbyhole to

talk to the bombardier (called a "radar-navigator" these days).

"Our first target is a factory," he told me. "We're going to hit the corner of the building. They'll score us within a foot." Electronic signals would tell a scoring team on the ground exactly where our "bomb" had hit.

"Can you knock 15 knots off the air speed?" the radar-navigator called on the intercom as he fed data into his bombsight computer. We slowed to 400 knots—still more than 7½ miles a minute. I saw the Missouri River on the radarscope; our target was in the sleeping city of Bismarck, North Dakota.

The operator carefully adjusted his radar cross hairs on the target, still 50 miles away. The automatic pilot and the computer would now fly the plane to that point.

Red phone at Strategic Air Command headquarters near Omaha, Nebraska, alerts nuclear bomber and missile crews in event of war. Buttons light automatically when bases respond.

In lonely passage above the clouds, SAC's airborne command post, "Looking Glass," maintains day-and-night vigil. Should enemy attack destroy SAC headquarters, Looking Glass would direct nuclear retaliation. A replacement goes aloft every eight hours.

Elite guard braces as SAC's commander, Gen. John D. Ryan, leaves his underground command post. Accompanied by his chief of staff, Maj. Gen. Charles M. Eisenhart, Ryan carries a two-way radio for instant communication with Washington through SAC headquarters.

RIGHARDWES BY BRUCE DALE (ABOVE) AND ENOCH KNIGHT © N.G.S.

"One minute to bomb release!" The operator flipped a switch and a high hum sounded steadily in our earphones.

"Ten seconds!"

"Bombs away!" The tone abruptly ended.

No switch or trigger had been thrown; the computer took care of everything.

The plane seemed to shake, but it was only the breakaway maneuver as the pilot

pulled hard to the left. The heavy g-force of our turn tugged at my stomach.

"Prepare for shock arrival!" In a real bombing we would still be perilously close to the nuclear blast—one of the normal risks a SAC bomber crew must take.

How close had our "bomb" come to its target? Captain Ferguson was not permitted to say. But I could read complete satisfaction in his smile.

Low-altitude Attacks Evade Radar

We dropped to 800 feet for an "oil-burner run" over South Dakota's Badlands. Low-level flight may avoid radar detection, but it burns fuel at a fierce rate in the denser atmosphere. A tormented landscape of rocky spires lay just below—so close in the deceptive moonlight that it seemed we could lower our landing gear and knock off some of the peaks. But special terrain-avoidance radar protected us: The plane would lift automatically over any peak or cliff ahead.

Coming in "on the deck" like this is not the only way to thwart a watching, waiting enemy. Aboard a B-52, the electronics warfare officer is referred to as the "EWO," the "spook," or the "raven"; his job is to

Burst of flame spawns a high-flying doughnut of white smoke, and a soot-blackened Minuteman erupts from a silo at Vandenberg Air Force Base in California. Three seconds later, the solid-fuel intercontinental ballistic missile curves toward a Pacific target 5,500 miles and less than 30 minutes away.

Two-man SAC crew fired this practice shot from a control chamber 50 feet underground (below). Encased in reinforced concrete, both silo and control room can withstand all but direct nuclear blasts.

United States strength now includes more than 800 Minutemen, each with a nuclear warhead. All can be launched within seconds of the order to fire.

detect enemy radar and jam it with a bagful of secret tricks.

In his earphones each kind of enemy radar plays a different tune. A warble means that acquisition radar is searching for the bomber. The EWO can confuse the enemy by dropping chaff, like Christmas tinsel, that fills their radar screens with blips. Or he can send out false signals to alter their radar waves.

Other radar sounds are more ominous. If the EWO hears "bagpipes," he knows that an enemy interceptor is on its way, guided by information from the ground via a radio system we call data-link. If he hears something resembling squeaky wagon wheels, enemy fire control is about to launch an antiaircraft missile. And if he hears a high-pitched whine, he knows that the missile is on its way—time for urgent evasive action by the bomber.

When our B-52 landed back at Ellsworth, 8½ hours and 4,000 miles after take-off, dawn was breaking. For me it had been an awesome venture into another world. But for the crew,

U.S. Air Force
ROUND THE GLOBE

Commands, Agencies · Overseas Air Forces · Bases, Stations

Ballistic Missile Early Warning Stations · Missile Bases

AFB—Air Force Base · AB—Air Base · AS—Air Station

Mean Scale, 1/50,000,000

PRODUCED BY
NATIONAL GEOGRAPHIC SOCIETY
GEOGRAPHIC ART DIVISION
DRAWN BY BETTY R. CLONINGER, RESEARCH BY GEORGE W. BEATTY

Bien Hoa and Tan Son Nhut AB Saigon

Da Nang AB

HQ 13TH AIR FORCE
Clark AB Luzon, Philippines

Naha and Kadena AB Okinawa

Osan AB Korea

HQ 5TH AIR FORCE
Fuchu AS, Japan

Yokota AB Japan

Andersen AFB Guam

Shemya Spacetrack Station, Alaska

Clear Alaska

SOUTH VIET NAM

South China Sea

NORTH VIET NAM

CHINA

TAIWAN

Pacific Ocean

HAWAII

SAC With some 1,500 combat and tanker aircraft and more than 850 Intercontinental Ballistic Missiles, the Strategic Air Command stands as the United States' chief deterrent to nuclear war. Its 250,000 highly trained men operate the most destructive weapons systems science can devise, both in the air and at scattered bases around the world, under the motto "Peace Is Our Profession."

TAC The world-ranging Tactical Air Command, which has 70,000 men in 37 fighter squadrons and 24 troop-carrier squadrons, provides air and ground-support units capable of fighting limited or all-out war. It extends its range by borrowing SAC tankers for aerial refueling. TAC elements also join the U. S. Army in the combat-ready, highly mobile United States Strike Command.

ADC uses its Distant Early Warning Line (DEW Line) and Ballistic Missile Early Warning System (BMEWS) to guard the North American continent against aerospace attack. It also supplies interceptor aircraft and surface-to-air missiles to the NORAD commander (page 323).

MATS The Military Air Transport Service gives the Department of Defense a global airlift capability, flying some 600 cargo and personnel carriers over 160,000 miles of air routes. Other activities: aeromedical evacuation, aerial mapping, air rescue, and weather reconnaissance.

MAJOR COMMANDS AND AGENCIES
KEYED TO SHIELDS ON MAP

1 AERONAUTICAL CHART AND INFORMATION CENTER, ST. LOUIS, MISSOURI
2 AIR DEFENSE COMMAND, AIR FORCE ACADEMY, AND NORAD, COLORADO SPRINGS, COLORADO
3 AIR FORCE ACCOUNTING AND FINANCE CENTER, DENVER, COLORADO
4 AIR FORCE COMMUNICATIONS SERVICE AND MILITARY AIR TRANSPORT SERVICE, SCOTT AFB, ILLINOIS
5 AIR FORCE LOGISTICS COMMAND, WRIGHT-PATTERSON AFB, OHIO
6 AIR FORCE SYSTEMS COMMAND, ANDREWS AFB, MARYLAND
7 AIR TRAINING COMMAND, RANDOLPH AFB, TEXAS
8 AIR UNIVERSITY, MAXWELL AFB, ALABAMA
9 ALASKAN AIR COMMAND, ELMENDORF AFB, ALASKA
10 CONTINENTAL AIR COMMAND, ROBINS AFB, GEORGIA
11 HEADQUARTERS COMMAND AND OFFICE OF AEROSPACE RESEARCH, WASHINGTON, D. C.
12 PACIFIC AIR FORCES, HICKAM AFB, HAWAII
13 STRATEGIC AIR COMMAND, OFFUTT AFB, NEBRASKA
14 TACTICAL AIR COMMAND, LANGLEY AFB, VIRGINIA
15 U. S. AIR FORCE SECURITY SERVICE, KELLY AFB, TEXAS
16 U. S. AIR FORCES IN EUROPE, LINDSEY AS, GERMANY
17 U. S. AIR FORCES SOUTHERN COMMAND, ALBROOK AFB, PANAMA CANAL ZONE

Cigli AB
Izmir, Turkey

Wheelus AB
Libya

AFRICA

R.

HQ 17TH AIR FORCE
Ramstein AB, Germany

HQ 16TH AIR FORCE
Torrejon, Spain

Morón AB
Seville, Spain

HQ 3D AIR FORCE
South Ruislip, England

Mildenhall
Royal Air Force—USAF
Station, England

ICELAND

Lajes Field
Azores

BMEWS: *Radar fans of Ballistic Missile Early Warning Stations sweep the skies for hostile launchings.*

NORTH POLE

GREENLAND

Thule AB
Greenland

Atlantic Ocean

Powerful missiles—Titan and Minuteman—poised at underground sites in the United States can strike any point on this map and beyond.

Kindley AFB
Bermuda

HEADQUARTERS, U. S. AIR FORCE
Washington, D. C.

Glasgow AFB
Montana

Ellsworth AFB
South Dakota

Ramey AFB
Puerto Rico

Patrick AFB
Florida

Homestead AFB
Florida

Eglin AFB
Florida

Beale AFB
California

Edwards AFB
California

Vandenberg AFB
California

Brooks AFB
Texas

Albrook AFB
Canal Zone

CUBA

MEXICO

SOUTH AMERICA

USAFE America's largest overseas air arm. U. S. Air Forces in Europe has more than 1,000 aircraft and 80,000 personnel. With NATO partners, combat-ready units provide tactical and logistic air support for Allied ground forces over an area of six million square miles, extending from Britain and Western Europe to Africa and Pakistan.

PACAF Pacific Air Forces bulwarks the western approaches to the United States with 35 strike, defense, and airlift squadrons. They join British, Asian, Australian, and New Zealand air units to cover the Pacific Ocean and eastern Asia—forty percent of the world's surface.

still running through routine post-flight checks, it was all in a night's work.

Some of SAC's planes are always in the air. One flight, called "Looking Glass," constantly orbits the central U. S. in eight-hour shifts (pages 310-11). This flying command post would direct U. S. nuclear retaliation if SAC headquarters at Offutt Air Force Base near Omaha, Nebraska, and its alternate ground command posts should ever be wiped out. Special planes, always ready for take-off, would provide emergency communications facilities. Other planes fly airborne-alert missions that last 24 hours. The number aloft at any time is classified, but it is enough to ensure survival of a strike force to retaliate instantly against enemy attack, even if many of our planes on the ground were destroyed.

Nothing stops such flights. At Glasgow, Montana, our northernmost domestic base outside Alaska, winter lashes with violent blizzards and temperatures far below zero.

"But we wouldn't dare call SAC to say that our bomber fleet was snowed in," an officer said with rueful pride. "We operate 24 hours a day, just the same as at Tampa, Florida."

At Glasgow I watched an airborne-alert plane come in from its grueling 24-hour mission. The men were whiskered, bleary-eyed, tired. The gunner, who had been isolated in the tail, climbed down carrying his own frying pan and thermos jugs. The pilot brought off the locked "hot box," containing secret orders

Sky-high gas station, a KC-135 tanker pours 1,000 gallons a minute into a B-52, five miles above snowy Kansas wheatfields. SAC keeps an armada of bombers in the air at all times, ready for instant nuclear retaliation should ground installations be knocked out in surprise attack. Every 4.7 minutes, somewhere in the world, a SAC bomber refuels in the air on a practice mission.

History's first aerial refueling took place in 1921 when Wesley May stepped from the wing of one biplane to another with a five-gallon gasoline can strapped to his back.

Cramped in a cubbyhole with electronic gear, B-52 navigator and radar-navigator sweat out a 10-hour practice mission. Oxygen masks, unneeded during a low-level run, dangle beneath the flyers' chins.

Pilot's gloved hand adjusts throttles, one for each engine. Refueling requires skilled maneuvering of throttles and controls.

to be consulted only if he is instructed to attack while aloft. The crew can never proceed to attack unless it gets the "go code," which is authorized only by the President.

Under the doctrine of deterrence so forcefully and ably advanced by Gen. Curtis E. LeMay, who retired last February after nine years as SAC commander and three and a half years as Air Force Chief of Staff, the Air Force relies on its defensive strength plus a mixed force of bombers and missiles to deter enemy nuclear attack. Each weapon delivery system has its own advantages.

Titan's Computer Whirs Constantly

The newest of our missiles—the solid-fuel Minuteman, of which SAC now has more than 800 (pages 312-13), and the extremely powerful liquid-fuel, instant-ignition Titan II, of which there are 54—can be launched within seconds from their concrete silos scattered across the central and western United States. They could obliterate any aggressor nation on earth, reaching their farthest targets within 30 minutes. Nobody has yet perfected a weapon capable of stopping them.

Missiles are almost living things, as I found when I went down into a Titan II silo at Little Rock, Arkansas. Titan's four-man crew lives in the underground complex for 24 hours at a stretch. Elaborate air conditioning, enough for a 120-room hotel, keeps the missile cool (60° F.) and dry, at 30 percent humidity. But the gold-plated guidance package which holds the missile on target must be kept specially warmed. Inside, a gyroscope and computer are always running, ready for that possible moment when the 700-ton steel-and-concrete door over the silo slides back for a launch.

As I stood with the crew at the bottom of the 155-foot silo, the gleaming aluminum shaft of the missile towered above us like a giant redwood (opposite). Then we rode up the elevator to view the warhead. Its devilish power, calculated in megatons—millions of tons of TNT—is, of course, secret. But Col. Peter H. Spear, commander of the 373d Strategic Missile Squadron, gave me a thought-provoking illustration:

"How many freight cars do you think it would take to carry enough dynamite for, say, a five-million-ton explosion?"

My guess was a train 50 miles long.

He smiled. "Well, you'd have to extend that train all the way from Little Rock to California and 1,400 miles beyond!"

Powerful as missiles are, they are an all-or-nothing weapon. Once launched, they cannot

Separating in space, a red-nosed Gemini moves away from the proposed Air Force Manned Orbiting Laboratory (MOL): an artist's view.

World's most powerful rocket, Titan IIIC makes its maiden flight from Cape Kennedy. Its 2.5 million pounds of thrust provide a new level of power for the future Air Force.

U. S. AIR FORCE (ABOVE); ROCKETDYNE BY OTIS IMBODEN © N.G.S.

Mightiest U. S. military missile. Titan II stands ready for instant action at Little Rock Air Force Base, Arkansas. With propellants that ignite on contact, the missile can fire within seconds after its silo cover opens. Titan II puts Gemini into orbit; a Titan III may propel MOL into space.

be recalled. So, in the Air Force view, it is always necessary to have another, more flexible, striking force: manned bombers that can be recalled or diverted and that can take to the air before any attack knocks them out.

Gen. John P. McConnell, Air Force Chief of Staff, sums it up succinctly: "I am convinced that, for the foreseeable future, we will continue to need a considerable number of bombers and a variety of other manned systems, and that we must replace obsolescent types with newer and better ones."

But the question that troubles many Air Force planners is—how soon? Our 200 Boeing B-47's—the jet bombers that preceded the B-52's—are currently scheduled to be retired next year. How soon will advanced bombers be needed to replace the B-52's and B-58's?

The latest model B-52, a 650-mile-an-hour plane with a fuel capacity for 12,500 miles, was delivered three years ago, and the oldest models are ten years old. In today's fast-moving technology, any plane approaches obsolescence in a decade.

The General Dynamics B-58 Hustler came into service five years ago as the world's fastest nuclear bomber. This remarkably compact delta-winged craft—a third the size of a B-52—carries its bombs externally. Its skin is a honeycomb sandwich of aluminum, glass fiber, and stainless steel, to withstand the tremendous heat of air friction when the plane "tops out" at 1,325 miles an hour. Its tires are filled with nitrogen to minimize expansion.

Unusual warning devices alert a B-58 pilot to trouble. He may see a flashing red light and hear a pleasant female voice caution, "Check for engine fire"; or "Landing gear unsafe"; or "The nose is too high."

"These recordings catch our attention fast," a pilot told me. "You might ignore a man's voice—but you don't ignore a woman's!"

Impressed as I was by the B-58, I confess to a surge of emotion when I first glimpsed

the endless white sweep of the spectacular XB-70, its slender fuselage arching swanlike from a great expanse of delta wing. At North American's Palmdale plant in California a year ago, I watched as it raced down the runway, reared up like a fighting animal, and leaped into the air on its maiden flight (below).

Research Becomes XB-70's Role

Flying at Mach 3—three times the speed of sound—the XB-70 is designed to ride its own shock wave like a surfboard. But it will never be a bomber, as I learned after the flight from the Air Force test pilot, Col. Joseph F. Cotton. He showed natural pride as he took me through the plane ("a good-sized wagon") and recounted how beautifully it had handled.

"It was originally planned as a bomber," he said as we sat in the two-man cockpit, 20 feet above the ground and some 175 feet from the tail. "But it's now a research craft, and only two of them are to be built. However, we'll learn a lot from the XB-70 about how to make supersonic transports."

He spoke of the planned commercial transports that will fly at Mach 3, and of the heat-resistant materials they need.

"Even in the very thin atmosphere of 70,000 feet," he said, "their leading edges will reach 600° F.—about the melting point of lead."

A radically new plane that holds promise as a strategic bomber is the General Dynamics F-111, once called the TFX. This fighter-bomber, now being tested, embodies a revolutionary principle: the variable-sweep wing.

With wings spread out in a 63-foot span, the F-111 can fly at low speeds for short take-offs and landings, even on unimproved airstrips. Yet in the air, it takes only 20 seconds to sweep the wings back sharply into a delta; then, at 60,000 feet and above, the plane can fly at 1,600 miles an hour—with enough fuel to cross the Atlantic (next page). But even more remarkable, the F-111's design permits

PHOTOGRAPHED BY SM/SGT CARMIE M. IACCARINI (BELOW) AND BRUCE DALE © N.G.S.

Miniature planes, precisely sculptured in stainless steel and brass, endure blasts of more than 1,000 miles an hour in wind tunnels. Tiny supersonic transport (left) copies a design at a scale of 1/9600; the B-58 bomber, at 1/1200.

Like a fighting animal, the XB-70 rears for take-off on its maiden flight from North American's Palmdale plant in California. This 530,000-pound delta-wing monster—185 feet long and 105 feet wide—can fly 2,000 miles an hour—three times the speed of sound. Conceived as a long-range bomber, the experimental craft now aids in the development of a Mach-3 transport.

Flying switchblade, the F-111 takes off and lands with wings out (opposite, above), then sweeps them back for supersonic flight to speeds of 1,600 miles an hour (lower). Both Air Force and Navy will use this revolutionary tactical fighter, which can range the world and has unprecedented firepower.

Escape from danger: The two-man F-111 crew will be able to eject their entire compartment in an emergency. During tests at Holloman Air Force Base, New Mexico, an escape capsule blasts loose from a mock-up fuselage (left) after rocketing down a track at 350 miles an hour. High in the air, it deploys a 70-foot parachute (below). Escape pod, which can float, provides oxygen and two-way radio.

supersonic dashes "on the deck," despite the buffeting and heat that defeat other jets in the lower, denser air. And it can carry larger payloads than any other fighter now in operation.

Whether SAC ever uses the F-111 or not, it will be a mainstay for the Tactical Air Command. The Navy plans to use a slightly modified version as a carrier plane.

NORAD Watches for Enemy Threat

Superb aircraft such as these undoubtedly discourage any potential enemy from launching an attack on the United States. Still the threat remains—not only from enemy missiles and planes, but possibly, someday, from fleets of satellites.

Detection, identification, and destruction of these threats is centered in NORAD, the North American Air Defense Command, of which ADC, the Air Defense Command, is the major component. Both are headquartered in Colorado Springs. Through NORAD, Canada and the United States share jointly in defense of some 10½ million square miles of North America and its seaward approaches, employing about 150,000 people at 650 locations.

At Colorado Springs I sat in NORAD's darkened Combat Operations Center watching lights and symbols on massive maps and display panels (foldout, next pages). Information comes in here from a host of electronic listening posts—the BMEWS radar stations in the far north and England, which make some 7,000 detections a day, including meteorites and satellites; the DEW Line (Distant Early Warning Line), stretching from Alaska to Iceland;* 150 sites in the United States; and

(Continued on page 330)

*See "DEW Line, Sentry of the Far North," by Howard La Fay, NATIONAL GEOGRAPHIC, July, 1958.

GLOWING SYMBOLS *give instant information. Numbered half-arrows mean aircraft—red for hostile, orange for unknown, green for planes of special interest. Star means friendly aircraft carrier; triangle, Soviet-bloc "fishing" trawler.*

ENEMY BOMBERS *from Cuba? In this hypothetical exercise, Florida's Communist neighbor shows on enlarged section (right) of map above. If the arrows move steadily toward the U. S., NORAD sends interceptors aloft to identify and—if need be—turn back or destroy the invaders.*

EKTACHROMES BY NATIONAL GEOGRAPHIC PHOTOGRAPHERS BRUCE DALE (ABOVE) AND EMORY KRISTOF © N.G.S.

NORAD: Vigilant guardian of North America's defense

IN THIS darkened chamber at Colorado Springs, electronic wizardry analyzes and displays any threat of war and U. S.-Canadian readiness to meet it. Here converge nerve impulses from hundreds of sky-sweeping sensors, including BMEWS, DEW Line, and far-ranging radar planes. Day and night, technicians of the North American Air Defense Command man the consoles, alert for sign of attack. In time of crisis, or for exercises like this one, decision-making generals fill the glassed-in observation room. Here, during the simulated attack, white ellipses (far left) encircle launching sites of Soviet missiles speeding toward the United States; similar ovals on the North America map show computer-predicted impact points.

GENERAL DYNAMICS F-106
DELTA DART
INTERCEPTOR

LOCKHEED YF-12A
PROTOTYPE INTERCEPTOR

McDONNELL F-101
VOODOO
INTERCEPTOR

GENERAL DYNAMICS B-58
HUSTLER
STRATEGIC BOMBER

NORTH AMERICAN F-100
SUPER SABRE
TACTICAL FIGHTER

BOEING B-52
STRATOFORTRESS
STRATEGIC BOMBER

McDONNELL F-4C
PHANTOM II
TACTICAL FIGHTER

FAIRCHILD HILLER C-123
PROVIDER
ASSAULT TRANSPORT

REPUBLIC F-105
THUNDERCHIEF
TACTICAL FIGHTER

MARTIN RB-57
CANBERRA
RECONNAISSANCE AIRCRAFT

NORTH AMERICAN XB-70
VALKYRIE
EXPERIMENTAL AIRCRAFT

DOUGLAS C-133
CARGOMASTER
CARGO/TROOP CARRIER

GENERAL DYNAMICS F-111
TACTICAL FIGHTER

LOCKHEED C-141
STARLIFTER
CARGO/TROOP CARRIER

LOCKHEED C-130
HERCULES
CARGO/TROOP CARRIER

KAMAN HH-43 B
HUSKIE
CRASH-RESCUE
FIRE-FIGHTER

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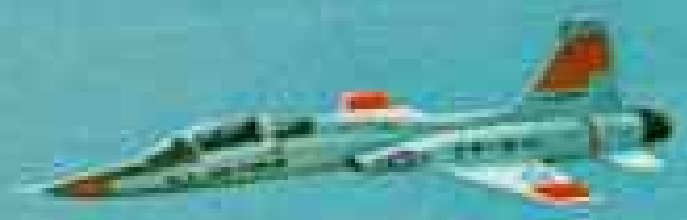


NORTHROP T-38
TALON
TRAINER

LOCKHEED WU-2
RECONNAISSANCE AIRCRAFT

DOUGLAS C-47
SKYTRAIN
CARGO/TROOP CARRIER

BOEING KC-135
STRATOTANKER
TANKER

LOCKHEED F-104
STARFIGHTER
INTERCEPTOR

GRUMMAN HU-16
ALBATROSS
SEARCH/RESCUE
AMPHIBIAN

DOUGLAS A-1E
SKYRAIDER
TACTICAL FIGHTER

DOUGLAS C-124
GLOBEMASTER
CARGO/TROOP CARRIER

SIKORSKY CH-3C
CARGO/TROOP CARRIER

LTV-HILLER-RYAN XC-142
EXPERIMENTAL V/STOL
CARGO TRANSPORT

PREPARED BY
NATIONAL GEOGRAPHIC SOCIETY ©
CARTOGRAPHIC ART DIVISION
ART BY DAVID WILCOX, RESEARCH BY GERARD M. SMITH

Flying arsenal of the United States Air Force drawn to a scale of 1 to 550.

(Continued from page 323)

radar planes continually patrolling the reaches of the Atlantic and Pacific.

Lt. Gen. Herbert B. Thatcher, commander of ADC, told me about a most remarkable development in radar that will be, as he put it, "the sensor of the future." It is phased-array radar, now under construction at Eglin Air Force Base, Florida.

It does not need to sweep back and forth, for its thousands of small transmitters and receivers, all in one huge screen 13 stories tall and 100 yards long, can cover almost half the sky. It can detect and track numerous objects simultaneously at such phenomenal distances as 2,500 miles.

Interceptors Seek Out Cuban "Bogeys"

NORAD's display boards show only significant flights. Sector headquarters identify and filter out most of the estimated 100,000 routine commercial, military, and private flights that appear over the continent daily.

During my visit to NORAD, I saw SAC's airborne command post, "Looking Glass," appear on the map as a yellow symbol in the middle of the United States. A small green arrow located President Lyndon B. Johnson's plane flying in Rhode Island.

What about unidentified planes? NORAD sector headquarters verify all flight plans, and if the planes are not accounted for, supersonic fighters intercept them. The interceptors—usually General Dynamics' F-102 Delta Daggers or F-106 Delta Darts—identify the strangers, turn them back if they are violating our air space, and would destroy them if necessary. These strangers, or "bogeys," show immediately as orange symbols on the display boards at NORAD, becoming red if they turn out to be hostile.

As I watched, three unknowns began to move across the board—one above Canada, two off Cuba. Interceptors—yellow symbols—quickly appeared. Minutes passed, and the arrows from the unknowns probed closer to the continental limits. Then the Cuban planes turned back, and their symbols disappeared from the board.

As for the other stranger, the interceptors found that it was a commercial airliner with navigation trouble, and it too was "erased."

Electronic intelligence swept up by reconnaissance planes undergoes study at SAC headquarters. Jackstraw lines on the technician's oscilloscope represent consecutive recordings of radar impulses; where they intersect marks a radar site.

High above Bering Strait (right), a powerful U. S. radar station at the Alaskan Air Command's Tin City constantly reconnoiters Soviet Siberia, 55 miles away. Part of the Air Force's Air Control and Warning System, it watches for hostile planes. Such facilities work with the Distant Early Warning (DEW) Line and the Ballistic Missile Early Warning Systems (BMEWS).

Not infrequently, NORAD helps bring commercial planes back on course.

A simulated attack by ICBM's flashed suddenly on the board. Ellipses appeared on the Soviet map, marking the launching sites from which missiles were flying at almost five miles a second. Computers whirred, millions of calculations determined the exact speed, trajectory, and targets of the ballistic missiles, and within moments calculations of time-to-impact were recorded.

New ellipses—the targets of the simulated attack—appeared on the big map. They centered around Los Angeles, New York, Chicago, Detroit—and Colorado Springs, where I was sitting at that moment!

If the attack had been real, all this information would have been flashed to SAC headquarters in Omaha, to the Pentagon, and to corresponding headquarters in Canada. One of the most amazing and foolproof electronic systems in existence, run by the Air Force Communications Service, guarantees virtually instantaneous communications throughout our entire defense network. Even as I listened, a controller punched a button and in three seconds was talking to "Looking Glass" flying over Omaha.

Because Colorado Springs would be a prime target, next year NORAD will move its Combat Operations Center deep into the heart of Cheyenne Mountain a few miles south of the city. This "hard site"—hardened against nuclear blast—has been under construction since 1961 at a cost of $90,000,000.

Sidewinder Aims at Hot Tailpipes

The Air Defense Command's interceptors embody some of the most fantastic and sophisticated gear in the entire Air Force. The arsenal of air-to-air missiles includes both conventional and nuclear weapons, some guided by radar or radio, some with commands fed in by the pilot. Most fascinating to me is the heat-seeking Sidewinder.

At Eglin I watched a plane drop a parachute flare, and as it floated toward the ground, an interceptor two miles away loosed one of its slender nine-foot Sidewinders. Almost immediately the missile swerved toward the slow-moving flare and unerringly bored in. A sudden flash, and the flare was no more.

Screaming earthward at 500 miles an hour, an F-105 Thunderchief looses a salvo of 95 Mighty Mouse rockets. Each launching pod holds 19 of the 2.75-inch missiles. Air Proving Ground Center at Eglin, Florida, provides the target range.

Empty shells spew from the M-16 Colt automatic rifle (upper left) now in use in Viet Nam. Partly Fiberglas, the weapon weighs only 6½ pounds; the small .223-caliber bullet carries such power that it usually kills by shock alone. Twenty rounds can be fired in scarcely more than a second. Air Commandos, training at Eglin, wear broad-brimmed jungle hats, now accepted uniform in Southeast Asia.

Arsenal of firepower displays types of weapons carried aboard the F-4C Phantom II, fastest and most versatile tactical fighter-bomber now in operation. It can load eight tons of armament, choosing among 20-mm. cannon shells (outer row); rockets; red-nosed rocket launchers; napalm fire bombs; black 750-pound bombs; finned Bullpups (right), or slender Sidewinders (left rear).

DETACHRONE (OPPOSITE, UPPER) BY WILLIAM ALBERT ALLARD AND AVIARCHNUMES BY CHARLES KRISTOF © N.G.S.

The Sidewinder's secret lies in an infrared homing device, ultrasensitive to heat. Even a lighted cigarette passed in front of its nose will cause the guidance fins to move.

ADC's equipment has become so automatic that an ADC controller can punch a button and launch a flight of interceptor planes. As soon as they have left the ground, the controller can take over from the pilots through black-box magic known as SAGE, or Semi-Automatic Ground Environment system. With computers and a data-link radio system, the SAGE centers guide the planes to the enemy. They can arm the missiles, fire them, and return the interceptors to their bases.

"Little black boxes have taken over from the seat of the pants," one veteran pilot mused, rather sorrowfully.

Mystery Plane Outflies a Bullet

A long black monster of a plane, the Lockheed YF-12A (Y stands for prototype), may be the long-range interceptor of the future for ADC. Designed in deepest secrecy, it was unveiled briefly just a year ago and has been largely a matter of mystery since.

I saw the YF-12A fly at Edwards Air Force Base in California's Mojave Desert a few days after the XB-70's first flight. The contrast was remarkable. The XB-70 suggests a huge white charger. The YF-12A is smaller, only about 100 feet long, but it is black, sleek, ominous (pages 348-9). As it slipped past us close to the ground, its two engines throttled back, it seemed to whisper by. Then it sat on its tail, cut in its afterburners, and disappeared in an incredible burst of sound and speed. (An afterburner injects fuel into the hot exhaust gases to give extra thrust.)*

The YF-12A is the fastest ground-based plane ever built. (The rocket-powered X-15, of course, has hit 4,104 miles an hour, but it must be launched high in the atmosphere.) Built of titanium and other special heat-resisting materials, the YF-12A has flown 2,062 miles an hour—153 miles an hour faster than a .30-caliber bullet leaving a rifle.

It can range over most of the United States at an altitude of 80,000 feet, tracking several targets at once. In every sense it represents a breakthrough, as if man had suddenly learned to run a mile in two minutes.

Another mystery plane, the Lockheed SR-71, goes into operation late this year at Beale Air Force Base in California. Similar to the YF-12A but heavier, it will carry out world-wide strategic reconnaissance with the most advanced cameras, radars, infrared

*See "Flying in the 'Blowtorch' Era," by Frederick G. Vosburgh, GEOGRAPHIC, September, 1956.

EDACHROME BY NATIONAL GEOGRAPHIC PHOTOGRAPHER WILLIAM ALBERT ALLARD © N.G.S.

Underwater for hours in a rubber suit, an airman volunteer undergoes an experiment in weightlessness. Space scientists at the Aerospace Medical Division, Brooks Air Force Base, Texas, gather before-and-after physiological data. Tubes carry food and air.

devices, and other sensing gear ever built.

One infrared camera now in use can register differences of tenths of a degree centigrade. Its thermographs can show "shadows" on an airfield where planes were parked hours before, simply from the heat left in the ground. Another reconnaissance camera system can take pictures, develop them in flight, and parachute them to a front-line commander—all without being touched by the pilot.

Nothing that moves above the earth escapes ADC's attention. Its vast networks of radar and optical-tracking cameras watch constantly for missiles and planes and keep a steady electronic eye on every man-made object in space. This clutter now totals more than 600, some 160 of them payloads. The rest are space debris, burned-out rocket cases and fragments, still in orbit. At any moment ADC's Spacetrack organization can tell you exactly where to find each one.

And if an enemy satellite should appear in the heavens with a payload of nuclear missiles, President Johnson has announced that the Air Force is ready with an anti-satellite system that can intercept and destroy it.

The third of the combat commands, TAC—the Tactical Air Command—is the Air Force's lightning punch. TAC's fighter-bombers are no longer tied to fixed bases. With in-flight refueling, they can quickly go into action anywhere, bombing supply lines, strafing targets, giving close air support to ground troops, reconnoitering enemy positions. And TAC's superb Lockheed C-130 Hercules can airlift men within any theater or deliver cargo with clever parachute techniques that offload pallets as the plane roars by five feet from the ground.

Mental Blackout 15 Seconds Away

What is it like to fly in TAC's powerful supersonic jet fighters? I found out, but it was not a simple matter of walking out to the flight line and climbing into the cockpit.

To begin with, I had to take "altitude in-

doctrination," a course that all jet pilots and flight crews repeat every three years. At Andrews Air Force Base near Washington, D. C., I joined a class to learn the hazards and discomforts of high-altitude flight.

They taught me about hypoxia, the shortage of oxygen that insidiously deadens the brain. They put me into a low-pressure chamber to feel what it is like at 43,000 feet, where air pressure is reduced by five-sixths, and where a man loses consciousness in 15 seconds without extra oxygen.

I learned about g-force, the stress on the body when a plane makes a fast turn at high speed, and about pilots' g-suits that inflate to help counteract this stress.

They explained egress procedures—how to get out of a fast-moving jet whose engine has "flamed out," or failed. I learned how to trigger the ejection seat to explode me out of the cockpit in an emergency; how to deploy a parachute, control its descent, and land without breaking a leg; how to get into a life raft; and how to use the survival kit attached to each parachute.

Equipped with all this knowledge (which I bleakly hoped I would remember if the time ever came), I began flying in supersonic planes.

