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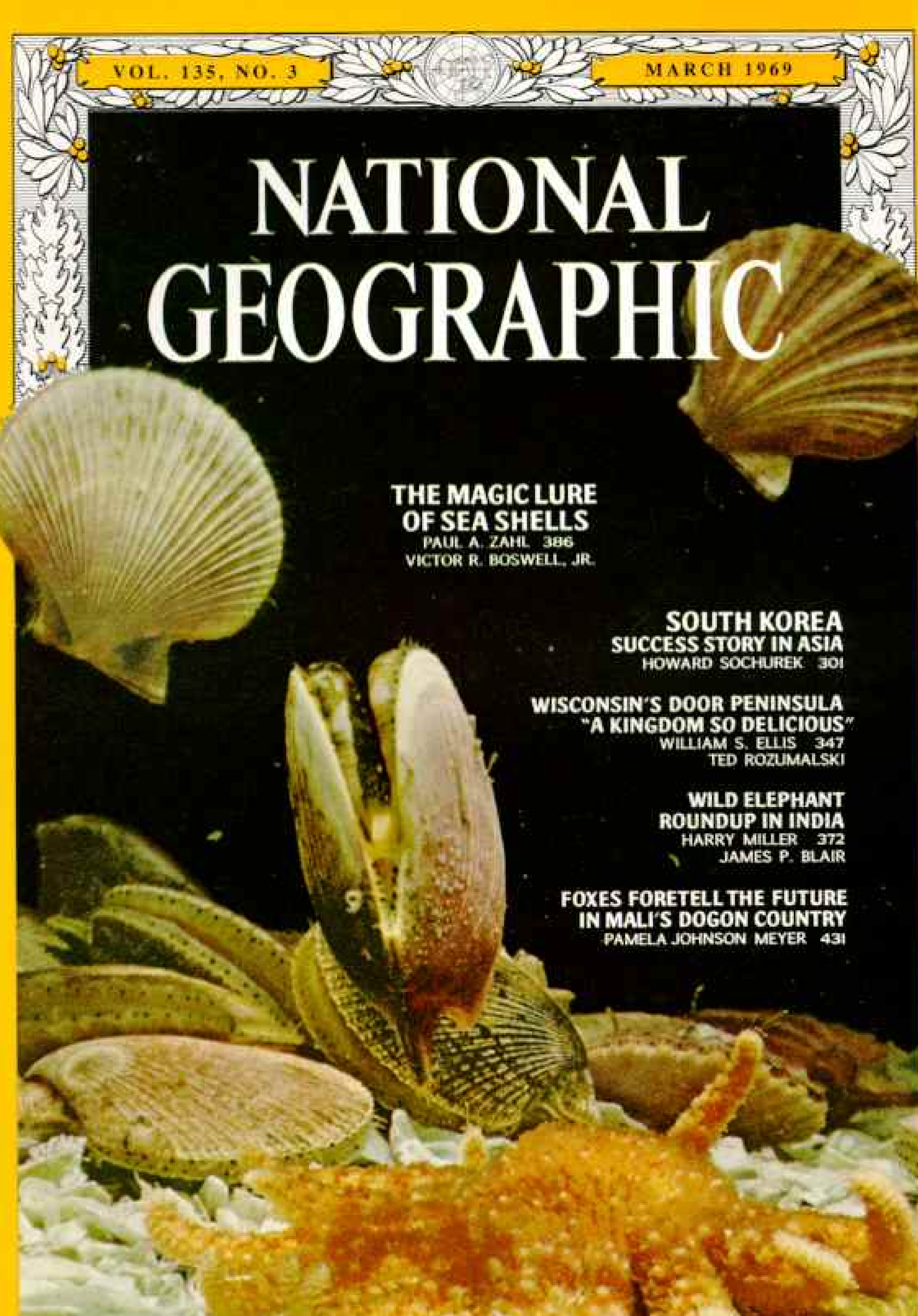
NATIONAL GEOGRAPHIC



THE MAGIC LURE OF SEA SHELLS
PAUL A. ZAHL 386
VICTOR R. BOSWELL, JR.

SOUTH KOREA
SUCCESS STORY IN ASIA
HOWARD SOCHUREK 301

WISCONSIN'S DOOR PENINSULA
"A KINGDOM SO DELICIOUS"
WILLIAM S. ELLIS 347
TED ROZUMALSKI

WILD ELEPHANT ROUNDUP IN INDIA
HARRY MILLER 372
JAMES P. BLAIR

FOXES FORETELL THE FUTURE IN MALI'S DOGON COUNTRY
PAMELA JOHNSON MEYER 431

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

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COVER: Frightened scallops jet frantically away from an invading starfish (pages 406-7).

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Snowflake, world's only white gorilla, takes up photography

ON HIS SUNNY PATIO at the zoo in Barcelona, Spain, the unique little albino makes a good-natured but determined attempt to seize the camera from the scientist studying his growth and behavior. Fending him off is Dr. Arthur J. Riopelle of Tulane University's Delta Regional Primate Research Center, who heads a National Geographic Society-sponsored study of West Africa's lowland gorilla.

World attention first focused on Snowflake in March 1967, when NATIONAL GEOGRAPHIC, in an article by Dr. Riopelle, announced the discovery of the two-year-old, 19¼-pound orphan in Rio Muni, then a province of Spain, now part of newly independent Equatorial Guinea. Today, at 4½, Snowflake weighs nearly 60 pounds and thrives on a carefully planned diet that includes yogurt, honey, and ham.

A future GEOGRAPHIC article will report on Dr. Riopelle's studies of Snowflake's development—one more scientific project supported by Society members through their dues. Let your friends participate by nominating them for membership below.

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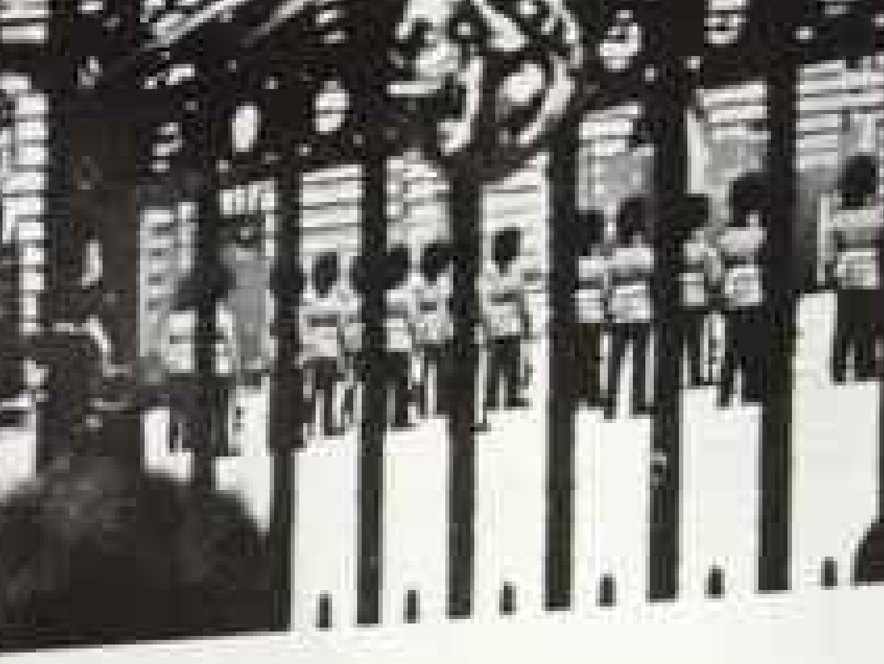

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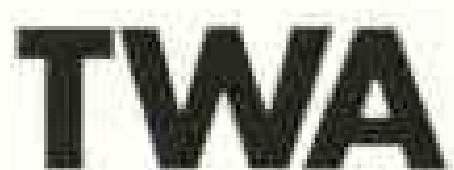

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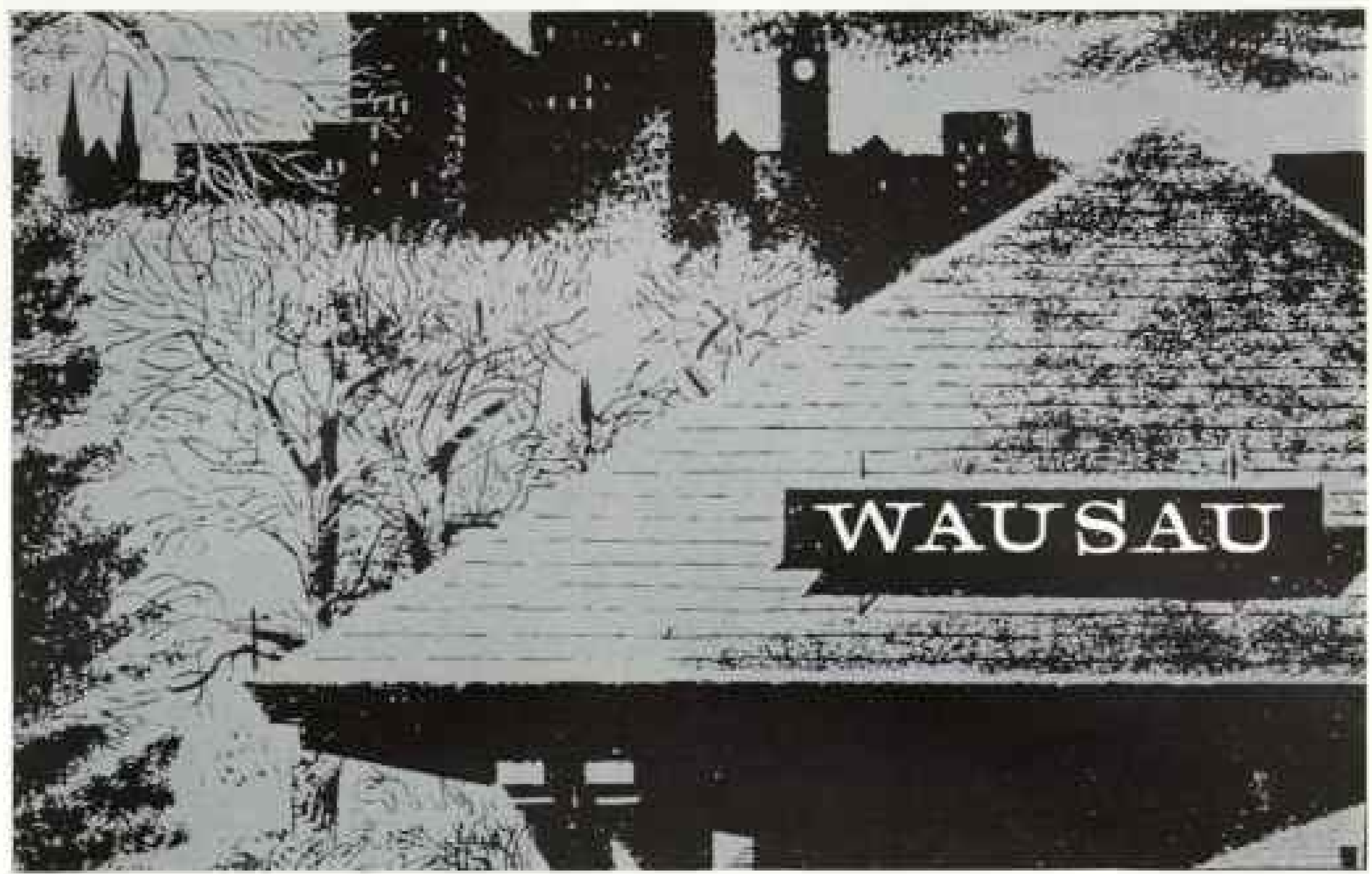

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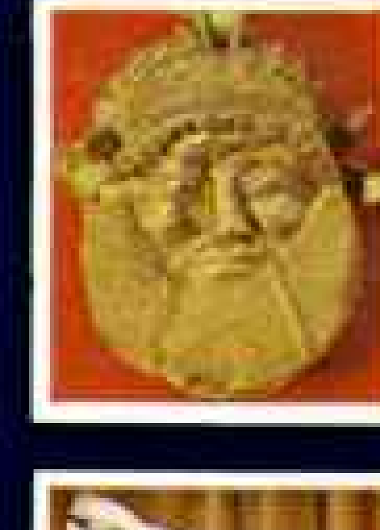

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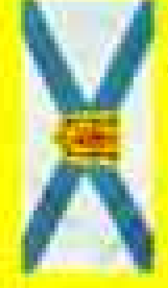

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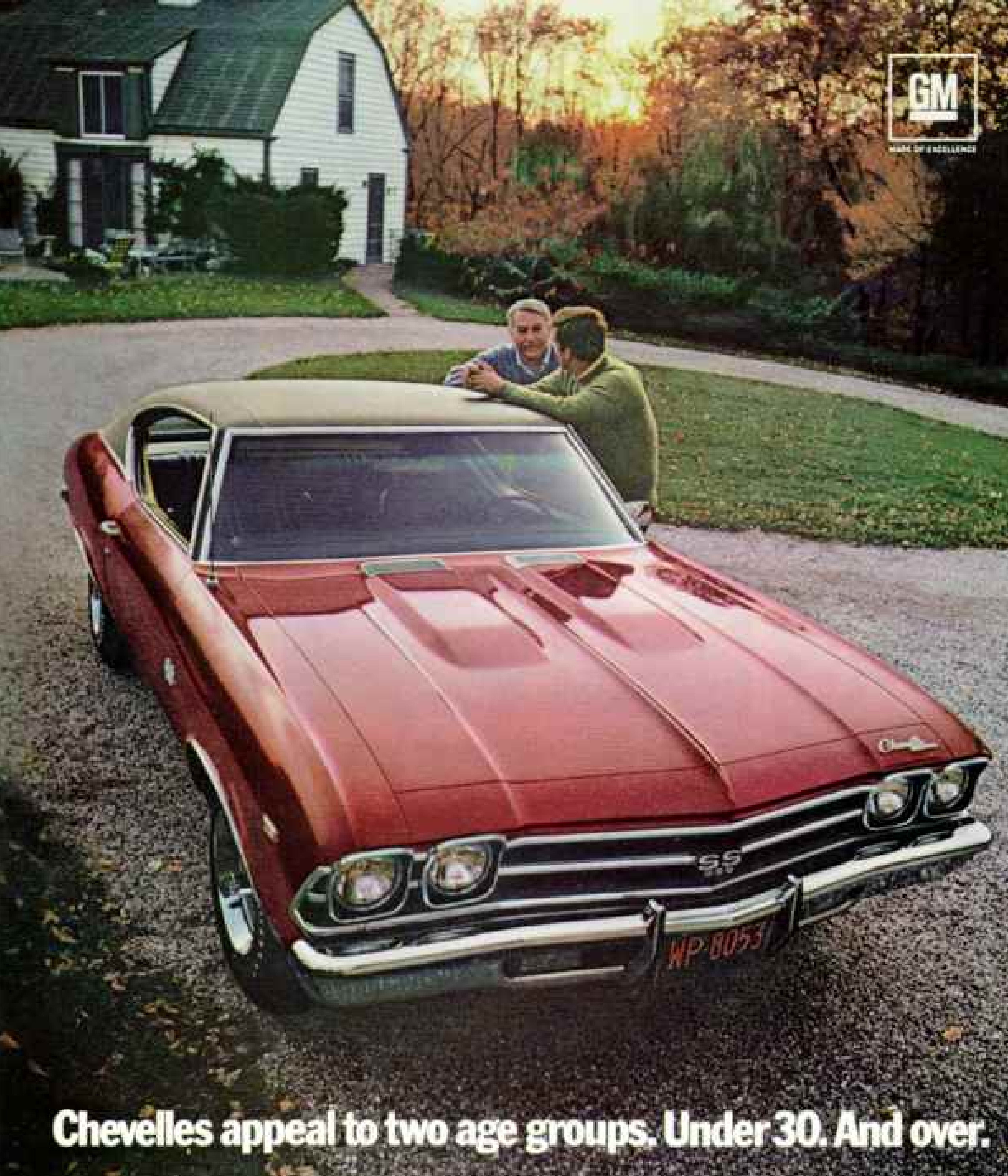

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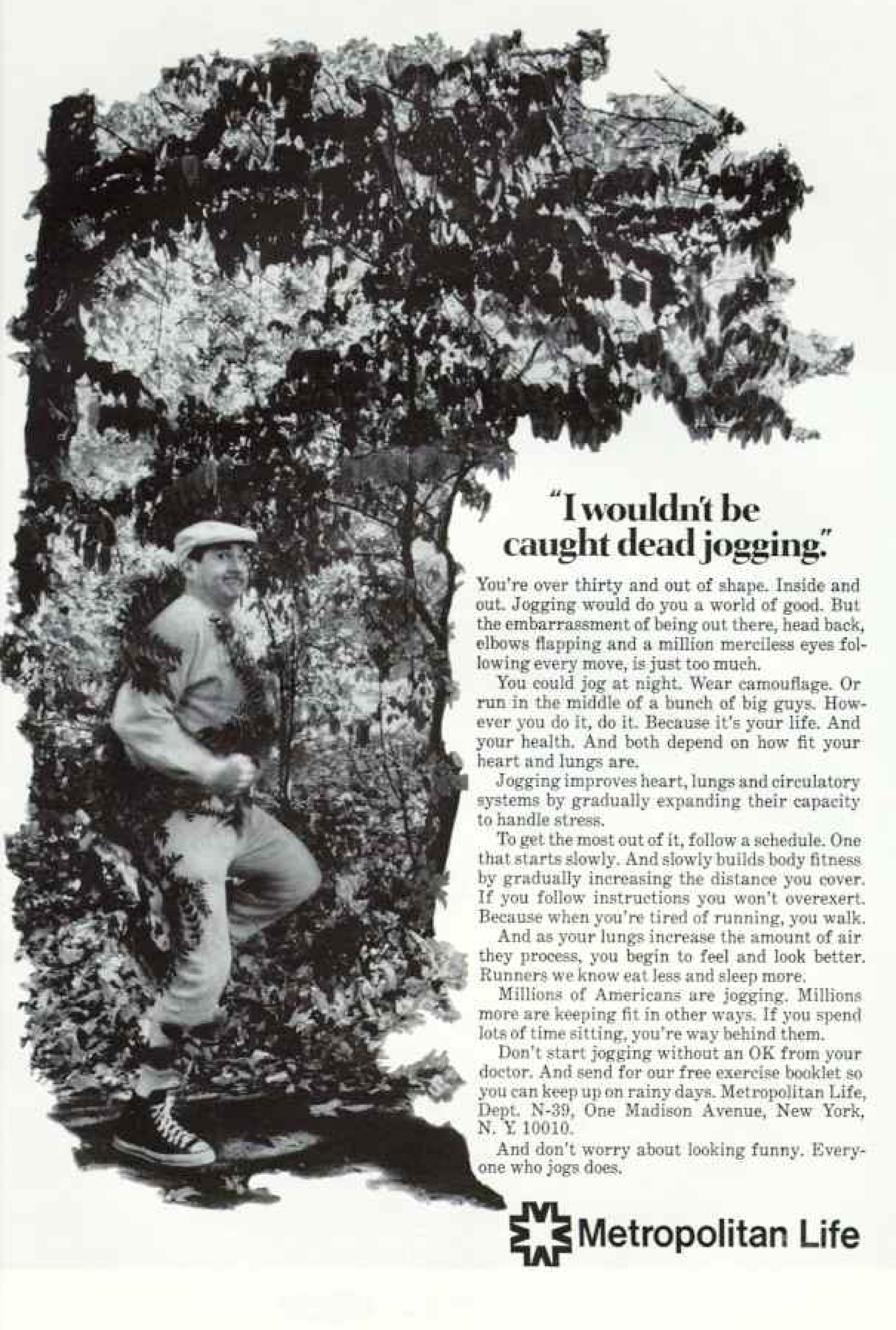
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South Korea

SUCCESS STORY IN ASIA

Article and photographs by
HOWARD SOCHUREK

THE ASSASSIN ordered Peking duck. He was a small man named Kim Shin Jo, aged 26. We were sitting in the warm upstairs room of a Chinese restaurant in Seoul, Korea. Three other men sat at the table with us, armed intelligence officers who had escorted the prisoner to this unusual secret interview.

Kim was the only man taken alive from a band of 31 members of the North Korean 124th Guerrilla Unit, who had infiltrated into South Korea six months before. Their assignment was to behead the President of the Republic of Korea, Park Chung Hee.

"We were given the mission to kill Park on January 13, 1968, by Lt. Gen. Kim Chung Tae," Kim told me (page 331). He spoke in a straightforward manner. "Our guerrilla unit has eight bases with about 300 men at each base. We departed one such base on January 16 about one in the afternoon, and reached the Demilitarized Zone at seven in the evening on the following day. Our team traveled in a military bus, with an escort jeep and a supply truck. We crossed the border on foot that night, without incident."

Keeping to lonely mountain trails, the assassination team made its way toward Seoul, 30 miles south. In the afternoon of the second day they surprised and captured four woodcutters. Some of the guerrillas wanted to kill them; others thought the simple woodsmen were too frightened to inform on them. They eventually let their captives go with a stern warning. It proved a fatal mistake. The woodcutters ran to a country police station, and Seoul security guards were alerted.

Aim: To Stop Progress, Bring Chaos

Spotted on the outskirts of South Korea's capital city, the assassins threw hand grenades at two city buses, wounding the driver of one and killing three passengers. Then they charged down the hill toward the Blue House, residence of the President. Seoul police opened fire on them, and the guerrillas, abandoning their mission, began to scatter. Twenty-eight were shot down. Two escaped. Kim Shin Jo was captured.

The Author: Four previous articles in NATIONAL GEOGRAPHIC, the most recent "Air Rescue Behind Enemy Lines" in September 1968, have carried the by-line of writer-photographer Howard Sochurek. In World War II he commanded a combat photographic team in Asia. In 1950, during the Korean War, he parachuted into North Korea at Sukchon, north of Pyongyang. Eighteen years later, he returned to Korea for the GEOGRAPHIC to report the dramatic recovery of this prospering but still-threatened "Land of Morning Calm."

Technology's weird temples awe a farmer wearing the traditional horsehair hat of a Korean elder. This modern refinery at Ulsan, processing crude oil from Kuwait, supplies all South Korea's needs; it sits in a huge industrial complex that will throb with nearly 100

EKTACHROME BY HOWARD SOCHUREK © N.G.S.

major installations by a target date of 1991. Throughout South Korea new mills and manufacturing plants, highways and housing projects quicken the tempo of life as the Indiana-size republic embarks on an industrial revolution reminiscent of Japan's in the early 1930's.

Now he sat across from me, in that incongruous social setting, telling me in matter-of-fact tones of the reason for the mission.

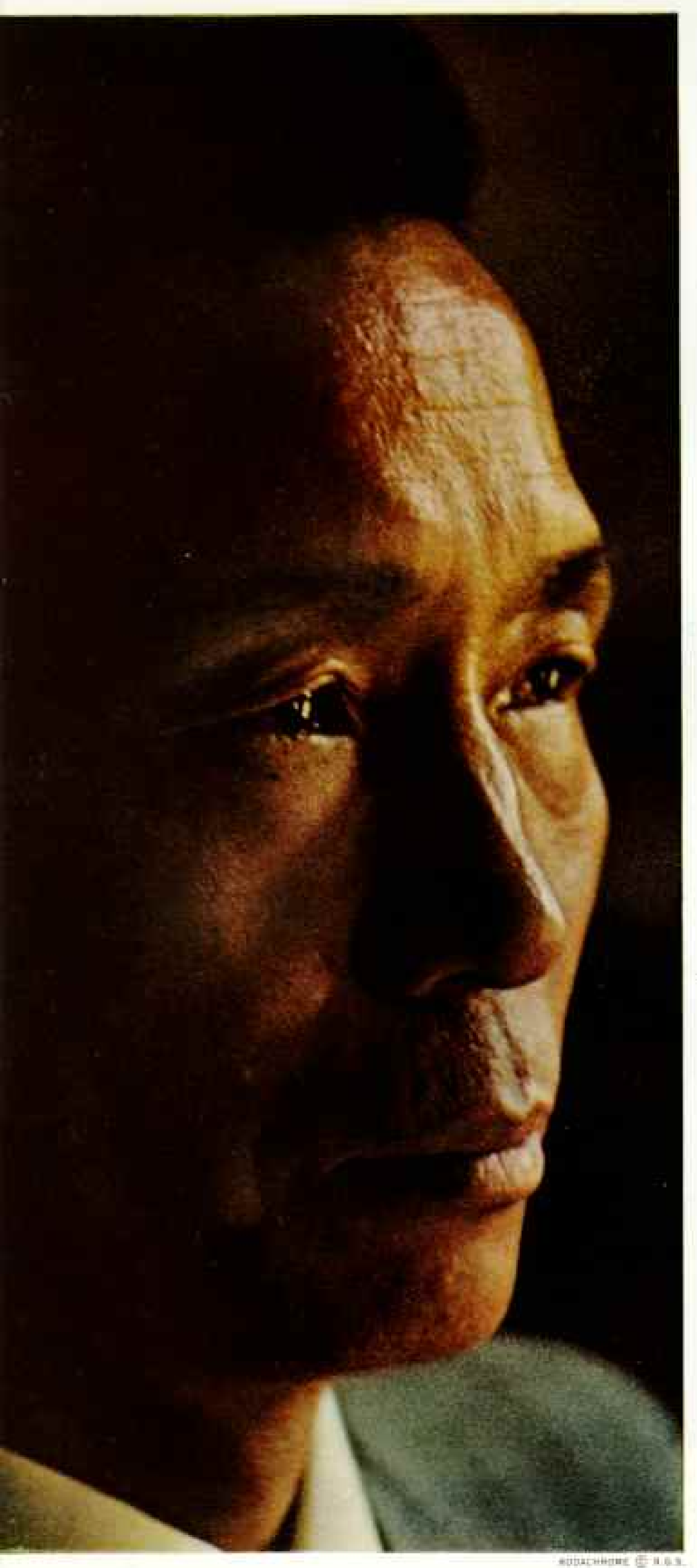
"We were told," he said, "that by eliminating Park, we would bring chaos to South Korea and inspire fear. We could stop the progress South Korea is making."

Kim had been instructed to destroy himself rather than be captured. He knew that his countrymen would now murder him if they could. I asked about his family—his mother, father, two sisters, and a brother.

"They are lucky if they are not executed by now," he said.

After the interview, Kim was led away. I walked the streets of modern Seoul back to my hotel, thinking about that doomed man, a hero-turned-traitor to the North, an assassin-turned-informer to the South. I thought, too, about what he had said. Communist North Korea's desperation is born of a simple fact—South Korea today, behind its forgotten battle front, presents a startling picture of success and progress.

I looked about me at the bright lights, the narrow streets crowded



"A fire burns inside him," says the author about Park Chung Hee, President of the Republic of Korea. Working an 18-hour day, the 51-year-old former army general pores over production charts and reviews blueprints for highways and industrial plants; at a moment's notice he boards one of two stand-by helicopters to make on-the-spot inspections. Because of his personal identification with Korea's progress, President Park lives in constant danger of assassination by agents of hostile North Korea (page 331).

Mirroring the intensity of their President, 12th-graders study chemistry in Seoul. Their Kyung Gi High School boasts a student body with an average IQ of 130. Learning holds a cherished place in Korea, with a culture rich in arts and invention and a written history at least 2,000 years old.

KODACHROME © N.G.S.

with shoppers, the busy restaurants. The contrast between the city of today and the city I had seen 18 years before was overwhelming.

In 1950 I landed at Seoul's Kimpo airport in an aged C-54 Air Force transport. In that city of 1,700,000, the stench of death and the rubble of destruction were everywhere. Orphans, their clothes black from gutter living, pleaded for food. Live wires dangled from severed trolley cables. My jeep dodged gaping shell holes in the dusty streets. By 1953 the city had shrunk to a million.

North Resents the South's Success

Today Seoul, with four million people, is a city transformed. As U. S. Ambassador William J. Porter told me, "All the energy that kept the Koreans from being destroyed over the course of centuries by their two great neighbors, Japan and China, is now being translated into achievement. They are literally building this city and land anew.

"There are two stories in Korea today," he concluded. "Remarkable economic growth—and increasing pressure from the North to try to prevent it."

How different was this note of optimism and progress, compared with so much of Asia. Yet the evidence for it was everywhere.

In Seoul I watched huge earthmoving tractors carving a new four-lane highway that will run the full 270 miles of the country from northwest to southeast, joining the capital with Pusan (page 315). An endless line of mixing trucks waited to pour concrete for a new 20-story office building, one of dozens that have revolutionized the skyline (next pages). Streetcar wires and rails were being removed in anticipation of a new all-bus transport system, planned for 1969. Right in the middle of the Han River, sand-suckers were building dikes for a new 700-acre island city.

Three busy bridges now span the Han. I became ensnarled on one in a huge traffic tie-up as workmen eased a 10-ton turbine across, bound for a new thermal power station.

Was this really the battered and blasted land I once had known?

"If you think Seoul is booming, take a look at Ulsan," Hamilton W. Meserve, head of the Seoul branch of New York's First National City Bank, told me. "The way things are going," he continued, "South Korea may one day pass Taiwan in per capita income."*

In a Korean Air Lines turboprop plane, I was soon bound for Ulsan with an interpreter from the Ministry of Culture and Information, Kim Kwang Sik—a brilliant linguist with a deep pride in his nation.

About a fifth of all Koreans are named Kim,

*See "Taiwan: The Watchful Dragon," by Helen and Frank Schreider, NATIONAL GEOGRAPHIC, January 1969.

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Caged by hills, new Seoul grows skyward

FOUR TIMES A BATTLEGROUND, Seoul emerged from the Korean War of 1950-53 a shattered shell, its million people facing famine. Today, transformed by native energy and foreign aid, the nation's capital, home to four million, presents a new and modern skyline.

In this view from Nam San (mountain), the National Capitol wears a dome at upper center. On a hillside at upper right stands the azure-roofed Blue House, the presidential mansion. Beside the curved façade of a new office building, left, scaffolding laces two unfinished hotels. Banks, insurance companies, and national headquarters of other businesses press shoulder to shoulder.

With 40 percent of the country's motor traffic clogging its streets, Seoul works to build a network of freeways. Above a laborer's handcart piled with sacks of rice (right), concrete pillars herald a 10-mile elevated speedway to Kimpo International Airport.

Yet despite its boom, Seoul lives in a shadow. Only 30 miles away lies the Demilitarized Zone, separating South and North Korea. Though a truce technically prevails, minor skirmishes across the line constantly threaten the uneasy peace.

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

Republic of Korea

PARTITIONING after World War II split the Korean peninsula into two worlds: the industrialized, Communist North—the Democratic People's Republic of Korea—and the agricultural South, today's fast-developing Republic of Korea (right). The name Korea—"high and lovely land"—derives from the medieval kingdom of Koryo. It aptly describes this verdant, mountain-ridged country.

AREA: 38,004 sq. mi. **POP.:** 30,410,000, more than twice that of North Korea. **RELIGION:** Buddhists, 3,970,000; Christians, 2,880,000; the remainder a melange of beliefs, including Confucianism. **ECONOMY:** Rice, barley, fishing. Large tungsten deposits. Food processing, cement, textiles. **CITIES:** Seoul, capital, 4,160,000; Pusan, port, 1,640,000.

and most of the others seem to be named Lee, Choe, or Kang. The custom goes back many centuries to the time when family clans dominated Korean life. Koreans call themselves by what, to American ears, sounds like the reverse order—the clan, or "family," name first. Thus President Park, whom Westerners would call Chung Hee Park, is properly Park Chung Hee.

Below our wing the Korean peninsula—a lightning rod of political storms throughout Asian history—stretched southward between the glinting waters of the Yellow Sea and the Sea of Japan (maps, opposite). Mountain after mountain, many of them bare and brown, rumpled the landscape. Little larger than the State of Indiana, South Korea covers only 38,000 square miles, and scarcely a quarter of it is flat enough to farm.

Kim grew up in a village, knew the vicissitudes of war in his homeland, gained a hard-won education, and is now part of the driving spirit of a fast-modernizing nation of 30 million people.

"Our great resource is the human one," Kim said. "We must compete with more

Heavy armor and mighty sword identify Adm. Yi Sun Sin, whose statue overlooks Seoul's busy Sejong Avenue. Commanding the world's first ironclads, the national hero crushed a Japanese invasion fleet in 1592.

KODACHROME © N.G.S.

THRUST TEMPTINGLY between great powers, Korea has long been a pawn. After World War II, the 38th parallel became the boundary between North and South. A cease-fire line took its place after the Korean War.

Hustle plus muscle equals a gleaming polish for a Shinjin. Sixty such cars a day roll off the assembly line of the Inchon factory, which uses many Japanese Toyota parts. Though the autos cost the equivalent of $3,000—about five years' salary for one of these workmen—the plant already has a backlog of 7,000 orders. Lured by the market, Ford and Fiat will open assembly plants this year.

With swatches of human hair, a pigtailed girl fashions a wig. Worth $50 or more in U. S. shops, machine-sewn headpieces sell for only $9 at this factory in Seoul. Skilled but inexpensive labor—Korea's most abundant resource—attracts increasing numbers of foreign investors.

Face to face with an inferno, a sweating steelworker tends an open-hearth furnace at the Inchon Heavy Industry Corporation. Largest steel producer in the nation, the plant disgorges an annual 120,000 tons. Fed by iron ore found recently near Chaun, Korean steel production soars.

highly developed nations by using our great reservoir of industrious people."

Ulsan came as a shock to me. An entirely new industrial complex was laid out near the old city in 1962. Two billion dollars—much of it investment, both public and private, from the United States, Japan, and West Germany—went into a five-year plan. Kim Kwang Sik and I drove out from old Ulsan to see the result.

Huge industrial structures sprawled across the hills and valleys rolling toward the vast new port complex. Here ten completed plants refined oil (pages 302-3), made fertilizer, rayon, nylon, and asphalt, produced caustic soda (a basic ingredient in soap, rayon, and paper), and manufactured chemicals. An ambitious new five-year plan, to cost six billion dollars, is moving Ulsan closer to its goal of 96 industrial plants by 1991.

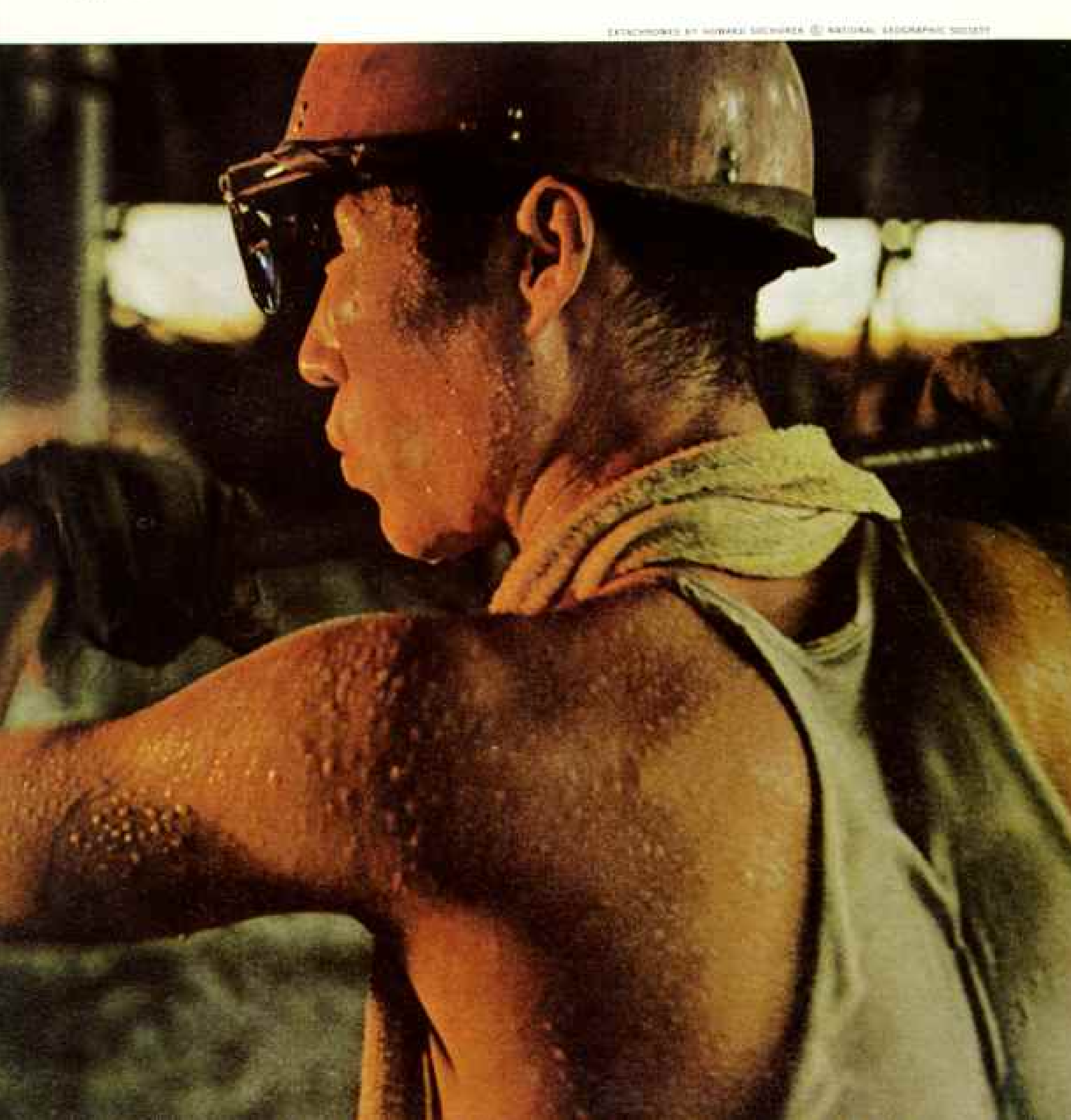
"What we are looking at," said Kim, "is the beginning of South Korea's Pittsburgh, its Essen, its Osaka."

Dried Squid and Fermented Cabbage

Foreign investors have had cause to be happy with their gamble on South Korea's future. One American oil company took a $5,000,000 share of Ulsan's $20,000,000 refinery in 1964 and has since, in four years, recovered twice its investment.

We went on to Pusan, South Korea's second largest city and largest port. My room at the year-old eight-story Keukdong Hotel looked

EKTACHROMES BY HOWARD SOCHUREK © NATIONAL GEOGRAPHIC SOCIETY



out onto the Sea of Japan, which Koreans call the East Sea. Japan lies only 120 miles southeast (inset map, page 309).

A fresh ocean breeze blew in. Below, clean white beaches welcomed crowds enjoying the August holiday season (pages 316-17). Kim and I joined them, stopping in a small restaurant for a favorite Korean snack—dried squid and beer. Others were enjoying the national dish, *kimchi*, made chiefly of fermented, highly spiced Chinese cabbage.

Relative wealth, the relaxation of a hardworking middle class taking time out from years of hardship and war, a feeling of well-being—these impressions drifted through my mind as I strolled the beach near Pusan. I thought, too, that in the United States today half the population is under 25—and thus half my countrymen have only the dimmest memory, if any at all, of the beachhead at Pusan in the dark days of the summer of 1950.

Korea was divided at the 38th parallel after World War II. The nine million people of the industrialized North, occupied by the Russian Army, quickly fell under Communist domination. The South, with 19 million—chiefly farmers and fishermen—was administered by the United States Army until 1948, when the Republic of Korea was formed.* Syngman Rhee, who headed a provisional government in the United States, returned to Korea and was elected president.

On June 25, 1950, the North Korean premier, Kim Il Sung, sent armor and infantry

*See "With the U. S. Army in Korea," by Lt. Gen. John R. Hodge, NATIONAL GEOGRAPHIC, June 1947.

across the lightly defended parallel. It was an act of premeditated and unprovoked aggression. While the United Nations met, United States military personnel joined South Korean troops in a futile attempt to stem the advance. Desk clerks and file clerks grabbed unfamiliar carbines and went to the front.

Seoul fell after only three days. The North Korean columns streamed across the peninsula, pushing the South Korean Army and the U. S. 24th Infantry Division before them toward the Sea of Japan. Finally, only a congested beachhead around Pusan remained, and there the defenders hung on grimly.

Now the waves near Pusan lapped peacefully on the beach. The lights of fishing boats bobbed toward the horizon, on their way to a night of squid fishing.

That way, too, had gone the ships that carried an assault force commanded by Gen. Douglas MacArthur in September 1950. In a brilliant tactical stroke, he moved a United Nations force around the entire Korean peninsula and landed at Inchon, 20 miles west of Seoul and deep behind the Communist lines ringing Pusan.

Seizing the initiative, MacArthur's troops quickly recaptured Seoul. The enemy ring around Pusan broke and reeled backward. The U.N. army—men of 16 nations in addition to the South Koreans—swept northward, into and beyond the North Korean capital of Pyongyang, as far as the Yalu River, the boundary between Korea and Red China.

Hundreds of thousands of Chinese troops then poured into the war, and it continued to rage for three long years. The bitter hill-to-hill struggle cost an estimated one million lives. In 1953 came military stalemate and an armistice. A no man's land—the Demilitarized Zone, or DMZ—was drawn between the positions of the armies, roughly at the same parallel that divided the country before the North Korean invasion. It has been so divided ever since.

East-West Partnership Pays Off

Korea's present prosperity began with a marriage of American capital and Korean energy. Since 1953 the United States Government has granted almost four billion dollars in economic assistance, in addition to military aid. In recent years, the trend has been toward loans for electric power, water supplies, credit institutions, and industries.

At the end of World War II, when the long Japanese occupation of Korea ended, the port of Pusan counted 280,000 people. Today more than 1,600,000 crowd the city.

Housing and water problems have been severe. Unemployment was running at about 8 percent last summer, but the city was spending 65 percent of a $40,000,000 annual budget on new housing and resettlement.

A clutter of shanties covers the surrounding hillsides, while the downtown area is dusty, noisy, and congested. A bus assembly plant and shipyards and docks that handle

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Seagoing buses at Inchon load and unload rush-hour passengers. The ferries plow the Yellow Sea, carrying workers to and from offshore islands. Currents generated by Inchon's turbulent 30-foot tides have sometimes capsized overloaded craft.

more than six million tons of freight a year make Pusan a bustling, energetic place. But some things, like fried ants, still remind visitors of older ways of life.

The ants—big red ones collected in the surrounding hills—scramble around in the glass jars of street merchants. The more adventurous among Pusan's gourmets still buy them at 30 cents a handful, wrapped in newspapers, and carry them home alive. Sauteed lightly, they are considered a delicacy.

Confident Land Under Constant Menace

All of Korea's progress has not been financed by government grants. Private money has come as well. I found one of the best examples at the Tong Myung Timber Company, a plywood manufacturing firm at Pusan. Mr. Lim Myun Jae, production director, told me the story as we watched huge blades peel pine trees down to thin sheets of wood, much as a knife peels an apple skin. Several sheets glued together make plywood.

"A vice president of the Evans Products Company of Portland, Oregon, came to Korea in 1961," Lim Myun Jae said. "He met our president, Mr. Kang Suk Chin, and they decided that timber from the Philippines and from northern Borneo could be made into plywood with Korean skilled labor and sold at a profit in the United States. Now, seven years later, we provide jobs for 6,000 people and are producing $25,000,000 worth of plywood a year. We believe it will reach $50,000,000 by 1970. We have grown together, because we have confidence in one another."

I looked out across the small bay near the plant to the United Nations Memorial Cemetery, with its precise ranks of grave markers bearing the symbols of many religions and nationalities (page 335).

"Are you concerned about another invasion from the North?" I found myself asking.

"In this plant," Mr. Lim replied, "we have 13 militia companies, equipped to fight. We will defend our plant."

Everywhere I traveled, I found South Koreans conscious of the threat from the North. The Communist regime of Premier Kim Il Sung keeps constant pressure on South Korea through infiltration and subversion.

One night, after returning to Seoul, Kim and I tuned in to Radio Pyongyang, transmitting from the capital city of North Korea. Precisely at midnight a coarse feminine voice announced in Korean: "I'm going to begin my broadcast. Please find paragraph one of chapter eight."

She was referring to the code book used by North Korean agents who had made their way into the South. Two minutes of blaring martial music followed. The choice of tune also gives information to the agents.

The voice came on again and, in a deliberate manner, announced, "Eight . . . five . . . two . . . four . . . one. . . ." Then came a break of three or four seconds, and again a series of five digits. After three or four such groups, she repeated all the digits.

It felt strange to think that maybe in the same hotel, in the next room, or next house, an agent might be listening to instructions for a new assassination attempt. The slow recitation of numbers continued for 10 minutes. Then came another military march, followed again by the five-digit code.

Pawn of Powerful Neighbors

As I listened, I thought about Korea's sad history: invasion, threat of invasion, infiltration, continuous vigilance to preserve hard-won independence.

