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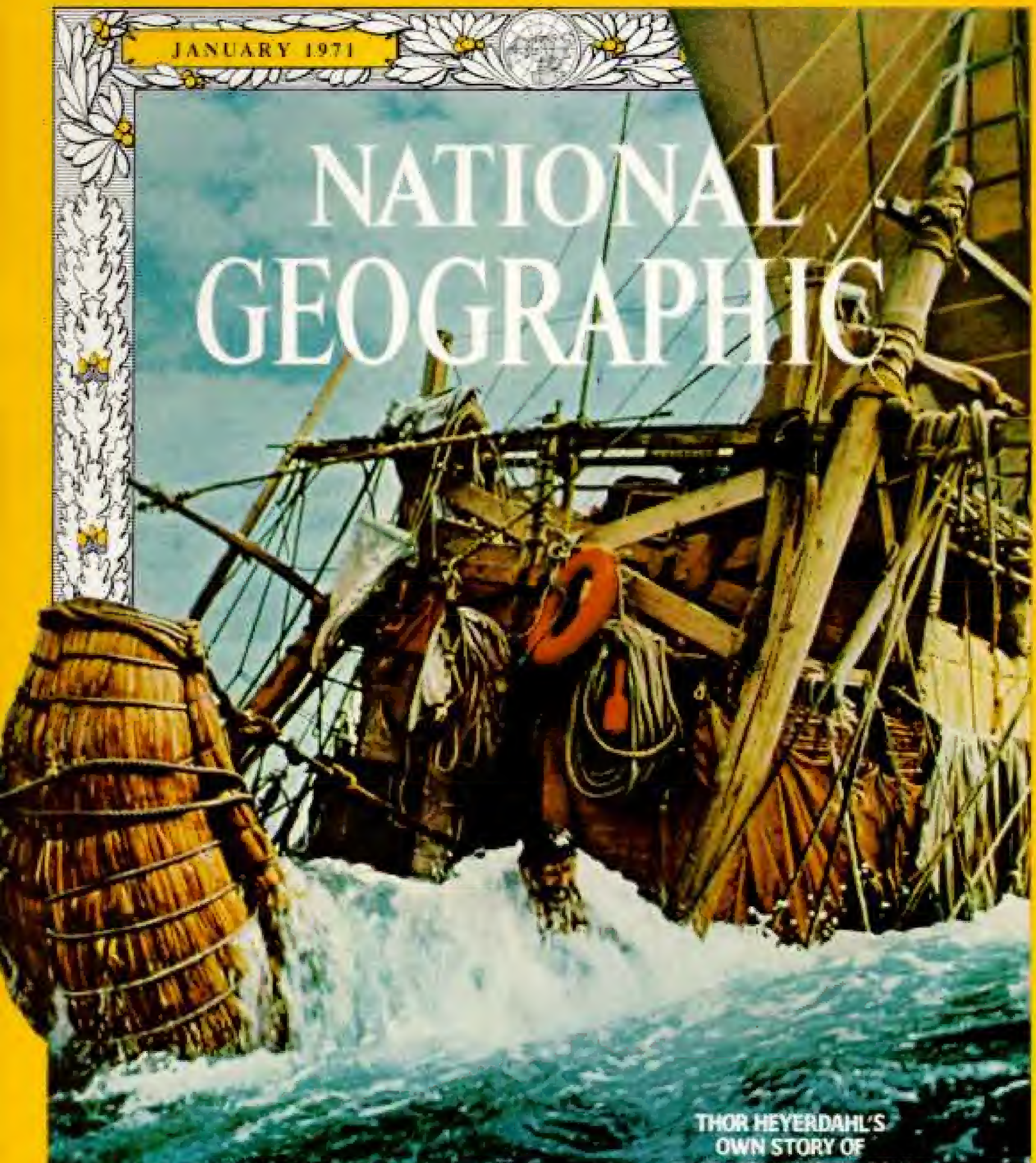

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THE VOYAGE OF *RA II* 44

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

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COVER: Swept by angry seas, *Ra II* inches across the Atlantic (pages 44-51).

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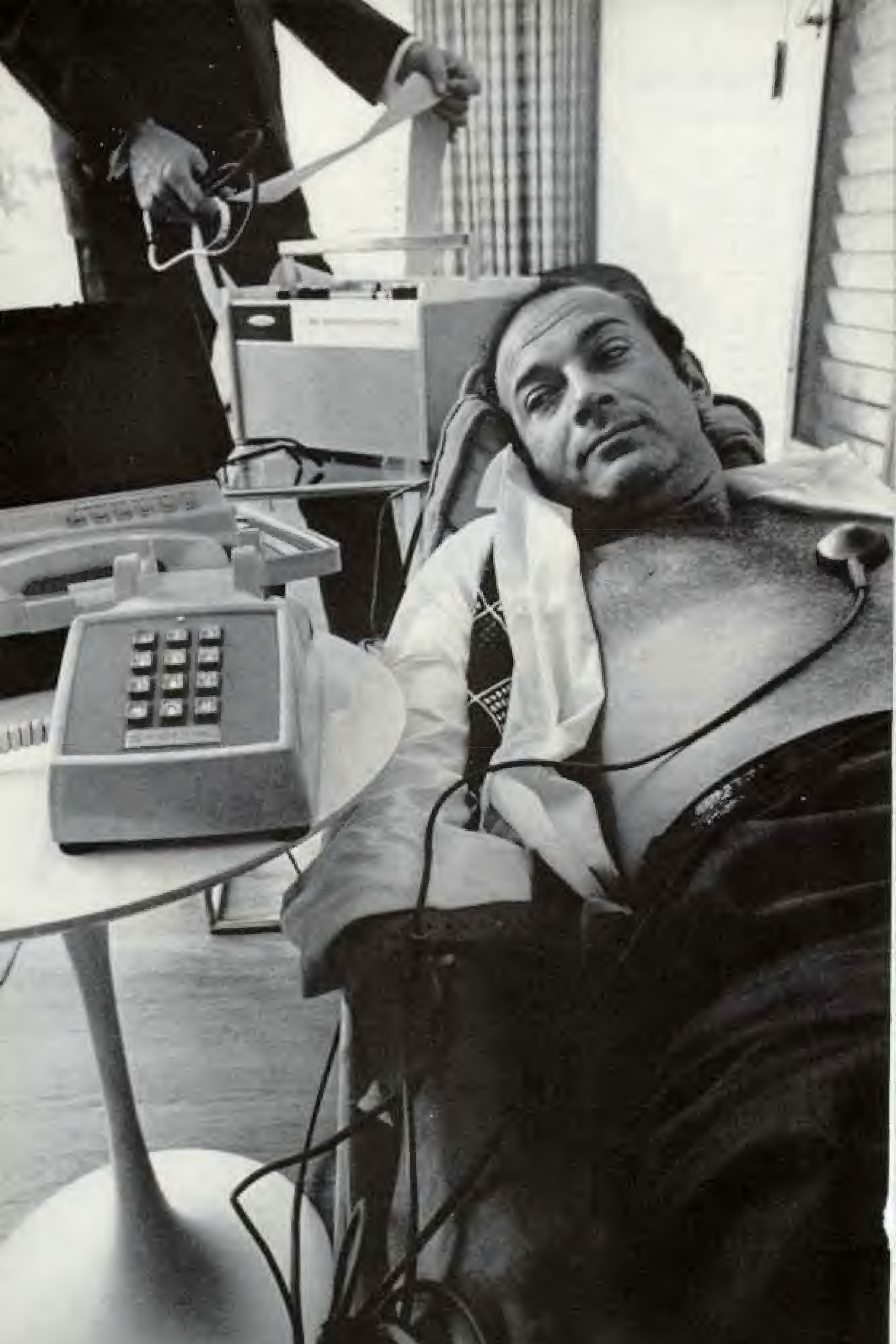

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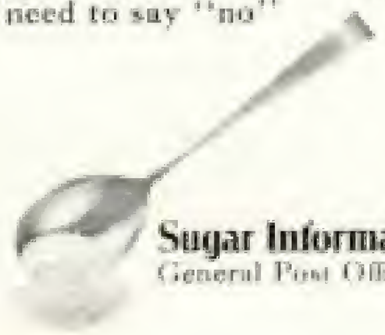

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JAVA

Eden in Transition

By KENNETH MacLEISH

SENIOR ASSISTANT EDITOR

Photographs by DEAN CONGER

NATIONAL GEOGRAPHIC PHOTOGRAPHER

WE HAD COME to the kampong after dark and in the rain, stained with the red mud of the trail. The *lurah*—the village chief—welcomed us to his earth-floored house, lent me a sarong to replace my soaked shirt and trousers, and fed us rice and salt fish and manioc greens. Only then did he ask us our business.

I answered through my companion, Kumar, an Indonesian of Indian descent.

"We have come to begin a journey down the length of Java. I wish to start here in the west, where Java begins. And I hope to meet the Badui, in the hills beyond your lands, who still live as men lived centuries ago. Are they not an ancient tribe, with ancient ways?"

The lurah snorted. "Their ways are ancient, indeed. They are not like us. We here, we work hard and serve God. But they are not Moslems. They grow little, and move when the land is tired. They have no science, and accomplish nothing.

"Even so, they have magic powers. They perceive distant doings, even future happenings. I will find a man to take you to them. But be careful. They cast spells."

In the humid darkness the villagers slept, as still as jungle creatures. No human sob or sigh or dreaming cry disturbed the insect voices of the night, joined in a chorus more soothing than silence. No flame dimmed the fireflies' cold sparks. No sound or sight or smell proclaimed the presence of people. The bamboo houses huddled under the tall coconuts could have been empty.

Then the night song stopped. The dancing sparks went out. The darkness became translucent and the blaze of stars began to dim. The people woke as easily as they had slept, suddenly, in the manner of roused animals. Bare feet moved silently toward the river. Bright batiks protected sleep-warmed skins from the mist of morning. Then, cooled and cleansed, the people of Tji Semak (Jungle

Essence of an island: A farmer of Central Java reshapes a dike around his tiny rice field near the white-plumed volcano Gunung Merapi. Though blessed by vast oil deposits and rich volcanic soil, Java suffers from one of the world's lowest standards of living, and does not grow enough food for its burgeoning millions.

[illegible] © N.G.S.

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River) returned to their tea, their rice, and their barely won struggle for survival.

"Quintessential Java," I thought. "Figures in a jade landscape."

We set off along a mud-slick path narrow as a deer trail. For an hour we held to the riverbank. Then the trail steepened. Forest trees grew thickly on the tangled slopes. The sun was high when we came into a Badui kampong at the top of a ridge.

"Here we must stop," said our guide. "This is a village of the outer circle, a ring of kampongs which protects the inner sanctuary where the most sacred Badui live. Foreigners may not visit them. But these people are their intermediaries; they sometimes speak to outsiders. We will just sit here, on the chief's porch, and see what they will do."

I squatted on the porch, sweat-soaked, footsore, and thirsty, eerily aware of the presence of people I could not see. Suddenly an earth-jarring thump brought me to my feet. A huge coconut rolled to a stop only yards away. A second and a third joined it. High above, a young man smiled down from a palm top.

He descended with the grace of a gibbon, slashed open the nuts with his heavy-bladed *parang*, and offered them to us. Each contained close to a quart of clear cool juice.

Our host explained that he was the chief's son-in-law. The chief would appear in due time. "Sit awhile," he said. "We will wait."

There were 3,600 Badui, he told us, living on some 14,000 acres. He would say no more. We waited.

Suddenly another man stood among us, tall, gravely courteous, obviously the chief. I had not seen him come, or heard him. He ordered tea and fetched a cake of palm sugar which he shattered with the handle of his parang. We ate the brown delicious bits and sipped our sour tea. He spoke to us of the round of daily life.

"We have no paddy [rice] here, only a little tapioca and taro, and some fruit. We trade our palm sugar for rice and salt fish. Our chickens give us a few eggs. We trade them, too; eggs are too valuable to eat. Meat is scarce. It is *tapi* [taboo] to breed livestock."

I put a delicate question: "I have heard

Cloistered mystics of West Java, reclusive Badui tribesmen claim soothsaying and spell-casting powers. Other Indonesians hold them in awe; sometimes high-ranking politicians consult them about affairs of state.

Bluish hue of turban and sash marks this villager, with a wooden-scabbarded *parang* at his waist, as a member of the outer circle of Badui. The blue Badui serve as a buffer between the outside world and the even more sequestered white-clad families that dwell in the heart of the mountain region.

Mindful of ancestral mandates to cling to a simple, self-sufficient life, Badui women (right) use handlooms to weave the tribe's garments—blue or white, depending on the group.

Smoldering on Indonesia's lengthy spine, Java counts 61 volcanoes—17 of them active. Political and cultural center of the 3,000-island archipelago and its 125,000,000 people, Java today reflects a mixed history of Malay, Hindu, Moslem, and Dutch influences.

Monument to fiscal folly: The skeleton of a skyscraper begun under ex-President Sukarno's bankrupt regime stood rusting for four years in Djakarta, capital of Indonesia. Construction resumed in late 1970, financed by a partnership of foreign firms.

KODACHROME © N.G.S.

important men—statesmen, professors, generals—say that the Badui have mystic powers, and understand the future. Is this true?"

"People sometimes come to us, believing we can help them," he conceded. "It is not proper to talk of our powers.

"We were left here long ago by the Old Queen. We do not know who she was, but she taught us to live as man was meant to live. We must continue in that way." He paused, staring out into the dappled green of the sun-pierced forest. "We are simple people, living peacefully on our sacred land. But others do not understand us."

Island Flavored by Many Faiths

The sun crossed the top of the sky. We headed down the jungle track, through steamy foliage in which cicadas hummed their soporific hymn to heat, bound now for the opposite end of the Javanese human spectrum. Three hours by foot, three by Land-Rover, and three by car would put us in Djakarta, the roiling and revealing capital of Java and of all Indonesia (map, above).

Between the uneven modernity of emergent Djakarta and the serene simplicity of the Badui village lie thousands of years of history. Malay migrations perhaps as early as 3000 B.C. brought the precursors of most of the present population. Indians came trading in the first century A.D., and by the third, Hinduism and Buddhism were taking hold in Java. For 1,200 years Hindu-Javanese princes ruled with sophistication and style. Then, in the 15th century, other traders brought Islam to Java's north-coast ports.

The Javanese philosophy, born of the overlay of Indian mysticism on simple spirit worship, was liberal and tolerant. It found value in all ideologies. But the exclusiveness of Islam, which sets its adherents apart from (and above) "infidels," helped to attract converts from the religion of the ruling dynasties.

By the 16th century Moslems had destroyed the Hindu-Javanese monarchy. Local kingdoms sprang up, to war with each other. They were still fighting for control when the Portuguese arrived in 1511. One kingdom, Mataram, had seized almost all Java by the time the Dutch came in 1596.

Working through the local princes, the Dutch established a fort where Djakarta stands today. They threw out the Portuguese, fought off dissident Moslems, strengthened their new port, which they named Batavia, and settled down for a 350-year stay.

World War II brought Japanese occupation. When Japan fell, nationalism flared. The way to self-government was open. A charismatic young engineer named Sukarno proclaimed independence on August 17, 1945. For four years the Netherlands tried to suppress the movement, then gave up their colonial claims.

By 1950 Sukarno was president. Batavia—renamed Djakarta—was the capital. Java, which contained 65 percent of Indonesia's people, was the seat of power. For the first time the entire Indonesian archipelago felt united, despite its dozens of different cultures. A Malay dialect, Indonesian, had become the national language. The spirit of the national motto, "Unity in Diversity," began to be felt.

"The birth and growth of the new nation was chronicled in "Republican Indonesia Tries Its Wings," by W. Robert Moore, January 1951 GEOGRAPHIC; "This Young Giant, Indonesia," by Beverley M. Bowie, September 1953; and "Indonesia, the Young and Troubled Island Nation," by Helen and Frank Schreider, May 1961.

Suffering from old age, like most vehicles on the island, a 1940 Chevrolet in Surabaja undergoes roadside surgery. Milk cans teeter atop the car. High prices and low average income—$70 to $100 annually—limit sales of new automobiles. The majority of Javanese walk or ride bicycles.

Djakarta's 443rd birthday—June 22, 1970—brings throngs of merrymakers to the streets. Ironically, the death only the previous day of Indonesia's long-time string man, Sukarno, failed to dampen the celebration. Tradition holds that the name Djayakarta (Victorious Town) originated after a battle in 1527 in which the Javanese repelled Portuguese invaders. The

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Dutch renamed the city Batavia in 1619. Japanese conquerors gave the old name a modern spelling when they revived it in 1942. Traffic streams between the Air Mantjur fountain at left and a new bank building. Beyond temporary government offices glows the National Monument, a soaring torch with a tip sheathed in gold leaf. A modern movie theater flanks the plaza at right.

Age-old lure of instant wealth adds excitement to the lives of these Javanese as they place bets in Djakarta's daily lottery. Revenues from officially sanctioned gambling—lotteries, dog races, and casinos—help pay for new schools and roads. In Java, however,

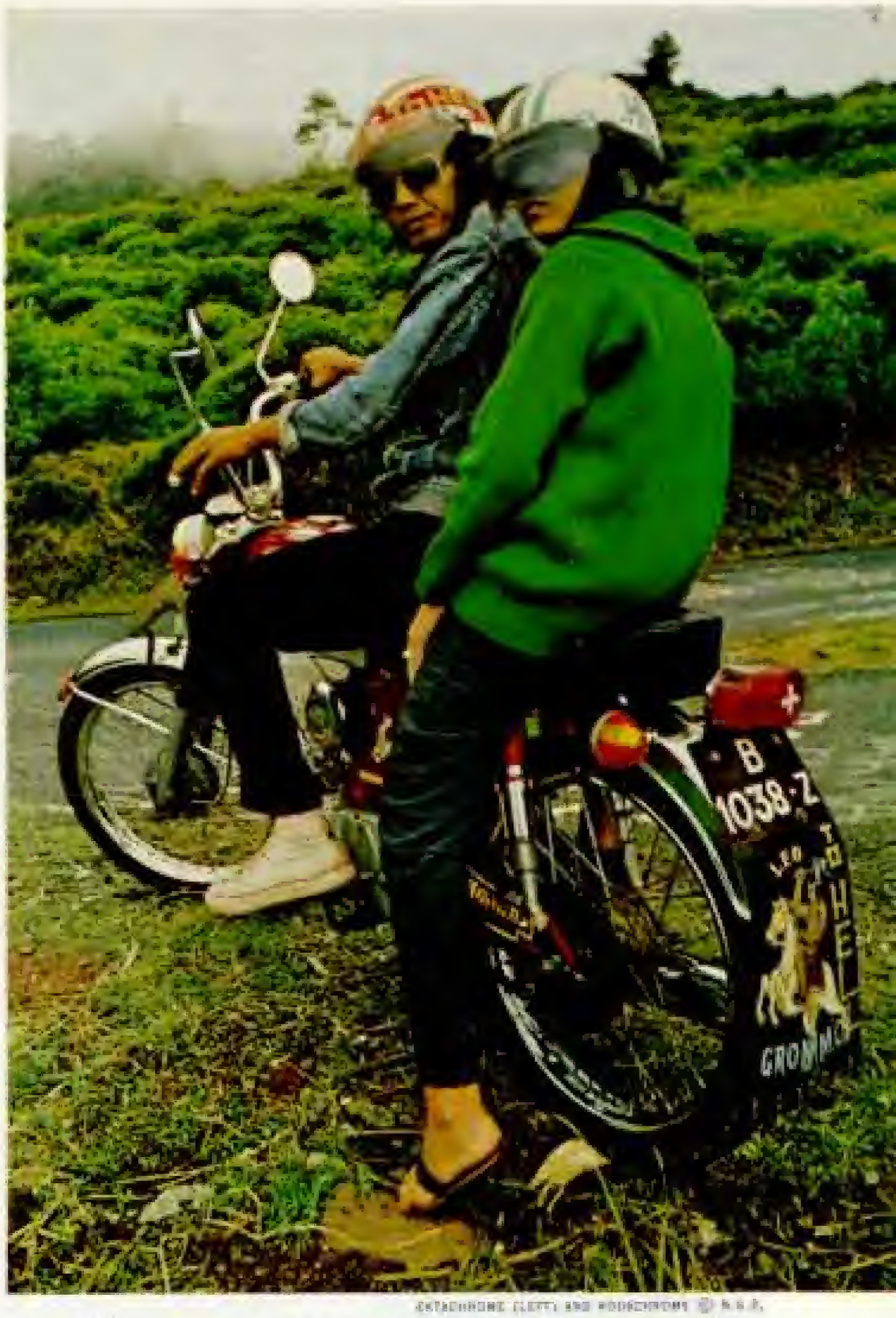
And now Sukarno was out, ousted in the murderous aftermath of the abortive Communist coup of 1965. But the Djakarta we entered still called to mind Sukarno's rule. The great sports stadium, the multistoried buildings, the arrogant monuments rose as reminders of his extravagance amid streetless slums watered by open sewers in which the poor bathed, washed their clothes, and voided their wastes.

We came to a stop in front of the luxurious Hotel Indonesia, whose rooms, priced normally by United States standards, cost as much per day as a Javanese professor gets in a month. Dirty and disheveled, I went to mine, shamelessly grateful for the air conditioning, the hot clean water, and the availability of foods other than rice and little salt fish fried whole.

Traffic Pileup Begins Before Dawn

In Djakarta, as elsewhere in Java, day begins before it breaks. The relative cool that precedes sunup finds hundreds of burden-bearing pedestrians hurrying about town, men with their Chinese-style shoulder poles, women with their slings of cloth. The gaudily painted *betjaks*—rear-driven pedicabs—

the government no longer permits cockfighting, once one of the islanders' most popular pastimes.



Easy-riding young moderns adopt many Western ways. Few, though, own such vehicles, which cost at least five times what the average Indonesian earns in a year.

course the streets with carefree disregard of traffic laws (page 21).

Trucks, buses, cabs, and cars begin to fill the streets. By seven o'clock, even the six-lane divided artery Djalan Thamrin (which interconnects the other symbols of Sukarno's spendthrift showmanship) has become again the setting for one of the oldest established permanent floating traffic jams in Southeast Asia. Kumar and I entered it to resume our week-long exploration of the city.

We prowled the old port area, where time-mellowed Chinese houses contrast strangely with the massive structures built by Dutch colonial officials three centuries ago. In the heart of the city, we found a crowded kampong, reached by a swaying suspension bridge over the main canal.

"You could walk all day through kampongs like this, hidden between the streets of Djakarta," said Kumar. "There are several square miles of such slums. They have their own elementary schools" (he showed me a bamboo house, earth-floored, divided by mats into three rooms) . . . "and little shops" . . . (some only eight feet wide, with a single counter).

We met the kampong lurah, a slim young clerk who earned 7,000 rupiahs (about $6.50)

and 100 pounds of rice per month in one of the government bureaus. He had only one wife; he could not have supported a second.

"But these are not the poorest people," said Kumar. "Here they live in houses and eat enough. The very poor are not so lucky."

He showed them to me, the very poor, living beside small ditches under plastic sheets laid over frames of sticks, or under roadside trees. A woman combed another's hair. "She is looking for little animals," he said.

The houseless men wandered the streets, looking for work or collecting things. Any things at all: splinters of glass or crockery, bits of plastic, of wood, of metal. No tin cans littered Djakarta's back alleys; cans have value. Men use magnets to fish for iron scrap in the canals. Small boys collect old wet cigarette butts.

"What happens to these houseless people when it rains?" I asked.

"They stand on porches of people who have houses. Sometimes this is permitted. In such cases, they will not take anything."

"There really *are* two populations here," said David J. Levin, Publications Officer at the United States Embassy, "those who live in the houses, and those who live in front of them. And yet, things are better than they were, because now there's hope."

We sat in the comfortable living room in his pleasant Dutch-built house in the suburb of Kebajoran. A frangipani the size of an ancient apple tree perfumed the night.

"The signs of improvement aren't dramatic," he continued. "A repainted storefront, a tidied-up ditch, a repaired fence. But they add up to a small retreat from despair. President Suharto is trying to do things right. He's stopped inflation. He's taking action against the graft and corruption that have become endemic in Indonesia. The nation is still struggling, but thanks to him it has a better credit rating now in the eyes of the world.

"Indonesians appreciate this sort of honesty and good will in high places, but they're slow to demand it. So it remains for the upper class to act in the best interest of the people. That has just begun to happen. For the first time, there's hope. At least enough to make a man paint his house."

This same point of popular permissiveness drew a sharp comment from Mochtar Lubis, a Djakarta newspaper editor who once spent several years in prison for criticizing Sukarno.

"Here the leader is considered a supernatural being. He can do anything. He must be believed, and he can never be blamed. Sukarno used this deep-seated attitude criminally. Yet even when he fell, it was not he who drew the people's hysterical rage; it was the Communists he had brought to power who were attacked."

Cultural Contrasts Mark Sultan's Life

I talked next with a man more closely involved both with mystical leadership and progressive administration than anyone else in Indonesia. He is Sri Sultan Hamengku Buwono IX, ruler of Jogjakarta in mid-Java and a senior member of the thoroughly republican government in Djakarta. He manages his diametrically differing roles with gracious responsibility toward both.

During his sojourns in Jogjakarta the sultan lives in regal splendor, served by kneeling retainers. His person is sacred. But our meeting was in Djakarta.

The sultan came out from behind his desk, a tall man, strong-featured. He seated me, then himself, in identical chairs (this would have been an unthinkable condescension in the palace at Jogjakarta) and spoke of economic matters.

"We are making up for past mistakes, and we have a long way to go. Our task right now is rehabilitation and repair. Our first five-year plan, begun in 1969, aims primarily

Cardboard hut with running water—an open sewage canal—is home for this Djakarta family. Such canals serve as bathtub, toilet, and laundry for countless hovel-dwelling and houseless poor.

Job-training projects have been launched and construction of some public sanitation facilities begun. But the government, still struggling to recover from the extravagances of Sukarno's rule, can offer little immediate relief for the bulk of Indonesia's 4,000,000 unemployed and 14,000,000 underemployed.

