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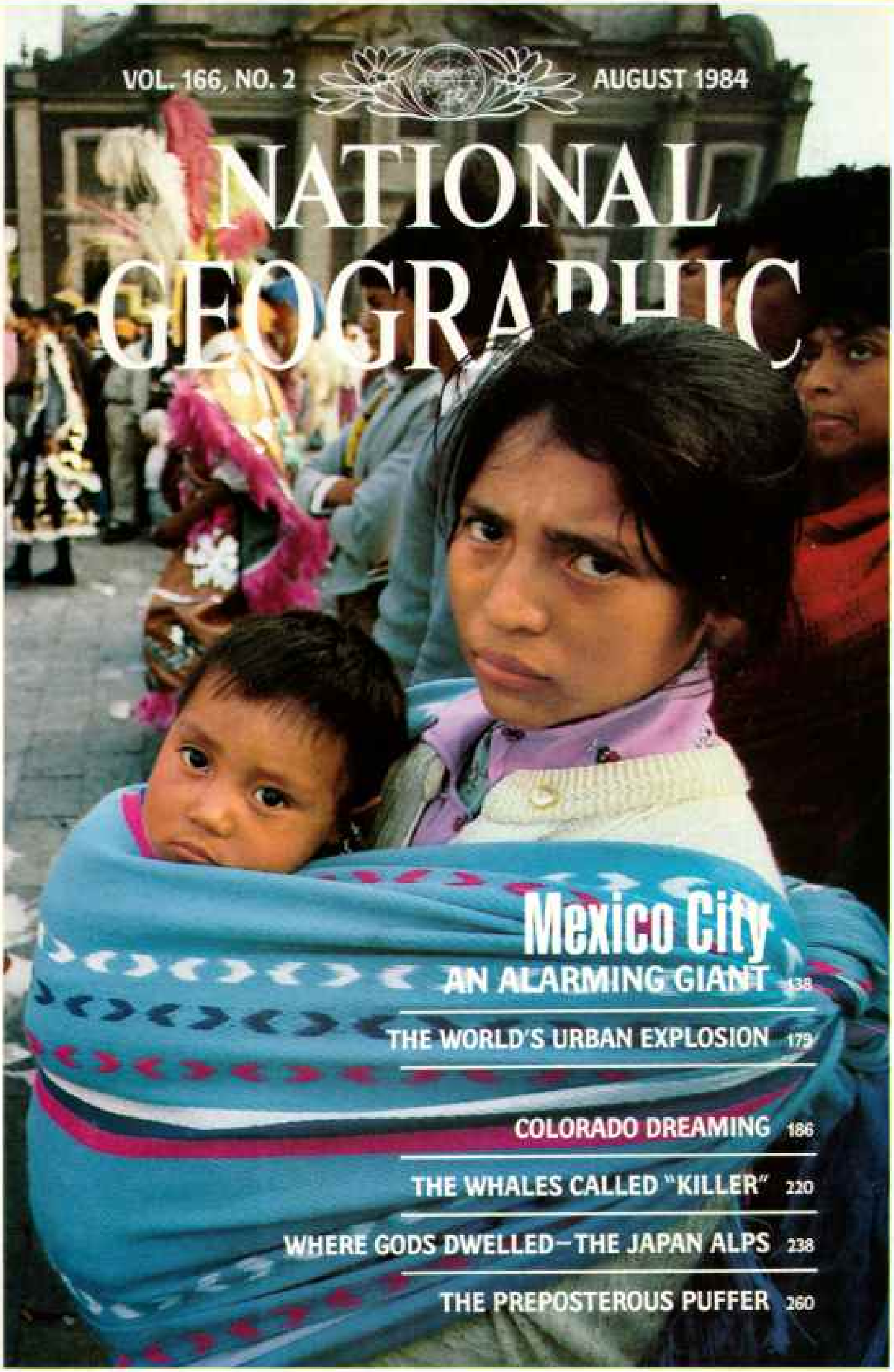

Mexico City
AN ALARMING GIANT 138

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

IT HAD ALL the makings of a childhood fantasy. An ancient city lost under the green canopy of a remote jungle. Vines and roots snaking over temples and pyramids. And, beneath it all, an undiscovered tomb containing the art of a vanished civilization and the skeletal remains of a long-dead nobleman lying in undisturbed repose.

But for eminent archaeologist R.E.W. Adams and his team, it was not fantasy but joyful reality. On May 15, 1984, in the jungle of northern Guatemala, they were excavating in a pit 12 feet deep when at 12:05 p.m. the ground gave way under the right foot of workman Andres Milian Torres. A tiny video camera probe assembled by the Geographic was lowered into the opening. As the excited party gathered around the TV monitor, it was clear that they had indeed found the tomb they sought—the first to be officially reported in Guatemala in 20 years. I witnessed the discovery as one of the few guests invited to accompany the joint Guatemalan-U. S. expedition, sponsored *(Continued on next page)*

Light of discovery *falls into a 1,500-year-old Maya tomb in the Río Azul region of northern Guatemala, as archaeologist R.E.W. Adams clears the entry to this major find.*

WILBUR E. GARRETT

NATIONAL GEOGRAPHIC

August 1984

COVER: *In solemn devotion, pilgrims gather at Mexico City's Basilica of Our Lady of Guadalupe. Photograph by Stephanie Maze.*

THE NATIONAL GEOGRAPHIC MAGAZINE
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Mexico City: An

By BART McDOWELL ASSISTANT EDITOR

Alarming Giant

Photographs by STEPHANIE MAZE

WHAT FACES a child of Mexico City, growing up in what is soon to be the world's largest city? Jobs, housing, and basic social services have not begun to keep pace with the wildfire growth of the Mexican capital, now home to 16 million people. Half of the population is under age 18, assuring tremendous future growth even with a now-lowered birthrate, and 400,000 rural immigrants annually swell the ranks. By 2000 Mexico City may count close to 30 million people.

Yet a spirit of survival prevails, an attitude that there's always a way to get something done. Faced with an unprecedented task, city planners try to tally the pluses. "At the least," as one puts it, "we can be a huge warning to the world."

Spacious tree-lined avenues sprouted walls of high rises during the spread of the city after World War II. Six times larger than any other in Mexico,

the metropolis serves as the nation's cultural center and holds a third of the jobs in private industry, as well as most of its bureaucracy.

In the immodest rush-hour crush, women and children find safety in separate subway cars. Opened in 1969, the Metro system now stretches more than a

hundred kilometers. Nearly four million commuters daily take advantage of the world's cheapest subway fare: one peso, or less than a U. S. penny.

WHATEVER you have heard about Mexico City—good or bad—may well be true. It is, or soon will become, the world's largest megalopolis, growing tumorously from some 16 million now toward 30 million inhabitants by the end of the century.

If you are a tourist with United States dollars, it is, as a newsmagazine reports, a peso paradise. (My own large suite in an apartment hotel cost less than ten dollars a day.) Gardens still explode with flowers yearround. Artists use colors as hot as jalapeños, and guitars throb like a stubbed toe. Pink Zone shops still sell abundant jewels and Paris fashions. Elegant restaurants and noisy discos stay full of *los juniors*, or pampered youths.

It's still a "city of palaces," as Baron Alexander von Humboldt once called it; new palaces, however, are often owned by retired politicians or policemen. And such palaces attract a folklore as rich—and maybe as spurious—as El Dorado of the conquistadores:

"A politician I know has a house with 14 bedrooms," says one informed gossip, "and each bedroom has its own swimming pool."

"The antique door to the new house of Señor X," says a guest at a fashionable dinner party, "cost $200,000—U. S."

If you are an impoverished rural Mexican, your national capital still represents—even in this financially troubled time—a chance for a better and longer life. But an uncertain chance: "You've seen the city dump?" asks a photographer friend. "People live in caves—caves in the mountains of trash. I'm afraid to work there."

If you are a city planner, Mexico City is a "case study in urban disaster." A headline writer says "Time Bomb." The celebrated novelist Carlos Fuentes calls it the "great flat-snouted and suffocating city, the city forever spreading like a creeping blot."

Journalist Ana Flashner—noting the 11,000 tons of gaseous waste emitted each day into the air—calls her hometown simply Smogopolis. It's the Monstrous City to the daily newspaper *El Sol de México*. And Carlos Hank González, after six years as mayor, compared the job of administering the city to "repairing an airplane in flight."

Hydrographers and engineers point out the grave problems of Mexico City: one of the few major cities in the world so far from a source of water, a city standing on the mushy, sinking soil of an old lake bed and girded by mountains that prevent dispersion of the smoke from some 30,000 factories and nearly three million motor vehicles.

Mexican President Miguel de la Madrid Hurtado (page 175) has observed that "Mexico City's growth and gigantic size are alarming and out of all known proportion."

One demographer jokes, "Our optimists count on an earthquake or atom bomb."

I AM NOT that kind of an optimist. As an old and worried friend of Mexico City, I have lately examined the worst deformities of its slums—lost cities, as they're called—and sampled its enduring pleasures in streetside restaurants, markets, and museums. I have watched its organic life from helicopters and subway cars and even within new sewer lines 30 meters underground. Most of all, I have talked to all kinds of *chilangos*, as residents of the capital are often called. From them I perceive the one fact that confirms both optimism and pessimism: This city is still very Mexican. And if Mexicans seem short on self-restraint, they are brilliant at improvising.

Mexicans are gregarious and warmblooded. Thus their scary national birthrate—34 per thousand population in 1980 (more than twice that of the U. S.). It is estimated that in the capital 30 percent of the families sleep in a single room—and those families average five people. Aside from Roman Catholic tradition, numerous children prove a man's machismo and a woman's fertility. "But children are also an investment for old age," a student told me.

Recent trends suggest significant change. "Mexico's family-planning program is a

Risky business *earns a fire-eater small change from drivers stopped at an intersection. Burns are an immediate hazard; breathing the fuel can lead to lung and brain damage. Thousands of roving vendors work the traffic-clogged streets. Official unemployment stands at 8 percent, but nearly half the city's families live on less than four dollars a day.*

Mexico City

Sign from a god directed Aztecs to establish their capital about 1325 on marshland in salty Lake Texcoco, some 2,100 meters above sea level. It was one of the world's great cities by 1521, when Hernán Cortés razed it to build the capital of New Spain. Without a sustaining river, Mexico City has depended on wells and springs for water. Now, with wells running dry—aggravating natural land subsidence—the city must bear the heavy cost of pumping water in and sewage out over surrounding mountains.

The metropolis today covers more than 1,000 square kilometers. Nearly half of this area lies outside the city's official boundaries, which lie within the Federal District, an independent entity in the United Mexican States.

NORTH

MEXICO STATE

FEDERAL DISTRICT

MEXICO STATE

FEDERAL DISTRICT

AREA ENLARGED ABOVE

MEXICO STATE

POPULATION SHIFT

Urbanization is the wave of the future for the entire nation, whose population of 72 million today is expected to rise to 161 million by 2025 and results largely in its cities.

UNITED STATES

MEXICO

Gulf of Mexico

Mexico City

Pacific Ocean

1984

2025

MEXICO CITY 24%

RURAL 34%

OTHER URBAN 42%

MEXICO CITY 14%

RURAL 19%

OTHER URBAN 67%

URBAN EXPANSION

URBAN AREA 1940

URBAN AREA 1960

URBAN AREA 1984

Contours read by optical scanner, then raised and tilted by computer, simulate relief of the Valley of Mexico. This view from the northeast offers an unobstructed perspective of the city.

VERTICAL SCALE EXAGGERATED TWO TIMES

NATIONAL GEOGRAPHIC CARTOGRAPHIC DIVISION

RESEARCH: DAVID C. CRANE, PRODUCTION: ROBERT CRONAN

DIGITAL TERRAIN MODEL BY GREENWORKS & O'HARA, INCORPORATED

model for the Third World," an international expert asserts. Nationwide, population growth is slowing, from 3.5 percent in 1970 to 2.4 in 1982 (see article, pages 179-85).

"Many Mexican priests condone contraception, but we do not condone abortion," a Jesuit told me. And abortions, though widely performed, remain illegal.

If large families bring large problems, they also furnish some solutions. Relatives take care of each other, and in a land lacking unemployment insurance, this is a fact of survival. "My brother sends money from Texas," explains an unemployed plumber in the Zócalo, the city's central square.

"I live with my uncle's family," says a newly arrived job seeker from Hidalgo.

But the very population density—along with a Mexican sense of neighborhood and a year-round outdoor climate—provides another service, creating the condition that urbanist Jane Jacobs calls "eyes on the street."

Sidewalks are alive and noisy with vendors selling tacos and lottery tickets, children at play, gossipy nursemaids and loiterers, and shops with open doors. Day or night, little escapes notice on Mexico City's informally self-patrolled streets. Sometimes a *ratero*, or pickpocket, does his light-fingered work. But violent crime is rare. I feel safer in the capital of Mexico than in any large U. S. city.

Even so, along with unemployment, some sorts of crime have risen—especially auto thefts, an appropriate felony since greater Mexico City is both shaped and afflicted by the motorcar. (Motor vehicles, for example, cause 70 percent of the air pollution, widely regarded as the world's worst.)

Today the urban area spreads over more than a thousand square kilometers (400 square miles), 550 within the Federal District and the rest along highways in the state of Mexico. To the northwest, at Naucalpan de Juárez, factories stand at the roadside, some at parade rest, with shifts cut back these days. Other plants spread west along the Toluca highway.

But it's in the center of Mexico City that the motorcar brings its noisiest implosion. Collective taxis supplement bus service, their passengers pressed together like skin grafts. Diesel trucks and city buses lay down solid-state smoke screens. Exhaust fumes shimmer. And dimly visible above it all is that new monument to the internal-combustion engine, the Pemex Building, seat of the government oil monopoly, Petróleos Mexicanos. "The tallest building in Latin America," taxi drivers boast. So it is, at 52 stories—though four projected floors were decapitated for austerity. And rumors of scandal swirl around Pemex almost as thick as the smog.

Yet, even traffic jams have a curiously Mexican quality. At stoplights drivers can buy newspapers, bouquets of flowers, or rugs, or watch fire-eaters perform for tips.

Along the streets and shops, hand-lettered signs tempt, warn, and proclaim in a personal way: "Have a beautiful nose without surgery." "No parking—tires punctured gratis." "It is agreeable to be important, but it is more important to be agreeable." "If God permits, here will be located a vegetarian restaurant." "The middle class will save our country."

MANY OF TODAY'S struggles were once known by the Aztecs, or Mexicas. They founded the city upon the mud of Lake Texcoco six and a half centuries ago. As compulsive warriors, they conquered their neighbors, taking over whole cultures as well as lucrative imperial tributes. This Mexica capital, with perhaps 200,000 people, was already one of the world's greatest and most opulent cities when Hernán Cortés and his conquistadores arrived in 1521. Many current attractions—from temples to tacos to *tianguis*, or street markets—were already part of Mexica life.

Even more, as poet-philosopher Octavio Paz explains it: "The fact that the whole country was given the name of the city of its oppressors is one of the keys to the history of Mexico. . . ." Paz refers to an unbroken "thread of domination," so that "the Spanish viceroys and the Mexican presidents are the successors of the Aztec rulers." Even now mayors of Mexico City are still appointed by the president of the republic.

What with the Spanish tradition of centralization and enjoyment of city pleasures, the Mexica trend continues strong. The capital concentrates both market and labor force for more factories—and still greater growth. Today Mexico City accounts for

roughly one-third of the whole nation's factory and commercial jobs and two-thirds of the national bureaucracy.

Plans for decentralizing the population consistently fail. Why?

"Remember," a wise friend once warned me, "all of us Mexicans have something to hide. Maybe a bribe given or taken, or taxes that we owe. Take my dear old aunt: She goes to Mass daily but drives her car without a license. When a policeman stops her, she says, 'This is your chance for a good deed today.' She gets away with it."

City planners conservatively estimate that half of the city's population lives in irregular housing. "Either the title is faulty or construction does not comply with the code—*something* is wrong," notes city planning director Javier Caraveo. Although city records are being computerized, land tenure is the major problem of urban development here, according to planners. "No one puts his best effort into a house if his ownership is insecure," says director Caraveo. On public lands, squatters usually get clear title after five years of "pacific possession in good faith."

Scientific city planning in Mexico City dates only from 1980, but the staff of young architects recruited by Caraveo (their average age is 33 years) are able and eager. In spite of budget cuts they continue to attack the city's broad spectrum of problems. Like water: a problem that varies from annoying to critical. Since 22 percent of all Mexicans live here on less than one percent of the land, much of the water must be brought in from outside the Valley of Mexico. And since the city is like a bowl sitting on a tabletop, pumps must lift the water and waste coming and going. Furthermore, most rain comes in summer storms and immediately runs off.

"It's a paradox," notes engineer César Herrera, "since we need to get rid of rainwater while bringing other water in." The water costs eight billion pesos (47 million dollars) a year—70 percent of which is subsidized by the government.

Almost no rain falls from November through April. The city then goes dusty and yellow with its annual drought. A new administrator confided to friends in his *colonia*, or borough, "My first official decision was to murder our park." A dramatic way of saying that the water shortage had forced the neighborhood to quit watering the grass.

On a rainy September 9, 1981, the famous artist Feliciano Béjar faced another sort of water problem. At dusk he was the only adult home in his studio compound with ten children, two of them babies in arms. "I had lived here for 30 years—since San Angel was country—with no disasters. But when highways and more houses were built—when we paved—I knew a flood was possible. So I put special doors on the level below."

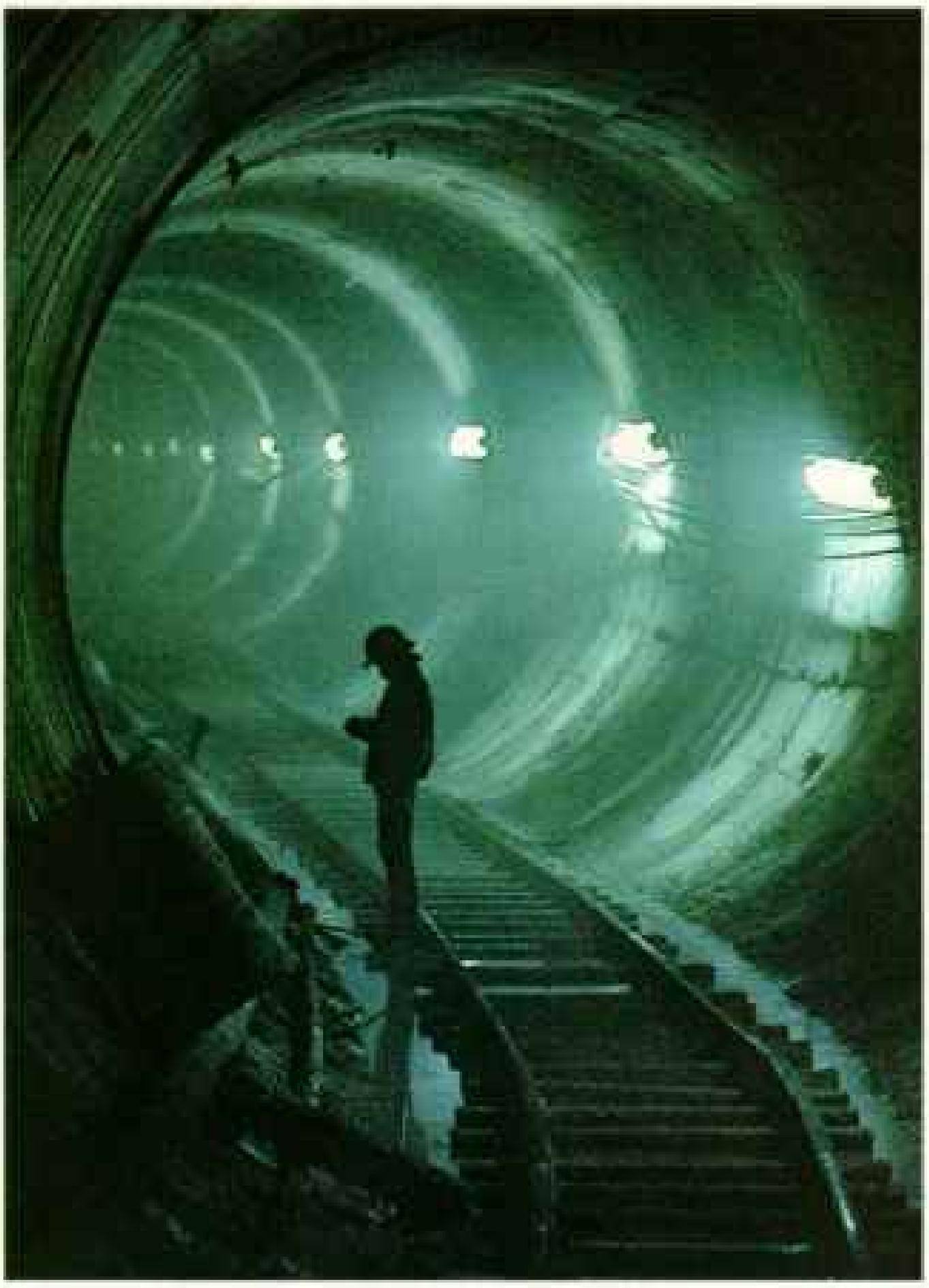
Doors weren't enough to hold back the flood that evening. It arrived—"almost to my chin"—in a swelling torrent. "I called for help and a neighbor came, but he was knocked unconscious and disappeared in the water," Don Feliciano recalls. Water was soon seven meters deep in spots. "We had to swim and hold on to the limbs of trees," he remembers. But by carrying small children and helping the older ones, he got all the household to higher ground.

The Béjar studio, house, and 15,000-volume library were wrecked; some 400 paintings required restoration. "The next day," the artist recalls, "the mayor came to see the damage. He told me, 'This is the only city that puts its rivers into the sewer.'

"I lost material things, but some people—the sick who couldn't move—drowned. All the damage was due to bad planning. So sad. And trees are dying in Chapultepec Park for lack of air and groundwater."

NOT ALL THE TROUBLE is man-made. Earthquakes caused seven separations in the Xochimilco aqueduct during 1979 alone. Leaks waste water wantonly, and pipes simply do not last as long here as in other places. The Cutzamala River Basin project, underwritten by the Inter-American Development Bank, should solve the city's water needs for a time—provided that leaks are kept to a minimum.

But the equations of earth and water have other ironies. The soil is one part solid to five parts water, so as pumps remove groundwater, the city sinks as much as ten inches a year—making deeper drain pipes necessary. The sinking, though, is not uniform: The famous Angel statue, erected on the Paseo de la Reforma in 1910, rests on pilings set deep in solid ground. Buildings and streets



Home to a family of twenty, *this house* ***(right)*** *grew with its three-generation household. A courtyard faucet fills jugs for drinking and tubs for endless clothes washing, aided by a new machine. "Sometimes we have water all day, sometimes none for a week," says a member of the family. More than half of the city's housing units are built by their occupants, and 40 percent, including this one, lack adequate sewerage. A vital link in the expansion of sewer service is the new Deep Drainage System* ***(left)****. Planners hope to reach 85 percent of the city by 1988.*

Witness to the success of Mexico's family-planning program, midwife Catalina Dávila ***(below)*** *examines an expectant mother in a rural area in the Federal District. Midwives deliver perhaps 20 percent of the city's newborns, and with government training they have become promoters of family planning and prenatal care. "Ten years ago women had five or eight children," says Dávila. "Now, only two or three."*

around the statue sink, so that every few years El Angel needs one new stairstep for its pedestal (page 161). El Angel thus seems to be ascending, gradually, into a smoggy sky.

The soil mechanics produce puzzles for engineers of the subway system. Before excavating, they must pump out just enough water; too much pumping would cause nearby buildings to sink even faster. And to excavate for large subway stations, engineers must match the weight of the material they remove with a heavy building above ground—to keep the underground station from popping to the surface.

"If we had no building on top, we would

Street markets thrive *year-round in Mexico City's moderate climate. Since Aztec times vendors have lined Calle Correo Mayor* **(below)**, *where many openly peddle fayuca—foreign-made goods smuggled into the country. Although chain-managed supermarkets supply most of the city's food, some 1,600 traditional markets are still a large source of meat and produce. This snack concession* **(below right)** *offers pineapple, watermelon, citrus, and cucumber slices in cone cups.*

need a heavy slab," said one engineer. "Instead, a heavy office building also provides rental income."

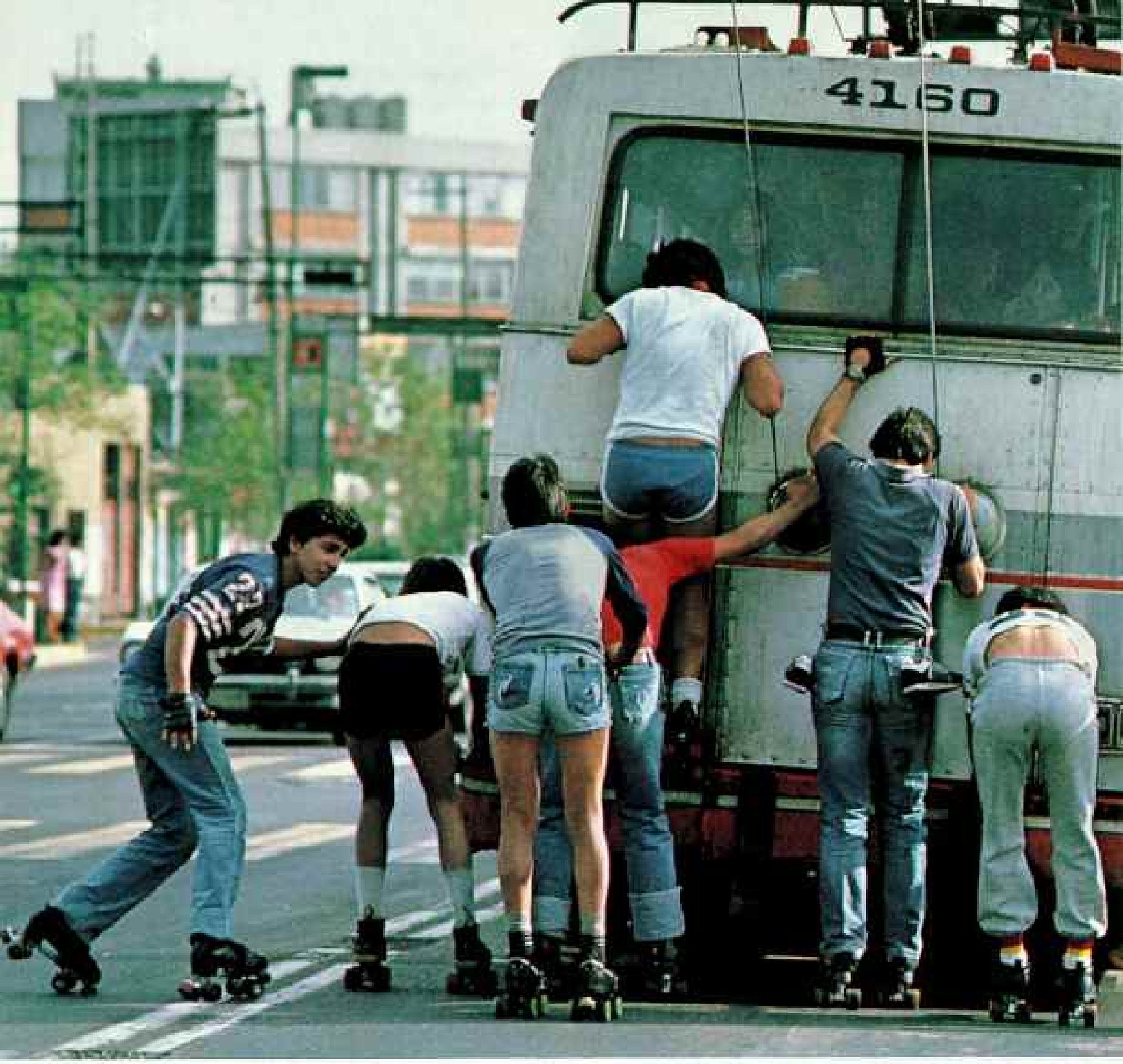
The very existence of Mexico City's subway seems miraculous. Initiated in 1969 with 11.5 kilometers of track, the system now has 104 kilometers (65 miles) and is still growing. "Every day four million people go down into the Metro—and all of them come out," notes one engineer with some wonder.

The subway fare—at one peso, or less than one U. S. penny—is the world's cheapest. The subway carries twice as many passengers as city buses, but still fewer than private automobiles.

During one early morning rush hour, I watched passengers outside the Zaragoza station, east of the city center. Men were scuffling for place in serpentine lines; women waited, crowded but less aggressive, in a separate area. Children stood, a bit bewildered, in a kind of holding pen; they would join their mothers before boarding the subway cars reserved for women.

I heard of no Mexican women who resented subway segregation. Those I talked with seemed relieved not to share rush-hour cars with working-class men.

The trains themselves seem wise. Once I was permitted to drive one briefly, set on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The acrid assault *of air pollution, judged by many the worst in the world, takes an increasing toll on the city's health as 11,000 tons of gaseous waste spews out daily* ***(left)****. Motor vehicles, running largely on leaded gas, account for 70 percent of the pollution; most of the 30,000 factories burn low-grade sulfurous fuel.*

Efforts to increase public transportation include reviving a nearly extinct trolley-car system and expanding a fleet of trolebuses powered by overhead electrical wires ***(above)****. Daring weekend skaters here hitch trolebus joyrides, a dangerous and illegal practice.*

automatic control, my hand on the dead-man switch; had I fainted or expired, my faltering touch would have stopped the entire subway line. Green lights flashed past me as the train coiled through the tunnel. The high-frequency whine changed pitch, we slowed, then stopped at a station; passengers flooded off and on. I had done nothing to cause these events, except to live.

But what would happen if the power failed? Well, it did—at 7 a.m., January 15, 1981. For three hours the city stopped—no electricity, no TV or radio, no elevators, no telephones, no traffic lights, no Metro. Seven subway trains were caught between stations with some 1,500 people on each train. Auxiliary lights came on, and passengers got off and walked to the closest stations.

Exciting, excitable, individualistic Mexico City had improvised. Citizens reported no assaults, no bad accidents, no deaths.

ON MORE PROSAIC DAYS, each of the city's thousand neighborhoods has a self-reliant routine of its own. Take the place where I live whenever I go to Mexico City. Mine is an unfashionable street in Colonia Cuauhtémoc. My neighbors and I enjoy a cheery mix of small shops, apartments, and private houses, and an animated current of the good and bad of Mexico City street life.

From my kitchen window I have a cubist's view of rooftops; a laundress hangs wet stockings on a clothesline, guarded by a fat old dog round as a balloon. From my front balcony I fathom the tides of traffic swelling noisily by day, ebbing late at night under a streetlight's jack-o'-lantern glow. As I come and go on errands early and late, neighbors recognize this graying gringo with a *buenos dias*, and night watchmen touch their caps.

At 5 a.m. our community drowses in the dark; a street sleeper and his toddler son huddle in a doorway under a counterpane of newspapers. At six a trash picker browses through our refuse, and a taxi slowly cruises Calle Río Lerma seeking an early fare. A sweeper wearing high-visibility orange attacks the sidewalk litter with a pushcart and a crude witch's broom. At 6:30 the corner fruit vendor opens his kiosk, offering fresh-cut papayas to domestics hurrying to work. Suffocated sounds come from the

Country club carved from a canyon, *Club Raqueta Bosques turns a geologic debit into a plush asset. Reflecting Mexico City's wealth, the innovative development of*

which it is part also tucks office buildings, restaurants, and a shopping mall into one of the city's toniest neighborhoods, Bosques de las Lomas—"forests of the hills."

corrugated-metal doorway of our local saloon, a *pulquería:* voices, the rasp of scrub brushes, and a murmur of radio music—a saloon humming to itself. The lunchroom, its stools still stacked on tabletops, smells of coffee and *empanadas*.

At eight our market opens, the concrete floor puddled with soapsuds. A maid flirts with the young butcher, and a widow crumples some damp pesos as she bargains for yesterday's wilted produce. (With her change she buys a bouquet of daisies.)