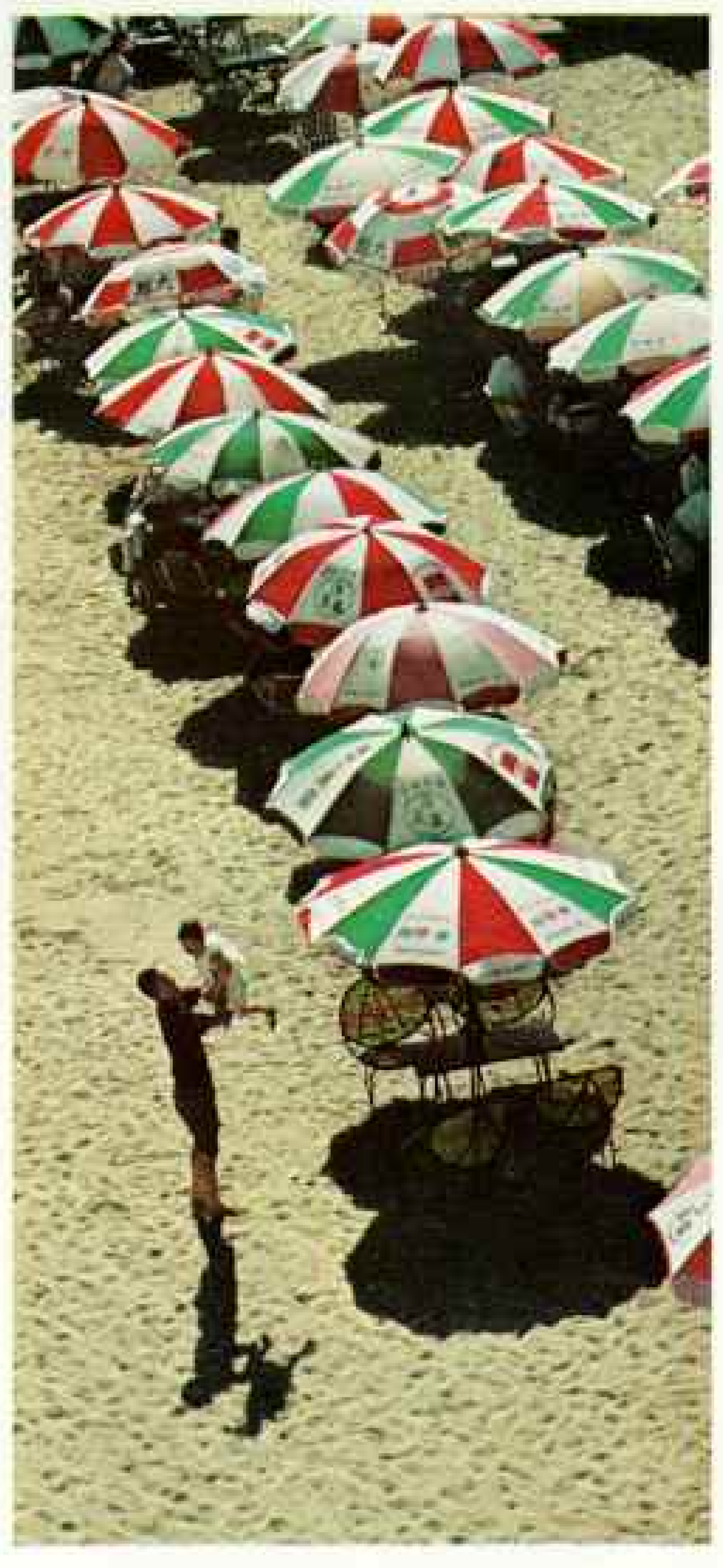
The first known peoples to find Korea migrated south from the forests of Siberia and the plains of Manchuria. They were nomadic hunters and gatherers thought by scholars to be a branch of the Tungus, a Mongol people. Those who reached the southern part of the long tongue of land stretching between the seas were called the Han.

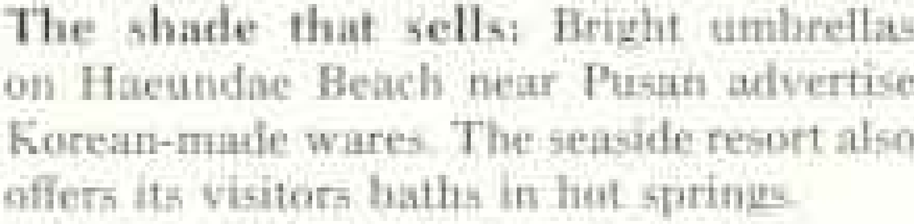
They found rich soil on the coastal plains and in the river valleys and became an agricultural people divided into three main tribes, the Mahan, the Chinhan, and the Pyonhan. Their northern cousins, the Koguryo, remained for a time hunters of deer and bear and other animals that inhabited the cold, forested mountains of the north.

An ancient name for Korea, Choson, means "land of morning calm"—a state of beatitude

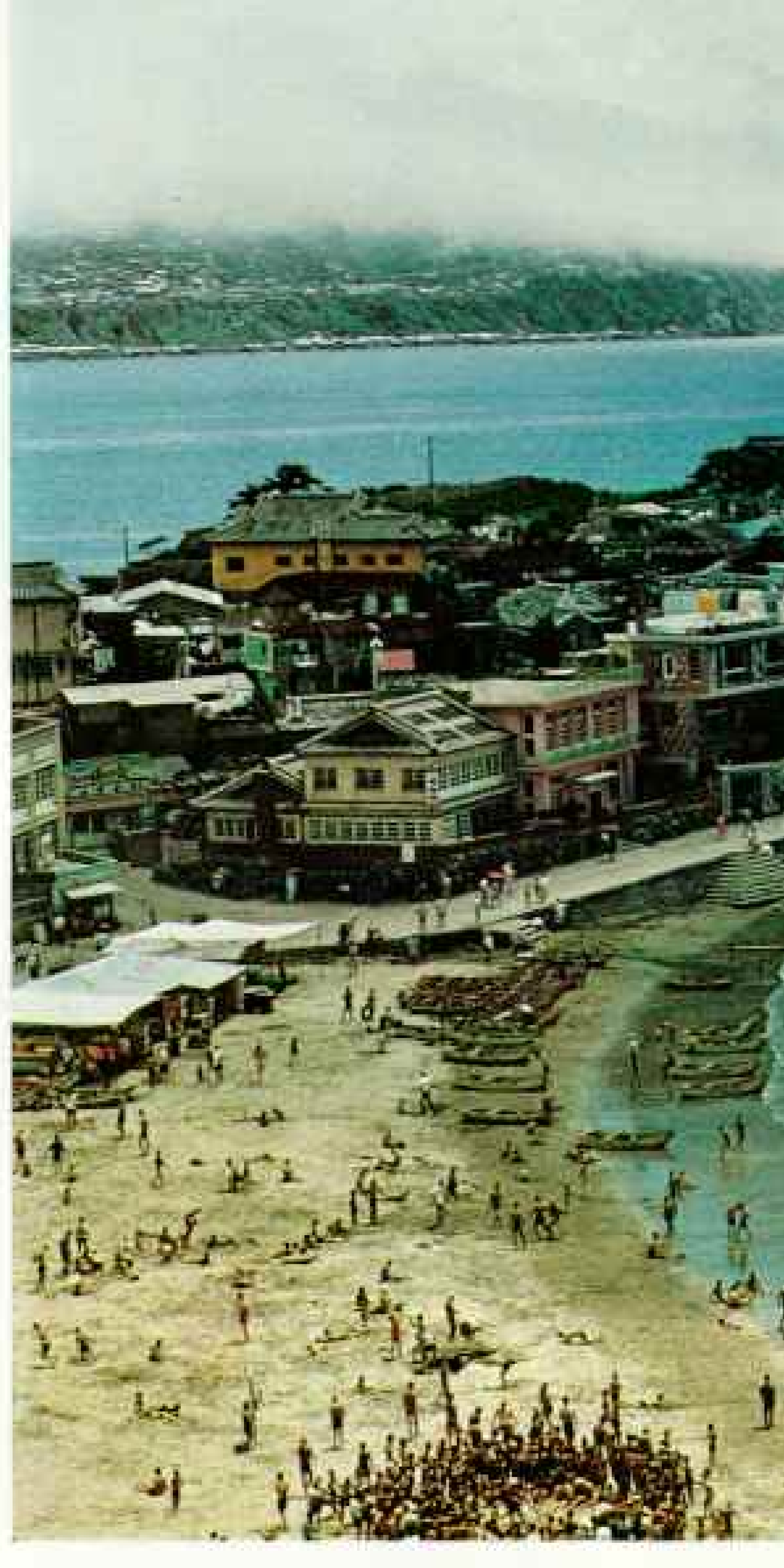
Tying a nation together, a four-lane expressway-in-the-making slashes past a village 20 miles south of the capital. A favorite project of President Park, the 270-mile-long artery connecting Seoul and Pusan will cost South Korea $122,000,000, making it the greatest single effort of the striving land. When completed in 1970, it will transform the countryside, putting village labor and produce within reach of big-city markets.

EKTACHROME © N.G.S.





The shade that sells: Bright umbrellas on Haeundae Beach near Pusan advertise Korean-made wares. The seaside resort also offers its visitors baths in hot springs.



Blue-water playground of Pusan, Songdo Beach swarms with school children in August; January is their other vacation month. Huddle in the foreground plots a game of leapfrog.

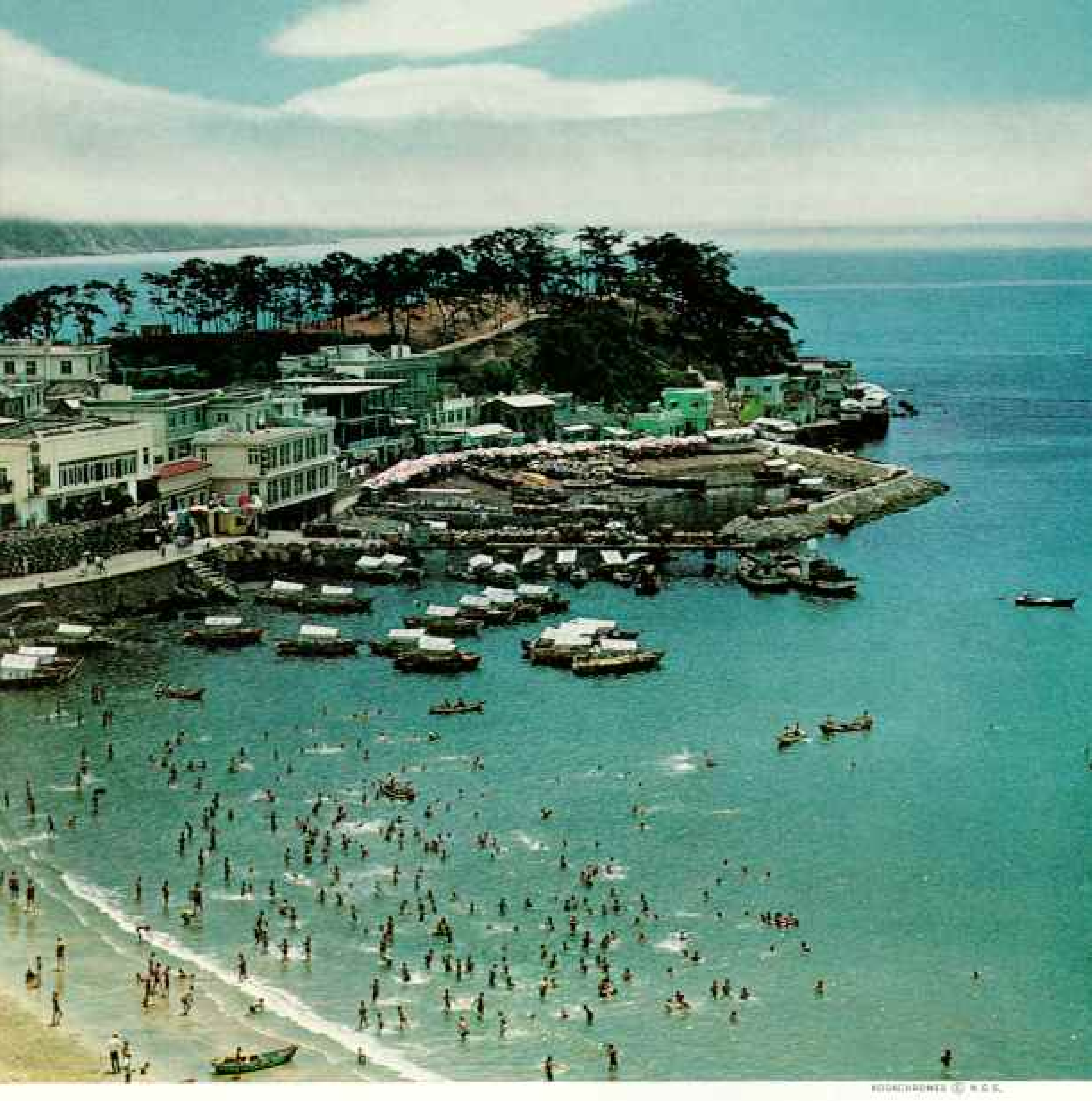
seldom achieved in the turbulent centuries that followed. For, unknown to these early Koreans, they occupied a strategic region amid what were to become great and ambitious powers—China, Russia, and Japan.

The Han tribes of the south established competing kingdoms called Silla and Paekche. The Koguryo of the north established a third kingdom, bearing their tribal name.

For seven centuries the three kingdoms of Choson fought each other and outside invaders, until Silla prevailed and unified the country in 668. Then came a time of glory. The arts flourished, inspired largely by the state religion of Buddhism. Poets sang "songs of the east"—that is, native lyrics rather than imitations of either Chinese or Japanese styles.

Invasions Sweep Away Kingdoms

The kingdom of Silla in 935 gave way to a rebellious chief, Wanggon, who founded the kingdom of Koryo—from which the modern name Korea derives. But the destiny of this crossroad of conquerors was fixed. Less than a century later, Manchurian tribes came down upon Koryo. They were followed by Mongol



KODACHROMES © N.G.S.

Crowding a finger of land inside the city limits, Songdo offers hotel accommodations for 3,000 sun-seekers. Beyond the fog-shrouded peninsula in the background lies the huge natural harbor that makes Pusan the nation's chief port. In 1950, during the Korean War, Allied forces retreated southward to this city, here making a last desperate—and successful—stand.

hordes, sweeping through the northern valleys to the fields of the south. The Koryo king submitted, and his successors accepted Mongol wives. Kublai Khan attempted two invasions of Japan from Korean ports—a lesson in geography the Japanese never forgot.

In 1392, a great Korean appeared in the figure of Gen. Yi Song Gye. He overthrew the Mongol-dominated Koryo king and ascended the throne himself. The dynasty which bears his name was to rule until 1910. The land was again named Choson (outsiders called it Chosen), with its capital at Seoul. As before under the Silla kingdom, a renaissance of Korean culture came with independence. A Yi king, Sejong, devised a near-perfect phonetic alphabet called *hangul*, used today. Movable metal type was in use here in 1403, half a century before Gutenberg printed his Bible.

During a dark era known as the "fifty bloody years," Korea suffered two more invasions. The troops of Toyotomi Hideyoshi, shogun of Japan, attempted to seize the kingdom in 1592 but finally withdrew after seven years of conflict. A Korean hero, Adm. Yi Sun Sin (page 308), fought and won a famous

naval engagement using history's first ironclad ships, shaped like turtles.

No sooner had the Japanese withdrawn than the Manchus invaded from the north, and Korea's Yi kings became more or less willing vassals of the Manchu dynasty in China. In time, the country's doors were sealed against the world, which henceforth knew the "Hermit Kingdom" chiefly from tales brought back by shipwrecked sailors.

Still more wars were to be waged over Korea. In 1894 Japan fought against China for control of the peninsula. Japan, the victor, agreed to guarantee Korean independence. Its failure to do so, among other reasons, led to the intervention of Russia in the struggle for Korea. The Russo-Japanese War ended in 1905 with complete Japanese occupation of the country and its subsequent annexation, which lasted until after World War II.

Thus, throughout most of its history, Korea has been dominated either by China or by Japan, or has been a battleground. With the exception of its brief days of independent glory under the Silla kings, and later the Yi dynasty kings, Korea has been a nation with a foreign yoke on its neck.

Now the voice of yet another threat—the calm, measured tones of Radio Pyongyang, reciting coded instructions to spies—filled my hotel room. At 1 a.m. the station signed off and Kim left, but I sat for a long time listening to the night sounds of the city.

Expatriates Gather at the Seoul Club

Few foreigners have survived much of modern Korea's turbulent history, but I found one man who had. I tracked him down at the Seoul Club, social headquarters of foreign expatriates in Korea. The building, a turn-of-the-century red-brick residence with queer gables and towers, is reached through a narrow alleyway. The manager, a Basque named José Serra, provided me with guest card No. 6889. A few moments later, No. 6889 met No. 2, a graying Englishman, short and stout.

"Cheesman," he said, extending his hand, "Squadron Leader, Burma, 1944."

W. Gifford Cheesman—known inevitably as "Cheesey"—came to Korea in 1931 as a young mining engineer. Gold brought him, and gold has kept him there.

"I worked at a gold mine at the village of Taeyudong, in what is now North Korea. Then the Japanese rulers started arresting foreigners. That was in September 1939, when Hitler moved on Poland. I escaped from Dairen, Manchuria, just ahead of a prison camp."

"Why did you come back?" I asked him.

"My father had an interest in a gold mine on Yongjong, an island off Inchon. I wanted to work it. Profits in the 1930's had been running at 15 and 20 percent. I have since spent everything trying to reopen the mine."

Tuned in to teaching machines, electronics-age students study a taped English lesson in Seoul's Kyung Gi Middle (junior high) School. Faced with a staggering illiteracy problem after World War II, South Korea mounted an educational effort that has now cut the rate to 10 percent.

Bare and beaming, boys take a break from swimming off the rocky island of Cheju, 30 miles south of the mainland. Soon they may have to earn their living aboard some of the island's countless fishing craft. Wind-swept Cheju served as a steppingstone for the Japanese in their 1931 invasion of Manchuria.

Abandonment during World War II had rusted the machinery and filled in some of the shafts. Muck had come in on high tides near Inchon. Cheesey employed special equipment to clear the mine. Then the North Koreans invaded the South. Now Cheesey, in keeping with the tradition of his adopted homeland, is starting all over again.

"Viewing things in a perspective of 37 years," he said, "I say things have never been so good as they are right now. I see more opportunity here now than ever before."

I wondered what opportunity meant to both the high and the low. I sought out, first, the richest man in modern Korea—Lee Byung Chull, or B. C. Lee. He is the chairman of a holding company, the Samsung Moolsan Co., Ltd., which includes more than a dozen major manufacturing enterprises. He also owns one of the 35 major daily newspapers and one of the two television networks that serve the country, which in two decades has become 90 percent literate.

Mr. Lee received me in his mahogany-paneled fifth-floor office in a newly built air-conditioned building in downtown Seoul. We sat at a huge, polished ebony table.

I asked him about the concentration of industry in the hands of a few people in Korea. Puffing on a cigar, he answered: "There certainly exists such a trend, but this is only a part of the story. You see, government steps in when growth becomes too great. Government control is necessary in the field of economic planning, but I do not feel there is excessive control. Government and industry are like husband and wife; President Park relies on industry for development."

"Who is responsible for the economic growth of modern Korea?" I asked.

KODACHROME AND EKTACHROME (RIGHT) BY HOWARD SOCHUREK © N.G.S.

Up for air, abalone diver Koh Doo Sim suspends her catch of meaty mollusks from a float. Women of Cheju Island can descend to depths of 45 feet and hold their breath for more than 2½ minutes.

Hung out like family wash, squid dry on lines at Sokcho. Fishermen of the east-coast port catch thousands of tons of this Korean favorite a year. Until the 1950-53 war shifted boundaries, Sokcho belonged to the North.

"President Park," Mr. Lee replied without hesitation. "He has built up the people's confidence in themselves. We feel we can stand on our own feet. He has a great obsession for modernization of the country. If one day our children ask what we have done for our country, we can proudly say we worked for its modernization."

Prices Soar Between Seoul and States

It was, in fact, a child who completed my economics lesson. She was a thin girl from a country village who worked in a wig-making factory and lived in a nearby dormitory with dozens of similar companions. The thought crossed my mind that she might have made one of the wigs I had seen on fashionable women at New York social affairs.

The factory is in a new building on the outskirts of Seoul. Human hair arrives from India and Indonesia in large cloth bags. The girls sit on the floor to sort it for length and texture, then dye, wash, and comb it. The more expensive wigs are hand-sewn onto cloth caps, an operation that might take 30 hours. Most are machine-stitched (page 310). The wig one can buy at the factory for as little as $9 costs $50 and up in the United States.

It is the kind of product—inexpensive materials worked by inexpensive hand labor and sold at high prices—that has been a boon to the Korean economy. About $100,000 worth of wigs were exported in 1964. Four years later the trade had skyrocketed to $28,000,000, almost all to the United States.

I stopped and chatted with one girl. She had been sent to town from her village only a short time before. Her father was a fisherman. I asked her how she liked her new life and her job, in which she earned 9,000 won,

or $33 a month. A small, sad tear trickled down her cheek.

In time, I knew, she would grow out of her homesickness. In the village, her marriage would almost certainly be arranged for her, and she would move into the house of her mother-in-law—not always a happy situation. In the city, she might have an opportunity to find her own mate.

I later asked my friend Kim about the role of women in Korean society.

"Women have a different place here," he said. "When a man calls his wife, it is never by name. He says, *'Yobo!'*"

"How does that translate?"

Echo from the past: A chimer plays a *pyen-chong*, a battery of 16 bronze bells of different tones first used in the 12th century. Dressed as an early court musician, he performs at the National Classical Music Institute.

Splendid as a peacock, a folk dancer entertains American visitors at Seoul's Korea House. Though classical steps yield to those from the West in the cities, villagers cling to folk dances, usually performed separately by men or women. Korea House, a government-run hospitality center, presents a capsule view of the nation's culture through displays of its arts and foods.

"Something like, 'Hey, you.'"

"Suppose the arranged marriage doesn't work out; suppose they don't like each other?"

"It would be a disgrace to desert the husband. No, the bride becomes part of the new family and may never return to her own."

I thought about the girl in the wig factory. Would she one day share Mr. Lee's pride in the modernization of the country, or would she think that the old ways were still the best?

Korean Prince, American Citizen

In search of the old traditions, I visited the youngest living descendant of Korea's royal family (page 329). Yi Kyu, aged 37, lives in Changdok Palace, at the foot of one of the hills ringing Seoul, where his uncle and his grandfather lived and ruled.

One Sunday he welcomed me at the palace gate. "Come in," he said. "It's always nice to see a fellow American."

I discovered that Prince Yi, an American citizen, was educated in architecture at the Massachusetts Institute of Technology. A former designer for the noted New York architect I. M. Pei, Kyu, as he prefers to be addressed, married a Pennsylvania girl, the former Julia Mullock.

In 1963 Kyu's ailing father returned to Korea after many years of seclusion in Japan. His illness became critical, and his only son turned his back on a successful and affluent life in New York and returned to Korea—an act that emphasized to me the burden of tradition and history that the eldest son of every Korean family must bear.

"My interest now is in the preservation of Korea's great cultural monuments," Kyu said. "I had to complain to the government last week about a highway, being built around Seoul, that was cutting right through a century-old shrine that ought to be preserved."

Kyu took me on a tour of his palace, an experience I'll not soon forget.

We visited the Chong Myo, the ancestral shrine on the palace grounds, which the Prince thinks is architecturally the most important building in the country. The original building dates from 1395; rebuilt in 1870, it contains ceremonial rooms honoring 49 Yi dynasty kings and queens.

At the back of this long, low building was one solid wall of brick, almost 200 feet long. It bore no load, had no function other than an esthetic one. It symbolized, according to Yi Kyu, the continuity of the dynasty.

Prince Yi finished his tour by showing me his private garden. It was on a lovely hillside

behind a single-storied, moss-covered, tile-roofed house whose wooden columns were streaked with white salt. Before building with wood, Koreans soak it in salt water to preserve it.

Kyu pointed out that four seasons had been built into the garden. For winter, the evergreen; for spring, the azalea and the blossoming cherry; for summer, water lilies; and for fall, the persimmon. Here and there a piece of upright volcanic stone, some six feet in height, jutted from soft beds of clover moss.

I was reminded of a famous Korean poem, the "Song of Five Friends," written by Yun Son Do in the 17th century:

How many friends have I? Count them:
Water and stone, pine and bamboo—
The rising moon on the east mountain,
Welcome, it too is my friend.
What need is there, I say,
To have more friends than five?

As I left Prince Yi that Sunday in late summer, he remarked, "This palace and the Chong Myo are the national treasures of the Yi dynasty. Remember, Seoul in a way is an old village, and I hope this village feeling stays. When the city loses this feeling, the city ceases to exist."

Hot War Burns Along the DMZ

As it has been at so many times in its history, the "old village" of Korea is again under attack. A deadly cat-and-mouse war continues along the Demilitarized Zone separating the two Koreas (map, page 309).

Early one Monday morning I loaded my cameras and myself aboard a big olive-drab army bus that lumbers north from Seoul. On the South Korean side of the DMZ, which runs for 151 miles from the Sea of Japan to the Yellow Sea, is a well-built barrier fence, bordered in depth by defensive mine fields. The DMZ is two and a half miles wide. A road

Elite of entertainers, *kisaeng* girls stroll in the garden of graceful Sun Wun Gak, or Angel Cloud House, in Seoul. In kisaeng houses across the land, highly trained women such as Miss Han Mi Ja (above) entertain diners with conversation, singing, and poetry.

Gay jumping jacks, schoolgirls bedecked in New Year's costumes improvise a seesaw; a good bounce may lift them three feet in this traditional holiday game. Pagoda-roofed pavilion shelters the more sedate in this public park in Suwon.

AODACHROME BY H. EDWARD KIM; EKTACHROMES (UPPER) BY HOWARD SOCHUREK © N.G.S.

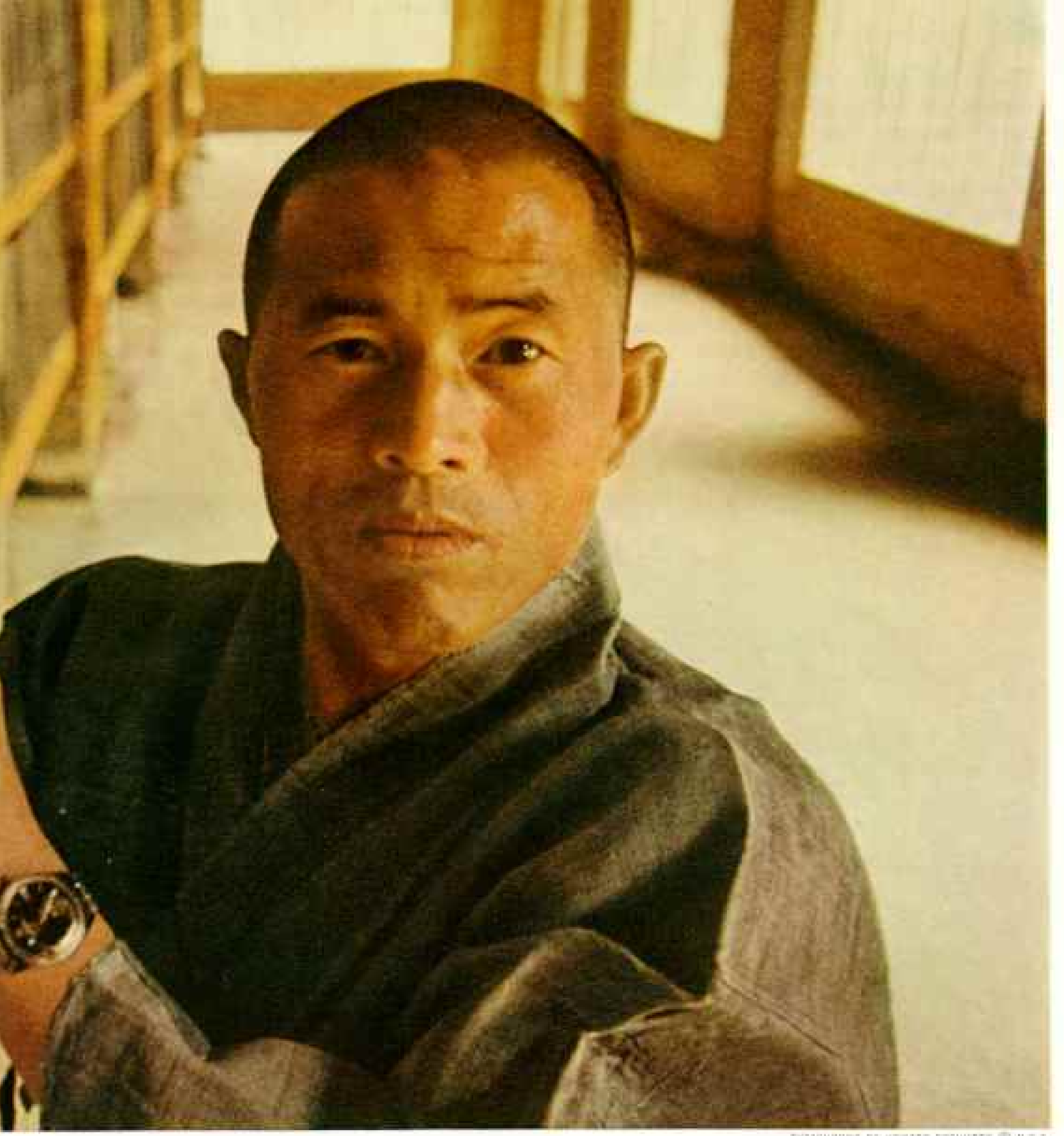
Guardian of a national treasure, a Buddhist monk at Hae In temple near Taegu displays one of 81,258 wooden printing blocks hand-carved in the 13th century. The blocks record Buddhist scripture in Chinese characters, read-

led us to the truce camp near the village of Panmunjom, the only point of contact between the North Koreans and the free-world forces. Here were held the meetings between the U.N. chief negotiator, Maj. Gen. Gilbert H. Woodward, who later won release of the *Pueblo* crew, and the Communist, Maj. Gen. Pak Chung Kuk.

When I arrived, the 275th meeting of the Military Armistice Commission was about to begin. Open windows at each end of a long, corrugated-iron barracks provide an observation place for journalists, both from the Communist countries and from the free world.

Looking in, I saw General Woodward seated at a felt-topped table. Opposite and facing him barely three feet away was General Pak, an expressionless propagandist for the Communist side. The line separating North and South Korea runs through the center of the conference table (page 334).

Across this table, the United Nations Command had up to then charged the North Koreans with 6,100 violations of the 1953 cease-fire agreements. The North Koreans had admitted to two in 1953. They, in turn, had charged the U.N.C. with 54,399 violations, of which 92 were admitted.



EKTACHROME BY HOWARD SOCHUREK © N.G.S.

ing from the top down and from right to left. Koreans were printing with movable metal type as early as A.D. 1403—half a century before Johann Gutenberg used the same technique to print his famous Bible in Mainz, Germany.

I heard General Woodward state: "I would like to cite the following incidents of premeditated violence that indicate a continuation of armed violence in deliberate violation of the armistice agreement."

He then documented 26 incidents that had taken place in the previous 10 days. All involved North Korean infiltrators invading the territory of South Korea. In these incidents, 20 Communists had been killed. The number of those who successfully infiltrated and moved on south was, of course, unknown.

General Woodward ended his report by saying, "I demand that those responsible be punished, and that a full report be made to this commission."

After translation of General Woodward's statement into Korean and then Chinese, for the benefit of the two Chinese liaison officers present, General Pak made his reply:

"It is you who are provoking a new war. You have fired 106,000 bullets into our lines. The results of your aggression will be the flames of total war. If you want to avoid the fate of dead Kennedy, stop making political invectives and accusations at this table."

At one point there was a stand-off. Neither side talked for nearly 10 minutes.

Then the action outside the conference chamber got hotter than that inside. North Korean military photographers make it a point to document any new faces that appear in Panmunjom. A new face, that of Lt. Col. Charles Spalding of Middlebury, Vermont, was present. Colonel Spalding commands the U. S. Army advance camp near the DMZ. As he was being photographed by the Communist military photographer, a South Korean newspaperman chose to photograph the event. A husky North Korean soldier gave the newsman a healthy push, and a scuffle ensued. It dents of infiltration and combat is increasing.

He said, "One of their motives is to goad us into reacting or overreacting."

Remarking on the lack of diplomacy at the meeting, I asked Colonel Lucas if this was common. "Oh yes," he answered. "General Pak's favorite expression is, 'You will all be dead in the streets like the Kennedys.' He often uses the words liar, snake, and rat to berate his U. S. counterpart.

"Another motive," continued Colonel Lucas, "is propaganda. We know this because Radio Pyongyang often puts out General

Glory of an epoch, this crown of gold came from a grave at Kyongju, ancient capital of the Silla dynasty. A Silla king unified Korea in A.D. 668, a time of cultural flowering.

Rock-hewn followers of the Buddha parade in a mountain grotto, Sukkulam, near Kyongju. To the right of candlesticks capped with lotus-blossom shades, a rounded stone forms the

was quickly broken up by security police.

One of the oldest hands at the talks is Col. John P. Lucas of Greer, Arizona. He was also present at secret negotiations in Panmunjom that first attempted release of the crew of the U. S. Navy electronic intelligence ship *Pueblo*, which was seized by North Korean boarders off Wonsan, North Korea, on January 23, 1968.

The day after my visit to Panmunjom, I asked Colonel Lucas why the number of inci- Pak's statements before he makes them at Panmunjom. Meaningful discussions don't exist here. The real problem is that a provocation may produce a situation that could get completely out of hand."

Colonel Lucas ended our conversation by saying: "It's been hard for me to realize after all these years of dealing in truth that I am now in a job where there is no truth. Do you know that while we were talking at Panmunjom yesterday, the Communists ambushed

one of our patrols less than a mile from the conference room? Three of our men were killed and two were wounded."

Horror Shatters an Easter Sunday

Such ambushes are not uncommon in this little-reported war; more than a hundred defenders, including 21 Americans, had been killed in the 12 months prior to my visit. I talked with Specialist 4C Leroy R. Jacks, one of only two survivors of a North Korean ambush (page 331). Jacks is a U. S. soldier whose duty was to stand guard in the Joint Security Area that surrounds the Panmunjom truce camp.

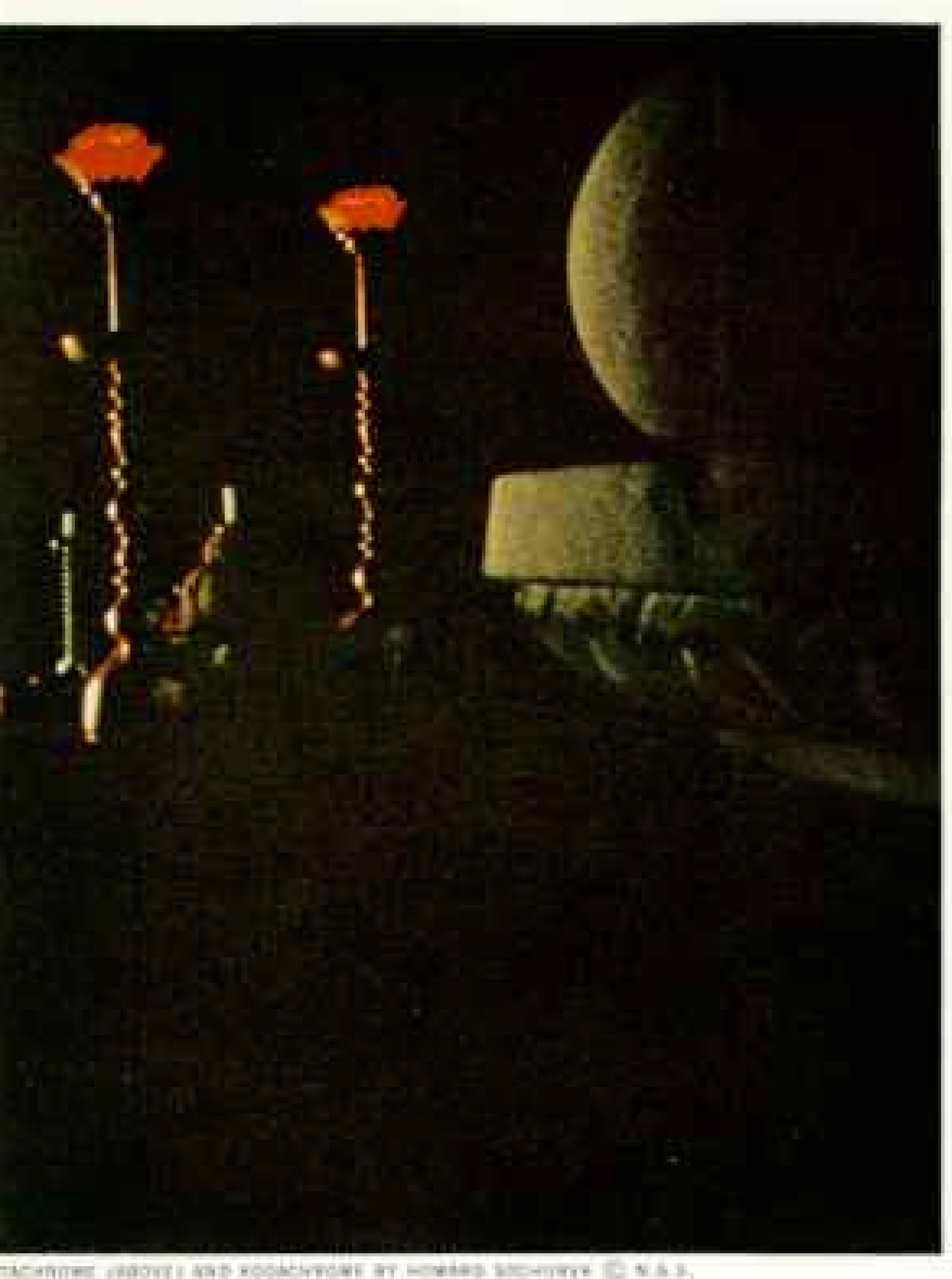
"I had written my mother that 'it's been too quiet here lately,' just the day before," he said. "It was last Easter Sunday, about eleven at night. We were in a 3/4-ton truck, six of us, going north in the DMZ to our guard post in the Joint Security Area.

"We were driving along, singing country music, when a grenade hit the right front wheel of the truck and stopped us. Then I saw muzzle flashes from both sides of the road—maybe 10 men in three firing positions just 10 to 20 feet ahead of us. I was hit in the leg and got down and doubled up on the floor of the truck.

"Sergeant Anderson [James L. Anderson of Camp Springs, Maryland] started to get out of the truck, yelling, 'O.K., you got us, we surrender.' There was a burst of automatic weapons fire, and he fell dead on top of me. Then they came up to the truck and started rummaging around. I felt somebody jerk the .45 pistol from my holster. I was trying to freeze, but I was so scared my left leg kept fluttering."

The ambush party then laced the back of the truck with fire. At that point a jeepload of soldiers also going to the guard post came along, and this evidently saved Jacks' life. The Communist troops melted away. A few minutes later a rescue group arrived and carried Jacks and a second wounded man to a hospital. Four of the six were dead.

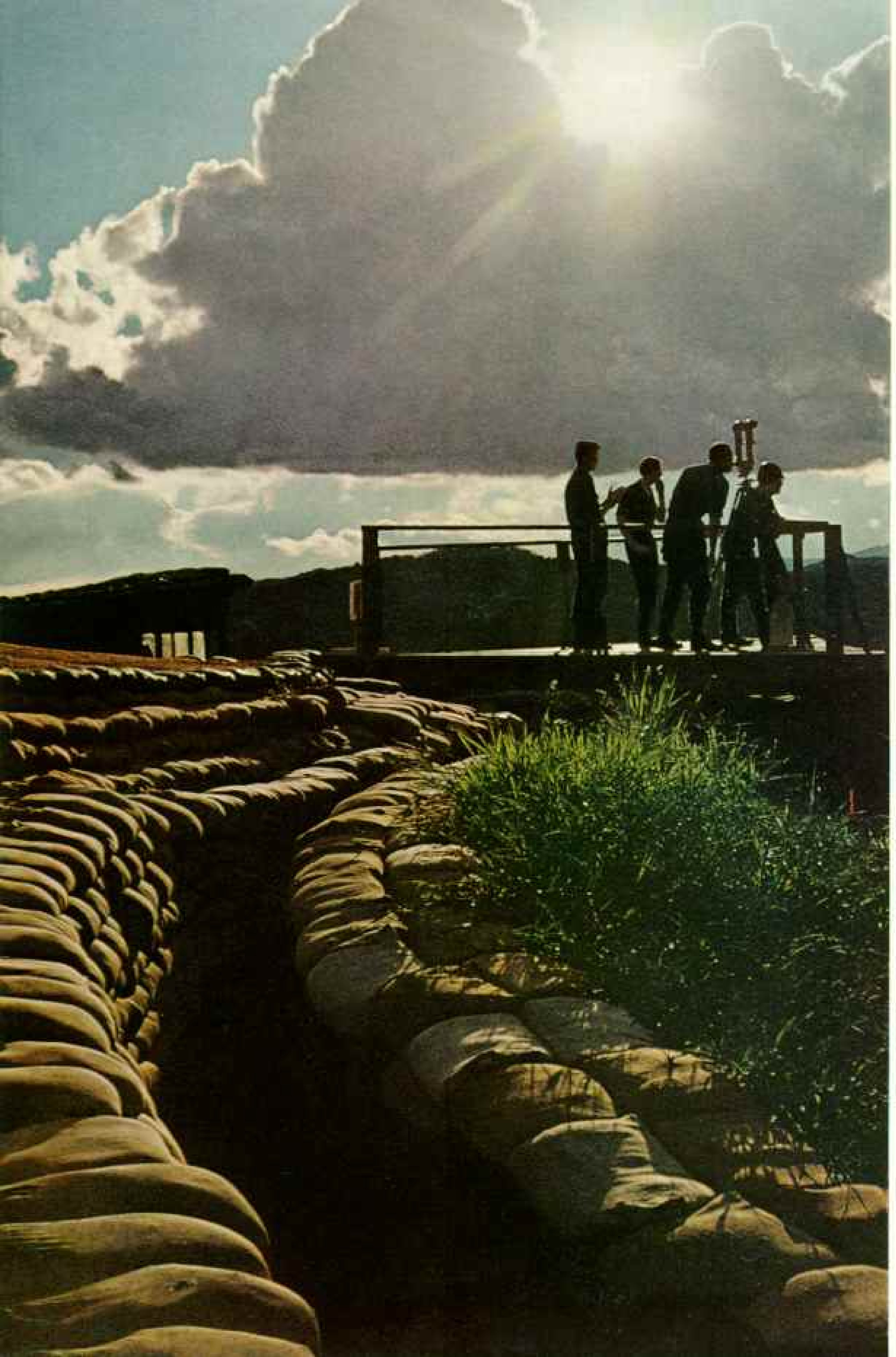
To get the feel of the DMZ, I arranged to spend a night at one of the U.N. guard posts.



EKTACHROME (ABOVE) AND KODACHROME BY HOWARD SOCHUREK © N.G.S.

knee of a giant seated Buddha. Capital of the Silla kingdom for nearly a thousand years, Kyongju abounds with temples and tombs, such as that which yielded the crown at left.

Descendant of kings, Yi Kyu preserves the name of the Yi dynasty, which ruled from 1392 until 1910. The MIT graduate works for preservation of Korean antiquities.



Observation Post Dort lies at the head of a beautiful emerald valley. Through such north-south passageways came the Communist invaders in 1950, as had Mongols in their 13th-century conquest of Korea.

Dort sits on a high chocolate-drop hill, surrounded by mine fields and barbed wire. During the Korean War, Chinese and U.N. artillery shaved 20 feet off its top by incessant bombardment.

First Lt. Melvin Banks, aged 32, of Eunice, Louisiana, greeted me in his octagonal command bunker. Almost completely underground, the bunker is the nerve center of the defensive position. From it, trenches run to four smaller satellite bunkers containing electronic detection equipment, searchlights, and night viewing devices.

"Pyongyang Polly" Offers Rewards

Lieutenant Banks was joined at dusk by his company commander, who came to brief the patrol going out for the night. He was 1st Lt. (now Capt.) Jasper J. Sanger, 29 years old, of Fitchburg, Massachusetts.

"There are a lot of people getting killed up here," Sanger said. "If you get into a fire fight here, you are at war whether it's called that or not. It's like a forgotten world. The men here work harder than they do anywhere else I've been, but who knows it?"

Lieutenant Banks and his patrol moved out. I settled down in the command bunker with 1st Lt. Gay Wright of Denver, Colorado, 23, the artillery forward observer. I slept on the dirt floor surrounded by canisters of flares and boxes of hand grenades.

At midnight, we were all awakened by "Pyongyang Polly." Her voice was coming from Communist loudspeakers about a mile away on the Communist side of the Demilitarized Zone.

Polly introduced a man she said was operations officer of the captured U.S.S. *Pueblo*. In a faltering, unnatural voice he began: "I am

KODACHROMES BY HOWARD SOCHUREK © N.G.S.

Victim of Communist ambush, U. S. Army Specialist 4C Leroy R. Jacks survived a night attack in the DMZ that killed four buddies. Shot in the leg, he played dead as assailants grabbed his pistol and fled.

Would-be assassin, North Korean Kim Shin Jo and 30 others crossed into the South last year on orders to behead President Park. Twenty-eight were killed and two escaped; Kim was captured and turned informant.

Like a dam against the flood, sandbags rim trenches at Observation Post Dort, a U. S. bunker at the Demilitarized Zone separating the two parts of Korea. American GI's defend 18½ miles of the 151-mile-long buffer, still the scene of bloody clashes. Here troops eye North Korean propaganda loudspeakers with prismatic binoculars, whose upturned tubes make possible reconnaissance from behind the trench walls.

