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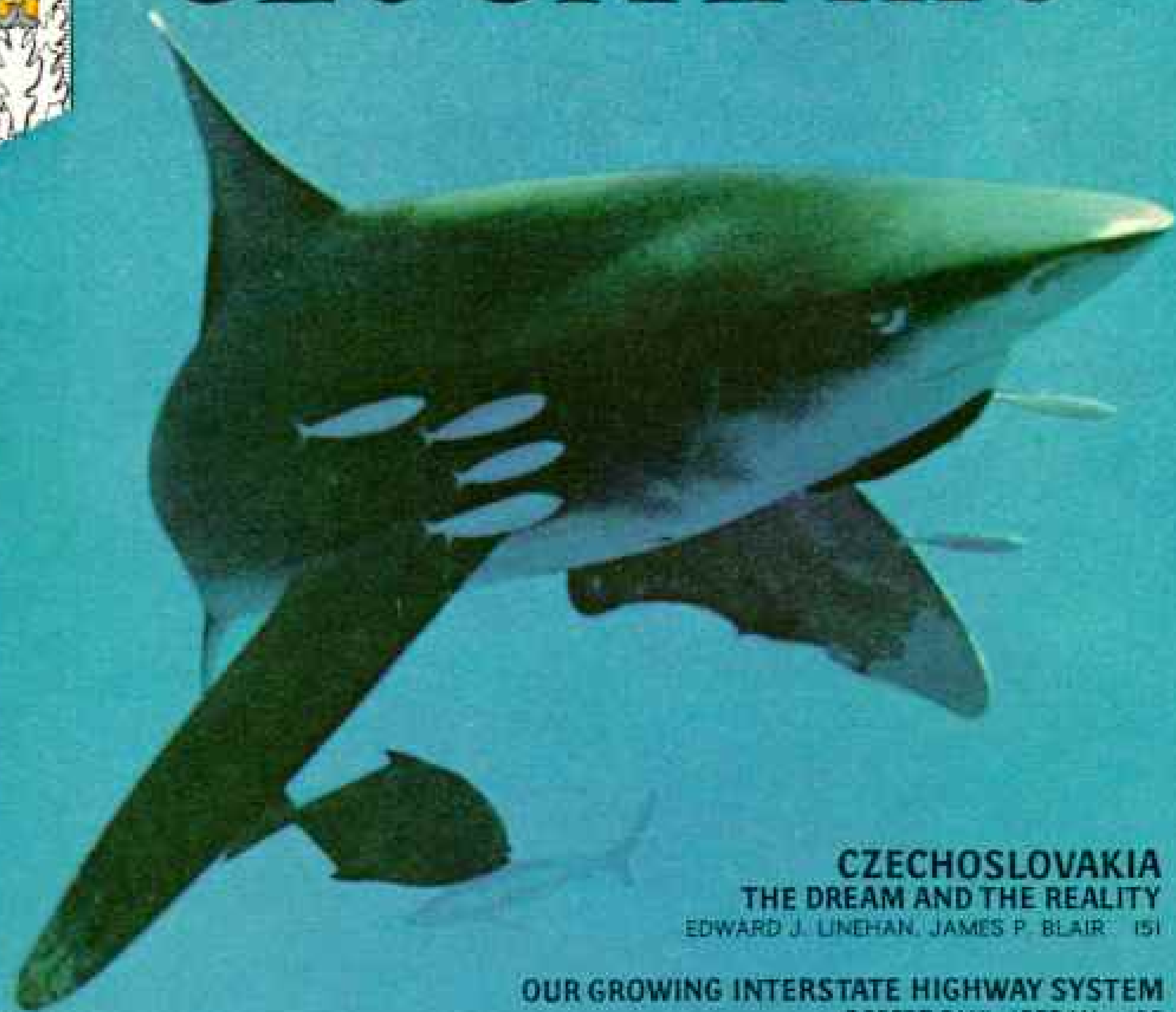

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OFFICIAL JOURNAL OF THE NATIONAL GEOGRAPHIC SOCIETY WASHINGTON, D. C.

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Aided by a National Geographic Society grant, Dr. William J. Morris, Research Associate at the Los Angeles County Museum of Natural History, led an eight-man team last summer into the Mexican back country in search of dinosaurs. Months of digging brought to light the nearly complete skeleton.

Through terrain too steep for vehicles, the men carried out monster bones and skin impressions preserved in rocks weighing up to half a ton. Dr. Morris's hard-won discovery of the first dinosaur of its kind found on the Pacific coast proves that these huge creatures once ranged the breadth of North America.

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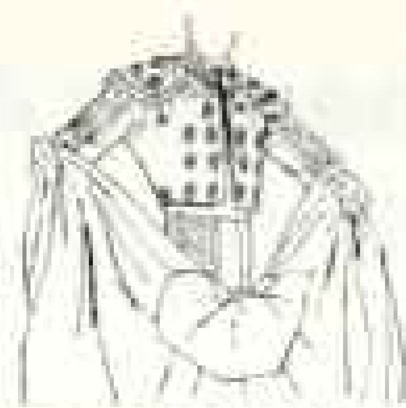

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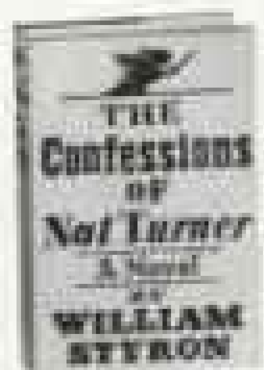

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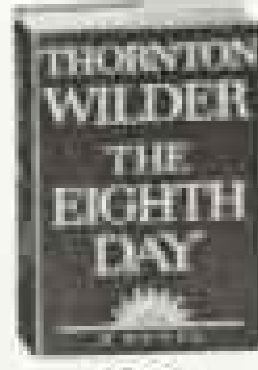

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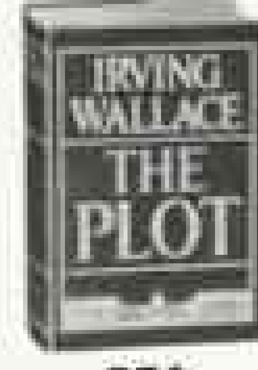

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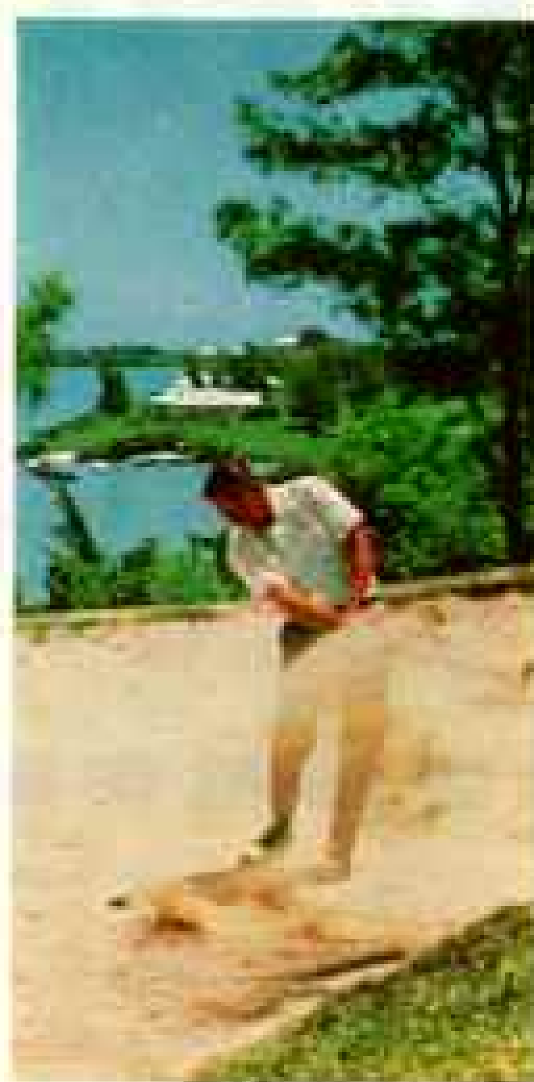

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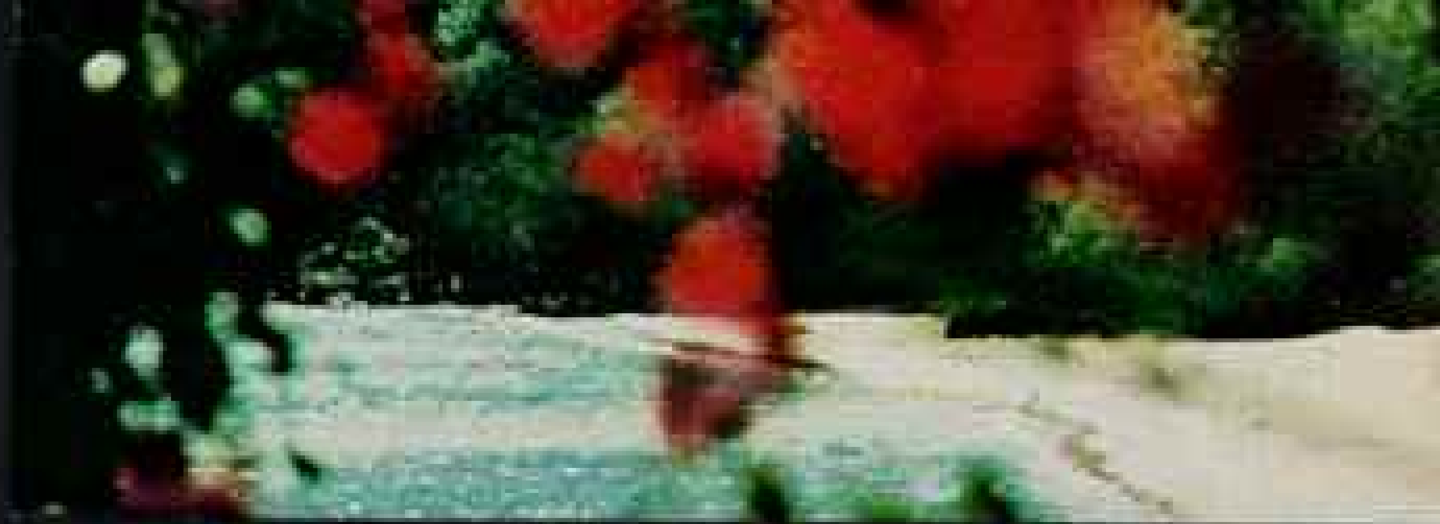

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Beechcraft

Beech Aircraft Corporation,
Wichita, Kansas 67201, U.S.A.

February, 1968

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Czechoslovakia

THE DREAM AND THE REALITY

By EDWARD J. LINEHAN
Assistant Editor

Photographs by JAMES P. BLAIR
National Geographic Staff

IN PRAGUE, Golden Prague, Mother of Cities, City of 100 Spires, lives an old Communist, a Party member for 40 years. He was only one of hundreds of people I talked with in Czechoslovakia. But he was one of the first, and his words often echoed in my mind as I traveled the land of Czech and Slovak.

"From the beginning our dream was this," he said, in thickly accented English with the rasp of age upon it. "There would be no more poverty, no oppression. No one could exploit us because we the workers would own the factories and farms and mills. The people all would have jobs and the people all would be happy. . . ."

Often, in the weeks that followed, I found myself comparing dream with reality after nearly two decades of Communist rule. And this is the story—the impressions, experiences, and observations—that today's Czechoslovakia wrote upon me.

The driver appraised me through the rear-view mirror as my taxi crossed one of Prague's dozen bridges over the serene Vltava River, burnished by late April sun.

"Deutsch?" he asked.

"American," I said, and he looked pleased.

"My sister lives in San Francisco," he said in English, and watched me. He decided to continue. "In 1948 she ran away. Before the war I was a lawyer. Maybe I should have run away too."

He let me out at my hotel just off the broad, tree-lined Václavské Náměstí—Wenceslas Square—in the center of the capital of the C.S.S.R., the Czechoslovak Socialist Republic.

"This is an unlucky country," he said, and drove away.

Czechoslovaks feel their history personally, and he spoke not only of Czechoslovakia today. This lovely, compact country in the heart of Europe has always been a hapless land.

I have traveled some 4,000 miles through its three major regions—from Bohemia's sedate hills and forests through fertile Moravian plains to primeval Slovakian mountains of breathtaking beauty. And in nearly every mile I could see and feel and touch the troubled past (map, pages 164-5).

Since Slavic tribes first pushed down from the north—perhaps as early as the first century A.D.—their descendants have sought elusive nationhood. Waves of fierce Avars and Magyars, Tatars and Turks spilled rivers of

PORTRAIT OF AN INDUSTRIAL PEOPLE: *Bathed in the glow of molten metal, a visored stoker tends a blast furnace at the new Košice steelworks in Slovakia, easternmost region of Czechoslovakia. Throughout the small and historically troubled land of the Czechs and Slovaks, these energetic people steadily press for greater freedom under Communism.*

EKTACHROME BY JAMES P. BLAIR © NATIONAL GEOGRAPHIC SOCIETY

KODACHROME © NATIONAL GEOGRAPHIC SOCIETY

Sturdy as faith itself, a Roman Catholic church 400 years old crowns a Slovakian knoll above parading geese; each Sunday worshipers crowd within its mellow walls. The government tolerates religion but exercises control over the clergy.

blood upon these lands; before them Roman legionaries skirmished here.

On this rich soil a great Slavic empire flourished briefly until the dawn of the tenth century, then died—and Slovaks chafed for a thousand years under Hungarian rule. Czechs enjoyed their own kingdom, Bohemia, for several centuries, too; then Austria's Habsburgs came to rule for 300 years, until 1918.

Then there was that grand and fleeting moment between the two World Wars when the Czechoslovak Republic emerged—to be engulfed by Hitler in 1939. And when that last Germanic wave receded, Czechs and Slovaks found themselves once more independent, but no longer free.

"How," I had asked the old Communist, "did you gain control of the country in 1948?"

"Organization and discipline," he had said, not without pride. "We were only 40 percent, but we kept our people busy with clubs and teams and brigades. We had the Ministry of Interior—that meant the police—and the army and the trade unions. Who was there to oppose us—the rich factory owners? They were discredited; many had worked with the Nazis. The petit bourgeois, *the shopkeepers? They were afraid. The right-wing students? How long could they stand up to the police and the army? It was easy. . . ."*

Czechoslovakia under Communism, I saw on my travels, continues its long tradition as a little industrial giant. With 14 million people, 1/2 of 1 percent of the world's population, it accounts for 2 percent of the world's industrial production. I saw coal and ore stream from its mines, and steel from its mills. Machinery, arms, chemicals, textiles, shoes, glass, sugar, and beer flow from its factories in impressive quantity.

But the traditional bad luck dogs the Socialist Republic, too. Plagued by local mismanagement, hamstrung by monolithic control from Prague, drained by harsh demands from the Soviet Union, Czechoslovakia found itself in 1965 heavily subsidizing many industries—and rapidly going broke under classical Soviet-style five-year plans. Reluctantly, President Antonín Novotný, an old-line Marxist (page 165), approved drastic measures.

Throughout the country I was to hear hopeful talk of the "new economic reform." In Prague I sought out its chief architect, youthful dark-haired Dr. Ota Šik, director of the Institute of Economic Affairs. He typifies a new breed of Communist—imaginative, daring enough to flout old dogma.

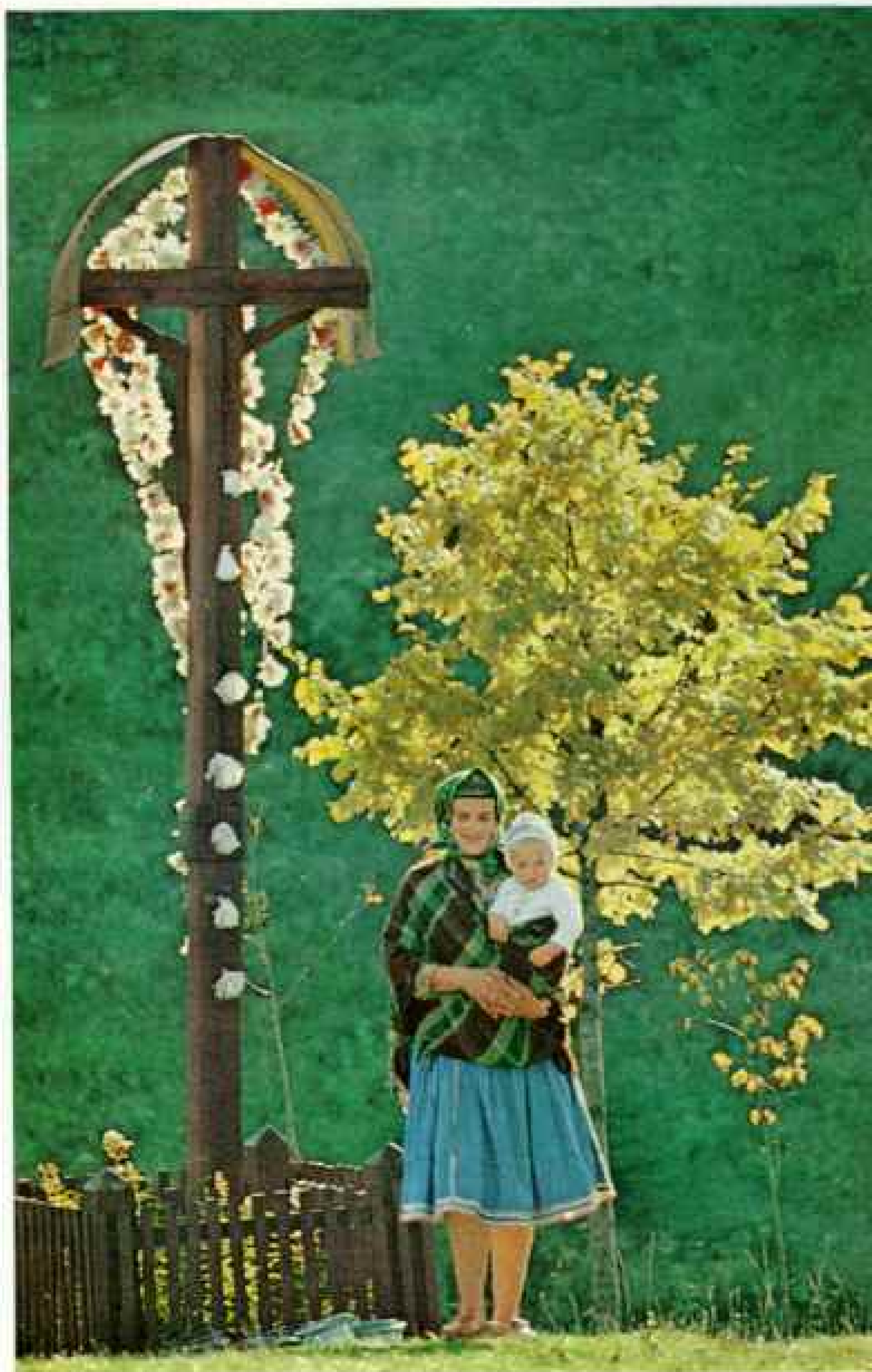
Sipping black coffee behind his desk, he admitted candidly in a soft and tired voice that flaws had appeared in the Socialist dream.

"Now we are taking steps to correct them," he said. "Oh, we will still have central planning, but only in very general terms. The management of each enterprise will have to make most of its own decisions. We must have competition among factories, and get rid of those which cannot make a profit. We must automate our industries. We must control inflation. We must pay more attention to the laws of supply and demand."

Competition. Profit. I said it sounded like a halfway return to capitalism.

"Not at all," replied Dr. Šik. "We are still talking about Socialist enterprises, remember. They are owned by the state."

One Socialist enterprise, the state travel agency known as ČEDOK, has embarked on an earnest quest for "hard" currency—dollars, marks, pounds, francs, lire—and in doing so has pulled aside the Iron Curtain.



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Roadside crucifix, a common sight in rural Slovakia, wears a saint's-day garland. Though largely Catholic, Czechoslovaks hail as a national hero the martyr Jan Hus, who ignited an unsuccessful religious revolt a century before Martin Luther.

U. S. tourists receive 16 Czechoslovakian crowns for their dollar, rather than the official 7 to 1. Tasteful hotels and motels have sprung up throughout the country. A visitor can secure a visa in minutes ($4.00), rent an inexpensive car, and drive anywhere he wishes, with or without a guide. A single room in the finest hotels can be had for less than $10 a day, including breakfast. A couple can stay quite comfortably at a class-C hostelry for $5.

Czechoslovakia's natural beauty, fine, inexpensive food, and well-preserved antiquities attracted 900,000 Western tourists last year—including 50,000 from the United States.

The visitor's first goal—Prague—wins his affection inevitably, though not at first glimpse. It is a city of earth colors, gray and ocher, and its outer reaches wear the drab hue of raw concrete in nondescript factories and slab-sided apartment buildings.

22

MAIN STREET, C.S.S.R.—*Stately Wenceslas Square cleaves the heart of Prague, capital of the Czechoslovak Socialist Republic. Above Czech-made trolleys, buses, and cars rides St. Wenceslas, the "Good King" of the Christmas carol, who ruled infant Bohemia a thousand years ago.*

KODACHROME © NATIONAL GEOGRAPHIC SOCIETY

Feigning aches and pains, high-school graduates display ruses for playing hooky in an annual "school's-out" spree that erupts each spring on Wenceslas Square. Bandages brag of fake toothaches; sign hails "stomach troubles." A lad's pajamas dramatize another excuse: oversleeping.

Prague's true beauty lies in its center, and it should be sought afoot, the more so since scaffolding and excavations (a new subway is in the test-boring stage) make driving a circuitous nightmare.

Older Town Lies Beneath Old Town

I strolled the city often. In rain I explored the maze of arcades that house shops and cinemas, and watched old Praguers munching sausages, and students in blue jeans and miniskirts gravely examining bookstore displays, hand in hand. Among the movies, John Wayne and Laurel and Hardy films drew crowds, as did a Western titled *Old Shatterhand*, made, I was told, in West Germany.

On sunny Sundays I wandered to the embankment to watch the sweep of one of Europe's loveliest rivers, the Vltava, with punts drifting like jackstraws on its green waters.

Other times I walked from the majestic National Museum at the top of Wenceslas Square—not a square at all, but a broad avenue—down to the street called Na Příkopě—meaning "On the Moat"—where Prague's Old Town begins.

Staré Město. Old Town. Prague catches the visitor up in a glorious maelstrom of history. It leaps from 11th-century Romanesque rotundas to the most recent ruin in the country, a massive pedestal where a huge monument to Stalin was quietly removed in 1963. And in the crooked streets of Old Town one finds the shadows of two giants of Bohemian history.

One was Charles IV, wise, farsighted 14th-century monarch when Prague was the seat of the Holy Roman Empire. His was Bohemia's Golden Age, and his legacy remains in the Charles University, oldest in central Europe. And in Old Town's rebuilt Bethlehem Chapel lingers the dissident voice of Master Jan Hus, a prime mover for church reform a century before Luther.

The Socialist state, for all its emphasis on

Bride borne high, a groom steps over a ribbon adorned with a doll and pacifiers, the Slovak way of wishing for the joys of parenthood. They leave the Marriage Room of Prague's Old Town Hall, where on a busy Saturday couples become newlyweds on an assembly-line basis. With church ceremonies officially discouraged, most Czechoslovaks take civil vows.

High-altitude hem sets the mode on Wenceslas Square. Despite government frowns, the latest fashions flourish, jazz clubs proliferate, and posters advertise Broadway plays, as the Czechoslovakian demand for Western contacts increasingly erodes the Iron Curtain.

KODACHROMES BY JAMES P. BLAIR © N.G.S.

the present, is carefully seeking out and preserving every ancient stone.

With Dr. Vladimír Píša, an enthusiastic Czech archeologist, I stood in the square before Old Town Hall, where in 1621 the flower of Bohemia's Protestant nobility was beheaded by a Catholic Habsburg, launching the Thirty Years' War. In that conflict armies from as far away as Sweden crossed and recrossed the luckless land, and when at last they withdrew, Bohemia's population had shrunk from three million to 900,000.

I followed Dr. Píša down a staircase beneath Old Town Hall to a sub-basement and into a dank stone room with arched ceiling and tiny slit window. "Romanesque," he said, "from the 12th century—probably the home of a merchant. Under the Gothic buildings of Old Town we have discovered about 40 such houses; there may be 200 more—who knows? When the new underground is dug through here, we shall see."

As I climbed up out of another 12th-century room, I noticed a handful of serious young men

reading in a library directly above. An archive of Prague history, I speculated.

"No," said Dr. Píša. "The Institute of Marxist-Leninist Studies."

I came face to face with Karl Marx and V. I. Lenin on May Day morning. They glowered at me from huge portraits over the reviewing stand where President Novotný was condemning United States "aggression" in Viet Nam.

But I looked in vain for the tanks and guns and rockets—the grim military accoutrements

"Prague the Golden" slips into melancholy in the hush of autumn twilight; the gentle Vltava River flows from Bohemian hills. Though often occupied in the turbulence of central Europe's history, the home of one million Praguers has miraculously escaped devastation. Spired St. Vitus's Cathedral watches over the city's time-mossed heart, a showplace where Gothic arches blend with extravagances of Baroque and rococo.

of this most fervid of Communist Party spectacles. The only martial note was a platoon of soldiers who sagged under heavy banners while their president spoke.

For the next four hours more than 200,000 marchers ambled through Prague's streets: electrical workers, restaurant workers, ironworkers, railroad men. Marching students strummed rock-and-roll on guitars, and mothers pushed infants in prams. The whole affair seemed less a political demonstration than an amiable mob out for a Sunday stroll.

It *was* a fine day for a walk. I crossed the crooked medieval span of Charles Bridge and passed the Baroque palaces of Malá Strana (Little Quarter), headed for the sprawling edifice that dominates the city, the Hradčany, or Prague Castle.

Here, at a major crossroads of European trade routes, Czech princes erected a wooden fortress more than a thousand years ago. Successive rulers built upon it, and today the

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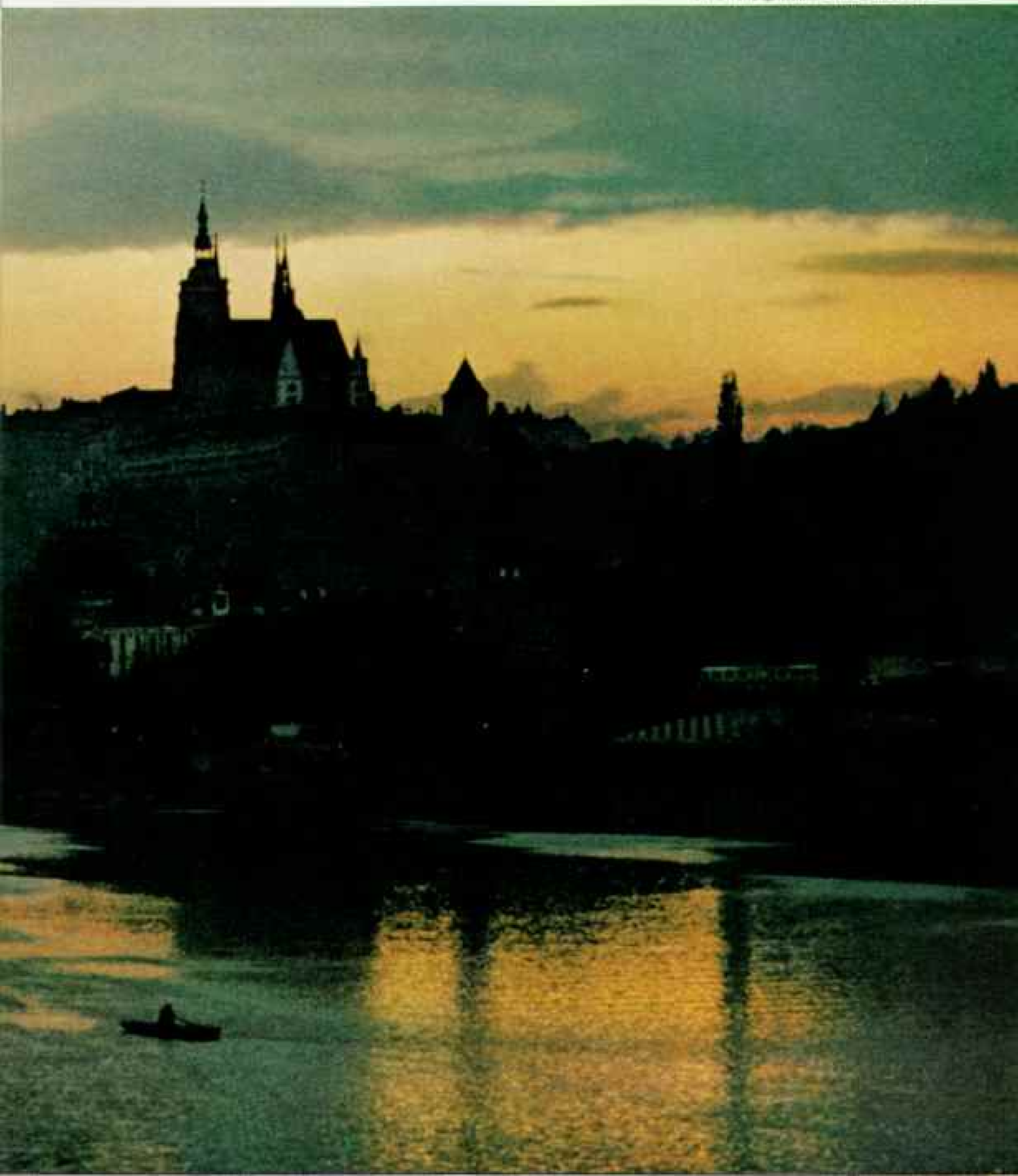


castle walls enfold a vast layer cake of architectural styles—Romanesque, Gothic, Renaissance, and Baroque—buildings that trace in stone the entire history of Bohemia.

From the heart of the Hradčany soar the spires of St. Vitus's Cathedral, rivaling Notre Dame in Gothic beauty (page 161). Begun by Charles IV in 1344, the cathedral was completed only in 1929. In its royal mausoleum lie Charles's remains. When his crypt was opened some forty years ago, the mighty emperor was found, surprisingly, to have stood only 5 feet 6 inches tall.

The Prague Castle houses more history than the visitor can absorb in a month; yet it is only one of some 2,500 castles that survive throughout the country. The state diligently maintains all the important ones—making it, as one Czech wryly told me, "the largest feudal landlord in the world."

Medieval Mines Endanger Town

To guide me through the country, ČEDOK provided an energetic former journalist named František ("Call me Frank") Faltys.

As we studied a map, I complained about the Czech language, which demands a nimble tongue. "How can anyone pronounce this name?" I asked, pointing at random to České Budějovice (*cheh*-skeh *bood*-yeh-yo-*vee*-tseh).

Frank gave no ground. "Maybe," he countered, "you think 'Machasushetts' is easy?"

I knew then that we would get along. He proved a cheery, resourceful man, able to open many doors.

I rented a little white Škoda automobile, and we set out eastward from Prague, headed for Moravia and Slovakia. Some 40 miles later, we descended a hillside into Kutná Hora, one of 26 Czechoslovakian towns and cities designated as historical reservations.

"*Pozor!*—Take Care!" warned a traffic sign in the middle of this once-great medieval silver-mining center. What was wrong?

"Look for yourself," said an elderly woman carrying a luncheon pitcher of beer. "The whole town is falling down!"

Then I saw the cracked walls, a tilted façade, a slumping doorway. Glorious Kutná Hora was indeed slowly sinking into the old mine shafts and cellars beneath it.

Here stands an old royal palace and, more important, the former mint, which stamped the silver groats that made Bohemia a great monetary power in the 14th century. Mine-owners and guilds built the city's magnificent Gothic Cathedral of St. Barbara; it would rival St. Vitus's in Prague but for its unfinished façade. Before it could be completed, the high-grade ore ran out—and a sea of silver began to flow from strange new lands called Peru and Mexico.

I sought out the man whose job it is to keep Kutná Hora from falling down, engineer František Dyntar. "The problem has become serious in the past five years," he said. "Walls are cracking, ceilings falling, houses are actually sinking into the ground. We've had to demolish several.

"We have no maps of these old mine tunnels; we have to dig to find them. The whole center of town is affected—priceless 15th- and 16th-century buildings." Mr. Dyntar shook his head at the task. "I think we can save most of them. But it will take us many years."

Brno Boasts of Youthful Spirit

I pushed on toward Czechoslovakia's second city, Brno. This central Moravian metropolis of 330,000 turns out heavy machinery, small arms, chemicals, tractors, and textiles—and a large measure of regional pride.

The editor of one of Brno's leading daily newspapers compared his city with Prague. "Here we are more youthful, more forward looking—in building, in culture, in politics. Prague is more bound by tradition."

We stood on the windy rooftop of the new 15-story Continental Hotel, tallest in Czechoslovakia. The editor proudly swept his hand around the horizon, pointing out new apartment settlements on the outskirts, housing 15,000 to 20,000 people each. He showed me the handsome new opera house, and the complex of glass-and-steel pavilions where Brno holds its annual International Trade Fair.

Proud of its youth, Brno has its antiquities, too, such as the 600-year-old church in Old Town. In the adjacent Augustinian Monastery, Gregor Johann Mendel patiently worked out the laws of heredity.

Now sightseers strolled in the courtyard

Beneath the frozen trumpetings of cherubs and angels, basso Jiří Joran presents Czech Gothic and Renaissance songs to the strains of a 17th-century harp and a chrotta, a 14th-century relative of the violin. The concert in the Mirror Hall of the Clementinum forms part of Prague Spring, a three-week festival of sound that crowds hotels with music lovers.

KODACHROME © NATIONAL GEOGRAPHIC SOCIETY

where monks once meditated. Monasteries and convents in Czechoslovakia have, for the most part, been converted to functional pursuits, such as housing the aged. Yet anyone who declared religion to be dead in this Communist land would be very wrong indeed.

"We were more clever than the Russians," the old Communist had said. "We took the wealth away from the church, but we let the people have their prayers. We got rid of the powerful bishops controlled by Rome. Now the priests are educated by the state and paid by the state and they are loyal."

For years officials made worship uncomfortable, at least, and minor harassment still occurs. A Protestant clergyman in Bohemia told me of a girl who was recently threatened by a local Party committeeman with the loss of her job if she insisted on a church wedding. But in Prague I stepped into Roman Catholic St. James's Church to find it completely filled for a Sunday Mass. More than half the congregation looked under 30.

I found further evidence of religious renaissance one evening at the ornate Mahenovo Theater in Brno. The drama was a revival of a 400-year-old Passion play traditionally performed by villagers of Bohemia's Krkonoše Mountains. From a gilded box I watched a narrator step onstage and greet the audience "in the name of Jesus Christ."

A murmur—almost involuntary, but quite distinct—arose from the audience: "Amen!"

Religious Play Draws Sell-out Crowds

I glanced around at well-coifed city women sitting beside peasants who resembled plump sparrows in their babushkas, velvet blouses, and embroidered aprons.

The play unfolded in striking tableaus: the Devil tempting Christ on the mountaintop; Jesus raising Lazarus from the dead; the Last Supper; the ultimate agony of the Crucifixion, the Resurrection.

"Two years ago," said crew-cut Evžen Sokolovský, the drama's youthful director,

CZECHOSLOVAKIA

THE CZECHOSLOVAK SOCIALIST REPUBLIC wriggles—perhaps symbolically—westward across the map of Eastern Europe. The size of New York State, it unites closely related Slavic peoples—Czechs and Slovaks—on a rich landscape varying from snow-crowned Tatra Mountains in Slovakia to fertile Bohemian fields bejeweled with man-made carp ponds. The Vltava River, also known by its German name, Moldau, splits the capital, Prague.

Under Communist rule since 1948, the country preserves centuries-old towns and castles while building up long-famous industries.

AREA: 49,370 sq. mi. **POPULATION:** 14,274,000. **RELIGION:** Predominantly Roman Catholic. **ECONOMY:** Heavy industry, including machinery, steel; glass, beer, textiles; agriculture, including sugar beets, hops, livestock. **MAJOR CITIES:** Prague, 1,025,000, capital; Brno, 330,000, machinery, chemicals, textiles; Bratislava, 272,000, major inland port on the Danube River; Ostrava, 265,000, manufacturing, iron and steel, coal area; Plzeň, 141,000, brewing, headquarters of Škoda industrial complex; Košice, 106,000, steel center in eastern Slovakia. **CLIMATE:** Central European—cold winters; warm, rainy summers. Prague, average July high 74° F., average January low 25° F. **RIVERS:** Danube, forming 100 miles of the southern border; Vltava, running through Prague. **MAJOR REGIONS:** Bohemia, land of hills and forests; Moravia, foothills and lowlands; Slovakia, high mountains.