Traffic now surges in the street, and midmorning sunshine, though hot, grows fuzzy with smog. A man carrying a large sack of merchandise musically chants his business: "Buying—shoes, curtains, rugs." This one-man conglomerate will sell his rummage on poorer streets. He is followed by our roving plumber, who announces his presence by blowing three notes on a pipe. ("He speaks like the birds," laughs a bootblack.)

All our shops are open now—the dry cleaner's, the stationer's, the picture framer's. Business slacks off for lunch at 2:30, and idle taxi drivers play checkers with bottle caps in the shade of a tree. The neighborhood gets a second wind at five. Moviegoers start to line up at the box office, and lovers hold hands in the park. As darkness falls, our local beggar hobbles up on aluminum crutches, one hand outstretched, his head tilted piteously; his clothes are good, and so are the coins my neighbors give him, for in Mexico, day or night, personal charity survives, and no one is anonymous.

So it is a city of newcomers rather than of strangers. But what is the attraction? Well, some have no choice, like the baby boy I met in the splendid, antiseptically scented Social Security Hospital in San Angel. The still unnamed five-and-a-half-pound son of one Señora Marcela Monroy de Jalapa, this baby had, for one moment, held the fleeting title of Mexico City's newest citizen. Some 360,000 other babies are born to chilangohood each year.

Older citizens migrate here by choice or by necessity. You can spot the new arrivals easily at the Eastern Bus Terminal—a thousand of them come each day—wearing country clothes and expressions of confused excitement. Not, though, a woman I saw there one afternoon, weeping desperately into her shawl.

"She has just come from the state of Puebla," a ticket seller explained. "And a robber has taken all her money. Poor little thing."

What would she do? Go hungry? Beg like uncountable professional mendicants here?

"Women can usually find work in the city—unlike so many unskilled men," explains social anthropologist María del Carmen Elu de Leñero. Studies even confirm the existence here of a "subproletarian" group, where women, as the more certain breadwinners, choose and discard their menfolk, in a kind of matriarchy, a curious reversal for macho Mexico.

More traditionally, an underemployed man from a farm area comes to the city, finds a job, then sends for his wife and children. Take short, dark Alfredo Ríos Pérez, age 25 (his best estimate), from a village in the state of Hidalgo. "I left home maybe six months ago," he says. Why? "To better myself!" As a farm worker he had earned about six dollars a week; now, in construction, he makes six times that—enough to bring his wife and three children to the capital. He proudly straightened a mud-spattered hard hat.

Or consider the mime I met one morning in the Zócalo. He was wearing wildly checkered trousers and oversize clown shoes and was applying white greasepaint to his face. He lives by laughter and the tips passersby toss into his funny hat.

"On a good day here I may get 1,500 pesos," he told me—the sum was then close to ten U. S. dollars. "And the same if I am hired for a party."

"I NEVER EARNED that much on the street," Mario Moreno told me. Don Mario is better known worldwide as Cantínflas, the wistful little comic in dozens of motion pictures during the past half century. "I was born here in the city, in Santa María la Redonda, a humble place. It was a struggle to rise.

"At the start I was a street actor, working in tent shows. It was good practice. People would shout at me and tell me what they wanted. That human contact was the basis for my profession. Tips are good-hearted gifts. When the actor makes people happy, they try to pay him for their happiness."

Cantínflas has obviously been rewarded

for millions of happy moments. His home—not far from the lavish four-house compound of former President José López Portillo—is expensively filled with carved ivory, stained glass, animal skins, portraits, and other trophies of a celebrated life. He has won his struggle up from the streets.

So has a young farmboy from Oaxaca named José Ruiz. "My military service brought me here first," he explains. "Later my cousin Margarita got a job as a cook in a private home, and she got me a job as the gardener. I then went to driver's school and became a chauffeur, so I could finish high school at night. And *then* I took an electricity course. So now I have worked three years in electric repairs with a friend." Why the city? "I want to save some money to open my own shop in Oaxaca. Margarita now has her own lunchroom in Netzahualcóyotl. It's nice. And two of our cousins have come to live with her." Success.

One early morning I drove out the Puebla highway to visit Margarita's place. Local maps can't keep up with the unnamed roads, so I got lost in a place called the Valley of Ayotla. In the chill of dawn workmen for a cinder-block factory were warming their hands at a smudgy bonfire of truck tires. Alongside some new homes a diked ditch steamed with tar-black waters and the overpowering stench of raw sewage. The scene could have been Dante's city of Dis: "The marsh from which the stinking gases bubble lies all about this capital of sorrow. . . ."

Yet electric wires randomly stitched houses together in a kind of Jacob's ladder. Most homes had a TV antenna on the roof.

"Yes," said a workman, rubbing his hands for warmth, "we have electricity, but we buy our fuel—propane gas. And we buy water by the drum." The price was 35 cents for 55 gallons.

Even so, clotheslines sported pennants of clean laundry, and curtains hung at the windows. Children in neat uniforms were

Writer and homemaker *Christina Ruiz de Velasco covers "everything except politics" in her weekly column in* El Universal, *one of the city's six major newspapers. Increasingly her topics reflect the growing pains of her hometown, where drastic peso devaluation and an 80 percent inflation rate dent the most privileged pockets. "We're all working harder now," she says. "I think we'll emerge stronger for it."*

walking to school, and one housewife was feeding table scraps to her flock of chickens.

Back roads finally led me to Netzahualcóyotl (pages 176-8). This community, just across the frontier of the Federal District in the state of Mexico, has an estimated 2.3 million residents and represents one of the world's fastest growing cities. Netzahualcóyotl is also a mess. I found trash dumped in dusty unpaved streets and garbage used for fill.

I passed the Club Bum Bum, a parlor for funerals ("day and night"), a public-housing project of neat brick, and then a cross-street banner proclaiming: Netzahualcóyotl, the City of Change.

Yet Margarita's lunchroom was clean and, as cousin José had boasted, nice. She had a TV set, a refrigerator, her own house next door, and tables for loyal clients. Compared with subsistence in rural Oaxaca, her place could represent success: It was *hers*.

"Well, of course, these were Oaxacans," a sophisticated friend observed. "Like Benito Juárez, each Oaxacan comes here and expects to become president of the republic."

SEÑORA CONSUELO Cervantes Fernández is a different kind of president. A woman of 76 from the lake land of Michoacán, she leads her neighborhood association in a subdivision with the leftist name Liberación Proletaria in Delegación Alvaro Obregón.

Doña Consuelo lives in an airy, tiny house, brightened by bougainvillea and ferns. Her neighbors in a 16-block area enjoy the amenities of running water and electricity. Their cottages cling to a steep slope negotiated only by stone steps, but all the houses are painted, planted, and washed.

"We used to look like *that*," said Doña Consuelo; she pointed across a ravine where a cataract of garbage litters the precipitous bank. "We had no road, no way to come by car. When we had a factory explosion in 1974, the firemen could not come. Terrible!"

The great change began two years ago when Liberación neighbors formed a cooperative to rebuild their community. The city government donated materials and advice, and residents volunteered the labor. "Sundays, evenings—all. We are many people, perhaps 2,000, for families often have 12 or

Anchored in firm ground, *the monument known as El Angel rose in 1910 to celebrate Mexico's centennial*

of independence from Spain. Because of subsidence of the surrounding land, terraces now lead down to the traffic that swirls on Paseo de la Reforma, a Paris-style avenue laid out in 1865, when Archduke Maximilian reigned as emperor.

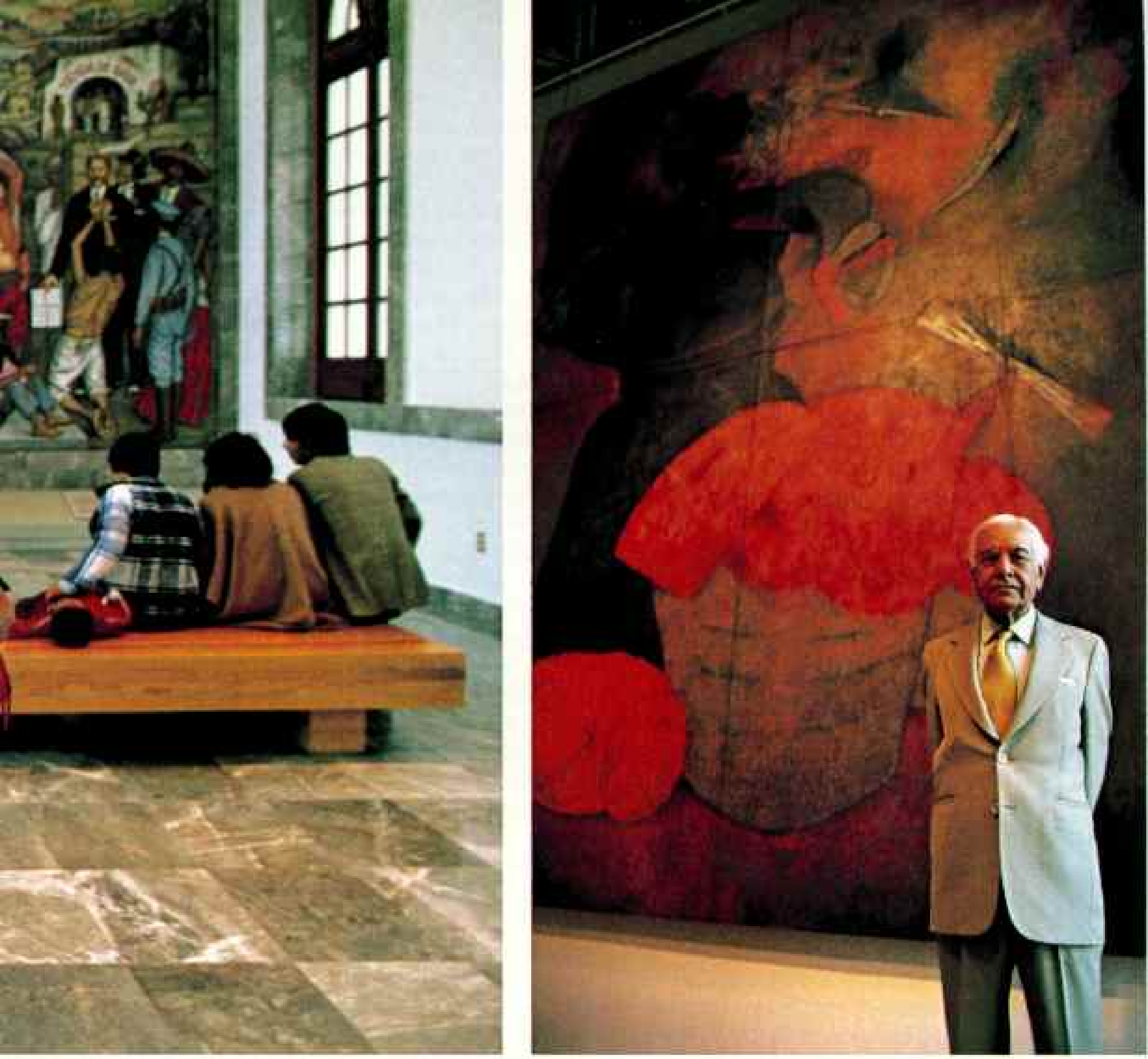
15 children. Many unmarried mothers. We worked even with the hands of children.

"The hardest job was convincing people this was possible. They had no faith in promises. My own son told his friends he thought I was a little crazy." She rummaged in a cabinet for an album. "Here—we are working." Stiff, posed photos showed the progress. "My son took this picture. This was the first truck to use the road." She sighed, smiling. "Such satisfaction! Nothing endures except the help we give others."

People from many neighborhoods visit Liberación now. And go home with plans and even some faith.

Near here families used to live in the hillside caves left from old sand quarries. "Dangerous because of cave-ins—people were killed," said Roberto Domenzaín González, then president of the neighborhood committee for the whole district. He showed me two caves still gaping above us. "Empty now. We have no one now living in caves. In fact, in the past five years we have resolved all our worst problems here."

But problems can return overnight, like the *paracaidistas*, or parachutists, the squatters who seem to drop from the sky upon any land still vacant. Dishonest brokers organize invasions of unused land—dumps, street rights-of-way, empty lots whose owners live elsewhere. The brokers find people seeking homesites, then "sell" them lots and orchestrate a mass invasion by



the families in the dark of night. The brokers keep the money, and the squatters keep the land—if they are lucky.

"We had an invasion here about five months ago," says block leader Daniel Calva Otento. "No warning. Their shacks appeared in the ravine one morning. Some families remain."

"Little by little we bring services to these communities," notes Domenzaín González. "And what an important change it makes. When people live in such lost cities, they are afraid to enter a store that is big and clean. Instead, they go to small, dirty shops where prices can be much higher. But after their own communities have been made decent, people feel different; *then* they

National pride flowered *larger than life when Mexico City's famed muralists first championed the reforms of the Mexican Revolution in the 1920s. The last murals painted by Juan O'Gorman before his death in 1982 captivate visitors in Chapultepec Castle (**above left**). "But art must be more than pamphleteering," says world-renowned artist Rufino Tamayo (**above**), who rebelled against politicized muralism. He collected some 300 works from such modern masters as Miró and Picasso to create Chapultepec Park's Rufino Tamayo Museum, where he stands with his "Homage to the Indian Race."*

go to the large stores and save money!"

A distinctive pride and flavor characterizes each part of the city. Consider the Tepito area in Colonia Morelos, famous for La Rinconada, its street market of secondhand clothes and smuggled electronic equipment. Here you could once buy pirated perfumes—or even ransom back your own stolen silver. No more. Police boast that they have forced a social climb from thieves' market to flea market.

Tepito today enjoys greater fame on sports pages as the starting place for boxing champions. The neighborhood gymnasium and sports center serves 700 members; it's a bright, well-vented complex that smells more of varnish than of sweat. By 7 a.m. the place echoes with the activities of coaches and sparring partners, the rhythmic stutter of punching bags. A sign warns: "It is strictly prohibited to spit on the floor or the walls."

Skipping rope, feinting, crouching, jabbing, wiry young men practice the motions that will take them up and out of Tepito to the cavernous Coliseo and fat prize purses.

A rangy 19-year-old welterweight named Juan Carlos Alvarado comes from the west, the state of Jalisco. "I'm staying in a hotel," he tells me, and he's a bit awed, though his hotel is located in a seedy neighborhood.

"Sure," his trainer insists, "a bullfighter may make half a million pesos per fight, but a boxing champion can earn 30 times as much." Juan is not yet so wealthy; he will get about $230 for his next fight, and half goes to his manager. But that's enough to bring a smile to Juan's face—a shy smile, since Juan is also shy some upper teeth.

THE NEIGHBORHOOD around Plaza Romita is older and more infamous. There boys kick soccer balls in the street, and loitering men watch visitors with wary curiosity. "Our neighborhood is known as the home of thieves," laughs Señora Josefina Bayardo, a schoolteacher and longtime resident. "But we are safe here. No one steals in his own neighborhood."

The local priest, Father Alfonso Aresti Liguori—for 20 years confessor to many and friend of all—fidgets, then defends his flock. "Once we had 500 crimes here each year, but things are much better now," he insists. With proud affection he shows visitors around his small colonial church, built in 1530. He is careful, I notice, to lock the church office before making his rounds.

A St. Jude nearby flickers with a constellation of votive candles. Is this not the patron saint of thieves? Father Alfonso seems embarrassed. "Well, there are *two* St. Judes. *This* St. Jude cured leprosy. He is a symbol for the people. I am not a policeman or a judge. The people have a good spirit."

Hushed parishioners are arriving for Mass with scrubbed, uncomfortable children. The priest views them fondly: "To understand the city, you must study our countryside. People come here from farms, knowing nothing about city life. In five days they're so miserable we have to give them help. But soon they are doing the hard work of the city. The second generation feels more at home, and the third generation is completely used to the city."

Social workers affirm this gradual assimilation, and they also talk about the "ruralization of the city," the habit that well-rooted countryfolk have of raising flowers, vegetables, rabbits, and chickens on the roofs of buildings and in small patios.

But parts of the 1,500-square-kilometer Federal District still, surprisingly, need no ruralization. Drive south past Xochimilco and its floating gardens and climb dark, volcanic hillsides planted with corn, prickly pear, and orchards. Here the air is cleaner and Volcán Iztaccíhuatl stands in white-capped clarity. At the market in Milpa Alta, you can still hear old women speaking Mexicano, or Nahuatl, the Aztec language.

"I spoke Mexicano with my grandmother," said Señora Catalina Dávila de Bonilla, "but not so much now." She and her husband have a butcher shop in the hilltop market in Santa Ana Tlacotenco, but Doña Catalina was more famous in these hills for 38 years as a midwife. She is a clear-eyed, energetic woman with a sunny smile and a success story: "My parents died while I was a child, and my grandmother raised me. She got up at four each day to go to work. When I started school, a pencil and paper cost only a few centavos, but my grandmother couldn't afford even that, so she took me out of school after one year. Now I am able only to write my name and to tell which bus goes to the city. So I always advised my children to go to

school. I have nine living children—and four of them are teachers. . . .

"I became a midwife by necessity, delivering my own babies. I knew the importance because my mother had died in childbirth. Later I had a training course and won a diploma. I used gloves, clamps—everything sterilized. And all difficult deliveries I sent to the hospital. When the time came for the pregnant woman to give light to her baby, I gave her courage. People had confidence in me. And later the children I delivered called me Grandmother. I have not counted their number." Her fee for a routine case came to about three dollars.

But like all midwives here, Doña Catalina was also a trusted adviser on family planning. "I had to use vulgar words when I explained. And if a woman had two or three children and wanted no more, her husband had to sign a paper for permission to tie her tubes. Many husbands want no contraceptives and will divorce their wives if they feel deceived. . . . No, the priests never caused me trouble." And who helps a couple decide when to have a child and when to wait? "Often the husband's mother decides—and often a pharmacist, or the midwife."

Perhaps 20 percent of the babies born in Mexico City are delivered at home and by midwives like Doña Catalina.

"And the trained midwives are unpaid volunteers in our program," says Dr. Jorge Martínez Manautou, head of family-planning services for the Mexican Institute of Social Security. "They are natural leaders in the community, so they aid us greatly. Of course," the doctor adds, "inflation also aids us." For children are no longer the economic asset in Mexico that they once seemed. Not with the 100 percent inflation of 1982, nor the still formidable 80 percent in 1983.

The pressure of these prices on family budgets can best be measured at the enormous old market, La Merced. The neighborhood of La Merced smells of produce both fresh and rotten, for along these narrow streets and 60 city blocks come truckloads of foodstuffs from all over Mexico—tons of bananas, for example, and tons of oranges arriving from both coasts daily.

Before the Spanish conquest, Aztec canoes unloaded cargo on docks located here, so the tradition is old: La Merced, with 1,800 fruit and vegetable stalls, for years fed the whole city.

It also fed some six million rats on the hundreds of tons of refuse the market generated each day. And La Merced has had its share of human refuse: speculators and extortionists called *coyotes,* drug addicts and pushers, prostitutes, and the drunks who sleep on potato sacks and empty truckbeds. Day-labor porters must rent "devils," or wheeled dollies, for 200 pesos a day; the devils' owner may collect 20 thousand pesos a day.

ONE MIDNIGHT I toured Merced with police in a patrol car and noticed other policemen walking three abreast for security. No wonder. Dark streets were sinister with debris that approximated wartime rubble. Stories of violence here were rife, as was gossip about 37 families who controlled the market gangster style.

Banner news headlines one day warned of "Tension: Eviction From La Merced Today." "Hitting the Underworld of Merced." No doubt. The 5,000-member union of produce vendors was protesting a forced move south to the vast new market complex at Iztapalapa. Virtually the whole of Merced was ordered to move. But nearly 200 owners of grocery stores were refusing outright to leave. Police were still insisting that it would be a "peaceful eviction."

"No space!" shouted one angry man. "Expensive!" said another. Others, mistaking news photographers for police, were pelting their car with splatty tomatoes.

The move was postponed. And since portions of the new Iztapalapa center would be completed one by one, the great market move was sure to furnish more headlines.

I flew over the Iztapalapa center by helicopter one afternoon and found it the most impressive construction site I had visited since Brasília. The complex stretched over 327 hectares (818 acres). A highway system inscribed arabesques to handle produce trucks, but just now it was gritty with the dust of construction and worsened by our rotor wash as we landed.

"This market will be one of the world's largest—it will feed millions of people," said an administrator. "More than 50,000 people will work here! And see: Pedestrians can walk everywhere without encountering

Wedding-day splurge: *A hired beautician pampers 20-year-old Patricia Perea, flanked by her grandmother Angelina Barrera and sister*

Alejandra. As Mexican custom dictates, most other wedding expenses, including the bride's dress, will be paid by the groom, a shoemaker.

***Paperwork traffic jam** of Mexico's seven million vehicle registrations (**right**) awaits funding for computerization under a tight budget. Computers speed the monumental work facing the Department of Planning for the Federal District (**below**).*

trucks. We have even tried to control the rat problem, at a cost of $120,000 a year."

Beyond the smell of wet concrete and the noise of construction, a small steep hill rises over Iztapalapa. It's called Cerro de la Estrella, "hill of the star," and on its summit Aztecs performed their New Fire Ceremony once every 52 years. Throughout the empire every old cooking pot was smashed and every fire extinguished. Not until a new fire was started on the chest of a human sacrificial victim could the world be renewed. Perhaps the Iztapalapa market represents a brand-new cooking pot. But where, we may wonder, will all those rats finally go?

In simple truth, no one can clearly see the future of Mexico City. For myself, I note two vastly different trends. First, as a friend in fashionable San Angel explained, "We have neighborhoods where people hire their own security guards and put chains across the street at night. With so much unemployment, some people are afraid—even of the regular police."

On the other hand, there are the neighborhood organizations of unpaid volunteers. I watched them at work one Saturday morning in Colonia Roma—housewives, lawyers, shopkeepers, students, accountants—ringing bells and wielding brooms to clean up their streets. They even had a special trash pickup service for old furniture.

"We keep the neighborhood much cleaner this way," said one cheery woman. "And

we get to know the people who live here."

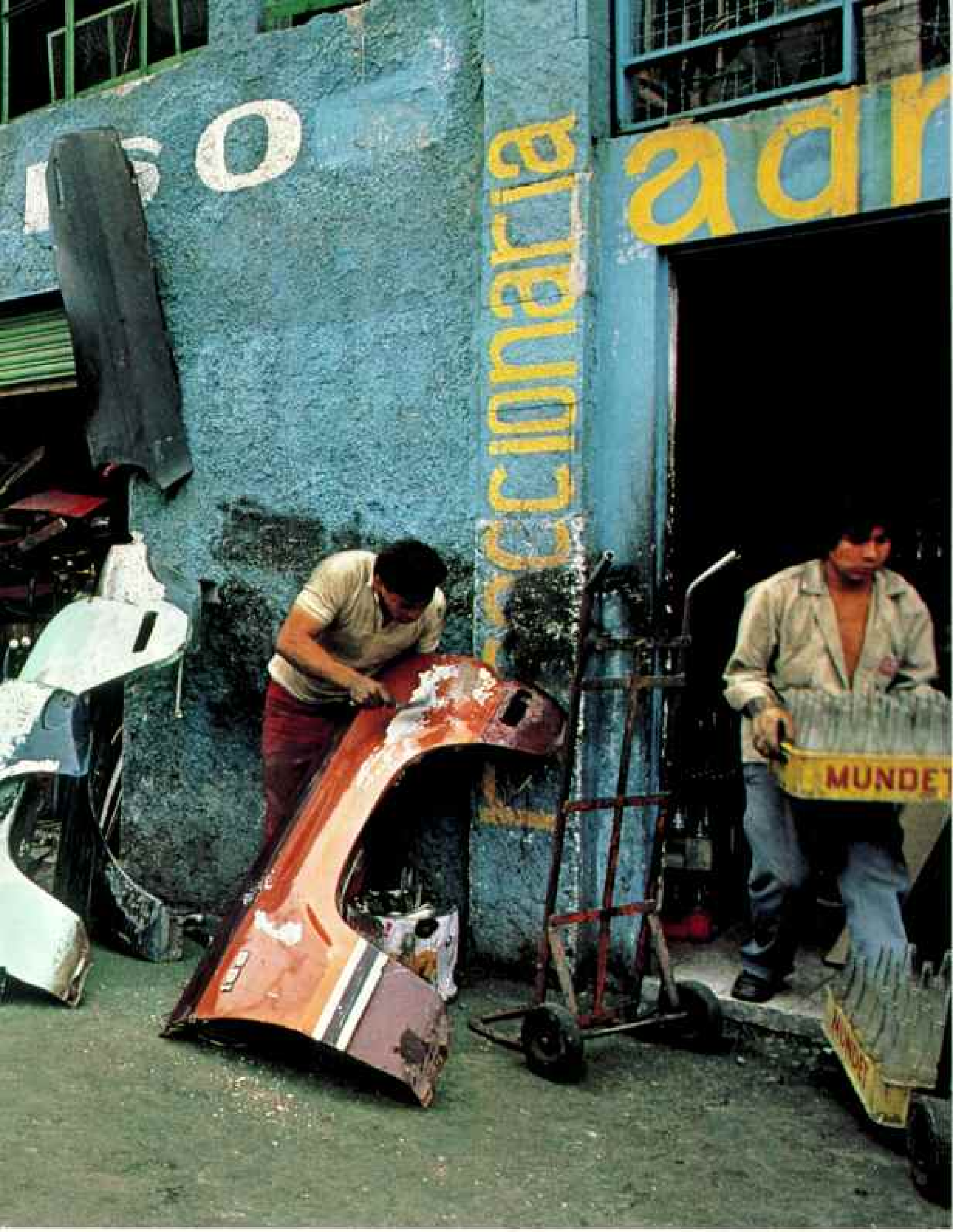
The neighborhoods have coalesced into precinct organizations and even formed a citywide council of neighborhoods—the closest thing to an elected city government that Mexico City has ever had. Though the council is strictly advisory, the city officials—all appointed—listen carefully to requests the council forwards.

The first elected president of the council, Arturo Díaz Alonso, is a young university professor and writer. He frets at length about his city—the loss of architectural landmarks, the clutter in the streets—because he loves being a chilango. "Yes, it was easy to be president of the council because I love the city very much. This is a new way for citizens to communicate. We're changing the rules of the game."

True. And some newspapers even speculate that the city could one day have an elected mayor.

OPTIMISM usually pulses through a Mexican parade, and Revolution Day was no exception. Well behind the reviewing stands on the Zócalo, I watched bands and floats assemble one morning on narrow side streets. While mothers adjusted the ruffles on their daughters' costumes, drummers practiced rhythms with restless sticks, and *charros* calmed their horses. The neighborhood was old and dingy, and I was searching along Calle de Regina for the

One of the highest accident rates *in the world gives Mexico City a big business in car repairs. Specializing in different auto parts—fenders, windshields, or engines—hundreds of shops line this ten-block area near the heart of town. Most collisions are mere fender benders, so streetside repairs are often done while customers wait.*



Smaller repair strips also operate throughout the city, often stocking spare parts of dubious origin. Car thefts have doubled since 1980; some 50 are now reported daily in the Federal District. Insurance companies, alarmed at the increase, will no longer cover theft of individual car parts.

address of a leather artisan. The place turned out to be a fourth-floor walk-up, well above the parade group on the street. Hallways were fouled with garbage, but curious neighbors directed me to the right apartment. I knocked, and a naked toddler opened the door into a one-room sweatshop. At a sewing machine a woman was stitching a belt; scraps of leather were everywhere, jumbled with bedclothes, children of all ages, piles of purses, leather vests on hangers, and uneaten food. Some of the children were helping to box the handicrafts. A baby was crying; a radio blared. And throughout this sweatshop-home a dozen people worked at a hurried pace.

This was not the poverty of Calcutta—nor even of Netzahualcóyotl. No one was starving. But buying my souvenirs, I hadn't the heart to follow the old Mexican custom of bargaining; I paid the asking price and left for the fresh air of the street. The musicians had begun to play, and with strut and style they marched off to honor the revolution.

The longtime president deposed in 1911 by that revolution, Porfirio Díaz, is said to have mused on his way to exile, "Nothing ever happens in Mexico—until it happens."

Will something happen soon? We can see the placards of striking students and workers. In the Zócalo, demonstrators protest against hunger and arrests. And Cuba's embassy here is that country's largest in the New World, the U.S.S.R.'s among its largest. So, how long can we count on a tranquil Mexico?

I trust the insight of poets more than of pundits. Take, again, Octavio Paz. He has noted how "half of Mexico—poorly clothed, illiterate, and underfed—has watched the progress of the other half." But he also has written that "social mobility . . . is a decisive factor, a true safety valve," and "if a rural uprising is to prosper, it is indispensable that it coincide with a profound power crisis in the cities. In Mexico this conjunction has not come about—not yet."

It may not come at all. I recall a dismal community of shacks at the bottom of a 500-foot ravine. Living there were 87 families, some with as many as 14 children. By stairsteps carved into the clay, I descended their hill in the dry season, marveling that anyone could manage that slope carrying bundles and babies in the rain.

Once there, I talked with the residents. "We used to live up there," Señora Rebeca González gestured toward some mountaintop sand quarries, "in those caves. Our only hope was one day to have a place to live. And now we do!" She smiled with pride at the jerry-built shacks. They stood in neat rows, I had to admit, and each one had a collection of flowers planted in tin cans. "One day, we hope to extend the water pipes and drainage—perhaps even pave. . . ."

And what was the name of her community? Señora González beamed: "Esperanza!" The name means hope. * * *

Lighting his way *to a career in engineering, Roberto Alvarez* ***(above)*** *studies electronics in secondary school. Going for sports, ten-year-old Rafael "El Kid" Herrera* ***(right)*** *hails from the hardscrabble barrio Tepito, famed for boxing champions, and hopes someday to turn professional. "We tell him it's more important to get a good education," says his grandfather, center. Undefeated after four years in the ring, Rafael says, "I'll do both."*

A scholarly president looks at Mexico's future

NOT MANY YEARS AGO, cities proudly drew attention to their growth. Large was good, and the largest cities bragged of their rank in the world. But big is no longer better. Today, to be a contender for the title "world's largest city" is like a healthy young person's being told he has a serious illness. It may be cured, but it cannot be ignored.

Mexico City, currently vying for the title of largest city, will this month welcome representatives of some 140 countries to a United Nations conference on world population.

In anticipation of these meetings, I talked with Miguel de la Madrid Hurtado (**right**, at left), the thoughtful and realistic president of the Mexican republic, as we flew across central Mexico in his official jet.

"Demographic policy relates to social policy in a very important way," the lawyer and economist told me. "We have to provide the basics that a human being is entitled to with regard to health, food, education, and housing."

Mexicans are acting upon this concern. Their birthrate has been pushed down dramatically from 45 per 1,000 in 1960 to 34 in 1980. But rural people are flocking to the capital at the rate of 1,000 a day.

"There are more attractions in the city," explains the president, "more opportunities for employment. But also other things: public utilities, education, and health services. What we must do to solve Mexico City's problems is vigorously promote development outside the urban area. Two-thirds of our people are now city dwellers. By the year 2000, it will be 80 percent."

Not everyone comes to the city to stay. That very day I had watched 5,000 campesinos, country people, march on the capital to complain about farm problems (**left**).

"People are allowed to express their feelings," President de la Madrid said, "to demonstrate, criticize, and even insult their government. Mexico has enormous social and economic problems, and I know that extremists take advantage of such problems. But I think that most of our people prefer to continue operating within the scheme of the Mexican Revolution."

Throughout this century Mexico has been what economists might call a leading indicator for developing countries: its populist revolution of 1910, the classic economic takeoff after World War II, the massive debt crisis of 1982, and now, perhaps, resolution of that crisis. Exports are now growing, and the success of austerity makes Mexico "the envy of other Third World governments," as the *Wall Street Journal* noted. Always, Mexico has followed an independent course.

WILBUR E. GARRETT, NGS (OPPOSITE); OFFICE OF THE PRESIDENT, REPUBLIC OF MEXICO (ABOVE); STEPHANIE MAZE (OVERLEAF)

"I think because of Mexico's historical and political conditions," says the president, "and also due to our being neighbors of the most powerful nation on earth, we have become strongly nationalistic.

"In Mexico there are those who think that there is too much U. S. influence on our border. My reply to them is that they must also consider the influence of Mexico on the southern region of the United States."