Swaggering grimly, North Korean security guards march to posts at Panmunjom in the DMZ, where U.N. representatives and North Koreans meet face to face (page 334). Author Sochurek, a veteran reporter of shooting wars, found the DMZ a place of chilling hostility, fused for explosion.

Profile of a liberator: General of the Army Douglas MacArthur leads his staff ashore in the 1950 amphibious invasion at Inchon. The bronze-relief sculpture decorates the base of a 30-foot-high statue of MacArthur erected by the Koreans on an Inchon hill overlooking the scene of his daring flank assault.

KODACHROME (TOP LEFT) AND EKTACHROMES © N.G.S.

Wooden guns and iron will mark a militia drill at Yangsong. The company belongs to a 2½-million-member South Korean home guard that sprang to life early last year after the North Korean assassination attempt on President Park and the seizure of the U.S. electronic intelligence vessel *Pueblo.*

ashamed of my criminal acts against the Democratic People's Republic of Korea. I am praying for the People's Republic of Korea to forgive us so we can get home."

His statement was followed by a kind of Korean death-march dirge that really shook me up. Using a combination of drums and trombones, it had a foreboding, eerie quality. Then Polly reverted to Korean. We had a Korean outpost on our right flank.

A Korean interpreter was with us, and he translated: "She say you come north and you get too good job, too much pay. Get nice girls. Bring machine gun and you get paid 1,000 won, North Korean money [$400]. Bring radio get 500 won, helicopter 10,000 won."

The propaganda program ended, and a machine gun fired a blast somewhere on the line. I heard small-arms fire in return. Then quiet. Far in the distance I heard the curious doglike bark of a musk deer.

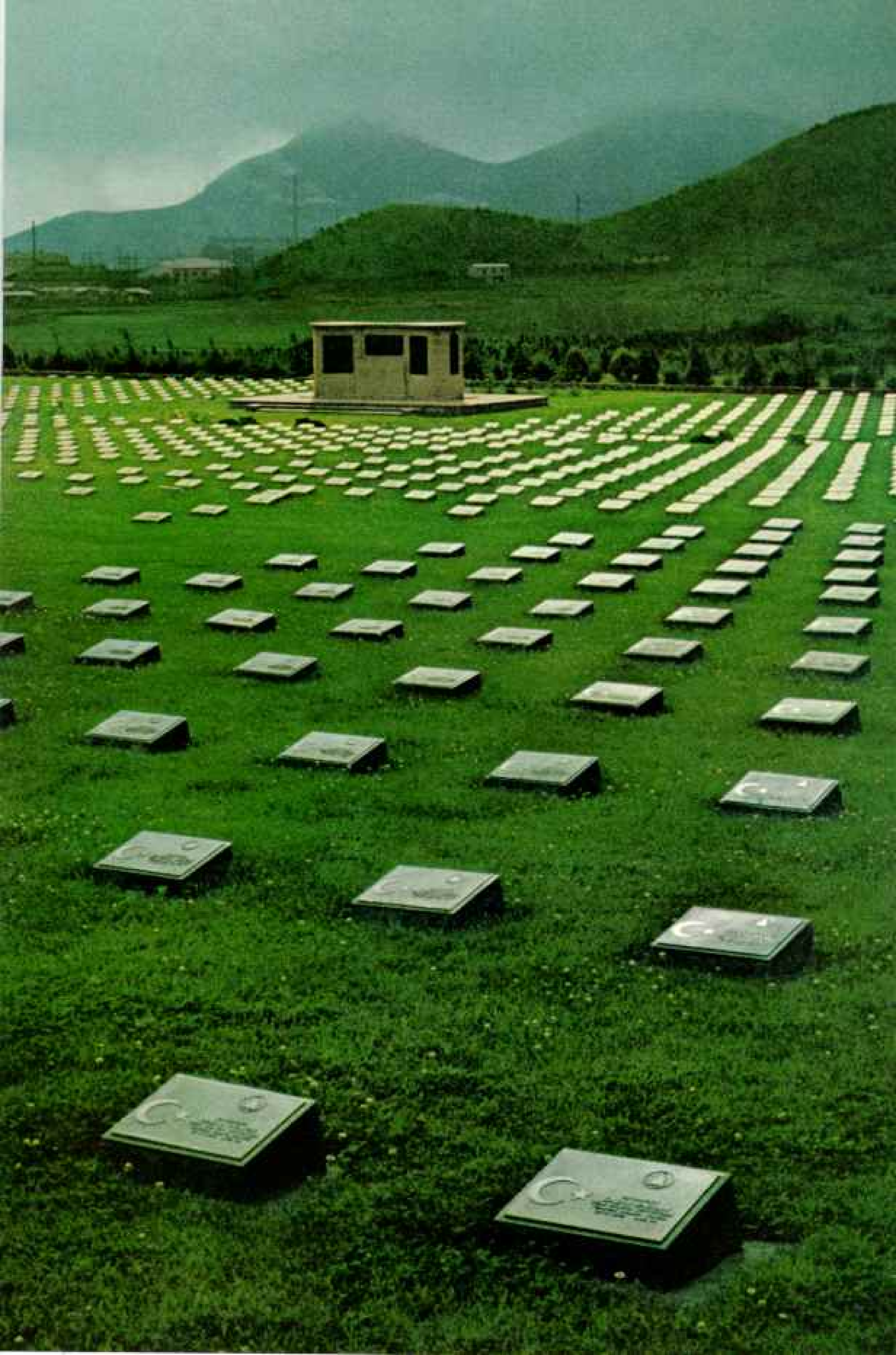
When I arose at first light, about 5:30 a.m., I found Lieutenant Banks and his patrol coming back through our perimeter. After breakfasting on canned cold ham and lima beans, they bedded down. A jeep mounted with a machine gun came for me, and I headed back to the world.

KODACHROME (BELOW) AND EKTACHROMES © NATIONAL GEOGRAPHIC SOCIETY

Cold-war combatants man the front line—the Panmunjom truce table in the DMZ. A ribbon, visible between the flags of North Korea (foreground) and the United Nations, marks the precise boundary dividing North and South. At right sits the chief U.N. representative, Maj. Gen. Gilbert H. Woodward of the U. S. Army, flanked by a South Korean general (background) and a British brigadier. Across from General Woodward sits North Korea's negotiator, Maj. Gen. Pak Chung Kuk. Charts behind him allege truce violations. It was over this table, just before last Christmas, that General Woodward successfully completed negotiations for the release of the U.S.S. *Pueblo*'s 82 surviving crewmen, who had spent 11 months in North Korean hands.

Kibitzers from Red China observe each move of the unending truce talks. Serious and unsmiling, they sit behind the North Korean negotiators.

Those who died for freedom lie in the United Nations Memorial Cemetery at Pusan: stones in the foreground mark the graves of Turkish fighters, famous for their bravery. The field, holding the remains of 2,266 men, symbolizes the war's grim toll of 175,887 U.N. battle casualties, four-fifths of them South Korean. The large marker honors troops of the British Commonwealth.



A mighty flood swept these rocks downstream to Todamsambong, or so goes an ancient legend about the Han River. Beyond a sculling boatman, a pavilion offers rest and vistas to summer visitors who flock to the Han's sandy

In Seoul I had a long-awaited date with President Park. At noon on a humid summer day, with the temperature nudging 90°, I rode alone in the back seat of an official car to a gatehouse where armed guards were searching some tradespeople before admitting them. After signing a form, I was taken by a military escort to a large building. There Cho Sang Ho, the protocol secretary, greeted me.

It was only a short distance to the Blue House, named for the color of its roof tiles, but we drove to it in a small Korean-built car which stopped, after a moment, before a heavy iron gate set in a high wall. Again I was under the questioning eyes of security guards in blue uniforms. Then a hand offered a small plastic badge; I pinned it to my suit coat. The gate rolled back and we drove through.

Inside the residence Mr. Cho escorted me to a small waiting room. He disappeared, and I heard someone practicing the piano on the floor above. It was a strange, tranquil sound. I learned later it was the President's daughter, Keun Hye, aged 16.

In a moment I was shaking the hand—and contending with the viselike grip—of Presi-

KODACHROME BY H. EDWARD KIM, NATIONAL GEOGRAPHIC STAFF © N.G.S.

banks. Meandering across the nation, the river was crossed and recrossed by opposing armies in the seesaw battles of the Korean War. Today five hydroelectric dams stairstep its headwaters, and two more are under construction.

dent Park. His brown eyes were intense and searching. They fell upon my four cameras.

"What's that ancient camera you are carrying?" he asked.

"Mr. President," I answered, "that is a Leica I used in the parajump at Sukchon, north of Pyongyang, in 1950."

President Park took the camera and examined it carefully. "That must be of great sentimental value," he said. "You must leave it as your family's treasure."

As I photographed the President (page 304), he seized and would not relinquish the initiative in the conversation. He kept up a steady drumbeat of questions, toying with a magnifying glass as he talked.

"How do you feel about Korea after an absence of 18 years?" he asked.

I answered, "It's like a new country."

"Have you visited the DMZ here?" he asked. I said yes, and he quickly followed: "Did you visit Korean or U.S. troops?"

"Both," I responded.

The Prime Minister, Chung Il Kwon, stopped by. While they chatted briefly I looked through a window into the garden

where two helicopters stand by on 24-hour alert. Double doors from the office opened on a sun-filled room, its tables piled high with engineering blueprints and renderings of bridges, highways, and factories.

President Park came into office after Syngman Rhee resigned in 1960, and after a military coup ousted the government that followed. A leader in the coup, Major General Park later resigned from the military and won national elections in 1963 and 1967. Another election is due in 1971.

Now my time had expired. The President asked, "Did you make any pictures of me with that camera—the one you jumped into North Korea with?" I assured him that I had.

He waved in parting. "Have a good trip."

I left realizing that the President had been interviewing me, and not the other way around.

Though Korea is fast changing in the cities, there is a vast area that remains relatively unchanged. It is rural Korea and the village.

One day I asked my guide, Kim, "Do you still have a village you consider home?"

"Of course," he replied. "Every Korean family has a traditional village. Most of my relatives are still there." After some persuasion, he consented to a visit.

Nogong-ni, which means "old valley village," lies about fifty miles southeast of Seoul in country typical of Korea: high hills, mountains, and fertile rice-growing valleys.

Security Drawn From Family Ties

"The family is very important to us here," Kim said as we drove over country roads to Nogong-ni. "It gives us security. You are not facing the world alone; you are also responsible for other people. Knowing the honor of the family is involved, you are a lot more careful of what you do."

I learned that Kim's father, a provincial official, had died when his son was 14. Since Kim was the eldest of four sons, he inherited the responsibility of family support. Kim moved to Nogong-ni, his father's birthplace. There he farmed 3,000 pyong of rice land, about 2½ acres.

Kim continued: "There are many similarities between Koreans and Americans, but more things that are different. The main difference is ego. We seldom say 'I,' or propel ourselves to the front. You say 'my family' or 'my wife.' We say 'our wife, our family.' We are contemplative and illogical and fatalistic."

That was enough to ponder for the rest of the drive.

Late in the afternoon we arrived at Nogong-ni and went to the house of Kim's cousin, a young man named Woo Sik. The thatch-roofed, mud-plastered house was in the traditional L-shape (opposite). It had three bedrooms, a kitchen, and a large porch whose floor, elevated about two feet from the ground, was made of a beautifully polished hardwood (page 340).

EKTACHROME (BELOW) AND KODACHROME BY HOWARD SOCHUREK © N.G.S.

Approaching a grassy burial mound, Kim Kwang Sik, the author's interpreter, pays respect to a departed uncle. Koreans often set aside several days a year for showing devotion to their ancestors.

Snuggling roof to roof, houses of rice straw and dried mud crowd Kim's village of Nogong-ni. Here, as a guest of the interpreter's cousin, Kim Woo Sik, the author found hospitality that made the days of his visit "among the most enjoyable I have spent anywhere."

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

Separate tables: Old customs persist in the home of Kim Woo Sik, where a farm laborer eats apart from Woo Sik's mother, wife, and daughters. The head of the household dined earlier and also alone. Flowers decorate the austerely furnished room.

Bearing her share of family burdens, grandmother Hwang Yung Sung combines baby-sitting with cooking noodle soup—the usual menu for breakfast, lunch, and dinner. By managing the home, she frees her son's wife to work the fields. Family well stands beside a vine-covered wall.

Furniture in the Korean house is at a minimum. In the room turned over to Kim and me, only a huge cabinet stood against the wall. It contained quilts, blankets, and a thin mattress for sleeping on the floor.

I left the Kim cousins to catch up on the family news and wandered into the village. Red peppers were drying everywhere, and children were running to gather them in for the night. I heard an odd sound—chuga, chuga, chuga, chug—and followed it to a thatch-roofed house. Inside was a Rube Goldberg contraption come to life—a single-cylinder gasoline engine driving a belt attached to an overhead shaft. The revolving shaft drove another belt attached to a set of wooden rollers. I watched a man putting flour and water into a bin, from which the dough oozed through the rollers, emerging in thin sheets. The sheets passed over a rack of fixed knives that cut them into strips to be hung up on a clothesline to dry in the sun. Noodles!

The machine had been in the village so long that no one could remember what genius invented it, but it provided a good income for the noodle-making family that inherited it.

I walked on to a house where women were sorting tobacco leaves. Beyond, a farmer was spreading night soil on his cabbage patch. It was wonderfully peaceful and quiet and basic.

Interest High, Taxes Low

Kim came to fetch me. He wanted me to meet his aunt, Jang Ju, aged 65. Over a bowl of delicious noodle soup, Aunt Jang Ju talked about her youngest son. Her biggest problem of the moment was to find, through a marriage broker, a suitable wife for him. At one point, in jest, she asked me if I knew of any suitable young ladies.

I asked, "Will an American girl do?"

She answered, "Anyone, anyone," and laughed. "But quickly, quickly."

Woo Sik, our host, works 15 hours a day farming the 5,400 pyong (about 4½ acres) of land he inherited. Half of his fields are irrigated, half are dry. In addition to rice, he cultivates barley, beans, red peppers, cabbage, radishes, tomatoes, lettuce, and pumpkins. Woo Sik's one ox pulls a wooden plow that

Like waves lapping a crescent beach, paddy fields climb a slope near Kyongju. A father, mother, and son, their backs seemingly forever bent, transplant rice seedlings; a neighboring farmer plows with an ox. Mechanization comes slowly to the fields; two Koreans out

EKTACHROME BY HOWARD SOCHUREK © N.G.S.

of every three still earn a living from the soil, usually on privately owned plots of two or three acres. But a government program of fertilizer manufacture has transformed the land's productivity, and a nation threatened by famine 20 years ago now can nearly feed itself.

has been in the family for at least 60 years.

"We live better now," Woo Sik remarked, "even though many of us are in debt here."

I learned that farmers traditionally borrow money to send their children to school. Interest rates are steep—6 percent a month on any amount up to 100,000 won ($370; one U. S. dollar is worth 270 South Korean won, as against 2½ North Korean won). If you borrow rice, interest runs 50 percent per year.

Taxes, however, are quite low. Woo Sik pays only 6,000 won (about $22) a year. His farm yields an annual profit of $300. The average per capita income in Korea is $143.

Like other farm villages, Nogong-ni is gradually losing population. A farm worker earns 40,000 won ($148) or 10 sacks of rice a year—about 1,500 pounds—in addition to food and shelter. In the city, he might make three times as much money.

But Kim Kwang Sik insisted that the villagers were better off than when he had lived there. Although they still had no electricity, or running water, or bathtubs, or tractors, and seldom ate meat, there were changes. The village had bus service. And now there were sewing machines and bicycles.

My days at Nogong-ni were among the most enjoyable I have ever spent anywhere. The discomfort of sleeping on the *ondol*, the heated, hard clay floor, was eclipsed by the hospitality of Kim's family. And my initial shock at a thick noodle soup for breakfast was softened by the kindness of one of Kim's cousins, who ran a mile to bring a single fresh egg for the *Migook* (American).

Stone Temple Recalls Past Glory

One of the finest religious shrines in Korea, and a cultural treasure as well, is a granite cave temple dating from the Silla dynasty—Sukkulam on Toham San (mountain) near Kyongju (pages 328-9). Here sits a nine-foot stone Buddha carved in A.D. 752. It is a masterpiece unsurpassed anywhere, to my mind, in Southeast Asia. On the walls are elegant relief carvings of Buddha's followers.

Nearby, Kim and I met and talked to two old men, No Ban Sik, 76, and Kim Hong Pil, 70. They, like us, had come to visit Kwae Nung, the tomb of a Silla king. They told me of some of the customs of their boyhood.

"The most dramatic change in my life," began Ban Sik, "is what has happened to women. When I was a boy, women were seldom permitted to come outside the house. If they did come out, they masked their faces. The only women we saw were the *kisaeng*, or art persons. The kisaeng were young entertainers skilled in music, conversation, and poetry [pages 324-5]."

As an aside, Kim said 72 distinct social classes were once listed in Korea. The king stood at the top. The six lowest classes were the kisaeng, servants, beggars, sorcerers, butchers, and, at the very bottom, actors.

Old Men Thank America for Peace

Though both No Ban Sik and Kim Hong Pil spoke wisely and well, they had no formal education. Neither had ever been to Seoul. They would most probably die having spent their lives within a radius of 20 miles.

"Are things better for you now?" I asked.

"Yes," answered Ban Sik. "We have smaller taxes, and when the crop is poor the government imports grain and distributes it to us. We have cloth to make clothes, and even ordinary people can buy rubber shoes. Before we had only shoes of rice straw."

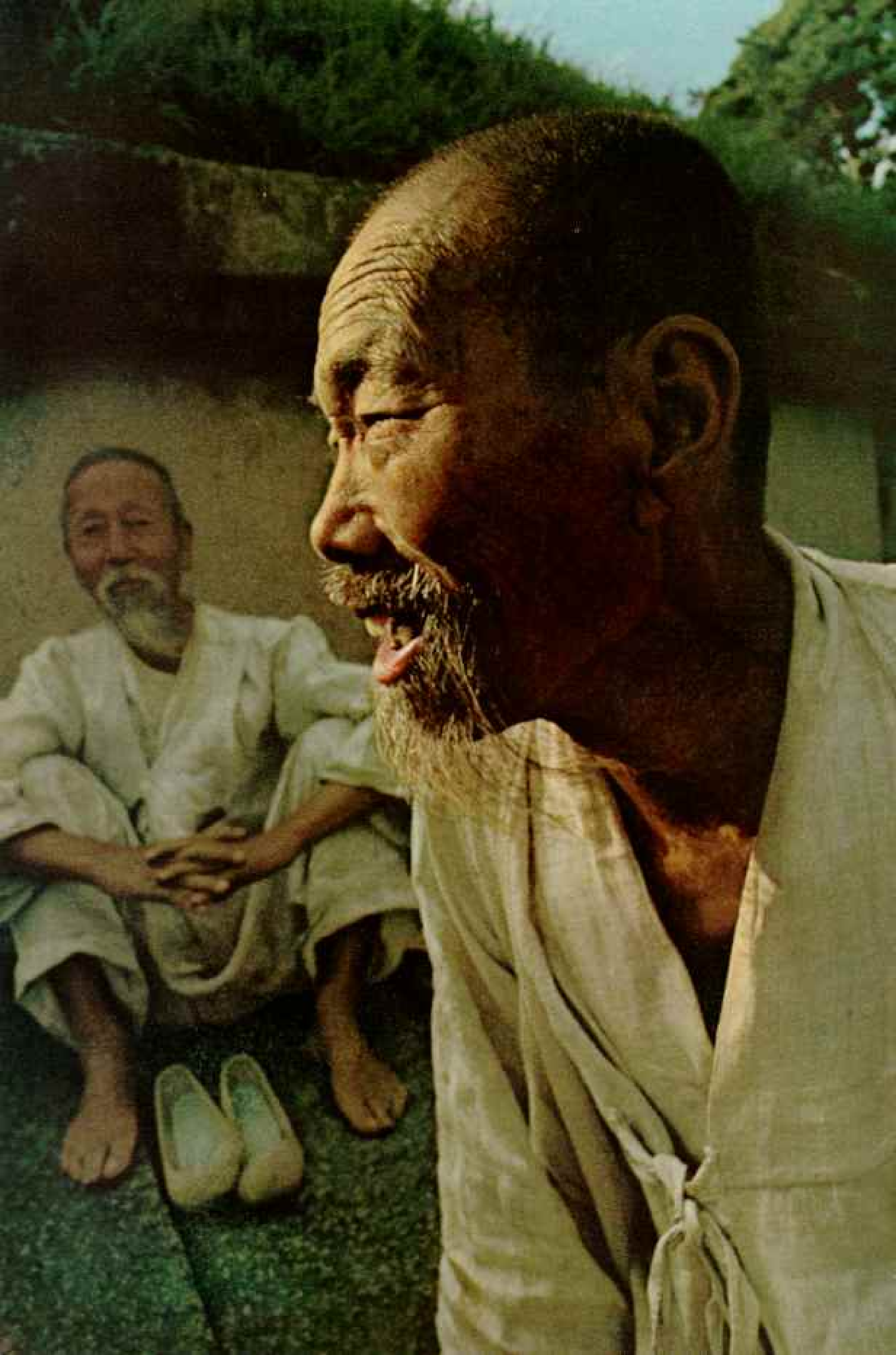
Then quite spontaneously he remarked, "Americans have saved us from our hardships, from the Japanese who took our men to forced-labor camps, from the Communists who invaded us."

As No Ban Sik waved goodbye, he said, "I will be most thankful if you will use some of my story. The Americans have delivered us; tell them we know about it." He ambled off with his old friend and a grandchild who clung to his left hand.

And now, as I prepared to leave Korea, I kept wondering how the sons of these old men of ancient Choson—the Land of Morning Calm—had managed to cope so well with the turmoil and promise of the 20th century. The answer for me came out of the conversation with No Ban Sik. At one point he had said, "Remember, this is not a place for ordinary men." THE END

His wispy beard a badge of dignity, 76-year-old No Ban Sik visits with another septuagenarian, Kim Hong Pil, at the tomb of a Silla king near Kyongju. Reminiscing about changes in his country during the three-quarters of a century he has seen, No Ban Sik spontaneously thanked the author for American help in freeing his country, first from the Japanese in World War II and later from Communist invaders.

EKTACHROME © NATIONAL GEOGRAPHIC SOCIETY



Wisconsin's Door Peninsula

"A KINGDOM SO DELICIOUS"

By WILLIAM S. ELLIS
National Geographic Staff

Photographs by TED ROZUMALSKI, Black Star

DARKNESS CAME QUICKLY as wind and rain gusted out of the sky to wreck the drowsy stillness of three o'clock on a warm summer afternoon. From atop a high limestone cliff, I watched the waters of the strait below bunch up into swells and then become driving beams of frothy fury. A skiff torn loose from its mooring slammed into the base of the cliff and backed off as kindling.

Churning, whirling, bloated with arrogance, this rip of water between a peninsula and the islands off its tip mirrored all the gray grimness of the name given it by French explorers many years ago. Porte des Morts, they called it—literally Door of the Dead, but colloquially translated Death's Door. On its floor rest the bones of hundreds of ships.

The Door of the Dead washes against the tip of Wisconsin's Door Peninsula (the name comes from that of the strait), a 70-mile-long shoot of land extending from the eastern reaches of the state and bounded by Lake Michigan on the east and Green Bay on the west (maps, next page).

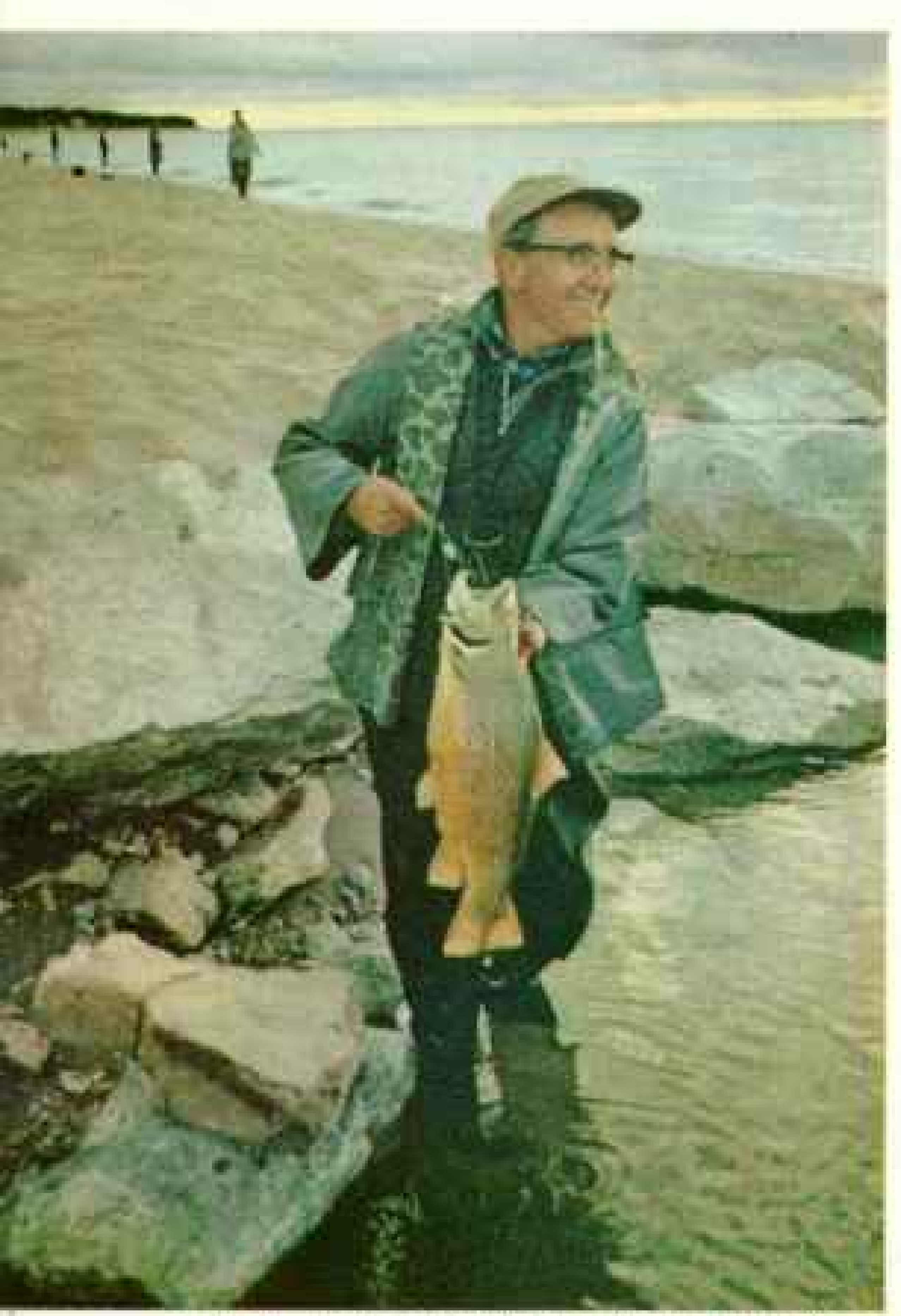
The vista here is one of striking contrasts—of land and water locked together by glaciers that receded thousands of years ago; of an acidlike surf sculpting a cove in rock, while inland, less than 100 yards away, a placid lake nuzzles a beach of white sand; of deer browsing amid wild wood lilies, and gulls in screeching pursuit of a boat, hoping for a handout; of harbors throttled by ice, and countryside awash in the pinks and whites of flowering fruit trees (pages 354-5).

As an alien thumb of land on the corn-knuckled fist of the Middle West, the Door Peninsula, with its 250 miles of shoreline, draws expressions of surprise from first-time visitors. More often than not, the reactions invoke references

Exploding in white fury, waters of Lake Michigan wash Cave Point on Wisconsin's Door Peninsula. Hikers scale 30-foot limestone bluffs where waves have carved countless arches, caverns, and ledges. With rolling hills and forested headlands—air-conditioned by nature—Door lures thousands fleeing the city's crush and summer's heat.

KODACHROME BY DONALD R. EMMERICH © N.G.S.

Scalloped with bays, the whole Door Peninsula shows in a photograph taken six miles up (opposite). Lake Michigan lies at left, Green Bay at right in this southward view above the dread strait French explorers named Porte des Morts—Door of the Dead, source of the peninsula's name.



KODACHROMES BY JOSEPH J. SCHERSCHEL (ABOVE) AND EMORY KRISTOF © N.G.S.

Sure cure for fishing fever, a 5½-pound brown trout brings a winner's smile to Green Bay angler Stephen Zacharek.

to New England, such as "Cape Cod on an inland sea."

Perhaps the most imaginative reaction of all belonged to Jean Nicolet, the French explorer who visited the peninsula in 1634, before any other white man, probably. Splendidly attired in a mandarin robe of fine damask silk, he stepped ashore, convinced he was in China. Later in that century, Pierre Esprit Radisson, the French trader who kept an extraordinary journal of his fur-seeking expeditions in the Great Lakes region, saw the peninsula and the surrounding islands as "kingdoms . . . so delicious." He made the observation 300 years ago, but the kingdoms, I found, remain as flavorful as ever.

Town and Country Learn to Get Along

"The wonderful thing about Door County," said Irving Miller, dockmaster at the town of Fish Creek, on the Green Bay side, "is the perfect combination of wilderness and civilization. Each makes its presence known, but neither one crowds the other."

I talked with the 80-year-old dockmaster the morning after the storm, as Fish Creek stirred and shook off the night chill. In days gone by, when the waters all around held lake trout the size of piglets, and sturgeon three times as big, the town thrived as a major fishing center. The lake trout nearly vanished for a while, victims of the repulsive, snakelike sea lampreys, which attached themselves to the trout and sucked their life juices, but recent

control of the predators finds the trout returning now. Not so the sturgeon, the "monster Mishe-Nahma" of Longfellow's *The Song of Hiawatha;* catching one today is a rare experience for peninsula fishermen.

New excitement for anglers is mounting, however. To prey on Lake Michigan's detested alewives, coho salmon from the Pacific have been introduced into area rivers, including the Ahnapee on the peninsula. Fish released in State of Michigan streams in 1966 have already returned upriver once for spawning, and will make another spawning run this fall, promising a bonanza to fishermen.*

Peninsula Wins His Vote Hands Down

On the beach at Fish Creek I found a single dead alewife, rigid and goggle-eyed under an umbrella of flies. Overhead a show-off gull executed an arabesque. And then, as if to match the bird's agility, an elderly man with a tan the color of tea spread a towel on the sand and performed a commendable, if wobbly, handstand.

"Hey, that's pretty good," I said.

"Pretty good for a 68-year-old, anyway," he replied. He was a retired businessman from Highland Park, Illinois, he said, and in only two of the past 24 summers had he failed to spend at least a week on the peninsula.

"At home I don't have the energy to scratch an itch, but that changes when I get up here," he added. "Same way with my father. He vacationed on the peninsula for 35 years."

Tourism on the Door Peninsula represents a $100,000,000 industry. Nothing approaches it in dollar volume—not agriculture, including one of the largest harvests of tart cherries in the Nation, nor shipbuilding, the peninsula's leading industrial enterprise.

A million visitors, most of them from the Middle West and especially the Chicago area, converge on the Door Peninsula each summer. They come back year after year, lured by the scenery and the eminently breathable air.

Equally appealing to me is the endearing fustiness to which the peninsula clings. Dating from the era of spas and the partaking of wondrous mineral waters, this cobwebby link with the past finds hotel guests still summoned to meals by the ringing of a clapper bell. Many of the hotels themselves remain rambling clapboard structures, their verandas freighted with wicker furniture. Amid such surroundings, croquet balls are still smartly dispatched over well-tended lawns.

*See "The Incredible Salmon," by Clarence P. Idyll, GEOGRAPHIC, August 1968 (page 214).

Jetting fountainlike sprays into the summer sunshine, collegians on holiday furrow the mirror-calm surface of Sister Bay. Here on the shallower Green Bay side of the peninsula, waters are slightly warmer than those of Lake Michigan on the opposite shore.

Toasting to a golden tan, University of Wisconsin student Kathy Berns chats with a lifeguard at Nicolet Bay Beach. Scores of college undergraduates work at Door resorts and recreational facilities during the summer months.

Chinese junk ***Sea Breeze,*** built in Hong Kong, has sailed Door waters for almost six years with owners Mr. and Mrs. Jerry Vallez of Highland Park, Illinois. The peninsula's 250-mile shoreline, with its many secluded coves, is a yachtsman's paradise. On summer weekends racing sails, brimming with the wind, swirl a cavalcade of color across the swells.

KODACHROMES BY TED ROZUMALSKI, BLACK STAR (ABOVE) AND DONALD R. EMMERICH © N.G.S.

For the average long-time summer visitor to the peninsula, vacation time is given over to a lot of leisure, a little culture, and the renewing of summer friendships. At least one evening is set aside for attending Wisconsin's oldest professional summer theater, the Peninsula Players' "Theatre in a Garden" near Fish Creek. Another evening finds the summer people at one of the nine concerts that make up the annual Peninsula Music Festival, held in the town of Fish Creek itself.

Otherwise, dinner is followed by the dabbing of citronella on arms and neck and a walk along the nearest beach.

"Such vacations were once commonplace, but now you might say they're almost unique," observed the owner of one of the resort hotels.

In any case, the overriding presence of things maritime is the major element in the uniqueness of the peninsula. Walking along Fish Creek's municipal dock, I counted dozens of boats, all feeding squiggling Silly Putty reflections to the clear water. They ranged from a luxurious teakwood-decked cabin cruiser to an authentic Chinese junk (page 350). On the latter, a sign announced:

BUILT IN 1959 BY THE SAU KEE SHIPYARD IN APLICHAU, HONG KONG. FOR FURTHER INFORMATION CALL HONG KONG 90029.

"I suppose people bother you with a lot of questions about the junk," I remarked to the woman on deck.

"Well, now and then someone stops and asks whether his shirts are ready," Mrs. Jerry Vallez replied, smiling. "Also, people see the Chinese characters on the stern and want to know what the junk is called. We've been told that the best translation is *Little Sea Wind*, but we call her *Sea Breeze*." Mrs. Vallez and her artist husband, summer residents for 10 years, do not know how *Sea Breeze* got from Hong Kong to a marina in Illinois, where they first saw it wearing a for-sale sign nearly six years ago.

The peninsula's nautical character begins to exert itself at the city of Sturgeon Bay, where a canal cleaves through Door's midsection, leaving a dual-lane drawbridge as the only access to the northern half. Crossing the bridge, I saw a proud-masted schooner, riding at anchor like an elegant crest on the water-sheathed dagger of land. Later I met owner Fred J. Peterson, chairman of a Sturgeon Bay shipbuilding firm (page 362), and he invited me to join the crew when the 65-foot staysail schooner *Utopia* took part in a race to Green Island, 16 miles out in the bay.

Schooner Has Known Far Landfalls

Flying most of her 2,500 square feet of sail, *Utopia* moved downwind through the open drawbridge. Smaller sailboats, flaunting their speed and maneuverability, skittered around us like children taunting the village oaf.

But when the breeze yeasted into a strong wind, many of the other boats fell behind while their crews worked to corral battered sails. "Class will tell now," one of our crewmen yelled as *Utopia* took the wind and ran.

Still, others crossed the finish line ahead of us. I suggested to Mr. Peterson that his steel-hulled schooner is better suited to the ocean.

"No question about it," he agreed, recalling a memorable voyage that began in 1956.

In that year, Fred Peterson, then 62 years old, hoisted anchor in Sturgeon Bay and sailed *Utopia* down the Mississippi River and across three oceans and 10 seas. With pickup crewmen ("was it the Tongan or the Marquesan who chewed kava root while hoisting sail?"), the vessel circled the globe, returning to Sturgeon Bay in 1959.

Moving *Utopia* back to her berth after the race, we passed docks crowded with the hulks of tankers and freighters gone to scrap after many journeys on distant seas. A Coast Guard cutter, somber and Spartan in coiled-line orderliness, backed away from its pier and hurried off toward the other side of the bay. A fleet of prams put out from a yacht basin, their colorful sails beating in the breeze like the wings of monarch butterflies; boys and girls no older than 15 handled the tillers.

Vessels under sail have plied Door Peninsula waters for almost three hundred years. Many went down there, taking their cargoes with them; as a result, scuba diving holds wide popularity as a vacation-time activity on

(Continued on page 357)

Elixir for exhausted urbanites: Stretching up toward the sun, birches and maples shade campers in Peninsula State Park and give a home to purple finches, scarlet tanagers, and indigo buntings. On a nearby bluff overlooking Eagle Harbor, a superbly manicured 18-hole golf course challenges even the experts. Established in 1909, the 3,767-acre park enshrines the site of first settler Increase Claflin's homestead.

KODACHROME BY TED ROZUMALSKI, BLACK STAR © N.G.S.

Blizzard of blossoms whitens Door country when buds burst across 6,000 acres of cherry trees. Riding between the lacy drifts, an orchard worker sprays them with a fungicide to kill leaf spot. Canneries on the peninsula process 90

KODACHROME © N.G.S.

percent of the crop, mostly the tart Montmorency so flavorful in pies and cobblers. Only a week or two after these petals flutter to earth, Door's half-dozen varieties of apple trees bloom and brighten the spring scene anew.

the peninsula. Of course, the booty includes few, if any, ducats, doubloons, or princely gems, for the ships that sailed the Great Lakes in the 19th century carried mostly lumber and grain and iron ore.

"We want to encourage the preservation of wrecks and stop them from sometimes being used as firewood, literally burned up." As he talked, Gene Shastal of Lake Villa, Illinois, ran his fingers over a coffee table made from the rudder of a schooner that sank in Green Bay about a hundred years ago. Other pieces from other sunken ships filled the living room of his lodge atop a high bluff near the tip of the peninsula.

Shastal and a group of Midwest divers have begun assembling the histories of the more than 200 charted shipwrecks in the area. Whenever they can get away from their jobs, they hurry to the peninsula, pull on wetsuits, and disappear under a frenzy of bubbles. I went along as an observer on two of the dives, one of them in the dead of winter with the temperature at five degrees above zero.

Our station wagon moved slowly over the 18-inch-thick covering of ice on a small bay off the northwest corner of the peninsula. An advance man on foot inspected the ice for weak sections through which the vehicle might plunge to what our driver laughingly (nothing uproarious, understand) referred to as "the ultimate in fluid drive."

"This is the spot," said Jack Michel, a scuba-diving instructor from Lake Villa, Illinois, and we came to a stop a hundred yards from shore. "We'll need a chain saw to get a hole in this ice."

The chain bit into the ice with authority, but progress was slow. The cold grew more punishing, and I soon joined the others in a spirited little dance to stomp the numbness from our feet. In an hour the opening was carved. Michel and the other divers slid into the ice water and trailed down about twenty feet to the remains of the schooner *Fleetwing*.

Simple Relics Evoke America's Past

Driven hard ashore in 1888, *Fleetwing* broke up and sank. She carried a cargo of lumber, including hundreds of white elm barrel staves. Jack Michel brought up one of the marble-smooth staves, and before the dive ended, at least half a dozen others lay in a pile on the ice. Certainly divers often receive more generous rewards for exploring sunken ships, but the treasure seldom comes invested with the tenor of 19th-century America. More than just parts of a barrel, the staves framed for me a mind's-eye picture of a lumber industry thriving on the demands of a nation in a hurry to grow.

The bones of Robert de la Salle's famous bark, *Le Griffon*, may lie off the Door Peninsula. In 1679 the ship arrived in Green Bay waters, the first sailing vessel on the Great Lakes above Niagara. With a cargo of

Red rain of summer

IN DAYS PAST, Door cherry pickers, pails in hand, climbed trees and teetered precariously on ladders or limbs. In today's mechanized world, motor-driven metal arms have largely taken over the job, shaking the ripe fruit onto twin canvas aprons (right).

Normally the peninsula's crop runs about 20 million pounds, but during the past two years late-spring cold spells have held the harvest to 11 million pounds. Fortunately, good market prices enabled growers to earn almost as much as in big-crop years.

Killing spring frosts and the threat of disease—trees must be sprayed five times annually—combine to make cherry growing a risky financial venture. One orchard owner insists that he never needs "to go to Las Vegas to gamble."

KODACHROMES BY DONALD R. EMMERICH © N.G.S.

beaver skins and possibly some gold, *Le Griffon* disappeared on its return voyage. One tradition holds that it sank, another that Indians burned it. What actually happened remains a mystery.

Perhaps the ship went to the bottom of the Porte des Morts because of a navigational error, easily brought on in the strait by whip-like winds and currents running counter to each other. The currents, as I witnessed, are strong enough to undermine and wash away two feet of solid ice on the waters in just 14 hours. During a single autumn storm in 1880, the ships wrecked in the passage and along the peninsula numbered in the dozens.

Here too a large canoe party of Winnebago Indians fell victim to winds and currents on a fateful day in the early 1800's. According to one story, 500 perished en route to do battle in one of the many intertribal wars that flared on the Door Peninsula: Illinois tribesmen fought Winnebagos, Winnebagos fought Potawatomis, and the far-ranging Iroquois fought everyone. Even now the ground remains hummocked with the burial mounds of braves, and plowed fields continue to yield arrowheads and, now and then, a limestone war club.

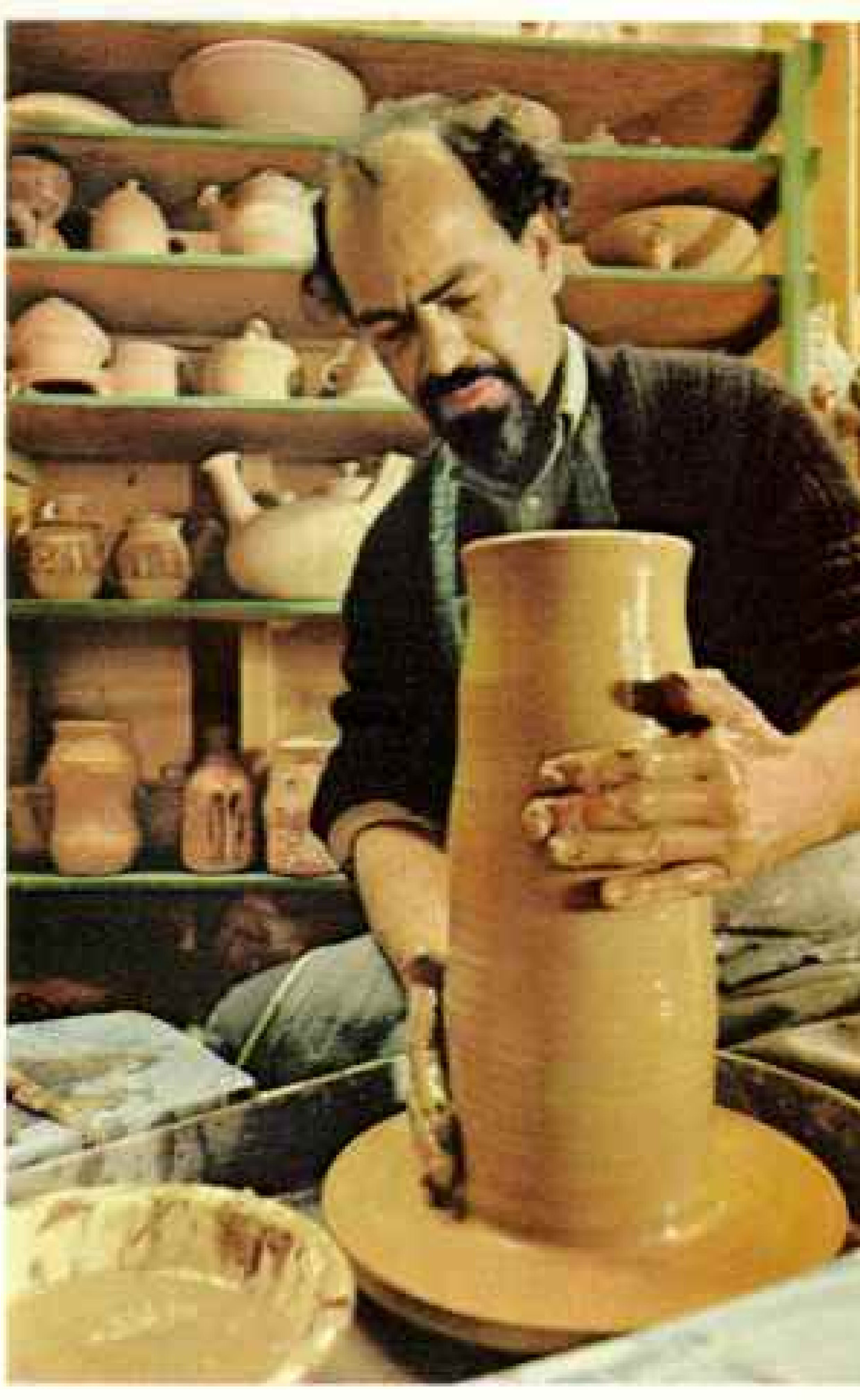
Chief Still Dons a War Bonnet

And yet, no tacky commercialism centered on packaged Indian lore afflicts the peninsula. "Of course, we have Roy Oshkosh and his trading post," said one of the hundreds of college girls who work as waitresses in the hotels. "But he's authentic, a bona fide chief."