"we could not have got permission to give this play. It has gone 90 performances so far, and every one has been sold out."

He introduced me to both Christ and the Devil as they left the theater for the night. The Devil complained about his rival actor. "Nuns send him nice notes and chocolates; the country women bring him sausages. Me? I get nothing but abuse!"

Later, at a smoky, candle-lit *vinárna*, a wine tavern, director Sokolovský pursued his favorite subject intensely:

"Here we have 52 professional dramatic groups, remarkable for such a small country. Even the smallest performs Shakespearean plays. And we use the works of modern Western playwrights, too: Edward Albee, for example. Of course, most of our people don't know of Virginia Woolf, so we had to change his title to *Who's Afraid of Kafka?*"

For two weeks in all I wandered through Moravia, and the driving was pleasant. Fat pheasants fed brazenly in open fields, and

EKTACHROME © N.G.S.

President and Communist Party chief Antonín Novotný has held the reins of the Czechoslovak Socialist Republic's government for a decade. He spent four years in a Nazi concentration camp in World War II. An old-line Marxist, he has resisted the liberalizing ferment at work in Czechoslovakia.

ČSM
PRACOVAT, UČIT SE A ŽÍT
PRO ROZVOJ SOCIALISTICKÉ
VLASTI

EKTACHROME (ABOVE) AND KODACHROME BY JAMES P. BLAIR © N.G.S.

As if launching human rockets, gymnasts show their skill in Prague's Park of Culture and Recreation. The group performed at Canada's Expo 67. Traditionally fond of gymnastics, Czechoslovakia produces many of the world's most daring circus acrobats.

Conclave of junior Communists fills the cavernous Great Hall in the Park of Culture and Recreation. Slogan exhorts delegates of the Československý Svaz Mládeže—the Czechoslovak Youth Union—to "Work, Learn, and Live for the Progress of the Socialist Fatherland." Discussions explore ways of stimulating interest in Communist Party youth activities.

spring breezes launched blizzards of blossoms from fruit trees lining the roads.

East of Brno I came to a place called Slavkov, a place of peaceful, rolling fields (map, page 165). In 1805 it knew another name: Austerlitz. Here Napoleon engaged Russian and Austrian imperial armies and, between dawn and dusk, cleared his way for control of central Europe. When the terrible smoke had lifted, more than 25,000 Russians and Austrians—and 9,000 French—had been killed, wounded, or captured.

"Such a result in so few hours in so small a space was never matched until Hiroshima," intoned a guide (who apparently had never boned up on Waterloo). "A peace treaty was signed 24 days after the battle." He looked at me, expressionless. "Today it takes longer."

North of Slavkov's gentle hills, around the thousand-year-old city of Olomouc, spread the fertile plains of the Haná region. Greening fields held promise of fine crops of wheat, malting barley for Czechoslovakia's breweries, and sugar beets—the country's valuable "white gold." Before World War II, Haná farmers were stubbornly independent, and prosperous. Today the soil is still rich; the farmers, largely collectivized, are not.

Farther north, not far from the Polish border, throbs the "Iron Heart of Czechoslovakia"—Ostrava. Its residents are the first to admit that this city of 265,000 is not a pretty place. Mine pitheads and heaps of slag rear up next to public buildings, and soot descends on its homes and streets. But Ostrava produces 75 percent of the republic's iron and steel and much of its coking coal (page 177).

Wearing a hard hat, miner's lamp, and gas

mask, I stepped out of a grimy elevator 3,000 feet beneath the surface in the Petr Bezruč coal mine, Ostrava's deepest.

"We're so deep here that the coal is quite plastic," a mine engineer told me. "Sometimes the floor will buckle *upward* from the pressure of the earth—about 3,000 pounds per square inch."

The tunnel walls, though braced with steel rings every 18 inches, bulged ominously in places. Our headlamps glimmered feebly on an inclined slope where two miners worked a machine, clawing coal from its bed. A swirl of black dust enveloped us as the coal cascaded onto a conveyor belt.

Ostrava's deep miners are among the best-paid workers in Czechoslovakia. For a six-hour day they earn more than 3,000 crowns—about $190—a month. Typical factory workers alternate a five- and six-day work week, at average salaries ranging between $75 and $112 a month.

New Industries Hum in Slovakia

Wealthy in coal, Czechoslovakia searches largely in vain for oil. I drove past a few derricks in Moravia, but the country's most productive "well" is a pipeline from the Soviet Union. It gushes into the Danube city of Bratislava, capital of Slovakia.

Slovaks enjoy some autonomy within the C.S.S.R., with their own national council. Though they share common ancestors, Czechs and Slovaks prior to 1918 lived apart for 10 centuries. Today even their languages differ, although they understand each other readily.

The Slovak still chafes under the Czech's lingering view of him as a "poor country cousin." Between 1860 and 1937, nearly three million Slovaks emigrated in search of work; much of their brawn went into the steel mills of Pittsburgh and Chicago.

Since 1945, however, Prague has poured billions of crowns into the industrialization of Slovakia, and a former air of desperate poverty has largely vanished. Throughout the region I saw new factories turning out everything from steel and aluminum to TV sets and textiles, from refrigerators and lumber to electric motors and pharmaceuticals.

Mr. Štefan Gál, head of the foreign department of the Slovakian Journalists' Union, introduced me to this eastern two-fifths of the C.S.S.R.

"First," he suggested, "it is important to have a healthy stomach. We Slovaks were ruled by Hungary for a thousand years, and you will find our goulash spicy."

KODACHROMES BY JAMES P. BLAIR © N.G.S.

Epitaph to infamy: Crowding the inside walls of Pinkas Synagogue in Prague, 77,289 names memorialize Czechoslovakian Jews who perished in the Nazi pogrom that scourged Europe in World War II.

Sobs for a murdered village: Widows still weep for Lidice, a town near Prague systematically destroyed by the Nazis in 1942. In retaliation for the death of a German official, troopers methodically shot Lidice's men, imprisoned the women, and took the children away. Finally, they obliterated all physical trace of the village.

Today, near the empty meadow that was Lidice, a new village holds the few survivors, including these two who mourn at the town's mass grave.

How, I asked, do Slovaks differ from Czechs?

"Czechs are very clever, more rational," he replied. "Slovaks have softer hearts. There are ten million Czechs and only four million of us, but we drink more wine and liquor than they do. Czechs may have more automobiles, but we have more fun out of life."

Mr. Gál glanced at his watch and excused himself. "Dinnertime," he said. "We Slovaks are afraid of nothing but our wives!"

Bratislava is Czechoslovakia's main doorway on the Danube, the country's southern frontier for 100 miles* (map, pages 164-5). Upstream, across from Austria, the riverbank bristles with barbed wire and watchtowers. Downstream from Bratislava, opposite the People's Republic of Hungary, the shore remains unguarded.

The banks flew past at 40 miles an hour as a sleek Russian-built hydrofoil launch sped me down the rain-swollen river. Capt. Michal Schneider had consented to take me along on an inspection patrol of channel markers as far as Komárno, 65 miles distant.

We passed heavy Danube traffic: rusty Russian river freighters; powerful Austrian tugs; gaily painted Hungarian craft with flower boxes whimsically hung on the wheelhouse.

Near the juncture of the Danube and Váh Rivers, Romans built a huge fortress, with walls nearly seven feet thick and an admirable drainage system, in the second century A.D. Today the busy industrial port of Komárno flourishes nearby.

The hydrofoil slowed and squatted back down on its hull as we cruised past the Slovakian Shipyards, which builds powerful

*See "Down the Danube by Canoe," by William Slade Backer, NATIONAL GEOGRAPHIC, July, 1965.

Women rake, man rides—the traditional division of labor—on a hillside farm in easternmost Slovakia. Beyond the distant hills lies a region of 5,000 square miles known as Carpatho-Ukraine. It has passed in this century from the Austro-Hungarian Empire to Czechoslovakia, to Hungary, and to the Soviet Union, the present ruler. Russian tanks rolled through the territory on their way to quell the 1956 Hungarian revolt.

White-collar farmer, Jiří Hýř directs the 18,000-acre Lubenec State Farm in Bohemia. Embracing 24 villages, the giant enterprise employs 1,050 salaried hands, raising livestock, fruit, and fragrant hops, which flavor Czechoslovakia's famous beer. When crops exceed quotas, bonuses reward the workers.

river craft up to 2,000 tons. A dozen new freighters awaiting delivery to Russia lay berthed together like fat gray sausages. We went ashore and washed down lunch with a splendid Slovakian white wine called *Malokarpatské Zlato*—Little Carpathian Gold. Captain Schneider declined a glass of *slivovice*, a fiery, colorless plum brandy. "I'm driving," he said. We sped back against the swift current to reach Bratislava before night fell.

Returning to my hotel, I was waved off the parking lot to make way for a fleet of black Tatra limousines bearing a delegation from the Soviet Union. I found another parking place, but as a matter of principle grumbled about the affair to a hotel clerk.

He nodded sympathetically. "You know the difference between you and these Russians?" he asked. "You are *paying*."

Though inextricably tied to the Soviet Union economically and politically for the past two decades, Czechs and Slovaks resent the numerous official Soviet visitors. "It's like having a mother-in-law in your house interfering all the time," one told me.

American "Delegation" Bewilders Villagers

I crossed the Russians' path again on my way eastward through Slovakia to Topol'čianky, the country's largest hunting preserve. A policeman flagged me down at a junction. The road ahead was closed to all but a Soviet delegation, expected soon.

Frank persuaded him to let us through. At the crest of a hill ahead I saw a roadside reception committee waiting to greet the Russian visitors.

Children dressed in the red-white-and-blue uniform of the *Pionýři*—Communism's political equivalent of the Cub Scouts and Brownies in the United States—waved flowers at us. I slowed, and the leader of the welcomers stepped forward to deliver a speech.

I could not resist a solemn nod to right and left, and a grandiloquent wave. The American delegation drove past without stopping, leaving the villagers, I fear, in deep confusion.

Now we wound through a region of firs and beeches, lovely meadows and streams. On a gravel road I stopped at a gamekeeper's cottage for directions. His wife shyly offered us a pitcher of rich milk and chunks of stout bread paved with slabs of home-churned butter. I never lunched better.

The director of the Topol'čianky Game Preserve,

With wish-I-had-one looks, lads press around ČZ motorcycles at the annual International Trade Fair in Brno, capital of Moravia. Darting motorcyclists swarm the roads, and races draw throngs.

Country commuters pedal briskly homeward after a day in the harvest fields. With men drawn to city industries, women predominate on the farms, usually working in teams under a masculine overseer.

engineer Desider Ambróz, is a big man with bristling mustache and military bearing.

"We have 22,000 hectares [about 55,000 acres] in this reserve, and 700 workers," he told me briskly. "Hunters come from all over Europe to shoot deer, wild sheep, wild boar, and other game."

He guided me to a log stockade. Inside, several shaggy brown brutes snuffled at a feeding trough—the almost extinct European bison. The biggest bull, named Putifar, glared at me from small, wild eyes and indulged in an earth-shaking roll in the dust.

"Are they dangerous?" I asked.

"Absolutely untamable," said the director. "They grow violent when even a rabbit enters the pen. They roamed wild here 600 years ago, but now there are only about 520 of them in the world—most of them in Poland and Russia. We started with four a few years ago. Now our herd numbers 16."

As we left the bison corral, Director Ambróz shook his head worriedly.

"This preserve is a state enterprise," he said. "Under the new economic system we are supposed to make a profit. But we are simply trying to build up our herd to help preserve the species—and where's the profit in that?"

The director's dilemma may not be insoluble. More than a score of European bison, I have learned, are scattered throughout the United States in half a dozen zoos; a prime specimen might fetch as much as $2,000 from other zoo directors anxious to acquire one.

Outside the city of Žiar I passed a more profitable state enterprise, a forest of smokestacks and mountains of bauxite ore. This immense aluminum plant bears the name, Enterprise of the Slovak National Uprising.

Headquarters of that 1944 uprising against German occupation forces was the mining town of Banská Bystrica. A museum here exhibits Slovak partisans' weapons and a homemade armored railway car built under the noses of the Nazis. One glass case contains the underclothing of an executed resistance leader, on which he had stitched, in barely visible white thread, a diary informing his wife of his fate.

Here, too, I saw tattered copies of illegal wartime newspapers and handbills. One read: "Rise up! Awake! The partisans are fighting for your freedom! No one will rule us in the future. . . ."

"In the early days after 1948," the old Communist had said, "there were people here in Prague who formed secret divergent groups, hoping to seize the radio and overthrow the government. They were fools, playing a game of Indians and cowboys." He snorted. "Fools. Of course they were easily caught and executed. No one tries that now."

I drove on through the Hron River Valley, nestled between spurs of the Carpathians that arch through most of Slovakia. Roadside piles of fir logs awaited transport to sawmills. Neat villages bore such names as Red Rock,

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

Tootling an invitation to an autumn celebration at Dobelice, a trombonist tramps from hamlet to hamlet. Evergreen sprig in his hat also announces the *hody*, or festival.

Every child's dream castle, graceful Karlštejn looms protectively above a Bohemian village. The massive bastion rose in the 14th century as a retreat and royal treasure house for Charles IV, the wise Bohemian king who also reigned as Holy Roman Emperor. Twice besieged but never taken, formidable Karlštejn, now restored as a museum, holds special charm even in a country where more than 2,500 castles survive.

EKTACHROME © N.G.S.

(Červená Skala), Upper Salty (Vyšná Slaná), and Lower Salty (Nižná Slaná). One—Stratená—meant simply "lost." Many tidy cottages were painted the color of peach ice cream.

Finally I saw the distant smokestacks of Košice, eastern Slovakia's largest city.

At the East Slovakian Iron and Steel Works a brass band and ranks of Communist Youth massed before a speakers' stand draped in red bunting. The Soviet delegation again!

The Russians had come to visit the most modern steel mill in Czechoslovakia—one day to be its largest, with an eventual capacity of 4,000,000 tons of sheet steel a year.

Next morning I followed an official, Mr. Otto Slafkovský, to the Furnace of the 20th Anniversary of the Liberation of Czechoslovakia.

Whatever its name, a caldron of molten iron is an impressive sight—a weird, unearthly thing that hisses infernally and showers sparks and soot. A burly Slovak stoker, masked against the fierce heat, labored with a long iron to rake slag from the white-hot metal as it cascaded from the blast furnace.

Proud of the plant, Mr. Slafkovský showed me its great rolling mills, nearly a mile long, sleek electronic control panels, the huge coking plant, even a steelworkers' training school. The Czechoslovak-designed plant, he said, uses equipment from all over the world.

At the workers' cafeteria I watched laborers ladle down gargantuan bowls of soup, goulash, and dumplings—at 9:30 in the morning.

"Isn't it early for lunch?" I asked.

"This is just their midmorning snack, something like your coffee break," came the reply.

Gypsies Thwart Socialist State

A few of the steelworkers looked different to me, dark-haired, swarthy, slighter of build.

"Gypsies," said Frank. Later he introduced me to a friend who could tell me more about

"Prettiest crane operator in the world," asserts photographer James Blair of Maria Holandova; she handles a 5½-ton overhead crane in the gleaming Košice steelworks. Each morning she and her husband leave their only child at a state-run nursery, a policy encouraged by the government to free mothers for industry. Today women form nearly half the total work force.

Mammoth "bicycle chain" turns a 70-ton ingot of glowing steel as a worker at Ostrava flakes off crustlike scale. Central Europe's largest press forge relentlessly squeezes the metal into a steel-mill roll. Set amid rich coal fields near the Polish border, smoking Ostrava pours forth three-quarters of Czechoslovakia's iron and steel.

Flat on his stomach, a coal miner of Ostrava tunnels into a shallow seam 1,600 feet underground. His metal mask filters out coal dust. Because of the job's danger and discomfort, miners can make more than 3,000 crowns —about $190—a month, double an average laborer's income and more than that of some doctors.

KODACHROME (RIGHT) AND EKTACHROME BY JAMES P. BLAIR © N.G.S.

them, Ján Marcovič, editor of Košice's daily newspaper.

"We have about 600 Gypsies in the steel mill," Marcovič told me. "The chairman of the Communist Party organization at the plant is a Gypsy. Many have become doctors and policemen. These have accepted what the state is trying to do for them. But the others. . . ." He shrugged.

Communist officials remain baffled and frustrated by East Slovakia's 80,000 Gypsies. By law they are required to accept jobs—but most of them report for work when they please. After payday many disappear to feast, drink, and dance as long as the money lasts. Another law grants Czechoslovaks an allowance for each child; the Gypsies raise large families and live happily on the subsidies.

The state broke up nomadic encampments and resettled individual families in new flats. The Gypsies, lonesome for their own kind, recongregated—often four or five families to an apartment. Craving fresh air, they simply broke the windows; they built cooking fires on the floor. To hard-working Czechs and Slovaks, such behavior is simply beyond comprehension.

At a village behind Košice's steel mill I heard the Gypsies' side of the story. Stepping out of my car, I was surrounded by hordes of ragged children. The village resembled a disaster area. Smoke drifted through holes in the roofs; it was difficult to tell what color the ramshackle cottages had once been painted.

A Gypsy steelworker with the piercing gaze and profile of a falcon spoke earnestly.

"We would like to have our own land and build a nice new village," he said. "But the local National Committee won't let us. We've even written to the president. All the government wants to do is separate us. We want to remain together!"

As I left the city, headed for the High Tatra Mountains on the way back to Prague, my Škoda balked and stalled on busy Leninova Street. A policeman eyed me sternly and approached, to my discomfort.

I struggled to start the car; he pointed to a box of matches on the dashboard. "Try those," he said, deadpan, and scowled at a honking motorist behind me.

Skiers Will Flock to Tatras in 1970

The High Tatras, sharp granite peaks that spill from northern Slovakia into Poland, thrust suddenly from a plateau. These glacier-carved Alps-in-miniature cover an area of only 100 square miles. Numerous snow-filled cirques make them a skier's paradise; Czechoslovakia will host the 1970 world cross-country and jumping ski championships here. With fine accommodations on the edge of its spectacular solitude, the area attracts

Links to the distant sea: Hulking barges moor beneath a giant crane at Bratislava, landlocked Czechoslovakia's major Danube port. A barge dweller dips water for her flowers; clawlike flukes, left, poise to anchor the photographer's craft in the Danube's swirling current. Beneath turreted Bratislava Castle, background, a double-decker bridge leads to the splinter of Czechoslovakia that lies across the Danube (map, page 165).

thousands of hikers and climbers in summer (following pages).

I found my own springtime paradise in the Tatras, a boulder-strewn stream in the foothills. With engineer Juraj Turošik, director of the Tatra National Park, I crouched behind a rock and cast my spinner across the current and into the pool below. A slow retrieve, a sudden tug; and my rod arched and sprang to life. When the fight was over, Turošik and I admired a beautiful two-pound brown trout.

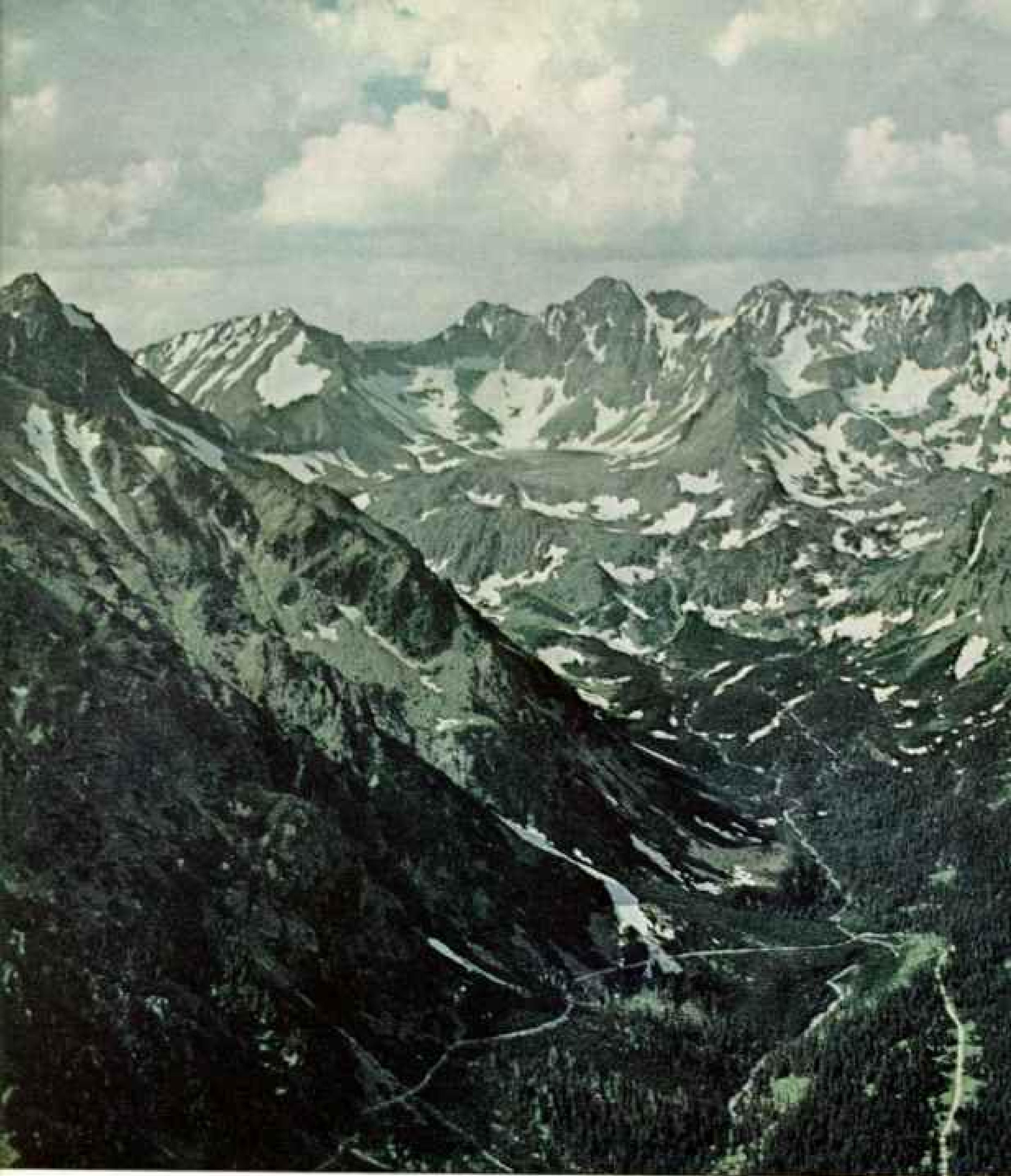
We took enough trout for breakfast and retired to my hotel, where an understanding chef served them up whole, crisp and brown, each with a radish in its mouth—golden monuments so beautiful even Attila would have wept at their destruction. We fell to, barbarously.

Returning to Prague at the end of May, I combed the city until I found a hotel room—scarce enough at any season, but this was the height of Prague Spring, a three-week festival that makes it a Mecca for music lovers.

Frank Faltys introduced me to another of his multitudinous friends, youthful-looking Jindřich Rohan, conductor of the Prague Symphony Orchestra, who led me into ornate Smetana Hall on the edge of Old Town.

"This is *my* hall," said Rohan. "Peculiar characteristics. When empty it has a fantastic period of reverberation—seven seconds. During rehearsals it's difficult for visiting conductors to get used to."

KODACHROME © NATIONAL GEOGRAPHIC SOCIETY



Threadbare mantle of summer snow drapes the shoulders of Slovakia's High Tatra Mountains, a compact massif only 18 miles long. Jagged 8,711-foot Gerlach Peak, right center, caps the range; a national park embraces the slopes. Each year more than a million visitors—foreign tourists mingling with vacationing workers bused from farms and factories—sample the region's superb skiing and scenery.

Beneath a banner that read "Through Music to Peace and Friendship Among Nations," we took seats behind the orchestra, where we could observe every gesture and expression of Yevgeniy Mravinskiy conducting the visiting Leningrad Philharmonic. For two hours I enjoyed the unusual experience of watching one symphony conductor watching another.

The Russians swept through the rich dissonances of Prokofiev's Symphony No. 6 as a

KODACHROME © NATIONAL GEOGRAPHIC SOCIETY

single, pliant creature under Mravinskiy's baton. Their conductor, spare and ascetic-looking with steel-rimmed glasses, pleaded, coaxed, *demanded* the perfect performance.

"Fantastic discipline," Rohan said admiringly over our coffee cups later. "We can't match the Russians in this. Our orchestras are collections of fine musicians, but individuals. It gives them more color."

Czechoslovakia has often been called the "Conservatory of Europe." From it sprang such composing geniuses as Bedřich Smetana, Antonín Dvořák, Leoš Janáček, and Bohuslav Martinů. Mozart, an Austrian, was commissioned to compose his immortal *Don Giovanni* here, and said, "My Praguers understand me."

I left Prague, heading eastward once again, to complete my tour of Czechoslovakia with a circuit of Bohemia. At the Glassworks Bohemia plant in Poděbrady I stopped to explore

Smile of anticipation greets a carp during a harvest festival at southern Bohemia's Rožmberk pond. Basket will transfer the fish to a holding pond, where it will fatten for its role as a favorite Christmas Eve dish.

Contented "King" Bacchus, grasping a mighty goblet, revels amid a comely court; thus Moravians of Znojmo pay an-

the area's traditional glassmaking industry.

A raised platform surrounding a roaring circular furnace served as a stage for an eerie ballet. Glass blowers scooped up blobs of molten lead crystal on the ends of long pipes and skillfully puffed and turned them into glowing stemware, bottles, pitchers, and vases. The sweating workers, many clad in shorts, paused frequently in the enervating heat for long draughts of beer.

Glassworkers Take a Four-year Course

The Bohemia glassworks turns out some $9,000,000 worth of Czechoslovakia's famous lead crystal for export each year.

Professor Vladimír Linka showed me about a state school at Železný Brod, where 260 teen-age students spend four years learning to work with this fascinating material. He held up a graceful smoky-blue abstract sculpture.

"Just look at it," he cried enthusiastically. "Each time you touch it, turn it, work it, new inspiration occurs to you. A glassworker always becomes a prisoner of his material—no one who starts in it ever leaves it!"

I drove along the so-called "Glass Highway" of northern Bohemia through other famous glassmaking towns, Jablonec nad Nisou and Nový Bor (map, page 164). Here houses beside the road looked vaguely different to me.

"Of course," said Frank. "They are German." We were in the former Sudetenland.

This mountainous region wears its unhappy history like a tattered cloak flung over the western rim of Czechoslovakia. Here amid woodlands and fields long fallow you can find overgrown concrete bunkers—a "Maginot Line" Czechs never got a chance to use in

EKTACHROME BY JAMES P. BLAIR © N.G.S.

nual tribute to the god of wine. In a jubilant festival recalling medieval times, 20,000 countryfolk stream into the grape center for a sleepless weekend of parades, dancing, wine, and feasting on spicy sausages and whole roast lambs. Moravians and Slovaks favor their local wines; Bohemians accord first rank to their own famous beers.

World War II. And villages near the present German borders stand half-empty and forlorn.

Germans settled in this scenic region centuries ago. With the birth of the first Czechoslovakian Republic in 1918, they suddenly found themselves a minority among Czech citizens, and, during the desperate depression days, accused Prague of discrimination and neglect. Many agitated for *Anschluss*—annexation by Hitler's Reich. With the Munich Pact, in 1938, it came.

Village Dies and Lives Forever

The events that followed wrote perhaps the darkest chapter in Czechoslovakia's unlucky history. And no place in this land was less fortunate than a little village of 500 inhabitants some 12 miles northwest of Prague.

On May 27, 1942, Czech resistance fighters who had parachuted in from England tossed a grenade into the car of Reinhard Heydrich, ill-famed Nazi "Protector" of Bohemia and Moravia. Eight days later he died. To set the retaliatory example, his successor chose the village of Lidice.

Anna Pokorná was 27 then. Now she is 52 and remarried.

"They came on June 10, early in the morning," she said as we looked out over the placid hollow where old Lidice once stood. Today only a tall wooden cross with a barbed-wire crown marks its site.

"They encircled the village and went from house to house. The men they locked in the cellar of a farmhouse. Women and children were taken to the school. I had one boy, three and a half. Later they separated us from our children and took us to the concentration

Haven of healing waters, Karlovy Vary sets manicured promenades beside the Teplá (Warm) River. A dozen mineral-rich thermal springs and geysers, soothing those who soak and sip (below), treat such ills as ulcers, gout, and gallstones. Once a retreat for Europe's aristocracy, the spa swarms today with workers.

KODACHROMES © N.G.S.

As if puffing a huge pipe, a visitor downs a pre-breakfast potion of spring water; he sips through the hollow handle of Karlovy Vary's traditional cup. As part of the Austro-Hungarian Empire until 1918, the resort long was known as Karlsbad.

camp at Ravensbrück, where we spent three years under very dreadful circumstances."

Mrs. Pokorná has told the story many times and emotion no longer shows.

"Sixty of us died in Ravensbrück, and we who survived did not know until the war was over what had happened to our husbands and children. They took our men out of the cellar, 10 at a time, and shot them. The youngest was 14, the oldest 87. Our children they scattered. Some were sent to Poland, some to Prague. Some who were fair-haired and blue-eyed were given to German families to raise. Of 105, only 17 ever came back."

Mrs. Pokorná's three-and-a-half-year-old son was dark-haired and brown-eyed. He died, she said, in a gas chamber.

Emptied of life, Lidice was methodically burned and razed. The new village, built after the war, stands a quarter of a mile away beside a large, well-kept rose garden, the gift of people all over the world.

Two partridges strutted peaceably in new-mown grass, seeking seed, as I left. It had happened in 1942—such a long time ago, I thought. But never long enough (page 168).

Jáchymov: Cradle of the Atomic Age

When World War II ended, the Czechs promptly expelled about three million Germans from the Sudetenland, more than a fifth of the country's population. Only 170,000 Germans remain today. The region has not yet recovered from the exodus.

In the town of Hranice (Frontier), tucked in the westernmost wedge of Czechoslovakia between East and West Germany, I talked to Zdeněk Čabart, a Czech who migrated to the old Sudeten area in 1952. He told me that his factory (it makes mirrors) could use 200 more workers. I asked if the townspeople felt worried about living so close to the German border, a scant kilometer away.

"Proč?" he snorted. "Why? We have a powerful friend in the East now. We are not on our own!"

Part of the power of Czechoslovakia's "friend in the East" came from the somber hillsides outside Jáchymov in northwestern Bohemia. Here I drove past dark tunnels and piles of gray-brown tailings, where during the 1950's political prisoners had dug uranium ore to strengthen the Soviet atomic arsenal. The mines are silent now, worked out.

Ore from this region yielded the world's first pure radium, isolated in 1898 by Pierre and Marie Curie. Since that time, Jáchymov has grown into one of Europe's newest spas.

Think-factory boss, Dr. Otto Wichterle channels Czechoslovak ingenuity into a stream of inventions at the state-supported Institute of Macromolecular Chemistry in Prague. Centering on new and tougher plastics, patents include a soft contact lens now bringing worldwide profits to Czechoslovakia.

Stabbing finger signals a film cut for Miloš Forman, young lion of Czechoslovakia's bold and booming movie industry, who won fame as director of *Loves of a Blonde.* Here he and editor Miloslav Hájek view *Fire and Firemen,* Forman's first color motion picture. Delighting in subtle, fleeting facial expressions that reveal emotions, Forman often works with amateur actors and films them without rehearsals.

"**Crystal of Kings**" in a Communist land: Master engraver Rudolf Schwamberger decorates a vase with an intricate scene of forest and deer. Goblets gleam like jewels at Karlovy Vary's Moser Glassworks. For a century Moser craftsmen have wrought exquisite table sets for monarchs, popes, and presidents. All across Bohemia, glass blowers fashion prized tableware, sculpture, and costume jewelry.

EKTACHROME (OPPOSITE, UPPER) AND KODACHROMES © NATIONAL GEOGRAPHIC SOCIETY

Treatment for arthritis, nervous disorders, gout, and other ills includes radioactive thermal baths and even inhalation of radioactive air in special "emanatoria" at the Radium Palace sanatorium.

Old Elegance Returns to Karlsbad

Some fifty spas throughout the country treat virtually every ailment known to man. Had I been ill, I might have visited Mariánské Lázně (Marienbad) for kidney trouble; Poděbrady for heart disease; Janské Lázně for muscular disorder; Luhačovice and Bardejov for respiratory ailments. I chose the graceful promenades of Karlovy Vary—Karlsbad (page 184).

Six centuries ago, says a legend, Charles IV discovered a hot spring here when a stag he was stalking panicked and leaped into its scalding waters. The spa he established eventually attracted generations of Europe's dyspeptic rich, royalty, and cultural genius. Great Britain's Edward VII and Russia's Peter the Great took the water cure here, as did Beethoven, Goethe, Chopin, Schiller, Pushkin, and Karl Marx himself.

I checked into a majestic old hotel whose names trace the ups and downs of Karlsbad: Before the war it was the Grand Hotel Pupp; in 1948 it was rechristened the Moskva. Today it wears a fresh coat of paint and a compromise—the Grand Hotel Moskva-Pupp.

Other touches of elegance have returned, like the clip-clop of a horse-drawn sightseeing carriage. Sleek shops display the fine Pirkenhammer porcelain and Moser glass for which the region is renowned (opposite). German tourists mingle again with dumpling-plump Czechs, here for the "slimming cure."

I watched sedate crowds stroll the Colonnade of Czechoslovak-Soviet Friendship, sipping thrice-daily doses of water from hollow-handled cups (page 185). Many nibbled at sweet, round *oplatky*—wafers—looking rather like Gothic saints solemnly munching their golden halos.

Perhaps significantly, one Czech in ten suffers from ulcers at one time or another in his life. Karlsbad's 12 sanatoriums (8,000 beds, 50,000 patients annually) specialize in this complaint. The alkaline water, charged with carbon dioxide, gushes from a dozen hot springs.

I sought out Dr. Leopold Šváb, First Doctor of Balneotherapy at the spa. Nowadays, he told me, physicians seldom prescribe more than six cups of the water daily. Two centuries

ago, waterlogged patients drank as many as fifty cups a day and soaked in the mineral water until their skin began to peel.

Not far from Karlovy Vary, I visited the headquarters of the Státní Statek Lubenec, the 18,000-acre Lubenec State Farm, where 1,050 salaried workers tend more than 6,000 beef and dairy cattle, 5,000 pigs, vast orchards of fruit trees, and 1,000 acres of Czechoslovakia's most valuable export crop, hops.

This vine in early June had climbed more than four feet up its 20-foot pole-and-wire trellises. By September it would bear the aromatic yellowish fruit that helps give Bohemian beer its unsurpassed flavor.

The farm's deputy director, Vladimir Vacek, showed me a new hop-picking machine, a contrivance of conveyor belts and mechanical fingers. Most of the crop, however—more than $1,000,000 worth on this farm alone—is still picked by hand.

During the three-week harvest period, said Vacek, 5,000 additional workers, many of them young teen-agers, come from factories and schools as far away as Prague.

"Then," he said, "we pray it doesn't rain."

"Would it hurt the crop?" I asked.

"Oh, no. But can you imagine," and his pained voice dropped almost to a whisper, "what it's like with a couple of thousand kids indoors on a rainy day?"

Pilsner Beer Pours From Plzeň

The harvest of this biggest hop farm in Czechoslovakia finds its way inevitably to the country's biggest brewery, in the old industrial city of Plzeň. Here is the source of the original Pilsner beer; more than 42 million gallons a year flow from its vats to 80 countries around the globe.

I toured some of the six miles of cavernous cellars hewn from sandstone beneath the brewery, where thousands of barrels of beer lay maturing. The aroma of these cellars is indescribably heady; I believe the air itself could be bottled and sold.

At the other end of the city, smokestacks belched a gray pall over the vast V. I. Lenin Works, more commonly known by its prewar name, "Škoda." From this century-old industrial complex rolled many of the "Guns of August," the awesome artillery pieces of World War I, as well as tanks and guns for the Wehrmacht in World War II.

"Do you still manufacture weapons?" I asked Škoda's export director, Mr. Miroslav Machálek.

"Not at the present time," he answered, carefully and without amplification.

Today Škoda employs 30,000 workers in Plzeň and 45,000 more in 16 other cities (pages 190-91). Production, said Mr. Machálek, has reached five times the prewar level, half of it for export. Škoda's sprawling factories in Plzeň turn out complete power plants—steam, hydroelectric, and atomic; metallurgical rolling mills; and transport equipment, including trolleybuses and electric locomotives.