Indeed, as water seeks its own level, so will the social and economic pressures that ebb and flow along the friendly 2,000-mile border. However, if the frightening global population forecasts on the following pages are realized, the flow may very well become a flood.

THE EDITOR

The World's Urban Explosion

▲ ***Unbridled*** *development marches across Netzahualcóyotl* ***(preceding pages)****, like the neighboring Mexican capital one of the world's fastest growing cities. Though social services are scant for Netza's 2.3 million people, this city means opportunity to rural emigrants and so exemplifies a global dilemma: chaotic urbanization and rapid population growth.*

By ROBERT W. FOX

Graphics by
ALLEN CARROLL
NATIONAL GEOGRAPHIC ART DIVISION

BY THE RECKONING of my fellow demographers, human population first reached one billion in the early 19th century. But it took little more than another hundred years for that figure to climb to two billion in 1930, and by 1975 the number doubled again. In the remaining years of this century world population will top six billion; by 2025, eight billion.

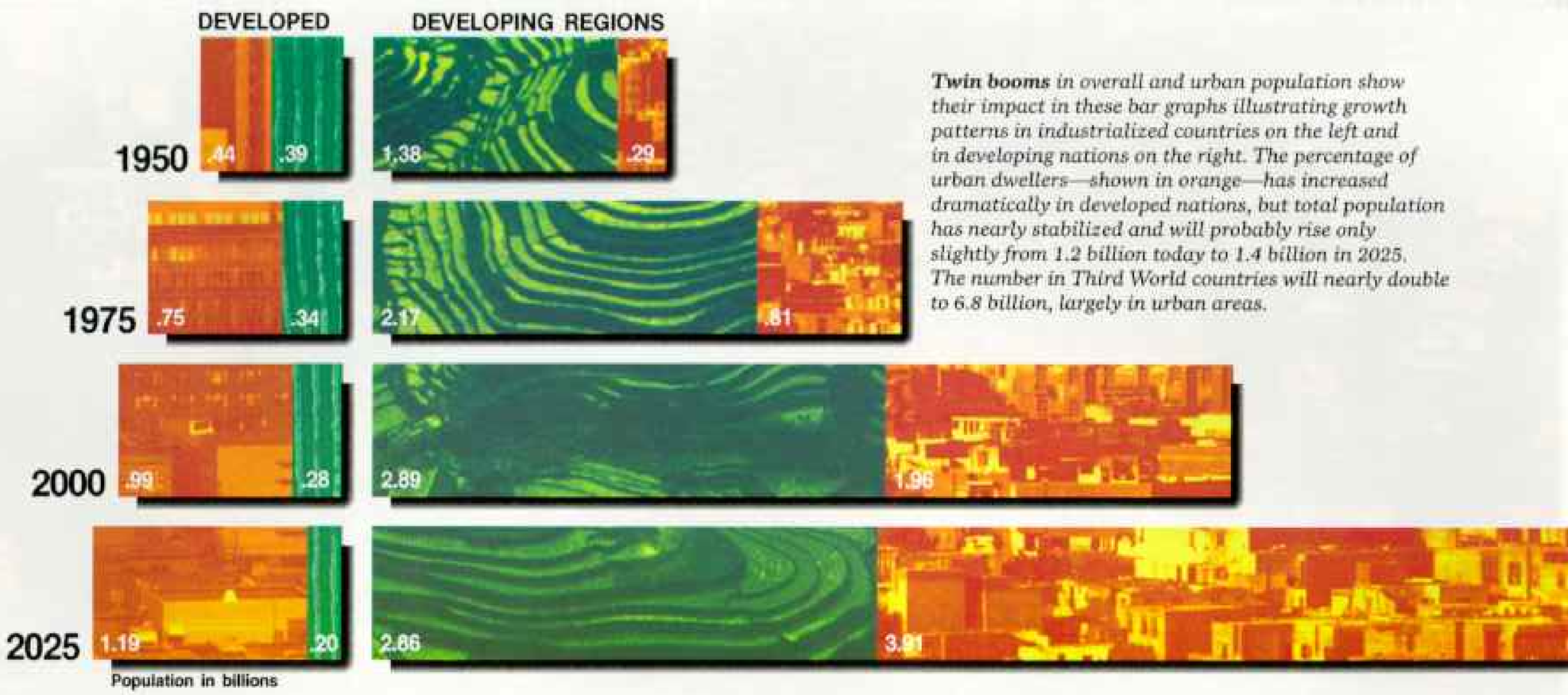
The lion's share of this increase will occur in the emerging nations, already home to most of mankind, and will be concentrated in cities overburdened by their current populations. Advances in technology and medicine that allow us longer, healthier lives have buoyed population size and growth rate—and thus created challenges of magnitudes the world has never before faced.

Urban authorities worldwide are declaring their regions to be in crisis situations with drastic shortcomings in housing, water, sewage, transportation, and job opportunities. Lagos, Nigeria, for example, with some five million people and one of the world's highest growth rates, has so far been unsuccessful in planning construction of a citywide sewer system.

Urban areas in developing countries are haphazardly spreading far beyond traditional boundaries to accommodate natural population increase and rural migration. Industrial and residential uses and speculation often take over valuable farmland. On the edges of Cairo, prime agricultural land is being lost to the destructive stripping of topsoil for brickmaking.

Rapid population growth and urbanization will continue into the foreseeable future, with bleak consequences. Conditions today are only the opening scenes of a drama in which Third World cities, now home to more than one billion people, will hold nearly four billion residents by 2025.

Since the 1974 United Nations World Population Conference in Bucharest, urban planning has earned new status in developing countries, and family planning gains increasing acceptance. This month in Mexico City delegates from some 140 nations will again confront the issue of the urban time bomb. No one anticipates prompt solutions, but focusing world attention on the problem is a step in itself.



Twin booms *in overall and urban population show their impact in these bar graphs illustrating growth patterns in industrialized countries on the left and in developing nations on the right. The percentage of urban dwellers—shown in orange—has increased dramatically in developed nations, but total population has nearly stabilized and will probably rise only slightly from 1.2 billion today to 1.4 billion in 2025. The number in Third World countries will nearly double to 6.8 billion, largely in urban areas.*

ONLY SEVEN urban centers held more than five million in 1950: New York, London, Paris, Germany's Rhein-Ruhr complex, Tokyo-Yokohama, Shanghai, and Buenos Aires. Labor supply and demand had grown in unison as these centers evolved over decades, if not centuries. The enduring architecture of London and Paris reflects slow, graceful development.

Today 34 cities boast more than five million residents. By 2025, the UN projects, there will be 93, and 80 of these will be in the emerging nations. Leisurely development and a low to moderate population growth rate are luxuries of the past.

The upsurge in Third World urban populations has overwhelmed resources. Sprawling slums, massive traffic jams, chronic unemployment, regular failure of electric and water services, strained educational and recreational facilities, and skyrocketing food and fuel costs are the stuff of daily existence.

Though demographers warned that the population of Mexico City would double during the 1970s, few others believed such a rise could occur. Yet the metropolis did grow from 8 million to 14 million people, and it may reach 30 million by 2000. Similar projections for other developing nations are now being accepted as realistic.

Mexico City
Over 30 million

The world's cities face a crush of numbers

New York 15-20 million
Los Angeles 10-15 million
São Paulo 20-30 million
Rio de Janeiro 15-20 million
Buenos Aires 10-15 million
Santiago 5-10 million
Lagos 20-30 million
Paris 5-10 million
London 5-10 million
Rhein-Ruhr 5-10 million
Kinshasa 15-20 million
Cairo 20-30 million
Moscow 10-15 million
Istanbul 15-20 million
Baghdad 15-20 million
Tehran 15-20 million
Karachi 20-30 million
Delhi 20-30 million
Calcutta 20-30 million
Bombay 20-30 million
Nairobi 15-20 million
Lahore 10-15 million
Dhaka 20-30 million
Beijing 15-20 million
Shanghai 20-30 million
Bangkok 15-20 million
Jakarta 20-30 million
Tokyo 15-20 million

NORTH AMERICA
SOUTH AMERICA
EUROPE
AFRICA
ASIA
AUSTRALIA
Atlantic Ocean
Pacific Ocean
Indian Ocean
EQUATOR

2025

Ninety-three metropolitan areas with populations greater than five million, according to current United Nations projections.

GREEN: Metropolitan areas in developed regions

ORANGE: Metropolitan areas in developing regions

1984

Thirty-four metropolitan areas with populations greater than five million

GRAPHIC BY NGS COMPUTER MAP LABORATORY, MAP BY DANIELA COLLINS, BASED ON UNITED NATIONS POPULATION DIVISION DATA. RESEARCH: SUSAN S. MALES, JR. AND BARBARA M. MCCONNELL

The paradox of population growth

FOR MOST OF MANKIND'S history world population grew slowly, checked by epidemics, famine, and chronic malnutrition. Though the mortality rate was high, the birthrate was slightly higher, and with that small excess our numbers gradually increased.

Human population grows much like a savings account accruing compound interest—greater amounts yield greater amounts. English economist Thomas Malthus cited this fact in his 1798 "Essay on the Principle of Population," warning that human numbers—if unchecked—would soon outweigh the ability of the earth to feed them.

But Malthus was writing on the eve of a new era, when the industrial revolution would transform Europe. The continent's population did rise substantially during the 19th century as medical breakthroughs lowered the death rate, but simultaneous agricultural advances also allowed food production to rise. And emigration to America helped siphon off population excess.

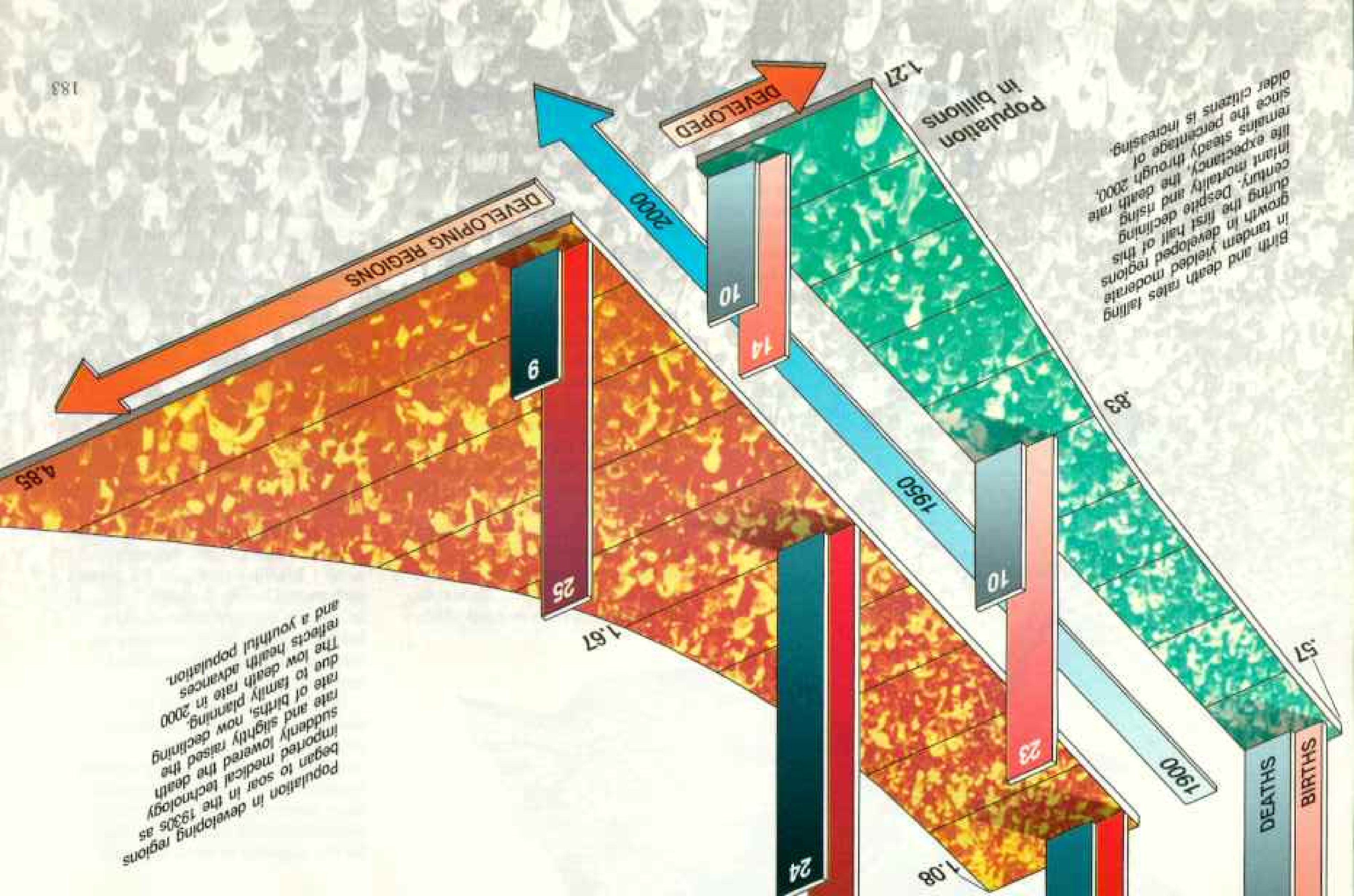
The newly widened gap between birth and death rates gradually began to close as smaller families became socially acceptable. That trend quickened in industrialized countries during the 20th century, and today the gap between births and deaths is once again small.

In the developing countries a far different history prevails. Only in the 1930s did the death rate begin to fall, but it fell dramatically as imported technology improved overall health and dietary conditions. The birthrate, however, remained high. Its decline depends largely on changing cultural norms, and family planning has made substantial inroads only within the past two decades. As the gap between deaths and births widened, the population exploded. Generally speaking, there were not more births—there were more survivors.

With this considerable momentum, population expansion in these countries will continue. Even optimistic scenarios do not foresee a leveling off of growth until late in the 21st century.

Because the traditional birth-and-death-rate relationship has been broken in Third World countries only within the past few decades, they now hold very youthful populations, and the populations will continue to soar because there are more women of childbearing age. Hence the paradox of modern population growth: Even as the birthrate continues to fall, the population will rise.

For every 100 Africans today, 55 are under 20 years of age. Among Europeans, only 30 out of 100 are under 20. In 1975, 93 million African women were of child-bearing age. The birthrate that year in Africa was 47 per 1,000, and 19 million children were born. The UN projects that by 2025 the African birthrate will fall to 25 per 1,000—a reduction of almost half. But by then the number of reproductive-age women will have risen to 430 million, and even with a lowered birthrate 42 million children will enter the world that year.

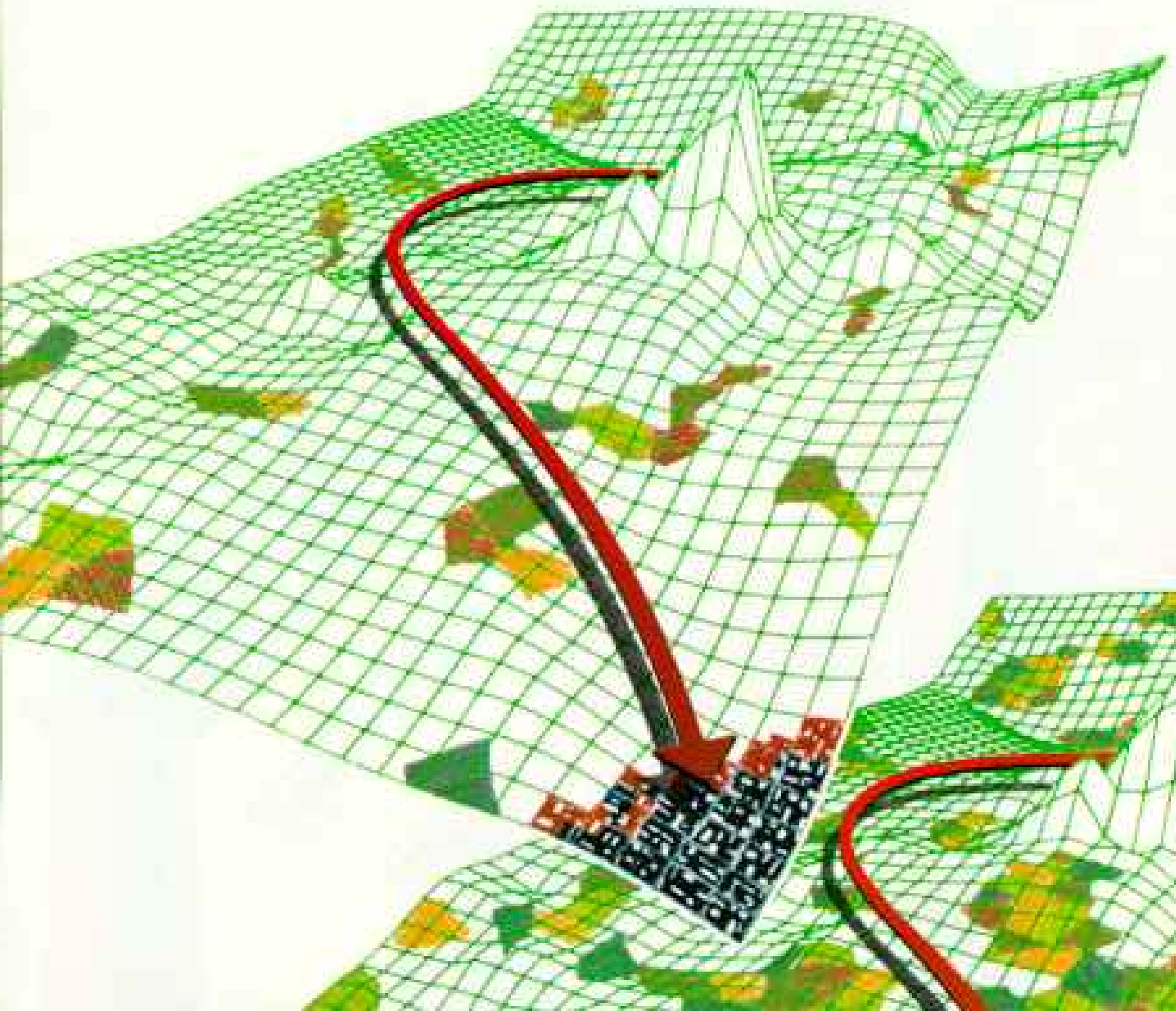


Birth and death rates falling in tandem yielded moderate growth in developed regions during the first half of this century. Despite declining infant mortality and rising life expectancy, the death rate remains steady throughout 2000, since the percentage of older citizens is increasing.

Population in developing regions began to soar in the 1930s as improved medical technology suddenly lowered the death rate and slightly raised the rate of births, now declining due to family planning. The low death rate in 2000 reflects health advances and a youthful population.

Rural exodus deepens the crisis

THIRD WORLD CITIES are awash with arrivals from the countryside. Although the impetus behind the migration and its rate vary from region to region, these maps illustrate the trend during this century. Red shading indicates increase due to migration. Dark gray shows natural population increase—boosted, of course, by previous immigrants.



The rural birthrate is consistently higher than the urban birthrate. As children grow and seek work, often their only choice is migration to a city. Most arable farmland is already under cultivation, and millions of small landholdings around the world can no longer be subdivided among large families. Often workers have no clear title to land, and primitive farming methods limit crop yield—and profit.

In Latin America, where seven out of ten people are already urban dwellers, most future growth in cities will be from natural increase. But the potential for rural migration remains enormous in countries such as India, Indonesia, and Nigeria, where two out of ten people—or fewer—now live in cities. India's urban total will probably expand from today's 180 million to 660 million by 2025, and Indonesia's from 35 million to 130 million people. The jump in Nigeria: 20 million to 150 million.

The struggle to find work is all consuming in Third World cities, where combined unemployment and underemployment rates of 30 to 50 percent are common. Relatively few people find work in industry; the majority fill the service sector, where jobs range from clerical work, to hand-delivering messages across town in phone-poor cities, to washing windows of cars stopped in traffic.

To accommodate rising populations in Mexico and Central America, some 1.2 million new jobs are needed each year. During the 1970s the U. S. created an average of two million jobs annually with an economy 15 times greater than the combined economies of those regions.

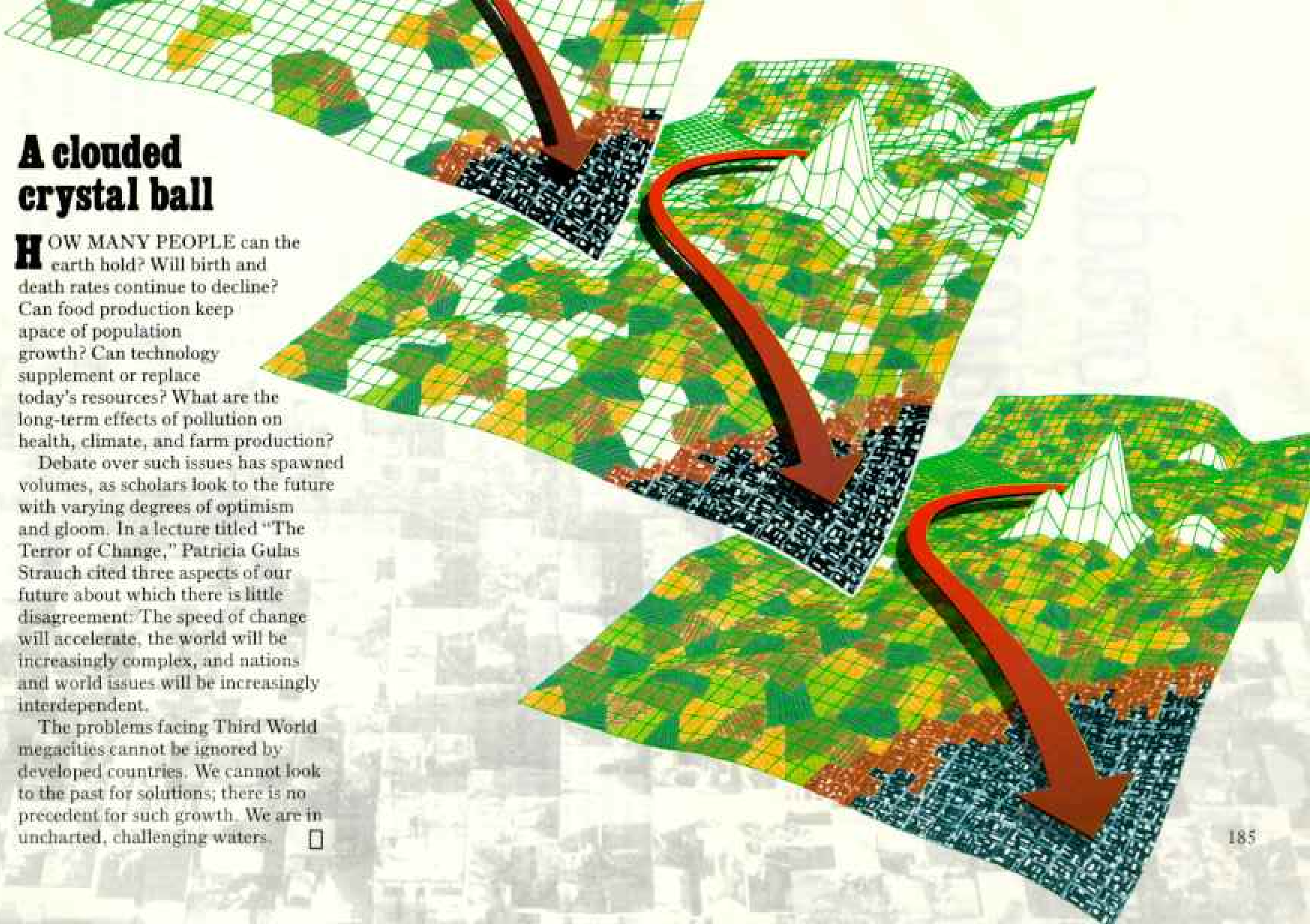
International migration has historically been a vital outlet for population pressures. But developed nations today are seeking to protect their own resources and labor markets. Third World cities increasingly will be the final stop for the majority of rural migrants.

A clouded crystal ball

HOW MANY PEOPLE can the earth hold? Will birth and death rates continue to decline? Can food production keep apace of population growth? Can technology supplement or replace today's resources? What are the long-term effects of pollution on health, climate, and farm production?

Debate over such issues has spawned volumes, as scholars look to the future with varying degrees of optimism and gloom. In a lecture titled "The Terror of Change," Patricia Gulas Strauch cited three aspects of our future about which there is little disagreement: The speed of change will accelerate, the world will be increasingly complex, and nations and world issues will be increasingly interdependent.

The problems facing Third World megacities cannot be ignored by developed countries. We cannot look to the past for solutions; there is no precedent for such growth. We are in uncharted, challenging waters. □



Colorado Dreaming

By MIKE EDWARDS
NATIONAL GEOGRAPHIC SENIOR WRITER

Photographs by CRAIG AURNESS
WEST LIGHT

I have made thirty dollars and over since I got here.
You had better come out here as soon as you can.

LETTER FROM A PIKES PEAK PROSPECTOR, SEPTEMBER 11, 1858

***On the threshold** of a new life, newlyweds Laird and Jeannine Walton get a send-off from a Victorian house (**facing page**) that now serves as a restaurant in their new hometown of Aspen. Jeannine, of Denver, and Laird, of California, reflect Colorado's union of native born and immigrant. They populate a state striving to utilize its abundant resources while preserving its singular natural beauty.*

YELLOW WOLF, venerable elder of the Southern Ute tribe of southwestern Colorado, had lived in two worlds, red and white. It was with the traditions of both that he went to the great beyond.

His corpse reached the cemetery dressed in a suit and bolo tie. A red stripe was painted on his face, a greeting to the spirits. Graveside prayers were said by a cassocked priest, a Baptist preacher, and a tribal councilman who, with long pipe held high, addressed the cardinal points of the compass in staccato Ute.

As the body was lowered, I raised my eyes to the great San Juan Mountains shining in the north. Perhaps, beholding this vista, a few mourners reflected that the Ute domain, just small reservations now, had once been vast. Yellow Wolf's ancestors surely stalked deer among those peaks, before gold and silver turned the Ute world upside down.

I had recently been in a little waffle grid of a town in the San Juans. Though nestled in a deep valley, Silverton is so elevated (9,300 feet) that a gardener would call the year tropical if a tomato ripened. In the assay office Chester Wittwer exclaimed as San Juan prospectors have exclaimed for more than a century: "Lookit that rainbow!" Chester held up a chunk of quartz in which a variegated streak—of gold, perhaps, or copper—was indeed to be seen.

"Me and my boy, we drove a hundred feet of tunnel this summer," Chester said. "We'll hit somethin' sooner or later. If this ain't it, we'll keep goin'. Hey, lookit that rainbow!"

Dreams are the delicious stuff of Colorado. Like Chester's rainbow, like the mountains themselves, they beckon.

Often, as many a disappointed *(Continued on page 194)*

Warmed by a midsummer sun, *winter wheat ripens near Akron between strips of ground left fallow to make the most of eastern Colorado's scant rainfall.*

The High Plains cover 40 percent of the state and, thanks to irrigation from rivers and deep aquifers, make a major contribution to the state's economy.

Early morning *cross-country skiers leave tracks in freshly fallen snow below the Maroon Bells, classic peaks near Aspen* ***(left)****.*

Signaling the change of season, aspens turn to red and gold at a sheep and cattle ranch near Telluride in the San Juan Mountains ***(left center)****. Telluride residents celebrate the changing hues with an observance called Coloride, including a film festival and the Autumn Eye workshop for photographers.*

Pilots from around the world come to fly a 30-mile triangular course during the Telluride Hang Gliding Festival, sponsored by a group of enthusiasts called the Telluride Air Force. In free flights lasting as long as five hours, pilots perform aerobatic maneuvers, often marking their trails with smoke bombs attached to their craft ***(right)****.*

Opened a century ago to carry gold, lead, and zinc ore, the Denver & Rio Grande narrow-gauge railroad ***(bottom left)*** *now transports a different payload. The steam-powered train, renamed the Durango & Silverton, carries 155,000 sightseers a year on a slow scenic tour of a 45-mile stretch of the San Juan Mountains between the two old mining towns.*

Snow-shovel *saddle pulled by a quarter horse carries a bold spirit down Lincoln Avenue in Steamboat Springs during the town's winter carnival (***below***). With hard-packed snow giving the horses sure footing, participants reach speeds of 30 miles an hour and better. Other merrymakers strut their stuff in the air. Sailing through steam rising from a heated swimming pool (***left***), a freestyle skier performs a somersault before splashdown. Come sundown, a downhiller will illuminate the night with lights on his clothing and skis and rockets shooting from his helmet—lighthearted evidence that Steamboat, population 5,100, takes its skiing seriously. The town's main ski area offers 81 trails with a vertical drop of 3,600 feet. Steamboat hosted ski-jumping trials for the 1984 Winter Olympic Games, and 15 Olympic skiers have hailed from the region since 1930.*

*Skiers at Vail (***right***) head for their rooms after testing themselves on slopes "built by skiers for skiers." French, Austrian, and Italian accents can often be heard in the resort, which many claim rivals St. Moritz for excellence.*

(Continued from page 186) prospector has found, bonanzas are elusive. Wise men among the dream seekers have settled for other pay dirt: the easy life in some elm-shaded town, perhaps, or, high in the Rockies, the sight of marsh marigolds popping up beside retreating snow. For some it is the relentless sprawl of the eastern plains, 40 percent of the state (map, pages 196-7). Subject to the vagaries of weather, water supply, and world grain markets, the plains nevertheless claim a faithful few. For others it is the parched mesas of the Western Slope, alluring in their loneliness, and the hot-coal glow of rimrock at sunset.

Most dream seekers in the past couple of decades have found their reward in the cities booming and humming beneath the Front Range, the eastern brow of the Rockies. Eighty percent of Colorado's three million people dwell in that urban string bean—in Denver and its satellites, in Boulder, Fort Collins, Greeley, and Colorado Springs.

WHEREVER the itinerant dream seekers stopped, they doomed Yellow Wolf to double minority status: an Indian in a white man's world and a native son in a state where the majority (58 percent) was born elsewhere.

I remember the tall miner nicknamed Timberline, a Californian possessing college degrees, who came here fleeing a bad marriage and a bad opinion of himself. Underground he found respect and friends. And Kathy the wood chopper, born and raised in Pennsylvania. Her ax helps her hang on in Aspen, and the work makes her cheeks wonderfully rosy. And Norm, lured by Colorado's good universities, now fighting to keep parts of his adopted state forever wild. And John, frail little John with the plastic suitcase, emerging from a railroad trestle's shadow. By slow freight he had come from Kansas City to seek his fortune—though, as he remarked to me, "It's a little hard to get a job when the only address you've got is a bunch of weeds."

Colorado's mineral wealth includes molybdenum, gas, oil, coal, and uranium. Wells tapping a huge deposit of carbon dioxide beneath southwestern Colorado provide the bubbles in bottlers' soft drinks; in this state even a belch turns a buck.

Climate and terrain dictate that Colorado will never be an Iowa, but it manages respectable rankings in agriculture—onions, barley, dried beans, and sugar beets, and sheep and cattle fattened in feed lots. Tourism, growing rapidly, bids fair to overtake mine and farm.

All have been outstripped by factories and assembly lines, many devoted to electronic gadgetry. Several serve the Department of Defense; Rockwell International alone employs 5,600 Coloradans at the Rocky Flats Plant near Golden, which produces components for nuclear weapons.

It all sounds rosy. Too bad it isn't. East of Denver, I left good times behind.

The wheat farmers of the plains prospered in the 1970s, when their crops fetched close to four dollars a bushel. But elder plainsmen look back on more bust than boom and upon a life that was seldom easy.

In the vicinity of a wizened crossroads community called Anton, on land that was a dish as far as the eye could see, I visited a feisty little man of 85 years. Frank Travis had spent part of his boyhood behind a plow and a horse. Remembering, he did some arithmetic. "To plow a quarter section of land, 160 acres, with the furrows a foot apart, you would walk 1,320 miles. Sounds tedious, doesn't it?" I said it sure did.

"I could plow two acres a day," he said. The most he and his horse ever furrowed in a year was an eighth of a section: 80 acres, 40 days of work.