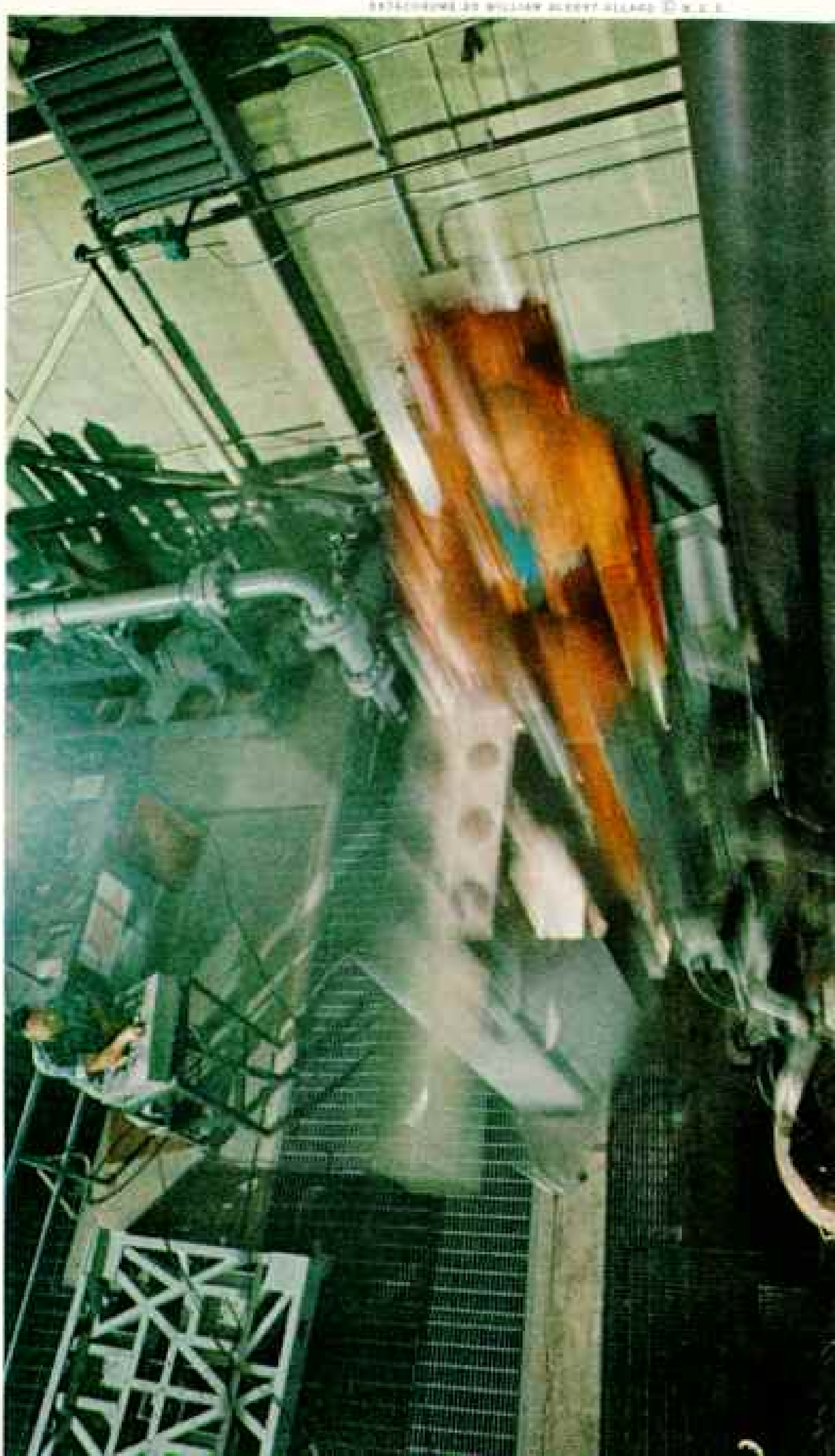
Sound Barrier All Velvet

At Eglin, home of the Air Proving Ground Center, I became a member of the select Mach-2 club, those who have flown at twice the speed of sound. The plane was the McDonnell F-4C Phantom II, TAC's newest (and, at 1,606 miles an hour, fastest) operational tactical fighter. My pilot, Capt. Clyde H. Garner, offered to show me what the twin-engine Phantom can do.

With full afterburners on, we shot off from Eglin's runway and turned on our tail for a maximum-performance climb. Gravity seemed to have lost its grasp on the plane, although it was ramming me into the back of my seat. The green-and-brown landscape receded so fast that I felt I was looking through the wrong end of a telescope. In 50 seconds we had climbed 20,000 feet, nearly four miles up.

Now we were over the Gulf of Mexico. Captain Garner said, "You ready? We're going to go supersonic."

Plunging downward in a blur of orange, an experimenter in a vertical decelerator at Wright-Patterson Air Force Base, Ohio, will jolt to a stop to test the body's ability to withstand g-forces.



Scramble!

IN GERMANY, at the huge Ramstein base, author Kenneth Weaver saw how U.S. Air Forces in Europe keep constant vigil:

"We sat upstairs in an alert barn [above] with four F-102's below us, all cocked and ready to go. Each pilot's parachute was in his cockpit as a backrest; his helmet was propped at the side of the open canopy, its oxygen mask and microphone already hooked up.

"Sitting around a table, pilots of the 526th Fighter-Interceptor Squadron—the 'Black Knights'—were telling me about the tension of patrolling so close to the East German border, only 130 miles away, and of the problems they have in flying down the three 20-mile-wide corridors through Communist East Germany to Berlin [shown, left, on radar screen at Berlin's Tempelhof Central Airport].

"'At times we have to help planes that are in danger of straying across the border,' one of the pilots was saying, 'because the Commies are spoofing them with spurious signals. They would love nothing better than to entice . . .'

"Suddenly, without warning, a horn blasted in my ear. Every man in the room shot to his feet. Two pilots grabbed jackets from wall hooks and disappeared down a brass firehouse pole [upper right]. I went in hot pursuit.

"I reached the nearest hangar stall in time to see the pilot fastening his harness and pulling on his helmet. The crew chief checked him over, removed the ladder, and—as the engine roared to life—pulled the wheel chocks and signaled with thumbs up.

"Down came the canopy. The pilot applied power, and the 'Big Deuce' began to taxi. All traffic had been cleared away, and a fire-wagon, with asbestos-suited men, had taken up station.

"Two minutes and 25 seconds: he was airborne, with another F-102 at his side [right], headed toward the Red border. Their assignment: to check on stray planes that *might* mean trouble."

Sound, at sea level, travels about 760 miles an hour. Until 1947 no one had ever gone that fast in level flight, and planes that tried it were shaken violently.

I expected at least some buffeting at this momentous threshold. To my surprise, the only way I could tell we had passed Mach 1 (the speed of sound) was by the instruments.

Now we were shooting for Mach 2. As we went faster, paradoxically we were also climbing, because as we used up fuel our weight decreased and we could operate more efficiently at higher altitudes.

Mach 1.7 . . . Mach 1.8 . . . Mach 1.9. Still we went faster. Out the window I could see the vents in the air intake opening wider to gulp in more and more air. Finally, at Mach 2.1, nearly 1,400 miles an hour, Captain Garner eased up on the throttle. The afterburners went out, and I slumped against my harness as the plane abruptly slowed.

In just three minutes we had climbed from 37,000 feet to 43,000, traveled 60 miles, and used up several thousand pounds of fuel!

Phantom Goes Both Fast and Slow

TAC's pilots think the world of the F-4C, although they laugh at its undeniably peculiar appearance.

"It looks as if somebody had got it halfway out of the hangar and shut the door on it," one said. "It's bent in the middle, its wings go up, its tail goes down, but it flies wonderfully. It's like a baby carriage; you really have to work at it to hurt yourself."

The F-4C is fast enough to follow Gemini boosters roaring up from Cape Kennedy. Yet it can also loiter better than any other operational jet, at 130 miles an hour, a speed that is handy for flying protective cover above slow planes and helicopters, or for striking at elusive jungle targets.

The secret is "boundary layer control." By forcing hot engine-compressor air over the wing, the air next to the wing is prevented from sticking and dragging, and lift is therefore increased.

"You fool the wing into thinking it is flying faster than it really is," a pilot told me.

Phantom II can carry upward of eight tons of bombs, twice the load of the B-17 of World War II (page 332). It handles any of TAC's weapons: rockets, missiles, napalm, and the truly remarkable Vulcan Gatling gun. This 20-mm. cannon spews out 100 rounds a *second*, with the most vicious rasping sound I have ever heard. The three-inch-long bullets fly in a tight stream that cuts like a saw. Pilots call the Vulcan "an overgrown six-shooter," because of its six barrels that rotate into place one by one.

At the Mito Air-to-Ground Gunnery Range near Yokota Air Base outside Tokyo, a pilot of the Pacific Air Forces put me through the paces of weapons delivery. Zippered tightly in a g-suit, I flew in an F-105 with Capt. Roderick

Occidentals taking to Oriental ways, Maj. Leonard A. Hughes, Jr., and his family welcome their Japanese neighbor-landlord and his wife to their home for tea. Kimono-clad youngsters kneel on pads by the table. Major Hughes, a staff officer for the Pacific Air Forces' 441st Combat Support Group at Yokota Air Base near Tokyo, believes that adapting to foreign cultures strengthens American ties with other lands.

Flashing Super Sabres, part of the U. S. Air Forces in Europe, thunder across Tripoli, Libya. These F-100's, like all USAFE fighter planes, come to nearby Wheelus Air Base twice a year for desert gunnery practice.

The Marine Hymn recalls a march to "the shores of Tripoli" in 1805; naval history records Commodore Stephen Decatur's battle with the Barbary pirates in this harbor.

Row of toes of a huge reclining Buddha intrigues off-duty airmen at Bangkok's Wat Po. Stationed in Thailand, they help train the Thai Air Force.

ILLUSTRATIONS BY NATIONAL GEOGRAPHIC PHOTOGRAPHERS EMORY KRISTOF (ABOVE) AND ROBERT MOSKOWITZ © N.G.S.

G. Beckett of the 36th Tactical Fighter Squadron, whose men since 1931 have called themselves the "Flying Fiends."

From far above, we could see other planes from the squadron flashing across the target, with bursts of fire brightening the bull's-eye on the ground. Then came our turn.

How It Feels to Weigh 800 Pounds

We rolled in at 7,000 feet and screamed downward 750 feet a second. I swallowed hard to keep my ears clear with the rapid change in air pressure. At 3,000 feet Beckett hit the "pickle button," the little red knob on his stick that sends the bomb on its way. Then he pulled back sharply on the stick, but so fast were we moving that only 1,500 feet and two seconds remained between us and oblivion when we turned upward again.

The g-meter jumped and hung at 4½; a crushing force slammed me back into the seat. My arms had turned to lead. I could hold them up only with painful effort. My body now weighed nearly 800 pounds.

Over and over we slashed at the target, strafing and dive bombing. But the ultimate sensation came with a skip-bombing run.

The target for skip bombing is laid out like a fence, to be hit on the fly by a bomb bouncing along the ground. In this maneuver we thundered across the Japanese countryside at 460 miles an hour, only 50 feet high, in perfect coordination of man and machine. We moved so fast that the landscape blurred and I could only sit transfixed in disbelief. So intimately did we ride with disaster that I welcomed the unpleasant smash of g-force when we turned once more to the sky.

KODACHROMES BY KENNETH F. WEAVER AND J.GYPSOLITE) EMORY KRISTOF © N.G.S.

I turned from skip bombing to ocean hopping, reporting to Homestead Air Force Base in Florida. A midnight rain squall whipped the palm trees as I pulled on heavy boots and thermal underwear and a winter flying suit, strange clothing for the subtropics.

TAC Fighters Vault an Ocean

But warm clothing was necessary—I was going with the men of the 307th Squadron of the 31st Tactical Fighter Wing on a rotational flight across the Atlantic to Çiğli (pronounced chee-lee) Air Base near İzmir, Turkey. There they would stay for at least three months, replacing the 306th Squadron that had finished its turn standing alert as part of USAFE, the United States Air Forces in Europe.

I was going in the back cockpit of an F-100 trainer, and the Air Force had told me that no other civilian writer had ever undertaken such a flight. The stories I had heard made the trip sound gruesomely uncomfortable: We would be stuck in our cramped cockpits for nearly nine hours.

It used to be "Kick the tires, light the fires, the first man in the air is the lead!" But no more. Plans for this flight had begun at least a month before.

At our briefing earlier in the day, the weather officer had said the outlook was good. The operations officer had outlined the schedule for five refuelings over the water until we reached Morón, Spain, near Seville, where we would stay overnight.

The flight surgeon had reminded us to watch for signs of altitude sickness—deepened breathing and delayed reaction time. He had reviewed the use of the survival kit in case we had to bail out. Each man carried flares, signal mirror, and a portable transmitter for emergency use.

Our flight number was Fox Able 172. My pilot was Capt. Steve Braswell, 30, one of the sharpest in the wing. He had already made eight rotational flights to Europe.

The rain had slackened by 2 a.m. when Braswell and I drove out to the flight line. Some of the planes, glistening in the floodlights, were already running up with a whistling roar; their hot breath hit us in the face.

Hunched over by the tightness of my parachute, I eased into the cockpit and strapped myself in. Braswell told me to pull the safety pins from my ejection seat so it could fire if we should have to bail out.

Two Planes Fly as One

On the runway we took our place in the formation just to the right and slightly behind the squadron commander, Col. W. M. Sullivan. Our canopy clanked down and locked with a sudden pressure in our ears.

"Release brakes!" Sullivan called. His plane and ours moved as one.

"Afterburner . . . *now!*" A 20-foot tongue of flame shot from the tail of Sullivan's plane ahead, and a violent blast shook us. I felt a kick in the seat from our own afterburner. I swallowed hard. We were on our way.

Unbelievably, our two planes moved in perfect concert, lifting from the ground, pulling up landing gear, and cutting off afterburners at exactly the same moments. Our wings were no more than 20 feet apart.

As the air conditioning abruptly dropped the temperature of the warm, humid air, a momentary snowstorm filled the cockpit. We saw the lights of Miami to the north; then we

Saddlesore and weary, the author eases out of the rear cockpit of an F-100 jet fighter after 12 hours of flying to Spain and Turkey. He accompanied the 307th Tactical Fighter Squadron deploying from Florida's Homestead Air Force Base to Çiğli Air Base, near İzmir, Turkey, where it became part of the U. S. Air Forces in Europe.

Weaver is the first civilian writer to make the grueling flight. Gathering material for this article, he spent 220 hours in the air, flying in most types of Air Force combat craft.

Over the Atlantic (opposite, upper) the author's camera catches a wing partner refueling from a KC-135 jet tanker. The writer's pilot jockeys into position for refueling (lower). He centers on a red line under the tanker, aiming his probe for the basket at the end of the tanker's flying boom (right).

pulled into the ghostly glow of a cloud bank and the other planes joined us. The formation wheeled through the sky in a kind of grand gavotte.

My memories of that 8½-hour flight are chiefly pleasant ones: The surge of sheer joy as we roared down the runway and took to the air; the beauty of the night sky above the clouds, and the soft arrival of daybreak, seen from so marvelous a vantage point; the clouds lying heavy on the ocean, reminding me of Antarctic snow and ice; the unmitigated pleasure of seeing Gibraltar to our right and the olive groves below, and knowing that we had arrived safely; the thrill of the pitch-out, the maneuver by which we turned smartly on our sides and slipped down in formation for the landing at Morón.

Our plane had no trouble at all, no emergencies, although two other F-100's dropped out at Bermuda with refueling troubles.

But when I read my notes now, I realize that I have forgotten a thousand and one discomforts, all too real at the time—discomforts that every TAC pilot lives with.

"Feel as though the plane is strapped to my back," I wrote. "Throat burns from the oxygen . . . ear itches, can't get to it . . . head

Frigid frosting on a KC-135 disappears under a bath of de-icing fluid at Offutt AFB, SAC's headquarters. The maintenance man, one of 250,000 in the Air Force, prepares the plane for a flying command-post mission.

SUBSCRIBERS BY NATIONAL GEOGRAPHIC PHOTOGRAPHERS GEORGE F. MOBLEY (ABOVE) AND BRUCE DALE © N.G.S.

Runway inferno gives way under the powerful rotor wash of an HH–43B Huskie helicopter. Two asbestos-clad firemen, spraying foam on flames, move in for a practice rescue at Andrews AFB, Maryland. A fire-deflecting Huskie helped save two of three crewmen in the crash last June of a B-58 at the International Air Show in Paris.

sweats, helmet pulls hair, now I know why pilots wear crew cuts . . . straps dig in my collarbone . . . noise unrelenting, like high-pitched humming in a generator room . . . seat hard . . . mask oppressive . . . back muscles ache. . . ." And so it went for nearly nine hours.

Numbness Comes as a Blessing

Braswell was worse off than I was because he dared not relax. The F-100 is a tough plane; the pilot has to fly it every minute.

"You feel worst about the third hour, then you get numb," he told me. "After that it's sorta like coasting."

He was right. But I have new respect for the TAC pilots who endure these discomforts on every flight of more than an hour or so.

One can easily become so engrossed in the glamor of the Air Force that he forgets one all-important fact: Behind each plane and pilot are hundreds of earthbound men, unseen and often unsung; without them, not a plane would leave the ground.

The story of the Air Force is not just SAC and TAC and ADC. It is also the Air Training Command, which each day takes a new group of bewildered youngsters at Lackland Air Force Base, Texas, shears off their civilian locks, shoots their arms full of vaccine, and begins the process of making them men. Six weeks later it graduates a smart-looking group of new airmen, ready for an Air Force job or for technical training that costs, for an electronics specialist, as much as $9,000.

A measure of the high level of this training is this fact: Few who are not high-school

graduates now enter the Air Force, and only college graduates are eligible for officer training.

"We don't want as many tigers in the Air Force as we used to," Col. Clarence A. Martin, Jr., deputy director of flying training at Randolph Air Force Base in Texas, explained. "Nowadays we build the tiger into the airplane and train the men to control it!"

The story of the Air Force also includes the Air Force Academy, high in the Rockies near Colorado Springs, where the heart of the future officer corps is given a splendid education combining scientific training with the humanities, and where mascot falcons fly at every football game (pages 346-7).*

And there is the Logistics Command, the Sears Roebuck of the Air Force, which provides the nuts and bolts, the typewriters and guns, the fuel and clothing and fire extinguishers, and all the other horseshoe-nails for want of which a war would be lost.

At Clark Air Base in the Philippines, PACAF's logistics

*See "Where Falcons Wear Air Force Blue," by Nathaniel T. Kenney, NATIONAL GEOGRAPHIC, June, 1959.

Fiery afterburner etches a trail of light as an F-102 takes off on a practice interception at Hickam AFB in Hawaii. Runway and night-maintenance lights blaze throughout the night. Hickam, headquarters of the Pacific Air Forces, is "Crossroads of the Pacific"—major staging depot and refueling base for the immense traffic to Southeast Asia.

Haze of smoke veils the silver snouts of the "Flying Tigers," an F-105 squadron running up its engines at Hickam. Pilots, preparing for practice bomb runs, pull on helmets, crew chiefs make final checks, and powerful engines—started by black-powder charges—shake the airstrip with ear-splitting sound. The squadron, on temporary duty in Hawaii, operates out of McConnell AFB in Wichita, Kansas.

Eighty pounds of fury discourages intruders at Naha, Okinawa. Some 2,200 German shepherds, whose jaws can crush with 500 pounds of pressure, guard sensitive areas on bases.

KODACHROME (LEFT) AND EKTACHROMES BY ALBERT MOLDVAY © N.G.S.

center in Southeast Asia, I saw warehouses and huge supply dumps stocked with more than 153,000 different items, an inventory worth more than $33,000,000. And at Kelly Air Force Base in Texas I watched mechanics work on 13 monster B-52's at a time in a Logistics Command hangar large enough to accommodate 12 football games.

Add to these branches the Aeronautical Chart and Information Service, which produces target materials and navigation charts by the millions, including maps of the moon. The Continental Air Command, which supervises the Air Force Reserves and the Civil Air Patrol. The Security Service, which monitors communications and guards them against eavesdroppers. And the theater commands, USAFE in Europe, PACAF in the Pacific, the Southern Command in Central and South America, and the Alaskan Command.

MATS: The 1,000-Plane Airline

Nor can one overlook three other vital functions of the Air Force: transport, rescue, and research.

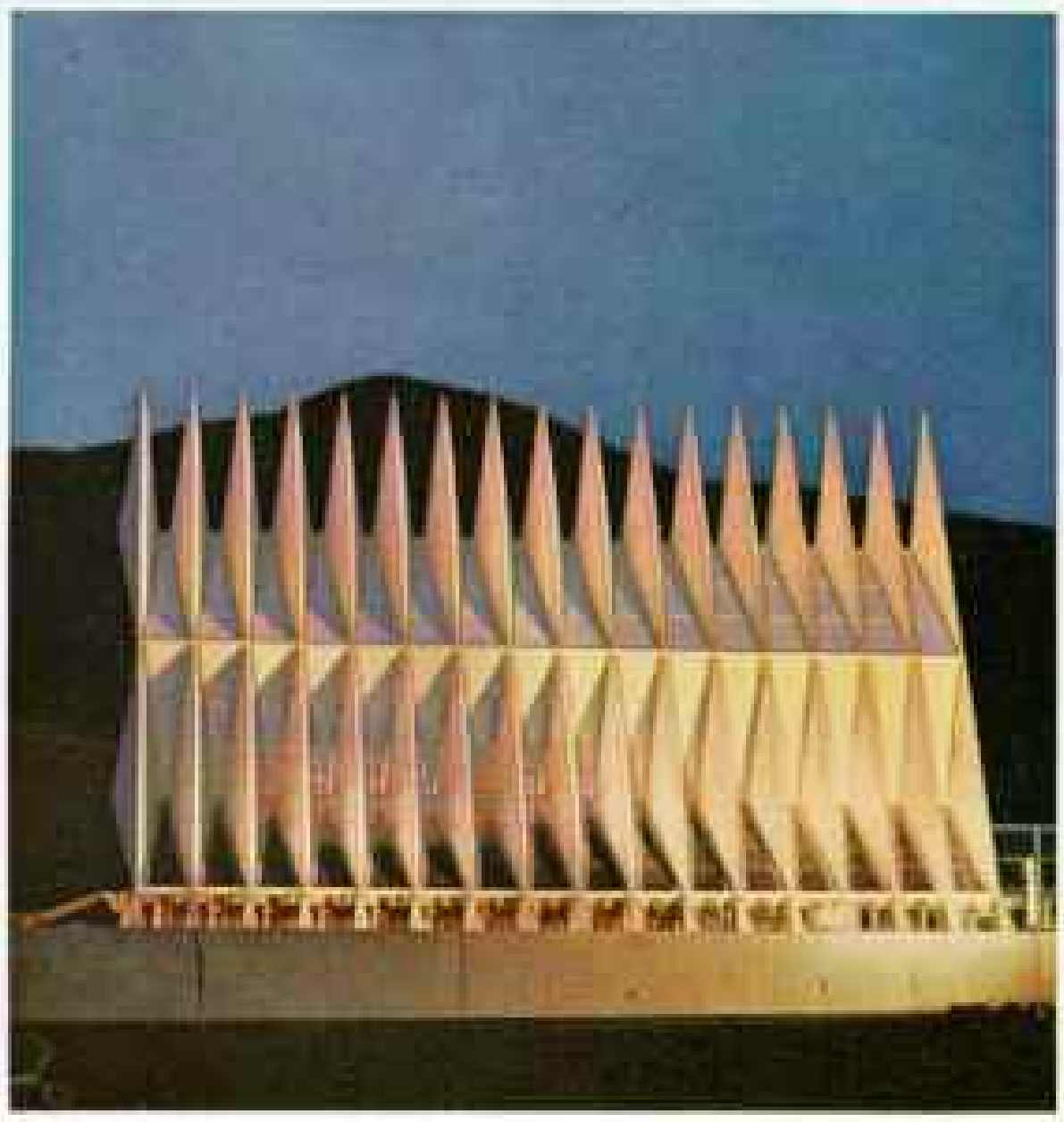
MATS, the Military Air Transport Service, is the most far-flung military organization in the world, with 90,000 people and more than a thousand aircraft, some 600 of them transports. I saw its black-snouted carriers at every base I visited, and rode parts of its 160,000-mile globe-girdling network.*

MATS knows little difference between war and peace. Does a battalion of Marines need to be airlifted to the Pacific? Does the State Department want a rush airlift to evacuate Congo refugees? Or does a scientific expedition on an ice island near the North Pole need fuel airdropped? MATS gets the job.

"Old Shaky," the Douglas C-124 Globemaster, is MATS' workhorse at the moment, but its role soon will be taken over by the Lockheed C-141 StarLifter, a big, fast jet. Gen. Howell M. Estes, MATS commander, estimates that on a supply run from Texas to Japan the new plane will save $500 a ton and cut flying time from 43 to 17 hours, with larger payloads and less maintenance.

Repeatedly I ran into MATS' specialized activities of aeromedical evacuation, air rescue, and weather forecasting. Every flight I made in a military plane was safeguarded by weather forecasts for the route. MATS' Air Weather Service makes more than 3,000,000 such forecasts annually, besides chasing typhoons and hurricanes to predict their paths,

*See "MATS: America's Long Arm of the Air," by Beverley M. Bowie, GEOGRAPHIC, March, 1957.



Gleaming tetrahedral spires soar 150 feet on the Air Force Academy's all-faith chapel, below the Rampart Range near Colorado Springs.

Soft floods of color from aluminum-framed stained-glass panels wash down on Protestant worshipers. Simultaneously, a priest and a rabbi can conduct services in two other halls. The three chapels accommodate 1,500.

Tucked-in chin marks the "doolie," or first-year cadet, at the "aerospace university." When expansion plans are completed, the academy will enroll 4,400 future officers, giving them a foundation in both humanities and sciences. Flight training comes later for those qualified.

KODACHROME (YELLOW) AND EKTACHROME BY RAMEY KRISTOF, © N.G.S.

and sampling radioactivity in the atmosphere to check other nations' atomic tests.

MATS' Air Rescue Service stationed search and rescue planes along our Atlantic route for the F-100 rotational flight to Europe, just as it does for any such overseas movement, flight by dignitaries, or space flight by Gemini astronauts. Its humanitarian rescue work during natural disasters has earned gratitude from countless people all over the globe.

On Air Force bases around the world, the Air Rescue Service keeps on alert a fine crash-rescue and fire-fighting helicopter, the Kaman HH-43B Huskie (page 307). If a homecoming fighter plane fails to pop its drag chute (used to slow it down after landing) and its overheated brakes present a fire hazard, this little bird hovers immediately above it, its twin rotors forcing down 55,000 cubic feet of air a minute. The brakes are cool enough to touch within four minutes.

Or, as I found out when I rode in one of the Huskies, its crew can hover beside a burning plane, blow the heat away from the cockpit, and drop two asbestos-suited fire fighters who foam a path to the plane and carry an injured pilot to safety (pages 342-3).

Last of the major functions of the Air Force, its scientific and research and development work, is assigned to the Office of Aerospace Research and the Air Force Systems Command. Literally hundreds of research projects are under way at any moment, many of them filled with the most far-reaching implications for man's future.

USAF Scientists Probe Many Fields

I found scientists and engineers working on every aspect of space: radiation hazards; sunspots; tiny ion engines for extended space travel at speeds as great as 100,000,000 miles an hour; Titan IIIC, a huge new space booster for putting 25,000 pounds into earth orbit; new kinds of solar cells for space energy; and the Manned Orbiting Laboratory (MOL) that the Air Force hopes to loft sometime in the

Black brute of a plane, the YF-12A holds the world's speed record, 2,062 miles an hour, and the altitude record for horizontal flight, 80,000 feet. The SR-71, a new plane similar to the YF-12A, goes into operation this winter as a highly advanced reconnaissance craft.

future (page 318). I learned that in the past four years Air Force scientists have launched well over 100 secret payloads into space.

I saw a machine that can translate 70,000 Russian words a day. I saw jet engines being tested in a huge refrigerated hangar at -40° F. and in wind tunnels that blast with Mach-20 hurricanes. I saw the world's fastest camera —firing at a rate of 100 *million* frames a second—and a fantastic new microwave radio-radar system, called Haystack, that can track a .22-caliber bullet a thousand miles away.

And I fired the world's smallest rocket motor, measuring half the size of a pencil eraser. It is strung on tapes like caps for a cap pistol, and each cap provides a tenth of a pound of thrust for one hundredth of a second —enough to nudge a spacecraft in flight.

The new look in aviation is reflected in the extensive work being done in V-STOL craft —those designed for vertical or short take-off and landing. One of the most promising is the LTV-Hiller-Ryan XC-142 now being flight-tested at Edwards. It turns its entire wing and propeller assembly upward to lift straight off the ground.

Maj. Gen. Irving L. Branch, commander at Edwards, told me that within another year he expects more than a fourth of the workload at Edwards to be the testing of V-STOL craft.

Dedicated Men Ignore Hardships

Fantastic machines and planes, powerful rockets, the mysteries of space—all these make life in the Air Force sound glamorous and exciting indeed.

But are these rewards enough, I often wondered, to keep a man in the service? Do they balance the hardships and outright dangers? Do they make up for the drudgery of long hours at which most civilians would rebel? Do they compensate the men in TAC who must be away from home half the year and more? Or their wives who must stay behind, wrestling alone with the problems of family and finances?

I sought answers to these questions wherever I went—sitting over coffee in alert shacks, in conversation during long flights, visiting in the homes of Air Force families.

The answers do not come easily. Men of action are not always glib of tongue, and they are often embarrassed to talk of altruism or dedication. But there is a pattern to the responses. Perhaps better than most of us, Air Force men and wives understand the threat to the peace. They know, as General LeMay points out in his introduction, that the way to peace lies in strength, and they mean to maintain that strength.

One officer, who gave up a highly paid job to come back to the Air Force, spoke of the deep satisfaction in what he is now doing, of his sense of obligation to his country.

Another said, "More than ever before in my life I feel I'm accomplishing something worthwhile. I may be a little cog, but I'm turning a lot of big wheels down the line!"

And an airman put it in the simplest of terms: "I feel like I'm promoting Uncle Sam."

You may call it what you will, but it adds up to patriotism. THE END

The Alps

MAN'S OWN MOUNTAINS

By RALPH GRAY
Chief, National Geographic School Service

Photographs by WALTER MEAYERS EDWARDS
National Geographic Staff
and WILLIAM EPPRIDGE

I AM SURROUNDED by a world of ice and sun. Above me a single glistening peak appears to prop up the sky. Below me stretch dizzying space and the jeweled miniature of an Alpine village, set in a jade-dark valley.

Like the mountaineer at right, I am captivated by this world, the majestic Alps of Europe. But while he has risked life and limb to reach it, I have arrived without taking a deep breath or a single chance.

The peak that looms so near is western Europe's highest, 15,771-foot Mont Blanc. The village in the valley below: Chamonix, France. Close by, on a plateau of perpetual snow called the Vallée Blanche, hundreds of summer skiers ride the tows and briskly skim the runs. Other hundreds of mountain lovers, like us, simply soak in the crisp air and warm sunshine.

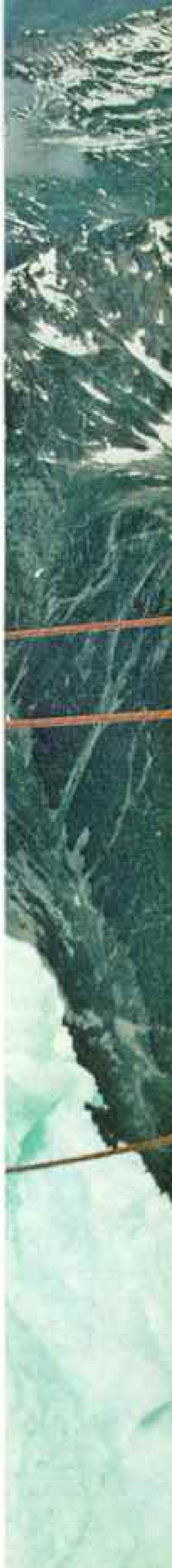
We—my family and I—had reached the Aiguille du Midi, an icy shoulder of the Mont Blanc Massif, aboard a multiwindowed cabin of the loftiest cableway in Europe. Such spidery conveyances, together with many fine Alpine highways, now bring tens of thousands of visitors each year to the high reaches of the Alps. For the peaks no longer belong only to the climbers, the rugged Alpinists who first tamed them.

Mont Blanc was one of the first conquered, climbed in 1786 by Dr. Michel Paccard and Jacques Balmat, both of Chamonix. And just a hundred years ago, on July 14, 1865, another titan fell—the Matterhorn, scaled by an Englishman, Edward Whymper. Now in 1965, the "Year of the Alps"—so designated by Switzerland to commemorate the centennial of Whymper's ascent—skiers and mountain watchers, like myself, far outnumber the climbers.

Still, as we viewed the Alpine panorama from the Aiguille du Midi, antlike climbers were at work, accepting the brutal challenge of mute stone wherever pinnacles of rock thrust through the snow. We later learned that two men overmatched themselves that day and died on the challenging heights. The previous year 74 climbers perished in the French Alps alone.

"Why don't you post danger warnings at the beginning of popular trails and make all climbers register?" I asked André Contamine, instructor in the unique French national mountaineering school at Chamonix.

"You don't know the French," he replied. "Restraints or warnings only



Like a spider on gossamer threads, a mountain climber high above Chamonix, France, inches across a void between two needles of ice in the Mont Blanc Massif, pinnacle of western Europe. Glittering tiara of six nations, the many-faceted Alps displayed their jeweled peaks and summery vales to the author and his family during a three-month tour.

challenge us all the more!" Safe climbing, André explained, is done with guides. If you are inexperienced but sound of wind and pocketbook, you can start with a guide on simple climbs and eventually yodel from the highest needle in the neighborhood. The Guides of Chamonix, a company formed in 1823, are among Europe's proudest and best.

Mountain Tour Begins at Sea

But, as I say, my love for the Alps takes a gentler form. At summer's start, I had embarked on a tour that would show me and my family many facets of these magnificent mountains. We would discover for ourselves why man for centuries has succumbed to the lure of the Alps.

First we drove to the French Riviera. There amid palms and bougainvillea, dark rocks slant upward out of the Mediterranean, and the Alps begin their irresistible inland tide—a tide that ends in the great crests of Mont Blanc, Matterhorn, Jungfrau, and Gross Glockner (see double Supplement Map, **Switzerland, Austria, and Northern Italy,** distributed with this issue).

As we skimmed along the Côte d'Azur on one of the speedy hydrofoil cruisers that ply between Sanremo and Cannes, the mountains seemed like a wave about to break over the line of gleaming dwellings along the coast (above). These were the Maritime Alps, the first of range on range that curve north and east—growing higher and whiter as they encompass northern Italy and spill into Switzerland, Austria, Germany, and Yugoslavia.

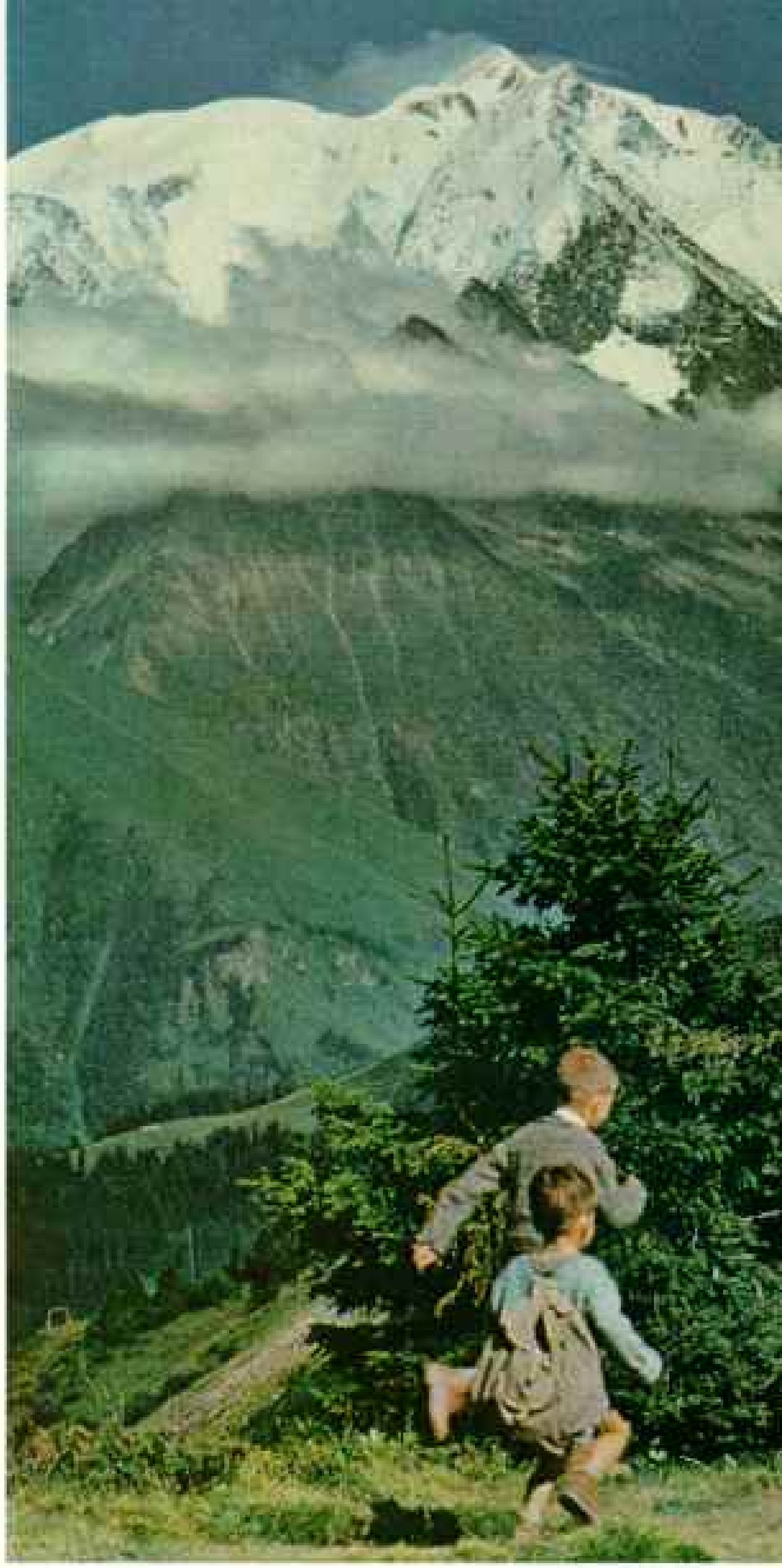
Skimming on stiltlike fins, the hydrofoil boat *Azure Flying Fish* froths the Mediterranean at 40 knots off Nice in the lee of the Maritime Alps. Two such seagoing expresses shuttle passengers between Sanremo, Italy, and Cannes, France, with stops at Menton, Monaco, and Nice.

