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EACH MONTH we give considerable thought to selecting a lead article. More often than not, it will have unusual breadth, like our recent survey of Maya civilization, or special import—Alaska at the crossroads, or major discoveries along the Mid-Atlantic Ridge. Sometimes, the sheer merit of an article itself, as in our Robert Frost tribute, commends itself. This month we turn with special satisfaction to a rare delight—the story of one man's lifelong search, and its triumphant conclusion.

When Dr. Fred Urquhart and his colleagues discovered the Mexican winter home of the monarch butterfly, it completed not only his lengthy search but also enlarged our understanding of that fragile creature's life cycle. This may not seem momentous when measured against the problems of the modern world. Yet how rarely do we have an opportunity to share a moment of such joy and beauty as when countless butterflies "filled the air with their sun-shot wings, shimmering against the blue mountain sky and drifting across our vision in blizzard flakes of orange and black." We could not resist giving that moment the place of honor in this issue.

Dr. Urquhart's work has been supported for five years by the National Geographic Society's Committee for Research and Exploration, under the astute leadership of our former President and new Chairman of the Board, Dr. Melvin M. Payne. In June, Dr. Payne turned the presidency over to Robert E. Doyle (page 224), but, we are happy to say, he will keep his "other hat" and continue to chair the work of the committee.

Time and again, the Society's journal has found fascinating material in the committee's projects. Our pages have been filled with the excitement of discovery and exploration—studies of polar bears in the Arctic and "sleeping" sharks off the Mexican coast; discovery of the *Monitor*; life with the orangutan in the jungles of Borneo; new insights into the culture of Ice Age man; retrieving a 2,300-year-old ship; unearthing the spectacular ruins of Chan Chan, Wetherill Mesa, and Aphrodisias; conquering Mount Everest; confirming Viking presence in the New World. We can only be pleased that Dr. Urquhart's project was among them, so we can share with you a matter of science that also has a large measure of magic about it.

Silbert Browner

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It took Canadian zoologist Fred A. Urquhart nearly 40 years to unravel this baffling mystery. Photographs by Bianca Lavies.

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Noel Grove and Robert W. Madden find much of this burgeoning nation awash in a sea of easy money. But a persistent worry nags at many minds: What will we do when the oil runs out?

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Oil-bought change sweeps Venezuela, and its Indians find their traditional world threatened by forces they cannot comprehend. Anthropologist Napoleon A. Chagnon describes a culture beset by civilization's "gifts"—shotguns, steel axes, measles, and influenza.

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A hitherto unexplored gash in the Caribbean's floor, four times as deep as the Grand Canyon, provides exciting clues to our globe's inner structure. By Robert D. Ballard and Emory Kristof.

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As the National Park Service prepares to acquire 900 square miles of south Florida wetlands, conservationists cheer. Real-estate developers and a handful of self-reliant residents see the action as just another land grab by "those people in Washington." By Rick Gore and Patricia Caulfield.

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Since 1707 Edinburgh—and the rest of Scotland—have lived under laws made in London. But now a Scottish National Party gathers strength on a platform dedicated to restoring Scottish independence. By James Cerruti and Adam Woolfitt.

COVER: *On a remote mountainside in Mexico, wintering monarch butterflies congregate by the millions (pages 160-173). Photograph by Albert Moldvay.*



Found at Last: the Monarch's Winter Home

By FRED A.
URQUHART, Ph.D.

Photographs by
BIANCA LAVIES
NATIONAL GEOGRAPHIC PHOTOGRAPHER



ALBERT MOLIVRY (OPPOSITE PAGE)

Domain of monarchs, Mexico's Sierra Madre unwraps its secret as the spectacular winter hideaway of butterflies from the eastern and central United States. Cathy Brugger (left) and her husband, Kenneth, discovered the site where millions rendezvous.

I GAZED IN AMAZEMENT at the sight. Butterflies—millions upon millions of monarch butterflies! They clung in tightly packed masses to every branch and trunk of the tall, gray-green *oyamel* trees. They swirled through the air like autumn leaves and carpeted the ground in their flaming myriads on this Mexican mountainside.

Breathless from the altitude, my legs trembling from the climb, I muttered aloud, "Unbelievable! What a glorious, incredible sight!"

I had waited decades for this moment. We had come at last to the long-sought overwintering place of the eastern population of the monarch butterfly.

Every wide-eyed child and meadow walker in the eastern United States and nearby Canada knows this colorful butterfly, by sight if not by name. It skims and dips in summer over fields and gardens from Texas to New England, from Florida to Minnesota. But in winter the monarch vanishes from the colder regions. Where does it go?

Until now, no one had known. But here

before me, on scarcely twenty acres of lofty wooded slope in central Mexico, the monarchs crowded by the millions to while away midwinter months in semidormancy.

I am a Canadian zoologist, Toronto-based. With the tireless help of my wife, Norah, I have spent much of my time since 1937 studying the ecology, and especially the migration, of the monarch butterfly.*

Monarch migration is a marvelously intricate pattern of behavior, baffling in many of its aspects. This butterfly has long been known to travel great distances, somewhat as birds do, on a round trip keyed to seasonal changes and the reproductive cycle. For the monarch, as for the feathered flocks, southward migration's clear and evident purpose was to escape the killing frosts of winter.

Some monarchs flying south in the fall return to their summer breeding grounds, we knew, though none ever survive longer than a year. Where, then, did the eastern butterflies

*See "Mystery of the Monarch Butterfly," by Paul A. Zahl, NATIONAL GEOGRAPHIC, April 1963.

Blanketing a thousand trees, monarchs converge in November on a mountain slope at 9,000 feet. Near-freezing temperatures immobilize the insects, enabling them to conserve fat for their return trip north. As sunlight increases in January, the monarchs stir and spread their wings, painting the evergreens orange (below). Earlier, in semidormancy, the butterflies resembled masses of pale dead leaves. In the exodus of spring (right), they take flight.



BOTH BY KENNETH C. BRUGGER







pass that single overwintering of their brief lives? One of the earliest questions asked, it was to be among the last answered.

Our first problem was to track the insects on their journeys, and plot the distances and directions of their flight; to do that, we had to mark them. But how do you mark a migrating butterfly, a delicate, featherweight insect that depends totally on freedom of flight?

It took many years—and many failures—to develop a foolproof way to tag a monarch. As long ago as 1937 we experimented with a printed label, affixed to the butterfly's wing with liquid glue. But tags and butterflies got tangled and sticky, and many of the insects couldn't stay airborne.

Norah and I next had labels printed on gummed stock, like postage stamps. We tested them on the Monterey Peninsula in California, where western monarchs from the intermontane valleys of the Great Basin have always congregated in midwinter. This experiment, too, failed dismally: A night of rain washed the gummed labels off the clustered monarchs. Over the sodden grass our thousand tags lay like soaked confetti.

But then a friend suggested trying the type

of pressure adhesive label used for price tags on glass merchandise. With an added fixative, this worked perfectly. Now we had a tag that would readily adhere, with a gentle squeeze, to the membrane of a butterfly's wing where the scales had been removed (facing page). The harmless labels even stuck to monarch wings deliberately soaked in water.

Thousands Join in Tagging Wings

In 1952 I had written a magazine article on "Marked Monarchs," which included an appeal for volunteers to assist in our tagging program. Twelve people responded, launching our Insect Migration Association. By 1971 it numbered six hundred; thousands have taken part over the past 24 years. The tiny labels carry identifying letters and numbers, and the words: "Send to Zoology University Toronto Canada." Over the years hundreds of thousands of migrating monarchs have been tagged all across the continent. Reports have poured in from enthusiastic collaborators of all ages and walks of life. We have received tagged specimens from Maine and Ontario to California and Mexico, from Florida to the shores of Lake Superior.



Blessed are the diligent: Dr. Fred A. Urquhart, zoologist from the University of Toronto's Scarborough College (left), climaxed a four-decade study last winter when he visited the monarchs' 20-acre Mexican enclave. The map above shows the migration routes to wintering grounds. A few eastern monarchs fly down the Florida peninsula and eventually reach Yucatán and Central America. The author and other members of his Insect Migration Association tagged several hundred thousand butterflies to plot the paths. Eager now to trace the northern return trip, the Urquhart party applied light, adhesive labels to another 10,000 wings (above).

Many tagged monarchs reached us alive, in packages lined with the field flowers they were feeding on when netted. A California golfer was about to drive his teed-up ball, when a butterfly alighted on it. Although unable to check his swing, he sent us the tagged remains in the name of science.

Early in 1965 I joined the staff of Scarborough College of the University of Toronto. Our program gained momentum. Grants in aid of our research came from the National Geographic Society, the National Research Council of Canada, and as donations from volunteer associates.

Our knowledge of the monarch proliferated as data flooded in. We learned, for example, that almost all males die on the way north from the wintering grounds. We also confirmed that the insects won't fly at night. One tagged butterfly—captured, released, and captured again—flew 80 miles in one day.

During the summer in Ontario we found not only fresh, flawless monarchs; many were somewhat worn, and still others badly travel-tattered. This suggested several overlapping generations, the most worn having flown from farthest south, and the freshest having

only recently hatched somewhere much closer on the northward migration route.

We also found that monarch populations include migrants and nonmigrants. What a fascinating complication this was!

After considerable study we concluded that most of the migrating monarchs are those that hatch in late summer, when daylight hours decline. The late females do not develop productive ovaries—and thus do not mate—until they fly south to that elusive overwintering place. (This light-responsive infertility probably holds for male monarchs as well.) As daylight lengthens in the wintering area, the monarchs—now sexually mature—feel the urge to mate and fly north, breeding new generations along the way.

Trail Lost in Texas

Still, we wondered where the migratory monarchs spent the winter. Despite our hopes, fieldwork in Florida and along the Gulf Coast disclosed no mobs of wintering monarchs. Widely scattered recoveries gradually enabled us to plot migration routes on a large wall chart. A pattern developed: a diagonal flight path, northeast to southwest,

Beauty is no protection against predators. Birds often attack inert monarchs at the Mexican roost, as the tattered wings of a recently tagged insect testify (below). Roaming cattle (facing page), mice, shrews, and ants also take a toll, as do violent rain- and windstorms. Many casualties also happen on the way north—a journey of slow, grueling flights.



across the United States. Most of the butterflies, it seemed, passed through Texas to Mexico (map, preceding page).

In our search for the overwintering place, years passed, years of frustration. Norah, late in 1972, wrote to newspapers in Mexico about our project, asking for volunteers to report sightings and to help with tagging.

In response came a letter, dated February 26, 1973, from Kenneth C. Brugger in Mexico City. "I read with interest," he wrote, "your article on the monarch. It occurred to me that I might be of some help. . . ."

Ken Brugger proved the key that finally unlocked the mystery.

Traveling in his motor home with his dog, Kola, he crisscrossed the Mexican countryside. He searched especially in areas where tagged monarchs had been recaptured, and places where other visitors had reported numerous butterflies. "Go out in the evening," we instructed him. "That's when you'll see

the monarchs moving about looking for a place to roost."

In a letter written in April 1974, Ken reported seeing many monarch butterflies in the Sierra Madre flying at random as if dispersing from a congregating site.

"Your data and observations are exciting," I replied. "We feel that you have zeroed in on the right area."

Ken Brugger doubled his field capability by marrying a bright and delightful Mexican, Cathy. Late in 1974 he wrote of finding many dead and tattered butterflies along the roads in a certain area. "You must be getting really close," we responded. These butterfly remains suggested that birds had been feeding on large flocks of monarchs.

Swiftly came the dramatic conclusion. On the evening of January 9, 1975, Ken telephoned us from Mexico. "We have located the colony!" he said, unable to control the excitement in his voice. "We have found them—millions of monarchs—in evergreens beside a mountain clearing."

Mexican woodcutters, prodding laden donkeys, had seen swarming butterflies and had helped point the way.

Breathtaking Climb to an Awesome Sight

With further support from the National Geographic Society, Norah and I made plans to visit the site early in 1976. Photographer Bianca Lavies would join us and the Bruggers. We met on January 9, at a mountain motel in the Sierra Madre, and from there negotiated steep roads to a village where we picked up our guides. Reaching one high summit, we left our vehicle and set out afoot toward the "Mountain of the Butterflies."

Norah and I are no longer young. At 10,000 feet, as we walked along the mountain crest, our hearts pounded and our feet felt leaden.

The rather macabre thought occurred to me: Suppose the strain proved too much? It would be the ultimate irony to have come this far and then never witness what we'd waited so long to see!

From the summit, dotted with junipers and holly glistening with hoarfrost, we had to descend steeply. Down, down we stumbled to a clearing surrounded by stately oyamel trees, a kind of fir.

Then we saw them. Masses of butterflies—everywhere! (Continued on page 173)





Life cycle of a monarch butterfly—*Danaus plexippus*—begins on the underside of a milkweed leaf when the female deposits an egg no larger than the head of a pin. The striped caterpillar that emerges 3 to 12 days later (upper left) immediately starts feeding on milkweed plants. Within two weeks the larva will have multiplied its original weight by 2,700. A six-pound baby that grew at the same rate would weigh eight tons!

The larva sheds its skin five times as it grows. The final shedding occurs when the fully developed caterpillar has stopped eating and located a sheltered perch, such as a tree limb or a windowsill. Here the larva weaves a dense mat of silk, then grips the fiber while violently dislodging its last larval skin to reveal the pupa.

This fragile blue-green pouch, studded with gold spots that control color in the developing wings, turns transparent in about two weeks, exposing the features of a grown butterfly. Cracks then spread across the chrysalis wall and the adult gingerly appears (bottom left), pumping body fluid into its limp, fleshy wings. The adult monarch—wings expanded—now soars away to propagate a new generation. The process from egg to adult takes about five weeks.

In her Mexican motel room photographer Bianca Lavies placed larva and adult on a twig with a pupa (right) to portray the insect's dramatic metamorphosis.









Warmed by the sun, monarchs descend in swarms upon a stretch of soggy ground where they draw water (left), a signal they are ready to venture north. There, flower nectar and water will be their diet. Monarchs, still sluggish, will cling anywhere, as on the coat, hat, and face of guide Juan Sanchez (below).

As days lengthen, the butterflies also begin to mate. Then they depart, flying solo at speeds ranging from 10 to 30 miles an hour.





(Continued from page 166) In the quietness of semidormancy, they festooned the tree branches (page 162), they enveloped the oyamel trunks, they carpeted the ground in their tremulous legions. Other multitudes—those that now on the verge of spring had begun to feel the immemorial urge to fly north—filled the air with their sun-shot wings, shimmering against the blue mountain sky and drifting across our vision in blizzard flakes of orange and black.

One of our guides, Juan Sanchez, added up the tall trees. He estimated more than 1,000, every one garbed in monarchs!

While we stared in wonder, a pine branch three inches thick broke under its burden of languid butterflies and crashed to earth, spilling its living cargo. I stooped to examine the mass of dislodged monarchs. There, to my amazement, was one bearing a white tag!

By incredible chance I had stumbled on a butterfly tagged by one Jim Gilbert, far away in Chaska, Minnesota. Later Mr. Gilbert sent me a photograph of the very field of golden-rod where he had marked this frail but tireless migrant.

Other Assemblies Probable

How could we be sure that this was the sole congregating area for our wintering monarchs? We couldn't. In fact, on their 1975 discovery trip, the Bruggers found two nearly equal concentrations a few miles apart. While I think it possible that the monarchs assemble in two or three or maybe even four overwintering roosts, I feel certain they are all situated within a restricted range in the same general area.

We know that monarchs will lay eggs only on milkweed plants (page 168). Because more than half of North America's hundred species of milkweed are native to Mexico, a tempting hypothesis arises. May it not be that, far back in geologic time, the monarch originated in Mexico? Now, in returning there each winter, the butterfly is "going home," after straying, perhaps over eras of a warming trend, farther and ever farther north.

Anyway, I'm convinced that the monarch's

selection of the Sierra Madre for overwintering is no random choice. Butterflies are poikilotherms, that is, creatures that adjust their body temperatures to the ambient air. At this 9,000-foot elevation, winter temperatures hover from just below freezing to just above. Ideal for monarchs! Inactivated by the chill, they burn up almost none of the reserve fat they'll need on their northward flight.

I believe the monarchs overwinter in this chosen area because it provides suitable conditions at the terminus of their naturally converging migration routes.

In our visits to the site over a span of several days we tagged about 10,000 butterflies, using distinctive fuchsia-pink labels. To our delight, two monarchs bearing these tags were recovered several months later, in April, in northern Texas, 1,000 miles from the overwintering place. Others may well appear as far north as Canada. Such an event would resolve one uncertainty: whether any monarchs from central Mexico make it back to the northern limits of the species' range.

As with our understanding of bird migration, awesome voids remain in our knowledge of the monarch's comings and goings. Not the least of the mysteries is how such a fragile, wind-tossed scrap of life can find its way (only once!) across prairies, deserts, mountain valleys, even cities, to this remote pinpoint on the map of Mexico. Certainly some instinct or programming is involved.

At the end of our last day at the site, we climbed back to the mountaintop. Scattered flights of butterflies displayed the restlessness that soon would possess the whole mass of monarchs. Some mysterious signal, probably involving the angle of light from the ascending sun, within a few weeks would trigger the northbound migration flight.

Maybe, in a few months, one of the beautiful monarchs we had just seen sipping nectar from a woodland flower would alight on a milkweed plant in my backyard at Scarborough, Ontario, to lay her eggs. Perhaps I would tag her progeny, and another numbered monarch might make the incredible journey to Mexico's Sierra Madre. □

In regal repose, a monarch drinks from a mountain stream. Having flown south to avoid killing frosts, the monarchs await the certain day when instinct again commands them north to fields and flowers.





Venezuela's Crisis of Wealth

By NOEL GROVE

Photographs by ROBERT W. MADDEN

BOTH NATIONAL GEOGRAPHIC STAFF

ASTRIDE A GLEAMING MOTORCYCLE, Felipe Brillembourg roared into a dawn filled with the hum and smog of Caracas traffic. Ahead lay a busy day: four hours of teaching engineering at Simón Bolívar University; a planning session for a graduate program; a meeting with an industrial group to form a new chemical company; consultation with his stockbroker.

At 25, the sixth-generation descendant of Dutch immigrants to Venezuela finds it easy to become involved in matters of national development, for his is a nation thirsting for technical skills. "There is terrific challenge for young people here," he had told me.

At the same time that Felipe was weaving his way through the bumper-to-bumper snarl of the *autopista*, a Yanomamo Indian was padding along a forest path near the headwaters of the Orinoco River. A tapir had been sighted near the village of Hasubowa-teri, and its 300-pound bulk would feed many families.

The Indian's hand gripped a palm-wood bow and three seven-foot arrows made of cane, and his eyes scanned the dense foliage as he ran along the path. Raiders from another village were expected, and ambush is the accepted method of warfare among these forest people. The Yanomamo tongue has no words for "national development."

It was not national development but economic

Nation on the rise: Almost completely rebuilt in the past thirty years, Caracas—capital of oil-rich Venezuela—ranks among the world's most modern cities. Boomtown in a boom country, it thrives as the cosmopolitan heart of one of South America's few buoyant economies and stable democracies.





Talk of profits—in many accents—fills a sidewalk café along Sabana Grande, a shopping district in Caracas. Since World War II more than half a million European immigrants have leavened Venezuela's already well-mixed ethnic batter. Soaring incomes, based directly or indirectly on oil, bring once-undreamed-of luxuries within range of an ever-growing upper and upper-middle class. Gleaming symbols of conspicuous consumption (left), Mercedes-Benz sedans roll off the assembly line at Barcelona, 150 miles east of Caracas. Even at \$32,000 each, there's a waiting list.

survival that concerned Diego Ramón Lopez as he cast his net into the neck of water that connects Lake Maracaibo to the Gulf of Venezuela (map, following page). His widowed mother and four younger brothers depend for support upon the fishing skills of the 21-year-old mestizo—the Spanish and Indian blend of 70 percent of Venezuela's population.

As he waited to feel the tremble of shrimp against the net, he turned in his dugout to watch an oil tanker plow by on its way to a lakeside terminal. Oil and the cities it has created hold no attraction for Diego. A true fisherman, he prefers his stick-and-thatch hut on the beach. "I like my life here," he said.

Oil—the Great Equalizer

Ambitious engineer, primitive forest dweller, canoe fisherman—all are countrymen in a nation building its future on a petroleum treasure. For half a century oil has been Venezuela's main export, a black ace in the hole that wiped out foreign debts and raised per capita income to \$2,300, highest in South America. With the quadrupling of oil prices in 1973, the blessing became a bonanza. In one year government revenue leaped from 3.7 billion dollars to 9.7 billion, for a population the size of New York City and Chicago combined. On January 1, 1976, Venezuela nationalized its oil industry, giving itself complete control of the purse strings:

Bold plans for national development accelerated—construction of factories, roads, and hydroelectric dams, reclamation of land for agriculture. Caracas, the capital city, where one in every five Venezuelans lives, proliferated its forest of skyscrapers, extended its veinlike network of freeways, slid further into modernity on skids greased by oil.

Personal wealth as well increased for many Venezuelans. "Sixty percent of the government's expenditures put money into circulation immediately, by purchasing materials, equipment, and labor for public-works projects," an industrial planner explained. "In this way, the money finds its way to the man in the street. In everything there is the hand of the government."

The growing numbers of consumers find plenty to buy. With a staggering amount of currency flowing into the country, Venezuela expends its overwhelming foreign-exchange reserves on equally staggering purchases



Venezuela

ARABIA OF THE AMERICAS," Venezuela was cast as a typically poor Latin-American land until the massive blowout of an oil well called Los Barrosos No. 2 near Lake Maracaibo in 1922 confirmed the enormous wealth hidden below. Though diversification of industry proceeds apace—looking to the day only decades hence when the



primary oil reserves will be gone—more than 80 percent of Venezuela's government revenue still comes from petroleum. Huge, yet-untapped reserves in the Orinoco River region's "tar belts" yield a heavy, expensive-to-produce oil not practical to export. This fuel may be preserved for Venezuela's own domestic use in the 21st century, when the country is fully industrialized.

AREA: 352,143 square miles. **POPULATION:** 12,361,000. **LANGUAGE:** Spanish, some Indian dialects. **RELIGION:** Predominantly Roman Catholic. **ECONOMY:** Fifth in world oil production; iron ore, diamonds, gold, coal, and bauxite. Agriculture—sugarcane, corn, cotton, cattle, coffee, cacao. Rapidly expanding petrochemical industry. **MAJOR CITIES:** Caracas (pop. 2,500,000), capital; Maracaibo (pop. 750,000), seaport, oil center; Valencia (pop. 356,000), manufacturing center; Barquisimeto (pop. 341,000), trade center. **CLIMATE:** Steamy lowlands, 75°-80° F. year-around at Caracas level, frigid on higher Andean slopes. Rainy season May-November.



abroad. Stores display a glittering board of imports—crystal from Sweden, television sets from Japan, hair dryers from the United States. In one shop I confronted a multi-layered world of porcelain figurines. "This is our biggest seller," said a clerk, carefully lifting an Italian-made owl, about four inches high. I checked the price tag—230 bolivars, about \$55. Gewgaws, the sign of affluence.

The evidence of national prosperity cannot help but dazzle the first-time observer in South America's sixth largest country. Here, on a continent where military rule is commonplace, sits a stable, modern democracy with a huge national income—and an energetic president who insists that the country's money be spent responsibly.

Crisscrossing Venezuela in a two-month visit, I encountered a kaleidoscope of cultures that will ultimately be touched by petroleum wealth. I also learned of the clouds that threaten to dim this nation's rising star.

The problem: Oil is finite, even the enormous reservoirs of petroleum in Venezuela. The income from it will eventually taper off. Venezuela is racing to develop government-owned steel, aluminum, and petrochemical industries, whose exports will, it hopes, take up the slack. Can it be done in time?

A former oil minister says that Venezuelans are being spoiled by easy money, that imports are curbing the growth of production. Can austerity be taught in an era of plenty?

Will a population riding on economic enthusiasm become restless and dissatisfied when the national bandwagon runs out of gas—or more precisely, oil?

Amid the Riches, Poverty

Development, growth, enthusiasm—these words describe a young person, or a young country. "Try to think of Venezuela as an adolescent," suggested a Caracas university student. "It feels things pulling it in many directions, and it is full of contradictions."

I could see the most obvious contradiction as I traveled car-clogged Avenida Libertador on my way to ornate, gilded Miraflores Palace, to talk with President Carlos Andrés Pérez. On the fringes of plenty, the makeshift *ranchos* of the poor cling like swallows' nests to the hillsides around the city (pages 184-5). Almost one in three households in the expensive metropolitan area lives on a monthly income

of less than \$230. Caracas's cost of living is the same as London's.

The pressures and the contradictions are well known to President Pérez, who sees Venezuela as a testing ground for democracy in a coup-ridden continent. "The problem of the concentration of wealth in a very few hands has not been truly confronted in Latin America," he explained, as we sat in his high-ceilinged office. "In the past, we have had simply *political* democracies."

Black Treasure Robs Incentive

By increasing customs tariffs and forbidding imports on many "unnecessary" items, he hopes to stimulate industry within the country, and thus create jobs that will provide income for the poor.

"We are undergoing a very difficult time," said the 53-year-old president. "Since petroleum appeared, an irresponsible mentality has been shaped—the feeling that we shall always have money, and that money will solve all our problems. To redirect this attitude, we set a ceiling of oil production at 2,200,000 barrels a day. This limit implies a warning to the country and imposes limitations on the government."

To hasten development of other major industries, he has announced plans to borrow perhaps 7½ billion dollars abroad.

The road to development, however, is potholed with change. At a hilltop park in Caracas I stumbled upon a festival aimed at preserving the nation's heritage. Crowds pressed close around a makeshift stage to hear a handsome *Caraqueño* croon a Venezuelan love song.

"Our young people listen to North American songs on radio and television and lose contact with their own music," said Señorita Issoris Tovar, who had organized the festival. "Even if a society changes its technology, it should still retain its culture."

We moved aside to let white-clad young men and women dance onto the stage in the stutter-stepped *joropo*, a wheeling, flirtatious dance that is as Venezuelan as the Highland fling is Scottish. "Most people learn a dreamy Hollywood version on television," complained folk-dance teacher Mercedes Santana. "The real *joropo* consists of jerky, stamping movements, the earthy prancing of a spirited horse." (Continued on page 184)





Kaleidoscope of climes distinguishes South America's sixth largest nation. In the Andes to the west soars the 16,427-foot crag of Pico Bolivar (left), the nation's highest point. In the forested Gran Sabana region, the Rio Carrao (above left) snakes toward its union with the Rio Caroni. On the torrid northern coast, silt from the Rio Tocuyo muddies the clear blue of the Caribbean, cut by a speedboat's wake (above right).





High-rise democracy: At first glance these sleek apartment buildings in Caracas look like luxury condominiums. In fact, they are low-cost, government-subsidized housing—contributing to Venezuela's high standard of living.

The sound of white ash hitting horsehide echoes from nearby sandlots, where Caracas youngsters dream of emulating such renowned Venezuelans as Luis Aparicio and Dave Concepción, baseball stars of

major-league teams in the United States.

With 65 percent of the population under 25, only an ever-shrinking older generation remembers days of dictatorial rule, which ended in 1958. Now, in an era of confirmed democracy, all Venezuelans are allowed—in fact, are expected—to speak out. Residents of a neighborhood in Caracas vocalize their problems and expectations with Diego Arria (left), the dynamic young governor of the Federal District.

National heritage notwithstanding, larger crowds turn up at the *beisbol* park, where Venezuelans watch off-season North American major leaguers such as Diego Seguí and Venezuelans César Tovar and Dave Concepción. I opted for small fry over the superstars and attended an evening game between two teams of eager 9-year-olds.