Thus farms were necessarily small, and yields modest, at the end of the homesteading era. No wonder that fire blazes in Mr. Travis's eyes when he recalls President Franklin D. Roosevelt's livestock slaughtering program, an effort to stabilize prices in the Depression. Mr. Travis let out the word that any Democrat coming to shoot his Republican cattle would get one shot before receiving in kind. No slaughterer ever came.

With enormous tractors Frank's son Clifford plants 1,700 acres—equal to almost 11 quarter sections. We sat in the shade of a truck watching a custom cutter's combine roll through his grain. I noticed a hole in the sole of Cliff's boot. "My fuel bill is $12,000," he said. "Another $5,000 for spraying, $14,000 for crop insurance—you can go through $100,000 pretty quick." Cliff

reckoned that his 1,700-acre crop might—just might—net $4,000. "I like farming. I just wish there was a buck in it."

LEADVILLE KNOWS WELL that Colorado is a yo-yo state, yanked by economics over which it has little control. Lead, silver, gold, zinc, manganese—all were abundant around Colorado's almost two-mile-high city. (See **The Making of America: Central Rockies**, a historical map supplement with this issue.) Yet the silver tycoon H.A.W. Tabor—who scandalized Colorado society by shedding his wife to marry the fabled Baby Doe in the presence of President Chester A. Arthur—lost all in the panic of 1893. In the 1930s, said Leadville's mayor Fred Parlin, he was glad to paint school bleachers for 30 cents an hour.

Leadville nevertheless survived as the classic mine town, lusty, loud, and proud of it. Its long suit proved to be molybdenum, used to harden steel. With the great Climax mine astride the Continental Divide working three shifts, Leadville throbbed to pulsations from such saloons as the Silver Dollar.

One snowy January night I headed for the Elks Lodge, whose throb made the Silver Dollar's seem thin as a dime.

Strange, this free-flowing good time. Climax Molybdenum was laying off, sending familiar shudders through Leadville. Stockpiles were full, while automobile and other industries needed less steel and steelmakers needed less moly.

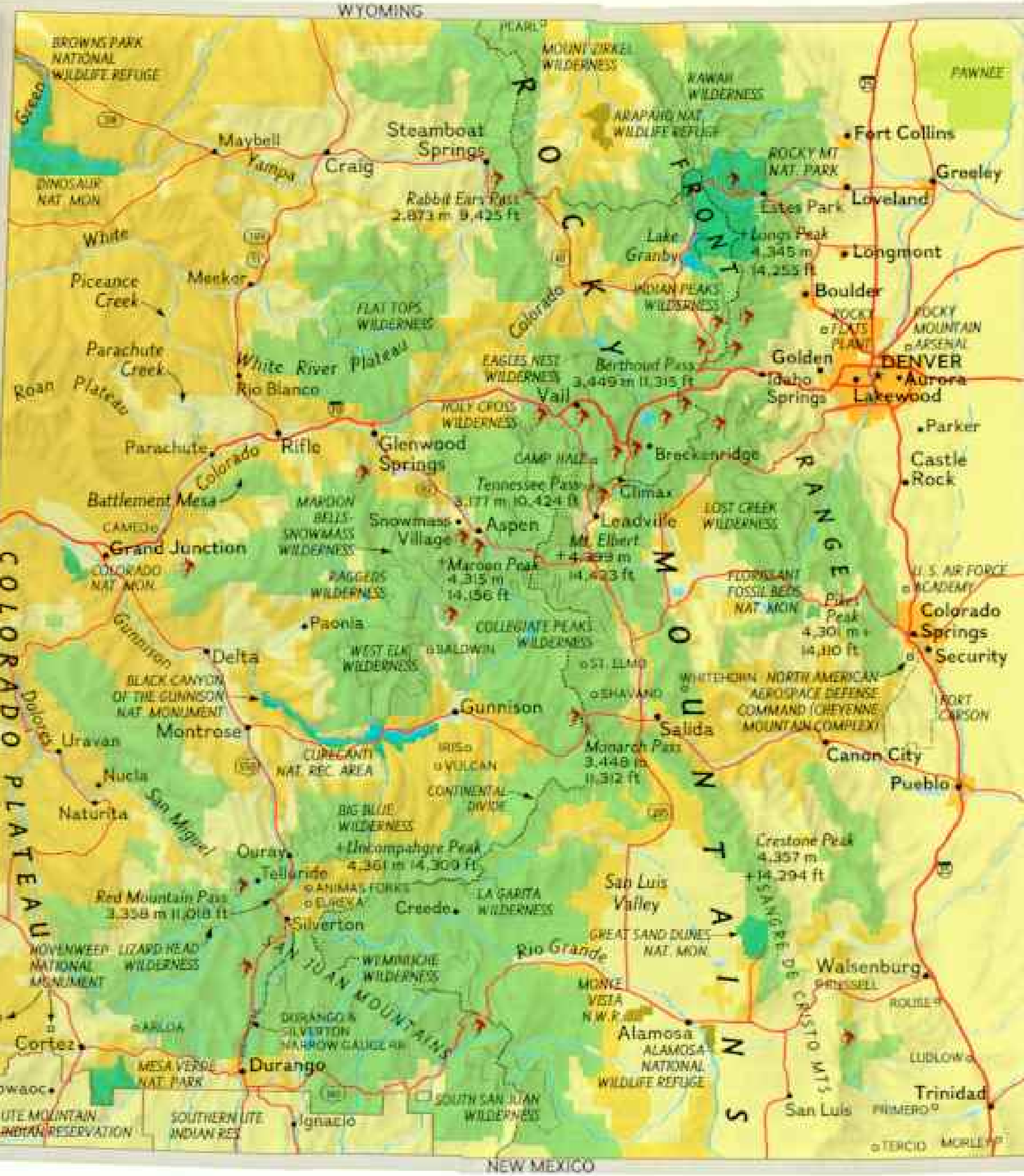
I identified the 30 guests of honor at the Elks Club party by name tags that also bore their pedigrees. K. C. Black, 24 years of service. Howard McCoy, 28 years. Foremen and shift bosses, in their 50s, they had good years left. But the Climax Molybdenum Company was extending a golden handshake. Each was getting several months' severance pay and then a pension.

"They say they got too many managers," Mr. Black said. "They gave me a bunch of money and told me to have a good time." He shot a well-lubricated smile at me. "Well, I'm gonna have a good time."

There would be no such generous send-off for miners paid by the hour. As the moly mine cut back production, idling almost 3,000 men and women, the area's unemployment rate climbed to 40 percent.

The last time I saw Leadville its main street had been prettied up. Wavy sidewalks had been replaced by level paving bricks. Victorian-era street lamps complemented the Tabor Opera House and the Tabor Grand Hotel. Stung once too often, the merchants were transforming Leadville into—ye gads!—a tourist town. But I hear the mine is working again now, so perhaps there is hope that Leadville will survive as

***In the spirit** of their forebears, a Ute boy and his Navajo partner practice traditional dances in a Head Start class in Towaoc on the Ute Mountain Indian Reservation. While Ute culture and language survive here, other areas face impingement by Anglo influence.*



Colorado's empire

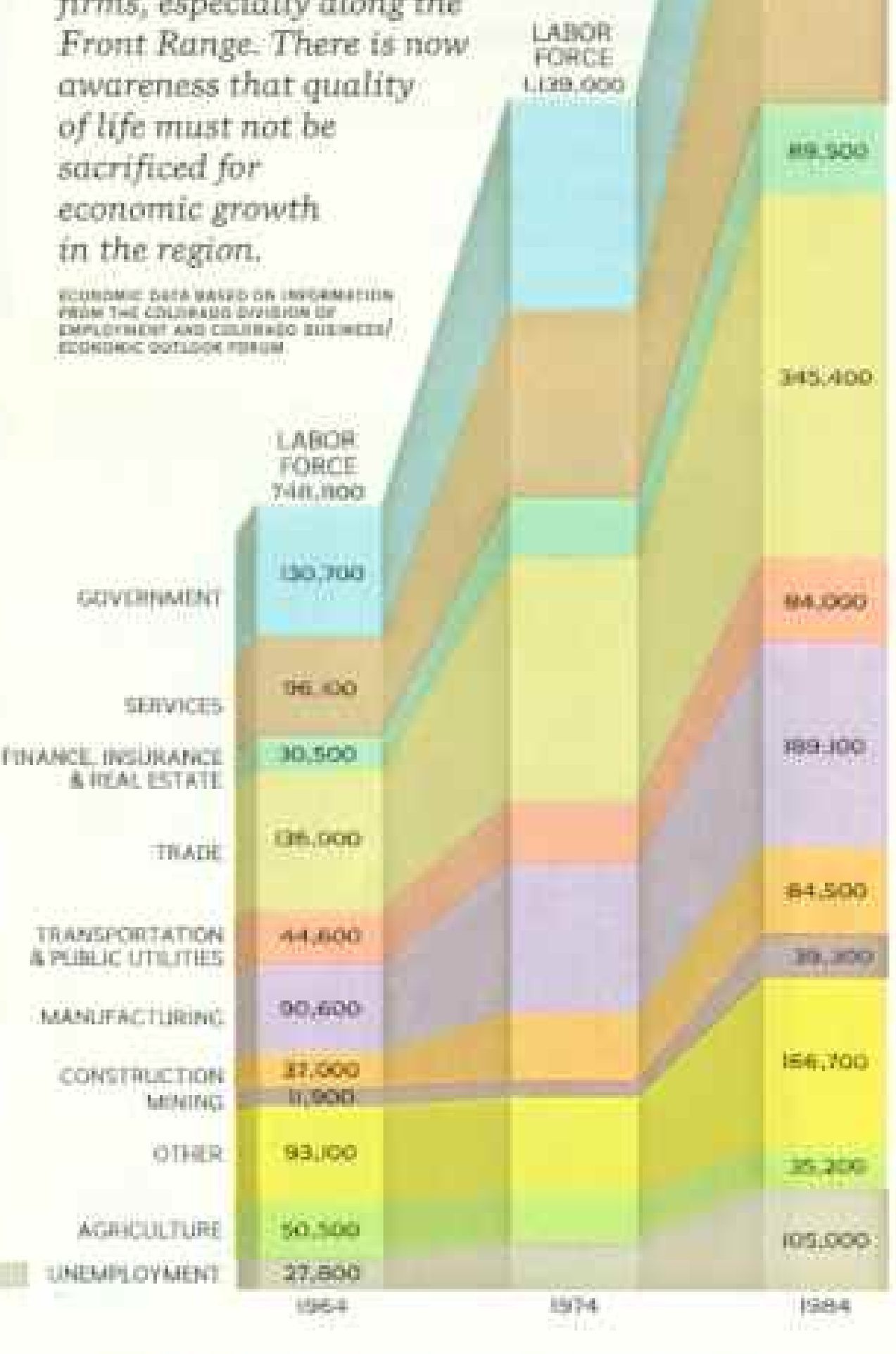
BEST KNOWN for the Rocky Mountains, the nation's loftiest state averages 6,800 feet above sea level. But Colorado encompasses other distinct geographic regions, including the fertile High Plains that sweep up from the east. Along the foothills of the Rockies nestle the metropolitan areas of Denver, Boulder, Colorado Springs, Pueblo, Fort Collins, and Greeley, containing 80 percent of the state's population. Beyond the Continental Divide lush valleys and mountains level off to the high mesas of the Colorado Plateau in the west.

Intense settlement began with the discovery of gold in the late 1850s, after which the population began clamoring for statehood, granted in 1876. Colorado continues to produce a wealth of minerals (map, right), the most important of which, molybdenum, is used to strengthen steel. Although the plains

Two decades of growth

FACED with an economic slump in the mid-1960s, state and business leaders sought to diversify the economy, then heavily based in aerospace, mining, and agriculture, by aggressively promoting Colorado as a place to work and play. The program spurred rapid growth in high-technology and research-and-development firms, especially along the Front Range. There is now awareness that quality of life must not be sacrificed for economic growth in the region.

ECONOMIC DATA BASED ON INFORMATION FROM THE COLORADO DIVISION OF EMPLOYMENT AND COLORADO BUSINESS/ ECONOMIC OUTLOOK FORUM



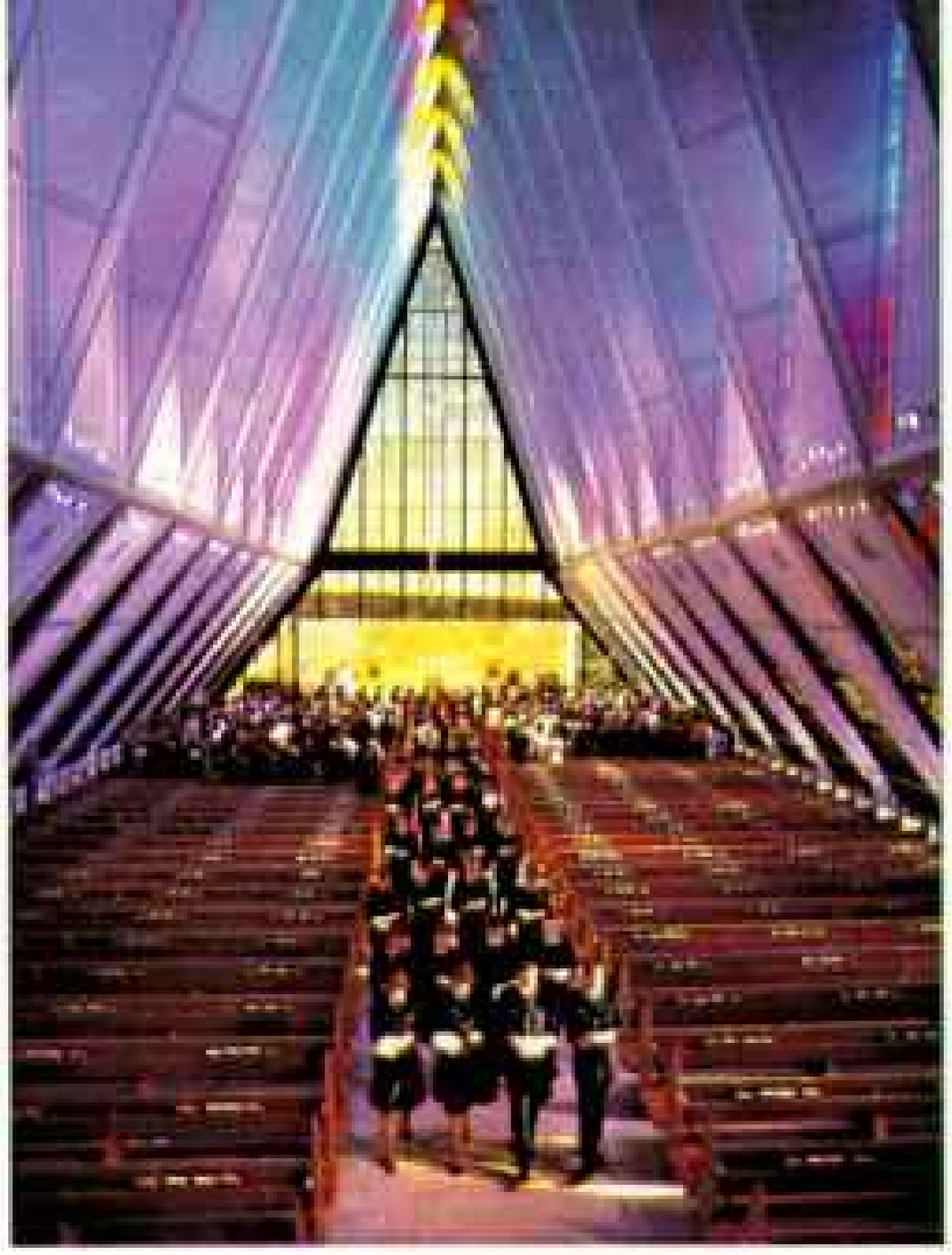
are semiarid, the mountains are the source of four of the nation's major rivers: the Platte, Arkansas, Rio Grande, and Colorado.

AREA: 104,247 sq mi. **POPULATION:** 3.14 million. **MAJOR CITIES:** Denver (capital), 505,600; Colorado Springs, 231,700; Aurora, 184,400. **ECONOMY:** Eastern areas produce sheep, cattle, wheat, barley, and sugar beets. High-technology manufacturing dominates Front Range cities. Mineral and fuel production, fruit, cattle, and tourism sustain the west.

Colorado Dreaming

Soaring voices *fill the Cadet Chapel at the United States Air Force Academy in Colorado Springs* ***(right)*** *when the Cadet Choir leads the recessional following Protestant services. Facilities for Catholic, Jewish, and other faiths are also included beneath the chapel's 150-foot-high spires.*

To the academy's 4,400 cadets, chapel offers one of the few respites from an intense regimen of study, physical training, and discipline. Toward its aim of supplying the Air Force with top-notch officers, the academy screens 12,500 applicants for an entering class of 1,500. During honor guard training ***(below)*** *Cadet 3rd Class Anthony Ross checks the military bearing of Cadet 4th Class Howard Huerta, who later also became an honor guard commander.*



Cadets are encouraged to test one another with calisthenics contests. Cadet 2nd Class Virginia Lynn Murray ***(right)****, among the academy's 485 female cadets, challenged several male counterparts at one-armed pushups, besting them with only 20, far below her record of 85.*

I liked her: a lusty, loud, miner's daughter.

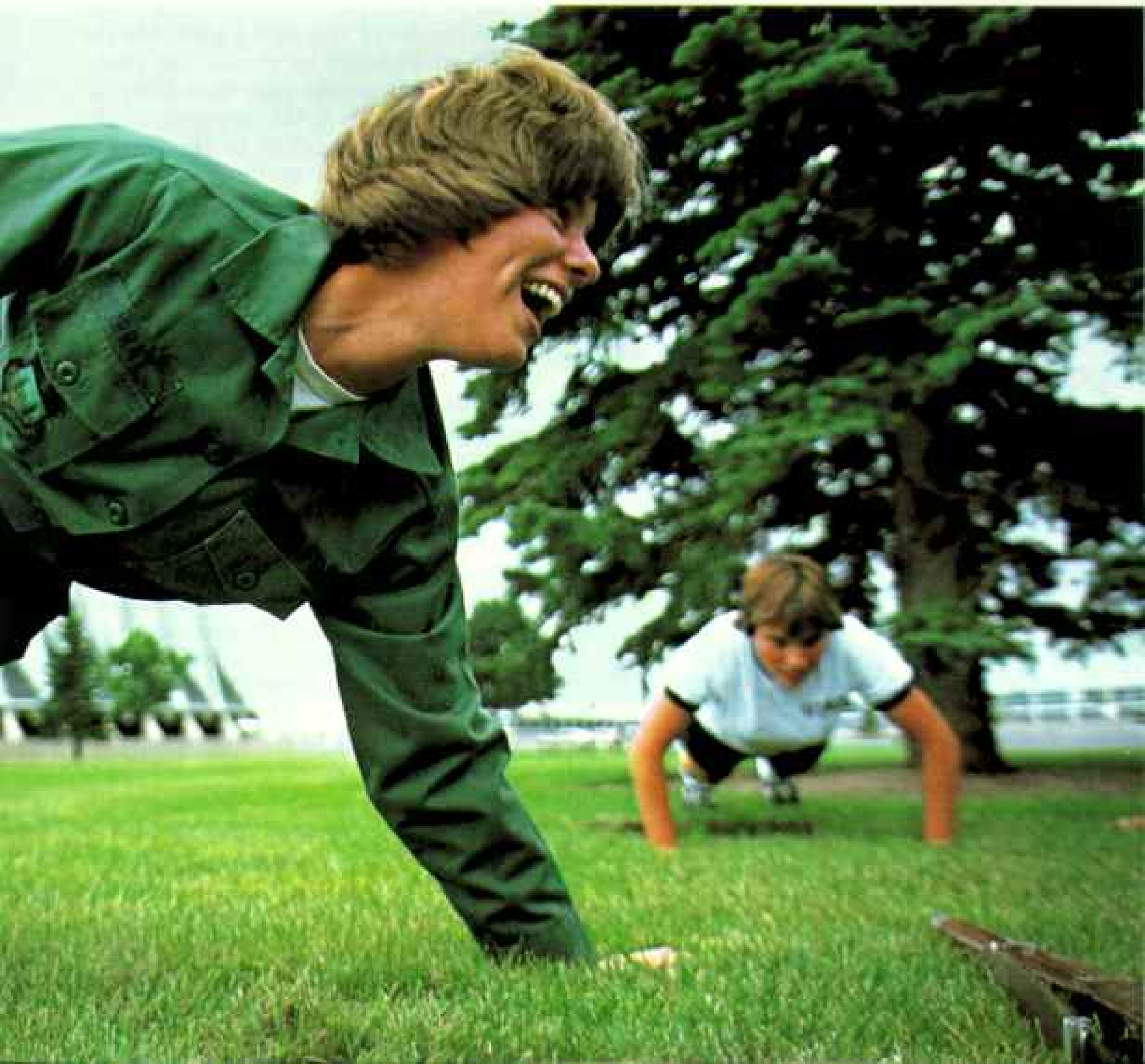
A dozen miles north of town I snapped on cross-country skis and creased a quiet valley. Here and there chunks of concrete poked through the snow.

The Army established Camp Hale in this valley in 1942, less than a year after the United States was plunged into World War II. (For a time Leadville was off-limits to the soldiers—not to protect the Leadville ladies from the troops but vice versa.) In civilian life the first men to train here had been mule skinners, lumberjacks, and members of college ski teams. To get into the elite unit that became the Tenth Mountain Division, "you had to know how to handle yourself in the mountains and in winter," said Bob Parker, who was there in 1943.

Though few put on skis in combat, most saw heavy fighting in Italy. At war's end many a man who had passed through Camp Hale thought a living might be made in resort skiing, in its infancy then. To the Army goes credit for making this a veritable industry in Colorado; today skiing lures vacationers to 35 areas and encourages them to part with a billion dollars a year.

I found Bob Parker an hour's drive from old Camp Hale—in corporate offices at Vail. Vail sprang 22 years ago from the dreams of Tenth Mountain veterans, especially Pete Seibert, who also was one of the first ski instructors in Aspen.

In its brief life Vail has spawned 21 miles of vacation homes and condominiums near the valleys where the Tenth Mountain men trained. Here Tyrolean, there California modern, over yonder ersatz Spanish, and *far* over yonder, house trailers. The Vail strip looks opulent, cute, or cluttered,



Victory celebration: *Dancers swirl around Denver's Larimer Square on Cinco de Mayo (May 5) in recognition of Mexico's triumph over French forces in 1862. Restored Victorian buildings, built in the late 1800s when the city was young, overlook revelers who feast on Mexican fare amid strolling mariachis. Nineteen percent of Denver's residents are of Hispanic descent.*

depending on where you are. The essential trappings: a hot tub, a stack of firewood, and two skylights in the roof to watch the sun. It is not Colorado. But Colorado is out there, its majesty the essential backdrop. Many of these dwellings have been wonderful investments; a house that cost $65,000 in 1963 may command a million now.

Half a mile above Vail, figures moving down the ski runs, passing stands of conifers spectrally black against the snow, appeared as ants. Swift, silent ants.

At the base I watched first-timers clumping about as if their short skis were logs. Fashionably garbed in jackets of riotous fuchsia and yellow, they all looked as if they devoutly wished they were somewhere else.

Into the midst of these beginners glided a teacher with a voice soft as a snowflake. "Hello," he said. "I'm John Boles." Soon John had them relaxed. In three days some would ski from the mountaintop, perhaps not on the fierce run called Look Ma (no hands) but certainly on gentler Tin Pants.

The big ski resorts each have their cachets. Vail appeals to the corporate family man, Steamboat Springs to the cowboy type. Keystone is known for gentle slopes.

Breckenridge, Goose Gossage says, is a "homey place—it seems more like a small town than the others." Another plus in the mind of baseball's great relief pitcher: This resort is just a couple of hours from his home at Colorado Springs.

No visage is more fearsome on the mound than that of Gossage, who now pitches for the San Diego Padres. It is the face of an angry bear. But in a restaurant, Goose, whose friends call him Rick, seemed merely a gentle family man. Around him were his wife, Corna, their two boys, Jeffrey and Keith, and Rick's mother, Susanne.

Rick's father mined and once thought he'd made a big gold strike. Months passed before he could tell Susanne it was just a pocket. "We made a poor living," she said, "but there was always that hope, you know." Colorado dreaming.

Rick does not ski—"I figure my career's gonna be short enough without screwing up a leg." But he is devoted to the mountains and once hoped to become a forest ranger.

How does Gossage spell relief? C-o-l-o-r-a-d-o. In a play-off game with the Boston

Red Sox in 1978, the Yankee season rode on Gossage's arm. "My knees were bangin' together. Boy, I've never been as afraid." He allowed two Boston runs. New York's lead shrank to 5-4.

"Then I thought, 'What am I so nervous for? The worst thing that can happen to me is that I'll be back in Colorado tomorrow.'" Ahhhh—relief. Gossage's fastball hummed. The Red Sox went down. The Yankees went on to win the World Series.

Then there's Aspen, blend of mine-town gingerbread and modern chic, with no high-rises to block the view of the snow-blasted mountains and no neon to blur the spangled sky.* You may see Henry Kissinger strolling by; if so, he's there to lecture at the Aspen Institute for Humanistic Studies.

The permanent population, about 4,000, seems slightly frantic; Aspen attracts people compelled to *do*. I think of the dedicated art patrons, of the explorers in go-anywhere pickups (always with a dog in the back—always). Few citizenries take such an interest in community life. If there's trouble in the schools, the whole town will be on its feet.

There are also few rules. Aspen has a reputation for liking drugs and a free and easy life. The divorce rate is high. "The prettiest girls you ever saw, and the best-looking men," observes Mary Eshbaugh Hayes, chronicler of events in the weekly *Aspen Times*. "It goes to a lot of people's heads."

Some become disenchanted, thinking Aspen too expensive, too precious. Mary once wrote a story about people "looking for another Aspen." Candidates: Telluride, Colorado; Santa Fe, New Mexico; and Sand Point, Idaho.

But soft-spoken Mary and her husband, Jim, a silversmith with an enduring Texas drawl, remain dedicated to their adopted town. "I raised five children here," Mary said. "I think I had less trouble with them than I would have had in Geneseo, New York, where I came from—because there's so much for kids to do here."

In their comfortable old house Jim bent over his workbench, applying a silver aspen leaf to a silver belt buckle. These buckles, his trademark, sell for $250 and up. Many

*Jill Durrance and Dick Durrance II wrote about Aspen in "A Town . . . a Mountain . . . a Way of Life," NATIONAL GEOGRAPHIC, December 1973.

BOTH BY LOWELL GEORGIA

Going in style: *A horse-drawn coach with Mayor Federico Peña and other dignitaries crosses Denver's 16th Street Mall to view Cinco de Mayo festivities. The mile-long mall opened in 1982 during a construction boom fueled by a soaring energy market. Though the market has since slumped, Denver today rivals Houston as an energy capital.*

are worn by the wealthy and powerful.

A couple of years ago two foreigners kept a cautiously arranged appointment with Jim. In imperfect English they ordered an aspen-leaf buckle embellished with initials in the Cyrillic alphabet. Jim will not identify his customers, so I must speculate: Somewhere in the Kremlin a Hayes buckle may secure an important man's pants.

One June day I strapped on my backpack and headed into the Eagles Nest Wilderness, north and east of Vail, in the Arapaho National Forest. Well before 10,000 feet I was slogging through winter's snowpack. I should have stopped. But no, I had set out for Upper Cataract Lake, higher and a few miles farther, and that is where I would go.

For four hours I plunged to my thighs and floundered in search of the vanished trail. Exhausted and soaked, I fell into deep sleep in a stand of spruce when finally in sight of the lake. Dimly I remember thunder, the pelt of rain, and a huge boulder tumbling down—bam, bam, bam, *BAM!*—from the Eagles Nest summit, 2,000 feet above.

In a national forest one might think the snow is the nation's. But the snow that wore me out is claimed by the Denver Water Board. It has rights to runoff from some 20 creeks in this wilderness, 70 miles from the capital—and on the other side of the Continental Divide. The reach of Denver is long.

Water rights are precious in Colorado. The thirst of the cities, farmers, ranchers, and other interests on both sides of the Divide are in competition with each other as well as with the conservationists, some of whom cling to the no-growth idea that blossomed in the 1960s. It is still not an idea whose time has come.

THERE ARE EXCESSES in Denver: Subdivisions of million-dollar homes mix Tudor and Victorian styles and look naked in their newness. In places chemical wastes poison the earth, and pollutants often foul the air. But by and large it is an agreeable metropolis. When the rising sun torches the glass and metal skins of soaring towers (highest: 56 floors), the cityscape rivals the distant mountains.

After the Arab oil embargo of 1973 Denver became headquarters for oilmen probing for new bonanzas in the Rockies and the plains. Wildcatters raised millions by floating dime-a-share stock on Denver's over-the-counter market. Canadian investors and French oilmen arrived—among more

KENN REID

***Native sons** of other states fare well in Colorado's political melting pot. Kansan Gary Hart, sent to the U. S. Senate from Colorado, here campaigns for the 1984 Democratic presidential nomination with delegates to a Sierra Club convention at Snowmass. Texas-born Federico Peña (**right,** at left), mayor of Denver, jogs through a city park with his brother, Alfredo. Colorado Governor Richard D. Lamm hails from Wisconsin and state Republican Chairman Howard (Bo) Callaway from Georgia.*

than 250,000 newcomers to the area between 1971 and 1980. And on the skyline spindly-legged cranes worked their magic, as many as ten at a time raising towers.*

When the energy fever subsided, Denver felt the touch of recession, although later and perhaps more gently than most cities. Newcomers with a dream continue to arrive, more than 50 a day.

After they have settled in, Eric Glade may sell them a bumper sticker that says "Semi-Native"—a badge of membership in the happy fraternity of Colorado. "It started as just a fun thing," said Eric, who is also vice president of a Denver petroleum firm. First he designed a bumper sticker like Colorado's

license plate, with a jagged mountainscape. It bore the word "Native."

This wasn't funny to natives, who felt engulfed. "I didn't have to market that sticker," Eric said. "It sold itself." He brought out "Semi-Native," then "Naive." Someone else produced "Alien" and "Who Cares?" Thus was launched the Great Bumper Sticker War on Colorado highways.

Semi-natives don't choose Colorado just for jobs. "I'm a skier," Jesse Aweida said. "When IBM opened a plant in Boulder, I was ready to come, no questions asked."

Nor was there any question where he would remain when he left IBM 15 years ago to found another firm. Storage Technology Corporation's handsome buildings rise just five miles from Boulder.

Said another StorageTech founder, Juan Rodriguez: "We stayed here because it was beautiful. Not much more to it than that."

The billion-dollar corporation grew from a combination almost unimaginable—except, of course, in Colorado. The four engineers who left IBM/Boulder to found it were by birth a Palestinian (Mr. Aweida), a Cuban (Mr. Rodriguez), a Hungarian, and one U. S. native.

To develop tape and disk drives and other computer gadgetry, the firm needed engineers, physicists, technicians. It was easy to lure them; Colorado's best headhunters are landscape and ambience. Such recruits help make the area's population the best educated in the U. S., after Washington, D. C.

High-tech dreams are expensive. Mr. Rodriguez, holder of ten patents for inventions, bossed a team that spent 120 million dollars to develop a data-storage system in which a laser etches microscopic pits on a metal platter. "I've known from day one what I wanted in this machine," he said. The challenge was to mesh talents of electronic and mechanical engineers, optical and metal physicists, and other specialists.

Mr. Rodriguez let me peek behind locked doors that shielded prototypes of his brainchild from competitors' eyes. The machine looked more or less like an office copier, except for the disk whirring beneath a pinpoint laser. Nothing remarkable, I said—until I realized that this machine can store on a 14-inch platter far more words than I will write in a lifetime. Its capacity is two million typewritten pages.

Back in Denver I had an appointment with another semi-native, Texas born. Just 36 when he was elected last year, Federico Peña seems an unlikely mayor in a city known for high rollers. He is an antiwar activist, and has been a civil rights lawyer. Yet on the road to becoming one of five Hispanic mayors of major U. S. cities, he had considerable support from businessmen, as well as from the Hispanic community that makes

*See "Denver, Colorado's Rocky Mountain High," by John J. Putman, GEOGRAPHIC, March 1979.