Too many people, too little space

SLEEPING SYMBOL of Java's population crisis, a baby (right) nestles in its mother's arms at Jogjakarta's annual Sekaten ceremony, honoring Mohammed's birth. One of an estimated 80,000,000 Javanese, the child may see the island's population double before his 30th birthday. Java already ranks as one of the world's most densely peopled lands; it averages 1,500 persons per square mile, compared to only 57 in the United States.

Public-health nurse Mrs. Rosini Karsono (above) explains birth-control techniques to women in Djakarta. The government and the International Planned Parenthood Federation sponsor the program. Such efforts are impeded by a shortage of trained personnel, a strong tradition of early marriages and large families, and widespread unawareness of the effects of overpopulation on Indonesia's economy.

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RUDOLPHOTOS © N.G.S.

Year-round summer permits as many as three rice crops annually. These fields near Bogor show Java's staple food in various stages of growth.

Smoke plumes mark rice straw burning in harvested fields. Though sometimes plowed under, the stalks more often are used to make paper, baskets, and mats.

Bent backs and beast-power do Java's work: A farmer, wooden plow on his shoulder, follows his zebu ox past a woman hand-planting rice. The average landholding of two acres precludes much mechanization.

Despite the soil's fertility, Java had to import 990,000 tons of rice in 1969. Officials hope that improved seed, more fertilizer, and new and repaired irrigation canals will eliminate the need for foreign rice by 1974.

at sufficiency in food. We who grow rice are forced to import rice. Our population outstrips our production, especially here in Java. We will correct that condition through family planning, but it will be a decade or more before we see results.

"With agriculture, we can move faster. We have new varieties of rice, which we hope will raise our output from 10 to 15 million tons by 1974. That would mean independence in rice.

"Badly as we need industry, we are not ready for major manufacturing. Still, foreign investors have promised us a billion dollars this year, as against almost nothing three years ago. The Western oil companies have returned, to seek out our mineral riches and share the profits with us."

Listening, I recalled that, during earlier days, this remarkable gentleman had risked his fortune and his freedom by embracing nationalism instead of the interests of the Dutch. A republican aristocrat, that rarest of men, he has continued to give his best to his two seemingly irreconcilable worlds.

Encounter in an Eating Place

I had one more evening to spend in Djakarta before resuming my eastward journey across Java's 680-mile length. I spent it at the establishment of Njonja Tjirebon, a lantern-lit, board-bench eating place which reputedly serves the best *saté* in town. Saté consists of bits of meat skewered on bamboo slivers, grilled over charcoal, and served with a spicy peanut sauce. This, with a bowl of rice and a bottle of local beer, makes for the tastiest and safest of Indonesian meals.

I savored mine and the human pageant around me. Youngsters with stacks of second-hand magazines rallied round. A tot who could not have topped 40 pounds sat at my

feet, determined to shine my canvas shoes. Then a blind man approached, shepherded by a motherly little girl of perhaps 10 years. The man did not call out or reach out his hand. Perhaps he felt that people rich enough to eat meat would, seeing his condition, give him a few rupiahs. No one did.

The child marched the old man about with cheerful solicitude. Poor waif, I thought, slave to a blind pauper. She left her father behind a post, where he would not be jostled, and came back alone. She surveyed the diners shyly, then stood for a moment wringing her hands, desperate and ashamed. But she could not beg. She simply turned her back to us and stood still, asking nothing, a far more touching figure than she could have been with outstretched hands. I probably only imagined that I saw her shoulders shake.

As I left, I went to her and took her hand and put money in it. She whispered thanks and ran to her father. I heard them laughing together over their good fortune as I climbed into a betjak, bound for the Hotel Indonesia where, at that moment, businessmen of a dozen nations talked million-dollar deals over New Zealand steaks and French burgundy.

Stern Measures for a Strained City

Before leaving the capital, I had a brief early-morning meeting with its hard-driving governor, Ali Sadikin. Courage is required to cure Djakarta's ills, and Major General Sadikin has it.

"You have seen what we have here," he said. "Intolerable crowding. Poor people coming from the country expecting jobs that don't exist. We have had to close the city to newcomers seeking work here, until we can solve our existing problems.

"We have just finished repairing our streets. Now we need better medical care

Big-eyed little girls learn the lessons of labor at a factory in Bandung, capital of West Java. The children, about 10 years old, transfer hanks of cotton yarn to bobbins used in handlooms. Paid on a piecework basis, they earn approximately 15 cents a day, roughly a third of what their older, faster colleagues receive.

Javanese officials can rarely enforce school-attendance laws because of a shortage of classrooms and family dependence on their children's earnings.

PHOTOGRAPHED BY KENNETH MACLEISH, NATIONAL GEOGRAPHIC STAFF © N.G.S.

and schooling, and a real start on birth control. We need these things *now*. But . . ." he smiled and shook his head, "people here like to make haste slowly. I don't know, maybe it is the nature of our island that makes them so patient, so calm. It is so beautiful. . . ."

And beautiful it is, particularly to visitors bound, as we were, for the verdant volcanoes that adorn the length of Java. Not only do these green-clad cones bring endless visual delight to the esthetic and artistic Javanese, but they enrich with their own fertile substance the lowlands around them. Streams carrying volcanic soil constantly replenish the fields at their feet (pages 2-3).

An occasional eruption may wipe out a kampong or two, breach a few roads, wreck a few bridges, but such damage is reckoned a reasonable sacrifice to the life-giving and soul-stirring powers of the magic mountains.

Gardens Hold Hope for a Hungry Land

We came up out of the north-coast flats into the cool hills of Bogor at midday, when clouds for the afternoon rains were beginning to form over the peaks. Dutch-built villas stood prettily amid flowering shrubs, along roads lined with wild almond trees. Silver-trimmed horsecarts jingled along the shady ways, and the air smelled of growing things.

Bogor boasts a botanical garden of international fame, founded in 1817. Here ornamental and economically promising plants, both native and imported, are grown and studied: rubber, cinchona (for quinine), cocoa, tea, oil palms. There are more than 15,000 plants and trees in the garden, including 400 kinds of palms. Birds call in the green gloom. Cannas blaze along well-tended ways.

Our route now led us eastward into higher country. Along the roads were stands displaying many kinds of fruit, most of them unfamiliar to Western eyes and palates. Rolling as the land was, it still produced rice in flooded, contour-following terraces. But as the slopes steepened and the temperature dropped, rice gave way to corn and tapioca. In these high lands, several thousand feet above the sea, mimosas shaded unexpected roses.

In the resthouses near the top of Puntjak Pass, people sat eating corn on the cob—a surprising sight seven degrees south of the Equator. Then the road dropped down into a great level valley that held a mountain lake in prehistoric times. Today it is a sea of rice, and in the middle of it lies Bandung, capital of West Java (map, page 6).

Wherever irrigable land exists in Java, that land must be planted to rice. In no other way can maximum food production be got from it. Villages are set in patches of unirrigated land. The result of the system is a scene which is doubly deceptive: Great tracts planted to a single crop suggest big landowners and a small population. In fact, the average holding is less than two acres, and today's estimated population of 80,000,000—1,500 to the square mile—is one of the densest on earth.

The great expanses of paddy are carefully divided by mud dikes invisible from the road; the tree-shaded kampongs contain in close, land-saving quarters the multitudes that spread out each day to try, not quite successfully, to grow the food they need.

These diligent, frugal, land-loving peasants make up the vast majority of Java's population. The rice they produce is the basis of Java's economy. Its price, known as the "mother price," affects that of all other commodities. Inefficient as hand labor by small holders may be, the time-honored techniques and mystiques of rice culture give the peasant a reason for living as well as a means to live.

Two Decades of Slow Decay

Like all Javanese cities (let me make the generalization once and for all) Bandung is largely Dutch in planning and architecture, run down and worn out at the center, and not as clean as it used—or ought—to be. Happily, its charm and importance—and it has both—do not depend upon its ailing heart.

Said a Dutch cleric born near the city: "I don't go downtown much anymore. It's too dirty now, not nice. You see, here the Dutch did everything, so after independence people didn't know how to manage. Also, the population is six times what it was before World War II. There used to be green places everywhere, to allow the town to breathe. Now they're full of hovels.

"Why? Partly because there isn't land enough, partly because the peasants have been harassed by the Communists on the one side and the most fanatic Moslems on the other, and driven from their homes to seek safety in the city.

"You will ask, 'But are not the peasants Moslems too?' Yes, nominally. But not in the strict sense. One hears that Java is 90 percent Moslem, which is a most deceptive truth. For many, religion is a mixture of animism, Hinduism, Buddhism, and Islam, which does not please the Moslem extremists. And some few,

Island foodstuffs—onions, peppers, and beans—brighten a Bandung vendor's trays. Though Java boasts a tremendous variety of fruits and vegetables, the basic diet remains rice and salt fish.

Java's tricycle taxis—rear-driven pedicabs called *betjaks*—also haul freight through city streets. *Djajabaru*, "new magnificence," probably identifies the Jogjakarta firm that owns this flashy buggy.

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perhaps 3 percent, are Christians. Sukarno, to his credit, believed in equality of religions. But now, I fear, the orthodox right-wing Moslems are trying to make Indonesia the Moslem state it has never been.

"And of course the old systems of corruption continue, despite the best intentions of the present administration. One good thing: We have a new governor, a young man with new ideas. Perhaps he will sweep away some of the old decay."

Bandung Thrives as a Place of Learning

The governor, Major General Solichin, shared the cleric's views about the state of his capital city. "I feel sorry that things are so bad after so long. I will not stand by and let ills go uncorrected. In any case you will find the true Java in the interior, away from the cities. Go where you please, do as you please, think and write what you please."

Apart from a devoted cleric and a dedicated governor, Bandung boasts a large academic community. There is a regional liberal arts college, a teachers' college, and the famous Bandung Institute of Technology, a national university. It was here, some 45 years ago, that a young engineering student known as the "Fighting Cock" or, more officially, as Sukarno, first made himself heard.

The government owns the institute and pays the small salaries ($30 to $40 a month) of its professors. One of these, Dr. Oei Ban Liang, showed me around.

"We are chronically short of funds," he said, "but we have the necessities for teaching a five-year course leading to a degree similar to your master's. We have 6,000 students here and a faculty of 370, of whom 200 have had training in the United States."

One such was Dr. Bambang Hidajat, the youthful chief of the excellent Bosscha Observatory on the hills north of Bandung. At his invitation I joined him there later in the day. He showed me his treasured telescopes.

"My own project at the moment is to seek undiscovered young stars," he said.

The valley below the observatory in which Dr. Hidajat conducts his specialized search contains one of the loveliest landscapes in Java, hence in the world. Here several kampongs lie fitted into the gentle curves of the valley floor, tree shaded and still. Their fields spread across the lower lands; their terraces, fashioned with such perfection that they seem sculptured rather than constructed, rise, narrowing, to the very tops of the mountains.

So idyllic, so impossibly pastoral is this scene that it lacks reality. It seems, in the fast-falling equatorial dusk, to be the setting for some serene dream. Down below, peasants awaiting supper sing songs of philosophies a thousand years old; here on the hill the young astronomer, blood of their ancestral blood, probes the universe with wonderful instruments in his search for new stars.

Power for Factories, Water for Rice

Though Bandung and its environs are short on industry, as are all Javanese cities at the moment, the region has maintained some of its European-created production centers in admirable condition. One is a 73-year-old quinine factory, once the world's biggest. Another is the tea estate and processing plant called Malabar (opposite). Dutch built and now government owned, where 2,500 people work 4,200 well-tended acres. Farther away, but still a source of pride, is the Djatiluhur dam and hydroelectric plant on the Tji Tarum, which will not only produce badly needed electricity (there is a contingency candle in every hotel room in Java) but will irrigate 725,000 acres of rice land as well.

An old industry, weaving, has been revived near Bandung. In a fairly modern plant, owned by a rich Chinese, I watched some 200 men operating Japanese-built power looms for about $7.00 U. S. a week and lunch. In another establishment owned by a not-so-rich Chinese, forty or fifty women and girls sat clustered on the earth floor, cranking little wooden-wheeled devices that wound thread onto bobbins (pages 18-19). I asked the age of one of the smaller girls. "She does not know," I was told. "But probably she is 10."

How much did she make? "See, she is too small to turn her wheel very fast. She could

Essential stimulant to Java's economy, a river of tea leaves flows from the government-owned Malabar plantation near Bandung. The batik-clad worker uses a vibrating sieve to remove fine particles of the green Assam tea from leaves and buds, which she then grades by hand. Introduced as an estate crop in 1827, tea now ranks as a major agricultural export. Others include rubber, tobacco, sugar, coffee, palm oil, copra, and cinchona—source of natural quinine.

not make more than 50 rupiahs [about 15 cents] a day."

We traveled next to Pangandaran, a village on the Indian Ocean, not far from the border of Central Java. Unlike the north coast, where sweltering, bustling port towns face upon the land-shielded Java Sea, the south coast of Java is exposed to the full sweep of ocean waves. It boasts only one natural harbor—Tjilatjap. At Pangandaran the heavy ocean surf pounds long, empty beaches. Behind a small peninsula lies a tidy fishing village, brightened by frangipani and oleanders, where outrigger canoes rest on palm-shaded sand. At night the men light lanterns to lure fish into their nets.

Though the village has the charm of a South Seas postcard come to life, it is the peninsula which shelters it that holds the deepest interest for visitors. This sea-bound segment has been left as natural jungle. Here teak and other tall trees maintain twilight at midday. Monkeys and squirrels play in the branches. Pea fowl and jungle fowl strut in the sunlit edges of the forest. Parrots and hornbills call from the canopy above.

Only one creature here offers any threat to man, and then only to the foolhardy. That is the beautiful *banteng*, the large and lithe wild ox of Southeast Asia. By luck, I came across a herd of 17 in a small savanna. The cows raised their heads from their grazing, but the bulls wheeled to face us, and froze.

"Now," said my guide, "we must stop. They are afraid of us, but they may charge instead of running. Here they would catch us in the open. We will go away quietly."

At dusk the flying foxes rose from their roosts and flew, straight and singly, toward the north, big wings beating slow as a crow's. Smaller bats and swallows flittered low to the ground. I wrote my notes by candlelight as lizards stalked insects on the walls, and soon slept, soothed by the sighing of the sea.

Clouds pregnant with rain cast a gray pall over islanders hauling a net from the sea at Panganlaran on the Indian Ocean. The fishermen earlier had towed the net several hundred feet from shore with their dugout outrigger. Men at right carry bundled nets ashore on a shoulder pole. Fish provides important protein for the meat-deficient diet of most Javanese.

Shark on his shoulder, a boy of Panganlaran heads homeward. Probably much of the 30-pound fish will be salt-dried by his parents to preserve it for future meals.

We left before dawn. By sunup we were in Central Java. Here was the historic heartland of the island and the nation, the seat of Indonesia's most magnificent civilization. The scene changes as you cross the border: Java narrows and the mountains nearly fill the land.

The appearance of the people changes too, as does their language; the Sundanese tongue of West Java gives way to heavily Sanskrit-influenced Javanese. Poverty seems more pressing. Women walk the roadside with bigger burdens than their Sundanese sisters bear. There is no less beauty, though. Gunung Slamat, the "Blessed Mountain," lifts its classic cone above 11,000 feet.

Jogja Still Linked With Java's Past

Noon found us in the sultanate of Jogjakarta (or Jogja, as most natives affectionately call it), a small principality and royal city in central Java. Here large, striking structures grace the downtown area. Because Jogja was the old royal center, it contains *kratons*—palaces. Because the kratons were there, the Dutch, who worked through the royal rulers, built fine colonial buildings of their own beside them. Because palaces and bureaus were there as

[illegible] and photographs © N.G.S.

In fearsome masks, two actors at Ponorogo perform the *rejog*, a centuries-old dance drama that originated in their village. Until exhaustion overtakes them, they enact the legend of a king who loses his betrothed to another suitor but wins her back by using a disguise and a hobbyhorse army to frighten away his foe.

"**Musick** . . . of a very strange kind, yet . . . pleasant and delightfull," observed circumnavigator Sir Francis Drake in 1580 when he first heard the melodic strains of a gamelan, an assortment of bronze and wooden instruments such as this xylophone-like *gambang*.

symbols of authority (and because Jogja was safely removed from attack by sea), the first formal capital of new Indonesia was established there in January 1946, to be transferred to Djakarta in 1950, after the Dutch renounced sovereignty.

Bearing a note from the sultan in Djakarta, I set off to see the seat of his sultanate. I made my way to the kraton through streets whose bicycle content—or, at any rate, bicycle density—must be the world's highest. Maybe it's because few Central Javanese own cars (there are not nearly as many high officials in Jogja as there are in Djakarta); maybe it's because Jogja is a university town, containing Gadjah Mada University, the nation's largest, with more than 16,000 students. In any case, one in four Jogjans travel on two wheels, and most of them travel at the same time.

Palaces Hold Symbols of Princely Power

A Javanese kraton bears no resemblance to a palace in the Western World. It has no impressive height, no soaring splendor. The palace here is a place more than a thing.

Within its gates are large, low, and lovely buildings, perfectly adapted to the hot and humid climate. The best of these are the *pendopos*, huge open-sided structures covered by four-sided roofs supported above gleaming marble floors by columns of carved teak.

A palace servitor led me to the unpretentious dwelling of Prince B. P. H. Prabuningrat, the sultan's brother. Dropping to a squatting position, the man waddled toward his highness, announced me, and waddled away. The prince rose and thrust out his hand. He glanced at his royal brother's note, then took me in tow.

"I cannot show you the sultan's private quarters, of course," he said as we passed them. "I'm sure you understand.

"But here," he pointed to a smaller, tile-topped pendopo, "here is where the sultan holds court. The building is one of our oldest—215 years. When the sultan officiates once a year, his uncles and brothers sit beside him, and officials come to kiss his knees."

I tried to visualize the simple, dignified gentleman I had met in a Djakarta office enthroned here among worshipful retainers. I found that I could, very easily.

A lamp glowed in the back of a dark hall. I'd been told about it: an eternal flame kept burning in the room containing the sacred *pusakas*, the heirlooms of the royal family. The most powerful and precious of these would be weapons, particularly the wavy-bladed krises, which, when old and revered and of noble origin and ownership, are believed to have great mystical power. Sukarno had had several pusaka krises and considered them important to his success.

The prince anticipated my request. "I am afraid no foreigners may see our pusaka objects," he said. "They're really very sacred. The room in which they rest can be cleaned only by women past childbearing age."

Everything else was open to me. We entered building after building, including the great pendopo given by the sultan to the university. "A master stroke, that," said the prince. "The sultan is an excellent politician. But I do wish the university had painted their pendopo a nicer color than pale violet."

As we walked back through the quiet courts, the prince spoke of the sultanship itself, rather than of its physical setting.

"It is really important to the people to have a sultan, and to know that he has mystical strength. The sultan does not impose ancient customs on this evolving society. His powers are available to the people, but never thrust upon them. And they are needed. If they were not, this would no longer be a living court but only a historical curiosity. The sultan himself would make it so.

"The existence of the sultanate within the new republic tells much about Java."

Temples Attest to Vanished Grandeur

Symbols of the court's brilliant cultural antecedents are not far to seek. The old temples still stand, to dwarf into insignificance everything built since. The old philosophies and beliefs persist, preserved in the *wayang kulit*. These puppet plays, still a favorite entertainment, present ancient Indian themes enacted by shadows cast upon a screen.

I went to a wayang kulit show, and couldn't have been more fascinated if I'd understood what was being said. And I met the wayang's legendary characters again, far from the puppeteer's screen, in the remote and barely accessible Dieng Plateau, where some of Java's oldest temples have stood since the eighth century. They are named for the heroes of the Indian epics. There, in the central mountains, where clouds trail their tendrils across a land too cold to grow rich crops,

the valley floor has gone to grass. Horses graze it. Small boys follow with baskets, to gather droppings for fertilizer.

But the Dieng temples are modest by Javanese standards. The great Indian-Javanese temples are near Jogja itself. Most renowned is the immense ninth-century Borobudur—an entire hill faced with stone and sculpture. Pictures convey the flavor of the place far better than words can do (pages 32-33), but let me make these few basic points about the theme of this overwhelming creation.

Its lower levels depict in high relief and earthy detail the story of Buddha's life. The levels above are undecorated. Human concerns are absent here, literally left below. Forms are large and pure: bell-shaped stone shrines, or stupas, in which figures of Buddha can be seen seated in contemplation. At the very top, a huge closed stupa broods above

Soft caress of a summer shower cools a Javanese woman harvesting rice near Klaten. Comprising half the labor force, women have traditionally enjoyed great—but not total—independence. Their current aims include the outlawing of polygamy, higher pensions for widows and orphans, and better education.

the hectic world below. It too is undecorated. Within it, one may assume, is nothing at all but a spirit of perfect serenity, eternally unseen and unseeing. Thus, from earthly passions to the sublime nothingness of nirvana, are portrayed the stages through which man's soul must pass.

There are many other temples in the Jogja region. The Hindu shrines of Prambanan are the most dramatic, for they thrust upward like geometric and richly adorned pinnacles (next page). Each once contained a statue of its divine patron. It is surprising to find that the tallest temple is dedicated to Shiva, the destroyer and procreator, and a lesser one to Brahma, creator of the world. Surprising—until someone candidly explains: "You see, Shiva is the one you have to worry about."

Dozens more such structures can be seen in Central Java, all thought to have been built between A.D. 700 and 900. What caused this superhuman burst of creative energy? What ended it so abruptly? No one knows. Perhaps the proud rulers of the land used up the last of its human resources, working the peasants beyond endurance. It is a fact that the center of power in the island shifted to East Java in the tenth century, to return only in the sixteenth.

Small Sacrifice to the Sea Goddess

Still, Central Java was never emptied of its peasants. They perpetuate the plebeian pattern of the Hindu-Javanese golden age, just as Borobudur and Prambanan immortalize its loftiest philosophies. For a closer look at their way of life, Kumar and I left the grand monuments in search of isolated kampongs.

One such was Parangtritis, on the Indian Ocean, where the sultans of Jogja once came yearly to commune with Njai Loro Kidul, the goddess of the South Sea. Lesser folk still pray to the sea queen. She is, after all, a figure of such importance that a room with bath is always reserved for her in one of Java's best hotels.

Kumar and I hired a young man with a tiny horse and a miniature cart to take us down to the sea so that we could make offerings of our own. Past royalty made rich gifts, but the average pilgrim offers a coconut, supplied at reasonable cost by the ladies of the village, who stand ready, also, to officiate at the sacrificial ceremony. My "priestess" was a shy, brave little girl who led me to the shore while fighting off the attempts of a grown man to seize her coconut and my payment. Kumar and I put the fear of Njai Loro Kidul into him, and he backed off.

The child went ahead of me into the wild, tawny surf, threw the opened nut into it, and retrieved it a couple of breakers later. She marched back and poured the mixture of coconut milk and sea water three times over my hands, telling me to make my prayer. This done, she reverted ingenuously from the role of priestess to that of little girl, and began to sing.

I recorded her song. When she was done, I played it back. She stared wide-eyed at the black box slung from

my shoulder, then, hearing a child singing a favorite tune, she joined her. The disembodied voice was, after all, only a minor miracle for one who lives in the shadow of the powerful Njai Loro Kidul.

"Our goddess can fix anything," said the boy with the horsecart as we drove back through the seaside paddy fields. "Are there such goddesses in Djakarta?" he asked.

Kumar admitted sadly that there were not.

Few Men Left in Sambasari

Our second kampong was well inland. Its name was Sambasari, and its distinction was poverty suffered with grace. The village lurah walked with us, not just among the tile-and-bamboo houses, but in and out of them. Wherever we stopped, we were invited to enter and rest. Mats divided the interiors into two or three rooms. Low platforms served as beds and as drying places for paddy and corn.

"People here have not much land," said the lurah. "But no one starves."

Said a middle-aged woman, "I grow no paddy. My husband died, and we had to sell our field because we could not work it."

Kumar cut in in English, speaking unobtrusively. "There are few men in the kampong. In this region the Communists won many sympathizers. After the coup they were murdered. I will show you a river near here that ran red in those days. More than 5,000 bodies were thrown in it."

The woman continued, "I have a store here, see? It is not so much."

Nor was it. On a single shelf rested one egg, two packages of noodles, four or five potatoes, a few vegetables. She had walked a long way to buy these things, and would make a few rupiahs if she could sell them all.

In another house an aging lady sat on the floor making lamp wicks out of cotton waste. Near her an emaciated boy squatted against

Hindu splendor rises from the jungle near Prambanan. Erected in honor of the deities Shiva, Brahma, and Vishnu at the peak of Hinduism's 1,200-year primacy on Java, the tenth-century temple towers 154 feet. Its buildings contain features of other cultures—stupas, the bell-shaped shrines of Buddhism, and vaults that appear to be early Javanese royal tombs.

Today, most islanders are Moslems, adhering to a distinctive type of Islam that incorporates many elements of other religions.

Borobudur glorifies Java's Buddhist heritage

HANDS FOLDED IN PRAYER, monks (above) from many Asian countries converge annually at the Borobudur shrine (left) near Jogjakarta to commemorate the three most important events in Buddha's life—his birth, his enlightenment, and his death.

Largest monument in the Southern Hemisphere, pyramid-shaped Borobudur dates from the ninth century, when Buddhist art and architecture flourished briefly on Java. Rising 103 feet, Borobudur is capped by a large central stupa surrounded by 72 smaller shrines of latticed stone, each containing a likeness of Buddha. Local legend holds that reaching into the cagelike enclosure to touch an image (right) brings good luck.

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the wall, immobile, staring fixedly at nothing. "*Slamat sorë, 'bu*—Good evening, mother," I said. "Is your son ill?"

"We do not understand his condition, *tuan*. We took him to a city doctor, an educated man. He could find nothing to do for him."

I bent near the boy and spoke to him. Suddenly the lad turned and looked straight at me, intelligent and alert. He uttered a sound, then once again retreated into his own world.

I touched his dull hair and rose to go. The mother took my hand in hers. "You see, tuan, he saw you. He spoke. Pray for my son, tuan!"

"I will, 'bu," I said.

