VOL. 164, NO. 1 JULY 1983

NATIONAL GEOGRAPHIC

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

WITH APOLOGIES to pioneers like Karl Benz, Gottlieb Daimler, and Henry Ford, no one invented the automobile; it was sent to earth to modify the behavior of the human species. It is a magic chariot that transports us in comfort to whatever horizon we choose. In exchange for which, it controls our lives.

Some who like to think of their home as their castle can spend more for a car than they do for a home. More than 40 million U. S. families have more than one vehicle. More than a million own a motor home. So I suppose their automobile may be their castle. Many sleep in them, eat in them, and some, I'm told, even make love in them, all to the music of a stereo that may cost more than the one in their home.

Many Americans who lack a dining or guest room provide a room for their car. Few walk to a store, even if they shop with food stamps. The corner grocery has had to buy the rest of the block for a parking lot.

To make room for the car and allow its swift passage, we have paved our landscape—at least 20 million acres are covered by roads. The shapes of our cities reflect the needs of the automobile.

Americans who otherwise abhor regimentation willingly carry at all times the national ID card, a driver's license. Try cashing a check without one. And heaven help you if you're caught running a red light without one—even if you're walking!

We submit to this because the alternative is chaos, but there is chaos aplenty just the same. Traffic accidents take twice as many lives as do guns, knives, and all other weapons combined. If a war cost our society the 50,000 lives taken each year by motor vehicles, there would be a general cry to stop the slaughter, but we drive on. In some states those who like to drink and drive can do so without getting out of their car as they wheel into drive-in draft beer and liquor stores.

The expense of maintaining our society on wheels is enormous—almost $70 billion annually for new and used vehicles, more than $35 billion for insurance premiums.

Where will all of this lead? Evangelists claim that the streets of heaven are paved with gold, but nobody's said what kind of automobiles—if any—are using them or whether a driver's license is required.

Wilbur E. Garrett

EDITOR

NATIONAL GEOGRAPHIC

THE NATIONAL GEOGRAPHIC MAGAZINE VOL. 164, NO. 1

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July 1983

COVER: *Phil Nuytten in a WASP suit is winched through Arctic ice, the first man to dive on the nearly intact* Breadalbane. *Photograph by Emory Kristof.*

Exulting in the freedom of wheels, Los Angeles young people indulge in a nighttime

THE AUTOMOBILE AND THE

Swing Low, Sweet

By NOEL GROVE Photographs by BRUCE DALE

ritual: cruising the boulevard.

AMERICAN WAY Chariot!

BOTH NATIONAL GEOGRAPHIC STAFF

KNIGHTS in chromium armor. We never admitted it, but that's how my friends and I saw ourselves in the fifties as we roamed midwestern highways on many a balmy evening.

In muscular, deep-throated steeds we sped from town to town, the wind hurricaning in through open windows and corn rows whipping by like picket fences. As we slowed to cruise an alien main street, there hung in the air an excitement that I long mistook as predatory. Perhaps it was only the movement that we relished.

And all for pennies, by swooping onto the ramp of Sam Slate's two-pump gas station, our blood up like colts in April, taking on fuel for a night of auto adventure: "A buck's worth, Sammy."

Our nation's blood was up as well. The United States was king of the industrial realm, and the automobile was its crown prince. One in every six workers in the labor force could trace an income to four-wheel travel, whether it be for road repair, insurance sales, or the assembly line.

Europe was still down from the war, and the buzz phrase for cheapness was "Made in Japan." America had built an entire economy around a machine that evolved from a functional tool into a garish alter ego. Cars created prosperity through jobs, sales, and the cash flow of innumerable by-products.

Even before the war a billboard had appeared around the country showing a family smiling out of a sedan and a caption that said it all: "There's no way like the American way, world's highest standard of living." Those were the days, weren't they?

In years to come, that idyll would be shaken and the U. S. crown prince nudged from its pinnacle of esteem. A deluge of foreign goods from television sets to automobiles outpriced, and often outperformed, their American counterparts. Confidence in American products took a dive.

In 1977 more American vehicles were recalled for suspected flaws than were built. In 1980 Japan took the world lead in auto production away from the United States, which had held it for 76 years.

The American labor force was characterized as being lazy and irresponsible. Management was faulted for being greedy and unimaginative. In the late seventies and

America's love affair *with the automobile is ardently pursued by collectors, who pay $25,000 and more for restored early Fords. At Bob and Peg's Vintage Tin near Front Royal, Virginia, Bob Grant pulls the engine block out of a 1928*

Model A sport coupe for restoration. After Henry Ford's pace-setting Model T lost ground to Chevrolet, Ford closed his plant for retooling in 1927. The Model A appeared later that year to carry Ford back to the top.

early eighties business executives, economists, and scholars journeyed to the Orient to see how goods were . . . made in Japan.

I began a year of studying the automotive world with a number of preconceptions shared, I believe, by many Americans:

The U. S. auto industry has been left in the dust of foreign competition; the automobile as we know it is doomed by dwindling fuel supplies; the American love affair with the automobile is dead. All contain elements of truth; all are misleading.

American automakers, grown fat by past successes and tripped up by oil prices and a lingering recession, lost an edge. They now struggle to regain ground lost to aggressive competitors.

Fuels will change, but the end of cars is not even in sight. Other fuels are waiting in the wings for the day when burning gasoline is no longer practical.

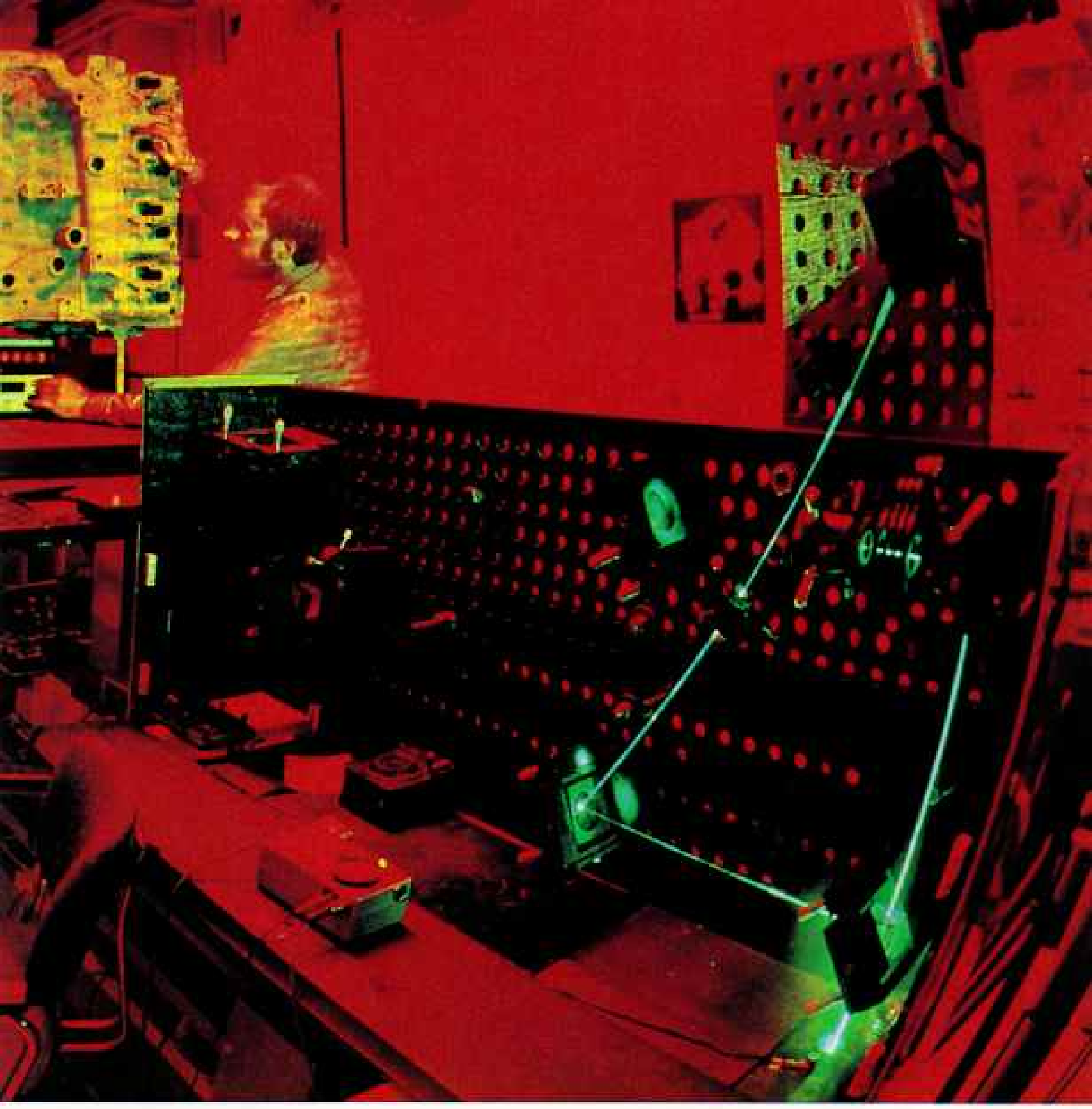
We appear to have lost a love affair with the automobile only because it has become a marriage. Now familiar with and dependent upon this mechanical mate, we have taken it for granted and become impatient with its shortcomings. One thing appears certain: The honeymoon is over.

WE *BEGAN* as the underdog. Karl Benz had been manufacturing automobiles in Germany for nearly a decade before the first successful American "motor wagon" rolled out of a shop in Springfield, Massachusetts, in 1895. Interesting though they were, the horseless buckboards of tinkerers like Frank and Charles Duryea were not taken very seriously. In Saginaw, Michigan, at one time the speed limit was eight miles an hour for cars and ten miles for bicycles. In other cities laws required that a motorist's approach be announced by a lantern, bell, or horn.

Latecomers though they were, American cars stood up well. The Duryea beat two Benzes in an early American race—55 miles from Chicago to Evanston, Illinois, and back. In 1908 one of the longest races in history was won by an American-made Thomas Flyer over a German Protos. The Flyer completed 13,341 miles (not including ocean crossings) from New York to Paris via Siberia in just under five months.

"There was excitement, energy, and a

Working out the bugs *before production, technicians at Daimler-Benz in Stuttgart, West Germany, troubleshoot with lasers (**above**). Emanating from a laser cannon at right, a beam is reflected onto a vibrating engine block. Stress registers as an H pattern on a video screen and as wavy lines on a monitor—tools in improving design to reduce noise and wear. Smoke streams over a Mercedes (**right**) in a wind-tunnel test for aerodynamic drag. Details as small as door handles can affect fuel consumption.*



Born-again mogul *of Detroit, Lee Iacocca* ***(above)*** *stands as the most visible champion of the American auto industry. Iacocca rose to the presidency of Ford Motor Company after conceiving the enormously successful Mustang, then was suddenly fired by chairman Henry Ford II in 1978. That year Iacocca was named president of a badly foundering Chrysler Corporation and became chairman in 1979. He got a quick fix from 1.2 billion dollars in federal loan guarantees, then closed 13 of 47 plants and slashed employment. In elaborately staged television commercials* ***(left)****, celebrities such as Frank Sinatra, Ricardo Montalban, and Iacocca himself pitch Chrysler's new fuel-efficient models. Rebounding from a 1.7-billion-dollar deficit in 1979, Chrysler posted a profit of 170 million dollars in 1982.*

sense of daring unmatched by the development of other industries, such as railroads and textiles," I was told by John Rae, considered the dean of auto historians. "Anyone with a certain mechanical aptitude who could get suppliers to furnish him with materials on credit could make a start in the automobile industry.

"Europe's interest in making cars was more as a toy for the rich or for sport. In the United States there grew an urge to make cars that everybody could own."

The father of that urge became the greatest folk figure in automotive history. Henry Ford has been variously credited with inventing the car, inventing the assembly line, and inventing standardized parts—all of which preceded him. What he really perfected was economy of scale—turning out a product so efficiently, quickly, and therefore so abundantly that the price could be held down. It was a practice relearned in Japan more than half a century later.

When introduced in 1908, the Model T touring car sold for $850. Most similar cars then cost $2,000 to $3,000, and the average factory worker made less than $500 a year.

With the bright architects and engineers he had gathered around him, Ford studied every inch of the assembly line, trimming industrial fat where needed. Production tripled, and by 1915 half a million Model T's were being built annually. The price fell to $290 before the last rolled off the assembly line in 1927.

Other giants emerged. Henry Leland, founder of Cadillac and later Lincoln, was an early prophet of precision parts, stating: "Even though you make thousands, the first and the last should be precisely alike."

The industry's mechanical genius was Charles F. Kettering, who brought women into motoring by introducing the self-starter in 1912. Industrial savior Walter P. Chrysler snatched one company after another back from financial disaster before building

a car and company that bore his name.

A believer in corporate immensity, William C. Durant gathered several companies together to form General Motors. He lost control of it not once but twice, but the giant he created remains the largest manufacturing corporation in the world.

Since the dawn of the auto age, some 2,000 companies have conjured nearly 5,000 makes of cars in the United States. Long gone are the Zip, the Buzmobile, the O-We-Go, and the 1914 Hazard.

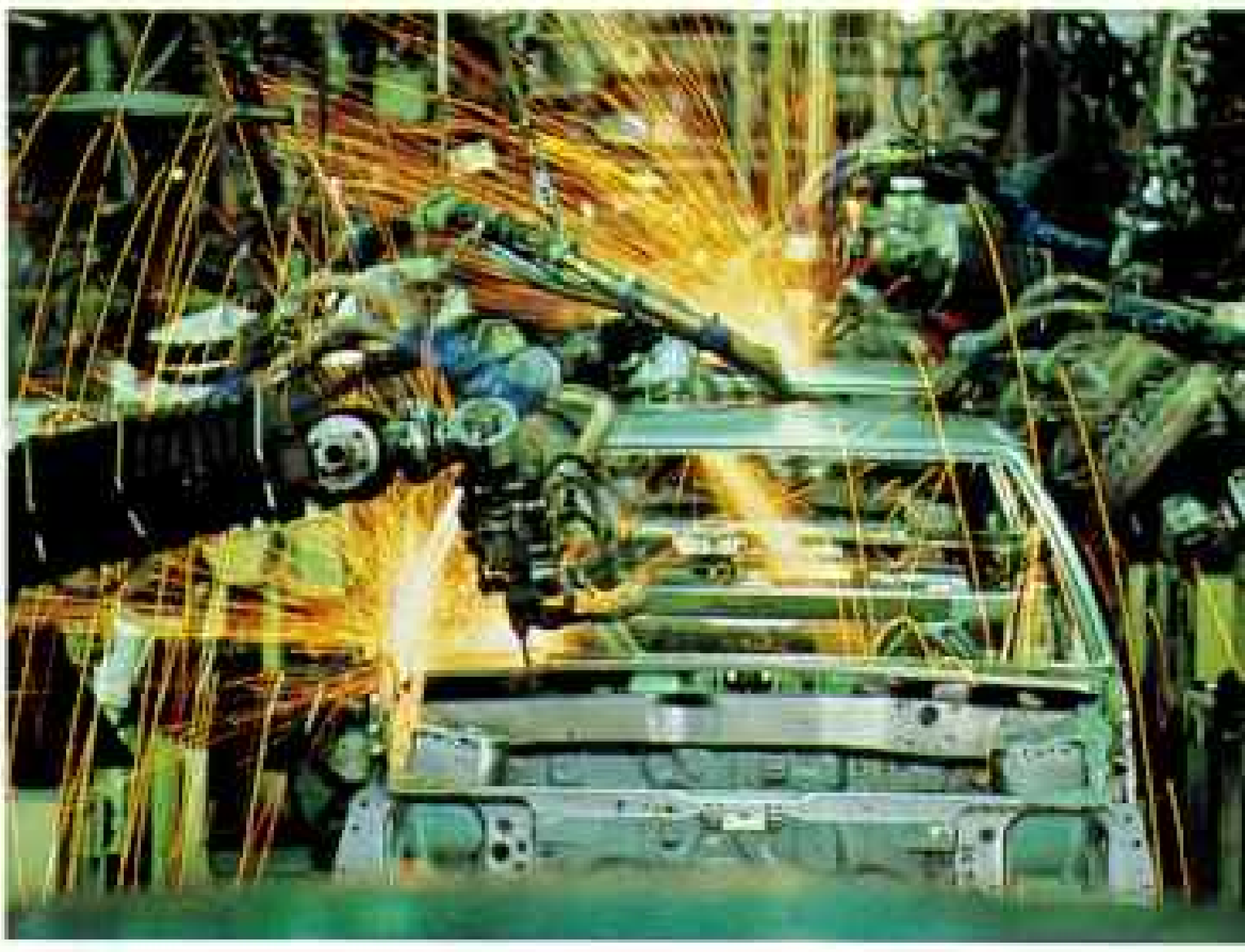
Few more than a dozen cars continue to be produced in volume by the big three—General Motors, Ford, and Chrysler—plus the smaller American Motors. Their models have grown powerful, quiet, comfortable, and complicated. But unlike powered flight, which boasts advancements that include different power plants, automatic pilot, and tenfold increases in speed, the theory of auto operation has changed little over three-quarters of a century.

"The basic technology was set in the 19th century," auto restorer Tom Batchelor told me in Reno, Nevada. We were surrounded by nearly a thousand vintage American-made cars in showroom condition at Harrah's Automobile Collection.

Most car engines still run on the four-stroke design developed by Nikolas Otto in 1876, Batchelor explained. Manual-shift transmissions are still changed by engaging different-size gears on a shaft.

Refinements? The 1903 Thomas had a tilt steering wheel. The turbocharger was being used as early as 1911.

In half a day at Harrah's I rode through nearly half a century of motoring history. Batchelor first rolled out a green 1904 Knox with a two-cylinder air-cooled engine and a boatlike tiller that steered like Columbus's *Niña*. A 1911 Pope-Hartford followed, with such luxuries as a steering wheel and the relative smoothness of four cylinders. A plain black 1915 Dodge reflected, like the Model



Slow-paced precision *is a matter of pride at Rolls-Royce Motors, which spurns most mass-production techniques in favor of hands-on craftsmanship, turning out 3,000 cars a year. A specialist* ***(left)*** *checks the fit of a quarter panel for a Phantom VI at the firm's London plant, where a made-to-order Rolls can take as long as six months. During the same period, Nissan's giant Zama plant near Tokyo turns out 230,000 Sentras and Silvia/Gazelles with the help of robot welders* ***(above)****. Only 3 percent of the work force at the body-assembly shop is human.*

T, the low-priced move to practicality. But a 1925 Franklin roadster, fire-engine red with a rearing lion on the hood, drew admiring glances on Reno streets. By the quarter-century mark motorists wanted fun along with convenience.

I purred out of Harrah's gate in a 1933 Chevrolet, a car that nudged Ford out of dominance in the low-priced field. Last page in my moving history book was a 1940 Packard. A modern car with hydraulic brakes and factory-installed air conditioning, it marked a high point before World War II stopped production.

FROM HORSELESS CARRIAGES to habitat control the United States soon emerged as the primary automobile culture of the world. Americans burst into song over the car. "In My Merry Oldsmobile" was the most enduring, but the romantic themes in all of them seemed to signal a new freedom between the sexes: "Tumble in a Rumble Seat," "Six-Cylinder Love," and "Fifteen Kisses on a Gallon of Gas."

The auto was welcomed as cleaner, cheaper, and safer than horses by such luminaries as Thomas Edison, who prophesied, "the danger to life will be much reduced."

The Wizard was seldom more wrong. If today's highways were combat zones, the casualty reports would topple governments. Instead, cars nurture governments with tax money as well as contributing to the general prosperity. In 1978, a good sales year, America's four major carmakers paid 2.8 billion dollars in taxes; in 1980 their losses earned them credits of 1.8 billion, a 4.6-billion-dollar drain on the national treasury.

As early as 1928 the American market was considered saturated. A used-car market began cutting into new-car sales. To fight it, automakers began introducing fresh models every year, a practice that came to be known as "planned obsolescence." Car stylists began to hold more clout than engineers.

Eventually even flashy chrome and fins could not cover up the realities of poor workmanship. Writer Jerry Flint summarizes what he calls the end of "the golden age of the auto" in his book *The Dream Machine:* "Nineteen-hundred-sixty-five was the peak, and the cars—even the country—seemed to go downhill from then. The engines got bigger, not better, the paint became wilder, and the knobs fell off the dash."

Then came the explosion of oil prices by the Organization of Petroleum Exporting Countries (OPEC) in 1973, and the auto game changed—drastically. United States buyers began demanding more fuel-efficient cars, and most came from outside the U. S. As gas lines eased, buyers drifted back to large American cars, then were hit by the "second oil crunch." A revolution in Iran cut that supply of oil, bringing back gas lines and a second wave of small-car buying. The seesaw of car size confused and angered nearly everyone.

The government called the car industry shortsighted, and the industry blamed government for long holding down oil prices. Auto management blamed the unions for rising wages, and the unions accused Japan of unfair labor practices. Buyers blamed them all and increasingly bought imports.

30 percent of new-car sales by early 1983.

"In a sense, everybody was right and everybody was wrong," said Professor Robert Cole, former director of Japanese Studies at the University of Michigan. "When Americans wanted large cars and only Americans made them, it made perfect sense for unions to ask for higher wages and management to grant them. The truth became apparent through hindsight, but really after the '73 oil shock everybody should have seen the handwriting on the wall."

Americans had access to small cars many times. Les Lindvig of Phoenix, Arizona, led me through a collection rejected by most U. S. buyers: the Henry J, the Nash Metropolitan and Rambler, and the Crosley Hotshot, a snappy pint-size sports car that got 40 miles per gallon in the late 1940s.

We paused by a roadster introduced in 1930 that was smaller than the Volkswagen Beetle—the American Austin.

"It was heralded as the practical car of the future, but cartoonists made it the butt of jokes," Lindvig said. He picked up an auto history book: "Look, here's one showing an Austin stuck to a wad of chewing gum. We were a big country with lots of open space. Americans went for big cars."

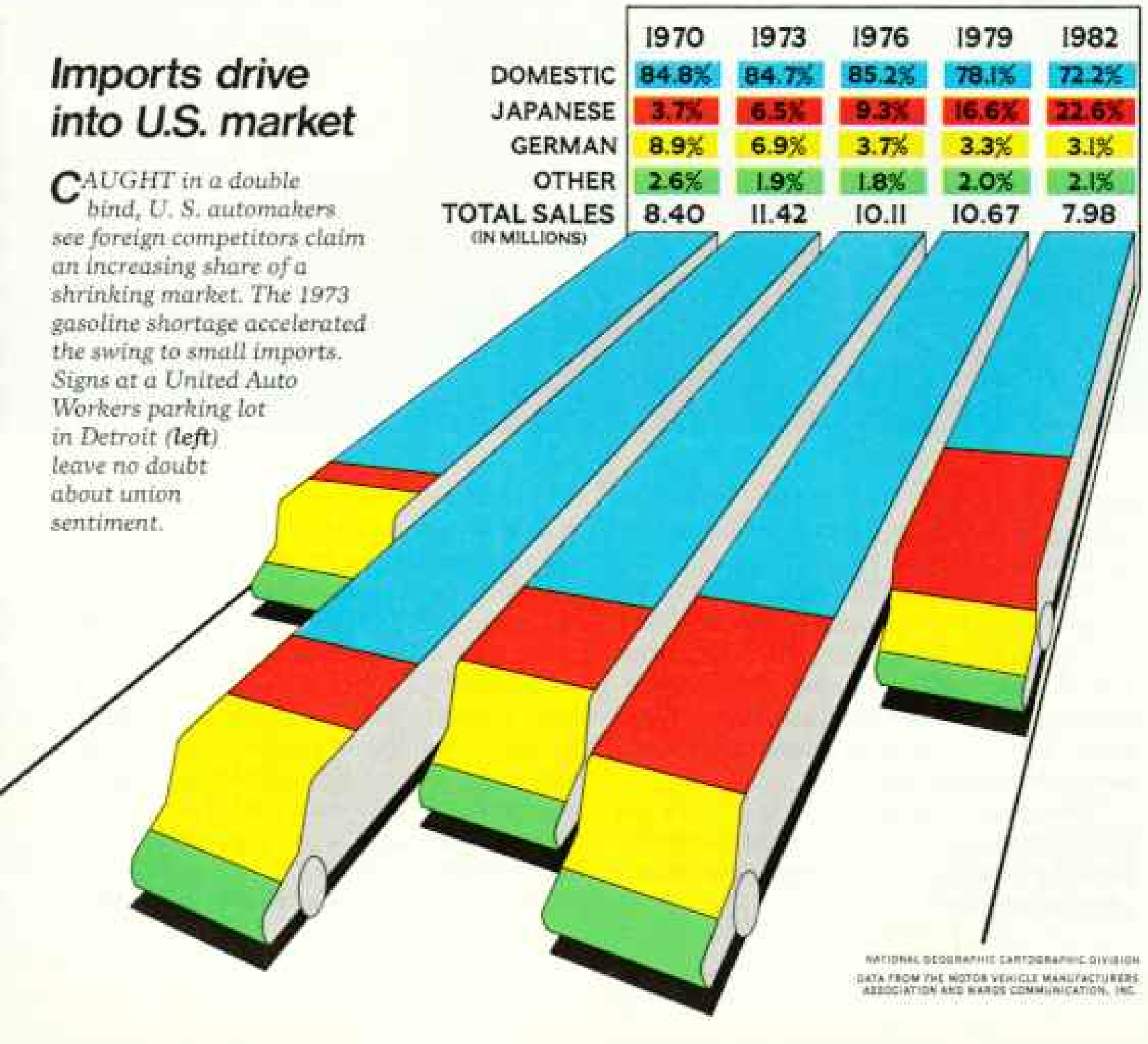
When the fuel squeeze helped change drivers' minds, the small cars were being built elsewhere. Twenty-two percent of U. S. sales are now Japanese cars, which are both well built and inexpensive. I went to Japan to find out how they do it.

AMERICANS HAVE long believed that they invented the "fast pace of living." I had to stretch my legs to keep up with the small, wiry 27-year-old striding briskly through a Tokyo rail station as we headed for a bullet train that would shoot us closer to Toyota headquarters.

The pace of the line workers equaled that of my guide. Nobody strolls in a Japanese

Imports drive into U.S. market

*CAUGHT in a double bind, U. S. automakers see foreign competitors claim an increasing share of a shrinking market. The 1973 gasoline shortage accelerated the swing to small imports. Signs at a United Auto Workers parking lot in Detroit (**left**) leave no doubt about union sentiment.*



NATIONAL GEOGRAPHIC CARTOGRAPHIC DIVISION

DATA FROM THE MOTOR VEHICLE MANUFACTURERS ASSOCIATION AND WARDS COMMUNICATION, INC.

plant. The physical movement, brisk but not frantic, reminds one of the hustle seen in an election headquarters.

"Every new employee begins with two to seven weeks of classroom instruction about the company," I was told by my Japanese host as I followed him through one of the assembly plants. "They learn its history, rules, goals, and an outline of relations between labor and management.

"Classroom instruction in a variety of jobs is followed by work on the assembly line—by everyone—to better understand car construction."

Suggestions are one way for an employee to gain attention, and in Japanese companies they appear in a steady deluge. It is not unusual for a plant to receive an average of one suggestion per employee per week, totaling tens of thousands a year. In Toyota headquarters I asked to see the results of such brainstorming. A giggling secretary brought a handful of pencils sharpened at both ends, and a serious-faced spokesman explained: "A clerk suggested that we glue or staple two short ones together back to back to extend their use."

The extended life of pencils is only a tiny

Period piece *on wheels, an 1898 Benz Velo gets red-carpet treatment* ***(above)*** *in the California home of a classic-car collector, who counts 17 vintage autos in his collection. Like-minded enthusiasts tool along in a 1900 English Mechanic* ***(left)*** *during the annual London to Brighton Run. The rally commemorates the abolishment in 1896 of a law requiring that a pedestrian waving a red flag precede each motor vehicle by 60 yards to warn of its approach.*

link in the chain of frugality that helps hold down the cost of Japanese cars. In a Nissan plant days later a line foreman told me of a suggestion by a door fitter that saved him two steps in the assembly line.

"Japanese productivity is the essence of simplicity," I was told later by Maryann Keller, Wall Street auto analyst for Paine Webber. "They use fewer people in less space than either Americans or Europeans. It's not how many modern robots they have; it's the smooth flow that they create."

THE JAPANESE COST advantage has spawned a host of scapegoats. Americans argue that the Japanese currency is seriously undervalued in international markets. If a Japanese car costing one and a half million yen is exported when one dollar equals 260 yen, the price of the car when it lands in Los Angeles would be $5,769. But if one dollar equaled 230 yen, they say, the price would be $6,522. The other side of the up-valued coin is that raw materials imported to make Japanese cars would then be cheaper, still holding the cost down.

Another key argument is that the Japanese government removes domestic taxes from cars exported to the United States. True. But when cars are sold here a sales tax is added, increasing the price.

The relatively low compensation of Japanese auto workers (an average of $7.66 per hour compared with $18.60 in the U. S.) has brought cries of unfair labor practices from the United States. If victimized, the Japanese are most content. Subsidized housing, free surgery, and recreational services at low or no cost help woo workers into a lifetime marriage with corporations. The cost of these benefits is borne by the Japanese firms. And some benefits have less to do with money than humanity.

"We have art clubs, basketball clubs, singing groups—something for every interest," said my host at Toyota, Yasuo Sasaki. Plus no firings—"except for just cause"—and no long strikes in more than 30 years.

In Japan's corporate unions, each auto company deals only with labor representatives elected from that company's ranks.

"Management doesn't mind divulging plans and finances to the union when they know they are dealing with their own people," said Ichiro Shioji, head of the parent Japan Automobile Workers' Unions.

Violent strikes and sabotage scarred Japan in the forties and fifties, he went on to explain. But when labor and management began talking about the mutual benefits of higher productivity, they declared industrial peace.

Japan's famous *kanban*, or "just in time" system, eliminates costly warehousing by the delivery of car components minutes before they are installed.

"The parts are checked for defects at the supplier's plant, not ours," a manager told me. "They know if they are late they risk losing business.

"Everyone is responsible for building in quality at each stage of production," he added. A mistake goes on the records of the employee finding it and the one who made it.

"We urge everyone to constantly think of the consumer," said Hideo Sugiura, chairman of the board of Honda. A public relations statement or an industrial philosophy? A steadily increasing number of American car buyers have cast their vote.

Concern for consumers, quality control, production efficiency—a visitor from outer space might think the Japanese invented the industrial revolution. Yet the highest award for excellence a Japanese company can receive is a silver medal called the Deming prize, which bears the profile of an American. Dr. W. Edwards Deming was already a well-established industrial specialist in 1950 when he assisted in the reconstruction of Japanese industry.

"I told them to build products of quality and stand behind them," the 82-year-old consultant remembered in the basement office of his home in Washington, D. C. "I told them they could develop worldwide markets and be prosperous. They didn't believe me at first, but they went to work improving the production line and quality."

The Japanese exceeded their own expectations, and the teacher became a near deity in their eyes, the Moses who led them out of economic wilderness. The visage on the medal turned to me with fire in his eyes when I asked if American businesses were on the right path to industrial resurgence.

"Does it look as if they are?" he barked.

"Here the emphasis is on showing a profit in the quarterly report to stockholders. If they fall behind, how do they try to improve their balance sheets? They raise prices, reduce research and maintenance, and close plants—what a good way to go out of business!"

AFTER I VISITED auto plants both in Japan and Europe, my first impressions of those in Detroit were not encouraging. At an engine plant I saw a worker saunter toward his station at the end of a conveyor, where the first of several backed-up engine blocks had already fallen several feet to the concrete floor. Never quickening his pace, he picked up the block and sent it on down the line.

In another plant I asked a production engineer if they used any statistical controls to assure quality.

"You mean the Deming method?" he said. "We used that more than 20 years ago, but we stopped. Why? People would buy the cars anyway."

"The accountants took over the business and told the real car people to keep their costs down," said a white-maned patriarch and second-generation automaker. Semon E. "Bunkie" Knudsen, son of former General Motors president William Knudsen, had been vice president of General Motors, president of Ford, and chairman of White Motors until his semiretirement in 1980.

"Cost considerations kept styles mediocre, and they concentrated on mileage and forgot about the guy who wants to pull a boat or have some performance," he said.

A car fancier and still a car tinkerer, his genial face tightened and his eyes flashed anger: "They say the American love affair with the automobile is over. Hell, they didn't give us anything to love!"

The flame still flickers. Auto buffs still clog auto shows and parade their wares on

CHARLES O'REAR

The auto as art *reaches glittering heights in Robert Magana's 1950 Buick, which sports mohair upholstery and brass spoke wheels. With 15 coats of new paint accented by gold-leaf pin stripes, it was judged the best paint job on a fifties car at the Five Star Productions Auto Show in San Jose, California.*

"**To attain beauty** *while respecting function is my aim," says Italy's Giorgetto Giugiaro (***above,** *at left), one of the world's most highly regarded auto designers. Over the past two decades, more than 50 models conceived by Giugiaro's Turin-based Ital Design have gone into production, from sleek, speedy Maseratis and Alfa Romeos to more practical Fiats and Volkswagen Rabbits. Even more have been designed in secret for companies the world over.*

*Near Turin scores of prototypes designed by the firm of Pininfarina are carefully preserved (***right***). Since World War II, Italian designers have built a reputation as the most astute purveyors of fashion in the automobile world.*

broad boulevards. The passion is usually lavished on the cars of the past—revamped jalopies of the twenties and thirties; dream coupes of the fifties that are simonized to a wet glow; "muscle" cars from the sixties and early seventies, jacked up in back and moving stiffly like bristling Dobermans.

If the nation is a car culture, California is its shrine. I joined Jeff Smith, a writer for the Los Angeles-based *Car Craft* magazine, for a cruise one evening in nearby Orange.

A cruise is a pilgrimage of sorts, where the faithful show their devotion in a parade of heavy metal. Here a born-again may be a 1922 Model T resurrected with a small-block Chevy engine, high-rise manifold, Oldsmobile differential, and a dashboard of polished mahogany.

A car went by trailing a shower of sparks. "That's a lowrider, its suspension so chopped that it literally drags on the pavement," explained Jeff. Highriders are usually Broncos or Blazers, jacked up to a height you could squat and walk under.

"Then you have your subcategories such as military vehicles, like that World War II ambulance in camouflage paint. . . ."

MATTHEW NEAL MCKAY (ABOVE AND BELOW)

IF *NOSTALGIA* inspires most California car love, Europeans shower attention on the fine-tuned cars of today. Any nation with few speed limits on its autobahns appears to be extolling the joys of auto operation. In West Germany I pushed my rented car to 160 kilometers per hour (100 miles per hour) on a long straight stretch and then felt it rock with the backwash of air from a passing Mercedes.

At the Frankfurt International Motor Show I joined crowds pressing close to slippery Maseratis, wedge-fronted Lotuses, sleek BMW coupes, and yard-high Lamborghinis seemingly flown in from another planet. We greased them with our fingerprints, sat at their controls in a gluttony of daydreams. The Aston Martin and Rolls-Royce displayers held us back with velvet ropes, as if from royalty.

Rare is the driver who views a car as a simple tool of transportation.

"We once designed a no-frills, inexpensive vehicle that we thought would be popular in developing nations," said Norm Krandall, a former Ford executive. "We

Dependence *may breed vengeance in a nation hooked on cars. Patrons at Colorado's Mountain Community Fair donated to the Muscular Dystrophy Foundation by taking out their aggression on a 1962 Chevrolet at 25 cents a whack* ***(right)****. Hit-and-run driving is all in the game at the World Championship Demolition Derby in Islip, New York* ***(left)****. Though knocked out of the running, truck driver Mike Bushaw* ***(below)*** *got his money's worth. "When you have to miss cars by inches all day, it's fun to go out and knock the hell out of something."*

couldn't sell it. Apparently when people are ready to move from a bicycle or oxcart to four wheels, they want a vehicle that makes a statement about their success."

Science now helps buyers make that statement. At Volkswagen headquarters in Wolfsburg, West Germany, computers not only aid car designers, they even pass judgment on them.

In VW's design laboratory I watched a technician use an electronic pen to draw a profile of an automobile on a display screen. Touching the pen to a critical point on the sleek hood, he then keyed in a request for verification. Was the design feasible?

Vehicle strength and space requirements had been preprogrammed in the computer. The lines on the proposed hood rearranged themselves slightly as the computer seemed to say, "It may be a cute car, but it leaves no room for the engine we're using."

At Stuttgart, Daimler-Benz engineers showed me how stresses and vibration can be detected by shooting laser beams at an engine block from two angles.

How does auto fuel burn? At General Motors' massive technical center, a 330-acre research campus for some 6,000 scientists, designers, and technicians, I saw lasers probing a flame. "Each kind of molecule in the fire gives the laser beam a different light frequency," explained research physicist James Bechtel. "So by sorting out the frequencies on a spectrometer, we can tell what molecules are being burned, which ones are already burned, how hot they are, and what remains. When you know this, you can control emissions better."

At Chrysler Proving Grounds west of Ann Arbor I climbed in a car with test driver and mechanic Mark Leidner, who drives alone for hours on the same closed loop of road. Following a list of printed instructions, we began a torture trip to nowhere. Through a corrosion trough of salt water, across two miles of gravel. Brake suddenly, honk the horn, roll the window down and up. A series of dips called the frame twister made the car creak and groan. Bumps simulating railroad ties drummed beneath us at 35 miles an hour. Over and over and over.

"We had a driver once who loved it so much he skipped his breaks," said 32-year-old Leidner. "In one year his mileage added

Life in the slow lane *is where it's at for the lowriders. With the street their showroom, aficionados of the largely Mexican-American cult promenade in low-slung, lavishly customized cars.*

CHARLES O'REAR

*Since riding too low risks a brush with the law, some install battery-powered hydraulic lifts, enabling the car to jump to legal height at the push of a button. At a San Jose, California, auto show, drivers compete to see whose car can hop the highest (**above**). With the coast clear, another driver (**below**) sends sparks flying from scrape plates attached to the undercarriage.*

FROM MAY 1937 ESQUIRE MAGAZINE; COURTESY LIBRARY OF CONGRESS

Selling an image *as much as a car, an ad for the trend-setting Cord* ***(above)*** *pursued the luxury market with unabashed snob appeal. Introduced in 1929, it popularized front-wheel drive in America. Later models were sleek packages of innovations. Designer Gordon Buehrig placed the differential in front of the engine, giving the Cord its distinctive long hood, often flanked by external supercharger pipes. His electric power shift predated the automatic transmissions of Buicks, Oldsmobiles, and Chryslers. In the Cord, Buehrig also pioneered hidden headlamps and uni-body construction with no running boards. A 1937 Cord Custom Beverly restored in White Post, Virginia* ***(right)****, won best-of-class honors in its first two classic-car shows.*

up to driving around the world more than three times."

In its lifetime—normally a decade—the average U. S. car goes even farther. How much torque can a steering connection endure? How many potholes add up to a snapped coil spring? Car components are twisted, bounced, and hammered repeatedly to test their limits. At Ford's Reliability Center I saw instructions for an incessantly shifting transmission lever. In two days it had shifted 122,116 times and was scheduled for 200,000 at varying temperatures.

There are carburetor laboratories, refrigerator rooms to test cold starts, and anechoic chambers with foam walls to pick up Noise Vibration Harshness. Why, one wonders, does anything ever go wrong?

The answer lies not in the testing but in the construction. I found neither Europeans nor Japanese gloating over Detroit's problems with car quality.

"Can Americans learn from you about making cars," I asked Katsuji Kawamata, silver-haired chairman of Nissan.

"No," he answered quickly. "They know it all. They've had problems—costs, quality, car size—but they will spend much money and correct their mistakes."

"Look how quickly they downsized—an unbelievable job of redesign," said a German auto executive. "Much more than the Japanese we fear the Americans, who have the resources to accomplish much if they put their minds to it."

With some 70 billion dollars going into plant reconstruction and automation and new products, more money is being spent to

put Americans back in U. S. cars than was spent to put an American on the moon.

