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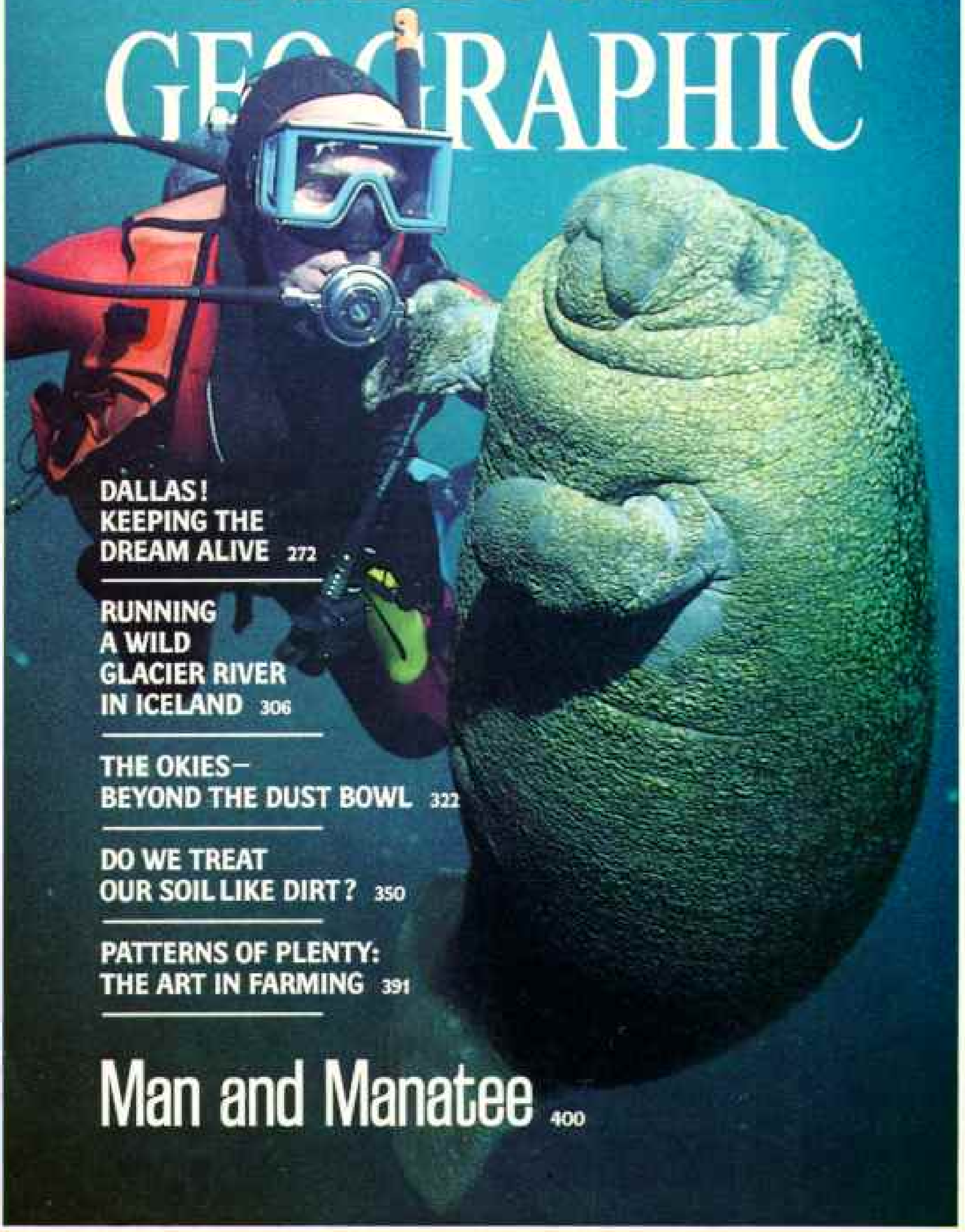
NATIONAL GEOGRAPHIC



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

IT SEEMED SIMPLE ENOUGH when we first decided to do a story on "topsoil." How wrong! Seldom has a story been so tough to edit into the GEOGRAPHIC blend of words and pictures. Like virgin prairie resisting the plow, this one defied efforts to narrow it to the space available.

It seemed self-evident that topsoil is the top layer of rich, fertile soil in which things grow. Maybe. It also can be mismanaged soil or leached out, virtually useless without massive infusions of expensive chemicals. Can we save what's left of our rich soils? Are we too dependent on expensive technology to cover for our mistakes? Maybe.

Erosion seemed an obvious villain to attack. Gullies are very graphic, and scare stories about soil losses are as seasonal as spring rains. Wasn't our best topsoil washing down the rivers and into the oceans? Haven't whole regions of the world been lost to farming because of thoughtless, man-caused erosion? Maybe.

Yet without weathering and erosion there would be no fields to farm. The soil would still be mountains of rock. There would be no Grand Canyon—the world's most gorgeous showcase of erosion. And, perhaps more important, no miles-deep sediment in California's Imperial Valley—one of the richest agricultural regions on earth. A simple process? Hardly.

The U. S. Department of Agriculture's 1983 yearbook featured a chapter titled "Specter of Another Dust Bowl Seems Laid to Rest." Yet this past June 18 the department announced that in the previous seven months wind erosion had damaged 12.3 million acres of the Great Plains—third highest amount in the 49 years since records have been kept. In a few areas soil loss was worse than in the Dust Bowl of the thirties. Will we experience another Dust Bowl? Maybe.

A skein of such inconsistencies confronted writer Boyd Gibbons and photographer Steve Wilson when they began their fieldwork. They've winnowed out a lot of the "maybes," added a few new ones, defused some of the scare stories, and focused on some very real problems in bringing us an important, fascinating, and sometimes frightening look at America's soils.

Are they right? Probably.

Wilbur E. Garrett

EDITOR

NATIONAL GEOGRAPHIC

September 1984

COVER: *Man meets manatee at a sanctuary set aside in Florida's Crystal River. Photograph by Fred Bavendam.*

THE NATIONAL GEOGRAPHIC MAGAZINE
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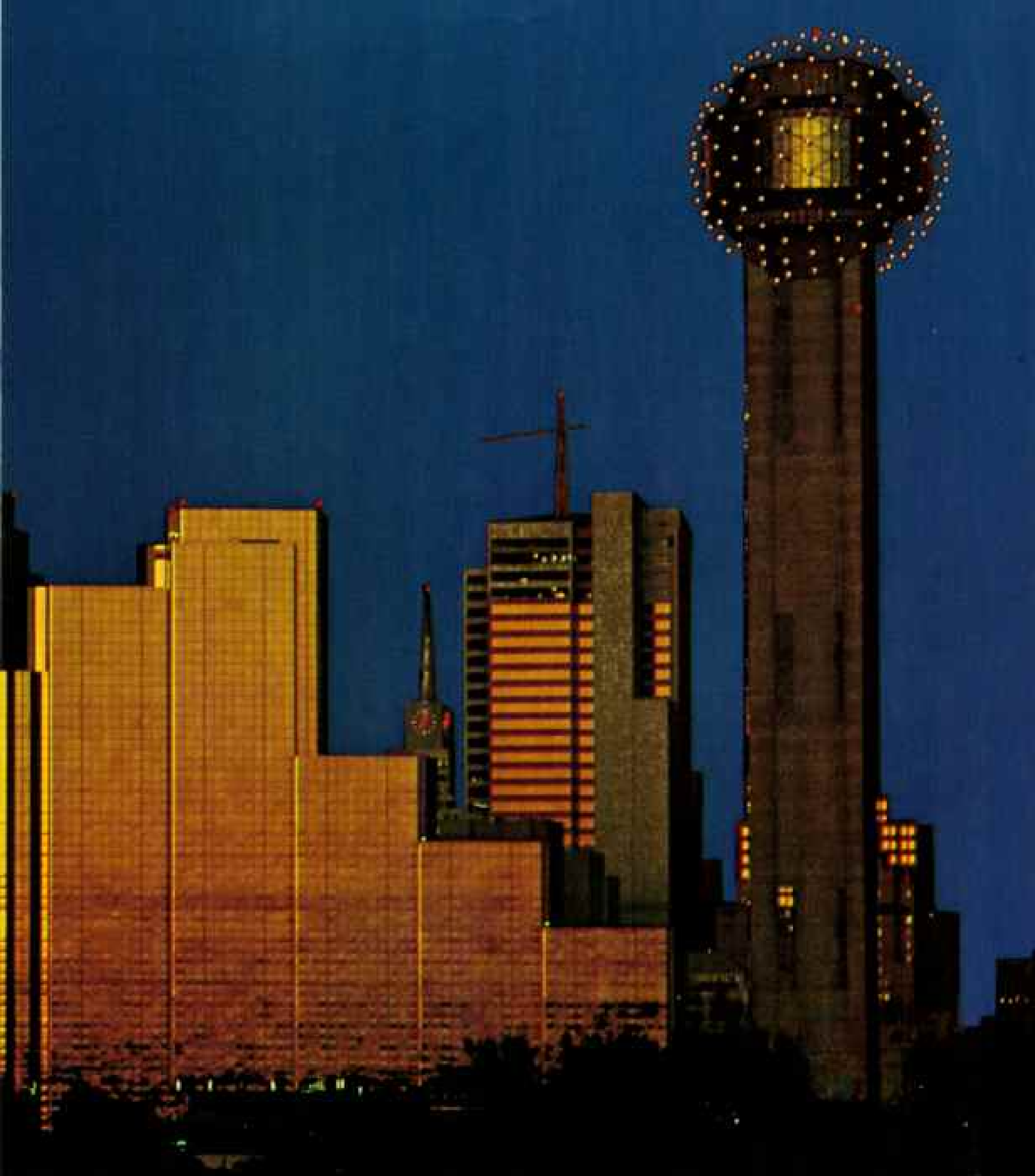
Dallas!