I had barely settled into my seat when *bate* met *pelota* with a resounding crack, and the crowd leaped to its feet. It was definitely a *batazo*, good for extra bases. Sure enough, the runner slid into home plate just ahead of the throw, and the crowd shouted, “¡Jorrón, jorrón!” The language of *beisbol* is an intricate marriage of Spanish and English. The losing team, for example, had adopted the name of the Mets of New York, but spelled it Mezz in Spanish, which is pronounced Mess—a name that admittedly loses something in the translation.

Lakefront Homes Spoke of Italy

The *hamburguesa* has infiltrated Venezuela, but it is still outsold by the *arepa*, a hot cornmeal bun filled with meat or cheese. Fast-food stands march hand in hand with the heightened pace of life, but modern technology has not hurt the *batido*; electric mixers instead of hand churns now grind fresh tropical fruits into this traditional drink of milkshake thickness—an explosion of taste.

With the Yanomamo of the upper Orinoco I savored a *batido* of bananas mashed in a wooden bowl; the drink probably existed when Columbus first sailed past the mouth of the great river in 1498. Indian houses on stilts at Lake Maracaibo inspired early Spaniards to call the country “little Venice,” or Venezuela. As a Spanish colony, it gained little attention, for it offered only a few pearls from the island of Margarita and a black, sulfurous tar that oozed from the ground. Colonists called the tar the “devil’s excrement,” and shipped bottles of it to Spain as a gout cure.

The agricultural and trading center of Caracas gained notice as the birthplace of liberator Simón Bolívar, who freed Venezuela and much of the rest of Latin America from Spanish domination in the 1820’s. Civil strife divided the nation for most of the remainder of the 19th century.

United though Venezuela now stands, I sometimes felt

(Continued on page 188)



Sun-gilded poverty: The day’s last rays give a plating of gold to *los barrios*—“the neighborhoods”—ramshackle slums clinging precariously to hillsides around Caracas (above). The jerry-built dwellings (right), called *ranchos*, have been constructed illegally on state-owned land. The government tolerates the squatters while trying to absorb them into the job market and into low-cost housing like that in the background at top. One thorny problem: Many barrio residents have no desire to move to the modern developments, where at least a minimum rent must be paid. Here most pay no rent at all. What’s more, many of the rural immigrants prefer the relaxed, community life-style, however squalid.





Shallow waters run deep with oil where forests of derricks pump the black lifeblood of Venezuela's economy from beneath Lake Maracaibo. These wells were owned by



Exxon until January 1 of this year, when the Venezuelan Government completed the orderly, compensated takeover of all petroleum facilities within the country.

(Continued from page 184)

I was in several countries at once, for the contrasts of the land are as startling as those of the people.

In northwest Venezuela the high, cold, spectacular Andes split into two ranges. Between the two lie coastal lowlands, with ovenlike temperatures that burn the land into wind-carved desert.

Across the middle of the country stretch plains called *llanos*, brush covered and billiard-table flat, nearly drowned half the year, choked with dust during the remainder. Farther south the land rises in the Guiana Highlands, a region of forests, grassy *sabana*, and strange geological architecture.

Income Once Hoarded by the Elite

"The highlands are the oldest land in Venezuela," explained petroleum geologist Gustavo Coronel. "At one time they formed the north coast of South America; the rest of what is now Venezuela was a shallow sea."

Organisms died and sank in the stagnant water and, in their slow decay, bequeathed the world an immense supply of oil.

North American and European companies sought and began to pump out this treasure in the early decades of the 20th century, and on it a succession of dictators built personal fortunes. Education, health, and employment were neglected until the last despot, Marcos Pérez Jiménez, fled Caracas in a small plane in 1958. In his haste, he left behind one suitcase stuffed with millions of dollars. Nationwide reforms came in 1959 with a freely elected president, Rómulo Betancourt.

Although crude-oil prices soared in 1973, Venezuela still depended on foreign oil companies to operate the intricate industry. The concessions of most ran until 1983, but Carlos Andrés Pérez announced after taking office in 1974 that he intended to nationalize the industry. The foreign companies were devoting adequate maintenance to their equipment, but were undertaking only minimum exploration, he charged; by waiting, Venezuela would inherit a substandard industry. "The Venezuelan people have decided to write their own history," he declared.

Not all Venezuelans share his confidence. "Many times I have heard Venezuelans talking among themselves about how inefficient we are," said Aura Mayoral, a Caracas journalist. "We have had an inferiority complex

about our management abilities." Geologist Coronel, a director of the new national oil company called Petroven, agrees, and adds: "Even if, at first, we don't gain a lot economically by nationalization, we stand to gain much in Venezuelan identity and pride. The discovery that we can run this complicated oil business is important to national morale."

The takeover on January 1, 1976, was smooth and amicable. Foreign companies will be paid a billion dollars for their assets. Venezuelans had filled most positions years before, at the government's insistence; few changes in personnel occurred.

Months later Petroven appeared to be on a steady course. "What's the difference since nationalization?" I asked Juan Zorilla as we stood on a steel platform a mile offshore in Maracaibo, South America's largest lake. Everywhere forests of steel structures spiked the shallow waters—more than 8,000 wells in all (preceding pages).

Juan, an oil-field mechanic, was hired 28 years ago by Creole Petroleum Company, a division of Standard Oil of New Jersey. Now he works for a Petroven subsidiary. "I work with the same people as before," he shrugged. "My salary is the same, 56 bolivars a day [about \$13], and although my house is rent free, the money still goes for school and living expenses for my seven children."

The difference was plain to an eager young engineer on another rig, however. "Now that the oil is ours, we are working for ourselves," said Hector J. Mata Alvarez. "Money coming into the government will be used to build more schools, roads, hospitals."

When the Treasure Runs Out, What?

Some 32 billion barrels of crude has been pumped from Venezuela, most from beneath Lake Maracaibo, a 133-by-72-mile depression that sank when the Andes rose. Perhaps 18 billion barrels remains, about enough for 20 more years. New discoveries—and there have been a few—could alter that forecast.

"The 18-billion-barrel figure doesn't include the heavy-oil belt in the Orinoco region," said Alirio Parra, also a director of Petroven. "Reserves there were estimated at 700 billion barrels five years ago, and now the estimates are much higher. But with present technology, only a tenth of that amount is economically recoverable. It is a very heavy,

high-sulfur oil, and the cost of producing it will be very high. One might consider it a source of domestic energy in the future, but not of significant fiscal income."

Twenty years of oil income remaining! Can Venezuela build the rest of its economy in time to take up the slack? And who will build it? Years of educational neglect have left Venezuela with a crisis in expertise.

"We do not have money problems, we have people problems," said Patrick Bertou, a government human-development official. "We know that we must develop quickly, but we need the skills to do so. It's like having a big car in front of your house but not knowing how to drive it."

Other Nations Tapped for Expertise

On the second floor of the magnificent Torre Europa, which an office worker proudly told me was "the most beautiful office building in Latin America," Andrés Duarte helps wage an international search for talent. "We have brought in European and North American specialists, including retired people, as consultants, but we need people who can stay and help this country grow," he said, his tie loosened, his dark hair falling over his forehead. Around us, doors slammed, telephones jangled, unhung pictures stood leaning against the wall. The Human Resources Program offices throbbed with the vitality of a campaign headquarters.

The search for technicians includes a scholarship program that has granted free training to about 10,000 young Venezuelans. More than half have studied abroad, some 3,900 of them in the United States.

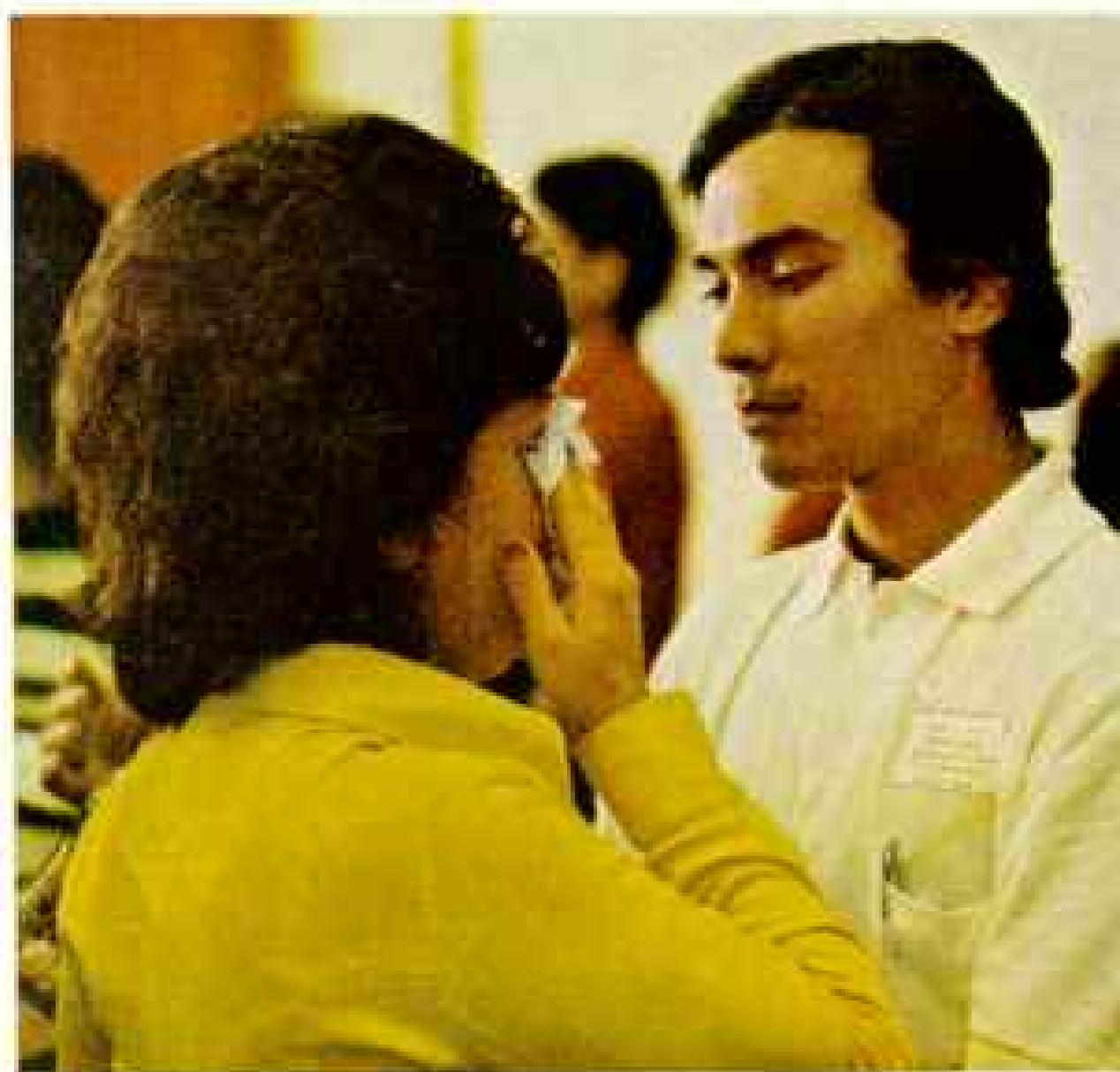
Zarina Aponte plans to study nutrition at the University of Maryland. "Venezuelans eat so many carbohydrates—rice, black beans, plantains—that they get fat, but they are not well nourished," she told me. "They have less energy on that kind of diet," she said, "so I will be helping my country's development by teaching them to eat properly."

If the nation's diet is deficient in energy, its streets most certainly are not. Gasoline sells for as little as 12 cents a gallon, and Caracas traffic can play havoc with the sturdiest psyche. The auto bug has bitten the country, and the American, European, and Japanese cars assembled at the northern industrial centers of Valencia and Barcelona are back

ordered. Traffic police are rarely seen; Caraqueños exceed speed limits, run stop lights, ignore one-way street signs. Drivers live by the horn and, increasingly, die by it. Fatalities have tripled in ten years.

Traffic is only one of a galaxy of problems facing the city, bursting at its mountainous seams. Garbage collection once fell behind so badly in the suburban town of Petare that fleets of trucks were marshaled from throughout Caracas to remove the smelly excess. As the middle class expands, the number of frustrated have-nots increases; thus, crime is on the rise. A watchtower loomed above the parking lot of my hotel; it housed a shotgun-armed guard on the alert against thievery.

"The main problem is not money, but a lack of the sense of community," said Caracas's young governor, Diego Arria. "We need volunteers. I believe we'll get them by reforming the tax laws to show that we care, and by talking about our problems with the people."



Tears of pride moisten a maternal farewell at Maiquetia International Airport near Caracas, where a Venezuelan student prepares to leave for studies abroad. In two years, full government scholarships have sent some 5,300 students to schools and universities in other countries—most of them to the United States—as part of a program to increase technological self-sufficiency.



Homes for the hinterlands: New government-built housing in Venezuela's fast-developing backcountry provides workers in fledgling industries with inexpensive living accommodations. Duplexes at Ciudad Guayana (left) sell for about \$5,700 each. The mushrooming industrial hub expects a population of half a million by 1985. Towel bur-noose protects one of the first residents (right) against the heat of aluminum-processing units.

Pumpkinlike ultramodern homes (below) house workers at the Caroni River's Guri Dam, which will be one of the world's largest hydroelectric plants when expansion is completed around 1990.





Talking with the public is an art at which the handsome 36-year-old governor excels. In a series of open forums last year, 1,682 civic complaints were filed; 88 percent were resolved by his Citizen's Attention Office.

"Some of our problems are different from those of other cities," he said, "because 40 percent of our growth is by *marginales*—people in the *barrios* who have come to this city with little education and few skills."

The Barrios: A Step Forward?

Marginals. I couldn't decide whether the word sounded harsher in English or in Spanish. As I picked my way along the steep slopes and nondescript shacks of Barrio Observatorio, a group of young men watched.

Did they live here in the barrio? "Sí," answered a tall, muscular 18-year-old named Miguel. "*Nosotros somos marginales.*" His voice held neither pride nor bitterness. No

slum is a pretty place to live, but the barrios of Caracas reflect measures of hope along with despair. Some rural immigrants to the city view the rent-free shacks as halfway houses on the way to the "good life" of automobiles and expensive homes they see in the valley below. In a reluctant acceptance of the poverty pockets, electric companies allow some free service, and where streets are too narrow for garbage trucks, the city buys refuse from whoever will collect it.

Maria Sanchez and her husband both work and could easily afford to move into an apartment in one of the city's low-cost housing projects. But like many from the country, they prefer the run-down but familiar atmosphere of their rancho.

"I would have no place to hang my wash, no place to grow a few things," Maria told me outside her construction-block shack. "And where would the children play?"



The increasing crime in the barrios may force them to leave. "I have seen purses snatched and people robbed at gunpoint right outside my door," she said.

They had come to Caracas from the east twenty years before, looking for a better life for their children. "Perhaps we would have been better off staying in the country and growing our own food," she said. "Here we earn more money, but we spend it all."

New Programs Keep Farmers at Home

The concentration of wealth in the cities has for years drained the countryside of *campesinos*—small farmers. Ironically, the nation that is now the wealthiest in Latin America is still unable to feed itself. To its embarrassment, Venezuela imports its national staple, black beans, along with other food.

In a sweeping program of agrarian reform, enacted in 1974, debts of many small and

medium-size farmers were wiped out, and low-interest loans made available. Machinery prices were stabilized, minimum guarantees placed on crop prices, and plans have been announced for construction of enough new rural roads to span the United States three times. Farmland that lies idle can be confiscated by the National Agrarian Institute and redistributed to those who will cultivate it.

"Until 1974 Venezuela operated almost totally on an oil mentality," said Agricultural Minister Carmelo Contreras Barboza, as he outlined the new program for me. "It is not good for a nation to have a big head and an empty stomach."

On a leisurely Sunday afternoon in the countryside of the Andes, I learned of one campesino's small contribution toward solving the black-bean crisis.

I had stopped along the road to watch groups of men rolling heavy, grapefruit-size



Pulsing aorta of Venezuela's wild heartland, the Orinoco—mightiest river between the Amazon and the Mississippi—flows majestically seaward. Seen here in its middle reaches, the 1,600-mile waterway broadens downstream to widths of more than five miles. Some fifty mouths channel its gigantic flow into the Atlantic.



Dancing devils through the streets of San Francisco de Yare on Corpus Christi Day. Grotesquely garbed revelers stomp and whirl to a bedlam of drums and



rattles, symbolically exorcising the devil from their midst in a volatile ritual mingling elements of Indian, African, and Roman Catholic religious tradition.

balls on the hard-packed earth outside an adobe tavern. "Señor, why don't you come try it with us?" said the owner, José Angel Santander, a slender man in his late 20's. Vaulting a board fence, I found myself with a beer in one hand and a wooden ball in the other, discovering the Venezuelan pastime of *bolas criollas*.

José tossed a small golf-size ball 15 or 20 feet away. The object was to roll the larger wooden balls as close as possible to it.

My first ball sped swiftly past the target, made a right turn down a slope, and headed for Brazil. The second stopped far short. The third approached within a yard of its small target, but José neatly knocked it aside.

My opponent and host, I discovered, was now a farmer as well as a tavern owner. "I have 80 hectares [200 acres] of formerly idle land that I acquired through the Agrarian Reform Law," he said. "I plan to plant it all in black beans. A government expert will give me advice on how to grow them."

Boom Reaches Into the Hinterlands

We watched his friends bowling enthusiastically as their families cheered them on. "It is not good," said José, "for too many people to move to the cities."

I agreed. And at the opposite side of the country a few days later, I learned of a farm plan that is keeping many people on the land.

The biggest program of regional development in Venezuela—perhaps in all Latin America—is taking place in the Guayana region in the southeast. The task of building industries and providing energy to serve them and establishing urban centers to house the workers and farms to feed them was undertaken in 1960 by the government's Venezuelan Guayana Corporation (CVG).

Some of Venezuela's richest soil lies in the vast marshy area where the Orinoco River exits to the sea. With a series of dikes built in 1969, CVG claimed 740,000 acres of rich

land, like Dutch polders, from the sprawling Orinoco Delta.

"A man may start with ten hectares, bought with credit advanced to him by the government, for growing black beans, corn, and plantains," said José Luis Marin Mata, an agricultural technician who manages his own plot and gives technical assistance to others. "Groups of small farmers are encouraged to market their products in cooperatives, and then split the profits." If a farmer demonstrates his ability to manage ten hectares, he can apply for more cropland.

The aim is to feed Ciudad Guayana, a new city formed by combining and expanding two old neighboring river ports, San Félix and



Time spins to a standstill in the Andean village of Seboruco. Evoking the Venezuela of pre-oil days, a lad twirls a wooden top in a near-empty street. With agrarian reform and a broader industrial community, the government attempts to revitalize such hinterlands abandoned in favor of city life.

Puerto Ordaz. Driving down the broad avenues and neat side streets already built is like a journey through a futuristic ghost town. Ciudad Guayana is a metropolis in search of a population (page 190).

Honing Steel for the Future

The pillar of the community—and the future national economy—will be steel. I drove eighty miles south of Ciudad Guayana to find its major source, stair-stepped Cerro Bolívar, where for 22 years men and machines have been stripping off iron ore. “It’s like taking the peel from an orange,” said Eduardo Boccardo, spokesman for CVG’s mining company, Ferrominera Orinoco, as we stood atop

the 1,600-foot promontory. Nearby, dust rose like fog as a power shovel bit into the hill and in three gulps loaded a house-size truck with ninety tons of ore. Cerro Bolívar furnishes 60 percent of the country’s iron ore and will last another 25 years at the present rate of mining.

“When this is finished, more lies over there,” said Señor Boccardo, pointing to a line of blue hills in the distance.

Ninety percent of the 25 million tons of ore annually produced here is exported—but expansion of the SIDOR steel mill at Ciudad Guayana promises to change that.

“Within ten years we may not be exporting ore at all,” a company representative told me.



"We will use it all for our own iron and steel, and export only manufactured products. That will mean more jobs for our people."

A red-hot steel ingot of several tons lent an eerie glow to a glass-protected room at SIDOR, as José Montaña directed the monolith between huge rollers. "I came from a small farm in the Oriente—northeastern Venezuela," he said as he pushed buttons and flipped levers. "I like working this big machine. And I know that the work is important to the country."

Workmen Outperform Their Teachers

I might have taken his words as patriotic sloganeering, but they were backed up by facts. "The men who work at this job have surpassed the production of the German technicians who trained them," my guide said.

A short distance across the town-to-be, the ALCASA aluminum plant, owned jointly

by Venezuela and Reynolds International, sells 60 percent of its output to manufacturers within the country and exports the remainder. More supplies for the nation; more non-petroleum income for its treasury.

Part of the aluminum processing is done in the United States, but that too will change. "Ours is the only aluminum-reduction plant in South America that is now expanding," explained Guillermo Cárdenas. "Aluminum making requires large amounts of electricity, and we have a plentiful, cheap supply."

It comes from a dam called Guri. The nation that already has one of the world's largest supplies of oil may soon boast one of the biggest hydroelectric dams. Built on the silt-free, swift-flowing Rio Caroni, it already provides nearly half of the electricity for all of Venezuela. By raising the dam 164 feet and adding 13 more turbines by 1987, CVG



will increase Guri's present output sixfold.

Steel, aluminum, agriculture, energy—what else is needed on Venezuela's road to self-sufficiency? Paper, of course, to keep track of it all. In 1969 CVG began planting thousands of acres of Caribbean pine north of Ciudad Guayana. Although 40 percent of Venezuela is covered by tropical forests, few of the trees have commercial value. From horizon to horizon the pines now stretch across the flat, previously treeless sabana. Each year another 25,000 acres are planted. Harvest will begin in 1984.

"Soon we have to start thinking of pulp mills," said Dr. Andrew G. Halfhide, a former Trinidadian, now submanager of the forestry program. More technology needed.

As leisure time expands along with the economy, many Venezuelans wander back to the forested wilderness to taste of its mysteri-

ous beauty. Erosion over millenniums has carved the Guiana Highlands into a geologic museum. Flat-topped, sheer-sided mountains called *tepuis* rise from the forest like huge corks. Gaping sinkholes a thousand feet deep dot a broad plateau, as though celestial giants had pogoed across the land. The kind of *Lost World* that Sir Arthur Conan Doyle described more than two-thirds of a century ago remains largely unexplored.

Man's Intrusions Mar Wonderland

Doyle's book helped draw U.S. botanist Julian Steyermark to Venezuela, and numerous expeditions to the highlands. "It's a treasure-house of flora," he told me. "If you sent an amateur into the *Lost World* area and let him pick plants indiscriminately, chances are that one in ten would be a new species."

But recently, (Continued on page 204)



Taking fury by the tail, madly galloping Venezuelan horsemen strive to flip a bull on his back in the bruising but bloodless pastime of *toros coleados*, meaning "bulls flipped by the tail." When at work, rough-and-tumble cowboys often ride barefoot, except for spurs (above)—a practical way of avoiding soggy boots in the oft-wet plains, or *llanos*.





Lifesaving catchments supply water to cattle during the parched dry season in Venezuela's llanos, a region of alternating flood and drought. Like a vast green carpet from 50 to 250 miles wide, the llanos unroll from the base of the Andes to the Orinoco River Delta—a distance of 800 miles.

Diamonds take a backseat to oil in Venezuela's income, but their glitter draws speculators to the Guiana Highlands. Output of about a million carats a year places the nation eighth in world production. Miner (right) sells his precious gleanings from the gravel of the wild Rio Guaniamo. The hard-won money usually flies fast in gambling and merry-making at primitive diamond camps (below), where riches-to-rags tales abound.



Threatened by progress, animal denizens of the formerly game-rich llanos keep a low profile. Despite the country's two-year ban on hunting—except by primitive Indians—poaching has seriously depleted game stocks. Cousin to the alligator, a caiman (**below**) patrols the surface of an algae-covered pond in search of food. This specimen at an experimental project in Caracas was artificially incubated—part of conservationist Tomás

Blohm's long-range effort to ensure the survival of these tropical crocodylians.

Momentarily mum, an anxious red howler monkey (**right**) takes refuge from intruders among the spines of a palm. Like miniature hippopotamuses, a pack of blunt-nosed capybaras gallop toward a water hole (**lower**). Partially webbed feet help these world's largest rodents—weighing as much as 100 pounds—swim and dive gracefully.





(Continued from page 199) Dr. Steyermark pointed out, atop a mountain called Auyán-Tepuí, botanists found disturbing evidence of the species *Homo sapiens*—a pile of tin cans. Will tourism eventually leave its mark on the world's highest waterfall, cascading nearby?

Natural Wonder Has an Apt Name

I am happy I got to see Angel Falls as its discoverer, Jimmy Angel, first did in 1935, from the cockpit of a single-engine airplane. The approach is through towering canyons, past mist-wreathed spires that look close enough to touch. The sudden sight of the majestic falls, pluming some 3,200 feet down the side of Auyán-Tepuí, is breathtaking and startling (page 209). Pouring from an obscure channel about 100 feet from the top, it dissolves into a fine mist at the bottom, caressing the rocks with a touch surely as soft as an angel's wing. I looked, and marveled at the

world's good fortune that the falls had not been discovered by a man named Smith.

I missed the ground-level view of the falls because "Jungle Rudy" Truffino had told me that the Churún River below the falls was too low for the five-day canoe trip. I believed him, for this hawk-faced Dutch immigrant has lived in the region twenty years. Lately he has seen civilization leave a disturbing imprint on his tropical paradise.

"Capybaras used to sit on the lawn in late afternoon," he told me at his quiet tourist camp along the Rio Carrao. "Deer would run past the house, and once I looked up and saw a jaguar watching me, right over there."

Now the capybaras, rodents weighing as much as 100 pounds (preceding pages), come out only at night, and jaguars are rarely seen. He blames illegal hunting, unsupervised burning of the forest by Indian subsistence farmers, and low-level flights by DC-9 jets.



The airplanes scream over the jungle to land at an airstrip just thirty minutes downstream by motorized canoe, at the seven falls of Canaima, a new tourist spa. In 1975 some 14,000 people viewed the falls from the terrace and bar just above the palm-fringed swimming beach.

"People should come to see the beauties of the forest, not just to drink and throw their junk around," says Rudy, a man embittered by the changes he has seen.

Gunfire — and Fire — Endanger Wildlife

Surprisingly, the open llanos, not the jungle, have been Venezuela's greatest repository of game. Hunting, except that done by Indians in the interior, was suspended nationwide two years ago by President Pérez. But heavy poaching continues.

"We found eight red howler monkeys one day, senselessly shot and lined up along the

road," said Tomás Blohm, a cattleman and conservationist, whose llano ranch doubles as a wildlife preserve.

As we drove the dusty backroads of the 8,400-acre Blohm ranch, deer bounced away in the distance, a fox stared at us curiously, and Brahman cattle glided into cover, their neck humps skimming over the brush like shark fins. The dry, heat-blached vegetation occasionally came alive with the flutter of tiny, brilliant-green miniature parrots called parrotlets. At a quiet lagoon a six-foot caiman let me approach within three yards, merely opening its tooth-studded mouth as if to comment before sliding into the water.

"Fires pose a bigger danger to wildlife than poachers," said Tomás. "Some land is burned every year—ranchers and farmers think it helps regrowth. But when the vegetation cover is gone, the ashes and minerals are blown away by the wind. Then the soil hardens



Fun under the gun: Keepers of law and order stroll packed beaches on Margarita Island during Holy Week, when Venezuelans flock to balmy Caribbean shores to shake off urban cares. Tourists are sometimes jolted by the frequent sight of submachine guns in public places, seeing in such an emphatically visible military presence a worrisome carry-over from the old era of dictatorships. But most Venezuelans look on such matters with good-natured tolerance—accepting the show of muscle as a warning to potential troublemakers.