Roy Oshkosh, titular head of the Menominee tribe, often dons a war bonnet, but only for the benefit of the summer people who crowd into his amphitheater near Egg Harbor on summer evenings for a campfire-crackling, drum-thumping, peace-pipe-smoking, evil-spirits-chasing powwow. Indian dances performed by boys and young men, schooled in the art by the chief for years, highlight the show.

Those who speak Menominee know the 70-year-old chief as Tshekatchakemau—the Old King. He is a graduate of Carlisle in Pennsylvania, a school founded especially for the higher education of Indians, but even that had not quite equipped him to deal with the complexities of a Medicare form. When I called on him, he laid the troublesome paper aside and told me that he is the great-grandson of Oshkosh the Brave, the famous Menominee for whom the city in Wisconsin is named.

"As a boy," Chief Oshkosh continued, "my father took me to visit an aunt on the reservation. She told me about a place on the Door Peninsula where our people gathered long



"Throwing a pot," Abraham Cohn shapes wet clay into a pitcher in his Fish Creek studio, the Potter's Wheel. After firing the vessel, he will glaze it and return it to the kiln for a second baking at 2,350° F.

Bounty from a graveyard of ships—the Door of the Dead—lures adventurous scuba divers to the peninsula. This new chalet lodge, On the Rocks, caters to the underwater explorers. Prize possession of owner Gene Shastal, left, and manager Bob Lapp is this half-ton windlass, believed to be from the schooner *Fleetwing*, which sank during a storm in 1888. Kedge anchor leaning against the windlass is a 285-pound relic recovered from 40-foot depths near Plum Island.

KODACHROME (OPPOSITE) BY TED ROZUMALSKI, BLACK STAR; EKTACHROME BY DONALD R. EMMERICH © N.G.S.

ago—a beautiful wooded site with a stream running through it. I looked all over the peninsula, and when I reached this spot, I knew I had found the place. I bought it."

Here the chief and his wife live the year round, although the Menominee reservation is about 60 miles to the west. "If something important comes up on the reservation, they send someone up here and we talk it over," he explained, "or I go there if necessary."

Because Roy Oshkosh has no sons, hereditary rule of the Menominee tribe ends with him. As we discussed this, he told me that the second son, rather than the eldest, always inherits the role of chief. When I asked him why, he replied, "You've got me." And then he crushed out his cigarette, picked up his peace pipe, and went outside to raise the curtain on another powwow.

Icelanders Find a Shangri-La

Indians of many tribes chose to live in the Door Peninsula region because of the great quantity and variety of food available. For the same reason, the first Icelanders to settle as a group in the United States came to Washington Island, the crown of the peninsula severed from the mainland by the Door of the Dead. As fishermen, they looked out their front doors on some of the richest waters in all the Great Lakes. Records of catches made about that time reveal that in 1862 a 14-year-old boy pulled in seven lake trout, of which the smallest weighed 40 pounds.

Little wonder then that Pierre Radisson, again writing in the journal that inspired others to explore the western wilderness, described Washington Island and nearby coasts as places where "whatever a man could desire was to be had in great plenty; viz. staggs, fishes in abundance, and all sorts of meat, corne enough."

Of the 500 permanent residents on Washington Island now, about 100 are descendants of settlers who came from Iceland in the latter half of the 19th century. Most of them retain only memories of the customs and language

Day fades into night at the village of Ephraim, whose Biblical name means "doubly fruitful." Moravians in 1853 founded the settlement. Tucked into a hillside above Eagle Harbor, it still retains an Old World charm. Gabled Anderson Hotel, nestling between the steepled Lutheran and Moravian churches, typifies the many rambling, verandaed inns that welcome the same visitors back summer after summer.

KODACHROME BY TED ROZUMALSKI, BLACK STAR © N.G.S.

EKTACHROMES © N.G.S.

U.S. Navy minesweeper takes shape in the Sturgeon Bay shipyards of Peterson Builders, Inc. Fred J. Peterson, left, chairman of the board, and his son Robert, executive vice president, check plans for installing fiber-glass fuel and water tanks in the all-wood, nonmagnetic hull. Assembled and fitted by the 500 workers in the Peterson yard—the peninsula's largest single employer—the ship required 15 months to complete at a cost of almost $2,000,000.

On a blustery May day, commercial fishermen net whitefish near Ellison Bay. The ship's mascot appears to be counting the catch. Besides whitefish, waters of Lake Michigan yield trout, perch, northern pike, walleyes, and coho salmon.

of the mother country of their parents and grandparents.

One of the few descendants of Icelanders who can converse in Icelandic is Magnus Magnusson. Born on Washington Island in 1888, the year the *Fleetwing* took its cargo of barrel staves to the bottom, Magnusson served as island postmaster for 34 years.

In addition to the Magnussons, there were the Gudmundsens, Gunnlaugssons, Bjarnarsons, and others. Norwegians and Danes and Swedes came too, but most of them took up homesteads on the mainland. The Icelanders, however, maintained their colony on Washington Island; there they farmed a little, fished a lot, and tried to understand the indifference of their American-born sons to preservation of Icelandic ways.

Magnus Magnusson now oversees a small museum near the northwestern tip of the island, where the waters of Lake Michigan explode against the base of a 150-foot-high bluff. The items on display there, such as a 100-year-old meat chopper brought over from Denmark, hold little value—except to a man seeking to tighten the ties with his European heritage.

Washington Island and much of the upper peninsula are turning to this heritage for reasons not completely divorced from commercial considerations. The Scandinavian Festival held on the island each August has the ferries tooting over from the mainland every hour, each time with a capacity load of tourists. Teen-agers in Scandinavian dress dance in the streets to folk music, acknowledging, for the duration of the celebration at least, that it's fun to be square. Restaurants feature smorgasbord—heapings of open-faced sandwiches, shrimps encased in shimmering jellied molds, and delicate little cakes, each packing a sugared richness that probably had something to do with the fearful girth of the old Viking warriors.

Babies Receive a Ringing Welcome

Many of the island's permanent residents shun such festival fare. "The men on the island outlive the women because they keep active and follow a low-fat diet," said Dr. Paul Rutledge, the island's only physician.

Dr. Rutledge first came to Washington Island in 1935 as a summer visitor. He became a permanent resident in 1960. "I've delivered 42 babies on the island and have a picture of each one under the glass on my desk," he told me, his voice touched with pride. "Once I attended a very difficult delivery, and when it ended successfully I was so happy that I went next door to the Lutheran Church and rang the bell. That became a tradition; whenever I deliver a baby, I ring the church bell."

Just north of Washington Island sits a brooding 912-acre outcropping of untrampled

Fresh from the soil, potatoes ride a conveyor to trucks on Washington Island. At Detroit Harbor the 200,000-bushel crop goes aboard two former ferryboats used in the Straits of Mackinac in pre-bridge days. Now towed as barges, the vessels move the crop to markets in Illinois and Michigan.

"North of the Tension Line," boasts Washington Island in its quest for summer visitors, who relax in a setting devoid of "great glamor, swank shoppes, and night life." The appeal pays dividends: Tourism outstrips potatoes, the island's other major industry.

KODACHROMES BY DONALD N. EMMERICH (BELOW) AND TED ROZUMALSKI, BLACK STAR © N.G.S.

Shaggy Icelandic ponies lend an appropriate look to Washington Island; Icelanders settled here in the 19th century, and today their descendants number about 100. Adele Richter feeds hay to her riding ponies, five of the 30-odd on the island.

Each August Washington's 500 year-round residents celebrate their heritage with a Scandinavian Festival that lasts two days and features a bountiful smorgasbord.

A succession of Indian tribes lived on Washington before the white man came. The island takes its name from a schooner that anchored briefly in 1816.

wilderness that once served as the private domain of Chester H. Thordarson, an immigrant from Iceland who made a fortune by inventing electrical devices and appliances.

Rock Island reminded Thordarson of his native land. To match its wild grandeur, he had constructed on the beach a massive stone combination boathouse-great hall with noble arched windows and a fireplace large enough to play ping-pong in. Here he kept his extensive collection of Icelandic literature; below, cliff swallows nested on the cavernous walls of the boathouse.

Thordarson died in 1945, and the island eventually became a state park. Except for the great hall, now under the care of a park manager, and the few other markings of the man who missed his native Iceland, Rock Island remains a preserve of woods and silver beaches which, in truth, only the gulls and deer can inhabit with grace.

I went next to Chambers Island, in Green Bay waters, where George J. Baudhuin, a Sturgeon Bay businessman and the person most closely associated with the island, waited to show me around.

A financial giant from Chicago purchased property on the island, Baudhuin told me, and began developing it into a lavish private playground. But the work stopped during the depression of the 1930's.

"There, see that rise in the ground?" he exclaimed as we bounced over a rutted road in his four-wheel-drive vehicle. "That's part of the old golf course. And that level stretch of ground with the stunted grass growth—the remains of a private airstrip."

Nearly 20 years ago, George Baudhuin and his four brothers purchased a large cottage on the island and turned it over to the Roman Catholic Diocese of Green Bay for use as a retreat house. It fronts on a 380-acre lake within the island, and within the lake itself are two islands. A heavy silence pushes down on this kaleidoscope of wilderness and water except when the sisters go boating. When that happens, visitors to the island can sometimes hear, as I heard early one morning, a soft voice skipping over the cellophane-like surface of the lake, imploring divine assistance in getting a balky outboard motor to kick over.

"Where Man Can Go . . . to Clear His Mind"

Of all the men who found a setting for their dreams on the Door Peninsula, one met quiet but complete success. Jens Jensen, a renowned landscape architect from Illinois, sought not a private domain or playground, but, simply, a place "where man can go to breathe and to feel his kinship with the earth, to have a chance to clear his mind and to take soundings of where he is going."

He found it at the village of Ellison Bay, on the Green Bay side of the upper peninsula, where centuries-old cedars and withered pines stand rooted in limestone bluffs.

Establishing 128 acres of the heavily wooded site as a retreat for study and contemplation, and calling it The Clearing, Jensen invited everyone to share with him "the strength and understanding that is found close to the roots of living things."

Jens Jensen died in 1951, but The Clearing, now under

Twenty-foot-high windrows of jagged ice pile against Table Bluff at the tip of the Door thumb. Occasionally the channel has frozen so solid

the administration of the Wisconsin Farm Bureau, continues to function as he intended it to. Week-long seminars on art, music, literature, philosophy, and other subjects attract participants from many states during the summer. The presence of five dormitories, a library, and a main lodge fail to detract from the primeval flavor of the setting.

On another day I walked through a living showcase of plant life that spans a range of ecology all the way from that of the Ice Age to that of the present. The acid bogs of the subarctic, the vegetation of the tundra, the wintergreen sharpness and rubberlike resiliency of the Canadian carpet—I found them all at the Nation's largest corporately owned wild-flower reserve, an 800-acre sanctuary called The Ridges (maps, page 348).

Located on the Lake Michigan side of the peninsula, near the town of Baileys Harbor,

KODACHROME BY TED ROZUMALSKI, BLACK STAR © N.G.S.

that cars could drive from Gills Rock to Washington Island, but ice-breaking ferries with powerful engines usually are able to run all winter.

the ridges that give the park its name mark former shorelines built of glacial sands deposited more than 10,000 years ago. A succession of ridges interwoven with lacings of water and cedar swamps runs through the sanctuary. The forest is there, and so is the sand dune.

More than anything else, though, The Ridges means wild flowers—rare, exquisite blushes of color on a canvas that stretches to the shore of the lake itself. The inventory includes more than 25 species of orchids.

The Door Peninsula of cliffs and coves and wild orchids and virgin forest lies north of Sturgeon Bay. A few miles south, the thumb becomes rolling farmland. And just about between the two, where both the moo of the cow and the mew of the gull can be heard, a group of 35 or 40 visitors gathers most every summer Sunday evening for a fish boil.

Thirteen below zero read the thermometer on December 31, 1967, when the Green Bay Packers kicked off to the Dallas Cowboys at Green Bay's Lambeau Field. First title game ever played in subzero weather, the contest decided the championship of the National Football League. Fifty thousand fans, bundled in parkas and masked in wool (left), roared their happiness when the injury-riddled Packers, sparked by second-string fullback Chuck Mercein (No. 30 at right), scored a last-minute 21-to-17 victory. Then, amidst a cloud of icy breath, the goal posts toppled (below).

Two weeks later some 10,000 Packer rooters thawed out in Miami, Florida, while cheering their team to a win over Oakland in the Super Bowl. Green Bay justifiably acclaimed itself "Titletown, U.S.A."

KODACHROMES © NATIONAL GEOGRAPHIC SOCIETY

This outdoor culinary exercise, indigenous to the Door Peninsula, originated more than a hundred years ago when men in lumber camps required great quantities of food in a hurry. The precise, carefully timed operation is more like a track meet than a cook-out.

"Time!" Jim Larsen shouted after consulting his stopwatch. Ted Anderson nodded and dumped 30 pounds of potatoes and seven pounds of salt into a pail of boiling water.

Anderson, a schoolteacher from Chicago, had invited me to one of the regular fish boils held at his summer place near Sturgeon Bay. Jim Larsen, the "boil master," was in charge.

At the end of 20 minutes, 30 pounds of filleted lake trout wrapped in cheesecloth went in. "The fish must stay in 17 minutes, no more, no less," Larsen said. "Otherwise, it will not be cooked properly."

Anderson threw fuel oil on the fire three times, causing the water to boil over and carry off the excess fish oil. What remained with the potatoes were mounds of sweet trout, brought to the peak of tenderness in exactly 17 minutes. No more, no less.

Winter-sports Fans Find the Door

After most of the guests departed, Mrs. Anderson stood by the water's edge and told me, "Our whole family looks forward to coming up here each summer. We manage to sneak away at Christmas and come up then too. I think I am as fond of the peninsula in the winter as I am in the summer."

More and more winter-sports enthusiasts from the Middle West share the sentiment.

After the snow comes, carloads of skiers crowd the one road leading to the seven slopes on the high hill near Fish Creek.

"The Door Peninsula is catching on as a winter vacation area," said Harold Larson, owner of the 120-acre skiing facility. "We get more people here every year." Harold and I sat in the warm glass-fronted lodge at the foot of the hill. A group of skiers, and some who only talk about skiing, gathered around the fireplace to autograph leg casts and recall past and memorable schussings.

At Potawatomi and Peninsula State Parks, both on the Green Bay shore, the buzz of snowmobiles racing through the woods smothers the screams of exhilaration trailing down the toboggan runs. And at the village of Ephraim, William Sohns raises the loudest noise of all with his homemade air iceboat.

"Stand back, now!" he yelled, snapping the propeller downward. The 65-horsepower airplane engine on the rear of the ski-fitted boat coughed into a rumble. I climbed into the cabin of the craft just in time to hear Sohns say, "I've had her up to 70 miles an hour, but I think I'll open her up today."

When he looked closer at the frozen expanse of Green Bay before us, he added: "The ice looks pretty rough. Tell you what, come back on a nicer day, and we'll give her a whirl." A nicer day never came during my visit, and I like to think my parting expressions of heartfelt disappointment sounded sincere.

Hardiest Fishermen Take to the Ice

Of all the winter-sports activities on the peninsula, none demands more dedication than ice fishing (below). As soon as the ice thickens and toughens, the colorful fishing shacks, smoke curling up from their warm innards,

Hardy is hardly the word for these ice fishermen, who hack a hole in the 32-inch armor plate of Sturgeon Bay while the temperature hovers around −9° F. Most fishermen make holes in the floors of heated huts, where they can pull up perch and trout in greater comfort. Snowmobiler at right ventures

appear on Green Bay; there the hardiest of all fishermen encamp for hours in quest of the bay's tasty perch. Some, like Clarence Chaudoir, a retired Coast Guardsman who lives in Sturgeon Bay, fish out in the open.

I slipped and slid for what seemed like 15 minutes before covering the 100 yards between the shore and parka-swathed Chaudoir. The temperature hung around zero. "I guess I've fished out here on the ice every winter for the past 20 years," he said. "Not much luck today; only caught nine all morning."

I glanced at my watch: shortly after one o'clock in the afternoon, and with the wind acting as if it had lunched on frosted steel. I marveled at Chaudoir's ability to tolerate the terrible cold. I marveled even more when he told me he intended to stay out another three or four hours because "sometimes they bite good in the late afternoon."

out from shore to pay a call. Many of Door's growing legion of winter-sports enthusiasts wear buttons that read "Stamp Out Summer."

KODACHROME BY DONALD N. EMMERICH © N.G.S.

Winters on the Door Peninsula are not kind, although the surrounding waters act as a moderating influence on the temperature, raising it a few degrees above that in the city of Green Bay on many winter days. Not that the people of Green Bay concern themselves much with the freeze that grips their city each year, for they wrap themselves up in the fortunes of their beloved Packers, 11 times world champions in professional football (pages 368-9).

True Packer Fan Never Despairs

When the Packers do battle at home, Sunday in "Titletown" starts with a whoop and ends with a holler. Some churches schedule services early so that members of their congregations can get to Lambeau Field in time for the kickoff. Admission to the 50,861-seat stadium is by season pass only, and so highly prized is a pass that divorce actions sometimes bog down when neither party agrees to let the other have it—the car, yes; even the house and dog; but not the season ticket.

"I heard the story told—not that I believe it, mind you—that a fellow in Green Bay lost a $5 wager when Minnesota beat the Packers one year," a shipyard worker in Sturgeon Bay told me. "He refused to believe the outcome, so when they replayed the game on TV the next day, he backed the Packers again and lost another $30."

But home games with the Bears of Chicago, a city more than 40 times the size of Green Bay, bring out the ultimate in partisanship. Each Packer gain draws from the crowd a great roar, a collective rising to the feet, a shaking of fists in a gesture of belligerent bliss. When the Bears score, the moan is like a concerto for a thousand bassoons.

This lionhearted devotion spills over into the Door Peninsula, where in the town of Sister Bay, a man told me he will always remember December 7, 1941, because on that day the Packers beat the Bears, 16 to 14.

Football seasons end, but winters linger on in the area until one day, usually in mid-April, residents of the peninsula wake up to find a warming sun scraping the flour paste from the winter sky. Soon the cherry trees blossom, the wild flowers weave their carpets on the woodland floors, and hotel people start recruiting help for the coming season.

About this time too, the spray from the ice-free surf of Lake Michigan hangs a necklace of small, pale rainbows over the shore as if to reaffirm the vows between this rocky land and the inland sea. THE END

Wild Elephant

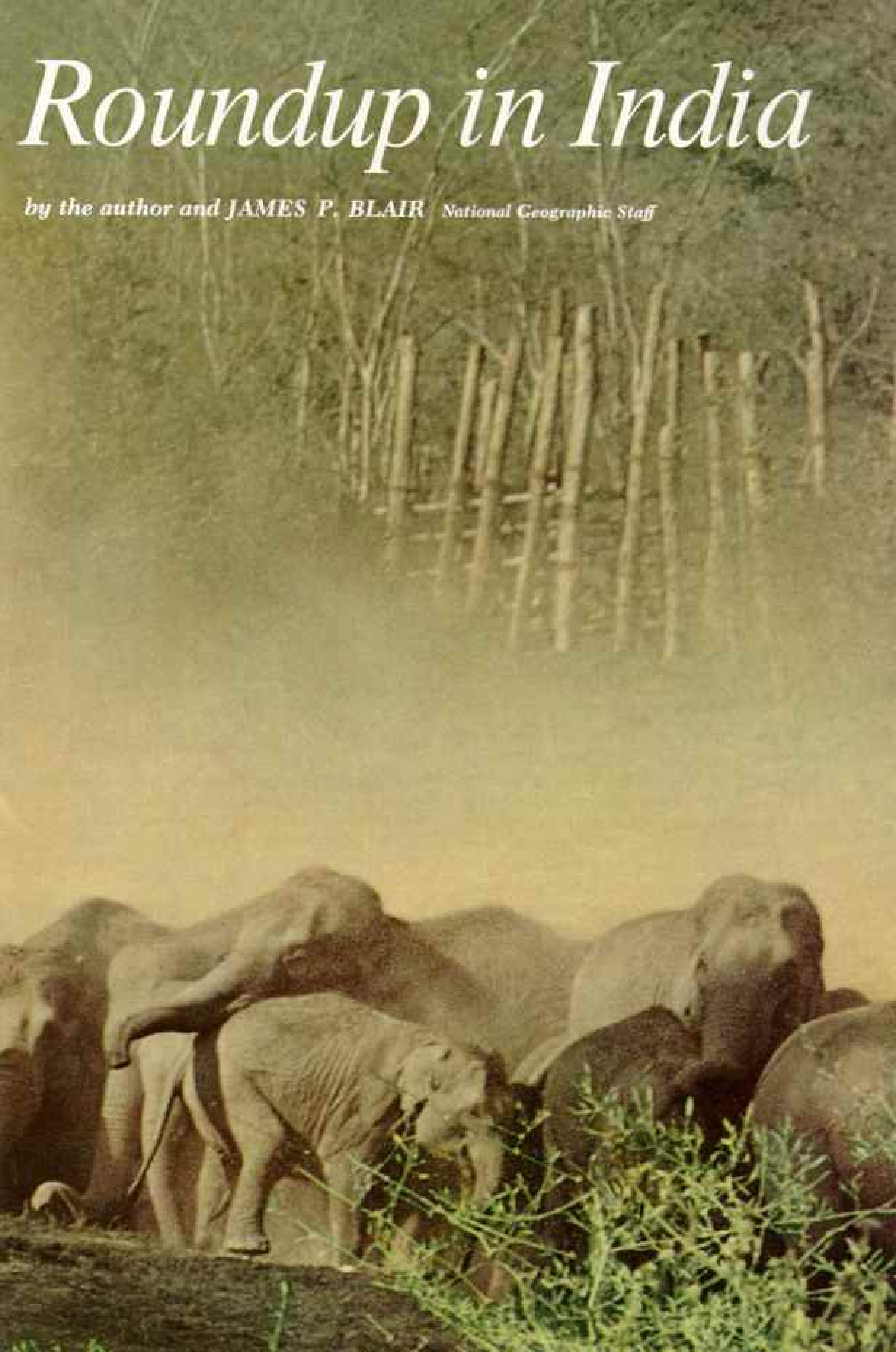
By HARRY MILLER   Photographs

TRUMPETING IN TERROR, *half-grown heavyweights from the forests of Mysore crowd together in a stockade during an elephant drive, India's first in seven years. Mahouts riding tame elephants, or* kumkies, *cut the dust-pounding animals out of the herd for roping and months of patient training.*

 KODACHROME BY HARRY MILLER © N.G.S.

Roundup in India

by the author and JAMES P. BLAIR National Geographic Staff



FROM MY SMALL PLATFORM in a mango tree I could look far down the Kabbani River of India's Mysore State. I had been waiting for hours. Now I heard the first distant cries of the beaters.

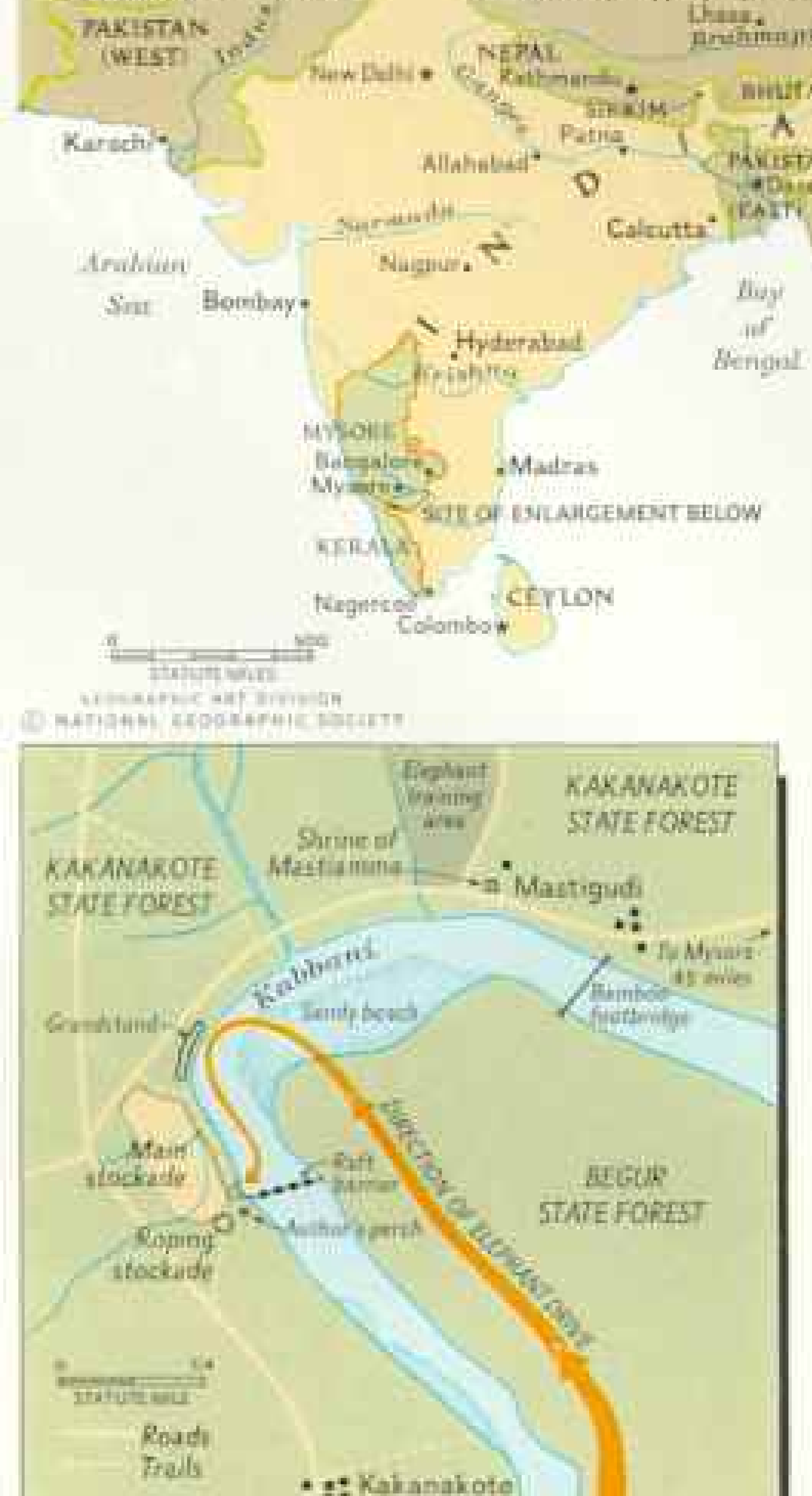
The din of bamboo clappers, the shouts and howls of men, the blasts of shotguns, and the trumpeting of wild elephants shattered the air. Then I saw the great herd moving through the teak in the jungle across the river. Soon the close-packed animals reached the river bend, where a band of *kumkies*—as tame elephants are called—turned them down a flat sandy beach and out into the river.

They drove directly toward my perch as I aimed my camera at the confused scene—a tumbling mass of gray shapes, with scores of trunks waving in the air and an occasional flash of white tusks. Behind the herd, steady and firm, came the lines of kumkies with tiny-looking men waving and shouting from their backs. Following them was an astonishing mob—tribesmen and villagers and forest guards, boys and men of all ages in all manner of clothes from ragged loincloths to shirts and ties, every one banging away furiously with bamboo clappers; howling, whistling, and cheering. This was the climactic moment of Mysore's famous wild elephant drive.

Elephants Work as Lumberjacks

I had come six weeks before to the State Forest at Kakanakote, near the southern border of Mysore (map, right), to watch the Forest Department catch wild elephants by the *khedda* method. In a dramatic roundup, lines of beaters and kumkies drive an entire herd of wild elephants through the forest to a stockade. From this they are later taken to be tamed and trained—primarily to help in harvesting teak, rosewood, and other valuable timber that can fetch up to $7,000 a tree.*

When I arrived at Kakanakote, the area seethed with activity. Under the direction of Conservator C. Jayaram Reddy, superintendent of kheddas, more than 8,000 teak logs and 20,000 stems of bamboo had been cut to build an 11-acre stockade and subsidiary structures. As work began, rows of diggers, wielding enormous long-handled shovels, scooped out four-foot-deep holes in the hard dark earth, and into these the kumkies tipped



Trail to captivity begins in the deep jungle where beaters on foot surround a herd of wild elephants. At dawn on the day of the drive, foresters on kumkies pray for the blessing of the goddess Mastiamma. Then they join the beaters in driving the entire herd into an 11-acre *khedda*, or stockade.

the heavy teak logs, each 18 to 20 feet long.

Following the kumkies, teams of villagers tamped down the earth at the bases of the heavy uprights, then lashed horizontal wooden bars between them. At the edge of the stockade others dug V-shaped ditches, eight feet deep and nine feet wide at the top—a precaution against newly captured elephants making a concerted attempt on the fence. Since elephants are unable to achieve even the smallest hop or spring and are extremely fearful of steep places, where their heavy bodies might be injured in a fall, the ditches make effective barriers. "Khedda," incidentally, means "ditch," but has also come to mean

The author: British-born Harry Miller has lived in India for 15 years, writing and illustrating articles on natural history. He shares his house, "The Frogs," near Madras, with his Indian wife, two children, and a collection of tree frogs, giant squirrels, and snakes—but no elephants.

*For a fascinating account of a lifetime with working elephants, see "The Elephant and I," by M. D. Chaturvedi, NATIONAL GEOGRAPHIC, October 1957.

EKTACHROME BY JAMES P. BLAIR © N.G.S.

To hold the quarry until the drive begins, a tribal watchman and his fellows, stationed 60 feet apart, form a human chain around the nervous herd. Blazing bonfires, the clamor of bamboo clappers, and a barrage of shouts keep the animals from making a break for freedom. As days pass, the noose tightens. Some 1,500 villagers, Kuruba tribesmen, and officers of the Mysore Forest Department took part in the roundup that netted a herd of 86 bulls, cows, and calves, one of the largest ever captured in Mysore.

both the stockade and the roundup itself.

The khedda of January 1968—the first since December 1960—was made unusually difficult by a great natural disaster that had befallen the area six years before. Over hundreds of miles of forest, all the bamboo simultaneously had come to the end of its 60-year cycle of life, flowered, and died. It was slowly growing again, but in the meantime the feathery fronds of the giant stems had vanished, and with them much of the food and cover elephants require.

Inside the stockade there would be neither natural fodder nor shade for the captured animals. Elaborate preparations therefore had to be made to truck in fodder—river grass, banyan-tree twigs, and sugar cane.

Meanwhile Divisional Forest Officer H. P. Viswanathan was tackling other problems:

"During the hottest part of the day," he told me, "elephants suffer from direct sunshine. Here in the stockade I'm setting up artificial shade and a shower system to keep them cool and damp."

His crew had embedded a pipe in a furrow cut into the trunk of a tree. This led to a grid of sprinklers, suspended high in the branches. Two pumps at the river would raise the water to supply this strange shower bath.

The health as well as the comfort of the elephants needed attention. In charge was diminutive Dr. C. V. R. Rao, veterinary officer to the Mysore Forest Department. He would eventually lose sleep over the wild herd, but right now his concern was for the 35 kumkies.

"For all their great size," Dr. Rao explained,

"my elephants are as sensitive and delicate as human patients. They suffer from indigestion and respiratory complaints, and even from the common cold."

With enthusiasm and affection, Dr. Rao explained how the kumkies, their forefeet shackled to prevent them from wandering too far, were released into the forest every evening after they had been bathed and fed.

"This keeps them in good health—they are happy roaming about freely, they can forage for themselves, and the females can mate with wild tuskers."

Occasionally a mishap occurs. Once a *khotal*, the boy whose job it is to assist the mahout—the elephant's keeper—by washing, feeding, and bathing the animals, went in search of a wandering kumkie cow early one morning. Unknown to him, an affair had been in progress between his kumkie and a wild tusker. The love-struck gentleman was concealed in a bamboo thicket when the boy ar-

Stampede! Fleeing a cacophony of gunfire, bugle blasts, and yells, the wild elephants crash through the forest ahead of this shouting horde

rived. He charged and killed the lad instantly.

Like the mahouts, the *yajamans*—the hunter-trackers—are vital to the success of a khedda. Many are old men with a lifetime of jungle experience behind them. They appeared from time to time at Kakanakote to report to the forest officers on the movements of wild herds. A few wore long black frock coats and sported silver medals attesting to their part in kheddas as long ago as 1923.

On December 30, 1967, the yajamans reported that a large herd had been discovered near the Kabbani River. The drive opened at Mastigudi, nearly two miles downstream from Kakanakote. There, early in the morning, the forest officers assembled all 35 kumkies with their mahouts and khotals beneath an ancient peepul tree before the small stone image of Mastiamma, the goddess of the forest. Then the long procession marched solemnly and silently off.

In time they would surround the wild

and pound toward the gate of the stockade. Mahouts sit astride the pursuing kumkies' necks; their passengers ride on straw mats.

KODACHROME BY JAMES P. BLAIR © N.G.S.

Sensing a trap, the herd halts at the stockade entrance. For 15 minutes, the great beasts stubbornly stood their ground in an earthshaking melee of surging animals and shrieking men. Once when a wild calf only days old ran blindly among the huge kumkies, its mother followed unhesitatingly and shepherded it back to the herd.

elephants and drive them toward the stockade. For the present, however, the herd was confined only by lines of tribal watchmen with stacks of firewood that they kept ablaze all night and smoking by day (page 375). Ordinarily the elephants would not pass this barrier, which stretched for miles. But the greatest care had to be taken not to panic the herd, for then it might well stampede through the thin defense.

During the next few days the forest officers, planning each move on detailed maps, gradually reduced the encirclement.

"Not only do we have to study every movement the elephants make and take countermeasures," Mr. Reddy told me, "but we must also control 1,500 watchmen. I must make sure they get food, that they don't drop off to sleep, that the fires are kept going, that there are no quarrels or desertions, and that they

KODACHROMES BY JAMES P. BLAIR (ABOVE) AND HARRY MILLER © N.G.S.

With the herd finally trapped, mahouts squat on the floor of an adjacent roping corral to plan the most perilous drama of the drive—roping the animals as a first step in taming. Sugar cane will lure them a few at a time into the enclosure, where Indian cowboys will risk their lives tethering heads and legs.

receive their daily pay of 40 cents each."

Finally the giant trap was sprung. The wild herd was sent thundering through the forest toward captivity. From my perch in the mango tree high above the stockade, I had a spectacular view as the immense animals charged straight toward me.

At the khedda entrance, two teak logs 27 feet high supported a hinged wooden drop gate held open by a rope. A short fenced corridor had been built from the gate into the water, and from the end of this a steel cable had been stretched across the river with four bamboo rafts attached to it at intervals.

Fires had been lighted on the rafts, and behind them, up to his middle in water, stood a great kumkie tusker named Ranga—one of the biggest elephants in India. Ranga, who carries the Maharaja of Mysore at festivals, was too old for the long, hot drive through the

forest. His assignment was to prevent any last-ditch attempt by the wild elephants to stampede past the rafts.

In utter panic now, the animals tried to climb the far bank of the river, only to find the way blocked by a stout barrier. Behind this, in a grandstand, thronged 1,700 spectators. Urged by the beaters and kumkies, the beasts wheeled back into the river, where a few of them broke away and tried to escape again along the far bank.

Elephants cannot gallop, but they can do up to 18 miles an hour at a kind of trot—astonishingly rapid for such big creatures. As the breakaway came, a detachment of kumkies trotted after the fugitives at top speed and drove them back to the main herd, which was now slowly making its way under the trees on the riverbank toward the gate.

Mother Makes a Heroic Rescue

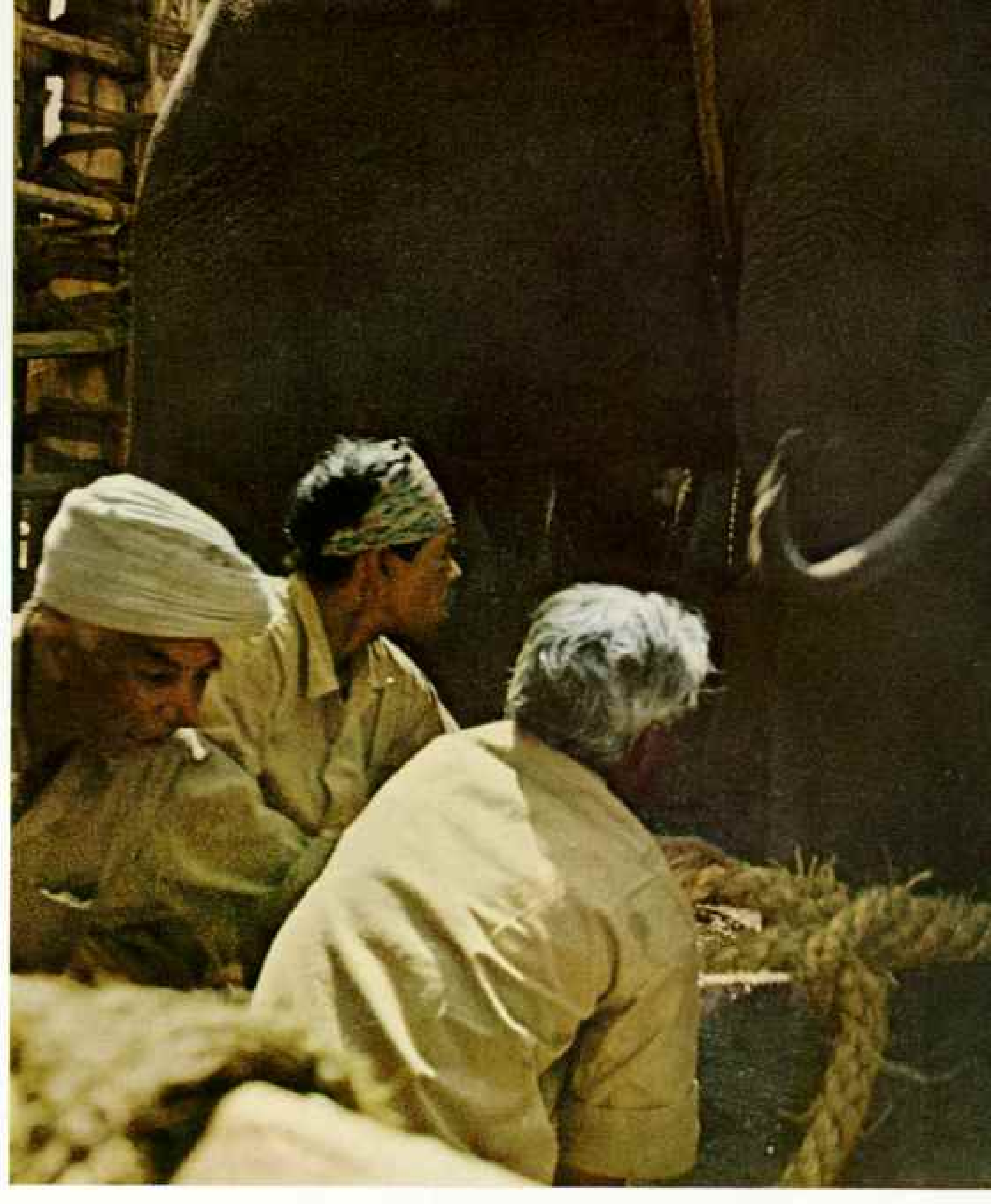
The whole great milling crowd of men and beasts surged below me at the khedda entrance. There, for a quarter of an hour, they stuck. The old cow who led the herd sensed the trap and refused to lead them in. The Moslem mahouts and khotals shrieked to Allah for assistance; the kumkies thrust their tusks hard and often into the broad backsides before them.

Then, for me, came an agonizing demonstration of the elephant's wonderful bravery and tenderness. I saw a tiny calf, a few days old, running among the legs of the kumkies, without the slightest idea of where it was or what was happening to it. The mother, a wrinkled, brave old lady, did not hesitate. Turning aside from the wild herd, she charged heroically at her tormentors—kumkies, men, guns, beaters, and all. Shouldering her way among them until she reached her baby, she turned him in the right direction and, nudging him along with her trunk, pushed him ahead of her to rejoin the herd.

Finally, exhausted and beaten, the elephants in twos and threes slipped through the gate and into the khedda. A cheer went up from the crowd as a concealed mahout slashed the rope that held up the gate and it came

Scrambling for his life, a noose-handler scurries up a kumkie's side in the roping corral. Seconds before, he dodged between the pile-driver legs of the wild cow he had helped to tie. Mahouts on kumkies slipped head ropes on the captive. Safe behind a wall of teak and bamboo, camera fans focus on the action, frantic and frighteningly near. Some 1,700 spectators paid as much as $66 each for seats.

KODACHROME BY JAMES P. BLAIR © N.G.S.

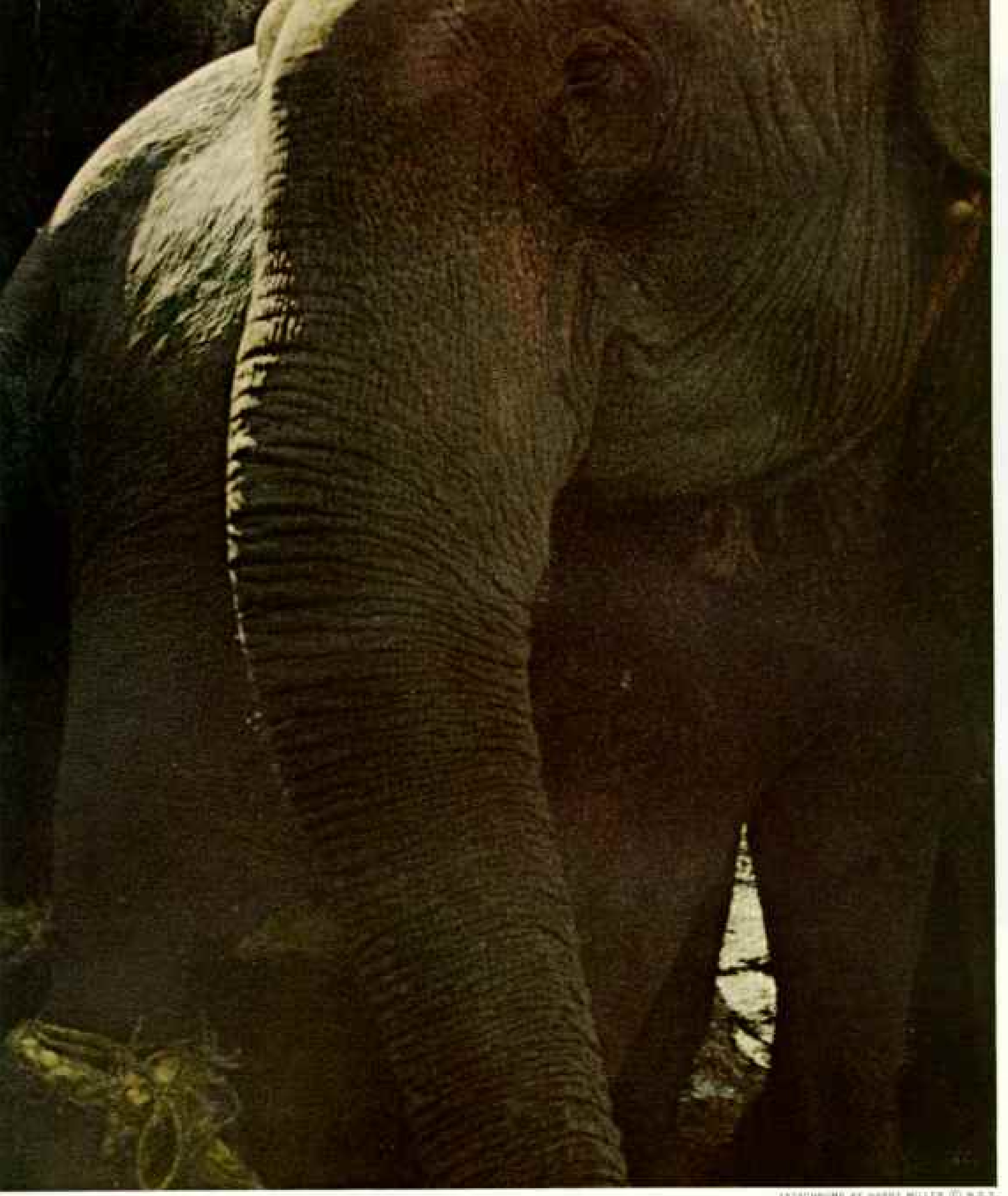


Amid stomping feet and swinging trunks, men tighten lines that restrain the hind legs of a wild elephant in the roping corral. Two huge kumkies at left and right, almost obscuring the captive, press tightly against her to keep her from lashing out with a trunk that could inflict a

down with a great crash behind the last of the herd.

Several days passed before the animals could be accurately counted, for the calves and young elephants huddled nervously together. But finally we knew the size of the herd: 86—one of the biggest ever caught.

Every evening the mahouts strewed sugar cane about the floor of the adjacent roping stockade, which consisted of three concentric circles of heavy log fencing (preceding pages). This enclosure was connected to the khedda by a short passage, and the gate at its entrance was left open. Scenting their favorite food, the elephants came into the stockade at night, and when four or five were inside, a mahout would drop the gate. Next day the mahouts would slip nooses around the animals' necks and hind legs so they could be tied singly to trees. Then training would begin.



EKTACHROME BY HARRY MILLER © N.G.S.

death-dealing blow. Finally subdued, the cow will be taken to a nearby training camp, tied to a tree, and assigned to a full-time guardian. He will stay with his charge day and night, talking to her, feeding her, and leading her to the river for the daily bath that all elephants relish.