I ducked instinctively as a pretty crane operator swung a great block of metal high over my head. She waved cheerily. A third of the plant's heavy-machinery operators are women, I was told.

Plzeň marked the high-water point of Gen. George Patton's advance into Czechoslovakia in 1945. Though Prague lay an easy 60 miles away and German troops were eager to surrender to Americans, prior agreement with the Soviet High Command held Patton's Third Army on a line from Karlsbad through Plzeň to České Budějovice in the south.

So the Red Army liberated Prague—and the Communist Party prevailed in the rebuilt Czechoslovakian Government.

"In the early days the Party was so concerned with a man's political reliability that it made mistakes," the old Communist had told me. "We gave power to some who did not use it well. We raised them up from the mud and put them in the sun, and they behaved ... they behaved very badly."

By now I had learned to pronounce "České Budějovice" with ease—even Domažlice, Prachatice, and Vyšší Brod, all charming, historic towns I visited in west and south Bohemia. It is a pond-studded region of carp culture, croplands, and castles.

No city or town of any consequence lacks its castle, fortress, or chateau to remind one of older times, both good and bad. With other

Woe without words: "I give up; I can't shut her off," despairs the unspeaking face of mime Ladislav Fialka, as Jana Pešková monotonously toots her recorder. They improvise from "The Fools," a pantomime produced by Fialka, whose troupe has won acclaim from New York to Moscow. Though disciplined professionals, Czechoslovaks boldly innovate—and their audiences respond, packing the nation's ubiquitous theaters night after night.

KODACHROME BY NATIONAL GEOGRAPHIC PHOTOGRAPHER JAMES P. BLAIR © NATIONAL GEOGRAPHIC SOCIETY

tourists I have donned felt-soled slippers and skated through the polished Tudor elegance of Hluboká Castle near České Budějovice, and Konopiště near Prague, with its incredible collection of hunting trophies.

At Český Krumlov, mighty castle of the Rožmberk family that once dominated southern Bohemia, I watched captive bears scratch themselves indolently in the moat. At Karlštejn I climbed to the great keep built to guard the crown jewels of Charles IV (page 175).

Through the country I stopped at dozens of other castles and marveled at their magnificent medieval armories and galleries of priceless art. But the castle most firmly fixed in my memory huddles behind a roadside wall in the northern Slovakian village of Strážky. It is a small place, twenty rooms or so, and it cries out for repair. But only here in all my travels did I find a castle still occupied by its aristocratic former owner.

"In the old days she was always good to the people, and they are very fond of her," said the village schoolmaster. He led me across the rain-soaked courtyard to meet Margit Czobel, the Baroness Medňansky.

The *baronka*, a tiny figure wrapped in a long blue robe, received us in her ground-floor room. It was dim and chilly, and crowded with remnants of grand furnishings—whatever the state museums did not want after this castle was nationalized.

Member of the power elite, high-ranking Communist Zdeněk Kadlec controls production of 400 gleaming Škodas a day at Mladá Boleslav. Four-fifths go for export.

In the giant eye of a dynamo, a girl helps insulate a maze of

At 76, the baronka stands not quite so straight as she once did, nor is her voice so strong in any of the five languages she commands. But time can never erase a certain nobility of bearing. The schoolmaster excused himself with a half-bow and left us.

Baronka's Paintings Not for Sale

The Strážky Castle, I learned, was built in 1120 and overrun by Tatars a century later. Through the centuries it served as a monastery, a stronghold of crusading Knights Templar, and a seat of Hungarian kings.

Over tea and tiny cakes we spoke of pleasant things, of books and art and travel.

"In the old days I traveled a good deal—Vienna, Budapest, Italy . . ." the baronka's voice trailed off.

And now? "Oh yes," she brightened. "I go quite often to Kežmarok." I had passed through the town, 2½ miles back.

She receives a pension from the state, the schoolmaster had said—230 crowns a month (not quite $15.00). Some of it, I could see, went for art supplies. I admired her water colors. Might I buy one?

"I am sorry," said the baronka. "I have no paintings to spare. The people of the village are very good to me, you see. They bring me things. My paintings are all I have to give them in return."

She seemed to be tiring, so I bade her

electrical wiring. The huge stator is part of a generator that will produce 50 million watts of power. These technicians work at Škoda's sprawling works in Plzeň, a trade center since medieval times and long renowned for its Pilsner beer.

EKTACHROME BY JAMES P. BLAIR © NATIONAL GEOGRAPHIC SOCIETY

KODACHROME © N.G.S.

In orbit on a rotating swing, youngsters sample a visiting carnival in Košice's Nové Město, "New Town." Eight thousand prefab apartment units have sprung up for steelworkers, with twice that many planned, as Czechoslovaks struggle to improve the quality of life in a nation that has long focused on industrialization.

Against a backdrop of the past, shapers of the future chase a ball in Telč, a remarkably preserved Renaissance and Baroque town set in the Moravian highlands. Arcade and ornate gables face the town square. Once a moated stronghold, the old town is now protected as a historic shrine, but its houses still serve as dwellings and its shops continue to draw customers.

goodbye and stepped out into the chilling spring rain.

I wished I had met her on a sunnier day.

There are many in this land who remember luckier times, but they belong to a middle class long since economically leveled by Socialism, and they are growing old. Their world now belongs to the workers.

And, in truth, many workers can recall unluckier days. The machinist—call him Pavel—remembers a depression boyhood in a northern Bohemian village, when often there was no bread and his widowed mother crocheted lace day and night to pay the rent of their single room above a tavern.

Now Pavel enjoys his two-room flat in Prague. It is crowded, but comfortable enough, and it costs only 240 crowns a month—less than a tenth of the family income.

Like more than half of all Czech women, his wife Anna works. When she finishes her clerk's tasks at 4:30 p.m., she buys the pork and potatoes and perhaps a bit of pastry for the evening meal. On her way home from the tram stop she picks up their four-year-old daughter Sonja from the neighborhood Mateřská Škola, the free state nursery school. And because they have managed to save part of Anna's salary, they now have the pleasure of television to watch on winter evenings.

Life is not bad, Pavel reflects. There is food enough, the family is decently dressed, medical care is free, and he will soon be entitled to a fourth week of vacation each year—and a pension, of course, at age 60. There is always the hope that wages will go up. It would be nice one day to be able to build a little hut in the woods near the river, to get out into the country on weekends.

If they had a car.... A new Škoda costs 45,000 crowns—more than two years' wages—20,000 of it payable in advance. And then there is at least a two-year wait. But it is something to look forward to.

It was probably good, Pavel muses, that he was poor in his youth. Had his parents been rich shop owners or intellectuals, he might not have been so lucky. Such things were important when one was assigned an apartment or sought a better job....

I visited the old man again and told him of my trip. "I feel a kinship with your people," I said. "I admire this country of yours. But I could never like the methods you have chosen to govern it."

He sucked at his empty pipe and stared somewhere past me.

"Why should you?" he said after a while. And a dream in his eyes seemed to flicker, like a candle flame when a door swings open.

THE END

KODACHROME BY NATIONAL GEOGRAPHIC PHOTOGRAPHER

Earth-gouging behemoths rumble over the roadbed of Interstate 81 south of Hazelton, Pennsylvania. Driver lowers the scraper's bowl to level the grade and scoop up a 64-ton load of dirt for fill where the divided highway will bridge the railroad tracks. Rearranging the geography of America, the revolutionary Interstate Highway System creates a 41,000-mile network of super-roads from border to border.

Our Growing Interstate Highway System

By ROBERT PAUL JORDAN
National Geographic Senior Staff

AMERICANS ARE LIVING in the midst of a miracle. A giant nationwide engineering project—the Interstate Highway System—is altering and circumventing geography on an unprecedented scale.

Millions of us see part of the picture as we drive for hours at a steady high speed on one or another of the magnificent new super-roads blazoned with red-white-and-blue signs (above). Yet an individual can no more grasp the scope and magnitude of the entire project than an ant can comprehend New York City.

Crisscrossing the United States on the new super-highways, I realized that they mark perhaps the greatest revolution in ground transportation since the invention of the wheel. The revolution affects us all, for America's roads are America's lifelines. Dewitt C. Greer, Texas State Highway Engineer, told me: "This Nation doesn't have superb highways because she is rich. America is rich because she had the vision to build such highways."

The vision persists, and I found it epitomized in the 41,000-mile National System of Interstate and

JAMES P. BLAIR; EKTACHROME (RIGHT) BY JONATHAN S. BLAIR © N.G.S.

Commuters jam a Los Angeles interchange where I-5, I-10, and U. S. 101 meet. Battling such traffic, California jokes it has two kinds of roads—under construction and obsolete.

Highroad to the wild green yonder, New York's Northway sweeps majestically through the Adirondacks. Planning for safety and beauty, engineers walked every step of the route from Albany to the Canadian border. Their dreams fashioned a highway for the future with parklike dividers

KODACHROME BY JAMES P. BLAIR © NATIONAL GEOGRAPHIC SOCIETY

between split-level roadways, wide shoulders of white stone chips for easy visibility at night, emergency telephones, scenic overlooks, and rest areas. They even built underpasses for hikers and wildlife. Completed last August, Interstate 87 carried streams of travelers to Expo 67 in Montreal.

KODACHROMES BY NATIONAL GEOGRAPHIC PHOTOGRAPHER DEAN CONGER (ABOVE), AND ...

Defense Highways—largest public works program in history (map, pages 216-17).

The super-roads are gobbling up 1.6 million acres for right of way—an area larger than the State of Delaware. Enough material is being excavated to bury Connecticut knee-deep. The sand, gravel, and stone going into the roads would build a wall 9 feet thick and 50 feet high around the entire world.

Trillion Miles of Driving in 1968

Does the Nation actually require new highways on so mammoth a scale? In Washington, D. C., I put the question to Francis C. Turner, Director of the Bureau of Public Roads in the new Department of Transportation.

"Today," he said, "Americans drive 97 million cars, buses, and trucks. Ten years from now we'll be operating 120 million vehicles—and the number goes up from there.

"In 1967 we drove 960 billion miles. We'll hit a trillion in 1968. Better roads and highways are vital to our social and economic welfare and to national defense."

Then he ticked off some of the Interstate's benefits. "It will reduce highway deaths by 8,000 a year. It has already shrunk mileage between major cities by up to 25 percent and motoring time by even more. Driving costs will be reduced by 11 billion dollars a year.

"Our studies show," Mr. Turner explained, "that the Interstate System is two and a half times safer than the old primary roads. The accident fatality rate on completed portions of the system is 2.8 deaths per 100 million vehicle-miles, as against 6.9 for the roads that formerly carried interstate traffic. This translates into 6,000 lives saved each year. In addition, we calculate that lessened congestion on the older highways will lower their fatality count by another 2,000 lives.

"As history's most mobile society, Americans no longer consider distance simply in terms of miles. We calculate it in hours and minutes. On this basis, the Interstate can cut the time of a major journey—from Washington to Boston, for example—by at least one-third. Intersections, stop lights, and traffic make it impossible to average more than 40 miles an hour on most primaries. On Interstates you can cruise at 65 or better.

"Finally, motorists will reap that 11-billion-dollar annual dividend from lower fuel costs, decreased maintenance—these roads are easier on cars—time saved en route, and, most significantly, reduction in accident costs."

Conceived during the administration of President Franklin D. Roosevelt, and enacted

(RIGHT), AND JAMES R. HOLLAND © N.G.S.

Bridge of glass, an Oklahoma restaurant caters to drivers on the Will Rogers Turnpike, Interstate 44, northeast of Tulsa. Highway planners expect increasing use of space above and below freeways for parking lots, parks, restaurants, and office and apartment buildings.

Clear, cool water gushing from a hand pump slakes the thirst of a young trail blazer at a Kansas rest area on I-70. Drivers on long trips are advised to make frequent stops.

Oasis of refreshment on the Great Plains serves a family near Manhattan, Kansas. For Interstate 70 travelers the state set aside 22 parcels of 10 to 14 acres each, landscaped them with trees and shrubs, installed picnic tables, water, and electricity. Historical markers point out the route of Coronado's expedition and the Santa Fe Trail.

Tangled thicket of traffic hazards confronts drivers on 40-year-old U. S. 1 in Woodbridge, Virginia. There is no median strip to prevent head-on collisions; jumbled signs impair vision; driveways feed autos onto the thoroughfare without warning; narrow shoulders leave little room for human error. The result: a death trap. The old highway follows the route of a

into viable law in 1956 under President Dwight D. Eisenhower, the Interstate program affords a classic example of partnership between federal and state governments.

Through the Bureau of Public Roads, the federal government contributes 90 percent of the highway costs and exercises its right of approval and reasonable control. Individual states, paying the remaining 10 percent, determine the routes, design the highways, and award construction contracts to low bidders.

Texas leads the Nation with 3,029 miles of planned Interstate roads. California ranks second with 2,165 miles, while tiny Delaware will content itself with a mere 40½. Hawaii will have 51½ miles. Alaska plans none; its highway officials consider that it has no present need for Interstate construction.

The Lone Star State contains 25 localities of 50,000 or more persons. Burgeoning California boasts 59 such urban areas. In the end, the Interstate System will link nearly all communities of this size in the country.

Interstate Now 65 Percent Built

Congress set an original target date of October 1, 1972, for completion of the system and has authorized 44 billion dollars for the pay-as-you-build project, from taxes on fuel, tires, and other automotive items. But because of rising costs, higher standards—especially for safety—and urban problems, completion is not expected until the mid-1970's, at a total price several billions higher.

Today the 41,000-mile network is about 65 percent completed, including 2,300 miles of pre-existing toll roads, bridges, and tunnels. These were taken into the system to avoid

colonial post road denounced by Thomas Jefferson as "the worst in the world."

KODACHROMES BY JAMES P. BLAIR © N.G.S.

Achieving the ideal: Interstate 95 rolls through the woods of northern Virginia. Travelers and commuters find it a safe alternate to U. S. 1. Even the huge truck-trailer rig at right, carrying half a prefabricated house, does not impede traffic.

wasteful duplication. Otherwise the system is as free of toll booths as it is of stop lights and intersections. The new map, **The United States**, with this issue, shows more than 26,500 miles of the Interstate built thus far and some 6,000 miles under construction. Only 8,500 miles are yet to be begun.

When fully open, the system will carry a fifth of the country's traffic on little more than 1 percent of its 3.7 million miles of public roads and streets. Motorists will be able to drive swiftly and safely from border to border and coast to coast without halting for a traffic light or a stop sign.

A drive along the Interstate System already provides a vivid lesson in the geography of the United States. The new highways cut through brooding forests and silent deserts; they course the endless prairies, skirt rivers that helped shape the destiny of a continent, and knife through high, lonely mountains.

Everywhere you find history, too—battlefields, monuments, yesterday's frontiers. And place names along the way ring with poetry—Tallahassee, Topeka, Cheyenne, Spokane.

But deserts and mountains can sometimes be lethal. One wintry day I inched along ice-coated U. S. Route 6 where it snakes through Loveland Pass in the Colorado Rockies. Suddenly I saw tire tracks in the snow angling off the road, vanishing where the mountain fell abruptly away—a stark epitaph for a car that lay smashed far below. On such roads a loss of traction or a moment of inattention spells tragedy. Incongruous and solitary among the tall pines, the wrecked car looked like a toy discarded by a careless child.

Such accidents, all too frequent on icy

KODACHROME BY JAMES P. BLAIR © N.G.S.

Mechanical brawn clears boulders loosed by explosives for Interstate 81 in Pennsylvania. The bulldozer can move 600 tons of rock an hour—enough to fill six railroad cars. Before work begins, states submit their plans to the Department of Transportation's Bureau of Public Roads, which pays 90 percent of Interstate costs out of a trust fund fed by federal taxes on fuel and parts.

mountain highways, explained the need for the tunnel I was about to visit.

The workers call it "the hole." At an altitude of 11,112 feet, it is the pioneer bore for the world's highest vehicular tunnel. Now being blasted through the Continental Divide 65 miles west of Denver, the tunnel will be part of Interstate 70 some three years hence. It will save lives and time by obviating the perilous 11-mile drive over Loveland Pass.

Where I-70 Will Pierce the Rockies

Hundreds of feet into the chill, dripping, exploratory tunnel, our battery-powered tram suddenly howled to a halt. Around us the steel ribs and struts bracing the sides and roof were slowly, grudgingly yielding to an elemental pincers. Deep within a 12,600-foot mountain, we were surrounded by decomposing rock, shifting and treacherous. Here nature was converting granite into soil and, in the process, was crushing the tunnel.

"We dug this shaft to find out what we'd be up against," explained R. C. Hopper, the highway engineer heading the project. "Now we know where we'll have to use special reinforcement when we blast through for keeps."

When completed, the two-lane tunnel will stretch nearly 9,000 feet and cost some $50,000,000. A second tube is planned, permitting one-way traffic through each.

As we stepped through the exit into bleak daylight, I gazed at I-70's raw cut curving westward through towering ranges and deep valleys. Giant earth scrapers, propelled by roaring engines, lumbered up 30-degree slopes and, in savage bites, gouged 50-ton chunks of rock and dirt from the future roadbed.

Building the Interstate Highway System requires a variety of specialized machines and instruments. Nuclear probes, for instance, fire gamma rays and neutrons into the ground; those that bounce back, instead of being absorbed, are counted on a gauge which scales

Caught in the path of progress, Carl Kolpack complains because Interstate 55 slices through his farm near Springfield, Illinois. Under the power of eminent domain, the state acquired 16 acres of Mr. Kolpack's land. "My buildings are here, my pastures across the road," he says. "But it's four miles around by the nearest overpass."

Owners of land taken for interchanges often sell remaining property at high prices to commercial users.

KODACHROMES BY HERBAL LUND (BELOW) AND JAMES P. BLAIR © N.G.S.

this "backscatter" into readings of soil density and moisture content. Hay blowers broadcast mulch over newly seeded embankments and shoulders, preventing erosion and drying out of the soil before grass sprouts.

Among the most remarkable machines of all is the slip-form paver. Unlike its conventional cousins, this huge machine straddles an entire roadbed on crawler treads (next page). Operated by one man, it lays concrete continuously at the rate of eight to ten feet a minute. I always watched in fascination as the giant, ungainly spider crept forward, spinning its strand of highway.

Road building is as old as civilization. On ancient Rome's famed Appian Way, linking the Eternal City with Brindisi, 366 miles away, traffic became so heavy that chariots were banned at certain times and places—and women were forbidden to drive them at all.

Long-distance superhighways, leaping rivers and piercing mountains, belong wholly to the 20th century. Germany's autobahns, begun in 1929, provided the prototype for the entire world. Adolf Hitler perceived the military value of such expressways and, by the outbreak of World War II, had completed a 1,260-mile network

Temporary trench cuts past the front door of a boardinghouse in Toledo, Ohio. Before road builders pave I-75 in this area, they lay a combination storm and sanitary sewer. Bulldozer operator Kenneth Speer packs sand over the huge sewer line.

of high-speed roads. Significantly, the majority ran east and west—from one jumping-off point of Nazi aggression to the other.

At the turn of this century, the United States could boast 2,000,000 miles of rural roads, but a scant 140 miles were paved. In Port Charlotte, Florida, I called on Ray C. Sackett, who with 13 other hardy travelers formed the fledgling Lincoln Highway Association's first cross-country auto caravan. They set out from New York City on May 15, 1915, and arrived in San Francisco 104 days later.

The newly opened Lincoln Highway—today's U. S. 30—then was mostly a gravel road, with a few miles of concrete and macadam, some brick, and plenty of dirt. Occasionally it degenerated into cattle tracks (page 216).

Turning the pages of a faded album, my host relived his epic safari: "In an Indiana town a motorcycle policeman stopped us for speeding. We were making 8½ miles an hour, and the speed limit was 8. Between Mooseheart and De Kalb, Illinois, we found a filling station—the only one I remember all the way; usually we gassed up at livery stables.

"Covered wagons were still a common sight in the West. We saw many homesteaders heading for their claims in prairie schooners. Our highest speed was 63 miles an hour, and we made our longest fast run on a concrete stretch between Sacramento and Oakland: 10 miles at a speed of 50."

To my eye, the Interstate System makes virtually all other roads as antiquated as the old Lincoln Highway. This colossal engineering achievement satisfies our demand for both speed and safety.

One needn't journey far to see the advantages of the new roads, particularly in preventing the traffic mishaps that now claim more than 50,000 lives a year—almost half of all accidental deaths in the United States.

The broad median not only prevents head-on collisions, but lessens the strain of headlight glare from oncoming cars at night (next page). Cross traffic travels over or under the superhighway, banishing stop signs, traffic lights, and intersections. Fences keep out pedestrians, including the four-footed kind.

Interstate Hazard: the Spell of Speed

Speed limits vary. Most common are 65 and 70 miles an hour. Iowa, South Dakota, Nebraska, and Kansas permit 75, and on the Kansas Turnpike, part of Interstates 35 and 70, one can legally drive 80 miles an hour. Montana posts "reasonable and prudent" as its limit; Nevada, "careful and prudent." Many states also set minimum speed limits, normally 40 miles an hour.

Studies show that the majority of Interstate accidents involve a single car, usually one that strikes an abutment. Too, drivers sometimes curve into an exit ramp with the

Instant highway unrolls, a mile a day, along I-90 west of Kadoka, South Dakota. Automatic paver scoops wet concrete dumped in its path and squeezes it into a 24-foot-wide strip, 8 inches thick. Sensor head (above) follows a survey cord to guide the machine's direction.

Minimum hand-finishing perfects the surface; Fred Oppegard shapes a fine edge. The paver rolls on, doing a job that would require as many as 50 men. Sliding forms along as it goes, it lays an endless concrete strip over steel reinforcing rods.

KODACHROMES BY DAVID MATHIAS (ABOVE) AND JAMES R. HOLLAND © N.G.S.

Monotonous stream of glaring headlights, taillights, and overhead signs can hypnotize a weary driver, even on the Interstate. With this time exposure of himself, photographer Jonathan Blair dramatizes the danger on a Los Angeles freeway, part of I-10, without a median strip.

habit of speed on them like a spell. At other times they exit at proper speed, then unthinkingly resume their fast pace on ordinary roads.

No one has yet devised a means of coping with "the nut that holds the wheel." I remember once watching rush-hour traffic in Detroit on closed-circuit television. A driver in the left lane stopped suddenly; in a series of jerks, he worked his way across the middle lane, then the right, and finally he disappeared up an exit ramp. With each of his moves, the cars behind him screeched to a stop. The shock waves he created still rippled across televised traffic half an hour after the event.

Wherever I journeyed on the Interstate System, I noted the growing role of television in controlling traffic as it enters and leaves cities. An experience at Houston was typical. Every weekday morning, the tide of city-bound traffic gradually swells on Interstate 45. Between 7 and 8 a.m., it crests in a swirling flood of commuters.

In a darkened surveillance center alongside Interstate 45, I scanned 14 TV screens that monitor a key 6½-mile section of the road (page 211). Nearby, a computer whirred and clicked, automatically analyzing the traffic. Sensing gaps in the pattern, the computer actuated signals regulating the flow of incoming vehicles from freeway entrance ramps.

Suddenly, on one of the TV screens, I saw a car veer out of control, smash into a lamp post, and burst into flame. "Accident on Camera 7!" a technician called. Beside him, a police officer snatched up a telephone and issued swift instructions. Soon a fire truck flashed onto the screen, followed by an ambulance and a police car.

Once upon a time such an accident would have stalled the commuters for hours. Now, mere minutes elapsed before the massed autos resumed their inexorable flow. Houston's computerized control has cut accidents as well as average driving time over this 6½-mile segment about in half.

Signs Will Cost $200,000,000

In cities and countryside alike, Interstate routes with odd numbers run north-south; those with even numbers, east-west. The odd numbers begin on the West Coast with I-5 and end on the East Coast with I-95. This avoids confusion with the older highways, which begin with U. S. 1 in the East and end with U. S. 101 in the West. The even-numbered Interstates begin in the South with Florida's I-4 and progress northward to Michigan's I-96 (map, pages 216-17).

Signs alone along the Interstates will cost some $200,000,000. Many run more than $10,000 each; particularly large ones, suspended from trusses across several lanes, can cost up to $35,000. One gargantuan example, to be built over the Long Island Expressway in New York City, will cost nearly $50,000.

All signs must be highly visible, understandable, and uniform. Traveling at 60 miles an hour, you cover 88 feet a second, which gives you about 11 seconds to read and interpret a sign 1,000 feet away.

It should be sufficient time. But I have taken enough wrong turns on Interstate highways to conclude that "signing" is an imperfect art. Surprisingly, federal highway planners agree with me; indeed, they say that signs themselves are obsolescent.

Within a year or two the Bureau of Public Roads will test—at a cost of three to five million dollars—an electronic system designed to supplement signs and even road maps. Already successfully demonstrated by the manufacturers, it allows a motorist to insert a card coded for his destination into a device in his car. Thereafter, electronic checkpoints beside the road—each with its own computer—pick up signals from the car and instruct the driver where and when to turn. Of course, such a system is years away.

Meanwhile, for safety, many states are replacing rigid highway signposts with breakaway signs. When struck by speeding cars, the posts fly up and out of the way, minimizing the impact and resultant damage (page 210). Safety studies by the Texas Transportation Institute led to development of these signs, which are now required for all new federal-aid highway construction.

The institute, along with other groups, also

KODACHROMES BY JAMES A. HOLLAND © N.G.S.

Help comes with a call: A lady in distress, below, summoned assistance through one of the 264 call boxes installed by Maryland at 1/4- to 1/2-mile intervals on I-495, the Capital Beltway around Washington, D. C. Such a device saves a wait for a Good Samaritan or a long trek to the nearest off-ramp.

is seeking ways to soften collisions with fixed objects like bridge abutments. Crash-easing devices being studied include foam-plastic barriers, 55-gallon drums stuffed with tin cans, and containers filled with water.

Other advances are in the offing. The head of the country's newest Cabinet department, Secretary of Transportation Alan S. Boyd, described some of them for me: "Multilevel highways—with trucks using one level, cars another—will become commonplace in cities. And within a decade I expect dramatic breakthroughs in development of a cheap, useful electric automobile for local use."

The Cabinet Member charged with overseeing what President Lyndon B. Johnson has called "the web of Union" went on to outline how a simple arrangement of lights on the rear of a car can indicate speed changes to the following driver, reducing spacing by a third. Electronic sensors in roadbeds will signal drivers—through devices installed in cars—when they may safely pass other vehicles on curves, hills, or narrow roads.

Still, congestion promises to get worse before it gets better. "I'll speculate," the Secretary concluded, "that within five or ten years we may have to book starting times on some major highways, just as golfers now arrange tee-off times on crowded courses."

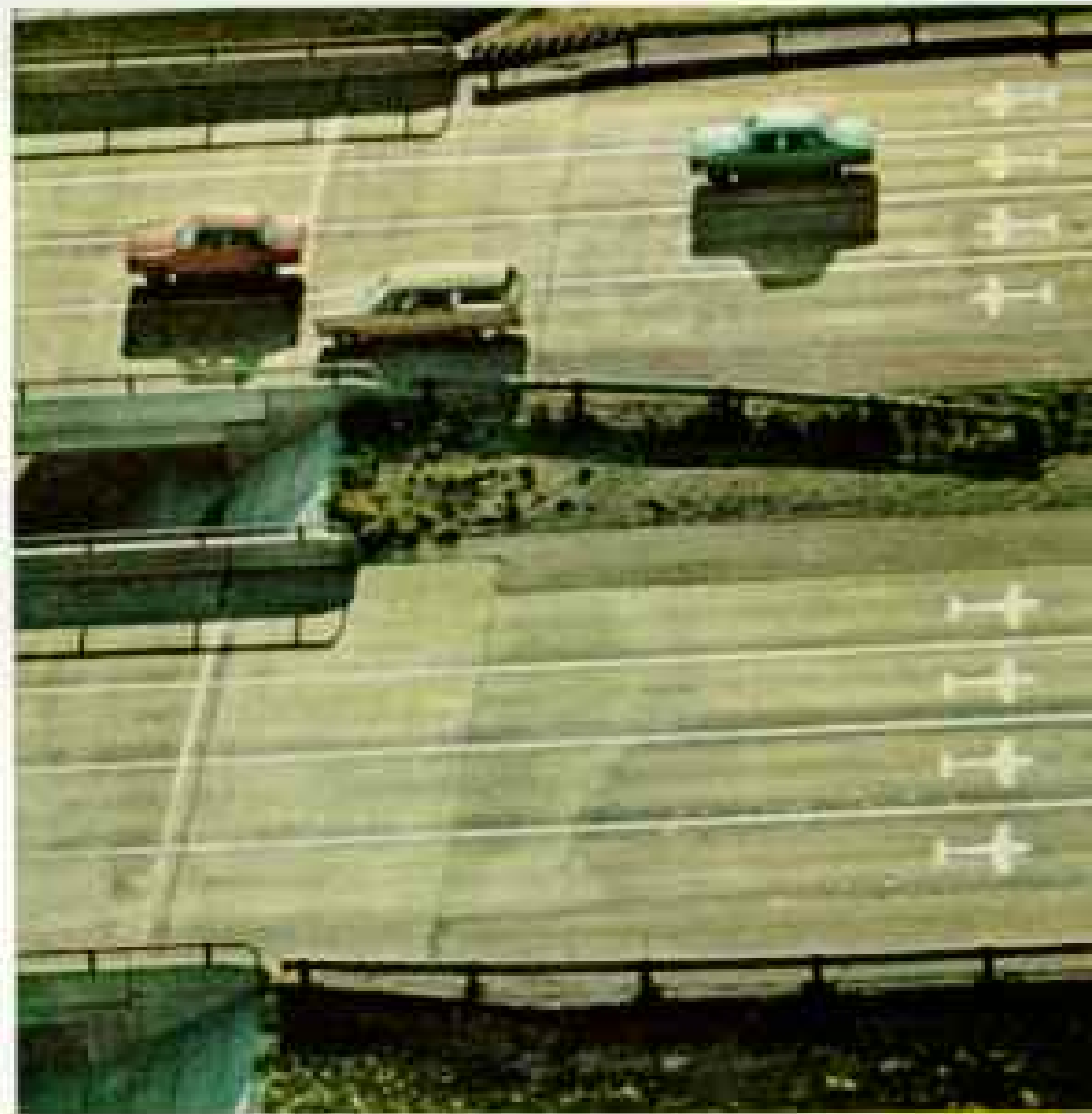
Impact of Roads Reshapes Cities

One thing seems sure: The Interstate brings dramatic changes to cities. Critics charge that urban freeways displace people and disfigure neighborhoods. On the other hand, they may bring badly needed urban renewal.

"The good they can do in cities is unlimited," Federal Highway Administrator Lowell K. Bridwell told me, "provided we weave them into the economic and social fabric of our urban areas." Proper planning, he said, must embrace housing, community facilities, parks, and business needs. This approach is being

The sky's his beat: Patrolling Utah highways from the air, Lt. Rex Nielson watches for traffic violators, stolen cars, and motorists in trouble. Here at 800 feet, photographed by a camera mounted under the wing, he clocks cars' speed on Interstate 15 in south Salt Lake City.

Airplane silhouettes painted at half-mile intervals show that the road is under aerial surveillance. Flying policemen use the signs as checkpoints; if a car passes two sets of markers in less than 27 seconds, it is exceeding the 65-mile-an-hour speed limit. Lieutenant Nielson radios a patrol car to issue a warning or a ticket.



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

tried in Baltimore, where a team of highway engineers, city planners, economists, and other experts today charts the Interstate's course.

Our highway planners have not forgotten beauty while designing the super-roads. The Highway Beautification Act of 1965 requires that states, to receive federal aid, control outdoor advertising, junkyards, sanitary land fills, and other eyesores along Interstate and federal-aid primary highways.

In general, billboards—other than those in commercial or industrial areas—must be removed beginning in mid-1970. New advertising visible to motorists is banned within 660 feet of the right of way; no unscreened junkyards may be established within 1,000 feet; existing junkyards must be effectively screened or removed by July 1, 1970.

The 1965 legislation also provides money for beautifying highways by planting trees and shrubs. Landscaping contracts sometimes run to $100,000 for 15- to 20-mile stretches of Interstate. On roads in the Midwest, I saw honeysuckle, ivy, and vinca creeping over roadside slopes and bridge walls. Shade trees in the right of way included various oaks, honey locusts, ashes, maples, and sycamores. Decorative trees ranged from dogwoods and redbuds to hawthorns, crabs, and elders.

Texas for decades has sown wild flowers along roadsides. In spring they bloom from horizon to horizon—bluebonnets, primroses, coreopsis, paintbrush, phlox, daisies. The highway department treasures one letter from an appreciative child. "Dear Texas Highways," she wrote, "you are prettyer than I can spell. Love, Janie."

But all is not love along the Interstate System. Nationwide, 750,000 pieces of property are being claimed for right of way under the power of eminent domain. Owners usually accept the amount that appraisers consider "fair market value." Boards of appeal and the courts are open to those who are dissatisfied.

EKTACHROMES BY UNITED STATES STEEL CORPORATION © N.G.S.

Hurtling off the road at 60 miles an hour, a test driver purposely crashes into a breakaway signpost designed to save lives. Unlike a rigid support that would stop the car and cause injury or death, this pole snaps free from its bolts on impact and swings up from its low concrete base.

Safety secret, a hinge joint permits the steel post to pivot away from the windshield. Uninjured driver, below, checks damage—dents and a flat tire. Texas engineers, who developed and installed the breakaway signs on their Interstates, report no fatalities in 100 collisions.

One of the most dissatisfied men I know is Carl Kolpack, whose 163-acre farm near Springfield, Illinois, was split in two when Interstate 55 came through (page 203).

I hailed Mr. Kolpack one bright morning as he was checking fences. Not far from us, the 64-year-old farmer's house, machine shed, corn crib, and other buildings stood on some 28 acres on I-55's west side. On the east side lay 119 acres of fields and pasture, where I saw cattle browsing.

"I have no buildings over there," Mr. Kolpack said. "Every spring I'm forced to haul 2,500 bales of hay all the way around here—four miles by road—to store it in the barn. Then I've got to haul it back for winter feed."

Where farms are severed by a highway, the states compensate the owners. Mr. Kolpack was offered $18,710, and after lengthy litigation he received $27,604. The states generally will build underpasses for animals or machinery when their cost—$25,000 to $100,000—is less than the probable damage payment to the farmer or rancher involved.

Road Builders Bring a Land Boom

Some farmers in the path of the Interstate juggernaut have profited handsomely. One pleasant afternoon I drove east from St. Louis across the Mississippi River and cruised a dozen miles on I-55 and I-70, which merge for a short distance in this part of Illinois. I turned south at the Collinsville Interchange, where the Mississippi's farm-dotted flood plain gives way to rolling hills.

There, on bisecting State Route 157, I counted several new service stations, a large motel and restaurant, and other businesses. On a bluff above the interchange rose a new multimillion-dollar motel and housing project.

Close by, modern brick homes clustered on a gentle slope. A commodious white frame farmhouse stood above them. I rang the bell. Mr. and Mrs. H. D. Brinkhoff invited me in and told me how this building boom evolved.

Back in 1949, said the farmer-turned-developer, he purchased 77 acres here, paying between $300 and $400 an acre. The rich Illinois topsoil lay several feet deep, and crops fairly burst from it: sweet corn, wheat, soybeans, watermelon, horseradish, cantaloupe. The Brinkhoffs operated a roadside market in front of their home on Route 157.

"We started from scratch," Mr. Brinkhoff said, "by subdividing some of the land for new homes." Later, he went on, Illinois acquired nearly 33 acres "right out of the middle of the farm" for the interchange of I-55

EKTACHROME (BELOW) AND KODACHROME BY JAMES R. HOLLAND © N.G.S.

All-seeing eyes of 14 television cameras monitor 6½ miles of Houston's Gulf Freeway. With their aid, Texas researchers study the effectiveness of computers in controlling traffic. Vehicle detectors embedded in I-45 report gaps between cars to a computer, at right, that activates traffic lights on entry ramps.

Live drama picked up on TV brings a policeman, center, to an accident site in minutes. When this truck's driver realized his brakes were gone, he rolled to a stop and attempted to back onto an emergency shoulder. His trailer jackknifed over the guardrail. Video tape records accidents for further study.

Glittering firmament of the Chicago skyline shines above the Halsted Street Interchange, meeting place of I-90 and I-94. Like comet tails, car lights trace graceful patterns over jug-handle ramps that carry drivers off to the right to go in any new direction. Nicknamed the "spaghetti bowl," this

focal point sorts a third of a million cars daily. The Eisenhower Expressway tunnels through the Post Office Building at upper right. Under the expressway, commuters ride a rapid transit line. It surfaces just off the picture, at lower left, and runs for eight miles in the median strip of I-90.