By GRIFFIN SMITH, JR.

Photographs by DAVID ALAN HARVEY
NATIONAL GEOGRAPHIC PHOTOGRAPHER



Gilded with the sun of dreams and promises,
Dallas springs from griddle-flat prairie,
suddenly, sleekly. Reunion Tower punctuates
the skyline like an exclamation point
in a city blatantly up-front and upbeat.

SOME CITIES reveal themselves from your hotel window on the first morning. Years ago in Calcutta, half awake and bleary eyed, I flung open the curtains and found myself eyeball-to-eyeball with a large vulture. He studied me gravely from the balcony rail before flapping away over the rooftops, a proprietor off to inspect his holdings.

More recently, freshly arrived in the prosperous glass-walled cityscape of North Dallas, I met what you might call the vulture's upscale counterpart: a sleek black helicopter descending with a great roar in a muddy vacant lot below my ninth-floor room. Five smartly dressed men and a woman emerged, briefcases in hand. They stepped from rock to rock across the muck, then strode with an air of purpose into the BancTEXAS building as their copter spun skyward above the rush-hour traffic.

That's Dallas with the cameras off: still doing things with style. America's seventh largest city doesn't merely meet your preconceptions: It exceeds them with a flourish. I never learned just what those airborne folks were up to, but whatever it was, they looked as though they had made up their minds to be successful.

"The attempt to succeed—and success itself—is what defines Dallas," Lyn Dunsavage told me over coffee at a trendy new café in the West End district near downtown, where private developers are transforming old warehouses into shops and offices. The room around us emptied almost as quickly as it had filled; busy young professionals do not linger over lunch in Dallas. Lyn, an East Coast native, has carved out her own winner's niche as publisher of the weekly *Dallas Downtown News*, and enthusiasm for her adopted city sparkles across her conversation like sunlight on water. "Dallas," she says, "is a city of doers, the epitome of the entrepreneurial philosophy."

Making a grand exit *from a limousine, a model in a gold lamé gown swirls through a silken night. One of the top three centers of fashion marketing in the nation, Dallas last year rang up three billion dollars in wholesale apparel sales.*

High profiles *in a city set in high gear include Trammell Crow, here with his wife, Margaret* ***(above)****, in front of their Highland Park home. Perhaps the largest private real estate developer in the United States, Crow has put together such packages as the 150-acre Dallas Market Center* ***(facing page)****. The complex features ten million square feet of showroom space in eight buildings, in addition to the Wyndham Hotel, foreground, and the pyramid-roofed Loews Anatole Hotel.*

Entrepreneur and Dallas celebrity H. Ross Perot ***(right)*** *walks with son Ross, Jr., on the new headquarters site of his company, Electronic Data Systems Corporation. In 1962 he left his job as a salesman for IBM to form his own electronics firm, which last year grossed 652 million dollars. This June General Motors Corporation agreed to buy EDS in a 2.5-billion-dollar merger.*

The outspoken Perot, who dispatched a private commando team to free two company executives jailed in Iran in 1979, says, "Dallas is a city of vision. Here men dreamed big dreams and made them come true."

Other cities say that. Dallas means to grab you by the arm, pull you aside, and *prove* it. The north Texas metropolis is the most optimistic big city in America, an anything-is-possible kind of place, where to describe someone as successful is to bestow the highest social and professional accolade.

Dallas is a Sousa march, not a barcarole. "The most telling thing about this city," says investor Tom Barton, "is that there's no 'hidden Dallas.' It's pretty much exactly what it appears to be." Like the lighted globe atop 262-foot Reunion Tower, Dallas revolves around the dollar: getting it, spending it, using it to keep score. Says former city councilman Lee Simpson, a young Princeton-educated lawyer: "The thing that leads people to come here instead of living by the sea or in the mountains is the same thing that brought my grandfather here from Tennessee at the turn of the century: It seems to be a place where if you work hard and you're plucky, you can make some money."

SOMETHING LIKE THAT was on the mind of the man who founded Dallas, John Neely Bryan. Bryan arrived in 1841 accompanied by five companions, his horse, his dog, and all his worldly goods—a rifle, a skillet, and some lead for shot. Some think he planned to open an Indian trading post near the Trinity River. Not so, says Dallas historian A. C. Greene.

"Let me tell you what Bryan *really* did," Greene said with a professorial air. "He picked this spot for a town thinking it was the head of navigation from the Gulf of Mexico. He was technically right about that, of course, although only two boats made it up the shallow, unpredictable Trinity in the next hundred years. But it's indicative of this city that he came down here with the idea of locating a steamboat port on a dry river—and Dallas still made it as a town."

Bryan set his hunter's lean-to on a bluff at a site that is now called Dealey Plaza. "Actually," said Greene, "if you want to get mystical about it, his little shed was on almost the exact spot where President Kennedy was struck by an assassin's bullets."

Before long, Bryan's companions had moved on and he had built himself a sturdier log cabin, hired a surveyor for the tract he was to receive from the Republic of Texas, and set about selling village lots. Bashfulness was not his style. He lured prospective buyers with free whiskey. But within Bryan, the frontiersman and the entrepreneur struggled for supremacy. Eventually the frontiersman won. "When he couldn't shoot breakfast from his front door," said Greene, "he began to think, 'What have I done?' " By 1855 the patron saint of Dallas land promoters had quit the real estate business.

A small structure in a downtown park commemorates him. The Bryan Cabin (actually it was probably built by another early settler, one Gideon Pemberton) is among the city's most arresting sights. Its single rough-hewn room is no larger than a good-size freight elevator in one of the nearby office buildings. Like the skulls that medieval philosophers kept on their desks to remind them of mortality, this tiny structure seems to say: Remember—from this we came.

Dallas exists by the energies of man and the smile of fortune. Its people know their city's catechism by heart: how the inland prairie town had no real geographic reason to be; how their forebears stuck together and secured the county seat, then finagled the legislature into making Dallas the first railroad junction in north Texas; how banker Bob Thornton snatched the Texas Centennial Exposition from San Antonio in 1936, even though Dallas hadn't even existed when Texas independence was won from Mexico, and delivered on his multimillion-dollar guarantee with a few phone calls before nightfall; how the top business leaders banded together to form the Citizens Council, an instrument that permitted them to guide the growing city with benign paternalism for the better part of the next 40 years.

Erik Jonsson, a founder of Texas Instruments and one of the city's grand old men, arrived in 1930 with a German immigrant friend. "Why," asked the German, "did they put such a big city so far out in the country?" He should see it now. Downtown Dallas is all thrusting towers by day, a splendid latticework of lights by night. To me the best vantage point is a secluded spot

Free-lance writer **Griffin Smith, Jr.**, reported on "The Mexican Americans: A People on the Move" and "Texas West of the Pecos" in the June 1980 and February 1984 issues.

Dallas

GROWING by boundless leaps, the metropolis sprawls beyond city limits and across the surrounding north Texas plains. With nearly a million residents, Dallas ranks seventh among the nation's ten most populous cities. It is also the third fastest growing and—with an average family income of $25,747—the second richest (after Houston). But most of the wealth is concentrated in the north, where a relatively young, professional population supports a building boom. Development falters in southern Dallas, a minority and lower-income section, though a recently appointed task force hopes to "make dirt fly" there.

Historically run by its businessmen, Dallas purrs like a well-oiled machine. Potholes are soon filled, sidewalks meticulously maintained, and backed-up sewers unclogged within hours. Founded in 1841 by John Neely Bryan, who staked a claim by the Trinity River, Dallas has become a center of banking, insurance, and high-tech industry.