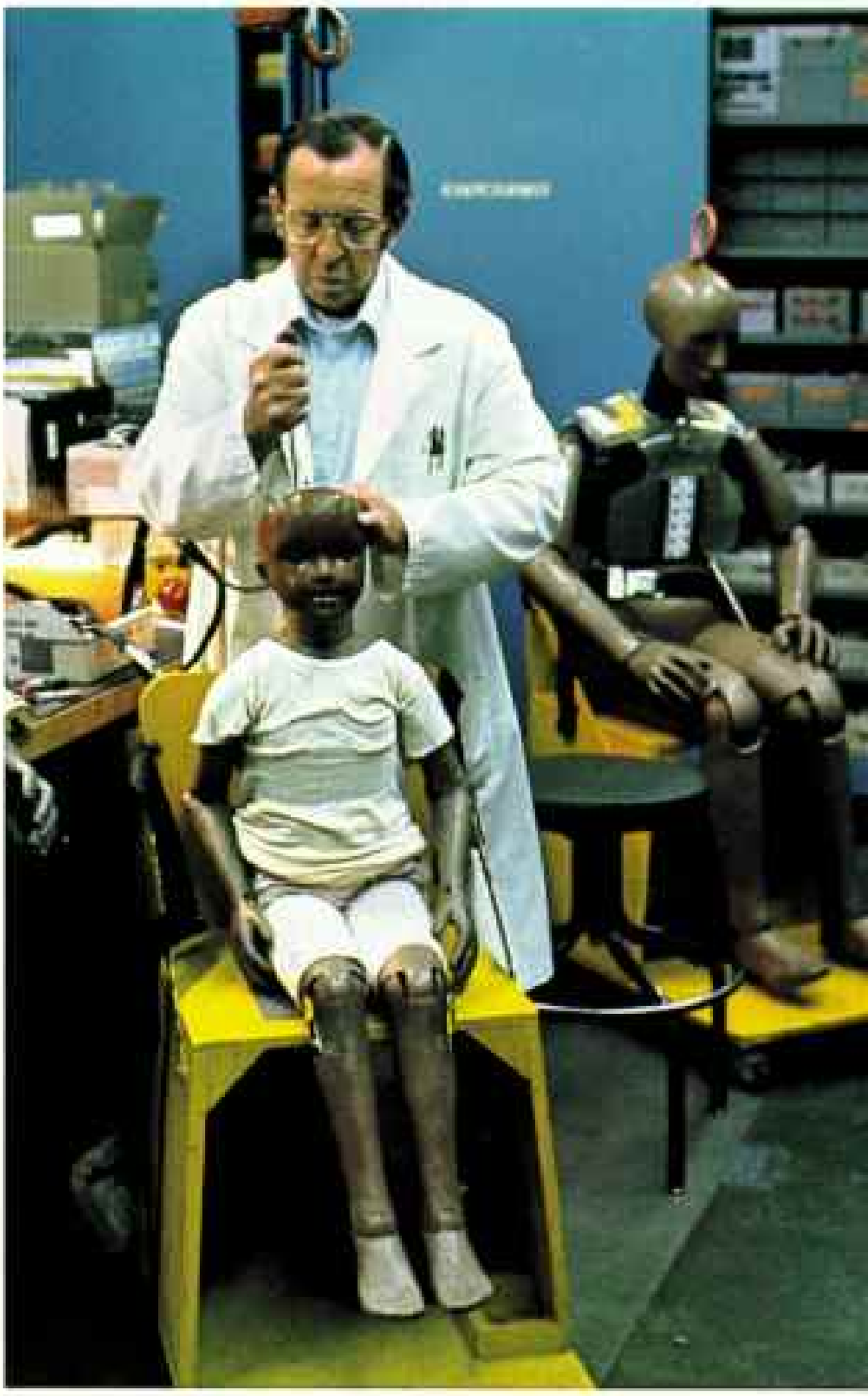
"This is a fight for survival," said Paul Guy, a Ford engineering and systems director. "I've been here 25 years and have never seen such dedication."

"Improvements in quality are taking place," says professor Robert Cole, "but the Japanese are not standing still."

CARS NOW STAND on the threshold of a new era, and excitement accompanies the sense of change. Imports seem to have an edge on quality, but most new American cars are superior to yesterday's machines.

"Maybe they won't outdrag the old muscle cars," said *Car and Driver* technical editor Csaba Csere. "But they ride more

***Shock troops** in the campaign for safety, dummies sit as surrogates for live passengers in tests for vehicle crashworthiness. Working on a child-size model at General Motors Proving Grounds (**below**), an engineer fine-tunes the sensing mechanisms that will determine the location and severity of injury. Technicians at Dynamic Science, Incorporated, in Phoenix (**below left**) pull a "victim" from a Mercedes-Benz crumpled from impact with a steel-and-concrete barrier. Despite safety measures such as padded dashboards and seat belts, auto accidents claim 50,000 lives in the United States each year.*



smoothly, use less fuel, last longer, handle better, and require less maintenance than those of 15 to 20 years ago."

And they are comparatively cheaper, I learned with reverse sticker shock. The average price of $9,500 represents only 38 percent of the annual U. S. median income, compared with 50 percent in 1960. (Small consolation, of course, to an auto worker with no job at all.)

Low marks *for workmanship: An inspector for a Yokohama importer flags an ill-fitting door and misaligned trim on an American car. The Japanese claim corrections are necessary for quality-conscious buyers; U. S. exporters accuse the Japanese of creating trade barriers.*

The biggest advance in cars is also one of the smallest—in size. Seldom seen by the average driver, almost never understood, microprocessors in on-board computers regulate car operations and warn of malfunctions.

Microprocessors monitoring the exhaust systems read the amount of oxygen and mix needed amounts of air with the fuel. In one day I drove from 280 feet below sea level in Death Valley to 9,000 feet on California's Mammoth Mountain in a turbocharged Audi Quattro, with no change in power.

Now available are cars that talk and alas, weak metal, even lie. Test-driving a voiced vehicle, I meekly obeyed synthesized commands to "Please fasten your seat belt" and "A door is ajar." But when it intoned "Your fuel is low," I shot a glance at the gauge and snarled "Wrong!" with a strange sense of satisfaction.

"Probably a bubble in the gas line," explained an embarrassed engineer.

Such a snarled reply to a car might elicit an argument from it in future years. Ford has developed a system by which voice commands will turn on car lights, raise the antenna, start the windshield wipers, or activate other electrical systems.

Trip computers have appeared within the past half decade, yielding information about gas consumption, average speed, and estimated time of arrival. Carmakers have even developed navigational aids using the same devices that guide ships on the seas—satellites and loran radio signals. If you don't mind the expense, you need never get lost again. But maps are still much cheaper, and even automakers feel that electronics can be overdone.

CHANGING ECONOMIES are forcing re-examination of the power plant itself.

"Four years ago Congress told us we built gas guzzlers, and it was true," said volatile Chrysler chairman Lee Iacocca between puffs on his cigar. "So Chrysler went to smaller engines. And we're now almost 100 percent front-wheel drive. The only reason we still have one rear-wheel drive, which is our worst gas guzzler, is that it is also our hottest seller.

"Once it appeared that everyone would

buy little boxes that got 50 miles per gallon; now we can't give them away. Someday, though, there will be another OPEC shock and gas prices will go up, and we'd better be ready with good, efficient transportation."

Some in the industry are already looking beyond the next price rise to the gradual depletion of oil supplies.

"The research is done," I was told by Thomas J. Feaheny, vice president for vehicle research at Ford. "The only obstacles are economic. We could run automobiles on methanol now, but it takes years to build the plants to produce the fuel."

West Germany is taking a serious look at alternate fuels. I flew to Berlin, where 600 cars running on a variety of them are being closely monitored. Most are powered by M-15 (15 percent methanol, 85 percent gasoline). A smaller group runs on 100 percent methanol. A number of electric cars are also being watched, and 20 cars powered by hydrogen fuel are to join the test before it ends in 1984.

"The M-15 fuel requires fewer engine adjustments and brings fewer changes in performance," said Rainer Paulsen, engineer with a transport research association. "But the M-100 holds more promise because of its greater substitution for petroleum. Of course it also requires more sophisticated changes in the motor.

"The Federal Republic now produces about a million tons of methanol a year," said Herr Paulsen. "A coal-gasification project now under construction could raise that to eight million tons, enough to run only 3 percent of our 25 million vehicles."

The verdict on the electric cars was a familiar one—limited range. There were no results available on the hydrogen cars still being built. As a fuel, hydrogen is virtually inexhaustible, and it burns without polluting. Extracting it from natural gas, coal, or even plain water, however, remains too expensive to make it competitive with more available fuels, and it is difficult to handle.

Also in the distance are radical new engines. I rode in a car with a whistle under the hood—General Motors' turbine engine fueled by coal dust. This plentiful mineral could free us from OPEC but would dirty the air unless cleaned of impurities. And all turbine engines await the low-cost ceramics that can dependably withstand temperatures of 2350°F.

Another promise for breaking America's costly gasoline habit may be shown by an engine invented in the 1940s by an oil company. The Texaco Controlled-Combustion System (TCCS) injects fuel directly past the spark plug and into a cyclonic whirl in the center of the rising piston.

"The fuel burns continuously and completely," said project manager William Tierney, who has worked on the engine for nearly 40 years. "That means octane ratings are unnecessary. We can burn many fuels."

Part of every barrel of crude oil that yields gasoline must be burned in the refining process. Using other fuels for TCCS engines could cut process-fuel needs by about half.

Gasoline, heating oil, diesel, alcohol—the TCCS will run on any of them. The United Parcel Service will soon be road testing 500 TCCS-powered vehicles and eventually expects to cut fleet-wide fuel consumption by 15 million gallons a year.

CHANGES in the conventional engines are on the horizon. An Indiana firm is developing a diesel that eliminates the conventional cooling system, making more efficient use of wasted exhaust energy. Superlubricants such as graphite could improve engine efficiency as much as 5 percent.

Two Arizona inventors have designed a valve with a double screen that could help engines run cleaner, cooler, and more economically. The device vaporizes gasoline and forces it to mix more thoroughly with air, allowing a more complete burn. Even with low-octane gasoline, it reduces emissions and improves performance.

Performance. The word emerged in nearly every car conversation. Often it means quickness more than headlong speed, and it spells danger if unadvisedly unleashed. But it cannot be denied that from the first hiccuping horseless carriages to the screaming blur of Formula One racing cars, the thrill of exceeding human limits in movement has been a seductive brew.

At Elkhart Lake, Wisconsin, I met a part-time sports-car racer who caught the speed bug late. P. L. Newman had never competed in an automobile until the age of 47. In 11

Serpentine symbol *of the auto's preeminence, the four-level interchange of the Santa Monica Freeway (**left**, top level) and the crossing Harbor Freeway in Los Angeles handles more than 400,000 vehicles a day. With budget limitations curtailing expansion of California's 15-billion-dollar freeway system, state transportation officials seek to smooth traffic flow with on-ramp signals, signs that flash warnings of disruptions ahead, and in-pavement sensors that give highway patrolmen early notice of stoppages due to accidents.*

*Downtown Detroit appears through the windshield and on the dashboard (**above**) of a 1982 Buick equipped with a prototype General Motors navigation system. Using radio guidance signals, the system's computer indicates the driver's location on street grids projected by reprogrammable cartridges. GM plans to link the device to satellites and offer it as an option on top-line models within the decade.*

years of racing since then he has won two national amateur driving championships and narrowly missed winning a third.

"Acting wasn't very competitive for me any more," said Newman, who has also starred in 32 films. "Now the passion for racing seems to feed into my acting as well."

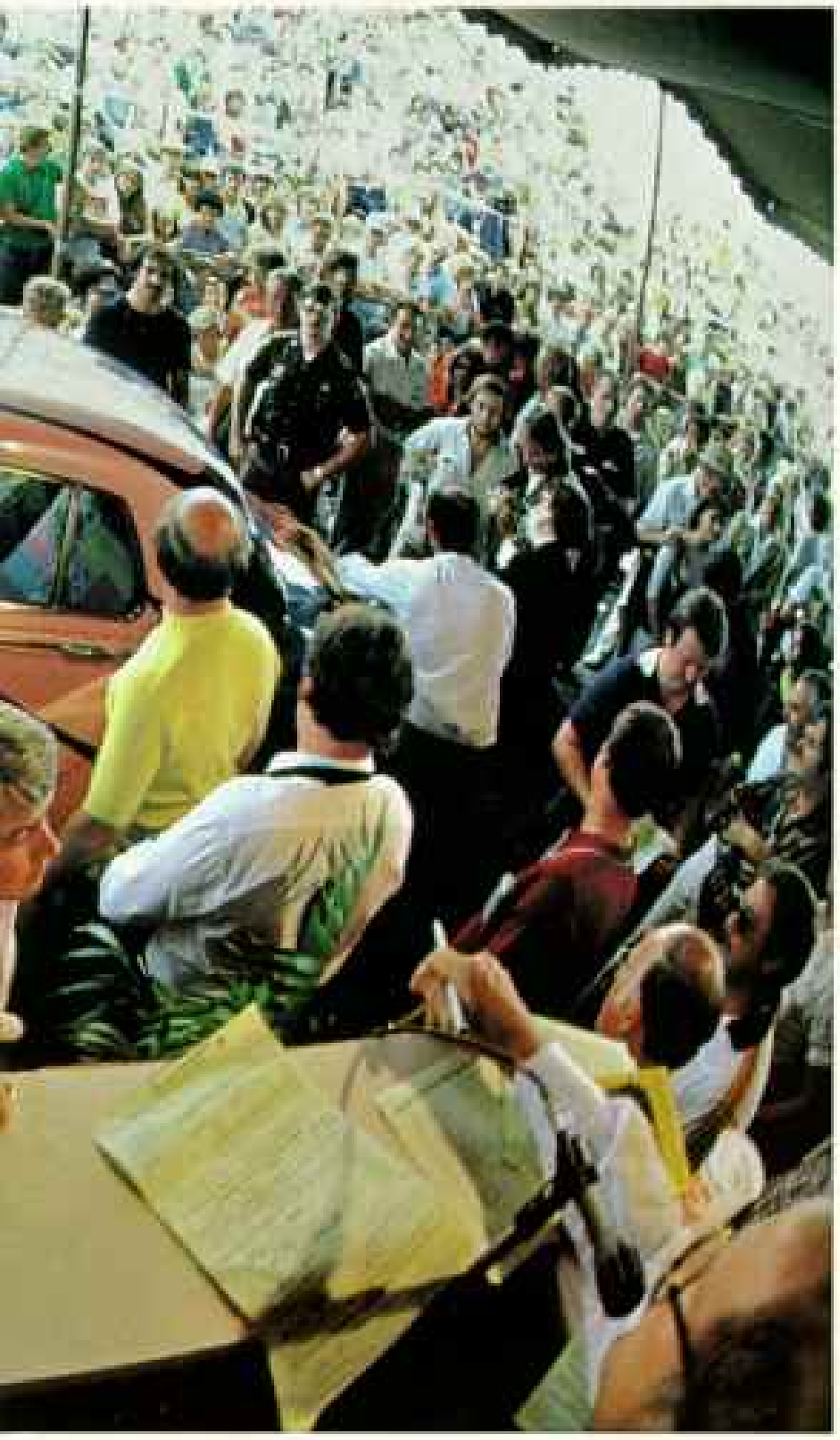
A flat tire knocked him out of the running that weekend, but an evening's drive to a go-kart track demonstrated to me that when the racing bug bites, it bites hard. As we waited for a turn at the sputtering toys, the famous cobalt eyes studied each vehicle as it passed. "Number five is a zinger," he murmured.

Our turn came, and Paul Newman, who had muscled a 400-horsepower Datsun 280ZX that day, sprinted gleefully to his pick of half-horsepower machines.

North of San Francisco at Sears Point I took a four-day course in road racing to learn what it was all about. Instructors at the Bob Bondurant school taught me to look for the proper apex of a curve, how to shift the weight of a car to avoid sliding, and how to control a spin if I failed in both of the above.

We began with sedans, moved to sports cars, and then I was strapped painfully tight and nearly reclining into the seat of a Formula Ford, an open-wheeled race car. At velocities exceeding 100 miles an hour the 2.5-mile circuitous track streamed under me in a loose, unraveling ribbon, and corners blew at me like a shotgun blast. What racing is all about, I learned, is total concentration. What it causes is an exhilaration and addiction borne by the wine of speed.

Is another heady brew coursing through American veins at more reasonable speeds?



Psychedelic shades *radiate from the hood of a 1956 Bentley used by the late John Lennon. Las Vegas doctor Lonnie Hammargren paid $325,000 at an auction in Auburn, Indiana, for the former Beatle's car, establishing a world record at the time.*

After years of stagnation, something is happening in this country's automotive community. Detroit is responding to the import challenge with sportier models of its own. Through such indicators as customer surveys and declining warranty claims on new cars, American companies see improvements in quality ranging as high as 59 percent. An upturn in the economy, creating capital to make even more improvements in automation and plant design, say the automakers, will make them more competitive.

Can they do it?

In a study prepared by a blue-ribbon panel of business executives, labor leaders, economists, and scholars, three scenarios for the future of the auto industry were proposed. Two had the U. S. continuing to slip in international markets. A third foresaw the possibility of this country becoming once more a hotbed of invention and change, creating and exploiting markets by "out-innovating" others.

But the days of high, easy profits are gone, and the cars themselves will be cut increasingly from an international fabric.

An engine designed in Germany and built in Brazil powers a Buick. Electrical components made in Taiwan end up in Fords. And GM transmissions are used by Isuzu.

Partnerships and ownerships are creating an automotive United Nations. Ford owns a chunk of Toyo Kogyo (Mazda), General Motors owns parts of both Isuzu and Suzuki and has signed a car-building agreement with Toyota. Chrysler is in partnership with Mitsubishi and Peugeot, and American Motors is part of a dizzying corporate tangle. In 1980 the Renault company—owned 93 percent by the French government and 7 percent by the workers—bought 46 percent of AMC. Renault also owns 10 percent of Volvo Car in Sweden and 20 percent of Mack Trucks in America.

Predictions are common that before the turn of the century, world car-making companies will number ten or less. Cooperation and efficiency are the keys to survival.

Management executives now visit with union officials in the labor headquarters called Solidarity House in Detroit, where they once dared not trespass. Ford has quality-control groups and regular forums for employees to participate in planning. At the new Cadillac engine plant in Livonia, Michigan, organized for more worker involvement, "business teams" of employees meet to discuss progress. I attended the weekly session of the camshaft group in the shade of a mulberry tree near the plant parking lot. Discussions included leaks in the cam bearings (and how to stop them), a report on work-improvement programs, and plans for a party.

***Last rites** for a gas guzzler: Soaring fuel prices inspired Los Angeles artist Dustin Shuler to impale a 1959 Cadillac with a 20-foot spike. Cut into 59 signed pieces, each with a photograph, the work became slices of Americana—and pointed reminders of the passing of an age of carefree consumption.*

"I've been with GM 15 years and worked lots of other lines," team member Ed Bentley told me after the meeting. "Always treated like a peon, the bottom of the heap. When the line broke down, everybody wanted to go home. Here they bust their butts to keep it moving."

In a meeting with plant manager Bob Stramy and a local union representative, I turned over a scratch pad I had been scribbling on and saw figures and columns. Had I been writing on someone's tally sheet?

"No, those are made of wastepaper supplied by the clerical team to save money," said Stramy. "Why throw them away when you can use the backs?"

A vision of the two-ended Japanese pencils danced in my head.

"The number of plants in the nation like the one at Livonia is still small, but it is growing," I was told later by Irv Bluestone, a retired vice president of the United Auto Workers.

"The industry will revive; but with increased automation and robotics, many of the workers laid off will never return," said historian John Rae.

Meanwhile, talk of productivity and a changing work ethic is not limited to the nation's automakers.

"The auto industry is the leader in changing attitudes because it goes down fast in a recession and its problems have been more visible than other industries," said Wall Street's Maryann Keller. "Each of the 19 companies I study is engaged in a battle to improve efficiency. As a financial analyst I look at them and say, 'Finally, they're getting their acts together!' "

Cars and Americans have come a long way from hand cranks, easy profits, and industrial dominance. This nation rolled to prosperity and a national togetherness on the wheels of the automobile. Could it be the car that drives us back again? □

— October — 23, 1980

By BRYAN HODGSON
NATIONAL GEOGRAPHIC SENIOR STAFF

Photographs by
FARRELL GREHAN

WALES
THE LYRIC LAND

Country of bards and saints, where castles such as Conwy anchor the present to a past haunted by the myth of Camelot, the nation of Wales lives in spirit, if not in fact.

THE GRAY WELSH WIND has howled me down from the Hunting Grounds of the Hounds of the King of Hell. Now I rest in a raking rain beneath the Cliff of Gloomy Caves. Below, the stream called Milk Brook flourishes foam white down a secret gorge, cherishing the legend of a gentle saint who once transformed its waters so that a careless milkmaid could refill her toppled pail.

I'm wet and weary, and well content with a day spent wandering on the stormy eastern ramparts of Snowdonia National Park. Celtic legends live in the swirling mist, and there is poetry in the names of things.

Meysydd Hela cŵn Brenin Annwn . . . Ogof Ddu . . . Llaethnant. . . . The Welsh words seem an incantation to the past, pleasantly romantic in a land that has a way of upsetting romantic expectations.

Wales. The name summons visions of coal miners singing homeward from the pits; of Druid-drowsy woods and brooding castles, rivers quaint with coracles, seacoasts fraught with fishermen and saints. Here is the land of bards, the last bright jewel of King Arthur's crown, fiercely guarding the ancient language of Britain, yearning still for freedom from Anglo-Saxon tyranny.

Well, yes and no.

Coal miners sing a muted song nowadays. Only 33 of 214 collieries are active in the famed industrial valleys of the south, kept alive despite losses of more than 175 million dollars last year to preserve 22,800 jobs. Meanwhile, the giant British Steel Corporation imports cheaper coal from Australia and the United States as part of an economy campaign that has eliminated more than 20,000 steel and tinplate jobs since mid-1979. A worldwide recession has helped push total unemployment to 17 percent.

But today a tide of economic aid rolls up the Rhondda and Rhymney Valleys and crests at Ebbw Vale, repaying in part the wealth that once flowed down on a torrent of Welsh sweat. Gone are the monstrous and deadly slag heaps, and in their place rise small modern factories designed to liberate Wales from its chronic dependence on mining and molten metal. Cardiff seethes with bureaucrats and businessmen, lured by the government's 600-million-dollar annual investment in commerce and industry.

"We've only one coal miner left," says Glynne Jones, director of the Rhondda Valley's famed Pendyrus Male Choir. "It's factory hands and office workers now. But they can still sing. We've not been a wealthy people. For generations the only instrument we could afford was the voice."

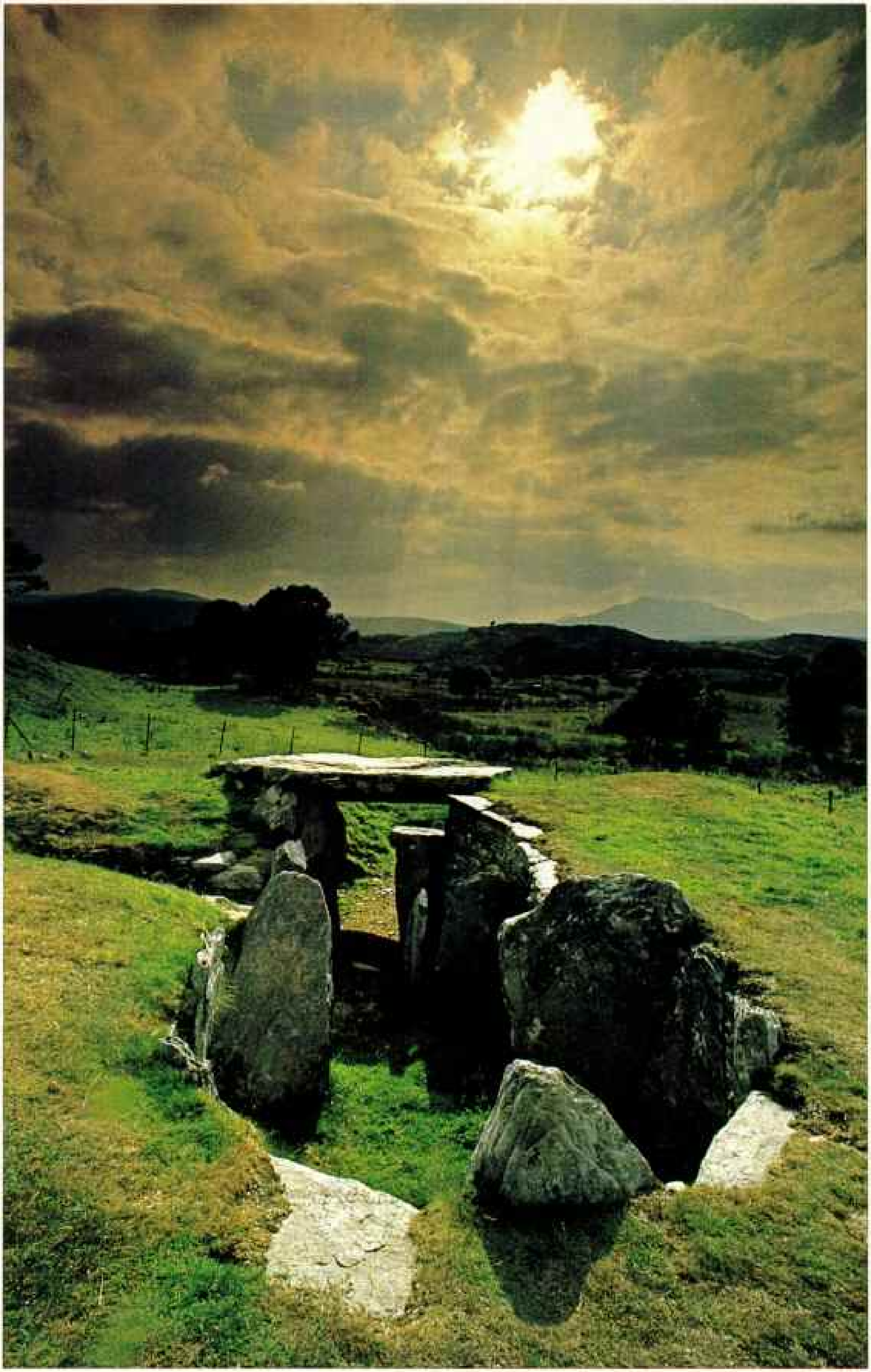
The voice of Wales speaks mostly English now. Fewer than 20 percent of the country's 2.8 million citizens can speak Welsh, that eloquent offspring of the Celtic language spoken at King Arthur's legendary court. For years, ardent Welsh nationalists have battled to restore its health by fostering its use in schools and government offices.

In 1979, after voters crushed a referendum to establish a Welsh assembly with limited home-rule powers, extremist groups in the country began a widespread campaign of arson against English-owned vacation homes. The nationalists redoubled their efforts to win government support for a Welsh-language television channel. Sabotage of transmission towers added a whiff of fear to what was largely a war of words. Helped by a tax on Britain's commercial television network, the new channel was inaugurated in 1982 with 22 prime-time hours a week broadcast in Welsh, one-third of its programming.

"We have three years to prove that Welsh TV can succeed," said Gwynfor Evans, a nationalist leader who threatened a hunger strike to the death to win the broadcast facility. "But they wouldn't dare revoke it now."

Politics aside, English-speaking travelers are forced to learn some basic Welsh, since night-riding activists deface English road signs with that mighty modern instrument,

Enigmas from prehistory, *Capel Garmon near Betws-y-Coed and scores of other stone burial chambers enrich the Welsh landscape. Experts believe they were erected by a dark-haired people from the continent of Europe, the Stone and Bronze Age ancestors of the Welsh. The present language stems from later Iron Age Celts—European migrants to Britain several centuries before Christ.*



the paint spray can. It helps to know that Caerdydd is Cardiff, Yr Wyddfa is Snowdon massif, and *cyfleusterau* means public conveniences. English Bastards Out is unequivocal, appearing on signs saying *Croeso i Gymru*, which means Welcome to Wales.

The welcome is real. It's also big business. Last year an estimated 12 million visitors spent more than 800 million dollars, creating some 80,000 vital jobs.

Tourists have also created a sort of instant Wales, strewn with graceless trailer parks, where summertime traffic clogs spectacular mountain passes and spills through tourist-tawdry towns whose castles—most of them symbols of English conquest—seem like sugar lumps of history for visitors who like their lessons short and sweet.

There's another Wales, a patient, river-running land, whose lofty silences are better found on foot or in the private seasons of the year. It is a land where patriots and scholars strive to link the future to the past.

Wynford Vaughan-Thomas is a better guide than most. A well-known television commentator, he is also an authority on

High romance *of the Druids comes alive in a festive dance at Swansea, last year's site for the Royal National Eisteddfod* ***(above)****. The costumes and rituals are products of modern imagination, since the ancient Celtic priesthood left no records. Highlight of the week's events is the "Chairing of the Bard," honoring a native-language poet. Welsh identity, symbolized by the dragon on a national flag in Cardiff* ***(left)****, is tied to the Welsh language, long a fertile medium for poets and singers.*

Welsh history and poetry and literary executor for Dylan Thomas, his boyhood friend. Not long ago he celebrated his 70th birthday with a 242-mile, nine-day walk from Port Talbot to Penmaenmawr.

"The center of Wales is almost unknown, except by old shepherds and farmers. It's a marvelous wilderness, lonely and wild and boggy, the secret of the Welsh soul if you like," he says. "Much of our poetry springs from love of nature. Our greatest medieval poet, Dafydd ap Gwilym, was a lyric genius in Chaucer's time. He wrote in a complex

WALES

THE WELSH derive their name from the Anglo-Saxon *Wallas*, for "foreign." More apt is the native name, *Cymru*, for "the land of fellow countrymen"—since their Celtic forebears had already endured three centuries of Roman rule before the Anglo-Saxons overran England in the fifth century A.D. The Welsh resisted them from mountain strongholds, but fared less well under the armor-clad Normans, who in the 12th century began to erect the many stone castles that became the centers of Welsh towns. Paradoxically, it was the ascension of a Welshman, Henry Tudor, to the English throne that led in 1536 to the Act of Union, bonding Wales to England.

GOVERNMENT: Principality of Great Britain. **AREA:** 8,018 sq mi (20,767 sq km). **POPULATION:** 2,791,900. **MAJOR CITIES:** Cardiff, capital, 281,300; Swansea, 188,500; Newport, 134,200. **LANGUAGE:** English; Welsh spoken by 19.5%. **ECONOMY:** Trend toward small manufacturing; traditional mining and coal-related industries now challenged by agriculture and tourism.

system called *cynghanedd*, which requires precise ordering of consonants, alliteration, internal rhyme, assonance at special places. It's disciplined music. Add thought and emotion, and it can be terrifyingly powerful. Translation loses much of the effect, but even so the feeling comes through, like this:

Gracing the tide-warmth, this seagull,
The snow-semblanced, moon-matcher,
The sun-shard and sea-gauntlet
Floating, the immaculate loveliness.

"Dafydd was something of a ladies' man as well. I rather like this one:

The gentle girl with the golden hair,
Golden is the burden that you carry on
your head.
White is your body, and slim,
And you shine with it. What a gift!

"Some of the world's greatest poetic utterances are found in Welsh. Our problem is that the average man can only take that on trust. For most people, I suppose, Dylan Thomas has become a symbol of Wales. His poetry was not by any means the wild outpourings of the drink, but was based on what he knew of bardic discipline. He spoke no Welsh, but I think his marvelous gift with language came from growing up in the atmosphere of Welsh eloquence. He wrote for the *voice*. Listen to his records—'And death shall have no dominion'—with the voice rising, rising. That harks back to the imagined chants of the bards, a rhythmic spellbinding called the *hwyl*. The old Methodist preachers were masters of it and could move whole chapels to ecstasy.

"Dylan didn't drink so much at home, you know. He wouldn't have written anything otherwise. It was in London, in New York, that he did his act—the wild bohemian boy. They clamored for the legend, and Dylan obliged."

The legend's creator—and victim—lies beneath a simple wooden cross (page 57) on the graveyard hill at Laugharne, where his last home was the Boat House, a cottage overlooking the estuary of the River Taf. He died an alcoholic in New York City on November 9, 1953, suffering an "insult to the brain." He was 39.

In Laugharne there's gossip still about his turbulent marriage, and residents aren't always amused if visitors see resemblances to Llareggub, the fictional setting of *Under Milk Wood*, his bawdy and brilliant comedy of Welsh manners. The name loses something of its charm when spelled the other way round.

The Boat House is a shrine now, admission 75 pence. On the shore below, there lies (or did when I wandered there) a rusty tin rocking horse, its rider vanished like the poet who once in childhood saw

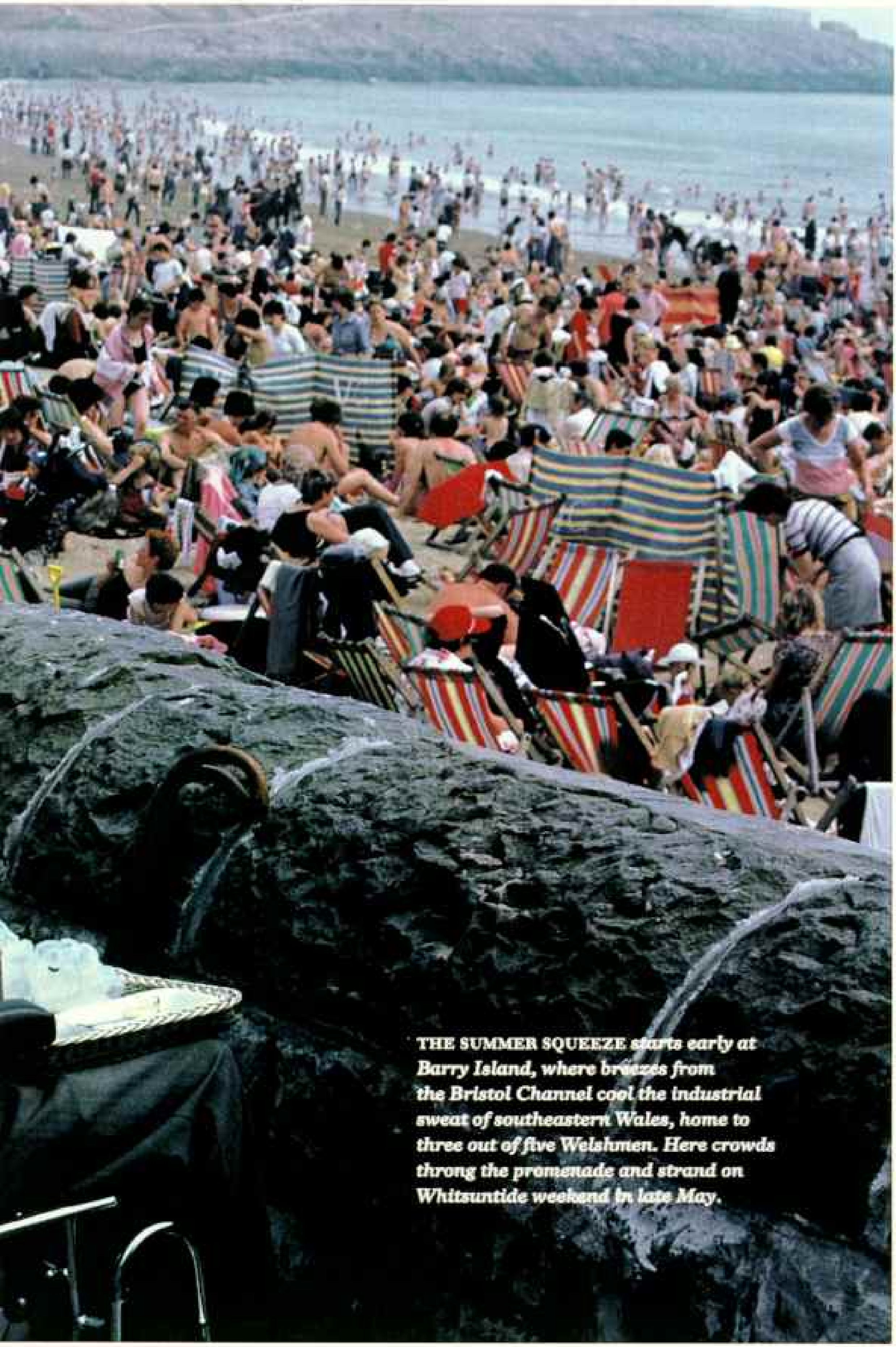
. . . spellbound horses walking warm
Out of the whinnying green stable
On to the fields of praise.

Dylan Thomas was born in Swansea, an "ugly, lovely town" that he immortalized in "A Child's Christmas in Wales" and other stories as a world of uncles and overcoats, smoky streets and brown pubs, dervish snowstorms and pusillanimous cats, of boyhood ending and manhood never quite achieved.

TODAY THE VIEW seems instantly familiar from the steep slope of Cwmdonkin Park. Serried rows of chimney pots breathe a homely coal-smoke haze over a bustling and friendly town. Small freighters still traffic in wanderlust at Swansea Docks, and prosperous suburbs sprawl comfortably along a curving shore toward Mumbles Head. Uglier by far but with a gritty energy of their own, industrial suburbs crowd along the lower Swansea Valley, once the largest copper-smelting center in the world. Until a decade ago it was a grim junkyard of dead factories and mountainous slag piles, but now the wreckage is nearly gone, revealing 900 acres of prime industrial and recreational land.

"It may not seem impressive now," says chief executive and town clerk Neil Rees, "but grass is growing there for the first time in a century. We hope to see modern factories growing there as well."

A professional city manager, Mr. Rees is chief strategist of a ten-year plan to restore Swansea's vigor while preserving its charm. An eight-million-dollar municipal leisure center, complete with indoor playing fields, dance hall, and a swimming pool with artificial surf, stands gleaming on waterfront land that has lain mostly derelict since



THE SUMMER SQUEEZE *starts early at Barry Island, where breezes from the Bristol Channel cool the industrial sweat of southeastern Wales, home to three out of five Welshmen. Here crowds throng the promenade and strand on Whitsuntide weekend in late May.*

bombs destroyed the city's heart in World War II. Old docks are being converted into a magnificent new marina, and plans call for an 18-million-dollar hotel and conference center surrounded by restaurants and tourist facilities.

"We're financing most of this work ourselves, hoping it will attract private investment," says Mr. Rees. "This is a do-it-yourself town. We don't just hold our hands out for government grants."

SPECIAL ENERGIES need special nourishment. The people of Swansea get theirs from cockles and laverbread. Cockles are small orange shellfish, slightly rubbery and nutmeat sweet, which shoppers nibble by the bagful. Laverbread, a sinister-looking preparation of boiled seaweed, is traditionally served with bacon and fried bread. Once it was a health food for women whose sweaty labor in tinplate works depleted their iodine, causing goiter. Now it's a delicacy.

"Not any seaweed will do," says Clifford Roberts, peering benignly over a steaming caldron at the Whiteford Bay Laverbread Factory in Penclawdd. "*Porphyra umbilicalis* is not as plentiful as it used to be—there's not enough to meet the demand. We import it from Scotland and Ireland now, at £400 [$700] a ton."

Cockles may become a costly delicacy soon. Only three dozen or so Penclawdd villagers still gather them, where once hundreds lived by the ancient time clock of the moon, racing the tide across the shimmering Llanrhidian Sands to rake the shellfish from shallow beds.

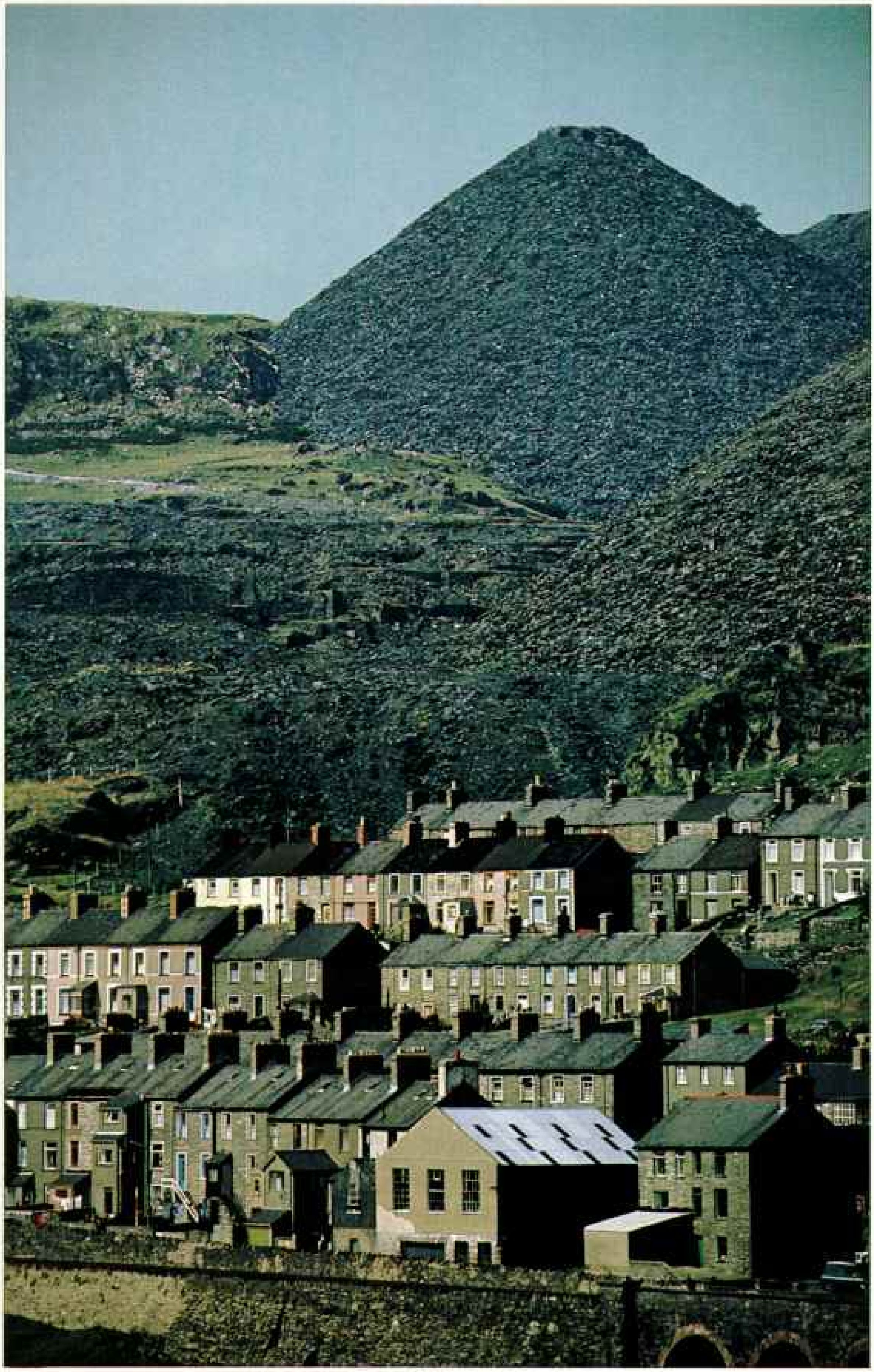
"We'll be the last, I think," says Haydn Williams, 64, pausing from his labor in an icy autumn dawn. "Youngsters don't like the working conditions, or the hours. Perhaps someday we'll import all our cockles from Holland."