The grand monuments we passed on the way back to Jogja were only old, cold stones. How much more moving, I thought, are human love and courage than the confections of kings.

Progressive Princess Defies Tradition

Jogja shares with nearby Solo (known officially as Surakarta) the distinction of containing noble families and of fostering the ancient arts. The finest batiks are made in both towns, as are exquisitely fashioned objects of silver, horn, and wood. In both, the traditional dance forms of Java are taught and performed, and classical music flourishes.

Solo's kratons, however, are no longer seats of political power. In one, I was received by a princess who, free from the sanctity of active

Javanese royalty, can and sometimes does welcome foreign visitors into her home.

This charming lady, notified of our coming, invited us to tea. We sat with her in a half-open octagonal sitting room, served by duck-walking girls. Then, to my amazement, she asked if we would like to see her private quarters. I was up and out of my shoes as quickly as decorum permitted. Turning to Kumar, her highness said in Indonesian, "Why should we close our doors to foreigners?"

She led us into a suite of three high-ceilinged shadowy rooms which gave the effect of simplicity on a regal scale. When we left, Kumar whispered delightedly, "If I tell my friends in Djakarta I had tea with a princess, sitting at her level, and entered her quarters, they will never believe me. Never!"

Drip-dry uniforms of these ballplayers in Pangandaran keep them from soiling school clothes. With increased emphasis on education, illiteracy in Indonesia—a staggering 93 percent in 1941—shrank to only 40 percent in recent years.

A member of the noble family, Suseno, showed us collections of art objects and weapons that would have graced any museum. I told him that ever since my childhood I had longed to own a fine kris. I'd looked at hundreds of the serpentine daggers, never finding one that felt right to me.

As any Indonesian knows, there is a special relationship between these intensely mystical objects and the people who care about them. The right kris announces itself, and, under the right circumstances, delivers itself to the right man. A kris must *happen* to you.

Pleased by my interest, Suseno referred me to a master woodcarver who was believed to own a true pusaka weapon—a royal heirloom. We sought him out at once. He welcomed us, sent for tea, and went to fetch the treasure. I unsheathed it, looked at it, and wanted it so badly my teeth itched.

"It is a pusaka kris," said the owner in a mild, gentle voice. "It was made in the 16th century, by a smith named Ki Guling who shaped the blade with his bare hands when it was red hot. It is decorated with pure gold, diamonds, rubies, and sapphires."

The price was high. I hadn't the required amount with me, and couldn't have spent it if I had. "Take the kris," the carver said. "Pay nothing. Send money when you can."

There, I thought, was the miracle that should accompany the acquisition of a kris. Not until later did I learn that the man risked nothing; if I had failed to pay, the kris, offended, would have flown back to him.

The deal was not made in a day. My offers were courteously refused. In the end, kris-like, the treasure became mine at a price lower than I had proposed.

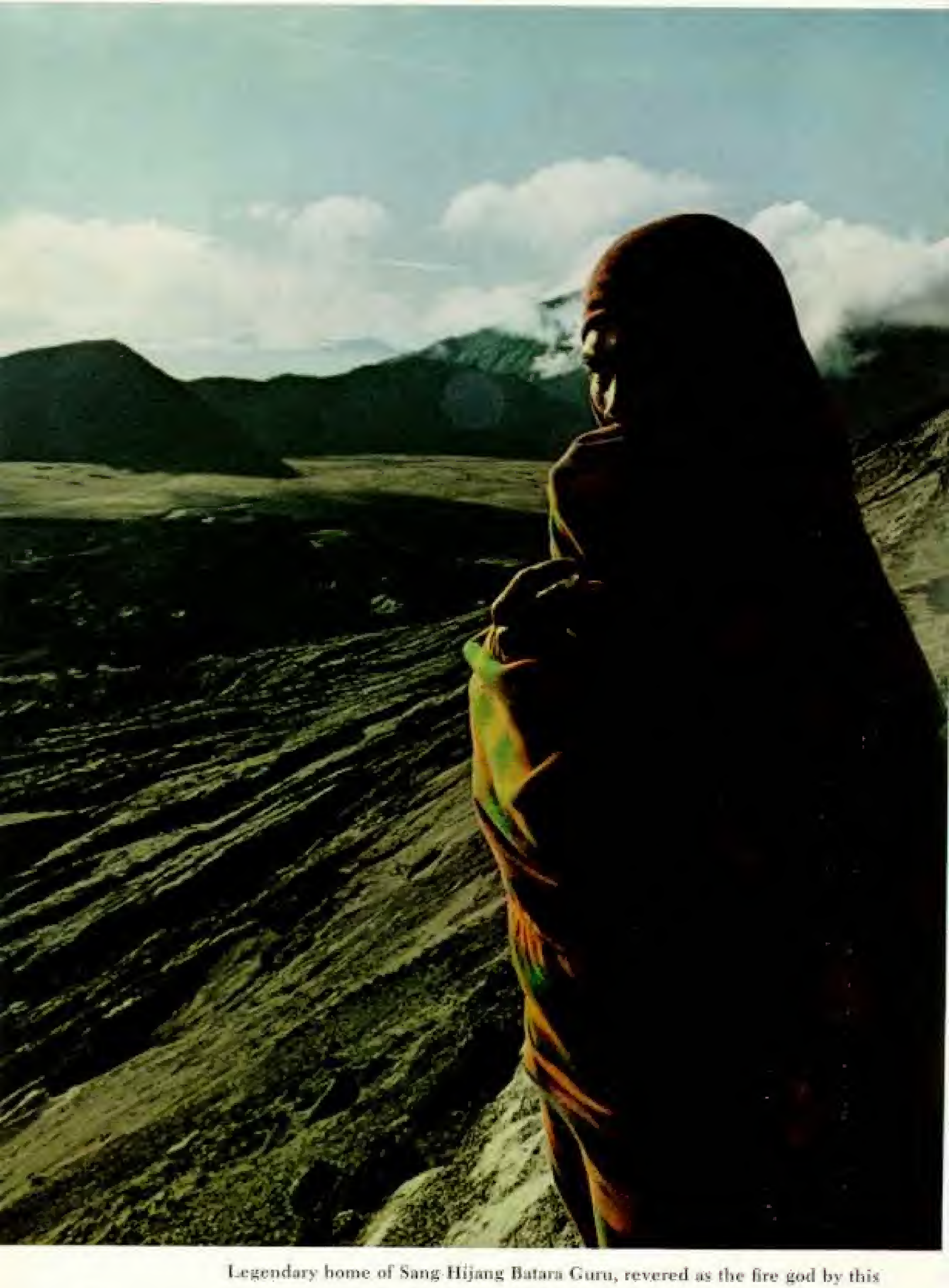
"That is a very good thing," said Kumar. "The kris wants to come with you. It will help you."

It did. Suseno, impressed by my fascination with the sacred weapon, offered to lead me further into the realm of mysticism. He summoned a *dukun*—a soothsayer—to meet me at the kraton.

(Continued on page 40)

Java's white gold: Milky latex gathered by this plantation worker will be treated with a coagulant and pressed into sheets of rubber, Indonesia's most valuable export after petroleum. The trees, which flourish on coastal plains, each yield from 7 to 12 pounds of rubber a year.

Balancing his bundles of leeks, a farmer slogs up a glistening mountain trail toward a Tenggerese village in East Java. In this highland area garden crops and corn provide the staple foods.



Legendary home of Sang Hijang Batara Guru, revered as the fire god by this

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Tenggerese mountain guide, Gunung Bromo steams from a vent in a sea of volcanic sand.

I had expected an elderly gentleman in traditional dress. I saw instead a lean, youngish man in trousers and a shirt, ordinary looking to a fault. He greeted us in a soft, deferential voice, sat down, and lit a cigarette.

Suseno, seated at my side, leaned over and murmured, "This man contains many souls of dead people. They talk through him, and know things he himself does not know."

The dukun began to speak in a harsh, arrogant voice. His body trembled with tension. His eyes, no longer downcast, were direct, gleaming, fixed. He transmitted several messages for the noble family from spirits of various periods. After one, Suseno sat in troubled silence.

I looked enquiringly at him. "That was a message from one of the giant servants of an ancient sultan, so of course it was in ancient Javanese. I could not understand it."

How did the dukun know the old language? He didn't, of course. But the spirit did.

Gold Means Safety for Hard-won Savings

We traveled eastward all afternoon through beautiful but ungenerous country. Just as Central Java feels—and is—poorer than West Java, so East Java conveys a sense of still greater need. The road ran through hot, moist lowlands beneath Gunung Lawu, a holy mountain almost 11,000 feet high. Surabaja, East Java's capital, lay ahead (map, page 7).

Despite its climate, Surabaja is a city on the move. It has a good port and makes its living by trade. Its streets are filled with Chinese-owned stores which in turn are filled with transistor radios (the favorite Javanese possession), sunglasses, and gold objects.

Here, as elsewhere in East Java, goldsmiths do an extraordinary business. People line up at their counters to buy small trinkets of gold. Perhaps the memory of recent and fantastic inflation still moves people to put their small savings into the precious metal. At any rate, they love it. I've even seen full sets of false teeth for sale with gold in them.

We went along to the port, which is second only to Djakarta's. It was both busy and decrepit, filled with a wonderful variety of vessels ranging from gaily painted fishing schooners to aging Russian-built warships. A stream of small craft, propelled by sail or outboard motors, carried people back and forth to the island of Madura, 1½ miles away.

Copra, teak, tea, coffee, rubber, and rice fill the godowns on Surabaja's docks. Yet signs of poverty are always in sight. In front

Java reveres her gentle highlanders

INHABITANTS of a Tenggerese kampong, or village, take shelter from a downpour (above) beneath the eaves of their tin-roofed wooden buildings—unusual on an island where bamboo-and-thatch houses predominate.

To combat the chill of mountain nights, the family at right places an eating-sleeping platform, covered with jars containing various sweets, near a wood-burning, chimneyless stove. Strips of meat hang drying on a back wall.

Idealized by other Javanese as free from dishonesty, jealousy, and quarrelsomeness, the Tenggerese rank among the smallest of Indonesia's 300-plus ethnic and cultural groups.

PHOTOGRAPHED BY NATIONAL GEOGRAPHIC PHOTOGRAPHER JEAN CURRAN © N.G.S.

of a rice storehouse an old woman squatted on the ground, winnowing dirt in a flat round basket, trying to separate the few grains of spilled rice it might contain.

We regained the north shore road and followed it eastward. Tamarinds flanked a well-paved highway which ran along a narrow plain between the clear, still water of Madura Strait and the stately procession of peaks.

As we traveled, the green of the land began to change. Tones of yellow appeared. An afternoon passed without rain, and for the first time we saw stream beds less than full.

In such country a peasant has little chance. There's not enough water for intensive agriculture. Crops that will grow on unterraced mountainsides—copra, teak, tea, coffee, rubber—require great acreages. Here the small man works for the big man, or he fishes.

Dusk Brings All a Moment of Peace

Before reaching Java's east end, on Bali Strait, the road turns inland to pass through a relatively empty jungle-covered region. Few people pass this way after dark, for then the wild pigs, tigers, and leopards that live in the forest may make the route dangerous.

We drove down out of the jungle slopes, through stands of coconuts (the east coast is copra country) and out onto a shore facing the beaches of Bali, little more than a mile away.* In Banjuwangi, the only town on the coast, we found lodgings in an antique hotel offering more character than comfort.

Dusk was an hour away. I went to the port to watch the evening scene. Low, lateen-rigged boats sailed into the harbor past men wading waist deep, feeling for clams with their feet. The small catches made during the long day at sea were unloaded upon rickety docks amid laughter and bantering talk.

Night came quickly. The waders went away. Aboard the boats corn-husk cigarettes glowed in the gloom. Ashore, a few lamps flickered—a very few; oil is not cheap, and night is a time for sleeping, or for talking comfortably with friends, or for singing songs that retell the old truths.

*See "Bali by the Back Roads," by Donna K. and Gilbert M. Grosvenor, GEOGRAPHIC, November 1969.

In this moment of ease, poised between the disappointments of the day and the perils of dream-haunted sleep, the deeply divided people of Java revert to their most serene similarities. All down the lovely length of this troubled island tens of millions of people—the Badui in their hills, betjak boys in their slums, peasants in their kampongs, and, here at land's end, fishermen in their villages—would eat and rest in peace. Separately but simultaneously, all of them would savor for a while the most basic form of human solace: freedom from torment and terror.

They have never really asked for more, these docile and accommodating people. Whatever their religion or politics, they are trusting and kind. Then why the orgiastic massacres that stain their recent history? Perhaps because, forced by the crowding and nature of their land to live in intensely close contact with others, they learn to make concessions beyond those required in less constricted cultures; perhaps they tolerate beyond the human limits of tolerance, and then go partly mad. *Amok* is an Indonesian word.

Faith Holds Meaning Where Figures Don't

But when these limits are not exceeded—and, with luck, they need never be again—the patience and fortitude of the Javanese enable them to live peaceably under circumstances that would shrivel a Western soul. Economists and politicians, and the wiser heads in Djakarta, concede that grave problems face Indonesia in general and Java in particular, with its dependence on foreign aid, its present inability to feed itself, its growing population, its delicate balance of political power. Said one pessimistic pundit, "I look at the arithmetic, and I don't see much hope."

The Javanese are more interested in hope than arithmetic. For them, hope is faith. And faith can confound figures.

No one moved on the waterfront now. I walked along the shore toward the waiting car. A voice spoke softly from a dark doorway.

"*Slamat djalan, mas*—May your journey be blessed, brother."

"*Terima kasih, mas*," I thanked him. And added in English, "It has been." □

Work-tempered muscles are the tools of his trade. A sinewy laborer prepares to weigh a load of coconut chips, destined for use as cattle feed, at a plant in Banjuwangi in East Java. He earns about 25 cents a day for toting the 180-pound bags. The Javanese use oil extracted from the dried coconut meat for cooking and making soap; most copra, however, is exported.

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THE VOYAGE OF *RA II*

By THOR HEYERDAHL

Photographs by CARLO MAURI and GEORGES SOURIAL

SAILING A SHIP OF PAPYRUS REEDS, *held together only with rope, we cross the Atlantic from Africa to the West Indies. We make the 57-day trip in this incredible craft to learn if such a boat—a copy of those used thousands of years ago—could have crossed the ocean and carried elements of the ancient culture of the Mediterranean to the Western Hemisphere.*

Here the sea sweeps across the deck of Ra II, *nearly engulfing a crewman. But, by bobbing like a cork and living with the water, not shored against it, the ship demonstrates a harmony with the sea that saves our lives.*

EKTACHROME BY GEORGES SOURIAL © N.G.S.

Proud lineage of a ship

THE EVIDENCE is abundant. In a tomb relief, ancient Egyptians carry papyrus to builders of a reed boat (**opposite, top**). In verses from the Bible, in scenes found at Nineveh, in writings of the Roman historian Pliny, the reed boat stands as one of man's most ancient vessels. And, strangely, it survived into recent times in Mesopotamia, Ethiopia, Sardinia, Corfu, and Morocco. Fishermen still ply central Africa's Lake Chad in reed boats (page 50).

But the most astonishing fact is that similarly designed reed boats also existed in the New World when the Spaniards arrived. Even today, on Lake Titicaca, Indians of Peru and Bolivia use totora-reed boats like those of the Old World.

Since my first expedition to the South Seas, which I described in a 1941 GEOGRAPHIC article, I have been interested in the navigation and routes of prehistoric voyagers. In 1947 I sailed from South America to Polynesia aboard *Kon-Tiki*, a copy of an Inca balsa-log raft, to show that ancient Peru could have contributed to Polynesian culture. And the Incas also used reed boats. Is it coincidence that South America's reed boats resemble early ones of the Nile, Tigris, and Euphrates?

Numerous theories of voyagers drifting from Africa to tropical America have been proposed to explain the sudden blossoming of high culture from Mexico to Peru. Like the ancient peoples of the Old World, Indians of the Americas worshiped the sun, built pyramids and giant stone statues, married brother to sister in royal families, wrote in hieroglyphs, performed cranial surgery, and mummified the dead.

I resolved to build and sail a reed boat from Africa to the New World to find out if ancient man could have done the same.

In 1969, on the sands behind the Great Pyramids of Egypt, shipwrights from Lake Chad helped me build *Ra I*. Their system was to lash together many small reed bundles

with separate ropes, their design featured a high bow and low stern. At my request, they added a stern to match the bow. But their patchwork method of construction didn't work. Under way, we saw the stern break apart. Waves rolled aboard, like combers onto a beach, tearing away quantities of papyrus. *Ra I* had to be abandoned short of Barbados (map, pages 50-51).

Starting anew, I decided to build *Ra II* like the ships of ancient Egypt and Mesopotamia—and today's Lake Titicaca. Four Aymara Indians from Bolivia, with an interpreter, came as our shipwrights.

Here, *Ra II* takes shape in a garden at Safi, Morocco (**above, left**). The hull consists of two main bundles, plus a small center one, all lashed together with a continuous spiraling rope. Thin bundles on each side form the gunwales. No metal—not a nail or screw—was used.

Moroccan helpers wrap ceramic jars in reed jackets to prevent breakage on the voyage (**above**).

The unveiling

ROLLING to her christening, 40-foot-long *Ra II* attracts a throng in Safi, Morocco, where a 16th-century Portuguese fortress (**right**) guards the harbor. I stand aft on one of ten crossbeams, supports for our bridge, cabin, and an A-frame mast that will be erected later. The bamboo top of our cabin—itself little larger than two double beds—gives us an extra deck.

The following day, May 7, 1970, we launch our little golden ark in waters well known to the Phoenicians, those intrepid mariners of old. "I baptize you *Ra, Ra II*, in honor of the sun god, and wish you a successful voyage," pronounces Aicha Amara, the Berber wife of the Pasha of Safi, as she splashes goat's milk onto the vessel. After ten days in the harbor, soaking up water, *Ra II* sets sail for the Americas.

The author

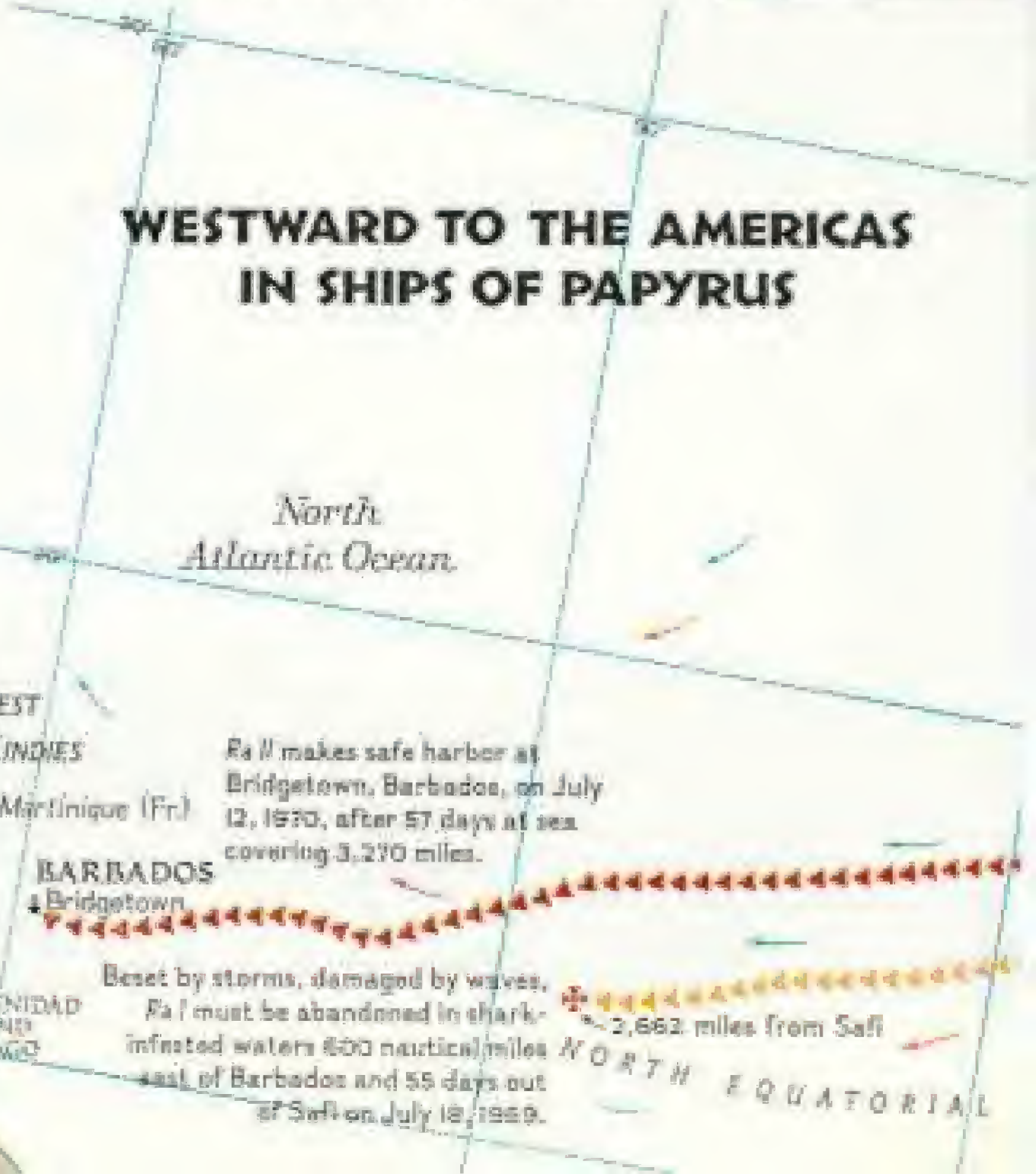
A SCIENTIST of great imagination and vigor, Dr. Thor Heyerdahl (**far right**) has long pondered the similarities in cultures lying oceans apart. Why, he wonders, do reed boats of Lake Chad (**below**) and Lake Titicaca (**bottom**) differ in so few details?

To explain why the Spaniards found civilized nations from Mexico to Peru, anthropologists hold to two schools of thought. "Isolationists" believe that the Americas, surrounded by oceans, developed their civilizations independently. "Diffusionists" think that voyagers were accidentally wind-driven to the New World from Africa, Asia, or even Europe, bringing Old World culture to the American aborigines.

Standing between these extremes, Dr. Heyerdahl believes the civilizations of the Americas might have been stimulated from abroad, at a time when Mediterranean culture was spreading through Gibraltar to the Atlantic coast. His approach has been to test feasible routes and means of diffusion.

For his lifetime of research, chronicled in many books and magazine articles, Dr. Heyerdahl has won honors from 12 countries, including the Royal Patron's Medal of the Royal Geographical Society of Great Britain, awarded by Queen Elizabeth II. A Commander of the Order of St. Olav, he also holds membership in the Norwegian Academy of Science, a fellowship in the New York Academy of Sciences, and honorary membership in the Academy of Sciences of the U.S.S.R.—THE EDITOR

Setting forth, the men dine well, but only on foods preserved in the manner of the ancients. In more than a hundred jars, goatskin bags, and baskets, *Ra II* carries water, dried and salted meat and fish, dates, figs, nuts, eggs, honey, flour, oil, dried vegetables, and Egyptian bread.



With the United Nations flag fluttering from the mast, *Ra II* starts off bravely; her purple sail rapidly bleached in the intense sun.

Ra I, brought from Egypt to Safi by freighter and truck, clears port on May 25, 1969.

Ra II departs Safi on May 17, 1970. Earlier, the author visited the ruined city of Lixus, 365 miles north, where walls of huge fitted stones resemble those built by sun worshipers in ancient Peru and Mexico.

Fast start, then a dead calm

OUTSIDE OLD SAFI, currents flow and trade winds blow direct to the New World. We begin our voyage with a strong breeze, but everyone is tired after the hectic departure. Two crewmen are seasick. I confide to the log. "Mess everywhere . . . as always at start. . . . *Ra II* is rolling: there is danger of falling overboard." The second day we have an ocean going white before gale-force winds. Then suddenly, on the third day, we hit a disastrous week of calm.

We drift helplessly (**above**): our red safety buoy, attached to a lifeline, floats off to starboard. And we sink ever more deeply into the water. We begin jettisoning some of our provisions.

We are in the shipping lanes, and by night we see big steamers that cannot see us. We beam a lamp onto our sail, hoping we will not be run down. As we flout nearer to Africa's dread Cape Juby, the ocean is like a mirror, broken only by the fins of sharks. To lighten tension, Georges, left, and Santiago perform a burlesque song and dance (**right**).

FROM THE SHIP'S BOWSIT, AND SAILS FROM

In mounting the *Ra* expeditions, I hoped to prove something not exclusively of the past but also of the present and the future. To share my adventure, I selected men from many nations, colors, and creeds, to show that such differences do not prevent men from cooperating peacefully for survival. I saw such expeditions as scale models of our shrinking little world of tomorrow, where all mankind will have to live closer together.

Of the seven who disembarked from *Ra I* ten months earlier, six of us now repeat the crossing in *Ra II*. Norman Baker, a 41-year-old U. S. civil engineer, is the only sailor. The others: Mexican anthropologist Dr. Santiago Genovés, 46; Italian alpinist Carlo Mauri, 40; Russian physician Yuri Senkevitch, 33; Egyptian skin-diver Georges Sourial, 30; and myself, 55.

Two new men are Japanese movie cameraman Kei Ohara, 40, and Moroccan businessman Madani Ait Ouhanni, 29. The extent of Kei's seamanship: He once rode a ferry across Tokyo Bay. Madani had previously been on the water only in a rowboat.

Aviary above, aquarium below

WE ARE SINKING! We are going down in perfect, complete shape, and we can do nothing but wait. Norman checks the amount of water absorption; he also ties a string to the foot of Sindbad, our duck, and gives him an outing (**below**)

Marveling at the life in the sea beneath us, I go under *Ra II* to swim with the pilot fish. After several dives, I come up and see our ship moving away. My waist rope has slipped off, and I am alone on the Atlantic! But the wind is weak, so it is easy to make it back to *Ra II*. This is fortunate, since the ship can sail only downwind and thus could not return to rescue a man overboard—the reason for our lifeline with the buoy at its end. "Our last grasp at life," Norman calls it.