Average family income
(Statistics from 1980 census)

- OVER $45,000
- $30,000 TO $45,000
- $25,000 TO $29,999
- $20,000 TO $24,999
- UNDER $20,000
- Dallas city boundary
- Other city boundary
- County boundary
- Major areas of new commercial development

0 10 km
0 10 mi

NGS CARTOGRAPHIC DIVISION
RESEARCH: LINDA BRUCE
PRODUCTION: COMPUTER MAP LAB

Homes on the range *in Plano, one of Dallas's northern suburbs that were little more than pastureland and horse farms a decade ago, are popular with the city's young professionals.*

Last year more than 19,000 new single-family houses were built in the Dallas area, an increase of 80 percent over the previous year, and the largest number of any U. S. city.

where the Hampton Road bridge crosses the Trinity River levee—early on a Sunday morning, say, when everything is quiet and mist is rising on the broad grassy floodplain. The landscape is soft and southern, just as it must have been when Bryan found it; and if you let your eyes follow the dirt road lazily down from the levee, past the willows, suddenly, *whoomph!* downtown Dallas squirts out of the very earth.

THE DRAMATIC VIEW is real enough, but the setting misleads. Dallas is not a southern city—nor is it a western one. Its hinterland was never plantation country. Even in the 19th century it drew its settlers, and consequently its attitudes, from the Middle West almost as much as from the South. More than any other city in Texas, it has looked over its shoulder to the East. By 1900 Dallas was self-consciously separate from its surroundings; now it aspires to be what its leaders call a world city.

Parts of Dallas haven't heard about this ambition. At night South Beckley Avenue resembles the black quarter of any small east Texas town. The Fort Worth Cut-off quickly leads to seedy hotels, men in undershirts, and fast-food stops. On Elam Road a hand-painted sign offers "Yard Eggs–Okra–Sheep for Sale." In 1983 Dallas County still had 16,000 acres of wheat, 10,000 acres of sorghum, and 1,600 acres of cotton, as well as 7,000 hogs, 20,000 cattle, and 30,000 horses—more horses than any other county in Texas. (But, despite its legendary reputation, not a single drop of oil.)

In truth, Dallas is two cities, divided north and south by the Trinity River to the west of downtown and Interstate 30 to the east. (The city's other great physical and psychological barriers are the Central Expressway and the Lyndon B. Johnson Freeway.) Below the Trinity and 30 is southern Dallas: median family income $16,049, nearly half black; above it, North Dallas: median income $26,028, four-fifths white.

To be sure, there are ethnic Dallases, as anyone knows who has heard the German voices at the sausage counter of Kuby's deli, eaten Sichuan crispy rabbit leg at the New Big Wong, or stopped for the traffic light at Fitzhugh and Ross, where the "Don't Walk" signals have been replaced by an outline of an upraised palm, a symbol understandable to the Asian immigrants who have made this neighborhood their own. Dallas is even starting to brag about these pockets of foreign culture—they are on the checklist of things a world city ought to have.

North Dallas—generally prosperous, Protestant, and white—sets the tone and temper of the city. North Dallas may be what all middle-class America would be if it could afford it. In the center lies Highland Park—a graceful community by any estimation, where nannies push baby strollers on crisp November afternoons, maids answer the telephone "*¡Bueno!*" and cyclists pedal the shady streets at dusk. Few cities have made as much of what nature gave them. Is there a more gratifying sight than Lakeside Drive, aflame with azaleas in the spring?

North Dallas is "silicon prairie" too: the bedroom communities of Richardson and Plano in the heart of north Texas' burgeoning electronics industry. The exasperating commute on the narrow and congested Central Expressway is worth it, many think, because these suburbs have separate school districts, and so are immune to the wrenching integration controversies that have kept the predominantly black Dallas Independent School District in turmoil since 1971.

And North Dallas is the mother city proper, rolling north past the LBJ Freeway over the county line, a promoter's dreamscape of apartments, condominiums, and luxurious homes for the city's upwardly mobile new money. Dallas is the top market in the United States for single-family homes, and most of the construction is in the north. More people now live north of the LBJ Freeway than in the city of Fort Worth, a fact that startles even Dallasites. Arriving families have begun to arrange their lives within this new urban satellite, venturing less and less often into the older parts of the city.

New developments stress what advertisers call water amenities—artificial lakes, ponds, and creeks curling among the condominiums. Though firewood costs a dollar a stick at the 7-Eleven store, on cool fall evenings the pungent smell of many fireplaces perfumes the North Dallas air. Some new homes have as many as four. "There is something very traditional and romantic

about a fireplace, even if at best you use one about 25 days a year," says real estate agent Jean Craver with a contented air.

THE REAL ESTATE BOOM would stagger John Neely Bryan, not only for its size but also in light of where it is occurring. Investors who acquired one 2,250-acre parcel of land in west Plano for 27 million dollars in 1978 sold it five years afterward for 180 million, making it one of the most profitable real estate transactions in Dallas history. The commission alone would have made real estate agent David Davidson, the broker, an instant millionaire—had he not already been one. In 1983 the village of Buckingham—a tiny three-street enclave of old frame houses between Dallas and Richardson—handed itself over almost in toto to developers, at a price of half a million dollars for each owner's two- to three-acre lot.

One day I drove out Preston Road looking for the place where North Dallas, for the moment, ended. Camfield Road, in the little town of Frisco, seemed to mark the frontier. But already the road was lined with a developer's yellow flags, and across the way, beyond the rusty gate of the CB Ranch, the soft open land awaited the Dallas juggernaut.

"Dallas is where you can *get* things," A. C. Greene told me. That may be the best seven-word description of the city ever coined. He meant the whole spectrum of commerce, including wholesaling, shipping, and distribution. But it is the retail frenzy of North Dallas that leaves most visitors goggle-eyed: More than 20 million square feet of retail space make this a glittering world apart—the most competitive consumer market in the country. There is Fishin-World, Baby World, Lighting World, and Floor World; there is Businessland, Magicland, and Sleep Country. Between stops you can gas up at Sello, whose name is its slogan ("Sello: that's what we do"). Every day is Christmas (except Sunday, when Texas blue laws lower a veil of silence). On Bloomingdale's opening day last October the store rang up more than $600,000 in sales.

Shopping is not merely a pastime or an entertainment in Dallas, it is *news*. When Bloomingdale's opened, TV anchormen announced the outbreak of what they described as a shopping war among the four North Dallas malls. In bulletins from the front, advertisers offered a free turkey with your microwave, a free car with your condo. The great malls are empires in

New frontiers *in medical research are broached at the NASA-funded Space Medicine Laboratory of the University of Texas Southwestern Medical School. Here research fellow Dr. Jim Beattie, center, conducts an experiment on a volunteer that subjects his body's circulatory system to conditions replicating the weightlessness of space. One of the lab's scientists, Dr. Drew Gaffney, is slated to be a member of the Space Lab 4 shuttle crew in 1986.*

High-tech, aeronautical, and defense industries account for 31 percent of the Dallas-Fort Worth metropolitan area manufacturing work force of about 310,000.

In the pink and proud, *top saleswomen of Mary Kay Cosmetics, Inc., show off their Cadillacs earned for superior performance* **(left)**. *Co-founder and chairman of the direct-sales company, Mary Kay Ash* **(above)** *presents another achiever with a mink jacket, won in a drawing during a recent sales seminar. Founded in 1963, the Dallas company earned $198,000 its first year with a can-do philosophy emphasizing family and home while lavishing prizes and praise on top performers. Last year Mary Kay's 200,000 representatives helped the New York Stock Exchange-listed company total 324 million dollars in sales. "Women can do it all," says Mary Kay.*

themselves. NorthPark set the tone for these climate-controlled oases of palm trees, *Ficus benjamini*, ferns, and waterfalls. There is the high-ceilinged aristocratic Galleria with its ice-skating rink and its store directories modeled on video games. There is Prestonwood, with its two-story chiming clock, and Valley View, whose endless promenades are crowded with strollers, young and old, bringing back the feel (if not the look) of old-time Main Street.

These shrines to spending are the last refuge of the pedestrian in Dallas. Some call them the city's highest art form. Certainly, I thought, they are the feature that archaeologists 50 centuries hence will most delight to excavate as they seek to decipher the culture of ancient Dallas.

Dallas comes by all this rightfully; the mercantile tradition is woven into the fabric of the city. When the railroad arrived in 1872, it brought merchants like the Sanger brothers, German Jews whose store was to their day what Neiman-Marcus is to this. They introduced revolutionary marketing methods to the Southwest—the fixed-price system (instead of old-fashioned haggling), systematic credit, a personnel director, women employees (who were escorted to and from their homes in a company wagon), advertising, and fashion. Dallas retailing took such hold throughout the Lone Star State that even today in west Texas, to say "Honey, you look so *Dallas!*" is taken as a compliment.