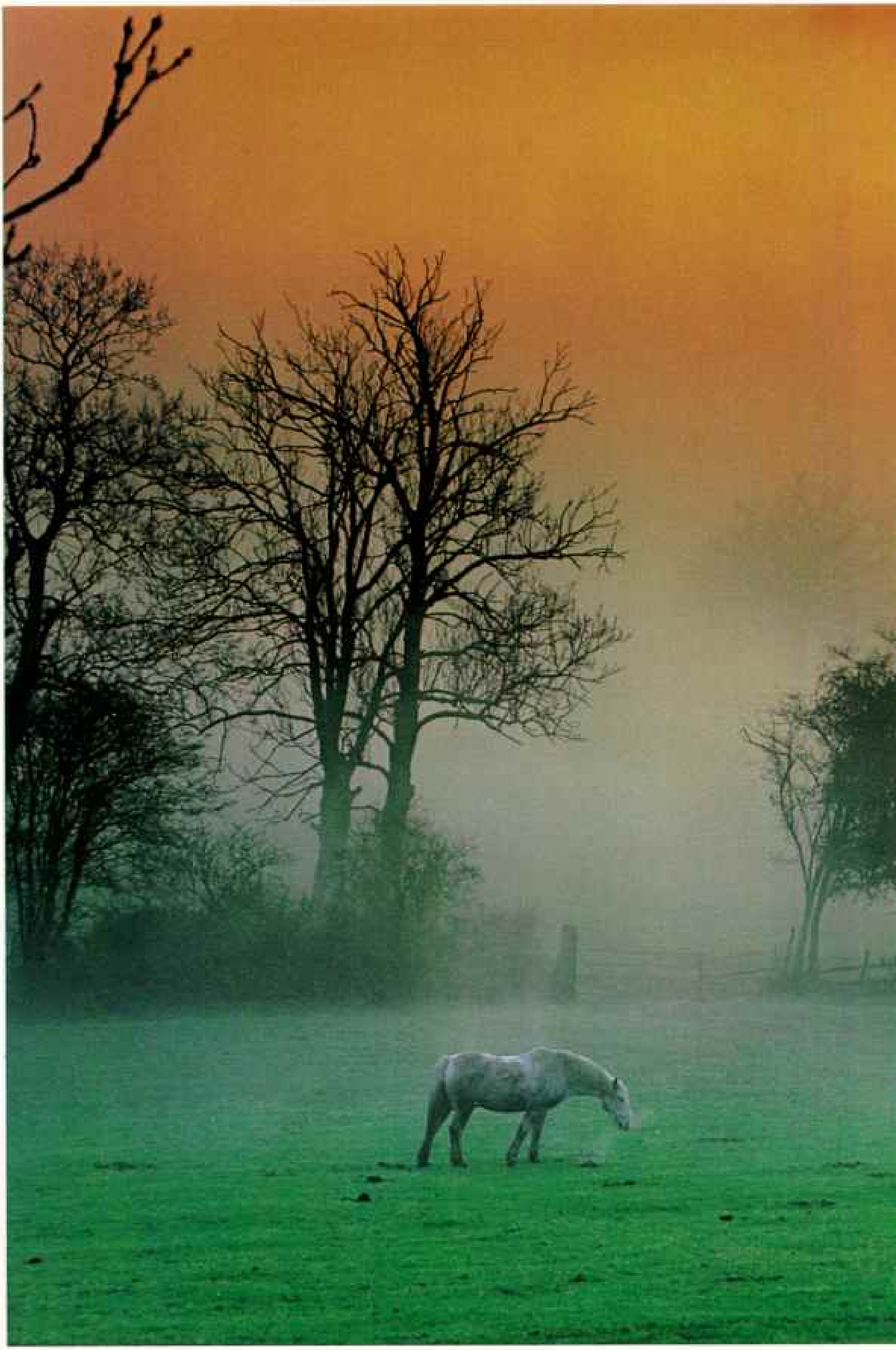
Foreign imports are no novelty in Wales. King Arthur himself may have been of Irish descent, for the Irish occupied parts of Wales in the fifth century. Today's popular vision of *The Once and Future King* is very much a French confection, clanking about in the armor of chivalry as a literary legacy of the Norman Conquest of 1066.

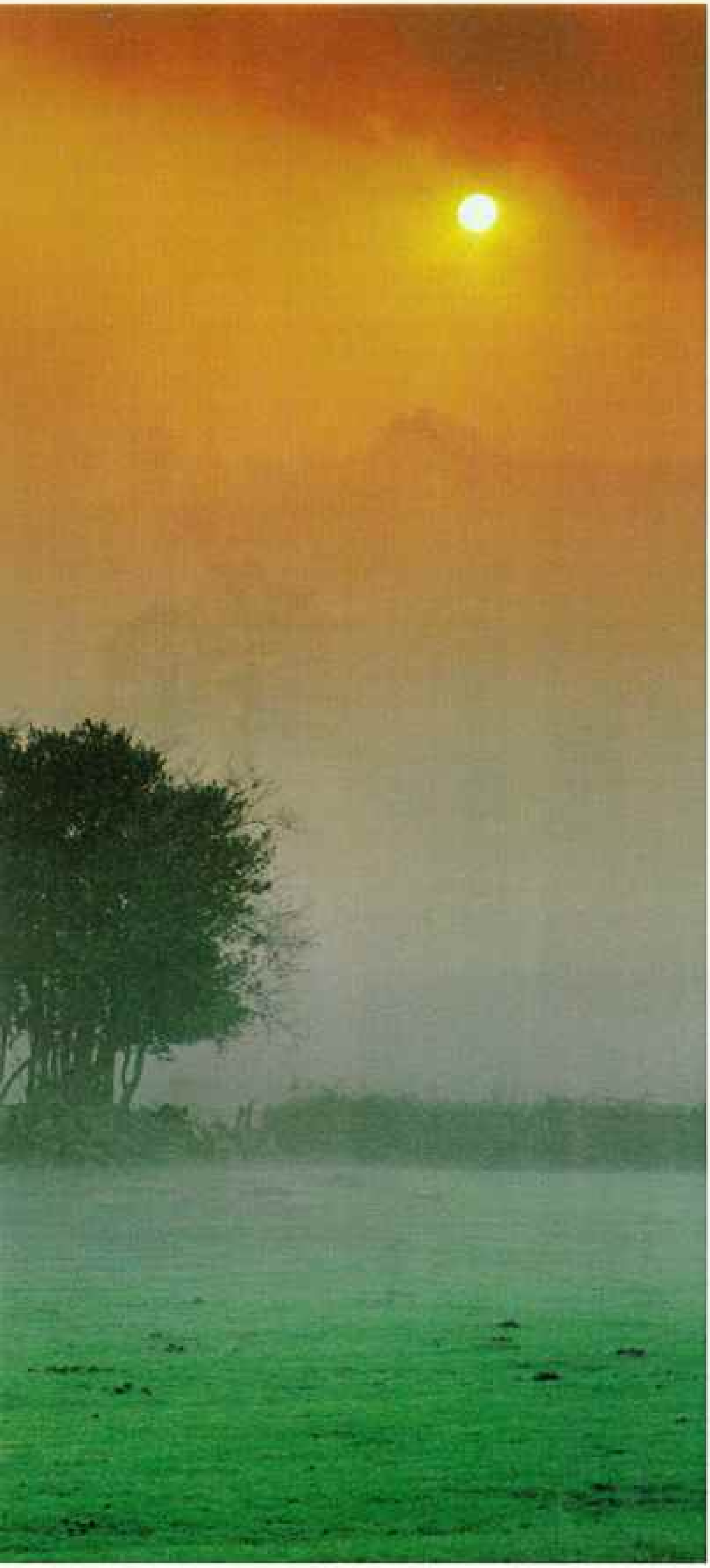
But Welshmen need no legend to confirm their warlike heritage. They repulsed Irish attackers, battled marauding Norsemen, and fought the Anglo-Saxons to a standstill along the line of Offa's Dyke, which after 1,200 years still roughly marks the modern border. The Normans found England ripe for plucking, but it took more than two centuries to subdue the Welsh, who revolutionized medieval European warfare with their deadly longbows. Later, fighting for

Gritty survivors *of the great Welsh coal era, colliers like Peter Boast in Maesteg (***above***) now fear for their jobs. With smokestack industries on the decline, the National Coal Board wants to close most of the unprofitable pits.*

*A center of the industry that once provided roofing for Europe and North America, Blaenau Ffestiniog (***right***) nestles under 200 years of slate residue from vast subterranean mines that are now a major tourist draw.*







A pastoral muse *from the countryside around Swansea, birthplace of Dylan Thomas, was the inspiration for much of his richest imagery:*

Then in the
delight and grove
of beasts and
birds
And the canonized
valley
Where the dewfall
stars sing grazing
still
And the angels whirr
like pheasants
Through naves of
leaves . . .

—*"In Country Heaven"*
Dylan Thomas,
Collected Poems

Edward III of England, they slaughtered the knighthood of France at the 14th-century Battles of Crécy and Poitiers.

And in 1485 a Welshman named Henry Tudor seized the crown from Richard III at Bosworth Field. The Arthurian dream came true. With a son of ancient Britain on the throne, England entered an age of glory.

In Carmarthen they still honor Sir Rhys ap Thomas, a Welsh knight who helped make it all possible. He led his troops to Henry's side and—one legend says—slew King Richard and placed his crown on Henry's head, an act of questionable chivalry and unquestionable common sense.

CHIVALRY WEARS SHIN PADS in Carmarthen nowadays, and very little else. Freezing wind sweeps the battlefield where 15 stalwart members of the Carmarthen Rugby Football Club wage nonstop unarmed combat with a team from Tumble. Tackles are vicious on the iron-hard ground. Eyes are blackened, noses bloodied. There are no time-outs, except to allow one stunned player to totter cross-eyed off the field, take a whiff of smelling salts from the shopping-bag medical kit, and return to battle.

Eighty minutes later, Carmarthen has lost, 12-0. The winners line up and formally applaud the losers off the field, and both teams adjourn to the clubhouse for a dinner prepared by players' wives, plus liberal liquid first aid.

Rugby is a thing of personal and national honor. More than 180 clubs compete in amateur Welsh Rugby Union play, supported only by membership fees. Players must earn the right to play each week. Injuries are shrugged off, but intentional disabling of an opponent brings instant dismissal. The ultimate honor is winning a Welsh Cap, which means selection for the national team and a chance to crush England.

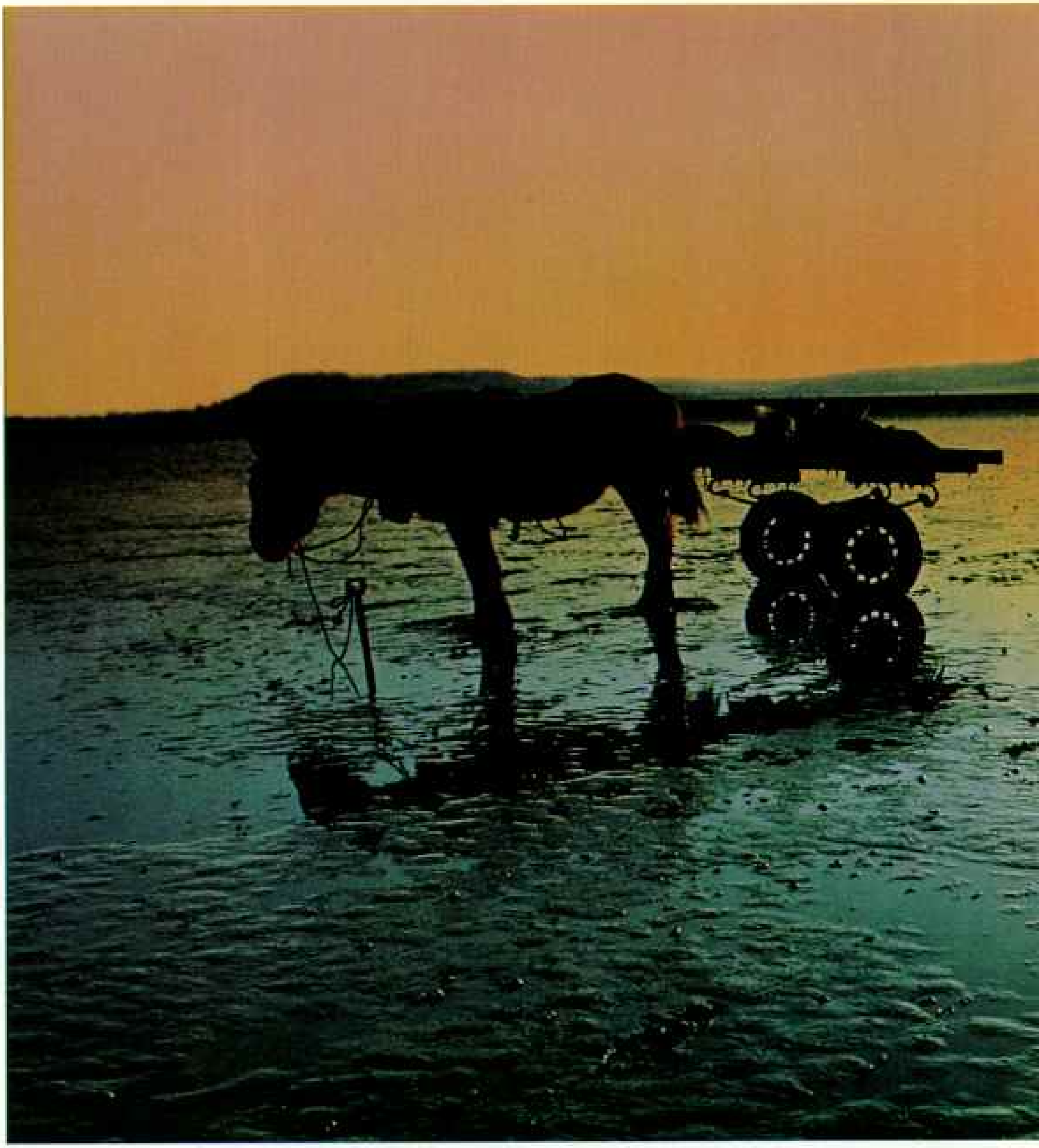
"The *Saeson* [Saxons] haven't beaten Wales in Cardiff in 20 years," says Huw Phillips, a Carmarthen rugby committeeman. "They don't have the stomach for our kind of game."

Carmarthen has its softer side as the hub of a dairy industry that flourishes on the lush pastures of Dyfed County. To the west lies Little England Beyond Wales, where placenames like Fishguard, Milford Haven, and Haverfordwest betray an early history of Norse trade and English settlement.

The western peninsula is dominated by Pembrokeshire Coast National Park, which provides 180 miles of spectacular coastal hiking trails from Amroth in the south to Poppit Sands, near Cardigan, in the north (map, page 42). Inland, along the famed River Teifi, small woolen mills crank out handsome Welsh tweeds and blankets, a tourist revival of a once thriving industry.

Country squires *from the rural heartland swap stories with a white-coated judge at the 1982 Royal Welsh Agricultural Show, held each July in Builth Wells. More pastoral than plowed, Wales has seen a decline in the last century of tilled land, while stock raising, particularly of sheep, has multiplied.*

*At Llanwrtyd Wells, the third annual Man versus Horse race (***right***) pits 60 men against 15 horses. Though the 22-mile course is designed to give men an edge, they have so far only placed second.*



Following an ancient calling, Welsh cocklers, like Andrie Swistun of Penclawdd,

North of Cardigan, beyond New Quay and Aberaeron, the country becomes more rolling. Passing Aberystwyth you cross an invisible border. Beyond lie the mountains of Snowdonia and the comfortable farmlands of the Lleyn Peninsula and the Isle of Anglesey. Here are some of the last strongholds of the native Welsh language, where history and industry have a northern character all their own.

"I'll dress a countess for you, and I hope I dress her pretty," says Meurig Evans, attacking a heavy slate block with hammer and chisel. With a sculptor's touch, he cleaves it into thin blue-gray sheets, trims one square, and presents it with a flourish.

"The countess, ten by twenty inches of the best Welsh slate for the world's finest roof—unless you'd prefer a princess or a little lady," he says, gesturing toward stacks of

race the tide on pony carts to harvest cockles from the Llanrhidian Sands.

slates large and small. "They'll keep you cozy for life."

It's anything but cozy in the tumbledown slate factory above Blaenau Ffestiniog, a few miles from the Snowdon massif. Outside, rain drenches an incredible black landscape of slate rubble, created by generations of men who disemboweled the mountains with primitive hand tools to provide roofs for urban Europe. Now, only a few score craftsmen keep alive what once was the major industry of northwestern Wales.

"I went underground at 16," Mr. Evans recounted. "A candle was our only light. We'd climb up the slate face, 80 feet sometimes, and hang there by a chain wrapped around one leg while we drilled holes for the blasting powder. I mightn't have been so brave if there'd been enough light to see how high I was."

Poorly paid, seldom in sunlight, often victims of rockfalls, silicosis, and typhoid ("Ffestiniog fever, we called it"), Mr. Evans and his kind carved their own awesome memorials inside the mountains. Abandoned quarries form an underworld metropolis of cathedral-like caverns, separated by huge curving pillars of unmined rock, descending level by level into darkness. It is difficult to believe that such works were made by candlelight.

The sheer drama of Blaenau Ffestiniog's industrial ruins is matched by the sheer charm of approaching them via the narrow-gauge Ffestiniog Railway, whose small steam engines and plush-seated coaches puff and clatter 13 miles uphill from the coast. The line opened in 1836 to haul slates for Porthmadog's fleet of sturdy 150-ton sailing ships that once plied Europe's coasts. Now it hauls tourists—more than 343,000 in 1982—plus Sunday surges of local residents who know the bar car is exempt from Sabbath closing laws.

Some trips are livelier than others. On a sunny October Sunday, police halt the train to eject a largely incoherent group of students proclaiming an anti-tourist "drink-in" on behalf of the Welsh Language Society.

"Students of bloody booze, they are," growls one bluecoat, and enters the fray with a fluent Welsh war cry. Perhaps there's a message for today in the majestic grief of the sixth-century poet Aneirin, who recounted the fate of more than 300 Celtic warriors against an Anglo-Saxon stronghold:

Of all those who charged, after too much drink,
But three won free through courage . . .
And myself, soaked in blood, for my song's sake.

Blood for centuries was the badge of Welsh freedom. In about A.D. 400, while England slowly crumbled beneath Anglo-Saxon assaults, a Celtic prince named Cunedda left his stronghold near present-day Edinburgh to rid Wales of Irish invaders. He founded a flourishing dynasty in northern Wales, but his homeland eventually fell to northern Irish attackers, the Scotti, from whom Scotland gets its name.

Despite frequent fratricidal struggles between Welsh princes, a true British state was born. Poets enriched the language, and Welshmen enjoyed such an enlightened

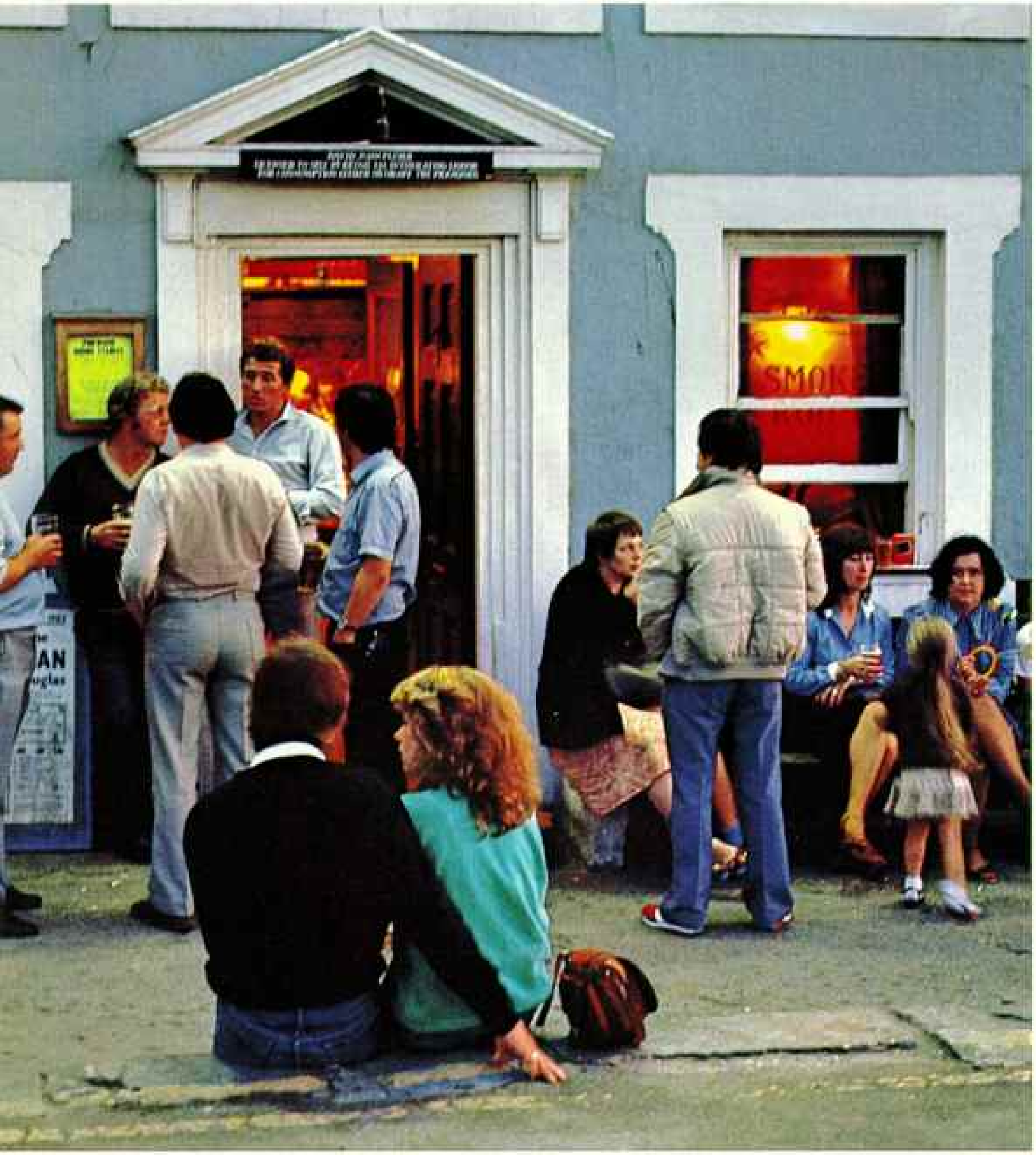
Bulwark of British fellowship, *the local pub fares well in Wales, despite pockets of Methodist temperance. Here in Conwy, mussel men end a hard day of harvesting the shore with a pint at the quayside Liverpool Arms, sharing a midsummer eve with English visitors who frequent Wales' north coast.*

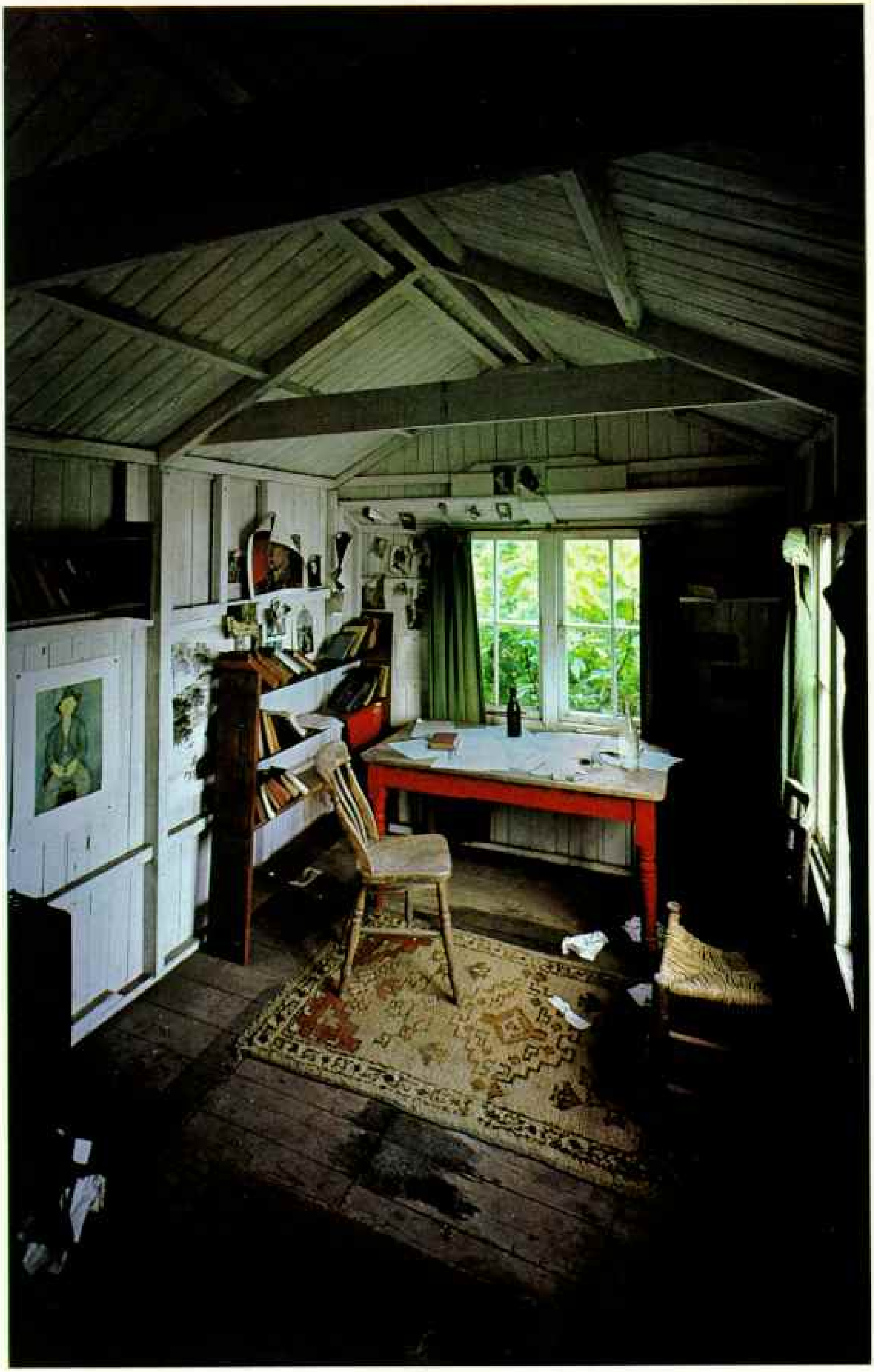
code of law that wives possessed property rights and could divorce their husbands for causes ranging from infidelity to bad breath.

Cymry, fellow countrymen, these Britons called themselves, and mocked the barbarians who named them *Wallas*, foreigners.

The Normans served in many ways to crystallize Welsh identity. William the Conqueror, recognizing a threat to his new kingdom, sent his powerful lords to fortify the border. Their Welsh lands were held by right of conquest, not by royal grant—a fact that bedeviled England's monarchs for generations.

Powerful enemies created powerful Welsh leaders such as Rhys ap Gruffydd, Llywelyn the Great, and his grandson, Llywelyn II, who successfully unified quarrelsome Celtic princes to mount major assaults on the Anglo-Norman lords, often coming within a historic hairbreadth of forcing England to recognize their sovereignty. The last dramatic revolt under Owain Glyndŵr was savagely put down in 1410,





leaving Wales ruined and wretched. Meanwhile the Norman lords took Welsh wives, and their half-Celtic sons were often more hostile to the crown than to their Welsh cousins. FitzGeralds and FitzStephens, eager for conquest, became involved in Ireland's internal power struggles, and their growing disdain for England's rulers brought royal retaliation, beginning centuries of Irish agony.

Wales became a cockpit of royal politics. Welshmen achieved titles of English nobility, and the Earl of Richmond, Henry Tudor, had a legitimate claim to England's throne. When he triumphed at Bosworth Field to become Henry VII, Wales rejoiced. Welsh aristocracy swarmed to London, luxuriating in newfound power.

In 1536, under Henry VIII, Parliament drew up the Act of Union, which abolished the Welsh nation. It also decreed that "from henceforth, no person or persons that use the Welsh speech or language shall have or enjoy any manner office or fees within this realm of England. . . ."

As England's power grew, the decline of the Welsh language began. Today, writes R. S. Thomas, one of the most distinguished of his country's living poets,

. . . There is only the past,
Brittle with relics . . .

to which English tourists come in droves,

Scavenging among the remains
. . . elbowing our language
Into the grave that we have dug for it.

"I'm known as a bit of a pessimist in Wales," R. S. Thomas says. He is 70, white hair adrift above a sea-cliff face, retired as vicar of Aberdaron, a tiny onetime fishing village on the Lleyn Peninsula. He is a poet-priest, contemplating

. . . such a fast
God, always before us and
leaving as we arrive

and hearing in a darkened church only

. . . the sound of a man
Breathing, testing his faith
On emptiness, nailing his questions
One by one to an untenanted cross.

In the same way does he test his faith in Welsh nationhood.

"Language is the only thing we've got," he says. "But we may be living in the last generation of spontaneous Welsh speakers. We're drowning it in tourism, the ultimate parade of the acquisitive society. The barbarians burst into this beautiful countryside with their transistors and caravans, and we're convinced we must defer to them. Our Welsh is becoming a patois, full of bastardized English words. At the same time there's a growing intelligentsia that makes the language almost a status thing. People in this area are doubtful about the Welsh Language Society, and they resent it when radicals

Celebrant *of the Welsh soul if not its tongue, Dylan Thomas was buried simply (**above**), though his legacy to English poetry is monumental. Prior to his death in New York City at age 39, the hard-living poet resided in the small coastal town of Laugharne, the principal inspiration for his famous verse play* Under Milk Wood. *He composed most of it in a tiny shed (**left**) that overlooks the broad estuary of the River Taf.*

come to deface road signs, but never come and explain their aims."

A paradox: R. S. Thomas speaks eloquent Welsh, but writes poetry only in English. "Art must come first," he says. "I can't satisfy myself in Welsh since it is my second language. Happy the musician or painter. They needn't worry about words."

On the Isle of Anglesey, artist Kyffin Williams respectfully disagrees. Wales is his native land, he says; English his natural tongue. And painting is not always enough.

Now in his sixties, he has devoted himself to recording the life of the north Wales farmer. He paints the portraits of these people, and the hard land from which they gain their livelihood, with an understanding that comes from the fact that his ancestors have

lived among the farmfolk for generations.

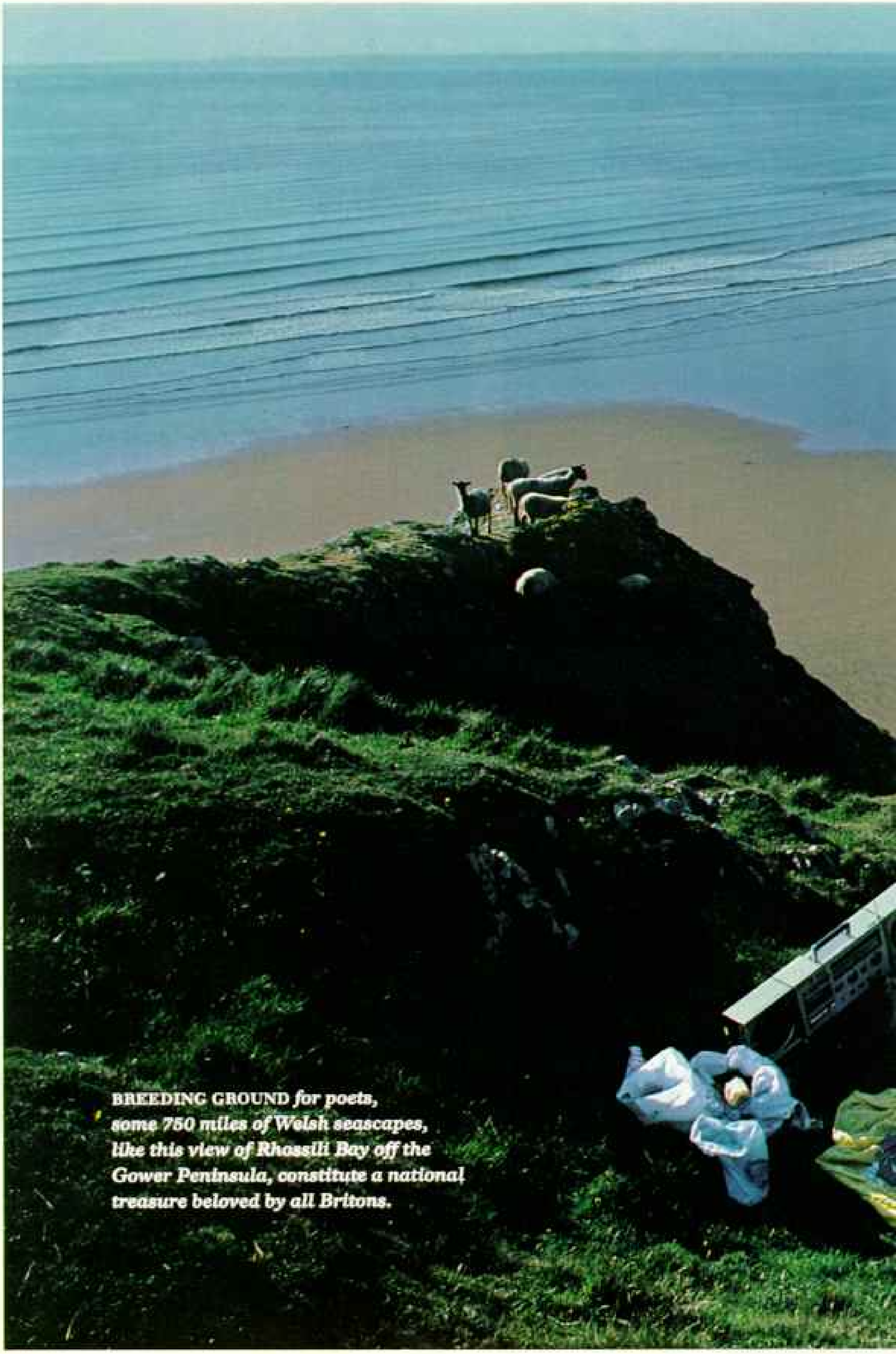
"Such people are known as the *gwerin*," he says. "They're tied to their land and to a stubborn culture that produces poets today as it has done over the centuries."

His Celtic passion thunders and broods on canvas, in stark landscapes and portraits that compel respectful silence. If there is a strong element of melancholy in his work, it may be because he knows of the constant battle of man against an often unresponsive soil.

Simon Jones might be a Kyffin Williams portrait come to life. He is 69 and raises sheep in a lonely valley called Cwm Cynllwyd, where English is spoken only as a courtesy to guests.

Interrupting his study of a long computer

Lush parcels of farmland, *kept green by abundant rain, carpet the Vale of Conwy, where the native tongue still dominates. In south-central Wales* ***(above)*** *elder Welshmen fear that future generations will allow the language to die.*



BREEDING GROUND *for poets,*
some 750 miles of Welsh seascapes,
like this view of Rhossili Bay off the
Gower Peninsula, constitute a national
treasure beloved by all Britons.

printout, he gravely offers hospitality.

"It seems we'll survive," he says. "But, without the computer I mightn't be so sure."

The simple gwerin life is a thing of the past nowadays in the Welsh-speaking heartland of Wales. Mr. Jones owns 1,045 acres, mostly mountainside, and grazes 1,050 ewes, 27 rams, and 24 beef cattle. Winters are harsh—in 1947 he lost two-thirds of his sheep—and he has ordered four tons of United States-grown corn for $900, including a 45 percent Common Market import tax. For safety he has shipped 280 ewe lambs and 60 older sheep to warmer lowland pastures, at $15 a head. Next autumn, he expects to sell his lambs for $20 a head with the help of a government-guaranteed minimum price, and will receive an $11 Common Market subsidy for each surviving ewe. Then the computer at the Department of Agricultural Economics at the University College of Wales in Aberystwyth will analyze the results. If earnings fail to provide the equivalent of full-time employment for two men, the government offers incentives for him to amalgamate his farm with a neighbor's for greater efficiency.

"Amalgamation means elimination of families," Mr. Jones says. "Once there were 110 people in this valley. Only 50 are left. The Welsh language is dying out. Now the government is making a belated effort to save it—but they didn't succeed in Ireland, did they? They could teach it in school, but they couldn't make it the language of the home."

He hoists his young granddaughter, Marian, who is bored with such incomprehensible babble. She is beginning to learn English at her school, but it hasn't become important—yet.

Before I leave, Mr. Jones adds a final provocative thought.

"There was a Simon Jones on this land in 1640," he says. "I don't know how long our family lived here before that. But when my sister was studying anthropology at Aberystwyth, she had the job of measuring the skulls of people living in these valleys. My father and I had exactly the same measurements as those of the Beaker folk who lived in Wales thousands of years ago—long before the Celts arrived."

IT'S A SHORT, sharp walk from the Jones farm to the Cliff of Gloomy Caves, where I began this story near my journey's end. The stream called Llaethnant may not be the most beautiful in Wales, nor are the Hunting Grounds of the Hounds of the King of Hell the noblest of Snowdonia's highlands. But they are my own discoveries, and the storm draws a welcome curtain of solitude around me. It is possible to believe that an earlier race, a people without poets, without history, still add their patient presence to a volatile land. In the hills, somehow, the past achieves the present tense.

Wales. I knew a little of it once. Swansea and Fishguard and Holyhead are harbors of high romance, whence old steam ferries carried me to Ireland as a child. And there was a mining village whose name I can't recall, where I was welcomed as a refugee from wartime London. Who was the miner, I wonder, who came black faced from the pit to wash himself potato white in a tiny tub?

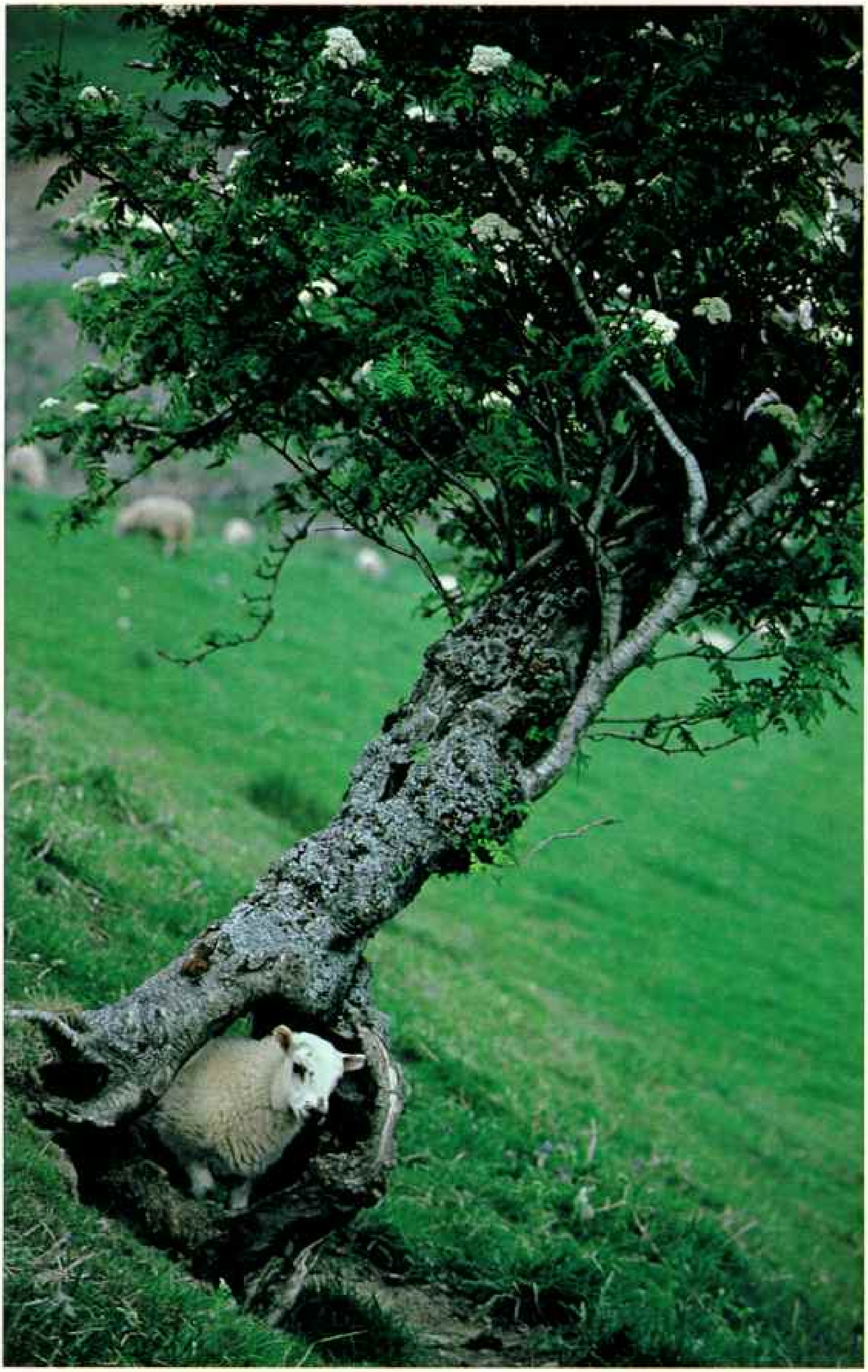
I've done something Dylan Thomas only dreamed of—sailed from Swansea on a rusty tramp steamer, passing the glorious coast on my way to America, leaving a land whose history comes to me now—embarrassingly enough—like the latest news.

Good news or bad? The swirling mist holds no answer. The wind is only the wind, and cold. I walk downstream toward the village of Dinas Mawddwy, and a certain inn I know where, in the ancient Welsh tradition

Mae'r cwrw'n hyfryd,
Ac mae'r tân yn boeth.

Or, as we say in English, where "the beer is lovely, and the fire is hot." □

"Antelopes in woolly pullovers," *as one Welsh farmer calls them, the willful and nonconformist sheep of Wales range freely through the hill country. Fitting symbols they are of a country whose sense of independence has never been diminished by the tether to its large neighbor to the east.*



SPECIAL ECONOMIC ZONES

China's Opening Door

By JOHN J. PUTMAN
NATIONAL GEOGRAPHIC SENIOR WRITER

Photographs by H. EDWARD KIM
SENIOR ASSISTANT EDITOR

The new uniform, blue jeans are worn proudly by well-paid workers at Shenzhen, one of four Special Economic Zones created by China to attract foreign capital and know-how. Here crews carve a boulevard (facing page) that will link with China's first expressway, financed by Hong Kong investors.