Alpine cableway lifts the author and son Will above the precipitous Arve Valley, a gem bordering the Mont Blanc Massif. In the distance, Mer de Glace (Sea of Ice) Glacier drapes a shoulder of Mont Blanc.

Like a mouse in a maze, a car winds across the 9,085-foot-high Col de l'Iseran, loftiest highway pass in the Alps. Snowplows, biting through 30-foot drifts, open the pass about mid-June each year, leaving sheer walls of compacted snow.

Scalloped skyline of 15,771-foot Mont Blanc (left) and its companions—Dômes de Miage (center), La Bérangère, and Mont Tondu (right)—attract visitors to this favorite outlook on Mont d'Arbois (foreground). Rutted road leads to an Alpine inn. A prize offered in 1760 by Swiss scientist Horace Benedict de Saussure to the first conqueror of Mont Blanc had no takers until 1786. That year two climbers from Chamonix, Dr. Michel Paccard and his guide, Jacques Balmat, reached the top. De Saussure, regarded as the first patron of mountaineering, scaled the peak in 1787.

Telescope tour of Mont Blanc satisfies "armchair climbers" at Chamonix. On a clear summer day, spectators follow the strenuous efforts of dozens of mountaineers on needlelike peaks above the town. Mark Twain "scaled" Mont Blanc by telescope, but only, he wrote, after asking if there was any danger.



During the next ten weeks and 3,000 miles we would see them all—my wife Jean and I, and our children, Will, 17, and Donna, 8.

In Monaco, Serge Bertino started us off with good advice. General Secretary of the Oceanographic Museum, Serge serves as Capt. Jacques-Yves Cousteau's right-hand man. But he was born and raised in the Alps and knows them intimately.

Flocks Migrate to Higher Pastures

"Spring was almost a month late," Serge said. "If you hurry you may still see sheep moving to high summer pastures. 'Transhumance,' we call it, truly an Alpine spectacle."

Serge was a good prophet. Heading inland, we had traveled no more than 50 miles before topping a 7,382-foot pass, the Col d'Allos, and overtaking hundreds of migrating sheep among the snowbanks (pages 360-61). In areas exposed to the sun the snow had recently melted, revealing pastures of fresh green grass —the object of the transhumance.

"We are from Castellane," said Yves Collomp, one of the shepherds. "There the hills become too dry for summer grazing. So we are moving the sheep to higher ground where the grass is sweeter. We shall pass the summer near Barcelonnette."

It was early morning. The flocks had spread over the green summit overnight, and now alert, businesslike little dogs were swiftly massing them on the road again. My son Will and I left the car, waded into the sea of wool

KODACHROMES BY WALTER MEAYERS EDWARDS, NATIONAL GEOGRAPHIC STAFF © N.G.S.

and bobbing heads, and followed along. The three shepherds took turns driving a Citroën jalopy that carried their modest supplies.

In a bedlam of baas, bells, and barks, we entered Barcelonnette. For several days we encountered other noisy flocks on the move.* They were following our pleasant winding, up-and-down highway, the summer route the French call La Route des Grandes Alpes. Finally all the animals found their grazing grounds and left the road to us.

In many a spot, in the course of the summer, we had the Alps to ourselves. We went for days without hearing English, though half a million Americans were seeing Europe with us. And we crossed national borders almost as often as we pass from state to state at home.

A grizzled sheepherder on the French slopes of Monte Viso remarked, "My relatives live on the Italian side. We visit back and forth. The border makes nothing. French, Italian, *c'est égal*—it's all the same."

We prized these meetings with the Alpine people—farmers making hay in meadows, villagers gathered round water troughs, children smiling from geranium-bordered windows.

No one knows when the first primitive peoples began settling in Alpine valleys, or when they first took cattle to high summer pastures which they called "alps." The Romans discovered and used the easiest passes in their

(Continued on page 359)

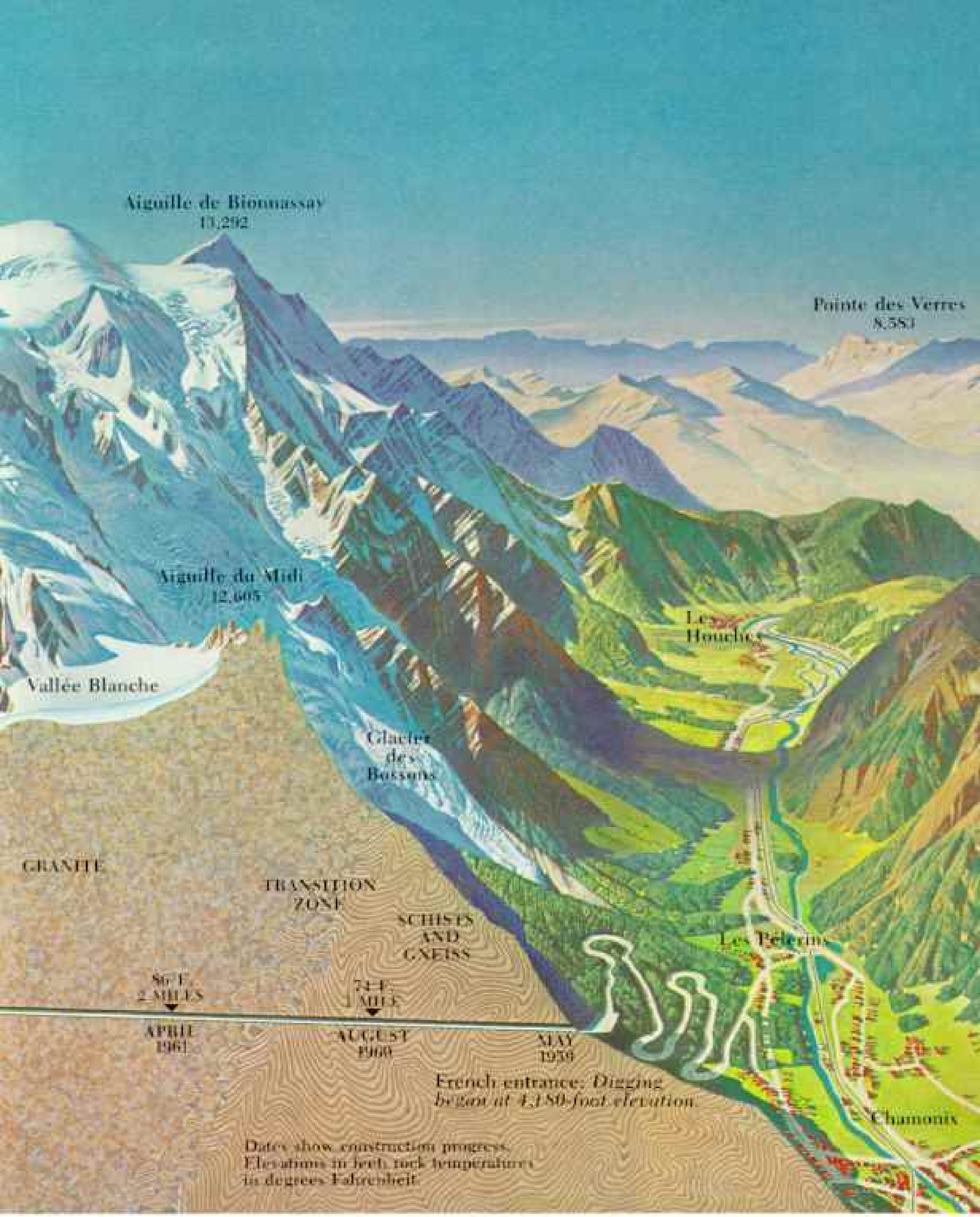
*See "Sheep Trek in the French Alps," by Maurice Moyal, NATIONAL GEOGRAPHIC, April, 1952.

Mont Blanc

WITH TUNNEL IN PROFILE

WORLD'S LONGEST HIGHWAY TUNNEL, a 7.2-mile Alpine tube pierces western Europe's highest mountain. Burrowing beneath the glistening icecap of Mont Blanc, the 31-foot-high horizontal hole runs from France's Haute Savoie southeastward to Italy's Valle d'Aosta. Dedicated last July, the tunnel makes an all-weather route of the most direct road between Paris and Rome. In its first year of use some 450,000 vehicles and 100,000 tons of cargo are expected to pass through.

To build this engineering marvel, French and Italian miners gouged out enough rock to build a sidewalk from Paris to Baghdad but paid a high



price in lives and toil. Tons of crumbling rock crushed the Italians' three-story-high driller. A miner died when a torrent of glacial water shot out of the rock and drove a metal bar through his body. Avalanches buried the Italian camp and killed three men. Falling granite delayed the French when they were only 50 feet from mid-point.

The Italians reached mid-point first; the French met them eleven days later, on August 14, 1962. So well had the two task forces done their jobs—each contracted to dig half the tube—that they were off only nine inches at the junction.

Temperatures rise toward the tunnel's heart, except for a zone two miles from the Italian entrance, where icy seepage from Toula Glacier, directly above, drops readings into the 50's.

Eleven-foot-high passage beneath the roadway carries fresh air, exhaust, and drainage water.

Puffing and panting, iron-legged Tour de France cyclists approach the Col de l'Iseran. Police on motorcycles escort the athletes on their 2,500-mile race across the mountains and valleys of Europe. A car follows with spare bicycles. The route varies each year, but usually traverses part of the Alps. The winner of this hotly contested international event receives a hero's acclaim.

Feet flying, Auguste Chenal gallops his handcart down a steep road in France's Valley of the Isère. His mother perches atop the load of brushwood to keep it from spilling during the giddy ride. Frugal Alpine folk glean fuel from mountain forests to heat homes.

conquests. To them, *mons* meant both pass and mountain.

Early settlers and the no-nonsense Romans ignored the peaks. These are an interest of modern man, who uses both "alp" and "mount" to refer to the heights.

But the Romans left their mark. At La Turbie, our Volkswagen Microbus climbed the skyline high above Monte Carlo to the Trophy of Augustus—called also the Trophy of the Alps—a monument built in 6 B.C. Here armies of Caesar Augustus crossed the Alps and, finishing the job started by Julius Caesar, subjugated the Alpine tribes—46 of them, according to the trophy inscription.

Even in ruins, the trophy, once faced with marble and alabaster, rises 115 feet. It looks out over the palm-shaded Riviera on one side, the first upthrust of the Alps on the other. Originally, a circular colonnade supported a heroic statue of Augustus flanked by captives, giving the monument a height of 164 feet.

After the legions of Augustus had pacified the Alpine region, this pass became a highway through which Roman influence flowed into what is now France and Germany.

Hannibal's Route Remains a Mystery

Our Microbus bobbed up and down the steep grades like a red Yo-yo as we pushed deeper and deeper into the Cottian Alps. Here, in the shadow of snow-capped Monte Viso, Will and I spent a day on foot, trying to reach the Col de la Traversette. This pass through a jagged highland, near the source of the Po River, is believed by some historians to be the place where the Carthaginian general, Hannibal, crossed the Alps with his elephants in 218 B.C. to battle the surprised Roman armies.

We surmounted one grassy height after another, and by midafternoon had to admit that our objective seemed as far away as ever.

Will doubted that we were on the right course. "I haven't seen any elephant tracks," he said with a straight face.

There are differing theories about Hannibal's route. I thought of a comment ascribed to Mark Twain: "The researches of many antiquarians have already thrown much darkness on the subject, and it is probable, if they continue, that we shall soon know nothing at all."

But we were learning more and more about the Alps. Though old in man's history, these mountains are young in earth time, still forming as recently as 70 million years ago. Not long before that, the skyscraping ranges—almost piling on top of one another—were mud on a sea bottom. At the University of Grenoble I saw a collection of large ammonites—fossil sea shells—some of them two feet across, that had been found in the Alps.

As time went on, pressures from land masses squeezed the silt deposits into stone and crumpled them upward, ammonites and all. Then earth's great forces relaxed, leaving an 80,000-square-mile region of soaring peaks and great glaciers, icy lakes and green valleys—an area that has invited man to settle, challenged invaders to cross, and today compels visitors by the thousands to look and climb.

By now we were climbing the great stairway to the Graian Alps—Col du Lautaret, Col du Galibier, and finally Col de l'Iseran, at 9,085 feet the highest Alpine highway pass.

Haying means fun for the children, work for their elders in the Val d'Hérens, Switzerland. Farmers harvest the steepest slopes, gathering forage for animals that must live out winters in barns and sheds.

We had learned that the Tour de France would soon come pumping over this bleak, snowbanked pass. The best cyclists of Europe gather every year for a 2,500-mile, three-week grind that covers much of France. The winner becomes a national hero.

"Next to De Gaulle, the Tour de France is *le plus important* . . . how you say . . . the most, the greatest," our innkeeper told us. "It is like your World Serious!"

We arrived early, but although the first of the cyclists were not due to pass until afternoon, the Col de l'Iseran already was covered with cars and excited family groups eating picnic breakfasts. On a narrow ledge between the highway and the abyss below, a cluster of men from Geneva whiled away the morning playing *pétanque*, a form of bowling. At noon they washed tomatoes and lettuce in a stream and tossed a salad for lunch. From a snowbank they pulled bottles of wine, nicely chilled.

A caravan of sound trucks blaring the virtues of apéritifs, tires, and sporting goods came by, followed by motorcycle gendarmes clearing the crowd from the highway.

Finally, at 3:30 p.m., the racers appeared, singly, in pairs, and sometimes bunched together in a pack. They wore T-shirts advertising their sponsors (page 358).

It tired me to think of pedaling up so many miles of steep grades, but these men were actually racing! Though their cycles were equipped with reduction gears, every face showed the strain. Occasionally an exhausted

PHOTOGRAPHED BY WALTER MEAYERS EDWARDS © N.G.S.

One-legged stool strapped in place, a cowherd pours milk fresh from his Tarentaise cows. He will carry the can on his back to a cheese-making plant.

Mountain migration—the transhumance! Snow melted, flocks near Allos Pass in France move to high meadows.

contestant would sip fruit juice from a plastic container on his handlebars.

Everyone cheered his favorite. The pétanque players shouted encouragement to stragglers and pushed them a few yards when judges were not looking. Others doused them with water.

Suddenly, almost as soon as it began, it was over—testimony to the enthusiasm of fans who had come so far for such a brief glimpse of their heroes.

Here, as almost everywhere in the Alps, wildflowers bloom just below the snow line. Their bittersweet fragrance rose from our feet as we walked through the meadows; sometimes it wafted into the car as we drove past.

The alpine rose, a dwarf rhododendron, caught our fancy from the first time we saw it at La Flégère, when we watched a petite French girl pick a bouquet for her mother. The shrub spangles many a highland slope with red from May to July.

One morning while my family shopped, I joined Walter M. (Toppy) Edwards, a fellow member of the GEOGRAPHIC staff.* Toppy had glimpsed Mont Blanc in the distance at dawn and wanted a closer vantage for pictures before the peak clouded over. We motored down the Isère Valley to Bourg St. Maurice, then up the opposite side on a road that dwindled as it climbed, and finally gave out in a vast cow-dotted, cloud-swept pasture.

*See "Across the Ridgepole of the Alps," by Walter Meayers Edwards, GEOGRAPHIC, September, 1960.

Fair field hands trim vines on the terraced slopes of the Rhône Valley at Sion, capital of the Swiss Canton of Valais. On distant rock towers, the fortresslike church of Notre-Dame-de-Valère (right) and the ruined castle of Tourbillon (left) provide the setting for a nighttime *Son et Lumière* (Sound and Light) spectacle recounting the history of Valais.

Taking cameras, rain gear, and a bite for lunch, we toiled up a steep path. This was the Sentier de Grande Randonnée, the 80-mile trail that circumscribes the Mont Blanc Massif. Then we came to the snowbanks—each one arched above a torrent we could hear roaring beneath us as we crunched across.

Finally Toppy and I reached the desolate Col de la Seigne—and walked into Italy without showing passports. Immediately north of us reared the Aiguille des Glaciers, and beyond the Aiguille loomed ice-laden, cloud-wreathed Mont Blanc itself—a stunning view.

Mark Twain Climbed the Easy Way

On the way down we saw cows on a green pasture, arranged as geometrically as soldiers at parade rest. We walked another kilometer to investigate.

"These cattle are Tarentaise," a cowherd informed us. "Very big, very famous."

The huge animals were staked out in rows for their 3 p.m. milking. When a large can was filled with the milk from several cows, a man carried it half a kilometer to the cheese plant. Almost all milk in the Alps goes into cheese.

I commented on the largeness of the cows and the smallness of their udders.

"Very good grass . . . the cows grow big," was the reply. "But they do not grow fat climbing steep *montagnes*."

After my brief glimpse of Mont Blanc, I couldn't wait to show it to my family. In Chamonix, a delightful blend of provincial town and modern resort, a man with a mounted telescope offered a view for a franc.

Mark Twain's *A Tramp Abroad* tells how after inquiring if there was any danger, he "scaled" Mont Blanc by telescope from the streets of Chamonix. Now we were about to do the same thing 85 years later.

Even though old Mark's method of climbing mountains was not dangerous, it took courage for him to make fun of Alpine mountaineering just when it was swinging into high gear and attracting grim-faced devotees from all over the world. He helped make mountain watching respectable. Today watchers and climbers coexist peaceably at all resorts.

Man's long preoccupation with the Alps has given the construction engineer many a rugged challenge; he must push railroads and roads over and through them. For four years, French and Italian crews bored through opposite sides of Mont Blanc, and finally, on August 14, 1962, met with almost surgical precision in the mountain's granite heart (pages 356-7).

This 7.2-mile automobile tunnel—longest in the world—saves motorists several hours on the Turin-Paris route. When I was there, the roadway through the tunnel had not been built, but with a French construction official I walked into the raw, gaping hole, beyond the reach of outside light. I thought of the 17 men

Watercolors by Walter Weber Edwards, National Geographic Staff © N.G.S.

who had died to make this convenience for motorists possible.

Flashlights kept us from stepping into a small river—the runoff from underground watercourses tapped by the drillers. Its steady churning reminded me of the traffic—450,000 vehicles a year—that soon would be roaring through here.

"What will you do with this water, and how will you keep the tunnel from filling with carbon monoxide?" I asked my companion.

"The bottom of the tunnel will be reserved for carrying off the water and for ventilation," he explained. "The roadway itself will be built 11 feet above the floor of the tunnel. I'll show you how the air will be forced through."

Walking back into the glaring sunlight, we saw where enormous diesels for pumping air were to be placed in pits, lest their roar condemn local residents to sleepless nights.

Mont Blanc Bathed by Alpenglow

We returned briefly to Chamonix, and then set out to tour the countryside. A priest in a crash helmet passed us on a peace-shattering motorbike. During a sudden shower, a housewife on a bicycle donned her oilskins, but left her loaf of bread astride the rear fender completely exposed to the elements.

The rain stopped at St. Gervais, where Jean shopped for a picnic supper, going to a different merchant for each item.

Boarding a cable car, we rode up to Mont d'Arbois, which faces the whole western flank of the Mont Blanc Massif. Here we spread our meal on a grassy slope, and sat entranced at the expanse of snow and ice crowning the mountain mass like frosting on a gigantic cake (pages 354-5).

By the time we finished eating, Mont Blanc was bathed in alpenglow; it gleamed first like burnished gold and then pink when the sun, long departed from the valleys, touched its cloak of ice in final benediction.

Again I thought of Mark Twain, who in serious vein wrote of Mont Blanc: "All I had ever seen before of sublimity and magnitude was small and insignificant compared to this."

A few days later another occasion combined sublime scenery with a memorable meal, when we were served in the garden of an old abbey-turned-hotel, right at the edge of Lake Annecy. Fresh-water crayfish tails au gratin and vintage wines accented the charm of forest-clad mountains whose reflections danced in the wake of tiny sailboats.

The festive yet intimate atmosphere of Annecy in summer, the gay gardens, the swans and pedal boats, the multicolored sails flitting about the lake like so many butterflies, all spelled holiday. No wonder the French regard Annecy as one of their favorite resorts.

Cracks in Liberty Bells Not Real

It seemed an unlikely place for industry. Yet here we spent a fascinating half day in a bell foundry, watching the pouring of the bronze into molds, and then the polishing and tuning. M. Alfred Paccard, the owner, reminded us that after World War II France had presented copies of the Liberty Bell to the United States, one for each state. "We had the honor of making them," he said.

Cracks and all?

"Ah, *non*." M. Paccard was shocked. "The cracks we painted on."

Like notes from a carillon, facts about bells pealed from M. Paccard: "We average two bells a day. Most are for churches and memorials. We made the carillon for the Taft Memorial in your city of Washington.

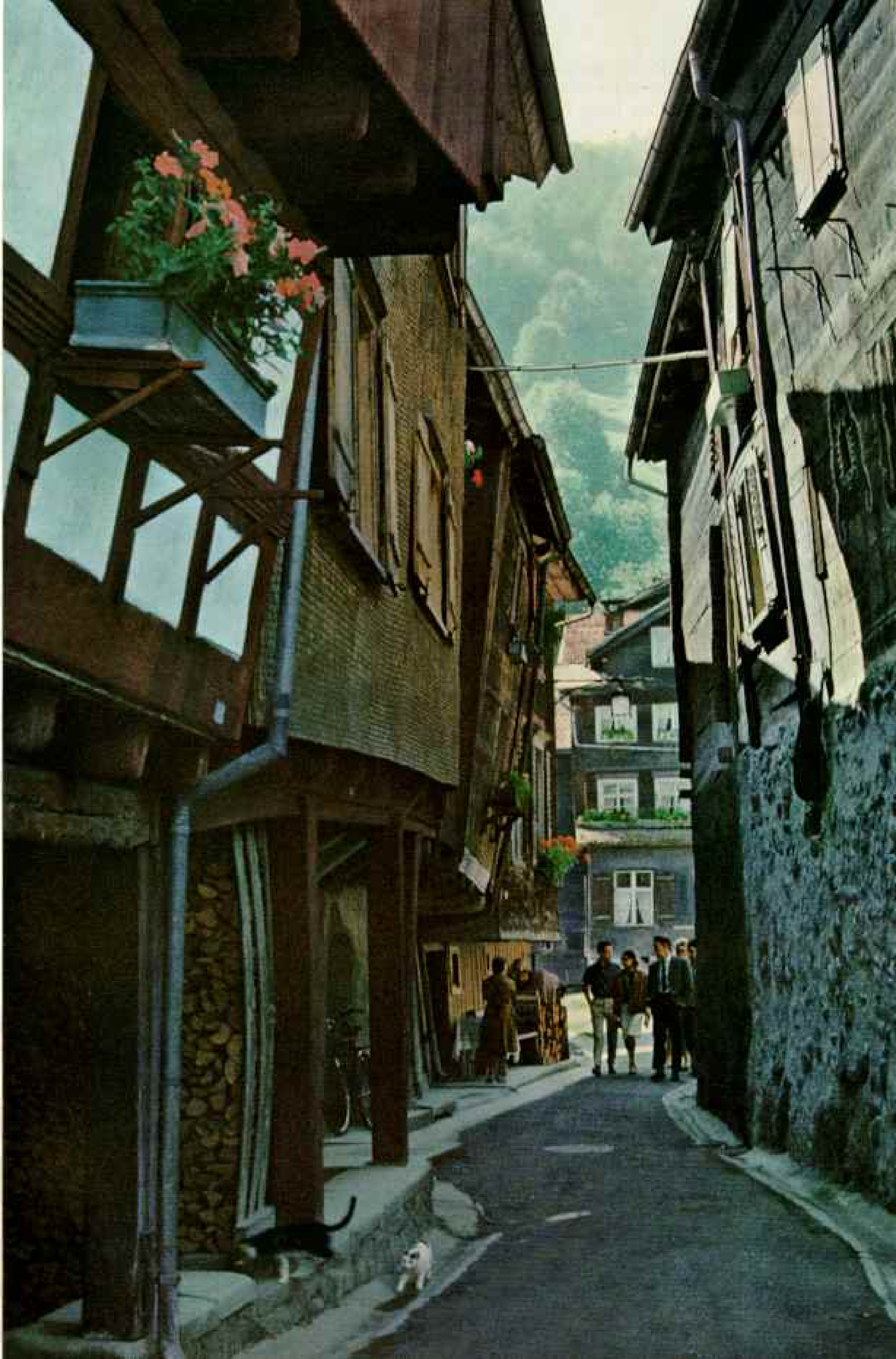
"When we make a group of bells for an Alpine village, the weight in kilos of the largest matches the number of inhabitants. The cost of bells works out roughly at a dollar a pound. For two centuries in France bells have cost about the same as butter."

Contrary to images of Switzerland as the rooftop of Europe, we drove down, down, down as we entered that country by the Forclaz road from Chamonix. Martigny and Sion, largest towns in the Canton of Valais, are almost 2,000 feet lower than Chamonix. Their warm sunshine and surrounding vineyards

WALTER MEAYERS EDWARDS (ABOVE) AND WILLIAM [illegible] © N.G.S.

Hanging gardens bloom on the faces of chalets at Brienz, a Swiss lakeside resort in the Bernese Oberland. A wood-carving center, the village fosters a technical school to maintain its artistic traditions (page 375).

Pocket of the past: Slant-walled houses on a twisting lane in Werdenberg preserve the atmosphere of the 17th and 18th centuries. Stacks of firewood stay dry beneath house overhangs in this Swiss village of the Rhine Valley. Geraniums brighten window boxes.



seemed to us more Mediterranean than Alpine.

Lateral valleys extend on either side of the trunk valley, that of the River Rhône, giving the populated portion of Valais the shape of a centipede. One of these legs, the Val d'Anniviers, took us south (and up again) to St. Luc. Here on the terrace of the Mont Cervin Hotel, we watched distant clouds wreathe the Matterhorn while we ate *raclette*.

This local specialty was invented by men who summered with the cattle on high pastures. Tiring of cold cheese, they melted it against a fire, scraping off the hot edge and eating it in one motion. Now tourists do the same, except that a pretty waitress runs back and forth between the charcoal fire and your plate with the tasty gooeyness (page 375).

We ate ours with potatoes, served in *robes de chambre* (jackets), and a coarse peasant rye bread, washing it down with a delicious dry white Valaisan wine.

St. Luc Reaps a New Harvest

Afterward, we strolled through the village and onto steep-pitched grasslands that have overgrown the grainfields of former generations. The mills on the noisy streams are quiet and grind no more. Many of the *raccards*,

log-built granaries perched on piles above flat stone rat guards, are empty. Fewer than 300 year-round inhabitants live in St. Luc.

"St. Luc is a good example of the changing Alpine village," said Madame Clotilde Gard, owner of the hotel. "The old things are here and the old ways can be appreciated, but today everyone depends on tourists rather than on the bounty of our fields."

Families from all Switzerland and beyond come up to St. Luc for two weeks or a month, rent a chalet or part of one, and glory in the Alpine air. Over every window box full of geraniums, a magnificent view greets their eyes as they watch their children play in the car-free streets and flower-speckled meadows.

Two crags in Sion dominate the valley. Atop one of them stands a fortresslike medieval church. A castle in ruins surmounts the other. The two seem to exchange glares in a mute tableau bespeaking man's spiritual-temporal conflict (pages 362-3).

At night the rivalry was not silent. Amplified voices representing Tourbillon, the castle, and Valère, the church, recounted the area's turbulent history as lights dramatically flooded towers and battlements during the *Son et Lumière* spectacle.

William Tell embraces his son after being ordered by the villainous bailiff Gessler to shoot an apple from the boy's head. Residents of Interlaken enact Schiller's drama of Swiss liberation from Habsburg tyranny.

Breathless moment: Tell aims his crossbow at the apple (far left). *This feat of Tell, the archer, will be told/ While yonder mountains stand upon their base./ By Heaven! the apple's cleft right through the core.* Tell then declares he would have killed Gessler with a second arrow if his shot had erred and struck his son.

Serpentine switchbacks, lacing Switzerland's rock-strewn Reuss Valley, lead upward toward 6,917-foot St. Gotthard Pass. Roadside inn nestles within a loop. Snowshed over

the highway (upper left) protects against avalanches. A mule path through the river's deep gorges served from the Middle Ages until engineers built a carriage road in the 1820's.

KODACHROME BY WALTER MEAYERS EDWARDS © N.G.S.

Our seats under the stars put us between the crags; following the lights and voices back and forth was like watching some cosmic tennis match.

Next morning we pushed east along the deep trench of the Rhône. Just past Sierre, the French-speaking area ended and German took over. Suddenly, *val* changed to *tal* and crept around to the ends of place names. Val du Rhône became Rhonetal. *Chute de pierres* —falling stones—changed to *Steinschlag*.

Mountain Climbers Flock to Zermatt

At Visp we stored our car and boarded the narrow-gauge train for Zermatt, which was filled with its usual crowds of climbers, mountain watchers, and strollers—all of them attracted to that magnificent mountain peak, the Matterhorn, and its parklike setting.

Zermatt is a world capital of mountaineering. Many other peaks had been climbed, mostly by Englishmen, in a burst that began in 1854. But for centuries men had looked in awe at Matterhorn's sheer rock pyramid—rising more than 5,000 feet above its 9,000-foot-high base (page 376). Edward Whymper, an English illustrator, had failed seven times before he reached the top in 1865.

When we looked out the window next morning, we saw the Matterhorn in dawn's rosy light. It looked as if it might have risen during the night, so fast that it hit the sky and bent over at the top. I caught Whymper's fever.

My son Will, Toppy Edwards, and I put on our backpacks and, keeping our eyes on our snow-ribbed objective, walked along Zermatt's main street with the morning crowd of climbers.

At the edge of town everybody pushed onto swiftly ascending cable cars, and we followed. At Schwarzsee, a pond of dark water at 8,500 feet, we got out and walked up a great bare

THOMAS J. ABERCROMBIE (LEFT) AND WALTER MEAYERS EDWARDS © N.G.S.

hogback another 2,100 feet to Matterhorn Hütte where the tough climb begins.

By now it was past noon. We were surprised to find that the "hut" boasted a restaurant. True to European tradition, it took two hours for a lunch to be served, eaten, and paid for.

Several of our fellow lunchers had that mystic look of exhaustion and fulfillment that told me they had just returned from scaling the "Deadly Alps." They reported that it was eight or nine hours of hard work on the rock pile, but not regarded as a difficult climb in mountaineering circles. All had guides. They had started at 3 a.m., and had reached the top about 7 or 8.

About 20 made the ascent that day. It was a poor season: late spring, snowy summer, early fall. We never succeeded in putting the two good days together that would have enabled us to attempt the climb.

Siren of the sea visits landlocked Switzerland on a flowery float during the Festival of Geneva. A parade, an outdoor ball, confetti battles, and fireworks enliven this celebration held on a weekend in mid-August.

First tourist submarine, the mesoscaph explores 1,000-foot-deep Lake Geneva at Lausanne, Switzerland; in background, a hydrofoil excursion boat planes the waves.

The mesoscaph, designed by Jacques Piccard and named for his father, Swiss scientist Auguste Piccard, took up to 40 passengers at a time to depths averaging 300 feet during the 1964 Swiss Exposition. In 850 dives it has carried 25,000 people. Piccard and five companions plan to ride a mesoscaph, capable of descending to 2,500 feet, on a 2,000-mile drifting voyage in the Gulf Stream from Florida to Newfoundland.

In other years as many as 175 persons have scaled the Matterhorn in one day. There is a standard route, with permanent rope railings through hard stretches.

Traffic is a problem; someone suggested signs: "Climb." "Don't Climb."

"Most accidents occur on Sunday; the guides don't work then," a former guide told me.

Alfons Gives an Emergency Haircut

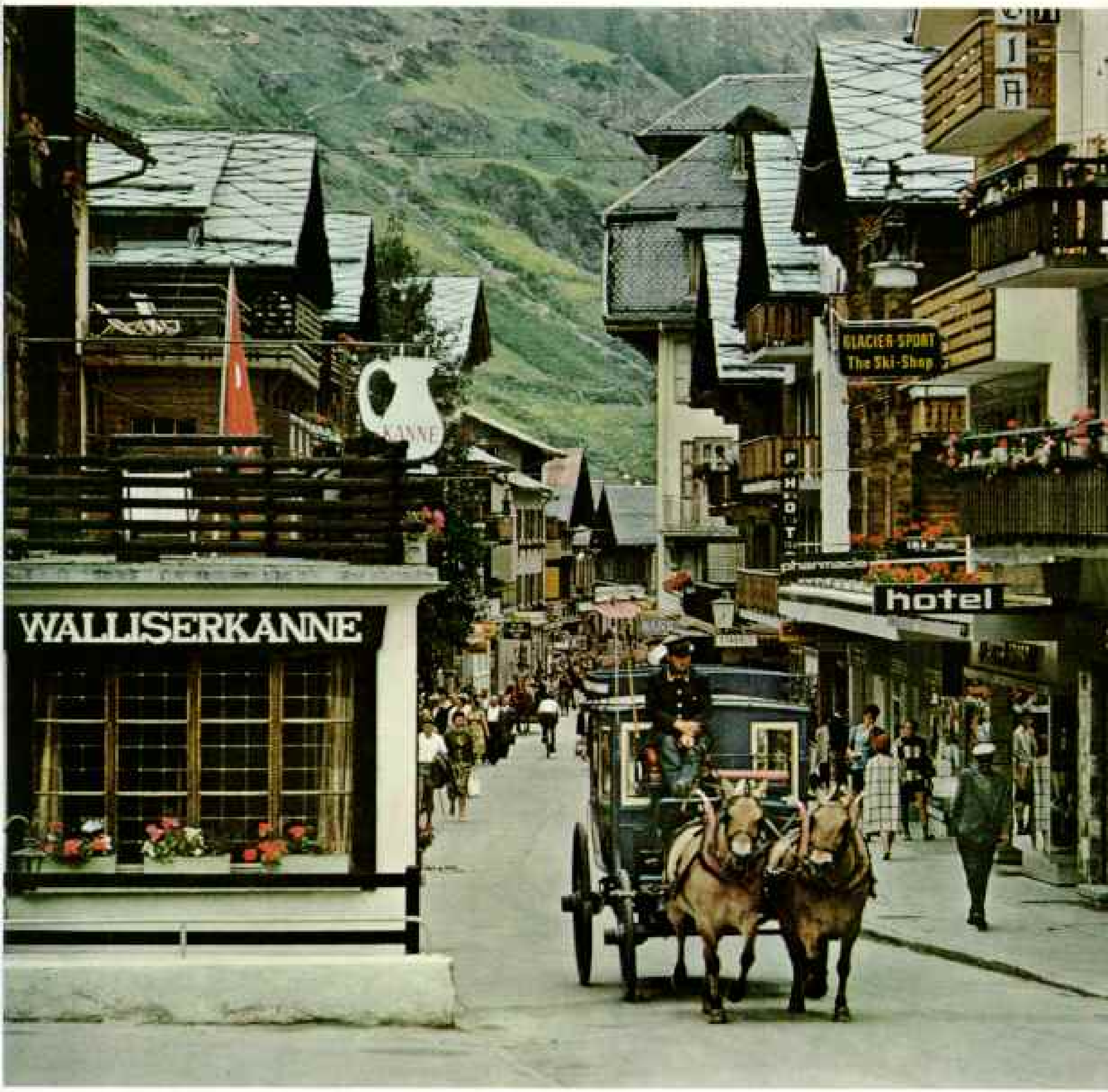
Next day I visited Alfons Taugwalder, a retired guide distantly related to the Taugwalder father and son who accompanied Whymper. While his grandchildren watched TV, Herr Taugwalder showed me scrapbooks of his 125 conquests of the Matterhorn. Summit photographs revealed men in knickers and mustaches with arms thrown around each other in the camaraderie of climbing.