The retail history of Dallas is nearly as

The subject is roses, *but nutrition, politics, and many other subjects also come up when the Tuesday Garden Club meets in Highland Park (**right**). Similarly chic Lakeside Drive (**above**), noted for its palatial homes, sets a gracious scene for strollers. Society and big money go hand in white glove in a city preoccupied with both. Benefits such as the Crystal Charity Ball, which once featured a carousel with live horses, helped Dallas citizens ante up 102 million dollars for charity last year.*

intricate as a family tree of European royalty: Herbert Marcus left the Sangers to found Neiman-Marcus in 1907; Roger Horchow left Neiman's in 1971 to start the Horchow Collection, a luxury catalog operation. There were many others in between. But none of the old family stores, not even the fabled Neiman's, is owned in Dallas any longer. Retail chains have gobbled up the independents, providing economies of scale that smaller businesses cannot match.

And from every corner of the country, big-name competitors have moved into the lucrative Dallas market. "Gump's, Tiffany's, Marshall Field's," said the wife of a Park Cities lawyer, gleefully reciting the litany I heard so often in the Big City on the Prairie. "There's no reason for anyone in Dallas to go anywhere else to shop."

One afternoon I noticed a vast expanse of something called Self Secured Mini Storage beside the LBJ Freeway. Store-and-lock companies are big business in Dallas, running to eight yellow pages, with names like U-Stor-It, The Attic, and One More Closet. Their purpose is to make room for the abundance that hardworking, hard-shopping Dallas has no other place to put.

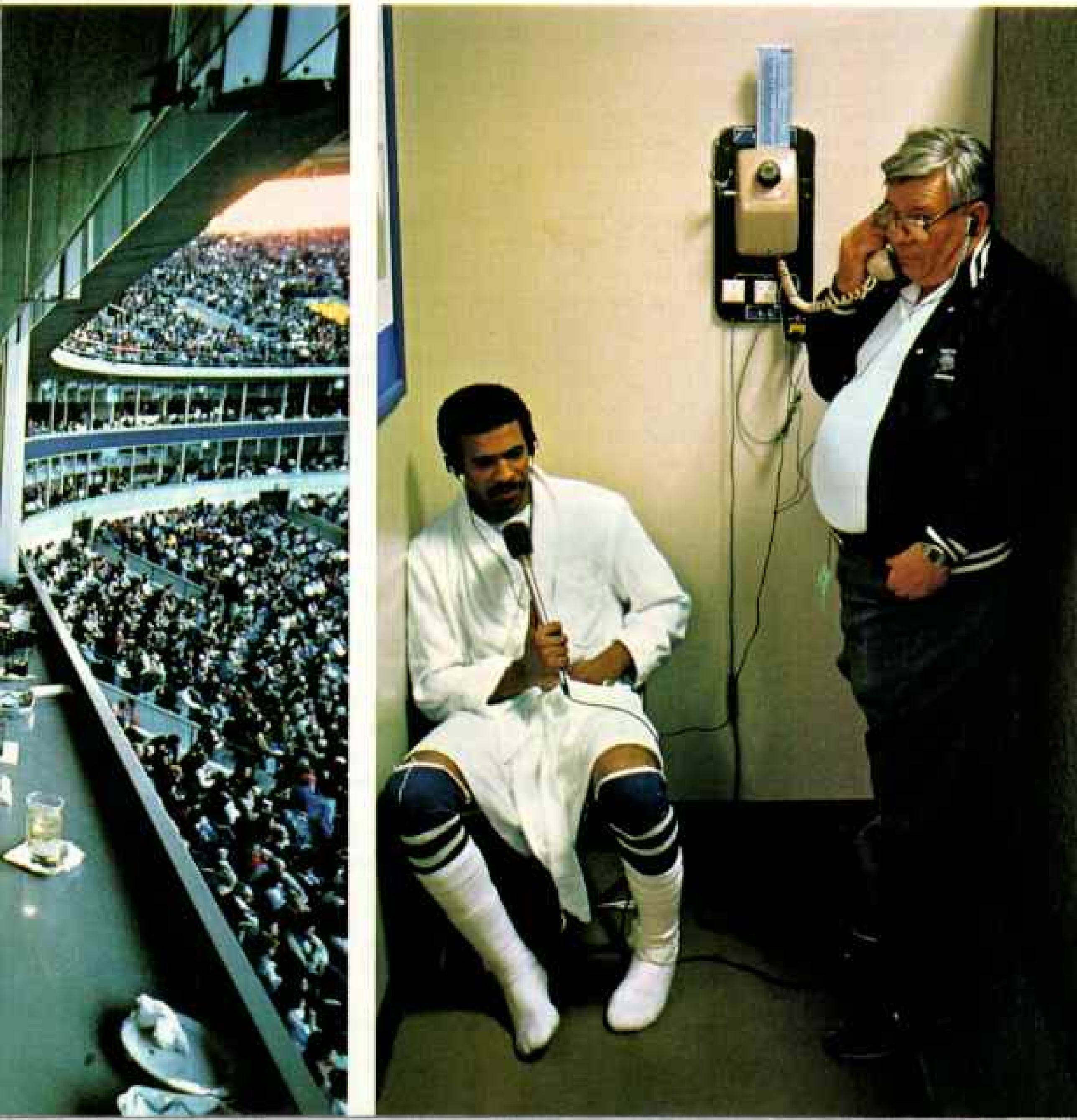
Dallas does believe in conspicuous consumption. Cadillacs attract scant notice. BMWs are as common as carrots. Every three hours last year, Dallas dealers sold another new Mercedes-Benz at prices ranging from $23,000 to $57,000. "A lot of our customers are what we call conquest sales—people trading Lincolns and so on," said

*Trademark of a supercoach, Tom Landry's hat seems always in place along the sidelines of the Dallas Cowboys football team (**left**). "I think hats provide a finishing touch," he says.*

*Finishing touches on the Texas Stadium suite belonging to Dallas businessmen J. L. Williams and Frederic Wagner include a crystal chandelier, oil paintings, mirrors, and blue-and-gold Louis XIV-style decor (**below left**). The suite seats 12 and includes the services of a solicitous bartender. The stadium, home venue of the Cowboys, boasts 178 "circle suites." Perhaps the most expensive pieces of Dallas real estate for their size, they are currently worth from 250,000 to a million dollars each.*

*An après-game interview with Cowboys wide receiver Drew Pearson is broadcast on radio (**below**) following a losing game with the Washington Redskins last year.*

The Cowboys recently changed owners, but Landry is the only head coach his team has ever had. They are justly proud of winning ways: 18 consecutive winning seasons, including 12 division and two Super Bowl championships.



Mervin Smoot, the sales manager at Autohaus. "This is one of the best Mercedes markets in the country."

"Money speaks in this town," I was told over wine and crackers by one Highland Park couple. "People are very intent for you to know they have money. Whether they really do or not is another matter—but they want to give that impression." Like other Dallasites who look askance at ostentation, my hosts alluded to their travels. "There's lots of money in Westchester," said my hostess, referring to the posh suburb north of Manhattan, "but no *show*. Dallas loves to be open and showy. Most of the nice things are man-made, things money can buy. People are obsessed with work, but they also work hard at spending what they earn. They love to tell about what they have in their homes. The women dress fabulously."

Where else but Dallas could I have found Dial-a-Quartet? "Create a positive, affluent image with background music performed by a string quartet," suggested the caption of a leaflet showing four enfiddled musicians. "Imagine having a string quartet in black formal tuxedos at your function! We not only play classical music, but popular and continental dinner music, too! Not too loud, either!" The quartet service cost $350 for two hours.

Dallas's fascination with wealth sometimes takes even more exotic turns. For $18 a lecture, a company called Ultimate Matchmakers tells single people how to find a wealthy spouse. "Don't rule out old money," advises the instructor. And think positively: "Write ten reasons why you want to be rich and ten reasons why you deserve to be rich." Cityfest 83, a month-long festival aimed at perking up the tempo of the central business district, interspersed its bluegrass concerts and sidewalk mime performances with lunchtime lectures on "Introduction to the Stock Market" and "Estate Planning and Wills."

Removed from this feverish chase, old wealth keeps a serene perspective. Visiting with a member of one of Dallas's oldest families, a woman of taste and learning who works quietly in many civic activities, I remarked on the flamboyant style of far North Dallas. "They're not rich," she observed gently. "They just spend a lot of money."

IN SUCH A CITY the heroes are the entrepreneurs—John Stemmons, the genial developer who calls himself a "cussed rascal" but is called by many Mr. Dallas; Mary Kay Ash, who built an empire on cosmetics; Lamar Muse, who masterminded a revolution in Texas aviation; Ebby Halliday, the real estate broker who catches the eye of newcomers with her beguiling slogan, "Ebby is your *Friend*"; Ben Carpenter, who turned a family ranch near Dallas-Fort Worth Airport into the much praised planned community of Las Colinas.