As we sail past the Canary Islands, we delight in visits from birds, who consider our boat a reedy island in the ocean. Though most of our visitors eventually flew away, as if knowing that land was about to disappear, two remain (**opposite, top**).

The bright-colored roller on the tiller died because we had no insects to feed it. The pigeon, wearing a Spanish leg band, lived with us until we neared the West Indies. Then it began circling and flew away to a new home.

On a daily survey, we observe the shocking pollution of the ocean. Blobs of solidified oil—studded with hitch-hiking barnacles—turn up frequently (**below, right**), together with plastic bottles and other human refuse. At times the water lies hidden beneath soapy foam and oily liquids shining in all colors.

Although the voyage often seems like a vacation time for all hands, I confide to the log, "Our lack of progress is not comforting. We are really very low in the water."

Ra runs west

JUNE BEGINS with heavy trade winds, whitecapped waves, and a fine sailing speed—60 to 70 nautical miles a day. We have learned to live with *Ra*'s strange movements. We roll (**right**), but not as much as one would expect on a vessel without a keel. Water pours into our hull, but drains out of the flexible bundles again like a waterfall. Here on the windward side, a curtain draped about the wickerwork cabin shields us against waves; sacks of dried bread hang above.

At this moment *Ra II* is as solid as ever: the hull bundles, water-swollen and tightened, are far stronger than when dry ashore. And our twin steering oars—one to starboard and one to port—give us good service, though with our lack of experience we often lose control of the vessel.

We face a new problem. The long central depression between the main bundles has become an inboard lake, because the swollen reeds no longer let all the water flow through. This means we are carrying tons of sloshing sea water—useless extra weight.

But we have finally stopped sinking: the submerged reeds have absorbed as much water as they will take. I believe now that we would never have had a sinking problem if our Indian builders had used all the 12 tons of papyrus I had brought from Lake

Tana, at the head of the Blue Nile. But, anxious to return home, they bound together only two-thirds of the reeds. Thus the hull tended to sink under the disproportionate weight of superstructure, cargo, and men.

On a morning watch I write, "It's beautiful to see the sun rise exactly behind *Ra II*, the lofty tail standing out as a dancing pole in the glitter of our wake." And at night I observe, "The sail stands as a shade of the past against the starry sky, while the moon plays in dark wave valleys and crests, like fire on old pewter."

It is unforgettable.

Illustrations by Odd Nerdrum © W.B.

Disaster: a steering oar breaks

IT HAPPENS during my watch. A superwave comes from behind, lifting us up, up, up. As the hissing giant passes under us, *Ra II* tilts nose down and tail up, surfing into a deep trough. Just as we tip over the breaking crest, I hear timber crack violently. Turning, I see the blade of one of the two steering oars hanging loose in its ropes. Our port oar shaft, a log the size of a telephone pole, has broken like a toothpick!

Ra II turns sideways, helpless before the furious ocean. The sail beats like gunfire against the mast, and green water bursts over us. Rough and discouraging hours follow, for we are unable to keep our stern to the seas. All but swamped, our topsides soaked, we start to sink again! What to do?

First, to keep the mainsail out of the waves, we twist the yard fore and aft and reef the sail.

Our second job—and the most critical—is to improvise a new steering oar. From a cardboard carton I make a 1/100th scale model of the broken pieces. Turning them around, I discover that if we use the longest shaft section and attach it to the upper end of the undamaged blade, it will just reach the floor of the bridge.

Immediately I cut new holes for lashing the shaft to the blade. With Madani's help, I chisel it flat for attachment (**left**).

"We fought against time," I record in the log. "All of us extremely tired, often working in water that broke to our necks. Finally everything was ready for inserting the new short oar, heavy as iron. Waited for medium-size waves, then rushed the log astern, up on end, tip of large blade into water with loops ready to tighten around its neck. One-two-three, and there it was. . . ."

Since we can no longer reach the tiller on this stunted oar, the helmsman hereafter must turn it one way with a long bamboo rod and the other way with a rope tied to his foot, at the same time steering the unbroken starboard oar with his right hand.

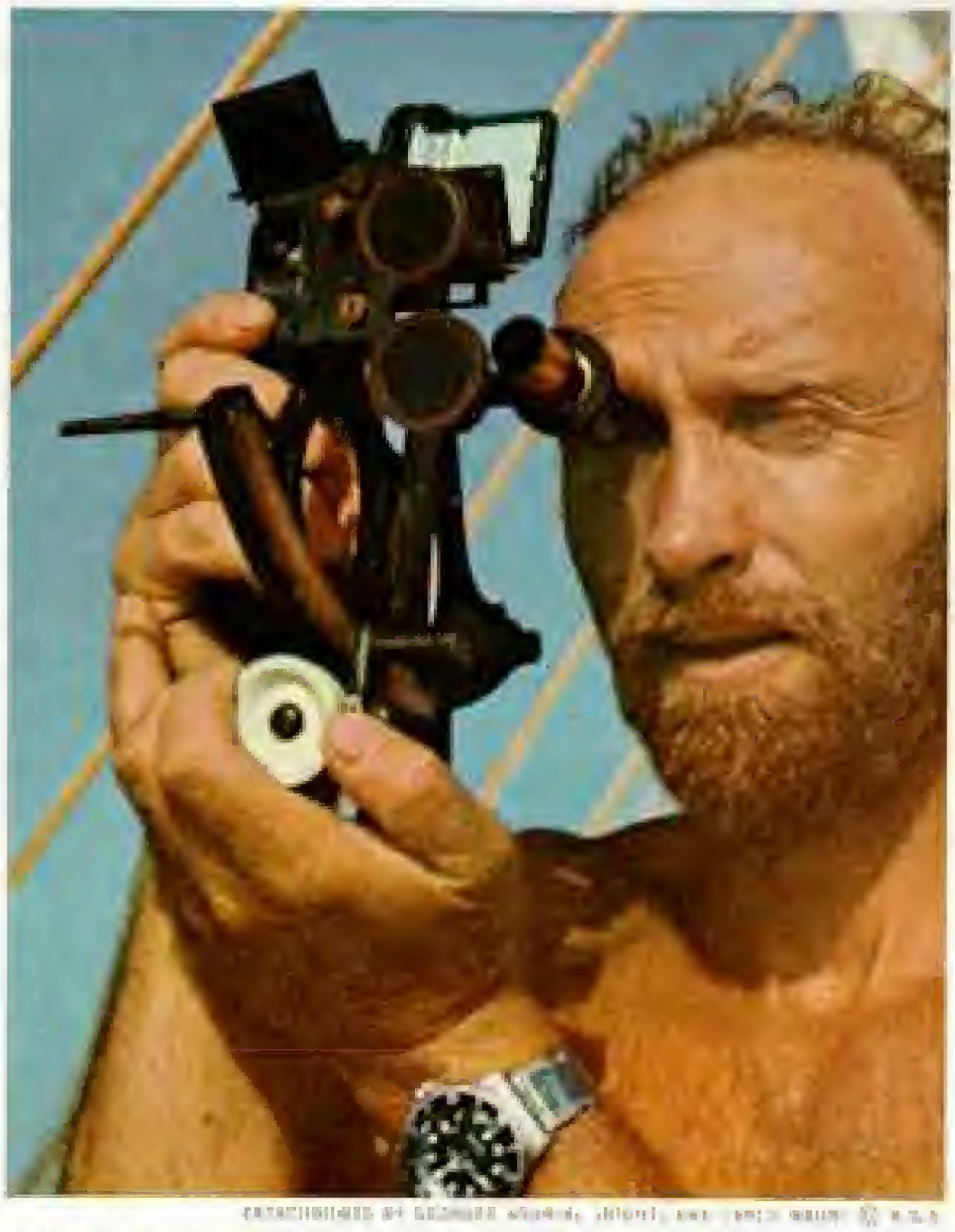
The wave that broke the port oar has also jammed the starboard one. Swept by waves (**opposite**), Kei hacks a larger opening in the wooden fork holding it.

After two wild days out of control, we finally resume sailing, and I sleep as if dead.

Off with a bit of bow

AFTER THE STEERING OAR BREAKS, navigator Norman (**below**) prepares to calculate *Ra II*'s position with his sextant. His report, that we are little more than halfway across the Atlantic, drives home the gravity of our situation. We are partially disabled and dangerously low, because so much water poured over us and drenched the upper hull while we were out of control.

With steering now immensely more difficult, we decide to rake the mast forward and set the sail ahead of the bow, so that the vessel will almost steer itself downwind. But to keep the



tall papyrus stem from tearing the sail, we have to cut off part of it.

Strange to be without a lofty bow slicing our view in half, but it is as if we have opened a window to look for the Americas ahead.

We also lop off the stern (**right**), using the papyrus to stuff our central depression, where water runs like a river. Here, with lifelines taut, Norman, left, and Carlo finish the cut.

"Duck moves to cabin roof with pigeon," I note. "It is too wet and dangerous below."

AT THE MERCY OF WIND AND WATER, *we sail on with the deck perilously close to water level. Our small triangular sail aids in steering, and the white topsail gives added speed. Seas continue to roar in upon us. The noise is terrific, like a landslide or a waterfall coming nearer and nearer. We are soaked above as well as below. But, unknown to us, we have sunk as far as we will go. Yet the sea washes over us so frequently that barnacles start to grow on the deck.*

Extraordinary tapestry has unconventional pitstop for Eritrean

Life aboard ship tests the mettle of men

WRITING IN THE LOG (**above**), I am happy to note, "I could not have had better companions. The multinational teamwork is perfect and a real comfort."

It is remarkable to learn that our small, short-lasting problems never come from racial, national, political, or religious differences, but solely from individual quirks, such as if one is making a mess where another wants order, or someone wants to rest while another feels he should finish an important job.

Man is man wherever you find him: I feel he cannot be divided or united according to height, color, or pencil lines on a map.

Here at the start of a new day (**above, left**) I brush my teeth in the ocean as the men gather for breakfast around our chicken-coop table.

Praying toward Mecca (**left**), Madani spreads his prayer rug on the cabintop. I give him the proper compass direction. Once, celebrating our progress, we broke out two bottles of champagne; we were glad to have a nondrinking Moslem as helmsman.

SIGNAL FLARES *brighten the dusk sky as crewmen search the horizon for* Calamar, *a United Nations fishery training ship. Contact was made a few hours later off Barbados. This day U Thant, Secretary-General of the U.N., radioed the expedition: "... you are helping to open a new era in harmonious relationship between people and nations. ..."*

EKTACHROME BY CARLO MAURI © N.G.S.

Rendezvous at sea

A GREAT MOMENT comes when we see *Calamar*, first vessel to meet us on the other side of the ocean (**right**). We dip our U.N. flags in salute to one another. The date: June 30.

Calamar's crewmen shout to us in many languages that we look like a fairy-tale ship or a gypsy boat with our burgundy, green, orange, and brown canvas rags tied on as wave-breakers above the reed bundles.

Going aboard *Calamar*, I deliver my pollution report and a suitcase full of film; returning to *Ra II*, I bring mail and a load of fresh fruit as a welcome gift from Barbados, now so near.

It is a happy moment for all. Even our ocean-going monkey, Safi, named after our port of departure, feels up to her favorite pastime—grooming Carlo's hair to show her affection (**above**).

Safi proved a worthy shipmate on both *Ra* voyages. On calm

days she delighted in swinging from a perch to grab for the waves. But she was most contented when, each night, she cuddled in my arms before going to sleep in her cage within the cabin.

Here with *Calamar* we think our trials are over. Yet one last agony lies ahead—four days of treacherous wind with rain, ending in a roaring storm.

July 6: Dense black clouds catching up with us, heavy rain, double rainbow in front.

July 7: Everything soaking wet, including our mattresses and sleeping bags. Restless sleep for all. Norman, in a nightmare and nude, rushes out of our cabin to shout that the sail is ripping to pieces. Yuri, in a dream, hits himself time after time. Carlo, also asleep, fights me for my blanket.

July 9: Truly terrible wind, full gale strength . . . an inferno. Sail flapping so wildly that not even the whole crew could hold its corners. This is the end of our sailing if we lose the mainsail.

I shout in half despair, "Norman, what can we do?" His answer cannot be heard in the chaos. Then I yell, "Sea anchor out!" It grabs and heads us into the waves. We secure the sail.

We are saved again.

Journey's end

BEFORE DAWN on the 57th day at sea I smell the perfume of green grass. Near noon we spot four airplanes and some 50 small boats, out from Bridgetown, Barbados, to welcome us (**below**).

We blow our horn and shout madly for joy. Norman salutes our escorts by dipping our United Nations flag. Georges lights a signal flare and poses like a liberty statue on top of the cabin roof. Carlo and Santiago wave from the mast. Kei and Yuri are everywhere with cameras. Madani is just one broad smile, struggling happily with the steering oars. I sit filled with gratitude.

From Bridgetown the ship was sent to Oslo, Norway, where a new hall is being built for her at the Kon-Tiki Museum.

Stepping ashore, we meet our families, the press, the Prime Minister of Barbados, and some 25,000 of his cheering countrymen.

The voyage has succeeded. But what has it proved?

First, we have demonstrated that a papyrus ship, properly built, can cross a major ocean.

Second, we have shown that a craft of such ancient design—coming from North Africa, a cradle of civilization—could have crossed the Atlantic with a crew

With sail down, we accept a tow into the harbor of Bridgetown. Standing on deck, we eight men from eight nations spontaneously begin to shake hands.

In port, intact and with honor (**right**), *Ra II* holds her shape as superbly as the day she was launched, still with all her papyrus and not even a broken rope.

to bring cultural influences to the aboriginal population of the Western Hemisphere.

Finally, we can attribute our success to cooperation among the men of many nations who undertook it, having learned that no space is too narrow, no stress too great, if men will only join hands for common survival. □


WESTERN NO 3

The Lower Keys, Florida's "Out Islands"

"ISOLATION," said affable Kermit Lewin when I asked what gave Key West its special flavor. "We were an island people before there was a railroad, much less an Overseas Highway, and we're islanders today.

"We tell a story here," he went on, "about the first man Key West ever elected to the state legislature. This was back before the turn of the century. Our man had to travel by sailing ship all the way to New York, then south again on a train to Jacksonville, and west from

there by horse and carriage to the state capital. It took him so long to get to Tallahassee they nicknamed him the Ambassador from Key West.

"Most Conchs," he concluded, "are still happy to stay right here and get along with one another."

Himself a Conch, whose grandparents brought from the Bahamas their traditional fondness for conch chowder and for fritters made from the meat of the big mollusks, Mr. Lewin was talking only about Key West. But his explanation

By JOHN SCOFIELD
ASSOCIATE EDITOR

Photographs by EMORY KRISTOF and BATES LITTLEHALES
NATIONAL GEOGRAPHIC PHOTOGRAPHERS

World's longest ocean-going highway stitches island to island as it sweeps down "sunshine alley"—the Florida Keys. Here the ribbon of concrete links Pacet (right), Missouri, Ohio, and Bahia Honda. Thirty miles farther on, beyond cloud-canopied Big Pine, lies Key West.

PHOTOGRAPHS (ABOVE) AND ROADSIGNS BY RALPH LITTLEPAGE © N.G.S.

Softly aglow in sea-washed sunlight, Christ of the Abyss stands 30 feet down in the Atlantic in John Pennekamp Coral Reef State Park. Visitors to the sanctuary don masks and fins or view the sea life through the glass bottoms of tour boats.

Still loaded after nearly 2½ centuries in the sea, X-ray of a pistol, encrusted with rust, reveals a lead ball lodged in its barrel. Pioneer wreck diver Art McKee displays both flintlock and photograph in his Museum of Sunken Treasure on Plantation Key. He found the weapon in the remains of a galleon that went to the bottom in a disastrous hurricane on July 15, 1733. The storm wrecked 17 ships of a Spanish fleet carrying an estimated $68,000,000 in gold and silver from Havana to the royal treasury in Madrid.

Spangle of islands linked as far as Key West by 42 bridges, the keys were first sighted in 1513 by Ponce de Leon, Florida's discoverer. Barely above the sea, the bits of limestone and coral create an arc some 200 miles long.

applies as readily to the friendly, individualistic residents of all the Florida Keys—those amazing limestone-and-coral steppingstones that march southwestward from mainland Florida, separating the Straits of Florida from Florida Bay and the Gulf of Mexico.

Not surprisingly, everything in this island chain centers about "The Highway." Driving the 90 miles between the easternmost end of Plantation Key—arbitrarily, I am going to call this the beginning of the Lower Keys—and Key West (map, above), the car-borne visitor comes upon one vista after another of incredible beauty. Palms rustle in the trade winds and man-o'-war birds soar effortlessly above seas blue beyond belief. But the Overseas Highway is also the southernmost leg of a busy interstate artery. Away from the spell of the water, it sometimes shows another face —a dolorous counterpoint of gas stations, hamburger stands, and motels that perpetuates the mood of Highway 1 almost anywhere else along its route from Maine to Florida.

I went to the keys first by automobile, but came back a few months later in *Sally*, my 30-foot sloop-rigged motor sailer. She can make her way through less than four feet of water —ideal for negotiating shallow bayside passages—and is roomy enough for comfortable dockside living. In nearly two months of exploring the "little South Seas" that lies at Miami's doorstep, I spent not a night ashore.

A boat offers the perfect approach to this watery world, whose ways have always been set by the sea. The first residents were tiny marine organisms that laid down their skeletons in untold numbers atop a submerged plateau. Changing sea levels and reef-building corals raised the chain above the waves. The coral polyps are still at work; you can see their fanciful creations through the glass bottoms of boats that cruise the John Pennekamp Coral Reef State Park. Wisely protected by the State of Florida, its spectacular underwater wonderland lies off Key Largo—too close to the mainland to fit my definition of

"Wait till I tell the guys back home!" This freckled visitor will long savor the memory of a tow behind Flipper, the film star, at Santini's Porpoise Training School. "Flipper is really Mitzi, and he's a she," explains Milton Santini, who, with his wife Virginia.

the Lower Keys, but no visitor should miss it (pages 74 and 82-3).*

Even after the keys had taken their present form, the slow march of nature continued. Distinctive creatures—boldly striped tree snails,† pale raccoons, and miniature white-tailed deer—found havens here.

Indians spread from the mainland. Then came Spaniards, looting the New World Columbus had given them. The Florida Keys became a nightmare alley—a storm-wracked gantlet between the riches of Mexico and Peru and the king's coffers in Madrid.

Unlike the vanished Indians, who even to modern archeologists are little more than ghostly shades, the Spaniards live on, inflaming men's minds with dreams of sudden wealth. Talk to a diver anywhere in the keys and the conversation will turn, sooner or later, to a chain of events set in motion on a Friday the thirteenth in 1733.

*Penrockamp's parade of sea life was pictured in the January 1962 GEOGRAPHIC: "Florida's Coral City Beneath the Sea," by Jerry Greenberg, and "America's First Undersea Park," by Charles M. Brookfield.

†See "Tree Snails, Gems of the Everglades," by Treat Davidson, NATIONAL GEOGRAPHIC, March 1963.

owns the school on Grassy Key. In addition to Mitzi, one of several animals that have starred as Flipper in films and on television, the Santinis have trained nearly 300 of the mammals for marine shows throughout the United States and in many foreign lands.

On that long-ago July day, a fleet of Spanish merchant ships set out from Cuba, bound for Europe. Aboard was a staggering accumulation of treasure—among it kegs and chests of gold and silver coins, including a large portion of the output of Mexico City's mint for the two preceding years. The fleet had hardly cleared Havana Harbor when a gale struck. By Sunday the ships were off Plantation Key, struggling for their lives against the full force of a southeasterly hurricane.

News traveled slowly in those days. Nearly three months had passed before the *Boston Weekly News-Letter* could tell its readers the outcome: "... lately the Spanish Flota consisting of 21 Sail of Ships, 14 whereof were Men of War) were all cast on shoar upon the Coast of Florida ... the Spaniards have saved 12 Million pieces of Eight, and carried the same to the Havanna with other Merchandizes, Rigging, &c ..."

Happily for those who live on hope, Spain's crude salvage methods perhaps missed as much of the treasure as they raised. "We know of eleven more 1733 ships we can work after this one's finished," bearded Capt. Tom

Salt-water jockeys ride bucking runabouts called Seadoos on the Gulf of Mexico. Marinas in the keys bristle with sailing masts and the flying bridges of powerboats.

Smog-free skies arch above campers on Bahia Honda, whose name means "deep bay." The Overseas Highway, southernmost section of U. S. 1, lies atop the roadbed of the Florida East Coast Railway, first land link between the keys. Built in the early 1900's at a cost of 27 million dollars, it was abandoned in 1935 when a hurricane washed out sections of roadbed and ripped apart miles of track.

After a rousing fight, veteran fishing guide Cal Cochran gaffs a 40-pound tarpon. He quickly released his catch, as he urges all anglers to do unless they plan to have their prizes mounted.

The keys teem with hundreds of species of fishes. "If you can't catch them here," advises Mr. Cochran, "then you'd better forget about fishing."

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Gurr told me aboard the little salvage vessel *Revinooer* as we bobbed in a wind-driven chop a few miles off Plantation Key. "This one" was the 190-foot Spanish merchantman *San Joseph y las Animas*, which grounded and broke up on that fateful Sunday of 1733.*

Clusters of bubbles marked the positions of three scuba divers working on the bottom, 30 feet below *Revinooer*. A head broke the surface, and a hand held out a strangely shaped bit of metal.

"Here's the other end of that spoon handle we brought up yesterday," Thomas Gore said, "only it's a fork."

Late in the afternoon, diver Al Green popped to the surface. He wore as wide a smile as I've ever seen, and something yellow and bright glinted in his fingers.

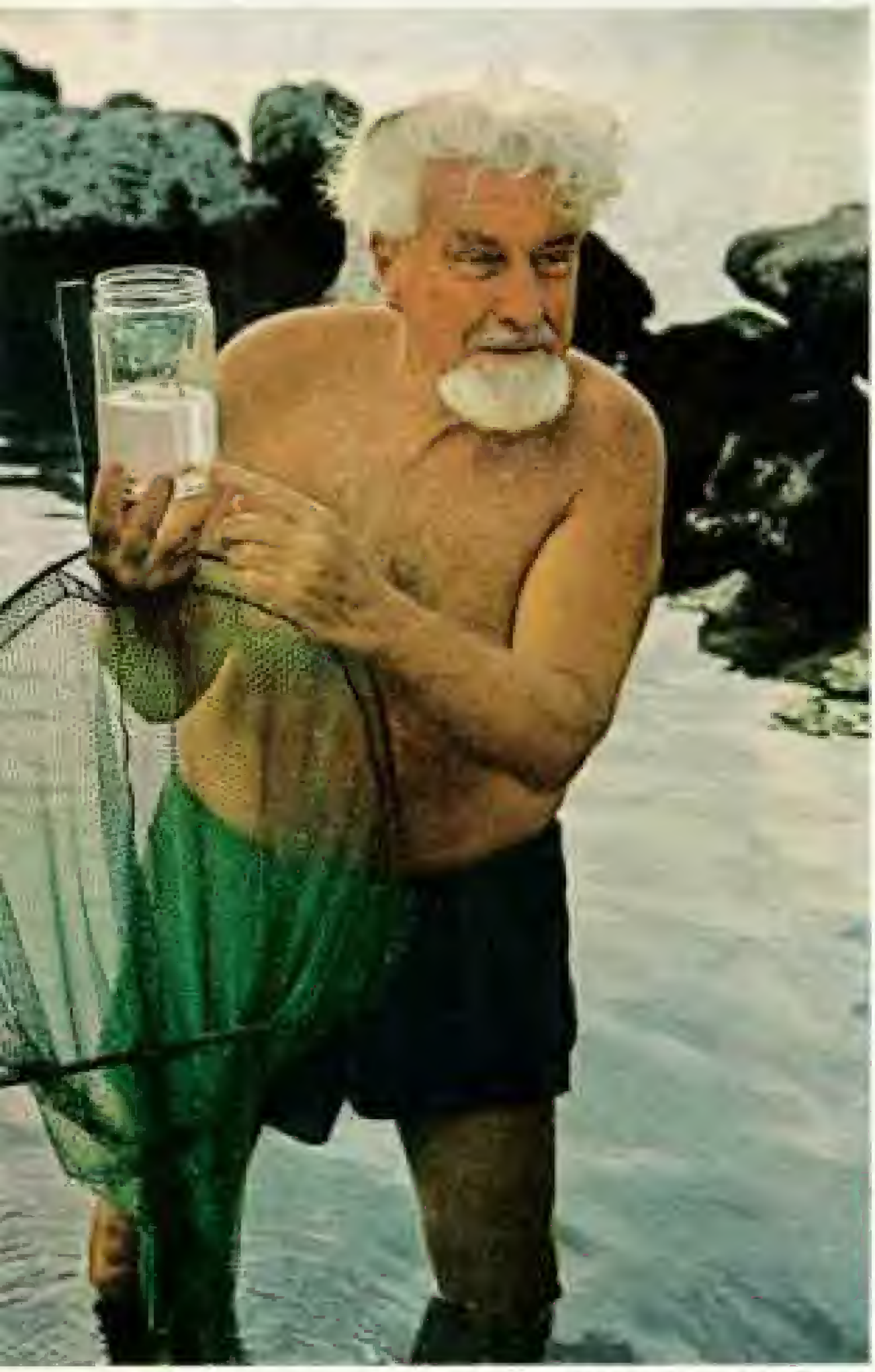
He handed it to Tom Gurr, and Tom passed it to me—a two-escudo piece about the size of my thumbnail, fresh and clean looking after 237 years in the sea.

"That's the second gold coin we've brought up in two years," said Tom. "In this business you have to have faith."

I left Tom and his divers (I hope by now they've struck it rich) and headed westward along the "Purple Isles"—Plantation Key, Windley Key, and Upper and Lower Matecumbe—to keep a date with a movie star. Milton Santini, a large, gentle man with a fisherman's seamed and weathered face, introduced us in an enclosure on the north shore of Grassy Key. I could see only a dark, swiftly moving shape deep in the water.

"That he?" I asked.