KODACHROME BY WINFIELD PARKS © N.G.S.

Master of a mountain, a double-barreled tunnel for I-80 burrows 1,135 feet through a bluff at Green River, Wyoming. During the bore, engineers used electronic devices to measure stress. They found that steel-rib supports could be placed farther apart than planned.

A century ago stockmen welcomed the Union Pacific Railroad, right background, the Nation's first transcontinental line. Now ranchers truck many lambs and calves to feeder lots in Nebraska and Colorado, only hours away on the Interstate.

and I-70 with Route 157. The 33 acres brought nearly $29,000—about $883 an acre.

"Then we sat tight and waited," said Mr. Brinkhoff. An oil company began negotiating, and the first service station soon opened.

Parcels of land subsequently have changed hands often. One well-located acre last sold for $50,000. In the past few years some 70 acres adjoining the interchange have been sold for a total of a million dollars.

All this proved a boon to Collinsville, which soon annexed the booming area. This is typical of the Interstate's Midas touch in many parts of the country.

In spinning their skein of highways, engineers must cope with wildly varied extremes of weather and geography. Where climate is benign and traffic loads are light, Interstate routes may measure less than a foot in thickness. But Maine's rigorous winters can frost-heave roads apart, so Interstate 95 there has to be a colossus. Top to bottom, it extends nearly five feet: 9 inches of pavement; 5 inches of crushed, processed gravel; an 18-inch layer of coarser gravel; and a 24-inch sand-and-gravel base.

Broad stretches of water present still another natural obstacle that road builders must overcome. In New York City, I marveled at the beauty and efficiency of the new Verrazano-Narrows Bridge (pages 218-19). Longest suspension bridge in the world, the 4,260-foot span outstretches San Francisco's Golden Gate Bridge. It links the Boroughs of Brooklyn and Richmond, and, as a segment of I-278, its six lanes help channel heavy through traffic between the Middle Atlantic States and New England around Manhattan's jammed streets.

"But already," an engineer told me, "so much traffic is using the Verrazano-Narrows Bridge that we'll have to complete and open the six-lane lower deck by late 1969."

Road-building bonus: Excavation for I-71 in Cleveland, Ohio, launched one of the biggest fossil hunts in American history. The city's Natural Science Museum has recovered tens of thousands of specimens of fish that swam Devonian seas 350 million years ago. Slab of shale in foreground shows pectoral fins of a shark species new to science. Museum Director William E. Scheele, left, and Research Associate William J. Hlavin sort the treasures. Federal grants underwrite such salvage of natural and historic treasures.

EKTACHROME BY JAMES [illegible] © N.G.S.

Later, on the other side of the country, I paused on the sweltering western slope of California's San Joaquin Valley and watched engineers team an Interstate route with a new aqueduct to make the desert come to life.

Through the canal, California will convey melt from the snowy Sierra of the north to the thirsty southern flatlands. I-5 will run beside the aqueduct through this parched world.

John Robinson of the Highway Division drove me over I-5's dusty roadbed. "California," he said, "gains about 1,000 citizens every day. We've got to expand, and the place for it is right here."

I glanced about. The harsh brown Diablo Range jutted up on the west, hiding the Pacific Ocean. Age-old silt from the mountains, fluffy as powder, puffed up beneath the tires and whitened my face.

"Water and transportation—that's all we've ever needed here," said John, "and now they're coming. With the water, we can grow oranges, grapes, figs, almonds, walnuts, pomegranates, alfalfa, sugar beets. With I-5, we can get them to market."

Bulldozers Unearth Thousands of Fossils

Besides changing the face and economy of America, road builders' bulldozers are providing scientists with a remarkable side benefit. On the southwest edge of Cleveland, Ohio, Interstate 71 is slashing through a fossil-rich, 5½-mile section of shale.

Three hundred and fifty million years ago in the Devonian period—the Age of Fishes—this was the floor of a huge shallow sea that blanketed much of mid-America. Until recently, houses and factories and a thin layer of soil covered the ancient sea bed.

During excavation for I-71, dozens of high-school and college students followed the bulldozers, digging in the shale for fossils.

Interstate Signs

80 — *Even numbers are assigned to east-west routes. Numbers ending in 0 are routes of great length.*

95 — *Odd numbers indicate north-south routes. Numbers ending in 5 are routes of great length.*

480 / 395 — *Three-digit numbers are used in urban areas. When the first digit is even, the route is a beltway or loop. When the first digit is odd, the highway is a spur from a main route into a city. These numbers may be repeated from state to state.*

Green-and-white signs give direction.

Blue-and-white signs tell of motorist services.

Half-century of progress: On the Lincoln Highway, America's first coast-to-coast auto road, a Studebaker inches west through Nebraska during a 1915 trip to promote touring. Heavy rain has turned the road into sticky gumbo. A good day's drive then was 200 miles at 20 mph; the route, now U. S. 30, struggled through every town along the way. Today, a turnpike-pampered motorist can cover 600 miles a day at 60 miles an hour and loop around major cities.

THE INTERSTATE HIGHWAY SYSTEM

AS PLANNED FOR COMPLETION IN 1975

Of the 41,000-mile network shown here, 65 percent is now complete and 15 percent is under construction (see the wall map, THE UNITED STATES, *distributed with this issue). Hawaii plans 51½ miles; Alaska none.*

0 — 300
STATUTE MILES

Driving times shown between circled dots assume an average speed of 60 miles an hour.

White roads indicate toll sections presently incorporated within the system.

E. SACKETT (OPPOSITE); KODACHROME BY JAMES P. BLAIR © N.G.S.

"Before we're finished," declared William E. Scheele, Director of Cleveland's Natural Science Museum, "we expect to turn up 50,000 to 100,000 new specimens for scientific research."

The museum's basic Devonian collection, 47 years in the making, enjoys a worldwide reputation. But in one year alone the students found enough fossils to triple its size (page 215). I saw some of their finds. Scientists were especially excited over the fossil of a coelacanth—the first ever taken from Cleveland shale, and only the second discovered in North America.

"So far," Mr. Scheele said, "we've found more than 75 animals and six plant forms previously unknown to science."

Nebraska Makes a Native Son Proud

The Interstate System is providing still another legacy to the Nation. Along the routes, highway departments are protecting and improving fish and wildlife habitats, historic sites, parks, playgrounds, and recreation areas. Maintenance crews even schedule right-of-way mowing to avoid nesting pheasants and other birds.

Of all the Interstate System's features, I like best what Nebraska has created to make your journey and mine more pleasant. I confess a certain bias: I was born and raised in the Cornhusker State. I love the prairie's sweep and swell—ever-changing, yet never-changing.

Bringing I-80 across the plains through the wide Platte River Valley west of Grand Island, contractors dredged sand and gravel from the wayside for roadbeds and embankments. The high water table soon filled the great gashes.

Now a chain of more than 100 lakes and ponds, the largest 43 acres in area, sparkles along the road. Motorists can pause beside them to fish and swim, picnic and relax. In the golden autumn, ducks and geese—their cries hoarse and lonely in the chill prairie air—wing down the Platte River flyway and alight by the thousands on the gleaming lakes.

In a twin-engine Cessna I flew the length of I-80 to inspect the lakes. Near Sutherland I received a dramatic bonus. We dropped low over the silver braid of the South Platte River, leveling off at 75 feet, and the pilot jabbed his finger down at the ground.

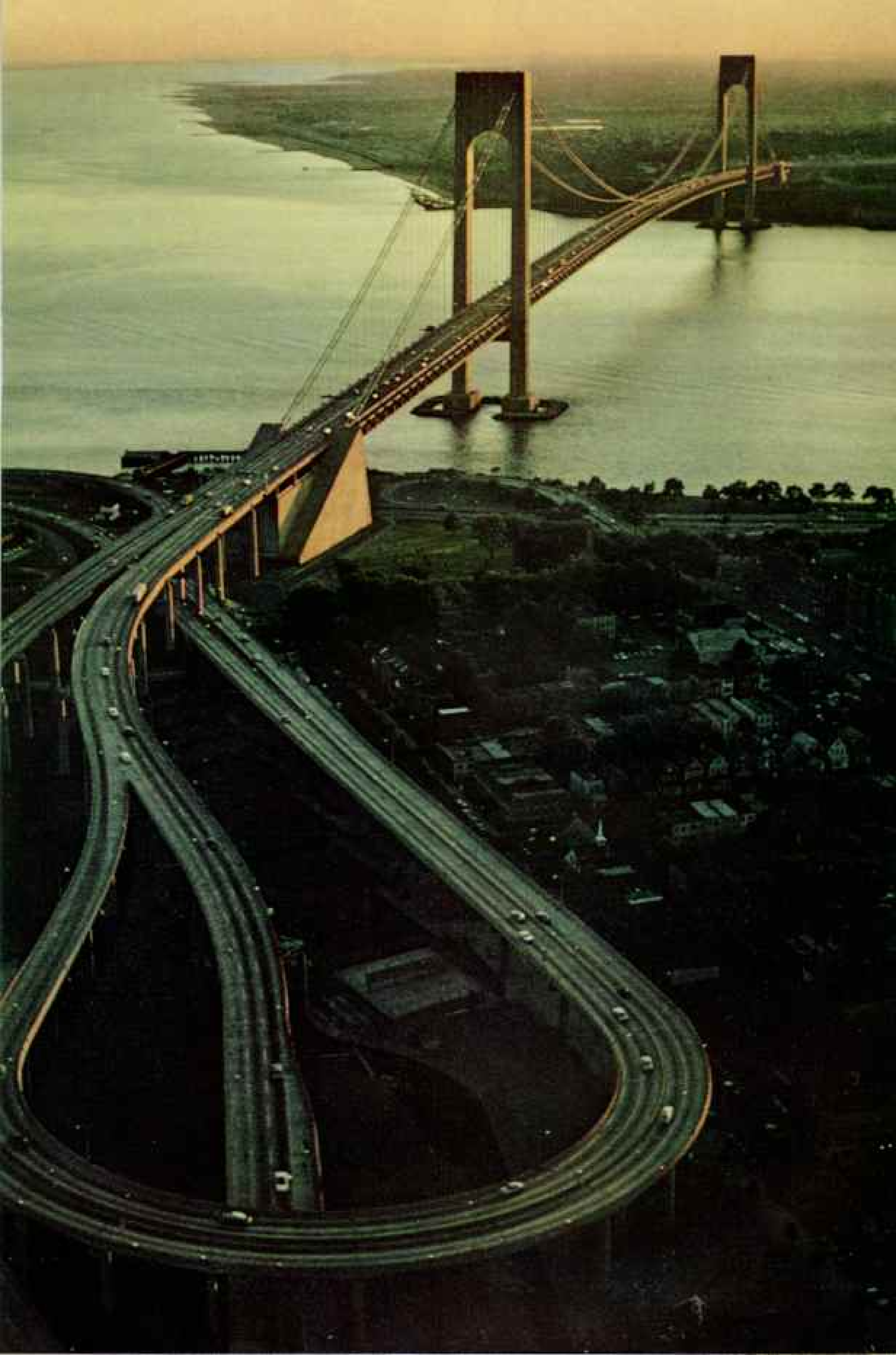
"There they are," he yelled.

I stared, and saw nothing. Then I picked them up: faint lines lacing the sandy river's unplowed bottomland. Wagon tracks a hundred years old and older—dozens of them, scores of them—cut by the prairie schooners of pioneers as they rolled toward the setting sun a century ago. The Oregon Trail.

Interstate 80 will cover some of these slowly fading memorials of a great American epic. Though I find it sad, somehow it seems fitting to me that a pioneering road of this day and age—part of our Interstate Highway System—should follow the route blazed by those who won the West. THE END

Shining conqueror of New York Bay, the Verrazano-Narrows Bridge takes a giant step from Brooklyn to Staten Island, carrying I-278 on a short cut to New Jersey. The towers stand taller than the United Nations headquarters in Manhattan. Longest suspension span in the world—4,260 feet—the bridge outdistances San Francisco's Golden Gate by 60 feet.

KODACHROME BY NATIONAL GEOGRAPHIC PHOTOGRAPHER JAMES P. BLAIR © N.G.S.



New Map Charts

FOR THE EIGHTH TIME in 45 years, the National Geographic Society this month presents a new wall map of **The United States** to its members as a supplement to their magazine.*

Since the Society issued its first such map in April, 1923, the country has grown by more than the present total population of France, Spain, and Switzerland combined.

That first map showed a land of 48 states, 3,022,387 square miles, and 110,850,000 people. Now the Nation is home to more than 200,000,000 Americans, and the admission of two states in the past ten years has added 592,824 square miles. The Nation's spiraling population—now adding one person every 14½ seconds—passed the 200-million mark last November 20 (below).

The new map, 42½ by 29⅛ inches, forms an impressive full-length portrait. With insets, it spans the 5,850 miles from Elliott Key, Florida, to Hawaii's Kure Island, west of Midway—greatest distance between any two points in the United States.

Men and machines constantly change the face of the land. Including 6,000 miles under construction, the new high-speed Interstate Highway System, shown by yellow-filled double red lines, extends for 32,500 miles of an eventual 41,000 miles (see article beginning on page 194).

Beltways now circle several large cities, speeding traffic around instead of through these ever more congested urban centers. Across the middle of Lake Pontchartrain in Louisiana a single red line traces the world's longest bridge—24 miles from shore to shore. The longest bridge-tunnel combination

Population grows: Census Clock in Washington, D. C., records a historic change at 11:03 a.m. on November 20, 1967. President Johnson marks the occasion with Census Bureau Director A. Ross Eckler, right, and Secretary of Commerce Alexander B. Trowbridge, left. Dials light with each birth, death, immigrant, and emigrant.

Living space shrinks: Homes, apartments, and shopping centers carpet a bluff above the Pacific in Daly City, California, within commuting distance of San Francisco. Two-thirds of the U.S. populace live in burgeoning metropolitan areas.

an Expanding Nation

reaches 17.6 miles over and under the mouth of Chesapeake Bay. Increasingly the map is spotted with blue, where dams have created new lakes for power, flood control, transportation, irrigation—and recreation, too.

Man-made Lakes Drown Pioneer Trails

In eastern Oklahoma, sailboats skim above the drowned tracks of covered wagons. River development has produced 12 man-made lakes with 3,000 miles of shoreline—longer than Lake Superior's. By 1970, a nine-foot channel in the sluggish Arkansas River will open the heart of Oklahoma to barge traffic from the Mississippi. The 1.2-billion-dollar project will exceed the total U. S.-Canadian cost of the St. Lawrence Seaway.

Place names are born, and others die. Port Lions, on Kodiak Island, Alaska, succeeds Afognak, destroyed in 1964 by an earthquake-triggered sea wave. Chesapeake, Virginia, a city not even on the map six years ago, covers 372 square miles formerly occupied by Norfolk County and the city of South Norfolk. Now fourth largest city in the Nation in land area—after Oklahoma City, Los Angeles, and Houston—Chesapeake has the added distinction of allowing bear hunting within its limits, which include a part of the great Dismal Swamp.

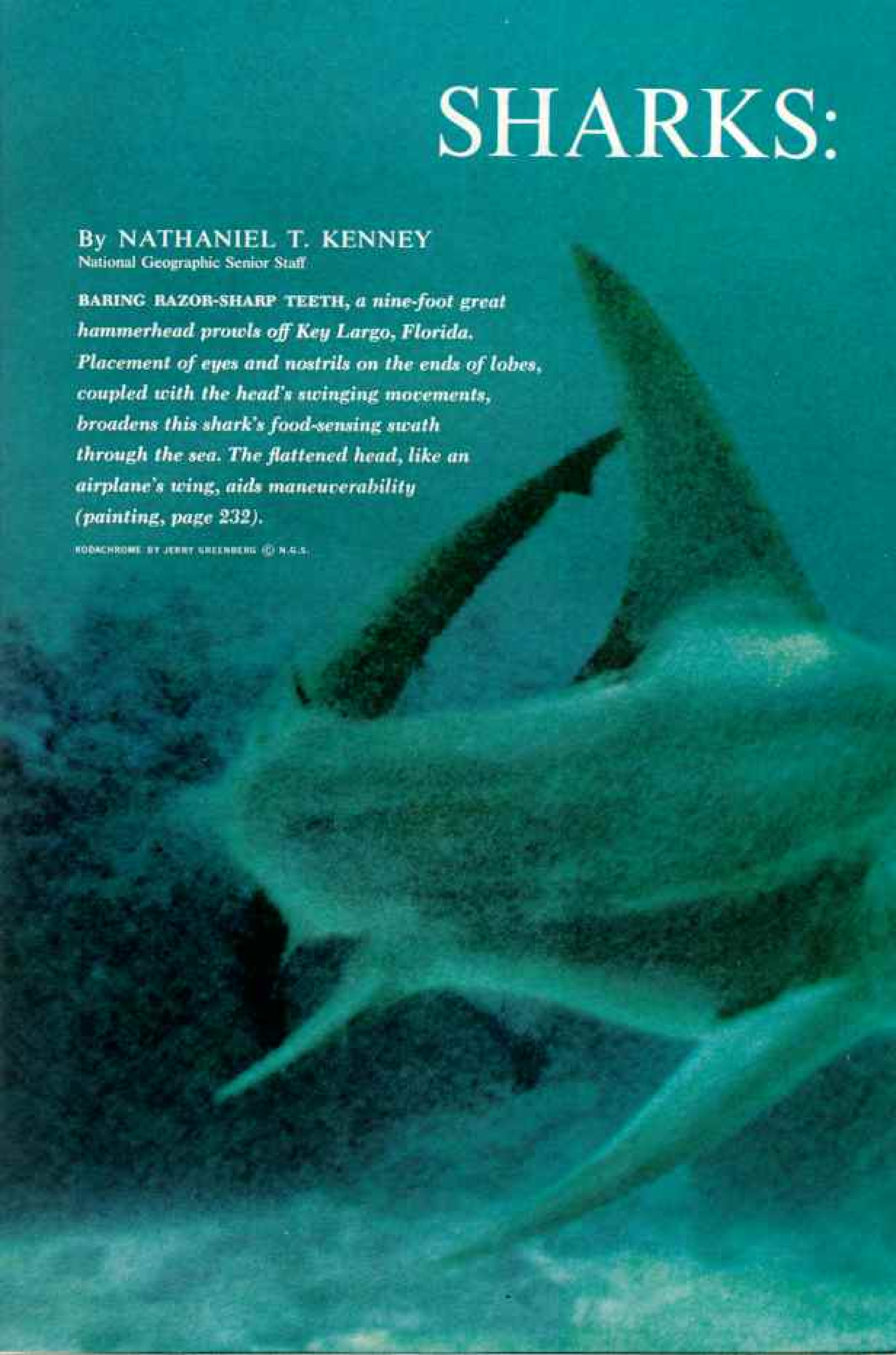
THE END

*Additional copies of **The United States** wall map may be ordered by mail from Dept. 472, National Geographic Society, Washington, D. C. 20036, for $1.10 each on paper, $2.30 on plastic, postpaid; both are available rolled. A new plastic, used by the Society for the first time, heightens the map's brightness and fidelity and makes it impervious to water and grease and highly resistant to tearing, folding, and fading. A convenient booklet index to the map's 10,732 place names is available for 50 cents, plus 5 cents postage.

EKTACHROMES BY LAURENCE LOWRY (BELOW) AND VICTOR R. BOSWELL, JR. © N.G.S.

SHARKS:

By NATHANIEL T. KENNEY
National Geographic Senior Staff



BARING RAZOR-SHARP TEETH, *a nine-foot great hammerhead prowls off Key Largo, Florida. Placement of eyes and nostrils on the ends of lobes, coupled with the head's swinging movements, broadens this shark's food-sensing swath through the sea. The flattened head, like an airplane's wing, aids maneuverability (painting, page 232).*

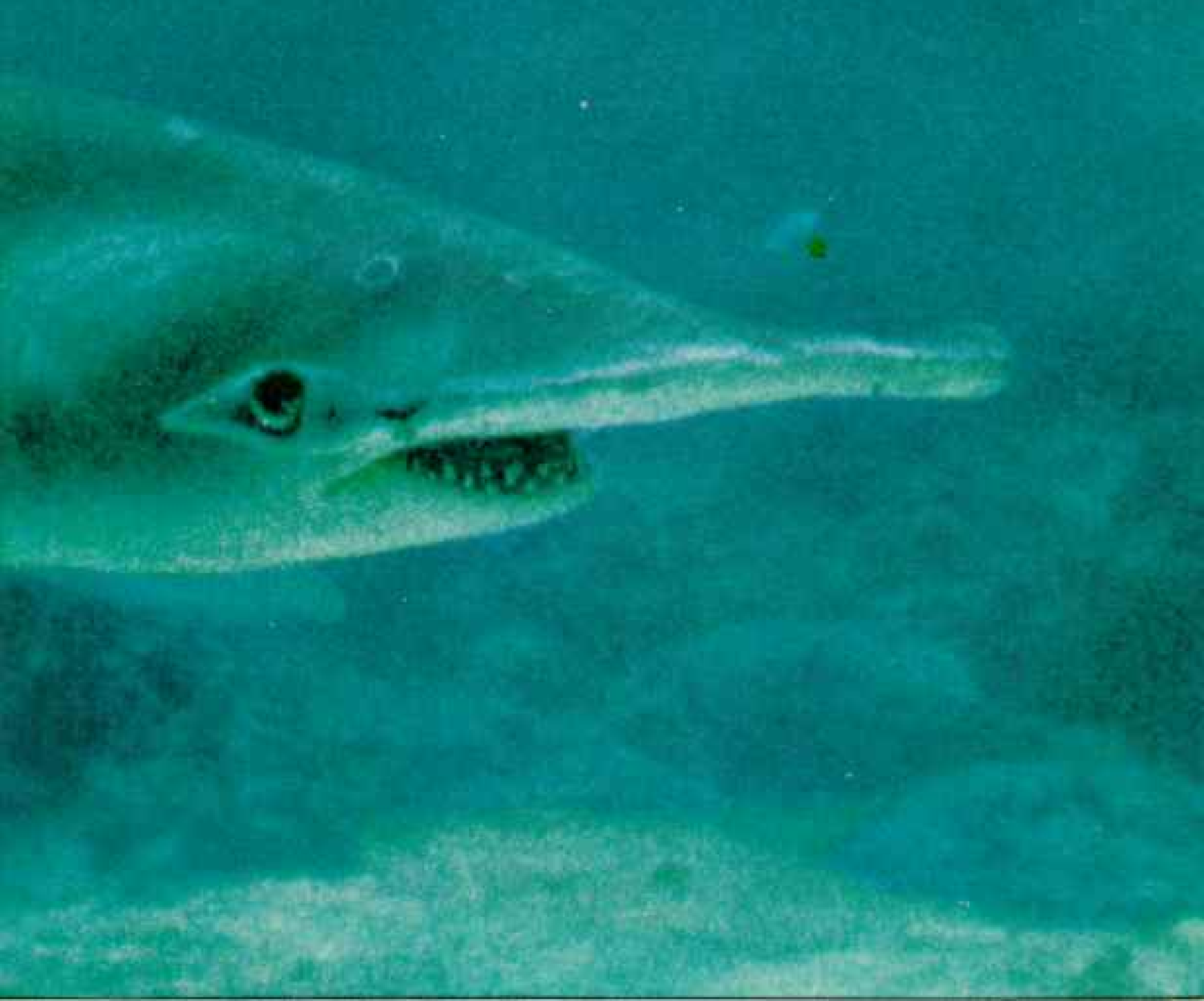
KODACHROME BY JERRY GREENBERG © N.G.S.

Wolves of the Sea

IN MASK AND SNORKEL I was diving in 15 feet of water off the western shore of North Bimini, tiny Bahama island. A jumble of coral-encrusted boulders lies on the bottom sands at this point; among them dwell thousands of brilliantly colored small fishes.

One moment I was surrounded by these vivid jewels of the warm salt seas. In the next I was uneasily alone, for my small friends had all dashed for shelter into crevices in the rocks or to concealing jungles of grass and sea fans. Turning seaward to discover what had alarmed them, I saw a shadow in the depths grow into an eight-foot-long torpedo headed directly at me.

Some 20 feet away it turned broadside. An eye the size



JOHN HARDING (ABOVE) AND JERRY GREENBERG © N.G.S.

Heroic photographer, Australian Henri Bource, who lost a leg to a shark in 1964, still films the marine world with the aid of a special flipper; crutches take him through shallows.

Other equally daring diver-cameramen risked their lives to make the spectacular photographs illustrating this article: Jerry Greenberg and Burton McNeely of Florida; Peter Gimbel of New York; and Ben Cropp, Ron Taylor, and John Harding of Australia. In warm seas and cold throughout the world, they spent countless hours beneath the surface, capturing some of the finest action portraits ever published of the sea's most dangerous and mysterious predator.

As if oblivious to human intruders, a whitetip shark—a species known to attack man—cruises in formation with banded pilotfish. Swimming in Tongue of the Ocean, a mile-deep trough in the Bahamas, diver Donald R. Nelson arms himself with a stout four-foot pole; a stainless-steel barrel at its tip houses a waterproof 12-gauge shotgun shell. Should the seven-foot shark threaten him, Dr. Nelson would jab the muzzle against its head, triggering the firing pin.

of a quarter inspected me from head to toe. Then, with sinuously graceful movements of body and tail, the monster returned to the open sea, never varying its serene cruising speed. Popping to the surface, I also returned whence I came—to the solid, sunny beach. I moved at something better than cruising speed.

I had met a shark, and if the encounter was dull theater, it was meaningful, and I have chosen it deliberately as the opening incident of this article. For in the overwhelming majority of meetings between these fearsome carnivores and humans who enter the sharks' domain, the sinister predators cruise on past.

Equally important: One must not count on it. Any moment the time may come when one of the enigmatic creatures will attack a man.

Results can be gruesome. Razor-edged teeth may remove an arm or leg or cleanly take out a 10-pound piece of flesh. Hide rough as a rasp can flay, edges of fins and tails cut like swords. A shark is all lethal weapon.

Cars Pose Bigger Threat Than Sharks

And what are the odds for or against your becoming a target for a shark's armament next time you go to the beach? To this most important question of all, the experts cannot give a completely satisfactory answer. You have only the assurance that the odds are long—perhaps millions to one—in your favor.

Since 1958 the Smithsonian Institution of Washington, D. C., has been custodian of a shark-attack file on an international scale. Senior Zoologist Leonard P. Schultz, in charge of the file, believes it to be far from complete.

"Faraway primitive peoples do not compile statistics," he explains, "and seaside resorts don't overexert themselves publicizing incidents that could plunge them into bankruptcy."

From the evidence of the file, plus the personal opinions of experts to whom I talked during a year of studying sharks in many parts of the world, I would make an educated guess that in a normal year sharks kill or maim not less than 40 or more than 300 people, without apparent provocation by the victims. In times of war at sea or major marine disaster, the toll undoubtedly rises.

Thus you can go into the sea—any principal sea or ocean, for the shark lives in them all, plus many rivers and a few fresh-water lakes—with far less risk than you run every time you take a trip in an automobile. You will also hear that lightning is a greater danger than shark bite, and the figures of about 150 lightning deaths a year in the United States alone, plus several hundred injuries, support the statement.

You must not, of course, provoke a shark into attacking—not even the small, slow species frequently encountered in coastal waters. If you step on one of these or tweak its tail, it can—and often will—bite hard.

Despite the odds against unprovoked attack upon us, we attach a sinister mystique to the shark. The sight of a gray fin in the surf, even the rumor that somebody has seen one, brings unreasoning panic. Add, on a more

impersonal level, the shark's inroads on commercial and sport fisheries, and you have a malefactor of some consequence. But it was not until fairly recently that science organized to study sharks and seek ways of controlling them.

Disasters at Sea Spur Shark Research

Blood-chilling mass attacks on survivors of torpedoed ships and crashed airplanes in World War II gave the initial impetus to the search. After the war, interest in sharks not only increased but broadened: We not only wanted to know how to protect swimmers and divers; we also sought an insight into the undoubtedly large part sharks play in the ecology of the seas.

The postwar human population explosion spurred this interest in sharks. One day, we realized, earth's soil might no longer support us all, and we must exploit the waters—71 percent of the world's surface—or perish.

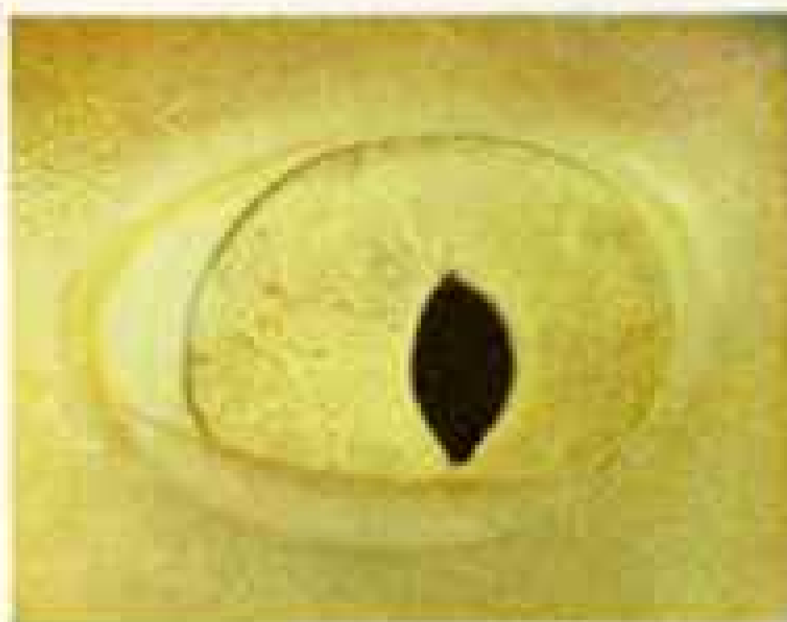
Divers in unprecedented numbers began searching the depths for oil and metals and ways to farm the oceans, in which are locked vast quantities of protein yet to be tapped; some worked from self-contained sea bottom communities pioneered by Edwin A. Link, the U. S. Navy, and Jacques-Yves Cousteau.*

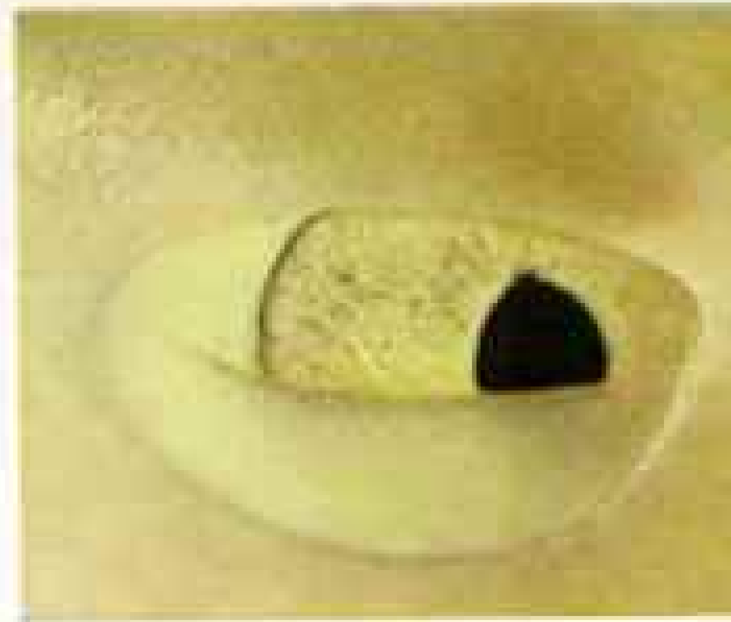
Encounters with sharks became everyday occurrences. Plainly, more knowledge of the fish was needed. In 1958, the American Institute of Biological Sciences, Washington, D. C., agreed to meet the challenge. It offered to serve as an international clearinghouse and repository for shark knowledge, and formed

*See, in the GEOGRAPHIC: "Working for Weeks on the Sea Floor," April, 1966, and "At Home in the Sea," April, 1964, both by Capt. Jacques-Yves Cousteau; and "Outpost Under the Ocean," April, 1965, by Edwin A. Link.

EKTACHROME (ABOVE) AND KODACHROMES BY JERRY GREENBERG © N.G.S.

Testing the vision of a young lemon shark, research assistant Samuel Gruber of the University of Miami's Institute of Marine Sciences employs an ingenious apparatus that he devised. The shark is lashed down in a tank of circulating water, its nose fitting into a Plexiglas hemisphere. At intervals the lamp at right flashes filtered light of varying color and intensity; at the same time a mild electric shock causes the fish to blink. Eventually, the shark becomes so conditioned that it blinks when only the light is flashed, an indication that it can see that particular color or level of light. Utilizing this approach, scientists hope to determine whether sharks distinguish colors. The knowledge would be invaluable in designing garments and gear for use in the open sea.





With a blink—the upward movement of a nictitating membrane that serves as an eyelid—the lemon shark responds to a shaft of light. Infrared detector enables scientists to observe each "wink" during the experiments in a darkened testing room at the institute. As the shark's eyes gradually become adapted to the darkness, its pupils begin to expand (right).

How sensitive is a shark to sound? It can hear moving objects in the water at a greater distance than it can see them, tests on young lemon sharks reveal, and its ability to locate the source of the sound is highly developed—vital to a predator (diagram, pages 230-31). A scientist at the institute prepares to place a live specimen in a water-filled tube into which sounds will be projected from the electronic equipment in foreground. Conditioning the shark with electric shocks, the researchers learn what frequencies the fish can hear and its degree of sensitivity to sounds.

the Shark Research Panel for that purpose.

Dr. Perry W. Gilbert, Professor of Neurobiology and Behavior at Cornell University and probably the foremost American authority on sharks, is chairman of the panel. Other members are Stewart Springer, Biologist, U.S. Bureau of Commercial Fisheries; Dr. John R. Olive, Executive Director of AIBS; Dr. Sidney R. Galler, Assistant Secretary for Science at the Smithsonian; Dr. Albert L. Tester, Senior Professor of Zoology, University of Hawaii; Deane Holt, Biologist, Office of Naval Research; and Dr. Schultz.

Military funds still largely support the work of the panel, and consequently it devotes considerable effort toward finding ways of protecting shipwrecked sailors or airmen against sharks. Obviously, you begin such a quest by noting that a shark is a predator and normally attacks for food. In a way, it is like a wolf.

"A shark is an opportunist," Perry Gilbert said. "It frequently hunts the weak, the old, the stupid, and the crippled. Like any predator, it may improve the prey animals by taking misfits out of the breeding stock.

"In the shark's case, the prey animals

often are weakened fishes. Thus a man in the sea should avoid appearing like a crippled fish."

And how does a crippled fish attract a shark? I asked Dr. Warren J. Wisby, then with the University of Miami's Institute of Marine Sciences, now Director of the National Fisheries Center and Aquarium planned for the Nation's Capital.

"Obviously, if the fish is belly-up," said Dr. Wisby, "the shark can see that something is wrong with it. But from far beyond visual range, other shark senses can pick up distress signals.

Thrashing May Whet Shark's Interest

"Low-frequency sound or pressure waves interest sharks, which have adequate hearing as well as pressure sensors, called the lateral line system, running the lengths of their bodies [next page]. Swimming motions, of fish or of man, generate low-frequency vibrations, and I suspect that sharks almost always become curious as to their source.