*"They start every morning, no matter how cold it is," says Jerry More (**right**, at right) of his horses, Doc and Mike. With his son-in-law, Calvin Powell, More loads a 16-foot sled with hay for the 110 Herefords they raise on rented land near Steamboat Springs.*

"I've been good to this land, and it's been good to me," says More, 64, who bought 600 acres near Steamboat in 1948, then sold all but 40 acres to a developer for condominiums and a 180-acre golf course.

*Little is left to chance at the Monfort Feed Lots near Greeley (**above**), one of the world's largest cattle-feeding operations with a 200,000-head capacity. Computers record the age and weight of cattle in each pen and prescribe the mix and amount of feed delivered. With a diet of enriched corn and alfalfa, animals gain about two and a half pounds a day.*

up 19 percent of Denver's population.

That Denver will continue to grow Mr. Peña has no doubt. Developers, as he noted, have long eyed a seedy warehouse district and the rail yard near downtown and speak of spending billions—*billions*—on commercial space and condominiums.

But first a few words from the mayor: "What will be the impact on the quality of life? How much open space would we like? Will the housing be affordable or all $300,000 condominiums?" His questions suggest that when the cranes return, they will find a new set of rules posted.

Writing a new chapter *in the volatile history of western water rights, Joy Sporhase (***above,** *at left) and his son-in-law, Delmar Moss, bought a farm straddling the Colorado-Nebraska line and began pumping water into Colorado. When Nebraska officials objected, Sporhase took his case to the U. S. Supreme Court and won, throwing the water-export laws of a dozen western states into question. Lightning highlights grain elevators at Holyoke (***right***), which have held bumper crops in recent years, despite a federal program that pays farmers to reduce planted acreage.*

MOST OF MY BRIEF TIME with Ray Winfree, I looked at his back. Cadet Winfree climbed into the front seat of a sailplane at the U. S. Air Force Academy, just north of Colorado Springs. I took the seat behind.

"You ready to roll?" he asked me. Then, into his microphone: "Academy tower, Forty-five Tango requests air tow north."

A cable attached to the sailplane stretched taut, and a Cessna pulled us into the air. Two thousand feet up we unhooked and whooshed on the currents. The 17 metal spires of the academy's chapel glinted in the morning sun. My eyes rose beyond the abrupt face of the Rockies to Pikes Peak, wreathed in cloud.

In the fearsome grind of academy life —formidable academic load, spit and polish—soaring is an optional activity. Ray had long ago mastered the basics. He had logged more than 200 sorties and was instructing other cadets. I think he loves flying as nothing else.

There's no capsuling the Air Force Academy. The feeling on its spacious foothills campus is of peace, not of making war. One

morning I braked on a road to let a mule deer lead her fawn across. Professors speak of academic excellence and of 26 Rhodes scholars graduated since the academy was founded in 1955. I remember the cadet who said he "wouldn't mind playing with the big toys" —meaning aircraft—but wouldn't mind being secretary of state either. And Ray Winfree, who hopes to fly a fighter.

Robin Wright came from an Ohio town. A railroader's daughter, she was one of 485 women among the 4,400 cadets. She had not yearned for a military career; she came for a good education and a challenge. But in her senior year, when I met her, Robin was saying, "Now I really want to be an Air Force officer."

Shoulder-board bars identified Robin as a cadet lieutenant colonel. She commanded a squadron and wore a wreathed star, emblem of the superintendent's list; she received that honor for a 3.7 grade average as well as military qualities. She had made five parachute jumps—another badge for that—and played on the academy's women's rugby team.

It sounded one-sided. Robin said it wasn't. She spoke of getting dressed up—"I consider myself very much a woman"—and of going out on weekends. She spoke of dates with cadets. "But I'm traditional. They have to ask me."

Colorado Springs owes much to William Jackson Palmer, who pushed rails into the mountains to carry ore, and began to tie the mine camps together. He thought the robust territory should also have a refined resort, and so founded it here in 1871.

"The Springs" has become a most peculiar resort. Retired generals—76 of them at last count—feel at home here, and not just because of the good golfing weather. Round

about is a huge, growing military complex, including an army base, an air base, and contractors supplying sophisticated electronics gear. A quarter of the 340,000 people are supported by military paychecks.

Much of this is due to the presence of the North American Aerospace Defense Command, whose nerve center is buried in Cheyenne Mountain. Besides watching for enemy bombers or missiles, it tracks virtually every man-made thing in space. Signals reach its computers from such diverse eyes as a giant radar dish in Alaska, a radar antenna on a balloon 12,000 feet over the Florida Keys, an eight-ton telescopic camera in Korea, and satellites that detect the exhaust of missile blast-offs.*

Withal, the Springs manages to retain its gentility. Many rate it as Colorado's nicest city—if you don't mind traffic jams.

PERSONALLY, I'm hooked on Pueblo. For one thing the drive south from the Springs to this city of 100,000, across billowing prairie sparkling with sunflowers, cheers my soul.

For another, there is Gus' Place. Nothing fancy, but a slice of the West that was, when mines and smelters boomed.

The jukebox spins polkas and the twangy music of the eastern European tamburitza. Gus's son, Freddy Masciotra, draws beer in

*See "Satellites That Serve Us," by Thomas Y. Canby, NATIONAL GEOGRAPHIC, September 1983.

Reigning king *of the paperback Western with nearly 150 million books in print, novelist Louis L'Amour* ***(below)*** *ambles through the Cumberland Basin near his mountain home in Durango.*

At the controls *of a Colorado institution, the president of Adolph Coors Brewery, Joseph Coors, poses behind the likeness of a vintage beer truck with his wife, Holly* ***(above)****, during a company picnic in Golden. The Coors process eliminates pasteurization in favor of filtering out impurities and microorganisms.*

Ski entrepreneur Bob Parker ***(right)****, with his wife, Barbara, in their Vail home, was smitten with Colorado during World War II training for mountain combat. He returned to help found Vail Associates, operators of the renowned ski resort.*

18-ounce twofers—they used to be two for a quarter. Some patrons down a twofer and a shot, the old workingman's friend. Many a lad passed through Gus' Place to have a five-pound lard bucket filled with beer—refreshment for Dad at the steel mill.

Beginning in the 1880s, scores of western towns were attached to the world with rails forged by the Colorado Fuel and Iron Company (now called just CF&I). Tapping nearby iron ore and coal, Pueblo boomed as the West's premier steelmaker.

I'm in the minority. To many Coloradans, Pueblo is Pewtown, a place of fumes and smoke. It is a bad rap today.

Gazing toward CF&I's stacks, I saw no smoke. Like other U. S. steelmakers, CF&I has been limping along with more than half its work force—once 5,500—idle. But even if all the blast furnaces were blasting, Pueblo would still boast cleaner air than some Colorado cities, thanks to 88 million dollars spent by CF&I on pollution control.

Still, many miss the smoke; it signified jobs, prosperity. "It never hurt anybody," insisted George Miketa, Sr., a man both formidable, standing beyond six feet four, and formal, with old-country reserve. "People lived a good long age." Mr. Miketa is 77 and proud of the 46 years he worked for CF&I. Three other generations of Miketas labored for the mill too.

In their immaculate little home Mr. Miketa and his wife, Mildred, spoke of their fathers, still calling them natives of Austro-Hungary. Mildred's left one part of that vanished empire, now Yugoslavia. George's came from another part, today Czechoslovakia.

George's father wrote kin and friends about the opportunities in Pueblo. Other immigrants came as well—Swedes, Welsh, Poles, Italians, Mexicans—to lend their muscle and sweat to western development.

Near the Arkansas River downstream from Pueblo, laborers in an onion field smiled shyly when I asked their origins. "Estado de Sonora," answered one. Mexicans still lend muscle and sweat to Colorado.

Sometimes a man of Hispanic origin reminds an Anglo that his people once possessed that part of Colorado south of the Arkansas. The river was the U. S.-Mexican border until the Republic of Texas was formed in 1836.

South and west of Pueblo a good highway soars into the conifers and aspens of the Sangre de Cristo Mountains, then drops into the

Classroom of the sky: *Students at the University of Colorado at Boulder* ***(left)*** *prepare to send commands to the Solar Mesosphere Explorer Satellite they operate under contract with the National Aeronautics and Space Administration. Launched in 1981, the craft monitors the creation and destruction of ozone by natural phenomena.*

At Boulder's Naropa Institute ***(right)*** *students meditate in rooms of different hues, a training technique for psychotherapists.*

San Luis Valley—a high valley, 7,500 feet and more, and an average 50 miles across.

Down valley, I walked among the low buildings of Colorado's oldest town. San Luis was founded in 1851 by people streaming north to occupy a vast prewar Mexican land grant. On a Saturday afternoon the loudest sound I heard was the click of scissors in the one-chair barbershop. For many it is not enough. Young Hispanics frequently leave to earn a living.

Arnie and Maria Valdez came back, after college, and built a commodious adobe home. A greenhouse attached to the front nourishes tomatoes and warms the interior. The adobe walls absorb the sun's warmth by

day and release it into the house at night.

Maria said, "If you live here, you're living for the beauty. It's the most depressed area in the state. But we have something powerful—300 days a year of sun."

Arnie and Maria teach others the value of solar heating, which is increasingly important in the valley. Hispanic grant holders once grazed sheep and cut wood on slopes considered to be communal land. But nearly all that land has escaped them—subdivided, fenced, managed for timber. San Luis citizens still fight in the courts for rights they contend were guaranteed their forebears.

"People depended on easy access to firewood," Maria said. "Now they depend on a lot of government help."

BEHOLD the hard underbelly of Colorado, pink and purty. "A manganese silicate," mining engineer Gordon Carlson said, swiveling so that the lamp on his hard hat played on the rock around us.

This pink stuff is valueless, but our lights also torched trails of glitter. Gordon chipped off a lustrous chunk and took an educated guess at the metals present: lead and zinc, probably also silver and gold. Every couple of days the mill outside Standard Metals' Sunnyside Mine yields a small "sponge" of nearly pure gold worth perhaps $100,000—plus thousands in other metals.

Gordon and I were near Silverton, but high above that high town. At 10,600 feet we rode an ore train into a mountain. Two miles in we ascended 900 feet in an elevator. Then we climbed ladders: 200 feet more. The San Juans are lofty; 13 peaks exceed 14,000 feet in this range, which carries the Continental Divide through southwestern Colorado.

Three times a day in summer a doughty Durango & Silverton Narrow Gauge train puffs into Silverton with 500 tourists. They pass a couple of hours buying T-shirts and such—and then are gone. By five in the afternoon the wind blows a lonely whistle through the streets, and it's hard to find a cup of coffee.

Beginning in the 1860s the San Juans yielded ores worth more than 445 million dollars. But booms never lasted; Silverton's population has long hovered around 800.

Treasures finer than silver and gold rise on the surface. These San Juans—ocean wave after ocean wave of ridges, spiny pinnacles, potato shapes, obelisks—are in the opinion of many, myself included, Colorado's most magnificent mountains.*

Miners with dreams left their mark. I remember the remains of Animas Forks at cold timberline: a tumbling house, rusted tin, and the carcass of an automobile with a bumper sticker, "God Loves You."

And little Ouray, a Victorian gem under

*The author described the San Juans in "Along the Great Divide," GEOGRAPHIC, October 1979.

A dream diminished, *Colorado's once promising synthetic fuel industry suffered a severe setback when Exxon closed its shale-oil extraction plant. In the half-finished town of Battlement Mesa, a trailer park* ***(above)*** *created for the boom still waits for residents.*

Exxon's move left the Union Oil Company plant at nearby Parachute Creek ***(top)*** *the state's only large shale operation. But with a trillion barrels of oil trapped in sedimentary rock in the Piceance Creek Basin, the boom could resume.*

Hands-on experience for Colorado School of Mines students comes in a played-out silver mine at Idaho Springs, Colorado ***(right)****. Kerry Bayer practices drilling holes for explosives with a compressed-air drill.*

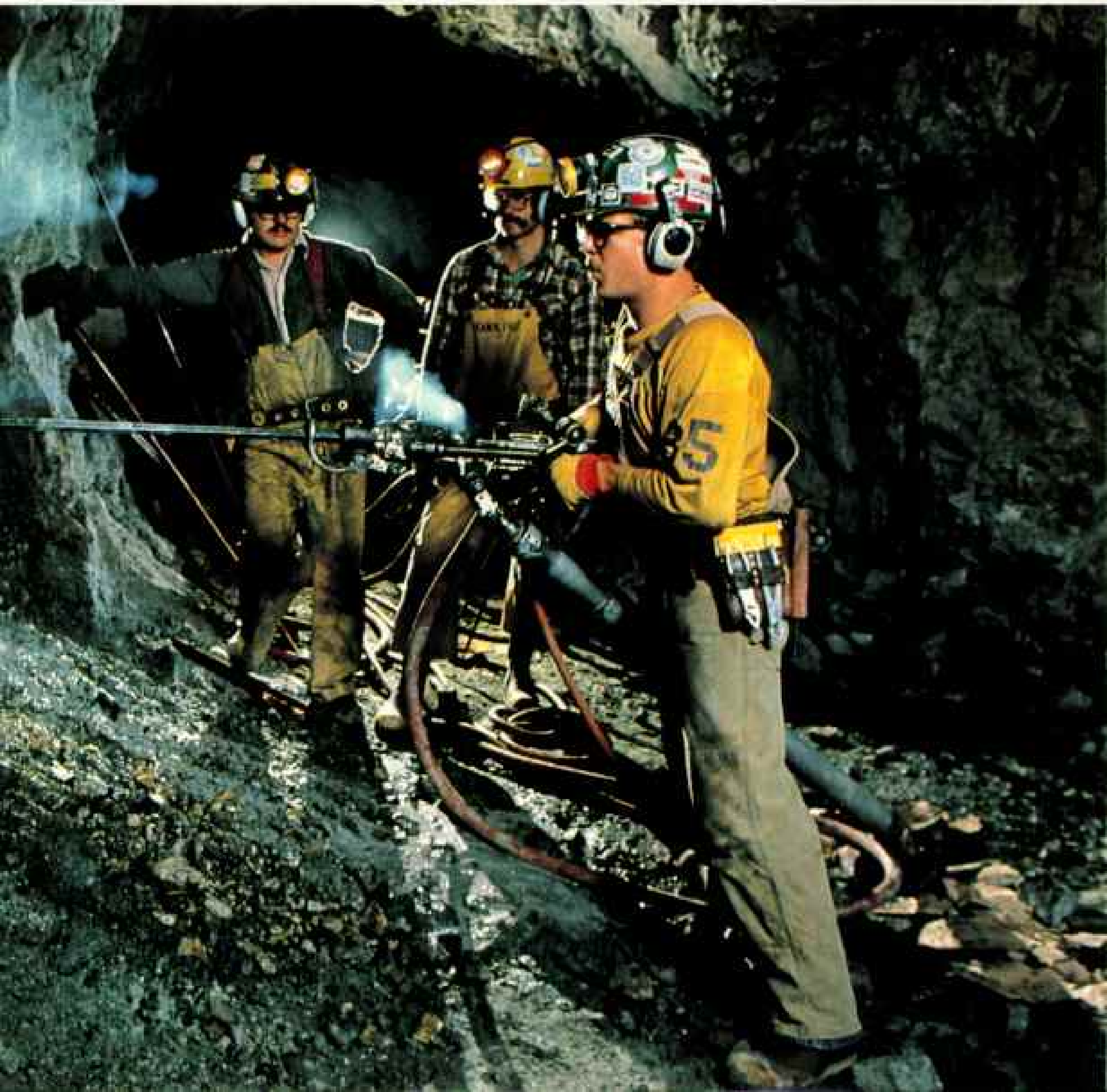
abrupt mountain walls. And the scary ride to get there, over lofty Red Mountain Pass with ice on the road—Lordy, how I wish there were guardrails on the curves!

WHAT were the dreams of Yellow Wolf, whose forebears were crowded onto ever smaller reserves as prospectors, ranchers, and farmers swept into southwestern Colorado?

Dignity for the Utes, I think, would have been one of the wishes of this man, whose Anglo name was Ralph Cloud. Long a tribal lawman, he surely had seen his people scourged by alcohol, their spirit lost, as they groped for a new way of life in conflicting worlds. He also would have wanted the Ute language and customs to remain strong.

Two tribes of Utes dwell on reservations along the southern border of Colorado. The Southern Utes clustered around what became the town of Ignacio; many of them settled as farmers. The Ute Mountain Utes scattered among tumbleweed and parched mesas in the contorted land that holds Mesa Verde National Park. For many years they dwelled in isolation, tending livestock.

After Yellow Wolf's funeral at Ignacio, I spent a long evening with Eddie Box, Sr., who had said the Ute prayers by the grave. "We tell young people, 'Learn the language; listen to your grandpa talk,' " Mr. Box said. To him the language is a link with the spirits above—and with one's own spirit.



For many Southern Utes the link already is broken. "I can't understand the language," said Mrs. Arlene Millich. "My mother and grandmother thought that the way for us to succeed was to be monolingual." In English.

Around the windswept buildings at Towaoc, the town of the Ute Mountain group, the language survives. Scattered as they were for many years, these Utes were less exposed to Anglo culture.

Reservation lands are rich in oil, gas, and coal. In the 1950s royalty checks began to arrive. About the same time the Utes were awarded large sums in a major land claims settlement and millions of dollars were disbursed into tribal coffers. "Per capita money" some payments to individuals were called, and "21 money" was received when a youngster came of age. Enriched, some Utes have moved off the land to adopt urban life.

No doubt the funds accomplished some good. They also were squandered. "Before my time we never had money," a Southern Ute told me. "All people knew about was little government purchase orders to take to the local store." In the future, many hope, royalties will be invested to improve farms.

A group of young Southern Utes have organized to gather information that will better enable the people to decide what to do with their resources. How much more development, if any? What kind? They collected data on strip mining and coal gasification. Decisions may take years. But in evaluating prospects and choosing the one that seems best, the Utes will exert more control over their lives. And in that, there is dignity.

A FUNNY THING happened to Cliff Hiett on his way to World War II. One night in 1943, at Camp Pickett, Virginia, his first sergeant told him: "Hiett, you're being transferred." He had been ordered to Oak Ridge, Tennessee. Why? No one knew.

Something big was abuilding at Oak Ridge. No one would tell Corporal Hiett what it was. He twiddled his thumbs for a few weeks. Then, new orders: Go to Grand Junction, Colorado. A lieutenant sent him on to Uravan, a small town by the San Miguel River then several hours south from Grand Junction by dirt road. Corporal Hiett was puzzled mightily, but now, at least, he was on familiar ground. Before joining the Army, he had worked in a mill at Uravan. It extracted vanadium, a steel hardener, from carnotite, an ore found dispersed throughout the multihued sandstone ridges. Carnotite also contained another element, uranium, which was discarded.

The Army rounded up other soldiers who had processed carnotite and sent them to work in a new mill built to reprocess vanadium tailings. Sergeant Hiett spent the war as a foreman for a precipitation process that produced a green sludge of uranium.

"We didn't know definitely what it was all about," said Mr. Hiett, now 67. But in August 1945 the atom bombs dropped on Hiroshima and Nagasaki confirmed his guess.

Uravan (from uranium and vanadium) is today much as it was in the 1940s—small houses, elms, a company store, and a mill with tanks and pipes. Except that there is a higher hill of tailings now.

In the postwar years the small towns of the uranium belt—Uravan, Naturita, Nucla—enjoyed a boom as the government stockpiled uranium, then another as nuclear generating plants came on stream.

One result is that radioactive tailings now rise beside not only Uravan but eight other Colorado towns as well. They provoke debate. How dangerous is the low-level radiation from them? Should the tailings be moved to unpopulated sites?

In the 1950s and early '60s tailings from a Grand Junction mill were innocently given to anyone who wanted them as fill. Thus far, 17.5 million dollars has been spent to remove radioactive fill from 510 sites—under homes, churches, offices, and schools.

A few years ago one company proposed to reprocess tailings; they still contained millions of pounds of uranium. Then uranium prices crashed—from $43 a pound to $20.

Familiar Colorado story: The uranium belt busted. Mines cut back, as did Union Carbide's Uravan mill. Some people blame cheap foreign production—in part. Declared Cal Sanders, who mined uranium for 23 years: "We're out of the market because of the bad judgment of the hippie class. People who oppose nuclear power don't know what they're saying."

Mr. Sanders is grateful to uranium; it

paid for his home and 200 acres of land.

He is more fortunate than some. Cancer felled many miners, especially those who labored prior to the 1960s, when the industry improved ventilation and dust-control. Statistics finger tobacco as a contributing factor. Most of the younger victims were smokers.

IT WAS A WONDERFUL RIDE that Gary Dean got, courtesy of the rock that burns. "Investors were coming here in private jets. I lived on the phone, saying 'This is a deal, this is a deal.' People wired money—'Buy this, sell this.'"

Before becoming Gary Dean of Gary Dean Investments, with offices near the Colorado River in Rifle, he had managed a supermarket and owned a bar. He also owned a parcel of land.

"One day Occidental Petroleum popped in, and suddenly I'd made half a million dollars off that land." Thus, in 1980, was he initiated into the oil-shale boom, then beginning. "I went out and bought and optioned all the land I could get my hands on."

Canadians and Europeans came, and men from Los Angeles and New York, wanting land for shopping centers, subdivisions, condominiums. Gary obliged them, creating corporations and partnerships.

There have been other oil-shale booms; in the 1920s oil companies tied up billions of tons of shale along and north of the Colorado River. With petroleum prices staying high in 1980 and 1981 and overseas supplies seemingly unreliable, many oil companies thought shale's time had truly come.

All you had to do was mine the stuff, heat it to 900°F, and draw off the viscous raw shale oil. Refine that and—presto!—petroleum. The possibilities were enormous; a ton of rock would yield 35 gallons of oil.

The petroleum companies began to spend. The town of Parachute ballooned from 300 people to 1,200. The oil companies invested millions there and in nearby Battlement Mesa on housing, schools, and services. Construction workers lived in recreational vehicles, some in tents. At night they helped O'Leary's in Parachute become the sudsiest bar in Colorado.

Then some oil companies began to have second thoughts. They put their shale projects on hold. Costs were high; the extracting process apparently was not as promising as engineers had hoped. Colony Oil Shale, however, was going full bore and, reassuringly, its major partner, Exxon, was the world's largest corporation.

Black Sunday, May 2, 1982. They made

***In the rout** of an invisible enemy, workmen demolish the floor of a Grand Junction home found to contain radioactive radon gas at higher than acceptable levels. Like others in the western Colorado city, the house was built on landfill composed of tailings from mills that furnished uranium to the government. Federal and state agencies are cooperating in removal of tailings because of the carcinogenic decay products of the gas.*

the announcement in the afternoon: Exxon was suspending operations.

Disbelief, then rage. Exxon softened the blow, buying 268 homes from employees and contractors at its new Battlement Mesa development.

Two thousand jobs vanished. Gary Dean had unsold condominiums on his hands, as well as empty commercial buildings. He was, he said a few months after the collapse, "restructuring," trying to hold on to what he could. "It was a helluva roll," he said, smiling at the memory.

The shale boomtowns settled back, now endowed with new pavement and water systems. The longer range benefit is perhaps to be found in the massive environmental studies that accompanied mine planning.

FOR THE RIO BLANCO shale project, partnership of Gulf and Amoco, biologist Jack Clark worked on a ten-million-dollar study that collected data to determine potential mining impact and explored ways to minimize it.

A few years ago a visitor to the sagebrush lands around Rio Blanco's 5,000-acre tract might have found Jack counting deer pellets among the scrub. A large mule deer herd migrates through the shale country; Jack wanted more data on its travels, and on which areas were most important to the herd in times of stress.

In addition to the deer studies, Jack and crew recorded water and air quality with sensitive instruments. They censused life in streams. They tested seed mixtures and shrubs for use on reclaimed land.

Environmentalists contend that several major shale projects under way at one time would cause severe damage. But Jack believed one project the size Rio Blanco envisioned—producing as much as 100,000 barrels of oil a day— could operate without bad effect. Most of all he worried about the human impact.

"When a guy comes to this wide-open country from Hackensack, it's hard for him not to go wild," Jack said. "He may not realize that the tracks his dirt bike makes will last 50 years or that the sagebrush he chops down has been there 40 years."

The shale game still has one player. Union Oil opened a huge mine at Parachute Creek

***Fresh flowers** and a fresh face add a bright spot to a summer day on 17th Street in Denver's main commercial district **(above)**.*

*Nature creates her own bouquet below the Maroon Bells **(facing page)**. A clump of aspens retains its brilliance long after its companions have shed their leaves. Such discrepancies may be due to genetic variations within the stands, changes in ground temperature, or the amount of sunlight received.*

The health of some stands suffers from blight and what one Aspen resident wryly called a "nervous breakdown from too many people."

Worthy companion *to the Sangre de Cristo Mountains, Great Sand Dunes National Monument evokes its own ever changing majesty as it blankets an area*

and built a retort to extract shale oil. The 650-million-dollar investment is partly offset by a contract with the government to provide oil for defense use. Union may learn much that will help make shale viable—someday.

THERE'S A CAFÉ in Maybell and a gas station where you can fill up. In far northwest Colorado these are amenities not to be lightly regarded. And between Maybell and the Utah line, 62 miles on Highway 318, there's not much else.

I took that road to the northern end of Dinosaur National Monument and camped by the Green River. This is a few miles downriver from Browns Park, where Butch Cassidy and his gang sometimes hid when not robbing banks. Blessed with abundant grass, Browns Park also was a gathering place for Indians. In the late 1830s it held a

of 50 square miles. Upon discovering the dunes in 1807, explorer Zebulon M. Pike described them as having an appearance "exactly that of the sea in a storm (except as to color)."

small fur-trading post, Fort Davy Crockett.

Park ranger Glade Ross wondered where the short-lived fort stood and at last found evidence beside the Green. He picked up charcoal, chunks of lead, and glass beads that trappers traded to Indians for pelts.

"I'll show you where it was," Glade offered. Soon we were slip-sliding in the clay of the riverbank, digging out charcoal. Glade inspected the shallow water. "Sometimes you can still find a bead," he said. Then, "I think I see one." A tiny burst of sun winked at us amid the gravel.

Glade stripped off his shirt and, with me sitting on his legs, ducked into the water. He reached but missed; the bauble was just beyond his fingers. Its light went out in the disturbed gravel. That's Colorado for you: a gleam, a dream, a bonanza—often just beyond your grasp. □

The Whales Called "Killer"

By ERICH HOYT Photographs by FLIP NICKLIN

Sleek, powerful, and fearless, they rule the seas.
With swift thrusts of their tails they leap from the water
or chase down their prey. Once creatures of mystery
seen as bloodthirsty man-eaters, killer whales have been
found to be highly social, intelligent, even gentle animals.

IN THE late afternoon shadows off the coast of Canada's Vancouver Island, the pod of killer whales came to rest. The great black-and-white bodies, weighing as much as six tons each and measuring up to 25 feet in length, rolled effortlessly with the swells.

The peaceful scene was suddenly shattered by a barrage of rifle fire, the sounds ricocheting off the slopes of nearby islands like firecrackers on a Chinese New Year. Bursts of spray erupted among the tall dorsal fins of the whales, and instantly they were gone, sounding below the dark surface of the water.

In the boat beside me my fellow whale-watcher, Peter Vatcher, trained binoculars on a dozen seine and gill-net fishing boats 300 yards astern of us. "Speaking of killers," Peter said in disgust. "Gun-happy fishermen—you'd think they'd know better."

The incident occurred more than ten years ago. At the time, I knew little about *Orcinus orca*, the killer whale, beyond frightening tales then widely believed despite contrary evidence. No less an authority than the U. S. Navy's official 1973 *Diving Manual* rated the killer whale as a mortal enemy of man. "Killer whales," declared the manual, "are extremely ferocious."

Another Navy publication solemnly warned that *Orcinus orca* "will attack human beings at every opportunity."

Even Alaskan Eskimos feared the killer whale. In one story still told around Barrow, an Eskimo hunter harpooned an orca. From then on, according to the story, whenever the hunter launched his kayak, he found killer whales waiting for him offshore. In the end he was forced to abandon the sea.

In his 1969 book *Man Is the Prey*, author James Clarke declared flatly that the orca "is the biggest confirmed man-eater on earth"—a statement Clarke neglected to confirm with a single proven instance.

But the last word on killer whales was expressed by Owen Lee, a veteran diver, in a book also published in the 1960s. "There is no treatment for being eaten by the orca," wrote Lee, "except reincarnation."

Such horror stories impressed my friend Graeme Ellis, who grew up on Vancouver

Island in the early 1960s and who has since become a leading researcher and authority on killer whales. Not long after my whale-watching voyage with Peter Vatcher, Graeme described his early years on Vancouver Island for me.

"As a boy," Graeme said, "I firmly believed all that nonsense about orcas. Whenever my friends and I caught sight of killer whales, we threw rocks at them. Others even used BB guns, and later .22s.

"Then one summer I got a job at the aquarium in Vancouver, helping to feed and train one of the first killer whales ever held in captivity. By the end of the summer that whale and I had become friends, and I'd decided I wanted to know more about orcas—not just in aquariums but in the sea." He smiled. "I've been at it ever since."

Thanks to the work of Graeme and a handful of other researchers, *Orcinus orca* has shed its aura of mystery and menace.

Journalist **Erich Hoyt** has studied killer whales for nearly a decade. San Diego free-lance photographer **Flip Nicklin** is a frequent contributor to NATIONAL GEOGRAPHIC.

Convoys of killers gather in Johnstone Strait (below) to feed on migrating salmon each summer. About 260 Orcinus orca inhabit nearby waters in three communities. One ranges north to the Alaska Panhandle, another south to the Washington coast, while the third is transient, roaming through the others' territories and beyond.

ONCE FEARED as "wolves of the sea,"
killer whales are predators of many kinds of sea life, but they are not cold-blooded killers or man-eaters. When fish are not plentiful, they feed on other dolphins and whales, as well as seals and sea lions.

JOHN K. B. FORD

One of the first things research revealed was that not a single documented case exists of orcas attacking and killing human beings.

The real turnabout in public opinion toward orcas started with the capture in the mid-1960s off British Columbia of Moby Doll, who died soon after, and Namu. Namu's 450-mile odyssey to Seattle via towboat and submerged pen was aided by NATIONAL GEOGRAPHIC. Thousands of visitors and millions of TV viewers took the whales to heart, and their dread image began to fade.*

Recently I joined Graeme and his associates during the killer whale census conducted every summer off Vancouver Island. The count is taken by Canada's Department of Fisheries and Oceans, for which Graeme has worked as a researcher.

"We've come a long way in just ten years," Graeme said as we left the small port of Telegraph Cove in his 20-foot outboard. We were bound for Johnstone Strait, a narrow channel between Vancouver Island and the British Columbia mainland (map, page 223). Here each summer hundreds of thousands of salmon school before entering the

*See "Making Friends With a Killer Whale," by Edward J. Griffin, in the March 1966 issue.

rivers to spawn, and here pods of killer whales gather to feed on the salmon. In this somewhat sheltered strip of water less than 60 miles long, many far-reaching discoveries about killer whales have been made.

"The fishermen have come a long way too," Graeme added. "Some of the same ones who used to shoot at orcas have become dedicated killer-whale watchers who know 'their' whales by sight. The whales sometimes surf beside the fishing boats, and the fishermen even throw them a few salmon."

As we entered Johnstone Strait, killer whales began spouting and diving all around us. While steering the boat with one hand, Graeme picked up his camera equipped with a shoulder brace and a telephoto lens. Suddenly a young orca surfaced just 50 feet off our bow. As the water washed over its sleek black-and-white body, the whale seemed to be looking straight at us with a beady black eye.

"He's curious," I said.

"Or hunting," Graeme replied. "Watch."