Seining for living silver, fishermen of Margarita Island share the sea's bounty with pelican hangers-on. Part of the old Spanish Main, the island was sighted by Columbus in 1498 just after he had made his first landing on the American mainland, at



nearby Paria Peninsula. Spanish explorers sailing after him along the Caribbean coast discovered villages built on piles in Lake Maracaibo; reminded of Italy's canal-threaded city, they bestowed a new name on the region—Venezuela, or “Little Venice.”

and erodes, and wildlife lose their habitat.

"Slash-and-burn agriculture in the once-forested hills upstream also has had an effect; rainy-season waters run off all at once. After four severe dry seasons, we now have an alarming water shortage. Everything happens so fast that we seem unable to deal with it, no matter how much oil money the nation has."

Ironically, the nation's most vocal critic of the fast-moving, oil-fueled prosperity is the man who was instrumental in bringing Venezuela its embarrassment of riches. As a former oil minister and a founder of the Organization of Petroleum Exporting Countries, Juan Pablo Pérez Alfonzo paved the way for the oil-price leaps of the early 1970's.

"I may be the father of OPEC, but now sometimes I feel like renouncing my offspring," he told me at the large home in Caracas that he and his sons built 35 years ago. "The income from oil has discouraged us from trying to do with less and arriving at solutions through hard work. That is why we have a line of ships at our harbors, loaded with goods; we think we can solve our problems by buying outside."

Between Battles, Tranquillity

Shortly after my visit, the 73-year-old Dr. Pérez Alfonzo, sprightly and cheerful despite his grave concerns, announced his plan to move to an agricultural setting in the eastern part of the country to demonstrate his belief in the need for self-sufficiency and a conservation of fossil-fuel energy.

In this nation of high-rise buildings, traffic jams, and fiscal concerns, I found perfect models of self-sufficiency among Venezuelans who know nothing of the country's development, nor even of its existence.

Dawn in the rain forest comes like a jaguar's padded footstep. Creeping through mist and the thick canopy of green, its exact arrival is not known, but its presence is suddenly felt.

In such a catlike dawn, deep in Amazonas Territory, I awoke with a sense of unease in a mud hut built by anthropology student Kenneth Good, near the Yanomamo village of

Hasubowa-teri. The tribesmen were expecting an early-morning attack from a neighboring village. Fortunately the raid never took place—but throughout the day nerves remained as taut as the drawn bowstring I imagined behind each bush.

Warfare looms large in the lives of the Yanomamo; it is their heritage and their pride. (See article that follows.) But for all their fierceness, they have a sociable, well-ordered existence within the confines of their fortlike villages. They live under a common roof, hang their weapons and ornaments from roof beams without fear of theft, and share meat when hunting is successful.

They called me *shori*—friend—and offered me food. I said yes, *awei*, to all but a handful of fat, squirming ants.

Concerns Strike a Familiar Note

"Most of their diet is made up of plantains and bananas, and sometimes manioc, grown in gardens near the village," said Ken, who is cataloging Yanomamo eating habits. "They could probably survive without hunting, but the men say they get *naiki*—meat hungry. Perhaps when the energy consumed begins to exceed the energy gained by the hunt, they move the village to a more productive area."

Energy, consumption—how similar to the language I had been hearing days before in Venezuela's other world.

Later that day I saw a flash of puzzlement cross the face of a young Indian studying a matchbook he had found near Ken's hut.

"*Shori, wedi ka ta?*" he said suddenly, holding it up. I looked at it and guessed at his question. On the flap was a picture of Caracas, with high rises and looping freeways.

"*Caracas-teri,*" I answered, adding the word that in Yanomamo designates a village.

"*Caracas-teri,*" he echoed, looking at it again. "*Awei, Caracas-teri.*"

Another village. Another hunting area. He tossed the picture aside with no further interest. The Yanomamo has reached an understanding with his world. I hope his countrymen reach an understanding with theirs. □

Feathery plume that caps the nation's beauty, Angel Falls hurtles three-fifths of a mile from the towering brow of Auyán-Tepuí, a flat-topped mountain. The world's highest waterfall—16 times the height of Niagara Falls—was discovered in 1935 by U. S. aviator Jimmy Angel, who was searching the Gran Sabana for the legendary treasure of El Dorado.





Yanomamo, the True People

ARTICLE AND PHOTOGRAPHS BY
NAPOLEON A. CHAGNON, Ph.D.



BOTH BY NATIONAL GEOGRAPHIC PHOTOGRAPHER ROBERT W. MADDEN

“WHAT HAPPENED to the baby?” I whispered to Bahimi. We sat huddled under the eaves of the great sloping roof in the circular village (left), far beyond the last road of southern Venezuela. Bahimi’s cheeks were smeared with black “sadness,” a crust of dirt mixed with tears, to signify her mourning. Across the village, women were returning home with firewood. Bahimi gazed at them without seeing.

“She exists no more... I... I...” More tears welled up in her soft brown eyes, and I knew then that she had killed her daughter at birth.

Kaobawa, her husband and the village headman, pressed my arm gently

and whispered softly: “Ask no more of this, my nephew. Our other baby is still nursing, and he needs the milk.” Firm, astute, and confident, he had the quiet dignity of a great leader. I nodded to him and changed the subject.

Scattered along the Venezuela-Brazil borderlands (map, following page) are 15,000 Yanomamo in some 150 villages, their seemingly simple farming existence complicated by politics, diplomacy, and warfare. Kaobawa had told me in detail about the many wars he and his village had fought with neighboring groups. He described how he and his followers had broken away from their parent village, and told of his

people's long war with Moawa's village.

I thought of Moawa and the stark contrast in his leadership compared to Kaobawa's. Much younger and more aggressive, Moawa at 35 had just taken his eighth wife, a young girl (preceding page) forcibly appropriated from another man in his own village.

An anthropology professor at the Pennsylvania State University, I have been studying the Yanomamo for 12 years and have lived with them for four.* I have gradually come to realize that a chronic shortage of women determines much of these Indians' social structure. One theory in anthropology is that warfare among primitive peoples can usually be traced to conflicts over land or water or some other inanimate strategic resource. Another view holds that blood relatives do not war against each other. The Yanomamo refute both theses by their actions.

Raiding Strength Is Prime Concern

To some extent their warfare mirrors our own. Each village behaves like a tiny nation-state, cherishing not only its sovereignty but also its capacity to wage war. Like nations, villages must ally with others, or the stronger will take advantage of the weaker.

No village with fewer than 40 inhabitants can last long, since it would have too few men for adequate defense. And that is the main reason Kaobawa and Bahimi want the potential warriors that male infants represent. Yet as a village grows larger, it becomes more difficult for the Yanomamo to hold it together through kinship and marriage ties, or by the charisma of a headman.

"When we are many," explained Kaobawa, "we fight among ourselves all the time—it is always over some woman." Such fights flare up, subside, and break out again, pitting close relatives against each other in skull-cracking club fights. Most villages break apart before they reach 125 people.

Alliances enable each village to call on friends for help in raiding other villages, or for temporary refuge from the raids of enemies. Yet allies cannot be

trusted, for they are tempted to abduct the women of visiting friends.

Even so, alliances are essential, and the Yanomamo have developed an intricate social intercourse that permits them to mask their real political intentions. They focus attention on trading, for example, making much over the exchange of such common items as spun cotton or curare-poisoned arrow points.

Trading alliances begin cautiously; visitors bring baskets and arrow points but leave women at home. As confidence grows, villages begin to invite each other—including the women—to feast.

Wild anticipation precedes the feast. Young men and women paint their bodies with red pigments and adorn themselves with colorful feathers. When the guests arrive, the leaders speak of political matters and air any grievances they might have. They may even decide to settle disputes by a formal duel.

If the allies are intimate friends, an emotional ritual—consumption of the ashes of some deceased kinsman—expresses their solidarity. The ashes are mixed in large half-gourds of plantain soup, which are passed from hand to hand for drinking.

*The author recounts many other experiences among the Yanomamo in the book *Primitive Worlds: People Lost in Time*, available from the National Geographic Special Publications Division, Box 2806, Washington, D. C. 20013.



Rerebawa, one of my closest Yanomamo friends, happily told me, "Make sure that you tell your wife to send me a gourd of your ashes when you die—I will drink them in friendship, for you are almost a real Yanomamo now, almost one of the true people."

Allies can also demonstrate their friendship by shamanism. When the men in the villages take hallucinogenic snuff, they call on their beautiful *hekura* spirits—tiny humanlike beings who live in the distant hills—and melodically entreat them to bring sickness to their allies' enemies.

Modern Tools Bring More Women

Fortunes of war in the tropical forest change, and onetime enemies may become honored friends. Kaobawa's village is now making peace with Moawa's after 25 years of mutual raiding and bitter animosity. Moawa's village wants steel tools, and Kaobawa has direct access to them at a mission post. Kaobawa's group will use this monopoly to great advantage, demanding more women from Moawa's group than it had planned to give. Resentment will finally surface, and the alliance, like all Yanomamo alliances, will crumble.

The subtle and intricate interrelationships that make Yanomamo warfare and politics scientifically important

are rapidly disappearing. Each year new mission posts are built, and in their wake come airstrips, metal tools, and weapons. Diseases—measles and influenza—have already struck with devastating effects.

The appearance of shotguns in a few villages has had a drastic impact on the scale and seriousness of wars. Fighting between villages has broken out where it did not exist before. Pondering these changes, Rerebawa concludes: "Give a fierce man a shotgun, and he becomes even fiercer—the gun makes him want to kill without cause."

The airstrips attract the planes of government officials, many of whom are striving to open up the interior for development. Krihisiwa, the headman of a remote village, saw his first helicopter last year. He approached it hesitantly (below) and touched the metal with great caution.

"It is made of machete skin!" he said. "What does this decorating on the side mean?" I could not adequately explain the meaning, in Yanomamo terms, of *La Conquista del Sur*—The Conquest of the South.

We will soon witness the end of a rich tribal culture that represents a type of adaptation that has endured 10,000 years. It will never be duplicated again during the history of humanity.





THEIR INVITATION to a feast accepted, members of a host village (above) prepare kettles of plantain soup that visitors will consume with ritual gusto and ceremony:

The village headman, Krihisiwa, far right, moves among children as he encourages his people to clean up for the arrival of the guests.

Of much more importance, however, Krihisiwa must now confront the complexities of Yanomamo politics. Will the feast end in alliance or hostility?

In the tangled and shifting patterns of Yanomamo friendship and enmity, Krihisiwa does not know that he now has a formidable new enemy—Moawa, who here squats (right, at right) with other men in his own village during the near-daily inhalation of hallucinogenic drugs by adult males.

Although the two headmen have never met, Moawa has taken Krihisiwa to be his mortal enemy, simply by allying himself with another of Krihisiwa's enemies—Kaobawa.



(LEFT) W. HEDDICH (BELOW)







DEATH TO KRIHISIWA! Through making a common enemy, warriors from Moawa's and Kaobawa's villages divert their own mutual hostilities, now ending in tenuous alliance after 25 years of warfare.

With perfect Yanomamo protocol, Moawa's brother curses and spits on Krihisiwa's effigy (above). Staging a mock raid, warriors from both villages silently stalk the effigy (left). This drama becomes part of a diplomatic triumph for host Kaobawa, in dark trunks, as he enlists an old enemy to attack a current one.

The next day 75 warriors set out to raid Krihisiwa's village, but after two days' march Kaobawa dreamed of a jaguar—a bad omen. The raiders turned back, operation warfare postponed, but operation alliance sealed.



AT A CRITICAL MOMENT in the new alliance, older men from the two villages—who have faced each other in battle—herd the younger males together to release tensions of pent-up grievances through combat by proxy. The youths roll on the ground (right), wrestling and slapping one another. The older men remain in the background to keep the struggle from getting out of hand.

It almost did. The fighting escalated to chest pounding before old scores were considered settled. From chest pounding, it might have gone a step further to club fighting, which can leave nasty scars—regarded as badges of honor (above)—or even on to ax fighting, followed by all-out war. Warfare, by raiding and ambush, appears most intense in areas where women are scarcest.

Many villages remote from the major river systems of southern Venezuela have yet to be contacted, and remain, however briefly, an uncataloged living library for the study of primitive man.







GAME OF INDIANS and Indians, though child's play, anticipates the life of adult warriors. Daubed with black, the raiding color, six boys (below) file across the clearing of Moawa's village to sneak up on an effigy target. Seeing the mock raid, Dedeheiwa, shaman of the community, joins the boys to instruct them in the tactical points of archery (left).

Constant practice at play and in hunting will train the boys to exceptional skill. They will learn to fell a sparrow-size bird perched sixty feet up in a tree—or do the same to a future enemy at even greater distances.

Although Yanomamo battles are fought in small skirmishes—one or two enemies slain make a successful raid—the toll mounts with time.

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ROBERT W. MADDEN, ILLUSTRATION





IN THE SUPPLE CADENCES of daily routine, a young girl (left) strings a waistband of blossoms. Among the Yanomamo, beauty is valued, and, having no native skills in metals or gems, they express their artistic impulses in personal adornment.

Capped in buzzard down, his ears pierced with feathered canes, a young visitor (below) reclines in ceremonial silence, part of the ritual of greeting and acceptance. He may be searching for a wife and be willing to work in the garden of a girl's parents for a year or more to earn his bride.

Lacking a written language, the Yanomamo prize facility in speech—rhetoric, plays on words, chanting, storytelling, and animated eloquence. A wise leader, Kaobawa (right, center), loses his oratory at a trading session with an ally; arrows to be exchanged lie at his feet. Gesturing, he evokes the great benefits to be gained from the trade of goods and goodwill.

Yet, statesman that he is, Kaobawa looks beyond the matter at hand, planning his future moves like a chess master, sovereign in his world. □





Trustees Elect



New Society Officers

ON JUNE 1 OF THIS YEAR, pursuant to an earlier vote of the Board of Trustees, Robert E. Doyle became the 13th President of the National Geographic Society. He had previously held the posts of Vice President and Secretary.

Dr. Melvin M. Payne, who had served as President of the Society since 1967, was named Chairman of the Board of Trustees. His predecessor in that office, Dr. Melville Bell Grosvenor, became Chairman Emeritus and retained his post as Editor-in-Chief.

Of Dr. Payne, the Board noted: "We rejoice in the knowledge that he will also continue to serve the Society as its Chairman of the Committee for Research and Exploration, confident that he will bring to both chairmanships the bold, skillful, and resourceful enterprise that was the hallmark of his years as President."

The same confidence extends to his successor in the presidency, Mr. Doyle, who has long been respected in and out of Society headquarters as an officer of rare executive ability combined with ready rapport with others. Mr. Doyle was born in Washington, D. C., on July 11, 1915. He attended George Washington University before joining the National Geographic Society staff in 1934.

During World War II, Mr. Doyle served with the U. S. Army in France and Germany, rising in rank from private to major. Similarly, he rose through the Society's ranks to become Assistant Secretary in 1951, Associate Secretary for Membership in 1958, a Vice President in 1961, and Vice President and

Secretary in 1967. He was elected a Trustee in March 1975.

As Secretary, Mr. Doyle supervised the relationship of the Society with its far-flung membership. His talent for easy and direct communication with people was reflected in this task, as some 56,000 letters from members arrive daily at the Geographic. We know of no other publication that can match the Geographic's friendly, courteous, personal relationship with its readers—attributable in large measure to the effort, efficiency, and concern of Robert E. Doyle. The office of Secretary will now be filled by Mr. Doyle's longtime associate, Owen R. Anderson.

Mr. Doyle coordinated construction of the Society's Membership Center Building near Gaithersburg, Maryland, and also directed installation of a computer system to facilitate delivery of NATIONAL GEOGRAPHIC and the distribution of globes, books, and additional Society educational publications.

He serves now as chairman of a committee

Eyeing the future, Robert E. Doyle (left), newly elected President of the National Geographic Society, inspects a new gravure facility now under construction in Corinth, Mississippi. The plant will begin printing the Society's magazine in July 1977. Former President Melvin M. Payne (right), shown here on a visit to Africa as head of the Committee for Research and Exploration, has been named Chairman of the Board.



DONNA A. GROSVENOR (ABOVE) AND NATIONAL GEOGRAPHIC PHOTOGRAPHER WINFELD PARKS



overseeing transition to a new plant being built at Corinth, Mississippi. In the summer of 1977 the magazine will begin shifting its printing operations to Corinth, converting editorial text from letterpress and offset to gravure. Reports Mr. Doyle: "We will have the most modern gravure presses, equipped with the finest electronic devices for quality control. Illustrations are reproduced with such fidelity that they virtually jump off the pages. The Society will also realize significant savings. We now use ten presses to print 9½ million magazines a month; with the new plant we will employ only four."

A Lifetime With the "Golden Book"

Dr. Payne's elevation to the chairmanship caps a career of 44 years with the Society. Also a native of Washington, D. C., Dr. Payne recalls his first acquaintance with NATIONAL GEOGRAPHIC, at the age of 9. "I was shoveling snow and filling the coal bin for a neighboring widow. 'Come here a moment, Melvin,' she said. 'I want to show you a beautiful golden book. I receive one each month, and you may have them all if you promise never to cut or tear out anything.'"

Twelve years later, in 1932, Dr. Payne joined the Society's staff. Ever since then his professional life has been dedicated to preserving and enhancing the quality of that "beautiful golden book," as well as in expanding the activities of the Society. When Dr. Payne first took up his duties, the Society's membership numbered 1,029,382. It now is well past 9,000,000.

Dr. Payne has long been closely associated with Geographic expeditions throughout the world. In his first major assignments, he helped organize the record-setting flights of the stratosphere balloons *Explorer I* and *Explorer II* in 1934 and 1935.

He strongly supported such projects as the first American ascent of Mount Everest, the underwater explorations of Capt. Jacques-Yves Cousteau, the dredging of a sacred cenote in the Maya ruins of Chichén Itzá, Yucatán, as well as the Leakey family's brilliant search for early man in East Africa and Jane Goodall's revolutionary study of wild chimpanzees.

Annually the Society grants a million and a half dollars for wide-ranging research projects. At this moment Society-supported



NATIONAL GEOGRAPHIC PHOTOGRAPHERS JOE BAILEY (TOP RIGHT) AND ROBERT S. GREEN

scientists are studying the behavior of sharks, and the green turtles and land iguanas of the Galapagos Islands. Archeologists are uncovering treasures of ancient art at Aphrodisias in Turkey, excavating a Byzantine shipwreck, exploring for traces of early man in Alaska.

Dr. Payne played a major role in the formation of the Society's television series. The hour-long specials produced by the Geographic have won an enviable array of prizes; they now appear four times a year on the Public Broadcasting Service. He also encouraged the use of other media—notably phonograph records, educational films, and filmstrips—to enable the Society to fulfill its mission: "the increase and diffusion of geographic knowledge."

Dr. Payne has devoted much of his free time to public affairs; he has served as a trustee of the International Oceanographic Foundation and the Supreme Court Historical Society, as a governor of the National Space Institute, and as Vice Chairman of the White House Historical Association. He recently retired as Chairman of the Secretary of the Interior's Advisory Board on National Parks, Historic Sites, Buildings, and Monuments.

In 1974 the Department of the Interior presented its highest honor, the Conservation Service Award, to Dr. Payne for his "distinguished leadership in exploration, research and education, together with his contribution to man's knowledge of the earth and to the preservation of its natural treasures. . . ." □



The Board of Trustees gathers at Society headquarters in Washington, D. C. Seated clockwise from left: Louis B. Wright, Frederick G. Vosburgh, James H. Wakelin, Jr., James E. Webb, Frank Borman, Chairman Emeritus and Editor-in-Chief Melville Bell Grosvenor, Robert E. Doyle, Benjamin M. McKelway, Thomas W. McKnew, and Melvin M. Payne.

Standing from left: Arthur B. Hanson, Robert C. Seamans, Jr., Wm. McChesney Martin, Jr., Juan T. Trippe, Carlisle H. Humelsine, Curtis E. LeMay, Editor Gilbert M. Grosvenor, Lloyd H. Elliott, Conrad L. Wirth, and Alexander Wetmore.

Not present at the Board meeting (above), counterclockwise: Mrs. Lyndon B. Johnson, Warren E. Burger, Crawford H. Greenwalt, H. Randolph Maddox, Lloyd B. Wilson, Laurance S. Rockefeller, and Caryl P. Haskins.

Window on Earth's Interior

By ROBERT D. BALLARD, Ph.D.
WOODS HOLE OCEANOGRAPHIC INSTITUTION

Photographs by
EMORY KRISTOF

NATIONAL GEOGRAPHIC PHOTOGRAPHER

PERCHED ON A LEDGE, our deep-sea submersible maneuvers to pick up a rock sample with its mechanical claw.

"*Lulu*, this is *Alvin*," I say into a phone, my words transmitted through water by sonic impulses to our tender far above us.

"Roger, go ahead," comes the answer from the sunlit surface of the Caribbean.

"We've reached the base of the fault scarp at 3,660 meters [12,000 feet]. We are now sampling at Station One. Will call back when finished. Over."

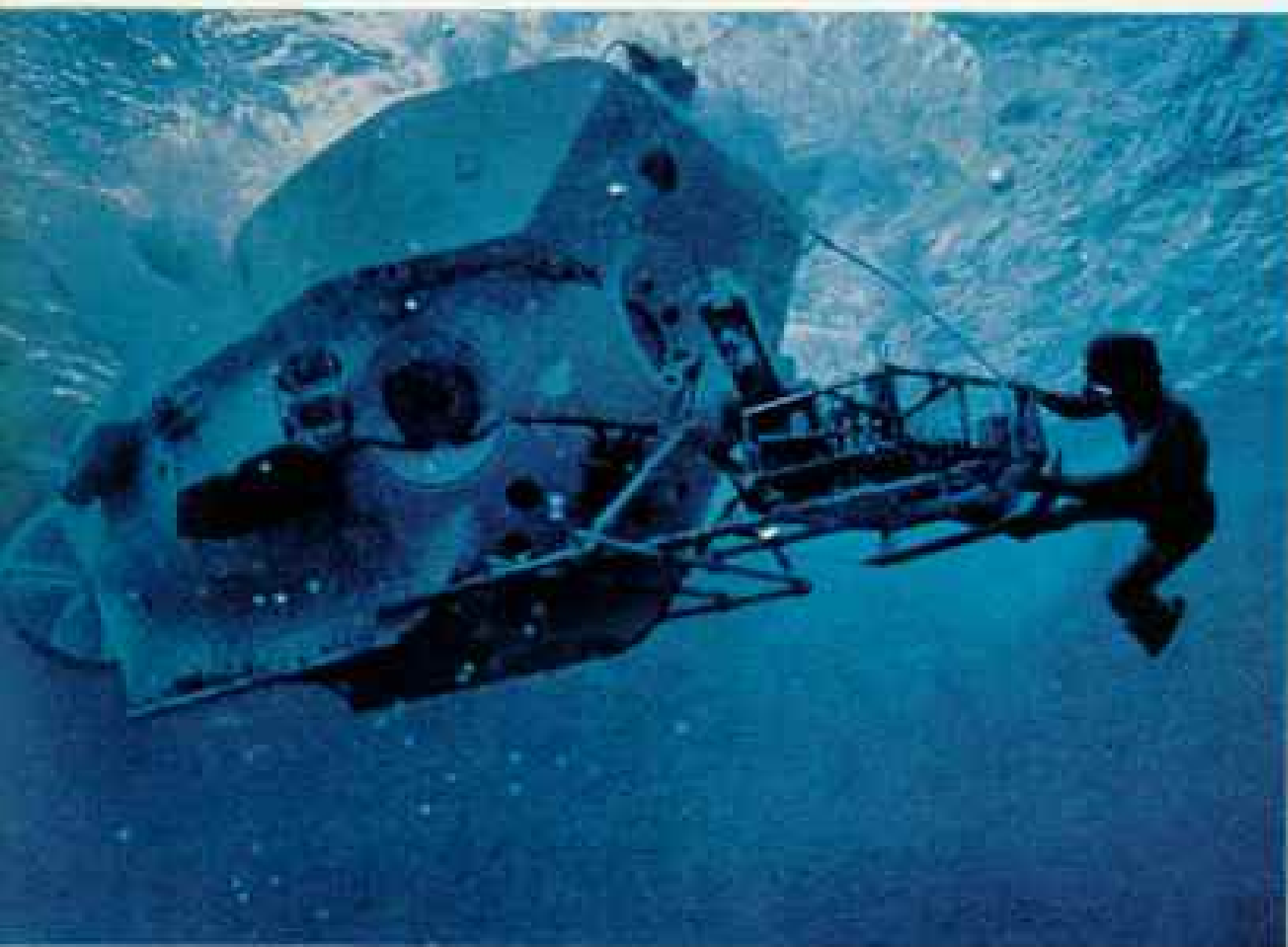
As Dudley Foster, our pilot, attempts to pry a sample loose, I plot our position on the face of this cliff, part of a gigantic tear, or fault, in the floor of the Caribbean Sea. I can do so within a few meters from fixes called down by the navigation team on *Lulu*.

Then I stare out of my view port at the black, manganese-coated outcrop just two meters (six feet) away. It is hard to realize

Three kilometers down in the Caribbean's Cayman Trough, scientists in the research submersible *Alvin* explore for the first time cliff faces that reveal deep layers of oceanic crust, which covers two-thirds of the planet. Here the craft, making an unprecedented self-portrait, triggers an underwater camera that it has carried down in the wire basket, then placed on the bottom with its mechanical arm.







"Like working inside a Swiss watch," author Ballard (in striped cap) says of the humming, ping-
ing instrument-filled *Alvin*. Last January he led the Cayman Expedition of Woods Hole Oceanographic Institution with support from the National Science Foundation and U. S. Navy.

For each of 15 dives, two scientists and a pilot ride within a titanium-alloy sphere housed inside



JAMES PHILLIPS, WOODS HOLE OCEANOGRAPHIC INSTITUTION (LOWER LEFT)

Alvin's white outer covering. Guarding against choppy seas, divers help launch the sub (upper left). Ballasted by steel weights, the sub sinks at 30 meters a minute through the fading glimmers of sunlight (lower left). During the two-hour descent, Dr. Ballard catches a quick lunch.

At the craft's maximum working depth of 3,660 meters—12,000 feet—Woods Hole pilot Dudley

Foster (right) will switch on floodlights, and quake-jumbled terrain will loom through the view ports: gaping cracks, broken boulders, and landslides. Time seems to stand still as sea creatures glide by. Yet all too soon, five hours of bottom time are up; weights are dropped, and *Alvin* returns to the world of light and air, bringing up samples and photographs of the seabed.



that in front of us lie rock layers from deep within earth's crust that never before have been seen or sampled in place in the sea.

Just then a large pink octopod flies by my port, upstaging the geologic importance of the moment. It passes just as one of our outside cameras takes a picture (pages 242-3).

"He flies with his ears," Dudley says, and indeed that's what the creature's fins resemble. "He must be at least a meter long. When he opens, his webbed tentacles make him look like a big umbrella!"

Dudley drops a rock from *Alvin's* claw into the revolving tray outside his center view port. "The sample is in bin number three."

Darkness, Cold, and Massive Pressure

The excitement of my first dive to *Alvin's* 12,000-foot limit, the constant noise within the sphere, the chance encounter with a strange and rare marine form, all cause me to forget momentarily why we are here. Instead, I imagine what it would be like to live in this alien world of eternal darkness, of extreme pressure and near-freezing cold: two and a half metric tons—5,500 pounds—to each square inch, and 4° C.

I stare beyond the small floodlit area around our sub and try to visualize the vast size of this long gash in the seafloor, which we call the Cayman Trough or Cayman Trench. It stretches some 1,500 kilometers, 930 miles, part of the fault that extends 3,500 kilometers from Central America east across the Caribbean into the Atlantic. The trench drops more than seven kilometers—23,000 feet—virtually straight down from the Cayman Islands (diagram, pages 234-5).