"He's a she," said Mr. Santini, and I learned that the star of the movie *Flipper* was in fact a lady porpoise named Mitzi.



MOSAICHROME BY BATES LITTLEHALES © N.G.S.

Strange Pay-off for a Broken Back

"When fishing was bad, back in '45," he told me, "I started catching porpoises just to sell them. When I got Mitzi, though, I knew right away there was something different about her, so I kept her as a pet.†

"Even then, there might not have been any Flipper shows if I hadn't broken my back delivering some porpoises in Seattle. While I was recovering, I'd lie beside the pool and play with Mitzi, talk to her and stroke her. Then my wife began getting in the water with her, even riding her. Before long Mitzi had learned so many tricks it would take her four or five hours to go through them."

Mitzi no longer pursues a film career, but she is still a big attraction at the Santinis' pools, where she entertains visitors with three half-hour shows a day (pages 76-7).

"Keeps her from getting bored," Mr. Santini

*Kip Wagner described the recovery of treasure from a similar fleet in "Drowned Galleons Yield Spanish Gold," GEOGRAPHIC, January 1965.

†See "Porpoises: Our Friends in the Sea," by Robert L. Conly, NATIONAL GEOGRAPHIC, September 1966.

Marine life lures scientists the world over to the keys. Renowned biologist Konrad Lorenz nets small specimens at Pigeon Key. Director of the Max Planck Institute for Behavioral Physiology near Munich, Germany, Dr. Lorenz is a founding father of ethology, the study of animal behavior in relation to natural habitat. He concludes that behavioral patterns are as important as anatomical structure in classifying species.

said. "That's Mitzi's problem, not overwork. And she lets me know about it. She'll cuss me out if I don't pay attention to her.

"I don't understand the words," he concluded, "but I know one thing. They aren't nice words for a lady to be using."

From Grassy Key the Overseas Highway leapfrogs across Crawl and Fat Deer to long, narrow Vaca Key, where commerce clusters in busy Marathon—a town, one resident told me wryly, "half a block wide and about five miles long. Nobody here goes shopping on foot, I can tell you that!" Then the highway makes its most dramatic leap, where the Seven Mile Bridge vaults blue Moser Channel.

About a quarter of the way across, as you head west toward Big Pine, sits the island I consider the prettiest of them all, the little key whose picture is mailed home from Florida on thousands of postcards a year. Today, 5½-acre Pigeon Key is leased to the University of Miami. College students from all over the country converge here for summer courses in the biology of the reef that lies at the key's emerald doorstep.

Islet Preserves Early Railroad History

Many students, I suspect, wind up back in Minnesota or Nevada still unaware of the history of the cheerful white-frame houses that sit under Pigeon Key's feathery coconut palms. They were put up more than half a century ago to house the men who built the "railroad that went to sea," the keys' first land link with the rest of the United States.

The dream of a railroad between Key West and mainland Florida was a long time coming true. The first surveys were made just after the Civil War. When it did come true, it was the work of public-spirited Henry M. Flagler, who had already developed much of Florida's east coast. In 1904 the financier, then an old man, decided to extend his Florida East Coast Railway to Key West. But it was not until 1912—four hurricanes, 27 million dollars, and many human lives later—that Flagler's luxuriously appointed private car, *Rambler*, carried him all the way by rail—across 29 islands connected by bridges and causeways—to Key West.

In the city itself, ten thousand people—many of whom had never before seen a train—crowded round to welcome Flagler, while school children scattered roses before him and sang. In this moment of triumph, tears welled from the old man's eyes. "I can hear the children," he said sadly, "but I cannot see them." He was nearly blind.

Flagler's railroad died in one terror-filled night in 1935. On September 2, Labor Day, while people watched with sickening apprehension, winds rose and barometers plunged to 26.35 inches—the lowest sea-level reading ever recorded in the Western Hemisphere.

Almost extinct 20 years ago, Florida's Key deer have increased from fewer than 50 to more than 500. They stand only about 30 inches at the shoulder and weigh less than 100 pounds. Here at the refuge on Big Pine Key, a ranger tags a deer and equips it with a radio transmitter. The project, to learn more about the animals' habits by tracking their movements, receives support from the National Geographic Society.

At 8:20 that evening a rescue train—11 cars hastily sent from Miami and already loaded with refugees—reached Islamorada, on Upper Matecumbe. Winds by then screamed at nearly 200 miles an hour. The engineer, backing up to avoid a time-consuming turnaround, was blinded by waves surging across the track. At first he missed the little station where hundreds more waited.

He pulled forward and people struggled toward the cars. Then a monstrous wave—survivors estimated it at 20 feet—smashed in from the sea, engulfing the fleeing islanders and sweeping the cars from the track.

Next morning the keys began counting their dead. Roughly half the bodies found were those of construction workers, victims of the Great Depression who were helping to build a highway that was to parallel the railway. And some 40 miles of the railroad had been reduced to a jumble of twisted rails and washed-out roadbed. Henry Flagler's dream had died, too.

And yet, in a sense, the railroad lives on. Its viaducts and bridges carry today's highway, and many miles of original track have been re-used as posts and guardrails.

Big Pine Harbors Tiny Deer

I had brought *Sally* as far as Marathon by way of shallow Florida Bay, where often only inches of water lay between her keel and the bottom (map, pages 74-5). Now the "inside passage"—the Intracoastal Waterway—went outside. Photographer Emory Kristof and I steered the little sloop through the swing span of the Seven Mile Bridge. Our way now would be through wide Hawk Channel, separated from the open sea only by the coral fangs that had claimed so many of Spain's treasure ships.

Big Pine Key, looming ahead, has its own memories of "Flagler's Folly." The railroad's builders were often harried by forest fires accidentally set amid the pines and buttonwoods by hunters and charcoal burners. Trees still cloak much of the island, sheltering its most famous four-legged residents.

One dark night on Big Pine I climbed into the front seat of an automobile beside Jack Watson, a refuge manager for the U. S. Bureau of Sport Fisheries and Wildlife. He plugged a powerful spotlight into a socket on the dashboard and tested it on the foliage outside. In the back seat a Southern Illinois University graduate student, Nova Silvy, checked out a second battery-powered light.

"O.K.," said Mr. Watson. "Let's go jacklight some deer." He swung the car down a

Slayers of ships, saw-toothed reefs paralleling the keys have claimed thousands of victims. But this vessel, lying at a depth of 50 feet in Pennekamp Park, met death as the result of a collision. Scuba divers glide past the hulk of the Norwegian freighter *Benwood*, which went to the bottom, carrying a cargo of phosphate rock, on April 9, 1942.

gravelly road past a sign that told us we were in the National Key Deer Refuge.

Nearly every night the two men cruise the refuge's narrow roads to record the movements and feeding and breeding habits of the nation's only herd of Key deer *(Odocoileus virginianus clavium)*. In a study directed by Dr. W. D. Klimstra of Southern Illinois University and supported in part by a grant from the National Geographic Society, they hope to learn enough so that the future of these tiny animals—a mature buck may weigh only 60 pounds—can be assured (page 81).

We turned onto a pine-bordered lane. Suddenly both spotlights converged on a graceful little animal no larger than a middle-size collie. Around her neck a black plastic collar bore a large white numeral.

"That's No. 2 Black," said Jack. "Probably doesn't weigh more than thirty pounds."

"She's the one that kicked me in the nose when we tagged her," Nova commented, as he

noted the time and location on his tally sheet.

In three hours Jack and Nova showed me 14 Key deer—seven of which wore identifying numbers. Nearly a third of the refuge's 71 marked animals also carry miniaturized radio transmitters that allow them to be tracked on the darkest of nights.

"Not a bad evening's work," Jack remarked. "I can remember when you could go out like this and not see a deer." From a low of only a few dozen animals two decades ago, the herd has been brought back up to about five hundred, and ranges now over 18 keys.

From Big Pine westward the bridges become shorter as the Overseas Highway threads low-lying Little Torch, Middle Torch, Ramrod, Summerland, and Cudjoe (named, say the Conchs, for someone's Cousin Joe). From the water they appear only as dark lines of mangrove linked by the white fretwork of the causeways. On Sugarloaf, though, I could see the top of a strange tower thrusting above the scrub. I succumbed to curiosity and went to see it by car.

With the pride befitting a former Commander in Chief, Harry S Truman inspects a Marine platoon at Key West during a 1969 vacation. As President, he often stayed in a rambling wooden house on the grounds of the U. S. Naval Base.

Moated by the sea, Key West has a thoroughly nautical flavor. Personnel of the busy naval base (foreground) and their dependents make up half of the 27,500 population and pump $56,000,000 annually into the city's economy.

Viewed close up, the tower became, in Alice's words, "curiouser and curiouser"—a weird Wonderland structure of weathered shingles, taller than a three-story house.

"For bats," explained an attendant at a nearby gas station. "Built about forty years ago by a man named Perky. He figured on luring a lot of bats into living there so they'd eat the mosquitoes.

"Matter of fact," he added, "folks here say it was the mosquitoes that ate the bats."

From Sugarloaf, where a building boom is in full swing and sprays now control the insects, we sailed past the Saddlebunch Keys and Big Coppitt to Boca Chica, "little mouth" in Spanish. Above Boca Chica the sky was noisy with jet fighters as trainees practiced flattop landings on a carrier deck painted on one of the Naval Air Station's runways. And then, dead ahead, lay the "big town."

Key West is a hard-working city, a place of more than 27,000 people these days, where several hundred shrimp trawlers headquarter during the fishing season. Tourists flock in by

the thousands, and year round the town plays host to other thousands of servicemen, most of them from the big Key West Naval Base. When you think about the size of the island—only a mile or so across, and built up right to the water's edge (preceding pages)—it isn't surprising that things sometimes become crowded and a bit hectic.

You have to let Key West sort of sneak up on you—and, chances are, it will. You'll discover quiet little areas of wooden Bahamian-style houses, for instance, with distinctive verandas built by ship's carpenters (page 89). Cuban restaurants and the sound of Spanish on the streets will remind you of the fact that, before the railroad came, there was more trade with Havana than with Miami.

Bankruptcy Gives Way to Radiant Health

You'll step into the peace and beauty of the Audubon House, where the artist lived while he did some of the paintings that later appeared in his magnificent *Birds of America*. And if you revere Ernest Hemingway, as I do, for what he taught writers about their craft, you will go often to the veranda-ringed house on Whitehead Street where he lived for eight years with his second wife, Pauline, and their two sons.

Since 1931, when Hemingway bought the big house on Whitehead Street, Key West has swung from one end of the economic scale to the other. "We've had our ups and downs," agreed my friend Kermit Lewin. "By the mid-thirties things looked hopeless. The depression struck. The cigar makers moved to Tampa for better wages. Blight wiped out our sponge fishery. And then we lost our railroad. Key West was bankrupt."

Two men get chief credit for Key West's return to radiant health; a Midwesterner who cared little for the sea and a man of the sea who solved one of its nagging mysteries.

The Midwesterner was Missourian Harry S Truman. A trip to Key West aboard the Presidential yacht *Williamsburg* convinced him there was little joy in the sailor's life. But Key West itself was something else.

"It was a real love affair," one old-timer said. "The President took to Key West right away—he put us on the map again by coming back 10 times, you know—and Mr. Truman's forthright ways went over big with the Conchs" (page 84).

The man of the sea was a shrimp-boat owner from St. Augustine named John Salvador. "He came into the story late in 1949," Maitland Adams told me. "I was manager of Thompson Enterprises then—we were dealers in fish and turtles, among other things. But not shrimp. Our men couldn't locate shrimp. Yet we knew they were in Key West waters, we'd find them in the entrails of fish when we'd clean them.

"Well, John Salvador and his brother and a couple of friends brought their nets and their know-how down to Key West. They tried every trick they knew, but always by daylight. Then, late one afternoon, Salvador made one last pass and caught a few shrimp. On a hunch, he made another pass after dark and brought up the first real haul of Key West pink shrimp. That one night's work changed the whole future of this town."

Today, at the height of the season, hundreds of tons of "pink gold" flow each month from the key's packing houses (page 91), while above the shallow waters west of the city, the black iron booms of as many as five hundred shrimp boats spike the sky.* In the anchored trawlers the fishermen sleep, waiting for darkness before they lower their nets.

Battered Craft Bear Spanish Names

Oddly, shrimping still is not Key West's major maritime activity. Submarines line the docks at the sprawling U. S. Naval Base, and a gleaming sub tender towers beside them. SPAR—an unusual 354-foot vessel that can tip itself straight up and down in the water, bow to the sky, lies at a nearby dock. Its instruments, located as much as 300 feet below the surface when the ship tips up, help scientists carry out acoustic research. In all, 30 separate commands and 8,000 men make the Navy Key West's biggest, busiest, and most complex organization.

My most vivid memory of the base is of something quite different: a jumbled pile of twenty or thirty small and almost totally worthless boats—wave-battered craft with names like *Santa Maria* and *Isabelita, Juanita* and *Elena* (opposite). They are graphic reminders of the fact that Key West lies only 95 miles north of Fidel Castro's Cuba.

Atop the pile the day I was there perched a fantastic little raft made of bits of pipe and

*Clarence P. Idyll wrote "Shrimp Nursery" in the NATIONAL GEOGRAPHIC for May 1965, and "Shrimpers Strike Gold in the Gulf," May 1953.

Fragile monuments to freedom: Across 95 miles of shark-infested seas, these battered boats brought refugees from Castro's Cuba. Many Cubans have been given permission to leave by air, but the boats, ranging from expensive cruisers to rafts of interlaced inner tubes, still come. Some, like *Juanita* (left), make it safely. Others do not; Coast Guardsmen find vessels drifting aimlessly, empty but for shoes and charts. At the U. S. Coast Guard Base in Key West, a permanent memorial may rise to honor both the lucky and the lost.

canvas supported on four inner tubes. A rudder had been fashioned from a board wedged into an old bicycle fork. Aboard was only a water can and a tire pump.

"Night before last, in the Gulf Stream, we picked up two refugees on that," said Coast Guardsman Robert Moore. "But they'd had a luxury cruise compared to the way some of them make it. We find them out there on nothing but bare inner tubes."

He pointed to a little green 14-foot-long rowboat. "Whole families come over on craft little larger than that—including pregnant women and mothers with two- and three-week-old babies at their breasts.

"You have to admire the guts of people who want freedom that badly."

Highway Ends, but Not the Keys

The Overseas Highway ends just outside the Key West Naval Base, but the keys go on. Another dozen or two islets—depending on how small a speck of coral sand and red mangrove you want to consider a key—stretch 70 miles westward.

My teen-age son Kendrick had joined me in Key West for his Easter vacation. Now photographer Emory Kristof, Ken, and I looked at the charts and made a hard decision: *Sally* wouldn't do for this part of the expedition. Emory and Ken wanted to dive, and we all wanted to try the Dry Tortugas' famed fishing grounds—projects that would be all but impossible from my high-sided little motor sailer. So we changed to the 41-foot *Lookout*. She had low sides and a roomy cockpit with fishing chairs and enough space for air tanks and diving gear. In her cabin hung an awesome array of rods, reels, and lures.

Lookout belongs to veteran Key West fishing captain Gainey Maxwell. A cherubic face and a tangle of damp curls under an old fishing cap belie a long Navy background and a speaking acquaintance with what seemed to be every fishing spot, shrimp-boat skipper, and sunken ship in the western keys.

We knifed past the uninhabited, mangrove-mantled Marquesas, 20 miles out of Key West. Then, beyond the low ring of islets, loomed an incredible sight: a great ship, rusted and shattered, but looking as if she were still afloat.

"The Navy ran her up on a sand bar so they could use her as a bombing target," Gainey explained. Cormorants stood at attention on the gunwales of the battered 500-foot-long hulk that had once been a proud destroyer

Key West: the old bones

SPANISH EXPLORERS roaming the site of Key West saw sun-bleached Indian skulls littering the ground. They named it Cayo Hueso—Bone Island—which settlers later corrupted to Key West.

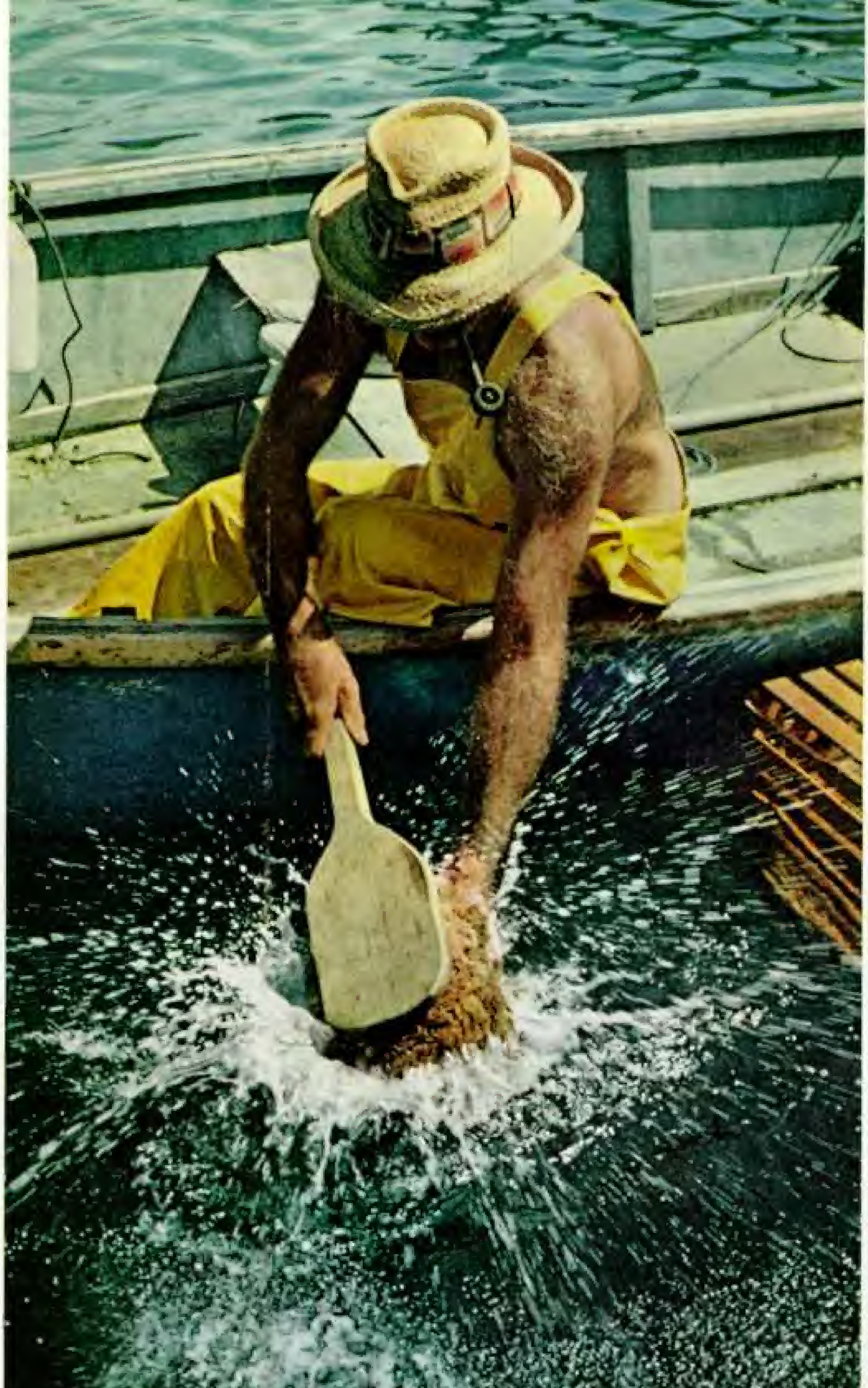
In recent decades the charm of the city has attracted a legion of writers and artists. Playwright Tennessee Williams (below) came in 1952 and still maintains a home here. Novelist Ernest Hemingway's house is now

a museum. Many other venerable homes have been restored, though not all boast a shiny Model A at the door.

As its dwellings reflect a Bahamian style, so does the city's music. When pianist William Butler and the Junkanoos entertain at Capt. Tony's Saloon, customers tap their feet to a Bahamian beat.

In Pirate's Alley, 77-year-old George Culmer rolls panatelas. In the 1880's Key West produced 100 million cigars a year, mostly from Cuban tobacco.

find new life



Tasty treasure from the sea rides a conveyor belt from ship to shore at the Thompson & O'Neal Shrimp Co. in Key West. As many as 300 boats, fishing the keys' rich beds only at night, annually harvest 11⅞ million pounds of the succulent crescents.

Cleaning his catch in Key West Harbor, C. B. McHugh swacks a sponge with a paddle. Sailing alone, he has grappled as many as 2,000 from the bottom in a week. He lets them dry before rinsing them in sea water and then pounding to remove the decayed animal matter. Key West was Florida's sponge center until a blight hit the area. Today sponges are plentiful again and the fishery slowly revives.

escort. Barracuda and sleek amberjack ("Forty pounds easy," Gainey estimated) patrolled the 10-foot shoal on which the old ship lay.

Four hours and 40 miles farther west, another astonishing sight rose from the sea: the brooding mass of old Fort Jefferson, whose massive brick battlements encircle nearly the whole of Garden Key, in the Dry Tortugas (following pages).

During the Civil War, this "Gibraltar of America" did duty as a Union prison. "Wether allkillen warm," noted Sgt. Harrison Herrick of the 110th New York Volunteers, who arrived in March of 1864 in charge of 68 prisoners. Herrick's diary, in its matter-of-fact way, preserves a vivid record of the tedium—and the occasional humor—of life on this desolate outpost.

"Sunday, March 19, 1865. After retreat, Doctor Holder & old Frost had a cat thron in the Break Water for the Shark, but he did-not seam to like cat meat . . . & som of the prisners haled her up on an old shirt that they had fast to aline. Mrs. Devendorf [one of the officers' wives] was mighty mad about it."

Life Sentence Shortened by a Selfless Act

The Civil War ended at Appomattox on April 9, 1865. The tidings took nearly two weeks to reach the isolated garrison.

But Fort Jefferson's most memorable chapter still lay ahead. On April 15, 1865, Abraham Lincoln lay dead, shot by actor John Wilkes Booth while attending Ford's Theatre. Unaware of his patient's identity, Dr. Samuel A. Mudd, a country doctor in southern Maryland, briefly sheltered the assassin while setting his broken leg.

In the ensuing trial, indignation overrode justice. Dr. Mudd was sentenced to life imprisonment for aiding Booth. Shipped off to Fort Jefferson, he was cast into one of its gloomy cells on July 24, 1865.

Two years ticked slowly by. Then, in August 1867, disaster struck. Of Fort Jefferson's 300 people, 270 came down with yellow fever. On September 8 the post surgeon breathed his last. The next day Dr. Mudd was released from his cell.

The prisoner and two doctors who had rushed from Key West fought the outbreak as best they could. "I could do more," said Dr. Mudd, "by a few consoling words than with all the medicine known to me." Only 38 people died.

Garden Key's survivors signed a petition asking President Andrew Johnson to pardon

the heroic Dr. Mudd. The document never reached Washington. But other sympathizers were more successful, and the President ordered that Mudd be released. On March 11, 1869, the 35-year-old doctor left Garden Key.

Now under the care of the National Park Service, haunted Fort Jefferson boasts a year-round population of only five. But yachts and fishing boats bring a steady trickle of visitors—8,500 of them came last year—to look from the slit windows of Dr. Mudd's drafty cell for the sharks that still cruise the moat below.

Now Capt. Gainey moved *Lookout* to neighboring Loggerhead Key. Here in 1926 the Carnegie Institution's Dr. W. H. Longley and National Geographic's Charles Martin pooled their talents to make the first successful published underwater color photographs of fish in their natural habitat (January 1927). Today five Coast Guardsmen manning the key's 157-foot light make up the total population of this westernmost bit of the Florida Keys.

"There she is," said Gainey, as he anchored only a few yards from the rusted midsection of an iron ship that, after more than half a century, still sticks a foot or two above the surface. Emory and Ken donned Aqua-Lungs and dropped into the clear water off *Lookout*'s stern. It was Ken's first real dive, and he popped back to the surface almost instantly.

"There's a barracuda down there!"

"He looks vicious," Gainey reassured him, "but he won't bother you." Ken gamely went down again.

"There were thousands of fish," Ken reported after he and Emory had sucked the last breaths from the two tanks each had brought—a total of nearly two hours underwater. He rubbed the welts left by a brush with fire coral and told me about the wreck.

"She's lying on her side," he said. "I could see the stumps of the masts, and something that looked like a big pressure tank."

"That was her boiler," Gainey explained. "She was one of those old steam-and-sail vessels; she grounded on the reef about 1913."

That afternoon and next morning we sampled what may easily qualify as the finest fishing ground in the United States. We released most of our catch unharmed, to be hooked another day. They included a 50-pound jewfish, a 100-pound jewfish, a 42-pound amberjack, and half a dozen permit, much-sought-after game fish that look like giant pompano. The biggest weighed in at 30½ pounds.

Gainey shook his head. "Permit are supposed to be among the wariest, hardest-to-catch fish," he said. "You'd never know it the way we've been pulling them in."

Garrison of ghosts: Begun in 1847 and completed in 1875 at a cost of $3,500,000, lonely Fort Jefferson never fired one of its 140 guns in battle. During the Civil War it became a federal prison and later housed Dr. Samuel Mudd, who treated Lincoln's assassin, John Wilkes Booth. Mudd won pardon for his role in fighting a yellow fever epidemic that swept the island. The light atop the southeast wall (left) once guided ships to the stronghold, today a national monument.

Back at the Fort Jefferson dock that night, Gainey filleted a permit and a 16½-pound mutton snapper while the sun went down and Ken, Emory, and I relaxed on *Lookout*'s afterdeck. When the skipper sounded dinner call, *Lookout*'s little dinette table had disappeared under an array of dishes: fresh broiled snapper with lemon butter, fried snapper, snapper with tomatoes and rice, snapper hash, fried permit, and permit in barbecue sauce.

Ken was overcome. He helped himself to a third portion of fried snapper and sighed. "For a fisherman, the Tortugas must be the greatest place in the world."