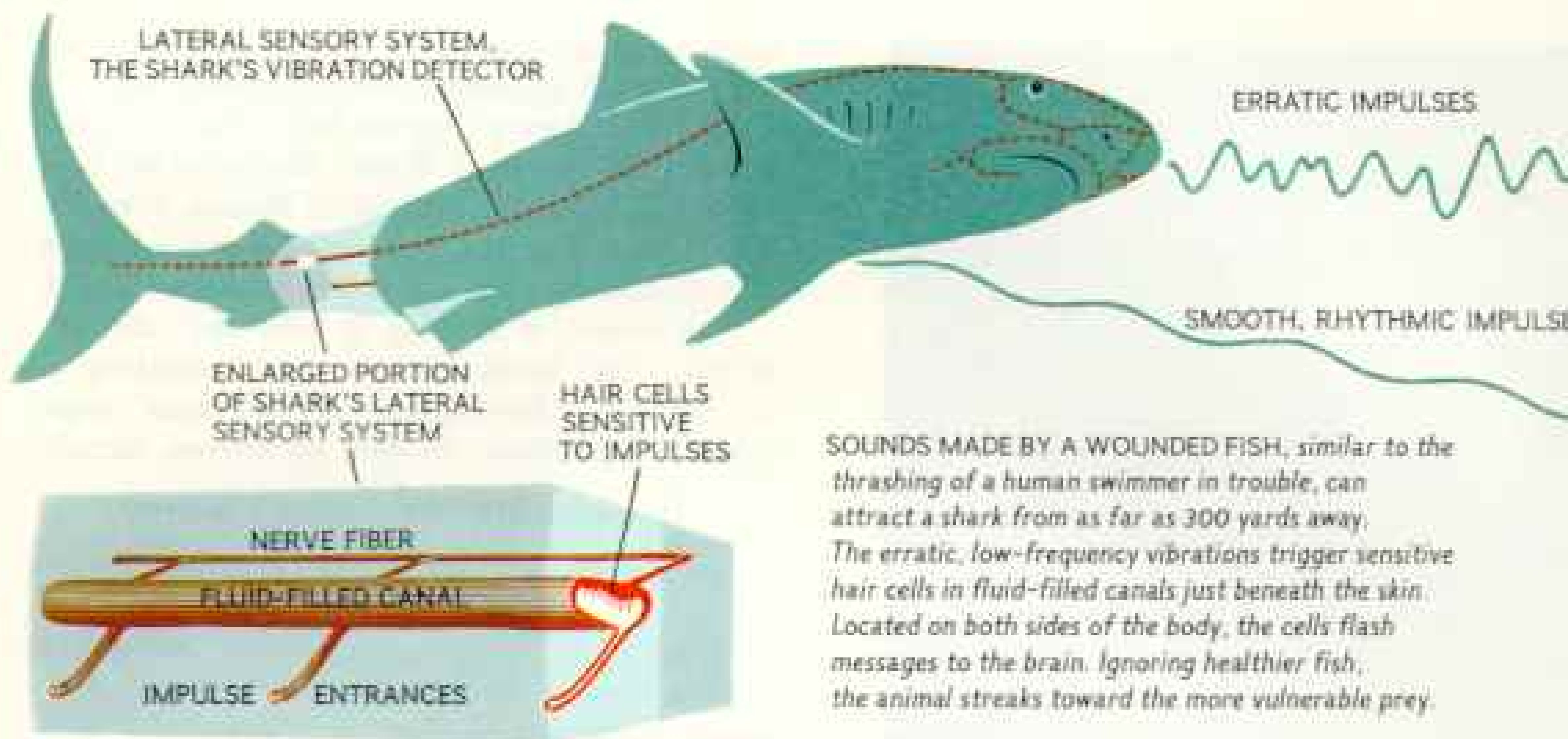
"If the sound is rhythmic and regular, denoting normal swimming activity, a shark's appetite may not be unduly aroused, and the predator may go on its way. If, however, the noise is something out of the ordinary—jerky, or thrashing, or struggling—then the shark may sense easy prey and follow it purposefully.

"We put the sounds of wounded fish and thrashing swimmers on tape and played them in the sea off Florida. From a plane I saw sharks

EKTACHROMES BY RON TAYLOR © N.G.S.

Rapacious ruler of the jungle deep, the great white shark is often called simply "man-eater." Leaning overboard from an Australian fishing boat and submerging his camera, Ron Taylor made this rare portrait of a 12-foot great white. Bait line dangles beneath the vessel at right.

Fangs of death: The great white moves its upper jaw forward when seizing prey. Like all sharks, it has reserve sets of teeth behind the outer row. When the creature loses teeth, new ones begin to work forward into place within 24 hours.



SOUNDS MADE BY A WOUNDED FISH, *similar to the thrashing of a human swimmer in trouble, can attract a shark from as far as 300 yards away. The erratic, low-frequency vibrations trigger sensitive hair cells in fluid-filled canals just beneath the skin. Located on both sides of the body, the cells flash messages to the brain. Ignoring healthier fish, the animal streaks toward the more vulnerable prey.*

Cruising lemon shark at the Lerner Marine Laboratory on North Bimini Island circles Dr. C. Scott Johnson, testing a "survival sack" of his own design. Attached to a life jacket, the plastic bag can be quickly inflated.

cease whatever they happened to be doing to home on the sound.

"They came in several instances from 300 yards. Had we continued the tests, I believe we would have found they heard the sound from far greater distances."

How else does a wounded fish tempt shark appetites?

"It bleeds," said Stewart Springer. "A small amount of blood attracts sharks from afar, especially from down-current. They have extraordinarily sensitive noses."

Following blood trail or sound, the shark approaches to within sight distance of a possible meal. It circles cautiously, gradually narrowing the circles. Eventually, if still alone, it bumps the object with its snout. A bite comes next, delivered with a savage shaking of the head. The rest is mayhem.

This is the normal feeding pattern of a lone shark. If other sharks appear, all may short-circuit the pattern, attacking in a competitive rush without the preliminaries. As feeding continues and the blood and flapping stimuli increase, the sharks become wildly excited and snap at anything they encounter, including other sharks.

One species of shark is a cannibal even before it is born. The eggs of the sand tiger hatch within the uterus, where the young remain until they are sufficiently developed to enter the ocean. The first baby hatched feeds on its weaker brothers and sisters as they emerge from other eggs. As there are two separate uteruses, two young sand tigers survive to be born.

This is the only known case of intra-uterine cannibalism in the animal world. Stewart Springer discovered the remarkable process

DIAGRAM BY WILLIAM H. BOND
GEOGRAPHIC ART DIVISION
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the hard way: As he was examining a pregnant shark, an unborn baby bit his hand!

Violent habits might not make sharks welcome at a swimming party, but the creatures do have their uses. Generations of premedical students of comparative anatomy, for example, have studied spiny dogfishes, small sharks that are cheap and readily obtainable.

Being boneless, dogfishes and other sharks are easy to dissect. Not as complex as mammals, they provide simple diagrams of features and processes common to many life forms.

Sharks Have Cancer Shield

Scientists now believe sharks to be resistant to cancer and less prone than human beings to heart diseases and other major ailments. At the University of Miami School of Medicine, Drs. L. William Clem and M. Michael Sigel, collaborating with Dr. Parker A. Small of the National Institutes of Health, discovered that sharks possess only one class of serum antibodies.

These are like the ones a human infant produces to protect itself against disease, and which adult humans make in comparable quantity only when afflicted with certain blood cancers. It could be of importance to learn how sharks synthesize such high levels of these proteins.

Through studies of shark blood, livers, and brains, Drs. David P. Rall and Richard H. Adamson of the Federal Government's National Cancer Institute seek knowledge of the machinery by which sharks detoxify cancer-producing agents in their bodies. Other researchers look for this process in various organs, such as the kidneys and gills.

(Continued on page 237)

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Nudging a rubber raft in the narrow shark channel at the Miami Seaquarium, a bold lemon shark risks a rude reception. The craft holds an electronic repellent under test by inventor John Hicks. When he activated the device, Hicks says, it emitted shocklike radio waves that sent the shark fleeing. Later trials in the Atlantic reportedly caused large hammerheads to retreat hastily when they came within range. Other tests ended less conclusively.

The United States Navy has long endeavored to develop an infallible shark repellent to protect seamen adrift in infested waters. Chemical-dye clouds have been the most widely used but have not proved satisfactory. Scientists today are optimistic about development of a new device, the survival sack (opposite), which is scheduled for tests in the fleet. Three air-filled rings, colored yellow for visibility, buoy the six-foot-long bag, called Shark Screen.

Ferocious yet fascinating, the sharks in this rogues' gallery comprise 27 of the more than 250 species, including nine known man-eaters: great white, bull, tiger, great hammerhead, lemon, whitetip, mako, dusky, and blue. Oddly, the whale shark, the biggest of all, and the basking shark, second largest, dine on plankton and small fish. Four possibly dangerous sharks—porbeagle, Greenland, six-gilled, and seven-gilled—offer little threat because they inhabit very cold or very deep waters. Large blacktip, sand tiger, sandbar, silky, and thresher show a preference for fish as food. Nurse shark has small, powerful jaws but seldom attacks. Wing-shaped pectorals, not a sweet disposition, inspire the angel shark's name. Experts regard other species shown here as too small or sluggish to be classed as dangerous. All sizes are average adult lengths.

OPPOSITE PAGE FOLDS OUT

GREAT WHITE SHARK 18 FEET

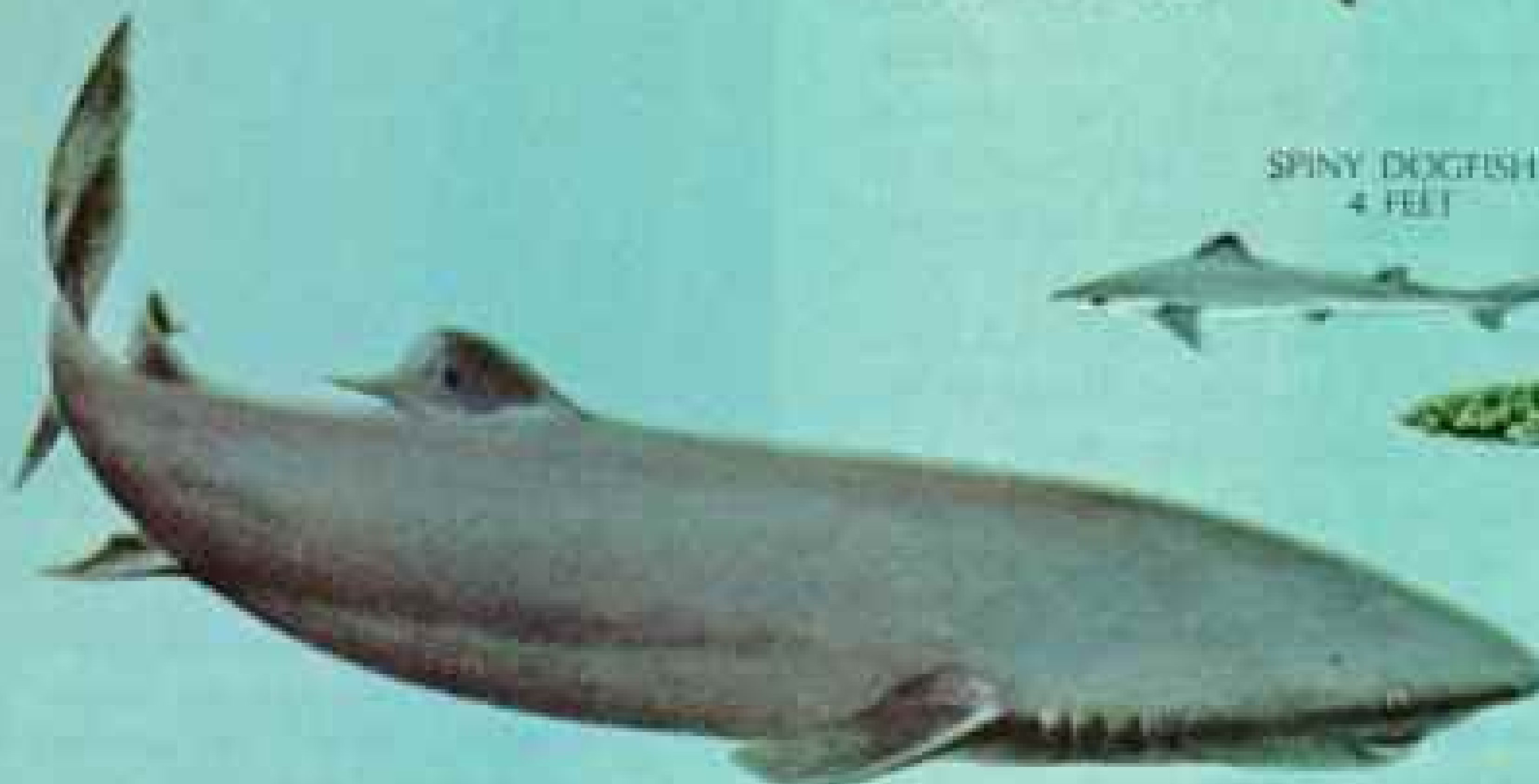
TIGER SHARK, 15 FEET

GREAT HAMMERHEAD SHARK 15 FEET

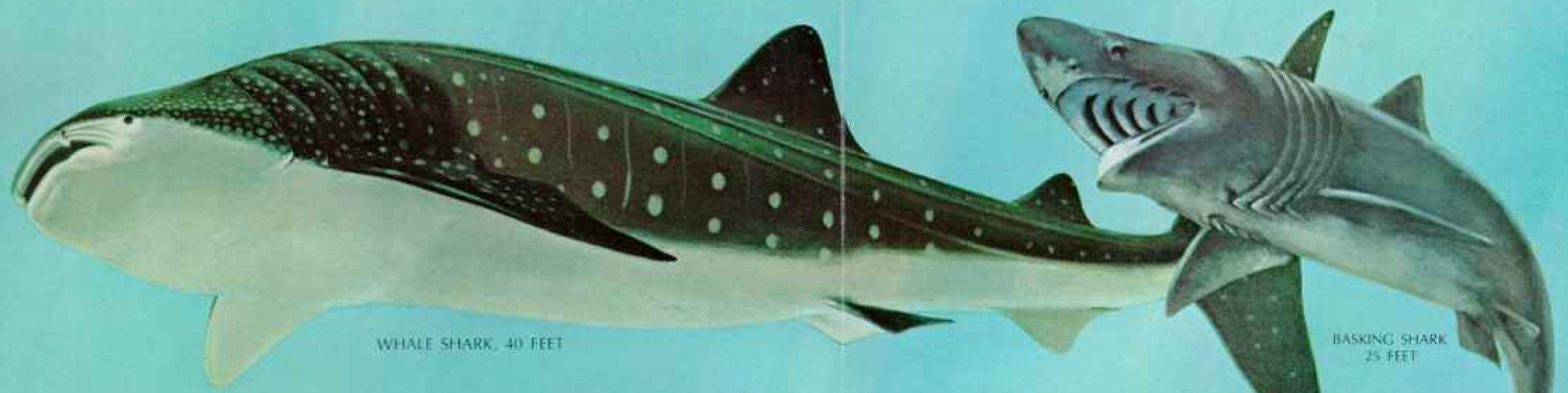
BULL SHARK, 9 FEET

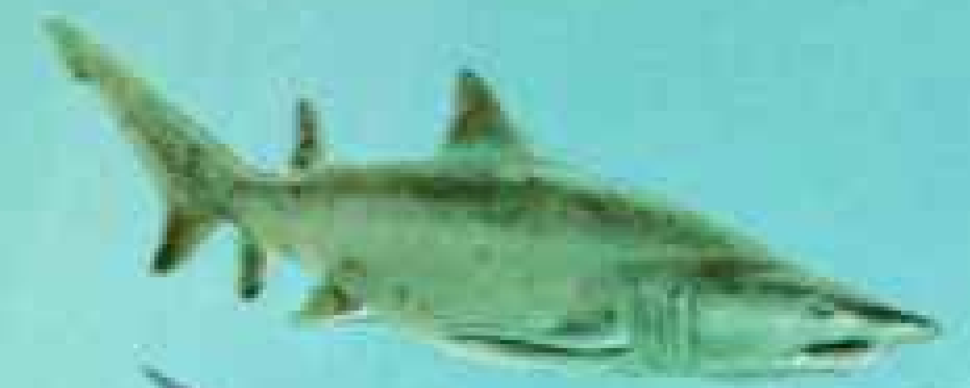
SPINY DOGFISH 4 FEET

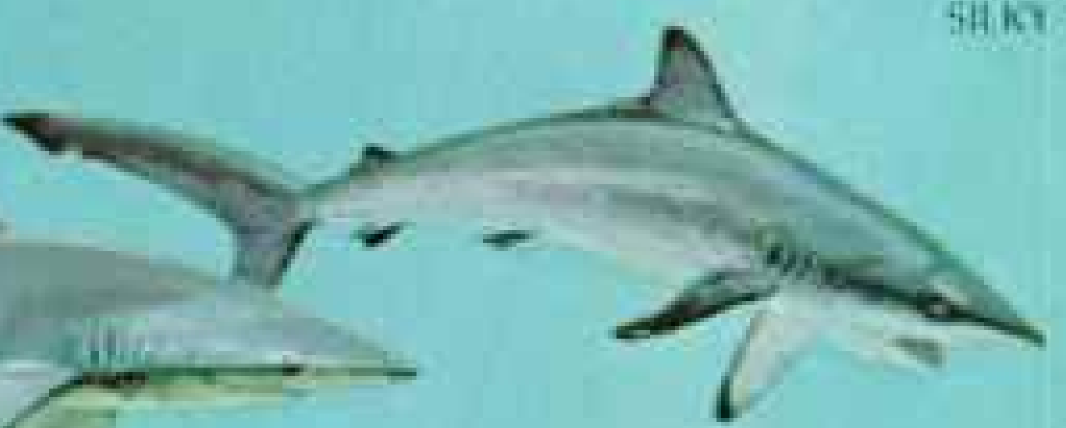
LEOPARD SHARK 4 FEET

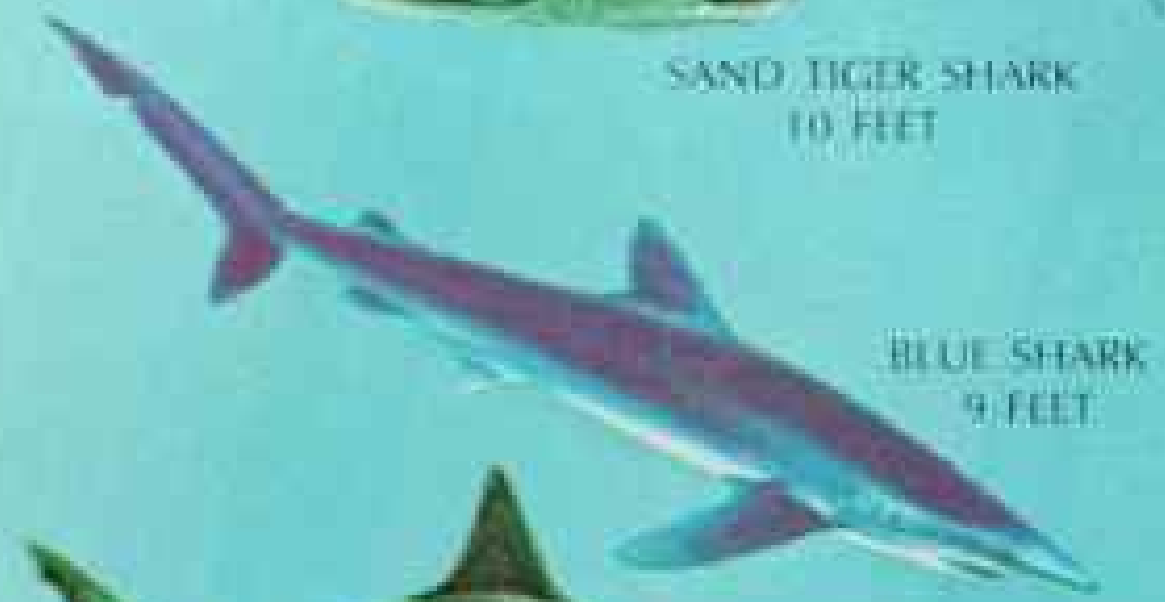


GREENLAND SHARK, 18 FEET









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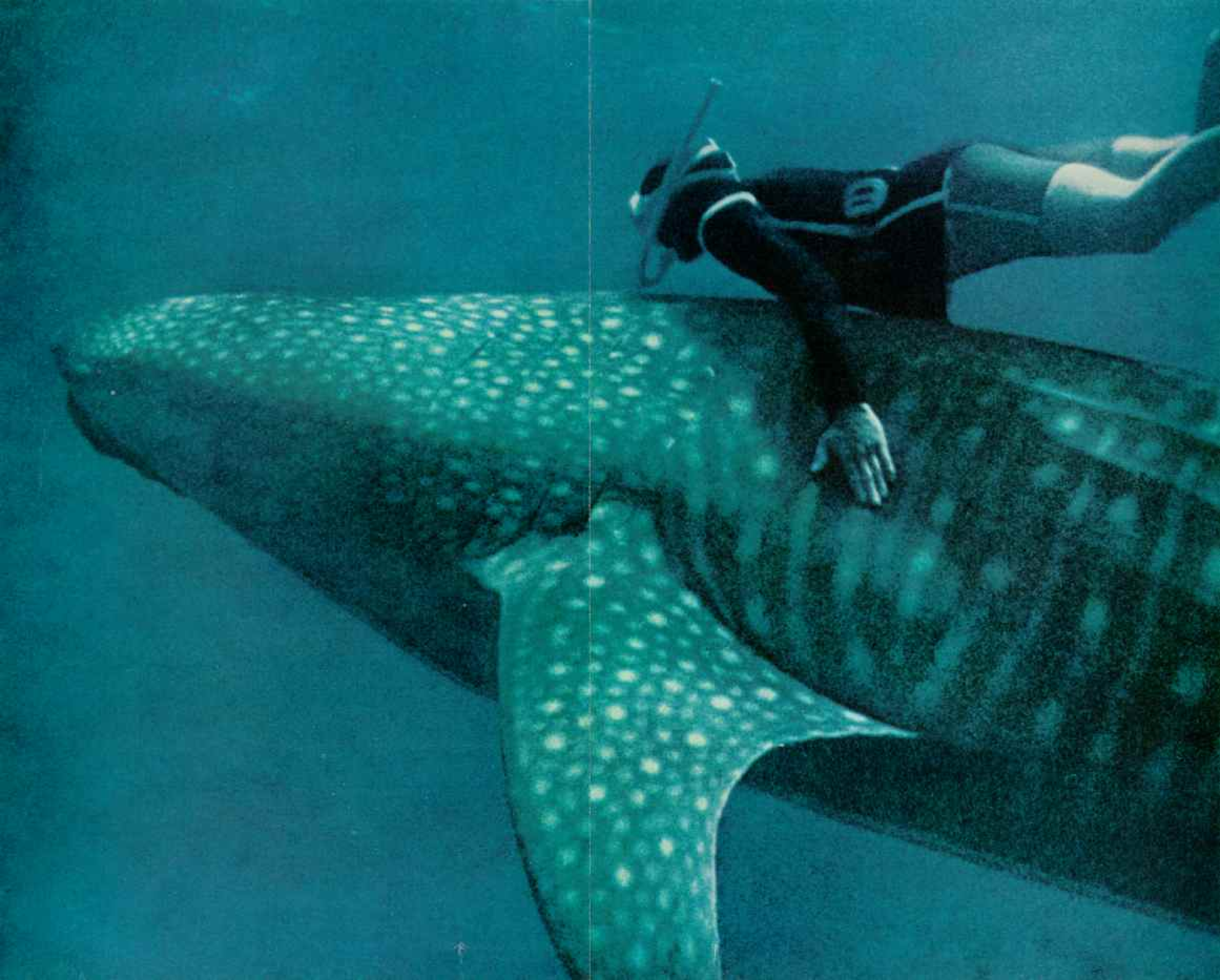
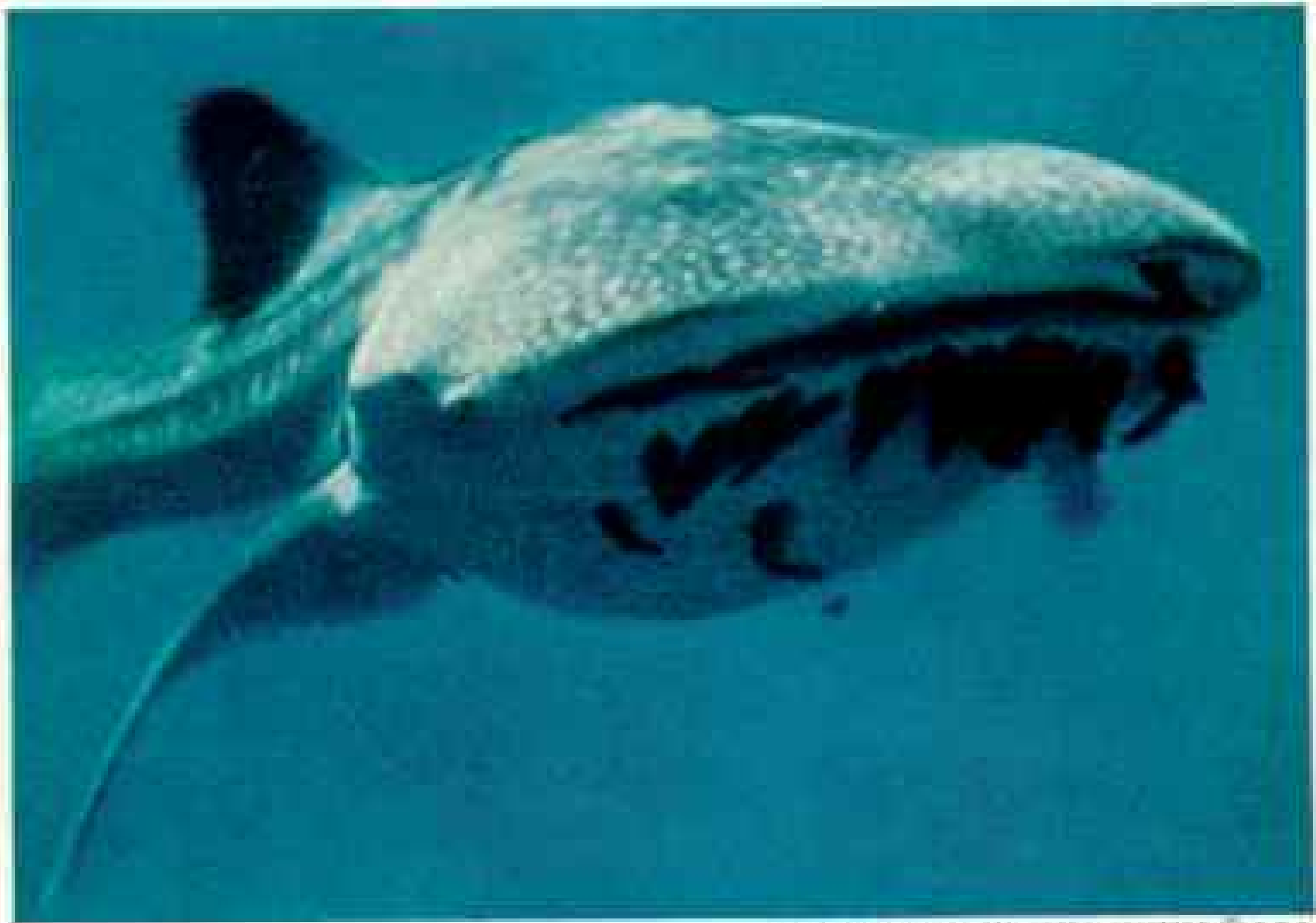




KODACHROMES BY BEN CROPP, KEYSTONE © N.G.S.

Finned hitchhikers waiting to dine on scraps, remoras beard the chin of a whale shark. With a cavernous mouth almost as broad as its head, this shark gulps down great loads of small fish and plankton, straining out larger organisms with sievelike gill rakers and hundreds of tiny teeth.

Human hitchhiker clings to the 35-foot whale shark as it lumbers through Australian waters. Straddling a shark or hanging on to its tail may be exhilarating, but the Shark Research Panel of the American Institute of Biological Sciences labels the sport "dangerous and foolhardy." Sandpaper hide and sharp fins of even the docile whale shark can inflict wounds.

Wondering why sharks' hearts gave their owners so little trouble, Dr. Kjell Johansen of the University of Washington, Seattle, spent one summer meticulously charting the vascular systems of West Coast species, keeping his anesthetized subjects alive with a specially designed respirator that fed water to their gills. Dr. Igor Klatzo of the National Institutes of Health is investigating why sharks show less reaction to brain injury than mammals.

Source of Boots and Belts, Soup and "Steak"

Shark hide makes tough, good-looking leather. For more than 40 years, the Ocean Leather Corporation of Newark, New Jersey, has been tanning shark hides and furnishing them to makers of belts and boots, wallets and golf bags, luggage, watch bands, and a dozen other objects.

Shark livers, huge organs making up as much as a quarter of the owners' weight, contain vitamin A in quantity. Until the early 1950's, the livers alone made Japanese and California shark fishermen rich. Then someone learned how to synthesize vitamin A in large quantities, and there is little demand now for shark livers.

Dried shark fins provide the costliest ingredient of sharkfin soup, fancied by Oriental gourmets. Fresh shark meat is eaten in many parts of the world, particularly in lands around the Indian Ocean.

Anyone who has ever ordered scallops or "steakfish" in a restaurant might very well have eaten shark. San Franciscans once bought it knowingly as "grayfish," but these days it is beginning to find a market under its own name, shark.

And just what is a shark? It is a somewhat unusual fish, numbering billions of individuals grouped in about 250 separate species

(painting, pages 232-4). I am forced to say "about": Here is yet another gap in the body of shark knowledge, and the figure could be wrong by at least 10 either way.

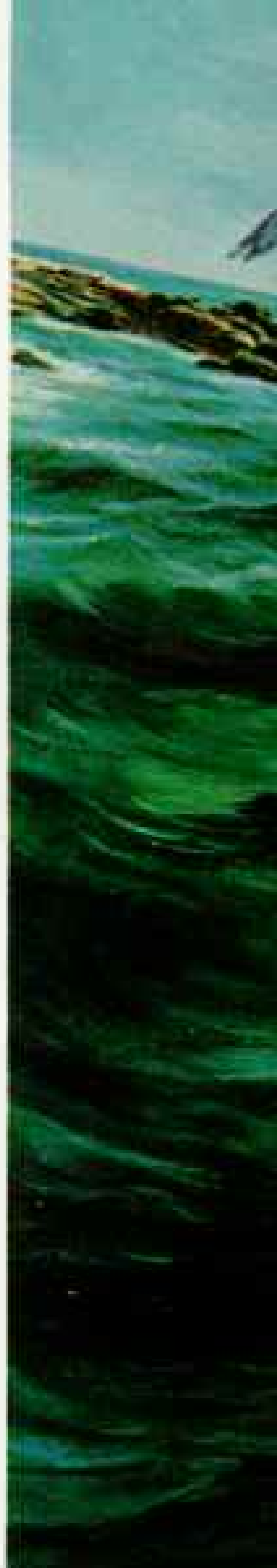
Of all the shark species known at present, only a handful can be listed as proven eaters of man. Against some of these there is the incontrovertible evidence of human remains found in stomachs, teeth left in wounds of victims, and eyewitness identification by unimpeachable experts. Against others stands the strongest kind of circumstantial evidence, including the characteristics of wounds and the proven presence of the shark species at the scene of attack.

Nine Killers Admit No Argument

Every list of proven man-eaters agrees on nine sharks. These are the great white, which also bears the name "man-eater"; mako; bull; lemon; tiger; dusky; blue; the largest hammerheads; and the whitetip, a pelagic shark, meaning one that dwells at or near the surface of the open seas away from land. All these sharks have attacked living humans as well as corpses.

To the sinister roster, some authorities add the Pacific Ocean gray and the Australian whalers. Several species may share these same names, and some of these may prove to be sharks known under yet other names in different parts of the world.

In addition to the "proven" man-eaters, there is a category of sharks—and the experts don't always agree on the individual species—best characterized as "reasonable suspects." The porbeagle is one, and the sandbar, or brown, is another. So is the silky, named for



Real-life Moby Dick, a great white shark matches the fury of fiction's famous whale in a sudden attack off Canada's Cape Breton Island. Seas swamped the splintered dory of two lobstermen; one of them drowned, and the other clung to the wreckage until rescued. Apparently scorning them, the animal swam away to seek a meal elsewhere.

The painting re-creates the harrowing experience of John MacLeod, who survived, and John Burns, who died, on a summer morning in 1953. A tooth embedded in the battered boat identified the species. The shark's length was estimated at about 12 feet, and its weight probably exceeded 1,000 pounds.

Mr. MacLeod still fishes the same North Atlantic waters.

Ravenous silky shark charges diver Donald Nelson. Frantically, Nelson pushes away the six-foot attacker with one hand and with the other aims his short-handled underwater gun at the shark's head. An instant later the would-be killer swam away to thrash out its own death agony.

Photographer Greenberg, swimming with Nelson off Florida, snapped this remarkable picture even as he himself desperately maneuvered to avoid attack.

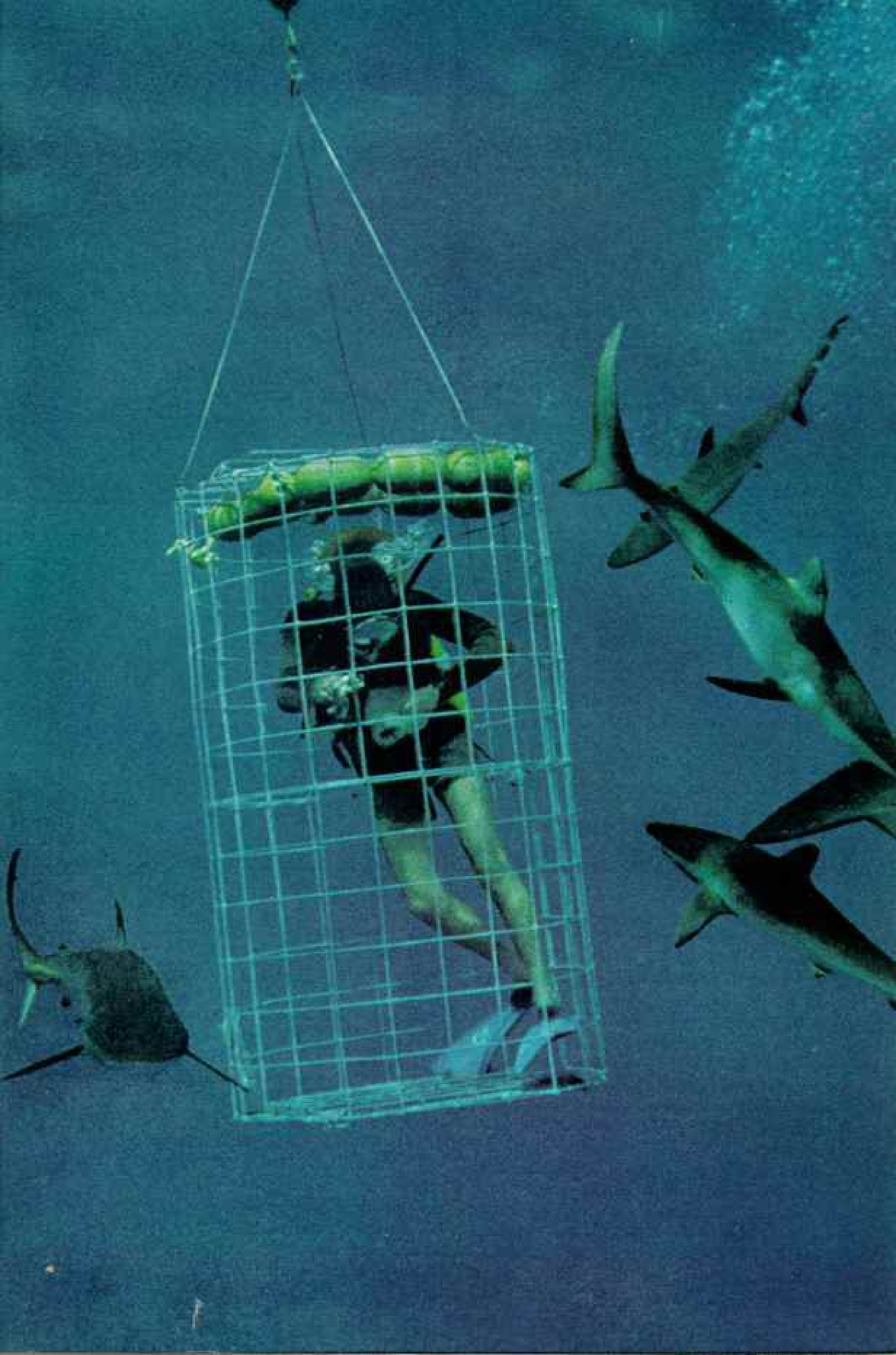
PAINTING BY PAUL CALLE; EKTACHROME BY JERRY GREENBERG © N.G.S.

its relatively glossy skin, a rarity in the shark world. Confusingly, there is another whitetip which might be dangerous, but it is a coastal or reef species, not the pelagic shark of the same name.

One other shark group can be called "potentially dangerous to humans," and all the experts agree on its members. They cite every shark which because of size, power, armament, and general disposition might be expected to make a meal of a man if the man got in its way. An example is the big Greenland shark. But it lives in waters too cold for swimmers and divers, and no one knows what it might do if it chanced upon a human.

The thresher and sand tiger could kill or injure humans, but both appear to feed entirely on small living fishes. The sand tiger once had a bad, but undeserved, reputation in South Africa, where it is named raggedtooth (page 244), and in Australia, where it is called grey nurse—and it should be pointed out that this is not the small-mouthed, bewhiskered nurse shark that ranges most of the world's tropical and subtropical waters.