On the north side of this fault, or rip, in earth's rigid crust lies the American plate. Created in part in the central rift of the Mid-Atlantic Ridge, the great mass is moving west at about one centimeter (four-tenths of an inch) a year. To the south is the Caribbean plate, moving relatively in the opposite direction. Between them runs the fault zone, similar to the San Andreas of California. Here the two plates grind and creep past each other; here earthquakes are born.

We had come from Woods Hole Oceanographic Institution in Massachusetts with the *Alvin*, her catamaran mother ship, *Lulu*, and the surface research vessel *Knorr* to study the great undersea fault. We hoped to map,

sample, and unravel the complex rock assemblages of one of the zones of creation and movement of the oceanic crust.

Little did we know that here we would also find exposed a fascinating cross-section of that crust, including layers that normally lie far deeper than anyone has yet been able to reach by seafloor drilling.

According to data obtained earlier by Dr. Troy L. Holcombe and other U. S. Navy oceanographers, an inner valley running north-south across the trough might be a small spreading center, or rift, located along the American-Caribbean plate boundary.

This bend or dogleg in the fault runs at right angles to the major east-west plate motion. If the crust is indeed separating along this valley, molten lava should be flowing out onto the seafloor, like toothpaste squeezed from a tube, to harden quickly into black volcanic rock. We had seen this phenomenon in the Mid-Atlantic Rift during Project FAMOUS.*

Hunting a Haystack With a Needle

Our initial goal, using *Knorr*, was to find this valley and the volcanic rift that theoretically should exist there. But theory is one thing, and finding recently active volcanoes in 5,000 to 6,000 meters of water is another. It's a bit like looking at night for a haystack with a needle lowered from a helicopter.

Knorr's depth sounders, however, located the valley. Then we brought the ship about and prepared to lower remote cameras, mounted on a tubular steel sled, to take a close look. No pictures had ever been made of the Cayman Trough's complex bottom terrain.

As we worked through the night, the sea began to build with the approach of a tropical weather front. In winds of 20 to 25 knots, we loaded our sled cameras with rolls of color film and started them down.

We paid out the cable swiftly, to get the cameras to the bottom within an hour, when they would automatically start taking pictures. Meanwhile we checked the instruments that would receive telemetered signals from below, reading the heading of the camera sled and its altitude off the bottom.

I reminded Dr. Elazar Uchupi, geologist in

*Project FAMOUS, a French-American undersea study of the Mid-Atlantic Ridge, was described in the May 1975 NATIONAL GEOGRAPHIC by Dr. J. R. Heirtzler of Woods Hole, its U. S. scientific leader, and by Dr. Ballard.

charge of the science program aboard *Knorr*, that to keep the cameras in focus we had to tow them within 4½ meters of the bottom.

"You're kidding!" Al replied bluntly. "With these winds and seas building up, we're in for a long night!"

The outcome was as he feared: "She's hung up! Back her down, let out cable fast." The sled was snagged far below.

Knorr's Capt. Emerson Hiller watched the cable-tension dial as he maneuvered the ship with her omnidirectional props to try to free the sled. We too watched the gauge anxiously. He inched to starboard, then reversed direction quickly when the tension soared to 15,000 pounds. The cable's maximum working load is 20,000 pounds.

I thought to myself, "Now we've done it!



ROBERT D. BALLARD LEADING PAGE

Shrunken-head souvenir, held by Richard Flegenheimer, captain of *Alvin's* tender, *Lulu*, was a full-size Styrofoam wig stand before going down in *Alvin's* flooded conning tower. Pressure of 5,500 pounds—2½ metric tons—to the square inch collapsed air cavities in the head.

◀ Born in sunlit shallows more than thirty million years ago, alternating layers of sedimentary rock (facing page) formed as minute creatures, silt, and sand rained down. The seafloor subsided, then tore asunder, shearing this wall. From its base the cliff rises more than six kilometers to the surface, where it becomes the south shore of Grand Cayman Island. A ten-centimeter white starfish clings to its near-vertical home.



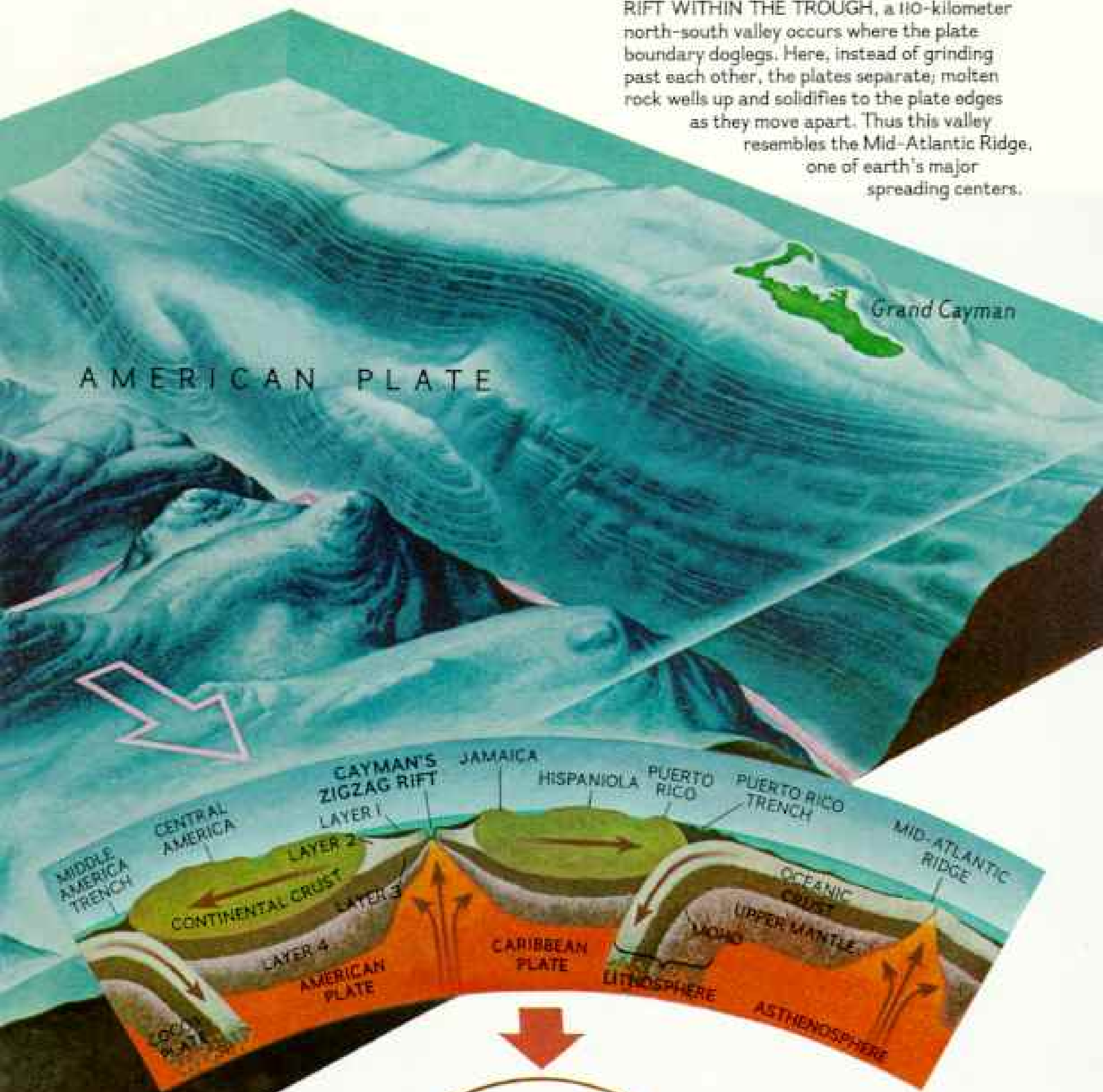
Green spots record earthquakes of 6.0 and greater magnitude on the Richter scale during a 50-year period. Red triangles show active volcanoes.



GREAT TEAR in the ocean's crust, the Cayman Trough (top) sheds light on the intriguing new science of plate tectonics. The 1,500-kilometer gash, four times the depth of the Grand Canyon, grows as two plates of earth's crust slide past each other at a snail's pace. Forces unleashed here set off devastating earthquakes, such as the February 1976 shocks, reaching 7.5 on the Richter scale, that killed 23,000 Guatemalans. Two weeks later Cayman Expedition sonobuoys on the ocean's surface picked up the rumbling of a magnitude 6 quake off eastern Cuba.

Widening zigzag within the Cayman Trough

RIFT WITHIN THE TROUGH, a 110-kilometer north-south valley occurs where the plate boundary doglegs. Here, instead of grinding past each other, the plates separate; molten rock wells up and solidifies to the plate edges as they move apart. Thus this valley resembles the Mid-Atlantic Ridge, one of earth's major spreading centers.



EARTH'S CIRCULATION system: As plates separate, magma from the interior slowly rises into the rift valleys; continuously building oceanic crust. Where plates collide, one edge plunges beneath the other, to be reabsorbed in the interior. Volcanoes usually occur along the overriding edge.

On our very first lowering, we've entangled one of our most important instruments." If we lost the camera sled, we would lose our eyes into the deeper areas of the trough, beyond *Alvin's* diving limit. And we *had* to have pictures from lower down to verify the spreading center—if indeed it existed.

Just as it appeared the cable would break, the tension suddenly slackened. "She's free!" someone called out. "Let's bring her up and

see how much damage we've done." An hour later the camera sled broke the surface.

The scars of its encounter with the solid floor were all too apparent, but our concern quickly gave way to elation. "Look at those rocks. They're fresh pillow lava!" Wedged between battered cameras and strobe lights were three big black chunks—direct evidence of recent volcanic activity on the seafloor.

"Instead of pictures, we get the rocks



themselves," exulted geologist Bill Bryan. "Watch out, that fresh glass surface is sharp enough to cut your hands. Handle it carefully—it can break into a hundred pieces."

In subsequent days, *Knorr* towed a dredge to sample the bottom. Haul after haul brought up more fresh volcanic rocks from a narrow zone running north and south across the trough. Many samples cracked and popped as they were laid out on the deck. They were so

PAUL J. FOX, STATE UNIVERSITY OF NEW YORK, ALBANY



LAYER 2: FINE-GRAINED EXTRUSIVE BASALT WITH NEEDLES OF PLAGIOCLASE FELDSPAR, MAGNIFIED 40 TIMES



LAYER 3: GABBRO WITH CRYSTALS OF PLAGIOCLASE FELDSPAR (GRAY), PYROXENE (RED), AND OLIVINE (PINK), MAGNIFIED 45 TIMES



LAYER 4: ALTERED POSSIBLE UPPER-MANTLE ROCK COMPOSED OF VARIOUS SERPENTINE MINERALS, MAGNIFIED 75 TIMES

Layer-cake west wall of the Cayman's rift valley (left) tells a different story than do canyons on land, where deepest usually means oldest. In oceanic crust, rock is youngest at the spreading center, lower right, and older as it moves up and away. Yet different layers do occur because upwelling magma crystallizes under varying conditions of pressure, temperature, and exposure to water. *Alvin* took samples that, sectioned .03 mm thin and photographed under polarized light, reveal their composition with kaleidoscopic patterns of abstract art (above). Sedimentary rock, layer one, often occurs like frosting on this geological cake. PAINTING BY DAVID WELTZER

fresh in geologic terms—perhaps only a few hundred years old—that there hadn't been time for all the volcanic gases to escape at depth. The sudden change in pressure was like taking the cap off a bottle of soda water.

The camera sled went down again, and this time brought back color pictures instead of rocks (pages 240-41). The film was developed in a special van on *Knorr's* afterdeck by Pete Petrone of the NATIONAL GEOGRAPHIC photographic labs. The pictures revealed much of interest about the terrain far below us.

Although it was similar in many ways to the volcanic central rift of the Mid-Atlantic Ridge, several differences existed. The lava pillows were larger and more uniform in size. The terrain of the floor was flatter. Cutting across it, however, were the familiar signs of crustal separation: deep fissures dividing the lava features, as one part of the valley floor is carried west with the American plate, the rest east with the Caribbean plate.

Quakes Jolt Guatemala and Cuba

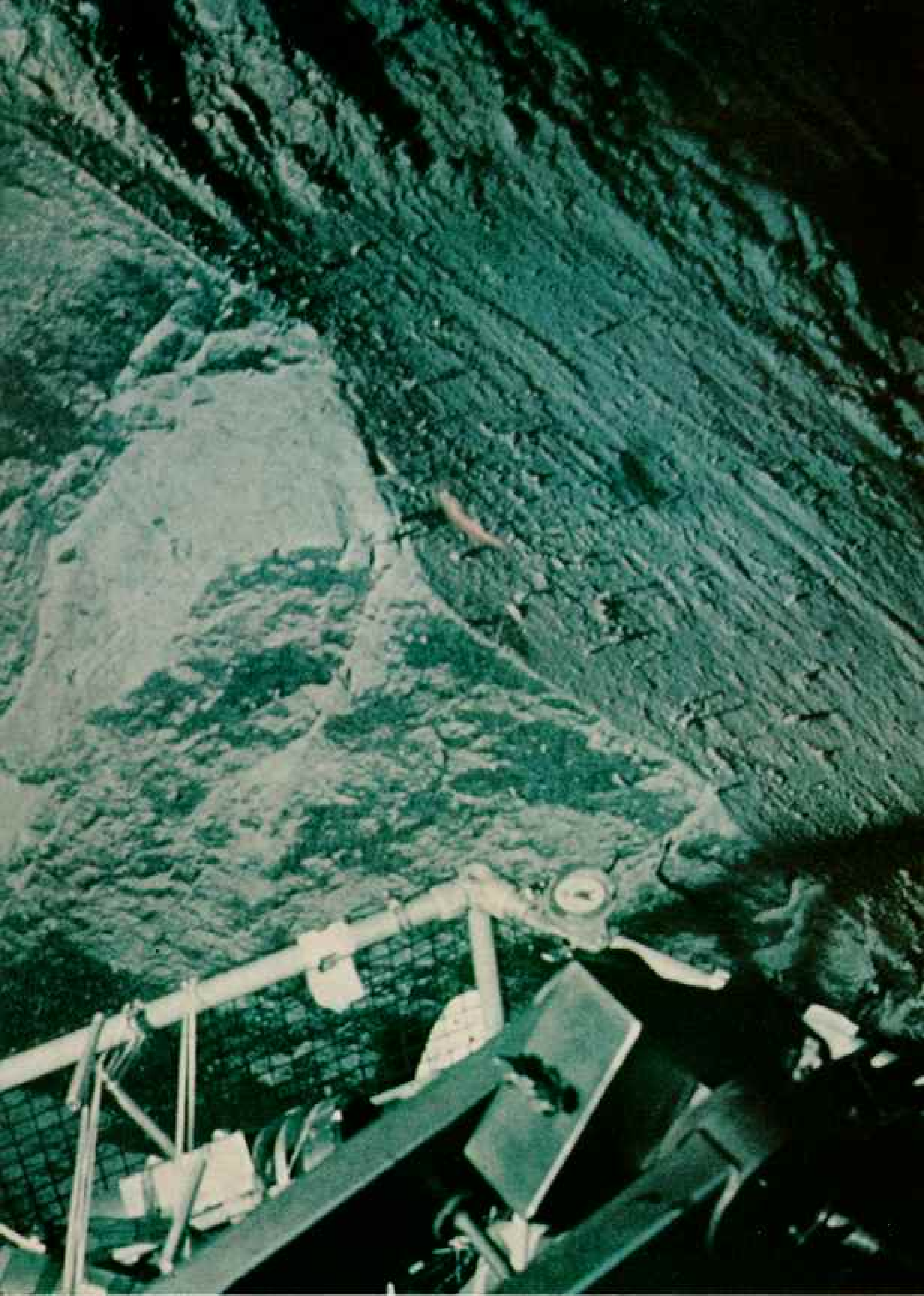
During our exploration, the plate boundary on which the Cayman Trough lies was rocked by a series of severe earthquakes. Evidently the plates, which normally grind slowly past each other, had interlocked at these places. Earth's inner forces had built up, until they reached a point of accumulated stress that demanded sudden and violent release.

The first such shock occurred early in the morning of February 4, centered far to the west on the mainland in Guatemala. The great quake, registering 7.5 on the Richter scale, and the shocks that followed left some 23,000 dead and countless others homeless and stunned.*

Far to the east, but on the same fault system, quakes were occurring in the area where we were diving. Seismic listening buoys, deployed from *Knorr* by Dr. Kenneth Macdonald of Scripps Institution of Oceanography, recorded small quakes near our diving site in the Cayman Trough.

A seismograph in nearby Kingston, Jamaica, showed that earth tremors in the region had multiplied some fourfold; this was learned later by Dr. Raymond M. Wright of Jamaica's Geological Survey, a member of our scientific diving party aboard *Lulu*.

*The human tragedy of this earthquake was documented in the June 1976 *GEOGRAPHIC*.



This abnormally high activity continued for 15 days. Then, on February 19, a severe shock, registering 6 in magnitude, occurred very near us, off to the east where the fault zone runs between Cuba and Jamaica. This was the first time a major shock has been recorded directly on a subsea boundary.

With this quake, stress in our area apparently was relieved. The earth's inner tremblings returned to a lower level.

Earth's Crust Moves at Tree-growth Pace

Earthquakes had not brought us to the Cayman Trough, but they reminded us that the planet on which we exist is, in fact, a living, restless body.*

It is as hard for most people to perceive the earth's crust moving as it is for a butterfly to sense the growth of a sequoia tree on which it alights. The butterfly has no way of comprehending the tree's slow growth, from a small seed to full grandeur. If asked whether the tree is alive, the butterfly might say, "Of course not. I've been here all my life, and it hasn't done a thing!" Likewise, a person living on the earth for less than a hundred years has no direct way of sensing that his world's surface has been changing and moving for four and a half billion years.

Once a molten body suspended in the cold reaches of space, the primordial earth cooled and eventually developed an outer crust. Water accumulated in its depressions to form the seas. To us this outer crust is solid ground, but actually it floats—thin and brittle—on a hot, plastic interior.

Our ability to sense this crust is similar to that of an ant crawling across a water bed. The ant does not feel the bed moving. Likewise, we do not feel the earth give beneath our feet. If we were giants, however, hundreds of kilometers high, the earth would respond to our load. As we walked across it, the hot plastic interior beneath the crust would flow away, reacting to our weight.

The heat trapped deep inside the earth constantly seeks a way out. It has a slow, inexorable circulation system, which geophysicists think may involve convection currents slowly bringing semimolten material from the hot interior, called the mantle, up to the surface. Perhaps twenty crustal fragments,

*See "This Changing Earth," by Samuel W. Matthews, in the January 1973 *GEOGRAPHIC*.



RAYMOND M. BRIDGES, JAMAICA GEOLOGICAL SURVEY AND (BELOW) WOODS HOLE OCEANOGRAPHIC INSTITUTION

In the bizarre landscape of the deep, scientists aboard *Alvin* find startling proof of a constantly changing seafloor. Like a thermal spring at Yellowstone, a vent (above) once spewed hot water carrying dissolved minerals from deep within earth's crust. On contact with cold seawater, the minerals precipitated, spattering the sediment-covered seafloor.

On a steep slope of the rift valley's west wall, *Alvin* noses in to pry out a sample of gabbro (left), the main rock of layer three, which the expedition sampled undersea for the first time. A ten-cm pink shrimp swims above the manganese-blackened outcrop.

In an unexpected encounter, *Alvin* locates rock from layer four, the upper mantle, at 3,660 meters (below). It formed deep underground and perhaps was forced up at this fault plane on the west wall. Only extensive analysis will give the answer.





Frozen in action, upwelling magma solidified into tubes and bulbous pillows (left) on contact with cold seawater, five kilometers down in the Cayman's rift valley. Some still carry a glistening black skin of volcanic glass, proof they formed very recently, perhaps less than 1,000 years ago.

When molten rock pours forth rapidly in air, it cools in folds, creating a drapery effect known by the Hawaiian name pahoehoe. Unexpected in the deep, this pattern was found covering a large area (below).

What volcanism creates, earthquakes tear apart, opening fissures (right) as avenues for new lava flows or water percolating into the crust. A compass shows heading of a camera lowered by the surface vessel *Knorr*.



ALL BY WOODS HOLE OCEANOGRAPHIC INSTITUTION



or plates, carrying the continents and the ocean basins, are moved by this circulation system, like ice floes pushed about by water currents below.

The way these plates interact is not random but highly ordered and systematic. Where two plates move away from each other, a rift or crack is created. The earth responds by sending some of its plastic interior up into the tear or wound. Some of this magma flows out onto the seafloor, where it cools rapidly and coagulates, forming volcanic pillow lavas (page 240). The remainder, called plutonic rock, solidifies deep in the rift between the plates—much as household cement may harden in the neck of an opened container.

These sites of crustal genesis or creation, situated above the rising convection currents, are known by various names: spreading centers, zones of crustal divergence, plate-separation boundaries.

Alvin Discovers Layer-cake Cliffs

To understand earth's present state, to unravel its long past and look into its future, we must know more about this creative process. We must determine the global pattern of the plates and their movements.

What form does new crust take after cooling at a spreading center? How is it torn apart and transported—on some sort of geologic conveyor belt—away from its site of formation? What lies beneath the surface skin of volcanic rock? What do the deeper inner layers of the crust consist of?

To help find some of the answers, we have powerful research tools in deep submersibles such as *Alvin*, named for Woods Hole oceanographer Allyn Vine. In her seven-foot-diameter titanium-alloy sphere, we can dive nearly four kilometers into the ocean depths. We can see the seafloor with our own eyes and take samples as direct evidence of what goes on there.

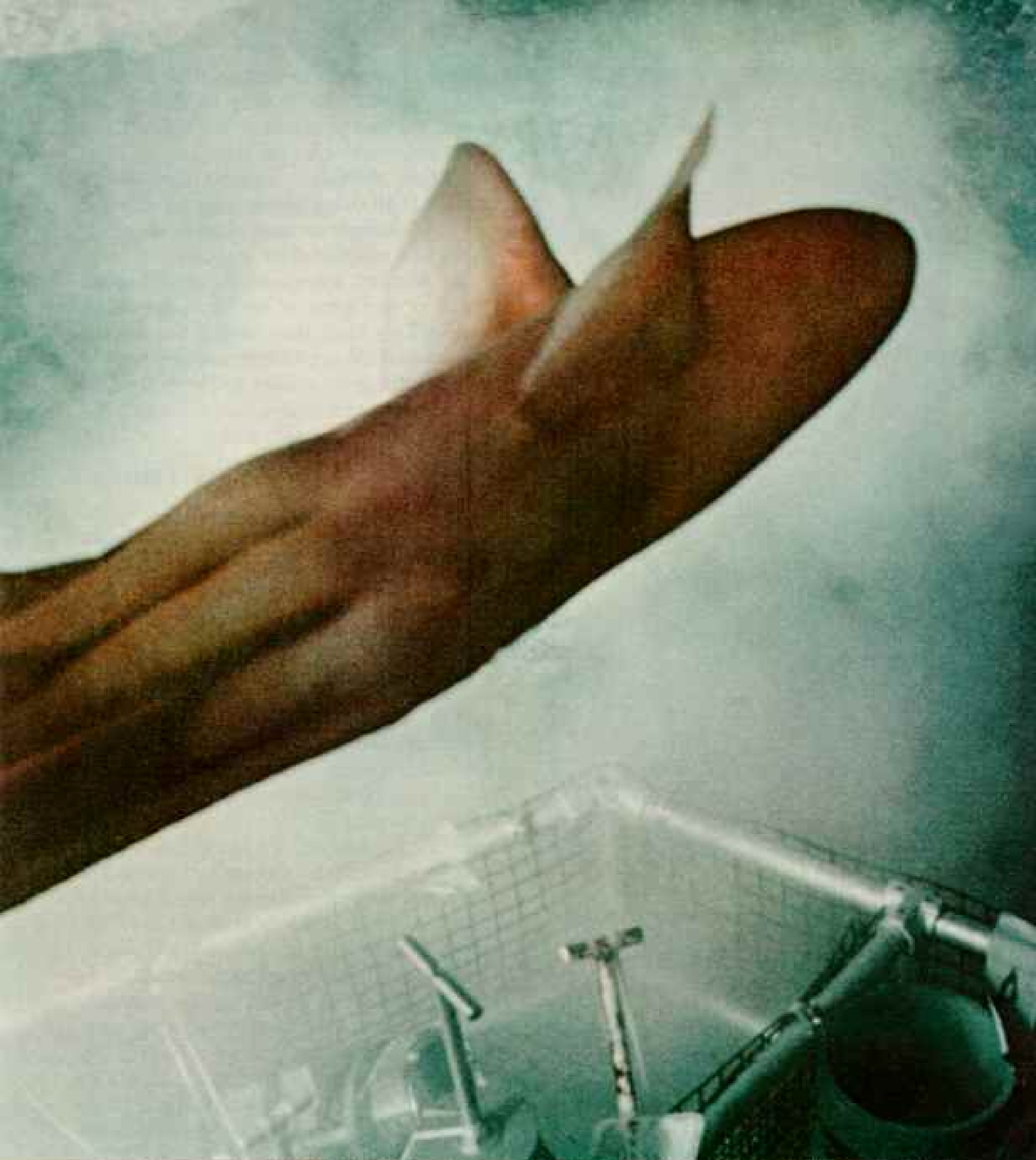
While echo sounding from *Knorr*, we had discovered two great scarps flanking the central rift valley, one on the east, the other to the west. As if made to our order, the east scarp began 3,660 meters down, at *Alvin's* permitted diving limit, and rose halfway to the surface.

Before we could dive, however, we had to install a series of navigation beacons, or sonic "lighthouses," on the sea bottom. These



"Eared" apparition, more than a meter long, glided in front of *Alvin* just as an automatic outside camera made an exposure. Biologists later identified it as a cirrate octopus, rarely seen alive. Its curious fins help it to swim. When webbed arms spread out, it resembles an umbrella.