"It wasn't always easy," said Taugwalder. "Once a storm came up. Snow and sleet. I was guiding a 65-year-old English lady. Her hair froze over her eyes. I cut it off so she could see. When we got down, the lady's new hairdo thawed out and she called me the worst name she could think of—'smuggler.'" In this border area, he explained, smuggling has had a long and disgraceful history.

We talked about Whymper's climb. It was a strangely mixed group: Whymper; Lord Francis Douglas and his guides the Peter Taugwalders; and three last-minute recruits, the Reverend Charles Hudson, Douglas Hadow, and guide Michel Croz.

The ascent, up the ridge so easily visible from Zermatt, was almost uneventfully easy. But just after beginning the descent, the inexperienced Hadow slipped and fell against Croz, who plunged downward from precipice to precipice, pulling the others with him. Whymper and the Taugwalders were the last three on the line. Their feet were firmly

Dusk drops a canopy over Lugano, its lake, and the encircling Alps. Lights of a cableway lead toward the 3,002-foot summit of Monte San Salvatore (left). The Swiss share Lake Lugano with the Italians; steamships and roads link the two neighbors. Italian is the official language in this southernmost Swiss Canton of Ticino. Silvery-leaved olive trees speckle the hillsides of the balmy city, whose appearance reminds travelers of the Riviera.



planted, but the line parted between them and their four companions.

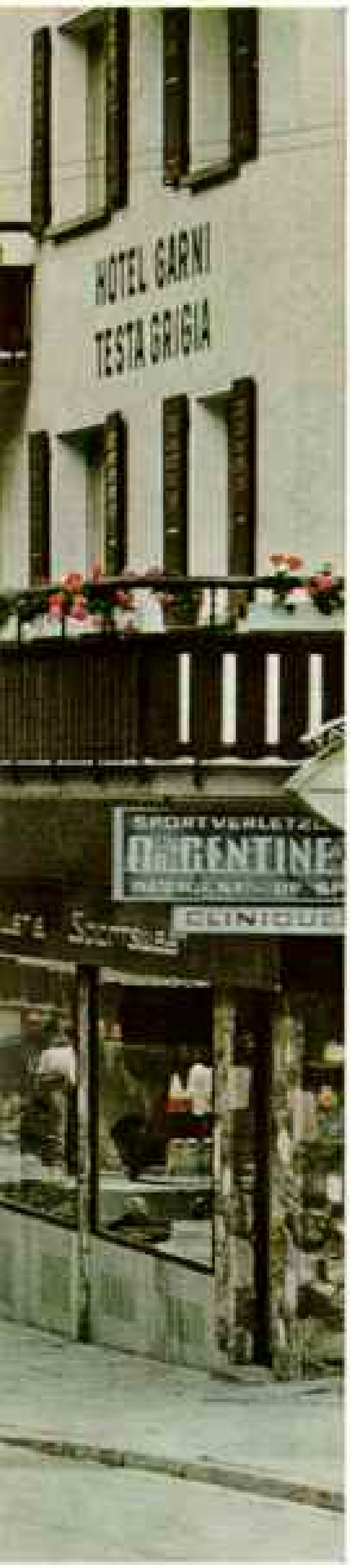
The remains of three—Hadow, Hudson, and Croz—were recovered 4,000 feet below on the glacier and are buried in Zermatt. Nineteen-year-old Lord Douglas's body was never found. The mountain is his gravestone.

Rescue Delays a Thrilling Flight

The concierge at the hotel was keeping us in touch with the Sion airport, as we had plans for airborne mountain climbing (my case of Whymper's fever had abated considerably). Now he told me this was the day; Hermann Geiger, the "Eagle of the Alps," would meet us at Täsch airstrip, a few miles down valley.

"I would have come yesterday, but I was rescuing two German climbers over near St. Moritz," said Geiger, as he welcomed us aboard his eight-place ski-fitted plane. Since 1952, when he pioneered the technique of landing on glaciers, this knight in shining aircraft has helped thousands of Alpinists.

We rose fast; a wilderness of rock and ice spread below us. A ribbon of green—Zermatt's valley—seemed so tenuous I wondered how the original settlers found it. Sunlight caught the gossamer thread of the Schwarzsee cableway. Diners in front of Gornergrat's castle-like hotel looked up and waved.



Geiger flew toward the great white whaleback of Monte Rosa, veered left, and landed light as a feather at 12,410 feet on the fresh snow just under the Cima di Jazzi. Facing upgrade, the plane taxied only a few seconds before stopping. We stepped out onto the top of the world.

Down below, Geiger had seemed distant and preoccupied. Here, on the eternal snows, he was in his element; his eyes sparkled as he put a hand on my shoulder and, introducing me to old, beloved friends, pointed out and named the peaks one by one: Dom, Rimpfischhorn, Dufourspitze (Monte Rosa), Lyskamm, Breithorn, Matterhorn, Weisshorn.

Master carver Max Huggler gives life to wood. Six-inch Alpine figurines of his design people his Brienz studio.

Delectable *raclette* goes to diners at St. Luc, a resort in the Val d'Anniviers. The cook scrapes warmed cheese from the cut edge of a half wheel of soft Valaisan that has melted near the bellows-fanned coals. Rye bread and baked potatoes served in their skins complement the delicacy.

Horses set the pace in Zermatt, Switzerland, which lacks a highway link with the world. A new road will eventually bring automobiles to the edge of the village, but they will continue to be banned from the streets.

Each rears more than 13,000 feet high—a circular gallery of celestial giants.

It was like a visit to Shangri-La (pages 378-9). We wanted to stay forever, but Geiger herded us into the plane. He turned downslope, gunned the engine, and took off after a run of only a few yards. I looked down and saw two tiny parallel arcs in the snow—tracks left by our plane's skis on the glacier's immensity.

Zermatt Bells Chime Quarter Hours

Now we flew along the Italian front of the mountains, where clouds were building up, and we knew why Geiger had hurried our take-off. Through a gray haze we glimpsed skiers and ski tows on the Plateau Rosa. As we re-entered Switzerland, the Matterhorn was half hidden in angry blackness.

Landing safely, we once again strolled the streets of Zermatt, which have their own thrills and perils. Though no automobiles are allowed, pedestrian hazards arise from battery-powered vans, horse-drawn taxis, and victorias (pages 374-5).

A flock of goats, each wearing a bell, clanged under our window each dawn. The church bell rang at the slightest pretext: for instance, quarter hours. Bands oompahed outside the hotels. Armies of children from camps came singing down the street, four abreast. Someone suggested that climbing is popular here because it takes one away from the village clamor.

We retrieved our car in Visp and continued up that narrow, green, village-dotted hayfield known as the Rhône Valley. Whole families labored in the manicured meadows, bringing in winter feed for their cattle.

But even the industrious Swiss can't do much with the land above Gletsch—except glean waterpower from it. Here the Alps come together in a granite snarl that puts a switchbacking pass or two in front of you no matter which way you want to go.

We geared down into first and inched up toward Furka Pass to the Rhône Glacier, where the river begins. The protests of our small motor almost matched the groans of the slowly moving ice. A man-made tunnel allowed us to walk through the electric blue of the glacier (page 381).

Tunnels are legion in the Alps. After we had motored to Interlaken, an electric railway carried us along a tunnel cut in the solid rock of the Jungfrau, the Bernese Oberland's famous peak. This remarkable railway climbs from Interlaken to Jungfraujoch, Europe's

KODACHROMES BY THOMAS J. ABERCROMBIE (BELOW) AND WILLIAM ATTRIDGE © N.G.S.

Eye-filling Backdrop for a Lofty Repast. Matchless Matterhorn Snags a Cloud

Scaling the Alps by railway, summer visitors lunch on the terrace at Gornergrat Station. In the cool, clear air of the heights, the 14,690-foot rock pyramid appears deceptively close; actually it rises 6¾ miles away. Italy lies just beyond the snow-covered ridge at left; Zermatt nestles in a valley out of sight to the right.

On the giant steps of the Matterhorn, a Swiss guide leads an American to the summit. Experienced mountaineers regard such a guided ascent—a nine-hour round trip—as arduous but not dangerous. In favorable weather, some sixty persons a day reach the top, a feat first attained 100 years ago by Englishman Edward Whymper.

Alpine snowbird, pilot Hermann Geiger points out to the author the major peaks surrounding Gorner Glacier. Geiger flew Mr. Gray and his family (right) to this frosty plateau in his 8-place ski-fitted plane. Another American who visited the site—humorist Mark Twain—stood on the ice and prepared to travel with the frozen river on its snail's-pace journey down the mountainside.

"Eagle of the Alps," as the Swiss call Geiger, pioneered the technique of landing on glaciers. Since 1952 his daring sorties into storm-swept aeries have aided thousands of climbers.

Helicopters replace mules in supplying climbers' huts. At the Swiss Alpine Club's Boval Hütte, near Pontresina, manager Arno Grass unloads an airborne cargo of wine.

highest railroad station, also cut into rock. It stands at a giddy 11,400 feet, only 2,242 feet below the summit of the Jungfrau—the Maiden. The railroad's final 4.4 miles, all tunnel, took 14 years to build.

During a 10-minute stop at the Eigerwand outlook within the tunnel, we gazed down the fearsome North Face of the Eiger—the Ogre. All but perpendicular and formed of crumbly stone, this incredible precipice has lured —and sometimes killed—the elite of mountaineers since 1935, when its conquest was first attempted.

I thought particularly of Toni Kurz, who died of exhaustion in 1936 while dangling just beyond help—not far above this very window. The North Face has claimed 24 other brave young men, but they keep coming. In 1963 a Swiss guide, Michel Darbellay, made the first solo ascent. Two others who made solo attempts before him died, and a third gave up.

A 360-foot elevator ascent from Jungfraujoch brought us into sudden glare from a sea of cloud that filled the valleys. To the south, across the Jungfraufirn, northern end of the Alps' longest glacier, Aletsch, we dimly discerned three tiny figures crossing toward the Jungfrau. The strident cries of the chocards, yellow-billed cousins of the crow, were suddenly silenced by the roar of a massive block of ice breaking loose from neighboring Mönch (Monk) and tumbling down the snow slopes in a spectacular avalanche.

Donna Visits Her First *First*

My daughter had been urging me to take her on a private expedition. From our headquarters in Interlaken, we drove to Grindelwald, where a chairlift elevated us 3,700 feet through the clouds to what seemed like a green flying carpet in the sky.

We walked to the edge of the meadow, where clouds were spilling upward over the brow, and looked down. This was a *First* (pronounced "fearst")—a high grassland, an alp, that breaks off in a sudden escarpment. In a dense fog it seemed that one could step off and die of shock before hitting the bottom.

A helicopter suddenly appeared over the rim and landed near us. It was supplying the

hotel on Faulhorn, a nearby mountain, taking the place, I learned, of a mule that was sick.

"Helicopter freight is not much more expensive than mulepower," the pilot ventured. "You feed the animal all year; the machine eats only when it works."

Donna and I were tempted to linger, but the entire eastern Alps lay ahead. We joined the rest of the family and motored to Andermatt and Chur, and finally over Julier Pass into the fabled Engadine Valley just at dusk. We had passed through the Rhine watershed and were now in the Danube basin—quick as that—where all streams eventually empty into the Black Sea.

Engadine people scratch designs into the exterior plaster of their solid masonry homes. These gray-and-white *sgraffiti* make the narrow streets of villages look like corridors in an art gallery. Among the patterns are inscriptions in Romansh, the fourth official Swiss language, after German, French, and Italian. Called the Lingua Rustica of the Roman Empire, this nearly fossil dialect of Latin still is spoken by 50,000 Swiss, mostly in the big eastern Canton of Graubünden (Grisons).

A carriage ride took us to the remote Valley of Fex for a visit with Anna and Dolfo Giovanoli-Willy. We asked them, through an interpreter, to speak some Romansh for us. Surprisingly, Anna answered in French: "We know Romansh, but we learn German and French in canton schools and we speak an Italian dialect *en famille*."

"Here is an old Romansh poem that tells how we feel about our land," said Dolfo, reciting from memory. "It's called *Il Pur Suveran*,' or 'The Sovereign Peasant.'

"Quei ei miu grep, quei ei miu crap,
Cheu tschentel jeu miu pei;
Artau hai jeu vus da miu bab,
Sai a negin marschei."
[To me belong these rocks, to me
this stony soil,
Here I walk with a firm foot;
For this is the earth of my fathers,
And for it I owe homage to none.]

German and Italian also meet in this canton, and its flamboyant place names reflect

three languages: Lenzerheide, Tiefencastel, Pisciadello, Pontresina, and the neighboring villages of La Punt-Chamues-ch and S-chanf.

In the lower Engadine we climbed the high shelf above the River Inn to Guarda, which retains the look and pace of yesteryear so remarkably that people call it the museum village of Romansh land. The horse-and-hay farmers who live here can raise a hand with Roman imperiousness when a mere auto gets in the way of their hay-cart chariots. They stable their stock in the basement.

A few miles away, at Samedan in the upper Engadine, the versatile Alps offer what many consider Europe's finest conditions for the modern sport of sailplaning (pages 386-7). I took a spin in one of these graceful motorless craft with pilot Jakob Ehrensperger. First he explained the dynamics.

"The warm wind comes through Maloja Pass from Italy, lasting from about 11 a.m. to 4 or 5 p.m. nearly every day in summer, and rises along the low mountain. There the updrafts take over and elevate you to snow and glacier levels, if you're lucky."

Jakob strapped me in, gave a signal, and the winch tow pulled us high into the air in seconds. He cast loose and maneuvered for elevation. I became well acquainted with a hotel on Muottas Muragl, the low mountain, as we passed it, circling again and again, each time a little higher and a little dizzier.

Gradually the winds became stronger and gustier. The plane creaked and groaned. The wind roared like an express train. Suddenly we dropped 100 feet.

"We'll try again," Jakob yelled confidently.

"Not on my account," I mumbled through white lips, but he apparently didn't hear me.

The third try got us over the invisible hump.

Then we easily sailed high above the snows and glaciers of the Bernina Alps. I reminded myself that no motor had put us here—just air, wings, and a good pilot.

St. Moritz Stages a Fiery Celebration

Unwinding from the thrill of this flight, I spent a quiet evening in St. Moritz strolling the Wasserfallpromenade with my wife. From this path along the hill behind town, we gazed down on the renowned patriarch of all summer and winter resorts.

Neat buildings hugged the Post-Platz and lined the crooked streets leading toward a curious leaning tower—the only remaining fragment of the original village. Turrets and towers of elegant hotels rose beside the sail-dotted lake. All around, peaks etched the sky.

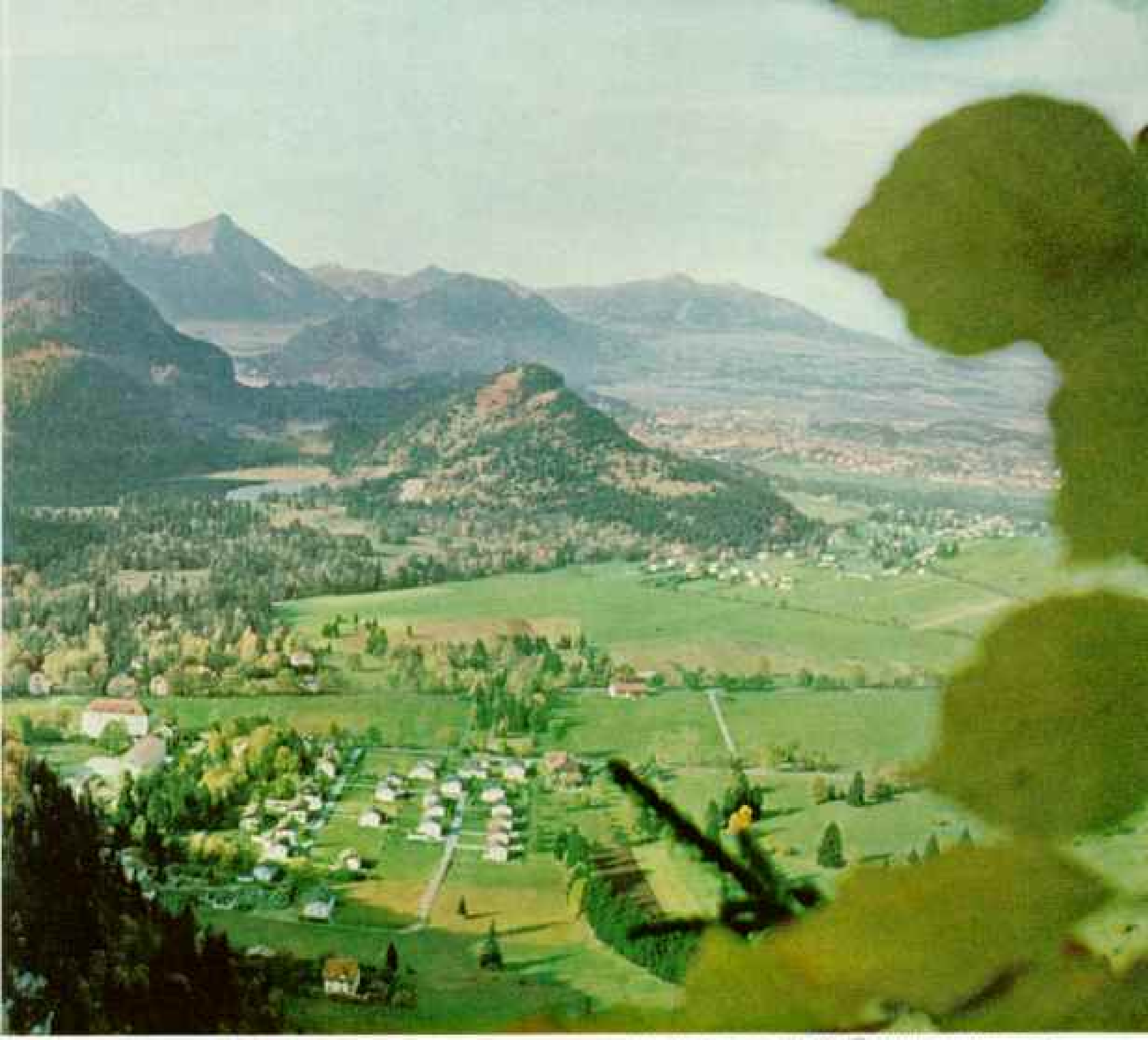
Forbidding stairway of tortured ice, Switzerland's Morteratsch Glacier creeps relentlessly down into the Bernina Valley. Its melt waters flow to the River Inn, thence to the Danube, and finally to the Black Sea. Helicopter pilot holds his bubble-nosed craft above the frozen cascade.

Blue radiance bathes a man-made grotto hewn into the side of the Rhône Glacier near Furka Pass. Each spring a new entrance must be cut, because a snow blanket blocks the old one in winter.

The 8-mile-long glacier, one of the largest in Switzerland, ends abruptly in an icefall that becomes a source of the Rhône River.

Mad King's hideaway: Neuschwanstein Castle in Germany's Bavarian Alps delighted its builder, Ludwig II, who devoted his last 17 years to its construction. The 19th-century Bavarian monarch perched this castle on a rocky pedestal in the foothills of the Alps, where it overlooks Alp See and the Bavarian plain.

Unofficial greeters, "sacred cows" escort the author's family through Bavaria's Garmisch-Partenkirchen. The animals graze by day in outlying meadows, spend each night in a mid-town corral, and, like India's cows, always command the right of way in the streets.



PHOTOGRAPH BY WILLIAM ALBERT ALLARD © NATIONAL GEOGRAPHIC SOCIETY

Dusk fell as we watched, and city lights added a fairyland touch. Bonfires blazed on the lake shore and throughout the hills and mountains—for this was National Day, August 1, and the Engadiners were celebrating their union with the Swiss Confederation.

Children carrying *lampions* (candles inside paper globes) followed a blue-uniformed band through the streets. Stores blazed with displays of colored lights, and strings of bulbs outlined boats dancing on the lake. At the far shore fireworks crackled in the air. Children lighted sparklers and leaped about like so many Tinker Bells.

Today's flocks of summer visitors come to St. Moritz for the sun, clear air, health springs, and mountain scenery. The springs brought resorters here before the mountains did—possibly as long as 3,000 years ago—and throughout Roman and medieval times. In 1537, Paracelsus, the Swiss physician of the Renaissance, praised the healing qualities of the waters. It is recorded that in 1859 "the unheard-of number of 450 visitors" came to St. Moritz. By 1910 it had become 10,000 a year. Now you may find the same number in St. Moritz on a sparkling winter's day. All, I suspect, are as reluctant to leave as we were.

Avalanche Strikes in German Alps

We picnicked on Flüela Pass, said goodbye to Switzerland, and motored to Garmisch-Partenkirchen in the Bavarian Alps, where Germany's highest peak, Zugspitze (9,721 feet), dominates the twin towns.

The Bavarian Alps display the romantic, almost ethereal quality often seen in paintings of mountains. But they have their cruel side. Last spring one of the worst avalanches in German history struck the Schneefernerhaus, a ski-resort hotel near the top of Zugspitze, killing 10 vacationers.

In Bavaria, instead of the wall designs we had seen on Engadine houses, we found painted scenes—often religious. Under the gables and flowered balconies every morning and evening pass a herd of large-boned cows on the way to and from surrounding pastures.

"They don't care what color the traffic lights are," said Georg Bader, president of the Hotel Proprietors Association, as we pulled over to let the animals pass. "We call them the 'sacred cows' of Garmisch. Not in the sense of India's cows, perhaps, but the beasts have the same right of way in the streets."

I especially wanted to show my children the spectacular castles of Ludwig II of Bavaria. "They called Ludwig the Mad King," said Bader, "but as tourist attractions, his castles bring the state of Bavaria more than half a million dollars a year."

Ludwig reigned from 1864 until his death in 1886. A bachelor, he received few guests in his extravagant hideaways. He liked to sleep away the day, rising for breakfast in the evening. He would dine on truffle-stuffed peacock at 2 a.m., then have supper at dawn before retiring.

Castles Reflect Builder's Genius

We visited two of Ludwig's castles, and came away convinced that some sort of genius, mad or not, was at work in the building of Neuschwanstein, near Schwangau, and Linderhof, closer to Garmisch.

Infatuated with the wild, romantic operas of Richard Wagner, Ludwig started Neuschwanstein on a crag overlooking mirrorlike Alp See in 1869 (pages 382-3). He died before completing the grandiose structure.

The tour requires determination—not so much because of the many floors, long corridors, and endless chambers, but because one becomes exhausted by the Teutonic turbulence of the paintings everywhere depicting the hates, loves, and murders of the Tannhäuser, Lohengrin, Tristan, and Parsifal sagas.

Linderhof is a jewel box compared to Neuschwanstein. In the style of the Petit Trianon of Versailles, it copies the late Baroque flamboyance of France, and was Ludwig's gold-leafed retreat from the industrial and political 19th century that he despised. Built between 1874 and 1879, Linderhof today is one of Germany's most visited sites (opposite).

The thirst of Germans for mountains is only whetted by their own Alps, and these people spill into Austria in vast numbers. No nation does a better job of welcoming outsiders; in Austria, in spite of the language

Deification of Louis XIV, Ludwig's hero, adorns a bedroom ceiling in Linderhof Castle, another of the Bavarian king's elaborate retreats, near Garmisch-Partenkirchen. Crystal chandelier, made in Vienna, holds 108 candles. Building his castle in the style of France's Petit Trianon, the ruler, like Prince Charming, rode to Linderhof during winter in a golden rococo sleigh with coachmen and outrider in 18th-century costumes.

Gantlet of spray keeps visitors alert in the garden of Hellbrunn Castle near Salzburg, Austria. "A Baroque water pistol," the author calls Hellbrunn, "abounding with hydraulic devices and wet surprises like fountains concealed in dining-room chairs."

barrier, we made friends so fast that I remember the country as much for them as for its magnificent mountains.

On one rare occasion in Innsbruck when I found myself alone, I walked at night along the inky River Inn flowing silently but swiftly between its man-made walls. I visualized the crossing in Roman times, the building of the first bridge—*Brücke*—in the 12th century, and overland commerce flowing through here between Bavaria's smiling fields and the broad valley of the Po River.

Our route still was eastward. Kitzbühel, full of German visitors, gave way to the high country of Lungau. Here the storybook towns of Tamsweg, Mariapfarr, and Mauterndorf retain the look of old Austria and keep alive the picturesque Samson Parades.

The *Samsonumzüge* are very "folkloristic," Herr Dr. Werner Oppitz of the State Tourist Department had told us in Salzburg. "No one knows how old they are, or what they really mean."

We arrived at Mariapfarr in time to see helpers lower a giant effigy, clad in a blue tunic, from a hayloft onto the shoulders of the strongest man in town (page 388). The tunic enveloped the man, and the figure above took on life of its own. To me, "Samson" looked more like a Crusader or a conquistador than the Biblical character. He carried a lance and wore a sword, armor, and helmet.

Two comical barrel-shaped dwarfs, a jolly man and woman, accompanied Samson. The red-vested village band led the way. In front of every inn Samson stopped and danced as the band played, and the proprietor came out with wine and beer. He lifted the skirts of each figure and gave drink to the man inside.

"Krott-cola" Washes Down *Jägerbrot*

South of Gröbming the land rises toward a range of the Alps called the Niedere Tauern and here, near Kleinsölk, we found the Peter Krott family, one of Austria's most unusual.

Dr. and Mrs. Krott and the boys Max and Martin had lived in the Italian Alps with two brown bears named Bumsli and Sepha for two years while making scientific observations on the animals' habits and physiology.

Peter Krott adopted the bears when they were infants and bottle-fed them until old enough to forage for themselves. But even when freed to roam, Bumsli and Sepha stayed with their foster parents. The cubs—with no knowledge of a father—regarded both Dr. Krott and his wife as their mother.

Bears, the Krotts learned, will always be

Gliding earthward, sailplane pilot Jakob Ehrensperger prepares to land at Switzerland's Samedan Airport in the Inn Valley. Here, where warm southern winds help create updrafts in the narrow depression, sailplaners ride their motorless craft above glaciers of the Bernina Alps.

Towed by a powered plane, a wide-winged sailplane climbs from a misty glen in Austria's Oberpinzgau region. In the distance, towering Kitzsteinhorn lifts its snowy cone above the clouds (left).

Sailplaners get their initial lift either by tow or from a motor-driven winch that hurls them skyward. Pilots maneuver skillfully in a series of circles to gain altitude.

bears. Though the cubs adapted slightly to human ways, it was the humans who had to do most of the compromising. The Krotts found that as long as you live with bears on their terms and never mistreat them, they will rarely, if ever, harm you.

Bumsli and Sepha lived pretty much as any bears in full freedom, except that they considered the Krotts bears, too. Max and Martin —then four and five—even began to think of themselves as bears, mimicking the actions of their animal playmates.

Once when Dr. Krott went out with the boys and the cubs to gather firewood, a big shepherd dog started barking at them.

"I wanted to go on," Dr. Krott recalled, "but suddenly I saw that I was alone. A branch creaked above me; bears and boys were sitting in a pine tree, all quivering on the same branch." Confronted with possible danger, the cubs had instinctively climbed a tree; so had Max and Martin, with all the naturalness in the world.

Again taking their cue from the bears, the boys learned to eat ants with obvious delight. On the other hand, while Bumsli and Sepha were experts at catching mice with their paws, Max and Martin were poor mousers.

Bear habits made life with Bumsli and Sepha somewhat

Grins greet a ruddy-cheeked mock-man (above) who pauses to entertain curbsiders during the Samson Parade in Mariapfarr, Austria. Star of the annual procession, the 18-foot-high effigy of the village Samson (left) emerges from a hayloft to ride the streets on the shoulders of the town's strongest man. Time has obscured the origin of the celebration.

Puppet master Hermann Aicher and his daughter Gretl (upper left) manipulate incredibly lifelike dolls in a dance at the Salzburg Marionette Theater. Donna Gray goes backstage to meet the nimble-fingered puppeteers, who perform nightly in summer.

trying in the home, Frau Krott explained. The cubs used easy chairs, sofa, and bookshelves as if they were tree stumps or branches. Above all, they quite rightly felt that they should sleep with their parents, and they made every effort to get into bed.

"But it is no fun at all to share one's bed with bear cubs," said Dr. Krott. "They take up much room, and are apt to be rather tickly.

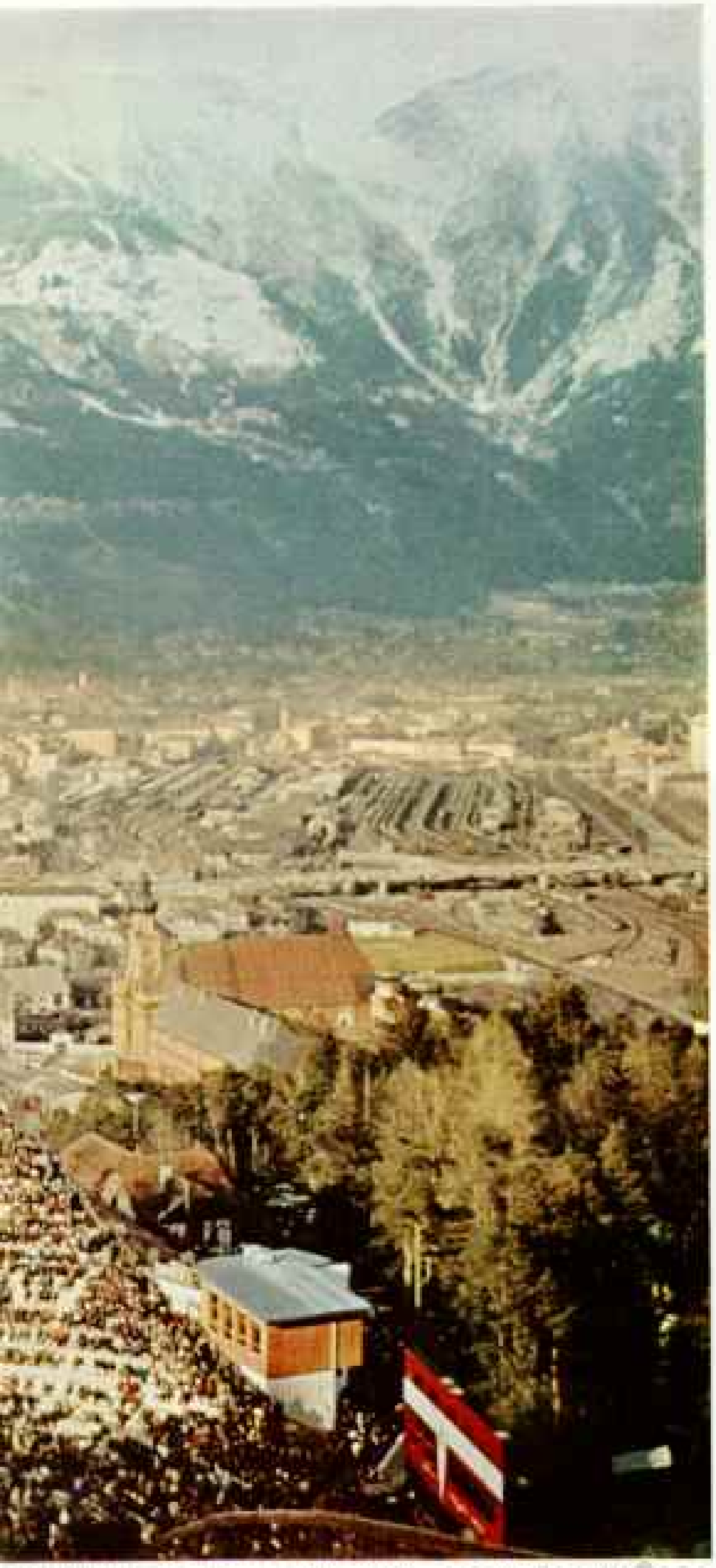
"Those cubs were no pets. My boys became more like bears than the other way around. Look at Max now."

Max was climbing a rough pine tree behind the house, but he came down when called.

"Cut Mr. Gray some *Jägerbrot*," Dr. Krott said. The "hunter's bread" appeared in the pulpy center of a daisylike thistle as Max cut away the outside. It tasted like turnip.

"I've lived on these morsels when out of food on long walks," said Dr. Krott.

His wife and little daughter Ilse, both in dirndls, appeared with a refreshing drink Frau Krott makes from flowers of the elderberry. She puts blossoms in a pot, adds sugar, lemon, and water, and steeps the mixture in the sun several days. "Krott-cola," Will called it.



Skis become wings as a jumper flies above a crowd of 60,000 at Innsbruck during the 1964 Winter Olympics. Hurtling into space at 60 miles an hour, he will span more than 250 feet before touching earth again. Body leans far into the leap to help skis plane the air for maximum distance. One mistake could mean injury or death.

White-water racers compete in the international slalom championships on the Lieser River near Spittal, Austria. In specially designed craft combining the lines of canoe and kayak, paddlers zigzag through gates—some less than four feet wide—on a two-mile course of frothing rapids. Best elapsed time determines the winner. Missing the gates or touching the posts in any way incurs penalty points that add to total time.

EXPLOSIVE LADIES | BY JAMES P. KLEIN | ILLUSTRATIONS BY WILLIAM EPPRIDGE © N.G.S.

That afternoon we all drove up the Kleinsölk valley to Schwarzen See, in the 33,000-acre estate of an Austrian *Fürst*, or prince.

"Mr. Gray, meet His Highness, Doktor Josef Colloredo-Mannsfeld," said Peter Krott.

As an American, I thought I'd be immune to nobility, particularly to a prince with no hereditary domain. But I knew I was in a presence—even though Dr. Colloredo had just awakened from a nap and dashed in the rain to the hunting lodge where we waited. He was tall, urbane, and spoke cultured English.

"I didn't expect to find so much empty

"**Enchanted" Isle of Bled** beckons a Slovene couple in old-time dress; their boatman rows a *pletna*, or skiff. Church of St. Mary's of the Lake thrusts its spire through verdant foliage. Wishes made while the church bell rings always come true, avows a local tale. Requests to ring the bell have become so numerous that authorities express fear of "exhausting the cooperation of Providence."

Yugoslavia's Lake Bled Gleams Like a Sapphire Amid Crystal Alps

Its temperatures sometimes reaching 77° F. in summer, Lake Bled began to attract vacationers in the 19th century. When winter freezes the water, residents of the area skate to church.

forest land in this part of the world," I ventured.

"Ah! But this land isn't empty," he said. "Many families live on my estate. They raise crops and graze cattle. They cut timber. Also there is much wildlife; the hills are full of deer and chamois."

"You see," Dr. Krott filled in, "we don't separate nature and culture and put them in special reserves. Here conservation and use go hand in hand. We use three-fourths of the Alpine world—everything except the bare rocks and permanent snow."