Add all the sharks on these lists and you come up with no more than 40 or 50 species. The others, it can safely be said, never dine on human flesh at all, or do so more or less accidentally, as when they bite in self-defense. In spite of this, no shark should be described as entirely "harmless," and a wise swimmer treats them all with the same respect he accords a strange fox terrier.



Sharks are close relatives of skates, rays, sawfish, and guitarfish, the latter named because of their unusual shape. All these have skeletons of cartilage and are called elasmobranchs; the other (far more numerous) fish, the teleosts, have true bones.

Between bony fishes and cartilaginous sharks lie many other differences. Most shark species produce live young, although some lay eggs. The horny egg cases from which skates and certain small sharks have hatched in the water are the "mermaids' purses" washed up on ocean beaches.*

No other fish can match a shark in jaw power. Perry Gilbert has measured this force with ingenious apparatus. The readings came out in tons, not mere pounds (pages 250-51).

From 20 to several hundred teeth, depending upon the species, stand in the ready-for-business rows at the front of shark jaws (page 229). Normally, five or six sets—but in some species as many as 15—wait in reserve behind, continuously moving forward so that when front teeth drop out, new ones take their place; in the young of at least one species, this occurs as often as every eight days. New teeth are always larger than the old to match the shark's growth.

One of the most persistent shark myths holds that, to use these teeth, the animal must roll over on its back or side. Not so. Of hundreds of sharks I have watched feeding, not one ever turned over to attack its prey. Sharks, however, are agile, and could do so if they chose.

Rough Hide Once Used as Sandpaper

Shark teeth grow not only in the jaws, but on nearly every square inch of hide, in a crude form called placoid scales, or dermal denticles. Abrasive shark hide, known as shagreen, was once used as sandpaper in cabinetmaking.

Air-filled swim bladders give bony fishes buoyancy. Sharks have no such thing. If they stop moving, they no longer plane on their bellies and fins, and they sink to the bottom.

Most sharks swim from birth to death for an even more vital reason. Their breathing machinery lacks adequate pumping apparatus; only forward movement passes oxygen-bearing water over their gill surfaces.

Dropping dynamite into a school of bony fishes will injure their swim bladders and kill or cripple them. Unless it is a direct hit, an explosion doesn't appear to harm sharks. In fact, it seems to attract them.

*See "Miracle of the Mermaid's Purse," by Ernest L. Libby, NATIONAL GEOGRAPHIC, September, 1959.

Descending into the blue underwater world in a protective cage he designed, diver J. G. Stemples finds himself surrounded by aggressive silky sharks. Bag in his hand, containing pieces of herring, attracts the pack into camera range as the strong but lightweight cage dangles 15 feet below the surface in Tongue of the Ocean. Plastic floats at the top keep the cylinder almost weightless. If the buoy line snapped, Stemples would escape through a hatch.

At work on a photographic study of the shark population in these infested waters, Stemples looked down once to see a small silky shark halfway inside the cage, and quickly kicked it out. Jerry Greenberg, outside the cage, found "one nipping at my swimming fins, and another giving my light meter a taste test."

EKTACHROME BY JERRY GREENBERG © N.G.S.

Curiously, several species of small bony fishes like the company of sharks. Pilotfish swim with them (page 225), sometimes apparently riding the sharks' bow waves, while remoras attach themselves to the big predators, using suckerlike disks on top of their heads (page 237). The little fishes probably feed on scraps from shark meals.

Mammoth Shark Ruled Ancient Seas

Sharks first appeared on earth about three hundred million years ago. Judging from fossil remains, their body shape has changed little through the ages, proof of the efficiency of the torpedolike form.

"Fortunately, the most formidable of the ancient sharks are extinct," said Dr. Shelton P. Applegate, paleontologist and Associate Curator at the Los Angeles County Museum in California. "But in a few cases they left descendants of considerable size."

He handed me a tooth recovered from 15,000,000-year-old Miocene fossil deposits, so big it almost covered my palm.

"It belonged to a most dreadful carnivore called *Carcharodon megalodon*," he said. "This creature was a shark that must have been 40 to 50 feet long."

The biggest fish is still a shark, the whale shark. The second largest is the basking shark. Both, like the largest whales, feed on plankton and tiny fishes. Barring collision, neither of these 40- and 25-foot monsters is dangerous to humans, though one whale shark

EKTACHROME BY BEN CROPP, KEYSTONE © N.G.S.

Daring woman diver, Van Laman pats the back of a nine-foot grey nurse shark. Captured off Australia's east coast, this specimen has survived for four years in an aquarium at Tweed Heads, New South Wales.

A close relative of the smaller Atlantic sand tiger, the grey nurse may reach 15 feet in length. Some shark experts consider it a dangerous species in Australian waters; others believe it undeserving of such a reputation.

stomach was found to contain varied items of clothing, probably swallowed accidentally.

Ben Cropp, diver-photographer and a member of the Shark Research Society of Australia, recently took turns with a friend riding a whale shark as it sluggishly cruised Ben's native Australian waters (pages 235-7).

"It didn't seem disturbed even when I knelt on its head and looked down into its mouth," Ben reported. "I stayed with it until I had used all my film. I could easily swim as fast as it was moving."

At the other end of the size scale, the rare *Squaliolus laticaudus* grows no longer than about half a foot. Occasionally caught off the Philippine Islands, it is so little known that it has no popular name.

Large or small, fast or slow, peaceful or aggressive, every shark—and every other marine creature as well—gives sea room to one member of the family, the great white shark, or man-eater. Here is the real lord of the sea, perhaps the most direct descendant of the prehistoric *Carcharodon megalodon.*

In 1916 a shark or sharks attacked five swimmers along the New Jersey coast. Four died of savage injuries. The fifth lost a leg. There was panic and publicity. Shortly afterward a fisherman caught a great white shark with human remains in its stomach.

Great Whites Attack Fishermen

As the years passed, fishermen from Maine to Nova Scotia reported occasional encounters with great whites. In most cases the huge fishes attacked their boats.

Sharks of several species charge boats with disconcerting frequency. In the best-documented Nova Scotia attack, a shark swamped a dory off Fourchu (painting, pages 238-9). In the splintered wood around an eight-inch hole in the dory was part of a shark tooth, the unmistakable serrated, triangular tooth of a great white.

Along the California coast, Barry Wilson died in 1952 and Albert Kogler in 1959, both from massive shark-inflicted injuries. In 1964, off the Farallon Islands, also in cold California waters, scuba diver Jack Rochette survived serious bite wounds. The surgeon found a tooth fragment in the victim's leg. It had belonged to a great white shark.

Two years before, Leroy French, Al Giddings, and other members of a Marin County scuba club had been diving in the same area.

"I was in the water near our boat," Giddings recalled. "Leroy surfaced from a dive 75 yards away. Suddenly he screamed for help and went under. I swam to him fast as I could. The water was red. Leroy came to the top. So did a large shark.

"I towed Leroy to the boat without interference from the shark. The Coast Guard

flew him to a hospital, where he eventually recovered from dreadful bites on a hip, left arm and left foot, and both legs.

"From my father, a California fish and game warden, I had learned to recognize all our local species of sharks. I saw this one quite well. It was a great white."

The most dangerous shark of them all gave an Australian sport fisherman a world record for the largest fish ever taken on rod and reel. He caught a great white shark 16 feet, 10 inches long, weighing 2,664 pounds, with a girth of 9 feet, 6 inches. A great white taken off Cuba measured 21 feet.

How big do these sharks grow?

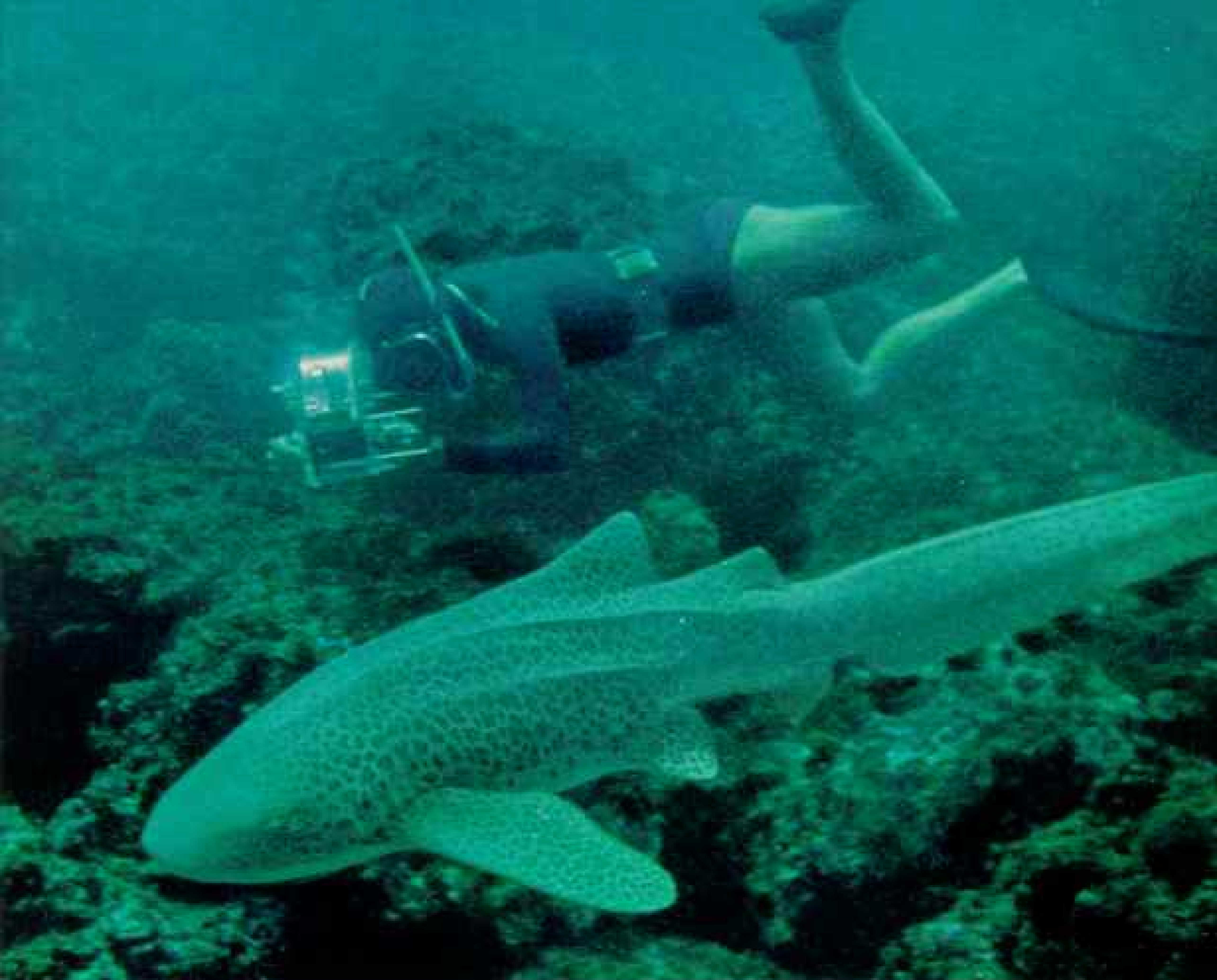
"No one really knows," said Cliff Townsend, General Manager of Marineland, near St. Augustine, Florida. "But one day a man brought in a tooth dredged up far offshore. It

The lady and the shark: Proving that a ragged-tooth can learn to eat from her hand, Dr. Anne Joy Alexander holds a 4½-foot captive and stuffs fish into its wicked-looking mouth. "I believe the bull, not the ragged-tooth, guilty of most attacks on South African bathers," she told the author at the Oceanographic Research Institute in Durban, where she served as principal research officer.

Pancake kin of the shark, the guitarfish can flap winglike pectoral fins to "fly" along the bottom, fanning up small crustaceans and other food.

Calico camouflage of a six-foot wobbegong shark helps to conceal it from its prey off Australia.

EKTACHROMES BY NATHANIEL T. KENNEY (UPPER RIGHT) AND BEN CROPP, KEYSTONE © N.G.S.



EKTACHROME BY JOHN HARDING © N.G.S.

Hovering above coral gardens off southern Queensland, a leopard shark ignores the approach of a diver-photographer. A sluggish creature also known as zebra shark, the leopard can pump water through its mouth and past its gills to obtain life-sustaining oxygen. All pelagic sharks—those living near the surface far out at sea—and most coastal species must forever swim to maintain a constant flow of water through their gills.

was a great white shark tooth, or that of an ancestor—and it was more than five inches long. The tooth of a 20-footer is two inches."

Captivity Fatal to Ocean Rovers

No one can yet keep the big, far-ranging oceanic sharks, among them the great white, alive for long in captivity. Most soon die, either of shock or from ramming tank sides.

"That is the main reason we know so little about the behavior of the pelagic species, including the great white," said F. G. Wood, head of the Navy's Marine Bioscience Facility at Point Mugu, California. "We must study them at sea, and there the sharks dictate conditions, not the scientists."

At Point Mugu I also talked with Dr. C. Scott Johnson, Navy physicist studying porpoise hearing. Dr. Johnson, who has worked with sharks, has a porpoise that, while blindfolded, finds small pellets on the bottom of its tank by echolocation.*

"How do porpoises feel about sharks?" I asked.

"From what I've seen," Dr. Johnson said, "they don't like them, although they don't attack on sight as people will tell you. Nor, in all probability, do sharks attack healthy porpoises. Let's call it a standoff, under normal conditions. You'll sometimes find sharks and porpoises quite near each other, but each gives the other room to pass."

If ever there are hostilities, shark teeth would probably have an advantage over the battering rams of porpoise snouts. Both animals are capable of speeds in the neighborhood of 20 knots.

Happily, the great white sharks seem to

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

be rare. Few people have seen more than two together. More than most sharks, they prefer a mammalian diet —whales, seals, sea otters, and so on. Paleontologist Shelton Applegate has a possible explanation:

"The evidence indicates that *Carcharodon megalodon* fed mainly on marine mammals. The white shark still appears to like them. The inference is obvious. Man is a mammal too."

In a rubber diving suit, a man looks like a seal. And according to Perry Gilbert, neither great whites nor any other sharks see things in clear detail.

"It's a matter of visual sensitivity as differentiated from visual acuity," said Dr. Gilbert. "The shark's retina, amply equipped with photosensitive cells called rods, permits the animal to see, in very dim light, the outline of an object against a contrasting background—in short, the eye has great sensitivity.

"But the shark's eye probably doesn't see sharp details, even in bright light, because of its relatively few retinal cone cells, responsible for visual acuity."

Scientists differ on whether or not sharks see color, pending more conclusive research (pages *226-7*). Dr. Tester of the shark panel doubts that they can.

"At Eniwetok Marine Biological Laboratory," he said, "we trained sharks to discriminate between different shapes. In one end of their tank we had alternately displayed triangular and square targets of equal area. With the triangles we gave the sharks electric shocks, but left the current off when we displayed the squares. In a remarkably short time the sharks learned to flee the mere sight of the triangles, even without the shocks, but ignored the squares.

"Then we tried the same experiment, using targets that differed in color, not shape. The sharks didn't clearly discriminate, even after days of trials."

Hammerhead Wears Its Eyes on Stalks

Of the proven eaters of man, I have met several species more or less personally. I have caught hammerheads off Florida, and wondered why they, alone of all sharks, possessed such oddly shaped heads.

"Nobody really knows why," said Perry. "The wide lobes undoubtedly make good planing surfaces and give these sharks maneuverability. Also, since eyes and nostrils are out on the ends of the lobes, the hammerhead samples a wider path of water than other sharks [pages *222-3*, *232*, and *252-3*]."

In the Red Sea, among the islands of Ethiopia's Dahlak Archipelago, I surfaced from an inspection of a bent boat propeller, and an Arab sailor said that a

Ripping out ham-size bites of flesh, a blue shark shreds a dead porpoise off Montauk Point, New York. Photographer Peter Gimbel, submerged in an antishark cage, witnessed the carnage. "The jaws opened so wide they seemed actually dislocated," he remembers. "With wild, vicious shakes the blue tore loose ten-pound hunks."

EKTACHROME BY PETER GIMBEL © N.G.S.

Like a grotesque insect snared in a giant spider's web, a ten-foot Oriental nurse shark meets death off New South Wales. The big fish suffocated when the mesh halted forward motion, cutting off its oxygen supply.

KODACHROME (BELOW) AND EKTACHROME BY BEN CROPP, KEYSTONE © N.G.S.

large tiger shark had passed within a hundred yards. The tiger shark, by the way, is not the same animal as the sand tiger. The scientific name for the sand tiger is *Odontaspis taurus*, while the tiger, named for juvenile stripes on its hide, is *Galeocerdo cuvieri*.

More than other large sharks, tigers scavenge. Ceaseless prowlers, especially at night, of shallow reefs, river mouths, and harbors, principally in tropical seas, tigers are known to have eaten such varied items as sea birds, garbage, human remains, tin cans, lumps of coal, and—in one instance—a 30-foot roll of yard-wide roofing paper!

Tigers may reach 18 feet in length. Like other sharks, they have extensible upper jaws; tigers can thrust theirs forward as much as six inches for a better hold on prey.

In several seas I have also met the bull shark, an inhabitant of shallow coastal waters. Even the experts find this animal utterly confusing. Up to 10 feet long, it haunts the beaches of Florida, the Gulf of Mexico, South American coasts, and the Atlantic seaboard as far north as New York.

Within the past few years, Dr. J. A. F. Garrick of Wellington, New Zealand, has discovered that the Zambezi sharks of the South African Indian Ocean beaches and some whaler sharks of Australia—all of them killers and all once believed to be separate species—are bull sharks.

So are the aggressive fresh-water sharks of Lake Nicaragua, Lake Izabal in Guatemala, and at least one lake in New Guinea. Further, it seems likely that the species responsible for human attacks in the Tigris and Euphrates Rivers, and in the Ganges and other streams of Pakistan and India, include bull sharks, *Carcharhinus leucas*.

From Chesapeake Bay, trapped in fish nets, have been taken the three largest bull sharks ever measured. The biggest came from waters in which I have swum since boyhood—the mouth of the Patuxent River near Solomons Island, Maryland. No shark attack upon a human, however, has ever been

Green flag signals safe seas for bathers at Queensland's Greenmount Beach. When the tower watchman sights a shark, he rings the bell and raises a red-and-white flag. Some beaches also send spotters aloft in planes.

To combat the shark menace that plagued its populous east coast, Australia began laying nets in 1937. Not a single fatality from shark attack has occurred at a meshed beach.

recorded in the Chesapeake, and this is a mystery in itself.

Yet at Durban, South Africa, the bull shark seems to change character. There I asked Dr. Anne Joy Alexander, principal research officer of the Oceanographic Research Institute, what kind of shark was responsible for the attacks at Durban and other beautiful beaches along the shore of Natal Province.

"Apparently mostly the bull shark," she said, "although obviously it's difficult to identify an attacker. In 1960 we found bull shark tooth fragments in the wounds of a victim. Since the circumstances of attacks and the wounds of most other people were like those in the proven case, we're inclined to believe our major marauder is this fellow.

"Once we suspected the ragged-tooth, the slightly sluggish shark you Americans call the sand tiger, and it may have been guilty in a few cases. But come with me. I'll show you what a nice shark a ragged-tooth can be."

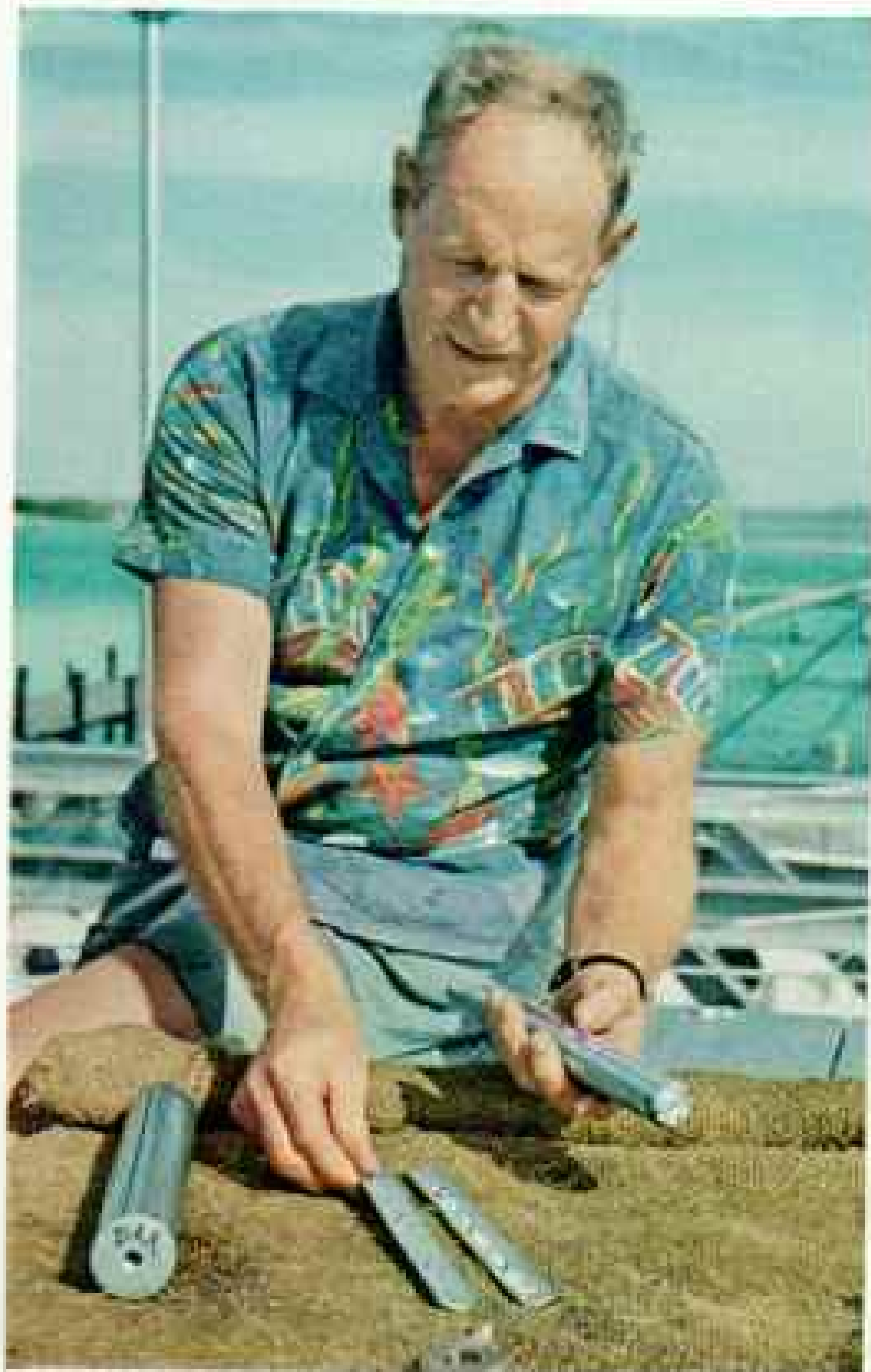
In a shallow laboratory tank circled a mottled 4½-foot shark, its protruding slender dental array identifying it as a sand tiger, its small size indicating immaturity. Reaching into the tank, Dr. Alexander pulled the shark out by the nose and stuffed chunks of fish into the gaping mouth. It swallowed the bits only after she released it (page 244).

City "Meshes" Its Bathing Beaches

Years ago, Durban tried to solve the shark problem with strong fences completely enclosing the city beaches. They worked, but they were prohibitively expensive, both to build and to maintain in the heavy Indian Ocean surf, and were eventually abandoned.

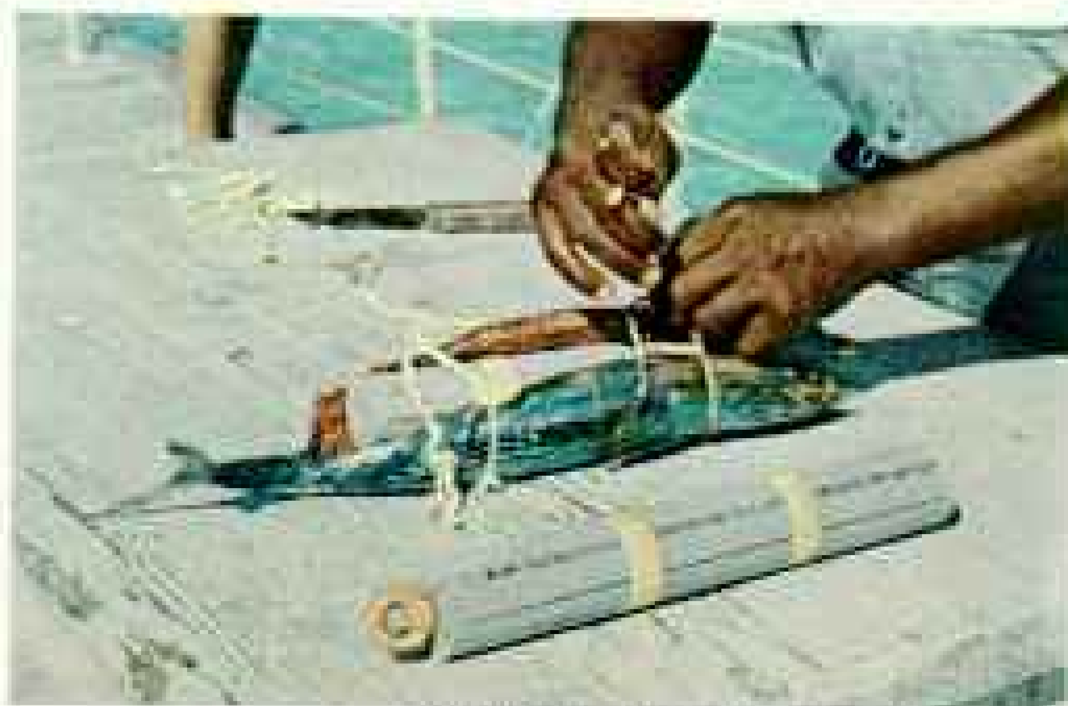
In 1952, the city engineers turned to a system of "meshing" already in use, with apparent success, in Australia, whose beaches held the world's worst record of shark attacks. To mesh a beach, you simply anchor gill nets at intervals off the shore. During the first year, the nets at Durban took 552 sharks. Since then, the catch has dropped to less than 110 a year. In seven years before the nets were used, the city had ten sure attacks, seven of them fatal, and at least ten probables.

After meshing, there were no attacks until



Power of a shark's bite measures in tons, not pounds, as Dr. Perry W. Gilbert discovers in tests conducted at the Lerner Marine Laboratory. One of the world's foremost shark authorities, Dr. Gilbert uses a "bite-meter," a cylinder containing an aluminum core of known hardness enclosed by four quadrants of steel. Twelve stainless-steel bearings lie between the two layers.

Bait wrapped around the device (below) attracts sharks like the 8½-foot dusky at right. It clamps down hard on the apparent meal, then releases the unpalatable offering. Knowing the force needed to dent the aluminum core, Dr. Gilbert estimates the dusky's biting pressure at approximately 18 tons per square inch!



KODACHROMES BY FRED WARD, BLACK STAR © N.G.S.

1965, when a surfer suffered a minor bite on one thigh. Attacks on surfers, incidentally, appear to be on the increase.

"Because a shark can swim over or past a net, it was a mystery at first how meshing protected bathers," said Beulah Davis of Natal Province's Anti-Shark Measures Board. "One reason may be that our sharks mostly belong to a local, nonmigratory population, and the nets caught just about all of them."

Sharks off Hawaiian beaches also appear to be nonmigratory. Last year, under Dr. Tester's direction, the 50th state opened a three-year campaign to eradicate them so far as possible, using set lines with hooks at 60-foot intervals. One of the first results was a noticeable decrease in a concentration of large tigers off Honolulu harbor.

Some 40 miles north of Durban, the golden sands of Zinkwazi Beach used to be lonely, unused because sharks swarmed in the creaming surf. Now they are meshed, and holiday-seekers come in increasing numbers.

Len Flowers, a professional fisherman, tends the nets. I went with Len to overhaul them. They held only a small cow-nosed ray.

"I don't believe you have sharks around," I remarked.

"No?" said Len. "Hang on." With that he headed the boat seaward.

Choosing a spot over a reef a mile offshore, he dropped the anchor, and we began fishing. Immediately we caught several five-pound Cape salmon, or geelbek. We stunned them and tossed them overboard. Within seconds the sea boiled with sharks, some six feet and more long.

"Here are our friends," said Len. "We'll be lucky now to catch a single whole salmon."

We scarcely had a chance to try before the ravenous sharks began banging against the boat. Fear gripped me. Even Len confessed to some nervousness.

To get through the surf without swamping, the boat had been decked over. We sat on it, not in it. Handholds were few. The sea that day was high. An eight-foot shark struck at the outboard propeller, although we had taken the precaution of tilting the motor to bring the propeller out of water.

BLAST FROM A SHOTGUN SHELL *on a stick kills a great hammerhead off the Florida Keys. Gas bubbles obscure the muzzle of diver Scott Slaughter's homemade weapon. The 10-foot shark courted death by circling too close to Slaughter as he tried to clear his boat's anchor, fouled on a coral reef in the Gulf Stream.*

EKTACHROME BY BURTON McNEELY © NATIONAL GEOGRAPHIC SOCIETY

"Let's go home," said Len. We picked up the anchor and left.

I photographed sharks as close as two feet. In the pictures Beulah Davis identified bull sharks, duskies, and sandbars, all of the so-called gray shark family. Duskies and sandbars live in most tropical and temperate coastal seas, including those of the United States.

In a feeding frenzy such as this, a man's chances of escaping death or injury would be slight. Stewart Springer says he has seen frenzied sharks eat packets of the chemical repellent issued to U.S. sailors and airmen during World War II. The repellent contains copper acetate and nigrosine dye.

"We'd learned that sharks, even though they're cannibals, won't touch decaying shark flesh," said Stewart, who helped develop the repellent. "As copper acetate is an organic acid like those in decayed shark meat, we put this into the packets.

"We added the nigrosine dye, which forms a dense cloud in the water, for concealment. It raises a man's morale to believe he is hidden. Moreover, the shark's final visual attack may actually be hindered, and it is also possible the fish may view the cloud as an obstacle and avoid it."

Although its efficacy is limited, the services still issue the repellent. The National Aeronautics and Space Administration puts it into the marker dye released by space capsules when they land in the sea.

At least one space landing in the Atlantic area attracted sharks.

"Nothing happened," a NASA spokesman reported, "except maybe the frogmen who helped in the recovery worked faster than

Extraordinary gathering of sharks peppers Oja de Libre Lagoon in Baja California. Pacific gray whales breed in these waters, and some scientists speculate that sharks, too, come here to mate.

usual. The sharks only circled and watched."

But in the same year, a Canadian military plane with 16 men aboard crashed into the same area of the Atlantic. Rescuers arrived within an hour, but it was already too late. Excited sharks nosed through the wreckage, in which dead or injured men were seen. A search vessel reported by radio that recovery of bodies was not feasible because of "many aggressive sharks."

No one survived this tragedy to report what kinds of sharks were involved or the method of attack. Not until the comparatively recent development of scuba gear did anyone meet pelagic sharks face-to-face in the open ocean and come back to tell what happened.

Captain Cousteau, co-inventor of the pioneer Aqua-Lung, may have been the first man to face the pelagic whitetip in its own element and live to describe the encounter. In 1951, in the open Atlantic off the Cape Verde Islands, he and his companions were harassed by one of these marauders.

The fish exhibited a pattern of curiosity, increasing boldness, and eventual attack. Captain Cousteau drove it off finally by banging it over the snout with his camera.

Shark Beaten Off With Boathook

In the Gulf Stream ten miles from Bimini, Jerry Greenberg of Miami, Florida, who took many of the pictures for this article, met a whitetip that behaved in much the same way.

"I was working for the U. S. Navy, photographing the hulls of vessels passing over me," said Jerry. "One moment I was alone, the next I had this shark as company. For half an hour or so it kept its distance, retreating whenever I made a sudden movement in its direction. Then it began circling faster and closer, and soon I had to beat it off with camera, feet, and hands.

"My diving companion, Ed Fisher, joined me, carrying a boathook. With this he jabbed the shark hard in the gills. This drove it off, although it stayed at the edge of visibility.

"No question about the species: We surfaced, baited a hook, and caught it to get rid of it so we could go back to work."

Chuck Henderson, a Washington, D. C., diver, told of a similar experience he had with a large pelagic shark off Delaware. From the description, it could have been a blue.

"I had a dead tautog on the end of my spear gun," Chuck said, "and this attracted the shark. I backed up against the plates of a wreck in 30 feet of water and fed the tautog to the shark, hoping it would then go away.

"It didn't. It kept returning, each time coming a little closer to me until I was pushing it away bodily with the spear. I pushed gingerly, you can be sure. I didn't want to make this fellow mad.

"When I began running low on air, I knew I had to take a chance on sterner measures. I stabbed the shark in the eye, and it rushed off, shaking its head.

"I could have killed this fish, but I didn't have an underwater gun."

Used skillfully, this weapon is probably the diver's best close protection (pages 225 and 253). Triggered by jabbing against a target, it will kill a shark instantly if fired close to the brain. But it is bulky, a menace to other divers, and likely to give its handler a nasty concussion if the shell used is too large.

Pursuing an elusive meal, a young shark—possibly a great white—broaches in San Ignacio Lagoon, Baja California. In recent decades more and more anglers have awakened to the fact that the fighting shark is one of the world's best game fish. The sport of shark fishing began in Australia in the 1920's; an Australian holds the record for the biggest catch on rod and reel, a 2,664-pound white taken on a 130-pound test line.

EKTACHROME (ABOVE) AND KODACHROME BY THEODORE WALKER © N.G.S.

Navy scientists seeking another weapon for divers have tested poison syringes on sharks in the Bimini pens of the Lerner Marine Laboratory, a field station of the American Museum of Natural History of New York. They were seeking a defense for underwater demolition teams. They found that strychnine killed, but took up to a minute for a large shark. In this time, the creature might yet kill or injure a diver.

What Triggers a Shark Attack?

One of the puzzles facing experts is why a shark in one part of the world harasses humans while its brother of the same species in another place does not. The late Dr. V. M. Coppleson, an Australian authority, thought water temperature was one factor. Most attacks occur, he concluded, above 70° F. Great white sharks, however, have attacked California divers in 55° temperature, and the Greenland shark, as well as the northern porbeagle, feeds in even colder water.

Dr. Coppleson also believed that multiple shark attacks in an area could be the work of a single "rogue," the marine parallel of the Indian tiger that has acquired a taste for human flesh. Stewart Springer, on the other hand, feels that entire shark populations living in less than ideal natural conditions may be dangerous to man.

"Principal populations of sharks establish themselves, quite naturally, in areas where food is abundant and other conditions are good," Stewart said. "The area may be large: Some species of sharks migrate over regular ranges, like African big game.

"Around the edges of the principal area you will find an accessory population that includes congenital weaklings, cripples, or possibly neurotics—all of them animals that can't compete with the others and drift away from them.

"Life is harder for these peripheral sharks, and they may be the dangerous ones. As you might expect, they take whatever food comes along. This could be man."

The bull sharks of fresh-water Lake Nicaragua may be an accessory population. Dr. Thomas B. Thorson of the University of Nebraska, who has studied these fish for eight years, is reasonably sure that the sharks come in from the Caribbean Sea via the San Juan River. Scientists once believed the lake sharks to be a separate species, blocked from the sea by the San Juan's rapids. Now they are virtually sure the rapids are no barrier.

The Smithsonian file records attacks on humans by Lake Nicaragua bull sharks. People nevertheless swim in the lake, and Dr. Thorson once watched a party of Nicaraguan soldiers happily splashing near shark lines he had set out!

The Only Certainty: Uncertainty

After I had begun this article, I stopped by to see Cliff Townsend at Marineland of Florida, where I had earlier helped the collecting crew add a pair of lemon sharks to the main fish tank.

Both had been caught in sight of St. Augustine in the Intracoastal Waterway; both were big, normal animals.

"What became of my friends the lemon sharks?" I asked Cliff.