THE TRAIN FROM KOWLOON in the Crown Colony of Hong Kong moved northward through the New Territories, pausing now and then to pick up passengers or allow a faster train to pass. My companions were mainly Hong Kong Chinese bound for the motherland to visit relatives. In the past few years such trips had become routine. My companions chatted with anticipation. At their feet were bundles of gifts and the shoulder poles they used to carry them. I was less assured, for this was my first trip to the People's Republic of China, and my mission was more complex than a warm family reunion.

I was to spend five weeks in China looking into a bold new experiment: the creation of four Special Economic Zones that had been set aside to lure foreign investment, technology, management skills.

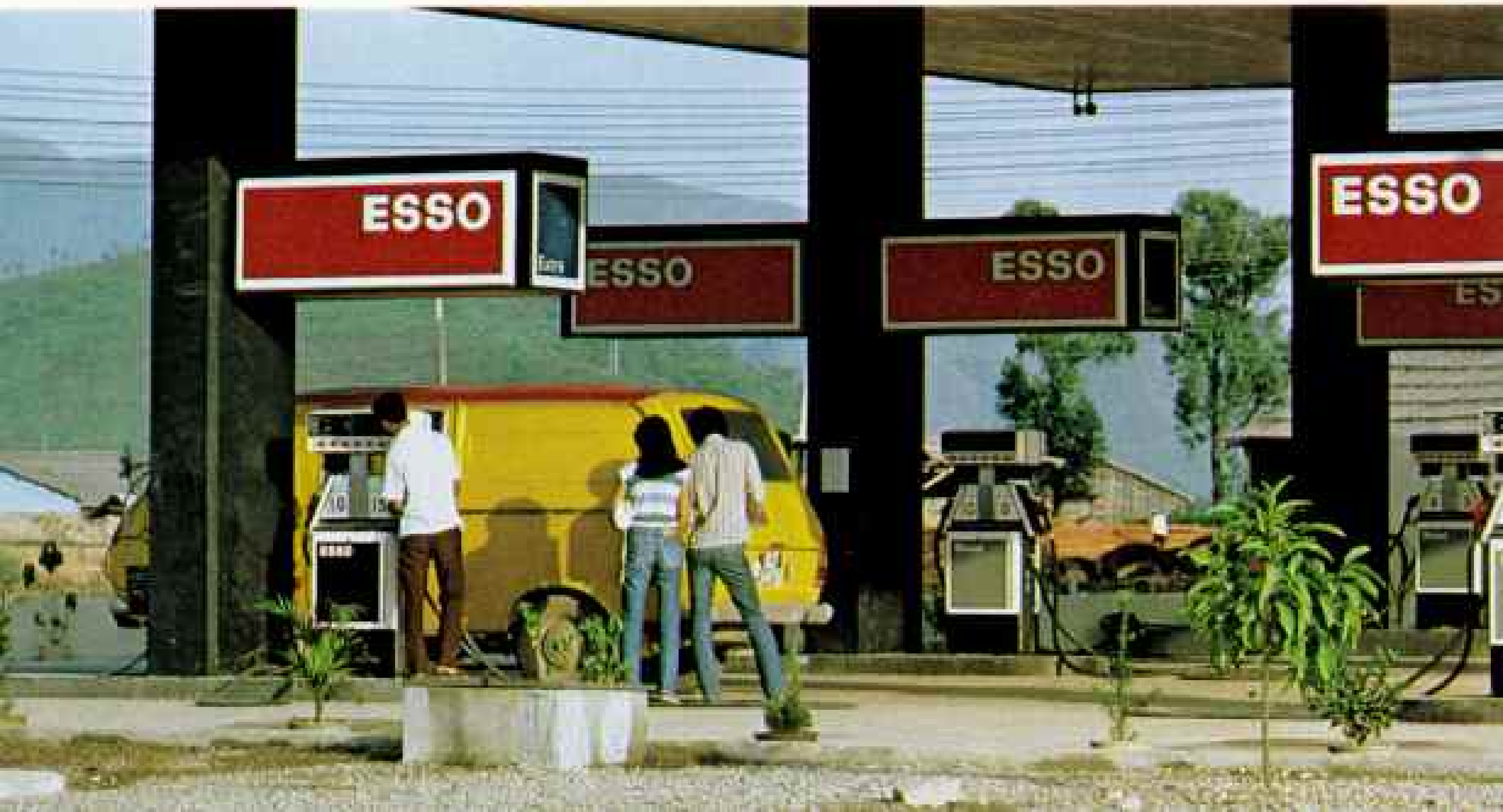
For almost 20 years the People's Republic had closed itself to foreign influence and had attempted to develop itself exclusively through self-reliance and socialism. Recently, dissatisfied with the pace of that development, it had thrown open its doors to the world again.

The Special Economic Zones, all on the southeast coast of China, were to play a leading role in this open-door policy. They were to become manufacturing and export centers, practical schools in which Chinese could learn the world's economic ways.

The largest and most successful of these zones, Shenzhen, lay just ahead. It is a dragon-shaped area, 327.5 square kilometers in size (126 square miles), that shares the northern boundary of Hong Kong. The location was purposeful, for the zone draws its impetus from Hong Kong, and may in time replicate it.

When the train reached the border, we got off in a mild scramble, passed the customs and immigration formalities, and stepped into the Special Economic Zone. Only a block from the station it became clear that Shenzhen city, long a sleepy little border town, was being transformed.

Amid dust and traffic jams an army of construction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Investments soar *like the high rises in a model of Shenzhen, examined by engineer Sun Jun (**left**). Colored buildings are under construction; white ones are planned. Five years ago only about 30,000 farmers and fishermen lived here. Then in 1980 Shenzhen (**map, below**) became one of four Special Economic Zones (SEZs). To foreign investors they offer low tax rates, low rents, comparatively low-cost labor, and other incentives.*

*Shenzhen Mayor Liang Xiang (**above**), whose city may house a million people by the year 2000, calls the SEZ concept "a very important part of our open-door policy."*

*Flocking through the door have been Shenzhen's neighbors from Hong Kong. Of some 1,600 approved contracts, about 90 percent are with Hong Kong firms. A service station (**lower left**) caters mostly to Hong Kong tourists and businessmen; very few Chinese citizens own cars.*

Giant of the SEZs, Shenzhen covers 327.5 square kilometers. Zhuhai, Shantou, and Xiamen together cover less than 12 square kilometers but areas open to investment are much larger.

Beating a path to a booming job market, carpenters shoulder-pole their tools and

workers was building roads, digging trenches for underground utilities, clearing sites, raising commercial and residential buildings. It seemed an army of the past, for stones were broken and shaped by hand; shoulder poles and handcarts augmented the work of trucks.

In the municipal planning office I glimpsed the great metropolis that was taking shape. Planner Sun Jun led me from table to table, showing the models of three new urban areas. "The first will include a new railway station and a 44-story tower. Around the tower will rise a hundred 18-story buildings. Thirty are already under construction. In the second area, the old town center will be renovated and transformed into a Chinese-style tourist district, with shops, restaurants, a walking street.

"The third urban area will be a totally new city, 30 square kilometers in area, complete with infrastructure and a light-rail system, and offering industrial, commercial, and residential properties to foreign investors. We'll also have a science and culture complex, a nuclear power plant, and a six-lane

bedrolls in age-old fashion as they head for new employment in Shenzhen municipality.

superhighway to Guangzhou (Canton).

"By the year 2000 these urban areas may hold a million people." And bordering the special zone, a 45-kilometer (28-mile), 45-million-dollar fence, including six check posts. It would contain the capitalist-like activities and also control the numbers of Chinese entering the zone in quest of the new, more attractive life.

It was a staggering vision. "Like building a new Brasilia," one investor had remarked to me. Sixty thousand construction workers, 34 construction companies, and 14 design companies had been drawn to the project from many parts of China and put to work.

Shenzhen municipality had committed 700 million yuan (370 million U. S. dollars) to the venture. But the greater sum needed —billions—would come from foreign firms.

Thus far some 1,600 contracts had been signed and 1.5 billion dollars had been pledged. Hong Kong Chinese provided 90 percent of the investments. In the days that followed, I set out to determine what the money was going into and how the investors had fared. I was in for some surprises.

That Pepsi spirit *invades Shenzhen, where employees at a bottling plant take a lunch break. PepsiCo Inc. supplied a prefab building, machinery, and capital, while the Chinese—who will get 55 to 60 percent of the profits—provided land,*

labor, and raw materials. Eight out of ten of these Pepsis go to Hong Kong, with the rest consumed locally.

I SAT BY THE SEA one day just east of Shenzhen city. There were mountains, crescent beaches, batwing junks, high rumped, that seemed to glide across the water as lightly as ducks. It was a lovely place to wait, and I was waiting—for a funeral.

The great cemetery that rose around me told a lot about Shenzhen's development. Wealthy Hong Kong Chinese had put up the money. Shenzhen had provided the land. The profit was split evenly.

The groundskeeper told me that special care had been taken to meet the conventions of Hong Kong people. The siting adhered to the old Chinese precept that burial places should have wind and water. The surroundings had been judged propitious "perhaps because the shape of that mountain is like the shape of a dragon, a horse, or a tiger."

In time the funeral party arrived by bus from Hong Kong. A father and his five children were burying the mother (page 79).

Why would a Hong Kong family bury its dead in the People's Republic? One of the funeral party told me: "They decided on this cemetery because if you are buried here, it is permanent. If you are buried in Hong Kong, you may be moved in the future, as that land is developed. And it is very costly in Hong Kong."

Space—the lack of it in Hong Kong—was powering Shenzhen's growth.

I was surprised one day to discover a Hong Kong country club in Shenzhen. It had 1,400 members, offered waterskiing on a lake, riding on Australian horses, food and comfort at the Hong Kong level. I dined there on shrimp, crab roe, and steamed ducks' feet, then talked with Mr. John Chan Wing-hong, who had conceived the idea.

"A long while ago," he said, "I tried to join a certain country club in Hong Kong. The membership fee was $30,000. Too much. The reason was not the cost of the activities, but the cost of the land. I decided that cheaper land might become available in China." Now Mr. Chan is one of eight partners in a consortium that has invested nine million dollars in the club. It is outside Shenzhen Special Economic Zone, but within Shenzhen municipality. Never mind, the Chinese are flexible.

But if they are flexible, they lack experience in making Western-style contracts.

Zone within a zone: *Long experienced in doing business with Westerners, China Merchants Steam Navigation Co. Ltd of Hong Kong manages the Shekou Industrial Zone in Shenzhen SEZ. There toy cars are molded and assembled (**below**) for the Schaper Manufacturing Company of Minneapolis.*

*A China Merchants venture with the East Asiatic Company of Denmark makes shipping containers, here observed by apprentice workers (**right**). Though Chinese officials stress that SEZ products are for export only, the firm won an order for sales in China—an example of a ripe internal market that outside firms yearn to penetrate.*

Mr. Chan recalled: "Seven consortia had come before, all were unsuccessful. None knew how to negotiate with the Chinese. You must be humble, patient, quick, tolerant. They want to know things, but it depends on how you explain to them. Not in a haughty way.

"And sometimes you must push. We talked for a long time with officials of the commune that owns the land and with officials of the Shenzhen municipality. At last all agreed on the contract, but nobody would sign it. I said to the mayor, 'Sir, somebody *must* sign.' So he signed."

The Chinese had gone into the resort business themselves, investing 6.5 million yuan in a large facility at Xili Reservoir. Director Wang Chang-yu told me the resort was designed to serve middle- and lower-income tourists from Hong Kong. A family weekend may cost as little as $60. On a busy day the resort draws 5,000 visitors.

There was another use for Shenzhen's land: growing food for a hungry Hong Kong that could not feed itself. At the Fu Yong Commune I watched young women of the Phoenix production brigade load a Hong Kong truck with flowering cabbages, spring onions, radishes, hairy cucumbers. Hong Kong investors provided the capital for the seeds and fertilizer; the commune provided the land and labor.

The Chinese co-manager told me the venture had failed at first, but then they had broken the brigade down into 17-person units and assigned each a 43-mu tract (about 7 acres) for which they were responsible. Along with a bonus system, it turned the farm around.

The investors were realizing a small profit. As for the brigade, household income had risen from 1,569 yuan a year to 5,669. The foreign experiment was a happy success.

ON DAYS OF TRAVEL through Shenzhen I noticed many new Western-style apartment houses. They had been built in a joint venture with Hong Kong investors, I was told, and units were sold to overseas Chinese who wished on retirement to come back to the motherland, and to Hong Kong people who wished to provide more comfortable quarters for their relatives living in China.

But the grandest housing scheme in Shenzhen was one that would turn the zone into a bedroom suburb of Hong Kong. An executive in one of the colony's great Chinese *hongs*, Hopewell Holdings Limited, explained: "Hong Kong people have beautiful watches, clothes, food, but not beautiful flats. They cannot afford them; land prices are too high. We see these people wanting good homes. In time it will be less than 40 minutes by hydrofoil or fast train to Hong Kong. What's the difference? And we can provide flats at half the price."

But the hong had not yet sent its millions across the border. As the Chinese lack experience in negotiating contracts, they also lack a solid body of business law. "The legal infrastructure must be in place before we put in the money," the executive said. China was working on the problem, drawing on assistance from a number of distinguished U. S. lawyers.

IT WAS TIME NOW to look at industry in the zone, for the development of export manufacturing was the declared first purpose of the Special Economic Zones. The Chinese had studied export-processing zones in other developing nations and now offered similar inducements for investors: low land and labor costs, little or no customs duty on needed raw materials, a tax rate on business profits of no more than 15 percent.

But the opening of the zones had coincided with a world recession, and progress had been slower than wished. Most of the factories were small and represented modest investments. Most performed assembly or processing work; technology was simple.

I visited garment lofts where young women at Japanese Juki and Brother sewing machines hammered out clothes for the international market; an electronics plant where imported components were assembled into digital clock radios bearing the J. C. Penney brand; a factory where women put together toy trucks, inserting them in packages labeled in part STOMPERS® FOUR-WHEEL DRIVE.

At the year-old Pepsi-Cola plant, a pride of Shenzhen, I talked with the Chinese co-manager, Guang Zhao. He said the contract signed between the American company and the Chinese side was typical of Shenzhen. The Chinese provided land, labor, and raw

Media event, *an operating 19-inch color TV draws a crowd to a department store in Shantou, where the price tag is $900 U. S. Long-overpopulated Shantou looks to handicrafts and light industry to utilize its labor pool and to Hong Kong, Macau, and beyond for buyers.*

materials; and Pepsi-Cola provided capital, the machines, co-management, and technical expertise.

During the first five years, the plant's profits are split 55 percent to the Chinese side, 45 to Pepsi. Eighty percent of production (24 million bottles a year) is sent to Hong Kong.

As the contract was typical, so were the problems encountered. There was a shortage of trained equipment operators, but workers learned quickly. "Our production capacity is 6,500 cases per shift," Mr. Guang said. "So far we have been able to produce only 3,000 to 5,000." He had experienced difficulty himself in adjusting to Western-style production. "The requirements set by foreign firms are extremely strict, by the Chinese rather loose."

To help encourage good performance by workers, managers in the Special Economic Zones are permitted to discharge workers for cause. "This is something new in China," Mr. Guang said. "We have had four cases."

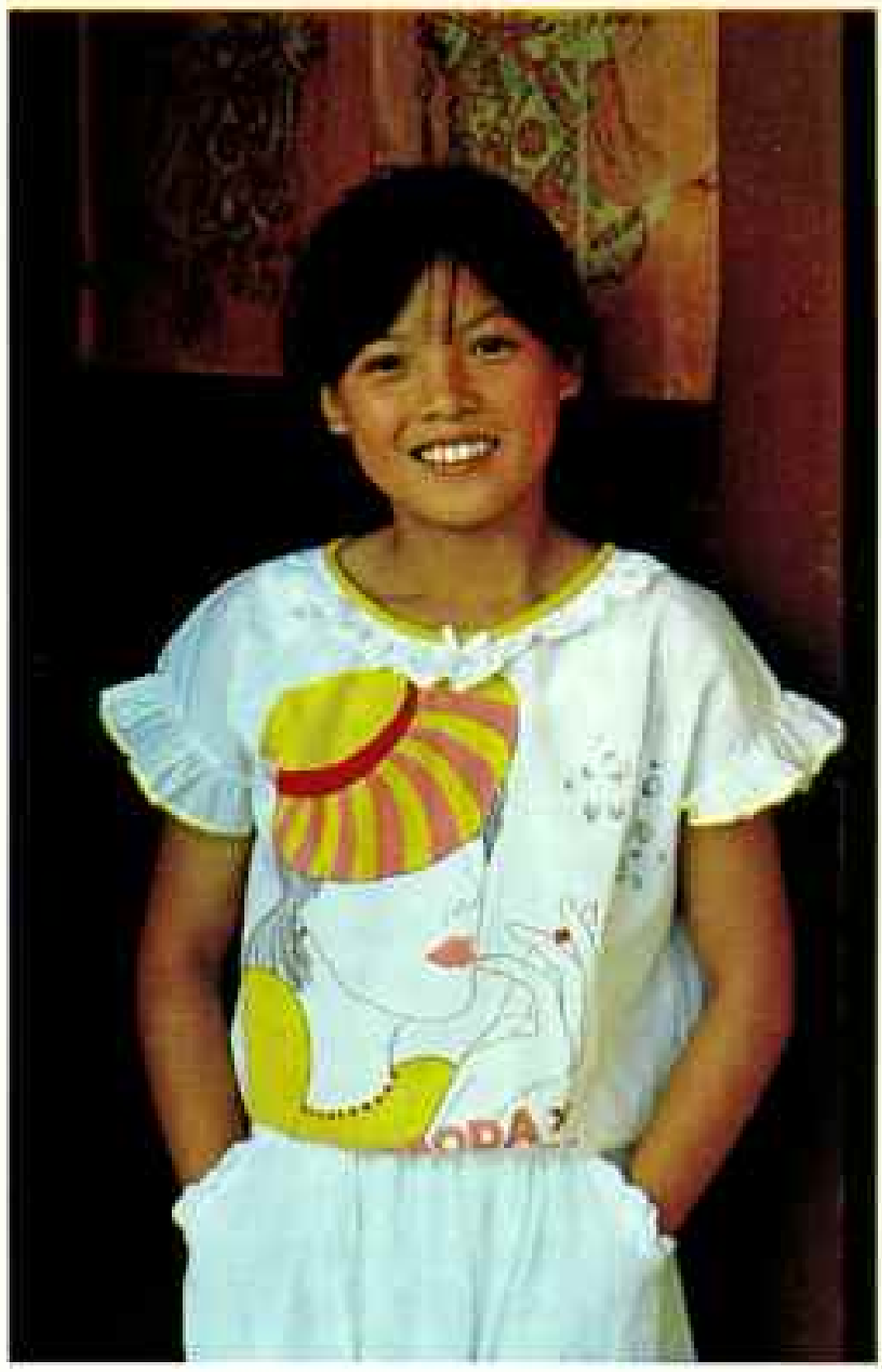
There was another incentive within the special zones: higher pay. The average worker in Guangzhou might earn 70 yuan a month (about $37), the zone workers from 120 to 150.

THE LARGER, more advanced factories, I discovered, stood in a special area within the Shenzhen special zone. In its quest for development, China was trying a number of approaches. The one-square-kilometer (247-acre) Shekou Industrial Zone was managed by the China Merchants Steam Navigation Co., a China-owned firm based in Hong Kong.

China Merchants has had considerable experience with Westerners, so its little estate is by Western standards more coherent, better planned.

By the dock stood a large feed mill, representing an investment by the Continental Grain Company of New York. Nearby, in a joint venture linking China and the East Asiatic Company of Denmark, a new factory was turning out several shipping containers a day for the international market. They were fashioned from Japanese steel and Malaysian planking, painted bright yellow and inscribed: U.S.A. DESIGNED TO COMPLY W/DEPT. OF LABOR REG. MAX. DESIGN AND TESTED PAYLOAD 48160 LB. MGW 52910 LB.

Shekou Industrial Zone had its own vision of the future. There were plans for a hundred factories, an indoor sports stadium, a 100-million-dollar luxury hotel. The key to growth was symbolized by a group of handsome seaside villas, the Crystal



Luxurious lures, *posh $100,000 Crystal Gardens seaside villas* ***(left)*** *in Shekou Industrial Zone are designed to appeal to foreign businessmen. To enjoy the view around Shek Ngam Lake* ***(below)****, members of the Lake and Hot Springs Country Club pay entrance fees starting at $3,000. The club, with 1,400 members, mostly from Hong Kong, chose to locate in Shenzhen because land there is cheaper than in the British crown colony.*

Zhang Jing-fang ***(above)****, 17, an aspiring journalist in Shenzhen, displays the image of a new China. Her clothing style, ubiquitous in the SEZs, bespeaks a siren song of capitalism that the government combats with fences and political education. But for China the potential rewards are great: foreign exchange, badly needed technology and training for skilled workers, and an interim step toward its stated goals of reabsorbing Hong Kong as well as Taiwan.*

Gardens. Laborers were at work, their hammers and chisels singing as they shaped the stone. The villas were for sale to foreigners at $100,000 apiece. A lot of foreigners were expected.

In Beijing 33 foreign oil companies were then bidding to develop China's offshore oil fields. In time perhaps some 20 billion dollars would be sloshing around the South China Sea, and the most promising fields lay in the nearby Zhu (Pearl) River estuary. China Merchants and associates were just beginning to convert a small fishing harbor, Chiwan, into the principal forward supply base for explorations in that area.

BEFORE I LEFT Shenzhen, I had dinner one night with Deputy Mayor Zhou Xi-wu, a thoughtful, soft-spoken man. We talked about the future, the past. He recalled the years of the Cultural Revolution. He had been taken before a large meeting and fiercely criticized as a suppressor of the mass movement, accused of following the capitalist line. He had not worked during those years.

It was after the downfall of the Gang of Four, which signaled the end of the Cultural Revolution, that a more moderate leadership came to power in China, and Mr. Zhou found himself back in a position of responsibility.

"In the past," Mr. Zhou said, "we used to stress that the development of our country should be through self-reliance. This is the correct policy, and we continue in this way. But some people misunderstood and had a lopsided idea. They believed if we carried out too many foreign activities, we could be controlled by foreign countries.

"But we knew we should not lose any opportunity to grow and expand. So the central government decided that we should experiment with foreign opportunities and exchange with foreign countries. New policies were adopted, among them the creation of the Special Economic Zones.

"We know the socialist economic system is not perfect, yet we cannot introduce an all-capitalist system. We shall persist in the socialist way. But we can introduce some advanced foreign economic experience, either capitalist or socialist, into our system—to reform it, change it, perfect it.

"If the experiment of the Special Economic Zones succeeds, if the reforming of our system succeeds here, other parts of China can use the lessons. If they fail, other parts of China can avoid these experiments."

We talked finally about China's stated intention of ultimately reabsorbing Taiwan and Hong Kong.

"The Special Economic Zones will have much to do with a solution of these issues," Mr. Zhou said. "If the special zones are successful, our compatriots in Hong Kong and Taiwan will see that under Chinese sovereignty businessmen can live well, invest, profit. And when sovereignty of Hong Kong and Taiwan is taken back, we will adopt special measures to administer them. Both can retain their present capitalist systems."

COMPARED with Shenzhen, the other Special Economic Zones are tiny, almost embryonic. The Zhuhai zone adjoins Portuguese-administered Macau and contains 6.8 square kilometers. During my visit I saw only one factory operating. But the zone had just signed a comprehensive development contract with a Hong Kong company owned by three overseas Chinese families.

And I was quickly to learn that the zone formed only a part of a much larger area opened to foreign investment. Again, there was a great vision.

Zhuhai official Huang Wen-zhong unfolded a plan of that larger area, spread it on the floor, anchored it with ashtrays. "We have," he said, "6,000 square kilometers of sea, 114 islands, 87 square kilometers of arable land, and Zhuhai city with a population of 150,000. We have many scenic spots and places for sports. We have good soil, abundant minerals, and building materials. We

To assure eternal rest *for the mother, a Hong Kong family buries her in a Shenzhen cemetery run by Hong Kong entrepreneurs. Burial plots in land-starved Hong Kong are not only exorbitant but also risk relocation as the living crowd out the dead. This traditionally oriented site enjoys wind, water, and a mountain view.*

are going to build an airfield, a harbor.

"We will turn Zhuhai into a new kind of border city, open to the world, an export and manufacturing base, a lively tourist center."

At Shantou (Swatow), 274 kilometers up the coast from Shenzhen, I visited another of the four special zones. As the plane from Guangzhou circled before landing, I saw a city crowded against the Han River, surrounded by green farmland and villages with black-tiled roofs.

Greener pastures *for urbanized Hong Kong lie on the other side of the border in Shenzhen. Investors finance seeds, fertilizer, and other needs for Fu Yong Commune, where beans (***above***) weigh in as part of its 87-ton monthly vegetable shipment to Hong Kong. Also destined for the colony, a 25-pound grass carp (***facing page***) comes ashore at a Hong Kong-backed fish farm.*

Unlike Shenzhen and Zhuhai, Shantou is a long-established industrial and trading center. It is also a place from which many overseas Chinese migrated. The problems that sent them abroad remain: too many people, too few jobs. Swarms of bicyclists came toward my car like waves from the sea; a crowd blocked one street, gathered to read a job notice; there were beggars.

The Shantou Special Economic Zone lay on the edge of the city, contained only 1.6 square kilometers, and was just getting started. Director Liu Feng took me to the top of the administration building and waved a hand toward the site, now open land.

"We have two factories under construction and have signed ten letters of intent. The second half of next year we will really do the big things." In time, he said, there would be 250 factories, 50,000 workers.

But Shantou was not waiting for completion of its special zone to draw in investment. "Shantou city," Mr. Liu said, "has 150 factories producing export items. If investors wish to cooperate with these existing factories, they will receive the same preferential treatment as in the special zone."

THE DRIVE from Shantou northward to Xiamen (Amoy) takes seven hours. The green fields give way to hills, some terraced; population lessens; here and there farmers tend flocks of pretty white-throated geese. A long causeway leads to the island city. There were bicycle taxis with sidecars; storefront shops with cobblers, tailors, bakers, a dentist and his chair; the fresh smell of the sea.

Xiamen's Special Economic Zone, like Shantou's, was at the city's edge and still mainly on paper. But sites were being leveled, roads built, and the *cramp* of blasting signaled that the city would at last have an airport. The zone, official Wu Zhong said, was two and a half square kilometers, part of a larger export-processing zone.

"We're aiming for light industry, labor intensive, with little pollution. We offer special inducements for early takers and for partners with more advanced technology—electronics, appliances, precision instruments. And if the investor prefers to go into the city, he may gain the same concessions."

One U. S. company was already in the

city, R. J. Reynolds Tobacco International, Inc. It had a small operation producing Camel Filters cigarettes. They could be purchased only with certificates of foreign exchange, not with local currency. But R. J. Reynolds was looking to a larger market. "We have hopes of producing not just Camels," an American executive said, "but also a joint brand with China." A joint brand! That would open up all China with its billion-plus people.

BUSINESSMEN AND LEADERS of nations, I mused, have dreams like all of us, and pursue them; they are dreams because they are uncertain, and yet sometimes they come true. The future of China's Special Economic Zones depends on many things—an end to the world recession, the price of oil, foreign confidence that the present course in China will continue, the skill of the present leadership in pursuing that course.

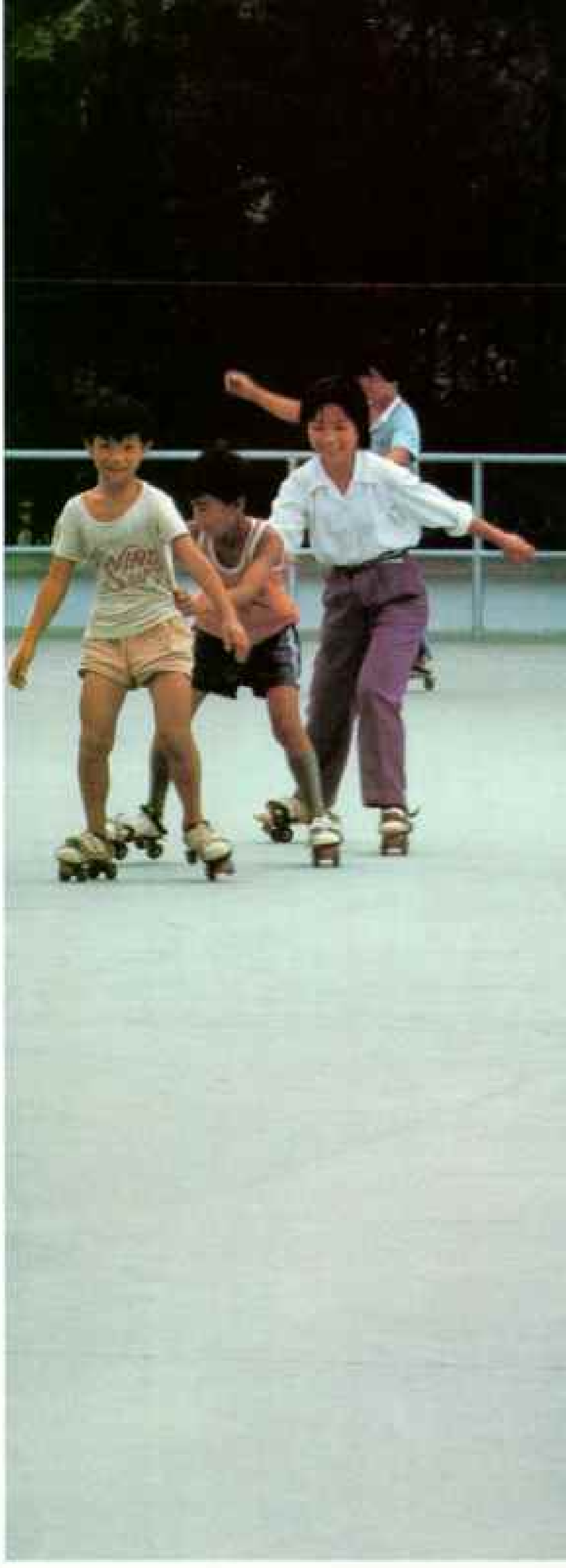
There are hazards. China has thus far drawn on Hong Kong's dynamic economy for investment in its special zones. But its declared aim of reabsorbing the colony, along with stiff replies from the British, had sent the Hong Kong dollar, its stock market, and real estate values plunging. There were reports of money flying to Singapore and the United States, of wealthy businessmen disappearing from the colony for a time, returning with new passports from small unlikely nations.

There was also the hazard of introducing Western opulence in a poor and struggling land: of having on the same street shops offering boutique eyeglasses and stereos and a government shop where clerks dispense rations of rice and other grains, 15 kilograms a month (33 pounds) for office workers, 14.5 for middle-school students, 22.5 for heavy laborers, 4.5 for infants. Supporters of the Cultural Revolution and the Gang of Four remain, quiet now, but eagerly awaiting the mistake, the tensions, that might provide an opening for their return to power.

ONE DAY I TOOK the hydrofoil from Shekou Industrial Zone to Hong Kong. As we slid across waters once haunted by pirate junks, opium smugglers, tea clippers, and British men-of-war, I recalled China's history of dealing with the West. In the mid-1800s British cannon in two wars—the Opium Wars—had forced open the doors.

Afterward a British historian optimistically wrote: "This vast empire, that had been so long isolated from the rest of mankind, and had looked with haughty contempt upon all the peoples outside of it, now undertook, unwillingly it is true, to enter into the comity of nations. . . . The men of the East would look in the face of the men of the West, not from behind frowning walls and loaded cannon, but in friendly intercourse and in growing mutual knowledge of each other's virtues. . . . The stagnation of ages was now to have an end."

In light of more recent history, that prophecy was premature. This time China opens its doors not under the threat of cannon, but of its own decision. Perhaps this time the historian's prediction will at last be proven true. □



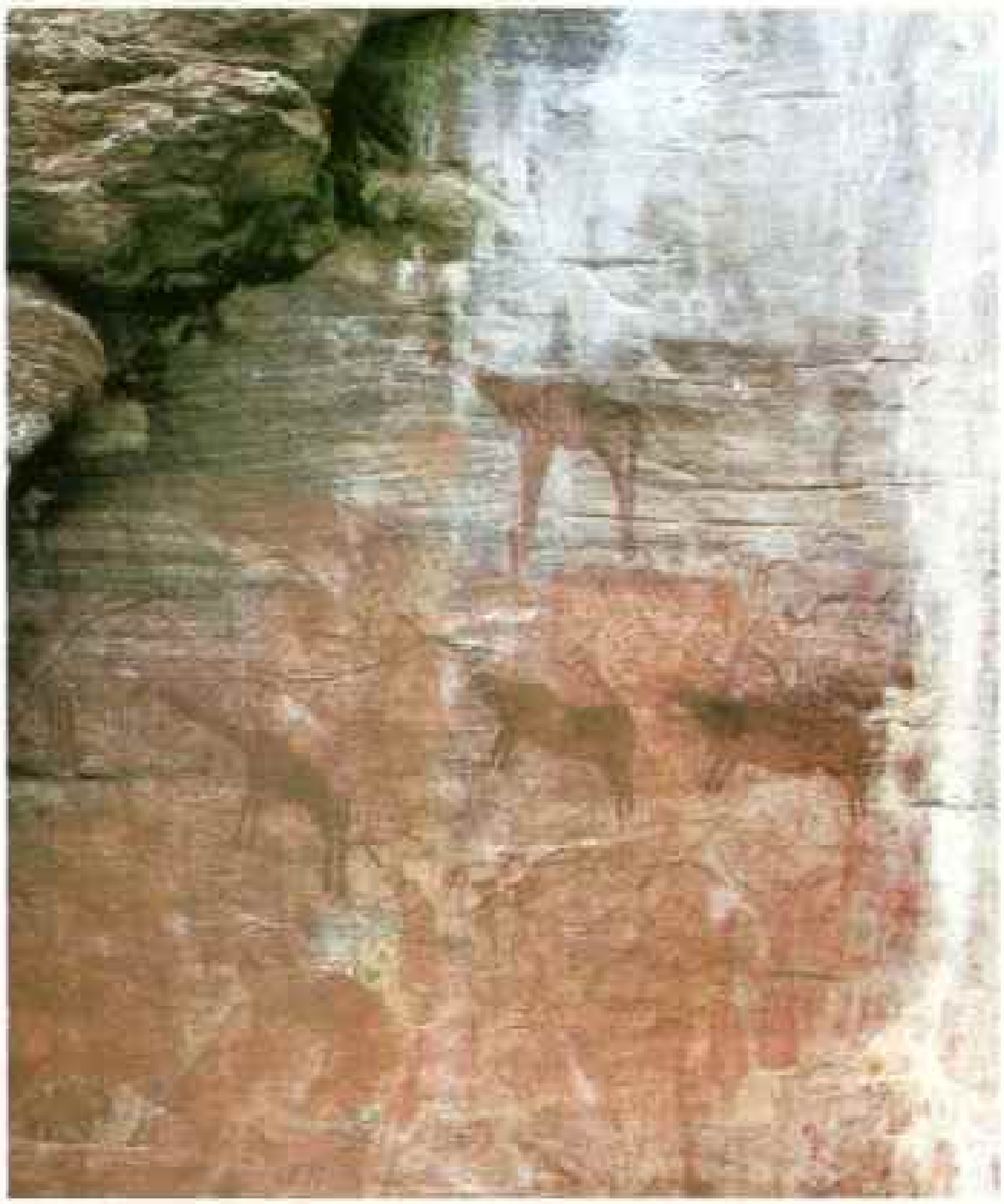
Joint venture *on a roll: Hong Kong visitors, at right, and local children try out a new rink at Zhuhai SEZ, which*

adjoins Portuguese-administered Macau. Planners hope to attract tourists —and someday welcome foreign oil personnel to the Zhu River region, when the price is right, and providing China and her new partners can keep their balance.

Tanzania's Stone Age Art

By MARY D. LEAKEY

Photographs by JOHN READER



IN TANZANIA'S remote central plateau region, a vast gallery of superb prehistoric art adorns cliff faces and rock outcroppings, above. The author, Dr. Mary D. Leakey, distinguished anthropologist and artist, first saw the paintings nearly 50 years ago with her late husband, Dr. Louis S. B. Leakey. She later made meticulous tracings of many of the scenes, right. The stylized human figures and remarkably realistic animals attest to the unknown painters' skill and artistry.

SEVERAL THOUSAND YEARS ago prehistoric artists in Tanzania, East Africa, produced a priceless and detailed record of various events in their lives. On the sheltered surfaces of cliffs and rock faces these Stone Age painters recreated the world around them in scenes reminiscent of the great prehistoric cave paintings of Europe.

Neither the identity of the artists nor the date of their work is known. It is doubtful that any of the paintings could have survived in open air more than several thousand years, although carbon-14 tests indicate that the coloring materials could be much older.

In many respects the paintings tell us more than we can learn from the bones and stone tools and other artifacts that form the basis of much of our archaeological study of man's distant past. Those long-ago works of art tell us, for example, that Stone Age man in Africa wore clothing, had a variety of hairstyles, hunted, danced, sang, played musical instruments, and may even have known the secret of fermenting spirits.

I first saw the Tanzanian rock paintings in 1935, on an exploratory trip with my husband, the late Louis S. B. Leakey. Having heard reports of the paintings, we visited the Kondoa region briefly at the end of our season's work at Olduvai Gorge. Sixteen years later, in 1951, we returned to Kondoa in order to study and record some of these superb paintings. The admission fee, as it turned out, was one goat.

The first evening after Louis and I had set up camp at a site known as Kolo, we were visited by local elders from the Irangi tribe. The elders informed us that the site of the paintings was sacred, and that in order for us to work there it would be necessary to sacrifice a goat to appease the resident spirits. Fortunately, the elders knew of a suitable goat; the price was 30 shillings (about $4).

I felt sorry for the poor goat and for the spirits, too, whose share of the sacrifice consisted of nothing more than the contents of the goat's stomach spattered on a rock wall among the paintings. As for the elders, they dined happily on roast goat and then departed, their duty well and faithfully performed.

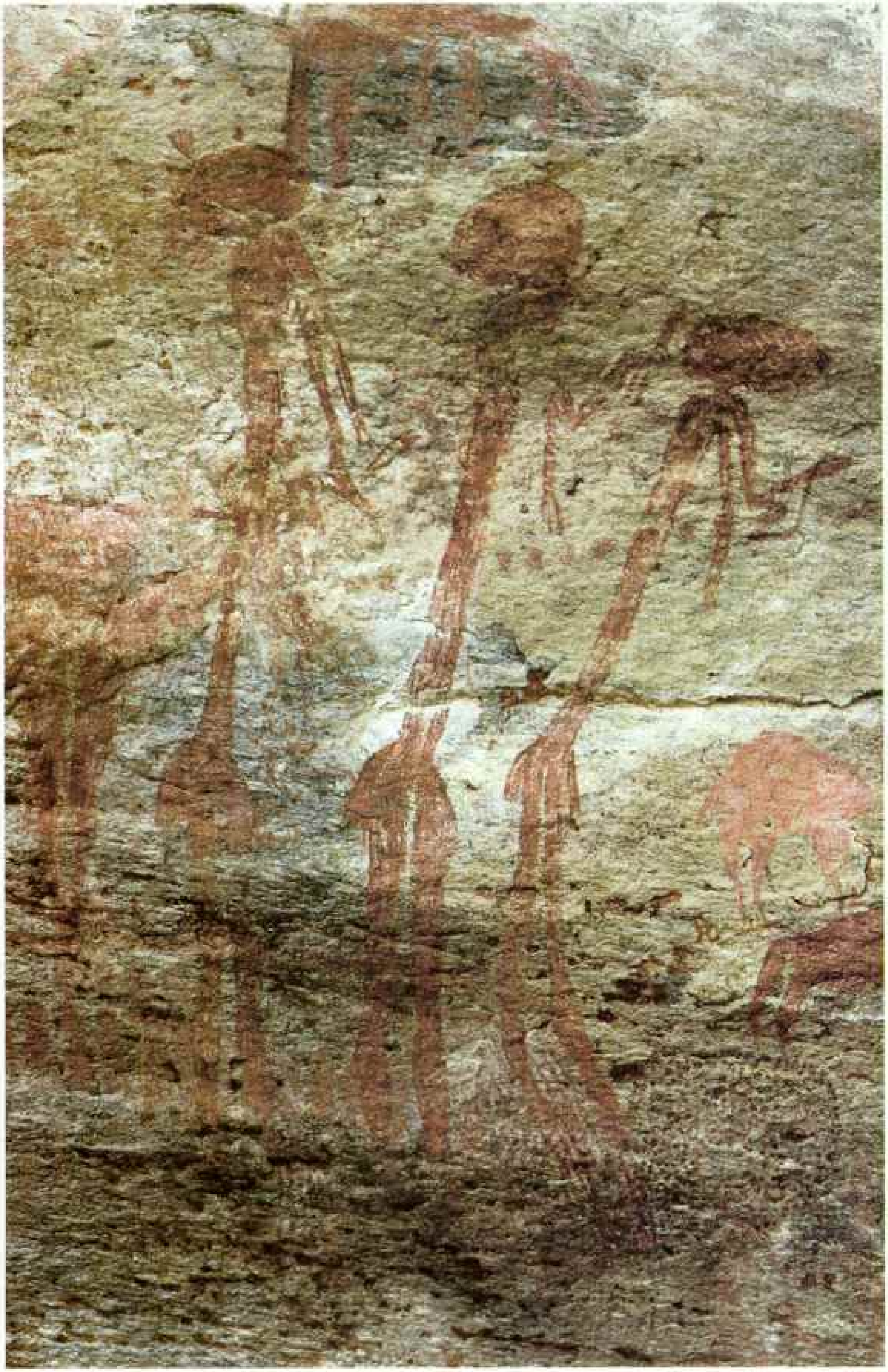
The next three months gave me more satisfaction *(Continued on page 92)*

*PREHISTORIC MURAL decorates a sheltered cliff face at Tlawi in Tanzania's Kondoa District (**above**). Rows of human figures wear what appear to be skirts and knee ornaments, costumes suggestive of dancers.*

In 1935 and 1951 the Leakeys cataloged 186 such rock painting sites scattered over some 500 square miles. Mystery shrouds the sites. No one knows who the artists were or, indeed, when they lived. The color on the walls probably could not have endured the battering of weather for more than a few millennia, even though carbon-14 tests point to a much greater age for the materials used as pigment.