Beneath the surface a predator/prey drama unfolded. With its other eye the whale apparently was following a salmon, and suddenly there was a scuffle. The salmon

Observer or observed? *A killer whale takes in its surroundings (**far left**) by "spy-hopping" out of the water. Passing close to a small boat, a group of orcas (**above**) have their portraits taken by researchers Mike Bigg and Graeme Ellis, who use photographs of dorsal fins to identify each animal. Veteran researcher Ian MacAskie (**left**) helped Bigg start a population study in 1971.*

Killer whales travel in highly stable family pods that hunt, play, and rest together. Pods in the transient community usually have five or fewer members, while pods in the resident communities range from six to 50 members. Pods seem to form around females, which may live as long as a century. Males enjoy life spans of about 50 years.

Playground for whales, *a stretch of water in Johnstone Strait serves as a "rubbing beach" for a killer that scratches itself on the smooth stones* ***(below)****. On another part of the same beach two young whales circle each other* ***(right)*** *in a bit of underwater horseplay. Killers gather in "core areas" like this to romp and relax together.*

Researchers don't know why the whales like to rub their sensitive skins on the bottom, but it may be a form of grooming. Maturing at about ten years of age, females average one birth per decade, though some calve as often as every three years. Gestation averages 16 months. Measuring about eight feet at birth, bulls can grow to 25 feet and weigh as much as six tons. Cows may reach 21 feet and four tons.

Orcas rest together for periods lasting from a few minutes to four hours. Staying in tight groups near the surface, they seem to synchronize their movements, often coming up for air at the same time. They may not use their sonar during such periods of rest, but instead keep track of one another through sight and touch. Researchers speculate that this subdued activity probably substitutes for sleep.

Pods tend to keep to themselves during the winter and spring months. But in the summer and fall they sometimes join together for hours at a time to socialize in large "superpods."

leaped free of the water, but in one lunge the whale snared it. Then, as the whale turned to dive, Graeme photographed the dorsal fin, crucial for identification.

"It's Sharky—*she*, not he," Graeme said. I, too, recognized Sharky from previous summers: a young female with a triangular, sharklike dorsal, distinct from the female's normally curved fin and the five-foot-tall dorsal of a mature bull.

"She's coming of age," Graeme said of Sharky. "I'd say she's pushing 12. She may soon be a mother."

Joining several other killer whales, Sharky headed for the Vancouver Island shore. We followed close behind. As the orcas rested among the swells, Graeme identified other individuals by their distinctive dorsals. There was Top Notch, a mature bull with a cleft at the top of his fin, probably the result of injury. In addition there was a cow that Graeme believed to be Top Notch's mother—Scar, named for a series of lacerations across her back. There were several other cows and half a dozen calves and juveniles, a pod of a dozen killer whales.

Graeme photographed them all and noted the time and location. Later that day we met a pod of eight whales, mostly bulls, including one with a forward curve to his dorsal that had earned him the name Hooker.

Over the next several days we explored Johnstone Strait and nearby Blackfish Sound, counting and identifying 135 whales. Graeme was delighted. "They're all here," he said as we headed back toward Telegraph Cove. "It's the same count as last year, 135 whales. Not a single mortality. That'll surprise Mike Bigg."

DR. MICHAEL A. BIGG is a marine mammalogist at the Department of Fisheries and Oceans' research station in Nanaimo on Vancouver Island. Since 1971 Mike Bigg and marine-mammal researcher Ian B. MacAskie have conducted research on killer whale behavior and population dynamics, a project later joined by Graeme.

Two other researchers, Kenneth C. Balcomb III of the United States and John K. B. Ford, a marine zoologist at the University of British Columbia, have contributed greatly to increased knowledge of killer whales.

Following the census with Graeme, I called on Mike Bigg at Nanaimo to learn what the new figures meant. "For one thing," Mike said, "they indicate that killer whales live a lot longer than we originally thought. If you know the individual whales in a given area and their mortality rate each year—in this case, zero—you can work out the whales' probable life expectancy. From our studies over the past ten years, we suspect that orca males may live as long as 50 years and cows may live as long as a century."

Such knowledge has come slowly. Since 1973 Bigg and his colleagues have collected a file of more than 30,000 mug shots, or identification photographs, of British Columbia killer whales. Many of the shots are duplicates of the same animals, so in fact the file represents 261 individual whales.

"They're divided into three main groups, or communities," Mike said. "What we call the northern community consists of 12 pods, totaling 135 whales. Their range extends from Johnstone Strait up the northern coast of British Columbia, a distance of about 350 miles. That's the community on which you and Graeme just conducted the census.

"The southern community is smaller, three pods totaling 79 whales. It ranges along southern Vancouver Island into Puget Sound and along the coast of Washington.

"The third group is strictly transient," Mike continued. "It contains some 15 pods totaling 47 whales. That community roams a wide area of the coast, including the territories of both the northern and southern communities and probably beyond. We rarely see them, and they always appear to be just passing through."

For further identification Mike and his colleagues have given each killer whale "family," or pod, a letter designation and each individual within the pod a number. Thus, Top Notch is A5—the fifth whale identified in the first pod to be designated—Hooker is B1, and so forth.

Identification provided the key to a wide range of discoveries. By long observation Bigg and company have found that killer whale pods are remarkably stable units.

"Unlike many other social animals—that is, animals that group together," said Mike, "killer whales travel, hunt, rest, and

play together, apparently for life. With orcas the only way a pod member arrives or leaves seems to be by birth or death."

During winter and spring the pods within a given community normally stick to themselves while occupying the same range. But in summer and fall, for reasons still unknown, pods often join together for hours or even days in "superpods" that sometimes contain every member of the community.

TO MIKE and his colleagues the whales in both northern and southern communities are known as residents. They follow the salmon runs in summer and early fall and range over a slightly wider area in winter and spring, but they do not actually migrate.

"The transients are another matter," Mike said. "We know less about them than we do about residents, but they are obviously different. For one thing, they travel in much smaller pods—usually fewer than six members, compared to resident pods numbering anywhere from six to 50 members.

"The transients even *look* different from residents," Mike said. "Their dorsal fins are more pointed, and many have a bulge at the front rarely seen among residents.

"Transients behave differently too. Residents tend to travel from headland to headland as they forage for food, surfacing at fairly regular intervals. But transients probe every bay and cove, charging through kelp beds and changing direction abruptly."

Mike attributes such differences in part to food supply. "Transients seem to concentrate in poorer feeding areas," he said. "We've wondered whether the resident whales are territorial, driving the transients away. But we've never witnessed an aggressive encounter between groups. Transients seem to live a different life-style. Living in areas where fish are scarce, they apparently feed a lot on marine mammals such as seals, sea lions, and even other whales. We rarely see residents do that."

Even more striking than differences in feeding habits are differences in sound. For the past six years John Ford has studied communication sounds among orcas. To record variations in killer whale sounds, John and his wife, Deborah, have lowered sensitive hydrophones into the waters all along the Vancouver Island coast. One day I joined them in a 17-foot outboard to make recordings in Johnstone Strait.

"Every killer whale pod has its distinctive 'dialect,' or repertoire of sounds," John explained. "Some dialects are highly distinctive; others differ in subtle ways. When you've listened long enough, you can identify individual pods by sound variations.

"For some reason," John added, "transients are much quieter than residents. I don't know whether the transients are silent

***To protect the eye** and keep it moist when out of water, a killer whale sheds a thick fluid like tears. The whale's vision is good above water as well as below, enabling it to see seals atop ice floes.*

The killer's complex brain, more than four times as large as a man's, suggests that the animal possesses a sophisticated system of processing sensory information. Though the whale seems to have no sense of smell, its mouth is sensitive enough, as aquarium trainers have discovered, to detect a pill-baited herring in a bucketful of fish—and spit it out.

because they're traveling through resident-whale territory, or whether silence is part of some sneak-attack method of hunting."

Once into Johnstone Strait we encountered a pod of orcas, and John lowered a hydrophone into the water. The phone was connected to a speaker in the boat, which began to emit a chorus of clicks, whistles, and short, piercing screams. John listened briefly, then nodded and said, "It's Top Notch's pod." I asked how he could tell and he answered, "From the screams, which are technically known as pulsed calls.

"The clicks you hear are probably a form of echolocation for navigation and for homing in on food. I'm still not certain about the whistles, though I often hear them among resting or socializing whales. The pulsed calls seem to be a way of keeping pod members in touch when out of sight of each other.

"Every pod shares a number of pulsed calls with other pods in its community," John added. "But each pod often has unique versions of those shared calls as well as one or two distinctive calls of its own. It's these differences that make up what I term a true local dialect, a trait shared with only a few other species, one of which is man."

Soon new sounds began to emerge from the speaker. Even to my ear they seemed different from the first, and John agreed. "It's Hooker's pod," he said. "They're still some distance off. Killer whale sounds are so loud that the hydrophones can pick them up at a range of five miles or more."

Sure enough, within an hour Hooker's unmistakably curved dorsal was cutting the water astern of us along with other fins.

THE WORK of John Ford and Mike Bigg has led to some remarkable discoveries. In 1965, when Namu was captured off the British Columbia coast, he was towed to the Seattle Public Aquarium in a steel cage that was followed for miles by a number of wild orcas. Fifteen years later, from a photograph of those whales, Mike Bigg identified one by her dorsal as C5—an older female from a pod in the northern community. At the time, Mike theorized that C5 might be Namu's mother. John Ford provided another clue.

Listening to tapes made of Namu's sounds in the aquarium, John instantly recognized the dialect of C pod, virtually unchanged for more than 15 years. It would seem that unlike their relatives the humpback whales, whose underwater song evolves from year to year, killer whales apparently retain individual dialects unchanged over long periods, possibly even for life.*

Not far from where John and I made the recordings lies something Mike Bigg refers to as a "core area," a sort of corner-drugstore hangout for killer whales.

"A certain amount of feeding takes place in the core area," Mike says, "but basically it's a place where killer whales simply gather to rest and play in summer."

*Humpback whales and their songs were described by Sylvia A. Earle and Roger Payne in the January 1979 GEOGRAPHIC.

Eavesdropping *on a killer whale conversation, John Ford (**left**) studies sounds made by different groups. Each pod, he discovered, has its own repertoire of noises. Some are shared with other pods, and some are uniquely their own. There are clicks used in echolocation, whistles used in social situations such as sexual activity or play, and pulsed calls, like the screeching of a rusty hinge, probably used to keep track of one another during travel or foraging for food. The call of a killer like this one (**below**) may be heard by others at least five miles away. Whales in transient pods, however, are almost silent, perhaps to sneak up on prey.*

The core area in Johnstone Strait is frequented by northern-community whales, and it has an added attraction known as "rubbing beaches" (pages 228-9). Rubbing beaches are stretches of shallow water whose bottom consists of rounded pebbles. For reasons still unclear, orcas like to scrape their bodies against the pebbles, though their skin is extremely sensitive to injury.

I first witnessed this phenomenon at one of Johnstone Strait's rubbing beaches. With two friends I was following a pod of orcas in an inflatable outboard when the engine died. The strong tide swept us along with the pod toward a rubbing beach, and suddenly we glimpsed a huge bull named Wavy rubbing beneath our boat.

Seconds later Wavy swam toward shallower water in the direction of a cow and her calf. Thrashing half out of water, Wavy and the cow came belly to belly and mated, with the calf only a few feet away.

It was an extraordinary moment, and it left us wondering: Could rubbing be orca foreplay? We still don't know. Killer whales have frequently been observed in the act of rubbing, but never rubbing followed by mating. Moreover, U. S. researcher Ken Balcomb and his colleagues have found no rubbing beaches in the core area of the southern-community whales, yet mating obviously occurs there.

MATING and reproduction are crucial to the question of killer whale survival. Although the birthrate among killer whales is low—less than 5 percent per pod per year—so is the mortality rate, except on those occasions when man enters the picture. Recently a Soviet whaling fleet in the Antarctic killed 916 orcas in one summer season. The Russians were obviously running out of larger whales, for a killer whale yields only a very small fraction of the oil obtained from a right or a humpback whale.

How many killer whales are there in the world? No one knows, though estimates run as high as tens of thousands. Killer whales are probably not endangered, despite such

Among the fastest swimmers *in the ocean, killer whales reach estimated speeds of 30 mph. The fine structure of their skin and their hydrodynamic shape allow this pair off the coast of British Columbia* ***(above)*** *to cruise just below the surface with barely a ripple. The water actually lifts over the domes of their heads like a blanket as they slip through the sea. A killer coming to the surface* ***(below)*** *rises a full 18 inches out of the water before breaking the surface tension. Only the air from the whale's blowhole disturbs the thin envelope of water that begins at the line of its mouth and rises over its head.*

slaughter as the Soviets dealt them. The International Whaling Commission has since placed a ban on pelagic whaling of orcas around the world.

Perhaps because of orca cows' great longevity, killer whale society appears to revolve around the females. "The mortality rate for cows," says Mike Bigg, "is about one percent a year, compared to 3 percent for bulls. The cows seem to run the show. I see grown bulls today that I photographed as juveniles ten years ago, and they're still traveling with their mothers. Recently we've found that most resident pods contain smaller groups, or cliques, each made up of a single cow and her progeny of all ages.

"Cows are the key to the formation and structure of the pod," Mike adds, "but the question is how long the process takes. We think cow subgroups eventually split off from the parental pod. That's how a new pod forms. Once cows reach the calving age of perhaps 12, they produce at very different rates. The shortest interval is around three years. But some cows may go six or seven years between calves, others much longer. The average seems to be about one calf per cow every ten years—one of the lowest birthrates among social mammals."

Such minimal birth and death rates, coupled with the longevity of cows, suggest that new killer whale pods may take many decades to form and many more to die off.

The occasional capture of an orca for

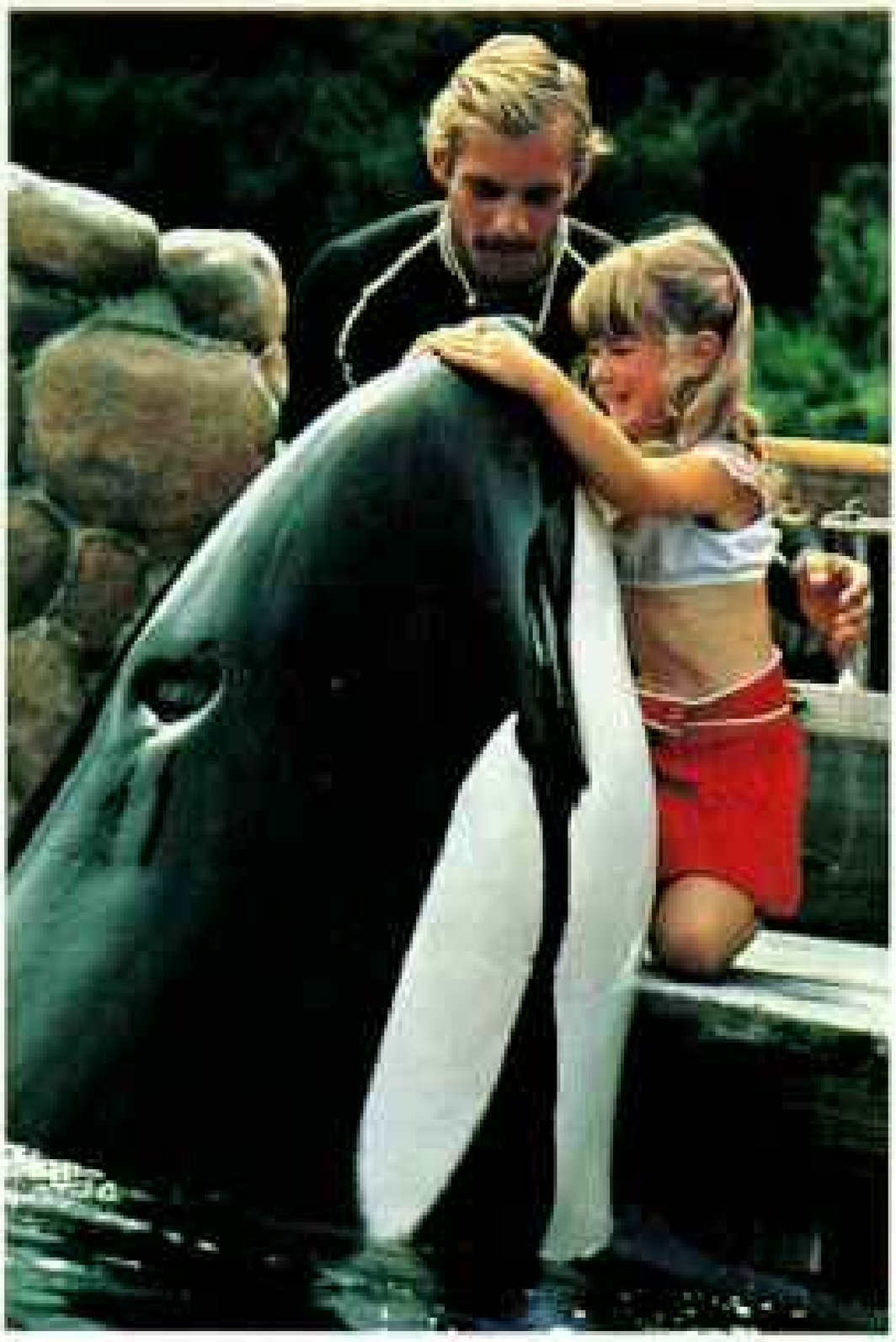
research or exhibit may alter the structure of a pod, but it probably does not affect the pod's survival. Mike has found that pods from which whales have been taken show a slightly higher birthrate than untouched pods. This suggests that killer whales, like other social mammals, can adjust their birthrate to changing circumstances.

A storm of controversy currently surrounds a five-year permit for capturing killer whales awarded by the U. S. government to the commercial California-based aquarium known as Sea World, Inc. The permit allows for capture of a hundred killer whales, not in British Columbia but in Alaska. Ninety of the whales will be held only temporarily for research, and the other ten will stock Sea World's marine parks in California, Florida, and Ohio.

Sea World educates and entertains millions of people annually with its performing killer whales, as well as devoting some profits to research. Yet many scientists, environmentalists, and Alaska residents wonder if the aims of a private corporation justify tampering with a natural resource such as killer whales.

Will capture and research disrupt the social fabric of the Alaska pods? Or will the whales be driven from their favored haunts? Neither Sea World nor anyone else can answer these questions.

Not long ago a British Columbia logging company proposed a logging port on Vancouver Island's northeast coast, precisely in the center of the northern-community whales' core area. Because Mike Bigg and John Ford could document the whales' use of the area, a small army of whale-watchers, coastal residents, and even salmon fishermen managed to persuade the British Columbia government to declare the 3,000-acre stretch of water a marine ecological reserve. With cooperation from the logging company, a move is now afoot to set aside a buffer strip of shoreline adjoining the reserve, which would create the world's first sanctuary for killer whales.



A big wet kiss *from Shamu delights a young fan (***above***) at San Diego's Sea World, where the whale performs for three million people a year. Overcoming an initial shyness, a killer at the Vancouver aquarium tugs on a flipper (***left***). Though some conservationists decry prolonged confinement of orcas, crowds all over the world have been charmed by the spunk of the whales called killer.*

ULTIMATELY the best protection for a species is the people who know and care about it. In the case of killer whales such a group continues to grow among the coastal residents of British Columbia, Alaska, and Washington State. Many have shared in the excitement of orca research, and many others have appointed themselves personal guardians to Top Notch, Sharky, Hooker, and the others.

That is especially true of the younger generation, including Jason Ellis, Graeme's son, who is a veteran whale-watcher at the age of 12.

Jason and his contemporaries are growing up with an awareness of killer whales totally different from that of their parents: no rocks, no BB guns, no .22s, only a sense of wonder and affection.

Therein perhaps lies the best hope for the killer whale, for a childhood playmate is a lifelong friend—never to be forgotten. □

Peaks where the gods dwelled were long revered—but mostly from afar. Now the mountains of central Honshu beckon worshipers of the outdoor life, as millions of hikers and skiers flock to . . .

THE JAPAN ALPS

By CHARLES McCARRY

SENIOR ASSISTANT EDITOR

Photographs by GEORGE F. MOBLEY

NATIONAL GEOGRAPHIC PHOTOGRAPHER

Icy gale *claws at the author* ***(above,*** *with guide), who uses an ice ax as a support on the slippery slopes of Hoken-dake (Mount Hoken). Their tent on Mount Shirane* ***(left)*** *was later shredded by even stronger winds. Such are the challenges of these ranges, tagged Alps by European hikers of the 1890s.*

A TYPHOON HAD PASSED over the Japan Alps the day before, and its boisterous afterwinds jostled and taunted us as we climbed the flank of Tateyama (9,892 feet). Thick clouds boiled around our booted feet. A sheet of cold rain streamed over the ridge, twisting and flapping like laundry pinned to a line.

With gruff impatience, as a disgruntled puppet master will cast aside a puppet, the wind picked up our guide, a merry young fellow named Hidehiko Noguchi, and blew him against a large rock. The same gust filled my rain jacket like a sail and knocked me down. Photographer George Mobley, gray beard blowing, clutched his cameras, and just managed to keep his balance.

"Gambare!" cried Noguchi-san. The word means, roughly, "Show your spirit!" A favorite saying of Japanese mountaineers, it is a jovial, all-purpose exhortation to laugh at discomfort and try your best.

Invigorated by the stinging rain and buffeted by the gale, we pushed on and arrived at the crest of the ridge. Suddenly the clouds were parted by fingers of sunlight. Beyond the ridge lay the silvery Sea of Japan. In every other direction the jagged peaks of the Japan Alps soared as high as 10,000 feet: Yari—"spear," Tsurugi—"sword," Yatsu—"eight peaks."

In early September some of these summits were already dusted with snow. For George Mobley and me, all were touched by the tantalizing mystery of mountains we had yet to climb. In the weeks ahead, we would stand on many of these summits. For now, though, we were content with what we had found on our very first climb—the serenity and beauty of a unique region of Japan, a place so little known to the outside world that we would encounter, in this age of the ubiquitous tourist, Japanese who had never before met a foreigner.

The Japan Alps (never Japan*ese* Alps) consist of the Hida Mountains (called the Northern Alps), the Kiso Mountains (Central Alps), and the Akaishi Mountains (Southern Alps), lying in the central and widest part of Honshu, the main Japanese island. Except for Mount Fuji (12,388 feet), the loftiest mountain in Japan, all of Japan's highest peaks are included in the Alps.

Why "Alps"? In Tokyo, before we set out for the mountains, Dr. Yasuo Sasa, president of the Japanese Alpine Club, explained how these mountains, which are so bound up with the Japanese spirit, happen to bear such an un-Japanese name.

"We Japanese always revered our high mountains and made pilgrimages to them," said Dr. Sasa, "but it had never occurred to our ancestors to climb them for sport. Then, in the latter part of the 19th century, English climbers saw them for the first time. The meadows and crags, the wildflowers and highland animals of our mountains reminded them of the European Alps—and so they got their name."

William Gowland, a British mining engineer, first used the term "Alps" in his *Japan Guide*, published in 1881. The Reverend Walter Weston, British chaplain of Kobe and Yokohama, popularized the idea—or the mystique—of climbing in Japan, describing his own experiences in books that made the appellation the accepted one.

Until the end of World War II, mountaineering in Japan was very much a sport for the educated elite. Nowadays, however, thousands of climbers swarm democratically over the Alps in July and August. Not all are equipped for the experience. According to Shizuo Tsukamoto, an official of Japan Alps National Park, in the past 30 years some 500 climbers have died on the two most popular mountains—Yari (10,433 feet) and Hotaka (10,466 feet).

A FAMOUS Japanese climber, Mrs. Tel N. Satow, told us about obstacles of custom and superstition she had faced as a pioneer among female alpinists. In Mrs. Satow's youth, many Japanese believed that it was irreligious for a woman to set foot on a mountain. Nevertheless, purified by the goddess of Asama Shrine and wearing straw boots with pepper sprinkled inside for warmth, she became, in 1927, the first woman to climb Mount Fuji in winter.

"Even today," said Mrs. Satow, 79, "I am sometimes reminded by a guide that the *yama no kami* [mountain gods or spirits] are not very hospitable to lady climbers."

Ascending the cinder cone of an active volcano, Mount Asama (8,340 feet), on a limpid September morning, Nancy, my

wife, made a joke about supernatural misogyny at high altitudes. "I do hope I don't cause an eruption," said she. There seemed to be little cause for alarm. We did not know that Asama, after several months of quiescence, had emitted an electrifying puff of steam only the day before.

We reached the summit in the bright sunshine of early afternoon and, after a peek into the sleeping crater, sat down on a row of blistered boulders to enjoy our lunch of chocolate and oranges.

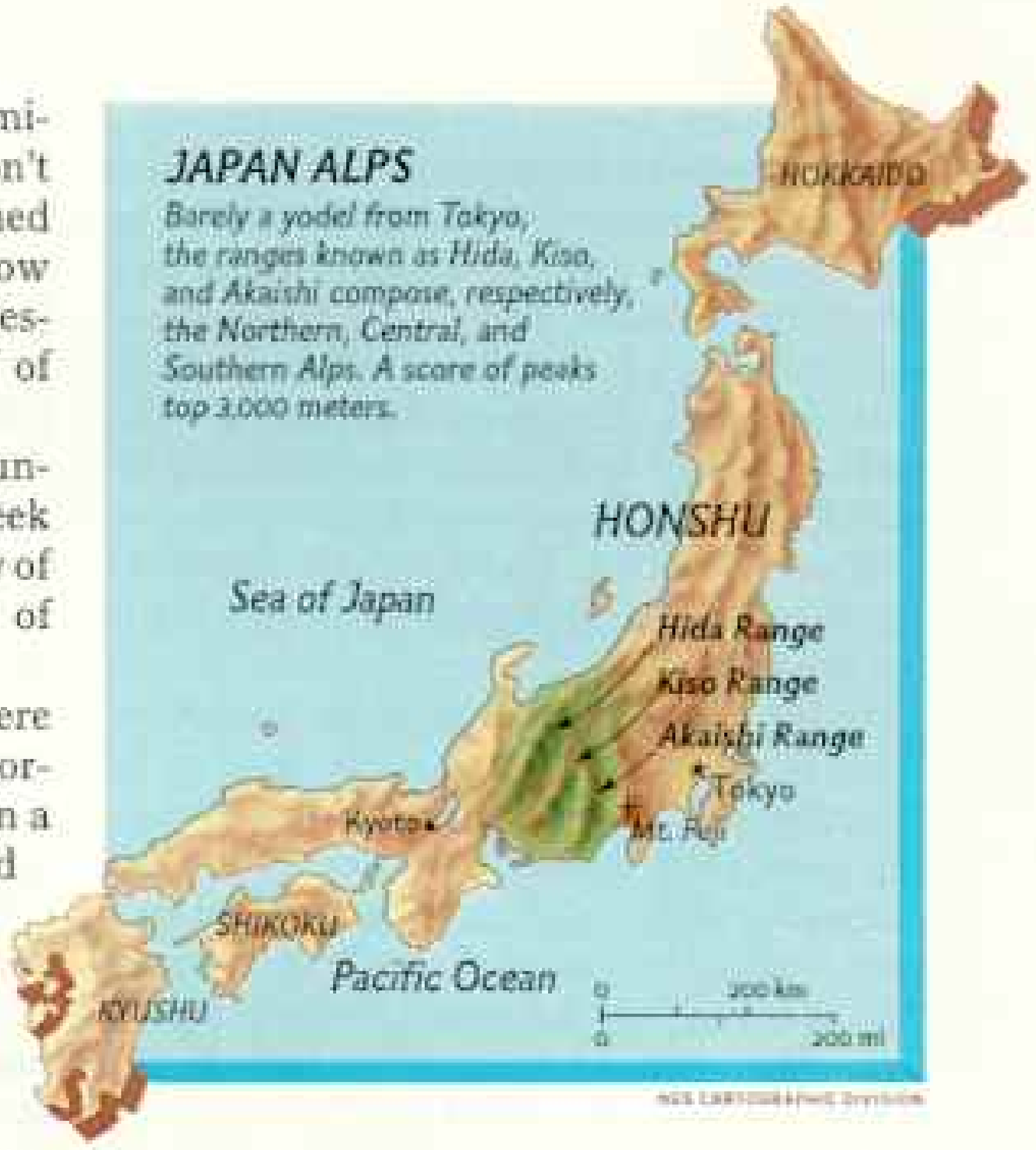
Abruptly, the bright quiet atmosphere changed. Having peeled our luncheon oranges in brilliant sunlight, we ate them in a driving hailstorm. Though we were seated no more than 20 feet apart, I could barely make out the bright yellow of a companion's parka. The temperature dropped 25 degrees Fahrenheit in half that many minutes.

Then, through the soles of our boots, we felt a little tremor in the mountain—just a shiver that came and went. It seemed wise to depart. Enclosed in a cocoon of thick white cloud and enveloped in a curiously muffled silence, we started down the volcano, hailstones pounding on the hoods of our waterproof parkas. The volcano had paid us—or maybe just Nancy—the great compliment of rumbling while we were climbing it.

Asama continued to emit smoke and steam for weeks afterward: We often saw the whitish exclamation point of its plume on the horizon as we climbed other mountains. But this incident, unlike the disastrous one of 1783 that killed some 1,200 villagers, did no damage.

Traditionally, guides in the Japan Alps backpacked equipment and supplies for Japanese climbers of the old aristocratic school who would not carry their own rucksacks. Our Japanese guides collapsed in embarrassed laughter when we alighted from the train in Hakuba, a mountain village below Happo-one, a popular ski resort in the Northern Alps. The cause of the merriment: our 21 pieces of luggage, consisting mostly of George Mobley's photographic equipment.

"It will be very difficult," cautioned the senior guide, 75-year-old Masayuu Ota, "for Noguchi-san and me to carry *everything* you have brought with you on our backs up the more difficult mountains." We assured



him that we'd be carrying our own packs.

In Ota-san's youth, when jobs were scarce and an ordinary worker earned one yen a day, guides earned a daily wage of 2.80 yen (at that time, $1.40). Bearing enormous loads (Sadao Ohtani of Hakuba once carried a log the size of a telephone pole to the summit of Mount Shirouma, and, like most old-time guides, frequently brought back the broken corpses of fallen climbers lashed to a pack frame), they climbed in straw sandals in summer and straw boots in winter, wearing a straw cape to keep off the rain.

These pioneer guides learned by doing. "Fifty years ago our understanding of first aid was not very good," said 82-year-old Sadao Ohtani. "Some guides rescued a man who had frozen. They built a fire and held him over it to revive him. It didn't work."

Today a qualified guide earns a hundred dollars a day, but few young men are attracted to such an arduous life. Money is far easier to come by in Hakuba, transformed from an impoverished upland hamlet to a fashionable mountain resort by another import from the original Alps—the ski.

SKIING WAS INTRODUCED to Japan in 1911 when the imperial general staff called on the Austrian Army for help in training ski troops. Vienna dispatched an officer who was also an expert skier,

Theodor von Lerch. He brought his own skis, equipped with modern bindings, and within four weeks the imperial armory in Tokyo—whose engineers and workers had never before seen skis or bindings—produced 30 perfect copies for officers of the 58th Infantry Regiment stationed at Takada, who had been selected as Japan's first skiers. The bindings were so cunningly reproduced, in fact, that it is said that von Lerch could not distinguish the copies from the originals.

Sadao Ohtani, commanded by a client to learn to ski, was the first guide to do so in Hakuba. He learned without lessons, wearing straw boots and a padded kimono. "Because I fell down so often, I was very wet and cold, but there was no choice," he told me. "Also, I was very unpopular with the parents of Hakuba; all the children came out to watch me, and all wanted skis."

This desire has now achieved epidemic proportions, and Hakuba, where marginal farmland has been transformed into ski slopes and ancestral houses into hotels and restaurants, is well able to satisfy it. It is not known precisely how many skiers visit Hakuba in a typical season, but between New Year's Day and February 12 this year, 350,000 tickets were sold on the cable car that runs between the village and the ridge of Happo-one.

THIS PROSPERITY BEGAN just after World War II, and in Nodaira, a village of 20 families tucked into the cedars and firs above Hakuba, I was startled to have the village patriarch, Toyomi Yamagishi, 76, thank me—as a representative of the American people—for making it all possible.

"For 700 years," Yamagishi told me, "we carried everything into this village on our backs. We worked in the fields from sunrise to sunset in summer and made charcoal in winter for wages of 60 sen [15 cents] a day. We ate rice, soybeans, and pickles, and perhaps once a month a salted fish. But in losing the war, we won a new life. Our grandchildren eat American food and are tall and carefree, like Americans."