I had to agree. After nearly twenty years of poking about in some of the world's strangest corners, I had found one of the most memorable here in the Florida Keys—right in my own backyard. □

On the Track of the West's Wild Horses

By HOPE RYDEN

Photographs by the author and DICK DURRANCE II

NATIONAL GEOGRAPHIC PHOTOGRAPHER

THE SKY WAS STILL POPPING WITH STARS as I curled up by a clump of sage on an Air Force reservation in southern Nevada. A tiny spring, rimmed with hoofprints, trickled past my hiding place. No other sound marred the desert night, and the quiet sang in my ears. I settled down to wait for dawn—and wild horses.

Suddenly there was a stirring in the brush not 15 feet from where I lay. Twigs snapped, hoofbeats sounded on soft earth. Bulky undefined shapes loomed almost within touching distance.

I tried to quiet my breathing. If the horses didn't hear me, they wouldn't detect my presence; they had approached from upwind and would not pick up my scent.

A few seconds passed, and I heard a horse blow and then begin to drink. I lay absolutely still, listening. A long pause followed each slurping sound. The spring was shallow, and after drinking for a moment, the horse had to wait for it to fill again. I relaxed. The band would be at the water hole until the sun came up. Perhaps I would get pictures.

Since the 16th century, descendants of domestic horses that had become feral, or wild, have ranged throughout the West. As late as 1925, the number was perhaps no less than a million, although an accurate census then, as now, would have been impossible. In recent decades, uncounted numbers have been put under saddles, shot because they competed with livestock, or trapped and sold for pet food.

The Bureau of Land Management believes that on public

"**The most beautiful,** the most spirited and the most inspiring creature ever to print foot on the grasses of America," wrote Texas folklorist J. Frank Dobie of the wild horse. Perhaps a million roamed the West in freedom half a century ago; today an estimated 17,000 fight for survival on harsh and inhospitable public lands. This alert mare peers from a piñon forest in southern Nevada's Kawich Range.

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lands on which wild horses live—a total area larger than France, scattered over nine Western states—only about 17,000 of the animals survive. They are found only in remote and inhospitable regions and are rarely glimpsed by man. Those who hope to locate them need four-wheel-drive vehicles, good hiking boots, and plenty of stamina.

I also carry camping equipment and a sleeping bag. By sleeping near a water hole, where horses were sure to come, I hoped to increase my chances of making close-up observations for a book I was writing—*America's Last Wild Horses*.

Now as the sky grayed, I began to make out the outlines of two bay mares and a newborn foal. They stood on a hill awaiting their turns at the tiny spring, which was monopolized by two young males.

This was not the usual band, made up of a single stallion and as many mares as he has been able to capture. In a way I felt relieved. Since a stallion must engage in fierce battles to win and hold the mares he collects, he

Isolated in barren splendor, a small band nibbles sparse grass in the Pryor Mountain Wild Horse Range. An estimated 200 horses, whose ancestors thrived on grassy plains,

becomes a skilled sentinel. A stallion would very likely have sensed me.

On the other hand, I knew what drama a stallion could lend a scene, particularly if he were challenged by a rival. I have watched fights that have developed into blood baths.

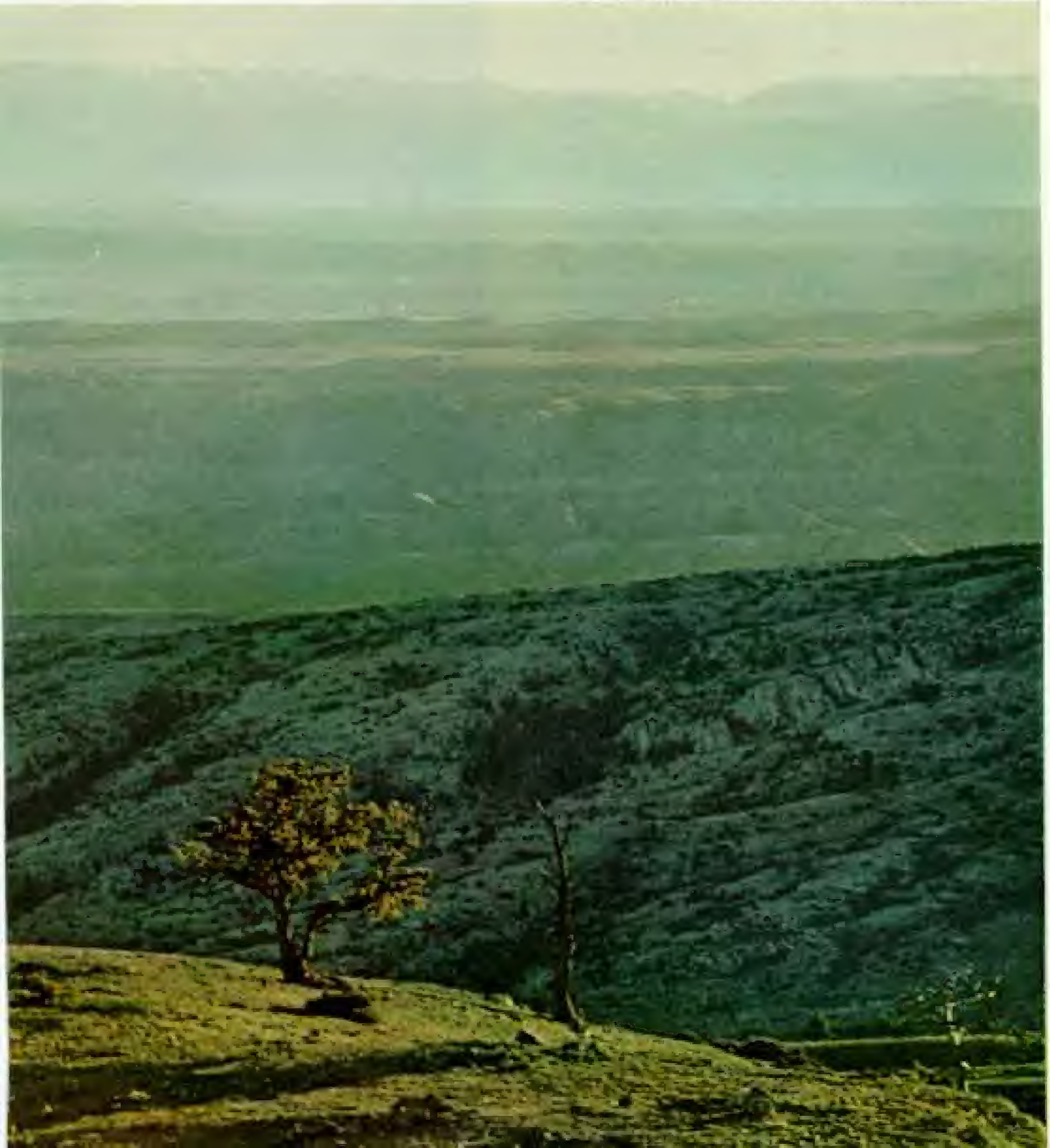
The two combatants first go through a preliminary ritual of posturing, during which either horse has a chance to back down and run away. But once the battle begins, it usually goes on with fierce intensity until one horse clearly emerges the victor.

The stallions rear and pummel each other with their front hoofs, then suddenly wheel and kick with powerful hind legs. They bite at each other, sometimes tearing off chunks of hide (pages 102-103).

The action seldom lasts longer than a few seconds. It often takes place in a whirlwind of dust, and is always punctuated by blood-chilling screams. At last, the loser takes lonely flight, while the winner turns to his harem.

Despite a stallion's fury when challenged by another male, he ordinarily offers no threat

roam the rugged 33,680-acre sanctuary on the Montana-Wyoming border, one of two federal ranges. The other lies within an Air Force reservation in Nevada (map, page 101).



Spindly baby slows its mother's escape

TOO TIRED TO RUN, a newborn foal totters at the heels of a mare in the Pryor Mountains. Unwilling to desert her offspring, the mother pushes the youngster into partial concealment (below).

Fleet-footed retreat is the wild horses' only defense against man—and it has proved futile. Despite public outcry, their decimation continues at the hands of pet-food canners, stockmen seeking more grazing land, and hunters who believe the animals deprive game of forage.

Paleontologists believe that North America was the ancestral home of the genus *Equus*. Early forms of the animal probably reached Asia across the land bridge then spanning the Bering Strait. Meanwhile, most scientists hold, American forms of the genus became extinct some 8,000 years ago. Today's horse came to the New World with the Spaniards. Animals that escaped from them, or from Indians who had bought or stolen them, multiplied to roam free on the Great Plains in increasing numbers.

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Dwindling bands of wild horses occupy remote pockets in nine Western states. Designated as feral—domestic animals gone wild—they are safe from hunters only on federal ranges. Legislative attempts to create more ranges have failed.

BOOK PHOTO BY DICK SWANSON © N.G.S.

"Words of love" help the author (above) talk herself within camera range of a shy stallion (left) on an Air Force reservation in Nevada. He circles her in mingled bafflement and distrust, his mane flying. "I believe the animal had never before seen a human being," says Miss Ryden, a producer of television documentaries.

to man. On the contrary, he is extremely wary of him—with good cause, since man is almost his only enemy.

Ironically, the background of every wild horse in North America includes centuries of close association with man, for all are believed to have descended from domestic stock brought to the New World by Europeans.

North America, however, was probably the home of the ancestral horse. Although fossil bones of *Hyracotherium*—the dawn horse, or eohippus—have been discovered both in Europe and North America, most scientists believe that after the early Eocene, some 55,000,000 years ago, horse evolution was centered on this continent.

These scientists hold that the genus *Equus* probably evolved here but that the present horse, *Equus caballus*, had its origins on the Eurasian landmass. He was a descendant of members of the horse family that had migrated across the land bridge that once connected the two continents.

Equus, according to current scientific thought, probably became extinct in North America some 8,000 years ago. The horse as we know it did not come to our hemisphere until the arrival of the Spaniards.

Lead Mare Chooses the Escape Route

The two young males I was observing at the spring had not yet developed their full fighting prowess. I assumed that they had been forced out of their parental bands by their sires and, not yet strong enough to win their own harems, were running together. Horses are social creatures: young males often gather into groups. For two or three years they play, stand side by side and head to tail to switch flies from one another, and in general exhibit none of the animosity that will later develop.

As adults, the stallions go their separate ways. Those able to collect harems dominate their mares, keep them together, and put them to flight if they sense danger. I have seen stallions drive their mares with seeming enjoyment, forcing them to wheel and turn to no apparent purpose. When a stallion gives a command, the mares are quick to respond, especially if he displays what I call his "herding posture," a lowering and elongating of the neck accompanied by a weaving motion of the head, with ears pinned back.

Only the lead mare seems to have any status in a harem. She runs first in line during a retreat and it is she who picks the escape

Lords of the range battle for a harem

STALLIONS CLASH in northern Wyoming as mares placidly await the outcome. An opening face-off allows either combatant to back down. If neither does, they rear to bite and lash out with front hoofs, or suddenly wheel and kick. Losers often retire in bloody defeat. This duel ended in a draw.

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route. The stallion normally brings up the rear, where he can pressure laggards by nipping at them, or make a stand against an enemy, thus giving his harem time to escape (pages 106-107).

I had hoped to photograph the band extensively at dawn by the water hole, but they heard the first clicks of my camera and disappeared over a hill. I'm used to such failures, though sometimes I have better luck.

Soothing Talk—or a Quieting Song

To take pictures of wild horses I use a technique I have developed during two years of tracking these elusive animals. I try to ease nonchalantly into view at close range, and, while the horses are momentarily surprised and confused, I begin talking in soothing tones. Sometimes I even sing softly to them. Baffled, the horses prick up their ears and listen. Then they move off a few yards and stop again.

If I make no sudden movements, I can hold their attention long enough to close the gap a little, thus gradually "walking down" the herd. My own attitude, however, must be one of pure affection, unmixed with fear. I have noticed that whenever I feel nervous, I am unable to hold the horses. I suspect that I communicate some negative emotion, either through tone or scent, that frightens them.

Though nine times out of ten this technique fails, on the tenth try I may be accepted by the stallion and allowed to tag along with, and photograph, his band.

Once, however, the approach backfired. Intent on charming a band of mares dominated by a sorrel stallion, I failed to watch for other animals in the vicinity. Suddenly I felt hot breath on my neck and heard a loud snort. Even before I turned to see the large gray stallion that was directly behind me, I knew I was in for trouble.

For a time he circled ominously, shaking the flashing cascade of his mane and prancing on legs that seemed to be made of spring steel. At last he stopped and pawed the ground, apparently challenging me to battle. Despite the desert heat—the temperature stood above 100° F.—I broke into a cold sweat. There was no place to hide, nothing to burrow under, nothing to climb. I was four miles from the safety of my vehicle.

The gray, I surmised, had been hiding in a

Double uppercut stuns a stallion. Returning to the fray, the horse—called Black King by the author—eventually drove off his challenger. Black King bears the Roman nose characteristic of many Barbs—the horses brought to Spain by the Moors during their centuries of occupation. The type known as Andalusian—Barb mixed with Spanish stock—was the original horse brought to North America by the Spaniards. Strays from Spanish and, later, Indian herds became the foundation stock of the Western wild horse—the mustang. Other breeds, escaping domesticity to join wild bands, have almost obliterated the original strain.

hollow, awaiting a chance to raid the harem of mares I had been tracking. By driving the sorrel and his mares in the opposite direction, I may have interfered with the lone gray's plan, and now he was in a surly mood. I tried to speak endearingly to him, but fear was all I communicated.

At last his interest in me flagged. He laid his ears back and rushed the sorrel stallion. I began to photograph the fight, but it lasted only a few seconds. Then the gray ran off toward another band grazing nearby, and I made tracks in the opposite direction.

The Nevada valley in which I spent my spring-side vigil (map, page 101) was designated an official wild-horse range in 1962, under the jurisdiction of the Bureau of Land Management. It is spectacularly beautiful—a sunny Shangri-La encircled by red and blue mountains and alive with gleaming perennials. Jack rabbits, coyotes, and the now-rare kit foxes thrive here. Closed to the public for nearly thirty years, this uninhabited region—a training area for Nellis Air Force Base—has become a desert haven for wildlife, including wild horses.

Rugged Mounts Survived Long Voyages

The original feral horses in the United States sprang from the famed Andalusian mounts of the early Spanish settlers. These animals had somehow survived months-long sea voyages during which they had been carried in slings, or tied down to heaving decks, and fed stale hay. Nevertheless, they were able to walk off the ships, be mounted, and break trail under heavy loads.

Their genetic makeup was basically North African—or Barb—first brought to Spain by the Moorish invaders in A.D. 711. In the centuries that followed, they were bred with Spanish stock and became what today we call Andalusian.

The Spaniards, in their determined penetration of the Southwest, had established a capital at Santa Fe as early as 1610. They couldn't have done it without their horses, and the value of the animals was not lost on the Indians. Tribal nomads from the plains soon began stealing a horse here and there, and even raiding Spanish settlements to obtain them. Over the years they became superb cavalrymen, and, having acquired the white man's skill, used it to resist his incursions for more than two centuries.

Because it was easy for them to get new horses, the Indians seldom bothered to recapture animals that escaped from their herds. As they wandered, the red men scattered horses from the Mexican border to Saskatchewan. Stallions regularly gathered mares and made off with them. These herds were the mustangs which became the fabulous cow ponies of the Old West.

Today's wild horse has become mixed with later infusions of ranch animals that strayed or escaped. Still, some remain that retain many of the qualities and beauty of their early ancestors in the United States.

Stallion Challenges an Unfamiliar Creature

Reports of wild horses with Andalusian traits had first lured me to Nellis Air Force Base. Malcolm Charlton and Eddie Mayo, natural resource specialists with the Bureau of Land Management, who had driven me there, now wanted to know what I had seen.

"A small band, no stallions. Couldn't get enough pictures," I told my two companions, disappointed.

So Malcolm and Eddie and I climbed into their pickup truck and spent the rest of the day searching for horses. But the animals gave our vehicle a wide three-to-five-mile berth. Obviously our pickup alarmed them. I thought I might have better luck on foot. So I alighted and circled alone downwind toward a distant band. I had to creep close so that my opening words could be spoken softly; no amount of sweet talk shouted on the wind will stop a fleeing herd.

After an hour of trudging and crawling, I reached a rise that separated me from the grazing herd by a mere 50 feet. But the stallion must have sensed my presence. When I topped the hill, I saw he was agitated, dancing in place and snorting.

I ducked, but he saw me. Yet, strangely, he neither ran nor signaled his mares to retreat. I doubt that he had ever before seen a human being. He appeared more curious than alarmed. After studying me for a few seconds, he moved closer and began posturing, arching his neck and tail and shaking his long mane.

He waited for me to answer the challenge. I stood motionless until he turned and herded his mares over a nearby rise. Then, as I began to photograph him, he suddenly wheeled and trotted straight for me. I prepared to run, but checked myself. It would have been futile.

Standing his ground, a stallion challenges the author in the Pryor Mountains after signaling his harem to retreat. Following, he will spur dawdlers and protect the rear, while a lead mare guides the band. Threats from rival suitors and from man keep the wild stallion ever alert, prompting J. Frank Dobie to call him the "eagle of the turf." Nineteenth century explorer David Thompson marveled at the reckless flight of wild horses, which plunged down steep hills as if they were on level ground. "They appear more headlong than the deer," he wrote in an 1809 diary. His dull packhorse, he also noted, quickly assumed the spirited temperament of the wild ones after it escaped to join them in the Rocky Mountains. The change in the animal amazed Thompson when he saw it later, with nostrils distended, mane flying and tail straight out.

I hoped the mares would leave, for he would then join them in retreat. But they stood transfixed on a nearby ridge, watching the confrontation between a very self-possessed wild horse and a very shaky wild-horse-watcher. As we eyed one another, the stallion suddenly gave a snort, reared, pawed the air, and then turned and galloped toward his mares. I am convinced that only then had he picked up my scent.

He charged after his harem, head lowered, ready to nip any female not moving fast enough. When the horses were a long distance off, he turned and made a final stand. He was a beautiful bay, a magnificent example of a wild stallion in his full splendor.

Wrong Truck—and On the Wrong Range

As I started back toward the spot four miles away where I had left Malcolm and Eddie, I was pleased to see a truck heading toward me. Soon, however, I realized it was not our pickup, but a gray vehicle with a stern-looking security officer at the wheel.

"I've just been taking pictures of a wild stallion and his mares . . ." I began, but the explanation suddenly sounded like fiction even to me.

"On foot?" he asked, and gave me a strange look. Briskly he confiscated my film and examined my camera. Then he walked to his vehicle and spoke tersely into a microphone to someone who blared back orders for him to bring me in.

As we drove away, I told the officer that I had been given permission from Nellis officials to visit the Air Force reservation over the weekend.

"Well, why aren't you on it?" he demanded.

"Where am I?" I asked lamely.

Tight-lipped, he told me. "You're on the Atomic Energy Commission's Tonopah Test Range."

This was the first knowledge I had of the testing ground which lies to the west of the wild horse range.

I was released after questioning, together with Malcolm and Eddie, who had also been picked up. The three of us were escorted off the vast test area. Happily, my pictures were returned to me a few weeks later. And the following year the range manager helped me

"They really belong, not to man, but to that country of junipers and sage, of deep arroyos, mesas—

by allowing me to visit a small portion of the test zone.

Whatever his ancestry, the wild horse in action is a beautiful sight (below). In a world growing ever more industrialized, he can survive, if left to himself, even in the poor habitat that man has left him.

Individuals Help, but a Law Is Needed

The wild horse's impact on the land is not yet fully understood. It may be beneficial, even though stock growers have long regarded the animal as a range robber. Two studies now in progress may shed light on its ecological role. Steven Pellegrini of the University of Nevada is examining the territorial habits of the horses. James Feist of the University of Michigan studies their behavior patterns at the Pryor Mountain Range, where an estimated 200 head live under the protection of the Bureau of Land Management.

Both Feist and Pellegrini agree that their studies of wild horses may be coming too late. The animals are already scarce, yet remain virtually unprotected by law. Technically, wild horses are classified as domestic animals gone wild. As such, they are not covered by federal or state laws that protect wildlife.

Concerned people predict that unless the wild horse can be given immediate legal status and further protection, he may be virtually eliminated within this decade.

A number of individuals and organizations work to save our remaining wild horses. Among them are the Brislawn brothers, Robert and Ferdinand, who founded the Spanish Mustang Registry and are protecting wild horses displaying Andalusian traits on their 4,000-acre ranch near Oshoto, Wyoming.

And Mrs. Velma Johnston of Reno, Nevada —better known as "Wild Horse Annie"— heads the International Society for the Protection of Mustangs and Burros. This group seeks legislation to set up additional ranges for wild horses on public lands.

Unless such laws are enacted, wild horses —the beautiful bay stallion I confronted, and the aristocratic gray with the high step— will soon find their numbers further reduced. The rugged rimrocks and desert canyons that have been their stronghold will no longer echo the drumming of wild hoofbeats. □

and freedom," wrote cowboy-author Will James, regretting his early days as a wild-horse hunter.

Deepstar Explores the Ocean Floor

A picture story by RON CHURCH

WE'RE "FLYING" nearly four-fifths of a mile down in the sea, off Florida's Gulf Coast. Lying prone, I glue my gaze to a five-inch-thick Plexiglas port. Outside, our head lamp punches a tunnel of light into which we nose at a gentle 1½ knots, skimming just above the bottom.

"Depth 4,000 feet," I note into the mike of my tape-recorder log. This is *Deepstar 4000's* maximum assigned working depth—hence the second part of her name. As pilot and photographer for scientists who charter her, I've skippered the amazing craft on more than 200 dives in the Atlantic, Pacific, and Caribbean.

ENTIRE CONTENT © N.G.S.

Based on a design by French oceanographer Jacques-Yves Cousteau and built under his guidance by Westinghouse, the 9-ton, 18-foot, battery-powered mini-sub can jockey about with an ease unknown to bathyscaphes and other submersibles of the past —making possible close-up photographs at great depths. Now, in *Deepstar's* beam (right), looms a 10-inch tripod fish (*Bathypterois viridensis*), poised majestically on tail and pelvic fins. With threadlike fin extensions it senses for prey. When a meal comes within range, the fish leaps from its three-point stance to snatch it.

After making a photographic record, I nudge the strange creature with *Deepstar's* mechanical arm, but it stands its ground, fearless of our gigantic yellow bug. I depart with a camera trophy, adding new details to man's knowledge of deep-sea fauna.

Light invades a sunless realm

DEEPSTAR's lamp reveals scenes normally played out in midnight blackness. Perched on a coral (left), a six-inch feather star, or crinoid, coils its arms in the glare of our beam 3,580 feet down off the Yucatán Peninsula. Another on the dark side of the coral remains partially open. Fernlike appendages filter the current for plankton and other drifting morsels.

Despite their flowery looks, feather stars are animals, and some can swim with flailing sweeps of their arms. Indeed, all living forms seen here are animals. Sufficient sunlight to nourish plant life penetrates the sea only to about 300 feet.

At 4,000 feet in the San Diego Trough, a 2-foot-tall sea pen (right) supports *Asteronyx*, a long-tentacled starfish. Nearby, another form of starfish, a rockfish (*Sebastolobus*), and bulldozing heart urchins scour the bottom for food.

Artfully dodging its enemies, the unidentified crab below carries a fragment of inedible sponge with specially adapted rear legs. Sensing danger, it may hoist the sponge over its back, as some shallow-water species do, to hide itself from predators. I photographed this 10-inch-long fellow at a depth of 1,200 feet off San Diego.

Deep-sea "city" pulses with life

THE OCEAN'S DEPTHS can be a navigator's nightmare, in which you rarely know exactly where you are or where you have just been. Once, cruising at 1,300 feet on the Coronado Escarpment off San Diego, we sighted some "trees" of the black coral *Antipathes* (right)—rarely reported in California waters until this discovery. On later dives, we were never able to find these particular trees again. In such vast and perpetually night-shrouded regions, you can easily ghost by things only 35 feet away and never see them.

Where these coral growths take hold, myriad creatures set up housekeeping in their branches. Spidery Chirostylid lobsters clamber about, seeking bits of food amid the coral polyps. Feather stars, some attached, some swimming, look from a distance like parts of the tree itself. The egg case of a filetail shark (*Parmaturus xaniurus*) clings to a branch at lower center. Sea anemones, sponges, starfish, mollusks, and barnacles live on and around the coral.

Inside a steel-skinned bubble

FISHEYE LENS, looking straight down into *Deepstar*'s interior, gives an idea of how it feels for three people—a pilot and two passengers—to live in a six-foot-wide, instrument-crammed inner chamber for as long as eight hours at a stretch. More than an inch of steel protects us from the immense pressure and near-freezing temperature outside. But it still gets cold inside, since *Deepstar* isn't heated.

Reclining on the pilot's couch, I talk on the telephone with our mother ship, *Burch Tide*, 1,400 feet above. My passengers, Dr. Eric Barham (right) and Maria Regan O'Neal of the Naval Undersea Research and Development Center at San Diego, study the effects of the deep scattering layer—a zone of closely packed plankton—on sonar transmission.

Slender patterns of the depths

LINES IN INFINITE VARIETY swirl and ripple in the deep sea. The snipe eel *Nemichthys* (opposite) often swims vertically, head down, undulating its 30-inch-long, pencil-thin body. Yard-high sea pens (top) snare food with outstretched tentacles. At left, a foot-tall stem of a black coral (*Bathypathes*) sprouts from a rock. I collected it in *Deepstar*'s specimen basket and photographed it later against a setting sun. The jellyfish above swims by pulsating its 6-inch body.

Oasis of life in a desert of mud

OOZY BOTTOM offers few footholds for living things. Any object that finds its way down—a rock, an anchor, a torpedo —becomes an artificial reef to which deep-

Photograph by Bob Cranston © N.G.S.

sea creatures cling. In this case, at a depth of 2,500 feet off San Diego, barrel-like anemones (*Tealia*) as much as two feet high attach themselves to the corroding remains of an airplane—perhaps a World War II fighter. I found this site by following a school of fish—a method divers sometimes use to locate shipwrecks.