Only once did this technique fail, because of trouble one night with the gate. Next morning there were no elephants waiting to be roped, so the kumkies with their riders entered the khedda to cut out a few and drive them into the roping stockade (pages 372-3).

The wild herd was drinking calmly at the khedda pond when the line of kumkies quietly approached. Like a row of kettle spouts, a score of upturned trunks lifted toward them, trying to catch the scent. Then the cow elephant who led the herd stiffened her tail and swung one forefoot angrily at the ground—the certain preliminary to a charge. The old lady went at them in a cloud of dust, with a screaming trumpet of rage.

There are few things in the animal kingdom more awe-inspiring than the infuriated charge of a wild elephant. Even the great kumkie tuskers momentarily recoiled before

EKTACHROME BY HARRY MILLER © N.G.S.

Kindness counts. Encouraging words and a gentle hand will build ties of friendship between a two-year-old elephant and the son of a mahout. Training usually takes six months to a year; in time the beast may learn as many as 30 commands. Most valuable animal captured in this khedda was a prime young tusker which sold for $1,265.

her onslaught, but she could do little against their solid ranks. The herd now left the water hole, milling about as the kumkies approached. Then five wild elephants broke away and headed toward the roping stockade. The kumkies followed hot on their heels, but it was many minutes before even the biggest tuskers, like Ranga, could push them in far enough for the gate to be dropped and the roping to begin.

With the kumkies leaning heavily on the wild elephants to jam them against the sides of the stockade, mahouts slipped in and out among the huge, thrashing legs, risking death from desperate kicks but always somehow managing to avoid them (preceding pages). After many attempts the mahouts on the ground slipped nooses high up over the wild elephants' back legs, while mahouts atop the kumkies got nooses around the necks. Where else, I wondered, do men take as many risks for $20 a month?

In 10 days all the herd had been roped and transferred in manageable groups to the *peel khana*, or training camp, at Mastigudi. To control the captives on the mile-long trip, the mahouts roped the wild elephants to the kumkies; at the training ground they transferred the ropes from kumkies to trees. It was an impressive sight to see in the small area of the peel khana no fewer than 121 elephants, including the kumkies.

Once a day the elephants were led from the camp down to the river and allowed to drink and bathe, a time-consuming operation involving many men and, in the case of big elephants, three kumkies each. Younger elephants could be trusted to a single kumkie, and it was on one of these, with only little Siddhappa, at 15 the youngest mahout present, that I went down to the river.

Temperamentally the wild elephants behaved according to their ages, much as humans would. The little chaps were by far the most active, tearing away at their ropes, lashing out furiously at anyone nearby, and at times rolling over and over on the ground in tantrums. The older animals stood quietly and stolidly, watching with tiny angry eyes for any chance of escape, or an opportunity for a swipe at their captors.

Training Goes On Day and Night

A permanent guardian was assigned to each captive elephant—mahouts to the big ones, their teen-age sons to the smaller ones. These guardians stayed beside their charges day and night, eating and sleeping there, talking to them constantly, feeding and cleaning them, dressing wounds caused by chafing ropes, answering any aggressive use of the trunk with a poke from the pointed elephant goad (called the *ankus*), and rewarding good behavior with chunks of sugar cane.

The first requisite of the training program was to win the elephants' respect. The mahouts knew perfectly well that cruelty was out of the question, for an elephant can split a man's skull with a flick of its trunk, and a badly treated elephant will look for the first opportunity to do so.

A change in almost all the animals was soon apparent. They ambled to the river with a minimum of coercion, though still wild and

dangerous to approach. In the river, the joy of the little elephants was indescribable when they found they could swim. They half-somersaulted on their ropes, heads down and bottoms up, in sheer excited delight, suggesting small boys let loose on a hot summer day.

Bargains Struck With Astrologers' Help

Five weeks after capture, 38 of the elephants were auctioned off at Mastigudi. They brought the State Treasury a total of $22,093. Females normally bring the highest prices, but this time the most expensive animal was a young tusker. He sold for $1,265.

Most of the buyers were either timber contractors or temple trustees. Many were accompanied by astrologers, who studied the animals for auspicious signs and markings believed to reveal temperament, working ability, health, and probable life span.

A trustee from the famous Hindu temple at Nagercoil, at the southernmost tip of the Indian peninsula, was shopping for young tuskers to serve as sacred elephants on ceremonial occasions. But the great majority of the elephants bought that day would find themselves in forests rather than in temples. Divisional Forest Officer Basave Gowda Balaiah assured me that the lumberjack kumkies of Mysore and Kerala would never be replaced by machines.

"No matter how carefully you handle a tractor," he said, "it is bound to damage young trees—and what a racket it makes besides! But even a big tusker can move so delicately—and quietly—through dense forest that hardly a blade of grass is injured, let alone trees. No, we will always want our kumkies here."

The elephant also appears content to forestall the technological revolution. This adaptable animal is one of the few wild creatures that can be tamed and trained when adult. One of the reasons is that the elephant is among the most intelligent of all animals. Still another is that, like the dog, the elephant develops a puzzling affection and indulgence for those noisy, destructive, simian little animals around them called men.

The animals I came to know so well at Kakanakote adjusted happily to human society—including mine. Mixed up among the lenses, film rolls, and notebooks in my pockets, I usually carried goodies for the kumkies—bits of sugar cane, jaggery (brown cane sugar), and tiny local bananas.

The females were especially adept at looting my pockets of these delicacies. Once, nine of them pinned me to the fence at the shrine of Mastiamma. Quietly but firmly, with the ultimate in good manners, these ladies robbed me of everything edible I possessed. When I tried to escape, there was always a trunk, a hefty shoulder, or a massive foreleg casually blocking the way. No one pushed or jostled or grabbed. It was all as genteel as a cookie-and-sherry party at a Victorian parsonage.

The grinning mahouts tried to dissuade the animals with one or two half-hearted bangs on their heads with the ankus, but these only produced foolish gurgles from somewhere up at the tops of their trunks. They knew exactly how far they could go. With a sucker like me, that was pretty far. THE END

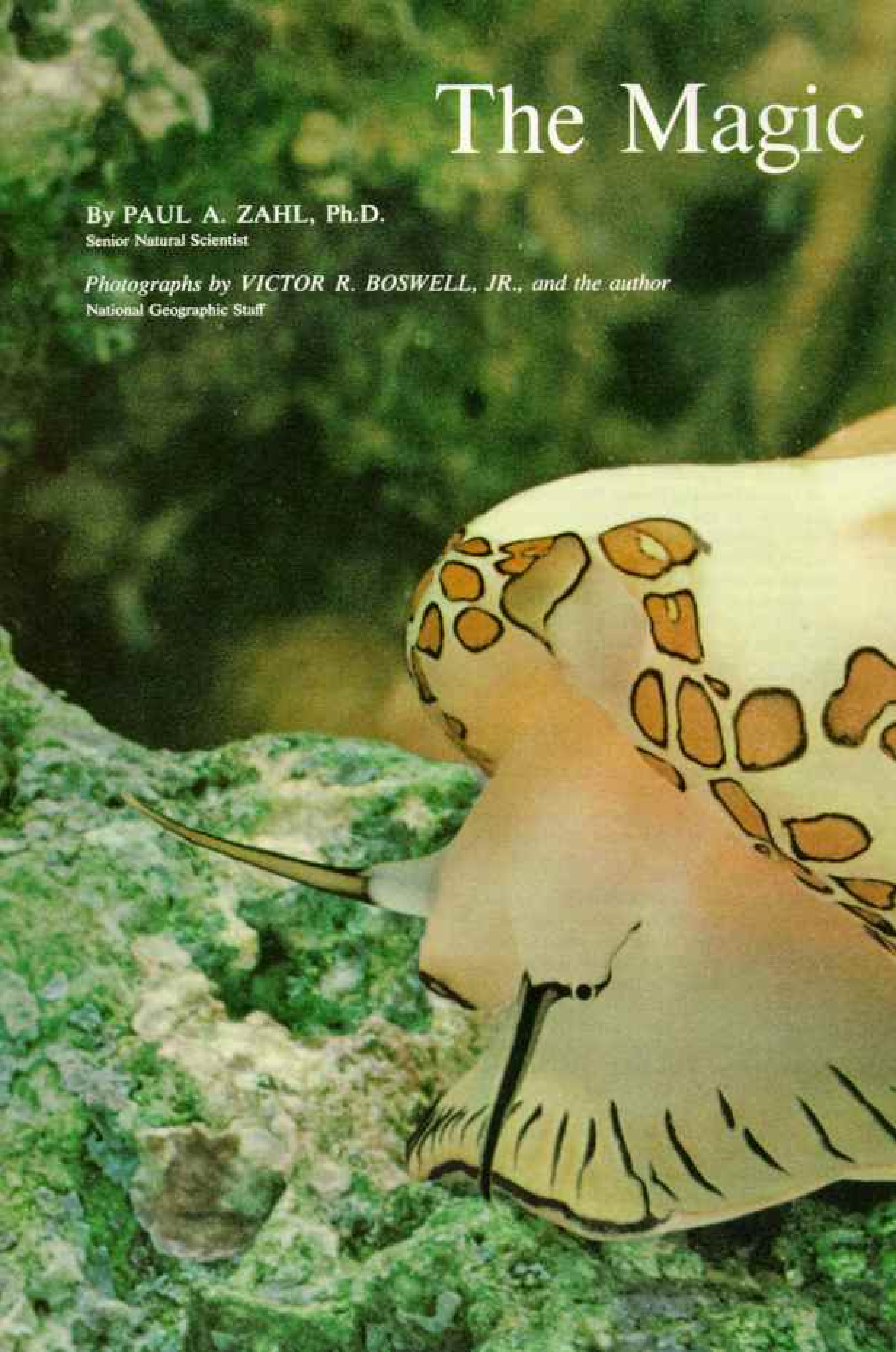
KODACHROME BY HARRY MILLER © N.G.S.

Glittering graduate, a young tusker in gilded headdress and howdah participates in a festival at a Hindu temple. Others among the captured herd went to logging camps and to Indian zoos that swapped them for foreign animals. The 1968 roundup may be the last in Mysore if a projected dam floods the Kabbani River site.

The Magic

By PAUL A. ZAHL, Ph.D.
Senior Natural Scientist

Photographs by VICTOR R. BOSWELL, JR., and the author
National Geographic Staff



Lure of Sea Shells

LITTLE LEOPARD OF THE SEA, *a Caribbean snail draws a spotted veil over its pale-orange shell. This fleshy mantle secretes a limy substance that continuously builds the fortress home. Inch-long* **Cyphoma gibbosa,** *commonly called flamingo tongue, glides on a muscular foot. Sensory tentacles and beady eyes flank its feeding snout. In myriad shapes and colors, marine mollusks bequeath a legacy of beauty from the seas of the world.*

KODACHROME BY PAUL A. ZAHL © N.G.S.

THE SOUND I always hear inside a sea shell is that wild music of wind and wave on the broken shore of Point Arena, California. As a boy I wandered that coast, following the ebbing tide and the morning fog into another world.

There cliffs brood over a smashing surf; weathered rocks stand sentinel over tidal pools thick with kelp. In those pools, as in dark mirrors reflecting life's beginnings, I glimpsed many wonders—anemones green with algae, starfish with skins of purple and pink, and sea urchins, the porcupines of the sea.

In one such pool I first chanced upon the chiton (pronounced KY-ton), a small oval animal attached to the underside of a boulder. Across its back stretched eight hinged plates of armor, held in place by a leathery girdle spiked with bristles.

Gently, I pried the strange creature loose with my pocket knife and placed it on top of the rock. It immediately rolled into a ball, like a miniature armadillo.

The turning tide dumped a warning wave into the pool, and I hastened back to shore with my prize. The tiny armored creature fired my curiosity, and soon I was poring over books on natural history.

The chiton's coat of mail is the product of a special fold of thick tissue called the mantle. I learned that the animal adheres to rocks with a strong ventral muscle, the foot. Chitons (page 404) browse on algae, scraping off digestible bits with the radula—a filelike tongue, coated with sharp teeth, that uncoils like a piece of thorny ribbon from the mouth.

Patient Survivors of Primeval Seas

Thus the humble chiton introduced me to that populous and varied phylum, the Mollusca, one of earth's most fascinating life forms. This primitive member also displayed for me the special equipment by which the molluscan way of doing things has endured for eons.

Scientists who find Lower Cambrian deposits of 600 million years ago strewn with tiny dunce caps that once housed primitive snails think that mollusks came into being long before even that faraway time. They postulate flabby, wormlike little creatures inching around in the ooze of primeval seas, probing for microscopic bits of food with a simple snout. As dissolving land masses began to feed their salts and other chemicals into the oceans, the first mollusks digested them and eventually used them to build durable shelters against a hostile environment.

Mollusks perform that feat with the mantle, one of nature's most unusual building tools. This fold of muscular flesh covers the back and sides of the animal. When fully extended, it spreads out like a skirt, and in some

Exploring wave-wet sands, collectors search Florida's Sanibel Island, long famed as a shelling ground. As they scan the shallows and rake the sand, they easily discover common beauties. Finding the unusual requires the smile of fortune. After a storm

species it wraps all the way around the shell (pages 422-3).

The mantle is pitted with countless pores, the open ends of tubes through which the animal secretes particles of the limy substance that forms the shell. This material solidifies quickly in a thin layer. Upon this fragile wall another is laid, often cross-grain to the first, and then another, until the edifice is built up. The animal may finish off the surface with a smooth layer like the finest porcelain.

Lime-secreting cells at the mantle's edge make the shell grow in length and breadth; those in the part of the mantle that lies inside the shell serve to increase its thickness and repair any damage it may suffer.

Some species make the interior walls of alternate layers of lime and horny tissue, coated with microscopic lime crystals that overlap each other in the manner of roof shingles. Light bouncing from the edges of the shingles produces the luster we know as mother-of-pearl.

Mankind has always been astonished by the fantastic structures that the mantle can produce—the frozen starlight of the Venus comb murex, the gleaming marble mound of the cowrie, the ivory minaret of the auger, the massive alabaster battlements of the conch, the petrified flowers of the thorny oyster. Only a highly sophisticated and biologically successful animal could create such magnificent architecture.

With a secure shell produced by the mantle, with a radula to help probe for and prepare its food, and with a strong foot for locomotion, the shell-bearing Mollusca have made their way onto every continent. They dwell in every ocean, and survive in just about every kind of environment.

A few daring adventurers have learned to survive above the snow line of the Himalayas, in the piping-hot water of thermal springs, in the solid ice of frozen ponds, in the dry wastes of shimmering deserts, and in the sea's abyssal deeps, where the pressure mounts to tons per square inch. Most of the ocean's 50,000 shell-bearing species, however, prefer to live at moderate depths—on coral reefs and continental shelves.

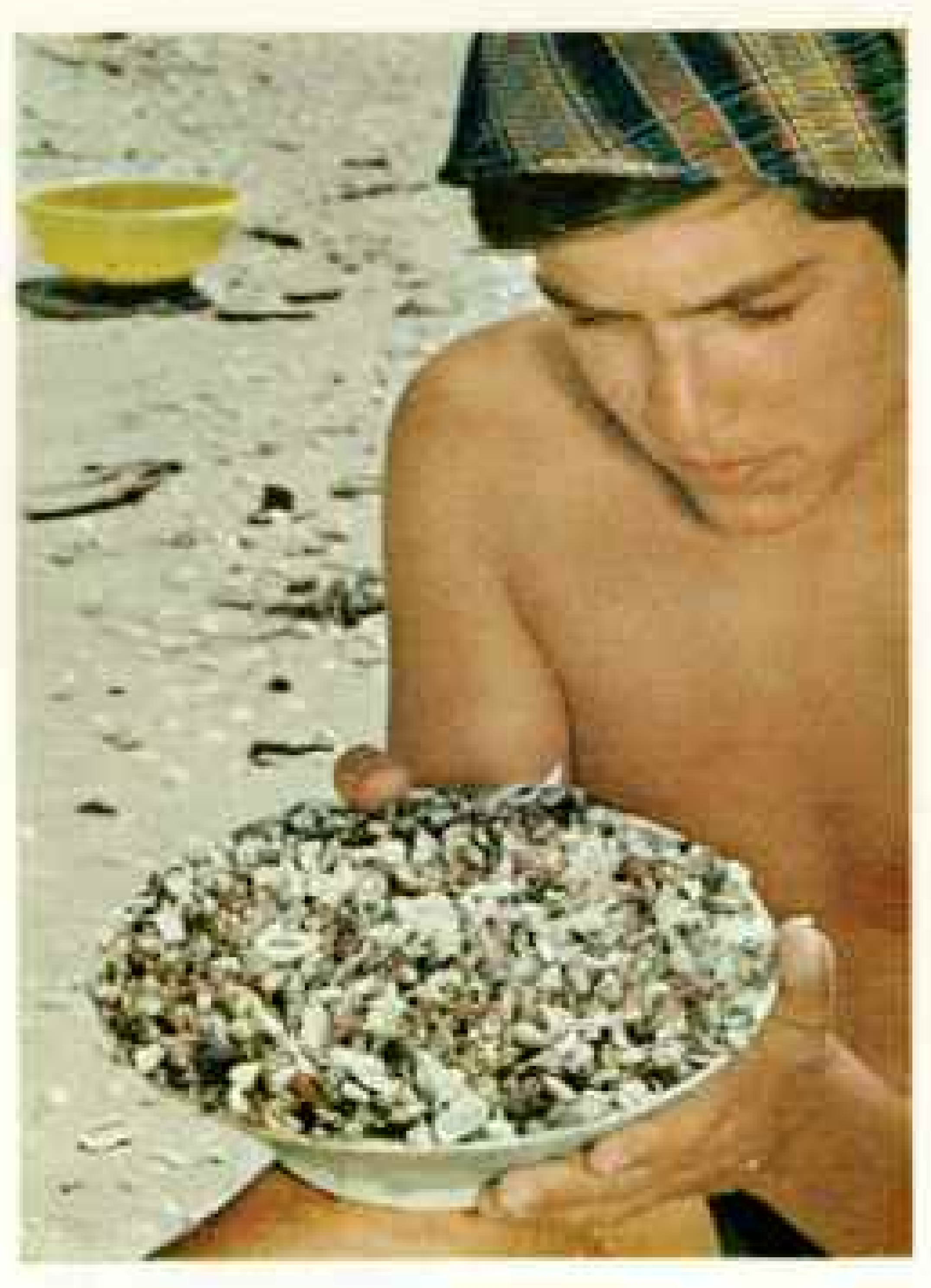
Coquinas Known by Many Names

The most familiar mollusks are those commonly associated with man's dinner plate—the succulent oysters, clams, scallops, and mussels that have provided human meals for thousands of years. All are members of a teeming class known as the bivalves—mollusks with two shells hinged together.

The first living mollusks that the Zahls met as a family were bivalves. It was a bright August afternoon, and my son Paul, then

has roiled the depths, surf may toss ashore highly prized shells. But even the profusion of specimens on Sanibel yields but a handful from the world's 50,000 species of marine mollusks, which belong to a group second only to insects in number and variety.

EKTACHROME BY NATIONAL GEOGRAPHIC PHOTOGRAPHER OTIS IMBODEN © N.G.S.



seven, and I were strolling the beach of Sanibel Island, a shell collector's paradise on Florida's west coast (preceding pages). Shells dotted the white sands around us—lifeless hulks washed ashore by the surf. Paul, with the enthusiasm of childhood, was gathering up cat's paws and turkey wings and pectens and whelks and others that attracted his eye.

Suddenly he stopped, staring straight down as a wide tongue of surf swirled the sand around his bare feet.

"They're alive!" he cried. "Dad! They're alive!"

Hundreds of tiny clams, each less than an inch long, squirmed about Paul's toes and ankles. They tumbled, dived, and dug furiously to return to their burrows from which the wave had troweled them.

Quickly we cupped up handfuls of the animated sand. When the fan-shaped shells were strained out, each revealed a different pattern and color, all with the sheen of lacquered fingernails (below).

Wonder comes in all colors to the author's son, Paul, Jr., on Sanibel Island. His bounty includes coquina clams, *Donax variabilis* (magnified three times, below), among Florida's most abundant bivalves. Twin siphons extend from the half-inch shells, or valves. One inhales oxygen- and food-bearing water; the other pumps out water and waste. Coquina meat makes a flavorful chowder. The shells, cemented by their own lime and compacted over the ages, create a limestone soft enough to be cut with a saw. The Spanish used it to build 300-year-old Castillo de San Marcos in St. Augustine, Florida; the material still serves road, hotel, and home builders.

EKTACHROME (ABOVE) AND KODACHROME BY PAUL A. ZAHL © N.G.S.

A passer-by paused and said to Paul, "Those are coquinas. They make wonderful chowder." Later, as we carried our catch home in a jar, a friend remarked, "Look at the butterflies Paul has caught." Still another neighbor said, "My, aren't those pretty wedges!"

The incident shows the importance, even to amateur collectors, of knowing the proper scientific name for each shell in a collection. In this case, coquina, butterfly, and wedge are all popular names for *Donax variabilis*, noted for their choking abundance on Gulf and Caribbean beaches. They are favorites of young collectors—enameled jewels upon which nature has painted a million different southern sunsets.

But we were more interested in the creatures inside the tiny shells. Soon we were huddled around a half-pint beaker of sea water, watching as the valves opened a crack and wedges of fleshy tissue cautiously poked out. They turned and probed, trying to dig into the bottom of the glass container as they would into sand.

"Those are the feet," I explained to Paul. "Many bivalves, like *Donax*, use them as digging tools. That is where their class gets its proper name, Pelecypoda, or 'hatchet-foot.'"

Frustrated by the hard bottom, the clams soon withdrew their feet and settled down.

"Look," Paul said, "snorkels!"

Two tiny hoses remained extended from the slightly parted lips of the valves (opposite). One drew in water with its life-giving oxygen, edible plankton, and dissolved minerals; the other pumped it out, along with wastes. Most bivalves live on microscopic life drawn toward the stomach on a current of water set in motion by vibrating filaments—called cilia—on the gills.

That evening we talked of this fascinating realm of nature as we sat on the porch of our beach cottage admiring a golden Sanibel sunset, with piled-up clouds reflecting the last light of day. It was the quiet beginning of a continuing interest in mollusks for young Paul. In the years that followed, we learned a great deal more about bivalves, which we came to call simply "the clams."

Baby Oysters Lead an Active Life

There are about 10,000 different species in the great clam class. Most of us think immediately of the quahog, *Mercenaria mercenaria*, and of the edible oyster, *Crassostrea virginica*, a lowly creature that spends its adult life fastened in one place like a living stone. But many bivalves do incredible things.

Scallops leap and swim. Mussels tether themselves like dirigibles. Shipworms cut through timber. Pens produce a golden thread that has been woven into cloth of amazing fineness. The giant clams are farmers; small gardens of algae grow within their mantles. And everyone knows of the fabulous pearl oysters, the *Pinctada*, that surround bits of irritating matter inside their shells with iridescent globes prized throughout man's history (page 411).

Most bivalves begin life foot-loose and fancy-free. During their childhood, which may last from a few hours to a few weeks, the tiny creatures propel themselves about the watery neighborhood with their hundreds of cilia. Even the oysters, the very souls of sedentary propriety, swish to and fro until they realize they are built to sit it out.

After the brief swimming period, they drift downward looking for a secure place in the world. In this stage, oysters are called spat. If lucky, the spat attaches itself to a solid object and becomes sessile for life (page 400). If a spat happens to land in soft mud, however, it soon perishes. Chesapeake Bay oystermen spread tons of cultch—empty shells—over the shallow oyster beds to give the little bivalves a firmer footing in life.*

Even then danger lurks nearby, usually in the sinister form of a snail, *Urosalpinx cinerea*, the oyster drill. Sidling up to a bivalve, the drill saws a neat hole in one valve with its radula, inserts a tubelike proboscis, and sucks up its victim's flesh.

So precarious is the life of the spat, and so

*See "The Sailing Oystermen of Chesapeake Bay," by Luis Marden, NATIONAL GEOGRAPHIC, December 1967.

THE MARINE MOLLUSKS shown in this article were selected to serve only as a broad introduction to shells and to the intriguing, seldom-seen animals that inhabit them. To aid the reader in the identification of shells, the author recommends the following books:

Sea Shells of the World, by R. Tucker Abbott; Golden Press, New York, 1962.

Sea Shells of North America, by R. Tucker Abbott; Golden Press, New York, 1968.

Caribbean Sea Shells, by Germaine L. Warmke and R. Tucker Abbott; Livingston Publishing Company, Narberth, Pennsylvania, 1961.

A Field Guide to Shells of the Pacific Coast and Hawaii Including Shells of the Gulf of California, by Percy A. Morris; Houghton Mifflin Company, Boston, 1966.

Common British Seashells, by W. S. Forsyth; Adam and Charles Black, London, 1961.

And, in the July 1949 NATIONAL GEOGRAPHIC, "Shells Take You Over World Horizons," by Rutherford Platt. (Although long out of print, this issue can be found in most public libraries.)

Star shell
Astraea phoebia
¾ to 2½ inches

Beau's murex
Chicoreus beauii
3 to 5 inches

Caribbean cornucopia

TO A BROAD STRAND in Florida or the tiny palm-screened beach of a Bahamas cay come these colorful castaways. The lucky vacationist may spy the rare junonia volute (left), its spotted brilliance surf-tossed upon the sand. A bonus for the skin-diver, Beau's murex inhabits deeper water. The star shell mollusk, a gastropod, builds its single shell in a tight coil, while the turkey wing, a bivalve, grows its house in two parts. The bleeding tooth blocks the entrance to its shell with a rust-and-black trap door, the operculum. The fighting conch uses its claw-like operculum as a vaulter would a pole to leap across reefs and sea bottom. The turret, banded tulip, and wentletrap construct their homes with delightful symmetry, but the worm shell—after the same disciplined beginning—follows a haphazard course.

On this and the following panels NATIONAL GEOGRAPHIC presents a sampling from the unrivaled 10-million-specimen collection of shells in the Smithsonian Institution in Washington, D. C.

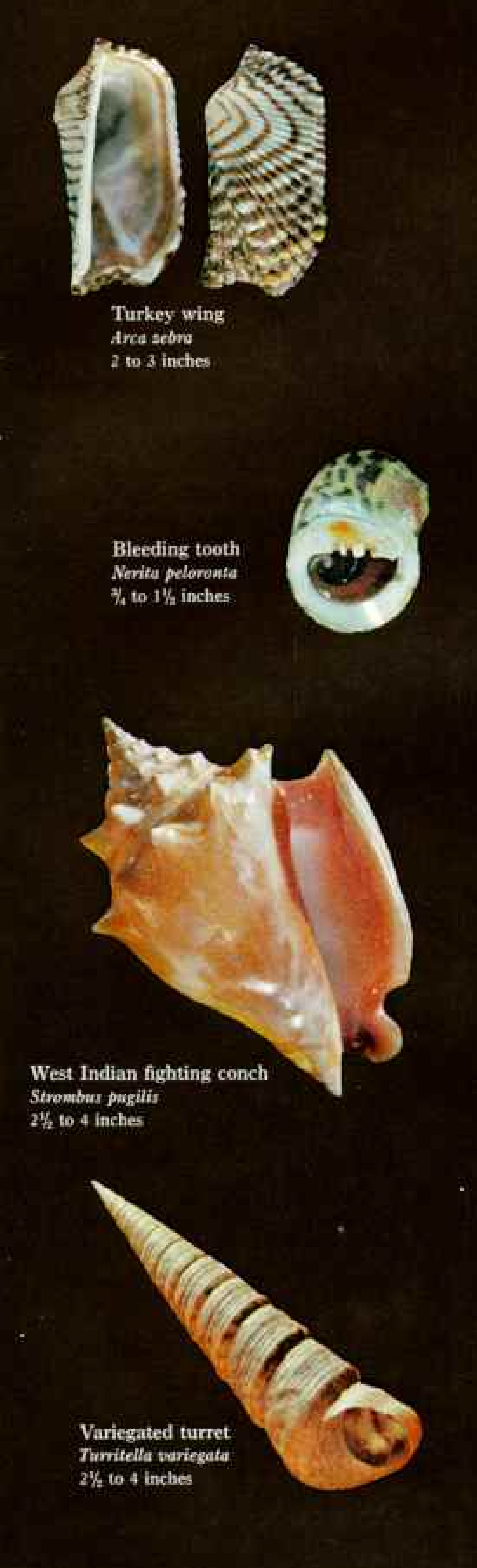
EKTACHROMES BY VICTOR R. BOSWELL, JR. © N.G.S.

Junonia volute
Scaphella junonia
3 to 6 inches

Lamellose wentletrap
Epitonium lamellosum
¾ to 1¼ inches

West Indian worm shell
Vermicularia spirata
2 to 6 inches

Banded tulip
Fasciolaria hunteria
2 to 5 inches


Turkey wing
Arca zebra
2 to 3 inches

Bleeding tooth
Nerita peloronta
¾ to 1½ inches

West Indian fighting conch
Strombus pugilis
2½ to 4 inches

Variegated turret
Turritella variegata
2½ to 4 inches

small are its chances of survival, that an adult female may produce several hundred million eggs at a time—of which only a few will develop. The eggs are released into clouds of sperm ejected by a nearby male.

Said the English satirist Swift: "He was a bold man that first eat an oyster." Today, around Chesapeake Bay, the oyster is big business. Some 5,000,000 bushels are caught and sold each season. Gourmets like them on the half shell, plump and juicy.

For shell collectors, the common oyster is altogether too common, but a bivalve called the thorny oyster (actually, a relative of the scallop) is a different cup of chowder. The many different members of the genus *Spondylus* are among the showiest of all bivalves. Most of them wear brilliant pinks, reds, and yellows, and bear on their oval backs long spines and fronds that give them a resemblance to stony flowers; they are sometimes called chrysanthemum shells (page 425).

Scallops Abound in Classical Art

All shells lure the human imagination to journeys through the world, to tropical coves where waves lisp quietly against a white shore, to wind-swept islands dreaming in sunlit silence at world's end. But the lively scallop beckons us to a marvelous journey through man's history, for it is the artistic royalty of the entire mollusk domain.

The art of ancient times made constant use of scallop shells. Archeologists probing the dry hills of Anatolia and the ruins of Greece have found statuettes of Aphrodite, whom the Romans called Venus, stepping from a scallop shell. Her symbol lingers through the classical world—on a garden wall at Pompeii, in mosaics at Herculaneum, in the niches of ancient chapels. The scallop is especially prevalent on funerary monuments—adorning lead coffins from Roman Britain and marble sarcophagi from Asia Minor, and alternating with the palm trees of paradise in Byzantine tombs. The case can be made that the scallop symbolizes resurrection, when the dead rise from their tombs just as the goddess stepped from her shell.

The scallop became a symbol of Western Christendom when Crusaders picked up *Pecten jacobaeus* shells along the Palestinian coast and wore them on their helmets and hats—a kind of bumper sticker or shoulder patch saying, "I was there."

In the 12th century pilgrims wore *Pecten maximus* as a badge en route to the purported tomb of St. James the Apostle at Santiago de

Compostela, Spain—after Jerusalem and Rome the third great pilgrimage of the Middle Ages. If you ever see a statue of a saint in a European church and he is wearing a scallop shell in the brim of his hat or on his purse, he will most likely be St. James.

An event of such magnitude in the life of a knight or a sinner deserved remembrance. As an English verse ascribed to Thomas Fuller, an 18th-century physician, runs:

The scallop shows a coat of arms,
That, of the bearer's line,
Someone in former days hath been
To Santiago's shrine.

Such fervent adventurers were legion; today the scallop shell adorns the coats of arms of many families, including those of Sir Winston Churchill and Sir Anthony Eden.

A student of these insignia who happened upon live scallops under Atlantic waters would be in for a breathtaking surprise. He might think that he had dropped in on a swarm of flying saucers. The scallop of the U. S. Pacific Coast, *Chlamys hericius;* the well-known Atlantic bay scallop, *Argopecten irradians;* and that collector's favorite, the cheery little calico scallop of Southeastern U. S. and Caribbean waters, *Argopecten gibbus*—all are champion swimmers.

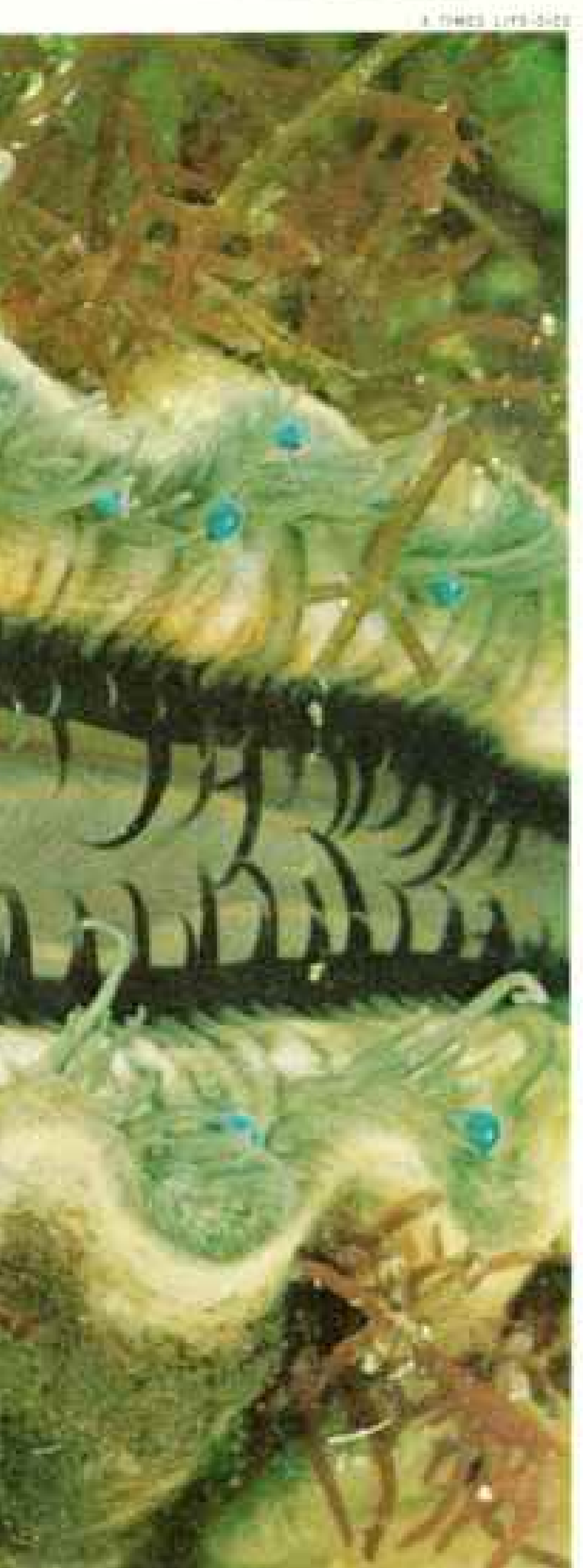
Scallops in action look like kites caught in a high wind. They swim in quick yard-long spurts, using something like jet propulsion, squirting water out forcefully between the two valves (cover and pages 406-7).

When danger threatens, usually in the form of a starfish, scallops blast off in a cloud of sand. Laggards pay dearly. The starfish wraps

Shining blue eyes festoon the mantle edges of an Atlantic bay scallop, *Argopecten irradians* (lower left). Marine growth encrusts its fluted valves. Although equipped with optic nerve, lens, and retina, the eyes detect only movement and light. Sinuous tentacles, both light and dark, also sense danger. Under attack by a voracious starfish, the bivalve jets away, snapping its twin shells like a bellows. Cilia—oscillating filaments on the gills—draw food toward the stomach.

East Coast fishermen harvest scallops from jungles of eelgrass for the succulent adductor muscle that closes the shells.

2 TIMES LIFE-SIZE

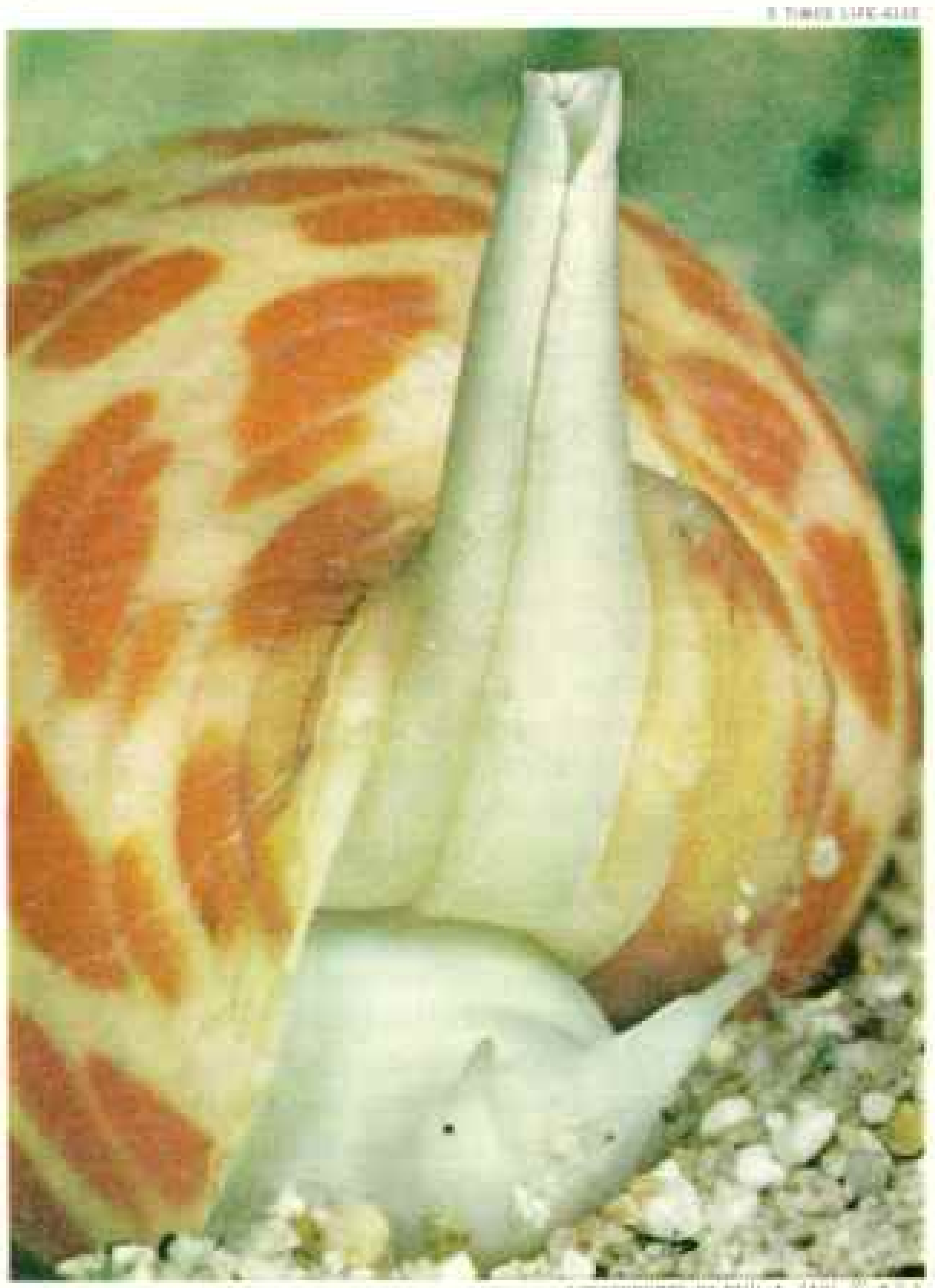


4 TIMES LIFE-SIZE

Eyes on stalks help a redmouth stromb, a member of the conch family, scan the sea. *Strombus luhuanus* browses for vegetation on coral reefs in the Indo-Pacific region (map, pages 396-7). South Pacific peoples use the shell's red lip for decoration.

Denizen of the night, the episcopal miter lives in the sand near Pacific reefs. Specklike black eyes at the bases of stubby tentacles see little. When gaily painted *Mitra mitra* digs in, the siphon formed by a mantle fold reaches up through the sand to take in water. Its popular name comes from the shell's resemblance to a prelate's headdress.

3 TIMES LIFE-SIZE



KODACHROMES BY PAUL A. ZAHL © N.G.S.

the scallop in its arms, equipped with rows of sucker-bearing feet, and begins a grim tug of war.

Sometimes the battle lasts for hours, but almost always with the same conclusion—exhaustion of the mollusk, forced opening of the shells, and dinner for the starfish. The victor devours its prey by extending its movable stomach between the scallop's valves and digesting its meal *in situ*—a disagreeable but efficient system.

I once ventured into the waters off Woods Hole, Massachusetts, in quest of flying scallops and found them in convention on grassy banks only a few feet down. But they also congregate as deep as 50 feet.

Scallop Sees With a Hundred Eyes

When at rest, the great scallop lies on its larger, slightly curved shell with the flat, smaller valve uppermost. With its valves agape, it shows the pinkish mantle and a fringe of feathery tentacles that can detect subtle chemical changes in the water.

One of nature's most startling sights, however, is the Atlantic bay scallop's double row of eyes—bright-blue beads, as many as a hundred, strung between the tentacles like Christmas-tree ornaments (preceding pages). Some of the eyes are larger than others, but all are equipped with lens, retina, and optic nerve. When disturbed, the scallop closes its shell, often leaving a tiny crack through which the rows of unblinking eyes peer out.

Somewhere nearby, the scuba diver will find clusters of tiny kites whose lines seem to have been tangled in slender bushes. These are young scallops that have tethered themselves to hydroids by a web of threads known as the byssus, which they have spun somewhat as spiders do.

Mollusks that spin spider webs? Strange as it seems, many shells familiar in collections once rode at anchor at the end of a byssus. The scallop eventually breaks away from its byssus, but other bivalves, notably the familiar blue mussel, *Mytilus edulis*, spend their adult lives spinning and tying guy lines to rocks and stones, and to each other.

Europeans devour mussels by the ton, as the strains of "Molly Malone" remind us. And harvesting a mussel entails cutting it out from its sturdy web of byssus mooring lines. I spent hours one afternoon peering into the water near a Pacific Coast wharf and watching mussels move, extremely slowly, by paying out their byssus webs and working their way along like mountaineers.

The artists of the byssus-spinning bivalves are the pen shells of the Mediterranean, *Pinna nobilis*, whose silky thread was the "cloth of gold" of the ancient world. Artisans of the city of Tarentum (modern Taranto in Italy) were famous for this rarest of all fabrics. Procopius mentions that Emperor Justinian presented to the satraps of Armenia robes spun of byssus threads.

Across the instep of the Italian boot from Tarentum, a Roman market stands partially submerged in the sea at Pozzuoli. The land on which the market was built has subsided, and then risen again. Visitors today can see strange pits in the solid marble pillars. The holes were made by the "rockeater," a small mussel called *Lithophaga*, while the foundation was under water.

A Clam "Invented" Hydraulic Mining

Many bivalves burrow into solid rock. *Lithophaga* performs its stunt by secreting an acid that eats away the limestone; a distant relative in the Arctic, *Hiatella*, can put a six-inch hole in concrete.

Bivalves that dig into sand and mud, like the familiar and much admired angel wing of our Atlantic Coast, actually pull themselves into the ground. The narrow tip of the foot extends and wriggles into the sand. Then the mollusk inflates the foot with blood so that a rigid bulb forms like an anchor at the end, and with it the animal pulls itself into the sand.

The razor clam has anticipated modern hydraulic mining by squirting a jet of water

SEPTENTRIONAL REGION

Relatively few species occur in the temperate waters of the northern Atlantic and Pacific Oceans. Their numbers diminish even further in frigid waters of the Arctic.

INDO-PACIFIC REGION

Here warm waters of protected seas, broad continental shelves, and coral reefs harbor a seemingly endless variety of bright-hued mollusks.

WEST-TETHYAN REGION

MERIDIONAL REGION

North Pacific Ocean

South Pacific Ocean

North Atlantic Ocean

South Atlantic Ocean

NORTH AMERICA

SOUTH AMERICA

AUSTRALIA

CHINA

INDONESIA

Geography of sea shells: Over millenniums each species of marine mollusk establishes its territorial range. As living conditions change, some migrate. They float in the larval stage, crawl along coastlines, or hitchhike on other seagoers. Dr. Rehder (below) divides the world of mollusks into four regions. Cold-water realms ring the Poles. Within the band of temperate and tropical seas, continents form migration boundaries. Similar species inhabit the eastern Pacific and the Caribbean, since the two areas once were linked by water. Species on the west coast of North America differ from those of the Indo-Pacific, however, because sea depths, open water, and north-south coastal currents form effective barriers to migration.

Partnership of scientists: National Geographic's naturalist-author, Dr. Paul A. Zahl, right, enlisted the help of a Smithsonian Institution senior zoologist, Dr. Harald A. Rehder, in preparing this remarkable article. A recent research grant from your Society helped Dr. Rehder extend his studies of mollusk distribution to Pitcairn and the Marquesas as leader of an expedition sponsored jointly with the Smithsonian and the Bishop Museum of Honolulu. Here, amid trays of spiny murex and varicolored volutes, the two scientists compare notes on their visits to Pacific shelling grounds.

KODACHROME BY JAMES E. RUSSELL © N.G.S.

into the hole as it pulls itself in; the mud washes out and the hole gets deeper.