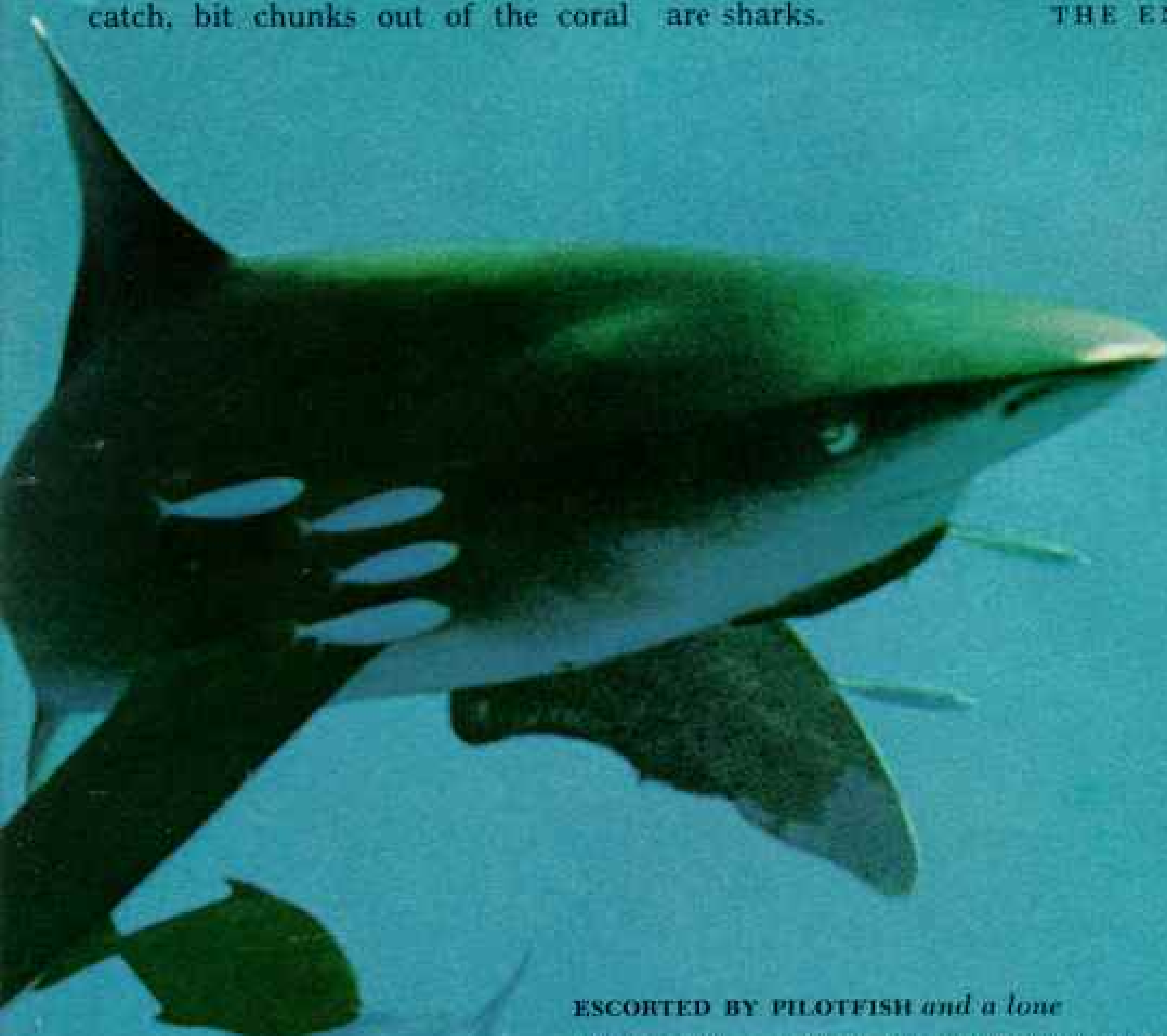
"One is the nicest, calmest shark you ever saw," he said. "It's the only large lemon we've had that never gives the divers a moment's worry, and it eats the food we give it, not its tank neighbors.

"The other killed every fish it could catch, bit chunks out of the coral rocks we put on the bottom for background, and nearly got a couple of divers before we could get it out of the tank.

"I don't know why these sharks were so different, and nobody else does. They did, however, prove one of the few things we know for sure about shark behavior: The animal is unpredictable. Never trust a shark."

No better advice could be given a man about to enter water where there are sharks.

THE END



ESCORTED BY PILOTFISH *and a lone almaco jack, a whitetip shark glides through crystal water off Florida. Long, paddle-shaped pectoral fins, broadly rounded at the tip, distinguish this dangerous species. As man steps up exploration of the deep frontier, he finds it imperative to know more about sharks and how to control them.*

Ecuador

LOW AND LOFTY LAND ASTRIDE THE EQUATOR

Article and photographs by LOREN McINTYRE

WE STOOD IN A SNOWSTORM at the only spot on earth where latitude and temperature both reach zero. Breath came hard after the climb to the place where the Equator crosses a glacier on 18,996-foot Cayambe volcano in Ecuador.

Far below, at the ice edge, an Indian boy guarded our steaming horses (left). With one of my climbing companions, Jack Cook, teen-age son of an American missionary, I had reached the slope where the 0° parallel attains its highest point at 16,000 feet.

Jack slipped and tumbled down the slope, braking with his ice ax.

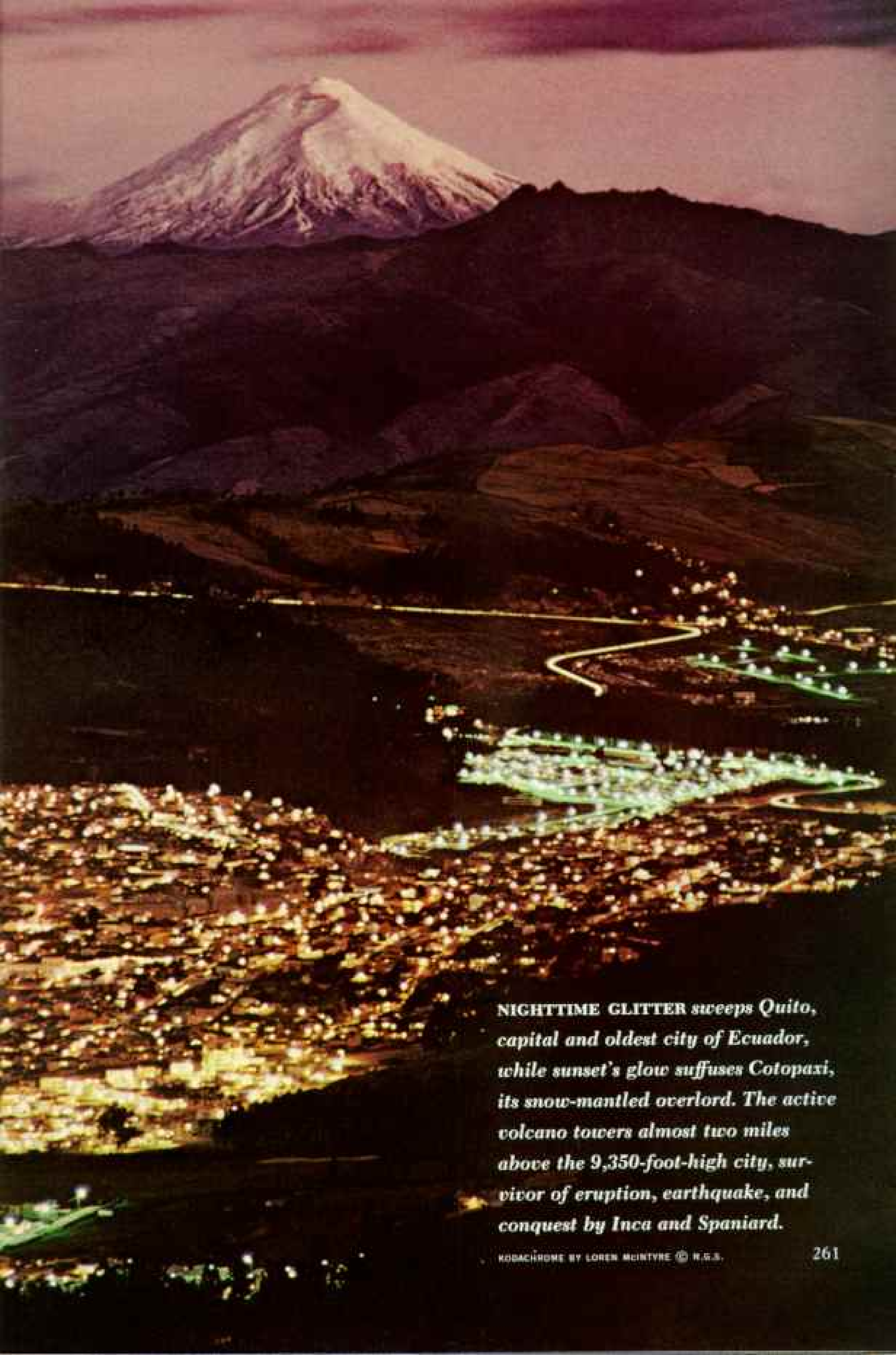
"I'll bet I'm the first person who ever tobogganed across the Equator on the seat of his pants," he yelled, and threw a snowball at me. It whizzed out of the Northern Hemisphere and hit me in the Southern.

When the snowstorm blew away, we could look down Cayambe's icy flanks into the Amazon jungle, which stretched eastward to the horizon—and 2,000 torrid miles beyond.

During four months of travel in the country named for the Equator,

EKTACHROMES © NATIONAL GEOGRAPHIC SOCIETY

Children of the Equator: Near 7,000-foot-high San Antonio de Pichincha, Marisol Lema (above) visits Ecuador's Equatorial Monument, which proclaims 0 degrees, 0 minutes, 0 seconds. Only 30 miles east but 7,000 feet higher, snow falls at the same latitude on José María Supalo, Jr. (left), and his dog as they guard horses of the author's expedition to Cayambe, whose lofty slopes spawn the only glacier to cross the Equator (pages 274-5).



NIGHTTIME GLITTER *sweeps Quito, capital and oldest city of Ecuador, while sunset's glow suffuses Cotopaxi, its snow-mantled overlord. The active volcano towers almost two miles above the 9,350-foot-high city, survivor of eruption, earthquake, and conquest by Inca and Spaniard.*

KODACHROME BY LOREN McINTYRE © N.G.S.

I crossed latitude zero many times (maps, opposite). The invisible line, curving in from the Pacific, touches the Galapagos, Ecuador's far offshore islands, where I played underwater, elated, with a herd of friendly seals. Approaching the deserted continental shore, it spans tropic waters I sailed in a dugout canoe.

Inland, the line nears the jungle clinic of my witch-doctor friend Abraham Calazacón, a red-daubed Colorado Indian. It intersects busy highways and a railroad, then wends up the bleak highland, the paramo, where the wind keens endlessly. After almost reaching the summit of Cayambe, it plunges down to headwaters of the Amazon, where a Cofán Indian boy with a blowgun and poisoned darts showed me how he hunts the cock-of-the-rock to get scarlet feathers for a necklace.

Few people have ever climbed to the isolated glacier Jack and I explored, although its upper reaches are visible from Quito, Ecuador's capital and one of the oldest continuously inhabited cities in the Western Hemisphere. It was in Quito, only 14 miles south of the Equator but nearly two miles above sea level, that my Ecuadorian travels began, one frosty morning in June.

Unseen sacristans swung on rawhide ropes, and the ragged ringing of church bells brought me out of my hotel bed in the predawn dark. I got up, shivering, and peered down from the window. Fog eddied around a streetlight, whose yellow glow revealed a wooden-wheeled cart piled with flame-colored gladiolus. The cart bumped along the cobblestones, pushed by a pigtailed Indian, who hurried as if he feared the flame would perish from the flowers before he could reach the market.

Quito Has Four Seasons Daily

Downstairs, hands warm around a mug of Ecuadorian instant coffee, thick and black, I waited for a Quiteño friend, Guillermo Suarez, to show me his city. A station wagon rounded the corner with such a hooting of its air horn that I flinched. It was Guillermo.

"Let's go!" he cried, the two English words he knew best. He cinched his coat and rubbed his hands. *"Qué feo invierno*—What a wretched winter!"

"But, Guillermo," I protested, "just yesterday afternoon you were saying, 'What a beautiful summer!' "

"True. Quito has four seasons. Our spring is the morning, our summer the afternoon. We have autumn in the evening and winter at night."

Winter thawed into spring as our four-wheel-drive station wagon labored up the slopes of Quito's backyard volcano, Pichincha. Eucalyptus smoke drifted from chimneys of pastel houses. We reached a granite obelisk.

"Bolivar's best general, Sucre, routed the royalists here in 1822," said Guillermo.

We stood at the Summit of Liberty. In fancy I whiffed the smoke of battle, but smelled only cooking fires. I listened for hoofbeats and bugles, but heard only the rustle of the awakening city.

Three solitary volcanoes soared above the mist—massive Cayambe to the northeast,

EKTACHROME BY JOSEPH FABRY, BLACK STAR © N.G.S.

Energetic advocate of South America's "little" countries, Dr. Otto Arosemena Gómez serves as president of his own small and politically turbulent land. Last October he expelled United States Ambassador Wymberley deR. Coerr for alleged disrespect of Ecuadorian authority. Dr. Arosemena had criticized the Alliance for Progress, economic and social cooperation between the U. S. and Latin America, and U. S. aid to Ecuador. Voicing pride in the Alliance, Ambassador Coerr incurred the president's displeasure.

CARTOGRAPHIC DIVISION
© NATIONAL GEOGRAPHIC SOCIETY

THOUGH NAMED for the Equator it straddles, Colorado-size Ecuador contains most of earth's climates, including polar cold, within its 400-mile breadth and four-mile height. Volcano-spired Andean highlands wall off low jungle and desert along the Pacific Ocean from steaming Amazon headwaters in the remote interior to the east.

Once the northern bastion of the Inca Empire, Ecuador has known three centuries of cloistered rule by Spain and 146 years of independence marked by tempestuous politics.

Much of the raw eastern jungle formerly claimed by Ecuador has been ceded to Colombia and Brazil; the nation currently disputes 70,000 square miles held by Peru. Ecuador's eerie Galapagos Islands shelter strange forms of life.

AREA: 104,506 square miles. POPULATION: 5,500,000; 40% Indian (mainly in highlands and jungle), 10% white (mostly Spanish), 10% Negro (concentrated in coastal cities), and 40% mestizo and mulatto. LANGUAGE: Spanish; Quechua and other Indian tongues. RELIGION: Roman Catholic. ECONOMY: 50% of people engaged in agriculture: bananas, coffee, cacao, rice, beef, balsa; some light industry, mining, oil. CHIEF CITIES: Guayaquil (population 650,000), seaport; Quito (450,000), capital; Cuenca (61,000), trade.

glaciered Antisana to the southeast, and the magnificent cone of Cotopaxi to the south, splashed red with dawn. Guillermo pointed out a lesser summit.

"That's Rumiñahui," he said, "named after the chieftain who burned this capital of the Inca Kingdom of Quito in 1534 to deny it to the advancing Spaniards."

On the embers, 55-year-old conquistador Sebastián de Benalcázar founded a new city, San Francisco de Quito, part Spanish, part Indian, and wholly Roman Catholic.

Now a metropolis with nearly half a million inhabitants, Quito lies on a terrace of volcanic ash like a necklace around Pichincha's lower slopes (pages 260-61). Growing steadily, the city is brimming over to the east into a valley warm with bird song and golden maize.

"You can trace the plan of Benalcázar's town in the middle of the modern city," said Guillermo. He pointed out the central Plaza de la Independencia, flanked by the cathedral and the balconied presidential palace, and served by coach-width streets.

Handicraft Finds World Market

Ecuador has very few immigrants, but one to whom the Indians owe a special debt is Hungarian-born Olga Fisch, a folklorist who has opened up world markets to native handicrafts.

Throughout Ecuador I found the traditional folk skills enjoying a popular revival. At Olga's villa on Avenida Colón, Indian artisans fashion ponchos and skirts, and rugs so handsome that they are more often hung than walked upon.

One day I strolled with Olga into downtown Quito. Under the clutter of signs along Benalcázar Street, we flattened ourselves against a silversmith's shop when a fat omnibus overhanging the sidewalk honked past us. The driver shared his bench with two passengers to his left and three to his right, hampering his vision to either side.

We walked up broad, boisterous Avenida 24 de Mayo—the date of the Battle of Pichincha in 1822. Marble-playing urchins, sherbet hawkers, tinkers, and pitchmen choke this 24th of May Avenue—until the afternoon rains send them scurrying. Here twirls a carrousel, there townsfolk pick through half an acre of furniture. Women roast bits of beef heart over charcoal braziers. Sidewalk stalls offer soap, sandals, and cheap aluminumware.

"Quito is no archeological ruin," Olga emphasized. "It's a colonial treasure house that

EKTACHROME (ABOVE) AND KODACHROME BY LOREN McINTYRE © N.G.S.

Darting like a dragonfly, a helicopter sprays insecticide over banana plants in the Guayas River Basin. Such modern techniques help Ecuador export more of the fruit than any other country in the world. Bumper crops of coffee, rice, sugar, and cacao also flourish in fertile coastal plains.

Weighty cousins of the banana, plantains bow the back of a Cofán Indian near the Amazon's headwaters. Starchy and less sweet, plantains taste better cooked.

some writers have called 'the Florence of the Andes.' When Quito had a population of only 3,000, it could claim a cathedral, seven parish churches, eight monasteries, and three convents, one with 200 nuns. No wonder the city grew slowly, with so many celibates!"

From the Plaza de San Francisco, with its acres of stone paving, Olga and I followed an old Indian who carried a huge, ornate candle into the Church of San Francisco (pages 272-3). It seemed that a river of gold had flooded the interior, and, subsiding, left every surface richly plated. Gilt adorned statues of saints, carved pulpits, balconies, portrait frames, and even the polygonic Arabic-style ceiling.

During Mass I climbed to the choir loft. Friars sang to the diapason of a pipe organ that engulfed me in sound. I looked down upon worshipers who knelt in ponchos and

overalls, in mantillas and frock coats.

Behind San Francisco's cloister, with its palms and flowers and captive birds, a museum displays brilliant painted wood sculptures. I marveled at the artistic perfection shown by Caspicara, the best of thousands of Indian sculptors trained by priests in colonial times.

"Notice, the Indians portrayed European rather than Indian features," Olga said. "An *encarnador*—flesh-giver—applied lifelike color to the wood. Such polychrome painting is a lost art. Old men say the artists rubbed the paint with sheep's bladder and orange peel."

Whatever the system, it worked. The colors have not even mellowed.

Of the hundreds of paintings we saw in churches and small museums, some of the most realistic are attributed to Miguel de Santiago, a 17th-century artist of Indian and Spanish blood, a mestizo. We failed to find any that surpassed the drama of his "Christ in Agony," a masterpiece that hangs in San Agustín Church.

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Coastal Negro, a girl with laughing eyes welcomes the author to Limones. Spaniards brought her ancestors as slaves centuries ago.

Señorita of Spanish blood, 15-year-old Ximena Crespo Vega of Cuenca wears a Panama hat and a hand-woven shawl adorned with her country's coat of arms.

"Miguel de Santiago was frustrated, so the legend goes, by his model's lack of expression," Olga told me. "Suddenly he buried his dagger in the man's chest. His reward was the violent expression you see depicted here."

A modern Quito artist, the son of an Indian taxi driver, sells paintings in the four-figure bracket throughout the Western World, although he decries capitalism. A mestizo proud of his Indian blood, he signs a single name, Guayasamin—"White Bird Flying."

I came upon Guayasamin uninvited, drawn through a gate and across a neglected garden by recorded music pouring from open studio windows. Guayasamin paused before his easel on a grassy terrace overlooking Quito. Apparently accustomed to invasion of privacy, he scarcely nodded to me. With both hands, he began to squeeze mounds of pigment from two tubes at once onto his palette and plowed them with his palette knife.

The artist cocked his head, birdlike, and stared at the city below. Then he flew at the canvas with brush strokes so fast he literally danced as he worked. To Guayasamin, Quito's streets ran red and its hills rose angular and black (following page).

"I call this 'Quito Llorando'—Quito Weeping," said the artist, "and try to mix the tears of my race with the paints. Quito is tragic—a place of betrayal. Quito is stricken, Quito dies, the Indian mourns . . . you see?" He brushed skeletal white above the mountains.

"Portraits I can finish in the time it takes to play a Bach cantata. But this Quito, though I have painted it two hundred times, takes weeks. How wonderful to be an artist in this cruel age!"

Matterhorn Conqueror Assails Cotopaxi

Quito's mountainous backdrop drew me like a magnet, and I scaled several nearby peaks with burly, red-haired Jack Cook, an enthusiastic climber and my companion on the equatorial glacier of Cayambe. But the strongest attraction to me remained 19,347-foot Cotopaxi, one of the world's highest active volcanoes (page 261). Each time I saw it I felt its challenge, and one day I asked Jack if he thought we could make the summit.

Legacy of yesterday, a multi-racial nation

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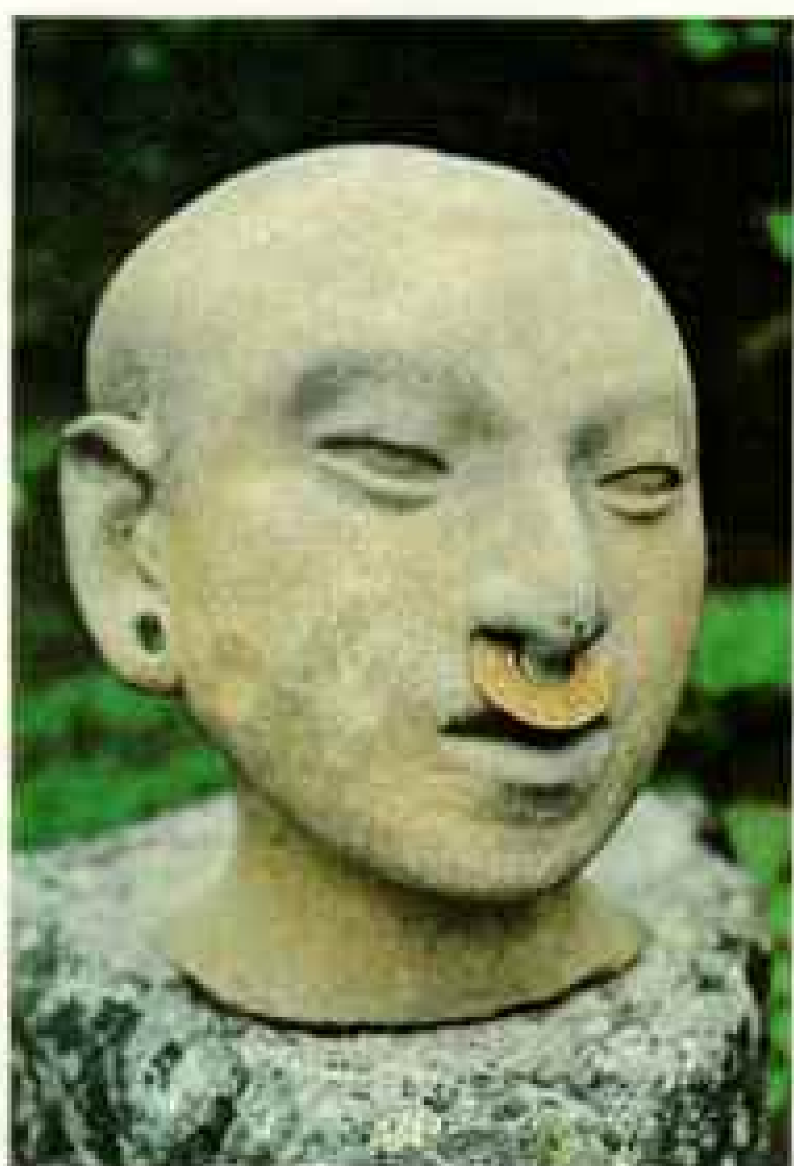
Jungle Indian, Felix Calazacón smiles under a red-paste hairdo typical of the Colorados, who with the Cayapas are the only surviving tribes in the northwest rain forest.

Highland Indian boy in his Sunday best—store-bought hat and overalls—watches the crowds at Cotacachi. He speaks Quechua, the lingua franca of the Andes.



Eyes of the East—a characteristic that reveals the Mongoloid heritage of the American Indian—and a nose ring of solid gold distinguish a pre-Columbian bust in the Guayaquil museum of the late Emilio Estrada. Much older pottery uncovered by the Ecuadorian archeologist suggests Japanese fishermen reached South America about 5,000 years ago.

Pocket of blue, a lake fills a crater beneath Cotacachi, one of a score of peaks along "the Avenue of Volcanoes." Jungle covers the cinder-cone islands despite their 10,500-foot elevation. Tourist chalets dot the smaller isle. Runoff from heavy rains has riddled the ash-layered countryside.

KODACHROMES © NATIONAL GEOGRAPHIC SOCIETY

Lightning-bolt lines of a stark painting portray emotions of Oswaldo Guayasamin, internationally known Ecuadorian artist. Proud of his Indian heritage, Guayasamin calls this canvas "Quito Weeping" in memory of the tragic history of the city and his people who fell under the heels of conquering Spaniards.

"We'd need three on the rope," he said. "Maybe I can get Rómulo Pazmiño to guide us. He's the best *andinista* in Ecuador."

Two days later we three drove 35 miles south of Quito along the Carretera Panamericana—the Pan American Highway. Turning toward Cotopaxi on a dirt road, we passed the enormous dish antenna of the NASA satellite tracking station, where an Ecuadorian-U. S. staff monitors orbiting spacecraft (page 298). Wild horses watched us from lava crags as we drove up the volcano's northern slope.

The ash steepened. The car stalled near Cotopaxi's snow line at 14,700 feet. We hiked a little higher and pitched our tent.

That evening a constellation of colored stars twinkled low in the northern sky. It was Quito. Above us the enormous mass of Cotopaxi blotted out the Southern Cross. Furious gusts blew away my sleep.

While Jack and Rómulo alternately snored and gasped for oxygen, I burrowed into my sleeping bag with a flashlight and reread a chapter from *Travels Amongst the Great Andes of Ecuador,* by Edward Whymper, first conqueror of the Matterhorn.

Whymper's ascent of Cotopaxi in 1880 was arduous, but technically uncomplicated. He passed an uncomfortable night on the crater rim. The temperature under his tent floor was 110° Fahrenheit while an outside thermometer measured 13° F. Cotopaxi had scarcely cooled from a major eruption 32 months earlier, which had melted away its glaciers.

In predawn darkness, we roped up and began to climb the ice. By daybreak we were above the clouds. Yellow light spilled down the mountain. Only a vertical mile to go—a few thousand paces, but it was no stroll.

Rómulo broke trail, setting a pace that was

Cocoon of bygone days drowses in Quito's heart. La Ronda—the Night Watch—a government-preserved street, threads beneath lamps and wrought-iron balconies of the 17th century. Only the sound of traffic on the arched overpass reminds pedestrians of today's pace.

Outing with art: Oswaldo Viteri, Central University professor and Director of the National Folklore Institute, relaxes with his family on the lawn of Quito's Galeria Artes. The museum owns several of his canvases, including the one behind him.

Forest of V-shaped pillars supports a dormitory at Quito's Central University; sketching students find inspiration in the unusual design. The university, founded in the 17th century, offers advanced schooling at nominal cost to any Ecuadorian with a high-school diploma. Education receives a large portion of the country's national budget, exceeding even public works and defense appropriations.

slow but incessant. All forenoon our crampons clawed at deep snow and fissured ice, massive new glaciers that blanketed the ash and lava Whymper had climbed. At last, gasping above half the earth's atmosphere, we smelled sulphur.

Rómulo waved me into the lead. The slope rounded off. I halted in awe on the brink of Cotopaxi's 2,000-foot-wide crater, which still leaked yellow smoke and steam.

From the seldom-conquered summit we saw an array of glistening pyramids fit for a Pharaoh's dream—16 solitary snow peaks, all but two of them volcanoes. One, El Sangay, was erupting, as it has throughout recorded time.

Indians Worshiped Andean Volcanoes

Gigantic volcanoes lend their names to five Ecuadorian provinces—as well as to trucking firms, cafes, pool halls, and patent medicines. Before Inca conquerors came from the south, local tribes worshiped the great peaks as gods.

First Inca to invade the country was Tupac Yupanqui, in the 1470's. His successor completed the conquest of the Kingdom of Quito by marrying an Ecuadorian Indian princess. Their son, Atahualpa, grew up to become god-emperor of a realm that stretched 3,000 miles along the Andes.

When Inca Atahualpa was 32, a Spaniard nearly twice his age, ex-swineherd Francisco Pizarro, disembarked with 180 men on the Ecuadorian shore. With fierce purpose, they plunged recklessly into the land of the Inca millions.

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

Bright flames of faith brought by worshipers fascinate a tiny churchgoer. Thousands crowd in and around a church in Gualaceo, near Cuenca, on July 25 to honor the Apostle Santiago.

Heathen gold glorifies a church in Quito. Wresting treasure from the Incas, zealous Spaniards lavishly gilded the Church of San Francisco, built on the site of an Inca temple. Dark streamers mute the splendor of the ornate main altar in observance of a Mass for the dead. The Indian Manuel Chili, known as Caspicara, carved many of the images in the 18th century when Quito flourished as one of Spanish America's greatest art centers.

KODACHROMES © N.G.S.

Pizarro garroted Atahualpa, thereby subverting an empire far larger than Spain. The Kingdom of Quito crumbled into rebellious tribal fragments.

If there was much precious metal in the subsoil of Ecuador, it lay buried beneath thick layers of lava and ash. Pizarro's lieutenant, Benalcázar, rode north to search for El Dorado, The Gilded Man. According to legend, one of the Chibcha Indian tribes of northwestern South America periodically anointed their king and coated him with gold dust.

Other Spaniards spurred their horses southward to a surfeit of adventure and a glut of treasure in Peru. They left Ecuador to the Indians, priests, and colonial administrators, who closed the land to foreigners for the next 300 years.

Ecuador's domain shrank drastically after Spanish rule was broken in 1822. Simón Bolívar's Gran Colombia—an embryonic United States of South America—survived eight years, then was dismembered into Venezuela, Colombia, and Ecuador.

Independence brought little democracy to Ecuador. During its first century, 40 presidents, juntas, or dictators ruled the republic.

Twenty-two chiefs of state entered and left the Palacio de Gobierno between 1925 and 1948. Then U.S.-educated Galo Plaza, young coalition candidate and son of a two-term president, won a free election, lasted his full four years, and has remained a distinguished figure in international diplomacy.

Galo Plaza, born in the United States while his father was Minister to Washington, always preferred blue jeans to cutaway. He was glad to resume

Striding earth's beltline, one foot in the Northern Hemisphere and the other in the Southern, Jack Cook crosses a slope on 18,996-foot Cayambe. Mist wreathes antlike figures of other climbers on a rock outcropping as they circle toward the sunlit glacier gleaming beyond the cleft at left. Though the river of ice lies only 40 miles from Quito, few mountaineers traverse its fissured surface to explore this highest peak on the Equator.

Masked against zero cold, goggled against dazzling sunlight, Jack Cook, left, and Rómulo Pazmiño pause for breath at the 18,000-foot level on Cotopaxi. Moments later they ascended the remaining 1,350 feet, making 16-year-old Cook one of the youngest climbers ever to conquer the peak. Distant Cayambe, extreme left, and glaciered Antisana poke through clouds drifting over the rugged highlands.

On a lofty shoulder of Cayambe, the author sights along the Equator. Guide José María Supalo, Sr., carries ropes for the climb on Cayambe's glacier.

Tribute to a popular ***patrón:*** Former President Galo Plaza reaches to catch a rooster, tossed by a lad on horseback. Riderless horse bears the offering of respect (right). In festivities starting each June 24, Indians bestow such gifts on landowners. Galo Plaza merits the tribute: His 6,000-acre hacienda pioneers a program of education, medical aid, and land grants to end the near-serfdom of many Indians.

ranch life some 70 twisting miles north of Quito amid the 200 families of handsome Indians on his Hacienda Zuleta, 9,400 feet high on the slope of Imbabura, an inactive volcano.

Señor Plaza invited me to his country home for the Fiesta of San Juan, the Indian festival of Saint John celebrated throughout the Andes. At the hacienda, I watched Indians singing down the mountainside through yellow fields of grain. To their patron they brought gifts of live fowl, symbolic of the share-cropping relationship of feudal days (above).

"Indians raise most of the food we eat in Ecuador," said Galo Plaza. "What nonsense it is to say that Indians are a drag on the economies of our Andean countries."

Out in the courtyard, two old women played harmonicas for a circle of dancers.

"Forty percent of Ecuadorians are Indians. Most of the rest are mestizos. With love and understanding, the Indians are ready to forget four centuries of abuse and increase their stature in our society. We need their common sense—and their colorful dress."

From Zuleta it was a day's walk around Imbabura volcano to Otavalo, a thriving Indian community. Otavaleños are proud, independent farmers and weavers. They travel widely through the country, sometimes in a family car, to sell their distinctive soft woolens. The men are instantly recognizable in floppy white culottes, blue ponchos, and braided pigtails, worn on trips as far afield as New York City.

As I drove the cobblestoned Panamericana toward Colombia, names painted on each approaching truck revealed something about its owner and his times: God is My Copilot, A

EKTACHROME BY LOREN McINTYRE © N.G.S.

Girl in Every Town, Jesus Saves, John Glenn, Flight to the Stars, Pass Me If You Can—even one called The Gilded Man.

All at once the highway plummeted 3,200 feet to a dusty village of thatched huts. Indians shun this scorched depression a scant mile above sea level, but 150 Negro families live there in a hamlet called Carpuela.

"Señorita Bertha, Please Come Back"

I clambered up the valley wall to photograph the town. Five little boys tagged after me.

"The Señorita Bertha had a picture machine," said one of them. "She took a picture of me carrying a bunch of bananas on my head."

"The Señorita Bertha cured a baby that was dying!"

". . . And it's still alive!"

"When is the Señorita Bertha coming back?"

I stopped climbing and caught my breath.

"I don't know the Señorita Bertha," I said.

The boys' eyes were round with disbelief. "She's a North American like you, no? You *must* know her!"

"Was she a missionary?" I asked.

They exchanged glances. Evidently not.

"From the Cuerpo de Paz, perhaps?"

"Yes, yes! The Peace Corps!" The oldest boy clapped his hands. "Tell North America to let Señorita Bertha Hall come back to Carpuela. We'll fix the church steps. We won't sneak out of school. And the Señorita Bertha will make Miguel stop beating me up!"

As I drove away, I shared their wish that Bertha Hall might return to help Carpuela's children fulfill their resolves and hopes.

I followed the Panamericana all the way to Tulcán, a border town linked by asphalt

—and economics—to the Colombian city of Ipiales (map, page 263). Because Ecuadorian currency holds steady while the Colombian peso slumps, goods cost less in Colombia. In Ipiales a merchant told me that heavy buyers often smuggle bulk loads back into Ecuador by mule on mountain trails.

"We're outnumbered and outgunned by the *contrabandistas*," an Ecuadorian customs police officer explained at a checkpoint some miles south of the frontier. I had stopped to declare a case of Colombian chocolate bars, convenient rations for back-country travel.

"Last week a contraband convoy of more than a hundred trucks with maybe a thousand riders roared up to this barrier at two in the morning. They hammered their horns and shouted threats."

"Did you try to search them?"

"With three men? Death should be noble, Señor, not ridiculous."

"The Old One" Runs Again

Back in Quito, Guillermo offered his company and station wagon for a swing through southern Ecuador. Speeding down the Panamericana to Ambato, we noticed walls of many buildings freshly stenciled with a caricature bearing the slogan "*Ayer, hoy, y siempre*—Yesterday, today, and always."

"*El Viejo*—The Old One—is back, seeking a fifth term as president," said Guillermo.

El Viejo is Dr. José María Velasco Ibarra. His awesome energy and oratory won him the presidency four times. His equal genius at losing his temper and following got him unseated and banished in 1935, 1947, and 1961. He has spent most of three decades in exile.

"Other presidents who have tried for a third term have paid with their lives," Guillermo commented. "Some argue that The Old One's a dictator; others insist he's a savior."

"Now that he's home again, I hope to meet him," I announced.

"It won't be easy," warned Guillermo. "He keeps on the move."

In Ambato we visited businessman Robert Roberson, an ex-GI from the Watts district of Los Angeles. Roberson was proud of his handlooms, set up in an aging villa where 50 girls were weaving custom-designed rugs.

"I learned how to weave in an Army hospital," Bob said. "'Occupational therapy,' they called it."

Bob injured his spine in World War II and spent so much time on his back in U. S. veterans hospitals that his legs began to fail with thrombophlebitis.

"I was turning into a vegetable. One day my wife and I decided to head for warmer climates, looking for a place to live on my disability pay. The farther south we went, the lower we found the cost of living. Our search ended four years ago here in Ambato."

Bob Roberson walks, I am sure, with much pain; Ambato's warmth has done little for his legs. But it has restored an enviable spirit.

We drove south past enormous Chimborazo, which Simón Bolívar called "the watchtower

Straw rick on legs struggles up an unpaved portion of the Pan American Highway. Women walk and carry while men grandly ride horseback in the central highlands.