Even permanent snow does its part. In Innsbruck I had studied Warmund Ygl's delightfully primitive 1604-05 Tirol map, which features a greatly exaggerated glacier hanging like doomsday over the city.

"Our maps today reveal this to be a group of relatively small glaciers in the Ötztal Alps," the noted cartographer Fritz Ebster pointed out. "Productive land lies just below the permanent snows, and is watered by their melt."

Our route threaded many a verdant valley as we drove south to the Höbe Tauern, the vast highland surrounding the 12,457-foot Gross Glockner, Austria's highest point. Highways over most Alpine passes are paved carriage roads of the 19th century, with switchbacks so sharp that buses and trucks must back and fill. But the magnificent road into this land of glaciers reminded us of American highways.

White Water Challenges Canoeists

We drove on through Carinthia, Austria's southernmost province, to Spittal, where the Lieser River joins the Drau in a fine rush of white water. As a canoe buff, I wouldn't have missed for the world the international canoe slalom championships being held here. Several of my canoeing acquaintances from the States were competing, but even though they performed most expertly, they were outmatched by central Europeans, who are world leaders in white-water sports (page 391).

In slalom racing, the paddler encases himself in his decked craft and plows through tumbling waters that would quickly swamp an open canoe. Not only that, he must pass through "gates" diabolically placed along seemingly unnavigable chutes.

A 25-percent grade south of Villach ushered us into Yugoslavia. In this border area the three great peoples of Europe—Teutonic, Latin, Slavic—are barely separated by fingering ranges of the Alps.

Lake Bled, Yugoslavia's beautiful Alpine resort (left), held us for days, then we skittered over the Julian Alps in the rain via unpaved Vršič Pass, with its 50 switchbacks. After a procession of desolately wet villages, we broke into welcoming sun on the heights overlooking Trieste and the Adriatic Sea.

A glittering Alpine semicircle lay behind us—the outer arc, that is. Ahead rose an equally spectacular inner arc, through northern Italy. We headed for the Dolomites, perhaps the Alps' most unusual range.

The Dolomites were named for Gratet de Dolomieu, 18th-century French geologist who studied the calcium-magnesium rock so distinctive in these mountains. Massive bare rocks—suffused or streaked with blue-black, yellow, and red—rise above green valleys and forests. It was like putting the colorful mesas of the southwestern United States on top of an Oregon forest.

Cortina d'Ampezzo, sprawled graciously in a valley between dolomite formations, was full of vacationists—mostly Italian. At the Cortina guides' headquarters we met Simone Lacedelli one morning as he was starting out on an all-day hike with 30-odd excited youngsters. He invited us along.

The day before, photographer William Eppridge and I had been caught in a three-inch snowstorm at the foot of the Tre Cime (Three Peaks). Now we wondered how these Italian city children—many dressed in shorts—would react when they reached the line of the new-fallen snow. Actually, it was adrenalin to them; they took off like arctic hares (above). Lungs bursting, Bill and I raced to keep up. Fortunately they stopped for an early lunch at the foot of Tofana di Rozes.

"There is the old boundary between Italy and Austria," said Simone, pointing south.

Relics of the 1914-18 war were all about—trenches, cannon emplacements in caves, rusted helmets and canteens, a crude cross.

In the valley near Pocol, a cemetery contains the remains of 7,725 men who fought

KODACHROME BY WILLIAM ISPHORDING © NATIONAL GEOGRAPHIC SOCIETY

and died for ownership of this breathtaking region. Here the golden eagle nests in the high crags; chamois and deer bound through the larch and fir; the woodcock blends with the ground cover. Who knows? Perhaps the Alps really belong to them.

The deservedly famous Dolomite Road kept us among colorful limestone formations all day as we drove to Bolzano, locked in a vineyard-tapestried valley. Bolzano residents still call their city Bozen, as in the Austrian era. Most of Italy's Trentino-Alto Adige Region was in Austria's Tirol before World War I, and many inhabitants still speak German.

Every day we bought picnic supplies and lunched at some sweeping viewpoint. At Passo del Tonale we looked north at the Ortles Alps and south to Brenta Massif, both covered with glaciers and dusted with falling snow.

Snow-dappled Dolomites hurl jagged limestone peaks to the sky above a pass near Cortina d'Ampezzo, Italy. A guide leads children on a hike through the lunar landscape. Rock-climber's paradise, the Dolomite Alps surrendered their mysteries to determined British mountaineers in the 1860's and 1870's. Cortina's superb ski and bobsled runs and ice stadium prompted its selection as site of the 1956 Winter Olympics.

"The snow that hit you day before yesterday in the Dolomites was the last one of spring," declared a fellow picnicker. "This is the first one of fall."

Como bestowed on us the warm climes of the Italian Lakes, a retreat from the care-laden world since Roman days. We drove along the west shore of Lake Como at dusk, while the lights of villas and villages came alive as in a fairyland.

Last Look at an Alpine Monarch

In the Valle d'Aosta, Italy's French-speaking corner, the Matterhorn was calling us again for one last look, and we took a side road to Cervinia-Breuil at its Italian base. No one had climbed it since snow had fallen 12 days before. The Swiss side was closed to climbing for the year.

"We've seldom had two good days to put together," said Capitano Giuseppe Lamberti, the official in charge of the two big cableways at Cervinia. It was he, I learned, who headed the construction crew that had built the cableway to the Aiguille du Midi, near Chamonix.

The Matterhorn was still playing hide-and-seek. Sometimes the summit was clear, sometimes leaden with storm and flying a plume of blown snow. Next day we looked out on a wintry scene of wind and driving mist. We waved goodbye to the invisible Matterhorn and drove down the Valtournanche to lower mountains. Here the shining sun beckoned us along a trail to a new-cut meadow that smelled of grass, flowers, and elemental earth.

We spread a picnic lunch, then lay on our backs and watched the fleecy clouds scud past nearby snow-topped heights. Suddenly two specks moved on the snow. I reached for my binoculars; sure enough, a couple of climbers were about to reach their heart's desire.

It was the moment to take leave of the Alpine world, where men and mountains meet.

The gods have Olympus; man has the Alps.

THE END

New look at the Alps: To bring Society members their first color relief panorama, GEOGRAPHIC artist Victor J. Kelley (center) and author Ralph Gray (left) consult noted Alpine artist Hein-

Europe's

THE ASTRONAUT SAILS his ethereal orbit, scanning his planet. There, curving off into the haze, tumbles a great reef of bold peaks and verdant valleys, timeless glaciers and historic passes.

These are the Alps—as no earth-bound mortal can see them.

No ordinary map or color photograph could capture Europe's high heartland in its true and total splendor. So a National Geographic artist projected himself into an imaginary space capsule in orbit over the sea to the south on a cloudless September day. His assignment: to paint the Alpine panorama that backs the Atlas Map **Switzerland, Austria, and Northern Italy**, distributed with this issue of NATIONAL GEOGRAPHIC.*

Newman Bumstead, Chief of the Society's Geographic Art division, conceived this dramatic and realistic painting as a necessary companion to the map.

"The Alps deserve more than gray mountain relief," he suggested. "Let's show them as they are—in color, in three dimensions!"

Staff cartographic artist Victor J. Kelley roamed the Alps with sketchbook and camera, recording the subtle mountain mosaics; he consulted noted Alpine panoramist Heinrich Berann (above). A relief map, photographed from the sloping viewpoint of our imaginary space traveler, formed the base for Kelley's panorama. By depicting the highlights and shadows in colors faithful to the actual terrain, he achieved the striking three-dimensional effect.

Your eye sweeps a 500-mile crescent of jumbled heights in five countries—Italy, France, Switzerland, West Germany, and Austria. An inset on the pictorial map identifies each of 23 Alpine groups.

Tunnels Pierce Mountain Barriers

On the other side of this remarkable double map, a new Atlas Plate graphically records the difficulties—and triumphs—of transportation across these historic mountain barriers of Europe. The mightiest, Mont Blanc, rises 15,771 feet between France and Italy.

Modern engineering, however, has conquered even the Alps' highest peak. The map shows the world's longest automobile tunnel, which burrows 7.2 miles through the

rich C. Berann and view his superlative panoramic paintings. Mr. Berann profiled the Mont Blanc Tunnel (pages 356-7).

Mountains spring to life with length, breadth, and depth in Mr. Kelley's rendition of **The Alps—Europe's Backbone** (lower center). Limited to the two dimensions of flat paper, his work closely resembles the splendid three-dimensional relief portrayal by the Army Map Service (upper center). Back home (below), Mr. Kelley checks his art against a contour map.

snowy crown portrayed on double map

base of Mont Blanc. Crews are blasting another passage of equal length near Fréjus Rail Tunnel, 50 miles to the south. The 4-mile San Bernardino Tunnel, scheduled to open in 1967, will provide a shortcut on a major north-south route across the eastern Swiss Alps. The world's longest train tunnel, the Simplon, bores under Italy's Lepontine Alps for 12.3 miles. Principal road tunnels are named in red, major rail tubes in black.

One of the highways that still go *over* the Alps follows the road through Little Saint Bernard Pass laid out by the Romans some 2,000 years ago. Italians still build superb roads. The map shows their superhighways (double red lines) connecting Milan, Italy's industrial hub, with Turin, Genoa, Venice, Bologna, and Florence. Broken red lines (incomplete construction) show plans to tie these cities together with other throughways.

Paralleling the roads of ancient Rome, an expressway from Milan to Rimini now nears completion. For most of its length it lies beside Via Emilia, which once echoed to the rumble of chariots. Another, still in the planning stage, will run alongside Via Aurelia, the Romans' "Great Coast Road" that threads today's Italian Riviera.

Austrians plan an expressway from Vienna to Villach. Meanwhile, they are stringing an autobahn on man-made pillars across mountaintops from Innsbruck to Brenner Pass. On this spectacular skyway, the continent's highest bridge—the Europa—spans the River Sill more than 600 feet below. These miracle miles one day will link Munich and Milan.

Energetic Alplanders prosper as artisans; their factories hum in a perimeter of lowland cities. But tourism remains the Alps' chief industry. An ever-rising tide of visitors, some 13,000,000 in 1964, flows in—to ski on the reliable snows that have attracted six of the nine Winter Olympics; to challenge the peaks that give their name to "alpinists"; or simply to look and find inspiration in mountains of true magnificence. THE END

*Additional copies of **Switzerland, Austria, and Northern Italy**, with the panoramic map on the reverse side, may be ordered—together with other NATIONAL GEOGRAPHIC Atlas Map supplements—for 50 cents each, postage prepaid, by writing to Dept. 254, National Geographic Society, Washington, D. C. 20036.

Safe Landing on Sable

Isle of 500 Shipwrecks

By MELVILLE BELL GROSVENOR
LL.D., Sc.D.
President and Editor, National Geographic Society

I WAS STANDING the night watch. The lookout and I were the only men awake on our part of the Atlantic. Fog thick as milk had settled around our yawl *White Mist*, and a faint breath of wind moved us north by east at a silent 3 knots.

I am still not sure how the sound began—a rippling or faint chuckle on the sea. Was this the jumping of tiny fish or squid? I studied the water and saw dimples like the splash of raindrops—or were they small whirlpools? For half an hour the rippling continued, then ceased mysteriously as it had begun.

White Mist was sailing north from Bermuda to our summer cruising waters in the Bras d'Or Lakes of Cape Breton Island. We'd had a wonderful week of fair winds from the south and swims in the warm Gulf Stream with 10,000 feet of bright blue water under us. Once my son Gil struck a big marlin. We saw

the fighter walk on its tail and shake the hook. Ten porpoises came up from the depths under the bow, crisscrossed and played so close we could reach down and pat them. For a while, fresh winds rushed us along under mizzen and jib at 7½ knots; we even had the excitement of broaching at night in a heavy following sea and flooding the cockpit.

Now we had left the tropic weather and run into fog. Checking tidal charts, I found the cause of the ripples. We had reached the rendezvous of two great ocean rivers. Hereabouts, icy waters from the Labrador Current veer south and meet the Gulf Stream, which laves U. S. shores with tropic waters and, flowing across the North Atlantic, warms Britain and Norway (map, page 404).

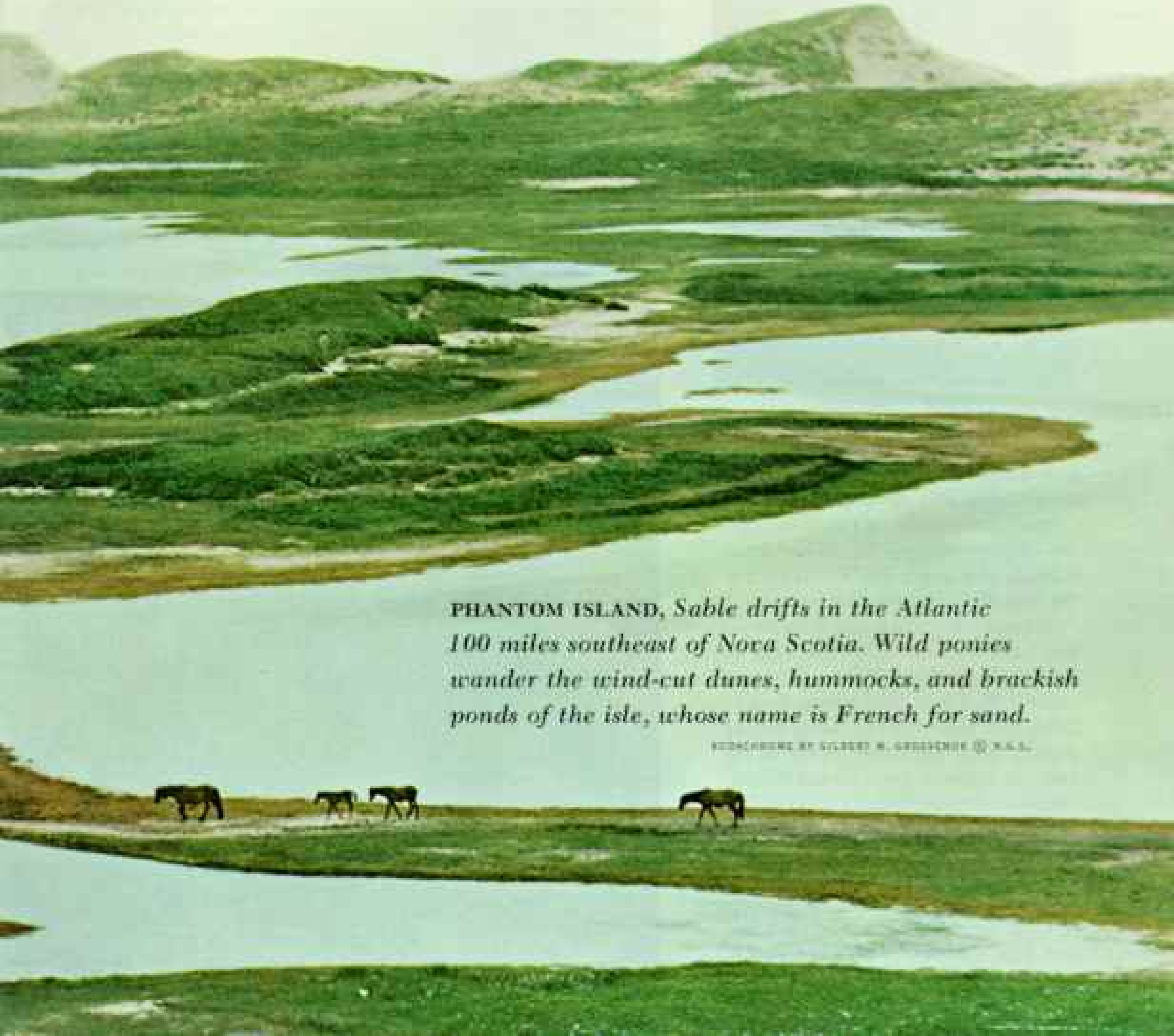
This meeting of mighty rivers churns the ocean, causing strange currents and damp, chilling fogs. Strong Atlantic winds further stir the witch's brew. Resulting treacherous currents, in the days before radio and radar, carried the most skilled skippers off course, wrecking many on Sable Island Bank ahead.

Would the currents carry us off course, too? We must be on guard.

Ship-killer Sable Waits for Prey

Sable! Sable Island! What memories the name brought back—tales of wreckers and gales, of 500 ships and 5,000 people lost.

"Graveyard of the Atlantic," my Grandfather Bell called it. "One of the world's most terrible traps for sailors." As I refilled his pipe, he'd tell me stories of his own trip in 1898 to Sable, that lonely island 100 miles southeast of Nova Scotia. He saw wrecks of ships littering the beaches and "wild ponies dashing down upon the shore into the midst of hundreds of seals." With Grandmother,



PHANTOM ISLAND, *Sable drifts in the Atlantic 100 miles southeast of Nova Scotia. Wild ponies wander the wind-cut dunes, hummocks, and brackish ponds of the isle, whose name is French for sand.*

Grampy Bell had visited Sable to search—in vain, it proved—for the bodies of two shipwrecked friends. Years later, they still recalled vivid details—storms that "undermine the bluffs and scoop out holes in the valleys," gales that make exposed skin bleed "from the impact of fine particles of sand."

Mostly they talked of the danger to ships, and the heroic work of the lifesaving crews.

Grampy brought back several ponies to our summer place in Nova Scotia. One foal, a wild, kicking thing, I tamed before I was 10. Dolley carried me on fishing expeditions. Sometimes she threw me, but I found her worth the bruises, for she came from a place where the only industry was danger.

My curiosity about Sable was nourished, too, on transatlantic crossings long ago. Steaming by at night, I spotted its flashing lighthouse. Once my ship passed at daybreak; Sable lay so close aboard we could see its pale dunes lying low and ominous. On other ships, we passed cautiously in fog. Every time, the captain had sighed in relief, "Sable astern!"

Indeed, those captains had cause to worry. I read in our much-battered 1947 volume of

Clear horizon enables Gilbert M. Grosvenor to find *White Mist*'s position. Later, heavy fog caused navigator's nightmares approaching Sable.

Intrigued by tales of wrecked ships, the skipper secured permission from Canada to explore the "Graveyard of the Atlantic," if sea conditions favored.

Designed by Sparkman & Stephens and built by Nevins in New York in 1950, *White Mist*, skippered by the late G. W. Blunt White, was first to finish the 1953 Buenos Aires-Rio de Janeiro Race. She raced across the Atlantic to Spain in 1957, thence to England and France. Having done well in her seventh Newport-Bermuda Race, the 46-foot yawl here rolls north at 7½ knots under mizzen and jib.

George Beck stands behind Comdr. A. G. B. Grosvenor, USN, at the tiller, and Kim Frinell sits on the cabin.

British Sailing Directions this grim note:

"Should vessels run ashore on Sable Island and be in danger . . . crews are urged to remain by the ship until assistance can be rendered by the life-saving staff on shore. Former experience shows that all attempts to leave in the ship's own boats have resulted in loss of life. . . ." Shipwrecked sailors would wait long for a surfboat today—there are none.

Now in the dark of a foggy night, in my own little ship, with Sable somewhere off our starboard bow, I knew the worries of the old skippers. I was eager to set foot on that little-known island, but determined that *White Mist* should not leave her lovely hull in this boneyard.

"What are the chances in this fog of landing on Sable?" I asked Gil, our navigator, next morning. "Can we duck the shoals?"

"If I can pick up that radio beacon on our direction finder, and if our fathometer holds up," he answered, "I'm sure we can feel our way in to the north shore—the south is too dangerous. Anyway, we're too far off now."

We studied the charts of Sable. Shifting shoals of West Bar stuck like a scimitar 20

Heaving the lead, Kim Frinell calls soundings —"20 feet, 25 feet!" Creeping through thick fog, *White Mist* had first anchored on a 10-foot sand bar. When blasts of the horn brought no answer, the yawl motored toward West Light and now finds deeper water closer to shore.

In pleased astonishment, Mr. and Mrs. Norman Bell, Sable residents, greet the author near Main Station. Word of the coming of *White Mist*, sent from the mainland, failed to reach the island; Mrs. Bell thought she was seeing ghosts. Crewman George Beck of Philadelphia stands at right.

miles out from the island's tip. For days we had been plotting a course well clear. Still Gil wondered what the currents were doing to us in this pea soup.

No sounds yet from Sable's radio beacon. Vainly Gil tried for a shot of an elusive sun with his marine sextant. "If only the fog would lift for a moment," he complained. Without a true horizon, he couldn't observe the sun's altitude and find our true position.

But the fog grew thicker. Moving at 5 knots, we listened for foghorns of fishing trawlers—halibut, cod, mackerel, and broadbill swordfish abound in these waters.

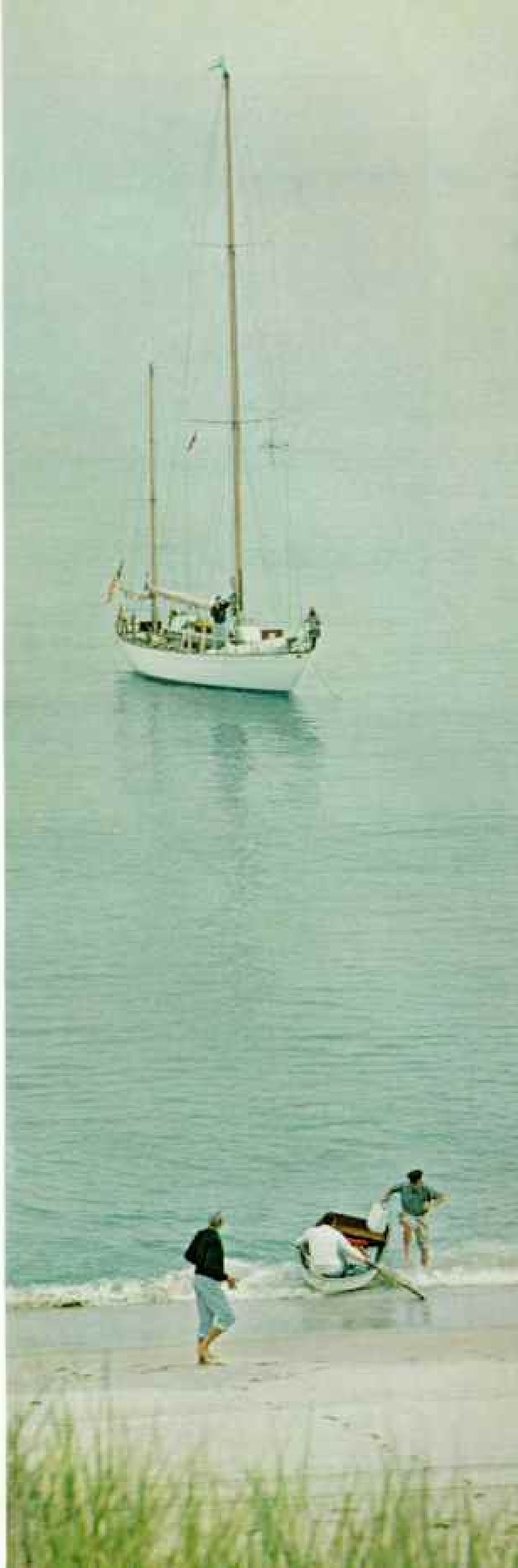
Gil fumed and waited for any slight break in the fog. When it came, he raised his sextant, made a quick sun shot, then dashed below to compute his position. A moment later he called up, "Wow! We're way off course—heading dead on the western shoals! I can't believe it. The horizon *must* be false."

To be safe, he quickly figured a new course, then ordered the helmsman, my son Alec, to turn 35° westward. Sable's strange currents had apparently set us miles to the east.

"Let's skip those plans for landing on Sable,"

Unusual feat: Small pram lands on Sable. The skipper, recalling how Pitcairn Islanders shoot the surf, held off for five big waves, then rowed for the beach on a "smooth." Sixty-six years earlier his grandfather landed here in a large surfboat used to bring visitors through breakers; Sable keeps no boats today. *White Mist* rides at anchor in 20 feet of water 100 yards offshore. She flies U. S. ensign at stern, Cruising Club of America burgee at masthead, former Canadian flag and radar reflector at the spreaders.

KODACHROME BY GILBERT M. GROSVENOR © N.G.S.



Alec urged. "It'll cost us an extra day—even if we're lucky."

Alec, a United States Navy test pilot and *White Mist*'s sailing master, understood the hazards. He remembered what the Canadian officials had told us. "There's a constant surf on the beaches—and no harbor whatever," they admonished. "No small boat should approach or land on Sable. Only in mid-July for a three-week period is the weather calm and surf low enough to permit small boats to land on beaches. Even then it's a 50-50 chance—and there's almost constant fog."

This was a foggy July 13. Would we get a break? If we did, I was determined to try.

By midday we were close enough to Sable's radio beacon to receive accurate bearings, which proved we had sailed 30 miles farther west than necessary.

Gil's suspicion about the sun sight was confirmed: Mist had made the horizon false.

"It's easy to see how early navigators wrecked their ships here. Suppose our error had been the other way, and we had changed course eastward toward Sable's shoals," Gil commented. "Electronics makes my job easier and safer."

Shifting Shoals Make Charts Treacherous

During the night we steered a long course around the western shoals to the north of Sable, watching our fathometer all the while. In well-charted waters we could have followed our track by the peaks and valleys of the ocean floor. But Sable's shoals shift constantly and charts are unreliable. Our Sailing Directions told us the sandy traps form in waves—unpredictable and undulating.

White Mist altered course at 1:15 a.m. to run down on Sable radio beacon, bearing 197°. We wondered how well our fathometer was working, for it registered "no bottom." Time and again, we hove to and checked with the old-fashioned hand line. No bottom.

Riding the beacon at 4¼ knots, we picked

Sliver of sand, Sable Island cuts the Atlantic near the edge of the continental shelf. Five thousand years ago, when the sea attained its present level after the last glacial age, waters from the cold Labrador Current (blue arrows) and warm Gulf Stream (red) gathered sandy glacial deposits into a dimple on the shelf. Growing through the ages, the sandbank emerged as Sable Island. With its underwater bars, it forms a 50-mile menace to mariners. *White Mist*'s voyage to Baddeck, Nova Scotia, with a stopover on Sable, crossed shipping lanes both old and new. Windjammers and early steamers seeking the shortest course to Europe often passed within sight of the dread island. Many vessels, caught in its clutches, never escaped.

up a sounding of 145 feet. Then 120, then 90, and 82. Shoaling up fast.

As pale daylight brightened the fog, we began to hear breakers on the starboard bow. This was the notorious surf pounding West Bar. Chill water and fog carried the sound for miles. Surf with this calm sea—what would it be like in a storm, I mused.

At 5:30, we found bottom at 65 feet; lead line confirmed the fathometer reading within two feet. Now I knew we were getting close.

"Douse the genoa!" I ordered. "I want to slow her."

The crew tactfully reminded me that *White Mist* drew only 4½ feet with her centerboard up. "Aw, we're miles out yet," they insisted. "It will take hours to get in."

Slowly we drifted on, the surf getting louder and the water shallower. Now the depth varied markedly, shallow one minute, deeper the next. But all the while, the bottom came closer. Quite suddenly, it was 10 feet. Glancing over the side, I saw sand.

"Round up into the wind!" I shouted. "Douse the main! Let go the anchor!"

Still no sign of the dunes of Sable. Snugly anchored in the gentle surge of the swells, we went below for a hearty breakfast.

As we lingered over coffee, Alec poked his head up the hatch for a look.

"Land ho!" he shouted. "And on the nose!" The fog had lifted; small waves frothed the beach 400 yards away. We could see the radio beacon antenna, its top jabbed into a mass of cloud. Triumphantly, we blew our horn three times as recommended in our Sailing Directions. We waited. No response.

We tooted again and watched the landscape rise and fall with ground swells. The beach remained deserted, and we were a bit provoked at this lack of welcome.

(Continued on page 411)

EKTACHROME (LEFT) BY WILLIAM ALBERT ALLARD,
KODACHROME BY MELVILLE BELL GROSVENOR © N.G.S.

Author's new-found cousin, Norman Bell talks with his wife in their living room. Mr. Bell, who runs the island's power station, emigrated from Scotland, birthplace of Alexander Graham Bell. "He must be a relative," said the skipper. "He certainly has the Bell nose!" Mrs. Bell coaxed fuchsias up the trellis; begonias bloom at the window. Only stunted wildflowers brave outside winds (pages 418-19).

Wind-whipped manes ripple on the necks of island ponies, grazing in knee-deep grass. Stories vary as to how the animals first arrived on Sable. To increase their size, mainland stallions were introduced shortly before Dr. Alexander Graham Bell's visit in 1898.

JULY 14, 1964
5:30 A.M.

Aircraft land on sand flats near Main Station to answer emergency calls.

Island now covers sites of several wrecks—shifting sands sometimes expose ship skeletons.

ROUTE OF WHITE MIST

White Mist's fathometer indicated varying depths on approach.

Sand bars, six to twelve feet below the surface, shift with every storm.

1883

1888

1917

Sand flats

West Point

1940
Old Main Station
(abandoned)

First Anchorage
6:25 A.M.

West Light
(built 1950)

Main Station

Meteorological Station

Lake Wallace

Station No. 2

Winter high-water shoreline

Grass
Stable sand
Unstable beaches and dunes

Ship
Bark
Brigantine
Brig
Schooner
Steamer

1888 Abandoned lighthouse and date built

Abandoned life boat station

Hydrography from 1964 Canadian Hydrographic Service chart, Banquereau and Misaine Bank, and the 1964 U. S. Oceanographic Office chart, Cape Race to Cape Sable.

rocky

sand

sand

position doubtful

sand

Fine white sand

10:00 P.M.

12:00 NOON

JULY 13, 1964
10:30 A.M.

ROUTE OF *WHITE MIST*

Roaring breakers continuously pound and crash over 20-mile West Bar.

WEST BAR

Ocean surface temperatures range from 35° in March to 64° in August.

S A B L E

SABLE ISLAND

Graveyard of the Atlantic

Known wrecks since 1800

Shipwreck information obtained from Lloyd's of London; The Mariners Museum, Newport News, Virginia; and The Maritime Museum, Halifax, Nova Scotia. Wreck positions approximate.

Land features interpreted from 1952 and 1964 Royal Canadian Air Force photography.

Decca-Lambda Station provides navigational aid in summer to oceanographic vessels and ships surveying for offshore oil.

Heavy winter surf lashes across East Dry Spit

East Dry Spit

East Point

East Light

Station No. 4

Station No. 3

0 5 10 15
STATUTE MILES

0 5 10 15
NAUTICAL MILES

Soundings in feet

JULY 14, 1964
1:15 A.M.

5:30 A.M.

East Point

Radio Beacon

West Point

AREA ENLARGED ABOVE

EAST BAR

THE GULLY

ISLAND BANK

mud

sand

sand and shells

sand and gravel

fine white sand

"**Mabel and I think ourselves alone,**" wrote Alexander Graham Bell of this photograph showing him with his wife. "But photographer McCurdy steals up behind us, and secures a snapshot."

Broad doors of the boathouse frame the visitors. Metal lifeboat inside, presented by humanitarian Dorothea Lynde Dix in 1853, rests on its carriage, ready for launching should a wreck occur.

Sad mission brought Dr. Bell and party to Sable. They came to search for bodies of friends lost in the sinking of the liner *La Bourgogne,* 60 miles south of the island. The inventor (left) and R. J. Boutilier, island superintendent, drove along the shore in a buckboard, looking for wreckage. Here Dr. Bell takes notes on a "fringe of shrimps upon the shore. Number inconceivable—millions and millions and millions."

"**Ladies first,**" wrote Bell of this surfboat boarding. "This is the regular way of embarking and disembarking ladies on Sable Island."

1898: The Bells on Sable

Majestic ghost: Like a docking ship, the *Crofton Hall* nestles against a spit of sand created by eddying waves around her hull. Bell recorded in his diary, "She cast ashore in April of this year—splendid vessel —seems perfect except (but this is a great exception) that her hull is broken in two amidships." All wreckage is swallowed by the sands today.

PHOTOGRAPHS BY ARTHUR W. MCCURDY © N.S.G.

Jagged green lifeline of vegetation divides the narrow north shore from the broad south strand. When pawing ponies uproot stabilizing grass, the wind scoops small craters that grow to large gullies. The far west end of the crescent dwindles into the sea, extending submerged for 20 miles. Crashing surf engulfing the beach in winter carved ripples in the sand. In like manner, rolling seas shift and mold offshore shoals. The skipper (below) strolls through mist created by the converging warm, moist air from the Gulf Stream and the cold atmosphere of the Labrador Current. Along one of the tracks that crisscross the dunes (right), meteorological technician Douglas Harrington halts the tractor until grazing ponies move off. Three-month-old Topsy seems more wary than her elders.

"Maybe we should feel our way down toward the lighthouse," suggested Alec.

Following the misty shore, we motored slowly westward along the beach, sounding constantly. Strangely, the water closer to shore was deeper than where we first anchored.

Through a cleft in the great sand wall, I saw rooftops and a lighthouse. "We'll try a landing here," I said. After eight days at sea, the crew was eager for a day ashore.

Incredibly the seas were calm. But the weather changes swiftly; so I insisted that our crew take turns standing watch aboard *White Mist*. From old eyewitness accounts, we knew what could happen.

"The sun often rises clear, giving indications of continued good weather," warned one Sable historian. "Suddenly a dull, leaden haze obscures the sun . . . the sky assumes a wild, unusual appearance. The wind begins to rise in fitful gusts. . . . Now the gale bursts in awful fury, whipping off the summits of the hummocks, carrying before it a cloud of blinding sand-drift. . . ."

Astonished Islanders Greet "Ghosts"

Calm as the water seemed, the swells were more than enough for our 8½-foot pram. But the little cockleshell made it to shore, though a wave swamped her on the first trip—in water ankle deep.

"Let's try Pitcairn Island technique," I suggested to Kim Frinell from Seattle, Washington, as we rowed in. When Pacific islanders bring their longboats through surf, they wait patiently, count five

big swells; then row like Old Harry for shore. We tried the same tactic, and I stepped ashore almost dry shod (page 403).

I saw no life, heard no sound except the roar of Atlantic swells breaking on West Bar. Wisps of fog still clung to the dunes like carded cotton. The panorama was as chill as the ghost stories that haunt this place.

Curiously I felt eyes upon us; looking up the 30-foot dune, I saw I was right: A big black stallion, ears up and mane stiffened by the wind, challenged us like a sentry. A flash of his tail and he was gone. Yes, horses still roamed Sable.

Loose sand pulling at our feet, we labored up the dune. Below us lay a green valley with clustered houses, a village rising from the sea.

"People," Gil said, pointing. A man and woman knelt in a patch of green.

The woman lifted her poke bonnet and peered at us. I waved. The bonnet bobbed down, and she resumed her work.

"I'm sure she saw us," Gil said, his voice not at all sure.