Ice Age boulder and a blind lobster

WHILE MY PASSENGERS glean data from instruments, I try whenever I can to focus my lens on the parade of undersea phenomena. Consider the life-encrusted rock below. About a yard across, it sits by itself 3,000 feet deep in the Hudson Canyon that slices into the continental shelf beyond the Hudson River's mouth. A melting iceberg probably dropped the rock here during the Ice Age. Now it plays host to a variety of guests: sea anemones (*Actinoscyphia saginata*) that remind me of the Venus's-flytrap plant, several species of deepwater shrimp, and a crab lounging at lower left. Squiggles are tubular houses built by marine worms.

The lobster *Neophoberus caecus* (lower right), found at 2,500 feet in the Caribbean, has no discernible eyes. It seeks prey with antennae almost four feet long. Ripples in the sand indicate a brisk current half a mile down. Until recently, many oceanographers believed that only sluggish currents flowed at such depths.

An ever-changing array of equipment bespangles *Deepstar's* brow (right), depending on the vessel's mission. Here she sports a rack of water-sampling devices; the extensible rod will probe the bottom.

Undersea ballet

TULIP-SHAPED SPONGES (left), their slender stalks costumed by undulating sea anemones (*Bolocera pauncia*), poise like dancers at 3,800 feet in the San Diego Trough. Measuring 8 to 10 inches across, the sponges (*Hyalonema*) stand on 1-foot-high stalks formed of braided filaments of almost pure silica. When a sponge dies, the glassy stalk remains. I have seen eerie forests of them rising from the sea floor like the stems of so many gigantic champagne glasses.

Barrel sponge (*Rhabdocalyptus*) 1½ feet high shelters tiny fish and crabs within its hollow interior (below). A rockfish, a starfish, and a scattering of heart urchins share this site on a rock-strewn slope 2,800 feet deep in the Coronado Canyon.

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PHOTOGRAPHS BY RON CHURCH © N.G.S.

Squids hang motionless in the abyss

A SUDDEN FLURRY of forms, hurtling straight at me out of the blackness, creates a startling sight. Attracted by our light, squids often ricochet off *Deepstar* and disappear. They cause no harm—being only a few inches long—but they stop my heart momentarily.

In their quieter moods, the animals often hover in mid-water. Seven-inch-long *Gonatus*, with tentacles raised (opposite page), awaits a meal 3,000 feet down off La Jolla, California.

Transparent 10-inch-long *Galiteuthis* (left, above) appeared at 3,500 feet in the San Diego Trough. Kidney-shaped gills and reddish liver show clearly within its body.

Curled-up foot-long *Histioteuthis* (above), photographed at 2,300 feet, shows the larger of its two eyes to the camera; a much smaller eye faces away from *Deepstar*. Many squids range from the surface to great depths. It may be that the larger eye evolved for vision in the twilight zone while the other functions in brighter waters near the surface.

Constellation of living stars

COMBING THE CURRENT with food-trapping tentacles, a lacy-armed starfish (below) sits 4,000 feet deep in the San Diego Trough. Browsing heart urchins beyond it leave trails in the sediment. Despite great dissimilarities, the animals belong to the same phylum, Echinodermata, which also includes sea cucumbers.

Perhaps no member of the phylum is more spectacular than *Gorgonocephalus* (right), whose writhing foot-long tentacles recall the coiffure of serpents worn by Medusa, hideous Gorgon of Greek mythology. An 8-inch-wide feather star, also an echinoderm, waves its delicate arms. Both perch on a sponge 2,400 feet deep off California. Calcareous coral clings to the rock below.

Teeming pasture of the sea

BRITTLE STARS and heart urchins graze at 4,000 feet in the San Diego Trough. A rockfish seems to goggle at a foot-high sea pen. Sea cucumber at upper right makes its slow way across the mud.

Innumerable hidden creatures burrow in the sediment, which has sifted down over uncounted eons. I can usually poke our mechanical arm 1½ or 2 feet into it before

meeting solid resistance.

Mission accomplished, *Deepstar* drops her 185-pound ascent weight and spirals gently to the surface. Carrying a cargo of new knowledge (right), she rides to *Birch Tide*'s deck —there to await another dive into the deep sea's enchanted chambers. □

Housewife at the End

By RAE NATALIE P. GOODALL

THE LITTLE AIRPLANE dipped into a turn over the Beagle Channel, then straightened for the landing on a grass field ahead. As I climbed out and set my small suitcase on the ground, the Argentine pilot shouted above the roar of his single engine. "I have to get back to Ushuaia. Someone from the farm will come for you. I saw them wave when we flew over. The farm is that way."

He took off into the dusk toward a gathering rainstorm on the western horizon. I started to walk in the direction he had indicated. Unfortunately, the pilot had not mentioned that my destination, Estancia Harberton, one of the world's southernmost ranches, lay six rugged miles across fields and hills.

It was almost 10 p.m. in Argentina's December summer, and I felt misgivings about having sought, and received, an invitation to visit Harberton, the oldest ranch in Argentina's portion of Tierra del Fuego, the archipelago at South America's tip. Nevertheless, I remained determined that a trip to the famous ranch should climax my four years of teaching and traveling in South America.

Silence Marks a New Life's Start

Wet, cold, and lonely, I trudged nearly a mile before spotting a tall figure in the distance. The stranger approached, nodded coolly, silently took my bag. We set off the way he had come, his walk so brisk that I had to trot to keep up. We crossed a footbridge and climbed into an ancient jeep.

My dark, handsome, and silent host took off with vengeful speed. We crossed swampy patches over jarring corduroy roads and roared over a wooden bridge a scant two inches wider than the jeep. At one point we seemed to fly into the air as the jeep shot down the side of a precipitous hill.

For five miles I endured this punishment. Finally we reached a farmhouse. There I was set down unceremoniously at the back door.

A woman came out to meet me, smiling graciously. She glanced disapprovingly at my untalkative driver and introduced him. "This is my son Tom. I'm Clarita Bridges Goodall. Welcome to Estancia Harberton. Tell

Tantalizing aroma of roast lamb fills a campsite on Estancia Harberton, a sheep ranch in Tierra del Fuego. Natalie Goodall and her daughters Abby, left, and Anne, join herders for an *asado*, or barbecue; a shepherd sprinkles seasoning with a leafy

of the World

Photographs by JAMES L. STANFIELD NATIONAL GEOGRAPHIC PHOTOGRAPHER

PHOTOGRAPHS © NATIONAL GEOGRAPHIC SOCIETY

branch. The Ohio-born author meets the challenge of living in earth's southernmost permanently inhabited region with an adventurous spirit and pioneer resourcefulness. Before coming to the Argentine ranch, she taught school in a Venezuelan oil camp.

Mountain-crowded and sea-embraced, Harberton thrusts wooded fingers into Beagle Channel (following pages), the passage between Argentinian Tierra del Fuego, right, and Chile's distant Navarino Island. Smoke plume at upper left marks Puerto Williams naval base.

Beyond the reach of television, the Goodalls enjoy an old-fashioned evening. Tom romps with the girls while Natalie learns to spin wool for sweaters. Slack times often mean school lessons for Abby and Anne, taught by their mother; the nearest school lies 40 miles away across the mountains at Ushuaia. A diesel generator supplies power for lights, radio, household appliances, and electrical tools.

me what brings a young woman so far south?"

I explained that I had been traveling around South America after completing a job teaching children at a Venezuelan oil camp. I wanted to see Harberton, I said, because I had read *Uttermost Part of the Earth*, an exciting history of Tierra del Fuego written by E. Lucas Bridges, Mrs. Goodall's late uncle.

I had expected to leave the next day, but I was invited to stay. Gradually, Tom's annoyance at my intrusion on his privacy evaporated. I remained a month and a half. Five months later Tom traveled to my home near Lexington, Ohio, met my parents, and we were married. Soon afterward we were back at Harberton, ready to begin life on a farm that is considered remote even by those who live in remote Tierra del Fuego. I have lived there now for seven years.

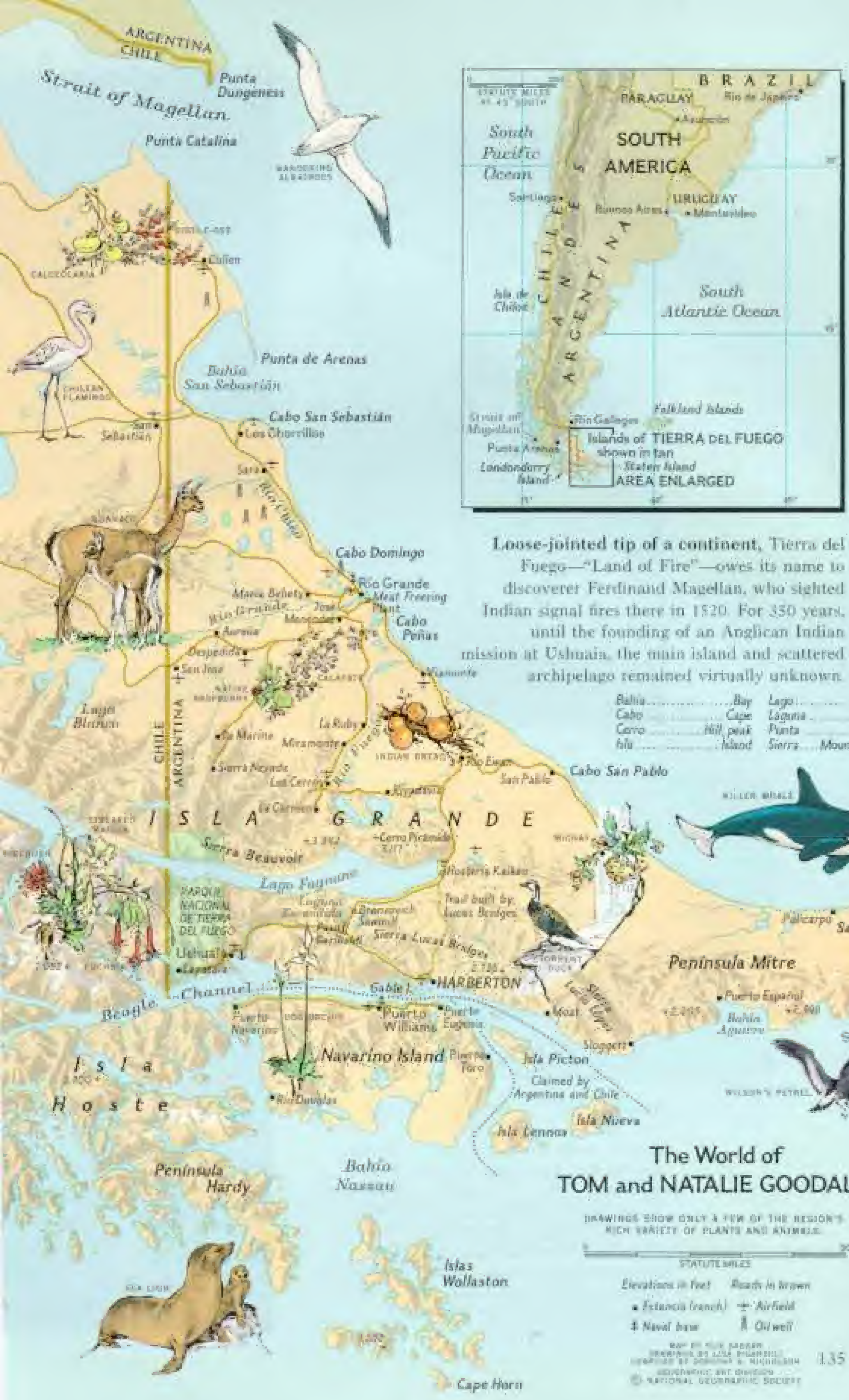
Argentina and Chile share ownership of this "Land of Fire." Argentina's Tierra del Fuego, or Fuegia, contains 67 estancias such as Harberton.* A few others lie on Chile's Navarino Island to our south. Thus Harberton just misses the distinction of being the southernmost ranch in the world, although it lies only 80 miles north of Cape Horn, less than 700 miles from Antarctica, and 2,400 miles from the South Pole. Though more than 10,000 people dwell in Argentinian Tierra del Fuego, the family nearest to us lives on a small estancia 20 miles to the west.

Harberton Ranks High in Natural Beauty

By local standards, our ranch, with 50,000 acres and 9,000 sheep, is small. The largest runs 80,000 sheep on a quarter million acres. But I think Harberton may be the prettiest of all. Our estancia includes four mountains, many steep wooded hills, four dozen lakes, and numerous swamps, some as long as two miles. It also includes 28 islands in the Beagle Channel, our gateway to the South Atlantic (preceding pages).

Our home consists of a group of white buildings that overlook a breathtakingly beautiful bay (page 137) surrounded by the channel and by hills that rise to the Andes

*See "Argentina: Young Giant of the Far South," by Jean and Franc Shor, GEOGRAPHIC, March 1958.



Loose-jointed tip of a continent, Tierra del Fuego—"Land of Fire"—owes its name to discoverer Ferdinand Magellan, who sighted Indian signal fires there in 1520. For 350 years, until the founding of an Anglican Indian mission at Ushuaia, the main island and scattered archipelago remained virtually unknown.

Bahía	Bay	Lago	Lake
Cabo	Cape	Laguna	Lagoon
Cerro	Hill, peak	Punta	Point
Isla	Island	Sierra	Mountain range

The World of TOM and NATALIE GOODALL

DRAWINGS SHOW ONLY A FEW OF THE REGION'S RICH VARIETY OF PLANTS AND ANIMALS

STATUTE MILES

Elevations in feet *Roads in brown*

• Estancia (ranch) ⊹ Airfield

⚓ Naval base ▮ Oil well

MAP BY ALAN SACHER
DRAWINGS BY LISA BYARUHAR
LETTERED BY DOROTHY A. NICHOLSON
GEOGRAPHIC ART DIVISION
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Life's blood of the estancia, Clarita Bridges Goodall, the author's mother-in-law, paints such Fuegian flora as the rare mountain flower *Phaiophleps lyckholmi* (upper), and star-shaped *Perezia pilifera*, which decorates Tierra del Fuego's fields with patterned carpets of blue.

"That paradise . . . called Harberton." Soft glow of dawn in a January summer evokes artist-writer Rockwell Kent's description of the ranch in 1923. The Reverend Thomas Bridges, awarded 50,000 acres by Argentina in 1886 for 15 years of service at the Ushuaia mission, chose this wave-bounded strip of land for his two-story house, prefabricated in England. Bunkhouses, repair shops, and a large shearing shed now surround it.

chain on the northern horizon. The main house, made of wood covered with corrugated iron, was prefabricated in England in 1886 and brought by ship by Tom's great-grandfather, the Reverend Thomas Bridges, founder of Harberton.

Stories about Tierra del Fuego's climate are so famous that I expected the worst. But I found the winters milder than those in Ohio.

"The coldest temperature we've ever registered was 10° Fahrenheit, and the warmest about 83°," Tom told me. "It might snow any month of the year, but usually it happens only in winter. And even then the snow stays on the ground only a day or two."

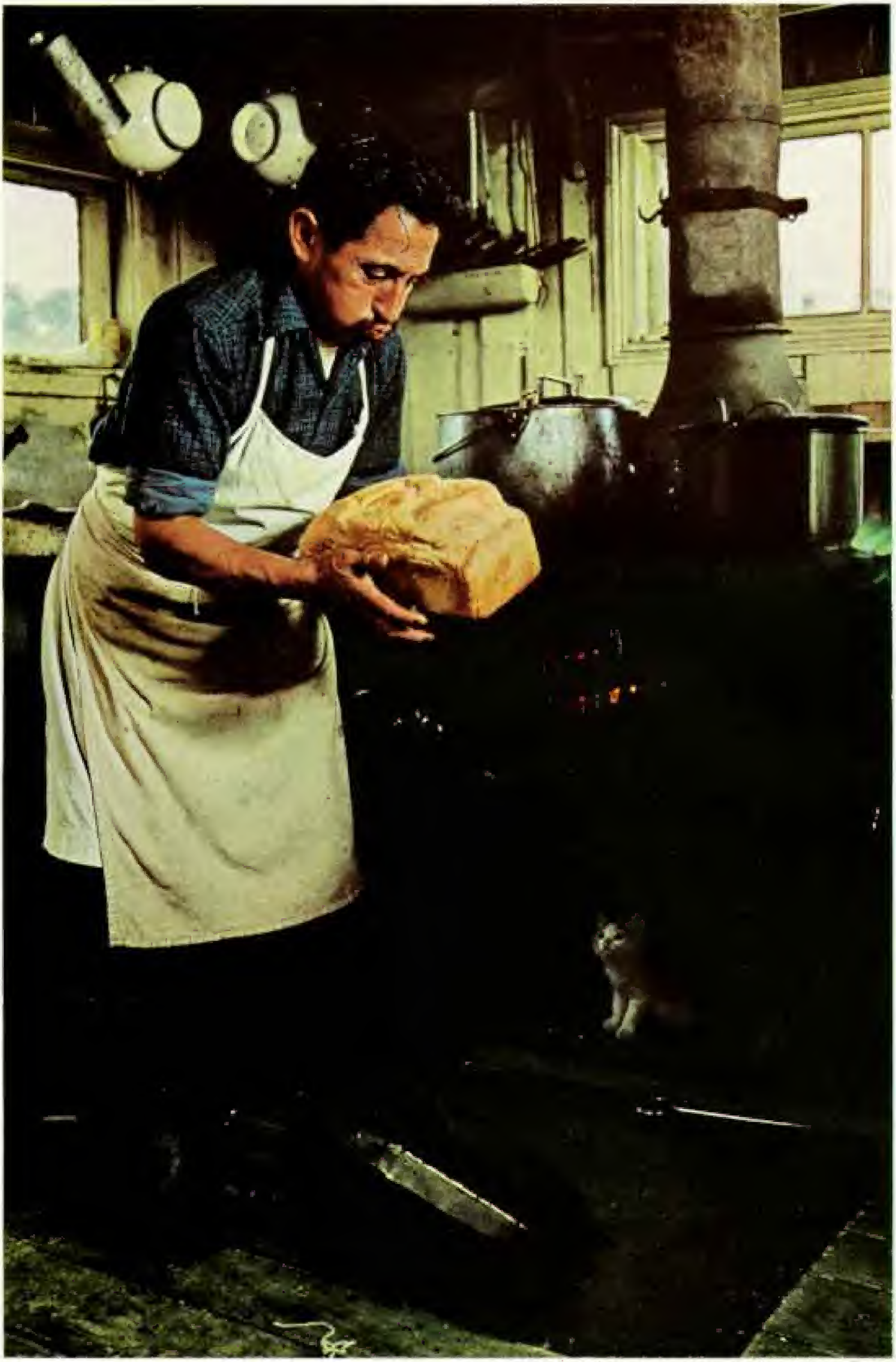
Steady and powerful winds sweep Tierra del Fuego, but we experience no hurricanes or tornadoes. Thunder is so rare that people here comment on the slightest rumble.

Shortly after my arrival I began restoring an 80-year-old terraced garden, planting lupines that now grow shoulder high, as well as roses, delphiniums, broom, poppies, honeysuckle, and eight-foot foxgloves. Begonias and native fuchsia grow here year round, and anemones bloom in the mild winter.

Mutton, Mutton, Mutton—Day After Day

As a bride in unfamiliar surroundings, I soon learned that my biggest problem was not the weather but the stove—a wood-burning type that demanded constant attention. If, after putting a cake in the oven, I took a walk or a nap, the fire inevitably went out. "Is it a cake, or a pudding?" Tom teased when I lifted one of my soggy concoctions from the oven.

In her first letter to me at Harberton, my mother asked, "What do you eat there?" The answer then and now is mutton. Every day, every week, every month.



At the height of the shearing season, in February, when our ranch employs about 22 workmen, we consume 8 to 14 sheep a week. When the men work any distance from the farm, a sheep carcass always accompanies them, slung behind a saddle.

After I had conquered the stove, I tried to devise a varied menu. In time I worked it out. We now have mutton stroganoff, mutton meatloaf, mutton steak, mutton sauerbraten. We eat boiled mutton, fried mutton, roast mutton, smoked mutton. For a change, we can enjoy barbecued lamb or chicken, or have crab, fish, and mussels from the waters of our own "front yard." Less often we eat beef, which is not as flavorful as Fuegian mutton. We sell most of the beef we raise.

Variety Comes From Estancia's Garden

Our fruits and vegetables provide the real variety. Queipul, a jolly, chubby man who tends our garden, annually produces 9,000 pounds of potatoes, as well as cabbages, rutabagas, carrots, lettuce, beets, radishes, peas, rhubarb, and cauliflower. Fruits include strawberries, raspberries, and currants. Tom built a small greenhouse where we grow cucumbers and tomatoes. Our chickens provide eggs, and we have a herd of cows; after many trials Tom and I have learned to make cheese. In February the grassy hills are covered with native raspberries, and other bushes burst with a dark blue barberry called *calafate*.

For our other needs—flour, sugar, rice, dried and canned foods, iron for the blacksmith shop, tools, fence wire, diesel fuel and gasoline—we must order from Buenos Aires, 1,500 miles north. Once a year Tom has goods shipped from there to Ushuaia, 40 miles west of Harberton (map, page 135). The supplies reach the ranch by local boat or in one of the Argentine Navy ships based at Ushuaia. It's a big day when our provisions arrive.

Harberton certainly is different from my father's farm in Ohio. No silos, no tractors, no farm machinery. Here our sheep, plus some 60 horses and 100 head of cattle and oxen (page 143), live on the range throughout the year. We have a shearing shed that doubles as a sawmill in winter. Other buildings include a boathouse, carpenter and blacksmith shops, bunkhouses, cookhouse, and storage and saddle sheds.

Most of all, life at Harberton emphasizes self-sufficiency. When I suggested buying curtain rods, for example, Tom was appalled. "We'll make them," he said, and he did. He even made cookie cutters from tin cans. Tom's mechanical skills are constantly in demand by friends who need to have their washing machines or radios repaired. Every other year Tom gives Harberton's venerable jeep a complete overhaul, and handcrafts hard-to-replace parts. Many of the amateur radio sets in Fuegia were Tom's creations.

Before I arrived, Harberton had a seldom-used washing machine powered by our big generator. But Santos, one of the workmen, did the household laundry by hand, when he wasn't tending the livestock. I thought I should assume that duty. Without consulting Santos, I put the laundry in the machine one morning. That afternoon Santos came into the kitchen, an embarrassed expression on his face. "Doña Nati," he blurted, "don't you like the way I wash the clothes?"

I had hurt his feelings, I realized. "Of course I do," I answered. "You have done a fine job. Why don't you continue to do the heavy clothes outside, and I'll wash the special things in the machine?" That satisfied him, and we're still friends.