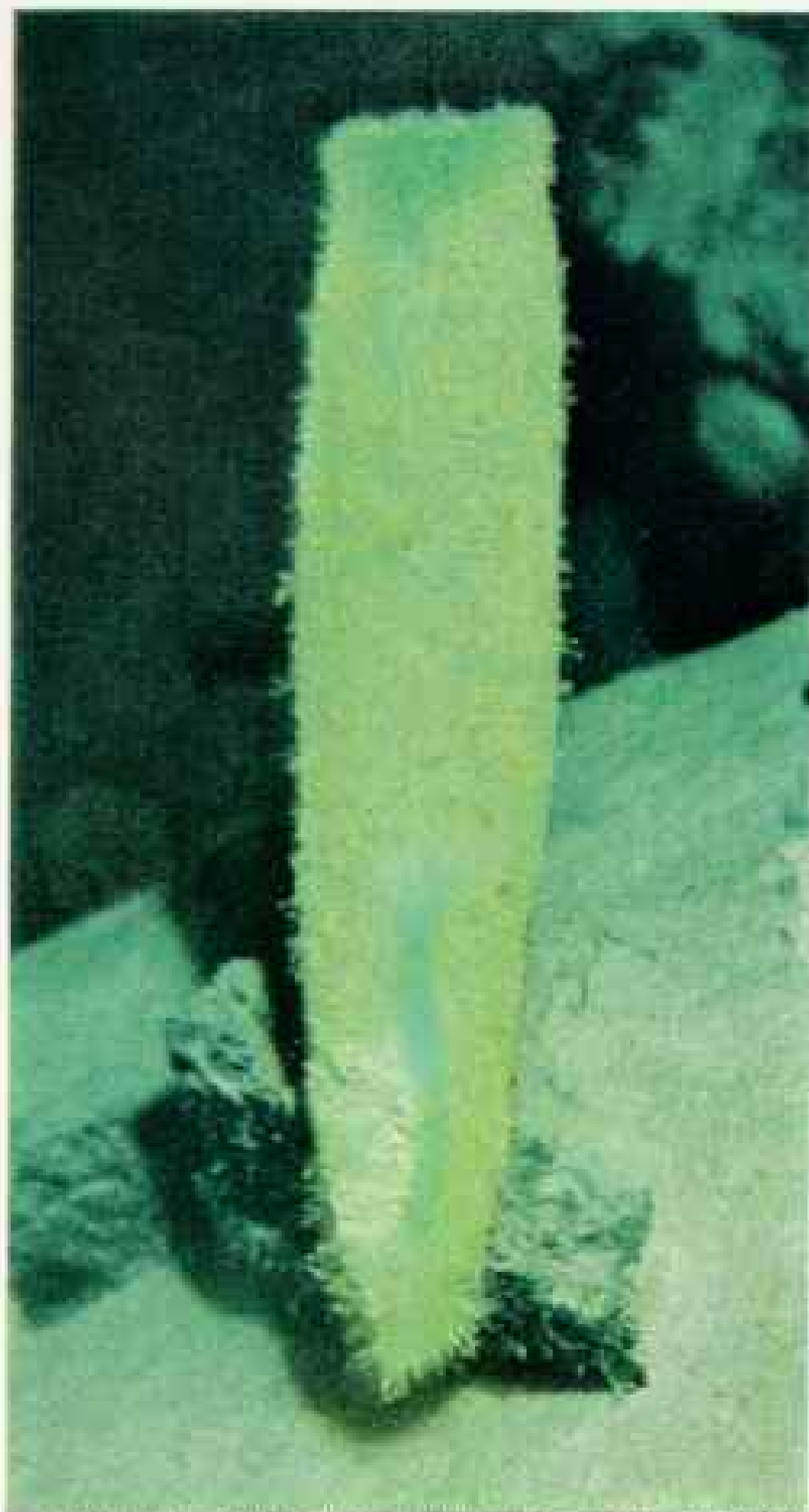
Photographs such as this one, made at



CYRILLIDITHIS OCTOPUS, WOODS HOLE OCEANOGRAPHIC INSTITUTION (WHOI) AND BENTHOPTILIS TYPICA, 10-15 CENTIMETERS (4 TO 6 INCHES), ROBERT S. BALLARD

3,660 meters (12,000 feet), reveal how animal groups differ with depth, just as mountain wildlife varies with elevation. At various depths *Alvin* observed rattail fish, corals, and dozens of holothurians (**right**), the vacuum cleaners of the deep. Also called sea cucumbers, they ingest mud rich in organic matter as they cross the seabed.

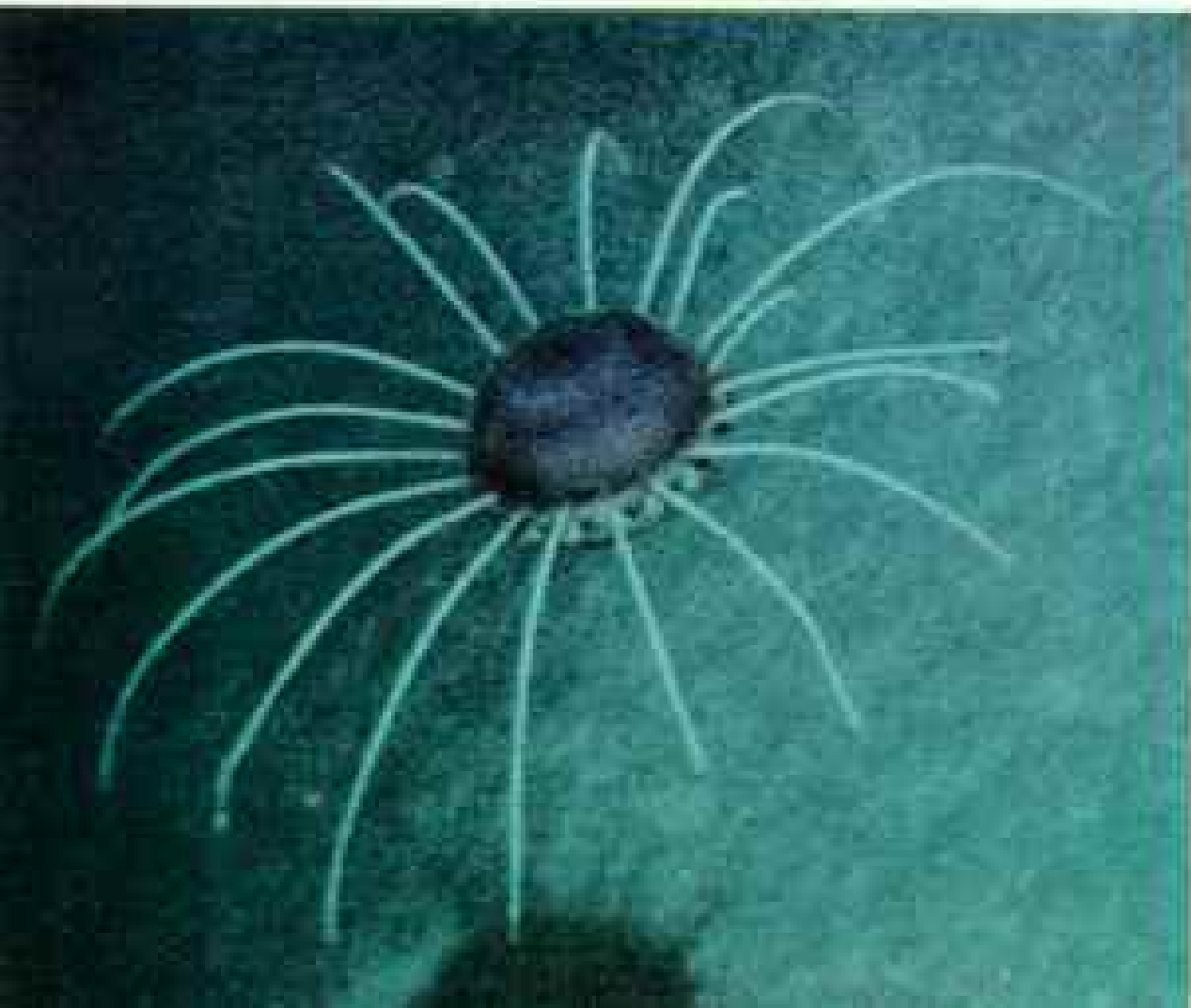




DIATOMELLA, 2.5-30 CENTIMETERS (ABOVE) AND STYLLA, 6-10 CENTIMETERS, BOTH BY ROBERT D. MALLARD

Ocean's water filter, a glass sponge (above)—so-called because its skeleton is silica—ingests microscopic tidbits through pores all over its body. It needs only a toehold on bare rock to survive.

A medusa, or jellyfish (below), expands and contracts its body to travel, waving its stinging tentacles to catch zooplankton.



acoustic transponders would tell us the exact position of our support ship on the surface, as well as that of *Alvin* as the submersible dived and worked on the bottom.

Without absolutely accurate fixes of our location at all times, the samples we collected and the observations and pictures we made would lose much of their meaning.

The buoyant transponders were dropped by *Knorr*, and tethered by 100-meter cables from anchors. Once they were on the bottom, their positions were plotted exactly by *Knorr's* satellite navigation system and by echo ranging. The first net, or grid, of buoys was dropped near the base of the east wall.

Sub Launch Is Like Dropping a Bomb

Our daily routine begins soon after dawn. "The earlier you're in the water, the longer you'll be on the bottom," Val Wilson, chief pilot of *Alvin*, likes to remind us.

"We'll be ready when you are," I reply for the scientific diving team.

While the *Alvin* operating group readies the sub for the dive, the scientists confer on the work for the day.

"Bridge, this is the science van," we call over the intercom. "Request you bring *Lulu* into simulated launch configuration and hold it for 20 minutes."

During this period, we track *Lulu's* drift. That way we can compensate for the effect of winds and currents during the time it takes to launch *Alvin*, in order to start the dive up-current from the target point on the bottom.

"We have the drift vector; we can move to launch position," I report on the intercom. *Alvin's* descent weights are loaded, and the hatch greased for a good seal. "Lower the sonar tower," calls *Lulu's* captain, Dick Flegenheimer. "Man your launch stations."

With *Alvin* in her cradle lowered into the water, Dudley Foster and I climb aboard. Dr. Jelle de Boer, a geophysicist from Wesleyan University in Connecticut, will make his first dive today as second scientific observer.

When all three of us are stuffed safely inside the instrument-crammed sphere, the hatch is sealed, the sub is lowered farther to ride free in the water, and she is driven out from between *Lulu's* twin hulls.

Final checks are completed. We open our ballast tanks and admit seawater. *Alvin* starts down at thirty meters a minute.

It is now well into the morning, and the burning Caribbean sun has heated the sphere to 32° C. (90° F.). The dive to the base of the scarp will take two hours. We have plenty of time to test our instruments and even have a quick lunch (pages 230-31).

Sonar echoes pinging loudly in the sphere tell us when we are nearing the solid seafloor. "I have visual contact, Dud," I call out. "It's a vertical rock wall—no place to land."

Having dropped two of our four ballast weights to end our descent, we begin driving up the cliff face, looking for likely places to take samples. "Let's try to get a rock every hundred meters," I tell Dudley, "or whenever we see a major change."

Maneuvering slowly up these massive scarps is like crawling on your hands and knees out of the Grand Canyon. It goes on for hours, until the sample bins are full, our exterior cameras have used up their film, and above us on the surface, night is coming on.

Our real excitement comes later, after *Alvin* has been recovered and the dive is over. Then, and only then, can we break open our rocks and see their composition.

Ocean Floor Composed of Layers

As we make more such dives, and gather more samples from the scarp face, we begin to realize just how significant our expedition has become. Never before have scientists penetrated so deep into the earth's crust to see and sample its internal layers.

Prior to these dives, earth scientists using a variety of indirect techniques have probed the planet's interior and speculated about its composition. Its exact structure and chemical makeup are still unclear, but geophysicists have provided a ghostly outline of its layers, and geologists have made informed guesses as to what makes up each layer.

The great plates beneath the oceans contain four basic layers. On top is layer one, consisting of sediments that have accumulated with time, like dirt on one's exposed skin in a dust storm. Close to the spreading centers, where the ocean-floor skin is young, the layer of sediments is missing or very thin. As the crust ages and moves outward, material keeps drifting down from the overlying water. Organisms that live in the sunlit upper reaches of the sea die and fall to the bottom, and like a deepening layer of dust and dirt,

their microscopic bodies pile up as sediment.

Beneath layer one is the seabed's uppermost skin of hardened magma—layer two. When the lava comes in contact with the cold sea, it quickly solidifies in pillowlike formations, and in tubes through which it moves for a time insulated from the seawater. These tubes twist about one another, coalescing into steep flow fronts advancing across a rift valley floor or building volcanic mounds.

Seabed Reveals Its Deeper Rocks

This is what we had learned—what we had seen with our own eyes—during the many dives of Project FAMOUS. This is what towed cameras and dredges have told us.

But what lies beneath this second layer? What makes up the rest of the plate that slowly forms at a spreading center? From reading earthquake shock waves and man-made seismic impulses, we are able to recognize differences between the deeper layers.

As a result, the old terms of earth's crust, mantle, and core have been greatly modified by scientists in recent years.

The thick rigid plate, for example, that is thought to glide on the plastic interior is now called the lithosphere. Beneath that is the asthenosphere, earth's soft underbelly.

The lithosphere contains *all* the crust, which under the continents may extend down 30 kilometers or more; in the oceans it may be only a few kilometers thick. In the seafloor, beneath the sediments and solidified lava, lies the principal segment of oceanic crust, layer three, which normally reaches down an average of some five kilometers.

Below that comes layer four, the upper mantle, which we now regard as part of the lithosphere's moving plates. The Moho, or Mohorovicic discontinuity, is the boundary between layers three and four, which are distinguished by a major change in velocity of seismic waves traveling through them.

For some time scientists have known generally this sequence of major layers; we know something about the density of their rocks, their ability to transmit sound waves. We have even seen comparable rocks themselves, in layers on dry land where ancient ocean floor has been uplifted and folded in mountains such as the Appalachians and Andes. We have actually gone into the two uppermost layers of the seafloor by core-sampling



Floating laboratory, the *Knorr* (left) surveyed the Cayman Trough with echo sounders, cameras, and dredges while serving as communications center for *Lulu* and *Alvin*. Here a launch shuttles film to a photo-lab van on the afterdeck, where NATIONAL GEOGRAPHIC technician Claude "Pete" Petrone processed 33,800 color photographs for on-the-spot analysis by scientists. In a *Knorr* science lab (below, right), graduate students Freida Malcolm, left, and Eric Rosencrantz catalog the jumble of dredged rocks, part of a six-ton haul.

Aboard *Lulu* (below), Dr. Paul J. "Jeff" Fox, right, inspecting a rock brought back by *Alvin*,

suddenly realizes, "This may be upper mantle!" Other geologists, from left, Drs. John B. Corliss and Kenneth O. Emery, together with *Alvin* pilot Dudley Foster and *Lulu* cook Conrad "Gus" Ocampo, share the excitement of discovery. For the first time, scientists had seen and sampled layer-four rock on the ocean floor at a documented site. Such precise observations make manned exploration of inner space as significant as the space flights of the past decade.



and by deep-sea drilling. But never before have we sampled either layer three or the mantle actually in place in the seabed.

Alvin's dives down and up the east scarp of the rift valley take us time and again into layer three. The principal rock type we find there is gabbro, a dense material that cooled and crystallized from magma while it was still deep underground.

First Rock From the Subsea Mantle

With the east escarpment crisscrossed by many dives, we move our transponders to the base of the west wall, where we hope also to find layer three and compare samples.

Our first dive on the steep west scarp wall will be all the way down to 3,660 meters. Paul "Jeff" Fox, marine geologist from the State University of New York at Albany, is the second scientist aboard. Larry Shumaker, head of *Alvin's* operating group, is the pilot.

We reach our maximum permitted depth right on schedule, but the sonar tells us the bottom lies still some hundreds of meters below.

"That's it—we'll have to level off at this depth and drive to the wall," Larry says.

"I have the wall on the sonar scope at 100 meters, on a heading of 330 degrees," I tell him. Within minutes, the scarp face emerges from the dark, and we maneuver for a sample (painting, page 236).

"The rocks are softer than before," Larry reports as he works the mechanical claw. "Their outer surface seems flaky."

"When you scratch with the claw, can you see white material?" I ask him. If so, it might be manganese-coated hardened sediments.

"No, it's as black as before, but it's definitely *not* like the fresh gabbro we got from the east wall," Larry says. Jeff Fox, looking out through his port, agrees.

"What is it, Jeff?" I ask.

Adventure of science—and its achievement—reward voyagers aboard *Alvin*, here surfacing at sunset; with the help of divers, the vessel drives toward *Lulu's*



"I don't know. We'll have to wait until we get it back on the surface."

Once safely back aboard *Lulu*, we scramble hastily out of the sphere. Before the sun has dried *Alvin*'s wet hull, we have unloaded the rocks from their numbered bins and laid them out in order on the deck.

Carefully we break them open, and with hand lenses look at their mineral composition.

"Tremendous! That's altered peridotite, dunite, more peridotite," says Jeff. "The soft outer surface is due to weathering, but inside is solid rock."

These are deeper, more basic rocks than the gabbro of layer three. We know them from the deepest ocean-bed layers, upthrust and exposed on land, and from occasional dredge hauls. But by theory, they should occur much deeper in the oceanic crust than we had penetrated.

We had apparently passed entirely through

layer three, and entered the upper mantle! But how could we have gotten through the entire crust in little more than two kilometers?

The answer to that intriguing question will require a long period of data analysis. Detailed bottom surveys by a sophisticated Navy oceanographic ship over that yawning trench in the Caribbean will help.

Next year we hope to go back with the Navy's big bathyscaphe, *Trieste II*. Basically an undersea dirigible, filled with gasoline for buoyancy (*Alvin* relies on air-filled glass foam), *Trieste II* can easily take us into the Cayman Trough's central rift valley, some five and a half kilometers down. She will let us drive across the valley floor and actually see the volcanic terrain at the very bottom of the rift, as well as the base of its flanking walls, through a view port rather than through a mindless camera lens.

Who knows what we will find then? □

welcoming lights. In the future, scientists plan dives into other seafloor spreading centers near the Galapagos Islands and off Mexico on the East Pacific Rise.





SIT SNUGLY BEHIND "GATOR BILL" as we bull our way through moonlit saw grass at the edge of Florida's Big Cypress Swamp. We are riding on Bill's "froggin' machine," a well-aged airboat with two lookout seats mounted on a frame of peeling pipes (left).

In one hand Bill holds a long spear tipped with a four-prong gig. On his head he wears a miner's lamp to spotlight the black water and reflect the buttonlike eyes of any big southern bullfrog that is out feeding.

He spots two close-set white specks.

"Frog, I'm gonna take you home with me," he says. He revs his engine, cocks his arm, and thrusts his gig. In a moment he brandishes a fat frog overhead. Some three hundred times that night Bill jabs his gig into watery black holes. All but twice he pulls out a green, flippered morsel to be delivered next day to a roadside restaurant and served up as crisp-fried frog legs.

"Frogs are pretty primitive," Bill tells me. "All they live for is to eat and reproduce and be eaten."

Frogs are definitely second-class critters to Gator Bill Schoelerman, but they are just about the only way a man from Big Cypress country can make a living off the land anymore, at least since strict federal laws shut down the black-market trade in alligator hides.

Bill is 35 now, a lanky, handsome man with a broncobuster's build and bearing. He is a natural-born woodsman, and in today's drained and disappearing Big Cypress Swamp that makes him as endangered a species as the alligator. Perhaps more so. For without the poaching pressures, alligators have been making a comeback. Bill, meanwhile, mutters about taking off for the Amazon, where he imagines he can still find some wild country.

About 1 a.m. we make a sudden halt.

"See those red dots? That's a gator's eyes," he says, veering the airboat suddenly. "I still always want to go look at 'em."

The gator, a four-footer, is unruffled by our intrusion. Bill pokes at it a bit with his gig, but the gator simply maneuvers out of the way. Its red eyes gleam confidently up at us, as if it would like to stare us down. Bill roars away.

"Maybe it's my imagination," he says after a while, "but since I stopped huntin' 'em, seems like every gator I see smirks at me."

A Big Cypress alligator would have good reason to grin these days. For a large chunk of this magnificent but beleaguered south Florida

Twilight Hope for Big Cypress

By RICK GORE

NATIONAL GEOGRAPHIC STAFF

Photographs by
PATRICIA CAULFIELD

One of a rare breed, "Gator Bill" Schoelerman spears the first of his nightly catch of 300 frogs in Florida's Big Cypress Swamp. He sells the legs to a restaurant in nearby Coopertown. Strict alligator protection laws pushed the gator hunter into frog gigging, a defiant last stab at living off the land. Encroaching development and drainage threaten both the swamp and its rugged, self-reliant residents. Joint federal-state purchase of 900 square miles for a Big Cypress National Preserve, now getting under way, may rescue the south Florida wetland.





AMBLYCORYPHA FLORIDANA, 4 TO 8 CENTIMETERS (1 1/2 TO 3 1/2 INCHES) ABOVE



FLORIDA CACIROLEA, 40 TO 90 CENTIMETERS HIGH (14 TO 28 INCHES) LEFT, ELAPHE OBSOLETA, 1.2 TO 1.8 METERS (4 TO 6 FEET)

A crayfish loses out when a little blue heron goes fishing (left). Florida's wetlands, kept clear and sweet by a gentle southward current, lure the wood stork, the roseate spoonbill, the great white heron. Fluctuating numbers of birds act as barometers of the swamp's health from year to year.

Female katydid on a pickerelweed (top) bears a sperm sack deposited by a male with whom she has just mated.

A yellow rat snake (above), one of 17 harmless species found in Big Cypress Swamp, peers from the branches of a long-needled pine. Poisonous cottonmouth moccasins and pygmy rattlers are also common.

wilderness will soon be bought by the National Park Service and turned into a national freshwater preserve.

The Big Cypress Swamp stretches along the western bank of the Everglades and sprawls to the Gulf of Mexico. Roughly the size of Delaware, it is a part of the same unique south Florida wetlands system as the Everglades. Yet the Big Cypress Swamp, higher and drier than the adjacent Glades, is its own ecological entity.

"Land Fever" Breeds Disaster

Scarcely fifty years ago Big Cypress country was virtually untouched. Forbidding thickets, oppressive heat, hip-deep muck, biting insects, and snakes made the swamp so inhospitable that few men dared penetrate it. Those who did brought back tales of incredible populations of alligators and immense stands of giant bald cypress trees, many of them more than a hundred feet tall, eight feet thick, and six hundred years old.

Then, in the 1920's, engineers cut the Tamiami Trail through the swamp to carry travelers between south Florida's two coasts. In the 1940's most of the mammoth cypress trees were girdled, downed, and dragged out by timbermen. By the 1950's the legendary masses of alligators were being decimated. And in the early 1960's land developers began moving in to drain the swamp and make it marketable. Throughout that period Florida was in a land-boom frame of mind, and so the occasional environmental protest was ignored.

"Up till a few years ago many of us didn't even know we lived in the Big Cypress Swamp," woodsman John Warren told me. "To us this was all just the Everglades. Till that jetport thing came up."

Indeed, Big Cypress can date most of its modern history from 1968, when the Dade County Port Authority broke ground for a proposed 39-square-mile jetport on the eastern edge of the swamp. Whole new cities were envisioned springing up around the ultramodern jetport.

"Land fever set in," recalled Everglades National Park technician Fred Dayhoff. "This was everybody's chance to make a fortune. It looked like a parade, all those trailers comin' down the road from Miami."

Environmentalists were horrified, but not

so much for the Big Cypress as for the Everglades. Water flowing out of the Big Cypress nourishes the western half of Everglades National Park. The park's eastern sections were already suffering from a water shortage brought on by a massive system of flood-control dikes and canals, built to drain farmlands and urban areas. Jetport development, conservationists contended, would mean the park's gradual death by thirst.

After a classic, bitter ecology-versus-economy battle, and finally White House intervention, Dade County agreed in 1970 to halt construction and to seek a new site. Today only a training strip for airline pilots marks the controversial spot.

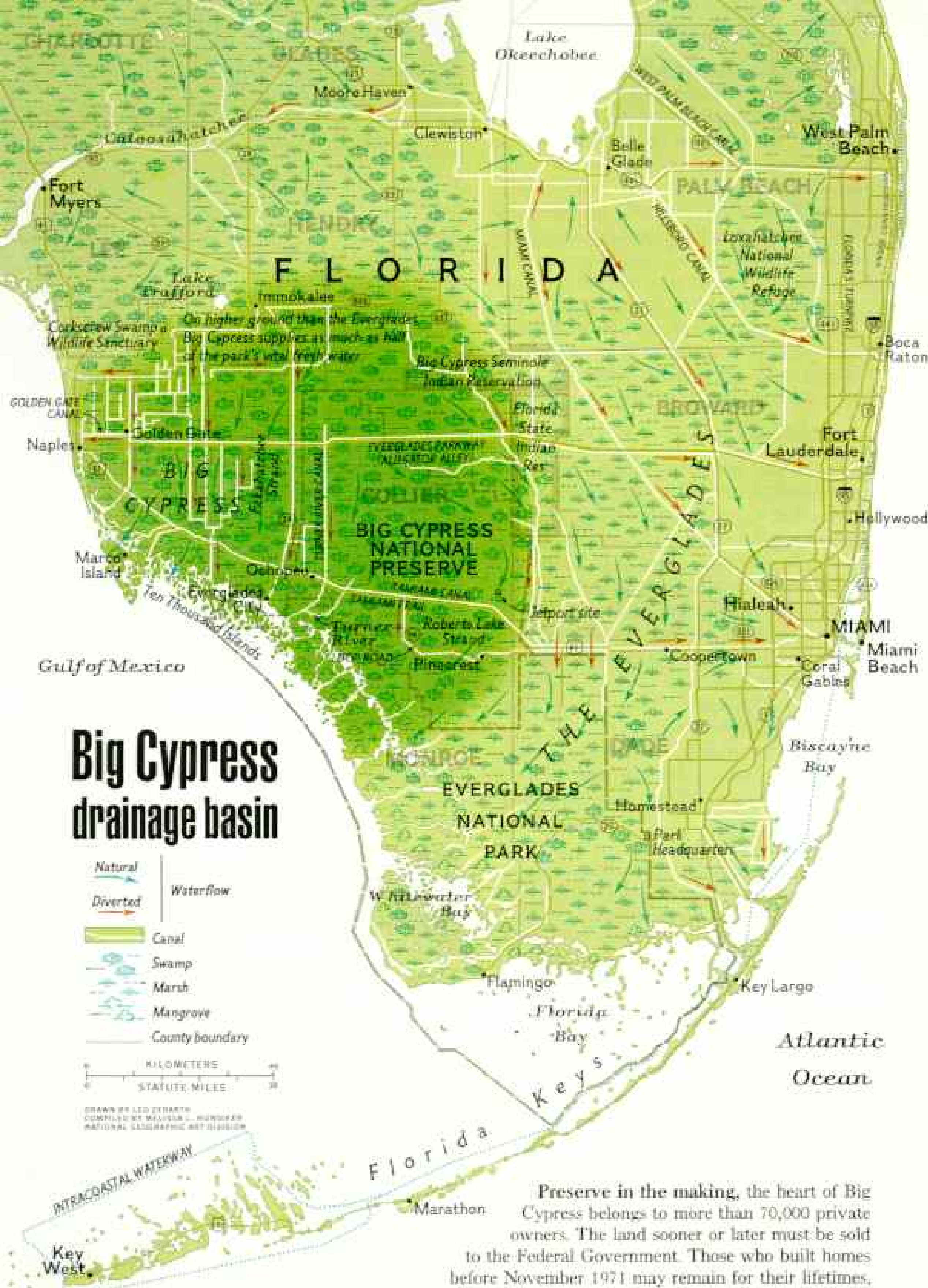
The jetport debate, however, had awakened the public to the plight of Big Cypress. The swamp sits atop a shallow and vulnerable aquifer that southwest Florida's fast-growing population, as well as its wildlife, may need to tap for fresh water. Already canals built by land developers had dropped the water table in places by as much as ten feet. Environmentalists, notably Joe Browder of the Environmental Policy Center, began to push for full protection of the entire swamp. The severe 1971 Everglades drought and the hellish fires it inflicted on the cypress country dramatized their plea.*

Western Area Lacks Protection

In 1974 Congress handed conservationists a landmark triumph. It approved the purchase of more than half a million acres in the heart of the Big Cypress. This is 40 percent of the original swamp. The State of Florida is buying much of a famed adjacent strand, the Fakahatchee. No one knows what to do about the rest of the swamp, its western front, which has been badly damaged by developers.

It will cost about 160 million dollars and take the Park Service at least four years to buy up the big central tract, the proposed preserve. Many of its 70,000 or more owners are investors around the world who years ago bought a plot of "sunny Florida," only to discover that their land was underwater much of the year. The state is contributing 40 million dollars toward the purchase.

*See "The Imperiled Everglades," by Fred Ward, *NATIONAL GEOGRAPHIC*, January 1972, and Frederick Kent Truslow's and Frederick G. Vosburgh's "Threatened Glories of Everglades National Park" in the October 1967 *GEOGRAPHIC*.