Trammell Crow, entrepreneur par excellence, emerged from his office like a whirlwind and swept me back inside with him. Creator of the Dallas Market Center, ten million square feet of wholesale showrooms for buyers of clothing, furniture, computers, and toys, he is, with 85 partners, owner of a company that describes itself as the largest real estate landlord in the world. Having achieved such colossal success, I asked Crow, why not retire and enjoy life? He was astonished by my question. "I'm never going to quit!" he cried. "I've got things to do, and if I stop, or die, they won't get done!"

Among those Dallas achievers, H. Ross Perot stands out. The city's number one business celebrity is a former IBM employee from Texarkana who built a billion-dollar enterprise called Electronic Data Systems Corporation (EDS) on one simple idea. "Companies were buying computers and trying to hire their own staff," Perot explained. "But what they really wanted was a fully operational system, not just a piece of hardware." EDS offered to do it all—design, install, and operate these large-scale data-processing systems. It was an idea whose time had come.

Within the bucolic grounds of EDS, smooth as a golf course, it is possible to believe the world is a serene and orderly place. But Perot, who once hired a former Green Beret colonel to lead a daring rescue of EDS employees unjustly imprisoned in Iran, knows better. "Every good and excellent thing," reads a large sign posted beside his office door where visitors cannot miss it, "stands moment by moment on the razor's edge of danger and must be fought for."

Following his own precept, Perot has taken time to head the Texas state committee

on reform of public education. His acid-tongued preference for toughened academic programs over extracurricular activities has won praise from parents but few friends among football coaches.

"The most overrated thing in the world," says Perot, "is money—and that comes from a fellow who's worked since he was 12. I've lived pretty much all across the economic spectrum, and I'm no more happy and no less happy than when my wife and I first drove into Dallas with everything we owned in the back of our car. It breaks my heart to see young people coming out of business school with money as their god. People who do that inevitably are unhappy. They wind up with severe family problems. They're chasing the wrong thing. Money is just the by-product of building a company that delivers a better service, serves its stockholders, and deals fairly with its employees."

To the entrepreneur, when it begins to seem there's nothing left in the world to accomplish, it's time to go invent something. Norman Brinker was so successful in creating a chain of restaurants called Steak & Ale that Pillsbury bought him out and gave him a cushy spot in the corporate hierarchy. At 53 he tossed it all out the window and started on his own again, joining a new chain called Chili's. "Go see Norm Brinker," Ross Perot insisted. "Norm's got the spark."

Brinker is a polo player—the Willowbend Polo and Hunt Club is one of his creations—and when I met him he was still limping slightly from having been thrown by a horse. This hadn't slowed him down a bit.

"I view business just like a game," Brinker said. "You play by the rules, you pick the players, develop the team, and have a go. There's a tingle and excitement, seeing whether a small company can be nimble enough to compete with the giants.

"My best friends are entrepreneurs," Brinker continued, "because they're exciting. They're instigators, innovators, imaginators. They know how to motivate people. They're givers, too. Dallas is one of the most giving places I know; there's a real commitment to excellence in this city. Every time you turn around, there is someone saying, 'Let's do it right and do it well!' You work hard, you try to create things, and you give back. It's such a happy thing—a magnificent way of life in a unique city."

Brinker's enthusiasm was contagious; I had to stop myself from asking how I could get the Chili's franchise for *my* hometown.

In Dallas parlance, charitable giving is divided into the "arts" and the "diseases." The diseases seem to have the edge, perhaps because they appeal more to Dallas's victory-oriented frame of mind. At the Polo Club, Cindy Brinker's Weekend to Wipe Out

Tender loving concern *is lavished on the Reverend Oscar Butler by Pauline Garey at the George Loving Place housing project in West Dallas. "I like to go where I'm needed," says Mrs. Garey, who regularly checks up on housebound neighbors. The tarnished side of Dallas includes some 1,200 uninhabitable public-housing units and a crime rate third among the 20 largest cities in the country in 1983.*

Cancer netted $108,000. Tickets to another Cancer Fund Gala cost $3,000 a couple. The Crystal Charity Ball, a social event so prestigious that even Ross Perot attends, raised $727,000 in a single night last year, all of it for child health care in Dallas County.

"They *search* for diseases to raise money for," said Shannon Wynne, the long-haired scion of a prominent Dallas family and owner of several of the city's livelier nightclubs. "If I went to every party that was $125 a person, I'd be so deep in the hole I'd never get out." Fund-raising is executed with precision and polish, usually by the wives of the socially prominent. "Some of these women," a wealthy Dallas matron said with awe, "could run General Motors."

DALLAS HAS WON international attention with a spectacular new art museum, whose farsighted director, Harry Parker, has quietly cultivated many of the city's private collectors in the hope that the museum will one day be favored with the harvest. Adjoining the museum is the emerging Dallas Arts District, a 20-block downtown development that will combine private office towers with various appurtenances of culture and (its sponsors hope) attract street life to an area now all but deserted after business hours.

Still, the arts must justify their existence in a city dedicated to business. They are not yet secure in the hierarchy of the good life: A subscription for 12 at the opera would cost $5,400 a year, but 12 box-seat tickets at Texas Stadium would cost almost as much—and the rights to a box have brought as much as a million. The Cowboys are to Dallas what the State Opera is to Vienna.

In the past few years Dallas has earned a new nickname: The City That Works. "It's as livable a big city as there is in America," says the *Texas Monthly*'s Peter Applebome, a relative newcomer from Long Island. "They pick up the garbage, and there are eight tennis courts across the street that are always empty." Graffiti are scrubbed from walls. Potholes are filled according to computerized timetables. Dead animals are whisked away before they stain the streets. "It's the greatest argument against democracy I've ever seen," Applebome marvels.

He was talking about the distinctive style

In God they trust: *Worshipers of the 26,000-member First Baptist Church attend one of three Sunday services (**right**) led by the Reverend W. A. Criswell. The minister preaches in folksy oratorical style without notes and often prays with members after the service (**below**). Reportedly the largest Protestant church in the country, First Baptist occupies five blocks of downtown Dallas, runs 22 missions in the city, has a 12-million-dollar budget, and records Sunday services on videocassettes. Churches thrive in Dallas, where 63 percent of the residents regularly attend some type of worship service.*

of Dallas politics: personal leadership by businessmen and ratification of their decisions at the polls—usually by big North Dallas majorities. "The genius of the 'village,'" said John Stemmons, using his own nickname for Dallas, "has been its good government. You don't have to pay anybody any money to get something done."

The top echelons of Dallas society maintain a strong tradition of public service—witness Erik Jonsson's move from chairman of Texas Instruments to mayor. When real estate agent Ebby Halliday says, "The town has been great to us; it's our obligation to put something back into it," everyone in Dallas recognizes that esprit. They call it Do It For Dallas, and they don't laugh: The principle behind the motto is an animating force at all levels of civic life.

Though power seems to be passing from bankers and corporate executives to real estate tycoons, the basic Dallas system persists. "The thing that has kept it together," says A. C. Greene, "is its unselfishness. I don't want to give the impression all civic leaders are angels, but if you did something crafty that benefited you and not Dallas, you'd be thrown out. If it benefits both you and the city, fine."