At numerous sites the Leakeys found prehistoric "crayons" —sticks of pigment mixed with animal fat. The predominant red was made from ocher, which is derived from iron ore. Black probably came from manganese, and bird droppings may have provided the basis for the white.

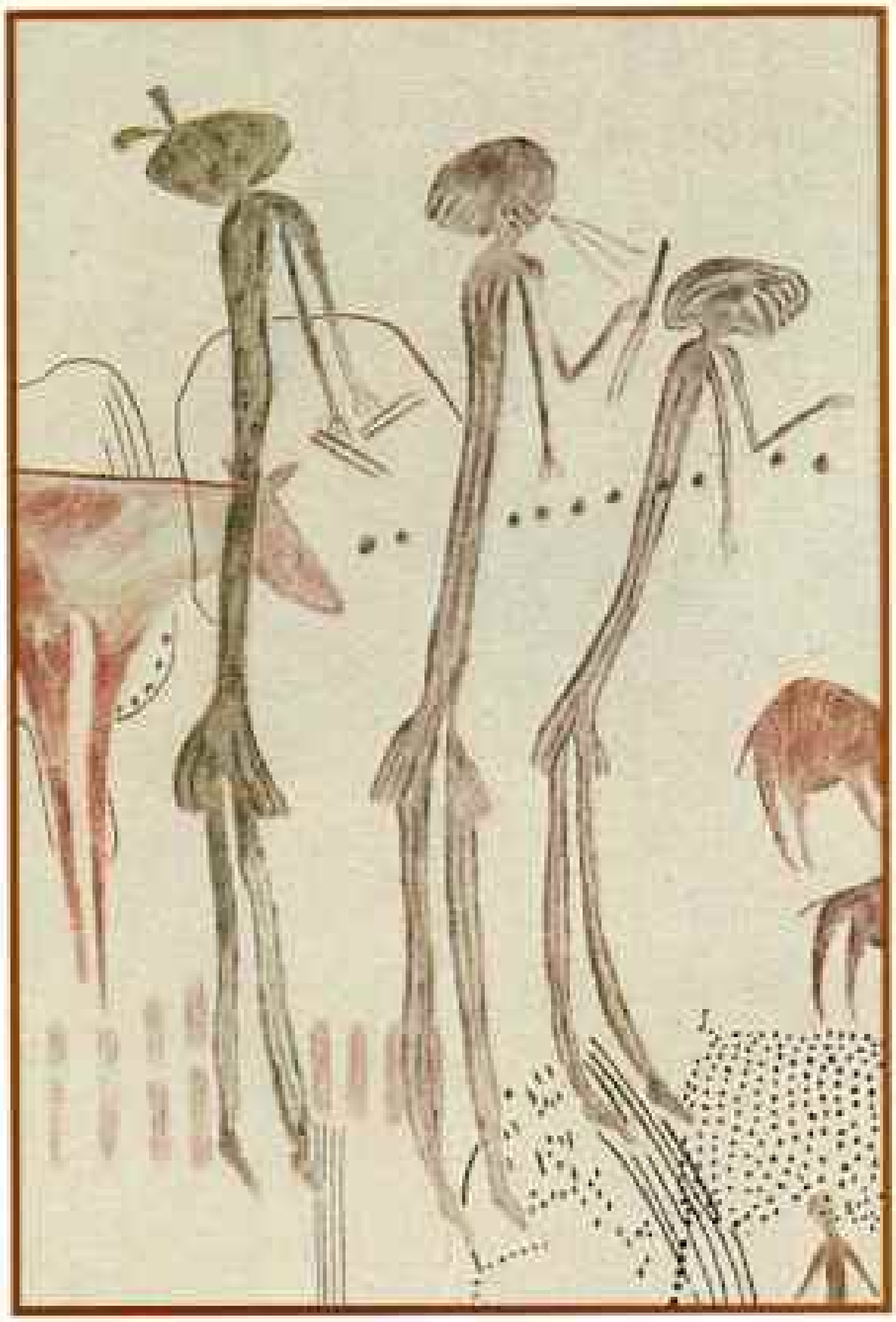
*Louis Leakey's 1951 photograph (**right**) shows the author on a scaffold at the Kolo site. To reproduce some 1,600 paintings, she traced scenes on cellophane taped to the rock, then reduced the tracings to half size. Mary Leakey's 128-page volume, Africa's Vanishing Art, will be published in October by Hamish Hamilton/Rainbird in London and Doubleday & Co., Inc., in New York.*



*MUSICAL TRIO adorns a rock face at a site called Kwa Mtea. A tracing (**below**) duplicates the actual scene (**left**) in which three figures perform to music. The figure wearing stylized plumes beats time with clappers, while music pours from the mouth of the central figure, and the one at right appears to dance. All three wear skirts, indicating they are female.*

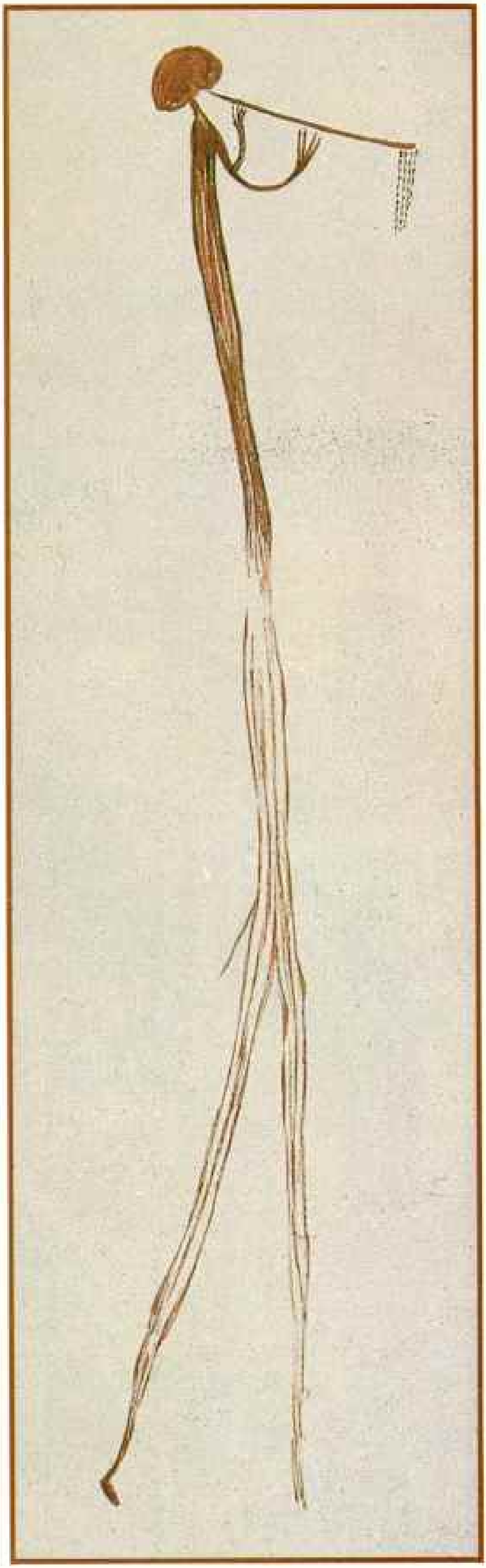
This tracing reveals that the figure at left was superimposed over an earlier rendering of an antelope. Fingertip prints, a common design, appear to overlay the other two figures.

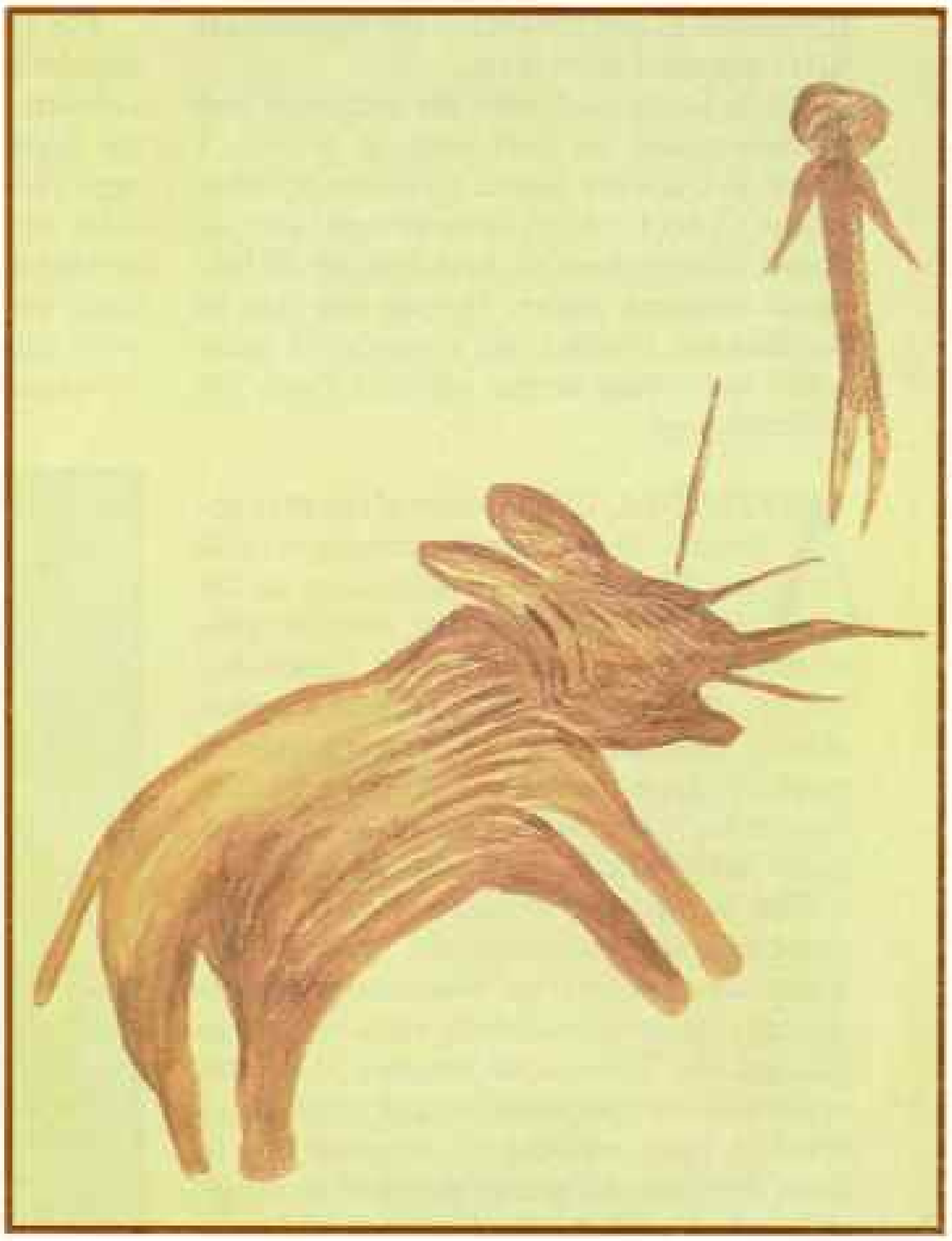
"Good painting surfaces were scarce,"



explains the author. "Later artists simply painted over the work of their predecessors, sometimes producing several layers of scenes."

*Although resembling the performers at Kwa Mtea, a pipe player (**right**) appears on a rock face at Pahi, 15 miles distant. Stylizations include four-fingered hands and musical notes that drip from the end of the pipe. The figure's tail-like appendage is a back apron, an item still worn by men of the San peoples in southern Africa, suggesting the pipe player is a male.*





*TRIUMPH OF THE ELEPHANT HUNT unfolds in two scenes. In one tracing (**left**) dancers cavort around an animal trapped in a stylized pit, corral, or net. The elephant itself is realistically drawn, the lack of tusks suggesting an immature animal. Scenes that predate the hunt include a giraffe, upper right, and two highly stylized human figures, far left, one with forklike legs and a spherical head, the other wearing what seems to be an enormous fringed helmet or headdress. Shieldlike designs appear at lower right.*

*In another tracing (**above**) a hunter hurls his spear at an enraged elephant. Animals pictured in the Tanzanian paintings are invariably large, suggesting that only major game was considered worthy of the artist's time and skill.*

Lacking cellophane sheets big enough for the larger paintings, the author taped smaller pieces together, and some of the photographs, such as the one at left, show the seams and tape.

(Continued from page 86) and pleasure than any of the countless archaeological projects Louis and I ever shared. Even now, after more than 30 years, I can still recall the sense of peace and serenity that surrounded the paintings and the aura of the distant past that emanated from them.

While Louis evaluated the paintings and recommended the best ones to record, I began to trace the scenes on sheets of cellophane taped to the rock faces and later reduced the tracings to half size on lightly tinted drawing paper. During our stay in the Kondoa District, we reproduced some 1,600 individual scenes selected from 186 different sites.

AT FIRST GLANCE many of the sites appeared to be merely indecipherable jumbles of scenes overlaid one on the other. Good painting surfaces protected from the elements were reasonably scarce, and in many cases prehistoric artists simply painted over their predecessors' work. In time, however, Louis and I "got our eye in," as he put it, and we could distinguish individual figures from one another.

The beauty and delicacy of some of the paintings are extraordinary, particularly when one considers that those ancient artists did not erase or correct their work as modern painters do. There is no blurring of strokes or abrasion of rock surfaces that would have resulted from rubbing or scraping out of lines. Perhaps the artists sketched in rough shapes first with charcoal or some other medium that has not survived.

The coloring materials consisted of various pigments mixed with animal fat to form primitive "crayons," whose remains we found at a number of sites. Ocher was the most common pigment, producing the predominant color, red, as well as the less frequent oranges and yellows. Manganese probably provided black, and bird droppings may have formed the basis for white.

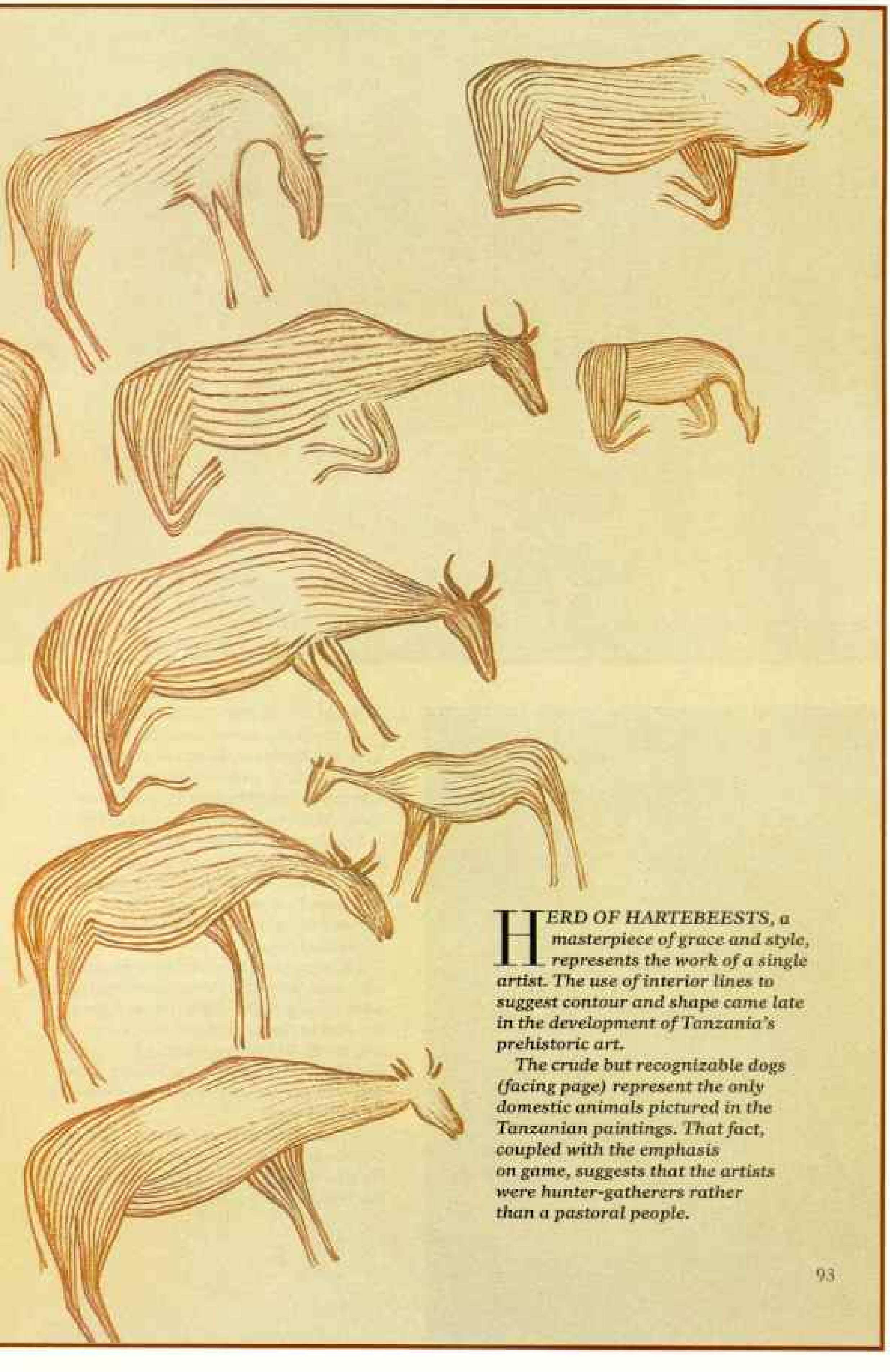
The prehistoric artists were obviously hunter-gatherers rather than a pastoral people, for the only domestic animal pictured anywhere in the paintings is the dog (above, right). Although we cannot date the paintings, Louis and I arrived at a rough sequence of styles that must have occurred.

The earliest figures were crudely drawn in rather thick black outline. These were followed by animals, stylized humans, and large dots apparently drawn by fingertips dipped in some sort of wet color. Then came an abrupt change in style.

The fingertip paintings were followed by wonderfully naturalistic outline drawings of animals in red. To my mind this is probably the finest period among all the rock paintings. Next came a technique of painting animals in solid red. A later style, which I believe to be unique to the Tanzanian paintings, consisted of animals whose bodies were filled in with sets of parallel lines to convey contour and shape (opposite).

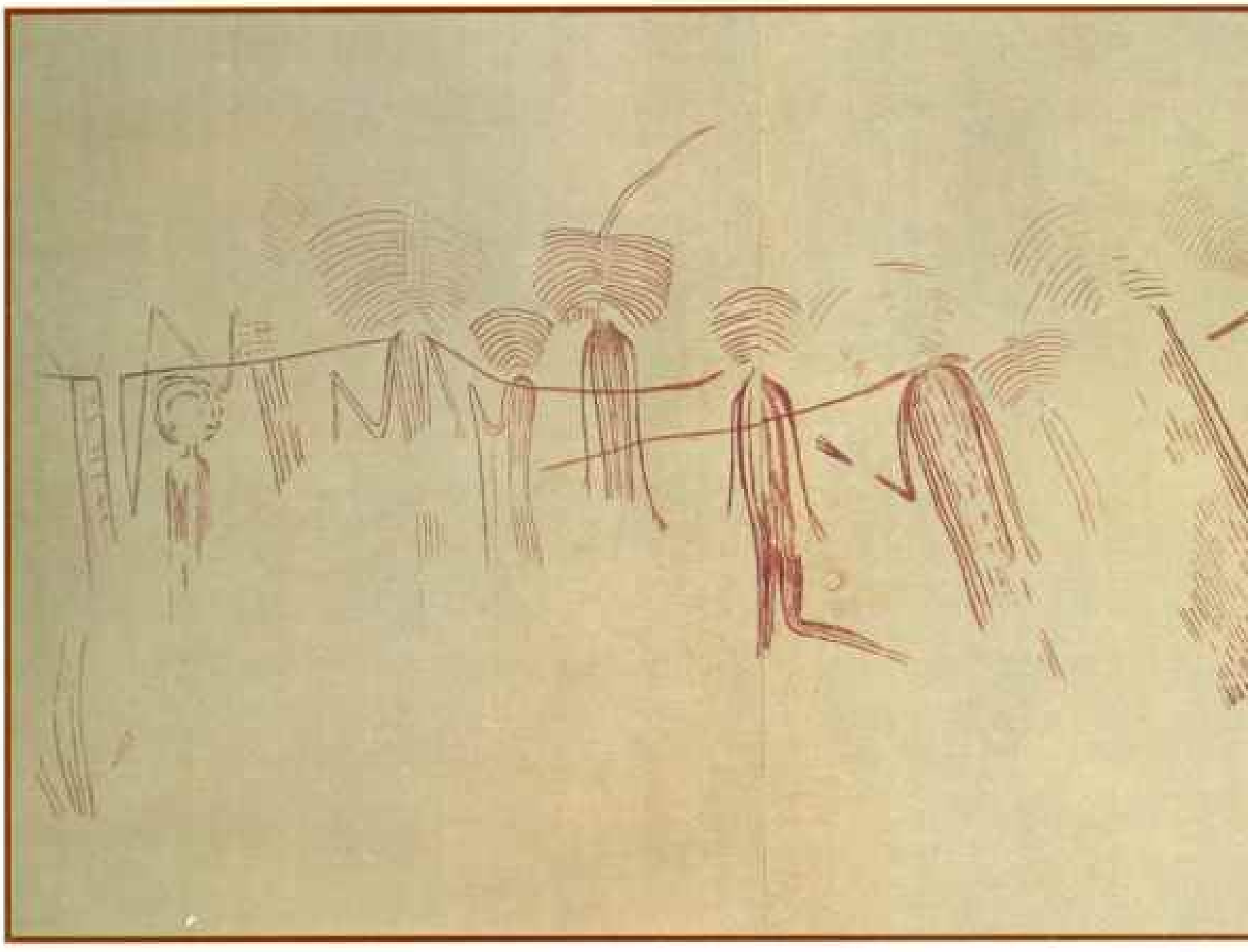
Finally, outline drawings came back in fashion, though they compare most unfavorably with the earlier outline style.

One notable characteristic among all the paintings is the complete absence of faces on the human figures. Even today many unsophisticated African tribes such as the Masai are reluctant to have their photographs taken for fear of "giving away" their images. In doing so, they put themselves in the power of others, who can then use the likenesses to work magic against the owners. Quite possibly Stone Age peoples held the same belief. (Continued on page 97)



HERD OF HARTEBEESTS, a masterpiece of grace and style, represents the work of a single artist. The use of interior lines to suggest contour and shape came late in the development of Tanzania's prehistoric art.

The crude but recognizable dogs (facing page) represent the only domestic animals pictured in the Tanzanian paintings. That fact, coupled with the emphasis on game, suggests that the artists were hunter-gatherers rather than a pastoral people.



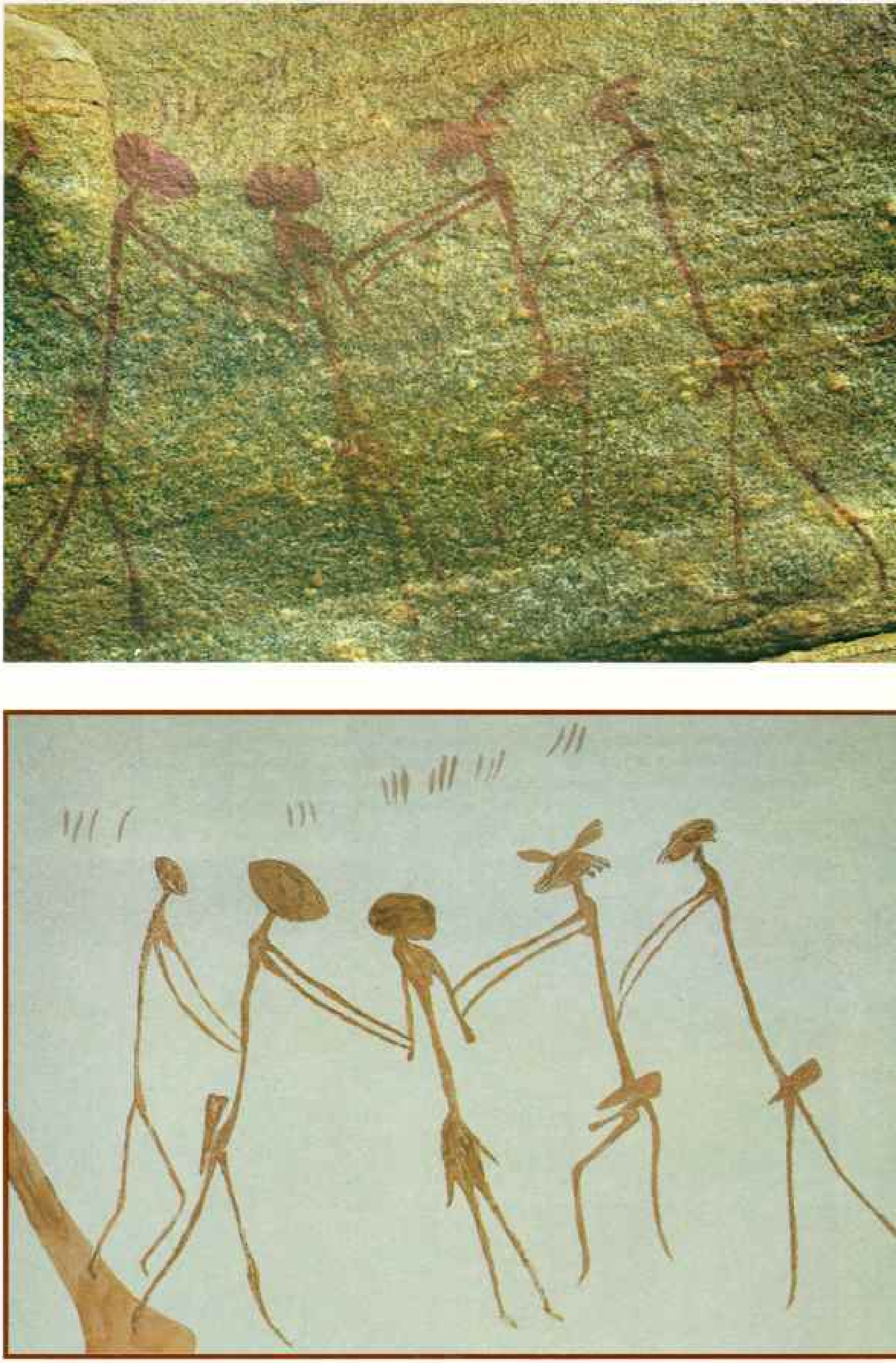
GRACEFUL PROCESSION moves single file across a tracing from the site known as Kundusi. Stylized human figures, possibly slaves roped together or warriors bearing staffs over their shoulders, troop from right to left.

The distinctive bushy headdress or hairstyle identifies the "Kolo-type" figure, so named by the Leakeys for the site where they were first seen. One exception appears at right center in the form of a dogheaded figure.

The marchers at far right are pictured with tails, probably from ornamental skins worn around their waists. Other figures are clad in cloaks, and one marcher at left wears a kudu horn protruding from his headdress. The small roundheaded figure and animals shown at lower right belong to an earlier work.

*A hint of violence connects two different paintings of Kolo-type figures (**left** and **right**). Although physically separated at the Kolo site by a distance of more than*

a quarter of a mile, the two paintings seem to depict the same three figures. In both cases one of them is pictured wearing stylized plumes on his headdress. In the first painting, the figures stand upright and are obviously alive, while in the companion scene they appear prostrate beneath a heavy bar. The author believes the trio must have been either captured or killed by enemies.



For some reason the theme of motherhood is also avoided, for there is not one instance among all the paintings of a woman either holding or in company with a child. I do not know whether mothers with children were considered unimportant or whether there was some magico-religious reason against portraying them.

AMONG THE HUMAN FIGURES there is incredible variety. Some are tall, some short, some have enormous fuzzy headdresses, while on other figures there is no suggestion of hair. Some figures appear to be naked, some wear bracelets or knee and ankle ornaments, some have long tails, others wear skirts, and still others are enveloped in cloaks.

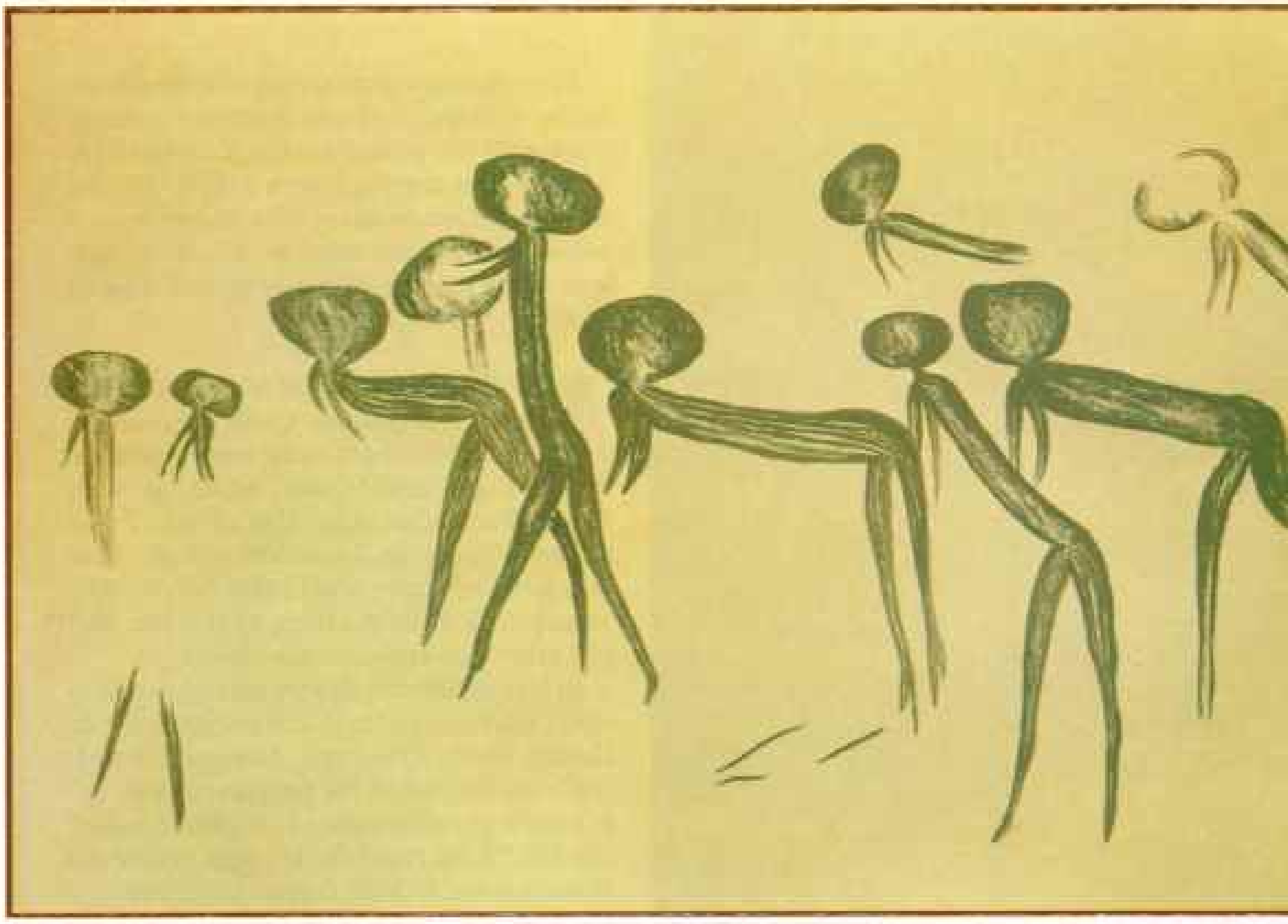
In fact the human figures are painted in so many different styles that it is impossible to classify them. One type, however, stands out from the rest in the frequency of its appearance at various sites. Louis and I named this the "Kolo type" for the spot where we first observed it. Kolo figures are invariably tall and thin, with headdresses or hairstyles that are very large and that sometimes include stylized plumes (pages 94-5). Kolo hands usually have only three fingers, with the middle one much longer than the other two. In addition, Kolo figures are often shown with thin, lionlike tails and with feet that seem to have either very long toes or something resembling high heels.

Music and dancing are frequent themes, and one of my favorite figures is that of a very elegant flute or pipe player whose music appears in the form of dotted lines dripping from the end of the pipe (page 89).

One painting suggests that Stone Age man may have been acquainted with alcohol,

TUG-OF-WAR for a female appears on a Kolo wall. The female, identified in this rare case by breasts, apparently belongs to the males at left, for her feet are braced against the pair at right. Sexual overtones are apparent in the penis of the figure wearing the doglike mask or headdress.

In an unrelated scene, right, an antelope butts a shield or panel. The author believes this may depict the early use of a hunting blind.



Frolicking beside a river, *bathers emerge from the water in this tracing of a scene at Kolo. The air of rejoicing may stem from a welcome age-old event—the*

probably honey beer or palm toddy. The evidence is tenuous, but the painting shows three gourds bubbling over with liquid in a manner suggesting fermentation.

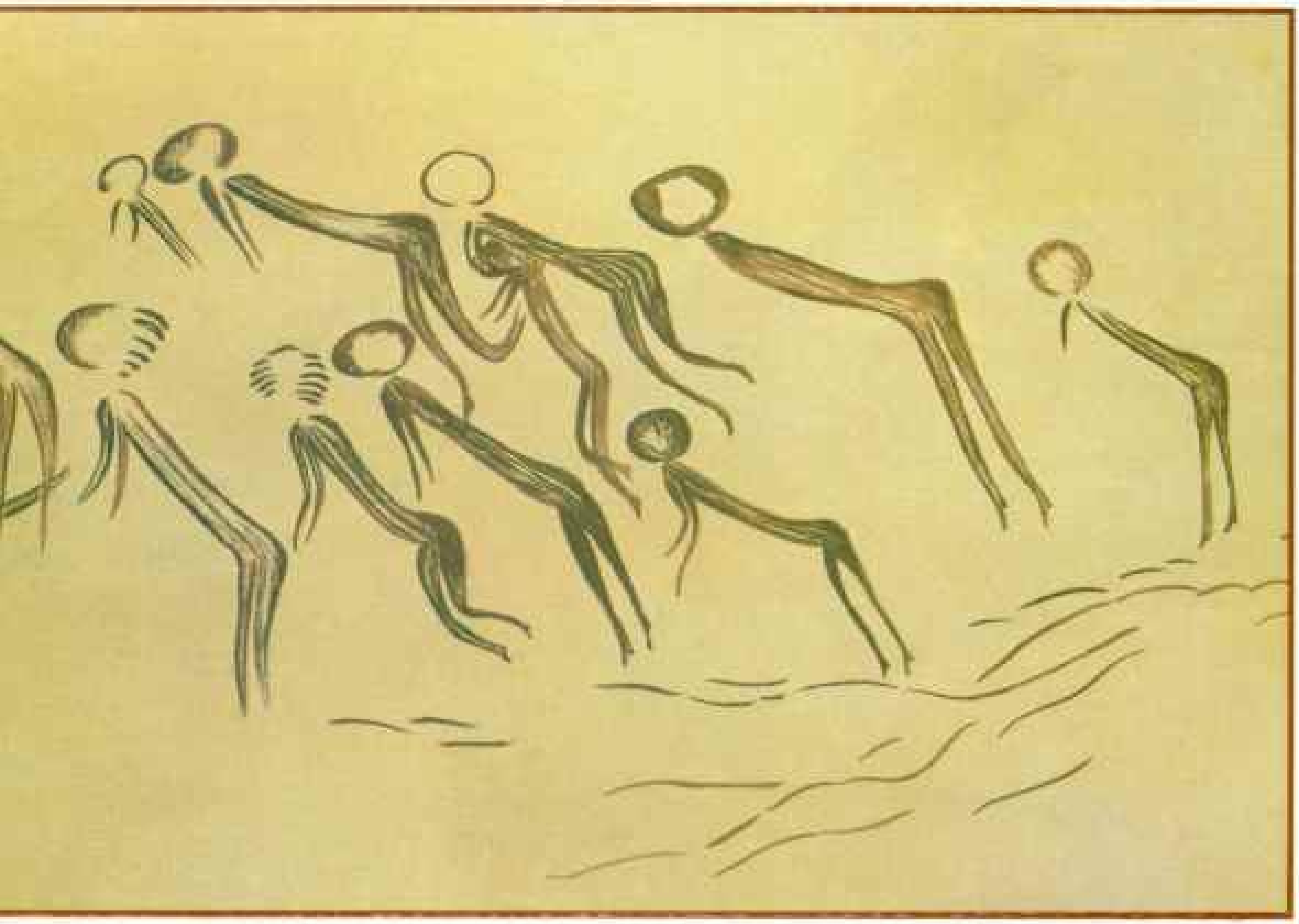
Although the paintings of animals in most cases are extremely realistic and well proportioned, they are almost always drawn in profile with all four legs showing but usually lacking hooves. This may be a stylization or simply an indication that animals were usually seen standing in grass.

In spite of their talent for realism, the Stone Age painters took certain artistic license. They often exaggerated the salient features of various animals. For example, snakes are shown with more loops than they normally have. The kudu, an antelope with horns that always have fewer than three complete spirals, is sometimes depicted with as many as eleven spirals. Roan antelopes with their characteristically large ears are drawn with that feature greatly exaggerated.

Yet the prehistoric artists were capable of subtle distinctions among animals. At one site called Kisese, Louis and I came upon two magnificent paintings of white rhinos. The anatomic details were so precise that it was instantly clear the creatures were white rhinos rather than black ones. The heads had the characteristically square shape common to white rhinos as well as the distinctive hump between head and shoulder that is lacking in black rhinos.

The two rhinos were portrayed in the familiar courtship pattern that Louis and I often observed at Olduvai—that is, with the female following closely behind the male. On more than one occasion we had been amused to see male rhinos apparently running for their lives, pursued by determined females thundering along behind.

Stone Age artists tended to be selective of subjects on the basis of size. Among the Tanzanian paintings small creatures such as hyraxes, hares, and little antelopes are rarely depicted, although we know from the bones found at the sites that these Stone



end of the dry season. In one example of perspective, the figures appear in increasing size from the right, as though approaching the unseen artist at left.

Age people regularly ate such animals.

The artists concentrated instead on large animals such as elephants, giraffes, rhinos, and the carnivores. Plainly, the killing of a large animal, which would provide food for many people, was considered of greater significance than an average small kill. Thus the number of elephants painted probably does not reflect the number killed, but rather the importance of such events.

The emphasis on carnivores puzzles me. It seems unlikely that they were a major source of food, except for the meat that could occasionally be scavenged from their kills. It is possible that Stone Age man regarded big carnivores such as the lion with the same respect shown it until recently by certain modern African tribes. Among the Masai, for example, a young warrior did not achieve full stature in the eyes of women until he had killed a lion; such a feat was considered proof of manhood. If Stone Age man held similar beliefs, the emphasis on carnivores in the paintings can be understood.

THE FUTURE of Tanzania's superb prehistoric art worries me greatly. Roads have now been constructed to the more spectacular sites, and vandalism increases. Visitors sometimes drench the best paintings with buckets of water to bring out color, others scrawl their names, and herdboys amuse themselves by throwing stones at the figures of men and animals. As a result, two of the principal sites that Louis and I recorded in 1951 have been tragically defaced beyond recognition, and for others it is only a matter of time. Some years ago the Tanzanian government erected wire fences around the more important sites to protect them from vandals. But the doors of the fences were soon stolen, and sites were wide open once more, as they are today.

The 186 sites that Louis and I recorded in 1951 are actually a small proportion of the total number in Tanzania. Some means must be found to protect and record them, lest these unique Stone Age works of art be lost forever. □

Prying open an icy trap, the author and his crew push ahead along the route of

Arctic Odyssey

By JOHN BOCKSTOCE Photographs by JONATHAN WRIGHT
Paintings by JACK UNRUH

a great Eskimo migration across the North American Arctic a thousand years ago.

SPOTTING an approaching gale, we turned and ran before the wind, heading for the safety of shore. Even in summer the temperature of polar seas remains near freezing, and a man overboard is likely to suffer hypothermia and drown.

Through driving rain we fought to steer our 32-foot walrus-skin boat toward an evil-looking beach a few hundred yards away on the coast of the Canadian Arctic. As we rode in on dangerous ground swells that occasionally thrust our outboard's propeller out of the water with a scream, I saw rocks that posed an additional peril. One blow would have been enough to puncture our hull.