Big Cypress drainage basin

- Natural Waterflow
- Diverted Waterflow
- Canal
- Swamp
- Marsh
- Mangrove
- County boundary



DRAWN BY LEO ZERBATH
 COMPILED BY MELISSA L. HUNTER
 NATIONAL GEOGRAPHIC ART DESIGN

Preserve in the making, the heart of Big Cypress belongs to more than 70,000 private owners. The land sooner or later must be sold to the Federal Government. Those who built homes before November 1971 may remain for their lifetimes, paying an agreed sum for rent beyond the date of sale. Cost to taxpayers—160 million dollars.

What is this newly proclaimed piece of the public domain? A casual motorist driving the Tamiami Trail might call it simply a tropical badlands. But to appreciate the Big Cypress Swamp, you must leave your car and wade waist-deep through one of its cool, pristine sloughs. Or stand in the cathedral-like hush of a dome of cypress trees and gaze up at the hanging moss, the hundreds of vines, the orchids and other air plants that fill the trees.

Crawling through the endless maze of Big Cypress, I could understand how in the mid-19th century the guerrilla warriors of the Seminole and Miccosukee tribes so easily eluded the pursuing U. S. Army here.

Imperiled Creatures Find a Haven

The Indians live on reservations now, or in scattered settlements along the fringes of Big Cypress and by the Tamiami Trail. The vast swamp remains a sanctuary for wildlife. It is a last stronghold for more than 20 rare or endangered birds and animals, including the wood stork, the Florida panther, the Everglades mink, the mangrove fox squirrel.

The Big Cypress is by no means all swamp. "Out here, just an inch or so of elevation makes for a completely different type of vegetation," Fred Dayhoff explained.

That is why one can walk out of a boggy cypress forest onto a big-sky prairie of tall grasses. Dotted the horizon might be islands of pine and cabbage palm. Throughout cypress country are hardwood hammocks of oak, bay, gumbo-limbo, and mahogany.

To the south the land drops gently toward the Gulf, and estuaries turn the soil salty. Here impenetrable mangroves replace the cypress and hardwoods. Each rainy season Big Cypress floodwaters flow into these mangrove wetlands, freshening them and flushing out decayed nutrients. As a result, the mangrove fringes are among the most bountiful marine nurseries on earth.

Elsewhere in the Big Cypress, stretches of snake-infested pinelands and palmetto thickets abound. The most striking landscapes,

Hanging garden of Spanish moss, orchids, and other air plants in a pond-apple tree shades a slough. The trees grow "so thick you don't walk," says Gator Bill. "You get down on your belly and slither."







however, are fields of dwarf bald cypress trees, which in winter reach up like hundreds of little white hat racks amid blue sky and yellow grass. They try their best to grow in the infertile, shallow soil that overlies much of the limestone floor of the Big Cypress. Some of these stunted trees may be 80 or 90 years old, yet stand less than a foot tall.

Not everyone considers the preservation of this hard land a victory. Many of the several hundred Big Cypress residents are furious that they will be forced to sell the land they live on, even though the Big Cypress purchase act permits a resident to use his land for his lifetime. The little town of Ochopee, for instance, has dubbed itself the "Site of the Federal Land Grab."

"You tell those people in Washington not to come out here, or I'll meet 'em with a shotgun," sputtered Loren Spradlin, half in earnest, when I visited the small rabbit farm that he and his wife, Valada, run.

On the other hand, even die-hard homesteaders sense a grave trouble on the land.

"Dammit, I don't believe in this ecology," I overheard a man say in Mimi's Bar, outside Ochopee. "But tell me, what's happened to all the animals?"

The trouble is that water does not stand on the land long enough anymore. Formerly the summer rainwaters flowed so slowly seaward that they kept the land flooded until February or March. These days the harsh dry season sets in by November.

Water is the blood of the Big Cypress, and without it all swamp life suffers. The carnage of creatures killed while scrambling across highways to drink from roadside canals has become extraordinary. Moreover, fires now easily ignite the dried peat, which then smolders for days. Many Big Cypress trees evolved barks that withstand normal brushfires. But smoldering peat

(Continued on page 262)

Developer's dream: Roads grid a sector of Big Cypress (right) scalped by mechanical tree choppers to make way for Golden Gate Estates subdivision near Naples. Drainage canals lower the swamp's water table and intensify natural droughts. Displaced by development, an alligator (left) finds uncertain refuge in a bulldozed borrow pit—dug to furnish fill elsewhere.





Water-bombing a wildfire, a daring pilot dumps 300 gallons at a time into a cloud of smoke (above). The phosphate-enriched solution puts out the blaze and encourages regrowth of foliage in burned-over areas.

Protected by a backfire, trailer owners watch as rangers try to block a runaway blaze (right). An alarming number of south Florida fires begin in backyards, when residents attempt to burn out snakes and rodents. A charred rattlesnake (left) testifies to the speed and intensity of such conflagrations.

Before man moved in, summer lightning sparked "healthy" fires that burned only dry brush and dead branches. But with water siphoned off by canals, today's swamp smolders like a dry sponge, the fire biting down into the soil and searing tree roots.



roasts their vulnerable roots, and their trunks topple in the next strong wind.

Seven years of drought is the main reason why the eastern Big Cypress, the federal acquisition area, is dry. In the western Big Cypress, however, a vast network of canals seriously compounds the drought. These canals, now clogged with weeds, lace 160 square miles just west of the Fakahatchee Strand. They have created an environmental morass known as Golden Gate Estates.

Orchids Wither, Gator Holes Go Dry

The canals were dug in the 1960's by the Gulf American Corporation, a land-sales company that was later bought by a subsidiary of the General Acceptance Corporation. More than 140 miles of these canals undercut the Big Cypress watershed and pour off into the Gulf of Mexico almost 150 billion gallons of fresh water each year—enough to support a city of two million. The loss aggravates a severe water crisis in southwest Florida.

"The Fakahatchee, I guarantee you, was the prettiest place in the state ten years ago," Collier County Deputy Sheriff Charlie Sanders told me angrily. "Now I can show you a grove where ghost orchids are shriveling up and falling off the trees, and bone-dry gator holes that a man had never seen the bottom of until they put those canals in."

Most of this ruined wilderness, despite the drainage, is still not high enough to build upon. Some eight hundred miles of rutted, poorly marked roads make most of Golden Gate a vast maze of seemingly identical plotted sections. I twice got lost trying to find my way out. Every time I ventured into Golden Gate, I saw several fires burning freely. Charred cypress stumps were everywhere, and in places the ground smoked.

"In fifteen years we'll have a desert out there if we don't do something," a Collier County official told me.

Thanks to the federal purchase act, most of the Big Cypress will be spared such trauma. The purchase, however, must be considered a tentative salvation. Even within the purchase area, roads and minor canals have altered the historical water flow across considerable stretches. Biologists worry that the cypress will not regenerate well on the dry, fire-scarred land, and that new plants—particularly pines and (Continued on page 266)



Runaway speculation drives deep into Big Cypress country, where swampland can



bring \$2,000 an acre. Investors buy large tracts and sell off pieces. But tough building codes make full development almost impossible in some areas.





Fiddle in his hand, music in his heart, Ervin Rouse (left) sings "The Orange Blossom Special," a hit he wrote in the 1930's. Cold beer and country music draw a regular Saturday-night crowd to the Gator Hook Lodge, where couples dance the sprightly "clog," or swing to a quieter beat (below). On weekends the rustic bar serves as social center for the Loop Road, a bumpy back stretch that forks off the Tamiami Trail.



the rapidly spreading melaleuca tree, a fire-and-drought-hardy invader from Australia—will overrun the swamplands. Throughout my travels I was haunted by the prospect that even if normal rains return, the Big Cypress may not recover.

Unquestionably the preservation will help Everglades Park and safeguard southwest Florida's aquifer. Big Cypress wildlife, too, will fare far better. But there will be a sacrifice. As the land is bought, an extraordinary "Florida cracker" way of life will disappear.

"This is the last frontier, the last great swamp," declares Jack Knight, owner of the Gator Hook Lodge, a tavern along the Loop Road. The Loop Road is a quiet dirt byway off the Tamiami Trail.

Loop Road life centers around the village of Pinecrest. Today it is only a few houses and a score of trailers scattered through the woods. About a hundred people, and, it seems, as many skinny, rangy dogs. A grocery store. A gas station. And two taverns.

"There was quite a settlement here in '28 when they opened the trail," recalled old-timer Ike Perry. "It was loggin' then. Those people are long gone. The Depression wiped 'em out. Those that stayed got washed out by the hurricanes of '47. Or else the deerflies and horseflies et 'em up."

Life Turns Robust on Saturday Night

The people of Pinecrest now are mostly refugees who, for one reason or another, do not take to the restraints of urban living. There is virtually no law in Pinecrest. Everglades Park cuts the village off from its county seat—Key West—and the nearest police station is 90 miles away.

"It's a good place to hide," said Mary Stephan, who with her husband runs the Pinecrest Lodge. A sign over the pool table reads: "No guns or knives allowed inside."

"Do you need that sign?" I asked.

"You'd be surprised," Mary answered. "I think the police are scared to come up here. They've heard too many stories about Saturday night."

Everyone on the Loop Road has his tales of memorable Saturday-night brawls, knifings, and shootings. I saw only people drinking beer, being neighborly, and dancing to the sweetest country music south of the Okefenokee Swamp.

"Foot-stomping music, that's what we play," brags Jack Knight's daughter, Joyce Willis, who sings with a country-and-western group Saturday nights at her father's tavern. "It's the best audience in the world. They love their country music. People just jam in here, but when there's music playing, there's never any trouble."

"They're too tired from dancin' to fight," interrupts one patron. "Why, I bet your father must sweep up a bucket o' toenails on Sunday mornings."

Jig and a Fling Add Up to a Stomp

The night starts slowly, until Joyce's group begins to play and a mellow Gator Bill is crooning "A Long Black Veil."

Next it's clogging time. The tempo of the music perks up, and I am drawn onto the floor by Sophie, a middle-aged woman with double taps on her shoes.

"What kind of dance is this?" I gasp to Sophie as we tap, shuffle, and spin across the floor.

"It's part Irish jig, part Highland fling, and part German somethin' that got all mixed up in the mountains of North Carolina. Out here we call it the Everglades stomp."

A wizened stub of a man now takes charge of the microphone, commanding instant attention with his backwoods twang.

"I wrote this song for momma," he intones. "She was swee-ee-ter than the flowers. The purtiest girl in the en-tire world. There ain't nothin' too good for momma."

The man is Ervin Rouse (preceding page), composer of the country classic "The Orange Blossom Special." He begins to wail.

"Lookie yonder comin' . . . Comin' down the railroad track . . . It's the Orange Blossom Special, bringin' my ba-ya-bee back."

And now because the spirit has struck him, Ervin takes up his fiddle, and, sweet mercy, the crowd is entranced. Ervin soars, an old sorcerer concocting with his fiddlestick notes that strut and swagger, frenzied runs that sputter through your brain stem and make you want to call the hogs home.

Ervin began fiddling about 45 years ago in the mountains of North Carolina.

"We were all poor people," he recalls. "We hardly knew where our next meal was comin' from. I was raised on a farm. Fifteen head o' children to one mother and one father."

Ervin perfected his technique during the Depression, when he and three brothers packed into a car like Okies to play roadside bars around the country, passing their hats for nickels and dimes.

"Once I played for 30 minutes continuous. Eighty songs," he insists. "I was wore down to a frazzle."

It was during his traveling days that Ervin turned out "The Orange Blossom Special," the royalties from which make him one of the Loop Road's wealthiest inhabitants. Nevertheless, his home, where he lives alone with his two dogs, Curly and Butterball, is ramshackle and dark. The walls are plastered with pictures of the country-music stars he once performed with.

"I don't think I could stay out here without my pictures," he says. "Been out here about ten years permanent now. A bunch of us hillbillies used to come here to hunt. This is all deer country. I'd never leave now. When you get out here, somethin' tells you to just relax, to kind of go along with the country. 'Cause you cain't own it. And to be proud. Out here you are in the wilds. When night falls, it is so dark. Oh, it's wild!"

Reminiscing With Uncle Mac

No one on the Loop Road, however, can talk of wildness with the authority of MacDonald Johnson, 90. "He's the granddaddy of the Everglades," Jack Knight swears as we head toward "Uncle Mac's" home, a dilapidated school bus beside the Loop Road.

Uncle Mac first came to the Big Cypress before the Tamiami Trail was built. Sitting in front of his bus wearing only his aged khaki trousers, he looked as tough as an old bull gator, as ageless as a crusty swamp turtle.

Uncle Mac and Jack Knight like to reminisce about early days along Loop Road.

"Al Capone's syndicate used to run a hotel here in Pinecrest," Jack recalls. "I don't think Al himself ever came out here, though. I call him Al now, but when I worked for him as a waiter in Miami, it was always 'Mr. Capone.'"

Uncle Mac chuckles. "They used to bring so-called 'dignitaries' out here for a vacation. A man can vanish real easy takin' a walk in the swamp. And a lot of 'em did—without a trace. Put a dead man in a gator hole, and in a day or so there won't be nothin' left of him. Not even bones. Heh!"



Fruits of his labor: Clare Phillips, 75, grows mangoes, papayas, bananas, and grapefruit. "When I built my cabin here, people told me I was crazy," the spunky Michigan bachelor says. He hauled mud from a pit to make high-water mounds for 77 citrus trees. Save the Big Cypress? "I think they're making a big mistake. This is the homeliest country in the United States."



The talk turns to the upcoming federal purchase of the Big Cypress. "They'll never starve me out," Uncle Mac boasts—as if anyone had planned to. "I know how to live off the swamp. Did you know that the roots of that saw grass there is good eatin'? Jest the other day I went and shot me a wild pig, hung him up, and skinned him. He'll feed me and my friends for a week.

"And here's my protection," he adds, reaching into his pants pocket and pulling out a .38 pistol. "This and my dog."

As a suburban man, I could not get used to the abundance of rifles and handguns. "Better

to have a gun and not need it," read a sign in a gas station, "than to need a gun and not have it." While I was there, a Loop Road woman went berserk and started shooting at anyone coming near her property. A man in the northern Big Cypress shot and killed a neighbor in a fight over a dog.

Gator Legends Grow With the Telling

There is nothing like an alligator, however, to set a true Big Cypress fighting heart thumping and to start the yarns coming lickety-split. Gators are both varmint and legend in Big Cypress country.



Saved by her sex, a doe runs for cover (left); only bucks are fair game for hunters (below), who plow through mud and knee-deep water at up to 60 miles an hour in their tracked vehicle. Some qualify as sportsmen and work to save the swamp. Others follow a different philosophy: If it moves, shoot it.



"A gator can run 40 miles an hour," swore "Miz" Frances Watson, a boulder of a woman who owns a small grocery store in Ochopee. "Not for very long, though."

"An ole cow gator, she'll tree you and sit there and beat the trunk with her tail," said one of Miz Watson's customers, Carl Ostrander.

"I once had an 11-footer goin' after my ducks," Miz Watson continued. "He'd knock 'em roof-high with his tail, open his jaws, and gulp 'em as they landed. Didn't even leave no feathers in the water."

For serious gator talk, however, I went to a more experienced source.

Gator Bill Schoelerman wakes up around noon when he's been frogging the night before. If his wife, Hilda, has not yet cleaned his catch, Bill helps out. On this day he decided to show me some of his swamp. He grabbed his snake stick, and we headed in along Roberts Lake Strand toward a gator hole Bill knows. The dry season was under way, and most swamp creatures, not just alligators, were gathering around the gator holes to feed, and be fed upon.

We reached a pond surrounded by cypress knees and covered with what must surely be *the* primordial ooze. Bill stooped to inspect



the track of a gator tail recently dragged across the muddy bank.

"The gator probably has its den under that tree," he pointed out. "It won't come up while it hears us. You got to sit real tight and wait 'em up. Usually it takes only one or two minutes, but I've waited as long as six hours. Sometimes you have to grunt to get 'em out of their caves."

Male Risks Being Consumed by Love

Bill let out a grunt he mastered long ago, that of a mating bull gator. "Usually this'll bring up a cow to see what kind of a suitor

she's got callin' on her," he explained. "A male has to be bigger than a cow he wants to breed with, or she'll chew him like corn on the cob, and send him packin'."

If there was a cow down there, she was not in the mood to show herself. So Bill led the way to a pond where he once hunted snakes for dealers; it was always good for a couple of pillowcases full. Mostly of venomous cottonmouth moccasins. The pond was bubbling with thousands of tadpoles and minnows. But no snakes. Bill stopped, puzzled and upset. "All I can figure is those damn deer hunters—the weekend warriors, we call 'em—had



Dollhouse post office, which claims to be the nation's smallest, serves 350 families scattered over 122 square miles of the Ochopee area. With space in short supply, packages jam corners and postcards brighten the door. The flag flies at half-staff for the death of a government official.

"Do I wish I was a game officer now," John muttered. "That fellow ain't even gonna use those birds. Some people just like to watch things die."

Hunters are the major users of the Big Cypress, and the federal purchase will not bar them. On airboats, trail bikes, swamp buggies with giant airplane tires, and atop tanklike half-tracks and full-tracks, weekend hunters now carelessly traverse lands the U. S. Army could never subdue. Each deer-hunting season, locals complain, brings raucous and brutal spectacles.

Some hunters are devoted conservationists, prudent with their rifles. These hunters, in fact, added momentum to the early drive to preserve the Big Cypress. But others set brushfires, hoping the new growth will attract deer. All too often, they burn each other's camps out as well.

Young Wood Storks Raise Happy Din

So many sights in the Big Cypress invite pessimism these days that it was a joy to arrive at the National Audubon Society's Corkscrew Swamp Wildlife Sanctuary. Lying 20 miles northeast of Naples, Corkscrew offers the Big Cypress Swamp in manicured microcosm. Alligators, wondrous birds, snakes, mossy glades, and Florida's only major unlogged stand of the old giant cypress trees can be relished from a boardwalk without getting the feet wet.

On a sunny February morning the treetops reverberated with the honking of fuzzy-headed, fledgling wood storks, Corkscrew's most celebrated residents.

"These storks are almost a symbol of the whole problem of wetlands in Florida," said Audubon biologist John C. Ogden. "It is an indication of how bad things are when a bird that can range fifty miles can't find food."

Before the days of draining, some 100,000 wood storks nested in Florida each winter. Their number has steadily declined to about

themselves a field day shootin' cottonmouths."

The frustration in Bill's eyes was something I saw again walking with other woodsmen. It flashed across Fred Dayhoff's face when he found that a favorite rare orchid had been snatched by a collector from a place he thought was secret. Big, burly Fred was on his knees, scouring the base of a cypress tree in hopes his orchid had left a seedling.

The look took on bitterness when guide John Warren and I saw a fisherman on an isolated stretch of the Turner River pull out a gun and bring down several white ibises and a Louisiana heron, both protected birds.





13,000 today. The wood stork feeds by groping, relying on its sensitive bill. That means it must find a pond where fish are concentrated in order to make a catch. The wood stork's breeding season—November into May—coincides with the normal dry season. During that period there should be plenty of richly stocked fishing holes it can harvest to feed its young.

Unfortunately, because the western Big Cypress dries out so much earlier now, there is often simply no food when the storks breed. The birds are so sensitive to feeding conditions they will abandon their nests if a cold front brings a freak heavy rain that briefly destroys the fish concentration. Like so much of the Big Cypress wildlife, they do not tolerate even a slight tampering with their ecological niche.

"Three years ago they didn't nest at all," Corkscrew Superintendent Jerry Cutlip said. "They just flew over."

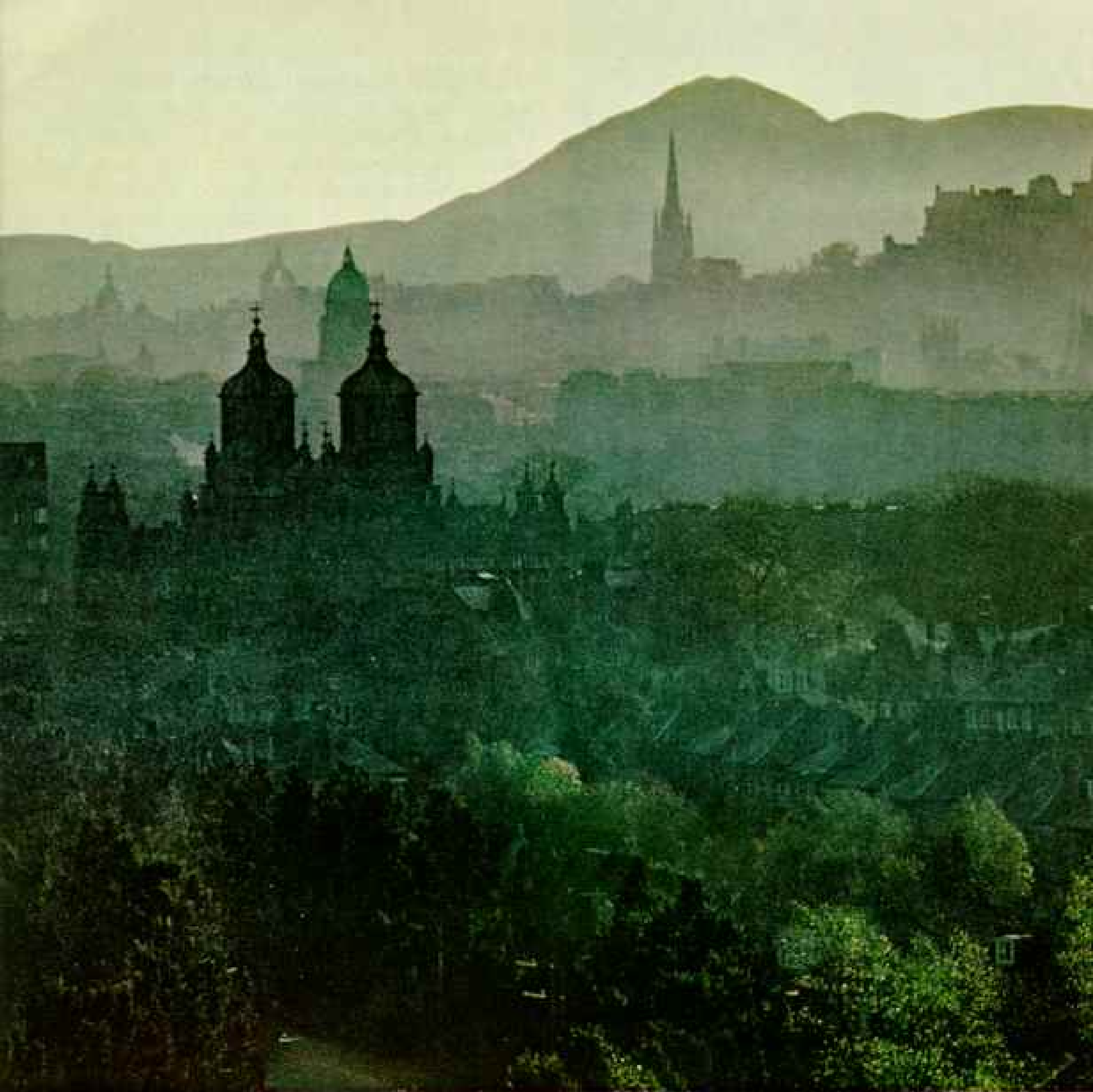
This season, perhaps because they began nesting early, they bred prodigiously.

Preparing a New Welcome for Animals

There is something encouraging about Corkscrew. True, water must be pumped now to keep the swamp wet. And each spring brings the recurring danger of fires, aggravated by the continuing drought. But the temperamental wood storks surprised everyone with a bumper brood.

There is more heartening news. The county has hired environmental consultants to determine how to restore as much of Golden Gate as possible to its natural state. There is increasing talk about a system of dams in the canals to raise water levels. Hydrologist Jim Hartwell told me that the long, life-sapping drought should soon be over. And the Park Service has made its first big purchases. Which means the improbable will soon happen in Florida: People will clear out to make room for the animals. For a change, hope is afoot in Big Cypress country. □

Rush of wings welcomes the dawn as white ibises head for feeding grounds. South Florida's ability to nurture its wildlife as well as water its human population depends largely on preserving such fragile wildernesses as Big Cypress.



Rising through a morning fog, Castle Rock dominates Edinburgh's

Edinburgh: Capital in Search of a Country

By JAMES CERRUTI
SENIOR ASSISTANT EDITOR

Photographs by ADAM WOOLFITT



skyline. Arthur's Seat, an extinct volcano, looms in the background.

EDINBURGH is a second-best city—and proud of it. Edinburghers like to boast that, within the arena of the United Kingdom, Edinburgh is the second most cosmopolitan city . . . after London; the second biggest tourist city . . . after London; and that it has the second busiest shopping street, Princes Street . . . after Oxford Street . . . in London, of course.

Edinburgh will take a backseat to a worthy opponent, but Glasgow is not in that class. Scotland's largest city and its center of industry, Glasgow, with a population of

905,000, as against Edinburgh's 475,000, wins hands down in bigness. But Edinburgh, Scotland's center of political administration, finance, medicine, law, religion, and the arts—and the historic capital of Scotland—is certain its cultural excellence overrides Glasgow's bigness. Glaswegians demur: "*Capital, ye say? She's nae capital—no' since the 1707 Act o' Union when the English bashed our Parliament into theirs. We're ruled frae London, no' Edinburgh.*"

I don't wish to put the cat among the pigeons, so I will say quickly that Edinburgh



All Edinburgh's a stage during the annual festival of music and drama. Participants include some of the world's most distinguished actors and musicians. Festival Fringe groups add spice, often setting up impromptu stages. A London company dances in the street (above); another Fringe troupe uses Calton Hill, a park, to perform a skit (right). Proud of its cultural and historical heritage, Edinburgh is also the political heart of Scotland—and would-be capital for those seeking independence from the United Kingdom.







Edinburgh (ENLARGED AT RIGHT)

Shoulders squared to the sea and locked between hills, Edinburgh grew up—sometimes 14 stories high—for centuries. Then, in 1767, its crowded citizens broke out into the carefully planned New Town. Today Princes Street cuts a sharp architectural boundary down the center of a city whose extinct volcano has become a beauty mark of open parkland for the city's nearly half a million residents.



and Glasgow only half detest each other—the other half is envy. Edinburghers love to tell stories that contrast their couthness with what they feel to be Glaswegian uncouthness. Glaswegians riposte with parables of their generosity, opposed to Edinburghers' uppity airs and stinginess.

Edinburgher: "Used to be two signs at the crossroads at Harthill. One said 'Glasgow.' T'other said 'Gentlemen'—pointin' t' opposite way—toward Edinburgh, o' course." (He pointedly neglects to mention that a gentlemen's toilet stood nearby.)

Glaswegian: "Ye drop by a friend's flat here, he says, 'Come awa' ben the hoose. Ye'll be wantin' some tea.' In Edinburgh they say, 'Oh, hallo, ye'll have had yer tea.'"

I did not find Edinburghers stingy, but rather, Christianly frugal; they strive to impart frugality to others—even against their own interest. In Young & Saunders, a superb old-fashioned grocery, I reached for a can of turtle soup. The clerk gasped out loud. "Ah nae, sir, tha's terrible expensive. 'S no' worth it, sir!" I quickly drew back my hand, as if the turtle had snapped at it. But Young &

Saunders had made a devoted customer of me.

I found much generosity in Edinburgh, but the generosity of an elderly gentleman I met in the Covenanter Tavern in the Old Town touched me most. He was a retired distillery worker named Robert McGuigan, and his passion was Robert Burns, the 18th-century Scottish national poet.

"We al'ays hae a Burns supper nea' tae his birthday, on January 25—a damn guid nicht oot," Mr. McGuigan said. He then recited the menu: cock-a-leekie soup (a chicken-and-leek broth) and haggis with chappit tatties and bashed neeps (minced sheep's innards steamed in the paunch and served with mashed potatoes and turnips).