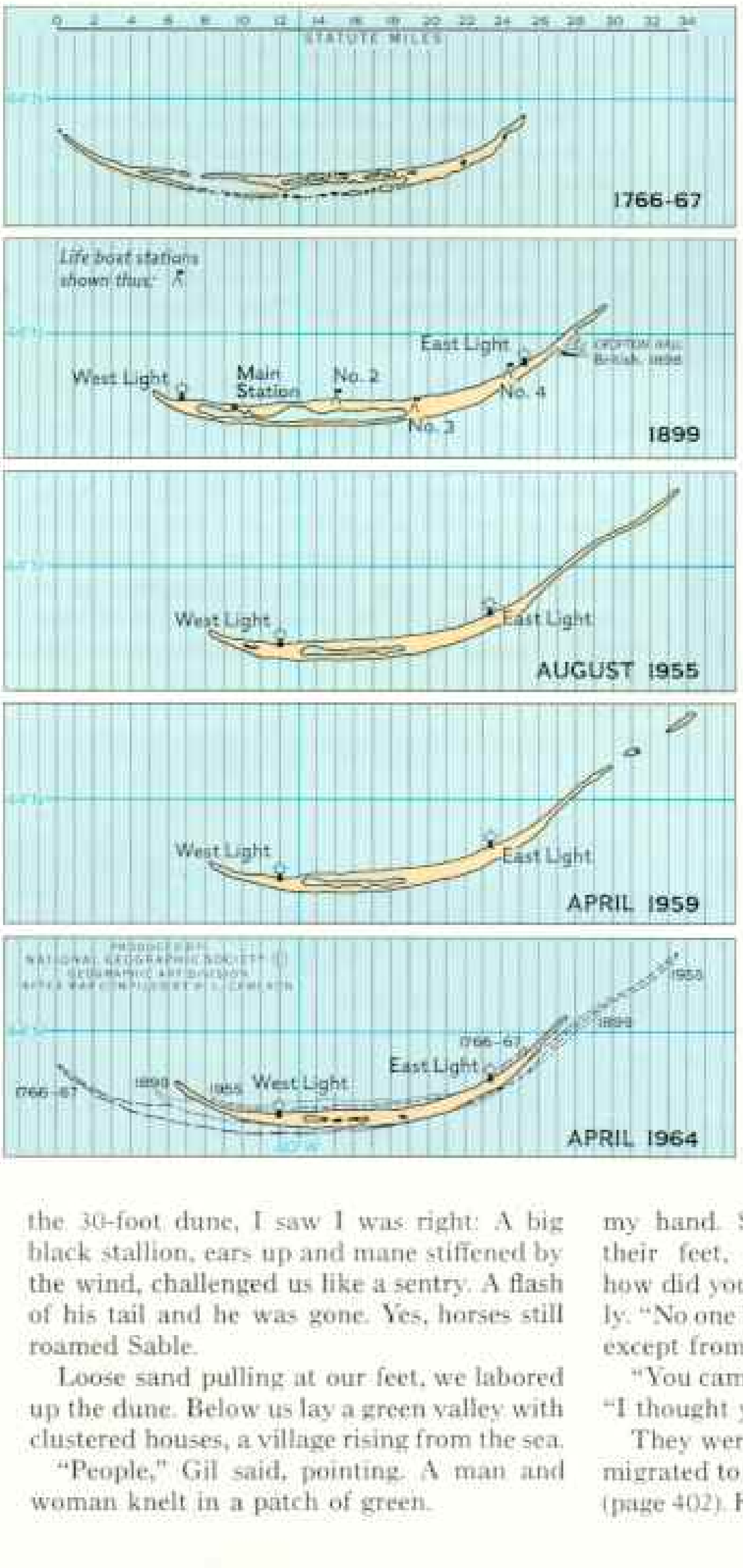
Again she looked up, then quickly down.

Without wanting to, I thought of pirates and shipwreckers who once had lived here.

I walked toward the woman, holding out my hand. She and the man scrambled to their feet, scattering strawberries. "But—how did you get here?" he asked incredulously. "No one has landed on this island for years except from a government boat!"

"You came out of the sea and fog," she said. "I thought you were ghosts!"

They were the Norman Bells, who had immigrated to Canada from Dumfries, Scotland (page 402). For a year they had lived on Sable,



Creeping crescent of Sable shifts slowly eastward. Centuries-long wave and current action, accelerated by violent storms, erodes away the western tip and builds a sinuous tentacle at the island's opposite end.

From the year J. F. W. Des Barres drew his map, here copied at top, to the visit of Alexander Graham Bell 132 years later, the island moved six miles. "The West end . . . is washing away so fast," wrote Superintendent Edward Hodgson in 1814, "that it is now very near the house. . . ."

Dr. Bell inspected vital life-saving stations and observed that West Light stood well inland; it succumbed to the encroachment of the sea in 1917. A sometime lagoon, Lake Wallace in 1898 gave Dr. Bell a spacious and protected pool for swimming.

In the three most recent maps, drawn by H. L. Cameron from Royal Canadian Air Force photographs, the island shows little movement other than seasonal changes, as might be expected in such a short lapse of time. Long eastern tail visible in the fall of 1955 seems to be breaking up, but the 1959 and 1964 springtime maps may only reflect winter's ravages.

where he tended the diesel station that generates all the island's electric power.

"My middle name is Bell, too," I said.

"Well, we must all be telephone Bells!" laughed my host.

"Righter than you think," I said. Then I explained that Grandfather—the inventor Alexander Graham Bell—was responsible for my lifelong interest in the island and the reason for my being here.

"Forgive me," said Mrs. Bell. "I have almost forgotten how to behave with visitors—we have only four government boats a year. You must come to our house."

Wind Sandblasts Vegetation

The Bells gathered up their berries, and we made our way to a neatly painted frame house. As we passed through the vestibule, she reached into a big freezer and pulled out a can of lemonade. A moment later we were sipping a refreshing drink over strawberry shortcake and discussing their life here. Some of the Bells' furniture was damaged when it was brought ashore ("the boat broached and water ruined our record player"); still the house was cozy and attractive.

Pots of begonias and fuchsias dotted the living room (page 405), and I recalled Grampy Bell's journal: "Flowers of various kinds are grown successfully indoors, but the dwarfed appearance of all vegetation out of doors shows that the weather is not always mild."

"Yes," said Mr. Bell. "Wind and sand cut everything down. We haven't a single tree."

"You're interested in geography," said Mrs. Bell, handing me a map. "Sable is a floating sand island, constantly shifting, anchored to the continental shelf. See how it has moved bodily eastward and gotten smaller since its discovery about 1500."

Portuguese cartographer Pedro Reinel called it Sanda Crus, and on early English, Italian, and French maps it varied in size. In 1633 a Dutchman, Johannes de Laet, reported "Sable . . . is about [forty miles] in circuit . . . the sea . . . being shallow and without harbors, and having a bad repute for shipwrecks."

Others, perhaps out of pure dread, calculated the island as 200 miles long with dunes towering 800 feet! The west end retreated before the storms: 6 miles between 1766 and 1899; 3 between 1899 and 1959. Meantime, the eastern tip actually grew (opposite).

Voracious seas and winds have gnawed at the island's dunes until today it measures scarcely a mile wide and about 23 miles long. Broad sand beaches and far-reaching shoals are remnants of the old island.

PHOTOGRAPHS BY MELVILLE BELL GROSVENOR (ABOVE) AND ALBERT W. GROSVENOR © N.G.S. CHART © R. J. MACDONALD

Victim of explosive winds, the old boathouse may collapse with another severe storm. Joseph P. Blair III of Miami, Florida, studies the date—1893.

Map shows known wrecks since 1800. Mr. Harrington points out *White Mist*'s anchorage to bosun Stanley Judge of Gorham, New Hampshire.

"You can trace the erosion by our lighthouses," Mrs. Bell noted. Since the first light was built here in 1873, the sea has swallowed six, one after the other. Surf beats today over the ruins of the West Light that Grandfather saw well inland.

"Dunes change overnight in storms, and landmarks disappear," said Mrs. Bell. "So it is hard to reconstruct island history." She told us that after a severe storm in 1963, an island resident found the exposed skeleton of a young man who may have starved to death. "And with the body," she added, "he found some old British coins dated 1760—and these." She handed me half a dozen lead musket balls and a shoe buckle.

Near Old Main Station lie the "French graves," never opened. Were these casualties of the long campaigns between the British and French in the New World? We know that in 1746 the Duc d'Anville, on his expedition against the British colonies, lost a transport and a fire ship in a storm here. Perhaps these were wounded men going home from the wars. Or was this ship lured upon the shoals by shipwreckers who murdered the crew for the cargo? No one could be sure.

We do know that in the autumn of 1799 the British sailing ship *Francis* perished here with every soul. She was bringing from England the equipage of the Duke of Kent—treasures of furniture, plate, books, and maps.

For years ugly rumor surrounded the sinking of the *Francis*. Stories were told of jewels and rare artifacts seen in the homes of certain Nova Scotia fishermen—"things from Sable Island," men cryptically explained. Some said that survivors of the *Francis* reached Sable Island safely, only to be murdered for their treasures. A proclamation was issued in 1801, investigations made, and certain residents of the island—wreckers, presumably—were expelled to the mainland.

Yet from this dark incident came a new role for Sable Island. The legislature of Nova Scotia established a lifesaving station. In succeeding decades, thousands of shipwreck victims owed their lives to these lifesavers.

Pounding along hard, wet sand, meteorological technicians Gordon LeBlanc and Harry Earle canvass the south beach. In days when ships struck Sable two or three times a year, lifesavers patrolled the island. They peered through summer fogs and stinging winter blasts for a distant sail or bit of wreckage. Today's riders pick up bottles released from the mainland for study of currents. In one experiment

Mess call! And a feast appears. Cook Eddie Melanson (second from left) prepared a fabulous roast beef dinner for *White Mist*'s crew and station meteorologists. "High point of the meal," said the author, "was homemade bread. Eddie gave us fresh loaves and a cake for the ship." Sable must import all its supplies.

827 bottles were released from Nova Scotia; of 36 returned, 24 came from Sable, suggesting a huge eddy around the island.

[UPPER RIGHT] AND WILLIAM ALBERT ALLARD © N.G.S.

"We find only a few relics of the shipwrecks now," said Mrs. Bell. She brought out a sternboard of the Italian bark *Raffaele D.*, wrecked in 1896, one of the scant souvenirs from 500 disasters. "The sand swallows most wreckage like quicksand," she said. "And the winds and currents carry floating objects around the island and out to sea." Or as Grumpy noted, "The wind is in the wrong direction to assist drift of bodies to shore."

Island Census Lists 200 Ponies

"You are extremely lucky with the weather," Norman Bell told us. "This is the calmest sea we've had in months. Most days you couldn't dream of coming ashore in that pram. Too bad the island no longer has longboats to give visitors a hand."

Mrs. Bell made a telephone call to Douglas Harrington, the officer in charge of the weather station. He sent word that he would be right over.

"How many live on the island?" I asked.

"Just 13," Mr. Bell said, "and about 200 ponies."

Outside the window grazed a herd with plumed manes and tails—bays, chestnuts, blacks, and several shaggy colts of a pinkish fawn color.

Mrs. Bell handed me some oatmeal cakes.

"Maybe they'll eat these from your hand," she said.

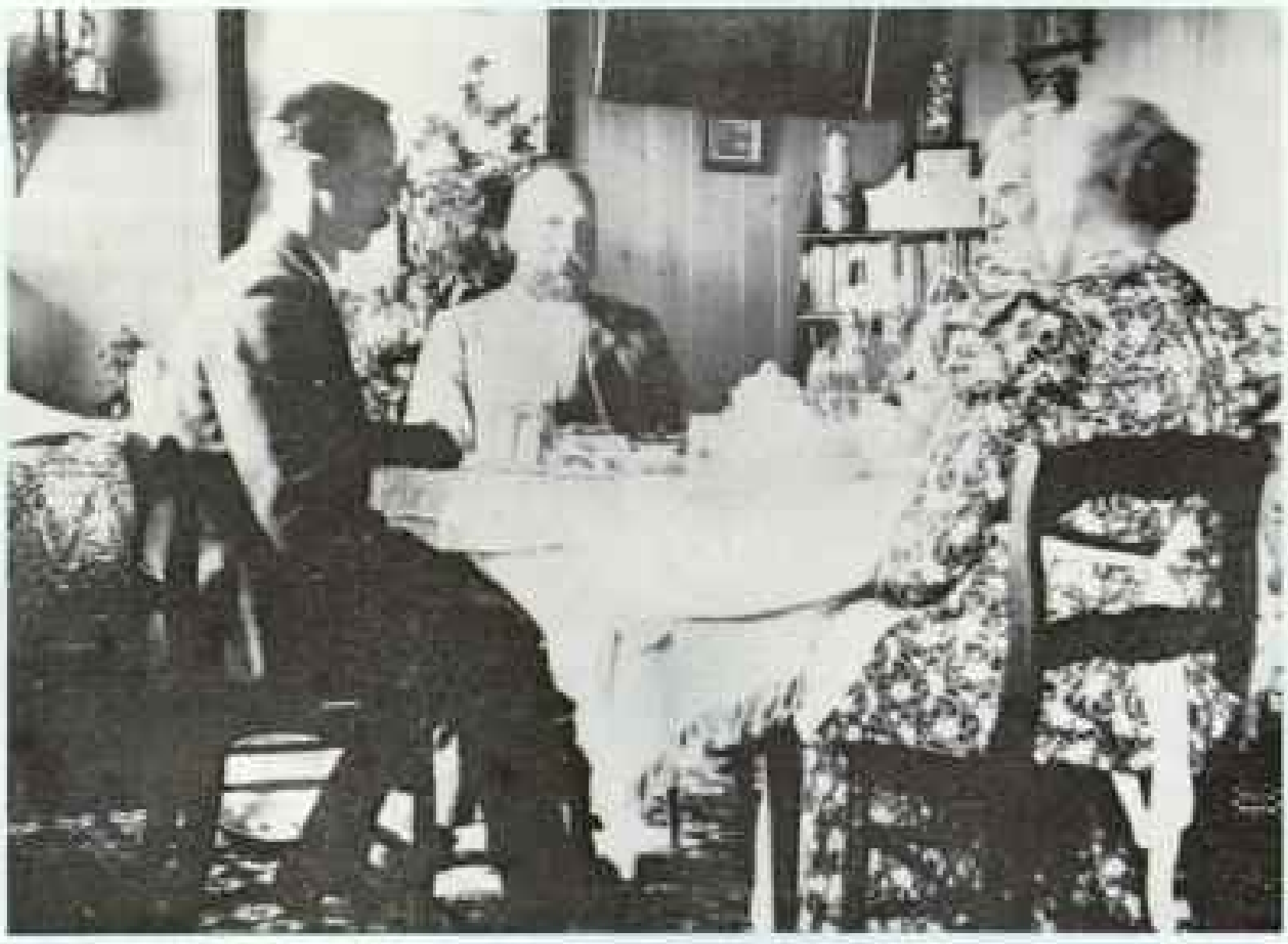
We walked slowly toward them. Tentatively, a colt approached to nibble, then turned into a little beggar. He even nibbled at my elbow and camera.

The origin of these ponies is lost in dim history. They may have descended from stock shipped to the island from New

Buildings bare to the elements, Old Main Station clings to treeless dunes in 1898. The American flag flies beside the superintendent's home in honor of the Bell visit. Hen house stands at far left with cow barn behind it, then milk shed, and staff house. Men used the tower to search for ships in distress.

Slender fingers of marram grass creep inside a window of the long-vacant superintendent's house in 1964. Sand sifts in through every opening; drifts build in corners. No longer do brave men dash from its rooms to risk their lives saving those wrecked upon the island's shores while their wives stand at the windows "to watch the foaming white mountains of surf," as Mrs. Boutilier wrote to Mrs. Bell.

Weather-wracked shell of the superintendent's house—here visited by Thomas Tirion of *White Mist*—shows



Dr. Bell dines with Superintendent Boutilier (center) and Mr. and Mrs. Smalcomb, who tended the island's Life Saving Station Number Four. The Boutiliers' eldest daughter, Bertha, entered nursing with the idea of returning to Sable to care for shipwreck victims. While studying at a hospital in Massachusetts, she contracted typhoid fever. "The hardest part to us," wrote Mrs. Boutilier to Mrs. Bell, "was . . . the steamer that brought . . . news of her death also brought her Christmas remembrances . . ."

the ravages of storms. Vacated in 1950 when Main Station was moved eastward, the building crumbles a little each year. When gales threaten the island, stinging sand-laden wind and rain take their toll. Window panes and shingles have blown away, revealing the bare bones of the old home.

PAINTINGS BY WILLIAM BLIGHT BLAND (LEFT) AND FROM THOMAS J. A. TYRON; BLACK-AND-WHITE PHOTOGRAPHS BY ARTHUR W. MCCURDY © N.G.S.

England in 1738, or from an even earlier herd that survived the wreck of a Spanish vessel off Sable. Whatever the family tree, ponies have flourished here since the 18th century, living for more than 40 generations in herds of six and eight on local grasses. And many shipwrecked sailors were thankful for "horse venison," as they called their survival diet.

Grampy's journal of 1898 had this to say: "These ponies are not small like Shetland ponies, but pretty nearly of ordinary size for horses." He explained: "The original ponies were not strong enough to haul the life-boats over the beach. Stud-horses, however, were

EXTACHROMES (ABOVE AND RIGHT) BY MELVILLE BELL GROSVENOR © N.G.S.

Ready for launching, the weather balloon will carry aloft a radio transmitter to send back information on wind, temperature, barometric pressure, and humidity. This lonely outpost provides weather data for ships and airplanes plying ocean and air lanes between North America and Europe. Joe Drebnicki releases the balloon upwind from Bob Hoogerburg. When the six-foot sphere floats directly overhead, Bob lets go of the transmitter.

Fragrant grass pink orchids *(Calopogon pulchellus),* above, and beach pea *(Lathyrus japonicus)* spice the sands with color.

ACTUAL SIZE

Regal blue flag *(Iris versicolor)* flourishes in the protected dunes near Sable Island's Lake Wallace.

ACTUAL SIZE

EXTACHROME (RIGHT) AND KODACHROME BY GILBERT M. GROSVENOR © N.G.S.

introduced from the mainland . . . after the capture of the native stallions. The half-breeds since produced are so much larger and stronger than the original ponies that they can be used for the work of the stations."

Wild Rides, Soft Landings

Mr. Harrington and his assistants arrived a few minutes later on the island's only "bus"—a lumbering tractor and trailer.

"Welcome to Sable Island," Mr. Harrington said, smiling through his luxuriant sable-colored beard. His assistants hopped aboard ponies bareback for a rollicking romp. Wild ones lurched, bolted, and tossed the riders onto the sand.

"Only three ponies on the island are tame enough to ride," a young man told me, "and only one is cart-broke."

But nature strikes a balance between the ponies' high spirits and sugar-soft sand. I saw not one rock on the whole island.

"I'd like to show you more of the island, our weather station, and the wreck of the *Manhasset*," Mr. Harrington suggested.

As the bus skidded in the loose sand and climbed the dunes, our host commented, "We call this a road." Warm sun bored through the

ACTUAL SIZE

Splash of red, sweet wild strawberries (*Fragaria virginiana*) ripen in mid-July.

Fernlike yarrow (*Achillea lanulosa*) might relieve toothaches or melancholy, said early botanists.

ONE-EIGHTH ACTUAL SIZE

Growing wild on Sable, *Aster novi-belgii* shows white flowers; the common garden variety of this aster usually blossoms blue.

PAINTING (BELOW) BY WILLIAM ALBERT ALLARD © N.G.S.

ROUACHROMES BY GILBERT M. GROSVENOR © N.G.S.

Perky Ipswich sparrow nests only on Sable Island. Though shy on the mainland, the six-inch birds are relatively tame on this lonely isle, to which they fly each summer to breed. In sheltered hollows they weave nests of grass on the sand.

PAINTING BY WALTER WEBER, NATIONAL GEOGRAPHIC STAFF ARTIST © N.G.S.

Man overboard! Bouncing up and down in the surf, the landing barge from *Sir William Alexander*, anchored a mile offshore, hits the beach. Impact tumbles man over; crew fears boat will crush him. Soaked but unhurt, he laughingly heads for dry land. Steamers from Nova Scotia make the 14-hour voyage to Sable Island four times a year to service lighthouses and bring supplies. Big wave piles up on the offshore bar where *White Mist* first anchored.

ENGLISHOMES BY WILLIAM ALBERT ALLARD © N.G.S.

overcast, melting the fog and brightening the lush grass in the gullies among the dunes. Small clans of ponies grazed here and there.

But all the while, we were thinking about the weather. If a fresh wind and surf came up, *White Mist* would have to put to sea instantly; it might be weeks before she could return. Mr. Harrington reassured us, however: "The forecast—fog and light winds."

As we came over a ridge, we saw the radar dome and buildings of the weather station, all huddled together starkly. Here we sent radiograms to the mainland that we had made safe landing on Sable.

Doug Harrington showed us a pile of bright glass-and-aluminum fishing floats. "We walk the beaches a lot and find them cast up—many nationalities, like the trawlers they came from. Those are French and Portuguese. The biggest ones are Russian." In fact, on *White Mist*'s radio, we'd heard guttural Russian sea talk; and once, we'd sailed through a squadron of four white Soviet trawlers—floating fish factories.

An operator in Sable's radio shack was talking to Alec on *White Mist*. Alec had picked a frequency that Sable could read; so we had a short chat, reassured that all was well aboard.

"Next time you come," said Harrington, "put a 2,800 crystal in your radio set. We monitor 2,800 kilocycles every hour on the hour. It's also a good idea to send word ahead to the

forecaster in Halifax, so we'll expect you."

The walls of the shack were decorated with pin-up girls. "The only two women on the island," Harrington explained, "are married!"

Two men watched a television screen. "Not a bad picture today," commented one. But hard as I looked, I could see only "snow" in the picture from Sydney, 150 miles north.

"Don't think it's always this quiet here," said Harrington. "Storms are very dramatic." He told us about 60-foot waves exploding on the shoals and rolling up the beaches, then showed us window glass frosted opaque by sandstorms in a single season.

Huts Save Castaways' Lives

During such storms, refuge huts often saved lives. Doug Harrington showed me a log for 1855: "The *Nisibis* . . . struck on the N. E. bar . . . during a most violent gale. . . . The crew clung to the wreck till . . . miraculously thrown on shore. . . . It was next to impossible for our men to go the rounds; and if those poor fellows had not had . . . the house of refuge" with a fire to warm them and bread to eat, wrote the superintendent, they would have died before reaching "the eastern station, the distance . . . being seven miles."

Doug broke out charts that located known shipwrecks by name and year. The dots—each one a terrible disaster—completely fringed the long crescent island (page 413).

Navigator Gil was fascinated by the chart. "*White Mist* is anchored near here," he said, pointing to a dot. "What wreck is this?"

"That would be the schooner *Arno*," Doug replied, "sunk in 1846. I'll show you the official report by Superintendent Joseph Darby."

An eyewitness, this colorful old sea captain commanded Sable Island station from 1830 to 1848. During a violent winter storm, he reported, giant waves piled up on the bars off the north shore. Across these very shallows *White Mist* had glided only this morning.

"All of a sudden," Darby wrote, "we saw an object to the north side dead to windward, which we at first thought was a large bird, but shortly after discovered that it was a sail, distant five or six miles, and that she was running down right before this tremendous gale dead on a lee shore . . . incredible that any vessel could live to come so great a distance through such mountains of broken water. . . ."

Through his glass, Darby watched the schooner approach over waves that "appeared like certain destruction." Miraculously, the sea before the ship seemed to turn "smooth as glass. . . . When she approached a little nearer we could see . . . two men were making great exertions with their arms. . . . Another half mile brought her to the beach, and her bow struck the sand." Safely ashore, *Arno*'s skipper explained how he had saved all hands.

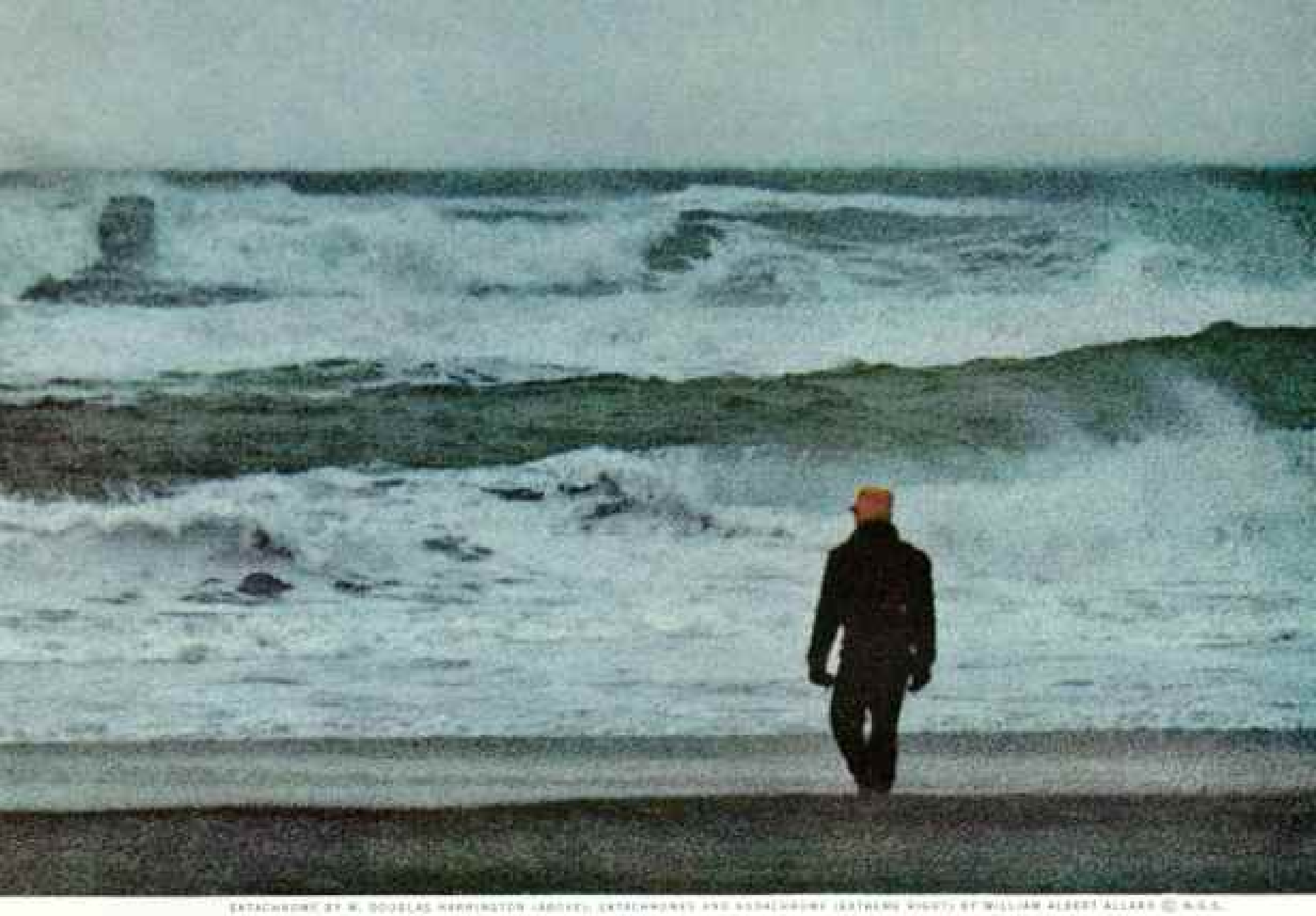
"He lashed himself to the helm," Darby's report continued, "sent all his men below but two, and nailed up the cabin doors. He had two large casks placed near the foreshrouds . . . . He then directed his two best men to . . . lash themselves firmly to the casks, which were partly filled with blubber and oil from the fish. They had each a wooden ladle about two feet long, and . . . they dipped up the blubber and oil and threw it up in the air as high as they could. The great violence of the wind carried it far to leeward [ahead], and, spreading over the water, made the surface smooth before her, and left a shining path behind. . . . It was raging . . . but not a barrel of water fell upon her deck the whole distance."

Thus wrote Captain Darby in 1846—officially, colorfully, perhaps even truthfully.

Hay for the horses completes the autumn cargo run. Husky seamen lug 125 bales onto the beach. Tame animals get their feed from the mainland; wild ponies forage through the winter months.

Where the sea turns killer

ATLANTIC VENTS its fury; breakers crash over the shoals; spume flies into the tempest. "The more violent of these [storms]," wrote a Sable historian, "strike the boldest with awe, if not with terror. The full force of the Atlantic beating upon a shore of fifty miles seems to cause the earth to quiver to its foundations. . . ." Ships carried off course by gales and capricious currents faced peril here. Once a ship's keel found the sandy bottom, she was doomed. Seams popped and sand rose in the bilges until the ship's back



ENTACHMENT BY H. DOUGLAS HARRINGTON (ABOVE); ENTACHMENT AND AQUATINT (ABOVE RIGHT) BY WILLIAM ALBERT ALLARD © N.G.S.

broke under the load. Like a tombstone, the mast of the *Manhasset* (opposite, below), Sable's most recent victim, marks her watery grave. En route from Hampton Roads, Virginia, to St. John's, Newfoundland, the freighter foundered off the south shore July 4, 1947. Skeleton of the 343-foot British steamer *Skidby* (below), sunk on the north coast in 1905, lies "in the graveyard of the deep," to quote the Sable Island Ballad, "where the ships are caught by the shifting sands, and remain in eternal sleep."

Lifting her skirts above the foam, a headless woman in wood seems to stride in from the Atlantic. This figurehead, found by an islander in the dunes, came from an unknown ship. She now graces the Maritime Museum in Halifax.

To see the breakers, our bus took us a quarter of a mile across the flat south beach. Terns followed us, calling uneasily lest we invade their nesting grounds.

Most of all, we enjoyed the seals. But their numbers have flagged since Grandfather recorded "hundreds" and even "thousands" on these beaches. At least their manners endured. As he reported: "...every seal had his head lifted watching our approach.... They seemed to display no fear, only curiosity to have a look at us. An uncanny feeling to see a human-looking head with great rings round the eyes suddenly pop out of the water to stare at you."

Fog still hung over the ocean as we reached the breakers. Sea stallions charging in from far-distant storms crashed at our feet.

What if a gale should blow up now? The sea would rise and these waves would suddenly grow monstrous, overwhelming us.

Returning to the dunes, we were lucky to have tracks to follow and Doug to lead us. Pity the poor sailor cast up here by the waves in a roaring maelstrom. He could stumble for miles across these flats in the wrong direction, perhaps to drown off East Point.

Yet on the loneliest patch of hard, wet sand, we could still see tracks of ponies. Inland, between the dunes, we passed skeletons of ponies caught unprotected by winter storms.

"Life still isn't easy for them," said Doug. "Each autumn we bring in hay to feed the tame horses through the winter. Some of the others will accept handouts, but the really wild ones prefer to forage."

As we rolled along the south beach, we saw

ROYAL CANADIAN AIR FORCE PHOTOGRAPHS, COURTESY R. L. CAMERON, PHOTOGRAMMETRY DIVISION, NOVA SCOTIA RESEARCH FOUNDATION, HALIFAX

GIGANTIC WAVES, *curling and breaking over a perilous shoal, dwarf the wreck of the American trawler* **Gale**. *The 320-ton ship struck East Dry Spit head-on in 1945. Fingers of surf probe the hull of the Greek freighter* **Alfios** *(inset) that went aground in 1946. Today, ten years after these photographs were taken, sand and water swirl over both hulks.*

Frosting of snow creates an arctic landscape. Lone horseman, muffled in coat and cap, crunches across a valley between frozen dunes; the chill Atlantic stretches to the horizon beneath a lowering sky. From November through March, brief snowstorms howl down from the northwest, followed by rain squalls that usually wash away the white blanket. Snow on Sable rarely lasts longer than a week, but the winter of 1964-5 was severe; snow and ice remained for two months, and many ponies died.

Rump to the wind, Blackie waits out a blizzard. Shaggy-coated Sable ponies shun the stable. "They are extremely hardy," wrote the Reverend George Patterson in the 19th century, "enduring the most inclement weather with only the shelter of some sand-hillocks." Snow-encrusted grass provides feed; for water, they break the ice in the ponds with their hoofs.

Weather balloon tugs for freedom in a winter's blizzard. Observers send them up at 7:10 morning and night.

AUDUBONOWS (ABOVE) AND ENTRANCE BY W. DOUGLAS HARRINGTON © N.G.S.

Sable Island's latest wreck: The butt of a mast with crossed yardarm stands like a grave-marker for the *Manhasset*, a Panamanian freighter that struck here in 1947 (page 422).

"That was the year the radio beacon was installed," Doug Harrington explained, "and ships began to carry radar and sonar. Since then we've had no shipwrecks. None."

But if a storm should silence the beacon—if that victorious V signal (three-shorts-and-a-long) should fail—or if the island itself should erode and disappear, as some geologists predict, then Sable's unmarked banks would trap sailors again.

Meandering back, we sighted a number of sprightly "gray birds," as islanders used to call the Ipswich sparrow, Sable's only nesting land bird (page 419). Named for Ipswich, Massachusetts, where it was first found, this little dune dweller ranges in winter from New England to Georgia beaches. But its breeding place remained a mystery until 1894, when the first nest was found here. Now we know that this little stretch of sand is its only nesting site in the world, and its declining numbers on the mainland may be due to erosion of these storm-tortured dunes.

At last our trail led us to the one place on Sable that still evokes a spirit of the past: the abandoned main lifesaving station. Since the need for surfboats and lifesavers has vanished, these snug homes have become a bleak ghost town.

The superintendent's house, the old barracks for marooned mariners, and the lifeboat sheds—all are in collapse and partly smothered by grassy dunes. Walls once neatly painted have taken on the luminous gray of driftwood.

The place was utterly strange—yet familiar. Then I recalled Grandfather's faded photographs taken on his visit. Houses stood freshly painted behind neat picket fences. Men with elegant mustaches posed with ladies in flowing skirts and bonnets.

On clear days, the lookout could survey most of the island from a tower that stood here. But in fog or storm, he patrolled the beach "mounted on a hardy pony," as one old chronicler reported, "sometimes in the face of a fierce blast . . . snow, hail, or rain, or driving sand so as to make his face smart, so that he was sometimes glad to take shelter behind a sand dune. . . . At length he met the roundsman from the next station. They exchanged notes, retraced their steps, and reported the results at headquarters. They thus made the whole circuit of the island."

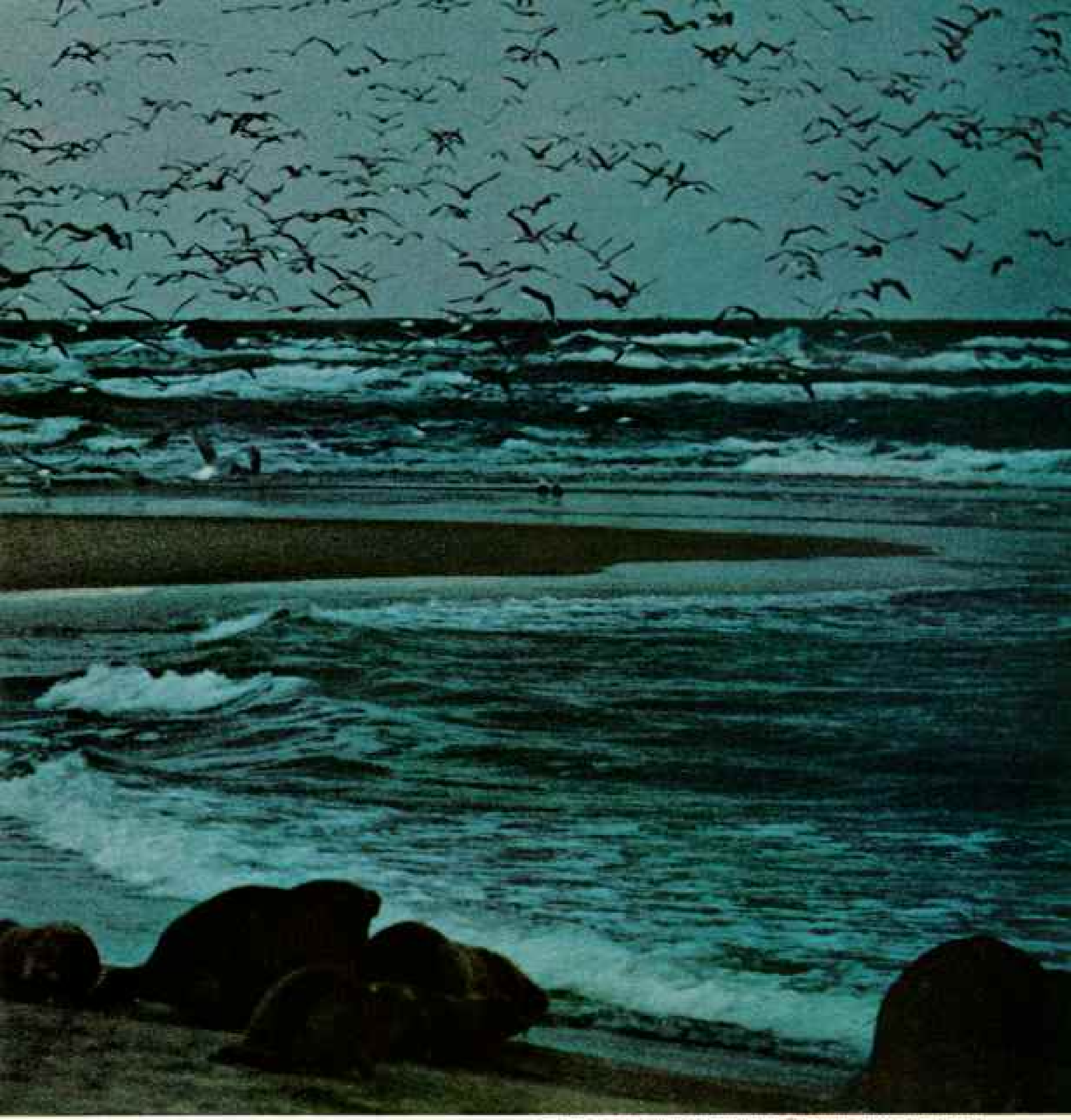
Grandmother saw these patrols and wrote that they examined "every inch of the shore so not even a bottle could escape discovery."