The terrors among burrowing bivalves are the shipworms—*Teredo navalis* and its relatives—which have been wreaking havoc on wooden ships and wharves since man first built them. Using the filelike surfaces of its two shells, a teredo can bore as far as two and a half feet into a ship's timbers.*

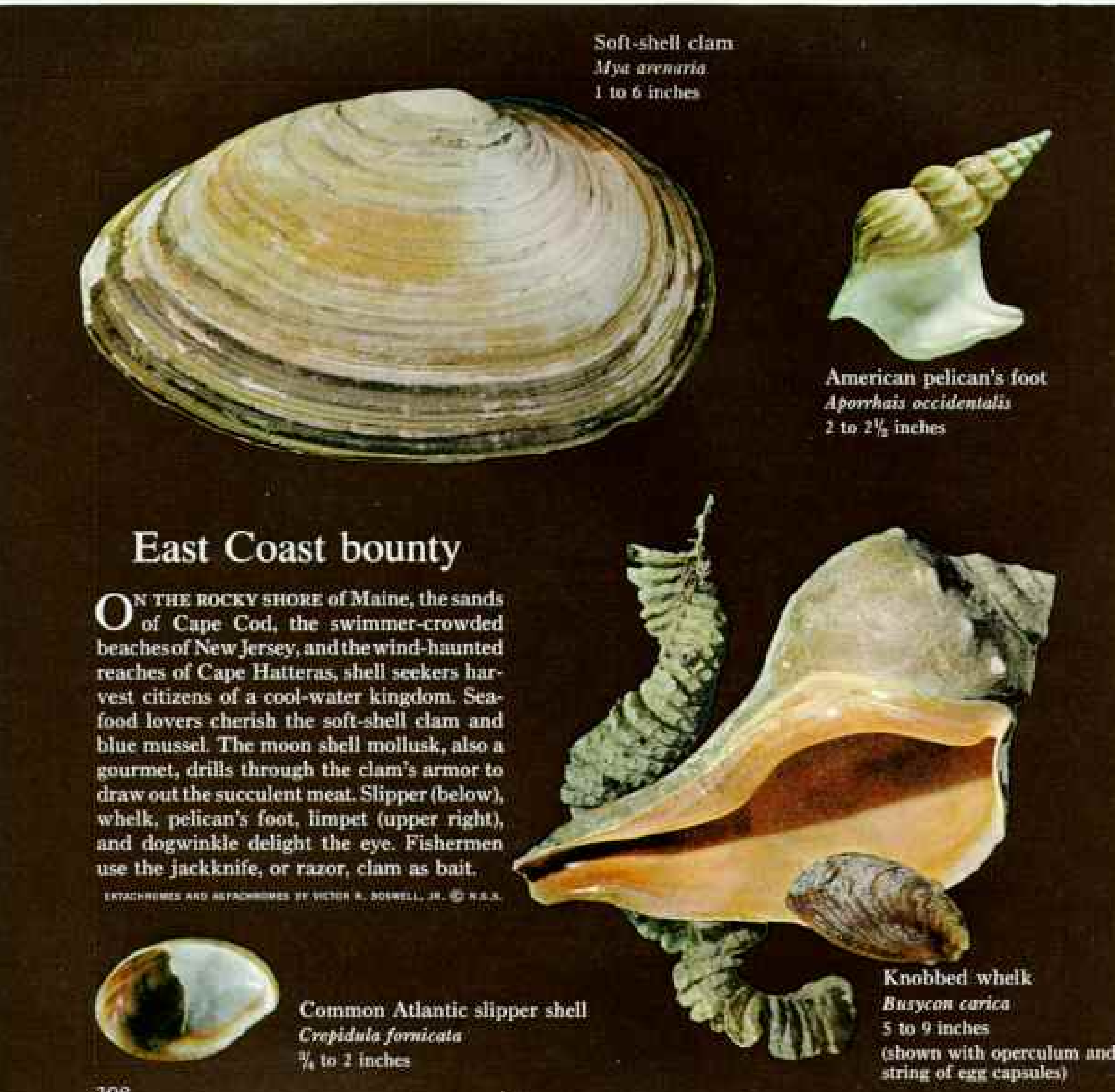
The teredo creates such destruction that it forced naval builders to sheathe ships' bottoms with copper. Even in this century its invisible damage toppled the municipal wharf of Benicia, California.

The shipworm lines its tunnel with a shelly coat, and trails behind it two tubes for feeding and discharging waste. It spends its entire adult life secure in its burrow. One might consider this the ultimate in self-sufficiency. But that honor, to my mind, is reserved for the largest of the tridacnid clams of Australia's Great Barrier Reef.†

I will never forget peering into the clear waters ringing Green Island and seeing giant clams *(Tridacna gigas)* three feet long and weighing several hundred pounds (pages 428-9). Popular belief tells of careless divers trapped in the stony grips of these clams, though in fact it seems never to have happened. But this much I can vouch for person-

*See "Shipworms, Saboteurs of the Sea," by F. G. Walton Smith, NATIONAL GEOGRAPHIC, October 1956.

†The author wrote of the reef in "On Australia's Coral Ramparts," NATIONAL GEOGRAPHIC, January 1957.



Soft-shell clam
Mya arenaria
1 to 6 inches

American pelican's foot
Aporrhais occidentalis
2 to 2½ inches

East Coast bounty

ON THE ROCKY SHORE of Maine, the sands of Cape Cod, the swimmer-crowded beaches of New Jersey, and the wind-haunted reaches of Cape Hatteras, shell seekers harvest citizens of a cool-water kingdom. Seafood lovers cherish the soft-shell clam and blue mussel. The moon shell mollusk, also a gourmet, drills through the clam's armor to draw out the succulent meat. Slipper (below), whelk, pelican's foot, limpet (upper right), and dogwinkle delight the eye. Fishermen use the jackknife, or razor, clam as bait.

EKTACHROMES AND AGFACHROMES BY VICTOR R. BOSWELL, JR. © N.G.S.

Common Atlantic slipper shell
Crepidula fornicata
¾ to 2 inches

Knobbed whelk
Busycon carica
5 to 9 inches
(shown with operculum and string of egg capsules)

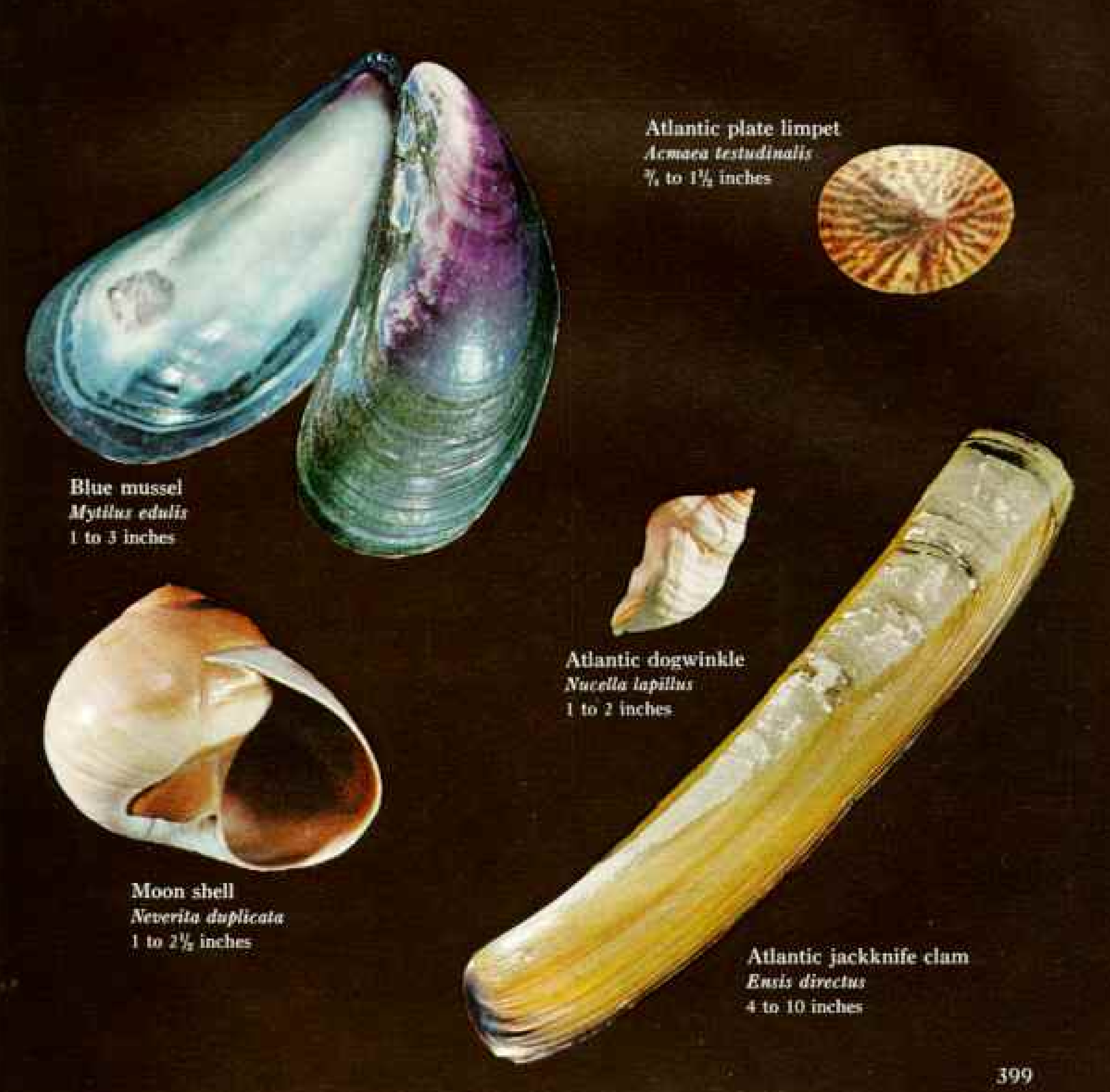
ally: A young clam clamped down so hard on a wooden pole thrust between its shells, and hung on so tenaciously, that I was able to lift it completely out of the water.

These animals, the largest of all the bivalves, are actually placid farmers. A close examination of the mantle reveals bright spots that are, in effect, small skylights. Below them, the mantle contains chambers (we can almost say "greenhouses") filled with growing algae. The skylights are actually lenses that direct sunlight into the gardens. There, recent research leads me to believe, the algae remove and utilize waste products from the clam's tissues, while the clam uses oxygen, and possibly organic nutrients, produced by the plants during photosynthesis.

On reefs farther to the south I waded into the domain of the giant clams' smaller cousins (*Tridacna maxima*). Their mantles, flowing like rivers of color, were unforgettable—electric blue, vivid orange, green, canary yellow, mottled, striped, speckled in every hue.

As I made my way across the tricky coral, the valves of the cantaloupe-size clams shut with such force that water spouted into the air; then, as I passed, they slowly reopened and the animals emitted steady streams of water from siphons as thick as garden hoses.

With each new assignment for the GEOGRAPHIC, our family collection of shells increased in size and beauty. From the Mediterranean, where my wife Eda and I went fishing for weird marine creatures near the



Atlantic plate limpet
Acmaea testudinalis
¾ to 1½ inches

Blue mussel
Mytilus edulis
1 to 3 inches

Atlantic dogwinkle
Nucella lapillus
1 to 2 inches

Moon shell
Neverita duplicata
1 to 2½ inches

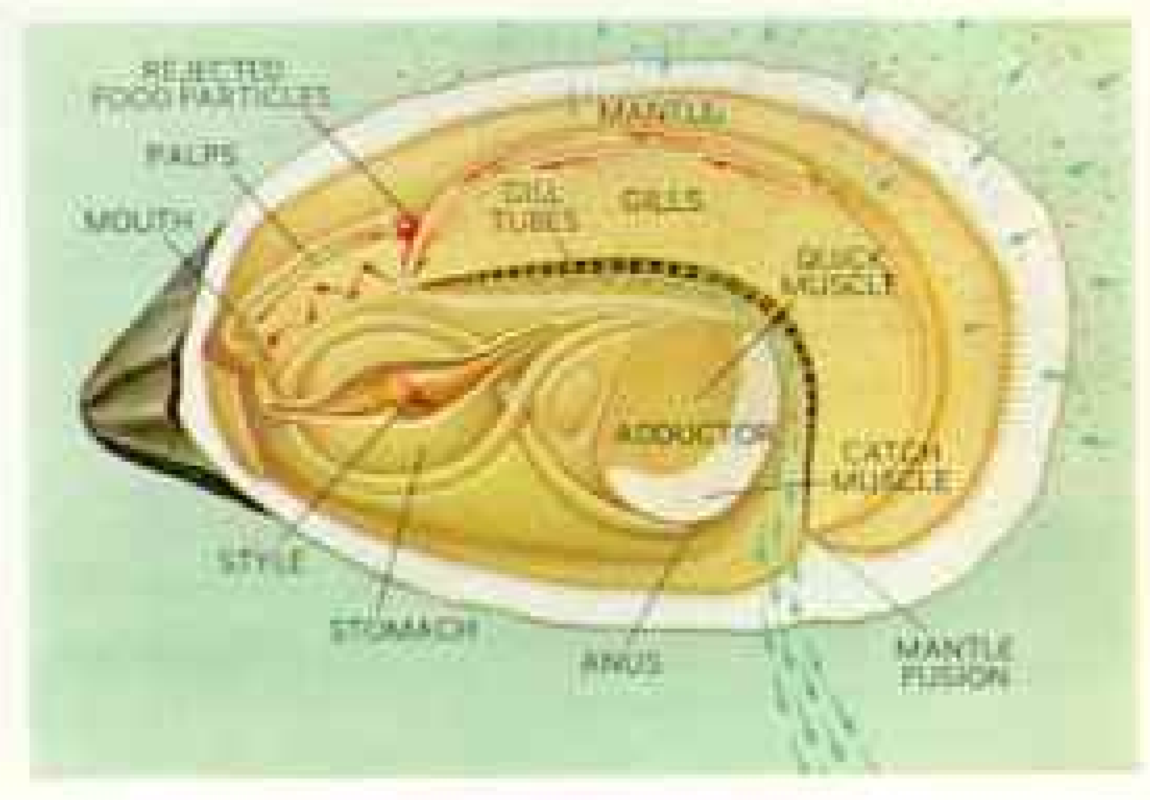
Atlantic jackknife clam
Ensis directus
4 to 10 inches

Life story of a bivalve

PUFFS OF "SMOKE" mark the first stage in the life cycle of one of the best-known mollusks. Rising temperatures in spring and summer signal spawning time to a male oyster, *Crassostrea virginica*, right, who discharges a cloud of sperm. The female, left, broadcasts up to several hundred million minute eggs. Sperm meets egg, and life begins.

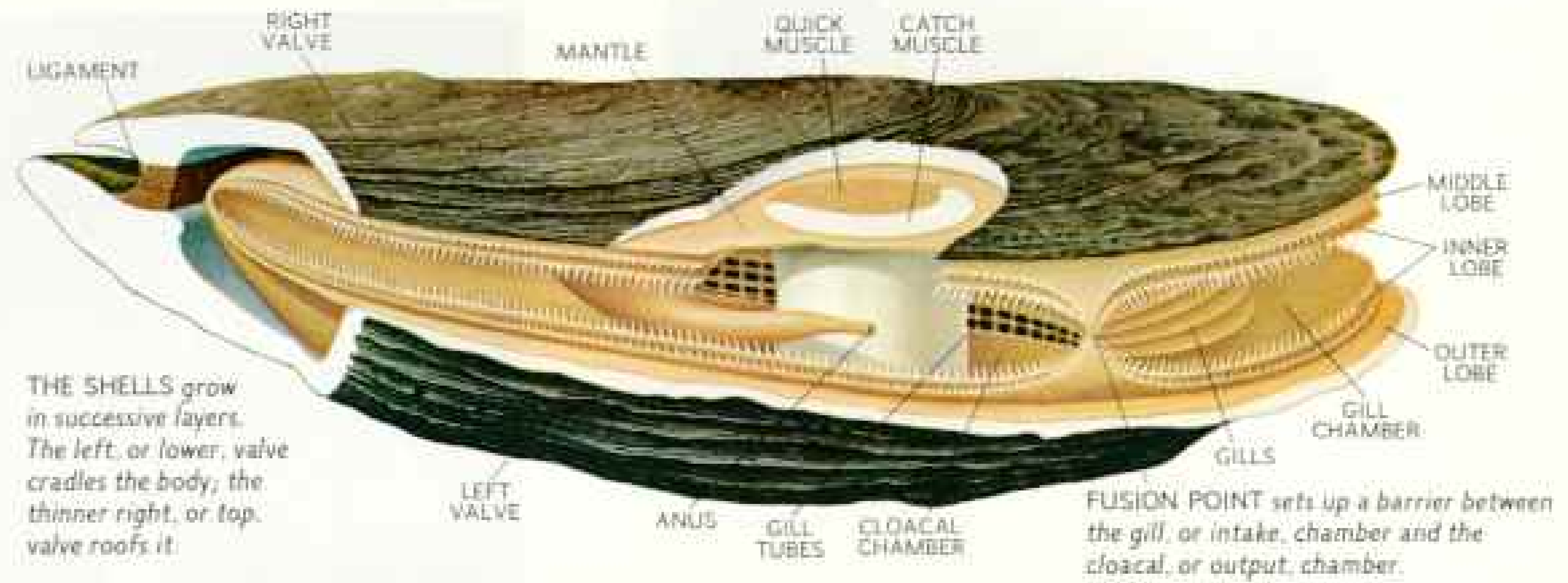
Free-floating egg (left, 1) grows by cell division (2). The shell begins (3) and slowly covers the soft body (4). The developing larva rides the currents for two to four weeks, waving hairlike cilia attached to a velum, or membrane. Fully developed (5), the larva drops to the sea floor and gropes with its foot for a clean, smooth surface (6). After it sets, cementing itself to the new homesite with secretions from the byssus gland, it retracts and absorbs foot and velum (7). Now called spat, the juvenile oyster begins to grow (8). In their fifth day on the bottom (9) and (10), spat freckle an oyster shell. Maturing mollusks (11) crowd each other until only the strongest survive. In two to five years, they reach marketable size.

Feasting night and day, the oyster grows on a diet of minute plankton (right). Cilia-lined gills pull in an average of 3½ gallons of water (blue arrows) an hour, absorbing oxygen and trapping plankton (red dots). After coating bits of food with mucus, cilia fan them along the gill edges to the palps, or sorting flaps, and thence to the mouth. In the stomach, a crystalline, knoblike "style"—unique to certain mollusks and the only known rotating mechanism in animals—releases enzymes and stirs food particles to aid digestion. Wastes leave through the anus, carried out by the discharge of water from the gills. With a snap of its shells, the oyster also disposes of rejected food.



THE MANTLE, *a fleshy pad lining each valve, cushions the organs. At shell edge the mantle divides into three lobes: The inner one regulates intake of water; the middle lobe senses light; the outer lobe and entire mantle spread a calcium-laden material to build and repair the shell.*

THE ADDUCTOR, *a two-part muscle at the body's center, controls movement. The quick muscle snaps shells shut. Then the catch muscle takes over and holds valves closed, permitting survival on coastal flats between tides and on the journey to the dinner table.*



THE SHELLS *grow in successive layers. The left, or lower, valve cradles the body; the thinner right, or top, valve roofs it.*

FUSION POINT *sets up a barrier between the gill, or intake, chamber and the cloacal, or output, chamber.*

boiling whirlpools of the Strait of Messina, we brought back not only *Pinna nobilis* but another shell associated with the pomp of ancient royalty.* This was *Murex brandaris,* a shell that launched a thousand ships and helped determine the course of ancient empire.

From this three-inch mollusk and the related *Trunculariopsis,* Phoenician artisans of the cities of Tyre and Sidon made the splendid purple dye that has been the color of royalty ever since. They pushed across the Mediterranean in search of them.

Fishermen trapped vast quantities of the mollusks in plaited boxes baited with cockles, the little leaping clams that murex likes to eat. The Phoenicians crushed the murex shells, extracted the mantles, salted them, and exposed them to the sun for two or three days. Poured into a kettle and covered with water, the mantles simmered for 10 days over a low fire. The result was a clear broth that changed in sunlight to bright yellow, through shades of green to blue, and finally to a permanent brilliant magenta.

Cloth dyed with this beautiful and enduring purple cost $10,000 to $12,000 a pound. Only the rich and the mighty were allowed to wear it, and the phrase "born to the purple" became a fixture.

Indo-Pacific Holds Varied Treasures

The Mediterranean lies within one of the four regions into which malacologists divide the world of marine mollusks (map, pages 396-7). But by far the most fabulous for the diversity of its shell-bearing animals is the Indo-Pacific, a vast reach of water extending from the Red Sea and eastern coast of Africa across the Indian Ocean, and into the Pacific beyond Hawaii and Easter Island.

The shores of India, of all Australia, Malaysia, Indonesia, the South Sea islands—

*See "Fishing in the Whirlpool of Charybdis," by Paul A. Zahl, NATIONAL GEOGRAPHIC, November 1953.

HALF LIFE-SIZE

Fluted cradle of the deep, this eight-inch shell once sheltered an octopuslike paper nautilus, *Argonauta argo*, and provided a case for her spongy egg mass, visible within. When the fragile shell, seldom found in perfect condition, was discovered on a Florida beach without its female occupant, it contained five sperm-carrying tentacles from fertilizing males; two show on the aquarium sand. The thin shell's translucence accounts for the name paper nautilus. The poet Byron called it "the Ocean Mab, the fairy of the sea."

Inner sanctum of a whelk egg case houses developing embryos. To photograph the interior, the author removed one sac from a chain of capsules similar to that on page 398 and sliced off the top.

1 1/4 TIMES LIFE-SIZE

Doting mother hen, a Philippine cowrie (below), sits on white egg capsules. But instead of warming them, she circulates oxygen-bearing water over her brood by waving the bushy green filaments on her mantle. Tentacles project like spears. When the mantle fully cloaks *Cypraea miliaris*, she resembles an algae-covered rock.

Among mollusks, reproduction varies greatly. Some scallops, clams, and shipworms are hermaphroditic—single animals are both male and female. A few, like the slipper shell and the oyster, may change sex during their lifetimes.

8 TIMES LIFE-SIZE

the Indo-Pacific region includes them all. But the center of this vast zone, and a mecca for shell collectors, is the Philippine archipelago, with its thousands of islands, reefs, channels, bays, seas, and record offshore deeps.

For years I talked of a trip to the Philippines to observe living shells in their undersea habitats, far removed from the museum tray or trophy cabinet. Eventually these dreams knitted into reality, and I set out for Zamboanga, on the island of Mindanao.

I flew across the Pacific by jet—and reflected upon the small irony that mollusks themselves "invented" jet propulsion. I was thinking specifically of the squid, octopus, and cuttlefish, all members in good standing of a great class of mollusks—the Cephalopoda. The name means "head-foot," for the arms that extend from the head.

Octopus: A Mollusk Without a Shell

Put a shell on an octopus, and you will see a typical mollusk—the covering mantle, under it the body and its organs, the projecting head, and a radula inside the mouth.

Included in many collections are the fossilized shells carried by the ancestors of modern Cephalopoda—curved, coiled, or bullet-shaped caps under which the primitive animals may have swum upright. The cuttlefish of eastern Atlantic, Mediterranean, and Asian waters still produce a small, limy shell,

worn inside, that is sold as cuttlebone to keep canaries happy. The squid carries about a small internal shell—its so-called "pen"—shaped like an antique quill.

While the squid's mantle does not secrete a covering shell, it does serve as a propulsion device. Water gathered in the mantle cavity is blasted out from a nozzle, and the animal darts backward. Squids, equipped with muscular fins, navigate with all the precision and grace of a jet airplane.*

One of the vivid memories of my life is of a warm, tropical night in the Bimini Islands, in the Bahamas. In search of the strange and wonderful creatures that prowl the Gulf Stream during darkness, I had rigged a light at the end of a dock; I lay next to it with a net poised for capture.†

When the squids appeared, they did so as if by magic. Suddenly they were there, pulsating near the light, flaps undulating and tentacles streaming behind. Carefully I lowered my net and made a stab for them; there was an explosion of motion, and I hauled up an empty net dripping with ink.

Two of the Cephalopoda bear similar names

*See "Squids: Jet-powered Torpedoes of the Deep," by Gilbert L. Voss, NATIONAL GEOGRAPHIC, March 1967.

†Dr. Zahl wrote of "Night Life in the Gulf Stream," in the NATIONAL GEOGRAPHIC for March 1954.

KODACHROME BY PAUL A. ZAHL (ABOVE) AND EKTACHROMES BY VICTOR R. BOSWELL, JR. © N.G.S.

Pacific largess

FROM the Olympic Peninsula to the Isthmus of Panama, 7,000 miles of American coastline face the immensity of the Pacific Ocean. Where chill waves crash against the Oregon coast, Dr. and Mrs. Zahl examine a colony of mussels, *Mytilus californianus*, anchored to the rocks with strong byssus webs. The chiton, limpet, and iridescent abalone cling to perches with powerful feet. The abalone's tough foot becomes a gourmet's steak after pounding.

Shallow waters harbor the pink-mouthed murex and tent olive. Graceful dweller of the deep, Amos' metula lives off southern Mexico and Panama.

Chiton
Tonicia elegans
1 to 1½ inches

Tent olive
Oliva porphyria
3 to 5 inches

Giant keyhole limpet
Megathura crenulata
2½ to 4 inches

but are very dissimilar animals—the chambered nautilus and the paper nautilus.

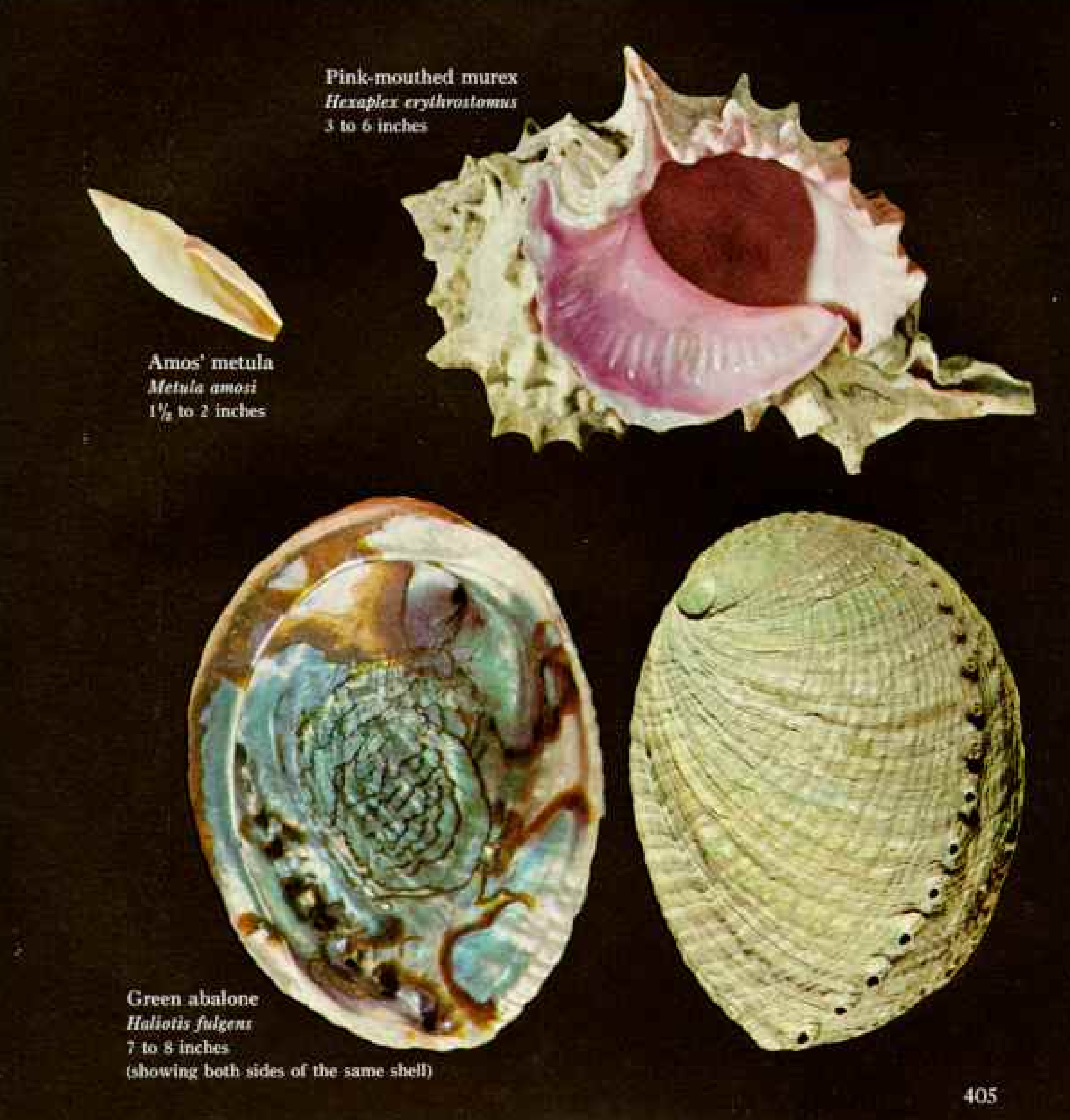
Aristotle first conjured up the charming picture of the paper nautilus resting contentedly in its boat-shaped shell and holding its two bladed arms, like tiny sails, before the wind, while using its other arms as steering oars. People believed it for years.

Actually, the shell of the paper nautilus (page 402) is a fragile shelter secreted by the two paddle-shaped arms of the female. The delicate case holds the animal and her eggs, its buoyancy preventing them from sinking.

The chambered nautilus, on the other hand, swims near the ocean bottom inside a heavy shell. It has a doormat of 60 to 90 suckerless tentacles with which to capture fish and shellfish (page 409). Among other unique features it has eyes without lenses—one of the few examples in nature of visual organs that operate on the principle of the pinhole camera.

Mathematicians and poets love the chambered nautilus, the former because of the near-perfect geometry of its spiral growth.* As for poets, Oliver Wendell Holmes enshrined the chambered nautilus forever as an inspiration for human striving (page 408). The

*The fascinating architecture of mollusks was illustrated in "X-Rays Reveal the Inner Beauty of Shells," by Hilary B. Moore, NATIONAL GEOGRAPHIC, March 1955.



Pink-mouthed murex
Hexaplex erythrostomus
3 to 6 inches

Amos' metula
Metula amosi
1½ to 2 inches

Green abalone
Haliotis fulgens
7 to 8 inches
(showing both sides of the same shell)

KODACHROMES BY ROBERT F.

mollusk, however, lightens its own load through a sophisticated technique. When the animal moves forward into new chambers, it uses the older ones as ballast tanks to change the buoyancy of the heavy shell.

As my plane continued its long flight over the Pacific, I thought of the millions upon millions of marine creatures that live below the surface of the ocean, to whom man's existence is no more than the momentary flicker of a shadow upon the blue ceiling of their world. Now I was to get a closer view of their unique way of life.

On my very first morning in Zamboanga I watched the *vintas*, their sails richly colored by a glowing dawn. They were plying the Sulu Sea, one of the world's best shelling grounds. Here can be found the rarest and most majestic of the Gastropoda, the most populous class of mollusks. Their name means "stomach-foot," for most of them glide on the "belly"—actually, the foot.

The snails and slugs that leave glistening trails on trees and suburban patios are members of this class. So are the magnificent cowries of tropical seas, and the dangerous cones, and the biggest of all gastropods, the Australian trumpet, the Florida horse conch, and the Pacific triton. The music sounded through the spiral

Snap! Whish! And away! Startled scallops leap for their lives as a 17-armed starfish, *Pycnopoda helianthroides,* invades their aquarium. The scallop can spit a stream of water from any side to jet in the opposite direction. Some species react to the scent of the marauder, but these *Chlamys* wait with watchful eyes until touched. Then they scoot frantically away.

A five-armed *Pisaster ochraceus* (above) embraces a scallop with deadly grip. The starfish pulls steadily with hundreds of tubular sucker-equipped feet until the mollusk's adductor muscle tires and the valves open. Then the victor thrusts its stomach between the shells to suck out the scallop's soft body.

AT FRIDAY HARBOR LABORATORY, UNIVERSITY OF WASHINGTON © N.G.S.

chambers of these mighty shells has called from remote islands to ancient gods, summoned armies to battle, and mourned the deaths of heroes.

The radula of the Gastropoda is one of nature's most sophisticated files and may reach twice the length of the body. Many of the gastropods bear another remarkable device, the operculum, a horny or limy shield that closes like a trap door when the owner withdraws inside the shell (page 424).

Strombus gigas, the queen conch of the Caribbean, like all strombs, has a clawlike operculum that can be used as a savage weapon. *Strombus* has a fearsome visage to begin with—two bright unblinking eyes like yellow targets at the ends of long stalks, a fleshy proboscis between them, and, below, a powerful foot bearing the operculum like a dagger. The large animal moves about by pole-vaulting on the operculum, a surprising exercise in strength and agility considering the weight of its shell.

After several days in Zamboanga, I finally enlisted the services of three former pearl divers, who agreed to join me as much out of curiosity as for the pay. They were turbaned Moros with dark sullen faces, but ready enough to respond in kind to a smile. Their former occupation was an all-but-forgotten practice, having succumbed to the technique of raising cultured pearls.

There was promise of a burning sun as we set out one morning for the coral-fringed San-

EKTACHROMES BY VICTOR R. BOSWELL, JR. (ABOVE) AND DR. J. M. BASSOT © N.G.S.

"Build thee more stately mansions, O my soul"

THE SILENT TOIL of the chambered nautilus, whose shell appears above in cross section, inspired the words of poet Oliver Wendell Holmes. These mollusks are seldom seen alive. The *Nautilus macromphalus* at right, trapped off New Caledonia by a French researcher, clings with its many tentacles to a dead fish. As it grows, the animal secretes partitions within its expanding shell, creating a series of ever-larger rooms. By varying the gas content of the abandoned chambers, it changes its buoyancy and dives as deep as 2,000 feet at night. Using its muscular funnel, it jets horizontally while feeding near coral reefs during the day. A cephalopod, or "head-foot," most highly developed of mollusks, the once-abundant chambered nautilus stopped evolving eons ago. Today, the western Pacific harbors the last four species of this living fossil.

ta Cruz Islands, barely visible on the southern horizon. We dropped anchor about fifty yards off one of the islets. Except for the turbans, the dialect, and the outriggers, we could have been in Florida waters—same tepid sea, same coral-and-sand bottom.

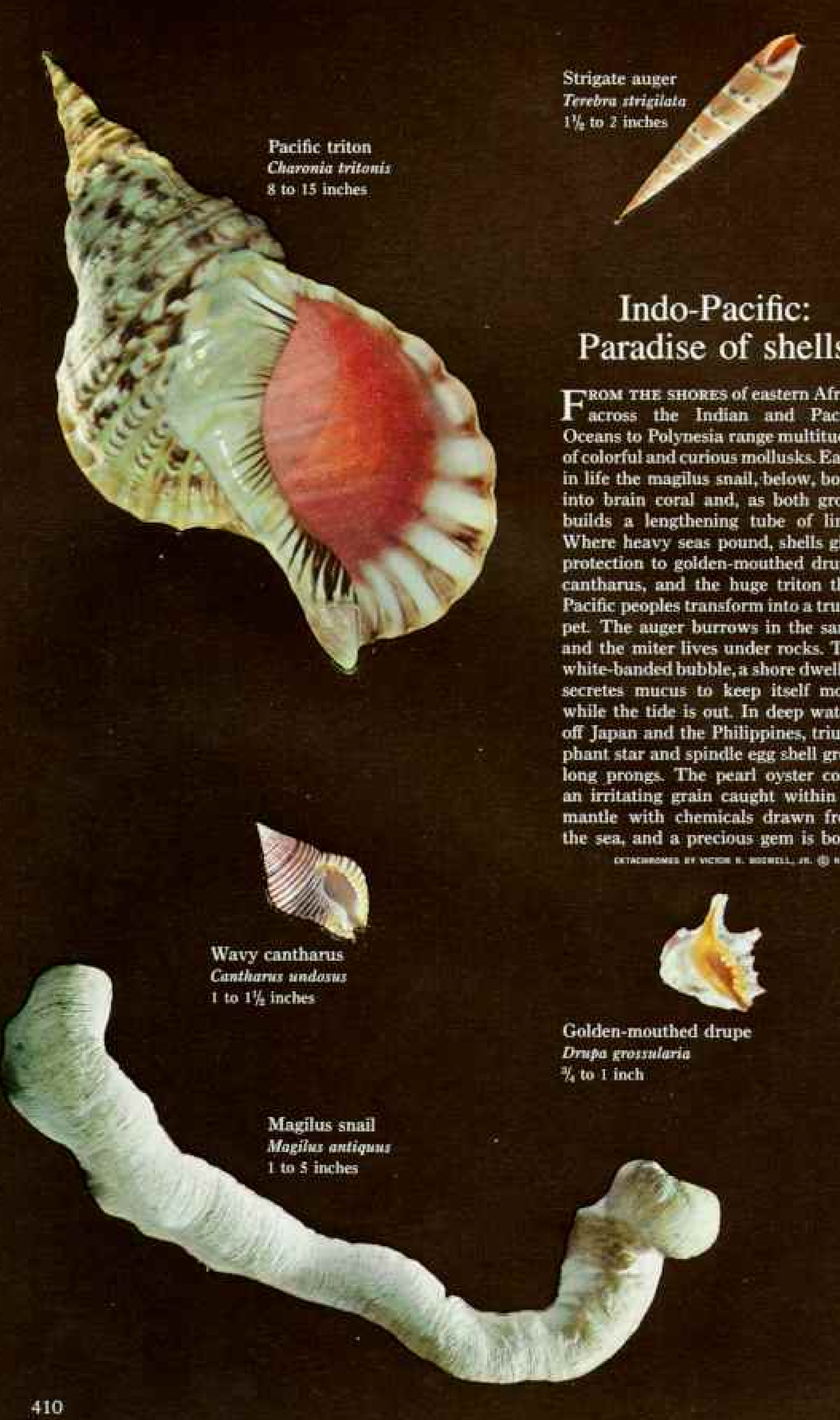
My Moro companions removed their clothes and adjusted carved wooden goggles. Instructions that I wanted living rather than dead shells were followed almost immediately by the splashes of three brown bodies.

Before long one of the men, whose only English was "Hi, Joe," came swimming back to the boat. Goggles shoved up on his forehead and face bearing a bright grin, he stretched up to me a handful of dripping specimens: two spiraled augers, two olives with tent-shaped markings, and a spiny oyster. In each, the animal was tightly drawn into its shell.

Then, from a pouch at his belt, the diver extracted a three-inch-long conical shell marked with yellow and black splotches. I recognized it—*Conus marmoreus*, a member of the deadly Conidae family—and noticed his caution as he placed it on the gunwale.

I had been told in Australia of an amateur collector at Hayman Island who picked up a *Conus geographus*, a shell with a marbled pinkish-brown surface, and carelessly placed it on his palm. He was stung, went into a coma, and was dead within five hours. Visitors to the Queensland Museum, where the *geographus* now lies, find a morbid fascination

(Continued on page 414)



Strigate auger
Terebra strigilata
1⅛ to 2 inches

Pacific triton
Charonia tritonis
8 to 15 inches

Indo-Pacific: Paradise of shells

FROM THE SHORES of eastern Africa across the Indian and Pacific Oceans to Polynesia range multitudes of colorful and curious mollusks. Early in life the magilus snail, below, bores into brain coral and, as both grow, builds a lengthening tube of lime. Where heavy seas pound, shells give protection to golden-mouthed drupe, cantharus, and the huge triton that Pacific peoples transform into a trumpet. The auger burrows in the sand, and the miter lives under rocks. The white-banded bubble, a shore dweller, secretes mucus to keep itself moist while the tide is out. In deep waters off Japan and the Philippines, triumphant star and spindle egg shell grow long prongs. The pearl oyster coats an irritating grain caught within its mantle with chemicals drawn from the sea, and a precious gem is born.

EKTACHROMES BY VICTOR R. BOSWELL, JR. © N.G.S.

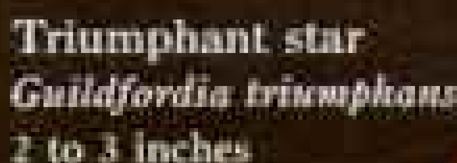
Wavy cantharus
Cantharus undosus
1 to 1½ inches

Golden-mouthed drupe
Drupa grossularia
¾ to 1 inch

Magilus snail
Magilus antiquus
1 to 5 inches

White-banded bubble
Hydatina velum
1 to 1½ inches

Triumphant star
Guildfordia triumphans
2 to 3 inches



Pontifical miter
Mitra stictica
1 to 3 inches

Spindle egg shell
Volva volva
3 to 5 inches

Black-lipped pearl oyster
Pinctada margaritifera
4 to 10 inches

Australia's reef treasures

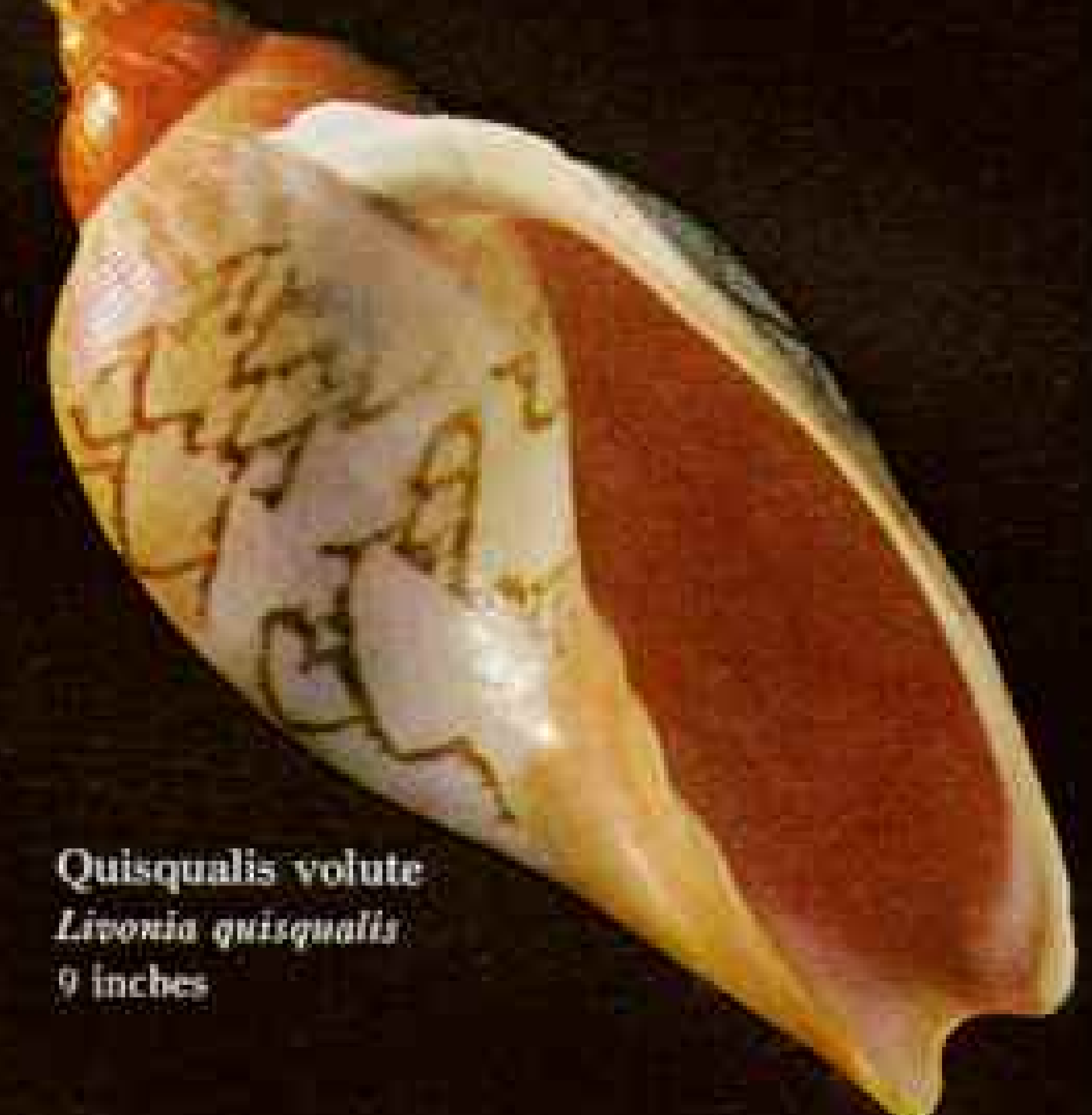
THE GREAT BARRIER REEF shelters a fabulous array of Indo-Pacific shell varieties. Ocean tides washing across Queensland's coral labyrinth create countless rock pools, each a miniature sea teeming with creatures.

Shouldering its shell, a bailer (below) creeps along on a foot twice the diameter of its house. Volutes feed on bivalves, and the little box dog whelk scavenges the shore for decaying animal debris. The bright-lipped frog shell and coral snail also dwell in shallow waters. Others, such as the girdled ancilla, are dredged from the surrounding depths.

Collectors prize the elegant textile cone, whose venomous barbed tooth harpoons worms, small fish, and other mollusks. The Australian trumpet, the largest gastropod in the world, feeds on clams. The perspective sundial winds itself clockwise into precise whorls. Striped helmet stalks and seizes sea urchins and sand dollars.