"Now, the haggis gies ye a guid foundation," Mr. McGuigan continued, "an' we sta't drinkin' a'ter thot. First, a toast tae the immortal bard. Then Burns tunes, us toastin' a' along. Finally, a toast tae the lasses—ah, Robbie Burns, he luv'd the lasses!"

A young kibitzer at the next table shot in: "Once ye've read one o' thim Burns poems, ye've read the lot. An' Burns suppers—they soond draidfu!"

Mr. McGuigan rose with dignity and left. Ten minutes later, he was back. "I can see that ye have the heart for Robbie Burns," he said, with a wrathful glance at the kibitzer, and then he presented me with *The Poems and Songs of Robert Burns* and a Burns biography—a considerable expense for a pensioner.

The Gaelic: Sacred to Scots

The just-plain people of Edinburgh truly held out their hands to me. They taught me Gaelic ballads and ancient dances. They introduced me to the mysteries of the ceilidh, at which they fling and reel, play their pipes and "tin whistles," and circle round with interlaced arms singing "Auld Lang Syne."

Ceilidh (pronounced KAY-lee) is from the Gaelic (pronounced GAH-lic). "Before I explain ceilidh, I must explain it is always *the* Gaelic, like *the* Church—a sacerred thing," said draftsman Charlie Fraser, a mite of a Gael with a pixie wit. "A ceilidh is a solemn consecration o' t' Gaelic by worshipers who canna even speak it—they jus' hum it."

We were at a ceilidh at the Wee Free Kirk in the Old Town, and manager John Lockie said, "Don't heed Charlie. A ceilidh's not solemn. It's sort of somethin' that happens—

Tightening a submarine's steel claw, a mechanic for Vickers Oceanics readies a manipulator used to assemble and repair underwater oil pipelines. North Sea oil, found off Scotland's coast in 1970, revived Edinburgh's ship-servicing industry and eased the city's unemployment problem.



like droppin' in for a friendly cup o' tea."

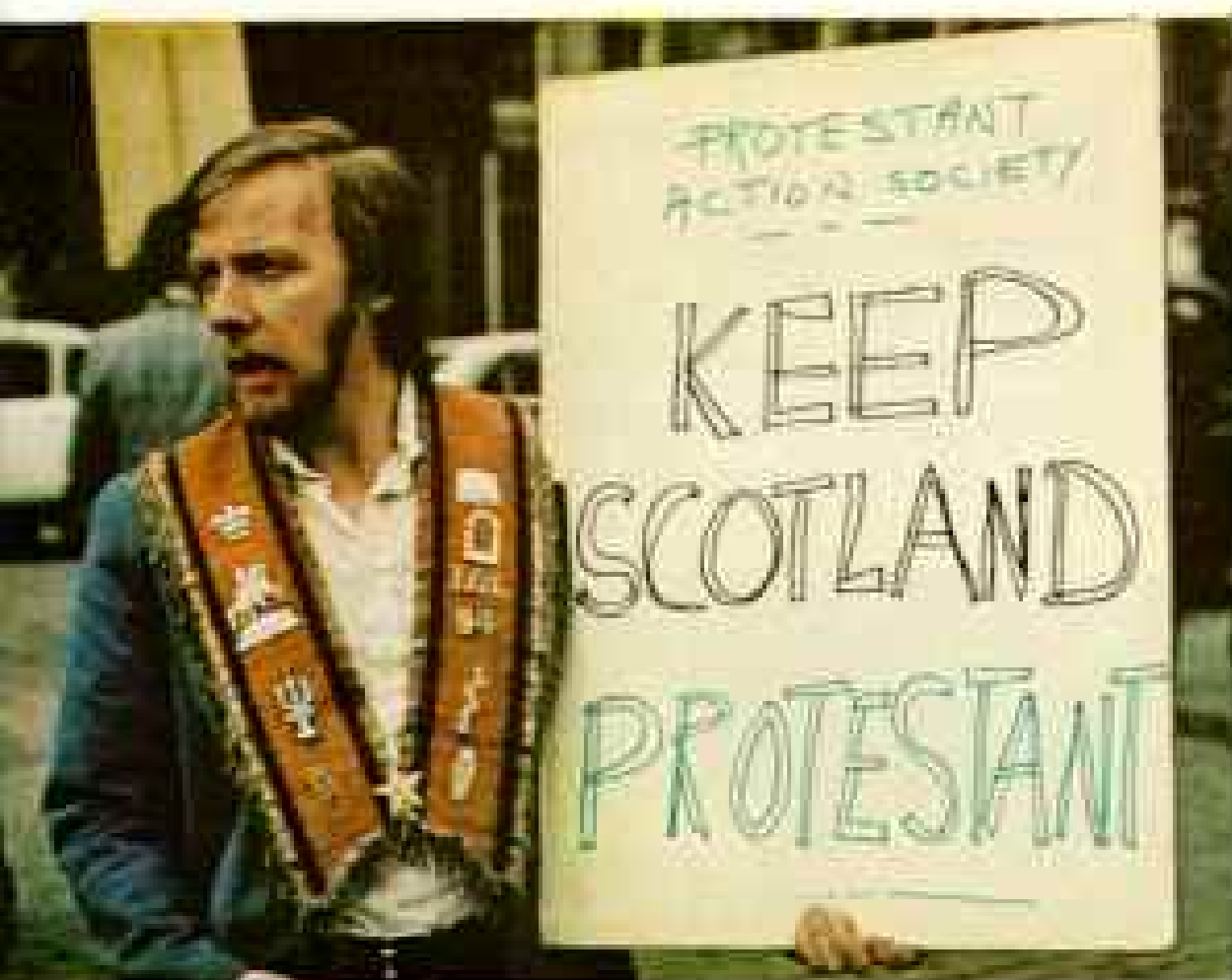
Baldish, beaming Bill Clark, a sewage-disposal superintendent, capped the rebuttal: "Solemn! Ye'll never see me solemn here!"

"Ye've nae right to be in this argument," Charlie said. "The Gaelic is fer Highlanders. Yer a Lowlander, Bill."

"Aye, one o' the finest Scots alive."

"Yer a Sassenach, Bill," singer Kitty Campbell said.

At this Bill blanched. A Sassenach, originally a Saxon, is forever an Englishman. "Kitty, I am a Scotsman," Bill solemnly



Defender of his faith, a Protestant pickets outside St. Giles' Cathedral (above). Inside, citizens protesting religious violence in Northern Ireland object to the appearance of a Roman Catholic, the first priest invited to the pulpit since the Protestant Reformation 400 years ago.

Puritan reserve still governs the city's pubs, required to close at 10 p.m. At historic bars like Bennet's (right), patrons provide their own entertainment—yarn swapping.

A hero of Edinburgh legend, Bobby, a shepherd's dog, followed his master's coffin to Greyfriars Churchyard in 1858. Fed by the gardener, he stayed nearby for 14 years. A statue (below) keeps the story alive.



avowed. "I am a guid Edinboro Scotsman."

Bill and Charlie took me to another ceilidh, in the Learmonth Hotel, where they blended the spirit and spirits of Scotland in traditional Gaelic toasts. "Sláinte Mhòr, Mo Caraid" came out "Slenjta Vor, Mo Karridge," which (however you pronounce it) means, "Great Health, My Friend."

Between toasts Bill and Charlie joined in the reels, their flying kilts lending a grace to the agile stepping that trousers would have shrouded. Such dancing prompted a legendary 18th-century Irish ballad: "Niver have Oi sane a payple so handy with their feet!"

The old Scottish airs were so tuneful that



suddenly, after a lifetime of croaking, I found I too could sing. “Ye must have a wee drap o’ the guid bluid,” Bill said. I boasted I did—my grandmother was a Gael from southern Ireland. And then I went too far. “You’re really Irish too, Bill. You told me yourself the Scots came from Ireland in the sixth century.”

Bill gave me a disgusted look. “I’ve enjoyed yer company, Jimmie,” he said, “up tae now.”

Bill’s disapproval was not of all Irish, but of the Irish rebels who were firing on Scottish regiments in Northern Ireland.

The age-old martial spirit of the Scots is embodied in the Old Town’s dramatic setting. Edinburgh is dominated by its castle, which

was begun, tradition holds, in the seventh century by King Edwin of Northumberland (regrettably, an Angle). It sits massively on a towering crag, 443 feet high, like a stage set from *Macbeth* (pages 274-5).

Skyscrapers Flourished 300 Years Ago

From the royal castle, the Royal Mile tails down to the 16th-century royal Palace of Holyroodhouse. The tall buildings along the Mile, called “lands,” were built 10 to 14 stories high more than 300 years ago. “Ye see, we had skyscrapers when yer New York wa’ jus’ a village,” Bill Clark said.

Long before the lands or castle were built,

Gaels lived on the crag and the slope behind it. The site is a crag-and-tail formation, carved by a glacier that butted against the dead volcanic plug that is Castle Rock. Edinburgh's largest volcanic peak, extinct Arthur's Seat, stands at the other end of the Mile, looming 823 feet above Holyroodhouse. The Gaels called their settlement Dunedin, the "fortress on the slope," but their Anglian conquerors, playing on "edin" and "Edwin," renamed it Edwinesburg in honor of their king.

Edinburgh has a New Town as well as an

Old (map, page 278). A mere two centuries young, it was planned in 1767 by youthful architect James Craig. It lies north of the Old Town across a glacier-cut valley, today occupied by lovely Princes Street Gardens and the not-so-lovely Waverley railway station.

Princes Street is the southern edge of the New Town, one of the largest areas of unspoiled Georgian architecture in the world. Alas, not much Georgian remains on Princes Street. As second busiest shopping street, it abounds in modern, expensive emporiums.

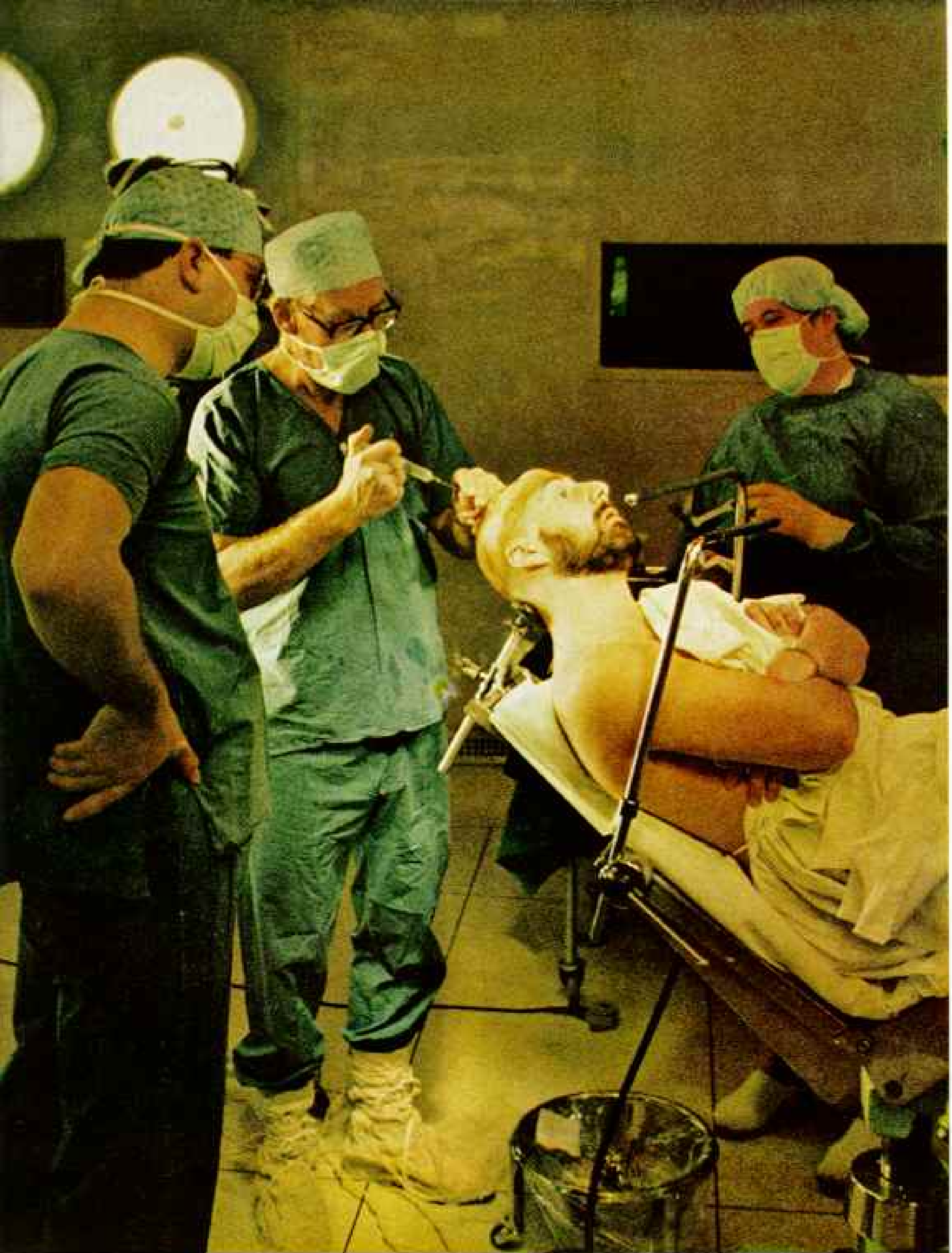


Behind Princes Street, the real, the stunning New Town begins. In Charlotte Square, architect Robert Adam produced its finest design. He planned each side of his square as a unit, with a sweeping neoclassical facade that gives the appearance of a noble's palace, though behind are mere houses and flats. One corner house there held special interest for me. A plaque on it read: "Alexander Graham Bell—Inventor of the Telephone—Born here 3rd March 1847." Bell was also a president of the National Geographic Society.

Adam had his inspiration for Charlotte Square in 1791, and for more than half a century succeeding architects took it up in a square mile or so of other elegant squares, ovals, crescents, and even one dodecahedron—Moray Place. There my wife, Hannah, and I had a flat, flanked by soaring Tuscan pillars. Our drawing-room ceiling soared too, to 14 feet, and blossomed into filigreed blue-and-white plasterwork. It was a relaxing neoclassical refuge from the strain of trying to take in everything of interest at the famed Edinburgh



Staid ways persist on Bellevue Crescent in the New Town, an old residential section sternly opposed to change. Local law protects its charm, and neighborhood pride keeps its brass door knockers gleaming (above). Plaques on many housefronts mark former homes of the city's famous sons: authors Sir Walter Scott and Robert Louis Stevenson and philosopher David Hume.



Wide awake but feeling no pain, a patient at Edinburgh's Western General Hospital awaits surgery for Parkinson's disease (above). The surgeon's hot probe will sear the diseased brain cells. University of Edinburgh professor F. John Gillingham, center, has been developing such techniques since 1954. At Donaldson's School for the Deaf (right), earphones amplify a teacher's voice. Concerned with speech and hearing, Alexander Graham Bell first studied phonetics in his father's Edinburgh laboratory.

International Festival of music and drama.

That proved an impossible ambition, of course. Last year's 29th festival, which ran from August 24 to September 13, consisted of 59 different events attended by 150,000 visitors from 117 countries. The world's foremost musicians appeared, from cellist-conductor Mstislav Rostropovich (page 293) to Leonard Bernstein. Nureyev starred in ballet and the Nottingham Players in Shakespeare. Operas ranged from Mozart's classic *Le Nozze di Figaro* to Jane McCulloch's and Carl Davis's brand-new rock operetta, *Pilgrim*. This was performed, surprisingly and at maximum amplification, in the Assembly Hall of the Church of Scotland; surely those sacred walls had never heard the like (not bad actually), and if walls have ears, after 21 performances they'll never hear again.

I particularly liked the readings with music, on Scottish life, given in the reconstructed oval 18th-century jewel box, St. Cecilia's Hall. Timothy West read letters of Edward Topham, an Englishman who lived in Edinburgh in 1774-75. Much remains unchanged, including the changeable weather:

"Frequently you experience all the seasons in one day. The fine weather is . . . formed [in] July, and continues till the end of October;

the remaining months all pass under the denomination of winter. They seem to have only two seasons, Summer and Winter." I think I must have experienced the month of autumn. Last September, the rains began early and stayed late. The natives referred whimsically to this period as "nice soft weather," perhaps because the winds off the Firth of Forth were not yet doing their worst.

Mr. Topham could be more cutting than the wind: "Tho' [the Scots] are lazy and improvident at home . . . the very same men become the most industrious and frugal abroad. It is in their own climate alone that their abilities seem to lie dormant."

Tomorrow Too Soon for Easygoing Scot

I was surprised to hear this harsh English judgment seconded by a Scotsman, in *Jock*, the work of Edinburgh playwright W. Gordon Smith. According to super-Scot Jock, an Englishman back from Mexico told a Scottish friend, "They have a curious expression in Mexico, *mañana*. Do Scots have such a word in the dialect?" The Scot asked for a definition. "Putting off till tomorrow what you can do today." "No," said the Scot, "we have nae word that admits o' sich urgency!"

Jock was part of the Festival Fringe, started by young groups that wanted to do something different, and couldn't or wouldn't get on the festival program. Now the Fringe has a consolidated box office, selling tickets to some 250 events (pages 276-7).

Listed in the regular festival program is the Edinburgh Military Tattoo. Tattoo manager Alex Thain says, with Scottish wryness, that this is a mistake. "The festival is part of the Tattoo." In any case, as last year's audience of 250,000 confirmed, the Tattoo is unmissable. I attended on a night when the nice soft weather poured down impartially on the viewers in the stands and the performers on the castle esplanade (page 292). No matter—the show went on. And what a show: band after band, with flaunting kilts, marching to the pipes and drums—and then all marching and piping together. That Gaelic quarter of my blood possessed me entirely.

I was also all Gael when I stood in a lonely room in the castle, thinking of the poignant, beautiful Mary Queen of Scots. There, in June of 1566, when she was 23 years old, she bore her only child, a son. A romantic legend



says Mary lowered the newborn babe from her castle bedroom, down hundreds of feet to a retainer below, to escape the clutches of reformer John Knox and rebellious Protestant nobles, and to be baptized a Catholic. Actually, Mary herself saw her son baptized in the "true faith," without serious opposition, though her cause as a Catholic monarch in a Protestant land was all but lost.

Years later Elizabeth I of England had Mary put to death. But when Elizabeth died, this son of Mary, James VI of Scotland, became James I of England, first Scot to rule Britain. This event should have meant that

Scotland had won a bloodless conquest of England. By Scots' luck, it turned out to mean the beginning of the still-continuing rule of Scotland from London—and the end of Edinburgh as a national capital. Many Scots still resent this quirk of history.

Nationalism — a Growing Debate

The Scottish National Party today is dedicated to the restoration of an independent Scotland, with Edinburgh as its reborn capital. The SNP is a force to be reckoned with; in recent elections it has won 30 percent of Scotland's popular vote, and has captured 11 of



Heels over head for rugby, tough-shinned rivals from Australia and Scotland kick it out in Murrayfield (right). "Rugby's a rougher game, soccer's a rougher crowd," say the Scots. As predicted, tempers flare in the grandstands at an Edinburgh-Glasgow soccer match, where police escort an over-enthusiastic fan off the field (above).



the 71 Scottish seats in the British Parliament.

As a first step, the SNP wants a Scottish Assembly to make Scotland's laws, now made by the British Parliament. Last December, the British Labour Government agreed to an Assembly, but angered the Nationalists by making clear that only limited powers would "devolve" to the Assembly and that the debate about these might last for years. The SNP wants the Assembly to have basic power to impose taxes on all Scottish wealth. Labourites declare this would imperil the unity of the United Kingdom.

I talked about nationalism with the SNP's

press officer, Stephen Maxwell, in his cluttered basement office in the New Town. The room was plastered with stickers and posters: "Rich Scots or Poor Britons" and "England Expects . . . Scotland's Oil."

"The opponents of Scottish independence—and they are still a majority of Scotsmen—are afraid that any kind of Assembly will make Scots more nationalist," Mr. Maxwell said. "And if the Assembly is limited in what it can do, it will bring further support to the Nationalists."

That is just what is beginning to happen. After the British Government announced its



limitations on the Assembly, a poll gave the SNP first place with the Scottish electorate, with 37 percent of the vote, dropping Labour to second place with 30 percent. Labour fears that with this lead the SNP could take most of Scotland's seats in Parliament in the next general election. It would then hold the balance of power and could do some hard horse-trading with Labour and Conservatives for real Scottish self-government.

To pay the costs of Scottish independence, the SNP covets Britain's North Sea oil, which has estimated reserves of nearly 17 billion barrels. The SNP claims it is "Scottish oil" because it lies off Scotland's coast. Opponents say this fixation on Scottish oil is a pipe-and-drum dream. Since Scotland is not a nation, she can have no offshore rights.

Regardless, the benefits of oil are already flowing Edinburgh's way. Fourteen oil-related companies have moved onto Leith and Granton docks, but, in their pride and prejudice, Edinburghers consider grimy oil operations unsuitable to their fastidious image. They prefer to deal with flamboyant oil types at a remove—as in the partners' dining room of Ivory & Sime Limited, investment managers, on tony Charlotte Square, which, with nearby St. Andrew Square, is the financial hub of Scotland.

City's Two Lubricants: Oil and Whisky

Over a gourmet lunch, the Ivory & Sime partners told me (here it comes again) that Edinburgh is second only to London in North Sea oil investments. Their own firm has directed about \$80,000,000 into North Sea oil, through investment funds it advises.

Another lubricant—a traditional and incontestably Scottish one—is still important in Edinburgh's economy. The Glenlivet whisky people showed me round their Edinburgh operation, and I marveled at the thriftiness of it. The twenty or so expensive Highland malts that go into making a blend are stretched

by inexpensive grain alcohol. The residue of the corn and sprouted-barley mixture that produces the grain alcohol is pressed, dried, and sold as cattle feed. The carbon dioxide that is a by-product of fermentation is sold to soft-drink manufacturers for fizz.

Edinburgh, London, and Burton upon Trent are the largest brewing centers in the United Kingdom. Scottish & Newcastle's New Fountain Brewery practices an economy that equals the whisky makers'. The brewing process is so computerized that it produces 1,620,000 gallons of beer a week with only a dozen operators on duty at one time. All this persuades me that the Scots got involved with



Ready for a dry run in summer, skiers gather at Hillend, four miles outside the city center, where bristled mats replace snow and heavy clothes protect against scrapes, not cold. The slope draws practice teams from as far away as London and offers locals a switch from the city's 22 golf courses.

alcohol not because they were sae thirsty, but because alcohol is sae thrifty.

If Edinburgh is thrifty with drink, it is prodigal with food. The quantity, quality, and variety of its restaurant food easily make it the second greatest restaurant city (etc.). Restaurants I would not have wanted to miss include the Pompadour at the Caledonian Hotel, Le Caveau, The Antiquary, Town and Country, Prestonfield House, the Beehive Inn (all of them basically French cuisine); Denzler's (Swiss); and Cosmo (Italian). But most also included some flavor of Scotland, like: Cullen skink, a fish broth as made in Cullen with finnan haddie as peat-smoked in Findon;

or rumble-de-thumps, a hearty blend of boiled cabbage and chappit tatties with butter and chives.

Amid the abundance of good Chinese restaurants, even Chinese chefs turned out a Scottish dish or two—though this surprised me, as did the Chinese waiter at my favorite Diamond restaurant, who told me, "I'll be back wi' yer change in a wee while."

Dining out is a favorite Sunday activity, since under the Scottish licensing laws only restaurants and hotels may serve drinks on the Lord's Day. The Church of Scotland not only approves but goes further. Said the Reverend Keith M. Steven, Secretary of the





Church's Committee on Moral Welfare, "Restaurants should be allowed to serve a drink with a meal at any hour, and pubs should be allowed to stay open till eleven, rather than ten as at present."

Soccer Match Ignites Old Rivalry

Despite this liberality of the Church, the best-attended religious ceremony I saw in Edinburgh was the soccer contest at Tynecastle Park, between the Edinburgh Hearts and the Glasgow Rangers. Any church would have coveted the flock of 35,000. And make no doubt about it, this *was* a religious rite, albeit a primitive one. The Glaswegian congregation outnumbered Edinburgh's hugely, and arrived full of good spirits (taken on in neighborhood pubs). They trooped in like a massive choir, every votary wearing a blue scarf,

sacred color of their front-running Rangers.

While waiting for the ceremony to commence, the Glaswegians burst into a Gaelic-like chant, totally incomprehensible—it was hard enough for me to understand Glaswegians when they were talking, let alone chanting. Clapping hands overhead, then raising scarves on high, an ocean of them surged like a breaking blue wave from one end of the stands to the other. The police, an army of Canutes, rushed to stem the unstemmable.

"Oo, I'm hopin' we dinna get iny violence," an Edinburgh fanatic to my right said.

"Why did they do that?" I asked.

"Just a tribal instinct—or perhaps like the lemmings."

A huge Glaswegian to my left cut in, "Oi heered at! Yer jes' jealous o' Glazgo." He turned to me. "Loook oot fer these Edinburgh

Model etched in his mind, a glassblower (left) shapes a goblet destined for the United States. A Bicentennial commemorative (below) sells for \$400. Handmade goods—kilts, cut glass, bagpipes—satisfy both the city's commercial needs and its compulsion to perpetuate Scottish tradition.



lads. They'll steal the shoes off yer feet an' the linin' out o' yer pohckets!"

The intricate ritual of soccer that ensued was derived, I would fancy, from an ancient sacrificial dance around a medicine ball by medicine men whose arms have been symbolically amputated. None of the shamans, with the exception of the goalies, may touch the ball with either hands or arms, but their manipulation of the ball with their handy feet is an elegant rite.

Glasgow outdanced Edinburgh, but my Glaswegian friend was disgusted. "Too easy!" He glared at the Edinburgh fan. "Too easy!"

I believe one reason Edinburgh's team lost is that most Edinburghers were out playing something themselves instead of organizing cheering sections to put more heart in their Hearts. Edinburgh rates participation sports

before spectator sports. Its public Meadowbank Sports Centre has a stadium for only 15,000, but facilities, open to all, for some thirty sports.

The Hillend Ski Centre in the Pentland Hills, just on the edge of Edinburgh, is open to the public year round (pages 288-9). The 1,300-foot artificial slope, longest in Britain, consists of plastic bristle set into a metal backing. It was raining the day I visited, but several skiers, looking happy about it, were preparing to descend.

"They like a wet slope, it's faster," assistant manager Pat Findlater explained; then, shaking her head, added, "Two various sets o' crazy people, ours skiin' i' the rain an' those over there playin' golf." She pointed toward a nearby expanse of hillocky lawn, one of 22 courses for the Edinburgh region, attesting to the high status of golfers in the local culture.

Judges, Lawyers, Doctors . . . and Mistery

Aside from becoming a golfing champion, an Edinburgher can have no higher station than that of a judge of the Court of Session, Scotland's supreme court, which sits in the old Scottish Parliament House. Next in the status hierarchy come ordinary judges, lawyers, and medical doctors—reverend doctors are of course *above* all such worldly vanity. Physicians and surgeons each have their own colleges, but I sense that surgeons have the status edge. They looked askance when I called them Doctor. Their title is Mister, and in this context it has the force of Maestro—sairtainly *not* Mr.

Mister James A. Ross, white-mustached President of the Royal College of Surgeons, said, "Our college was founded in 1505, the Royal College of Physicians 175 years later."

President Ross showed me through Surgeons' Hall, pausing before the portrait of a predecessor: Joseph Bell, President 1887-89. "There is the original Sherlock Holmes," Mister Ross said—and so I recognized: the beak, the taut features, the keen eye. "Like Holmes, Bell used to make great play of diagnosing where patients came from. Conan Doyle studied with him, became an eye specialist, and started writing when custom was slow. As an old man, Bell got interested in Holmes and used to send Doyle clumsy 'good hints' for further Holmes adventures."