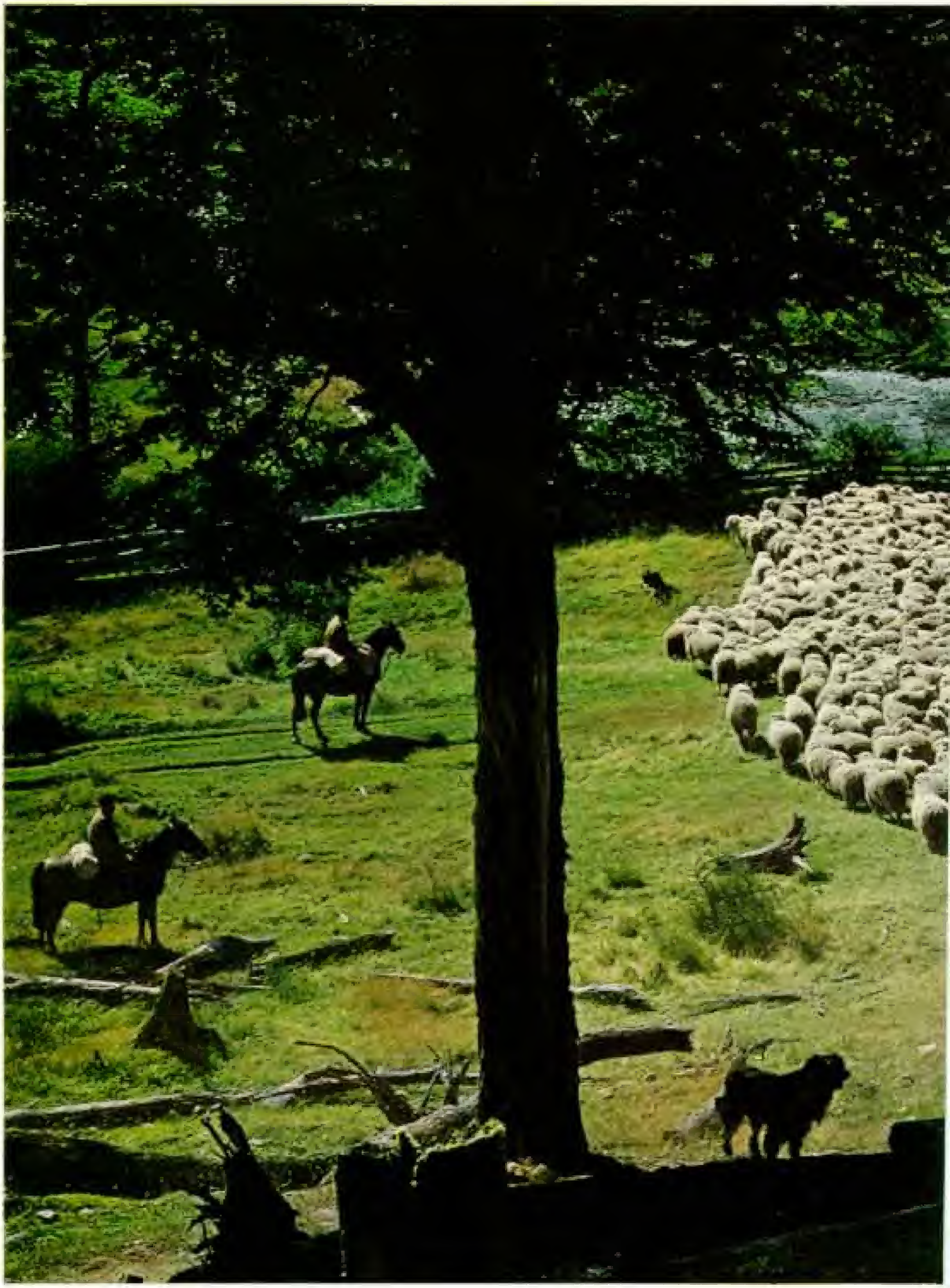
Pirates and Explorers Followed Magellan

Another friend is Agustin Clemente Waiyellen, one of the last survivors of Indians who roamed Tierra del Fuego when Magellan in 1520 passed through the strait that bears his name. Magellan was followed by a procession of pirates and sealers, along with explorers—Drake, Cook, Fitz Roy, and Darwin.*

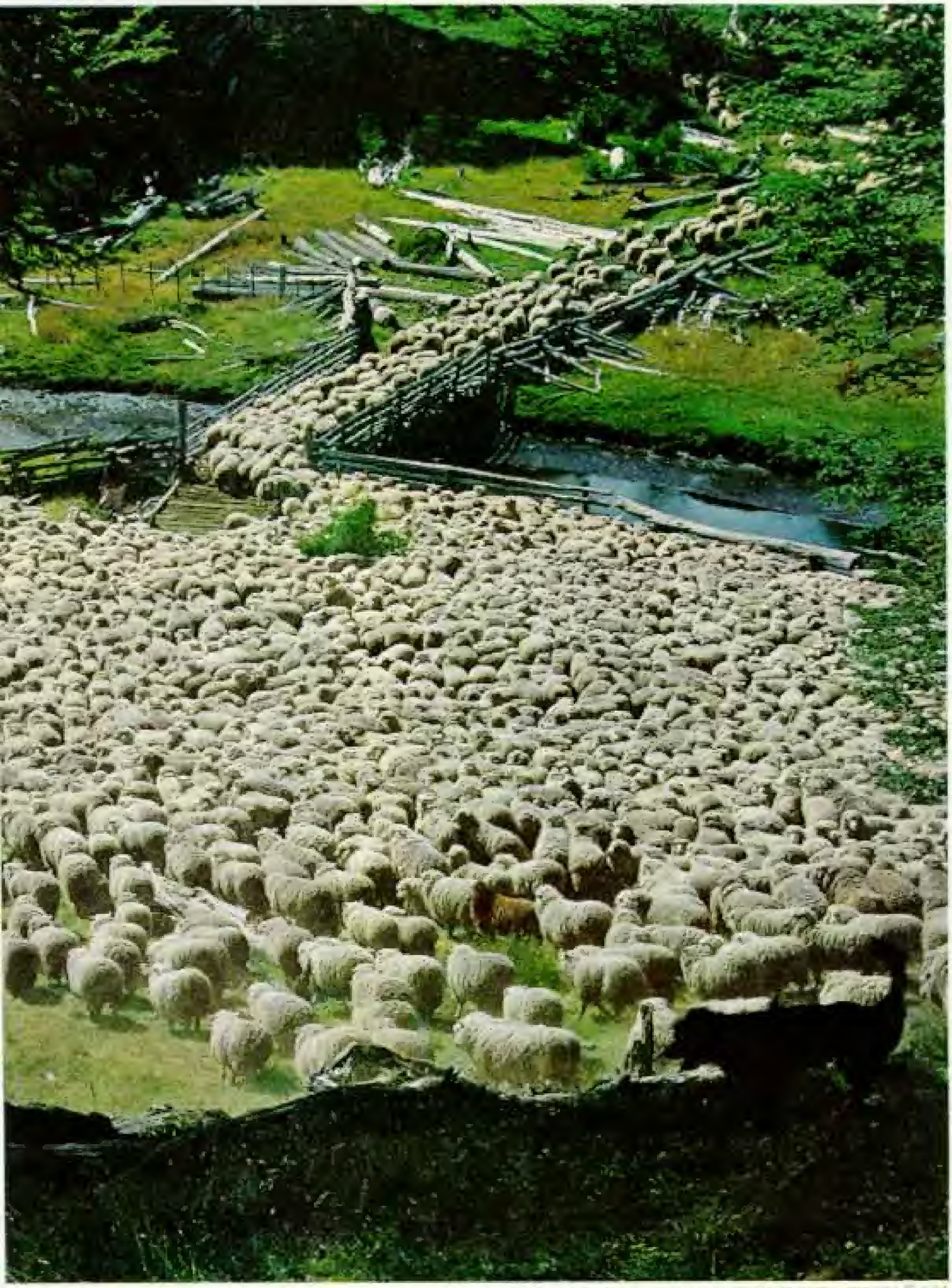
Four Indian tribes—Alacaluf, Yahgan, Haush, and Ona—plied the cold channels in

*The account of a modern sequel to Darwin's and Fitz Roy's voyage, "In the Wake of Darwin's *Beagle*," by Alan Villiers, appeared in the October 1969 GEOGRAPHIC.

Chef when he's not a shepherd, agroned Edmundo Nail juggles a loaf of hot bread under the gaze of the cookhouse cat. The wood-burning stove frustrated the author until she learned to stoke an even fire. Main fare for the family and for crews of up to 22 workers: mutton, augmented by home-grown vegetables that include nearly five tons of potatoes annually. Other foods must be brought from Buenos Aires, 1,500 miles away.



Flood of sheep funnels across a corduroy bridge as skilled dogs and mounted shepherds guide the flock toward shearing pens. Log roads help the sheep over creeks and marshes, but make jeep rides a bone-jarring nightmare. Roundup of Harberton's 9,000 head requires an arduous search amid hills and steep gullies interspersed with tangled



EXPLORER BY NATIONAL GEOGRAPHIC PHOTOGRAPHER JAMES L. STANFIELD © N.G.S.

thickets and bogs. Flocks on channel islands must be boated home, a procedure vastly different from the author's girlhood memories of mechanized farming on Ohio's checkerboard fields. Harberton, with 50,000 acres, ranks as a small operation in Tierra del Fuego. The largest of the region's 67 estancias runs 80,000 sheep on 250,000 acres.

Animal barbers, heads cooled by dampened handkerchiefs, work fast for high pay, earning four cents per ewe, eight cents per ram. Anérico Mayorga, foreground, sheers 300 sheep in nine hours. The wool, bound into bales that average about 500 pounds, goes to Buenos Aires. Rest periods for workers, most of them Chilean, feature yerba maté, a South American tea sipped from gourds through silver straws (right).

Fireland's ready fuel: Logs snaked down a forested hillside by oxen heat Fuegian homes. Though less than 700 miles from Antarctica, Beagle Channel's winters are milder than those in the author's native Ohio. But squalls and clear weather alternate abruptly on the rugged shores, only 80 miles north of historically turbulent Cape Horn. Snows melt quickly on the coast, shielded by a southern arm of the Andes from prevailing westerlies that sweep the interior.

search of otters and seals, or pursued the llama-like guanaco on foot across mountains and plains. The Yahgans, who roamed the Beagle Channel and the islands to the south for great distances, named thousands of sites in their intricate language. Most of these native names have been lost. I am trying to recapture some with the help of Clemente, a Yahgan-Haush.

As we sat in the living room at Harberton one evening, maps spread out before us on the table, Clemente recalled a voyage he had made many years earlier to lonely London-derry Island west of the Beagle Channel.

"We portaged our canoes here," he said, pointing, "to get to the outer bays where the otter were plentiful. We couldn't go around the island because of the huge waves coming in from the seas."

Life was hard for the Indians, he said, and nearly impossible for Europeans. An Indian would travel long distances for food, and even then have to rely on mussels or tree fungus in the absence of meat. The whites faced hostile Indians and loneliness, and died of starvation and exposure.

In 1871 Tierra del Fuego received its first permanent white settlers—the families of the Reverend Thomas Bridges and his assistant John Lawrence, Tom's great-grandfathers, who founded an Anglican mission at Ushuaia. When Thomas Bridges resigned after 15 years of befriending and helping Indians, a grateful Argentine Government gave him a grant of land, the ranch now known as Harberton.

With the discovery of gold along the northern coast at the close of the 19th century, and the realization that the plains could support sheep, the island began to attract hundreds of settlers. In 1900 E. Lucas Bridges, Thomas's son, set out from Harberton with Ona Indians who helped him build a rough trail north over

the mountains. When he reached the Atlantic, he founded Estancia Viamonte. There he provided a home for the last Ona who survived the settlers' diseases and rifles.

Viamonte still belongs to the Bridges. Tom's brother Adrian and his uncles Len and Oliver live there with their families. For years Ona men worked there as shepherds and shearers, but eventually the last of them died.

Today only three pure Ona remain, all women. The eldest, Mrs. Angela Luij, lives in the town of Rio Grande, 75 miles north of Harberton. When NATIONAL GEOGRAPHIC photographer Jim Stanfield and I visited her in her small wooden house, she was washing her hair, but seemed delighted to have visitors.

"My husband, he dead. I had four children, but all dead. The girl, she got married, but she dead too. I am all alone."

But, full of memories and good humor, she drank her coffee and looked through the window at the plains she knew so well. I asked if she minded having her picture taken. "Mind? Yes, I mind. I don't like it at all," she replied—and grinned broadly at the camera. (page 147).

Apt Name for an Awful Road

Living at Harberton has its primitive side, of course, such as the absence of refrigeration and of many modern foods. The lack of a refrigerator disturbed me at first, but now I wouldn't want one. Our "cold room" keeps milk for a day and a half in summer and three to four days in winter, and we make a point of finishing leftovers quickly. We can't operate our generator continuously because fuel must be brought by ship, so we limit its use chiefly to lights, radio, and the washing machine. In one way, though, we are quite advanced: Where most people walk or drive, we fly in a Cessna 180.

The nearest usable land for an airfield, as I had discovered on my first visit, lies six miles away beyond swamps and hills, and the road linking it to Harberton was created by pick and shovel. People who suffer an hour of bruising bumps over that road never forget it. Capt. Ernesto Campos, a former governor of Tierra del Fuego, told us, "I think we should call it 'Route Zero.' It doesn't deserve a number!"

When I was expecting our first baby, our doctor in Rio Grande instructed me to visit him once a month. For a few months I did. Then one day the doctor came to see me. The minute he alighted from the jeep, wiping his brow, he told me sternly, "Don't you dare go over that road again in your condition! And

Massive sheep jam clogs a street in Ushuaia and spills over the sea wall. This mob—8,000 head of breeding stock—will go to Colombia. Thomas Bridges carved civilization's toehold here among Yahgan Indians. Though able to live scantily clothed in the damp cold, the aborigines lacked resistance to diseases brought by explorers and settlers. Today only a handful remain.

don't wait until the last minute to get yourself to the clinic, either!" So a month before the baby was due, we went to our little airfield by boat, and from there flew to Viamonte, to be nearer the doctor.

The flight to Viamonte takes about half an hour. We fly inland through a pass near Uncle Lucas's mountain trail, past rugged coffee-colored cliffs. The land slopes down to Lago Fagnano, an azure lake that stretches 65 miles across Tierra del Fuego, protected by snow-capped mountains on each side. A small hotel—Hosteria Kaikén—perches at the eastern end of the lake, with an array of immense windows facing Fagnano and mountains to the west. North of the lake the forest thins to plains as we descend to land at Viamonte and greet the rest of the family.

On our return, we sometimes stop at Laguna Escondida, nestled in a valley between high ridges south of Lago Fagnano. At its edge our friends the five Bronsovich brothers, originally from Yugoslavia, operate Fuegia's largest sawmill.

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"We started with a pushcart, selling wood in Ushuaia," recalled Andrés, the eldest, a big quiet man. "Now we charter planes and ships to send our lumber to Buenos Aires." Since large areas of Argentina consist of semi-desert or plains, wood from Fuegia's beech forest enjoys a good market.

Harberton's major product, however, is sheep. They're also a source of entertainment for our daughters Anne and Abby. The girls love to watch the men herding the sheep in the midst of swirling dust and frantic bleats (pages 140–41).

Shearers work long and hard: two and a half hours of labor, followed by 30 to 60 minutes of rest, starting at 6:30 a.m. and ending at 6 p.m. (page 142). After the fleece comes off, the shearer puts the animal he has shorn into a small pen. Twice a day Tom counts the sheep to figure each man's pay.

Later the rolled fleeces are pressed into bales of 440 to 660 pounds each. We pay the Argentine Navy to deliver them to Ushuaia, where the wool is loaded onto other ships for the long trip to Buenos Aires.

After shearing on the main part of the farm, Tom begins on the island flocks. Gable Island, our largest, holds 2,000 to 3,000 sheep. Usually Tom and the men go alone, but once I asked if the girls and I could join him.

"If you want, but you'll have to sleep in the little tent, while I'm in the shed with the men," he said. "We're leaving early."

Family Sails While the Horses Swim

The next day everyone was in a jubilant mood as pots and pans, meat, saddles, tents, and rolls of bedding—enough provisions to support 15 men, a woman, and two children for a week—were loaded onto the barge *Lamuca*. After 20 sheep dogs clambered aboard the barge, our launch *Lela* towed us into the bay. We turned west into the Beagle Channel for the hour-long trip to our campsite on Gable Island. Meanwhile, a few men drove 16 horses into the water to swim 300 yards to the nearest point on Gable.

We landed and settled down just as one of the unpredictable snowfalls started. By morning everything was covered with snow, and for two days we waited for the weather to improve. The third day dawned cold and windy. While Tom repaired a leak in the launch, I mounted a horse and joined the roundup.

Three hours of riding brought us to the steep, gablelike cliffs that give the island its name. The wind seemed stronger and colder than ever. It took great effort just to remain on my horse, and my fingers felt frozen.

Every hundred yards or so a rider peeled off from the rest and disappeared over the hills surrounding us to search for sheep. As we passed a lake, I looked back for a moment and saw on nearly every hill a silent horseman, like a sentinel in the howling wind, driving trickles of sheep together to form a flock. At last we turned back and headed for the campsite.

We reached our camp late in the afternoon, ate dinner, and bedded down. Next morning Tom and the men began loading the sheep onto the barge to take them to the main island for shearing.

When all the sheep were moved in 32 trips across the narrow channel, Tom called his mother on the old hand-crank telephone. "We're coming home today," he said. "The horses are swimming over now. Have Queipul make a big kettle of soup for lunch."

The girls and I packed our things. We helped reload the launch, then joined a tired, dirt-covered group of men for the trip home.

Hospitality an Estancia Tradition

During winter some workers, most of them from the Chilean island of Chiloé, a thousand miles to the northwest, return home. But we're hardly wanting for company. By tradition, an estancia will feed and house, at least for a day or two, any local worker who drops in. Sometimes idle workers stop by and stay most of the winter, occasionally chopping a little wood to help the cook. Our farm also attracts a variety of guests: ambassadors, scientists, and adventurers who arrive by plane, ship, or yacht, or on horseback. One man last year walked over the mountains to reach us.

Sometimes visitors are surprised to find any civilization at all so far south. One day three young Australians entered Harberton's bay in a yacht, and we invited them to dinner. Seated at the table, we Goodalls began eating—while our guests simply stared in apparent bewilderment.

"Is something wrong?" I asked. "Why aren't you eating?"

"It's just . . ." one of them began, with a wave of his hand taking in the lace tablecloth, the bowl of anemones, the houseboy serving a steaming platter of mussels. It was too much for him, there in that incredibly remote farmland.

"And speaking English, too!" he added. He didn't realize, of course, that English is spoken

in the *casa grande*—the big house—of at least a third of Fuegia's estancias.

Many of our friends move north in winter to enjoy a warmer climate, but Tom and I usually stay at the farm year round. I teach the girls their lessons in English, and when we are able to get to Ushuaia, Anne joins the second grade in a Spanish school. As the world's southernmost Argentine-British-American children, our daughters should, I think, be fluent in both languages.

Plant Hunters Bag Botanical Trophies

Since coming to Harberton, I've developed an interest in whales, a dozen of which have drifted onto Harberton's winding shore in the past few years (page 149). And I'm continuing my interest in botany, which I had studied in college. I've collected plants for ten herbaria on three continents, sometimes joined by botanists from the United States and England. My own herbarium contains some 2,500 specimens. My mother-in-law, an energetic woman with a talent for painting plants (page 136), often leads the horseback expeditions. Several times we have found plants that no one knew grew so far south.

"Watch out when one of the Bridges asks you to go for a walk," a relative joked soon after I joined the family. She was right. On one climbing expedition with Tom's Uncle Len, I was terrified that I was about to plunge down steep Cerro Pirámide. Almost reduced to tears, I kept shouting, "Wait, Uncle Len! I have to blow my nose."

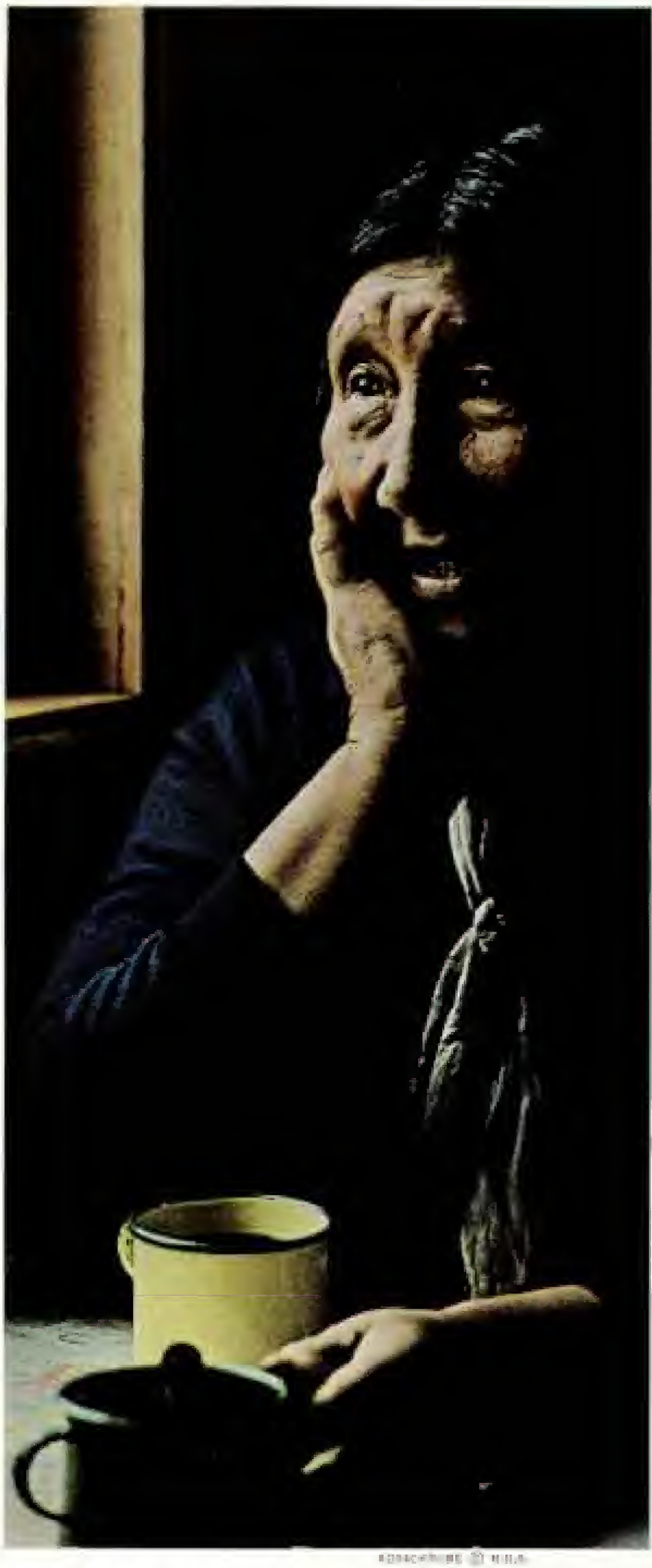
"If we stop, we'll slide downhill," he answered, not slowing his marathon pace.

I am an awful mountain climber, but luckily our hills are not too high, perhaps 3,000 feet on the average. So far I've scaled a dozen mountains, including a few that had not been explored previously, unless by a wandering Ona long ago.

The occasional trips that Tom and I make to Ushuaia for supplies, on business, or to pick up visitors are far more relaxing. Ushuaia, a once-sleepy village that has begun to bustle with tourists, is Argentina's southernmost town (pages 144-5). It has a large new hotel and shops that offer Japanese radios, English woolens, and other imports.

When we travel to Ushuaia, Tom spends much of his time at the airfield, where he, his cousin Martin Lawrence, and other friends founded an air club in 1959; now it has grown to five planes.

"When we started," says Martin, "we would



One of three surviving pure Ona Indians, Angela Luij lives alone in the town of Río Grande. Her ancestors, hunters of the llama-like guanaco, ruled the interior until stockmen warred against them. Some survivors found sanctuary with the Bridges family, only to fall victim to measles, a disease introduced by white traders.

Lending a hand to science, the author and her husband's cousin, Anthony de la Rue, examine the bleached skull of a common baleen whale. Bones of rare species collected on Harberton's shore will eventually be shipped to the United States for study. Pursuing a lifelong interest, Mrs. Goodall also devotes much time to collecting plants, and regularly sends specimens to botanists on three continents.

Long-deserted Indian camp (below) yields a broken whalebone wedge and a miniature harpoon, a toy given to Yaligan youngsters to develop their hunting skills.

make sure there wasn't a cloud in sight. Now we fly in almost any weather."

The air club runs a taxi service, taking local officials to Río Grande, workers to remote farms, and tourists around the island. Once Martin brought a doctor from Ushuaia for Anne, flying only a few feet above the Beagle Channel in a thick storm.

"I've never seen a family so attuned to the sound of an internal-combustion engine," a visitor remarked during lunch at our home one day when we heard a distant motor. Tom dashed to the radio to talk to the pilot, and the girls and I raced to the hill behind the house, hoping for mail from Ushuaia. Sure enough, as the plane flew by, it dropped a small bundle of letters—truly airmail delivery.

If any ranch on Fuegia's southern coast could be considered more remote than Harberton, it would be Estancia Puerto Español at Bahía Aguirre, the home of the Ostoich brothers, Juan and Vicente. When Tom and I flew the 60 miles to Bahía Aguirre for my first visit, our plane descended along high cliffs covered with evergreen beech trees, and we landed on a narrow beach beside a winding river. Juan, white-haired and smiling, came to meet us.

"Welcome to our home," he exclaimed, giving me a bear hug, then led us to their sparsely furnished cabin.

Immigrants from Yugoslavia, Juan and

ROUGHRIDER BY NATIONAL GEOGRAPHIC PHOTOGRAPHER JAMES L. STANFIELD © N.G.S.

Vicente arrived at this lonely spot while in their teens. They have lived alone for more than 40 years on the swampy farm, whose sheep and garden provide a scant living. Though they have no radio transmitter, they have a receiver, and listen to us talking every day. We're their nearest year-round neighbors, so they consider us members of their family.

Fuegian Andes End on an Island

Even more isolated, and inhabited only by seals and by penguins and other birds, is Staten Island, the Andes' last rugged outburst along the eastern face of Tierra del Fuego (inset map, page 135). Forty miles long and a third of a mile wide at its narrowest point, Staten Island consists of rocks that rise sheer from the sea. It contains only one possible landing strip, a narrow beach.

Two members of the air club, Vladimir Bronsovich and our cousin Martin, made the first landing on the beach in 1967, and Tom was eager to try it. One fine sunny morning Tom suggested that a visiting English botanist, Dr. David Moore of the University of Reading, might want to investigate the island's flora.

We took two planes, Martin piloting the first and Tom ferrying Dr. Moore and me in the second. Twenty miles of frigid water separates Staten Island from the main island, and few ships sail the Strait of Le Maire, if

PHOTOGRAPHS BY THOMAS R. GOSNELL © N.G.S.

Scooting on homemade sleds propelled by nail-tipped poles, men race over an ice-sheathed field at Estancia Vinmonte, a Fuegian ranch also owned by descendants of the Bridges family. "Life in this remote land spurs inventiveness," says the author. "My special interests keep me so busy I have little time to miss the conveniences I once knew."

anything happened to a solitary plane, the occupants might be stranded for weeks.

As we flew over Staten Island, the water below appeared a deep blue in the narrow bays between steep mountains. I looked down over the strait and thought of all the sailing ships that had been caught in treacherous currents and blinded by thick fog, then dashed against these rocks. The Yahgan Indians called the island Chuanisin, "Land of Plenty," but they dreaded the strait that separated them from this wooded haven.

Minutes later we landed on a hard sand beach, and wheeled a few hundred feet along the shoreline, one plane behind the other. When the propellers stopped, we tumbled out.

Amid the lush vegetation, I felt as if we had landed a few thousand, instead of only a few hundred, miles from Antarctica. Wild celery grew shoulder high on the inland edge of the beach, and the trees were laden with moss and fern. The island, we were delighted to discover, offers a wonderland of Argentine flora.

After an hour of plant collecting in the forest, I noticed that a huge gray cloud had perched atop a mountain peak not far away. Simultaneously, Tom shouted from the beach, "Hey, everybody, come on."

We jumped into the planes with the three sacks of plants we had collected. As the propeller turned over, Tom explained the hazards of flying through clouds over the strait.

"We have no radio-navigation aids," he said. "Just a few degrees off course, and we could end up in the South Pacific, or on the side of a mountain."

The island seemed even more lonely and mysterious as we climbed into the gray sky. We soared above the strait, then touched down at our airfield just as rain began to fall.

Dispute Hinders Cross-channel Travel

With such places to explore, life along Beagle Channel could scarcely offer more excitement. Unfortunately, some of the most spectacular spots, especially dozens of dazzling glaciers in the west, remain inaccessible.

Argentina and Chile dispute ownership of three small islands, and both navies forbid anyone from crossing the channel without prior arrangements with both governments. Thus, to travel from Ushuaia to the Chilean naval base at Puerto Williams on Navarino Island—a 15-minute flight—one must first get permission at the Chilean provincial capital of Punta Arenas 190 miles away. Perhaps one day this restriction will be lifted, for I would love to visit the few Yahgan descendants living on Navarino Island and collect plants on the islands around Cape Horn.

Meanwhile, Clarita, Tom, the children, and I, with pride in our self-sufficiency, continue to meet the challenges of life at the end of the world. □

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