EKTACHROMES BY VICTOR R. BOSWELL, JR.; KODACHROME (BELOW) BY PAUL A. ZAHL © N.G.S.

Frog shell
Bursa rubeta
3 to 5 inches



Quisqualis volute
Livonia quisqualis
9 inches

Little box dog whelk
Nassarius arcularius
¾ to 1¼ inches

Elliot's volute
Amoria ellioti
2 to 3 inches

Textile cone
Conus textile
2 to 4 inches
Australian coral snail
Tolema australis
1 to 1½ inches
Australian trumpet
Syrinx aruanus
10 to 22½ inches
Girdled ancilla
Ancilla velesiana
1¾ to 3 inches
Perspective sundial
Architectonica perspectivum
1 to 2¼ inches
Striped helmet
Casmaria vibex
1¼ to 2¾ inches

KODACHROME BY NATIONAL GEOGRAPHIC PHOTOGRAPHER ROBERT S. OAKES © N.G.S.

From Neptune's chambers to a collector's trays come the oceans' rarest shells. In the past 16 years John E. du Pont of Newtown Square, Pennsylvania, has put together one of the world's finest private collections. Here he examines two *Cymbiolacca thatcheri* while preparing a book on volutes. Nearby rest five gargantuan *Melo aethiopicus*. Through purchases and his own expeditions to the Pacific, Mr. du Pont enlarges a 300,000-specimen treasure that will go on display when the planned Delaware Museum of Natural History is built in Wilmington.

in the knowledge that this very specimen once killed a man.

The deadliest hunters of the mollusk world, cones kill and paralyze other mollusks, small fish, and worms by stabbing them with a poisonous harpoon shot from the proboscis. The wicked little weapon wears sharp barbs; it is, in fact, the familiar radula modified into spearlike teeth (pages 426-7). The poison has curare-like properties; it acts on the nervous system, paralyzing the victim.

As the divers filled my buckets with a melange of living mollusks, I thought that the one certainty about the shells was that few collectors would recognize them. Aside from the olives and cowries, whose enveloping mantle keeps them clean and shiny, the others wore untidy cloaks of algae, coral, or sponge.

The pristine finish of the cones in their famous textile and parchment patterns lay beneath a brownish skin called the periostracum.

Back on shore, I transferred the catch to a battery of aerated sea-water aquariums I had set up in my workroom. At first the creatures seemed hesitant in their new surroundings. Then as I watched, a stromb cautiously extended its stalked eyes for a look around (page 395 top), and a cone began to move tentatively over the sandy bottom.

A friend, Professor José Domantay, a marine biologist retired in Zamboanga, suggested a place where I might photograph gastropods in their natural habitat. He described a sand bar on a nearby island that was a favored haunt of the beautiful bat volute, *Aulica vespertilio*.

"Volutes spend much of their time in the sand," he said, "but if you can be there during the last half hour of an ebbing tide, you'll possibly find some."

A day later I was on that bar, wading through clear, shin-deep water, alert for tracks on the ripply bottom. During their brief emergences from the sand, volutes leave a telltale trail an inch or so wide and as much as twenty feet long, stopping abruptly where the animal has dug in again. Having found a track and its

Precious gems of the animal world

LIKE JEWELS, shells vary in value depending on supply, demand, and condition. Beyond price, the King Midas' slit shell was lifted from 2,000-foot depths during research in the Bahamas. The long notch serves as an opening for the gills. Differing from 14 other species of slits, it earned a new name, *Perotrochus midas*, and now graces the Smithsonian's collection.

One of three *Cypraea leucodon* in collections, this spotted cowrie was found in the stomach of a fish caught in the Philippines. Dealers value the shell, owned by Mr. du Pont, at $3,000.

Rare in the 17th century, the precious wentletrap fell in value when collectors found scores in the Pacific. Specimens that once sold for hundreds of dollars now bring only about $4. The shell's name derives from the Dutch for "spiral staircase."

Beauty and scarcity give value to *Conus gloriamaris*. This specimen, one of 70 known, belongs to a Philippine collector.

EKTACHROMES BY VICTOR R. BOSWELL, JR. (TOP) AND JOHN E. DU PONT; KODACHROMES (LOWER) BY PAUL A. ZAHL © N.G.S.

King Midas' slit shell
Perotrochus midas
4 3/5 inches

Leucodon cowrie
Cypraea leucodon
3 inches

Precious wentletrap
Epitonium scalare
1 to 2 1/2 inches

Glory of the seas
Conus gloriamaris
2 to 5 3/4 inches

terminus, one need only dig to discover a molluscan jewel.

So far I had discovered two tracks but no terminus. At the end of a third my probing fingers felt something hard. Digging fast, I overtook and lifted out a magnificently tapered shell, amber hued, with bold zigzag markings. On contact the gastropod retreated into its whorl. I carried my prize shoreward to where the sea was a thin sheet of liquid glass, and set it before me on the sand bottom.

Familiar terrain restored the volute's confidence; almost immediately there was action. The fleshy foot began to spread ever so slightly beyond the shell, permitting an inflow of water. This not only started respiration, but also stimulated olfactory organs. The animal was, in effect, "smelling" the water around it.

Now the grotesquely shaped lump of the head emerged from the shell. Its pair of tentacles bore invisible sense organs for measuring temperature and pressure.

At this stage action stopped again, as yet another set of sensors, farther back within the body mass, was brought into play. Microscopic limestone grains were constantly shifting in response to gravity, gently brushing against touch-sensitive cells. Nerve connectives reported these shiftings to ganglia, or neural centers, which in the mollusk serve as primitive brains. There, as in a computer, the animal's horizontal and vertical planes were being determined, and the information relayed to appropriate muscles, which in turn made body adjustments.

With all systems go, the volute marshaled

St. James scallop
Pecten jacobaeus
2½ to 6 inches

Banded murex
Trunculariopsis trunculus
2 to 3 inches

Gifts of the Mediterranean

IN THE ANCIENT LANDS that witnessed the rise and fall of great civilizations, the shell has long worn a halo of romantic fancy and religious symbolism. To medieval Christians the scallop, emblem of St. James, signified pilgrimage to his shrine in Spain or participation in the Crusades. Tyrian purple from the banded murex dyed the robes of Imperial Rome and the vestments of the early Christian Church. The russet-colored Venus clam honors the Roman goddess of love. Fanciful shapes give names to the pelican's foot, the globular canoe bubble, and the top shell (upper right). The spiraling cerith derives its name from the Greek for "little horn." Cockleshells decorated drinking cups in Minoan palaces.

EKTACHROMES AND KODACHROMES BY VICTOR R. BOSWELL, JR. © N.G.S.

Talents of two artists—man and nature—produce a delicate cameo carved in a helmet shell preserved by the Smithsonian. More than a century ago, an unknown European craftsman worked the design on this five-inch *Cypraecassis rufa* from the Indian Ocean, cutting through layered hues of the thick orange-red shell to create the portrait.

Man's interest in unusual shells, together with his many uses for them, dates to antiquity. Pompeii's ruins yield cowries and cones from the Indian Ocean. Aztec and Maya Indians of early America decorated their bodies and their temples with shells that symbolized water. Many 16th- and 17th-century European navigators brought home chests full of colorful Pacific species.

Common top shell
Calliostoma zizyphinum
¾ to 1¼ inches

European Venus clam
Venus verrucosa
1¼ to 2⅜ inches

Common European cerith
Cerithium vulgatum
1 to 3 inches

Pelican's foot
Aporrhais serresianus
1¼ to 2¼ inches

Canoe bubble
Scaphander lignarius
1½ to 2⅜ inches

Spiny cockle
Acanthocardia aculeata
2 to 3½ inches

its full power. The head protruded fully and a pair of eyes, one at the base of each tentacle, established visual contact with the surroundings. Finally, up reared a snorkel-like tube to convey water to the interior.

Apparently no further threat to safety registered, for with its zebra-striped foot now flattened and spread like a carpet, the animal began to slide gracefully over the sand. But suddenly something in the environment, possibly my shadow or the click of my camera, called for a hasty dive. The foot's front edge angled sharply and, as if slicing into soft butter, drew the entire creature into the sandy underworld. Within a few seconds the volute had vanished, save for the snorkel's tip, and even that might easily have been mistaken for a mere worm hole in the sand.

My favorite among the Gastropoda is the cowrie. When I mentioned this to Fernando G. Dayrit, former curator of shells at the Philippine National Museum in Manila, he said: "Go straight to Evaristo Zambo. You will find him in Cebu. Shells are his life, and he will show you where the rare ones are."

Zambo, an amiable and articulate graduate of the University of the Philippines, agreed immediately to lead me to cowrie habitats.

Camotes Sea Yields Rare Cowries

On a brilliant blue morning we set out from Zambo's home port of Mandaue, a few miles north of the city of Cebu, bound for an area known as the Camotes Sea. Here, in a channel separating Cebu from its satellite island of Mactan, Zambo had found a new species, christened *Homalocantha zamboi* by American conchologists.

Zambo's boat was a wonder of invention. Broad of beam and about 25 feet long, it had the usual outriggers, a tiny pilothouse, and an equally miniature galley (page 420). There was a forward cabin on whose floor boards I slept when time and weather permitted. Projecting over the water on the port side was a cramped annex referred to by its designer-builder as the "discomfort room."

A one-cylinder inboard diesel pushed us along at a good four knots; for greater speed to outmaneuver a storm (or, as I was warned, to escape hijackers who sometimes ply these waters), auxiliary outboards lay ready. The vessel drew very little water, making it ideal for work in reef shallows.

As we lingered over gorgeously colored coral beds, Zambo sent his crew—cook, motorman, and deckhand—overboard for shells. Effortlessly, they brought up bonnets, helmets, cones, sundials, murexes, turbans, and now and then a pearl oyster. I placed the choicest into a live well we had improvised alongside the boat. Rejects were claimed by the crew.

Meal Includes a Deadly Cone

Later, while Zambo and I ate a conventional lunch, the crew tossed a few handfuls of rice into a pot of boiling water. Into another went the leftover mollusks. When cooked, they were drained and served in a dishpan set on the afterdeck. One lad selected a steaming pearl oyster, valves now wholly relaxed by the cooking; another chose a *Conus textile*, dangerous when alive. With audible gusto, they ate the lot.

When I described the caution urged on some of our military personnel regarding toxic sea animals during World War II, Zambo laughed, "The sea people here eat every mollusk they can lay hands on, with the exception of a large white cowrie. Even that isn't harmful—it just doesn't taste good." At the public market in Zamboanga I had seen heaps of live shells of every description being sold as standard table fare.

That evening we struck a course for some distant palm-studded isles. Near land, we cautiously poled through a mine field of barely submerged coral heads. That night, while a white moon turned the ocean to soft fire, we watched as the tide ebbed and the coral seemed to rise like a lost continent around us.

Well before sunrise I awoke to find our boat resting on the bottom. The smooth and shallow sea of the evening before had become a vast expanse of coral, sand flats, and quiet pools, a realm of flamboyant color. We could easily hop overboard and set out walking across the reef.

"This is one of the richest cowrie habitats I know," said Zambo, "but I hope you will not mention its precise location. A stampede of collectors would be hard on conservation, as well as on the market.

"Take these sieve and zigzag cowries," he continued, lifting the edge of a loose coral rock as though he knew exactly what to expect underneath. "A few hundred prime specimens sent to the U. S. or Europe would lower their value drastically."

I stooped to examine the coral's underside. Amid its clutter of sponge growth, sea urchins,

Lustrous wares from the sea

TRANSLUCENT BUT TOUGH, windowpane oysters of the western Pacific offer man a substitute for glass. In the Philippines fishermen dredge thousands of the bivalves, *Placuna placenta*, from muddy bays, and clean and sell them to wholesalers such as Mrs. Emma R. Agco (below), who stores this supply under her house in Cavite. Graded and shaped, the shells go to factories that fashion lamp shades (above), screens, windows, and ornaments.

KODACHROMES BY PAUL A. ZAHL © N.G.S.

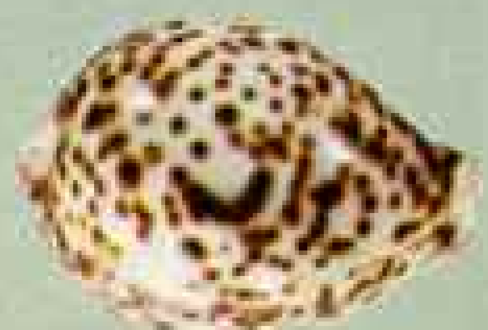
Life in a glass house gives the windowpane oyster no privacy at all. Here a strong light shines through a live mollusk, exposing internal organs that wedge into a space only a quarter inch deep. The V-shaped ligament attaches to the hinge, at bottom. The adductor muscle shows like a golden coin partially surrounded by the gills. Dark mass at right is the stomach.

Kaleidoscope of cowries

"GLORY BE TO GOD for dappled things," wrote poet Gerard Manley Hopkins. And collectors of cowries agree. Though this selection from the Smithsonian comes from the tropical waters of the Indo-Pacific, cowries range throughout the world. They are shown here in uniform size to emphasize their varied patterns and brilliant colors.

From earliest times man has used the shells for both ornament and good luck. Given to a bride, they guaranteed offspring, primitive peoples believed, since cowries held to the ear whispered with the voice of the goddess of fertility, whose spirit dwelt within. In parts of the Pacific, cowries attached to fishing nets promise a good catch. The golden cowrie from the Fiji and Solomon Islands is a badge of rank for chieftains. The money cowrie, as its name indicates, serves as cash, particularly in the interior of New Guinea, where strings of shells still buy food, land, and brides. Some African peoples, such as the Dogon (page 447), also treasure cowries, which they once used as currency.

EKTACHROMES BY VICTOR R. BOSWELL, JR., AND JAMES L. BOSWELL (GOLDEN COWRIE), KODACHROME (BELOW) BY PAUL A. ZAHL © N.G.S.



Tiger cowrie
Cypraea tigris
$2\frac{2}{3}$ to 3 inches

Money cowrie
Cypraea moneta
$\frac{1}{2}$ to $1\frac{1}{2}$ inches

Asellus cowrie
Cypraea asellus
$\frac{1}{2}$ to 1 inch

Mole cowrie
Cypraea talpa
$1\frac{3}{4}$ to 4 inches

UNDER A MOTHER-OF-PEARL SKY, *Philippine shell collectors search off Bohol Island from a specially rigged craft beached by the falling tide. Millions of cowries and other warm-water mollusks live on these reefs and isles.*

Chinese cowrie
Cypraea chinensis
1 to 2 inches

Isabelline cowrie
Cypraea isabella
¾ to 1¾ inches

Eyed cowrie
Cypraea argus
2 to 4 inches

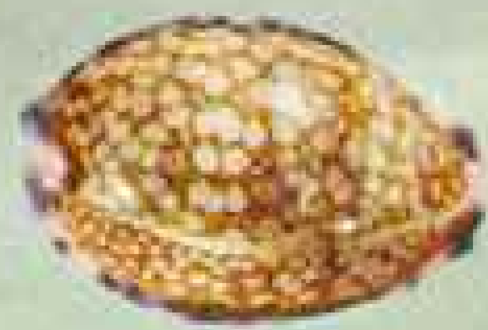
Carnelian cowrie
Cypraea carneola
1 to 2½ inches

Dawn cowrie
Cypraea diluculum
½ to 1 inch

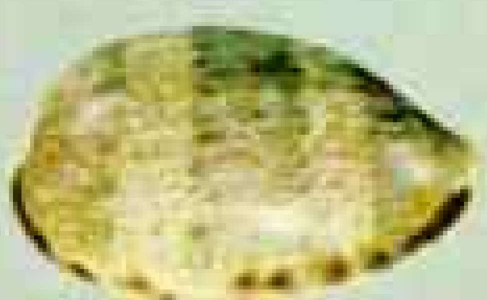
Tessellate cowrie
Cypraea tessellata
¾ to 2 inches

Poraria cowrie
Cypraea poraria
½ to 1 inch

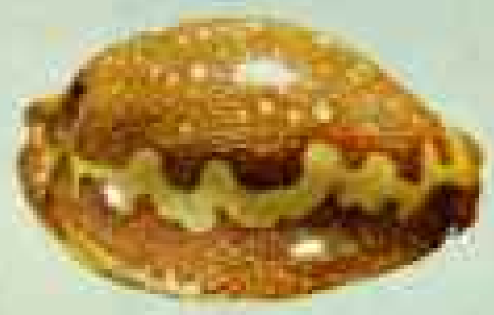
Golden cowrie
Cypraea aurantium
3 to 5 inches



Reticulated cowrie
Cypraea maculifera
1½ to 3¾ inches



Caurica cowrie
Cypraea caurica
1 to 2 inches



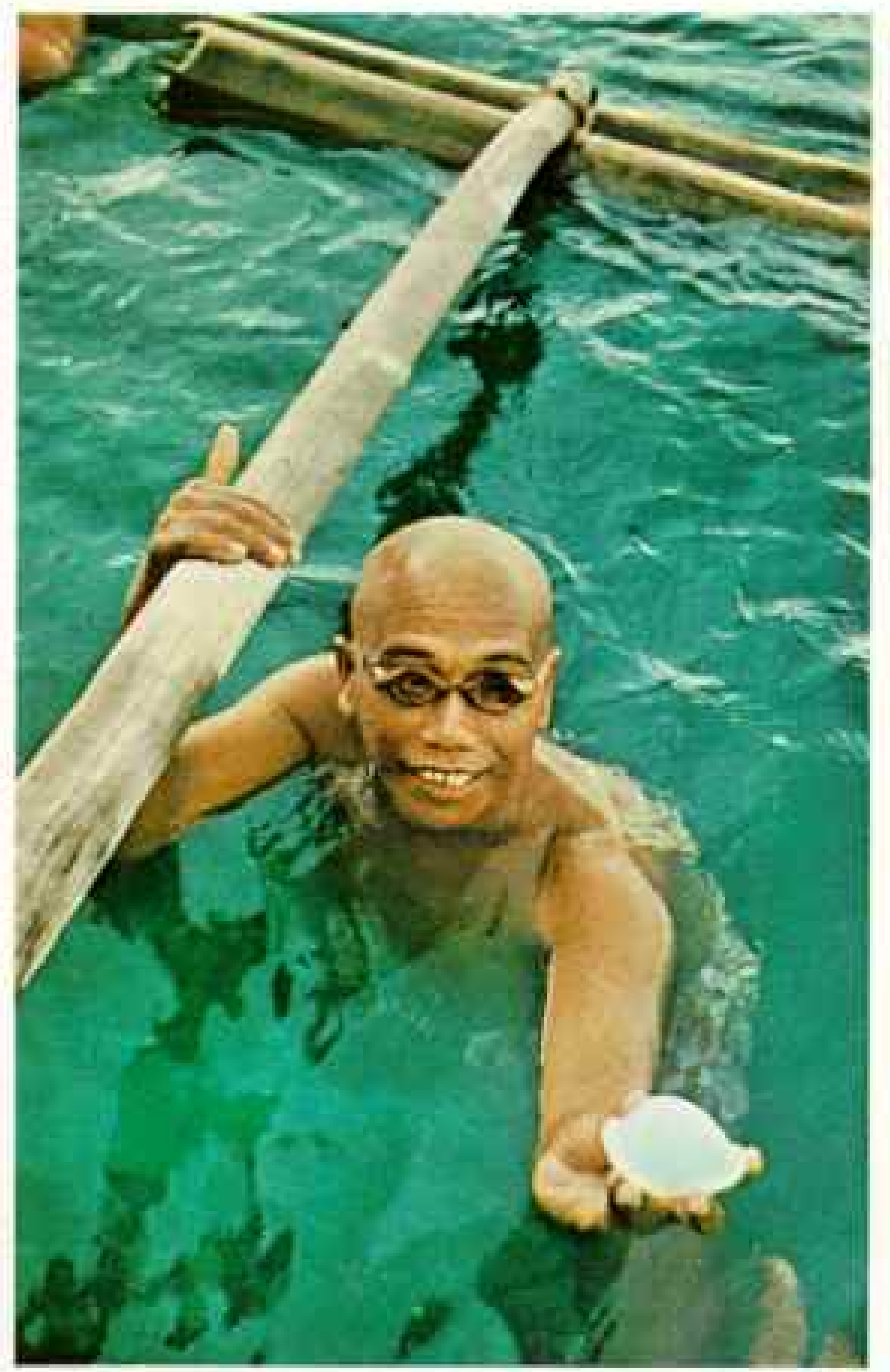
Map cowrie
Cypraea mappa
2¼ to 3½ inches

Ridged ring cowrie
Cypraea obvelata
½ to 1¼ inches

and anemones nestled a dozen or more enameled lumps, some no larger than a salted peanut. Disturbed, they had snatched in their mantles, revealing the color and markings of their shells. And indeed the two species Zambo mentioned were there, *Cypraea cribraria,* richly brown with white splotches, and *Cypraea ziczac,* with rows of tent markings across its polished dome and an orange underside flecked with chestnut dots.

Within a few hours we had harvested scores of money cowries, *Cypraea moneta,* knobby and pale yellow, used even today for barter in parts of the South Pacific; ring cowries, *Cypraea annulus,* cream-colored and crowned with a circlet of yellow-orange; intricately patterned reticulated cowries, *Cypraea maculata;* Arabian cowries, *Cypraea arabica,* gray with brown markings that resembled Arabic script; and larger tiger cowries, *Cypraea tigris,* sold in souvenir shops throughout the world (preceding pages).

Living cowries in motion are among nature's most fascinating sights. Normally shy creatures, they shun daylight and come out in the evening to feed on algae. The foot tissue spreading from beneath the shell resembles the frills of an old-fashioned petticoat. Some shine with a vivid scarlet; others are



Midnight black asparkle with stars, a velvety mantle closes over the porcelain sheen of an egg shell, a cousin of the cowrie. The white dots are papillae—groups of sensory cells. When alarmed, the mollusk withdraws its cloak, transforming itself into the armored hermit held by a Moro diver wearing carved wood goggles (left). He located this *Ovula ovum* on soft coral off Zamboanga, 12 feet below his drifting craft. The diver assisted the author on a shell-collecting expedition to the rich Philippine grounds.

KODACHROME (ABOVE) AND EKTACHROME BY PAUL A. ZAHL © N.G.S.

rich brown or purest white sprinkled with spots of black.

The cowrie glides across the rough coral on its undulating foot without once lifting a hem or shifting a degree off course. The mantle, wrapping completely around the shell and hiding it from view, is festooned with branched filaments, looking like a grove of leafless trees riding a rainbow hill.

Shells Followed Trade in Ancient World

Many cowries are avidly sought by collectors. Good specimens of some, like *Cypraea valentia* and *Cypraea leucodon*, bring prices of several thousand dollars.

The collecting excursion with Zambo brought to mind the rich history of conchology; as long as there have been men, there have been collectors of sea shells, for both food and ornament.

Archeologists find sea shells in grave sites all over the world, some dating from 15,000 years ago. Such finds trace ancient paths of commerce: a Pacific shell discovered in the ruin of an Arizona pueblo, a North Sea shell in a Swiss lake village, an Atlantic shell in an Etruscan grave.

Suetonius tells us that one of the first major-league collectors was that madman the Emperor Caligula. Arriving with his legions at the English Channel during the spring of A.D. 40, he looked at that forbidding barrier and decided that he would rather conquer Neptune than the Britons. He therefore

Common hammer oyster
Malleus malleus
3½ to 8 inches

Elephant's tusk
Dentalium elephantinum
2 to 3 inches

Philippine gallery

WITHIN THIS GALAXY of islands in the Indo-Pacific, nature fashions bizarre sculptures, scattering them across shallows bordered by tropical jungle. The hammer oyster, with its slender, elongated hinge, lives buried in the sand, anchored by its byssus. The elephant's tusk curves and tapers. Spines bristle from the thorny oyster, dolphin, and spiky Venus comb (below). A cat's-eye operculum guards the opening to the tapestry turban. Heart cockle, spindle, and olive take the names of their look-alikes. Cockscomb oysters cluster atop another bivalve, the knobby-shelled chama.

EKTACHROMES BY VICTOR R. BOSWELL, JR. © N.G.S.

Dolphin shell
Angaria delphinus
1 to 2½ inches

Heart cockle
Corculum cardissa
1 to 3 inches

Tapestry turban
Turbo petholatus
1 to 3 inches
(with cat's-eye operculum)

Venus comb
Murex pecten
4 to 6 inches

Imperial thorny oyster
Spondylus imperialis
2 to 4 inches

Spindle shell
Tibia fusus
4 to 8 inches

Carnelian olive
Oliva carneola
½ to 1 inch

Cockscomb oyster
Ostrea cristagalli
2 to 4 inches

issued orders to his troops, drawn up in battle array, to begin gathering sea shells along the French shore, surely one of the strangest commands to an invasion army in history. He went back to Rome with what he called "the spoils of conquered ocean"!

The ashes of Pompeii have yielded specimens from another ancient collection. Most of the shells are Mediterranean, but a few, including a textile cone, came from as far away as the Indian Ocean.

Collecting in the modern sense began when Dutch merchant ships sailed back to Amsterdam with the colonial spoils of the East Indies. The first field naturalists were often the administrators of empire. One, Georg Eberhard Rumphius, spent the greater part of his 75 years on the island of Ambon, site of a small trading post in the East Indies. During the 17th century, he wrote a masterwork of natural history based on observation; some of his names for mollusks were adopted by Linnaeus half a century later.

Great Collections Started as "Cabinets"

During the 17th and 18th centuries it became the fashion in Europe for cultivated men to assemble "cabinets": large rooms cram-packed with every kind of curious object imaginable—birds, animals, fish, shells, minerals, weapons, primitive utensils, coins, bones. Sir Hans Sloane's cabinet became the nucleus of the great collection now belonging to the British Museum in London.

In 1625 the Englishman John Tradescant commissioned Edward Nicholas, on behalf of the Duke of Buckingham, to "Deall withe All Marchants from All Places But Espetially the Virgine & Bermewde & Newfound Land Men ... to furnishe His Grace Withe All manner of Beasts & fowells and Birdes ... shells ... Bones Egge-shells. ..." The Tradescant collection became a foundation stone of the famous Ashmolean Museum at Oxford.

An outstanding English collection was assembled by a woman, partly from gifts brought home by a wandering husband—the famous Capt. William Bligh of the *Bounty*. His voyages to the Pacific took him within reach of shells seldom, if ever, seen until then by European eyes. Among her treasures, Elizabeth Bligh counted "a very perfect specimen" of the precious wentletrap. They, too, made their way to the British Museum.

Thus the great collections of Europe grew. Some of them eventually flowered into national museums replete with rare and beautiful shells.

A killer cone attacks: Lying in the sand, two-inch-long *Conus striatus* extended its proboscis toward a blenny. When the sensitive tube brushed against the fish, a barbed harpoon, similar to the one at right, darted out. On target, the needle-size arrow injected a paralyzing toxin and the snail pulled the fish toward its mouth, which stretched wide to receive the prey. Here the snail engulfs its supper. Inexperienced collectors, carelessly handling live cones of the Indo-Pacific, have suffered painful stings—even death.

Certain shells in particular have had a magic about them for the collector—a fascination based more often on rarity than on beauty, but often on both.

Price of "Spiral Staircase" Tumbles

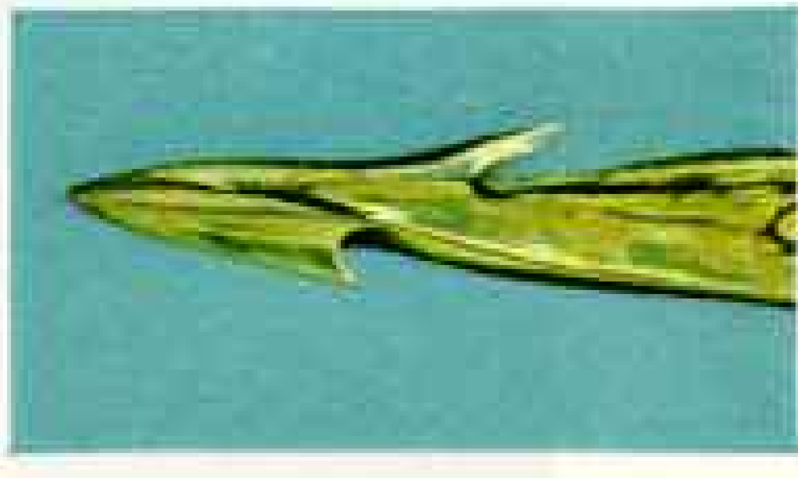
Perhaps the first of these—and one still greatly admired and avidly collected, although no longer at astronomical prices—is *Epitonium scalare*, the precious wentletrap. A lovelier thing is hard to imagine (page 415). Christened by the Dutch with their word for "spiral staircase," it was the possession of royalty. Catherine of Russia owned a large one; so did Queen Louisa Ulrica of Sweden. Tradition tells of Emperor Francis I, husband of Maria Theresa, paying 4,000 Austrian guilders for one in 1750—a sum roughly translated into $20,000 today.

In recent years, as shell collectors have probed into the lairs of the wentletraps near Sumatra and Australia and other parts of the Indo-Pacific, the price has fallen. One dealer, in 1958, listed two of these "very rare beautiful shells" for only $5 and $3 respectively. Still, one must wonder how any price could truly reflect the wentletrap's intricate structure and beauty of design.

For more than two centuries collectors considered the rarest and most expensive shell in the world to be *Conus gloriamaris*, the beautiful glory of the seas. This regal shell, with its tapered spire and its elegant color patterns reticulated like the finest needlework, satisfies both the artist's requirement of exceptional beauty and the collector's demand for exceptional rarity.

Before 1837 only half a dozen were known to exist. In that year a famous British collector, Hugh Cuming, visiting a reef near Jagna, Bohol Island, in the Philippines, turned over a small rock, and found two, side by side. He

THE UNIVERSITY OF WASHINGTON, SEATTLE (ABOVE) AND PAUL A. ZAHL © N.G.S.



recalled that he nearly fainted with delight. When the reef vanished after an earthquake, the world believed that the only habitat of *gloriamaris* had disappeared forever.

So famous did this shell become that a Victorian novel by Fanny Steele built its plot around the theft of one and used the popular name as its title. Many years later, in 1951, the world was reminded of its continued value when someone, still unknown, broke into a display case at the American Museum of Natural History and carried off a perfect specimen.

Prices for glory of the seas still run into hundreds of dollars, but a recent list cites no fewer than 70 of the once-rare shells now residing in collections.

A few other shells are now considered more valuable, such as the magnificent glory of India, *Conus milneedwardsi*, of which only a dozen have been found. Among the cowries, *Cypraea leucodon* rules supreme; three are known—one in the British Museum, one at Harvard University, and one in the extensive private collection of John E. du Pont of Newtown Square, Pennsylvania. Mr. du Pont kindly permitted us to photograph some of his treasures for this article.

I found one of the rare glory of the seas cones in the superb collection of shells brought together by Mr. and Mrs. Bernardino Guerrero of Manila. My visit to their home climaxed three months spent studying the mollusks of Philippine waters.

As I stood before the fantasia of shells displayed in glass cabinets, my hand went almost involuntarily toward a strikingly handsome, gently curving shell with a greenish-white surface, *Dentalium elephantinum* (page 424). The small tusk shell, also known as a tooth shell, represented another of the large classes of the mollusk phylum, the Scaphopoda, which means "digging foot."

Indians Bought Wives With Shells

Members of the Scaphopoda have fascinated people since time immemorial, for nature designed them as though she intended them to be strung into superlative necklaces. Gleaming like ivory, slightly curved, open at both ends, they invite collection. When trappers of the Hudson's Bay Company arrived on the North Pacific coast of America, they found a lively currency—*Dentalium pretiosum*, the money tooth shell. A string of large ones might pay for a canoe or a squaw.

Tooth, or tusk, shells are found the world over on sandy or muddy bottoms from the shallows to very deep water. The animal inside is blind and has no gills; it spends its life with the larger end of the tusk stuck in the sand. The mollusk breathes by taking in and expelling water through the hole at the smaller end.

To burrow into the sea bottom, the creature extends a little digging tool from the large end of the shell—a foot that some people think resembles a horse's hoof—and plows in at an angle, until only the tip, like a white dagger, is left exposed. Once secure, the tooth probes around in the sand with a cluster of ciliated tentacles. These sweep microscopic organisms into its mouth in such steady profusion that one 19th-century malacologist referred to the common tooth shell of Europe, *Dentalium vulgare*, as a "fastidious Pig from the herd of Epicurus. . . ."

As I admired other shells in the Guerrero collection, Mr. Guerrero left for a moment and returned with a small box. His wife

All lip and a yard wide: A giant clam extends ruffled jaws, its exhalant siphon gaping. Popular legend pictures swimmers such as this pretty snorkeler trapped in the valves, but the chances of such an accident are slight. *Tridacna gigas*—the world's largest bivalve—harbors "gardens" of algae within the thick mantle tissue, speckling it with green. This behemoth lies 10 feet deep on Australia's Great Barrier Reef. EKTACHROME BY BEN CROPP © N.G.S.

opened it with great care. From its velvet-lined interior she lifted out and placed in my hand a light-brown shell, four inches long, with small white triangular markings. This was a perfect *Conus gloriamaris* (page 415). My hostess told me that she had once refused an offer of $2,000 for it.

For both collectors and scientists, the lure of shells rests in part on the generosity of the oceans that continue to yield unsuspected treasures.

Perhaps the most sensational find of our generation occurred in 1952 when the Danish research vessel *Galathea* hauled up a handful of "living fossils" from a depth of 12,000 feet in the Pacific Ocean off Costa Rica. The 10 tiny animals, about an inch long, were living examples of a kind of primitive mollusk thought to have vanished 350 million years ago.

Looking like little buttons, the simple mollusks set off a lively debate among scholars. Some pointed to the paired muscles, gills, and kidneys and hailed the discovery as a "missing link" between mollusks and the wormlike annelids. A pair of flaps behind the mouth suggested those of a modern clam, and a small bunch of tentacles in front of the foot were thought to correspond to those of the squid and octopus. These mollusks were assigned to the class Monoplacophora, which had been created in 1940 to cover fossil species.

In 1958 the U. S. research ship *Vema* dredged four more specimens from their hiding place 19,000 feet down in the Peru-Chile Trench. Since then others have been found by deep dredging.

Shells Hold the Record of Eons

Another unexpected glimpse into early mollusk life came in 1963 when the *Gerda*, a research ship of the Institute of Marine Sciences of the University of Miami, dredged up a living Pleurotomarian, or slit shell, from the waters off Sombrero Key, Florida. *Mikadotrochus amabilis* was the first new species of Pleurotomarian found in the Caribbean in more than 100 years. Fifteen species are now known to exist—the majority from recent finds in Japanese, Indonesian, southern African, and Caribbean waters.

Since 1964, the National Geographic Society has supported several voyages of the *Gerda*, with many exciting results. In 1965, University of Miami researchers dredged from Bahama waters three species of slit shells, two of them new to science. Another new species was added during a *Gerda* cruise in 1966.

Thus each year brings the bright hope of discovery and knowledge. And each year, I am sure, some boy makes his way to the edge of the sea and finds there a fellow creature of his planet that evokes the magic of creation. THE END

Foxes Foretell the Future in Mali's Dogon Country

Article and photographs by
PAMELA JOHNSON MEYER

BEFORE THE SUN had fully risen, the old man bent close to the ground, intent on the animal tracks made in the night. They ran across a drawing he had traced in the sand the previous evening. Suddenly he looked up and announced, "You will return to Sanga before the year is out."

I wanted to believe Balpa Dolo, a respected diviner of Sanga, who predicted the future from fox tracks (page 448). But Sanga, a remote village in the African Republic of Mali, is a place visited by few even once in a lifetime.

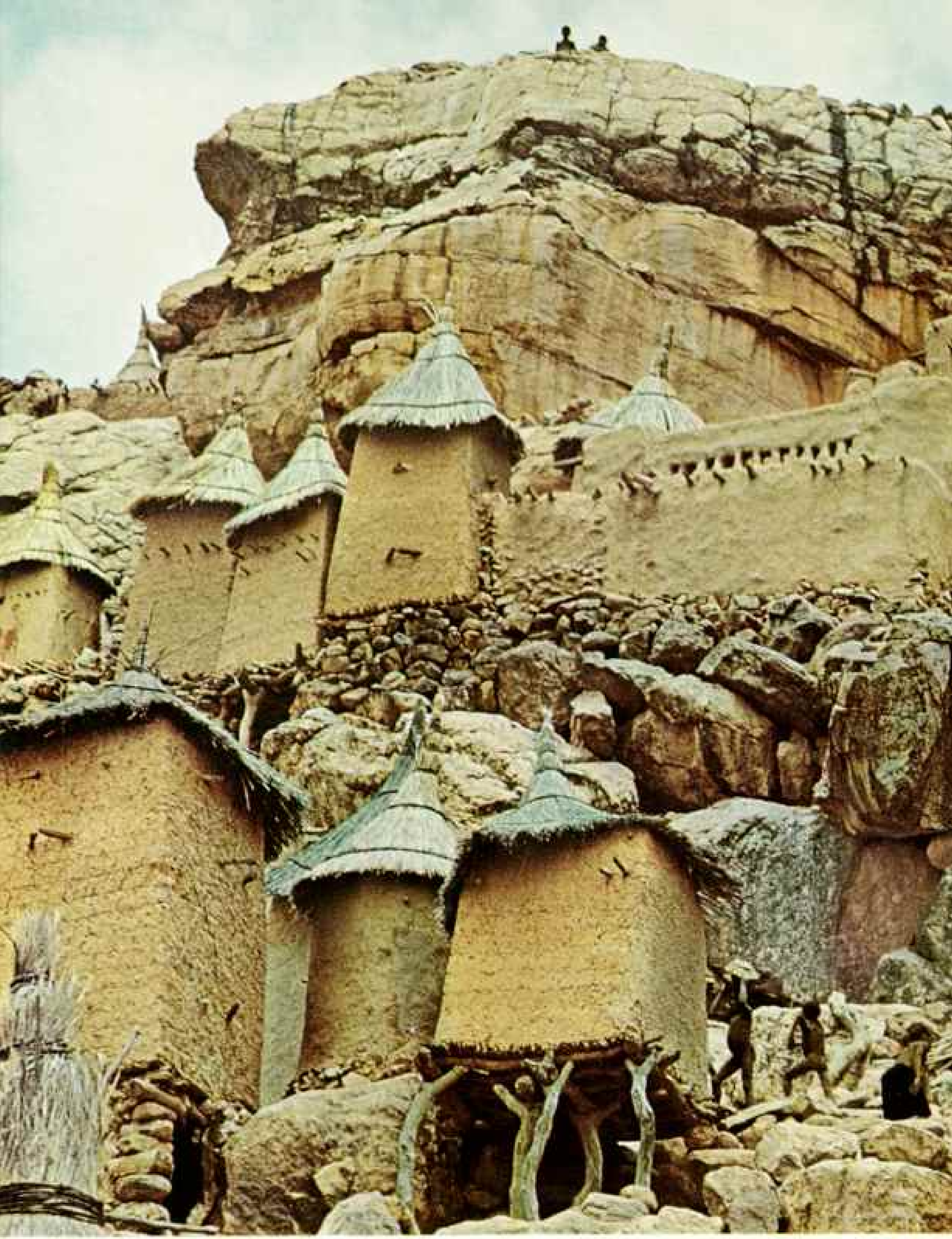
Nine hundred miles east of Africa's Atlantic coast and 150 miles south of Timbuktu and that other great sea, the Sahara, Sanga lies in the heart of Dogon country. The Dogon, who comprise some 250,000 of Mali's 4.7 million people, live along a 90-mile stretch of escarpment called the Cliffs of Bandiagara (maps, page 435).

Dogon cliff villages seem to defy gravity. Their mud houses and straw-hatted granaries cling recklessly to the cave-pocked sandstone face, which averages 600 feet in height. Some of the higher buildings nestle in wind-eroded caverns, while below, on the scree, the crooked lanes and curving houses conform to the haphazard terrain of fallen boulders (following pages). Staircases rise in great fault fissures. And overhanging rocks offer shade from the relentless sun.

I had come to Mali on a photographic assignment for the United Nations, and curiosity had drawn me to Dogon country. But time was short; the Niger River was receding, and the water route to Timbuktu would soon be impassable. I left Dogon country to sail down the Niger, with a longing to return but with little faith in the fox's power of prophecy.

But the fox was right. In April, less than two

Towering headdresses flail the air as Dogon dancers of Sanga, in the West African nation of Mali, perform for visiting dignitaries. Cowrie-shell masks and rustling skirts adorn these men, who masquerade as women. Famed for such displays, the Dogon inhabit precarious cliffside villages such as Yenndouma (right), where two women go forth in the morning for water.



Propped by rubble, logs, and faith, a family compound at Yenndouma clings to a rock face of the Bandiagara escarpment. Smooth mud walls with rounded corners mark the living quarters, upper center. Straw-hatted granaries perch haphazardly. In some, the head of the family stores his reserves of millet, sorghum, rice, and beans; others hold a day-to-day supply for the household, given out by the wife. A hogon, or village priest, may own larger granaries, communal sources of food in lean times.

KODACHROME BY PAMELA JOHNSON MEYER © N.G.S.

The Dogon took up their way of life centuries ago, driven by the Fulani and other warrior tribes to these inhospitable but defensible heights that had earlier sheltered a little-known people called the Tellem. Here, secluded from the outside world, the Dogon nurtured their complex social order, based in almost every detail on elaborate religious precepts and beliefs. They also developed the arts of sculpture and dance, permeated with symbolism that still intrigues anthropologists.

KODACHROME © N.G.S.

Trade route of the market-bound, a staircase wends up a convenient fissure at Sanga. A precipitous climb of 600 feet links houses on the plain with cliffside and clifftop settlements. These women trudge for miles under heavy baskets of onions, grain, and handwoven cotton cloth. Some tote babies as well.

months later, I was heading back to Dogon country on a NATIONAL GEOGRAPHIC assignment. In Dakar, Senegal's capital, I boarded the diesel-powered Niger-Ocean Express for a rail journey to sultry Bamako, capital of Mali. From there I flew via Mali's national airline to Mopti, hired a government Land-Rover, and followed a dry, rutted road across the high plateau to Sanga, 70 miles to the east.* Once again I walked to the edge of the inhospitable cliffs and saw the homes of my friends below.

Fabled Climbers Had Sticky Hands

The Dogon, by their own telling, have not always dwelt here. More than 600 years ago they came from the southwest of Mali and retreated to the cliffs to protect their granaries from such hostile tribes as the Fulani. Earlier cliff dwellers were the Tellem, some of whom may have remained to greet the Dogon; dates of Tellem occupancy are uncertain.

"The Tellem were dwarfs," a Dogon elder explained to me. "They had a special medicine they put on their hands to stick to cliffs, and they strung fiber bridges across the gorges."

Archeological findings suggest that the Tellem were of more normal proportions, and that their sticky fingers and suspension bridges are only myth. Nevertheless, the phenomenal agility of a people who built granaries in the shallowest niches of the sheer cliff face awes even the Dogon.

Sometimes the Dogon use these almost inaccessible storage places as graveyards. They lower the wrapped bodies of their dead with ropes made from the bark of the baobab tree, guide them into place, and seal the entrances with stones.

From Sanga I headed north to Yenndouma, which I planned to make my headquarters, and, because the 14-mile route is only a narrow sandy track, I traveled on foot. Five shoeless porters carried equipment and a month's supplies on their heads.