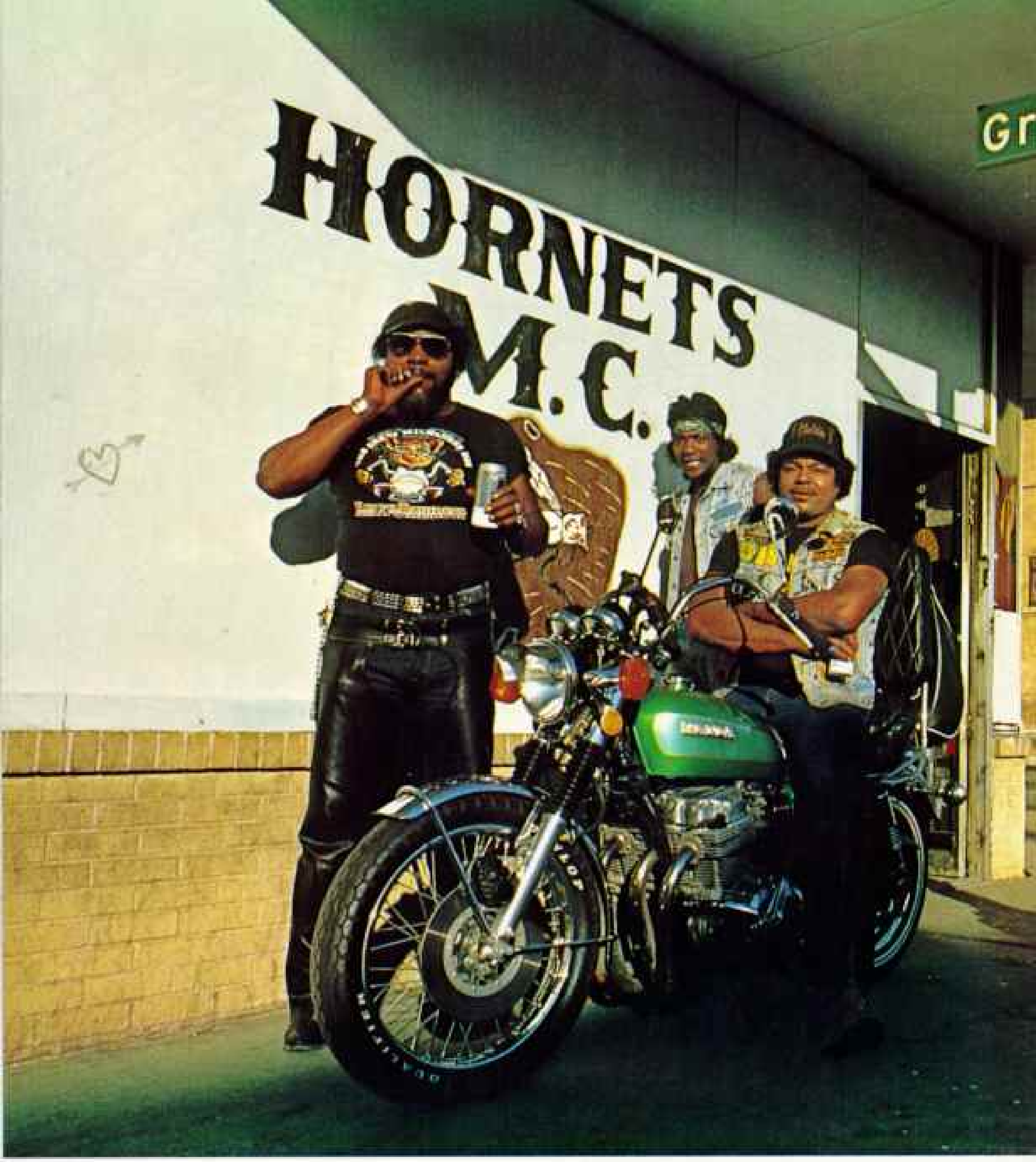
The older generation of Dallas leadership worries most about single-delegate council districts, required by a recent federal court decree. "After 50 years of clean government," says Erik Jonsson with anguish in his voice, "we've had a ward system forced down our throats. That will be trouble." Dallas now has some 140 different neighborhood associations. As conflicts among them intensify over issues like commuter roads, many fear the new system will eventually balkanize Dallas into warring factions.

Skating and shopping *pair off at the Galleria Mall (**facing page**), where Ernie Van Dam takes a noontime spin (**above**). The Galleria is one of four upscale shopping centers in a seven-square-mile area of North Dallas. The 19-billion-dollar Dallas-Fort Worth retail market has sparked a store war, as chic out-of-towners such as Tiffany's, Gump's, and Bloomingdale's vie with hometowners like Neiman-Marcus to cash in on Texans' free-spending ways.*

THE MAN who must contend with these pressures and still make Dallas work is city manager Chuck Anderson. At the new Dallas City Hall, a soaring concrete building designed by I. M. Pei, the atmosphere is quiet and efficient, like a corporate headquarters—which in a sense it is. Word processors click softly. Polite young people bustle to and fro. There are no stale cigars, no pothellied ward heelers (yet) to mark it as a den of big-city politics. It is sleazeless.

Anderson tells me about the magic of Dallas, the abiding faith of its people; how Dallas wants to reach the international scene; how the new rapid-transit system, DART, will facilitate the city's growth. Balance requires that I ask him: Does Dallas have anything to be ashamed of?

"You know," he says, with disarming candor, "I haven't ever really thought about that. It's such a positive, upbeat



The gang that does good, *the Hornets Motorcycle Club, based in a rough-and-tumble neighborhood of southern Dallas, collects food and toys for needy kids and helps control crowds at parades. "Our rules are strict. We don't do dope or allow guns," says president Goldie Darnell, at right.*

environment. This city has a remarkable potential for greatness." He weighs the thought further. "I guess if there is anything to be ashamed of, it's that we haven't yet been able to seize all the opportunities that are here."

"We had a neighbor," remarked one bemused Highland Park resident, "who rang our doorbell one Saturday morning and said

she was 'jogging for Jesus' and would I sponsor her for a lap? Dallas just goes after anything religious with a vengeance. I don't know if it's a reaction to the materialism, or what." Religion in Dallas is not a thing apart; it is a pervasive social and civic presence. Prayer breakfasts are part of business life. Some are small and exclusive gatherings of the devout; others, like one held monthly at Bent Tree Country Club, bring together 500 or more participants.

Churches routinely advertise themselves on highway billboards and in television and radio commercials. The country's largest Presbyterian, Episcopalian, and Southern Baptist congregations are found in Dallas; First Methodist and Highland Park Methodist rank among the top ten Methodist

churches in the United States in attendance.

The First Baptist Church of Dallas, pastored by the Reverend W. A. Criswell (it is also the home church of evangelist Billy Graham), has 26,000 members and an annual budget of 12 million dollars. I took a seat one Sunday as the congregation was already booming out the opening hymn, "Come Thou Fount of Every Blessing." Every pew was packed, but room was made for the stranger and the warmth of the welcome was palpable. Worshipers brought their personal copies of the Criswell Study Bible; those unable to attend could obtain audio- and videocassettes of this service (or any other) from the church's communications department.

At the close of the service, after the television cameras had been turned off, several parents brought their infants forward to be blessed by white-haired Brother Criswell. "I pray," he said, "that these children may receive every good gift that only God could afford to bestow."

But even in Dallas there is despair in the midst of plenty. Jim Smith sees it in his work

CRAIG FUGII

Following the footsteps *of a dance coach at the Arts Magnet High School, Angela Williams awaits her turn to perform in a master class* ***(left)****. A modern master of exaggerated statement, sculptor Claes Oldenburg created his "Stake Hitch"* ***(below)*** *for the 40-foot-high vault of a gallery in the Dallas Museum of Art.*

as a family counselor for Highland Park Presbyterian Church. I had wanted to meet him personally, but his calendar was booked six weeks ahead. So we spoke on the telephone at eight o'clock in the morning.

"With great affluence comes great expectation," this busy counselor told me. "Here you have men who are very much into their careers, 14 or 16 hours a day, pursuing wealth often to the neglect of their families. They love things and use people. I tell them, in the Christian perspective it's an illusion to think that *things* are going to satisfy. They never have, in any culture."

Later I attended services at Prestonwood Baptist Church, a North Dallas congregation whose sanctuary is larger than most cities' municipal auditoriums. The pastor's lively sermon was sprinkled with diverse allusions. Some were homely and rural—farm animals, home-canned prunes. Others were sophisticated—divorce settlements, fur coats. All drew knowing laughter. On the wall beside the pulpit hung a huge banner. "Keep the Dream Alive," it said.

That same afternoon in southern Dallas at

the St. Luke "Community" United Methodist Church, I saw another sign: "Liberation–Unity–Power." The psychic distance between Dallas's two halves can be measured by that difference in slogans.

THE ALABASTER CITY does gleam less brightly below Interstate 30 and the Trinity. Southern Dallas encompasses pleasant neighborhoods like Parkdale, but it also includes such squalid districts as Fair Park and such civic embarrassments as the public-housing projects of West Dallas, where more than a thousand vandalized or neglected units have been boarded up. Unemployment in southern Dallas is twice that of the rest of the city. Some neighborhood storekeepers have taken to carrying guns.

The Reverend Zan Holmes, pastor of St. Luke's, is a former legislator and a respected black spokesman. As I waited outside his office, I looked across the hall through a door marked Operation Breadbasket. Inside was a shoulder-high sea of bagged groceries.

"We have a substantial degree of poverty in the midst of plenty," Mr. Holmes told me. "But because Dallas doesn't have as much poverty as Houston or New York, we celebrate ourselves. Instead we should be doing

***The line forms at the front** of Herrera's, a nine-table Tex-Mex eatery popular with the Southern Methodist University crowd, who happily install themselves on the curb, pop open some beers, and wait their turn to be called.*

look at it as overly conservative and averse to social programs. But instead of more welfare, Dallas wants more jobs. It wants more blacks to join the business arena. In the quest to be the mecca of free enterprise, the leaders of this city understand that opportunity has to be open to everyone."