Village sealed against time nestles in a highland valley near Alausí. Beside angular homes that often double as stables, threshers trample out wheat with a team of horses and donkeys. Spiked century plants yield fiber for rope, field stones form corrals, and lofty eucalyptus trees, introduced from Australia, provide lumber and fuel.

KODACHROMES © NATIONAL GEOGRAPHIC SOCIETY

Awed Incas called this massive collapsed volcano and its crescent of peaks "Capac Urcu—Almighty Mountain." Like an amulet on a string, a rarely visited lake sends a trickle from the cavernous caldera. Seeing the mountain as a titanic cathedral, Spaniards named it El Altar and christened the northern summit, left, the Canon, the eastern, Tabernacle, and the southern, Bishop—at 17,457 feet loftiest of the three.

of the universe." In his day it was thought to be the highest mountain in the world.

In Chimborazo Province, horses carry men, and women carry burdens (preceding page). To the peasants here the industrial revolution still ranks as a minor insurrection, though locomotives of the Quito-Guayaquil railroad have chugged past their doors for 60 years.

Night sleet drove us off the road to an inn at Cañar, where our hostess prepared a "late"

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supper at 7:30 p.m., an hour when most highlanders are abed. From the cupboard she rummaged rice and eggs, my inevitable potluck dish in rural Ecuador. Guinea pigs nibbled greens in unswept corners—their privilege throughout the Andes. Fried or stewed, they taste rather like rabbit. *Cui*, the guinea pig is called, from its "cui, cui, cui" squeal.

We warmed our hands and dinner plates over the wood range while the lady bemoaned the problems of operating the family's two five-ton trucks, which haul farm produce.

I had expected to find Cuenca, Ecuador's third largest city, moribund from the collapse of the Panama hat industry, which fell from 23 percent of Ecuador's exports in 1945 to less than 1 percent in 1966. But my forebodings were wiped out by flashing signs advertising hi-fi sets, farm machinery, and fast bus-truck transport to Quito, the coast, and Peru.

Jukeboxes blared hit tunes from restaurant doorways. We sought a hotel in a quieter neighborhood—and heard sweeter music.

An amorous young man peered up anxiously for some sign of requital while a singer and a guitarist serenaded a shuttered window. Presently the two troubadours glanced at their watches, abruptly bowed to their employer, and walked away.

"They were very good," I remarked.

"And in great demand," lamented the young man with a pained look at the closed shutters. "I could afford to hire them for only fifteen minutes."

Later I saw a transistorized version of this old Spanish custom: An ardent sidewalk swain played his serenade from a battery-operated phonograph mounted on a bicycle.

Seasons Shift With Changing Landscape

South of Cuenca no volcanoes pierce the high Andean horizons. Guillermo and I drove through all four seasons of Ecuador several times each day, from spring to summer to fall, from valley to wintry valley.

Here cattle and goats grazed on drought-shriveled hillsides; there oxen plowed black loam. Peasants bent over ripened barley,

Eyes pinned to a tissue-paper balloon, all ages join a family festival in Cuenca. Kneeling torchbearer has fired a tallow-soaked rag held by wires in the mouth of the balloon, filling it with hot air that will lift it out of sight.

grasping the grain in one hand, sickling the stalks with the other. Teams of ponies threshed the yellow harvest. The next valley? It might be a lifeless rift in the Andean rock, or perhaps a sudden meadow.

Long columns of cattle trucks southbound from Loja sent clouds of dust billowing across dry scrublands. It drifted through the twisted branches of scattered ceibo (silk-cotton) trees. When the dried seed pods burst, they yield kapok, fluffy stuffing of pillows and life preservers (page 289).

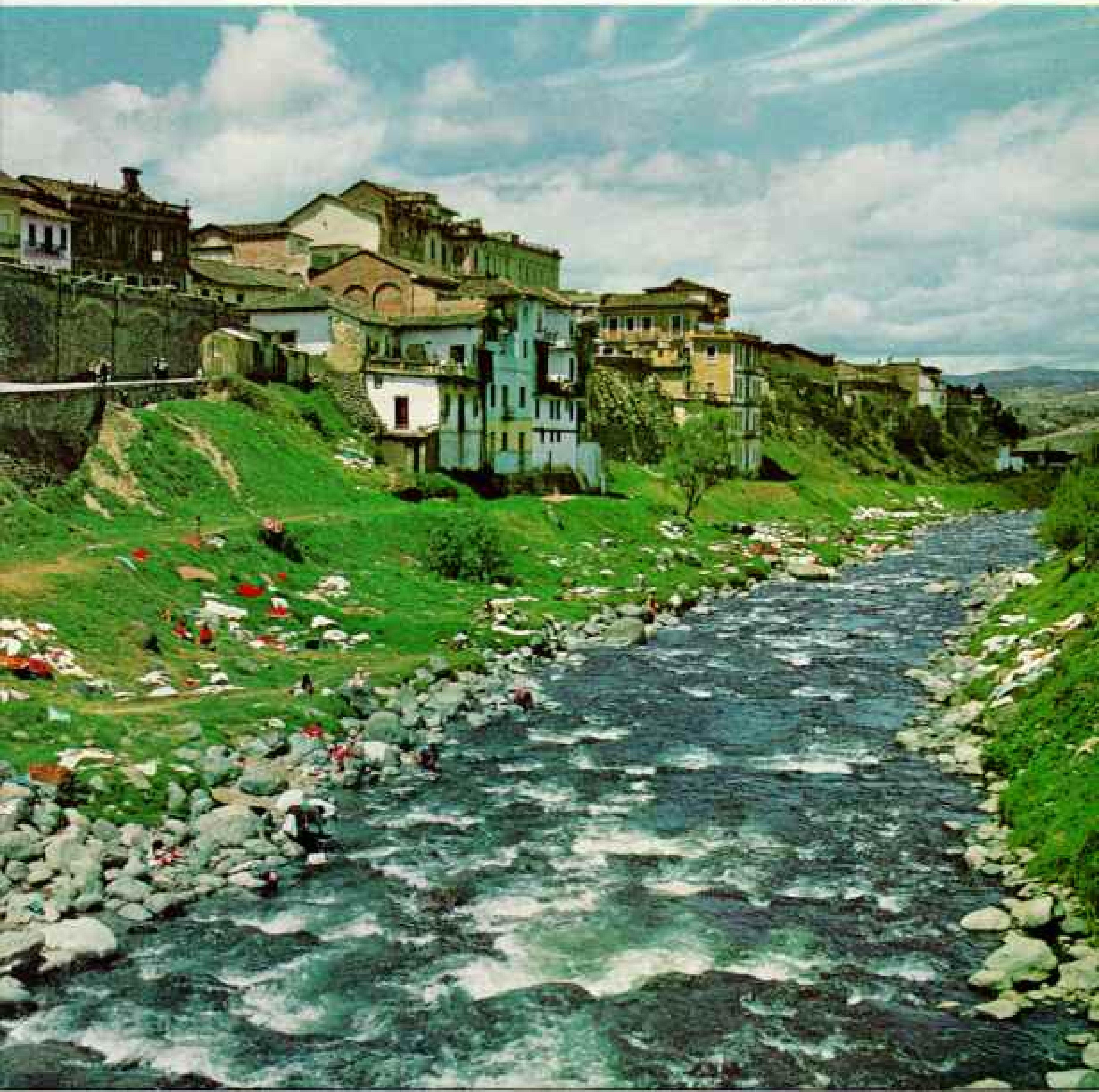
The cattle trucks stopped at the Macará River, frontier with Peru. There I found another unofficial "common market" arrangement, like the duty-free traffic across the Colombian border. The stampede of contraband—in this case Ecuadorian cattle—fords the river in lowing herds by night.

It is hardly a covert operation—almost in sight of the new International Bridge which carries the Panamericana across the river. But the bridge was chained at each end, evidence of a century-old border dispute still unresolved. A lone Peruvian soldier stood guard.

Landslides and damaged bridges often blocked us during our drive, mostly in the rain, to Guayaquil by way of Machala and

"Seventeenth-century Spain under glass," a visitor once exclaimed upon viewing Cuenca. The city preserves an Old World charm despite a veneer of progress. Here housewives scrub the family laundry where the Rio Tomebamba splashes down its boulder-strewn course.

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



Hopeful huckster at the Thursday market in Cuenca proffers a guinea pig. Natives of the Andes, the rodents enjoy the run of rural houses as families fatten them for the pot. Vendors down the line display onions, limes, beans, and hot peppers. Another nearby open market, a city block in size, offers pottery, furniture, and tableware; a third sells only clothing.

Bed and board on their backs, Indians pad home from the market in Otavalo, north of Quito. They brought produce to town before dawn, napping on the rolled bed mat until bargaining began. Between sales, the woman spun yarn on her wooden wheel.

Cuenca (map, page 263). Near Guayaquil, tropical forest gave way to banana plantations. The fruit accounts for more than half the country's annual exports of $185,000,000. Ecuador has reigned as the world's top banana supplier since 1952 (pages 264-5).

The Guayas River Basin has always responded generously to shifting demands on its remarkable fertility. From 1870 cacao was king, until a disease called witches' broom swept away cocoa fortunes in 1922. Rice then saved the day and became the nation's chief export. Coffee helped. Finally, bananas boomed when blight struck the Central American banana crop.

"Treasure seekers have overrun Ecuador's highlands and eastern jungle for centuries," said young Lautaro (Tayo) Aspiazu, a Guayaquil banana export executive. "Yet real wealth has always been right here—our rich soil."

With Tayo I helicoptered to plantations where he was supervising experiments to improve bananas. We followed the fruit from

Squealing and kicking, a porker rides piggyback to the weekly market in Riobamba. Each April the city holds a livestock fair.

harvest to mechanical loaders on the docks. No longer shipped on stalks, the bananas are separated into "hands," washed, wrapped in plastic, and packed in cartons.

Tayo Aspiazu moves in an atmosphere of success and sophistication. He wined and dined me at the Union Club, overlooking the riverfront boulevard, the Malecón, then dropped me at a swimming-pool party at the home of an Ecuadorian diplomat. One of the guests happened to be a Swedish sea captain's daughter, Margareta Arvidsson by name, reigning Miss Universe by occupation.

Guayaquil began as a landing place on a mudbank and did not change much until the 20th century. Its cane-slat buildings have burned so often that its volunteer fire department—1,570 strong—has become one of the world's largest. Mariners feared the city's yellow fever, smallpox, plague, and typhus. As recently as 1942, tuberculosis and malaria were blamed in half the deaths in Guayaquil.

But it was inevitable that this port of entry to highland Ecuador would emerge as the country's largest city (following pages). The World Bank financed the new deepwater harbor, and aid from the United States, starting in 1942, has supported health measures which have largely eradicated disease.

Today hustling activity animates the city of 650,000. It turns out such diverse products as lumber, balsa centers for plywood, cement, flour, polished rice, candy, cocoa butter, and instant coffee.

Guayaquil and Quito: Poles Apart

Rivalry between Quito and Guayaquil pervades the nation. Quito dominates the northern highlands, Guayaquil the southern coast. While Quito is traditional, conservative, and insular, Guayaquil is consciously contemporary, liberal, and worldly. Quiteño leaders are landed gentry; Guayaquileños are merchants. Quito's power is in the ministries; Guayaquil's in the banks.

Guillermo and I pushed on to Manabi

Jungle yields to man as sprawling Guayaquil, the nation's largest city, invades encircling mangroves. Streams of countryfolk, drawn by high wages, throw up dwellings on stilts in the outskirts of this exploding city of 650,000. Guayaquil, situated 30 miles

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inland on the Guayas River, background at right, handles 50 percent of Ecuadorian exports and 90 percent of imports through its recently completed deepwater harbor, Puerto Nuevo. Here a cargo-laden sailboat plies an estuary toward a smoking cement plant.

KODACHROME © N.G.S.

Panama gets the credit, Ecuador makes the hats. At a factory in Cuenca, Regina Guamán weaves brims for the Panamas, misnamed in the 19th century by gold seekers who purchased them as they crossed the Isthmus of Panama on their way to California. Today the classic white model, fine-textured as linen, gives way to gay, casual styles in demand by vacationists. Families weave the hats from fibers of a palmlike plant called *toquilla*, then deliver them to factories for finishing.

Golden bounty of rice dries in the sun on the Guayaquil waterfront. Longshoremen unload bulging bags of grain trucked from plantations nearby. With a crop ranging to 220,000 tons a year, Ecuador feeds her own people and exports the rest.

Province, north of Guayaquil, a region seared by drought. Unattended burros, carrying kegs of water for village housewives, patiently followed the pavement's edge as if on rails.

The only relief from drabness was an orange sign proclaiming "God Bless José Maria Velasco Ibarra." It hung from the eaves of a four-story house swaying on stilts; the three lower floors had no walls. A man leaned idly on a fourth-floor windowsill.

Guillermo called out, "How come you live upstairs with no downstairs?"

"Well, it's cooler and it brings the name of The Old One closer to heaven. If I wall the lower floors, the wind will blow the house down. Besides, from here I can see all the way to Jipijapa."

Jipijapa—pronounced "heepy-hoppa"—reminds me of the long-eared raider in Mr. McGregor's garden. But it is the name of the town that once set the pace in Ecuador's multimillion-dollar Panama hat industry. A disastrous decline occurred when U.S. hat fashions changed after World War II. Today Jipijapa prospers again, processing coffee, cotton, and other farm products.

Villagers Weave Hats—and Dreams

The best Panama hats are still made in nearby Montecristi. Old men weave them in the first light of day, when humidity is high and the straw is supple. At Maruja Largacha's shop you can buy a dollar hat—or one of the finest quality for fifty dollars.

Maruja showed us the road through dismal scrub woodlands to the plantations that grow *toquilla*, the palmlike plant from which the hats are made. On the way, the ruts widened into a street. I asked one of a scattering of menfolk, "What do you do for a living?"

"We weave hats."

"Do they sell?"

"No. We're waiting for the market's return."

"But it disappeared twenty years ago. What if it doesn't come back?"

"We might take up farming."

"There seems to be no water around here."

"We're thinking of digging a well."

Guillermo started the car.

"What's the name of this village?" I yelled.

"Bajo y Afuera, Señor."

Bajo y Afuera—Down and Out.

In the once-sleepy seaport of Manta, now awakened by an artificial harbor, a trucker counseled us about the northward route.

"You could take the paved highway," he said, "but the old road is better, when the moon permits."

KODACHROME © N.G.S.

Afloat on a cloud of kapok, Jesús Ruiz bags fluffy stuffing destined for cushions and life jackets. The resilient fiber comes from seed pods of the ceibo tree, a native of coastal provinces.

When we reached the "old road"—the ocean beach—the moon did not permit, for it was high tide. Nothing traveled the road except enormous dugout canoes loaded with nets. We swam in the surf, dived from the roof of a shipwrecked truck awash to the windows, and lunched on fried bananas.

When at last the moon permitted, we set out along the oldest, widest, smoothest, and fastest road in Ecuador.

Between the seaports of Bahia and Esmeraldas we drove the man-made highway that veers far inland to Santo Domingo de los Colorados, a boomtown risen amid the forest homes of the Colorado Indians (page 292).

Santo Domingo lies in the heart of Ecuador's western Andean jungle, winter home to scarlet tanagers, redstarts, barn swallows,

Reapers of the land: Indian men and women sickle barley under the eye of an

and other North American birds. We couldn't see much jungle from the road; it had been pushed back by the advance of banana plantations and cattle ranches.

At the junction of roads to Quito, Esmeraldas, Manta, and Guayaquil, Santo Domingo has become one of Ecuador's busiest crossroads. City planners now talk of half a million population by the year 2000. Real estate offices advertised cleared land for $275 an acre, downtown property for a dollar a square foot.

"The police chief says there are 83 pool tables in town," Guillermo remarked. "Do you realize that, on land that was jungle not long ago, pool tables alone occupy plots worth three thousand three hundred dollars?"

In the central market a striped-skirted, red-smeared Colorado youth stepped out of a taxi smoking a fat cigar, transistor radio plugged in his ear. He blew smoke rings while he had his black rubber boots shined. In the old days he would have blackened his bare legs to give them strength.

Witch Doctor Sets Standard Fee

From the Guayaquil highway we turned in at the painted shingle put up by witch doctor Abraham Calazacón who, some say, owns 2,000 acres. This Colorado headman runs a forest clinic where he prescribes lotions and potions for a broad spectrum of ailments. We saw two packloads of wilderness herbs arrive, and counted 12 inpatients—coastal Negroes, highland Indians, and whites.

"How much for a stomach-ache?" asked Guillermo.

Reapers of the sea: Airing nets hung like giant cobwebs, shrimp boats anchor at sunset

KODACHROMES BY LOREN McINTYRE © N.G.S.

overseer, right. Ponchos ward off the chill of dusk in the highlands of Chimborazo.

"Twenty-five dollars . . . any ache," replied Abraham.

We didn't disparage his herbs. Several reinforce modern medicine, especially cinchona bark, a source of quinine.

We slanted seaward across the Equator to Esmeraldas, following a new highway which had opened the jungle to the banana boom.

No place I visited in Ecuador had such high temperature, high prices, and high wages as Esmeraldas. The labor shortage was so acute that a coin-operated laundry, a rarity in Latin America, does big business, and our overcrowded hotel was managed by children.

The eldest, "Pedro Pulga" (Peter the Flea), was 13. His junior helpers allocated beds without regard to sex or family. Guillermo was paired with the wife of a European diplomat while I drew the mother-in-law. We all protested politely, and the next shuffle dealt me two anthropologists, man and wife. Guests took over the assigning of rooms, throwing the youngsters' bookkeeping into hopeless chaos, for no two beds were priced alike.

Growling Contest Rends Galapagos Night

Guillermo returned to Quito, and I sailed to Limones by motor dugout in the open sea.

Six hundred miles farther out in the Pacific lay the Galapagos Islands, unclaimed until Ecuador annexed them in 1832. Early in my visit, Ecuadorian friends and I had rollicked in the Galapagos surf with herds of wild seals, wonderfully friendly.

But I remembered the Galapagos sea lions as less amiable. Swift sundown once caught us

near Playas. Dugouts and wading stevedores will speed the day's catch ashore.

EKTACHROME © N.G.S.

At home on city street or jungle trail, a family of Colorado Indians shops in Santo Domingo de los Colorados, a booming crossroads of the western Andean jungle. When a new asphalt highway crossed their forest home, skyrocketing land values brought prosperity to the Colorados. Tradition holds them to their painted stripes and cool costumes. Men style their hair with a paste called *achiote*, scooped from the pod of a tropical plant.

Bone in her nose, a Cofán girl of the Oriente region feeds banana to a pet tanager. Beneath a bib of beads, she wears flaming feathers of the cock-of-the-rock.

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

Smile belies the tribal heritage of a young Jivaro girl named Rosario Ushpa. Until missionaries tempered the ways of these Amazonian Indians a few years ago, they took the heads of slain enemies and shrank them to baseball-size as trophies.

without a lantern, far from our boat. To avoid getting lost in a cactus forest in blackest night, we followed the beach, picking a path among lava boulders. I sat down on one to remove a pebble from my shoe.

It yielded, then loomed like a nightmare. I leaped into another sea lion. It lunged, outraged, and showered saliva on me, roaring viciously.

Another bull snorted. Shaken and angered, one of my companions snorted back and bedlam awoke the beach. That was our cue.

We strode along that eerie Galapagos beach growling at every shadow, dodging around those that growled back, beating a retreat to our boat.*

For Delivering a Baby, Five Dollars

To step ashore at Limones and settle into a wicker chair at the rundown wooden hotel was like opening yellowed pages of an old South Sea novel. The illusion persisted into the evening, when rain pounded the rusty sheet-iron roof.

The rain abated. I heard drums, a marimba, and a woman singing—Spanish words, African rhythm. Limones is a Negro town.

A visitor came, starved for talk with an outsider. Graying Reinaldo Mesa, a Spanish doctor, told me he had delivered 3,542 babies, more than the total population of Limones today.

"One hundred sucres—five dollars—is my fee," he said. "I don't expect prompt payment. A young lady came to me and said she'd got a job and could pay her bill at last. I didn't remember the case, but asked how the baby was doing. She laughed and handed me a hundred-sucre note. 'Not my baby,' she said. 'This is for delivering *me!*' "

Coasting through mangrove estuaries brought me to San Lorenzo, a deepwater lumber port tied to Quito by two strands of steel, a railroad authorized in 1861 but completed only in 1957.

My boots were green with mold the morning I boarded a train that climbed out of the warm rain through the gamut of Ecuador's seasons and landscapes. The "express" paused at 53 whistle stops. At nightfall, getting off in Quito, I shivered in the Andean wind.

I found in my mail the long-hoped-for invitation to meet 74-year-old José María Velasco Ibarra. Night mist wrapped Quito as I climbed with Dr. Velasco to the television studio in an old villa overlooking the city from Itchimbía Hill. A tall, courtly figure in black cape and carrying a black umbrella, The Old One was bound for a telecast.

"I shall be discussing old friends," El Viejo told me. "Rousseau, Descartes, Voltaire—these were my heroes 50 years ago at the Sorbonne.

"Like Rousseau," he went on softly, "I believe

*See "The Galapagos, Eerie Cradle of New Species," by Roger Tory Peterson, NATIONAL GEOGRAPHIC, April, 1967.

Rope trick in reverse: Pail holding flashlight batteries descends to the hands of a chief of the Oriente's isolated Secoya tribe. Incredibly, the rig is towed by the plane in the distance. A missionary pilot flies the aircraft slowly in tight circles to make the line spiral. Centripetal force—the opposite of centrifugal—causes the weighted end of the line to seek the center of the spiral and dangle almost motionless. Nate Saint, who devised this technique for contacting remote tribes, was one of five missionaries slain by spears of Auca Indians in 1956.

Like an oil slick on a sea, the broad Napo River shimmers in trackless jungle before an approaching storm. Conquistador Francisco de Orellana descended its silt-brown waters in 1542 to discover the mighty Amazon and chart its course to the sea. Beneath the Napo's matted jungles, drillers tap vast pools of oil, promising a financial bonanza to Ecuador.

"With each telling it grew," the author recalls of this Secoya's story about a boar that fell to his muzzle-loading shotgun. Boar-tusk necklace proves his prowess. Cock-of-the-rock feathers thrust from ears and headdress.

EKTACHROME (BELOW) AND KODACHROMES © N.G.S.

the people are sovereign. I know my strength lies with them alone, for I have no party. I have been forced out of the Government Palace once by Congress, twice by the Army, but never by the people."

At the door of the TV studio a group of townsfolk awaited their champion. A wrinkled lady lifted a shawl from her head, waved it, and cried, *"Viva el doctor!"* A quavering chorus answered *"Que viva!*—May he live!"

During the two-hour program Velasco tugged at his wide lapels, stabbed at the TV cameras with a forefinger, and lambasted the government for keeping his name off a recent presidential ballot. He compared his years abroad as a "man without a country" to Voltaire's banishment from France, and he quoted Rousseau as if he were indeed an old school friend. I studied the faces of the studio audience. All were solemn; an old man wearing rope sandals was weeping.

I flew east from Quito in a light plane to trace one of history's most disastrous expeditions. If the Spaniards could have seen the unbroken expanse of rain forest from the air they would never have searched here for El Dorado's golden land.

After Benalcázar rode north in search of El Dorado, Francisco Pizarro appointed his own brother Gonzalo governor of Quito, and sent him eastward to find cinnamon and The Gilded Man. With 220 Spaniards, 4,000 Indians, and thousands of hogs, llamas, and dogs, Gonzalo crossed the snows between Antisana and Cayambe in February, 1541, and followed their runoff into the steaming morass.

***TEAR OUT THE ATTACHED PAGE** as your reminder to take a TV trip down the Amazon, February 20* ▶

Come explore earth's mightiest river — the Amazon

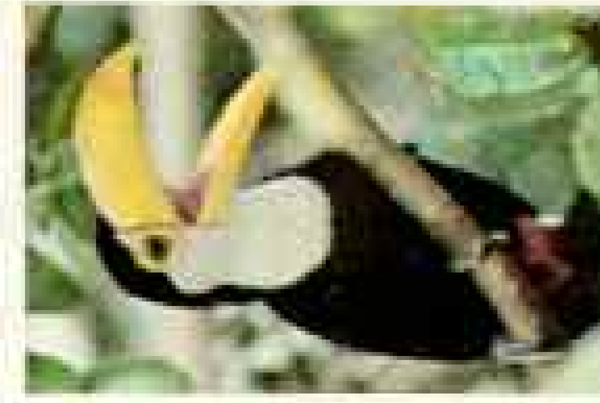
Jungle masquerade: a Tukuna in bark-cloth costume celebrates the coming of age of an Indian maiden.

Living saucer of a *Victoria regia* lily keeps a little girl safe and dry above dark waters.

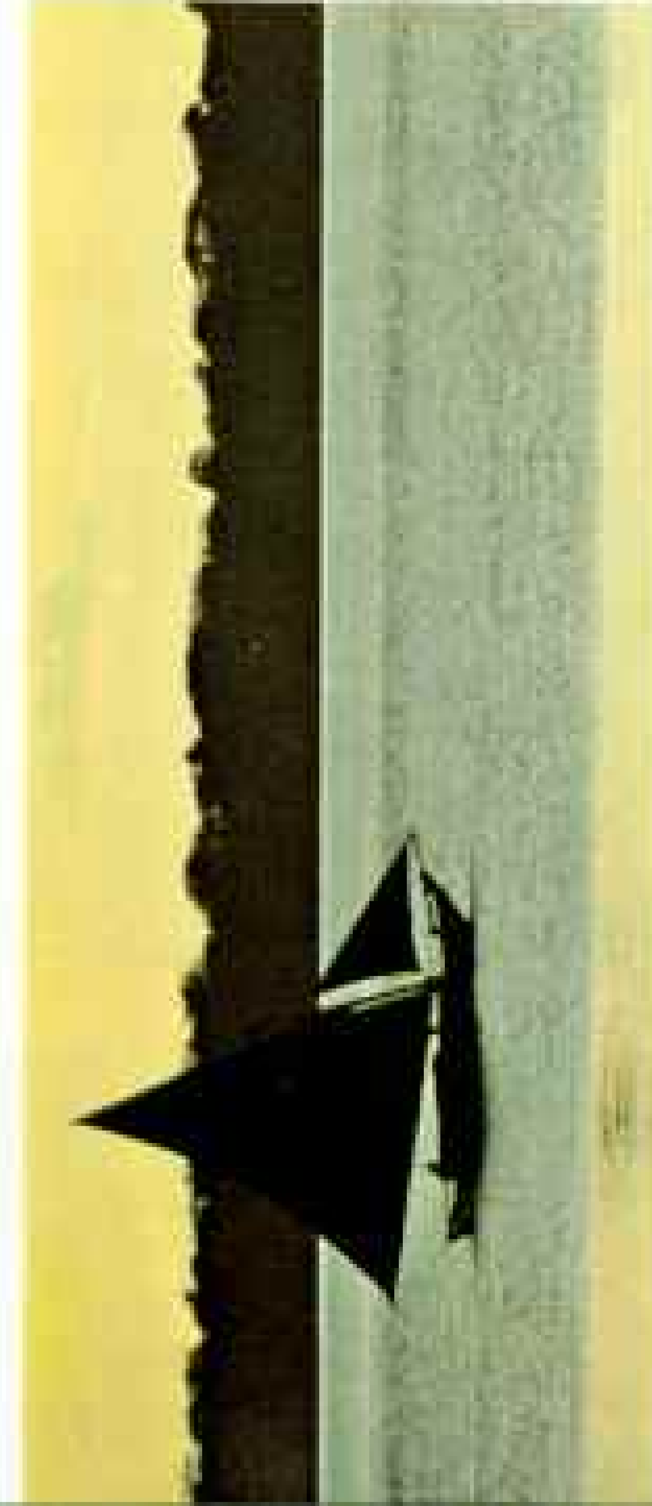
Overleaf: The Amazon yields an anaconda, a snake capable of crushing a small deer.

PHOTOGRAPHS (INCLUDING OVERLEAF) BY JAMES R. HOLLAND © N.G.S.

Floating market, produce boats await buyers at Manaus, Brazil. Ocean freighters put into this Amazon port, 1,000 miles from the Atlantic. Sailboat (left) plies the river near Belém.



Raucous call of the toucan spills from a massive beak.



BEGINNING AS TRICKLES high in the Andes, rivulets rush down the eastern slopes and widen into rivers with names like jungle drums—Marañón, Ucayali, Urubamba. That way, through misty gorges and lush forests, lies the path of one of the unforgettable journeys of your life—tracking the mighty Amazon from its headwaters to the sea.

You explore a vast valley of excitement—a struggle to capture an anaconda, a view of strange rites as Tukuna Indians prepare young girls for marriage, a plea to savage Mayorunas to come peacefully out of the jungle.

These adventures and many others will be yours to share on the evening of Tuesday, February 20, when the National Geographic Society presents "Amazon"—third in the 1967-68 series of full-color specials on the CBS television network.

Your ports of call span three countries: Peru, where the market town of Iquitos draws men of many races and cargo boats from the Atlantic, 2,300 miles away; Colombia, where hunters and trappers seek the cayman and the anaconda; Brazil, where the opulence of long-dead rubber barons lives on in a lavish opera house at Manaus.

Produced by your Society in association with David L. Wolper and narrated by Alexander Scourby, the one-hour program is sponsored by Encyclopaedia Britannica, Inc., and Aetna Life & Casualty.

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Amazon

A few airborne minutes out of Quito, I sighted the Rio Napo, as far as Gonzalo got by Christmas. His retinue was reduced to eating live flesh sliced from the flanks of their priceless horses. Gonzalo sent a party of foragers under one-eyed Francisco de Orellana down the Napo, an Amazon tributary.

The gathering waters swept Orellana's boat to the east. He never came back upriver. He fought women warriors—"Amazons"—and struggled 2,800 miles down the world's mightiest river to the sea, explorations that established Ecuador as an Amazonian country.

My plane landed at Limoncocha (Lime-colored Lake), near the site of Pizarro's 1541 Christmas camp (map, page 263). Today it is the Ecuadorian base of the Summer Institute of Linguistics. The linguist-missionaries create alphabets in the Indian tongues and bring clinics and Christian ethics to the Indians.

Tattooed Indians Share Plane Space

I was eager to see the jungle hideaways of head-shrinking Jivaros and other Amazonian tribes. For 400 years their wooden weapons turned aside all intruders. A few priests endured appalling sacrifices to teach kindness and also Quechua, the lingua franca of the Andes. But when Spain expelled the Jesuits in 1767, outposts reverted to wilderness.

Left to themselves, the savages speared one another so fiercely that extinction threatened. Then 20th-century missionaries came, Catholics by canoe, Protestants by plane.

George Fletcher, a missionary pilot, offered me a ride on a measles-inoculation flight to Cuyabeno near the Colombian border. We skimmed the treetops, scaring up flocks of birds in explosions of white wings.

George dropped neatly between the green forest walls onto the 200-yard Cuyabeno strip. Painted Secoya Indians met us, bared arms and bottoms to the needle, and within an hour U. S.-donated vaccine had protected one more tribal remnant from death by measles.

I made many flights in the next few weeks, on jam-packed little planes with fascinating passengers: Indian chiefs; tattooed ladies nursing babies; monkeys, both caged and roasted; and sloths, both two- and three-toed.

One squally afternoon we landed at Chinimpi, an unkempt airstrip in Jívaro country, the propeller slashing brush. We tumbled out into tall wet grass—George and I, chickens on a leash, and a Jivaro coming home with his two girl-wives and a new baby.

Giggling excitedly, the Indians led us a muddy mile to a lodge where Grandfather Ushpa, his two wives, and his brother's three wives, all urged us to stay for a homecoming dinner.

I stared at Grandfather's tattooed nose. Grandfather stared back. I felt his eyes, keen as spears, sizing me up through long bangs. He carried a percussion-lock shotgun.

"Grandfather," murmured George, "had a reputation for skill in the vanishing Jívaro art of shrinking human heads."

"I trust he has retired from active duty."

I unpinned myself from Grandfather's gaze to play volleyball with his granddaughters, pretty Rosena and Rosario (page 293).

I was losing the game when the blast of a shotgun jolted me. Buckshot ripped leaves over my head. I whirled to see Grandfather Ushpa waggling his smoking weapon not at me, but at his rapt relatives. He had simply enhanced a hunting yarn with sound effects.

Head-hunters Yield to Oil Hunters

Where a road from the highlands nears the edge of Jívaro country, Royal Dutch Shell built a major airport at Mera, to spearhead a 1937-1950 search for petroleum. Shell spent 40 million dollars, employing as many as 5,300 Ecuadorians at one time, but failed to find "Oil Dorado," as one disillusioned Shell Mera tavernkeeper called it. "The savages," he said, "were so hostile that much of Shell's search was confined to the air."

Today helicopters fly *whop-whop-whop* over the northern jungle so frequently that Cofán and Secoya children no longer pause in their play to watch them hauling slingloads of supplies to Texaco-Gulf oil prospectors.

At Santa Cecilia on the Rio Aguarico, base for a Texaco-Gulf concession, the oil men greeted me cautiously, obviously concerned about possible espionage by rival firms. Then survey boss Walter "Woody" Steele of Geophysical Services, Inc., radioed his Quito headquarters. It was all right for me to stay.

"Even our helicopter pads," said Woody,

Hushed by a gently swaying hammock, a baby sleeps, peaceful as a china doll; ribbons of vegetable fiber bind her bunting. She shares an unwalled house on stilts with more than a dozen of her relatives of the Cayapa tribe, rain-forest neighbors of the Colorados. The author reached the remote Cayapas after an arduous canoe trip up ever-narrowing rivers in northwestern Ecuador.

EKTACHROME BY LOREN McINTYRE © N.G.S.

Eye on the sky, a satellite tracking station perches on bleak uplands near Cotopaxi. Beacon and distant twin summits of Illiniza frame the dish antenna, operated by the Bendix Corporation for the National Aeronautics and Space Administration. About 110 technicians commute 30 miles from Quito.

KODACHROME BY LOREN McINTYRE © NATIONAL GEOGRAPHIC SOCIETY

"are hardly visible in the rank jungle growth."

A crew whacking with machetes cut a new trail. Fragments of the forest fell around us. Sap bled from wounded stumps. Rain washed them clean. In one whole day we advanced only half a mile.

I retired at nightfall and wakened to sunrise sounds like falling water, like the ringing of little bells, like cellos and chimes. I never saw the birds, nor did any two people agree on their identity.

Every five miles the crew widened the trail, opening a heliport for delivery of men and tons of gear. To chart subterranean sediments, teams bored into the muck and set off charges that made squiggles on graph paper.

Texaco-Gulf teams were sounding out a possible southern extension of producing oilfields in the Colombian jungle. As reported in *El Comercio*, Quito's leading newspaper, Texaco-Gulf by 1967 had spent 60 million dollars. This brought the total cost of oil search in the Oriente region to more than 100 million dollars, an amount equivalent to the whole 1960 Ecuadorian national budget.

Last year, after I had left Ecuador, a news dispatch reminded me of the legend of The Gilded Man. El Dorado had materialized, in a way, near the place where Gonzalo Pizarro had searched. The story read that around midnight on March 29, 1967, oil had been discovered ten miles north of Santa Cecilia, and "roustabouts bathed exultantly in the liquid that rose to a great height."

Deep beneath the rain forest, almost on the Equator, Well No. 1 had tapped a geyser of oil that surged up 10,200 feet of pipe. Some time later No. 2, then 3, struck oil.

To use the oil will require a pipeline over the Andes. Along the route where Gonzalo Pizarro slogged home hollow-eyed to find his brother murdered and the land in chaos, and to come to his own death on the block, liquid treasure soon may flow through the morass, across the ravines, and up the wintry cliffs to Benalcázar's high city and beyond.

The treasure, I reflected, had been there all the time. It simply had been intended to enrich neither armored plunderers on horseback nor kings of distant Spain, but instead a nation and its people—the land of the Equator itself.

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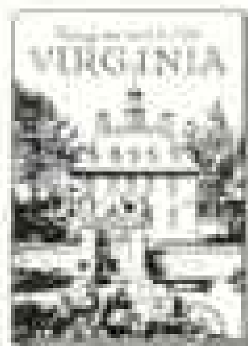

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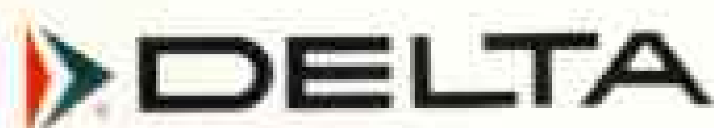

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