When ships in distress were sighted, the lifesavers launched their surfboats. I could imagine the craft striking out through crashing breakers. How the sailors on sinking ships must have prayed for those heroic oarsmen!

My thoughts moved back to 1853 when that remarkable humanitarian and philanthropist Dorothea Lynde Dix visited Sable Island on a mission similar to Grandfather's. While here for only three days, she witnessed a shipwreck, the 132-ton *Guide*, of London, which ran aground under full sail on the south side of the island. Longboats rescued the crew through high surf, but the captain "had become a raving maniac, and would not leave," wrote one witness.

"Miss Dix rode to the beach on horseback, as the last boat landed from the ill-fated vessel, and learned the sad fate of the commander .... She pled with [the sailors] to return to the wreck and bring him on shore, and to bind him if it was necessary. . . . They obeyed her summons, and soon were again on the beach, with their captain bound hand and foot. She loosened the cords . . . and persuaded him to thank the sailors for saving his life."

The experience convinced Miss Dix that the station needed more modern surfboats. When she returned to the United States, she raised



PAINTING BY W. DOUGLAS HARRINGTON © NATIONAL GEOGRAPHIC SOCIETY

Cloud of gulls floats above seals scrambling for the sea. After an attempt to snap a picture, Dr. Bell said, "When you catch a weasel asleep, you may be able to photograph a seal on the beach of Sable Island." Telescopic lens and high-speed film made this recent view possible.

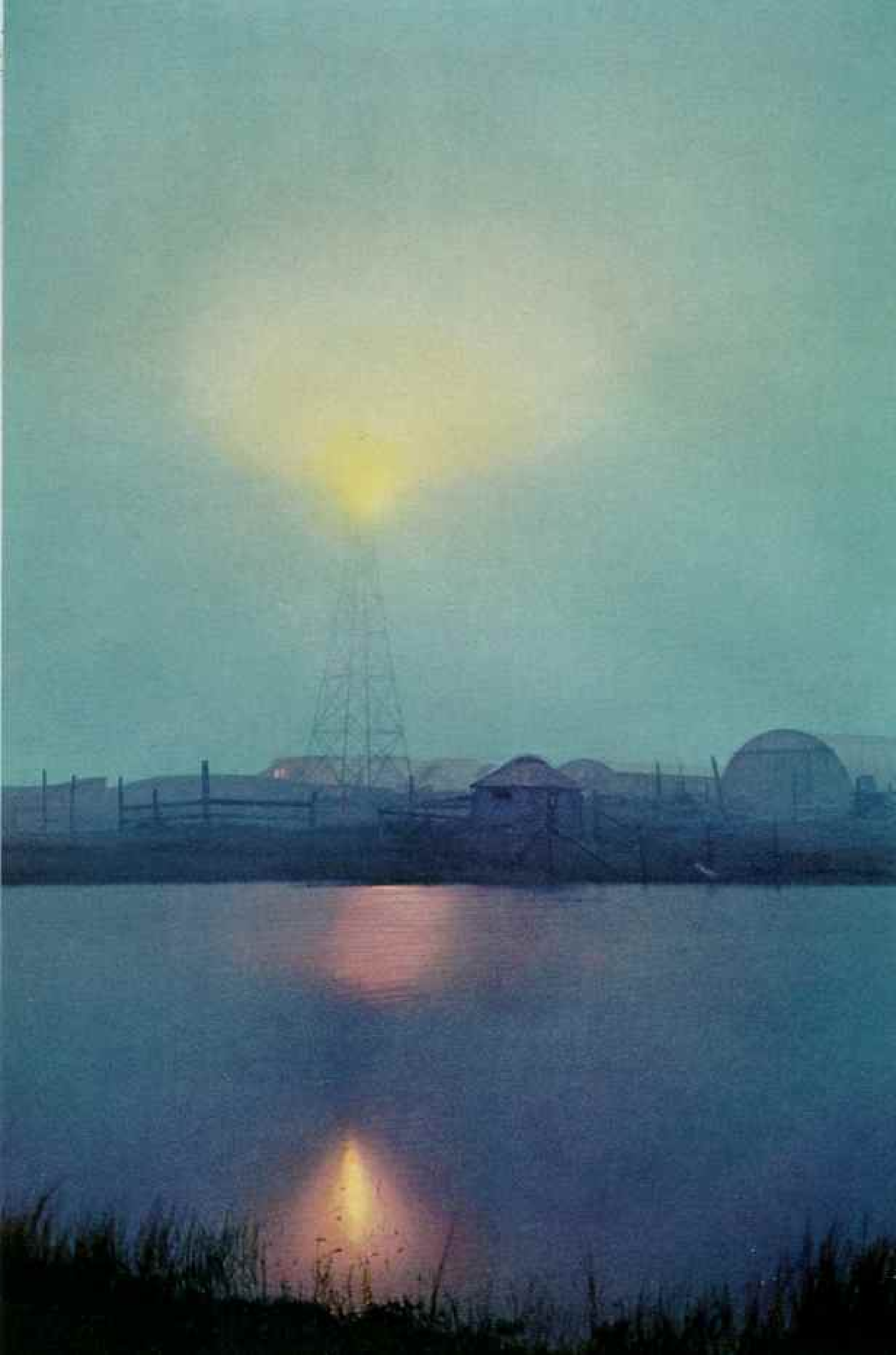
funds, and the station received two new boats.

We climbed sand-clogged stairs of the staff house at Old Main Station, which recalled "the house for shipwrecked sailors" that Grandfather had described, and saw gloomy "rooms . . . like the staterooms of a vessel." But instead of bunks there were iron cots, rusty as the tools in the blacksmith shop.

Stepping over a sandy doorsill, we entered the superintendent's home and explored its deserted rooms. The bathroom was a period piece. Beneath an arbor of pipes stood an old tin bathtub—elegant, uncomfortable. In other rooms heavy Victorian wallpaper peeled from the walls; one room with an ornate floral pattern must have belonged to a woman.

As we prowled, I thought of Robert Boutilier, the superintendent when my grandparents came here. Years later Mrs. Boutilier still corresponded with Grandmother.

"Letters are visits of friends to us here," she wrote. "We have had such a stormy, cold winter . . . almost continuous gales from January



until the wreck of *Moravia* [a German liner carrying coconuts and wine] . . . I stand at the window to watch the foaming white mountains of surf." When time was measured by shipwrecks, which of the sand-covered windows framed that view of violent seas?

Mrs. Boutilier always included lonely bits of family news: "I have only one daughter home with me this winter. . . . [Bertha] has always wished to take up the study of nursing . . . I feel it is better for her as she needs more social life."

Her husband wrote to Grampy: "I am dreading having to attack 6 or 7 months back news. Of course, we are like those marooned, constantly watching for a steamer smoke and within the last fortnight all are out of tobacco, which to many of them is more serious than if out of beef. . . . All of my household are thankful for good health."

Yet he was tragically mistaken. Soon the Boutiliers would learn that their daughter Bertha, the student nurse, had died suddenly of typhoid fever on the mainland. "The hardest part to us," wrote Mrs. Boutilier, "was that the steamer that brought to us the news of her death also brought her Christmas remembrances to the household and she had then been laid to rest nearly two months."

One of these rooms had been hers.

"The old buildings are going fast," said Doug Harrington. "A crack opens; then, in a winter storm, a blast of wind gets in—and the house explodes."

"You have no boats now?" I asked.

"Only one—a small skiff," he said. "The boys use it on Lake Wallace when they go fishing or duck shooting."

The lake sprawls, green and marshy, for five irregular miles. Once it was open to the sea and used as a harbor, but in 1836 two American sailing ships were caught inside during a storm and marooned.

Now Lake Wallace figures in Canadian folklore as the watery home of ghosts. Mrs. Copeland, a lady murdered by wreckers for a ring, returns in legend to display the stub of a missing finger—lopped off by her murderers. Like the Lifesavers' Ghost—a man drowned on a rescue mission a century ago—Mrs. Copeland has not been seen lately.

Five Waves—and Goodbye

The afternoon light was waning, and we had to leave. The tractor took us past the Bells' house and then to the beach. We counted five large waves, and in our little pram returned to *White Mist*. Alec called Radio Sable to say thanks and goodbye.

We hoisted sail, weighed anchor, and motored slowly to sea. Doug Harrington waved from the beach near the spot where the schooner *Arno* had died. A herd of ponies moved in single file across the dunes.

Suddenly the green water paled, and I saw sand.

"Ten feet," shouted Gil. "Cut the engine—we're running on a shoal!"

Was *White Mist* to be caught after all in the sucking sands of Sable?

Gently we coasted into deeper water—and then I remembered *that* sand bar where we had first anchored coming in.

Heading away from our dangerous landfall, we steered clear of the shoals and breakers off West Bar. Our fathometer recorded again the undulating ridges: deeper, shallower, deeper.

And still Doug stood there—a merest receding speck on the beach—a reminder that the only permanence on Sable Island is its loneliness.

THE END

Beware, all ships: Flashing its warning, West Light penetrates thick fog above Main Station and glows on a tidal pool.

Lonely figure of Doug Harrington watches *White Mist* put out to sea from Sable.

Asian Insects in Disguise

Article and photographs by
EDWARD S. ROSS, Ph.D.

THE LUSH GREENERY of the Malay Peninsula's Gombak Valley languished in equatorial heat. Not a whisper of wind disturbed this tropic wilderness. A National Geographic Society grant had brought me here, halfway around the world, to hunt. Not for tigers but for smaller game—insects.

As I followed a delightful flower-fringed trail, I paused to admire a pink orchid that grew beside the pathway. To my utter astonishment, the orchid moved! I stooped for a closer look—and discovered that a large part of this incredible flower was, in reality, a praying mantis *(Hymenopus coronatus).*

What a perfect masquerade! The insect's body matched the flower in amazing detail.

This astonishing insect was a spectacular example of a common phenomenon of flower resemblance, found in tropical mantids as well as other

DEATH IN A FLOWER: ***Malayan mantis closely mimics pink orchids of the Gombak Valley. Its prayerful pose belies a fiercely predatory nature. A sudden end awaits victims that mistake it for a blossom and land within its reach.***

KODACHROME © N.G.S.

ACTUAL SIZE

Mantis or orchid? Rare *Hymenopus coronatus* convincingly poses as a blossom on a leaf (left), or passes itself off as part of a real flower (right). Amazing similarities in detail permit the deception: leg flanges as petals, green margin of prothorax as part of stem, brown markings as wilted areas. At times the mantis may even rock in imitation of a breeze-blown blossom. In the bower of bloom at right, the mantis's head may be located by the hairlike antennae; its body extends downward diagonally to left. Hind legs spread wide like dangling petals. During four months in Malaysia and Thailand, the author found only this one specimen.

Saw-tooth forelegs clutch a misguided nectar seeker—a *Neptis* butterfly. Not even relatives escape the voracious mantis. The female often devours the male shortly after mating.

predatory creatures. In meadows nearer home, one often sees flower-matching crab spiders and ambush bugs.

Deceit for the mantis serves a dual purpose —protection against its own enemies as well as aid in ambushing its prey. Pursued in turn by larger insect eaters—birds and lizards that hunt by sight rather than smell—the mantis thwarts detection by its resemblance to a bit of uninteresting vegetation.

Even when perched on a bare leaf or stem, the flower mantis may effectively pose as a full-blown blossom. When an innocent nectar-seeker alights to feed, the "flower" strikes with lightning swiftness, seizing its prey in cruelly spiked forelegs (left).

Insects Excel at Camouflage

Among both hunters and hunted, many insects defy detection simply by looking like something they are not. I have seen amazing examples of animal adaptation and coloration in my 20 years of scientific travel, but this exotic Malaysian mantis and its flower habitat formed the finest correlation of insect and blossom I have ever found.

That mantis reinforced a lesson I learned long ago: An entomologist must look—then look again. For many of the creatures he seeks are masters at camouflage and illusion.

Often, while searching a tree trunk for silk-spinning Embioptera—the insects in which I am primarily interested—I found my eyes inches away from a spider or insect playing

TWICE LIFE-SIZE

THREE-QUARTERS LIFE-SIZE

LIFE-SIZE

Leaflike shades and shapes help some mantids escape notice. Vibrant green aids the specimen at upper left, probably of the genus *Theopompula*, whose white patches break up its body outline. In dim jungle depths, the caped *Rhombodera* (middle left) looks like a dead leaf lying on the forest floor.

Nature's cunning provides self-defense and concealment for many insects other than mantids. The acrobatic caterpillar of the *Stauropus* moth (bottom), found in Malaysia, hangs head down from a leaf trapeze and waves front legs to frighten foes. If disturbed, it ejects a stream of powerful acid. The same spray makes the species unpalatable to most predators and parasites. The caterpillar excels at camouflage as well as chemical warfare; in both shape and color it appears remarkably like leafy debris.

the part of a blotch of light-colored lichen or blending perfectly with the lights and shadows of the bark's wrinkled surface.

But I recall a more subtle performance that I missed completely. I photographed a flat-tailed gecko that deceptively matched its background of bark. Months later, when I studied the picture in my San Francisco laboratory, I detected an even more deceptive moth seated only inches from the lizard's nose. It had succeeded in fooling both of us!

This was camouflage in the pure sense—being fully exposed to view but not recognizable. It was a type of camouflage that depends largely upon immobility. Even my pink mantis would be a dead giveaway once it started to walk off.

Although I investigated almost every flutter of the foliage—just in case—I was still startled in the Malaysian jungle to see a leaf *hop* off a bush. Caught in my tweezers, it revealed itself as a short-horned grasshopper, *Systella rafflesii*, which—with the dead-leaf butterfly (*Kallima*)—ranks among Asia's most accomplished leaf imitators.

Offensive Traits Say "Keep Away"

Other insects depend upon a bad sting, bite, taste, or smell to discourage attack. They usually advertise their identity with distinctive colors or markings. Thus predators that have already sampled their species identify them with a previous unpleasant taste trial.

I watched one of these boldly marked creatures—the red-bordered assassin bug—trap its food in a most remarkable way. A sticky white secretion like bird lime covered its front legs; any prey that came into contact with it

Year-long, 21,000-mile safari of the California Academy of Sciences, aided by grants from the National Geographic Society and National Science Foundation, carried the Ross party through Pakistan, India, Nepal, Malaysia, and Thailand. With his assistant David Cavagnaro, Dr. Ross (above) discovered 150 new species of silk-spinning Embioptera and gathered 500,000 other insects for the Academy, where he is Curator of Entomology. Covered-wagon camper (below) allowed the collectors to explore remote regions. A Thai family comes to call as the author's wife Wilda prepares lunch; their son Clark goes to check specimens in the truck's lab.

TWICE LIFE-SIZE

True tiger beetle, *Tricondyla,* proves so distasteful to larger insectivores that it wanders Malaysia's Jerai Mountain virtually unmolested.

1 1/2 TIMES LIFE-SIZE

False tiger beetle, a tasty katydid, avoids attack from natural foes by assuming the appearance of its objectionable look-alike (upper). So disguised, it often eludes hungry birds and lizards.

Two-faced fulgorid of Thailand hides its real head, at right, behind a tail-like mask. Fake eyes, antennae, and beak planted on wing tips near its tail create the impression of reverse posture. In a "head-on" encounter, the bug seems to hop backward; even if struck it may sacrifice only an expendable bit of wing.

Fringed form of a spiny green *Euthalia* caterpillar casts so little shadow that it blends into the Malaysian foliage. It stirs mostly at night when enemies sleep.

2 TIMES LIFE-SIZE

was caught with flypaper certainty. Then the assassin inserted its beak and sucked out the victim's nutritious body fluid.

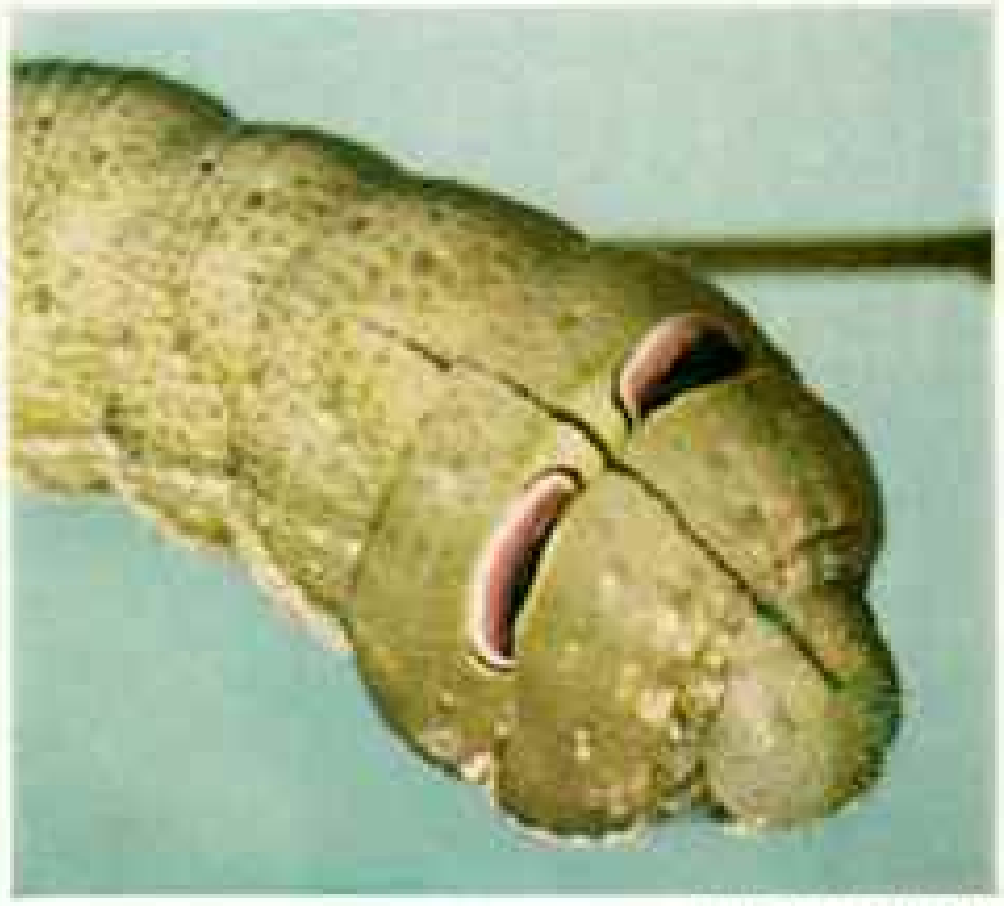
Some tasty insects mimic the appearance of these objectionable species. One of Malaysia's many katydids resembles in shape, color, and movement a type of obnoxious tiger beetle. So disguised, it moves about freely and relatively immune to attack, even in broad daylight (above). Its leaflike cousins, on the other hand, usually remain "planted" all day, becoming active only at night when their predators are inactive.

Other edible insects have managed, through natural selection over the ages, to imitate undesirable items like bird droppings and odd bits of debris. Once, in northern Thailand, I happened across what seemed to be a small dried-up fig lying on a leaf, not far from our fold-away camp. When I picked it up by its shrivelled "stem," eight legs unfolded and a lively spider struggled in my grasp. Here was one more marvelous adaptation for survival in this tropical rain forest.

Months earlier, in Assam, India, I saw an innocuous-looking hornworm. When I tapped it gently, I witnessed another startling defensive trick. All puffed up in resentment, it suddenly exposed a frightening false face with great red-and-black eyes printed on its back. These eyes are partially covered by a transverse fold of skin when the hornworm is undisturbed (opposite, right).

My reaction was one of amazement; a

2 1/4 TIMES LIFE-SIZE



2 1/4 TIMES LIFE-SIZE

India's hornworm feigns ferocity. When danger threatens (lower) its real head retracts, and scary false eyes appear on its back. In repose (upper) these eyes are masked by a skin fold, the head reappears, and the animal resembles any helpless caterpillar.

predator's probably would have been alarm and possibly instant retreat. The oversize eyes could certainly bluff an enemy into believing it had met an animal too large to attack—or one not on its customary diet.

False Features Divert Attackers

Fake eyes, antennae, and mouths protect their wearers in yet another way.

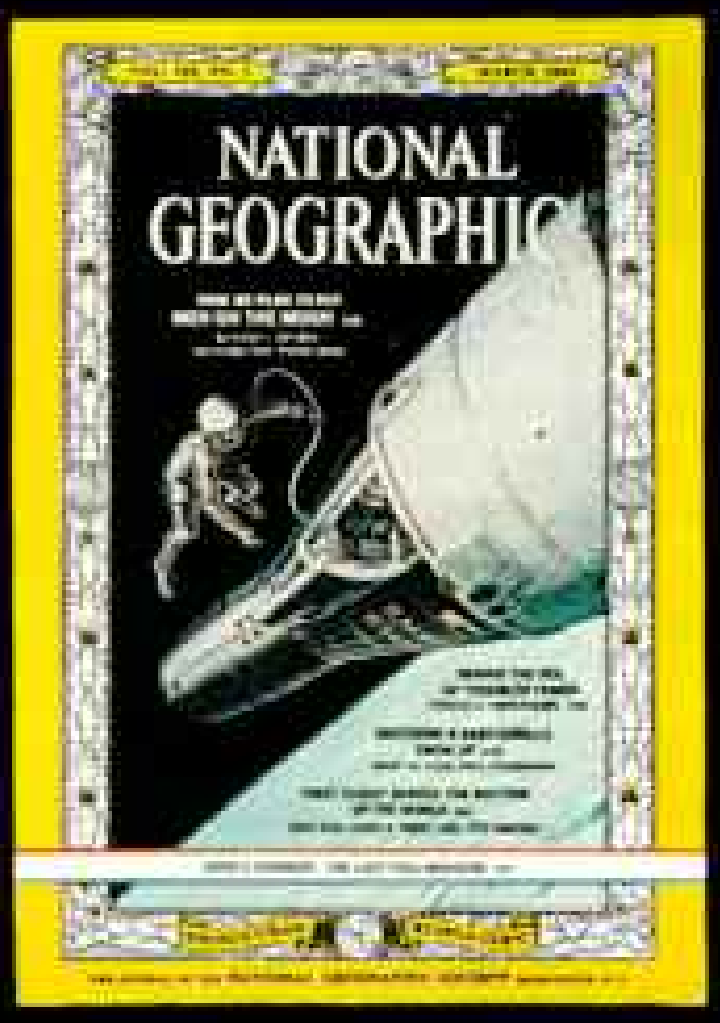
Since a predator probably strikes at what it believes is the head of its victim, a convincing counterfeit on some expendable part may save the would-be prey from vital injury.

A fulgorid bug I observed in Thailand did well at this duplicity. On its wing tips it wore a mask of beady, believable eye bumps and projections that closely resembled mandibles and antennae (above, upper left). Furthermore its real head was camouflaged to focus attention on the sham. An enemy, lunging at the forgery, would end up with only a bit of wing the fulgorid could afford to lose.

For the insect photographer, the forests of Southeast Asia offer a spectacular studio and some of the world's most glamorous models. Here, to the accompaniment of a cicada symphony, I witnessed biological dramas that have played without intermission and have been steadily perfected since life on this planet began. But the stars of the show, as far as I was concerned, were the marvelous make-up artists—those insects with the means to conceal their true character in order to survive. THE END

America's 6,000-Mile Walk in Space

TETHERED by a looping, golden umbilical cord, Maj. Edward H. White II moves freely 100 miles above earth. The historic date, June 3, 1965, marks man's longest walk in the deadly vacuum of space. The American astronaut, using the guidance gun in his right hand, maneuvered at will until its compressed oxygen ran out. He thus became the world's first self-propelled space man. Though orbiting at 17,500 miles an hour, the space walker "had little sensation of speed and no sensation of falling, only a feeling of accomplishment." Millions of earthlings heard White talk with Gemini 4's command pilot, Maj. James A. McDivitt, during the 21-minute sortie into space.

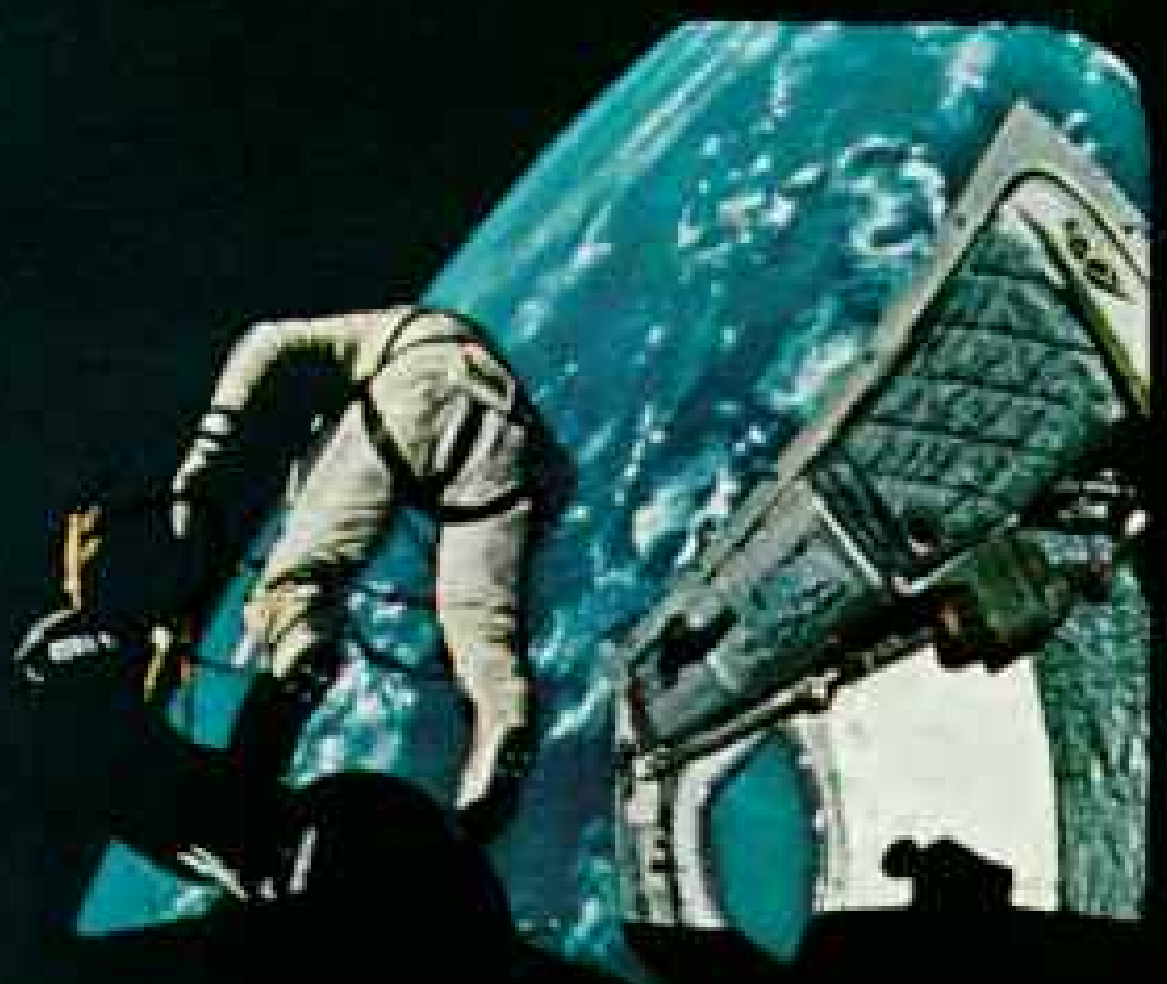


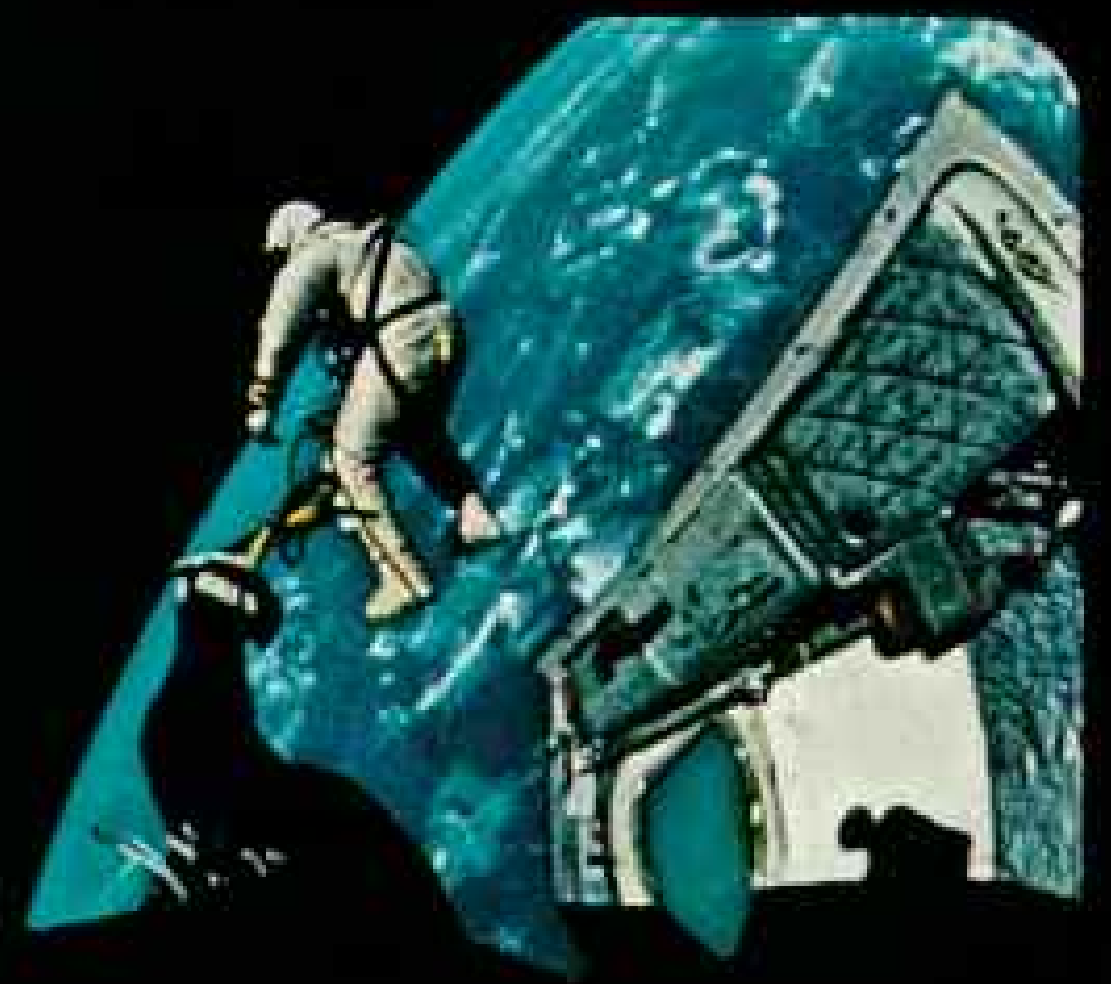
Prophetically, NATIONAL GEOGRAPHIC pictured this incredible feat 18 months ago, in its March, 1964, issue (inset). In the accompanying article, Dr. Hugh L. Dryden, a Society Trustee since 1951, visualized the day when a Gemini pilot would leave his ship and stroll among the stars. As Deputy Administrator of the National Aeronautics and Space Administration, Dr. Dryden plays a vital role in NASA's manned flight program, which made possible the dramatic photographs on these pages. GEOGRAPHIC's cover painting proved amazingly accurate, except that the tether turned out to be plated with gold instead of silver, and the emergency oxygen pack rode White's chest rather than his thigh.

EKTACHROME BY JAMES A. McDIVITT, NASA

EKTACHROMES FROM 16-MM SEQUENCE CAMERA, HAS

McDIVITT: *"He's getting out right now."* *White makes his first exploratory*





move into space, propelling himself in a controlled turn to the left.

ROSY GLOW OF SUNRISE over the Pacific burnishes White as he stands in the seat (upper left, opposite) and thrusts himself into space with the maneuvering unit. The tie-down strap of his helmet floats free, catching a shaft of light. White moves away from the ship (other pictures) as McDivitt holds the spacecraft steady. Shadow of the mounted movie camera that took these extraordinary photographs appears on the open hatch door at lower right. Three times, as he stood in the seat, White had checked this 16-mm. sequence camera.

"I wanted to make sure I didn't leave the lens cap on," he said later. "I knew I might as well not come back if I did."

Curvature of the earth as seen by the astronauts was not as pronounced as it appears here. "The camera's wide-angle lens exaggerates the curve of the horizon slightly," McDivitt explained after the flight.

At left, the spacecraft approaches the California coast. "I was taking some big steps," said White, "the first on Hawaii, then California, Texas—lightly, in deference to the President—Florida, and the last on the Bahamas and Bermuda. The gun worked superbly; I just wish I had had more oxygen. Changing my position by pulling on the tether was easy, like pulling a trout, say a two- or three-pounder, out of a stream on a light line."

From the moment he stepped outside to his reclosing of the hatch, White's seven-league boots covered some 6,000 miles.

McDIVITT: *"Let me take a close-up picture of you." White's visor mirrors*

THUS THE PILOT converses with his "vagabond passenger" via the 27-foot umbilical cord that supplied voice communication as well as life-sustaining oxygen. His gun now exhausted, White does a tumbling act (upper right) by means of the tether extracted from the olive-green stowage bag. In a world that knows no up or down, the outrider feels no discomfort, no disorientation, he later reported. As he floats serenely on his back above earth's cloud cover (center), the Stars and Stripes shines proudly on his shoulder. Pulling on the tether (lower right), he approaches the spacecraft. McDivitt meanwhile focuses on his partner through a hatch window. Here, and on page 441, he captures some of the most breathtaking color photographs ever made. Moments later, White's left shoulder and elbow touched McDivitt's window and evoked a loud complaint: "You smeared up my windshield, you dirty dog." Far below, spellbound listeners the world over chuckled at this fantastic bit of banter in the heavens. Without a pressurized suit, an astronaut's

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EKTACHROMES BY JAMES A. McDIVITT, NASA

the Gemini spacecraft.

blood would boil and he would lose consciousness instantly.

White's walk lasted about twice as long as the world's first such venture into space—by Soviet cosmonaut Lt. Col. Alexei Leonov on March 18, 1965. Unlike the American, Leonov had no self-propulsion device.

EXTACHROMES FROM 16-MM. SEQUENCE CAMERA, NASA

ONE OF WHITE'S SPARE GLOVES *floats into space to become an accidental satellite. Santa Rosa and Santa Cruz Islands pass below White as he reports: "I can sit out here and see the whole California coast."*

EKTACHROME BY ROBERT GOMEL © N.G.S.