STILL, many of the gravest problems that go under the label "human needs" can be seen at their most acute in the southern sections of the city. I got a glimpse of them when I visited the Boston Home for Handicapped Children, located in a small house on southern Dallas's Prosperity Street. Thelma Boston, busy and earnest, has given shelter to more than 200 abused and retarded children since 1962. Among the 16 in residence when I visited was Jackie—teenaged, blind, unable to talk. Jackie was brought to the home 11 years ago after being discovered abandoned by the side of a Dallas County highway.

"We don't know anything about him," said Mrs. Boston. "There were no inquiries. They found him gnawing on his arm; it took six people to feed him. Now he can feed himself, dress himself, and knows the way to the bus. He rides it to the Deaf School." In such achievements is love expressed; rather than make Jackie leave the home when his eligibility for foster care expired at age 18, Mrs. Boston legally adopted him.

Needing new kitchen equipment, among other things, Thelma Boston applied to the Crystal Charity Ball committee for a $29,000 grant. She went to North Dallas to present her case—"at one of those ladies' homes, whooo! It looked like it took up an acre of land"—and when she finished her talk, "I thought I didn't have a chance after all those doctors and educated people." But when she spoke, the committee stood up and applauded her. She got her $29,000, as well as a generous endowment.

George Loving Place housing project may

something about it. I don't think blacks own a dozen buildings in Dallas over two stories high. What the poor and minorities need is the same opportunity everyone else has—not special treatment, just fair treatment, including affirmative action programs to overcome past racism and neglect."

Not everyone would agree with the dapper Mr. Holmes, who drives a Mercedes himself. Comer Cottrell brought the country's second largest black hair-care products company to southern Dallas from California in 1979. "Dallas is the most generous community I've ever seen," he says. "We blacks don't look at our own city objectively. We

Big D's: *Dancing and drinking are consuming passions for many of the young and not-so-young who flock to clubs on Greenville Avenue. At Confetti* (**right**) *a wall-to-reverberating-wall crowd gets footloose and free-spirited, like this heel-kicking celebrator* (**above**). *Dallas is a relatively young city among major cities, with a median age of 28.7.*

be the grimmest spot in Dallas. Contamination from a nearby lead smelter forced the closing of 260 of its 1,474 units; another 300 have been condemned as unfit for occupancy. I rode through its littered streets with Kenneth Hogg, president of the Residents Council and an 18-year veteran of the place. Though the day was a holiday, it was business as usual for the bootleggers. On Delhi Street a group of men threw dice on the sidewalk. A child tugged at a loosened fence. "We're very concerned about the crime and the unemployment," Hogg said.

We stopped to buy a soft drink from Viola Daniels, who was traveling the project in a "store truck" she owns called the B&W Grocery. "Any trouble?" I inquired. "Oh, yeah, they break in whenever I leave."

In the midst of this depressing scene the senior citizens center is an oasis of calm. There I met Pauline Garey, a jovial black woman wearing rimless glasses, and Willie Mae Coleman. It turned out that they *were* the senior citizens center; no one else ever comes. The two women spend the days painting ceramics, which they manufacture from molds heated in their portable kiln. And Mrs. Garey has her other work, too: cooking and shopping for her housebound neighbors and successfully lobbying for improved security measures in the project. "You heard of Mister Arthur Ritis?" she quizzed me. "If you don't stay busy, he'll overtake you." She chuckled merrily.

Dallas is trying hard to help the neglected areas of the city catch up with the other sections. A special task force was created to study housing and economic conditions, and a joint public/private share-the-risks program offers new development incentives. "The potential for Dallas is unlimited," says city manager Anderson with optimism. "It's like having a good security in your investment portfolio—if you do the right things with it, the result will be terrific."

What can Dallas teach other cities? "Free enterprise," said former mayor Bob Folsom, looking across the vast expanse of North Dallas from the office of his investment company. "That the free enterprise system works best."

And what can Dallas learn? Tranquillity of heart, perhaps—an understanding of where individual success and wealth fit in the larger scheme of things. Walking through a corridor at the University of Dallas, I noticed a quotation taped to a professor's door. "We have all," it said, "warmed ourselves by fires we have not built, and drunk from wells we did not dig." This resonant thought stayed with me in the excitement and self-absorption of the great city.

MY STAY IN DALLAS ended as it began, at a window. This time it was the sixth-floor corner of the Texas School Book Depository where, 20 years to the minute earlier, Lee Harvey Oswald had fired his fatal shots. A small crowd drawn by the fateful anniversary had gathered in Dealey Plaza. Upstairs in the bare room I was alone, remembering not only Dallas's and America's dark hour but also another brighter time some 140 years before, when John Neely Bryan staked his claim and stood on the peaceful bluff considering the village he would build.

In Dealey Plaza the road curved gently past the oaks that grew beside the place Bryan chose; in the distance the Hyatt Regency's mirrored columns and Reunion Tower rose like the Emerald City of Oz; and farther still, across Stemmons Freeway and the noonday bustle, ran the Trinity, the unnavigable river that occasioned it all.

The window rattled softly in its wooden frame. Dallas had begun with a single frontiersman, his horse laden with everything he owned; now it is home to a million people awash in an ocean of abundance. From the frugal age of John Neely Bryan to the extravagant era of malls and mini-storage, Dallas has made its hard-working, spirited, never-look-back journey. It is a city of dreams—and of the people who make them come true. □

Putting down roots, *a young couple head toward suburban Dallas, where nursery-bought redbud, crape myrtle, and dogwood now enhance former grazing land. Watered by development money, warmed by feverish Sunbelt growth, Dallas environs sprout subdivisions as the city moves ever onward and outward.*