Hanging onto the gunwales, the five of us careered ashore. Even as we grounded on the sand, we were out of the boat, hauling it beyond reach of breakers. Quickly the outboard motor was removed from the stern,

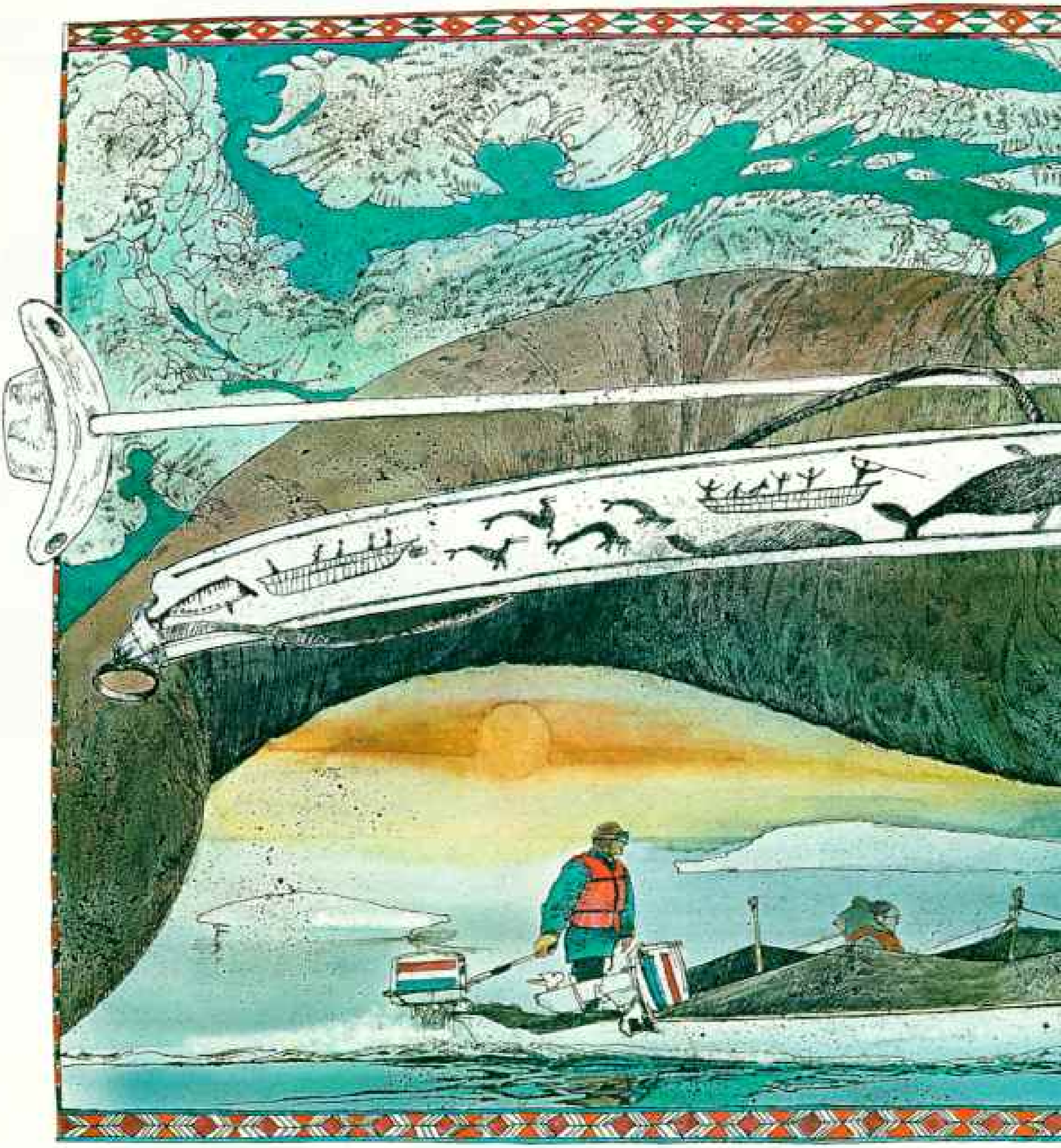
the hull was emptied of gear and supplies, and the boat hauled farther up the beach.

Lifting together, we tipped the boat over on its side, then propped it up with oars and poles to form a rainproof shelter (pages 116-117). Within five minutes water was boiling on our portable gasoline stove.

"Not bad," Billy Cockney remarked with a grin as we sipped hot tea and waited out the storm. "You guys are getting more like Eskimos every day."

The remark was a compliment, for Billy is an Eskimo himself, yet his words held added meaning. He was referring not to modern Eskimos but to their distant ancestors, who had traveled these seas before us and whose route we were now attempting to follow. As we huddled beneath the shelter of our boat and gazed out on the windswept sea, those long-ago voyagers crowded close among us.

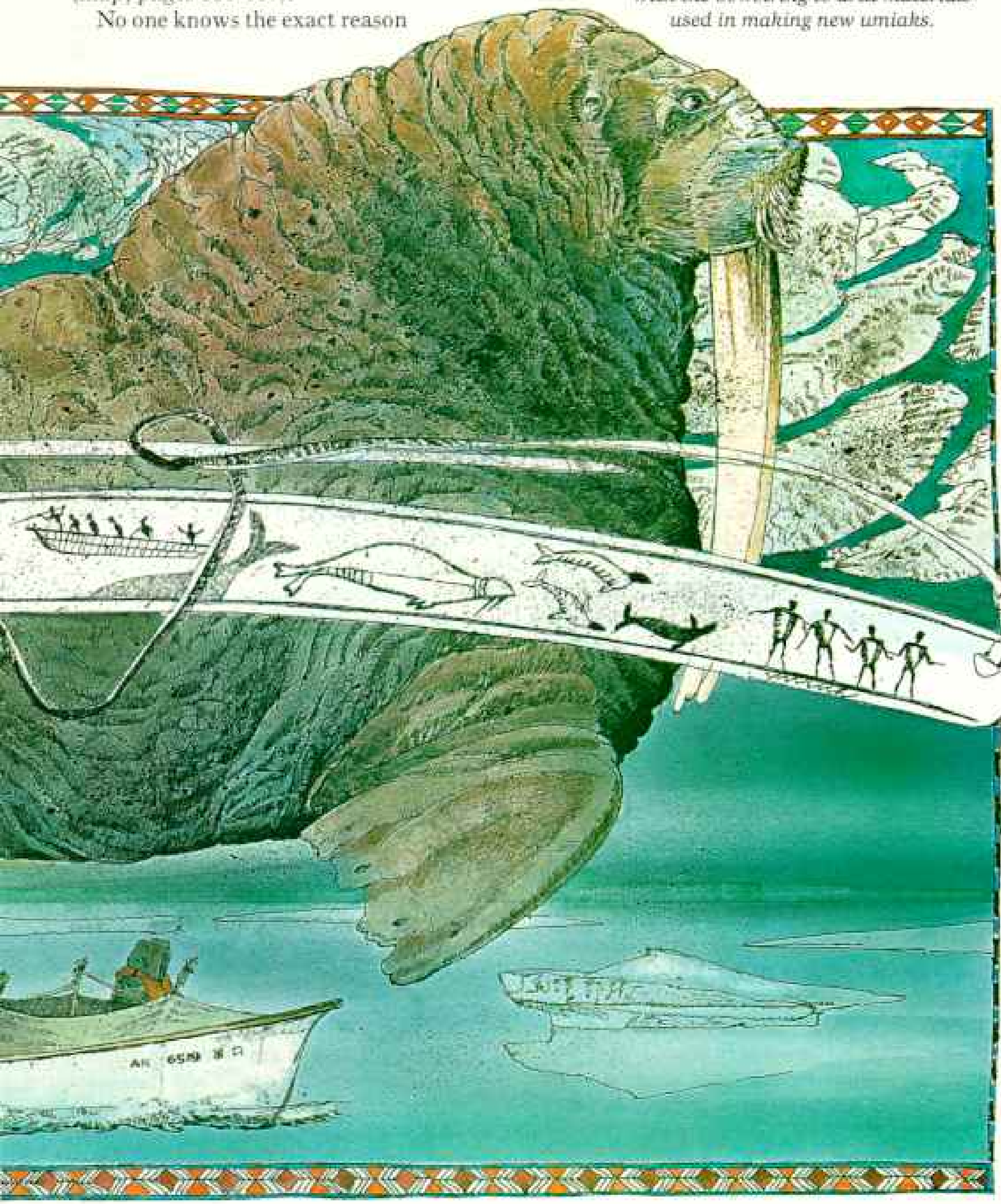
They were a remarkable people, known to anthropologists as the Thule Eskimos—



direct ancestors of today's inhabitants of northern Alaska, the Canadian Arctic, and Greenland. Probably the Thule Eskimos originated in northeastern Asia and eventually made their way to Alaska. Around A.D. 1000 the Thule gradually migrated from the Bering Strait region, moving eastward across the Canadian Arctic to Greenland—a distance of more than 3,000 nautical miles (map, pages 106-107).

No one knows the exact reason

Tough enough *for impact with ice, walrus skins formed the author's umiak, an open boat for hunting or hauling cargo. The fearsome walrus gave Eskimos meat as well as skins and ivory for weapons and tools, such as this bow drill depicting hunting scenes. The long shaft, steadied by a mouthpiece, was spun rapidly with the bowstring to drill materials used in making new umiaks.*



for the Thule migration, though climate was probably a factor. During the same period a warming trend in the Northern Hemisphere affected the seasonal movement of migratory game such as seals, walruses, and bowhead whales. Being expert hunters whose lives depended on game, the Thule people doubtless were influenced by the trend. They may also have spread eastward in search of new hunting grounds as population pressure depleted the old ones.*

Whatever the cause, the Thule Eskimos moved steadily eastward over a period of a century or more. In the course of their migration they absorbed or replaced the much older Dorset Eskimo culture that had dominated the Canadian Arctic for 1,800 years.

Thus the Thule migration drastically altered the pattern of human life in the North American Arctic down to the present day. In Eskimo terms the event was as profound and far reaching as Europe's conquest and colonization of the New World.

AS AN ETHNOLOGIST and longtime student of arctic history, I have long been fascinated by the Thule people and their extraordinary migration. How did they accomplish it? What route did they take? What challenges and dangers did they overcome?

One thing appears certain: Much of the route lay over water, and the Thule Eskimos traveled part of it by umiak—the traditional open boat of seal or walrus hide stretched over a frame of driftwood. Such craft served the Thule people over centuries both for hunting and transportation, and the design has changed little. The Eskimos at Point Hope, Alaska, still use smaller versions of the umiak to hunt bowhead whales, but elsewhere the skin boats are disappearing.

I first visited Alaska in 1969 as a graduate student in archaeology. During my early years in Alaska I often marveled at the umiak's versatility and durability. The boat's frame is lashed together with sealskin thongs rather than joined by bolts or nails. The result is a remarkably supple craft that can withstand heavy seas and survive shocks that would shatter a hull of wood or fiberglass. Such traits are essential in arctic waters, where sudden storms are commonplace and ice floes are a year-round hazard.

From the moment I took my first ride in an umiak, I determined one day to use a skin boat to follow the route of the great Thule migration. It was not until 1971, however, that I came across an abandoned umiak frame on a beach near the Alaskan town of Nome.

With the help of my friend Dwight Milligrock, a Diomede islander whose people still build umiaks, I replaced the frame's broken sections and relashed it with new sealskin thongs. Then I hired several Eskimo women in Nome, first to scrape and later to sew half a dozen new walrus hides together with braided caribou sinew. Finally Frank Ellanna, another Eskimo, cut and fitted the hides securely to the frame with walrus-hide rope. My umiak was ready for sea.

In 1972 I sailed the coast from Nome to Cape Bathurst on the Beaufort Sea. Using the craft with an outboard motor as present-day Eskimos do, I continued over the next several years to make archaeological surveys along Alaska's western and northern coasts. In addition to my interest in Eskimo history, I have specialized in the study of the 19th-century American whale fishery in the Arctic and have examined many whalers' winter settlements ashore. Always at the back of my mind, however, lay the thought of an umiak voyage across the Canadian Arctic. In 1977 the chance finally came.

Through its long interest in polar research and exploration the National Geographic Society agreed to support an expedition by umiak across the Arctic from Alaska to Greenland. Since I had already explored the coastal waters as far as Cape Bathurst, I planned to begin my voyage at the small Eskimo community of Tuktoyaktuk near the mouth of the Mackenzie River. From there I would make my way northeastward along Canada's northern coast, where the scattered remains of Thule settlements mark the stages of their prehistoric migration.

With luck I might reach the northwest coast of Greenland as the Thule Eskimos eventually did, but I would gladly settle for Cornwallis Island, one of the great crossroads of their migration and also a hunting site for the earlier Dorset Eskimos.

*Peter Schledermann traced the Thule migration in "Eskimo and Viking Finds in the High Arctic," NATIONAL GEOGRAPHIC, May 1981.

TRAVEL in the Arctic, especially in an open boat, can be difficult at the best of times. To reduce the risks, I spent a year collecting the proper equipment and assembling a team of experienced arctic hands. My two mainstays were Pat Hahn, a longtime friend from Nome, and Billy Cockney, a Canadian Eskimo hunter and trapper from the village of Inuvik.

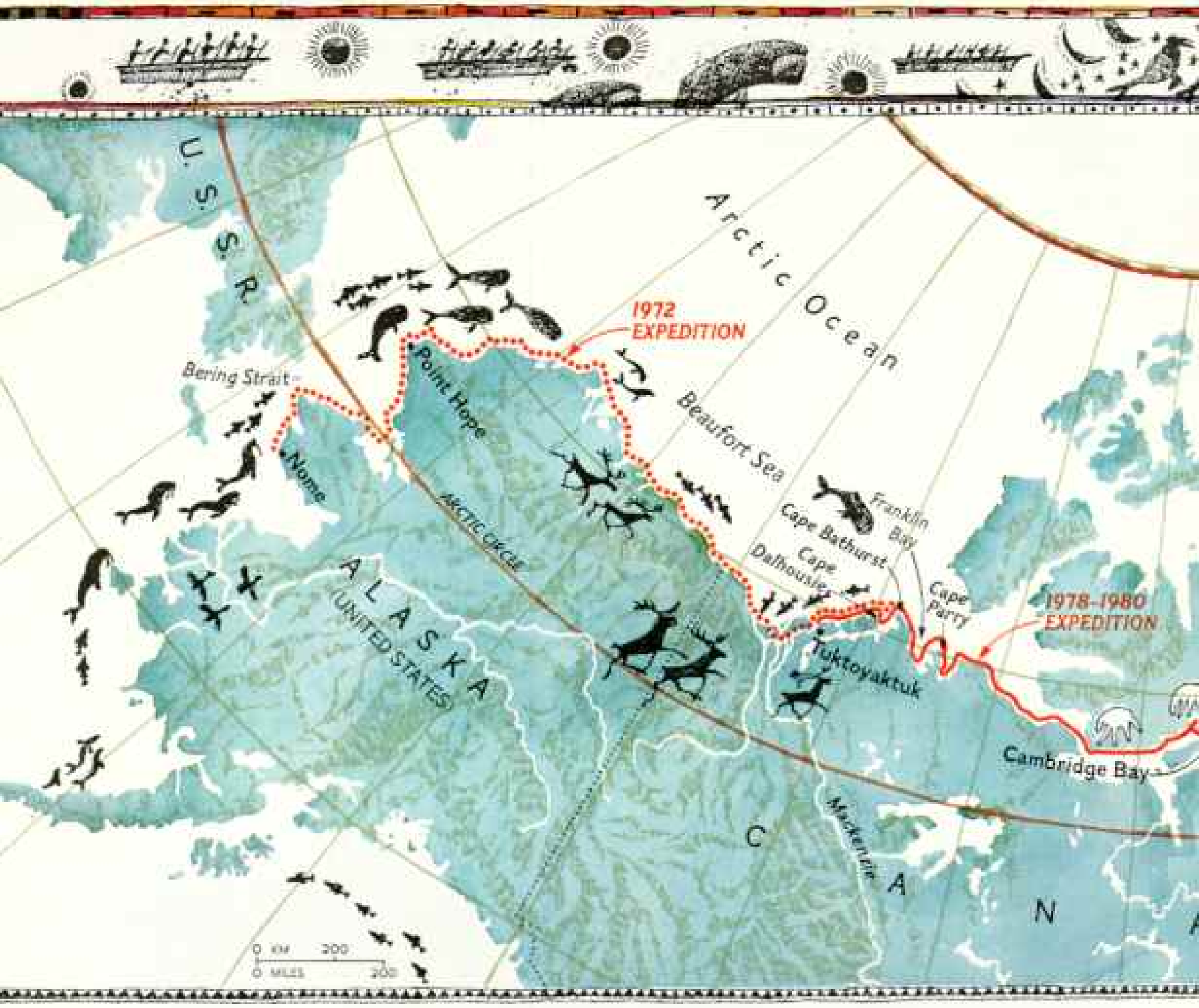
My wife, Romayne, who had spent several seasons with me in the Arctic, volunteered as cook for the first leg of the voyage, and the GEOGRAPHIC assigned an outstanding freelance photographer to the expedition—Jonathan Wright, an expert mountain climber from Colorado. The remaining team members: Pat Hahn's older brother, Ken, and two Eskimos—Bib Tevuk of Nome and Ashley Long of Point Hope. Others joined us for part of the voyage.

To strengthen the umiak, I installed a steel runner along the keel and a steel brace in the stern. For safety and extra space on the voyage I added a second boat, a 20-foot-long canvas-and-cedar freight canoe of the type commonly used in the Canadian Arctic. The canoe and the umiak each carried a 35-horsepower outboard motor and a spare. Under ideal conditions the two boats could average eight knots.

In early July of 1978 our team assembled at Tuktoyaktuk. The summer thaw turned out to be much later than usual, and ice still barricaded the village's small harbor. After a frustrating two weeks the ice finally cleared, and we left Tuktoyaktuk on July 16, setting a course northeastward along the coast toward Cornwallis Island, by our route a distance of some 1,600 sea miles.

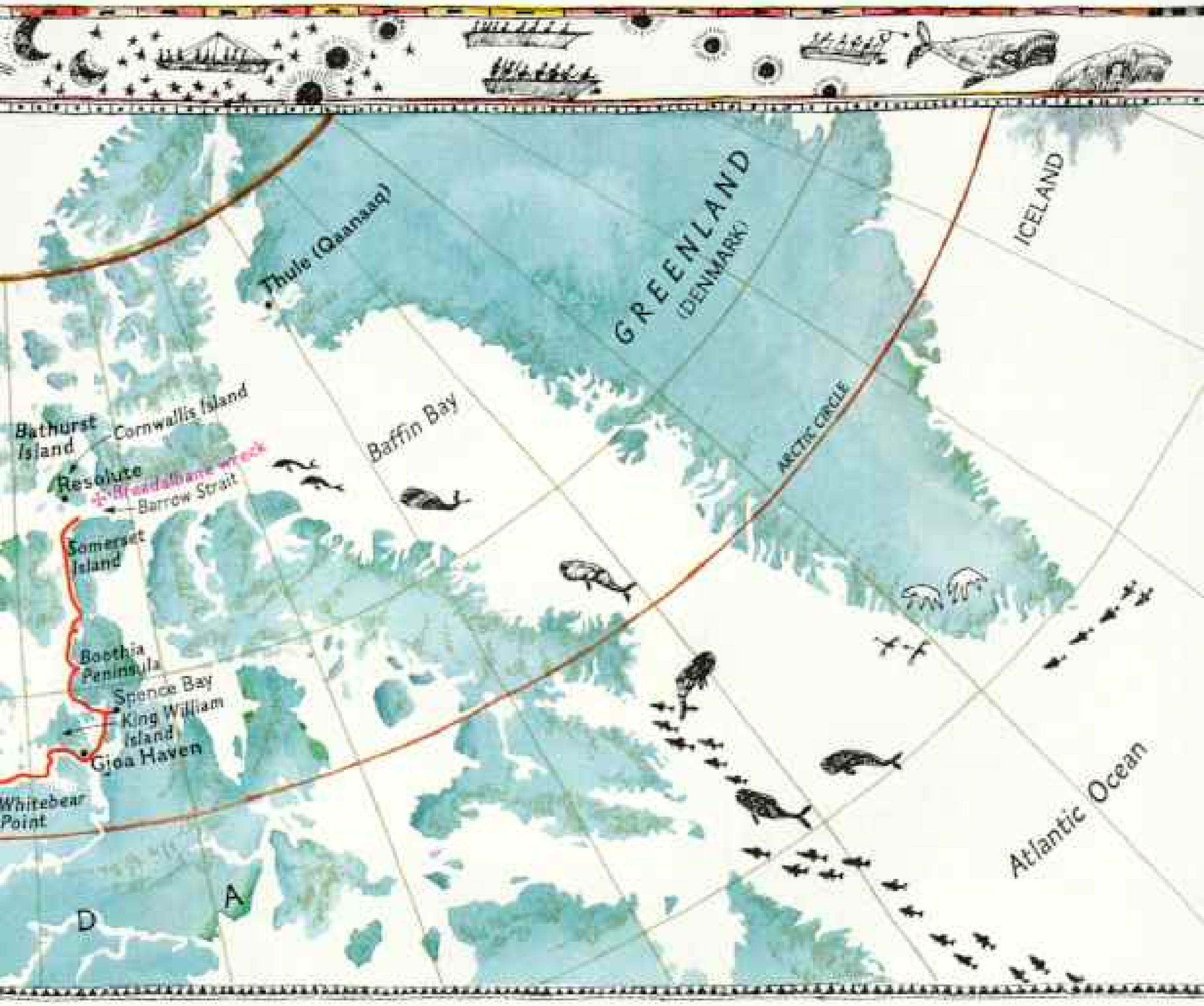
After more than a year's preparation it was good to be under way at last. Traveling side by side about a hundred yards apart, the two boats skimmed a mirror-smooth sea laced with fog wisps and dotted here and there by small ice floes. To the north of us the midnight sun hung liquid red on the horizon, and to our right a featureless coastline of tundra slipped *(Continued on page 112)*

Prehistoric wanderers *left clues about their mobile culture all across the far north. A ring of stones found by the author* ***(above)*** *on Boothia Peninsula held down one of several skin tents at a Thule summer camp, from which hunters set out after fish, seals, and other sea mammals. Thule families moved inland in the fall to hunt caribou for skins to make winter clothing. The remains of their sod houses on Cape Parry still contain fragments of wood, bone, and ivory tools.*



THE VERSATILE UMIAK helped set Thule Eskimos apart as a maritime people. Lightweight yet durable, its flat-bottomed hull could carry two dozen hunters into deep waters in pursuit of a giant bowhead whale—or safely transport several families and their belongings across a shallow bay. With kayak and dogsled, it gave Thule hunters the mobility to exploit a wide range of arctic game.

The umiak's design had changed little from the days of the great Thule migration of about A.D. 1000 to the summer of 1971, when the author determined to secure one for a journey retracing their route. Traditional sealskin thongs lashed the frame, but it was reinforced by a steel runner on the



keel and a stern brace. The hull was sealed watertight in the traditional way, by skillfully sewing braided caribou sinew into each seam. Then the hull was painted for extra protection, a canvas spray screen added to keep the crew dry, and a 35-horsepower outboard motor fitted to the stern in the fashion of umiaks still used in northwest Alaska.

His boat proved its worthiness for arctic travel during a survey trip in 1972 along Alaska's northern coast. It was from this area ten centuries ago that the Thule people set forth on their eastward migration during a warming period in the arctic climate. Under pressure from growing populations and shrinking hunting grounds, Thule families pushed eastward across Canada's northern coast, eventually coming into contact with groups of the vanishing Dorset culture, another Eskimo people whose ancestors were the first humans to occupy these harsh lands 4,000 years before. The successful adaptation of the Thule immigrants to eastern Canada and later Greenland accounts for the many similarities found today among the dialects and cultures of their descendants from one end of North America to the other.

The author's expedition along the path of the Thule migration took three difficult summers, from 1978 to 1980. Fighting drifting ice floes, blinding fog, sudden gales, and draining fatigue, he and his crew gained a new respect for the voyagers who went before them.

Wings of youth *flash skyward in a rough-legged hawk nest* ***(left)****. Along with several hundred million other birds summering in the far north, these young hawks will flee south to escape the brutal arctic winter. Only a handful of land birds stay behind: the raven, snowy owl, gyrfalcon, and ptarmigan. A scattering of seabirds also remains to search the ice for open water.*

At the bow of the umiak, Bib Tevuk ***(below)*** *scans the water ahead. He and fellow voyagers Ken and Pat Hahn helped the author excavate archaeological sites near Nome, Alaska, before joining the crew in 1978. Ashley Long was hunting whales at Point Hope when he first met the author. And Billy Cockney, a young Canadian, was hunting and trapping in the Mackenzie Delta. The author's wife, Romayne, signed on as the expedition's chief cook.*

It looked so easy *the first night out from Tuktoyaktuk as they skimmed across glassy water beneath a sun that never set. By pushing hard in good weather and taking two-hour shifts of duty, the crew hoped to complete the journey to*

Cornwallis Island by summer's end. But it was only a matter of hours before they ran into massive ice fields near Cape Dalhousie, the first of many along their 1,600-mile route that time and again stopped the voyage cold.

(Continued from page 105) slowly past.

The effect was magical, and despite the belated summer thaw I began to think our troubles might be behind us. In fact, they lay directly ahead. Within hours we encountered iceblink, the telltale reflection against the clouds of ice fields beyond the horizon.

"Bad luck," Pat remarked beside me in the umiak, and the ice soon materialized—an unbroken band of white along the darkening sea before us. The band gradually widened into a great expanse of solid ice stretching north and east as far as the eye could reach. Relentlessly the ice hemmed us closer and closer to shore until at last we grounded on a speck of land ironically named Relief Islet on our charts.

IT WAS A NAME we were to recall often in the weeks that followed—Relief Islet, symbol of unrelieved frustration. For so it seemed in the ensuing struggle against the ice and contrary winds that were to plague us the remainder of the summer and rob us of all hope of reaching Cornwallis Island that year.

A reconnaissance from Relief Islet confirmed the bad news—no open water to seaward and only a narrow lead between the ice pack and the shore. We had no choice but to follow the lead and hope it wouldn't turn into a dead end. It never did, but the effect was almost as bad. The water was so shallow in spots that the outboards were useless. For miles we had to pole our way along or get out in hip waders and drag the boats ahead.

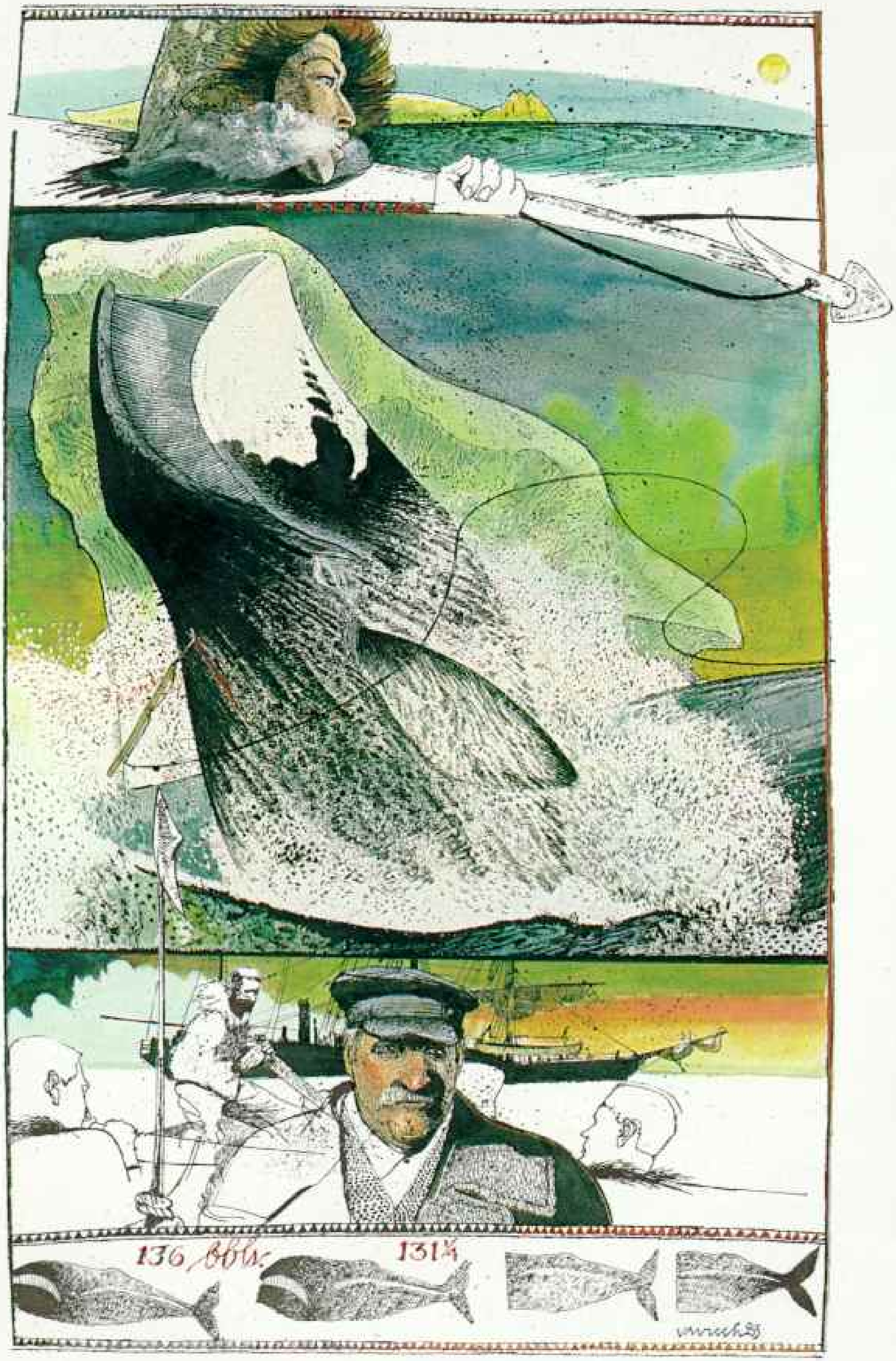
Romayne wanted to take a regular turn at poling and dragging the boats. When I pointed out that she was the expedition cook, she remarked dryly: "I'll trade that camp stove for a pole any day!"

In some ways the ancient Thule Eskimos had had it easier than we did, but in most ways their mode of travel was harder. In good weather and open water they had to paddle heavily loaded umiaks every mile of the way, whereas we had the outboards.

On the other hand, they had neither a timetable nor a precise destination such as we had. When drifting sea ice or adverse winds barred the way, they simply chose another direction or came ashore and camped until conditions improved. When autumn freeze-up came, they could either camp for the winter or load their umiaks on dogsleds and continue over land and frozen sea.

After five days and more than 40 miles of poling and hauling, the ice finally relaxed its grip on us. Beyond Cape Dalhousie the ice pack gave way (Continued on page 119)

Chased toward extinction *by commercial whaling fleets from New Bedford and San Francisco, the mighty bowhead whale (**right**) was hunted by Eskimos for centuries without depletion. But Bering Sea stock shrank by 90 percent between 1848 and 1914, under assault by Yankee whalers. Although restricted today, whale hunting still plays a key role in Eskimo art and culture, as symbolized by a beluga whale (**below**) carved from a caribou antler by Billy Cockney in a quiet moment.*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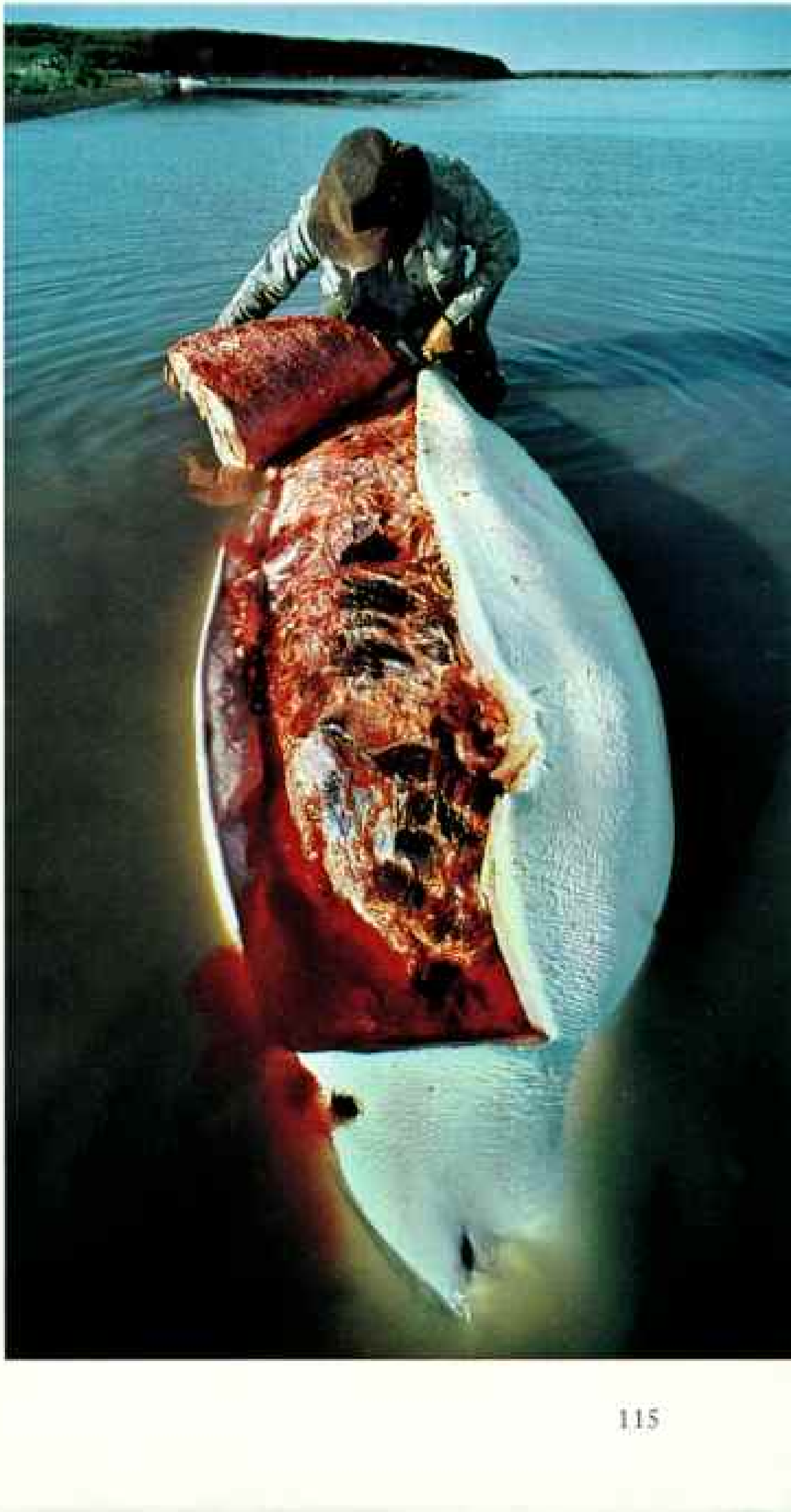
With the eye of his ancestors, *Billy Cockney* ***(left)*** *takes aim at a beluga whale near Tuktoyaktuk, where he hunted each year before rejoining the author's crew. Like generations of Eskimos before him, he strikes the whale with a harpoon attached to a float—here a ten-gallon plastic jug—before killing the animal with a rifle. Only natives may hunt these white whales. From a herd of about 5,000 that calves in the Beaufort Sea, 107 belugas were landed in 1982, primarily for* muktuk*—skin and blubber* ***(below)****—a favorite Eskimo food that may be traded among villagers.*



Frustrated again *by ice fields blocking the way, the author and crew kill time at Cape Parry* ***(above)****. For every day on the water during the long journey, they spent three more on land waiting for the ice to clear.*

The crew used such times mainly to eat and catch up on sleep. The umiak, turned on its side and propped up with poles, served as a cook tent for meals of freeze-dried vegetables, meat, and potatoes, and occasional feasts of caribou, whitefish, char, or arctic hare.

Bib Tevuk ***(left)*** *used a crate for shelter from the*

*strong winds that frequently blew across the flat shoreline. At the Ellice River camp (**right**) the author awoke to find the dinner table covered by a snowstorm that soon became cold, slashing rain.*

Time ashore was also spent visiting the ruins of Eskimo and Yankee whaling camps and the cairns left by early explorers. Some of these commemorate sailors who came in search of the Northwest Passage. Instead, they found death in the ice at the top of the earth.

(Continued from page 112) to drifting floes, and we made our way cautiously among them through drenching fog.

By the end of the week Billy Cockney had had enough of our freeze-dried vegetables, beef, and potatoes. One evening as we made camp by a small freshwater stream, Billy disappeared across the tundra with his .22 rifle. Before long we heard shots, and soon he returned carrying several freshly skinned and dressed quarters of caribou meat. Thereafter Billy's skill with the rifle and gill net provided us with occasional fresh meals of caribou, ducks, arctic hare, whitefish, and char.

BEFORE LONG sea ice barred our way again, driven shoreward by a relentless northwest wind. What we desperately needed was a warm summer wind from the south that would break up the coastal ice and drive it north away from land into the Beaufort Sea. But day after day the polar winds continued, and our progress was agonizingly slow.

At the end of our second week ice still blocked shore waters of Franklin Bay, barely 200 miles from Tuktoyaktuk. In hopes of finding a way through, I radioed the DEW line, or distant early warning station, at Cape Parry 55 miles to the north of us.

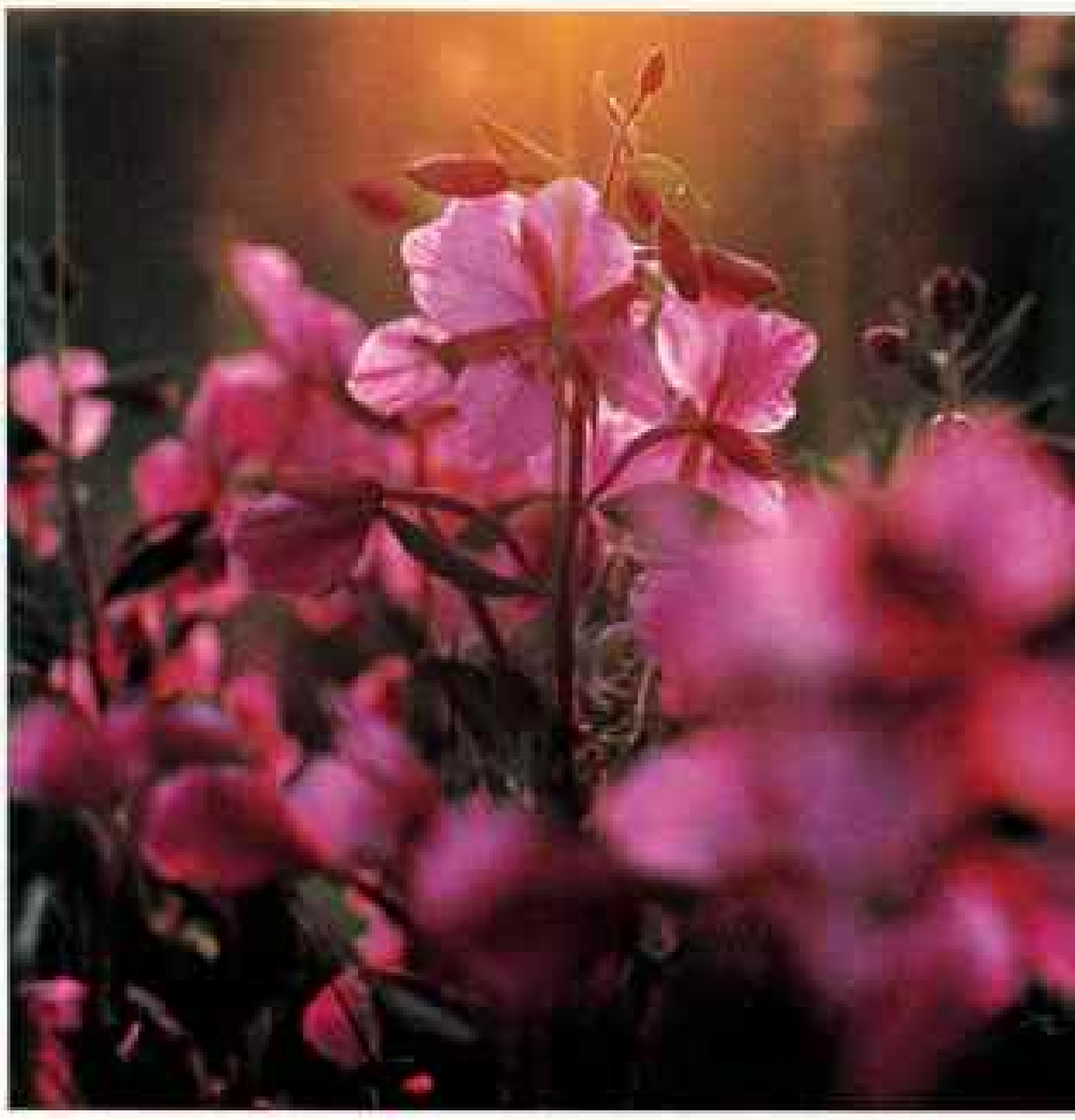
Cape Parry had nothing but bad news to offer. The radio operator reported that the coastline between us was a solid mass of ice, and there was no way through. As we talked, another voice broke in on the channel: "This is the Coast Guard icebreaker *Camsell*, standing off Cape Parry. There's open water beyond the shore ice; I think you can make it if you head straight out and detour around the pack."

I thanked *Camsell*, and later when we sighted the icebreaker, I radioed that we had made visual contact. *Camsell*'s operator was puzzled. "What is your hull material?" he asked. "We can't pick you up on radar."

"Walrus hide," I answered, thinking that would puzzle them. And it did. The radio was silent for several minutes.