Hearts stir to skirl and drum roll as massed pipers perform the famous Tattoo—a military drill—each night of the three-week summer festival of music and drama (left). Regardless of the weather, devoted crowds fill the stands, even to watch the groups practice.

In Usher Hall, cellist-conductor Mstislav Rostropovich (above) rehearses with the London Philharmonic Orchestra for a festival performance of Russian music. Such high-caliber billings have inspired growth of Edinburgh's cultural offerings: the Scottish Opera and Theatre Ballet and the National Orchestra.

Pacing their conversation, supreme court advocates in Parliament Hall (facing page) discuss cases under the stone gaze of Duncan Forbes, 18th-century court president. Scotland holds fast to laws framed by such men, defiantly calling all others—even England's—"foreign law."



Champion of independence, Scottish National Party leader William Wolfe (above) seeks to reestablish Scotland's own government. He stands in the old Royal High School, proposed site of the Scottish National Assembly.

Among the gruesomely fascinating exhibits of the college's medical museum, President Ross singled out the death mask of William Burke after he was hanged in 1829. Burke and William Hare sold bodies to surgeon Robert Knox. "Knox was a great anatomist and our first curator of this museum," Mister Ross said. "He just didn't look at the credentials of the bodies brought to his room."

The run-of-the-mill resurrectionists supplied anatomists with newly buried bodies, but Burke and Hare, seeing that the price was higher for the freshest bodies, began to manufacture their own. They manufactured about 16 before they were caught. Anatomist Knox's fate was barely less severe than hanging. "He had to leave Edinburgh, died neglected in a village in England. But our college, we still have sympathy with him," said Mister Ross.

Edinburgh Leads in Education

The world fame of the Colleges of Surgeons and Physicians reflects the Scottish dedication to excellence in education. With 9 percent of the population of the United Kingdom, Scotland has 18 percent of the universities.

Of the eight Scottish universities, the University of Edinburgh, founded 1583, is the biggest (11,000 students) and the most internationally known and attended. It ranks high in teaching the traditional arts and sciences.

Heriot-Watt University, founded as a technical institute in 1821 and a university since 1966, doesn't try to compete. A sort of Edinburgh MIT, it offers up-to-the-minute studies to its 2,900 students. Swift off the mark on North Sea oil, it established an Institute of Offshore Engineering in 1972.

Heriot-Watt opened a new campus in 1974, on 250 country acres at Riccarton, six miles out but still in Edinburgh. In part this was a response to the outcries of environmentalists who rose against the University of Edinburgh's expansionist methods. The University of Edinburgh has knocked down decrepit but still beautiful old buildings and replaced them with disharmonious modern blocks and towers in the old city. The modern architecture of the Riccarton campus, standing apart in a wooded landscape, is, by contrast, a lovely harmonious unity.

At Riccarton, Heriot-Watt has established the first university research park in Britain, where students can get on-the-job experience



in a center for research and development. Tenants like Syntex, a pharmaceutical company, look good to the city fathers, too. Edinburgh wants industry to relieve growing unemployment, but it wants it light and clean.

For years Edinburgh unemployment has been lower than the Scottish average. As a "service city," it has had a stable employment market for people in education, government, tourism. But now with Britain's depression deepening, Edinburgh's 5.1 percent unemployment is creeping up on the Scottish average of 6.7 percent.

City Suffers from Housing Shortage

Edinburgh's worst problem is housing. At the fall opening of the universities in 1975, more than 600 students had no place to sleep. Those who did pooled for a room in which up to a dozen spread their sleeping bags. The combined wealth of the students drove poor families out of the market for these accommodations. Many young families must live with friends and relatives. Others are trying to get out of housing that still has outside toilets or is crumbling from decades of neglect.

Mrs. Liz Bowker, administrator of the Shelter Housing Aid Centre, told me: "About 15,000 families are on the housing waiting list. If the Edinburgh Council started new housing tomorrow—and it won't—it would be years before people could move in."

Edinburghers have a healthy bent for self-criticism, and many quoted me two biting old saws on this situation: Edinburgh wears a fur coat but nae breeks (in this sense, drawers); she has lace curtains on the winders but nae sheets on the bed. One critic, Barry Wright, coauthor of slashing *Alternative Edinburgh*, told me, "It's because we care for

Edinburgh that we complain about it." He then ordered me to take circular bus route 2/12 through the slums of Craigmillar, Leith, and skid-row Grassmarket. "Have a look at the back side of Edinburgh; you won't see it from your Moray Place ivory tower."

I had the look, and I felt bad. I also felt guilty about living in Moray Place. But the guilt didn't last. Life in Moray Place, like the rest of the city, was down-to-earth, full of homely old-time charm. The milkman came by in a horse and wagon and left the milk at the door. A workman doing the flat upstairs knocked daily to ask my wife, "Ye could nae puit a kettle on fer me, could ye?"

And there was Mrs. Cathie Curry, cleaning lady, full of the auld wisdom: "If yer goin' tae a ceilidh, ye'll have tae get the tartan jacket an' black trousers, an' shoes wi' a big silver buckle—or ye'll be oot! An' a nice shirt too, wi' a fancy piece i' front. Ye'll be the envy when ye gae hame."

And so we did go home, envying those who could stay in Edinburgh. To say a regretful good-bye to all of them, I will take one more leaf from Edward Topham's book:

In Remembrance
of the
Many Civilities
Received by the Author
During his Residence in
EDINBURGH
The Preceding pages
Are Inscribed to the
INHABITANTS OF THAT CITY
by
Their Most Obedient,
And Most Respectful
Humble Servant. □

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How to take a self-portrait two miles down in the sea

VETERAN of hundreds of explorations, the research submersible *Alvin* had never been seen operating in the gloom of the deep. For the Cayman Trough Expedition, described in this issue (page 228), NATIONAL GEOGRAPHIC's Emory Kristof and Alvin M. Chandler, working with Benthos, Inc., of North Falmouth, Massachusetts, developed an ultrawide-angle underwater camera able to withstand pressure of more than ten tons to the square inch. The camera and its separate flash unit rode to the depths in *Alvin's* revolving sample basket and were placed on the bottom (upper right) by the vessel's remote-control claw (above).

A photoflash from the submersible triggered the camera and its own strobe light, making this unusual photograph of *Alvin* as its propellers stir up sediment 3,000 meters (9,840 feet) beneath the surface (lower right). Destined for future use at even greater depths, this ingenious camera package was part of the total photographic support—color film, on-site processing, and advice—that the National Geographic Society provided to the Cayman Expedition.

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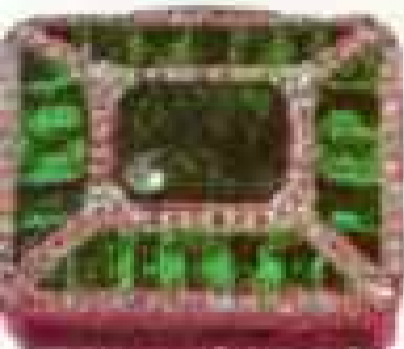
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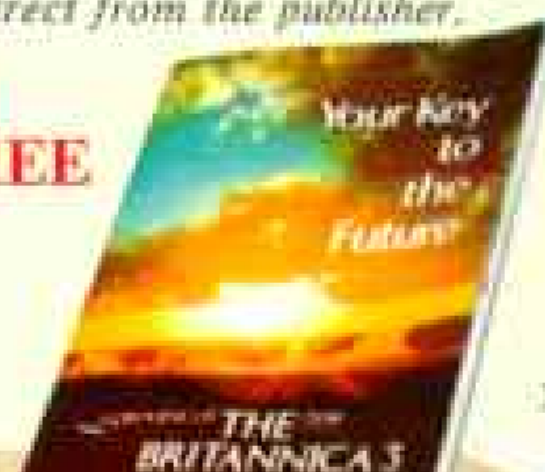
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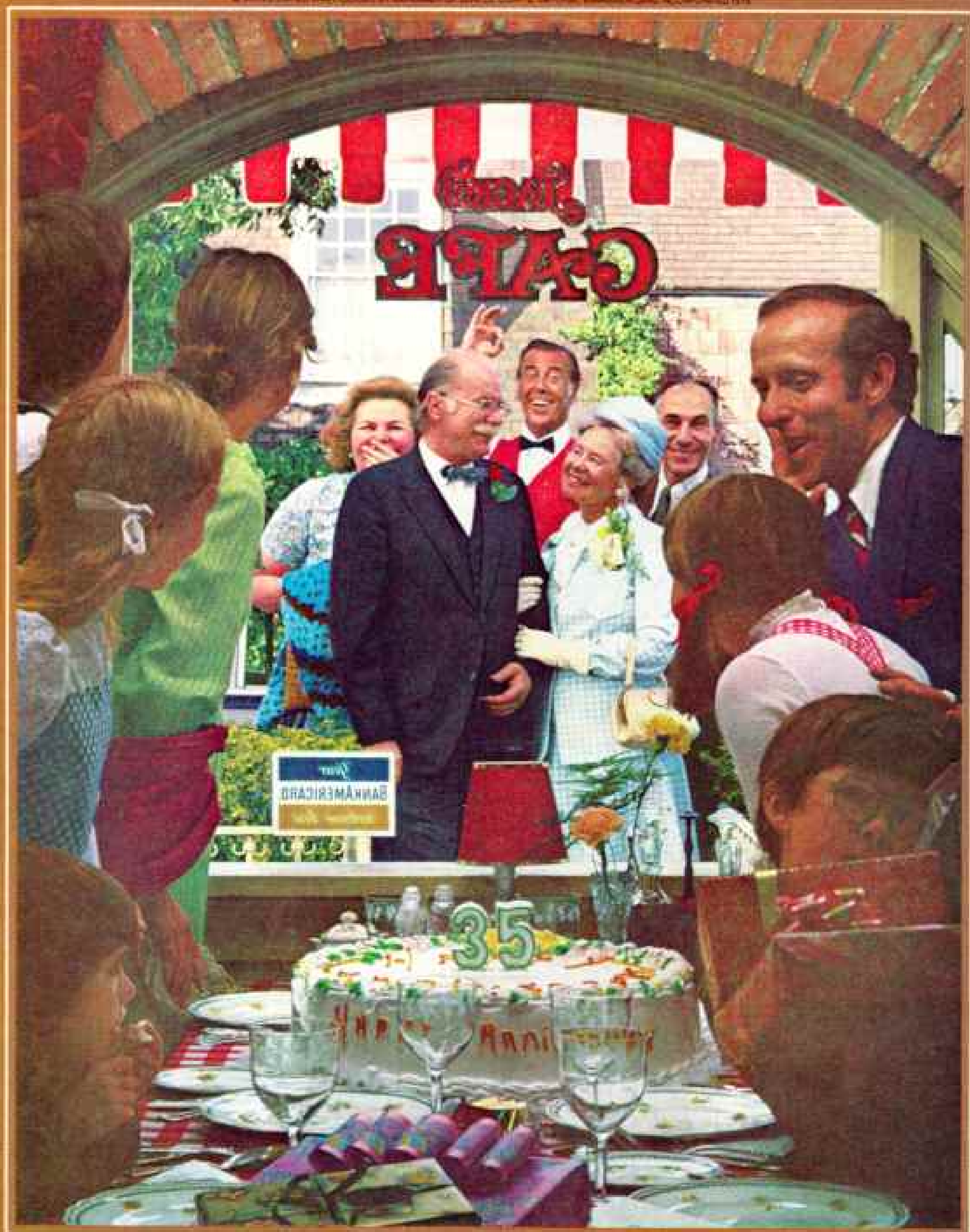
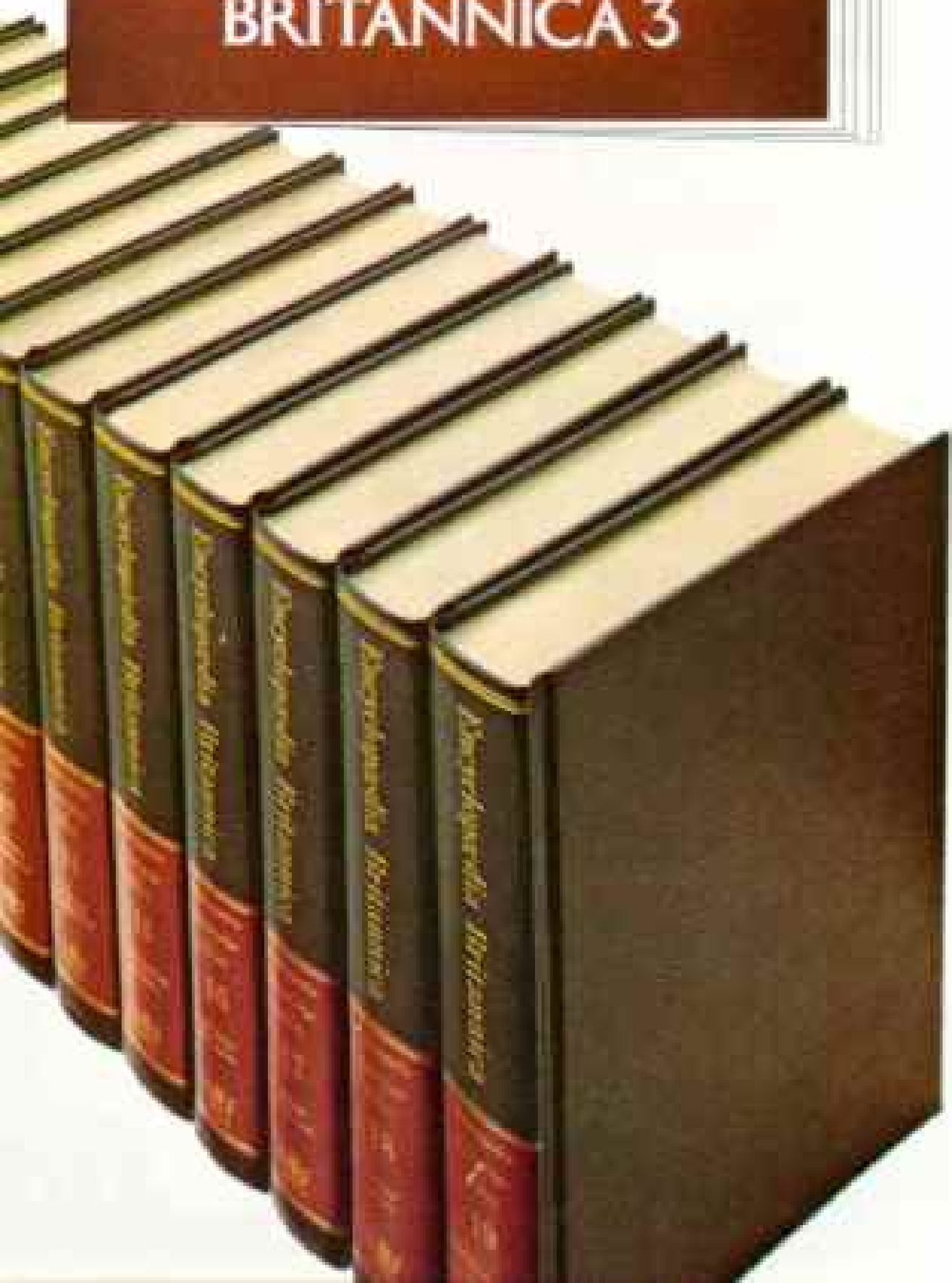
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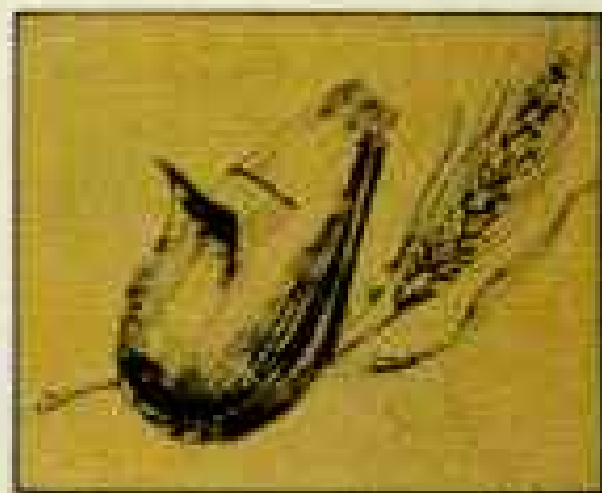
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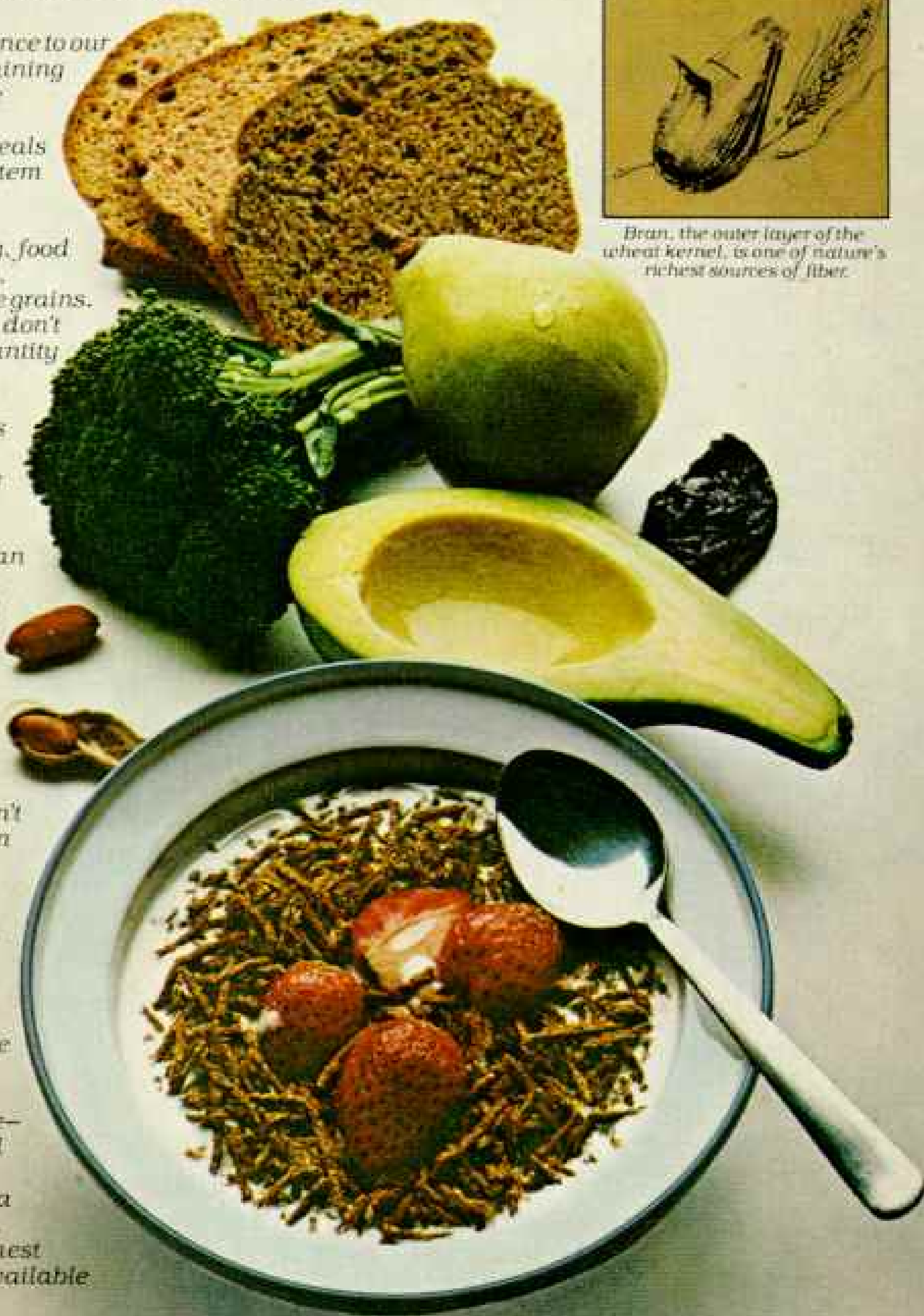
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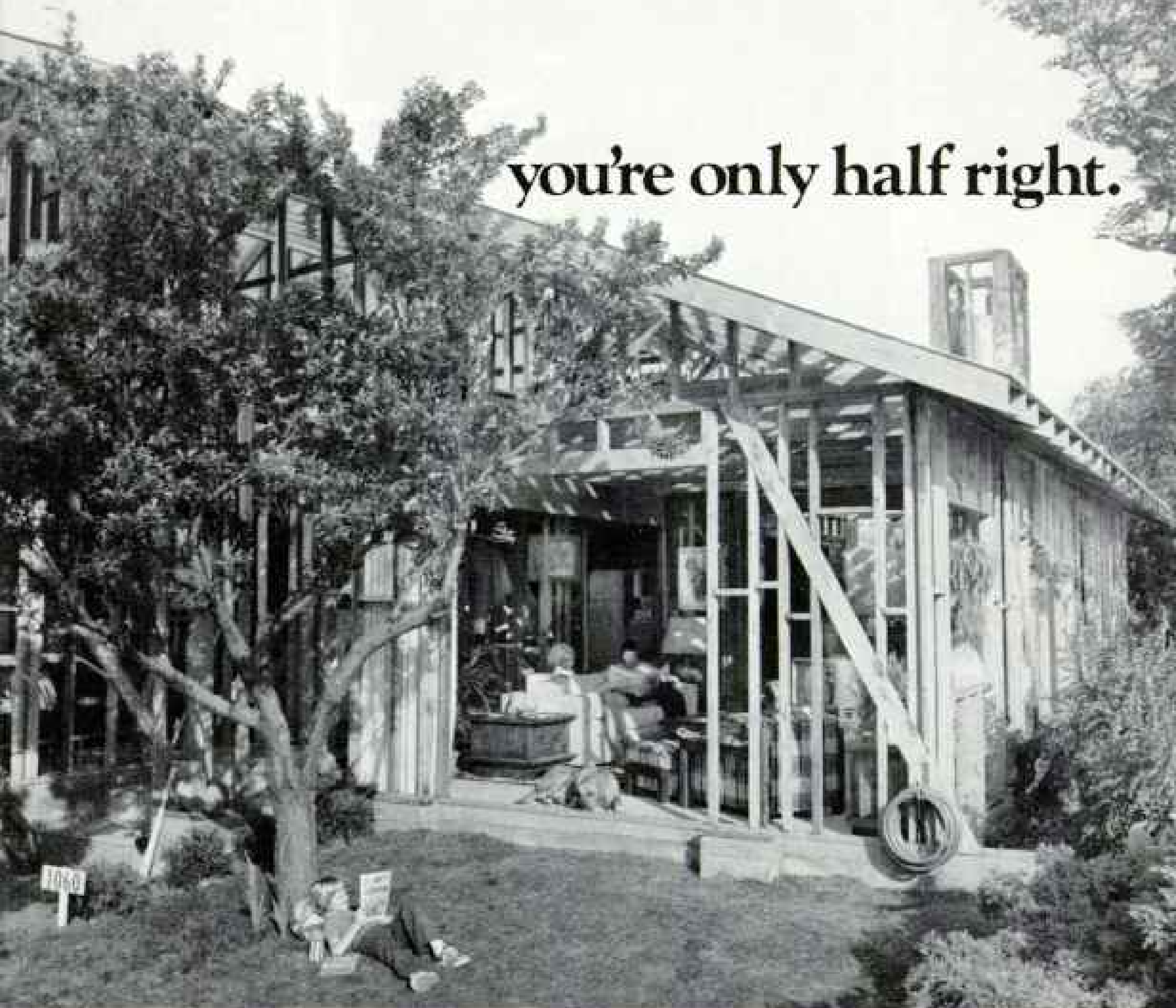
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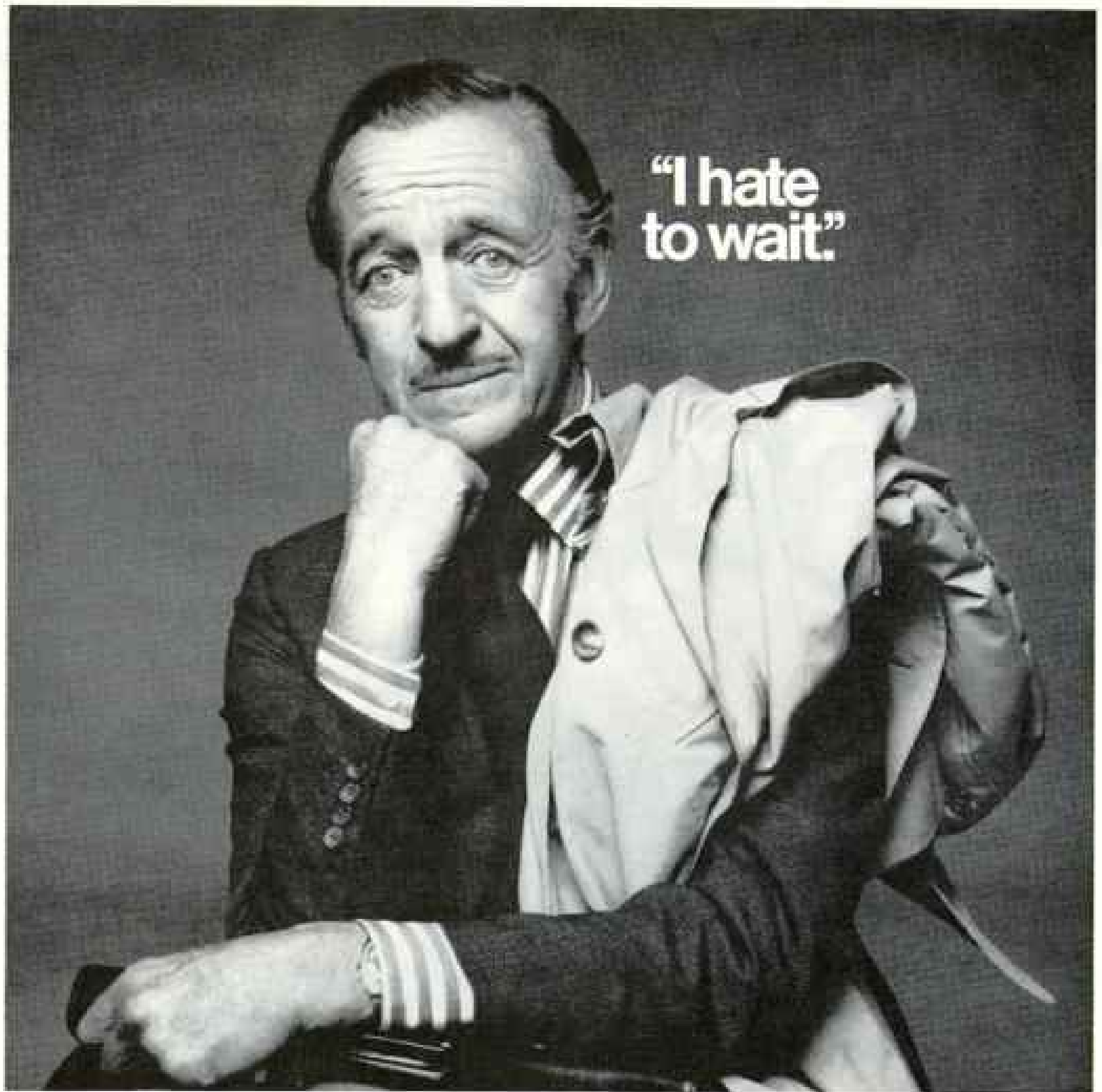
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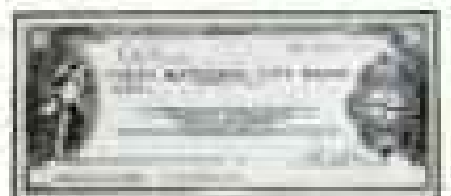
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