We walked briskly across the wind-swept plateau, guided by Diangouno Dolo, an elder

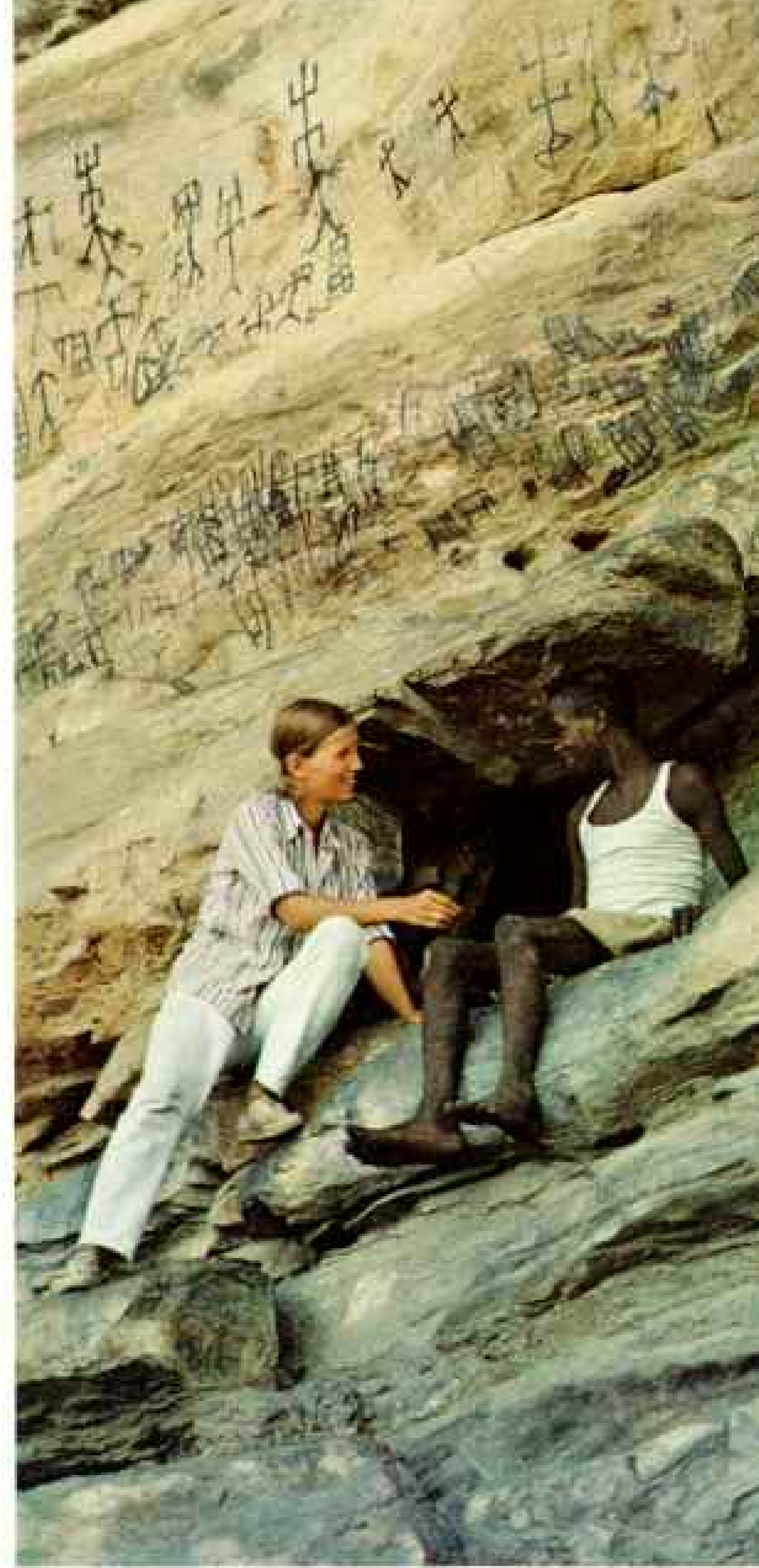
*See "Freedom Speaks French in Ouagadougou," by John Scofield, GEOGRAPHIC, August 1966.

Domain of the Dogon straddles the natural barrier of the Bandiagara cliffs. Here in the sunbaked heart of Mali, a land more than 1½ times the size of Texas, live 250,000 Dogon. Some of their villages have spread to the plateau above the cliffs and to the more commodious plain below.

Mali, formerly French Sudan, won independence in partnership with Senegal in 1959, then struck out on its own in 1960.

Beneath dancing graffiti, author Pamela Meyer strikes up a friendship with Yeriama, a young artist of Nombori. His finger paintings, made with charcoal and saliva, depict Dogon dancers (page 430).

Pert, blond 24-year-old Pamela is a Vassar graduate with a degree in anthropology. She visited 18 African nations in a year of travel as a freelance writer and photographer prior to her sojourn in Dogon country on a GEOGRAPHIC assignment last April.



KODACHROME © N.G.S.

of Sanga. Despite his surname, Diangouno was not related to Balpa Dolo. Among the Dogon all people of the same area have the same surname, and everyone in Sanga is a Dolo. As for Balpa, he never appeared during my brief revisit. Perhaps, in his mind, such an inevitable event merited no notice.

It was early morning when we set out, and the breeze cut the 100° F. heat. Around the village of Koundou piles of firewood, protected from thieves by small wooden fetishes, dotted the landscape. Great irregular swirls of rock left little room for the fields scratched out between. Now the fields lay fallow, waiting for the rains to begin. The stream beds were empty, but the ripening berries on the *sa* trees signaled that the rains were not far off.

"You have drunk the juice of the sa," Diangouno said, reminding me of the drink, like sweet prune juice, I had tasted in Sanga. "When the berries are ripe, the women collect

them, dry them, and soak them in water. They use the oil from the seeds on their skin."

Since I know few phrases of the subtle Dogon language, Diangouno spoke to me in French, which he had learned during World War II while serving France in the Sahara.

As we descended from the plateau, the sa gave way to baobabs, whose sparse leaves the Dogon gather to make *nja*, a mushy leaf stew. At the foot of the cliff, thorn trees studded the endless plain, now yellow with the stubble of millet. Crisscrossing sandy paths led beyond the horizon to the villages of Yougodogorou, Bamba, Ibi, and Yenndouma.

We pushed on to Yenndouma, where two months before I had attended the Sigui festival, a ritual held in each village every 60 years to honor Amma, the Dogon's god and creator, and a varied company of ancestors.* Then the marketplace at the base of the cliff had been alive with dancers. Hundreds of men and boys in dark pants, yellow beads, and white cotton caps with red tassels filed singing into the marketplace, circling with shuffling steps the three silk-cotton trees in the center. A select few older men recited in Sigui, the secret language used only on sacred occasions.

"Fill Our Hands With Wives...."

As night fell, the dancers wound toward the cliff village (opposite), following the great drum and pleading with Amma:

Fill our hands with wives
Fill our hands with children
Fill our hands with millet
Fill our hands with sorghum....

But now Yenndouma had returned to normal. Goats grazed in the marketplace. In the village everyone worked to prepare for the rainy months ahead. Water pots and baskets, straw roofs and rain gutters, hoes and axes had to be made ready. For during the June-to-October rains, the season of cultivation, no time could be spent away from the fields.

Dimon, the 50-year-old chief of Yenndouma, welcomed me and led me to a one-room mud house at the foot of the cliff, mine to use as long as I stayed. He wore a flowing blue cotton tunic over the baggy trousers that Dogon men tailor from homespun cotton.

Unusually tall and thin, Dimon bore himself with the authority of a man whose father and brother had been chief before him. Today the central government reinforces his hereditary position and pays him a salary. In return, Dimon and other village chiefs help collect an annual tax from the villagers.

Change Comes Slowly in Dogon Land

Like most Dogon, Dimon clings to traditional ways, despite the pressures of living in a Moslem land and the Christianizing efforts of American missionaries in Sanga. His wealth permits him to support two wives; trying out the English he had learned as a young man working in Ghana, he introduced me to them and to his children, and showed me the compound where they live. The rude mud houses formed an unbroken circle around a rocky courtyard. The largest held the kitchen, the sleeping room, and a passageway with a notched ladder to the roof, where the family sleeps during the hot dry months.

Several smaller buildings with straw-thatched roofs held grain. Dimon explained that he had two types of granaries. "At the end of each harvest I give my wives a portion of the millet, the sorghum, the rice, and the beans. They keep this in their granaries and feed the family with it during the dry season."

Dimon stores the rest of the harvest in his larger granaries, which he seals. "When the rains come, I open one granary and give millet to my wives to prepare." The unused grain is kept from season to season as insurance against crop failure. A wealthy man may have ten granaries, their wooden doors sealed with mud plaster and the grain inside sprinkled with ashes as protection against insect damage.

The other houses of Yenndouma were similar to Dimon's. One had a dark rocky kitchen cut into a cave. Here I came upon an old woman kneeling by a fire and stirring a milky white

*A comprehensive study of Dogon religious beliefs, *Le Renard Pâle* (The Pale Fox), was published by the Institut d'Ethnologie, Paris, in 1965. Mme Germaine Dieterlen, its co-author (with the late Marcel Griaule), served as consultant for this article.

Single file in order of age, elders first, tribesmen in conical caps snake up to Yenndouma during a celebration of Sigui. Traditionally held every 60 years, the festival symbolically renews the Dogon way of life. Celebrants brandish one-legged stools, calabash bowls, and fly whisks—objects imbued with religious significance. Throughout the day they dance and chant praises of the creator Amma; some use a secret language reserved for such occasions. As in most Dogon rites, only men take part in the dances.

KODACHROME © NATIONAL GEOGRAPHIC SOCIETY

No women allowed, decrees tribal custom. A rocky niche at Yougodogorou serves both as a men's club and as a sanctuary for ritual objects. Here elders prepare to feast on legs, head, and intestines of a goat whose carcass has been divided among the villagers.

Carrying on the craft of his ancestors, a weaver works his crude loom in Yenndouma. Tribal myth says weaving originated with a *Nommo*, or spirit, who spat out sacred thread and wove it on a loom made from his jaws, teeth, and lips. As he worked, he spoke words of revelation, which his forked tongue wove into this first fabric. Even today, Dogon weavers mutter incantations.

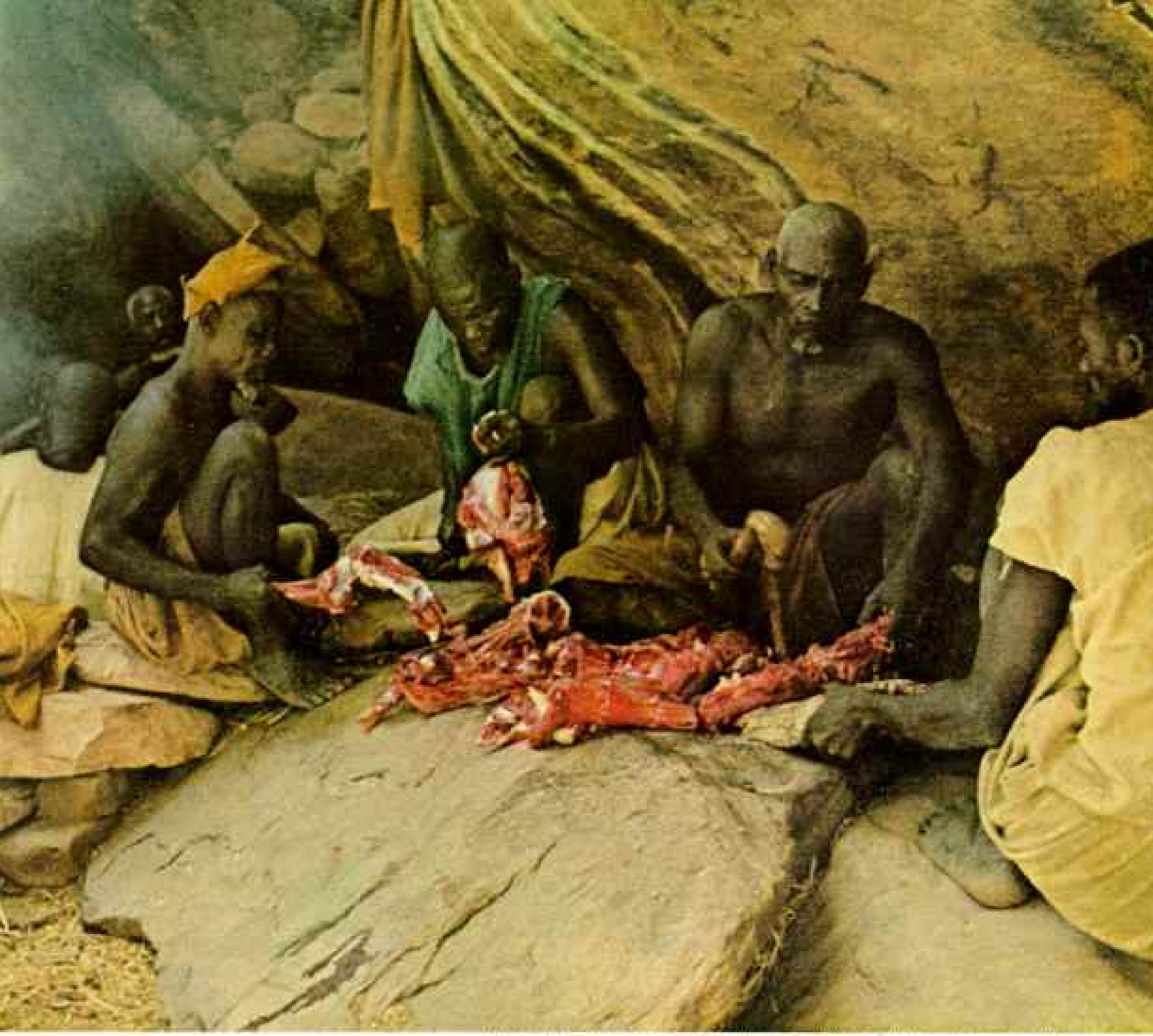
mixture of crushed millet and water. She handed me a gourd brimming with the thick porridge-like *punu* that the Dogon drink for one of their two daily meals.

"Drink more!" she protested when I took only a polite sip. "You are too thin. You could never work in the fields of millet as we Dogon do. You need to eat so you will be strong."

"How Is Your Skin?"

It was my first clash with the cultural values of the Dogon. I was content to be losing weight under the rigors of cliff climbing, but in Dogon eyes I was scrawny and useless, too weak for the work expected of even a lazy wife.

The women's day began early. Before sunrise they filed past my house, already returning from the water hole (page 431). Each managed a smile and a greeting while deftly balancing a clay pot with some 40 pounds of water on her head.



EKTACHROME (ABOVE) AND KODACHROME BY PAMELA JOHNSON MEYER © NATIONAL GEOGRAPHIC SOCIETY

"*Aga po*—good morning," they called out in the shrill voice the Dogon find feminine.

"*Aga poi*—good morning to you all," was my sleepy response.

"Peace stay with you until evening."

"And with you."

"How are you?"

"I am well."

"How is your family?"

"They are well."

"How is your health?" (Literally, "How is your skin?")

"It is well."

Then it was my turn to inquire after their well-being. With the judicious use of the plural forms, it was just possible to get through the entire, unvarying ritual before the last woman had filed out of earshot.

During these dry months, the women spent the day gathering firewood, making pots, pounding millet, preparing meals, spinning cotton, tending children, and perhaps helping their husbands with a cash crop of onions. In the planting season they would toil beside the men, sowing millet from dawn to dusk.

Their spirits stay high the year round, and they groom themselves with care. Each morning the lovely daughter of Venndouma's chief brought a pot of water to my tiny house. Sanu's skin glistened with the sa oil she had applied after her morning bath, and the single amber bead caught round her neck with a leather thong gleamed in the sun's first rays. When she was older, she would line her ears with a dozen aluminum earrings and perhaps pierce her lower lip for a slender aluminum ring.

Sanu was not more than 14 and not yet married. Soon a young man five or six years older would ask for her hand and bring her parents the traditional gifts.

"What is the first gift?" I asked Diangouno.

"Before anything else, the young man brings

two loads of firewood to the mother of the girl. Later he will bring a basket full of millet with 80 tiny cowries on top. More gifts will follow, and when the last are given, the couple is considered married."

The Dogon have no formal marriage ceremony, and not until a couple's second child is born will the wife go to live with her husband permanently. Divorce is easy for women as well as for men, and a man may take more than one wife if he can afford to.

Diangouno's mention of the cowries surprised me. Centuries ago such shells, from islands in the Indian Ocean (see pages 420-21), crossed the Sahara with camel caravans to become West Africa's most common currency. Under colonialism, francs and shillings largely replaced the shells. But in isolated Sanga as late as 1940 a measure of millet, which today costs five Malian francs (one cent), sold for 80 cowries. Thus, the symbolic marriage gift of 80 shells once had economic meaning.

"Sold" Into Slavery for a Shell

I asked Diangouno whether there were any other surviving uses of the cowrie shell, and he told me the story of his name.

"Diangouno means 'slave of the leatherworker.'"

When I looked puzzled, he continued.

"I was my mother's tenth child, but all before me had died. She feared that all the children she bore were doomed to die young. So, before I was born, mother 'sold' me to the leatherworker for a single cowrie shell.

"Throughout my childhood I never worked a day for the leatherworker. I lived with my mother, who raised me carefully. When I was fully grown, we went together to the leatherworker to thank him for his protection and to return the cowrie shell that had fooled fate. But even today I am called the 'slave of the leatherworker.'"

Children's names are usually chosen by the oldest, and therefore wisest, man in the area, the *hogon*. Confined to the village by tradition, Kiré, hogon of Yenndouma, received visitors in the narrow entrance to his compound. When men came with problems, Kiré would chase away the curious women and children, tuck his tiny frame into a recess in the passageway, and listen.

Often as not, he reached into the lizard-skin bag that was always at his side and pulled out a few polished stones, a bead or two, perhaps some cowries. With this simple equipment and the skill learned from his father, Kiré could choose a newborn's name,

KODACHROME © N.G.S.

predict the future, or diagnose a disease.

He was as well known for his treatments as for his powers of prediction, but he balked when I asked him to share his wisdom of the barks and leaves and herbs.

"Tell you my medicine? Then no one would come to me! Everyone knows the trees of the plateau and the bushes of the plain, but they don't know my medicine. If I show you this, how will I eat?"

In former times, an assistant to the hogon sounded a ram's horn on the eve of market day. Now the people need no reminder. Each fifth day the market comes to Yenndouma.

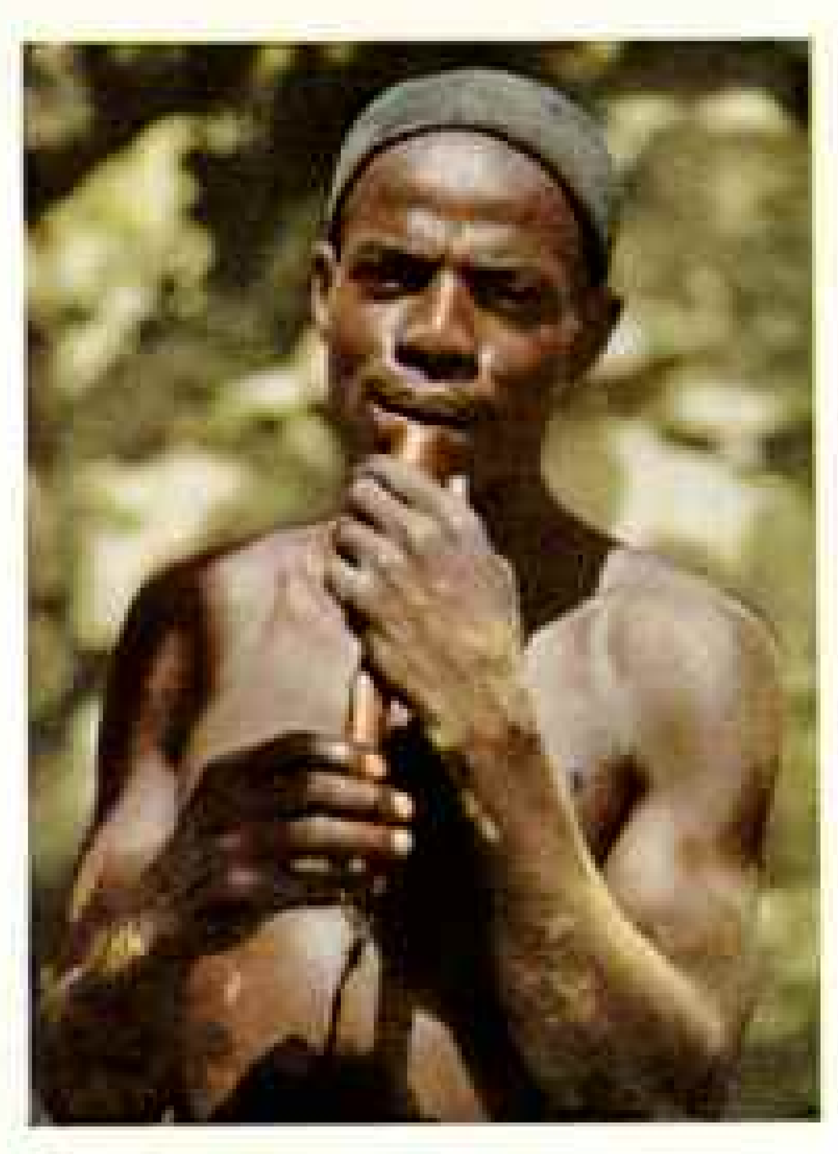
Women of the Fulani tribe, the old enemy of the Dogon, come from the plains to sell milk. Enterprising young men walk the 85 miles from Mopti with razor blades and matches, sugar and store-bought cloth. They return with onions and strips of the homespun cotton that the Dogon men weave.

People of the cliffs

PROUD FACE and special headdress bespeak the privileged status of a *yasigine* (left), who is permitted to approach masked male dancers with food and drink. Ornamental aluminum rings pierce her nose and lips.

The ancient game of cat's cradle amuses three lads (below), who use a shelter reserved for men. A young girl (bottom) balances a water-filled jar and a bundle of dried millet stalks atop her head; new to the task, she sloshes water down her face.

The musician at right pipes a tune on a homemade flute. A vendor of *sa* seed oil raises well-greased hands to her face in delight at hearing the author greet her in the tongue of the Dogon.



KODACHROMES BY PAMELA JOHNSON MEYER © N.G.S.

On the far side of the market Yenndouma men slaughter and barbecue goats, conducting a brisk open-air restaurant trade. But only men eat here; meat is a rare treat for Dogon women. I therefore felt greatly privileged when the men asked me to share a goat leg (very tough).

The market is the heart of the famous "bush telegraph." The men, comfortably seated on the roots of an old silk-cotton tree, take long drafts of *konyo*, or millet beer. With an occasional thought-provoking pinch of snuff or a crunch on a cola nut, they swap the news and gossip of the cliffs (opposite).

Tomorrow would be Sanga *ibe*, market day at Sanga, and the news of Yenndouma would travel with the merchants. And Yenndouma would receive all the latest news of the other villages upon the return of the mobile market five days hence.

Goats Have a Taste for Dogon School

My house lay between the marketplace and the government school. Each morning boys, and sometimes girls, walked four or five miles to their sun-baked mud desks to learn to read *Mamadou et Bineta*, the Malian equivalent of *Dick and Jane*, a French text about Moslem children. All other lessons were also conducted in French, the official language of the republic.

Though Yenndouma's school, like many in Mali, was made of mud bricks, one classroom had walls of straw, and each evening before going home the children ringed it with thorny acacia branches to keep out foraging goats.

One night as I lay on my cot, a volley of shots broke the dark silence. Round after round rang out as men came to dance and shoot off their flintlock guns on the roof of the house of an old man who had died and been buried in the cliffs the previous week.

At dawn I joined the mourners. A group of old women sang in the dead man's courtyard, beating great hollow gourds and shaking the dried, seed-filled fruit of the baobab tree. They continued through the morning while friends filed in to offer condolences and the traditional gifts of millet and monkey bread (the common name for baobab fruit). On the roof of the house the younger women began a slow deliberate dance.

The pace quickened toward evening when the mourners converged on the village square. The women, bunched at the entrances to the square, drummed on gourds and swished fly whisks to dolorous rhythms. Then, from every corner of the village, men came shouting and brandishing flintlocks, crafted by the village blacksmith and crammed with homemade powder. They followed a drummer into the square to give their friend an unforgettable send-off.

Noise, sparks, and sulphur fumes filled the air as a mock battle was staged in the dead man's behalf. Holding guns at arm's length, the men raced across the square to engage imaginary enemies. Groups advanced and retreated, making mock lunges at the other mourners with guns and spears. For most of an hour the battle raged, until participants, daylight, and gunpowder were all exhausted.

The rugged beauty of the funeral reinforced my desire to see the *dama* ceremony that follows the funeral of an important man. Held a year or more later, the dama is a second funeral in which dancers put on huge wooden masks, bid a final farewell, and commend the dead man's soul to the ancestors.

Hunter Awaits a Musical Cue

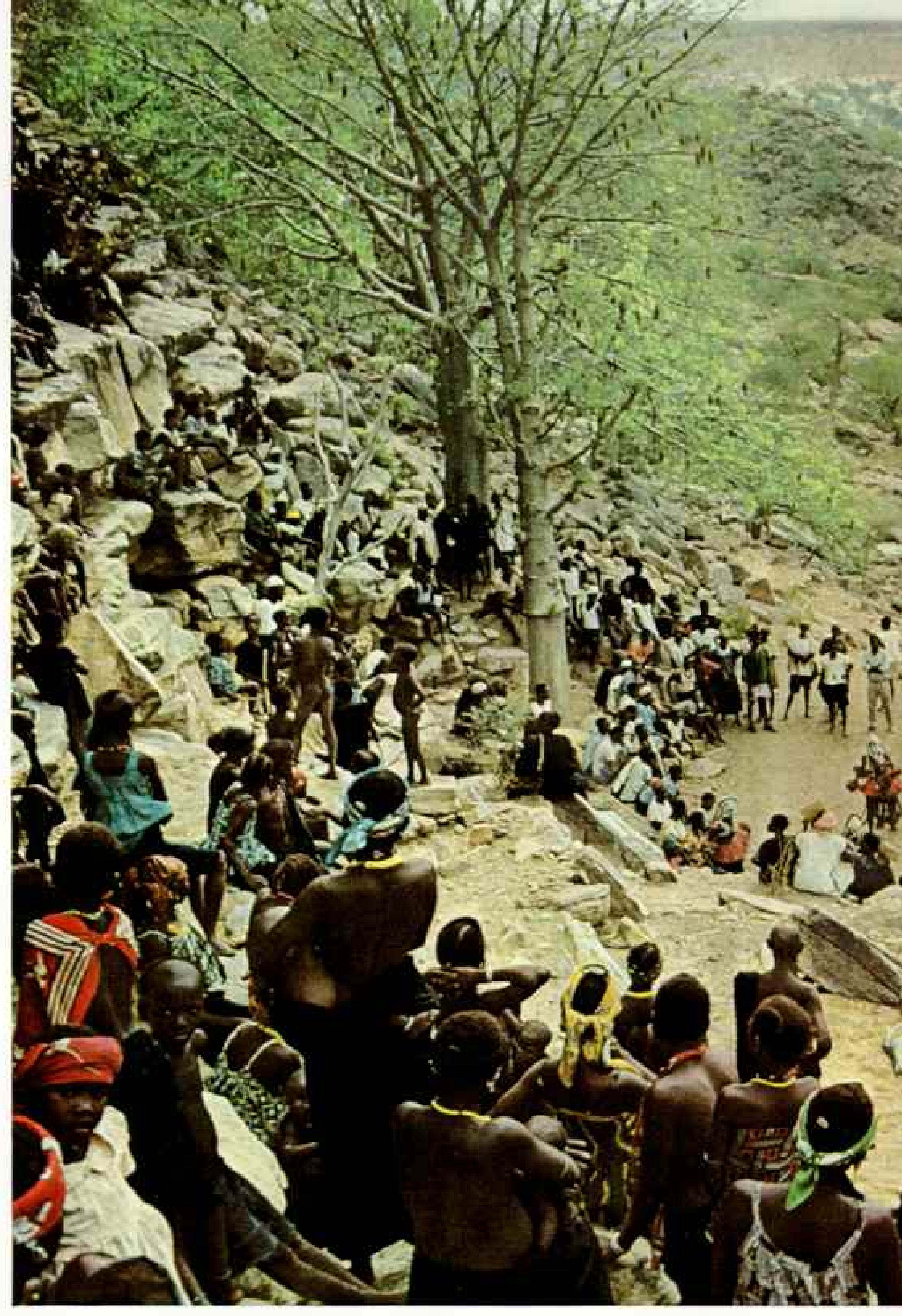
I heard through the bush telegraph of a dama to be held at Idiéli, a village 19 miles southwest of Yenndouma, in honor of a village elder who had died the previous year. When I arrived in Idiéli, the dama was already under way. Masked dancers filled the village square in a wide undulating circle, their fiber skirts swinging. All were men, but their masks and costumes mimed both men and women, as well as birds and beasts.

Half a dozen *kanaga* dancers, men in masks topped by the outstretched arms of Amma, swung into line in front of me. Now they began a series of great swooping arcs. Three, four times they circled, swept down to touch the ground with Amma's creating hands, and then soared up again.

Soon *dannane*, the hunter, would take his turn. He waited, crouching, his ocher tunic

Sharing gossip and millet beer, men of Yenndouma pass market day around the base of a huge silk-cotton tree, local equivalent of the old general store's pot-bellied stove. One seals a bargain with a vendor, left. Dogon women, background, bear the brunt of market-day chores. Traveling merchants make a regular circuit of the cliffs, setting up shop at Yenndouma every fifth day. They hawk wares, buy cloth, and serve as a "bush telegraph," carrying news from village to village.

EKTACHROME © N.G.S.



The living honor the dead during a *dama* ceremony saluting a deceased elder of the village of Idiéli. In this natural amphitheater men enjoy a ringside view of masked dancers and musicians, while the women look on from afar, forbidden to approach. Staged a year or more after the death of the wise man, the three-day ritual ends a

KODACHROME © NATIONAL GEOGRAPHIC SOCIETY

formal period of mourning and commends the dead man's soul to the spirit world of his ancestors. At the foot of the escarpment, mud dwellings and small gardens blend into sandstone scree. An acacia-studded plain stretches beyond. Reduced to semi-desert by drought, searing winds, and overgrazing, it slowly yields to invading dunes.

trailing on the ground. He listened for *danna boy*, the drum rhythm of the hunter, indelibly associated with this dancer in the minds of the Dogon.

When the drums took up the rhythm, the hunter began his slow, loping dance. Head down, he stalked an imaginary victim.

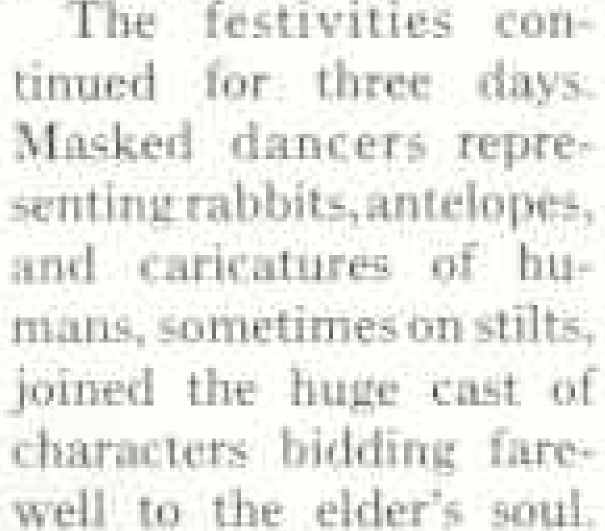
The menacing glances he cast at the audience made me pity the prey (below). I recoiled from the grotesque face, its rough-hewn features gleaming lacquer-black and fringed with a beard of ocher raffia. Triangular eyes gaped beneath the bulging forehead; haphazard ivory pegs crammed the chiseled mouth.

I thought of the warning that Diangouno had given me: "If a woman gets too close to the masks, the spirit of the masks may possess her. She falls sick. She starts to cry, to dance, and to sing the songs of the masks."

The Dogon women, their blue homespun wrap-around skirts festively accented with beads and trade-cloth scarves, watched the ceremony from a safe distance (preceding pages). Only because I was not a Dogon was I permitted to stand at the edge of the arena and to approach the powerful masks.

The festivities continued for three days. Masked dancers representing rabbits, antelopes, and caricatures of humans, sometimes on stilts, joined the huge cast of characters bidding farewell to the elder's soul.

Each man had carefully crafted his own costume from the simple materials available. Each had colored his fiber skirt with dye squeezed from the fruit of the *bala* tree,



Stalking invisible prey, a dancer representing a hunter, or *dannane*, lopes ferociously around an earthen arena during the dama at Idiéli. His frenzied ritual recalls the hunting prowess of Idiéli's deceased wise man.

Before the dance he crouched off to one side in his wooden mask, pretending to hide. Only when the drums beat out the special hunter's rhythm—instantly recognizable to all Dogon—did he stride menacingly into the arena.

Beginning slowly, his dance and the accompanying drums gradually quicken in pace and intensity, climaxing in a feverish moment when the hunter spears his imaginary victim. At the end he drops exhausted to the ground.

EKTACHROME © N.G.S.

an acacia. Buttons, shells, and a few Malian francs adorned the green fiber headdress of a man who, with the help of black wooden falsies, posed as a woman of the neighboring Fulani tribe (below). A white shirt and a folding camp chair identified another dancer as a European.

The dancer of greatest skill and strength wore the *sirige* mask, and he needed both. Carved from a single tree, the sirige mask, 15 feet high, represents a many-storied house.

Cliffs formed the backdrop as the sirige dancer mimed the daily motion of the sun. He knelt, bracing for the tremendous strain, and slowly drew an arc in the sky with the enormous mask. With the sun thus represented, the Dogon cosmos was complete. The soul could be at rest in the spirit world.

Dogon masks, as well as statuettes, rank high among the African sculpture that excited and influenced such painters as Pablo Picasso and Georges Braque early in this century. Dogon quality has suffered in recent years, however, as many carvers have worked increasingly for sales to tourists.

Tobacco Juice Cures a "Broken" Foot

Early on the second day of the dama, I was jumping from rock to rock, trying to keep up with the kanaga dancers as they snaked through Idiéli's narrow lanes to the public square. Suddenly a loose rock gave way beneath my weight and fell back onto my left foot. While two men came to lift it off, images of the tiny foot bones smashed into hundreds

In female dress, a male dancer impersonates a Fulani maiden. Dama dancers portray humans, animals, and mythical figures, each of whom bids farewell to the dead man's soul.

At this dancer's waist hangs an amulet containing verses from the Koran. A Christian religious medal adorns the hooded headdress. Both are tokens of the growing influence of Islam and Christianity among the Dogon. But most villagers cling stubbornly to the beliefs of their forefathers.

Because the Dogon believe the performers' masks possess spirits harmful to women, only those females specially indoctrinated may approach the dancers. The author, as an outsider, won permission to go near.

KODACHROME BY PAMELA JOHNSON MEYER © N.G.S.

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Portents in the sand: Soothsayer Balpa Dolo fathoms the future by studying fox tracks made on a sand drawing, a Dogon divining technique that the author found strangely accurate. Dolo predicted she would return to Dogon country; two months later she was back. Another diviner, Kiré, foretold that she would soon be wed; six months later in New York she became the bride of Alfred Paul Meyer, executive editor of *Natural History* magazine. Kiré also predicted that she would make a third visit to Dogon country—a prophecy she hopes to fulfill.

of still-tinier pieces flashed through my mind.

As the day progressed, the pain grew. By late afternoon it was so intense that Diangouno insisted I see the village "curer."

Domno's house was like the other mud houses of Idiéli. Several women pounded the evening's millet in one corner, and half a dozen chickens pecked out a meal from chaff that had fallen to the dirt floor. Because it was a special occasion, Domno's wife had made millet beer and the courtyard was full of men talking and sharing a gourd of konyo.

Apprehensively, after the endless round of greetings, I took off my shoe and tendered my foot for Domno's inspection.

"Ssppt!" Before I had time to react, Domno had spat on my foot and was carefully rubbing the tobacco-stained saliva across my instep. Scarcely had I recovered from the initial shock when Domno took aim a second time with equal accuracy.

What madness had led me to put myself in the hands of this unsanitary back-country healer in a home-dyed ocher tunic, instead of an M.D. in spotless medical whites? Yet how could I walk two days to the nearest clinic?

Before I could follow my thoughts further, Domno gave my foot a yank, and I shrieked.

Reassuringly, Diangouno translated Domno's diagnosis: "Mademoiselle, your foot is not broken."

"Ssppt!" A third time Domno spat on my foot, turned it over, and casually directed, "Wait a minute before you stand on it."

I stood up, expecting a stab of pain. Miraculously the pain was gone. It seemed incredible, but I was cured. Gratefully, I gave Domno the standard fee of 50 francs—10 cents—and thought of the rates charged by a New York specialist for X-rays and an office visit.

Late next day I started the long walk back to Sanga, stopping to spend the night at Tirelli. I lay awake a long time, gazing at the Southern Cross and at the improbable shapes of the straw-roofed granaries etched against the moonlit sky.

Who knew when I would return to this whimsical land of masked men and fortune-telling foxes? When would I again see my Dogon friends? But that I will return, I am sure. For before leaving Yenndouma, I asked Kiré to consult the fox. And speaking this time through Kiré's stones and shells, the fox once again predicted that I would return to the Cliffs of Bandiagara.

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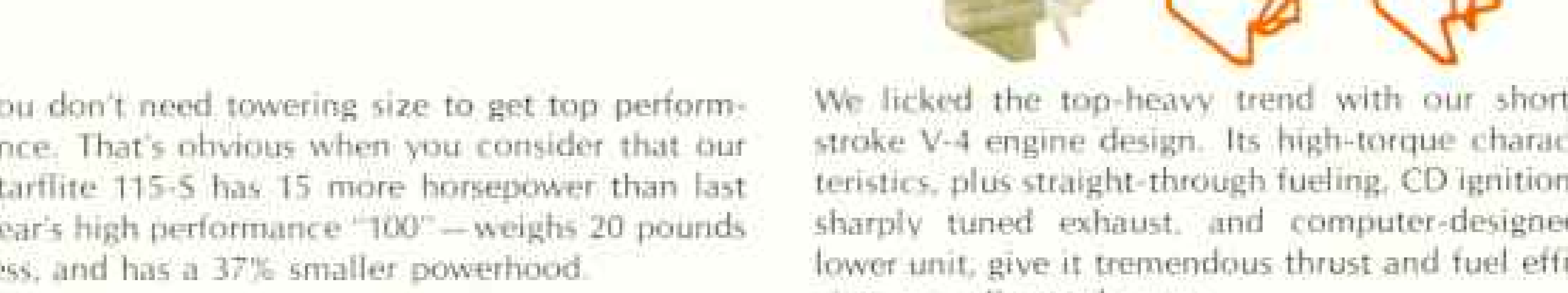

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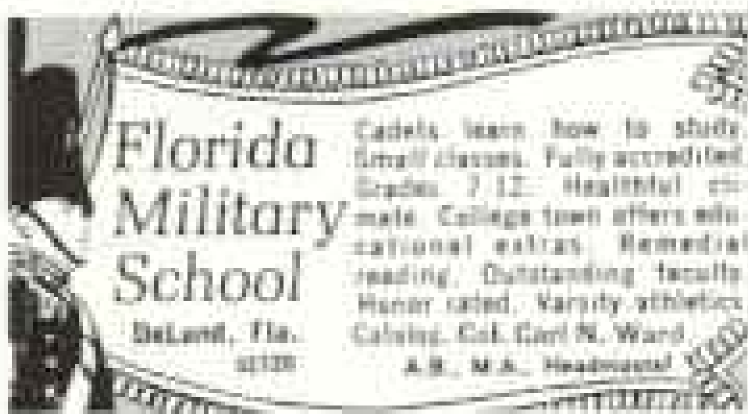

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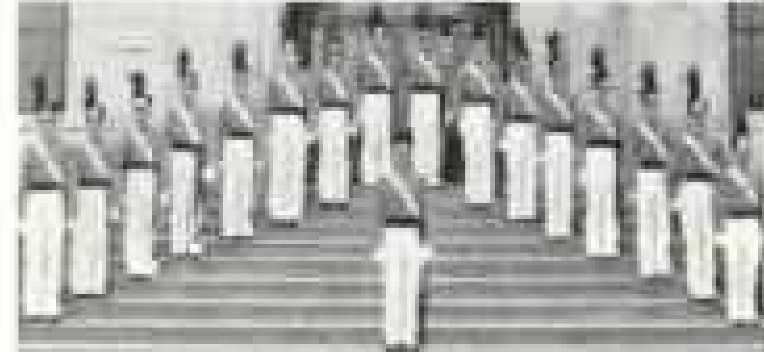

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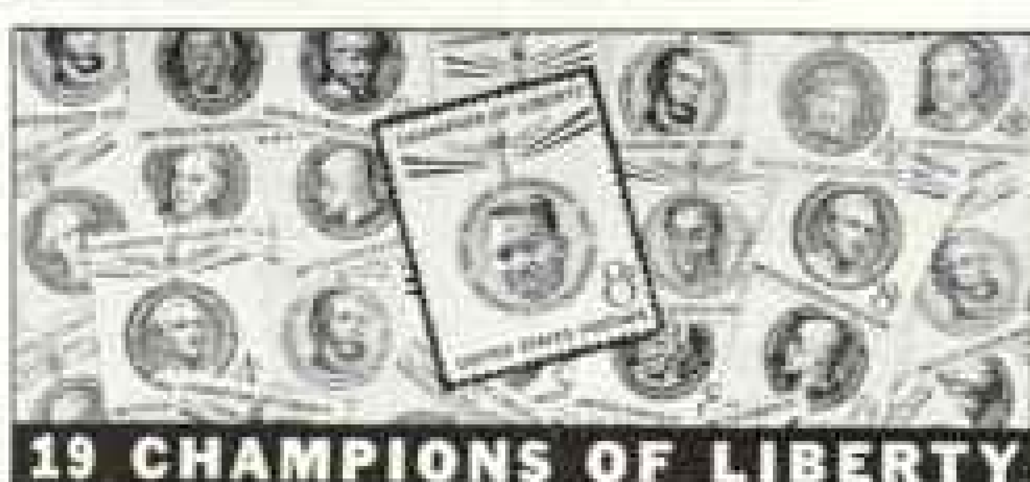

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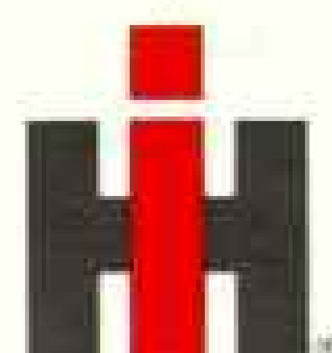

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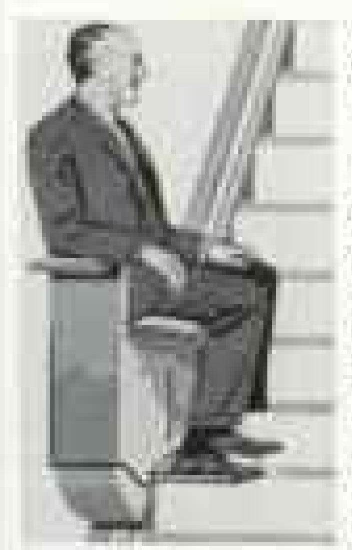

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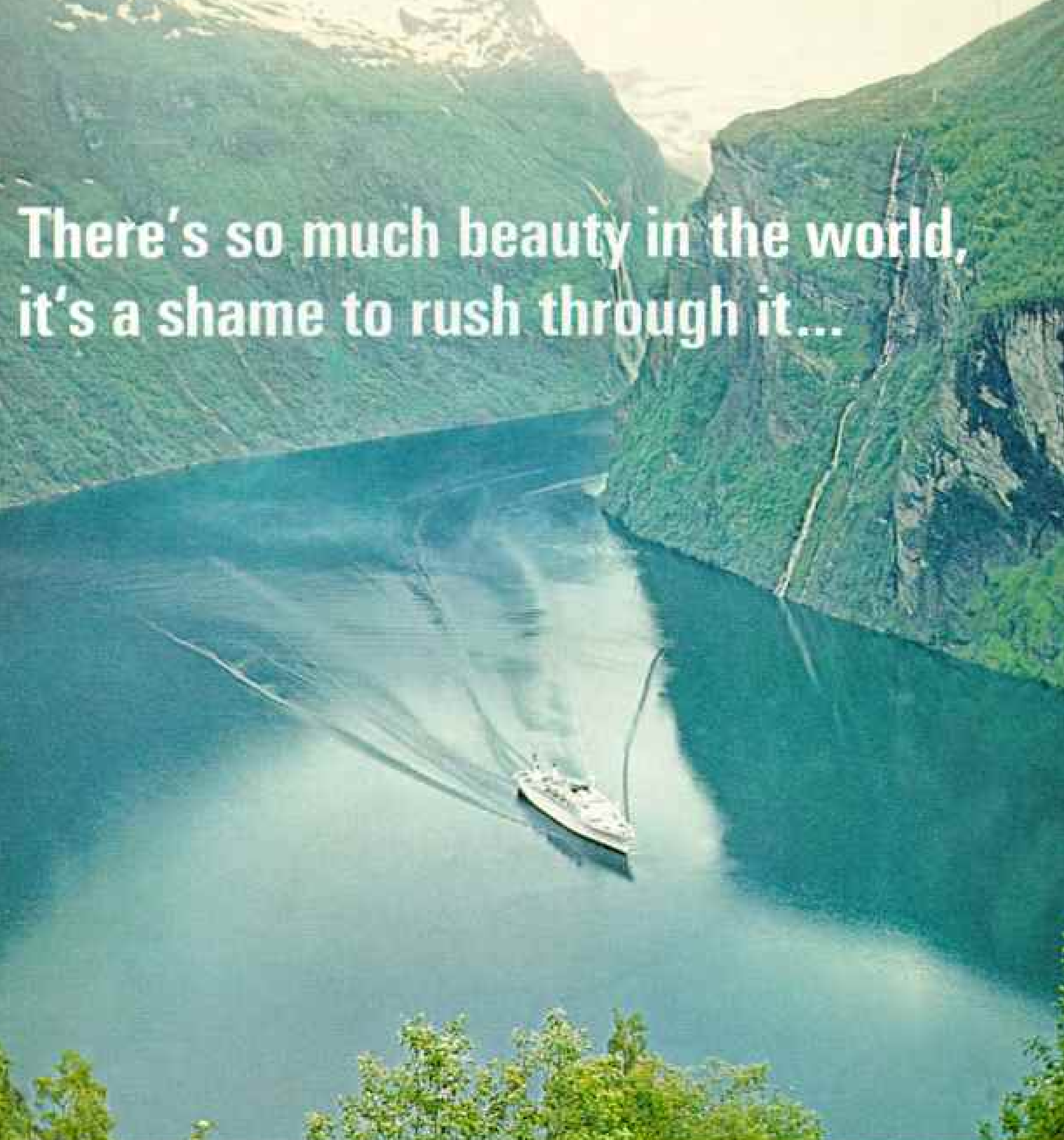

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