With a fine natural harbor located beside the great water route across the Canadian Arctic, Cape Parry became both a way station and permanent settlement for the Thule Eskimos. It also saw service as a

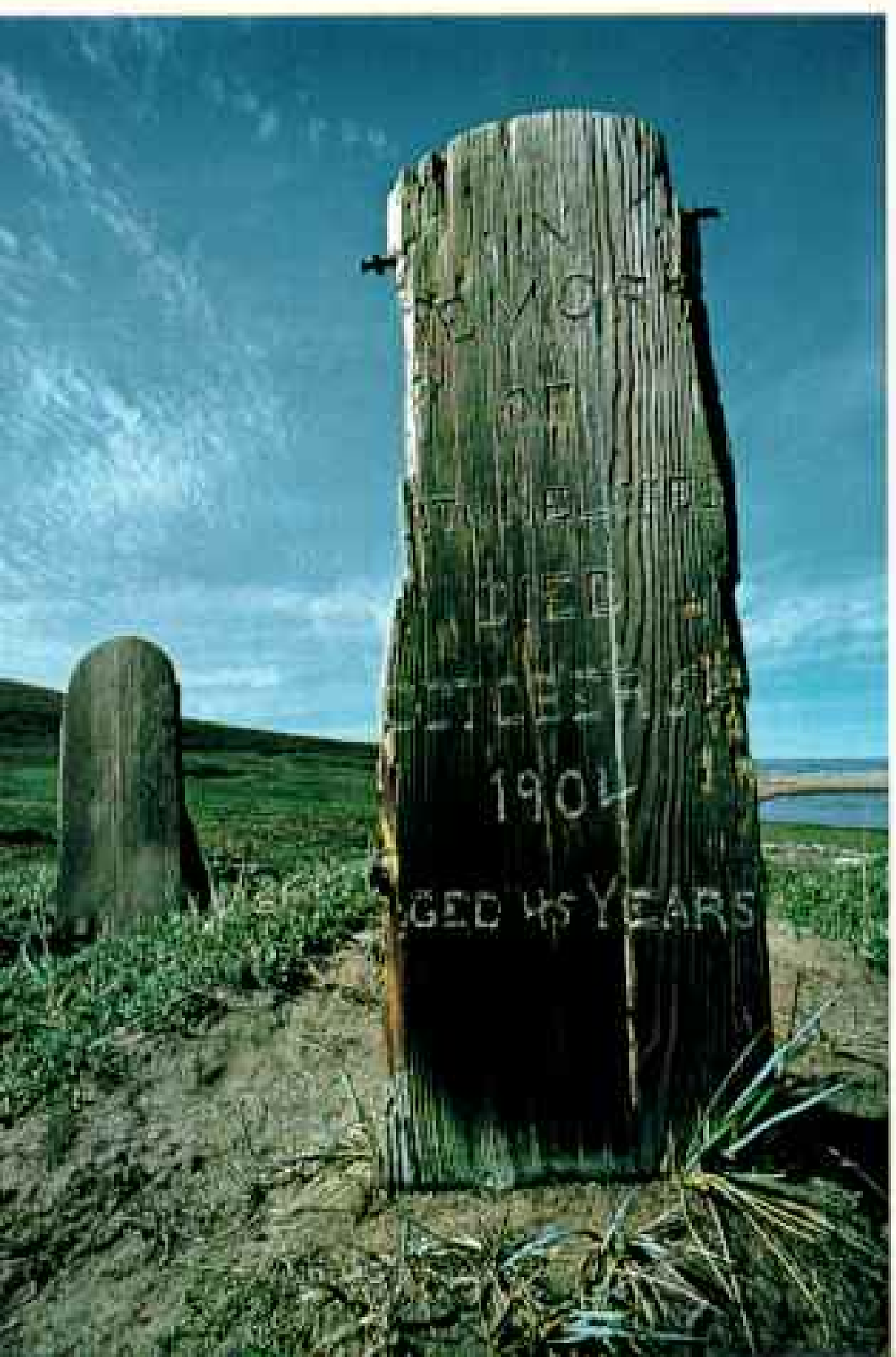
Quick to bloom *in the brief arctic summer, wild flowers along the route burst into colorful displays: white cotton grass* ***(above)****, pink willow herb* ***(below)****, purple saxifrage, yellow buttercups, and sky-blue forget-me-nots. Hugging the tundra to preserve warmth and avoid winds, dwarf birches and other heath plants* ***(facing page)*** *surround a lone egg on a cushion of reindeer moss.*



Ancient fires smolder *in the Smoking Hills of Franklin Bay, where cliffs have been burning perhaps for several thousand years. In a rare phenomenon, layers of jarosite—*

an unstable mineral that becomes red hot when exposed to air and bituminous material—have ignited seams of shale, producing billows of sulfur dioxide-laden smoke.

Dove of peace *marks the Cape Parry grave of six men of the San Francisco steam whaler* Balaena, *possible victims of pneumonia. Their captain in 1895 tried to gain earlier access to bowhead feeding grounds by wintering over farther east than any ship had before. But the ice did not break up early enough to give him an advantage. Men lost from other ships are buried at Langton Bay (***below***).*



wintering-over camp for the Yankee whalers who arrived nearly 900 years later.

Remains of both cultures dot the bleak shoreline at Cape Parry. In the case of the whalers the remains are human, memorialized by two carved wooden grave markers for seamen who died there in the winter of 1895-96 (left). Usually whalers were buried at sea. One such bleak ceremony was described in the log of *Tamerlane*, a whaling ship operating in the Arctic in 1866:

Haul back the head [yard] and call all hands aft and the Capt. read a chapter in the Bible and then launch the body to the deep. His name was Jim. One sail in sight, but no whales, only hard luck.

The Thule remains at Cape Parry consist of collapsed sod houses that were dug partly below the surface of the tundra, then roofed with beams of wood or whale bones and covered with sod. During several days while we were stranded ashore by heavy fog, we inspected the shelters and saw fragments of bone, wood, and ivory tools, flint arrowheads, and flakes of flint left over from the making of other stone implements.

Billy Cockney was especially interested in the shelters, since his ancestors had built them. "We've got the same kind of ruins at home in the Mackenzie Delta," he told me. "My father has a camp there, and it's a natural hunting area, with plenty of beluga, fish, seal, and caribou. The Thule people sure knew a good thing when they saw it."

In fact, good hunting and good water have been decisive in the location of settlements throughout man's history. Rarely in our voyage did we call at an Eskimo village without finding some evidence of prehistoric occupation such as ruins of houses or a collection of primitive artifacts.

IF THE THULE ESKIMOS knew a good thing when they saw it, they often paid a price for getting there. As we followed their route east from Cape Parry toward Dolphin and Union Strait, we played a constant game of cat and mouse with drifting ice, sudden gales, and dense fogs that reduced visibility to a matter of yards. The experience gave me new respect for the umiak and its prehistoric designers, for despite dangers and discomforts the boat

National Geographic, July 1983

handled beautifully under all conditions.

At length the fog lifted at Cape Parry, though the sea remained heavy and lowering dark clouds thundered over us, sending in light snow flurries and making the sea ink black in contrast to the whitecaps. The sea was still rough when we decided to leave this naked place, so we rigged long lines to either side of the umiak's bow and held it perpendicular to the surf. While it heaved and bucked, we loaded our gear over the stern.

Once we were under way again, the sea became greasy flat and rain showers passed us, but soon the old ominous swell began rolling in, signaling another blow. As we crawled along this exposed and dreary coast, we were repeatedly prey to the fast-traveling northwesterly gales that give the Beaufort Sea in August its cranky reputation. Our entire passage along the 200 miles of coast between Cape Parry and Dolphin and Union Strait became a steady repetition of sudden gales, panic landings, abrupt departures, and sudden gales again.

Nearly every place we were forced ashore, we found the remains of prehistoric houses, and I began to understand some of the problems the early Eskimos faced as they, too, worked their way eastward along this coast. Once again I was reminded how the umiak—part boat, part house—must have assisted their summer travels.

Nothing, however, could make up for lost time, and by mid-August I knew we had to come ashore. We had covered only about a third of the distance from Tuktoyaktuk to Cornwallis Island, but already the brief arctic summer was drawing to a close.

As we approached Dease Strait between the Canadian mainland and Victoria Island, the scattered ice floes drew closer and closer together in front of us until at last they formed a solid barrier. It was only a matter of time before the ice closed in behind us.

Fortunately the arctic tanker *Pinnebog*, with my old friend Capt. Douglas Thomas in command, was steaming within a few miles of our position. I raised him on the radio and said, "Captain, I'm in kind of a fix." I explained the problem, and Doug instantly offered us a lift through the ice to Cambridge Bay, a settlement 55 miles to the east.

On August 25 we rendezvoused with *Pinnebog*, hoisted the boats aboard, and entered Cambridge Bay behind a recent acquaintance—the icebreaker *Camsell*. Our odyssey of 1978 had come to an end.

BY ALL ODDS the summer of 1979 should have been different from the previous one and it was: It was infinitely worse. We returned to Cambridge Bay in July to find the summer thaw even further behind schedule. I was tempted to leave the boats in storage and delay the voyage for another year, but we had come all the way from New England and Alaska to make the attempt, and I thought it was worth a try.

I was wrong. The harbor at Cambridge Bay was ice-fast. The route eastward lay blockaded by drifting floes until August 10. It took us more than a week to reach Whitebear Point 150 miles southeast, and there we came to a dead end. A strong northwest wind had driven masses of pack ice against the point, creating an enormous barrier that stretched many miles out to sea. There was no way around the barrier and certainly no way through it, so we came ashore and camped in hopes of a change.

Change took the shape of several slashing rainstorms followed by a two-inch snowfall. After another week I no longer wondered whether we could continue eastward, but whether we could even return to Cambridge Bay. We finally made it just as new ice began to form in the harbor. Once again the boats went into winter storage together with our dwindling hopes.

IT CAME out of the south that following summer—a warm wind carrying a promise of change. It ruffled the coarse gray tundra around us, tugged at our tent flaps, and stirred something deep inside us all: a feeling that our luck had finally turned.

Certainly we needed it. After an early summer thaw and a promising start from Cambridge Bay in mid-July of 1980, we had been brought to a dead stop once more by the great ice barrier at Whitebear Point and were forced to camp ashore.

Now, as the south wind began to blow, I calculated our chances. If the wind continued for 48 hours, it could shift the pack just enough to open a narrow ribbon of water along shore past Whitebear Point and along

Racing to beat winter, *the voyagers dodge ice floes in James Ross Strait on the last leg of their trip. Too near the north magnetic pole, the compass was no help in*

the coast of Queen Maud Gulf. If the wind continued for a week or more. . . . But I put that optimistic thought aside.

Within two days the ice opened a bit and we rounded Whitebear Point. From there we set a course southeastward along the coast. Twelve hours later we reached Perry Island, a small trapping outpost where I had set up a cache of gasoline and food by air earlier in the summer. In the glow of arctic midnight we hurriedly packed the supplies aboard the two boats and got under way again. From here on, it would be a race not only against the waning days of summer but also against the return of the polar winds.

FROM PERRY ISLAND we picked our way cautiously through the labyrinth of rocky islets that dot Queen Maud Gulf. Here our charts were useless, for the islets are so small and numerous and so difficult to see from a distance that even small-boat pilotage is extraordinarily difficult.

On August 5, at the eastern end of Queen Maud Gulf, we literally reached a turning point in our voyage. From Tuktoyaktuk our course had been almost entirely eastward; now it would swing north in the direction of our goal—the settlement of Resolute on Cornwallis Island.

The eastern portion of Canada's Arctic is rich in the history of exploration, not merely by Eskimos but by Europeans. As we threaded the narrows of Simpson Strait between the mainland and King William Island, we noticed rock cairns along the coast—monuments both to the gallantry and tragic fate of Sir John Franklin's men.

They were a British expedition sent out in 1845 to find the legendary Northwest Passage through the Canadian Arctic. Under the command of Sir John Franklin, two ships, *Erebus* and *Terror*, were trapped by winter ice in Victoria Strait. Summer breakup never came, and finally after two barren years the surviving 105 officers and men began the long trek south to Hudson Bay. Weakened by hunger and ill with scurvy,

navigating the dangerous shoals. Yet they safely reached Barrow Strait as ice closed in, culminating the longest arctic voyage by skin boat in modern times.

the men died one by one along the way. Later explorers built the rock cairns as memorials to the bravery of the British sailors.

In the end, all of Franklin's men perished. Many years later an Eskimo woman who claimed to have seen several bodies said of the doomed men: "They fell down and died as they walked along."

BEYOND SIMPSON STRAIT we called briefly at the Eskimo village of Gjoa Haven, named after Roald Amundsen's small herring sloop, *Gjoa*, in which the Norwegian explorer made the first traverse of the Northwest Passage between 1903 and 1906.

Despite a warm welcome from Gjoa Haven's residents, we stayed only long enough to sleep and reprovision. The southeast wind continued to blow, but it was now August 8 and no one could say how long our luck would hold. We crossed Rae Strait, and after an even briefer call at the village of Spence Bay we turned north on the final leg of our voyage with 350 miles still to go.

We were navigating now through waters previously traveled by only a handful of ships, and I was wary of what the charts told me. Moreover, thanks to our proximity to the north magnetic pole off Bathurst Island, the pull on our compass was more vertical than horizontal. The needle moved sluggishly as if suspended in molasses, and most of the time it pointed unerringly toward our outboard motors at the stern.

To make matters worse, as we emerged from James Ross Strait into Larsen Sound, we met heavy fog and drifting ice floes that began to close around us. As a final blow our southeast wind deserted us, swinging into the northwest and bringing the floes directly at us. After dodging the floes half blind through fog for 14 hours, we finally took refuge in Pasley Bay on the Boothia Peninsula.

For the next four days we were prisoners of the wind, locked in the shelter of Pasley Bay. During the long hours ashore as we waited for a break in the weather, my

thoughts turned once again to the Thule Eskimos who had come this way before us.

In their long passage across the Arctic they had doubtless been immobilized many times by weather just as we were. Yet even in the most barren surroundings such as the shores of Pasley Bay, they had taken sustenance from the land and from the waters that divide it. As evidence we discovered tent rings in the area—circles of small boulders used in prehistoric times to anchor summer tents of hide against the arctic wind.

Even more striking evidence of Thule skill survives in their descendants. With the eyes and instinct of the born hunter, Billy Cockney was always first among us to spot the movement of game: thin skeins of eider ducks skimming low across the water, the distant burst of spray from a surfacing beluga, the shadowy wraith of a polar bear stalking seals among the ice floes.

ON AUGUST 14 the wind swung southeast again, lifting the blockade of ice. We quickly broke camp and set off northward in a soaking rain toward the entrance of Franklin Strait. Heavy fog soon replaced the rain and drove us ashore for a time, but then it lifted and we continued north with only about 220 miles to go.

Over the next five days we fought a running battle with fatigue, drifting floes, fog, falling temperatures, and dwindling daylight as the arctic summer began to draw to a close. At sunrise on August 20 we finally reached Barrow Strait, which separates Cornwallis Island from Somerset Island on the south. The community of Resolute, population 170, lay barely 30 miles away across what appeared to be open water.

"Big city, here we come," Pat said with a grin. And then we saw the ice.

It stretched across the northern portion of Barrow Strait, a seemingly impenetrable barrier between us and Resolute. There was nothing to do but come ashore on Somerset Island, as we had at Whitebear Point—and hope for a change. But this time summer had run out and the odds were against us.

We pitched camp on the northwest corner of Somerset Island and enjoyed the first real sleep we had had in days. In the middle of it a team of Canadian historians from Resolute landed by helicopter right next to our tents, and we discussed ice conditions. "It doesn't look good," one of them said. "The ice is now packed close all the way into Resolute, and it's pretty late for a temporary breakup."

After three days I climbed a cliff on Somerset Island, looked northward across Barrow Strait, and I saw even more ice than I had before; there was no way we were going to get through that pack.

Five Canadian Coast Guard icebreakers were already standing by near Resolute to escort the summer supply ships south on their homeward voyage. One of the icebreakers, *Pierre Radisson*, under command of my friend Capt. Patrick Toomey, raised us on the radio and offered to bring us in. I gladly accepted, and *Pierre Radisson* crunched through the ice to pick us up off Somerset Island. They loaded our boats and gear aboard, then delivered us to Resolute. On the afternoon of August 24 we came ashore for the last time.

For me it was an appropriate end to our voyage. Over several years we had covered the major portion of the great Thule Eskimo migration route from Bering Strait to northwest Greenland. In the process we had completed the longest voyage made by skin boat across the Arctic in modern times, a voyage that would probably never be repeated.

We had experienced many of the rewards, the challenges, and certainly the frustrations that the Thule Eskimos had faced before us. And finally we had gained new respect for the enormous skill and determination that had driven those remarkable people on one of the great journeys in the history of mankind. □

King of arctic hunters, *the polar bear has no rival but man, who must magnify his strength with technical ingenuity. A Thule spear brings down a swift caribou. A bola snares a ptarmigan. A fishhook made from a seal's tooth and twisted wire pulls a char from icy waters. Skin boats carry hunters after whales, caribou, and seals. The skill to make such devices—and the courage to use them—served the Thule people well as they searched ever eastward for better hunting.*

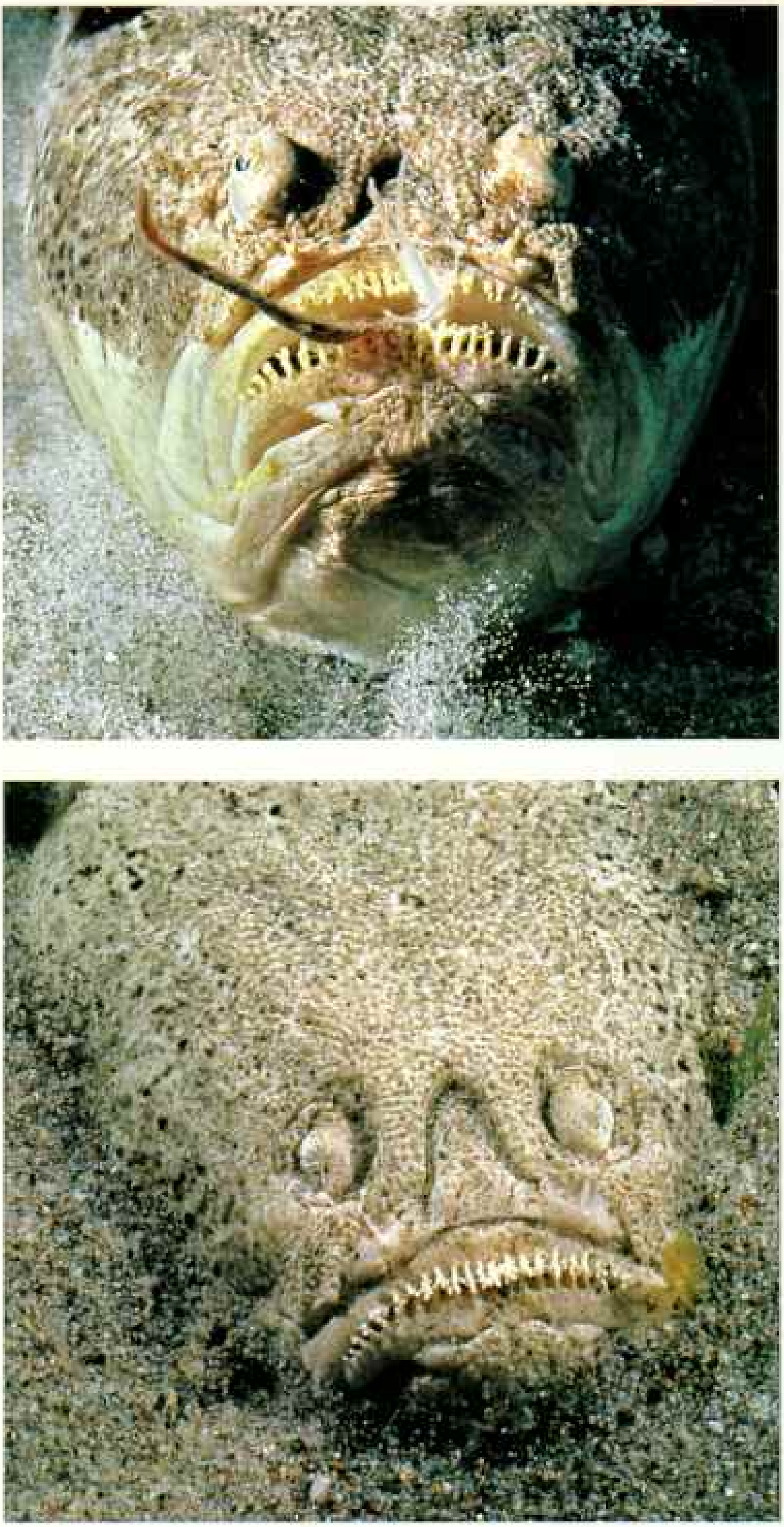
Hidden Life of an Undersea Desert

By EUGENIE CLARK

Photographs by
DAVID DOUBILET

ELEGANT DANCERS in a realm of illusions, wispy garden eels sway to the rhythm of the Red Sea off Sinai's Ras Muhammad. With their tails always anchored in their burrows, these dainty, yard-long creatures (Gorgasia) seem to be rooted in the sand like the stalks of willowy sea plants. Bending their bodies into the gentle current, they eat, fight, and mate with eels around them. But when approached by a diver, they sink eerily into their holes.

The appearance of emptiness in the shallow waters of the Red Sea conceals a world of strange creatures. Some disguise themselves with camouflage. Others hide in tiny shells. A few, like the garden eels, disappear into the seafloor. And some lie just below the bottom with only their eyes poking up through the sand. Not a barren place at all, this desert beneath the sea is a neighborhood of wonders.



*CHESHIRE CAT of the sandy sea bottom, a stargazer (Uranoscopus) disappears from view, all except for its smile (**above**). What seem to be teeth are actually fringes on the fish's lips that allow it to breathe a steady flow of water while buried in the*

sand. There it will remain until some unsuspecting prey ventures within its grasp, attracted perhaps by the dark skinny flap and noodle-like lures that the stargazer sticks out from its mouth (**upper left**). *Its small eyes* (**left**), *cleared of sand by the photographer, look upward. Two organs behind the eyes can generate as much as 50 volts, possibly creating an electric field around the stargazer to help detect approaching creatures. The 12-inch-long fish has been known to swallow victims nearly its own length.*

*LIKE A PLUMED WARRIOR of the deep, the jet black razor fish (**right**) glides serenely past my face mask. In the undersea realm, where most fish can either take on protective camouflage or vanish instantly into the sand, the bizarre-looking razor fish seems at a disadvantage. But appearances underwater can be deceptive.*

Stretching out my hand toward the fish as it hovers near the bottom, I make a sudden threatening gesture. Instantly the razor fish tilts sideways, extends its plumelike dorsal fin, and lies motionless against the white sand like some bit of discarded rubbish on the seafloor. If I had not witnessed the transition myself, I would never have believed that the drab object before me could be a living creature.

Such marvels of adaptation and survival still intrigue me after many hundreds of dives in the Red Sea. Exploring that seemingly barren expanse of ocean floor is like playing the children's game of finding hidden faces in a picture; the longer you look, the more faces you discover.

Among all the areas of the undersea world that I know, none is more challenging, more enjoyable, more frustrating, and more a test of a diver's patience and endurance than that magical sandy bottom of the Red Sea (map, page 135).

Leaving the razor fish to recover from its game of undersea possum, I proceed across the sunlit ocean floor. As I pause farther on, the sand in front of me begins to jitterbug crazily like the prelude to some miniature volcanic eruption. Presently two tiny periscopes with eyes thrust above the surface and swivel toward me in a way that tells me I am being watched.

Beyond the periscopes a small snorkel camouflaged with spots resembling grains of sand busily pumps water in and out from some invisible source. Nearby, a dozen miniature noses emerge from the seafloor and simply remain there—whether sensing my presence I do not know.

Farther on, a shell gets up and walks unhurriedly away past a tuft of transparent needles that begin to undulate. From among the needles a crown of translucent tentacles gradually emerges. Finally, with the slow-motion grace of a time-lapse camera, the tentacles blossom into a huge, exquisite beige flower that I know will vanish instantly if I touch it.

I have learned the origins of most of these intriguing phenomena. The periscope eyes belong to a mantis shrimp. The walking shell is the home of a hermit crab bent on a change of scenery. The beautiful beige flower is the head of an anemone known as Cerianthus, *and the small triangular noses are all that one sees of arrow-slim fish named* Trichonotus nikii *when they decide to go into hiding. As for the snorkel, it is merely the nostril of a buried Moses sole, that remarkable fish whose*

EYEWITNESS REPORT

milky secretion acts as a powerful shark repellent.

Unfortunately, science has yet to develop a repellent for the lionfish, whose venomous spines can inflict severe wounds. For newcomers to the undersea desert, it is decidely unsettling to lie quietly on the seafloor in contemplation of some small creature, only to turn and discover that several lionfish have cuddled companionably against one's legs. The reason is not friendship but the fact that any projection above the sandy bottom—an old shoe, a tin can, a concrete block, or a hapless diver—attracts a variety of small marine life on which the lionfish feeds. Fortunately, if the diver lifts slowly off the bottom, the lionfish soon goes in search of another decoy.

Despite thousands of hours of underwater observation and years of photography by my colleague David Doubilet, we have barely touched the wealth of information about marine life to be found in the shallows of the Red Sea.

In our eagerness to extend man's reach far beneath the sea, we often tend to overlook the challenges close at hand. To me some of the most exciting and rewarding areas for study are those seemingly barren shallows that actually teem with life—the world of the undersea desert. * * *

Marine biologist **Eugenie Clark** teaches at the University of Maryland. Her most recent NATIONAL GEOGRAPHIC article, "Sharks: Magnificent and Misunderstood," appeared in the August 1981 issue. Based in New York City, **David Doubilet** has been taking underwater photographs for NATIONAL GEOGRAPHIC since 1971.

*SINAI SPILLS into the sea at the mouth of Wadi Magresh (**above**), where rare torrential rains deposit sediments from the desert's mountains. Here in the sparkling waters of Marsa al Muqabilah, a gentle bay ten miles south of the Egyptian-Israeli border, the author since 1969 has pursued research into the remarkable fish that inhabit the wadi's outwash.*

Geologist Farouk El-Baz has identified three types of sand in this part of the Red Sea, each forming a

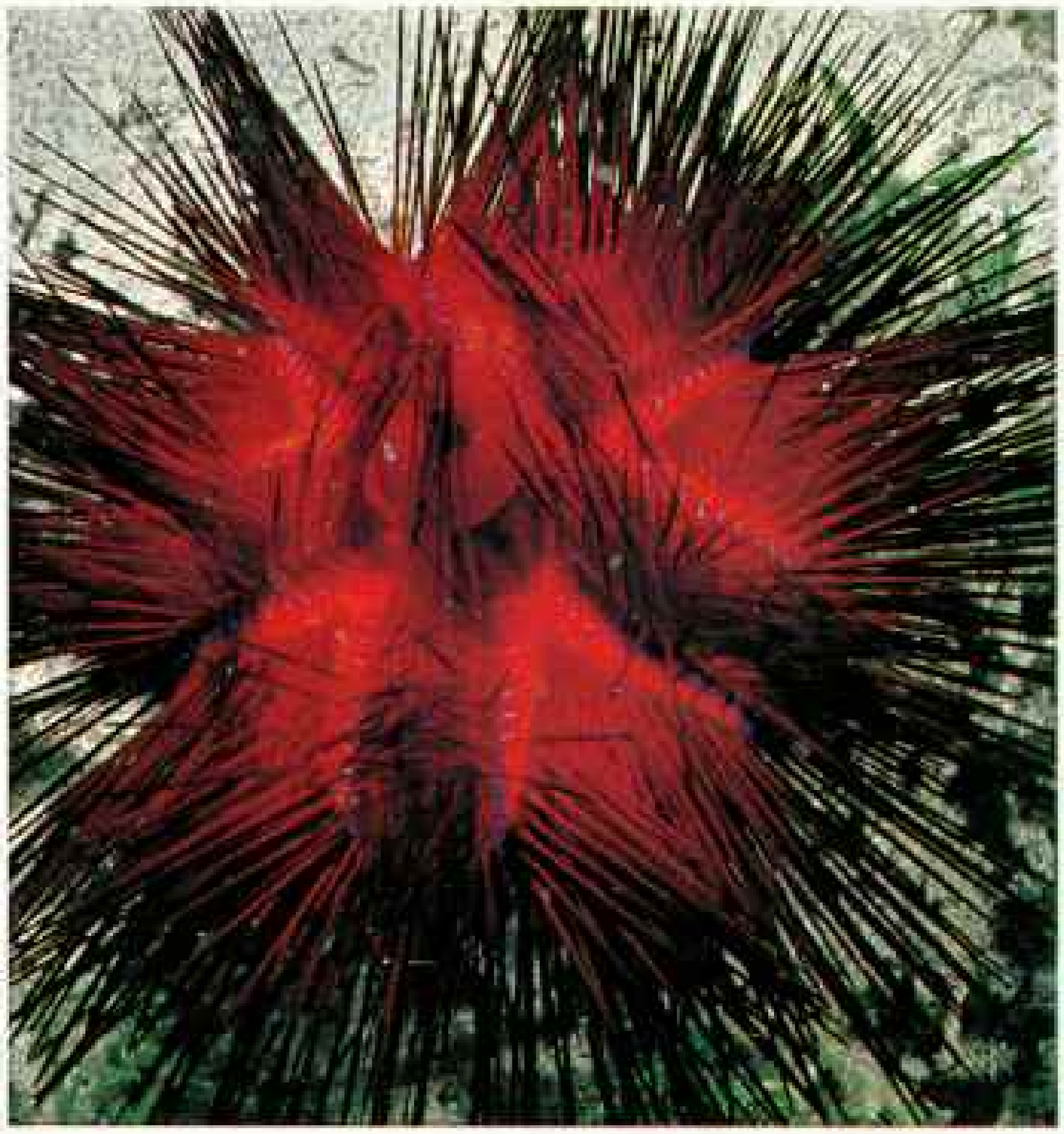
SCARUS TERRICULIUS, 18 INCHES

SCARUS GHOBBAN, 30 INCHES

special habitat for unusual creatures. Wadi sands, composed of fine, angular grains, are washed into the sea from Sinai's mountains. These sands are so soft that some species of fish can dive into them headfirst when threatened.

A second type of sand, found in quiet, deeper waters, has highly rounded grains. Currents here carry nutrients to colonies of mysterious garden eels that seem to sway in an undersea breeze like flowers growing in the sea bottom.

*The third sand is manufactured by fish that ingest stony coral while feeding on the algae growing on it. A hungry parrot fish chews off tiny chunks with its strong beak (**center**), swallowing bits of dead coral as a chicken does gravel. Grinding plates in the fish's throat break down the coral. Then, having extracted nourishing organic materials from the algae, the fish passes the residue into the sea (**bottom**). In this way, swarms of parrot fish convert enormous quantities of stony coral into fine layers of sand, constantly renewing this desert beneath the sea.*



*CLEAR WARNING to predators—in a realm where most animals try to camouflage themselves—the bold red of a sea urchin (Astropyga radiata) signals trouble. Unable to flee or dive down a burrow like other creatures in the undersea desert, the six-inch-wide urchin (**above**), a relative of the starfish, wields hundreds of prickly spines to protect itself. Even so, some fish manage to penetrate its defenses and feast on its soft insides.*

*A blossom-like anemone (Cerianthus) delivers potent stings with the slender tentacles that encircle its mouth (**left**). Related to jellyfish and corals, the ten-inch-wide tube-bodied animal feeds on small invertebrates and fish. Yet somehow a cloud of opossum shrimp (order Mysidacea) seems to thrive among its deadly stingers.*

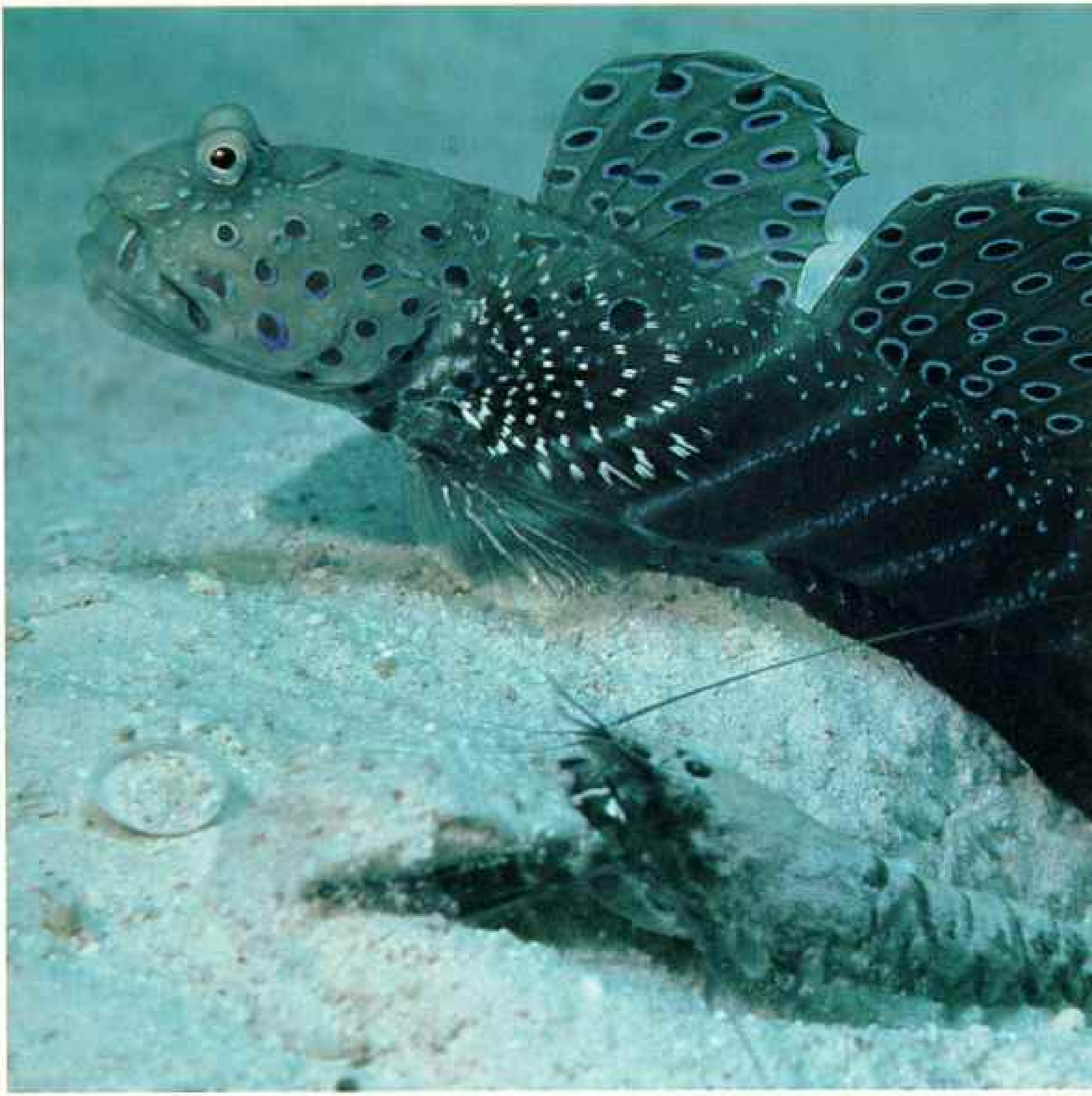
EUGENIE CLARK

PUTTING ON A SHOW to drive off a razor fish, a male Trichonotus nikii, *dubbed Tricky Niki by the author, flares three striped plumes above his streamlined body and quivers his pectoral fins (**left**) in a display of aggression. These arrow-shaped fish set up temporary territories in which to court females, sometimes encroaching on the home turfs of razor fish* (Xyrichtys) *that patrol nearer the bottom.*

Half-inch-long juveniles, like six-inch-long adult T. nikii, hover in large swarms above the wadi outwash as they graze on plankton in Marsa al Muqabilah. Both are identified by their unique golden internal eyelashes. And both, like the razor fish, plunge into the sand whenever mackerel shoot by.

A pair of sea moths (Eurypegasus draconis) *spread diaphanous "wings" (**below**) in another undersea drama—perhaps some stage of courtship. Like sea horses, these four-inch-long animals have stiff external skeletons, long tubular snouts, and small mouths. Barely visible against the sand, they glide slowly along the bottom, though they are capable of short bursts of swimming during such displays.*

As they outgrow their bony armatures, sea moths shed them like skins, though these skins are in fact rigid castings of mucus. Specimens of the bizarre creatures, sometimes called pegasus fish after the winged horse of Greek myth, first reached Europe from China, where they were dried and sold as curios. Home remedies in the Far East still recommend using ground sea moth in tea as a curative for sore throats.



ROOMMATES IN THE SAND, a snapping shrimp (Alpheus) *and a six-inch-long goby* (Cryptocentrus coeruleopunctatus) *help each other to survive. While the goby stands sentry* (**left**)*, the shrimp uses enlarged claws to bulldoze debris from the mouth of their shared burrow. As it works, the shrimp keeps one antenna in contact with the fish. Then if the goby senses danger, it wiggles its body and the shrimp disappears down the hole—quickly followed by the goby.*

A more reclusive resident of the sandy bottom, the delicate acorn worm (Balanoglossus) *makes its presence known by leaving a coiled fecal mound* (**below left**) *on the seafloor above its burrow. The yard-long sea worm ingests sand and mud as it digs through the substrate, extracting microscopic organisms from the inorganic particles before passing them. In the process, it builds a burrow down below, hardening the walls with a lining of mucus. Highly sensitive to vibrations, the worm pulls back rapidly when disturbed. And if damaged or torn, it can regenerate the missing parts.*

A volcano-like eruption catches a sand perch by surprise (**far left**)*. A small crustacean is probably responsible for the brief disruption as it builds a home in the sand. The seven-inch-long sand perch* (Parapercis hexophthalma) *is another burrower in the sea bottom, though it may also find shelter beneath the chunks of coral that litter the desert seafloor.*

BITTER SURPRISE for the fish that tries to swallow it, Pleurobranchus **(above)** *secretes a film of acids nasty enough to make any predator spit it out again. A member of the snail family, the six-inch-long mollusk grazes on sponges, crawling along the bottom on its broad foot. A small shrimp* (Periclimenes imperator, **right**) *comes along for the ride, possibly to feed in the water around the pleurobranch—but perhaps for some other reason. Too little is yet known about the inhabitants of this undersea desert to explain all its puzzles.*

MUTT AND JEFF of the seafloor, a pair of wandering hermit crabs size each other up with their stalked, beady eyes. These four-inch-long crustaceans explain a minor mystery of the sandy bottom: the case of the shells that get up and walk away. The rear part of the crab's body, unprotected by any hard covering, is so soft and flexible that it can change shape to fit the whorls of almost any shell the crab chooses. In some parts of the world, hermit crabs have also taken shelter in coconut shells, soup cans, pieces of bamboo, and chimneys from broken lamps. As the crab grows in size, it must search for larger quarters. When it finds a likely new home, it wriggles deep inside. Then, if satisfied with its choice, it fits its pincers into the opening as if to close the front door.

Things are seldom what they seem in this desert beneath the waves, a magical world of marine Houdinis where survival can hinge on a knack for deception. □

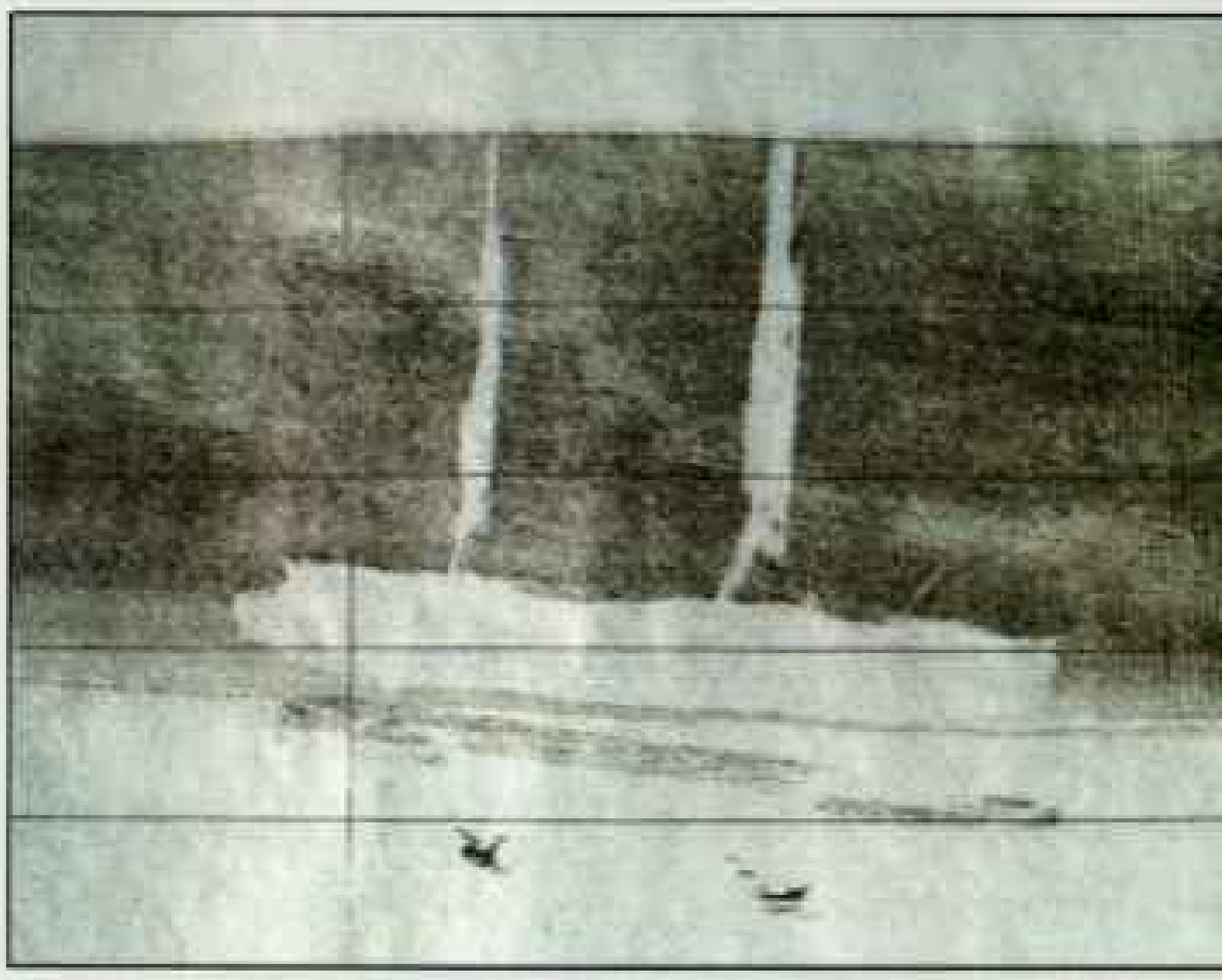
SIX-MONTH INDEX AVAILABLE

As one of the benefits of membership in the National Geographic Society, an index for each six-month volume will be sent free to members, upon request. The index to Volume 163 (January-June 1983) is now ready.