Mr. Yamagishi's 75-year-old wife, Mitsui, a tiny woman with apple cheeks and a radiant smile, served a feast: tangerines, sweets, cakes, homemade pickles, three kinds of tea. "It was a bitter thing to be defeated," said Mr. Yamagishi. "But if Japan had won the war, the militarists would not have given us democracy and farm machinery and proper food and a road into the village. Thank you!"

Still, some folk, such as our pensive guide, Masayuu Ota, fear that the spirit of mountaineering, with its close bonds of friendship based on shared hardship and triumph, may be fading away. "Today's skiers, with their fine modern equipment, seem to suffer more injuries than the farmers of Hakuba did years ago using primitive skis and rope bindings," Ota-san mused. "We call it the bad luck of the city people."

Certainly the mountaineering spirit is in evidence on the mountains. Sometimes, at a place where a wayfarer has been moved by the splendor of the scenery, one will find a homely little shrine—a cone of rocks with a flower or a gift of chocolate or cigarettes laid beside it.

On almost every high summit, pilgrims have built a shrine. Here, it is traditional to leave a five-yen coin, called a goen, a word that also means "bond" or "close relationship" and implies that he who leaves the offering will remember the place and be remembered by it—and, with luck, return.

At the summit of Tateyama's Oyama peak, on a shaft of rock not much larger at the tip than a dining-room table, stands a famous shrine. Thousands of small flat stones form the pavement of its tiny courtyard; on each pebble, a pilgrim has written, with ink and brush, his name and the date on which he visited the summit. Orange robes ruffled by the alpine wind, the priest, Norimaro Saeki, chanted his prayers to the beating of a drum and afterward poured sake.

After Tateyama, we proposed to climb Hotaka and Yari, second and fourth highest summits in the Alps. First we tackled Yari, the "spear," so called for its sharp stone profile. For all but the impetuous young, this is a three-day expedition—a 12-mile hike along sun-dappled forest paths to Yarisawa lodge, followed next day by a steep ten-mile climb to a hut on the shoulder of the mountain. From there we would make the final ascent onto the point of the spear, descending on the third day.

WE STARTED from Kamikochi, mecca of 8,000,000 climbers and other visitors to the Japan Alps National Park each year. This wilderness of some 420,000 acres, only 120 miles from Tokyo, is home to eagles, bears, the red-faced monkey (which, in cool weather, has been known to slip into a simmering mineral spring with human bathers), and a variety of smaller mammals, birds, reptiles, and fish.

As we set out on a brilliant October noontime, crows cawed raucously overhead. Below the trail, in the clear greenish waters of the Azusa River, great speckled trout lazed in deep pools. It was a well-beaten path we followed through forests and over teetering log bridges, and one that afforded fine vistas of the lesser mountains, blushing with autumn color, that ring Kamikochi.

"*Konnichi-wa!* Good day!" cried a steady stream of Japanese hikers. "In summer," joked Masayuki Itonaga, our guide for this climb, "the greatest hazard in the Japan Alps is not broken bones but a sore throat, from returning the greetings of strangers. We Japanese are *very* polite."

The next day broken bones seemed more likely than sore throats as we labored upward through the great field of jumbled boulders that form the flank of Yari. At 9,000 feet or so, the temperature had dropped to a point just above freezing, and we began to encounter patches of snow. But lurching from stone to stone under 50-pound rucksacks, we needed no sweaters and jackets; we were soaked with sweat.

Just after noon, at the end of a five-hour trek, we arrived on the ridge. All that remained was the spear itself, a 700-foot rock wall, dusted with early snow, etched against a lowering sky. After a hot lunch George and Itonaga-san and I started up. "Keep left," advised jocular ideograms painted on the rock. Going up was largely a matter of fingers and toes. We were glad of wool sweaters and down jackets again, for the bright sun had vanished and a keen wind blew.

Just below the summit there was a slight overhang, a long step, a dizzying look at several hundred feet of empty space below the toe of a boot jammed into a well-worn slot in the soft rock—and then, the top.

There to greet us, clad in bright red parkas, were four young women, members of the Wandervogel Club of Kyoto's Doshisha University. The girls offered us tea, and

***Aches of the trail** dissolve in a hot spring at Shinhodaka in the Northern Alps. Though cooler water at the pool's edge affords some relief, the preferred condition is "red like a boiled octopus." Further comforts for hikers are offered by inns called ryokan or, for a French connection, pensions. Prices include dinner and a heroic breakfast of, typically, soup with a raw egg, salad, dried fish, cold ham and eggs, pickles, custard, seaweed, tea, and several bowls of rice.*

SERRATED SPINE *leads to Mount Hotaka's major peak, at 3,190 meters (10,466 feet) Japan's third highest. Ridgetop hut in foreground, one of some 250 public and private facilities in the Alps, shelters hikers. Hundreds have died on perilous Hotaka and nearby Mount Yari.*

there was just enough room for the seven of us to crouch around the sputtering blue flame of their camp stove. On every side, peaks brooded in the hazy violet light of the subsiding afternoon.

It began to snow. One of the girls, Ryoko Kawaguchi, caught a snowflake on the back of her mitten and, thinking herself unobserved, laid it gently on a rock before the warmth of her skin could melt it. Who but a Japanese, I wondered, would be so aware of the small and the impermanent, while surrounded by such grandeur, as to save the life of a snowflake?

NEXT DAY, after a 14-hour hike back to Kamikochi, we were grateful to sink into a steaming hot mineral spring—one of the signal pleasures of a sojourn in the Japan Alps.

Below Kamikochi, at Kaminoyu, the "bath of the god," the coolest spring emerges from the earth at 118°F, the hottest at 172°F. "The best time to bathe—though it is too taxing to do it every month—is the night of the full moon, especially when fireflies are numerous," said Seikaku Ohmori, keeper of the springs at Kaminoyu. "The full moon is the symbol of perfection, and it is very moody and good for romance."

Mr. Ohmori, long hair flowing from under a wide-brimmed hat, is himself something of a figure of romance. Twenty-eight years before, he had followed his teacher of judo and kendo to this place, moving into a simple hut carved out of the rock. When the teacher died, the disciple remained, practicing rigorous religious disciplines, living in exalted poverty on the few yen that bathers leave for him in a discreet collection plate.

As Mr. Ohmori recited the history of his life, a young woman sank modestly into a steaming spring behind a screen of trees. His eyes wandered. "They call me *gyoja* [hermit]," said Ohmori-san. "Still, I enjoy

Stairstep to heaven, *Tateyama's Oyama summit bears a shrine, where the prayers of Shinto priest Norimaro Saeki are spoken. Elsewhere, small personal shrines receive humble offerings, such as cigarettes, to mark vistas that move the hiker's spirit.*

watching beautiful girls with smooth skin!"

A few days afterward, on the summit of Oku-hotaka (10,466 feet), highest of Hotaka's five peaks, an eagle greeted us, soaring on translucent wings against a sky as blue as pottery. While clambering up the rocks glistening with patches of treacherous black ice that guard the summit, it had seemed to me that Hotaka was in some indefinable way a "happier" mountain than Yari.

Perhaps this was because Yari had recently taken a life. On the day after our climb a young physician had slipped on a scrim of new-fallen snow, near that overhang below the summit, and plunged to his death.

On Hotaka I encountered the Reverend Hideo Nakamura, a Christian clergyman from Kobe, who had climbed the mountain in order to offer prayers for a young woman who had been carried away by an avalanche the year before.

Like many climbers in the Japan Alps, Mr. Nakamura carried an umbrella lashed to his pack. "I have two umbrellas—a black one for town, this bright yellow one for the mountains," he explained. "If it rains, the yellow umbrella keeps me dry. If I have an accident, it is a distress signal. And if I meet a bear, I can open it and close it very rapidly and frighten the animal away."

TO COMPLETE our expedition, we were determined to climb the highest peak in the Alps—Kita-dake. The Japanese suffixes "dake" and "take" are applied to the noblest and highest peaks, while the more familiar "yama" may refer to a revered mountain, such as Tateyama, or to any ordinary one. Many obstacles lay in our way. Typhoons had caused severe damage in the Southern Alps. The road that led to the base of Mount Shirane was closed, cut in many places by timber falls, landslides, swept-away bridges.

Few climbers had attempted the summit recently. The mountain huts were closed. By now it was late October, and heavy snows might descend at any time. Our Japanese advisers told us that a climb was "very difficult"—meaning, in the Japanese lexicon of polite phrases, that it was impractical, unnecessary, and unwise.

Finally we compromised: If no one would climb the mountain with us, we would fly to the highest pass in a helicopter and climb from there.

In this embarrassingly unsporting way, we arrived at the pass on a bright but gusty noontime. To the south, only 35 miles away, Fuji in its wimple of snow floated majestically among billowy clouds. Above us hung the crags of Kita-dake, a wild landscape of broken black rock. We pitched a tent, boiled some tea, and then set out for the summit.

The light would last just long enough, we thought, to see us to the top and down again.

The trail was well marked, but as we climbed, the cloud grew thicker and we wandered off the track from time to time. At the summit, beside a wooden sign that gave the altitude as 3,192.4 meters (10,474 feet), we could see no farther than 15 feet.

Within that tiny compass, however, Kita-dake revealed wonders. From within the cloud bank the mountain lark, *hibari*, sang

a few twittering notes, then flew out of the gauzy whiteness. At our backs the sun was descending, and its powerful horizontal rays penetrated the clouds.

In a dazzling trick of the light, our forms—lifelike images—were projected onto the cloud. Perfectly circular rings of color formed around our figures. This astonishing sight lasted only moments, fading and intensifying as the light changed, while we waved to ourselves in this ghostly "photograph" trembling on thin air.

Before dawn next morning the mountain lark chirped again outside our tent, but we needed no wake-up call. We hadn't slept much—like an angry wife, the night wind had sighed and tossed for hours, rustling the canvas. When we stuck our heads outside, fatigue vanished. A glorious sunrise was just commencing. A line of molten gold stretched across the purple fabric of the night, slowly intensifying to reveal Fuji once again in all its brilliant symmetry and color.

All through that day, ever changeful Fuji was our companion as we climbed Aino-dake (10,463 feet), Shirane's other major peak. Among patches of snow and ice we saw the shriveled vestiges—yellow, white, violet—of alpine flowers that clothe the summit of this mountain in early summer—gentian, a *(Continued on page 256)*

Legendary snows *make futile a woman's walk-clearing labor at a shop in Omachi near the Northern Alps. Winter brings frigid Siberian air south over the Sea of Japan, where it soaks up moisture that drops as heavy snow on Honshu's north-central coast. Not far from Omachi, Japan's record snow accumulation occurred in February 1927—8.18 meters (27 feet).*

"***I have found a grandeur*** *. . . seldom associated with the typical Japanese landscape," wrote the former British chaplain of Kobe, the Reverend Walter Weston, of the Alps in 1896. In his footsteps followed the first Japanese alpinists. Many were university students who learned to climb literally by the book—the German book, since most texts in that era, including those on mountaineering, were in German. In Hakuba* ***(left)****, one gateway to the Northern Alps and Japan Alps National Park, Teutonic tradition lives*

on as Bavarian Schuhplattler *dance music wafts through an assiduously Europeanized atmosphere.*

To Hakuba in winter ***(left)*** *throngs another well-adapted and prolific breed, ski-toting Japanese snowbirds. More than 70 years after an Austrian Army officer introduced the sport to Japan, the nation counts some ten million skiers. Discos rock nearby Tsugaike* ***(above)****, ne plus ultra of the après-ski scene.*

On one popular slope the author watched in awe as a chair lift delivered skiers, "each with brand-new skis, ski poles, boots, jacket, sweater, hat, and goggles—$2,000 packages going up the mountain two by two, in absolutely endless supply."

Poised to leap, *a Japanese contestant prepares to attack a giant slalom course near Hakuba during an international meet called Descentecup '84* ***(left above)****. The sponsoring company may sound French but is as Japanese as an onlooker whose jacket bears its name* ***(above)****. Weekend skiers endure ten-hour round-trip train rides from Tokyo to crowd Hakuba's slopes* ***(left)****.*

After breaking the Winter Olympics ice in 1928, the Japanese had to wait until 1956 for their first medal, a silver won by skier Chiharu Igaya, trained at Dartmouth College and in Europe. Japan gained immense stature by hosting the 1972 Winter Olympics, and in 1973 the Alpine Ski World Cup competition was held here for the first time.

SCULPTED BY DRIFTS *that earn income from skiers, a Shinto shrine called Togakushi, not far from Hakuba, welcomes local farmers, whose grain is also economically important.*

(Continued from page 249) Japanese type of edelweiss called *hahakogusa* ("mother and child"), black lily, mugwort, as well as a variety of five-needle pine, often seen in Japanese painting.

After another windy night, as I watched another brilliant sunrise, a sheet of cloud blew over the mountain, blotting out the horizon. Bad weather, we knew, came from that direction. Over a hurried breakfast we decided we would climb down before the storm, already filled with snow, worsened.

Descending a mountain is in some ways more difficult than climbing it. You see where you're going, not always a psychological advantage. The knees take a good deal of strain, especially if you're carrying a heavy pack, producing a tremulous condition that the Japanese call "laughing knees."

SNOW swirled around us. At first the trail followed Eight-tooth Ridge, through fields of boulders, beneath rock monoliths, over logs cut from limber young trees that bridged chasms hundreds of feet deep, down steep rock walls, along narrow ledges and cracks in the faces of precipices.

The snow changed to rain. Stopping by a brook for tea and chocolate, we saw that two interesting things were happening: First, the stream, fed by the rain and snow above it, was swelling very rapidly; second, it was freezing as it ran over the rocks.

A few yards farther on, one of the Japanese members of our party, interpreter Akio Saneyoshi, took a long sliding fall on a patch of ice-coated rock, twisting his ankle and striking his head. He wasn't seriously injured, and he was young and stoic, but we had a long way to go. Even after we reached the bottom, we would still be 25 miles from the nearest town.

Following the freezing brook, we came to a larger streambed. It, too, was filling rapidly, but the trail—designed for use in the dry summer months—went right down it, so we plunged ahead. The rain grew heavier, the streambed became a river, and as we passed below the tree line into a dripping forest, we lost the trail.

George Mobley, the best climber among us, scouted downstream and in a few moments found the way. Soaked but encouraged, we pressed on. It was, at times, an

In total control after launch from

a snow mound, today's sledder could be tomorrow's ski-jump medalist.

Storm veil parts *for a glimpse of Japan's highest and most sacred peak, 3,776-meter (12,388-foot) Mount Fuji, from the nation's second highest, 3,192-meter Kita-dake in the Southern Alps. Seconds later a snow-laced fog whipped in with a vengeance, hurrying the author's party on a hazard-filled, 12-hour descent—price of admission to the "roof of Japan."*

adventurous process, as we danced from rock to icy rock above the chorusing waters of the rushing stream.

At last, after 12 hours, we reached the bottom. Here we faced one more obstacle—a larger river, spanned by a ruined footbridge. During the typhoons a flood had folded the near end of the bridge over onto itself like a bent playing card.

Happily, a tree had washed up against the bridge, which dangled some 40 feet above

the stream. George shinnied up its trunk and hauled up our packs on a length of rope.

Our injured friend was supposed to go next, but when I turned around, I saw that he had other plans. With zestful fatalism, wearing his pack, Saneyoshi-san plunged into the raging river and splashed across.

I scrambled up the fallen tree onto the bridge, and George and I ran to meet Saneyoshi-san, who pulled himself onto the riverbank—high, but far from dry. He was limping painfully. His face was windburned, he was tired to the bone, trembling with cold, and soaked to the skin.

"Gambare!" he cried. "Show your spirit!"

We gazed upward at the summit of Kitadake under its gleaming crown of storm clouds and new-fallen snow.

"Shall we go back up?" I asked.

The spirit was willing, but the body demurred. We decided to leave a goen instead, in remembrance, and in hope of return. □

The Preposterous

By NOEL D. VIETMEYER Photographs

Puffer

To console the souls of puffers, Shinto priests in Shimonoseki, Japan, offer prayers to fugu, as the fish are known. Delicious, ugly, and deadly poisonous puffers can be—literally—the ultimate edible.

by JOSEPH J. SCHERSCHEL ASSISTANT DIRECTOR OF PHOTOGRAPHY

PAUL CHESLEY

"THE BOOT, with its tiny steel tongue, flashed out. Bond felt a sharp pain in his right calf. . . . Numbness was creeping up Bond's body. . . . Breathing became difficult. . . . Bond pivoted slowly on his heel and crashed headlong to the wine-red floor."

So ends Ian Fleming's spy novel *From Russia, With Love*. James Bond's fate is left hanging. Agent 007, of course, survives to brave new dangers in *Doctor No*, in which it is revealed that he had been dealt a near-fatal dose of *fugu* poison. "It comes from the sex organs of the Japanese globefish," a neurologist tells Bond's boss. "It's terrible stuff and very quick."

Ian Fleming's evil globefish—also known as puffer, blowfish, swellfish, or, in Japanese, fugu—is one of the most mysterious creatures of the sea. It is perhaps the world's most deadly fish, yet in Japan the honorable fugu is the epitome of gourmet dining.

About 100 species of puffers in several closely related families can be found throughout the world. Their most obvious characteristic is their ability to balloon out from a reasonable fish shape into a sphere two or three times larger. When frightened, excited, or annoyed, they gulp water, or even air, into a sac on the belly. It swells inside their tough, elastic skin, like an inner tube inside a tire, so as to discourage predators or intimidate rivals. When the fish feels safe, it squirts out the water or releases the air, deflating to its normal shape.

In Japan, eating fugu has been the gastronomic version of Russian roulette for centuries. Sometimes a diner still loses the gamble. His chopsticks clatter to the table from nerveless fingers; he pales; his breathing labors. It is often the subject of traditional *senryu* verse.

Last night he and I ate fugu;
Today, I help carry his coffin.

"It's a terrible death," a Japanese restaurant owner told me. "Even though you can think very clearly, your arms and legs become numb. It becomes impossible to sit up. You can think but cannot speak, cannot move, and soon cannot breathe."

Why the Japanese, who venerate hygiene, should make a ritual of eating deadly poisonous fish is difficult for foreigners to comprehend. Fugu ovaries, intestines, and liver can be so deadly that if even a tiny touch of them is left in the flesh, the gourmet dies, often within minutes. About 60 percent of puffer poisonings prove fatal. And as the haiku poet Buson observed, for some that is the enticement. . . .

I cannot see her tonight.
I have to give her up
So I will eat fugu.

Those who dare the risks of dining on the puffer prize above all the raw flesh of the tiger fugu. It is customarily sliced

very thin and arranged in exquisite patterns of flowers or birds. For this the Japanese will pay as much as $200 for a plate that serves four.

When eating fugu, the diner puts his life in the hands of the chef. Before practicing their risky art, all fugu cooks must be licensed and must take intensive courses, extensive apprenticeship, and written exams.

Despite this, the fatalities continue. A celebrated death occurred in January 1975: The revered Mitsugoro Bando VIII—one of Japan's most gifted Kabuki actors, who had been officially designated by the Japanese government as a "living national treasure"—died of paralysis and convulsions several hours after eating fugu liver in a Kyoto restaurant.

To eat fugu liver is the height of exotica. It is one of the most poisonous parts of the fish, and techniques for detoxifying it are not dependable. Chefs are prohibited from serving fugu liver, but they sometimes relent under the impassioned pleas of gourmets. Mitsugoro Bando had four servings and paid the ultimate price.

TAMOTSU Kitagawa, owner of a restaurant in the city of Shimonoseki, is a sprightly man of middle age. There is gusto in his voice and a sparkle in his eye as, through an interpreter, he tells me fugu stories. He loves to talk about the fish, and his restaurant is hung with calligraphy, cartoons, lamps, and small kites all relating to fugu.

In a tank at the entrance of the restaurant a large puffer swims lazily with sole, sea bream, octopus, and other delicacies destined for the table. Mr. Kitagawa catches it with a long-handled net and carries it, dripping, to the kitchen. There are 30 steps prescribed by law for preparing fugu, and even veterans take 20 minutes to accomplish them. With swift strokes of a fearsome *hocho*, a thin-bladed knife, Mr. Kitagawa removes the fins, slices off the mouth and nose, and extracts the entrails. He carefully removes the poisonous parts—intestines, liver, ovaries, kidneys, skin, and eyes—and begins carving out pieces of flesh. These he places under running water to wash away blood and toxins. Finally only fillets of glistening white meat remain. With infinite care Mr. Kitagawa slices the fillets into tiny diamond-shaped pieces. An average-size fugu can yield more than a hundred of these pieces, each almost as thin as paper.

Mr. Kitagawa deftly arranges the wafer-thin flesh on a plate. Each little piece becomes a feather. The result depicts a crane flying with its neck outstretched and its wings spread wide. The tail is made of tiny, splayed-out slivers of dark skin; the eye is a dot of hot pepper. On the side is a butterfly with wings of fugu fins and body of fugu

***The inflatable** Red Sea porcupine fish, a type of puffer, swells to soccerball size when frightened **(left)**. Pectoral muscles that act as bellows and lack of ribs enable these oddballs to suck up water or air and treble their size. They can inflate and lodge in the throats of predators, perhaps starving them. There are some 100 species of puffers, including the delectable tiger fugu **(right)** being prepared for shipment by a woman in Shimonoseki, Japan's chief fugu fishing port. Fugu fins, drying behind her, are grilled and dipped in sake.*

DAVID DOUBILET (LEFT); PAUL CHESLEY

Japanese roulette: *An exquisite wheel of whisper-thin slices of tiger fugu comes to table* ***(right)*** *after being carefully rid of puffer toxin—275 times deadlier than cyanide and concentrated in the liver, ovaries, and intestines. In the past ten years the toxin has claimed nearly 200 lives in Japan, mostly from fish improperly cleaned at home. In the hands of a licensed master fugu chef, such as Kaneharu Koshima* ***(above)*** *of the Nakashima Inn* ***(top)*** *in Shimonoseki, the risk is slight. Chefs apprentice for at least two years, then—for an exam—clean a fugu, identify its parts, and prepare a plate of sashimi in 20 minutes. One mistake spells failure.*

meat. The effect is enchanting.

The raw fugu is cut so thin that it is transparent. Through it shines the full richness of the brown, blue, and purple geisha design on Mr. Kitagawa's prize serving plate. It is a work of art. The crane is flying over the formal scene of geishas. Cranes signify longevity in Japan, and to Japanese the beautiful and symbolic design makes the food taste better.

I feel guilty at breaking up the "picture" on my plate. But at Mr. Kitagawa's urging I lift off one of the diamond slivers with my chopsticks and dip it in a mixture of soy sauce, radish, and red pepper. Strangely I feel no danger, but with every bite I sense the thrill. The meat has no fiber; it's almost like gelatin. It is very light in taste. More like chicken than fish, there is only the slightest hint that it is a seafood. Truly, as it has been said, the taste of fugu is reminiscent of a Japanese painting: delicate, subtle, and elusive. It is also as smooth as Japanese silk.

Mr. Kitagawa also serves me a soup of fugu chunks boiled briefly with tofu, mushrooms, leeks, and Chinese cabbage. The fugu meat in it again tastes like chicken. It is delicious!

THE PUFFER is one of the most expensive foods in Japan. A single fish can bring $50 to $140. Cut up and served in a restaurant, it can bring $200. Yet fugu is increasingly popular. Each winter for the past two years, for example, has brought 40 million dollars in fugu sales at the small Haedomari Market in Shimonoseki, Japan's "fugu city."

At one o'clock in the morning I visit the Haedomari Market, a large, high-roofed warehouse on the waterfront where 80 percent of Japan's fugu catch is sold. Even at that hour the fishermen have already transferred into warehouse tanks hundreds of live fish caught as far away as Korea.

The hands of the clock overhead pass two. A swirling mass of fish is poured out onto a large green tarpaulin on the floor. Glistening under the lights, tails flip in desperation and fear. A few of the fish inflate. Workers in rubber boots, purple gloves, and bright jackets wade in the sea of puffers. Furiously they throw fugu into blue crates—the black-splotched tiger fugu (*Fugu rubripes*) on one side, the white-striped mackerel fugu (*F. xanthopterus*) on the other. They slide the crates across the concrete floor, now running with water. The auction begins.

Crafted in beauty, *a soaring crane and chrysanthemum blooms were made of fugu by chef Tsutomu Satoh (**right**, at left), for Tokyo's Fukugen Restaurant, owned by Michiyo Kawashima, at right. A complete fugu meal here can cost more than $150 a person.*

*At Shimonoseki's Haedomari Market (**left**) buyers silently bid on crates of fugu by thrusting their hands in the auctioneer's sleeve and communicating by finger pressure. Last year 50 million dollars' worth of fugu was sold in Japan. But the devotee faces an age-old dilemma: "I want to eat fugu. But I don't want to die."*

Auctioneer Hisashi Matsumura stands on a box full of the squirming fish. Buyers clamor round. With an exquisite Japanese sense of propriety the bids are kept secret. A long black sleeve completely covers Mr. Matsumura's hand. The buyers put their hands inside and grasp the auctioneer's fingers in a code that indicates the amount of the bid. Chanting all the while, Mr. Matsumura keeps track of as many as nine or ten

coded handshakes before designating the successful bidder and singing out the price.

At wholesale prices of $20 a pound, Hisashi Matsumura has auctioned each blue box of fish for $1,500 or more, all on a handshake. This morning he sells two tons of puffers—$80,000 worth—in about 40 minutes. From Shimonoseki they will be trucked or flown throughout the country.

Only in Japan does the puffer send a whole nation into philosophical ecstasies (one Tokyo

waters: all that have fins and scales shall ye eat: And whatsoever hath not fins and scales ye may not eat; it is unclean unto you" (Deuteronomy 14: 9-10).

PUFFERS are also found in the Indian Ocean and in the South Pacific. A species familiar along Hawaiian coasts is so toxic that natives reportedly used the fish gall to poison their spears.

Puffers in North American waters can be equally deadly.

Carolinas and occasionally in Maryland or even Massachusetts. The northern puffer is nontoxic and was a popular food fish during World War II. The mild-flavored, meaty back portion was marketed euphemistically as "sea squab," and is still sometimes sold under that name today. In recent years the puffers, once abundant in Chesapeake Bay, have declined in number, and the "sugar toad" is now the prize only of sport fishermen.

Full-grown puffers can be as

High-flying fish, *kites resembling fugu decorate the studio of Hakushu Yasumoto of Shimonoseki* ***(right)****, who has been making them for 26 years. The bamboo-and-paper kites take two hours to build.*

Among other fugu fantasies available in Shimonoseki are lanterns ***(left)*** *made by Haruo Ito. Small puffers are filled with sawdust to retain their shape, dried, fitted with candles, and sold as good-luck charms.*

park has a statue of the fish, and a famous temple near Osaka has a memorial tombstone honoring fugu). But puffers have fascinated other observers around the world for centuries. Depictions of the fish have been identified on tombs of Egypt's V Dynasty, 2700 B.C. Ancient Egyptians apparently used one puffer species as a ball in a primitive game of bowls.

The highly toxic Red Sea porcupine fish may have prompted the biblical injunction: "These ye shall eat of all that are in the

John Steinbeck and Edward F. Ricketts describe in *Sea of Cortez* how they offered to buy a puffer from a boy in Baja California, but the boy refused, "saying that a man had commissioned him to get this fish and he was to receive ten centavos for it because the man wanted to poison a cat." Six species are commonly found in Florida. All are probably toxic; one is violently so. Every year sees several nonfatal puffer poisonings.

Another variety of puffer is caught as far north as the

long as three feet and weigh as much as 30 pounds. Some species are protected by short, overlapping, sharp-pointed spines. A swollen fish feels like a firm balloon full of water and is surprisingly strong. A big man can stand on it and do little harm to the fish. So tough are the skins that they often are dried, fitted with light bulbs, and used for lamps. The lamps pass a soft, even light through the translucent skin.

Puffers have other weird specializations. Their teeth are

fused into hard, pointed structures that look like a parrot's beak and that can often be heard grinding by the lucky fisherman who pulls one in. This strange buck-toothed dentition is powered by massive chewing muscles. Suggesting underwater birds of prey, the fish use their beaks savagely to tear apart crabs, clams, oysters, corals, sea urchins, and starfish. Some also inflate themselves and blow out water to blast aside sand and uncover their food. Although puffers are fun to catch and will take almost any bait, they've been known to bite through wire leaders and rusty hooks. I heard that a few days before I arrived in Tokyo a fugu bit off a chef's finger.

Puffers have beautiful iridescent blue and green eyes that are quite mobile. In some species the eyes are photochromic. Like many eyeglasses, they darken automatically as light intensity increases.

There's no end to the puffers' eccentricities. Below their eyes they have nostrils raised on tiny tentacles. These sense chemicals in the water as our noses detect them in the air.

PUFFERS don't swim like other fish. They have far fewer bones —no ribs or pelvic bones, for example. Their floppy fins lack both spines and the rigidity needed to push against the water. Puffers drift slowly through the oceans, undulating their dorsal and anal fins in a sculling motion that makes them look to me like helicopters of the sea. The two pectoral fins flutter almost constantly, giving unusually delicate control. The tail fin that drives most fish acts mostly as a rudder for the puffer.

With its lazy, almost feeble way of swimming, the puffer fish gives no hint of its deadly nature. Here is no shark knifing through the water, with gleaming jaws agape. But the poison hidden in the puffer's entrails makes it fearsome indeed.

AT the University of Tokyo, Professor Kanehisa Hashimoto and his colleague Dr. Tamao Noguchi show me a small brown vial of the poison, known as tetrodotoxin. Inside is a white powder—less than one-tenth the weight of an aspirin tablet—about the amount found in one medium-size fugu. The scientists explain that it is enough to kill more than 30 persons. They tell me that it has a molecular structure unlike anything previously known to organic chemistry.

For some remarkable reason tetrodotoxin doesn't harm the puffer, but in man its effect is stunning. Capt. James Cook described it in the journal of his second voyage around the world. In 1774 the *Resolution*'s clerk procured a strange fish from the natives of recently discovered New Caledonia. J. Reinhold Forster and his son, George, the naturalists for the expedition, sketched it before it was prepared for dinner.

"Luckily for us," recorded Captain Cook, "the operation of drawing and describing took up so much time . . . that only the liver and roe was dressed of which the two Mr. Forsters and myself did but just taste. About three or four o'clock in the morning we were seized with an extraordinary weakness in all our limbs attended with a numbness or sensation like to that caused by exposing one's hands or feet to a fire after having been pinched much by frost. I had almost lost the sense of feeling nor could I distinguish between light and heavy bodies, a quart pot full of water and a feather was the same in my hand. We each of us took a vomit and after that a sweat which gave great relief. In the morning one of the pigs which had eat the entrails was found dead."

Tetrodotoxin is one of the most poisonous nonprotein substances known, 25 times more powerful than curare. Because of its potency, the toxin is an important tool in modern neurological research. In a dilute form it is also used commercially in Japan as a painkiller for victims of neuralgia, arthritis, and rheumatism.

The puffer toxin blocks nerve impulses, and in sufficient amounts will eventually shut down the victim's entire nervous system. The lethal dose is a mere one milligram, about the amount that could be put on a pinhead. There is no known antidote.

DESPITE the danger, demand for puffers is increasing so fast that the Japanese fishing grounds are being depleted. Today the Japanese are successfully culturing the fish.

Every year from October through March, millions of diners bet their lives on not getting fatally poisoned. Thanks to strict regulation of restaurants and wholesalers, the number that lose decreases each year. But this droll and preposterous fish with the goggling eyes, swollen belly, and floppy fins remains the world's most deadly feast. The enigma of the fugu is summed up in the traditional verse:

Those who eat fugu soup are stupid.
But those who don't eat fugu soup are also stupid. □

(Continued from page 137) by the National Geographic Society.

Was Andres frightened when he plunged in up to his thigh? "*Si*—I knew I was in the tomb. I just hoped I hadn't hurt anything."

He hadn't. The team had entered the tomb exactly at the exit sealed by the Maya 1,500 years ago. From the time of the fall of Rome the tomb had lain undisturbed. Even food and drink left for the deceased remained—now only powdery residue in ceramic pots and plates.