WHITE'S THUMB-UP SIGNAL OF SUCCESS and McDivitt's broad smile proclaim two joyous but weary astronauts on the recovery carrier *Wasp* in the Atlantic. "I was the happiest man in the world that day," said McDivitt, "except possibly for Ed." White admitted, "I felt so good I didn't know whether to hop, skip, jump, or walk on my hands." He did a jig step as he walked to the captain's quarters, where the Gemini twins talked by radiotelephone with President Johnson and received his plaudits for the four-day, 66-orbit, 1,700,000-mile flight. Their excellent condition delighted doctors.

Both Air Force officers, the astronauts were promptly nominated by the President for promotion to lieutenant colonel. "If I had seen your space films before," he told them, "I might have promoted you to full colonels."

Major White, born in San Antonio, Texas, graduated from West Point in 1952 and later became a test pilot. Before entering the space program himself, he flew a total of five weightless hours while piloting a transport in which astronauts rode during training for the weightlessness of space. Resuming college studies while an Air Force officer, Major McDivitt, of Jackson, Michigan, graduated from the University of Michigan in 1959, first in his engineering class of 607. In the Korean War he flew 145 combat missions.

National Geographic's newest adventure: a color television series

WOULD YOU LIKE to stand with Barry Bishop on the glittering top of Mount Everest? Or visit Jane Goodall as she camps among wild chimpanzees? Or sail around the world in Capt. Irving Johnson's square-rigger and explore strange South Sea ports? Or even live many fathoms beneath the waves in one of Capt. Jacques-Yves Cousteau's undersea dwellings?

DECEMBER 22: MISS GOODALL IN AFRICA

Beginning this month, you can enjoy such adventures in your own living room, as the National Geographic Society enters the new medium of color television.

The camera and the printing press have been your Society's tools for 77 years, disseminating knowledge of the world and its peoples through books, maps, school bulletins, news bulletins, monographs, and the journal you are reading. Now we add the broadcasting tower—and your own television set.

I am happy to announce that on the evening of September 10 the Society's color motion picture "Americans on Everest" will be televised by the CBS Television Network.

This will be the first of four hour-long National Geographic programs scheduled for the 1965–66 television season in the United States. Later, arrangements will be made for presenting these films in other countries.

Ever since the founding of your nonprofit Society in 1888, illustrated lectures have been part of its activities in the Nation's Capital. Four Presidents of the United States have appeared on our platform.

Such explorers as Peary, Amundsen, and Greely brought back lantern slides to illustrate their talks. Our motion-picture phase began in 1903, when Arctic explorer Anthony Fiala took a "bioscope" to the Far North, "warming the machine," as he explained in the GEOGRAPHIC, "and wrapping it up in hot blankets just before taking a picture."

Movies became standard for these lectures, and the films—all in color in recent years—have matched the caliber of the speakers: Adm. Richard E. Byrd, Sir Vivian Fuchs, Sir John Hunt, Sir Edmund Hillary. The age of flight summoned Wilbur Wright, Charles A. Lindbergh, John Glenn.

Through the years, we have wondered how we could share such programs with members outside Washington, D. C. Television seems the answer—especially color television, for we insist on the same high standard the GEOGRAPHIC sets in the magazine field. Now a large audience can see the Society's films at their brilliant best. We are particularly pleased that CBS chose "Americans on Everest" as its first color presentation of the season.

Your Society began active preparation for television four years ago. To head the new division, we chose one of the industry's ablest young producer-directors, Robert C. Doyle. Harvard-educated Bob Doyle, a Navy line officer and fighter pilot in World War II, started in TV at the bottom—as a page boy. Soon he was directing programs himself, and from 1952 through 1960 he directed, for all three networks, the television pool coverage

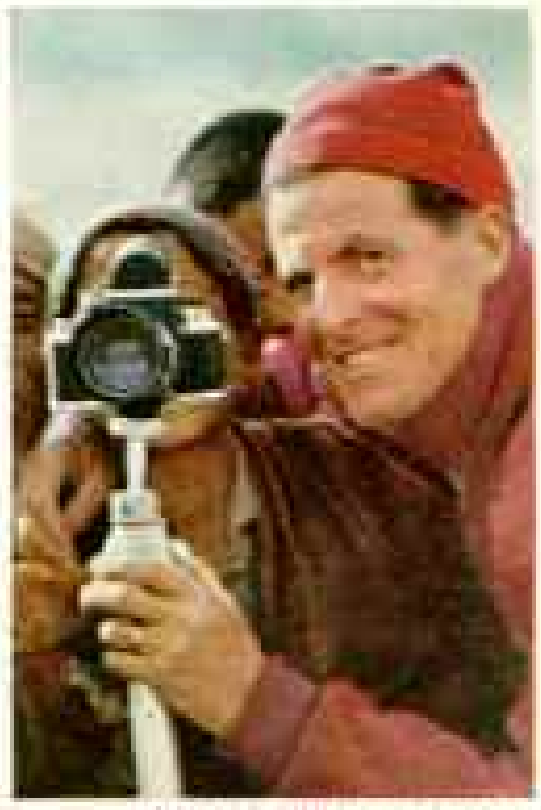
APRIL 28: WORLD OF COUSTEAU

FEBRUARY 11: VOYAGE OF THE BRIGANTINE *YANKEE*

AMERICANS ON EVEREST: a tale of courage, suffering, and triumph. At the cost of a life, of toes lost by frostbite, and of sheer physical torture, a team of Americans plants the United States and National Geographic flags on the roof of the world.

Six of their number gain the summit. Two ascend by the forbidding West Ridge, a feat many considered impossible, and then descend by the opposite route, becoming first to traverse a major Himalayan peak. Besides answering the challenge of Everest, the American expedition counts a wealth of scientific data among its rewards.

Light tents offer the only shelter from gale winds and subzero cold. Ravens, begging scraps from measured rations, appear to be the only residents of the heights.



BARBARA GUMBEL (TOP, LEFT) AND BARRY C. BISHOP © N.G.S.

of five of the six major political conventions.

As Chief of the National Geographic Society's new Television Service, Mr. Doyle has worked closely with the Society's Committee for Research and Exploration and with Executive Vice President Melvin M. Payne. He has built an outstanding staff of film editors, cameramen, and researchers, and has enlisted the valuable aid of award-winning David L. Wolper Productions, Incorporated.

For "Americans on Everest," the Society invited the distinguished American actor-producer Orson Welles to serve as narrator. Background music was specially composed by the Italian musician Franco Ferrara.

Thanks largely to the skill and determination of the expedition's leader and chief cinematographer, Norman G. Dyhrenfurth, the color motion picture is superb—truly worthy of earth's superlative mountain. As readers know from the Everest articles in this magazine, the climbs in May, 1963, rank with the great adventures of the century.* And the motion-picture camera tells that story more vividly than it has ever been told before.

I shall always remember my own first look at these extraordinary films, when Norman Dyhrenfurth presented them for the first time at his National Geographic lecture in Washington, attended by more than 6,000 people at

*See in NATIONAL GEOGRAPHIC: "American and Geographic Flags Top Everest," by Melvin M. Payne, August, 1963; and "Six to the Summit," by Norman G. Dyhrenfurth, "How We Climbed Everest," by Barry C. Bishop, and "The First Traverse," by Thomas F. Hornbein and William F. Unsoeld, October, 1963.

Norman G. Dyhrenfurth (inset), cameraman and veteran Himalayan climber, organized the expedition of mountaineer-scientists, Sherpas, and more than 900 porters.

The group brought back the first motion pictures from the summit of the 29,028-foot-high peak. This unique footage will be televised for the first time on September 10.

Executive producer Robert C. Doyle, Chief of the Society's Television Service (right), and National Geographic President and Editor Melville Bell Grosvenor confer amid equipment used on the history-making climb. Explorers Hall displays the proud trophies at the Society's new headquarters building in Washington, D. C.

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

afternoon and evening showings. We watched the expedition take shape in Katmandu and saw Nepalese porters thread through some of the world's most challenging scenery. We saw the dangers: the crash of a suspension bridge, the monstrous mass of ice that buried one climber, the slow ascent through thinning air. We saw the expedition's scientists tirelessly at work, under conditions of ever-increasing difficulty and danger.

Viewers Relive Everest Ascent

At last we beheld the incomparable view from the summit—in the world's first motion pictures from the top of the world! Great mountains stood below us, and snow crystals blew in a cutting wind that all but snatched the little camera from Lute Jerstad's grip. And we sensed the grimness of this struggle as two members of the party that spent the night in the open at 28,000 feet limped back down on feet frozen so badly that they lost most of their toes.

We had seen some of the most extraordinary motion-picture sequences ever filmed. More than that—for such is the power of moving pictures—we felt that *we ourselves had climbed Mount Everest.*

Every member of your family can share the Everest adventure just as fully on September 10—and succeeding programs will have the same universal appeal. Such expeditions represent the high adventure of man struggling against his environment—a conflict far more exciting than fiction.

"Miss Goodall in Africa" will bring you the adventures of a young British scientist who studies wild chimpanzees by living among them in Tanzania. The action sequences of the attractive Miss Goodall with her wild apes are truly astonishing. The film will be televised on December 22.

"The Voyage of the Brigantine *Yankee*" will appear on February 11, 1966. The age of sail comes alive again when 22 young men and women sign on as crew aboard the world's most-traveled yacht with Irving and Electa Johnson. Sharing labor and expense, the youngsters touch faraway ports and romantic islands—Tahiti, Pitcairn, New Guinea.

Filming of "The World of Jacques-Yves Cousteau," the program to be broadcast on April 28, 1966, is now being completed in the Mediterranean. From the footage I have already seen, I know that this picture will be as memorable as his *Silent World* and *World Without Sun*, both award winners.

Naturally, such far-reaching subjects are expensive to film. To help defray the costs, Encyclopaedia Britannica, Inc., and the Aetna Life and Casualty Insurance Companies have joined your Society as sponsors. These distinguished institutions are old friends of the National Geographic Society.

Among my own earliest assignments on NATIONAL GEOGRAPHIC was to help my father prepare reports for *Encyclopaedia Britannica*—part of the information that both staffs have exchanged for generations. The Society's association with Aetna goes

WATCH "AMERICANS ON EVEREST," ON MOST OF THESE CBS TELEVISION STATIONS

(A few stations may schedule the program at a later date. Check your newspaper for day and time.)

ALABAMA
Birmingham WAPI-TV (13)
Dothan WTVY (4)
Huntsville WHNT-TV (19)
Mobile WKRG-TV (5)
Montgomery WCOV-TV (20)

ARIZONA
Phoenix KOOL-TV (10)
Tucson KOLD-TV (13)
Yuma KBLU-TV (13)

ARKANSAS
Fort Smith KFSA-TV (5)
Little Rock KTHV (11)

CALIFORNIA
Bakersfield KBAK-TV (29)
Chico KHSL-TV (12)
Eureka KIEM-TV (3)
Fresno KFRE-TV (30)
Los Angeles KNXT (2)
Sacramento KXTV (10)
Salinas-
Monterey KSBW-TV (8)
San Diego KFMB-TV (8)
San Francisco KPIX (5)

COLORADO
Colorado Springs-
Pueblo KKTV (11)
Denver KLZ-TV (7)
Grand Junction KREX-TV (5)

CONNECTICUT
Hartford WTIC-TV (3)

DELAWARE*

DIST. OF COLUMBIA
Washington WTOP-TV (9)

FLORIDA
Fort Myers WINK-TV (11)
Jacksonville WJXT (4)
Miami WTVJ (4)
Orlando WDBO-TV (6)
Tallahassee WCTV (6)
Tampa-St. Peters-
burg WTVT (13)

GEORGIA
Atlanta WAGA-TV (5)
Augusta WRDW-TV (12)
Columbus WRBL-TV (3)
Macon WMAZ-TV (13)
Savannah WTOC-TV (11)
Thomasville WCTV (6)

IDAHO
Boise KBOI-TV (2)
Idaho Falls KID-TV (3)
Lewiston KLEW-TV (3)
Twin Falls KMVT (11)

ILLINOIS
Champaign WCIA (3)
Chicago WBBM-TV (2)
Peoria WMBD-TV (31)
Quincy KHQA-TV (7)
Rockford WREX-TV (13)
Rock Island WHBF-TV (4)

INDIANA
Evansville WEHT (50)
Fort Wayne WANE-TV (15)
Indianapolis WISH-TV (8)
Lafayette WFAM-TV (18)
South Bend WSBT-TV (22)
Terre Haute WTHI-TV (10)

IOWA
Cedar Rapids-
Waterloo WMT-TV (2)
Des Moines KRNT-TV (8)
Mason City KGLO-TV (3)
Ottumwa KTVO (3)
Sioux City KVTV (9)

KANSAS
Ensign KTVC (6)
Goodland KLOE-TV (10)
Hays KAYS-TV (7)
Hutchinson-
Wichita KTVH (12)
Topeka WIBW-TV (13)

KENTUCKY
Lexington WLEX-TV (18)
Louisville WHAS-TV (11)

LOUISIANA
Baton Rouge WAFB-TV (9)
Lafayette KLFY-TV (10)
Monroe-West
Monroe KNOE-TV (8)
New Orleans WWL-TV (4)
Shreveport KSLA-TV (12)

MAINE
Bangor WABI-TV (5)
Portland WGAN-TV (13)
Presque Isle WAGM-TV (8)

MARYLAND
Baltimore WMAR-TV (2)
Salisbury WBOC-TV (16)

MASSACHUSETTS
Boston WHDH-TV (5)

MICHIGAN
Cadillac-
Traverse City WWTV (9)
Detroit WJBK-TV (2)
Kalamazoo WKZO-TV (3)
Lansing WJIM-TV (6)
Marquette WLUC-TV (6)
Saginaw-Bay
City WNEM-TV (57)

MINNESOTA
Duluth KDAL-TV (3)
Mankato KEYC-TV (12)
Minneapolis-
St. Paul WCCO-TV (4)

MISSISSIPPI
Columbus WCBI-TV (4)
Greenwood WABG-TV (6)
Jackson WJTV (12)
Meridian WTOK-TV (11)

MISSOURI
Cape Girardeau KFVS-TV (12)
Hannibal KHQA-TV (7)
Jefferson City KRCG (13)
Joplin KODE-TV (12)
Kansas City KCMO-TV (5)
Kirksville KTVO (3)
St. Joseph KFEQ-TV (2)
St. Louis KMOX-TV (4)
Springfield KYTV-TV (10)

MONTANA
Billings KOOK-TV (2)
Butte KXLF-TV (4)
Glendive KXGN-TV (5)
Great Falls KFBB-TV (5)
Helena KBLL-TV (12)
Missoula KGVO-TV (13)

NEBRASKA
Lincoln KOLN-TV (10)
Omaha WOW-TV (6)

NEVADA
Las Vegas KLAS-TV (8)
Reno KOLO-TV (8)

NEW HAMPSHIRE*

NEW JERSEY*

NEW MEXICO
Albuquerque KOAM-TV (13)
Carlsbad KAVE-TV (6)
Roswell KSWS-TV (8)

NEW YORK
Albany WTEN (10)
Binghamton WNBF-TV (12)
Buffalo WBEN-TV (4)
Carthage-
Watertown WCNY-TV (7)
New York WCBS-TV (2)
Rochester WHEC-TV (10)
Syracuse WHEN-TV (5)

NORTH CAROLINA
Charlotte WBTV (3)
Durham-Raleigh WTVD (11)
Greensboro WFMY-TV (2)
Greenville WNCT-TV (9)

NORTH DAKOTA
Bismarck KXMB-TV (12)
Dickinson KDIX-TV (2)
Fargo-
Valley City KXJB-TV (4)
Minot KXMC-TV (13)

OHIO
Cincinnati WCPO-TV (9)
Cleveland WJW-TV (8)
Columbus WBNS-TV (10)
Dayton WHIO-TV (7)
Steubenville WSTV-TV (9)
Toledo WTOL-TV (11)
Youngstown WKBN-TV (27)

OKLAHOMA
Oklahoma City KWTV (9)
Tulsa KOTV (6)

OREGON
Klamath Falls KOTI (2)
Medford KTVM (5)
Portland KOIN-TV (6)

PENNSYLVANIA
Altoona WFBG-TV (10)
Erie WSEE (35)
Harrisburg WHP-TV (21)
Johnstown WARD-TV (56)
Lancaster-
Lebanon WLYH-TV (15)
Philadelphia WCAU-TV (10)
Pittsburgh KDKA-TV (2)
Scranton-
Wilkes-Barre WDAU-TV (22)
York WSBA-TV (43)

RHODE ISLAND
Providence WPRO-TV (12)

SOUTH CAROLINA
Anderson WAIM-TV (40)
Charleston WCSC-TV (5)
Columbia WNOK-TV (19)
Florence WBTW (13)
Spartanburg WSPA-TV (7)

SOUTH DAKOTA
Rapid City KOTA-TV (3)
Sioux Falls KELO-TV (11)

TENNESSEE
Chattanooga WDEF-TV (12)
Jackson WDXI-TV (7)
Johnson City-Bristol-
Kingsport WJHL-TV (11)
Knoxville WBIR-TV (10)
Memphis WREC-TV (3)
Nashville WLAC-TV (5)

TEXAS
Amarillo KFDA-TV (10)
Austin KTBC-TV (7)
Beaumont KFDM-TV (6)
Bryan KBTX-TV (3)
Corpus Christi KZTV (10)
Dallas-
Fort Worth KRLD-TV (4)
El Paso KROD-TV (4)
Harlingen KGBT-TV (4)
Houston KHOU-TV (11)
Laredo KGNS-TV (8)
Lubbock KLBK-TV (13)
Lufkin KTRE-TV (9)
Odessa KOSA-TV (7)
San Angelo KCTV (8)
San Antonio KENS-TV (5)
Sweetwater-
Abilene KPAR-TV (12)
Waco KWTX-TV (10)
Wichita Falls KAUZ-TV (6)

UTAH
Salt Lake City KSL-TV (5)

VERMONT
Burlington WCAX-TV (3)

VIRGINIA
Bristol WJHL-TV (11)
Harrisonburg WSVA-TV (3)
Norfolk WTAR-TV (3)
Richmond WTVR (6)
Roanoke WDBJ-TV (7)

WASHINGTON
Bellingham KVOS-TV (12)
Pasco KEPR-TV (19)
Seattle KIRO-TV (7)
Spokane KXLY-TV (4)
Yakima KIMA-TV (29)

WEST VIRGINIA
Charleston WCHS-TV (8)
Clarksburg WBOY-TV (12)
Oak Hill WOAY-TV (4)
Wheeling WSTV-TV (9)

WISCONSIN
Green Bay WBAY-TV (2)
La Crosse WKBT (8)
Madison WISC-TV (3)
Milwaukee WISN-TV (12)
Superior KDAL-TV (3)
Wausau WSAU-TV (7)

WYOMING
Casper KTWO-TV (2)
Cheyenne KFBC-TV (5)
Riverton KWRB-TV (10)

*see neighboring states

back to 1913, when the companies began advertising in the pages of this journal. Similarly, over the years Aetna has insured Society expeditions—including a policy for the Everest expedition itself.

Writing for your magazine in 1907, the Society's first explorer-cinematographer, Anthony Fiala, made this prophecy: "There is still land to be conquered; and it is good to know that when these unknown places are found and the flags of discovery are planted . . . we will all be able to view with the explorer what had once been forbidden and mysterious territory."

On September 10 your family, and millions of others, can join with the National Geographic Society in exploring those very mysteries—and in your own home, through a miracle of science undreamed of in the time of Fiala and his blanket-warmed bioscope.

Melville Bell Grosvenor

PRESIDENT AND EDITOR

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Kodak brings the Instamatic Camera idea to movies . . . and introduces a new era in movie enjoyment

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Kodak has redesigned the movie film with 50% more picture area for better, sharper movies. The new KODAPAK Movie Cartridge is factory-loaded with improved KODACHROME II Film in the new Super 8 format —giving you 50 feet of uninterrupted shooting.

Kodak has redesigned the movie projector. The KODAK INSTAMATIC M70 Movie Projector lets you show any scene at normal, fast, or slow-motion speeds—forward and reverse. "Still" projection, too. Brilliant illumination, fully automatic threading. Less than $170. Other models are priced from less than $63.

Prices subject to change without notice.

EASTMAN KODAK COMPANY, Rochester, N.Y.

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TRADE-MARK

This year, go where everybody isn't.

(That's just one of the nice things about South America!)

Start in the tranquil lake country of the Chilean-Argentine border. Here, you can stay in bed 'til lunch—or fish a mountain stream at daybreak. Ride horses, play golf . . . or simply play possum, in the peaceful luxury of your hotel.

Eat Corvina a la Huancaina—delicious local fish in a spicy cheese and egg sauce. It's a specialty of Lima's swank Trece Monedas.

Believe it or not, this is an apartment building—South American style! And when you're in Viña del Mar, you'll also discover beautiful hotels, lovely beaches . . . even a casino. And peaceful Viña is only two hours away from the bright lights and bustle of Santiago, Chile's capital.

Discover sun-warmed peace in the courtyard of Quito's San Francisco monastery. This museum includes works by Caspicara—an Indian convert who lived four centuries ago.

Watch the Alpacas grazing as they did hundreds of years ago on Machu Picchu—sacred citadel of the Incas. As you climb its walls, explore its watchtowers, you'll discover the special excitement that *is* South America!

Today, South America is only $550 away, economy round trip. First Class is only $165 more on the same 30-day round-trip jet excursion from New York to Buenos Aires . . . on Panagra, the one U.S. airline specializing only in South American travel. Panagra's *El Interamericano* DC-8's fly every night of the week—the most frequent jets to South America's West Coast and B.A. You fly with no change of plane over the routes of National, Pan Am and Panagra—from New York or Miami. See your Travel Agent. Or call Pan Am, our sales agent.

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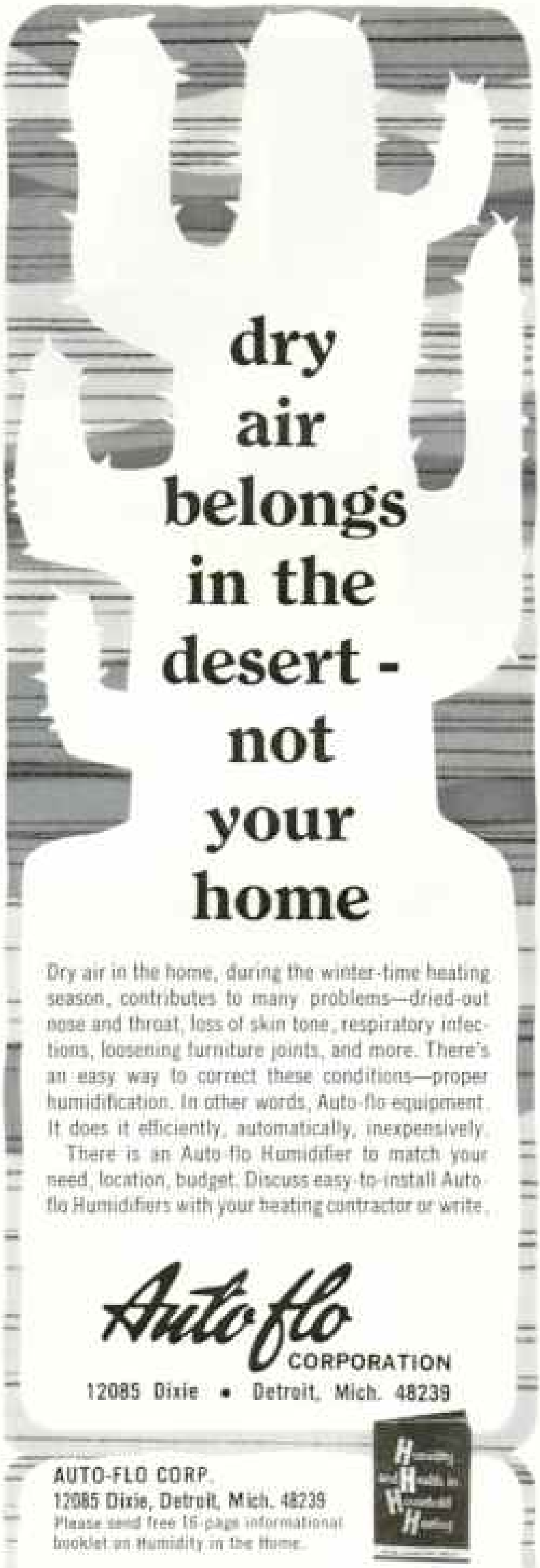

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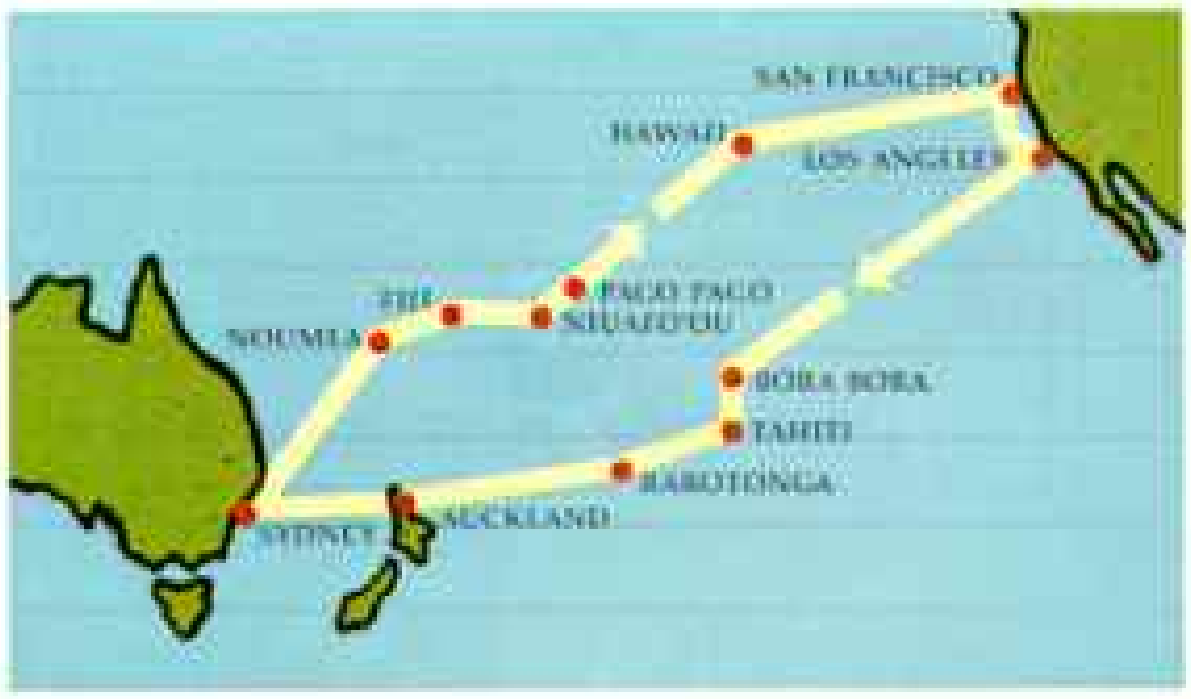

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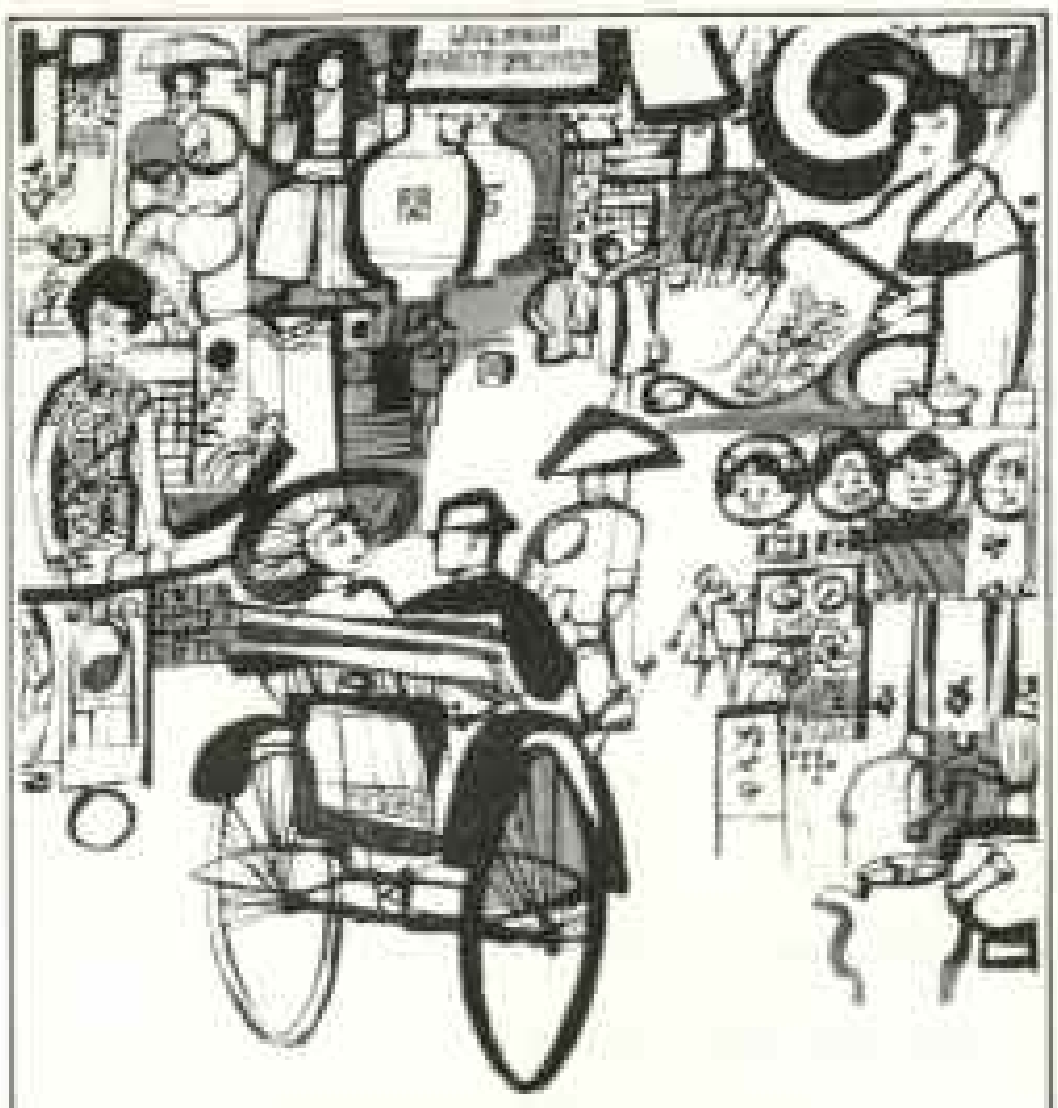

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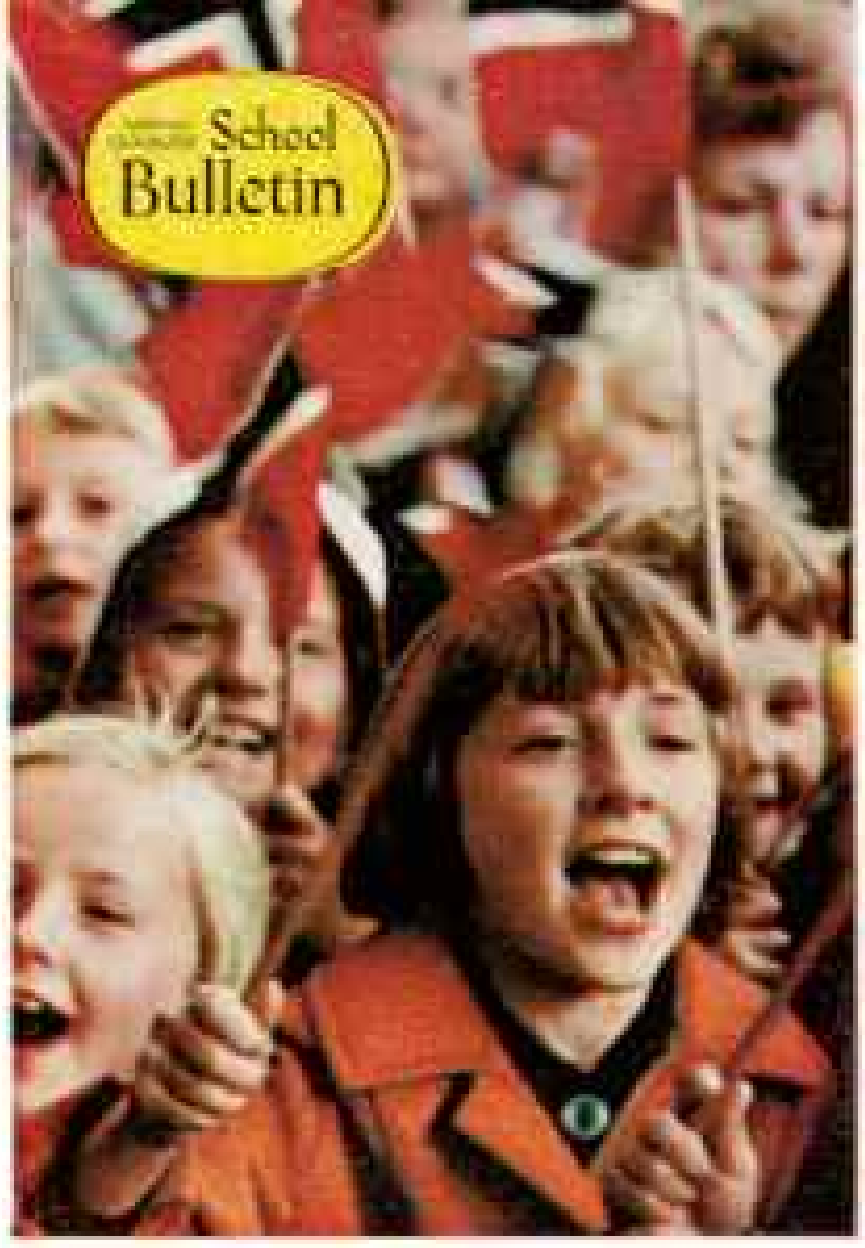

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THERE ARE 3,000 'BITS' OF INFORMATION ON THIS PAGE

Dots like these are part of an amazing electronic memory that can store, in binary language, 5.8 million "bits" of information. Such a memory unit is a fundamental part of the complex new Electronic Switching System that Western Electric is building for the Bell System. ☐ The dots are precisely 35 thousandths of an inch square and one thousandth thick. They are etched from magnetic material bonded to a thin aluminum sheet. One hundred and twenty-eight of these aluminum sheets are next placed into a module containing microscopically thin wires embedded in thin plastic to make a complete memory unit. ☐ This is merely one measure of the complexity of electronic switching. A typical central office equipped for electronic switching requires more than half a million other tiny components, such as transistors. Each of them must meet rigid standards of quality during manufacturing. Only then can they be assembled into units that will work perfectly with every other of the billions of components that make up the nationwide Bell System communications network. ☐ As the manufacturing and supply unit of the Bell System, we share the goal of bringing you continual progress in communications. Electronic switching—developed by Bell Laboratories, built by Western Electric, operated by Bell telephone companies—is another giant step toward ever-better, low cost communications.

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Boeing jets (707s, 720s, 727s) fly to more cities than any other jetliner — 250 cities in 110 countries.

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Now flying Boeing jets: *Air Congo, Air France, Air-India, Air Madagascar, All Nippon, American, Ansett-ANA, Avianca, BOAC, Braniff, BWIA, Continental, Eastern, El Al, Ethiopian, Indian, Iran Air, Irish, JAL, LIA, Lufthansa, National, Northwest, Pacific Northern, PIA (Pakistan), Pan American, PSA, Qantas, Sabena, Saudi Arabian, South African, TAA, TAP, TWA, United, Varig, Western, World.* In service later with: *Alaska, Flying Tiger, Japan Domestic, Olympic.*

BOEING JETS

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Competitor's stainless steel ballpoints | Sheaffer's new stainless steel ballpoints

Sheaffer's new stainless steel ballpoints go around in the best circles

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