Exploring a 140-year-old Ship Under Arctic Ice

FAR BELOW the surface of the hostile sea, tomorrow's technology unlocks the secrets of a long-dead vessel. She is *Breadalbane*, a British bark launched in 1843 and lost a decade later in the ice of Canada's Northwest Passage while aiding in the search for survivors of the ill-fated Franklin expedition. She is the northernmost shipwreck ever discovered on the seafloor.

During my six long years of search and exploration for *Breadalbane*, my first real view of her occurred on August 13, 1980, in a ghostly side-scan sonar image (***right***). Entombed beneath six feet of surface ice and 340 feet of numbing arctic water, the ship appeared far beyond human reach or ability to explore. Yet only three years later, in early May, a diver touched down on *Breadalbane*'s deck in a revolutionary submersible destined to extend man's reach under the sea (***below right***). Dubbed WASP for its resemblance to that insect, it is also referred to as "a submarine that you wear." Equally remarkable, this photograph was taken by a National Geographic camera mounted on a versatile robot nicknamed RPV, for remotely piloted vehicle. Working together the two devices are revolutionizing our exploration of the deep.

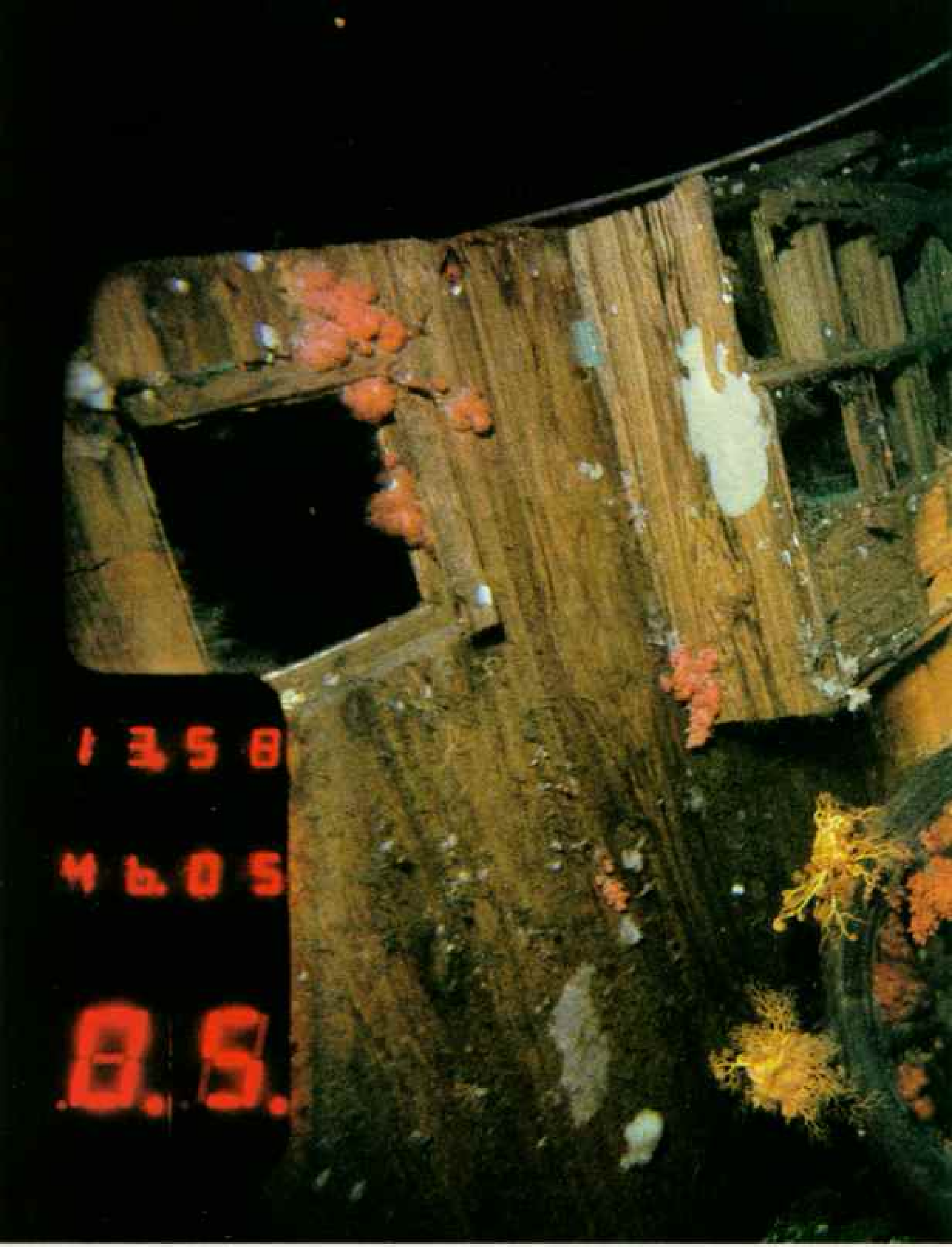


KLEIN ASSOCIATES (ABOVE)

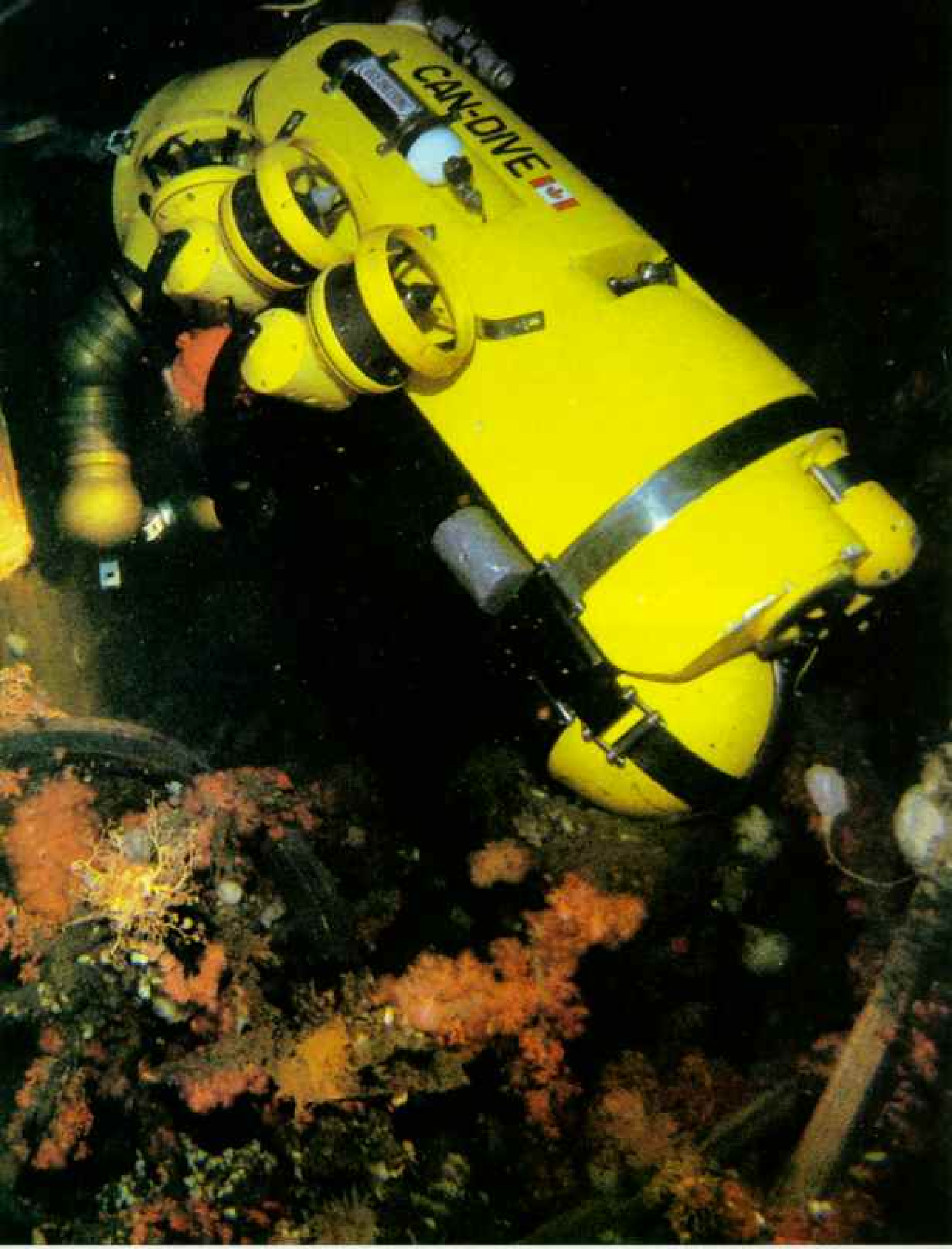
By JOSEPH B. MACINNIS

Photographs by
EMORY KRISTOF
NATIONAL GEOGRAPHIC PHOTOGRAPHER

Joe MacInnis is a Canadian doctor of medicine who has specialized in the physiology and safety of divers as well as undersea exploration. His article on diving under arctic ice appeared in the August 1973 GEOGRAPHIC.



Like a space-age helmsman, *diver Doug Osborne hovers over Breadalbane's coral-encrusted wheel where it fell from its mounting aft of the deckhouse. Six thrusters powered by cable from the surface give WASP maneuverability, and clawlike*



"fingers" combine strength with precision. Numerals at lower left indicate time, date, and film roll. Moments after this photograph was taken Osborne lifted the wheel from the deck and was winched to the surface with the treasure ***(following page)****.*

WHEEL OF MISFORTUNE guided *Breadalbane* in her final moments before storm-driven ice punctured her hull and sent her to the bottom off Beechey Island in Canada's high Arctic (map, pages 106-107). By some miracle all 21 crewmen aboard managed to scramble to safety on the surrounding ice and joined an accompanying ship.

Doug Osborne, here wearing a watch cap, joins me in examining the prize, which was promptly flown to the world-famous Parks Canada conservation facility in Ottawa. Like the rest of the ship the wheel was beautifully preserved by near-freezing temperatures and an absence of pollution or marine borers.

Exploration of *Breadalbane* was conducted from our camp on the sea ice a mile south of Beechey Island, seen here in the background (**above**). Cutting through six feet of ice at two separate points, we erected tents over the holes to protect the operators and equipment of WASP and RPV. To establish the camp we brought supplies in by air and by tractor train across the sea ice from the outpost of Resolute on Cornwallis Island, some 60 miles to the west. Hampered by a steady temperature of minus 20° Celsius but aided by clear skies and 24-hour daylight, we managed six man-hours of diving on *Breadalbane* and more than twice that time exploring with the RPV, all within the space of 18 days. Finally we broke camp and on May 9, 1983, set out for Resolute and home. When the project is completed, the NATIONAL GEOGRAPHIC will present a detailed record. * * *

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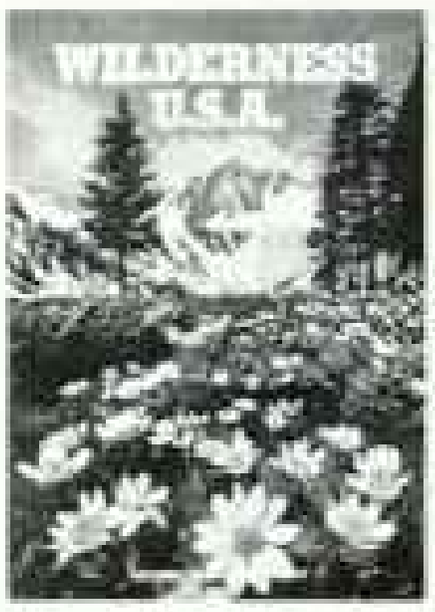

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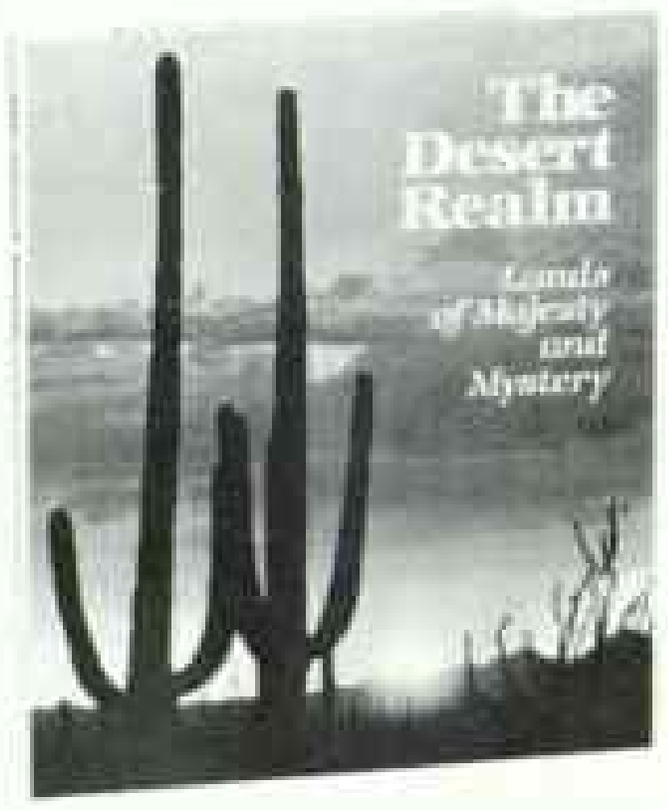

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Photographed by Noel Snyder. *Puerto Rican Parrot:* *Genus: Amazona* *Species: vittata*
Adult size: 30cm long average *Adult weight: 250g average*
Habitat: Dense rain forests on the island of Puerto Rico
Surviving number: Approximately 25—30

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Flamboyant, with feathers in shimmering shades of green and a patch of brilliant red above its beak, the Puerto Rican parrot has a beauty that conjures up visions of "tropical paradise." Once this bird ranged across all of Puerto Rico and adjacent islands. Today it is so rare, it is estimated that no more than 30 survive in the wild.

The Puerto Rican parrot could never be brought back should it vanish from the face of the earth. And while photography can record it for posterity, more importantly photography can help save it and the rest of wildlife.

Conservation work on the Puerto Rican parrot has been under way for almost 15 years. Though progress is slow, the efforts have improved the bird's chances of survival considerably, with photography playing a very important role.

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Members Forum

ETOSHA

Once again, Des and Jen Bartlett's photographs have astonished and delighted this reader. Your article on Namibia's Etosha National Park (March 1983) is a rich treat, a glimpse of a remarkable exercise in ecological planning, and a visual feast. Don't lose track of the Bartletts; they are a resource to be treasured!

Anne W. Beaman
Boston, Massachusetts

As a graduate of park management I question the method of identification illustrated on page 347. The reflective green horn plug, although effective for nocturnal research and in helping to prevent animal/vehicle confrontations at night, also illuminates the presence of the rhino for the ever present poacher's searchlight beam.

Howard T. Munn
Woodbridge, New Jersey

Mr. Chadwick states that many sandgrouse soak their breast feathers to carry liquid to their young. The late E. Thomas Gilliard, world bird authority, said this often repeated belief is in error. Further, Col. Richard Meinertzhagen in his *Birds of Arabia* proved by long observation that sandgrouse always regurgitate water into mouths of young. Although they may arrive at the nest with breast feathers soaked, the young never once took water from that source.

Edward Harvey Prouty
Mayer, Arizona

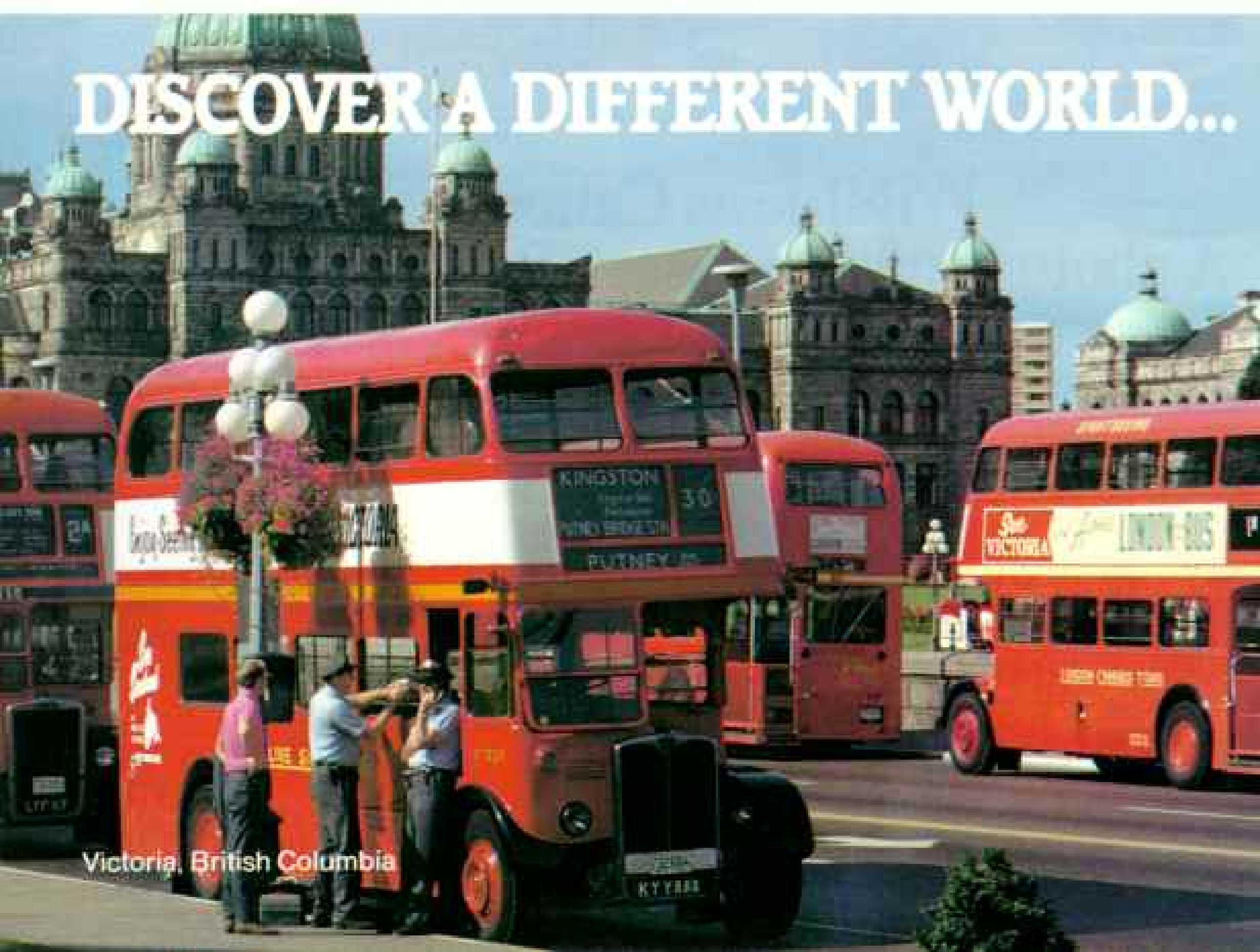
Recent studies have shown that, despite previous reports, sandgrouse do transport water to their young in their feathers.

GHOST SHIPS

Congratulations to Dr. Daniel A. Nelson and photographer Emory Kristof for the incredible photographs of the *Hamilton* and the *Scourge* (March 1983). After seeing the eerie figurehead of Diana on the bow of the *Hamilton*, it is easy to understand Cousteau diver Albert Falco's exclamations of *"Magnifique!"* and *"Fantastique!"* She is indeed both.

John M. Bloodworth, Jr.
New Orleans, Louisiana

In the all-too-short piece on the wrecks of the *Hamilton* and the *Scourge*, there was a reference to the massive shipbuilding efforts made on Lake



Ontario during the War of 1812. I do not believe that anything as large or as powerful as ships of the line that participated in the Battle of Trafalgar in 1805 was laid down in either the United States or Canada during that period. The first ship built in the United States or Canada to surpass the wooden monsters of Trafalgar was the U.S.S. *Pennsylvania*, constructed in the 1820s.

Terry L. Stibal
St. Louis, Missouri

U. S. and Canadian sources report that by war's end the British had launched the 102-gun (some say 120-gun) St. Lawrence *and had three similar vessels on the ways. The U. S. had built the 66-gun* Superior, *and two 110-120-gun ships were under construction.*

The sketch of the *Scourge* by Richard Schlecht on pages 292-3 shows the ship with at least ten guns. I have an 1814 *Farmer's Almanack* that lists the Navy of the United States as of July 1813: *Scourge*—8 guns. Did your divers determine an exact number of guns for each ship?

Edward A. Misisco
Feeding Hills, Massachusetts

Records conflict concerning the guns on the Scourge. *Actual observation via underwater cameras by artist Schlecht and other expedition members provided the correct number.*

Your excellent article "Ghost Ships of the War of 1812" was marred for Canadians by the casual assessment of the War of 1812 as leaving neither Britain nor the United States "better off." The war for Canadians was a major factor in the emergence of our nation. The repulsing of American land forces by Canadian militia led to that course in our history when we "remained British because we did not care to be Americans." The dismissal of Canadian history by most Americans is unfortunately commonplace; for NATIONAL GEOGRAPHIC it is extremely regrettable.

R. Bryce
Edmonton, Alberta

I was saddened and shocked to learn that our Navy and our government were so callous as to hand both the *Hamilton* and the *Scourge* over to Canada. These ships have the same historic significance for the United States that the *Vasa* and the *Mary Rose* hold for Sweden and England. At least one of those ships should be preserved in America, and I think our government should find the money to accomplish that task.

Griffin T. Murphey, D.D.S.
Fort Worth, Texas

HERBS

Reading your article "Herbs for All Seasons" (March 1983), which on the whole I enjoyed, I

did smirk a bit at the description of a "Greek-style dinner." No ordinary Greek would think of using basil in salad or otherwise eating it. True, every house has its pot of basil, but it is never put in food. One is supposed to run one's hands over it and smell it and perhaps be presented with a sprig of it on entering the courtyard, but never put it in one's mouth.

Betty Anthony
Cambridge, Massachusetts

Several Greek cookbooks include basil in salad dressings and various other recipes. Its use may vary from region to region in Greece.

I attended the dedication of the National Herb Garden at the U. S. National Arboretum. I remember the great contribution to the garden by Dr. John Creech, director of the arboretum, and by Betty Rea, former president of the Herb Society of America, during whose term the majority of the $500,000 was raised for construction and planting. Credit should be given to these two individuals, for without their efforts the garden would not be a reality.

Mary Dent Crisp
Washington, D. C.

PHILADELPHIA

"They'd Rather Be in Philadelphia" (March 1983) was to me a long-overdue tribute to the city of my birth. I think you captured the feeling of this great city, which was quite a feat considering how much there is to Philly.

Ernie Zenone
Hammonton, New Jersey

I was disappointed in your Philadelphia article. There were interesting facts presented, but the feeling of Philly never came through.

Adelaide Iannelli
Woodlyn, Pennsylvania

If Philadelphia's conservatism and stodginess have been the salvation of that city's vintage buildings, I only wish that we had more of those same virtues in Denver, where over the past 20 years so much of our rich architectural heritage has been squandered in the name of progress. Philadelphia, I salute you for your old-fashioned ways.

Mark Reinbold
Lakewood, Colorado

The Academy of Music has been the home of the Philadelphia Orchestra since 1900, not 1906. That the building "remained roofless for a year after construction to let the timbers age naturally" is not so. The ground breaking took place in June 1855, and the cornerstone was laid the following month. In February 1856 the building

was roofed and meetings were being held there. There was absolutely no time for it to stand roofless.

John Francis Marion
Philadelphia, Pennsylvania

The city's shrine to music also enshrines an old wives' tale.

DOGSLED RACE

The Iditarod (March 1983) is an event that does not lend itself easily to understanding by those people who do not live in areas where a personal challenge of this nature is accepted and looked forward to. I personally do not participate in dog mushing, but the history and challenge of the sport earn my respect.

Elsie M. O'Bryan
Houston, Alaska

I'm sure I'm one of thousands of GEOGRAPHIC readers who want to know how Susan Butcher made out in this year's Iditarod.

Matthew Borden
Unity, Saskatchewan

Susan came in ninth. The winner was Rick Mackey of Wasilla, Alaska.

After reading "A Woman's Icy Struggle," by Susan Butcher, I was very distressed and surprised that NATIONAL GEOGRAPHIC would glorify a race dedicated to abusing animals. I'd like to see Susan Butcher pull 15 dogs for 1,000 miles in next year's dogsled race to Nome!

Janet Knowlton
Fairfax, California

ATLANTIC GATEWAYS MAP

We noted with disappointment the reference on your "Atlantic Gateways" map to Titusville, Pennsylvania, as the site of the world's first oil strike in 1859. Our small museum preserves what seems to be a well-guarded secret—the site of the continent's first commercial oil well, dug in 1858 in Ontario by James Miller Williams. Drake's contribution at Titusville was drilling through rock.

Robert J. Tremain, Director-Curator
Oil Museum of Canada
Oil Springs, Ontario

Our reference to Titusville should have noted "first U. S." or "first drilled" well.

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On Assignment

JONATHAN WRIGHT

PUSHING A BOAT is a poor way to cross the far north. But archaeologist ***John Bockstoce*** knew it was better than getting trapped in ice off the Tuktoyaktuk Peninsula. So he and his companions leaped into arctic slush and for four long days hand-hauled their walrus-skin umiak and canvas freight canoe through meandering cracks in the frozen sea.

Though exhausting, it was not the toughest part of their 1,600-mile venture. "The waiting was worse," Dr. Bockstoce said. "Every time the ice forced us ashore, we felt the summer ticking away, and with it our chances to finish the voyage."

Finish they did, though it took three summers instead of one (see page 100). Fighting severe weather, they were held back from starting their journey until mid-July. By late August, winter winds had begun to howl. The ice was so bad one year it forced them to return after only 150 miles. But they never gave up.

Bockstoce has been visiting the Arctic since he was a teenager. His first job was on a boat delivering medical supplies to villages. Later he loaded dynamite on aircraft for mineral-exploration crews.

Today, as a curator of the New Bedford Whaling Museum in Massachusetts, he explores the ruins of Yankee whaling camps. "I don't know why I love the Arctic," he says. "I guess it's the stark beauty of white ice, blue sea, and green meadows. Besides, it was fun sloshing along in icy waters and getting a sunburn at the same time."

***Companions in adventure, Jonathan Wright**, foreground, and **Ashley Long** share a moment of relaxation during their voyage across the Canadian Arctic. Both would soon perish in accidents unrelated to the journey—Ashley in an explosion in Alaska in 1979, Jonathan in an avalanche while climbing in Tibet in 1980. Another tragic postscript: Crew member Bib Tevuk drowned in Alaska in 1979.*

Jonathan contributed to a dozen National Geographic Society projects, earning a reputation as a sensitive photojournalist. Born in Aspen, Colorado, where his wife and daughter live today, he was an avid outdoorsman whose work frequently took him to the Himalayas. Says a friend of Jonathan: "He was the best partner a man could have—either on the mountain or off it."

JOHN BOCKSTOCE

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Designed by a world leader in aerodynamics.

Ford is an acknowledged world leader in aerodynamic design. And Ford's aerodynamic expertise is well expressed in the '84 Tempo.

Aerodynamic design can have a profound effect on the performance of any car. No more than six horsepower is needed for Tempo to overcome air resistance at 50 mph. This results in less fuel consumed.

And impressive fuel economy figures are not the only result. The airflow is directed to reduce lift for improved stability and directional control.

The world's most advanced automotive computer.

If you've ever had your car's engine buck and stall on a cold morning...or choke up on a hot day... or had *any* irregular power output due to weather, temperature or altitude–you'll appreciate the capabilities of Tempo's new EEC-IV computer.

COMPUTER FUNCTIONS

- Pedal Position
- Fuel Air Mixture
- Spark Advance
- Intake-Air Temp.
- Engine Speed
- Crankshaft Position
- Engine Coolant Temp.
- Amount of O_2 in Exhaust Gas

EEC-IV (Electronic Engine Control) monitors and controls engine operation *precisely* and *instantly* under *any* conditions for optimum power output and fuel efficiency.

New Powertrain.

Developed specifically for Tempo, the 2300 HSC (High Swirl Combustion) four-cylinder engine works in concert with the EEC-IV computer.

This high-compression (9-to-1) engine generates 84 horsepower at 4400 rpm.* There's a surprisingly quick power response to even slight throttle pressure. Available with 4-speed, 5-speed or automatic transaxles.

High mileage?

Although EPA mileage ratings were not available at the time of publication, Ford Engineering tests project 42 estimated highway and 28 estimated mpg*

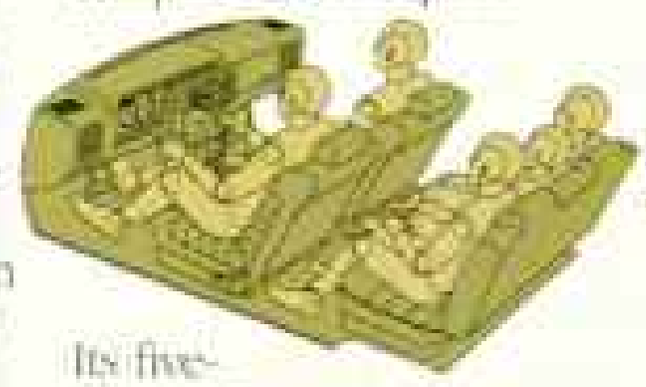
Ride and handling.

Tempo's front-wheel-drive design not only delivers added tire-to-road traction, but provides precise handling and tight cornering.

Tempo's new-design 4-wheel independent suspension permits each wheel to absorb road shocks independently. This results in better handling and a smooth, quiet ride.

Computer refined interior.

Computer technology and designer ingenuity have joined forces to ensure the best use of Tempo's interior space.



Its five-seat configuration allows for a comfortable combination of head, shoulder and legroom. In fact, there is more rear passenger room than a Mercedes 300D.

Commitment to quality.

An example of Ford's commitment to quality is the closeness and uniformity of the body panel fits. You can compare Tempo's stringent standards to those set by any European Sports Sedan.

What's under Tempo's glistening paint? Three more full coats of tough acrylic enamel and two coats of primer. That's almost 10 pounds of protection. The final result: a tough, brilliant finish that is highly resistant to weather, chipping, cracking and peeling.

Pick up the Tempo of your life.

To obtain a brochure with more information on Ford's all-new sedan, see your Ford Dealer or call 1-800-772-2100.

Get it together–
Buckle up.

*Based on SAE standard J1349
*The above estimates are projected Ford ratings based on Ford Engineering test data, and are expected to be very close to official EPA ratings. Use for comparison. Your mileage may differ depending on speed, distance and weather. Actual highway mileage and California ratings will probably be lower. See your Ford Dealer for a copy of the Gas Mileage Guide when available.

Have you driven a Ford ...lately?

Ford

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It's now possible for people who've only admired great pictures to take them.

The Programmed FG.

Inside everyone who's ever gazed appreciatively at a photograph is the urge to take great pictures themselves.

And now, no matter how much or how little picture taking experience you've had, there's a camera worthy of an admiring look.

The remarkable Nikon programmed FG.

The FG is a camera that ambitious beginners can still use after they've become accomplished veterans.

In the programmed mode, just focus and shoot. A microchip computer automatically selects the proper lens opening and shutter speed.

And through-the-lens flash metering with the optional SB-15 speedlight makes flash pictures virtually fool-proof.

Automatic and manual, too.

But what happens when you want a camera that allows you more flexibility?

Then the FG is an automatic camera that allows you to set the aperture yourself to control depth-of-field. And, in the manual mode, you can make all settings yourself for complete creative control.

$35 rebate for a limited time.

But the real genius behind the FG is that it costs so much less than you'd think. And until August 15, 1983, there is a $35 cash rebate.*

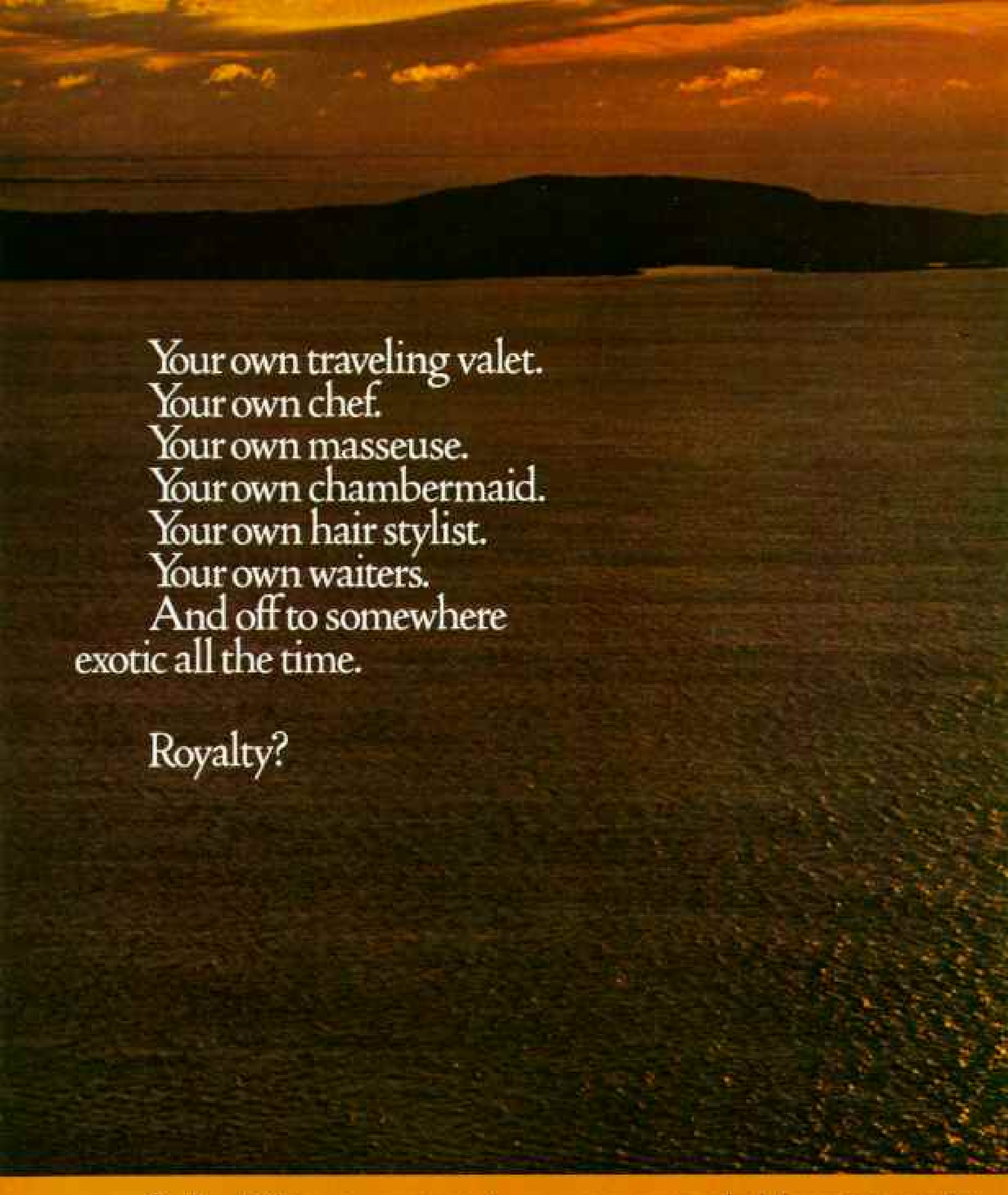
So visit your Nikon dealer soon and check out the programmed FG.

You'll never be content just looking at great pictures again.

Nikon

We take the world's greatest pictures.™

*Offer applies only to purchases which include the Nikon, Inc. limited U.S.A. warranty form. Photographs courtesy of the Witkin Gallery, Inc., N.Y.C. For further information write Dept. 47, Garden City, N.Y. 11530. © Nikon Inc. 1983.



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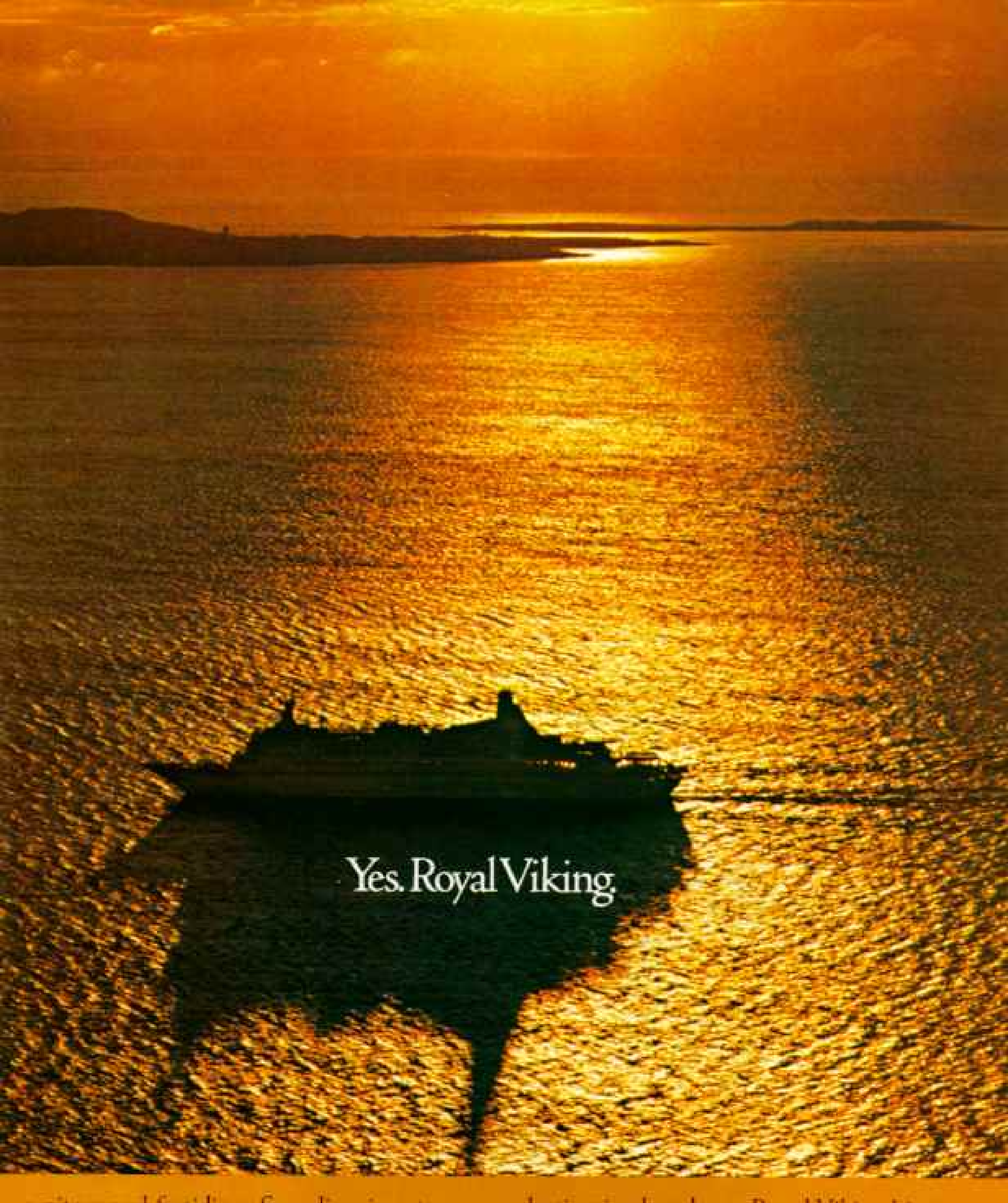

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Today Citicorp/Diners Club has virtually 100% acceptance at major airlines, car rental agencies and hotels. We're also accepted at most of the world's finest shops and restaurants, located in precisely those continents, countries and cities where the vast majority of the world's business is conducted.

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Pure driving pleasure is what Pontiac is all about. And now, there are three luxurious Pontiacs to choose from: the new full-size Pontiac Parisienne, the family-size Bonneville Brougham and the personal-size Grand Prix Brougham.

PARISIENNE
Roominess, comfort, impressive roadability—Pontiac's new Parisienne has it all. Shown is the Parisienne Brougham, which features a 60/40 luxury cloth front seat with fold-down center armrest and distinctive two-tone paint treatment, standard. Still need more room? Try the eight-passenger Parisienne Wagon. With both back seats down, it has 87.9 cubic feet of cargo area.

BONNEVILLE
Here's a car that can make short work of a long trip. Bonneville carries a family of six with ease. And its full coil suspension carries you down the road in style. Shown is the Bonneville Brougham.

GRAND PRIX
This personal-size luxury car is as maneuverable as it is comfortable. Shown is the Grand Prix Brougham with available Landau package.

See your Pontiac dealer today, and test-drive the driver's choice in luxury cars... Pontiac.

PONTIAC WE BUILD EXCITEMENT

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This car does not have a fireplace. BUT it does have living room. Elbow room. Head room. Toe room.

Family room!

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But that's not all Camry offers. There's front-wheel drive traction. An impressive, new, electronically controlled 4-speed automatic overdrive that lets you set the pace — "Normal" for most everyday driving conditions; "Economy" for improved fuel efficiency; "Power" for added performance. There's variable assist power rack and pinion steering, cruise control, power windows, power door locks. Two glove compartments — Yours and Theirs.

OH WHAT A FEELING!

TOYOTA

The Toyota Camry. Whether you buy the 4-Door Sedan or the 5-Door Liftback, it's not just the family car. It's The Family Camry.

*Camry Deluxe 5-speed. Remember: Compare this estimate to the EPA "Estimated MPG" of other cars with manual transmission. You may get different mileage, depending on how fast you drive, weather conditions and trip length. Actual highway mileage will probably be less than the "Highway Estimate."

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