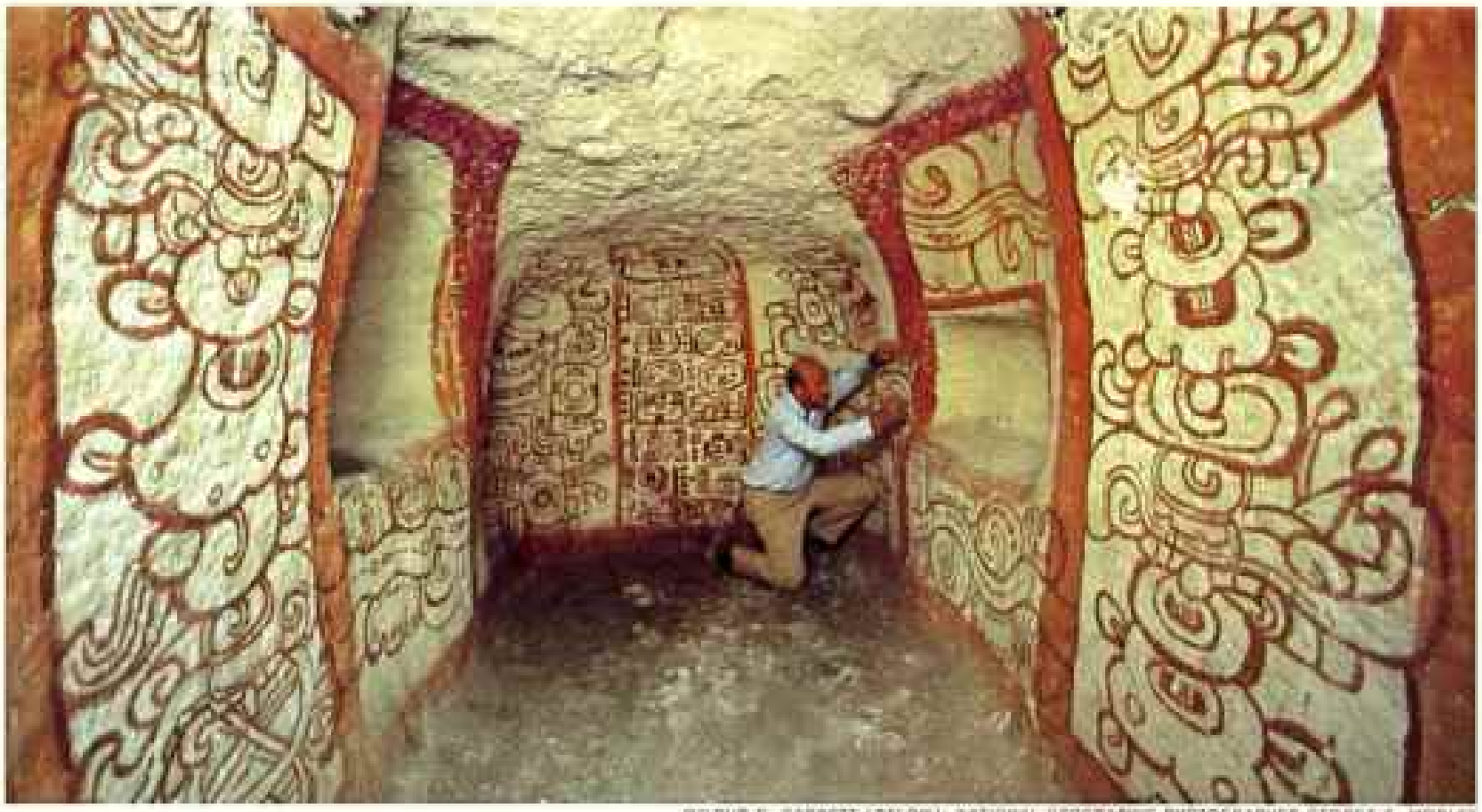
UNIQUE FIND, THIS CERAMIC POT WITH A STIRRUP HANDLE HAS A TWIST-OFF TOP SIMILAR TO A CHILD-PROOF MEDICINE LID. PROBABLY THE MOST VALUABLE TOMB DISCOVERY, THE POT IS PAINTED WITH GLYPHS THAT, WHEN TRANSLATED, MAY PROVIDE DYNASTIC INFORMATION ON THE TOMB'S OCCUPANT AND FIFTH-CENTURY MAYA RULERS.

For reasons still unknown, the site and the Maya culture had faded away by the tenth century. Under cover of the jungle the city—now known as Río Azul—lay for a thousand years as a vast mausoleum protecting the artifacts of the once bustling society. Palaces, homes, and pyramids of the Early Classic period (A.D. 250-600) ever so slowly slumped into piles of rubble under the relentless wash of tropical rains and the insidious pushing and shoving of tree roots. As the green canopy grew over fields, canals, and plazas, only the occasional Indian chicle collector, armed with nothing more devastating than his machete, disturbed the tangle of vines and brambles.

In 1962 worker Trinidad Pech reported the mounds to Sun Oil geologist John Gatling. Richard Adams, then a student doing fieldwork in Guatemala, was invited to survey the site. A joint Adams-Gatling paper two years later put the discovery into the literature but left it undisturbed.

Then in 1979 the territorial bickering of parrots and the screams of tree frogs were punctuated by the pounding of pickaxes, the scraping of shovels, and the snarl of chain saws. Looters in force attacked the site in search of tomb treasures. With a skill and tenacity begrudgingly admired by all who have seen their predations, they slashed at the temples as if with meat axes cleaving a beef. More than 125 man-wide trenches were cut to the core of the temples so the looters could gut the tombs. Twenty-eight

***Brilliant paintings** of deities and motifs of Maya royalty adorn Río Azul tombs. The newly discovered chamber (**left**) still holds pottery, jade jewelry, and a male skeleton stained by its decayed funerary shroud. Dr. Adams salvages information from a nearby crypt (**below**), emptied earlier by looters.*



WILBUR E. GARRETT (BELOW); NATIONAL GEOGRAPHIC PHOTOGRAPHER GEORGE F. MOBLEY

tombs and crypts were emptied in 1979-80, with historical and archaeological data tossed to the rubble piles. Millions of dollars' worth of Maya art began to surface in world markets, with the value-enhancing cachet of being from Río Azul—wherever that was.

Harvard Mayanist Ian Graham appeared there in 1981 in search of undisturbed Maya art. His report of the devastation led to the arrival of Rafael Morales, head of the Guatemala Institute of Anthropology and History's Department of Prehispanic Monuments. In a blazing gun battle Treasury Guards drove away the looters, who in their haste left behind clothes, supplies, and even some of the loot. Government guards have since kept watch over the site.

In 1983 Dr. Adams, now professor of anthropology of the University of Texas at San Antonio, began his scientific study of the Río Azul site. A year later, as the TV camera probed the tomb, his team of graduate students, Guatemalan archaeologists, workers, friends, and family hugged, kissed, and even shed a tear or two.

Here was one tomb that would not fall prey to looters. It will forever be a part of Guatemalan and Maya history. Knowledge

gained from it will be important in understanding the vanished culture. The artifacts will be displayed for all and not become the trinkets and trade items of art collectors.

Propitiously, less than a week after the discovery, U. S. Secretary of State George P. Shultz and Foreign Minister Fernando Andrade of Guatemala (above) signed a treaty to prevent stolen Guatemalan cultural artifacts from entering the United States.

When Dr. Adams has analyzed the discovery, we'll bring you his report on Río Azul—one of the greatest New World archaeological finds in recent years.

Wilbur E. Garrett

EDITOR

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Geography has been losing ground in our schools

A MAJOR RIFT in U. S. geography opened in 1904 with this Society's decision to popularize a field of study then just emerging as an academic discipline apart from geology. Harvard professor William Morris Davis took violent objection to the Society's change of course, resigned his seat on our board, and soon joined in founding the Association of American Geographers (AAG), which remains the preeminent U. S. organization for scholarly geographers.

Recently I had the pleasure of addressing the AAG in convention. Any disputes between the Society and the AAG have long since dissolved, but I remarked, "In my opinion the lack of communication, joint research, and utilization of resources by our organizations has unwittingly contributed to the decline of geography in U. S. schools."

I reviewed the *usefulness* of geography at the end of the 19th century. North America was a developing continent flush with finding and mapping its basic resources. Geography had a strong civic purpose, and civics had strong geographical content. The classroom map was a call to adventure, real or imagined, and the call was answered.

But geography has been losing ground, particularly in our primary and secondary schools. Its future as an independent and useful area of study awaits a new sense of mission. Geographers must help students understand the wholeness of the world, as they once helped us understand the wholeness of the nation and continent.

If men and women of reason are to cope in an age when the post-industrial minority grapples with the needs of the pre-industrial majority, vital geography must be revived.

Although it seems to be a diffuse science, geography has a tradition of bringing specialists together—geologists, biologists, soil chemists, meteorologists, oceanographers, demographers, and more—to cope with problems no single science can.

What can the Society do to advance the discipline from the deepest taproots of graduate study to the youngest leaves of elementary education?

For decades our Committee for Research and Exploration has supported proposals on a case-by-case basis. Many grants so given have led to research work of major consequence. That the research budget is now some 3.5 million dollars yearly is a testimony to the loyalty of our membership, whose dues are the ultimate source of funding.

Now new priorities have evolved, competing for our funding. The provocative list includes such areas as mutual interaction of biosphere and atmosphere; the planet's water resources; soil fertility and management; renewable energy resources; loss of biological diversity and the apparent extinction of genetic stocks on a global scale.

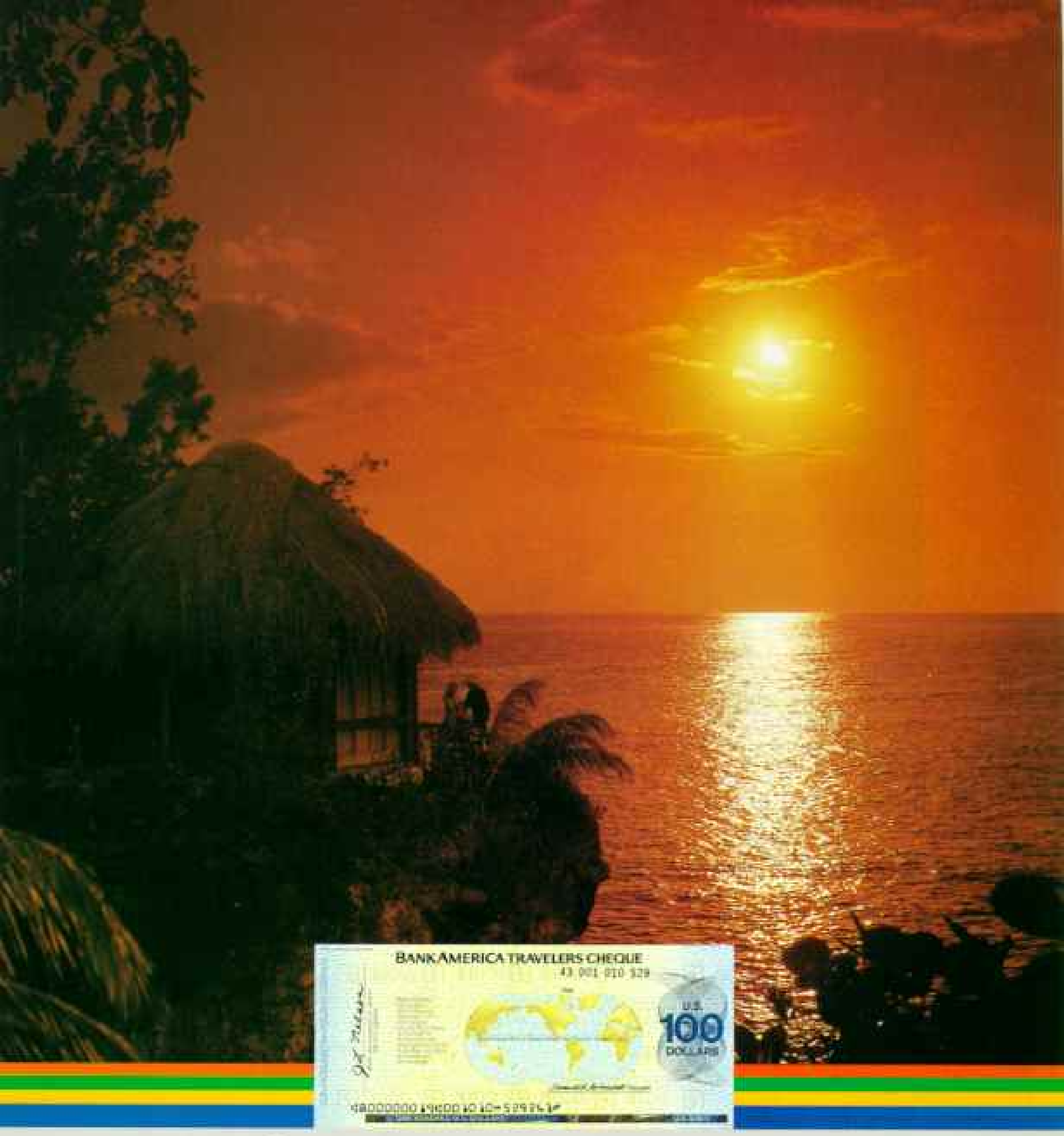
We intend to disseminate the results of such studies more effectively through a new refereed scientific journal, *National Geographic Research*. And we intend to increase contacts between the Society and visiting scholars, already successfully begun by our intern program for undergraduate and graduate students.

And as opportunities warrant, we intend to do more at levels from the elementary classroom on up—perhaps through satellite-transmission technology, curriculum development, and innovative study materials.

None of this will come easily or overnight, but I closed my remarks to the AAG with this thought: "You have the professional skills—the engine; the National Geographic Society has the delivery system. I am confident that American schools and the general public would embrace a modern, state-of-the-art resurrection of the geographer as a vital participant on global problem-solving teams of the 21st century."

Gilbert M. Grosvenor

PRESIDENT, NATIONAL GEOGRAPHIC SOCIETY



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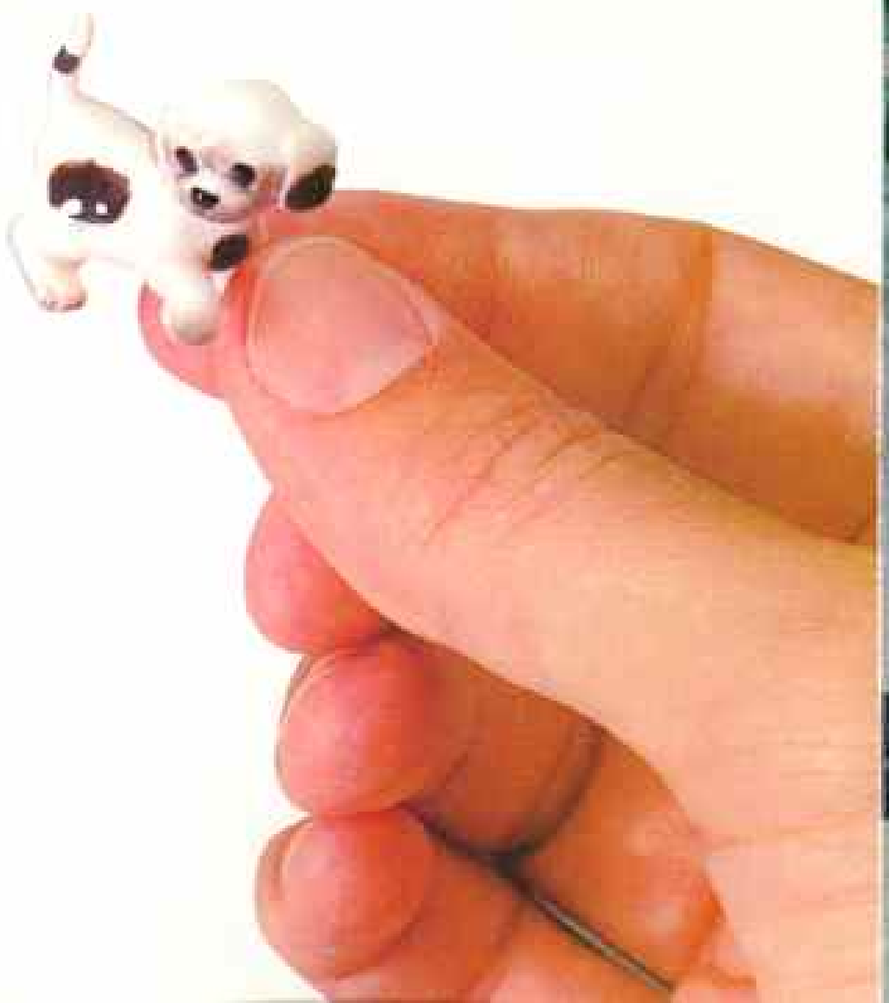

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Members Forum

Vesuvius

As a sixth grader fervently studying ancient Egypt in summer school, I decided that I would become an archaeologist. Frequent trips to the museums of New York City with my parents convinced me, however, that I had been born too late and all had been discovered. I'm 28 now, a nurse in a busy emergency room, and about the only bones I see are broken ones. I wish to thank you for opening my heart once again to the joys of discovery with your wonderful and moving article on the lost cities of Pompeii and Herculaneum.

Mary Caldwell
Milton, Massachusetts

I was enthralled by your May article. The author states "Very few other Roman skeletons have survived; the Romans cremated their dead." Later he recalls the cemetery at Pompeii "just outside the city walls." Was burial reserved for patricians, or is this an Etruscan cemetery?

David Garrett
St. Louis, Missouri

It was common in Roman times to build a necropolis honoring the dead along a major avenue outside the city walls. In Pompeii, monuments in various degrees of elaboration contained the cremated remains. However, some of Pompeii's tombs date to the pre-Roman Samnite occupation, when actual burial was preferred.

The Vesuvius article included pictures of the city of Ercolano lying above Herculaneum, and references to the fertile volcanic soil. As a greenhouse operator, I noticed acres of greenhouse frames next to the excavation site. As Italy boasts the second largest area of protected crops in the world, I would be quite interested to know what crops are cultivated in these "trellised fields."

Ron Marchuk
Olds, Alberta

These plots produce three or more crops a year. Vegetables such as cauliflower, eggplant, and tomatoes are rotated with flowers grown both for the cut market and seed production.

Plain People

As an Amish Mennonite, I would like to compliment you on your recent article on the Plain People of Pennsylvania (April 1984). Articles that recognize and accurately describe the diversity

among the Plain People are rare. Yours was outstanding. Thank you.

Dorcas Yoder
Grove City, Minnesota

The implement on page 505 is a cultivator, not a harrow. A cultivator is used between rows of plants, but a harrow is used to prepare a plowed field for planting.

Louise Streiff
Portland, Oregon

You and several other sharp-eyed readers have caught an error that farm-reared staff members embarrassingly missed.

As a Mennonite minister, I want to commend Jerry Irwin for his excellent presentation. So many articles magnify the oddities of the Mennonites, overlooking the fact that they are a warmhearted, hardworking, outgoing, close-knit, conscientious people.

Mahlon M. Horst
Stanley, Virginia

I read about the Amish girl pressing the dress she made. It states that the light she is using was a butane lantern. I would say it is a gasoline lamp made by Coleman.

Dwight Coop
Bloomfield, Iowa

The light she is using descends from Coleman lamps, which go back as far as 1903. Hers is called a Leacock lamp, designed by Levi Esh of Lancaster County and made in Ronks, Pennsylvania. It burns either kerosene or gasoline-like naphtha.

Narwhal Hunters

We strongly object to the article "Narwhal Hunters" in April 1984. It is ridiculous and wrong to feature an ignorant and backward people who slaughter our rapidly diminishing wildlife. It is no longer acceptable to attack nature for some macho, egomaniacal motives and call it survival.

M. Lutter
Torrance, California

The Eskimo way of life has existed for centuries in a harsh environment where, even today, jobs and grocery stores are rare. Neither macho nor egomaniacal, these men hunt primarily for food.

Blue Heron

The Portland, Oregon, area is fortunate in having several great blue heron (April 1984) rookeries along its many waterways. One night I spied a great blue standing alongside a lamp at the edge of our mooring dock. The bird went into that stiff crouch, shot out the cocked neck, and drew back with a small fish presumably lured by the wash of light. Entranced, I watched as the process was repeated, and then the bird proceeded with that very deliberate heron gait to the next lamp down the line! For perhaps half an hour it moved to the end of the dock and back, pausing at each fixture, where it caught several fish.

William C. Crayne
Hillsboro, Oregon

Far West Map

I have always had a high regard for your maps, and in most respects the "Far West" (April 1984) is no exception. But I am dismayed to find the Salton Sea shown on all of those maps. This body of water in southern California was not formed until 1905, when the Colorado River flooded an area of former salt flats.

William T. Lingstrom
Pasadena, California

The physical features on our historical maps are shown as they are in the present day. Acquiring historical data for different time periods would be difficult and subject to error.

Hologram Cover

I was most impressed with the hologram on the cover of the March 1984 NATIONAL GEOGRAPHIC. On reading the article, I was surprised that a "first" is claimed for this hologram. The U.K.'s *Amateur Photographer*, which is celebrating its centenary this year, published a hologram on its front cover several months ago. British insularity claims the "A.P." is the world's best-selling photo weekly. Therefore I think it can, like the NATIONAL GEOGRAPHIC, be considered a "major magazine."

R. E. Mills
Malmesbury, England

We were aware of Amateur Photographer's *hologram. But with our worldwide circulation of 10,600,000 versus theirs of 96,650, mostly in Britain, we felt justified in claiming to be "the first major magazine to reproduce a hologram on its cover."*

In the publishing world your hologram on the cover of the March '84 issue should rank with the conquest of Mount Everest. You deserve all the accolades I am sure you will receive.

Leo G. Parker
New Melle, Missouri

And we have received many. More than 700 readers have written congratulations—our largest volume ever on a single subject.

Rhinos

For years, the reputation of the Chinese people has been badly maligned by the oft-repeated and

groundless assertion that the rhinoceros (March 1984) has been indiscriminately slaughtered to meet the demands of the Chinese who use its horns extensively as an aphrodisiac. Thanks to Dr. Esmond Bradley Martin, who doubted this fanciful proposition and took pains to ascertain its truth, the myth can now be laid to rest. I too have made extensive inquiries. I learned from reliable sources in the folk-medicine trade that the horn has been used for medicinal purposes as an antipyretic to bring down a fever, but never used as an aphrodisiac.

A. S. Yeo
Ipoh, Malaysia

Calgary

I'd like you to know how much I appreciated the article on Calgary (March 1984). It was a terrific overview of a great city. There are many things to be proud of here, and the article mentioned quite a few, covering different aspects of the city. I even learned a few things myself, and I've lived here for nearly 20 years. One point: All Americans (or even most of them) do not end all (or even most) of their sentences with "huh?"; nor do all or most Canadians end theirs with "eh?".

Marcia Sanchuck
Calgary, Alberta

All Canadians do not end their sentences with "eh?". However, it is widely used. Every consultant, including Canadian Embassy personnel

here in Washington, D.C., verified our statement—as did those quoted using the expression.

Platinum

I have read your fascinating November 1983 article on platinum. The first successful attempt to refine platinum was the work of Chabaneau, a French chemist in the service of the Spanish crown. If Mr. Young had inquired as to the origin of the chalice that Pope Paul VI gave to the Philadelphia Archdiocese, he would have found that it was made with material from New Granada (Chocó), refined by Chabaneau in Madrid.

Rodolfo Segovia S.
Bogotá, Colombia

Chabaneau and Marc Étienne Janety, mentioned in our article, independently discovered methods of refining platinum within months of each other. Unfortunately the Spanish kept Chabaneau's process a secret for more than a hundred years; thus his work was eclipsed by Janety's.

Letters should be addressed to **Members Forum**, *National Geographic Magazine, Box 37448, Washington, D.C. 20013, and should include sender's address and telephone number. Not all letters can be used. Those that are will often be edited and excerpted.*

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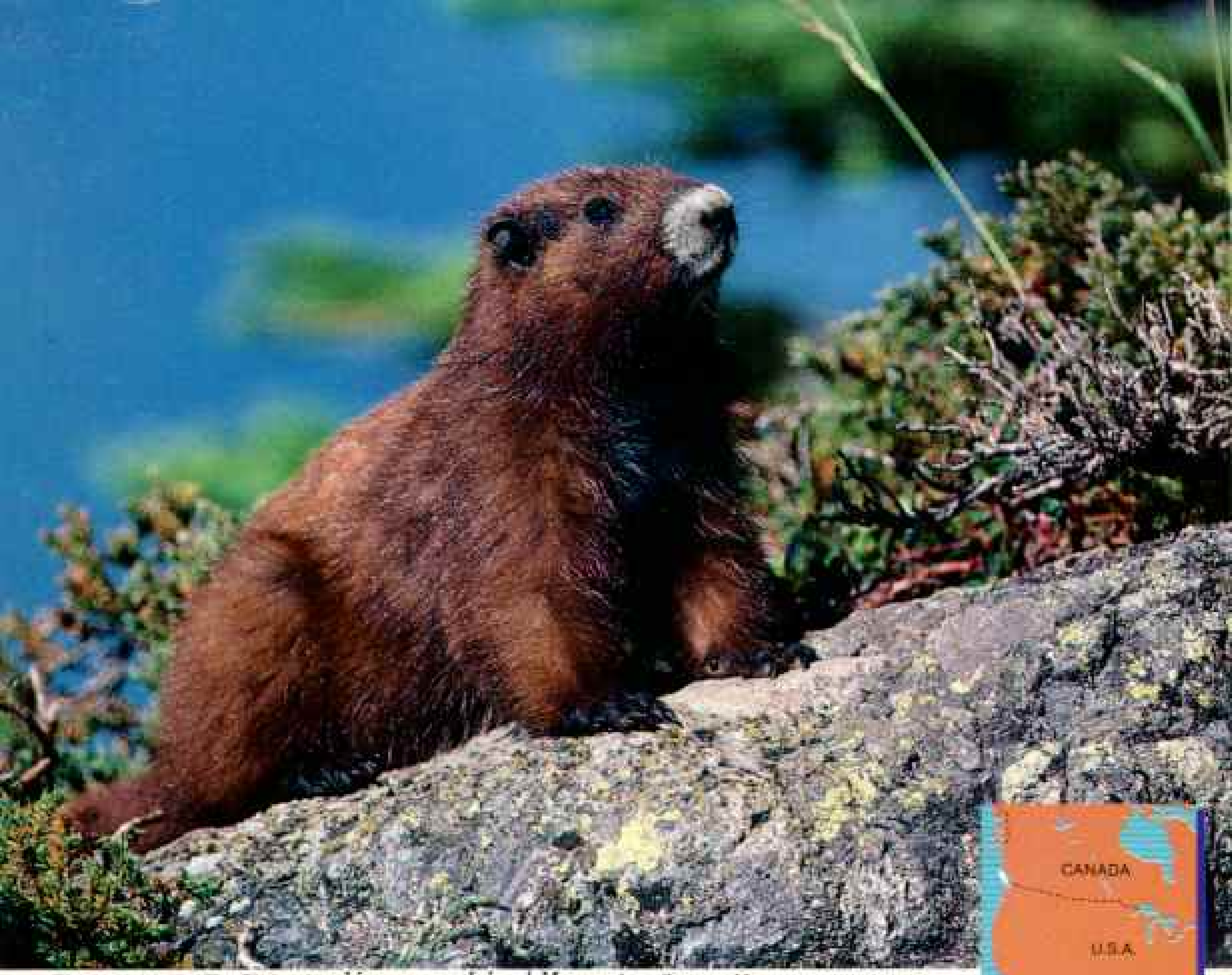


Photographed by Tim Fitzharris. *Vancouver Island Marmot:* *Genus: Marmota*
Species: vancouverensis ***Adult size:*** *674mm length* ***Adult weight:*** *3.5kg*
Habitat: *Hillsides, rocky bluffs and meadows of the alpine regions on Vancouver Island, British Columbia, Canada* ***Surviving number:*** *Less than 200*

Wildlife as Canon sees it: A photographic heritage for all generations.

The carefree nature and attractive appearance of the Vancouver Island marmot give it a unique appeal that is captivating to anyone lucky enough to observe this rare animal. High in the alpine regions of Vancouver Island, the playful marmots can be seen foraging among meadow flowers or sunning themselves on rocky cliffs. First recorded in 1910 and seldom sighted until recent years, the Vancouver Island marmot is today considered endangered.

The Vancouver Island marmot could never be brought back should it vanish completely. And while photography can record it for posterity, more importantly photography can help save it and the rest of wildlife.

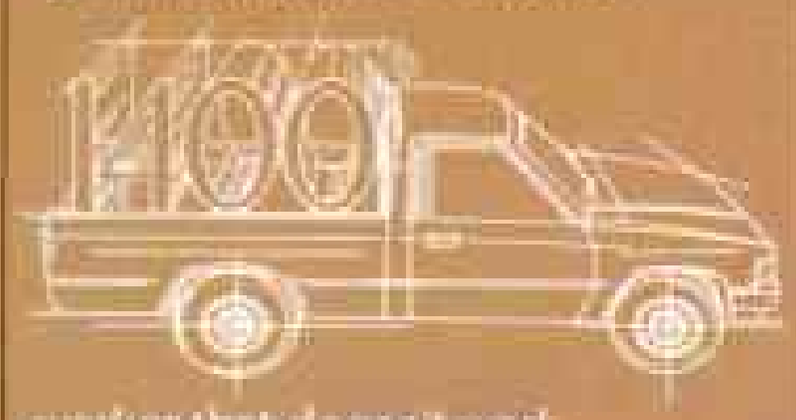
An invaluable research tool, photography can assist in conservation efforts being undertaken to protect the Vancouver Island marmot. In addition, photography can help foster among people a greater awareness and understanding of this unusually charming animal.

And understanding is perhaps the single most important factor in saving the Vancouver Island marmot and all of wildlife.

Canon

Images for all time

The last thing you need on your next project is another



worker that doesn't work.

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On Assignment

THE EXHILARATION of the climb was soon balanced with a perilous descent for senior assistant editor ***Charles McCarry*** and photographer ***George F. Mobley*** (***right***), who scaled the 10,474-foot summit of the highest of the Japan Alps, cloud-swathed Kita-dake. When a sudden winter storm forced them down early, their group became lost, and it was the woods savvy of Mobley—a northern Californian who has backpacked in the Siskiyous, Cascades, and Sierras—who found the trail.

The Japanese guides delighted in Mobley's six-foot-two frame and flowing beard. The photographer admits that a guide jokingly complained "that he had to take two steps for every one of mine."

A veteran of a score of trips to Japan, McCarry also teamed with Mobley for a 1976 GEOGRAPHIC article on the Kyoto and Nara region. "There is an affinity between a Japanese who creates superb pottery in Kyoto and one who climbs a mountain," he says. "Both achievements involve harmony of mind and body." In addition to his nine GEOGRAPHIC articles, McCarry has written nine books, both novels and nonfiction.

PHOTOGRAPH BY GEORGE F. MOBLEY

ROAMING the Rockies for his article on Colorado was almost like a homecoming for senior writer ***Mike Edwards,*** who hiked the Continental Divide from Mexico to Canada for a 1979 GEOGRAPHIC article.

"You really don't have to interview folks in the West," he says. "You just introduce yourself and they start talking." Edwards found that former President Gerald R. Ford was no exception when they met (***left***) in Beaver Creek, where the Fords maintain a home. Such luminaries as Clint Eastwood, Jimmy Connors, Cliff Robertson, and Henry Mancini were competing in the Jerry Ford Celebrity Cup ski race. "But what he really wanted to talk about was what a great place Colorado is to raise a family," Edwards recalls.

A 15-year veteran on the NATIONAL GEOGRAPHIC staff, Edwards has also written on the Pacific Crest Trail, California's Monterey Peninsula, Montana, Pakistan, and Shanghai. "If I had my druthers, I'd spend half my time in the West and half in Asia," says Edwards, who served as a Peace Corps staff member in Afghanistan. He is currently working on an article on the Moguls of India.

PHOTOGRAPH BY CRAIG AURNESS

One drive is worth a thousand words.

Thunderbird

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