TEXAS
270·DVM

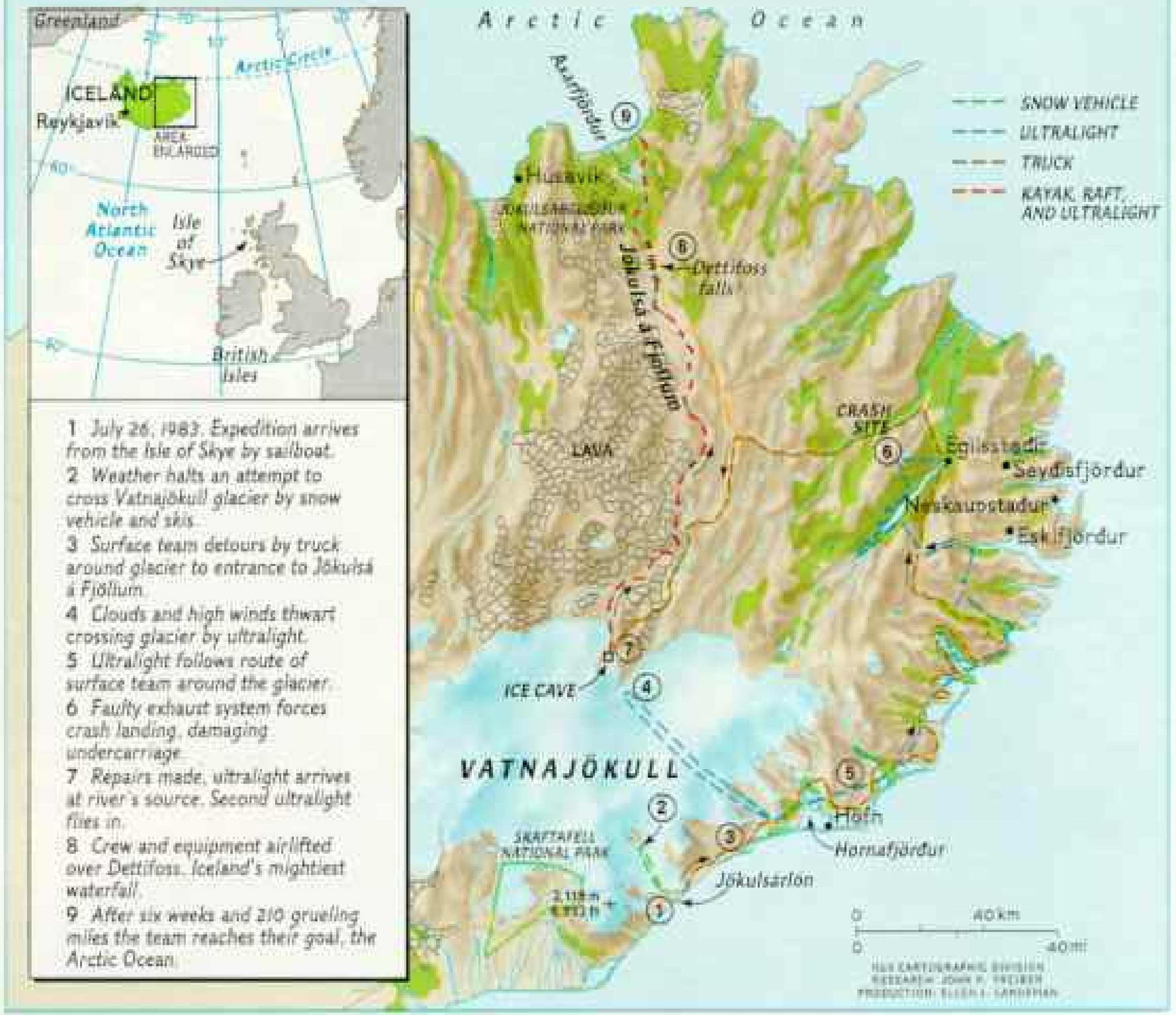
RUNNING THE JÖKULSÁ Á FJÖLLUM

Iceland's Wild Glacier-born River

By PAUL VANDER-MOLEN

Photographs by ROBERT GRÉGOIRE and JEAN-LUC CHÉRON

THROUGH a mist-shrouded cavern of ice, helmeted kayakers ride the Jökulsá á Fjöllum at its source deep inside the mighty Vatnajökull glacier of Iceland. The stream's name means "glacier-fed river in the mountains." Here Mick Coyne leads teammates in a tunnel formed by geothermal springs. The river soon emerges from the glacier and flows north for 128 miles, marked by violent rapids and four major waterfalls. Last summer our 12-man international team successfully challenged the Jökulsá with a revolutionary technique using kayaks, inflatable rafts, and ultralight aircraft.



1 *July 26, 1983. Expedition arrives from the Isle of Skye by sailboat.*
2 *Weather halts an attempt to cross Vatnajökull glacier by snow vehicle and skis.*
3 *Surface team detours by truck around glacier to entrance to Jökulsá á Fjöllum.*
4 *Clouds and high winds thwart crossing glacier by ultralight.*
5 *Ultralight follows route of surface team around the glacier.*
6 *Faulty exhaust system forces crash landing, damaging undercarriage.*
7 *Repairs made, ultralight arrives at river's source. Second ultralight flies in.*
8 *Crew and equipment airlifted over Dettifoss, Iceland's mightiest waterfall.*
9 *After six weeks and 210 grueling miles the team reaches their goal, the Arctic Ocean.*

COAST-TO-COAST TRAVERSE of Iceland (***left***) carried our expedition on a roundabout route from Hornafjördur in the south to the island's northern shore, where the Jökulsá empties into the Arctic Ocean. Our first challenge was the Vatnajökull, one of Europe's largest glaciers, occupying one-twelfth of Iceland and creating its own unpredictable weather. For transport as well as reconnaissance of our route, we brought along British two-man ultralight aircraft (***below***), equipped with detachable floats, wheels, and skis, for landing on water, tundra, or ice. With a carrying capacity of 400 pounds, the craft could airlift our entire expedition by stages, including kayaks and the rubber raft designed to carry the disassembled ultralight downriver. Here our Icelandic crew, who are also members of the National Life-Saving Association of Iceland, which gave us generous support, watch pilot Gerry Breen make a practice takeoff from Jökulsárlón lake at the southern edge of the glacier.

PAUL VANDER-MOLEN (BELOW)

FURY OF A GALE (***above***) envelops us on the third day of our attempt to cross the surface of the Vatnajökull. The blinding storm struck without warning, forcing us to make camp. Wind and cold combined to produce a chill factor of minus 30°F. Though polar daylight was almost continuous, driving snow reduced visibility to a few feet. Despite efforts to keep the tents snow free, their collapse on the third day forced us to dig ice caves in the glacier for shelter. On the fifth day we retreated to the foot of the glacier. A second mishap (***below***) befell pilot Gerry Breen and me when our ultralight's exhaust system failed during a flight around the glacier and we had to crash-land. We rigged a shelter out of the ultralight's wing and a pair of skis while we made repairs. Three days later the craft was airborne again, and we met the team in the ice cave at the source of the Jökulsá, deep beneath the glacier's northern edge.


DYNASTAR
DYNASTAR

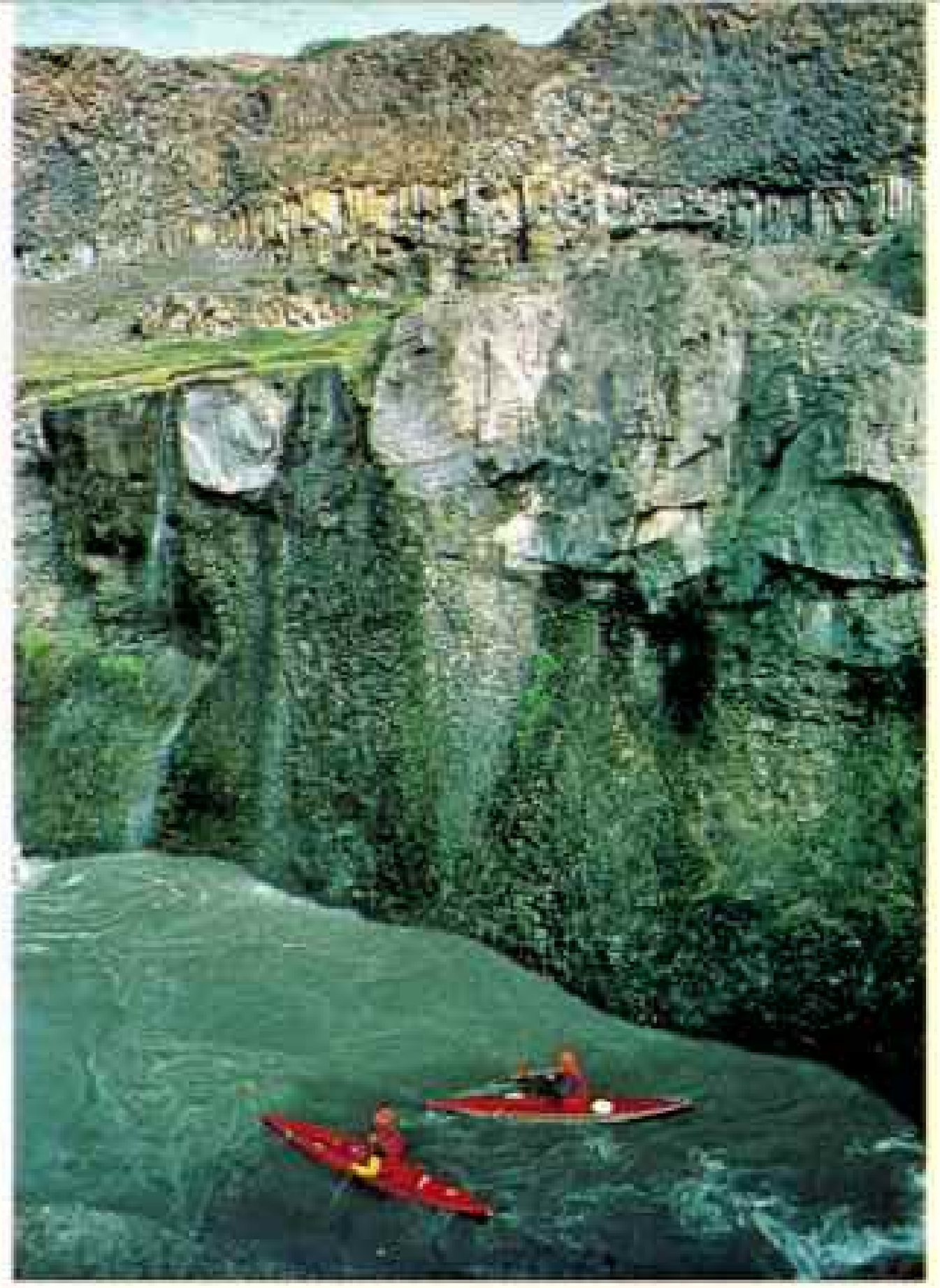
YAWNING SINKHOLE of ice pierces the Vatnajökull like a huge inverted funnel 150 feet deep and 70 feet across at the surface. Formed by steam from geothermal vents, it provides an entrance to the source of the Jökulsá. An experienced mountaineer as well as kayaker, Mick Coyne descends into the shaft as teammates lower his kayak. High winds and freezing temperatures slowed the operation topside, but within the sinkhole the air was warm. A relic of the most recent ice age, Vatnajökull is thousands of years old. Layers of ice exposed on the sinkhole walls reminded us of giant tree rings. "Lowering yourself past them," Mick recalls, "was like drifting back through time."

THROUGH *a glistening column, Mick Coyne and kayak continue the descent of the crater wall. Ice screws anchoring our ropes required constant resetting in ice walls softened by warm air currents. All of us wore crampons, as well as helmets for protection against falling ice.*

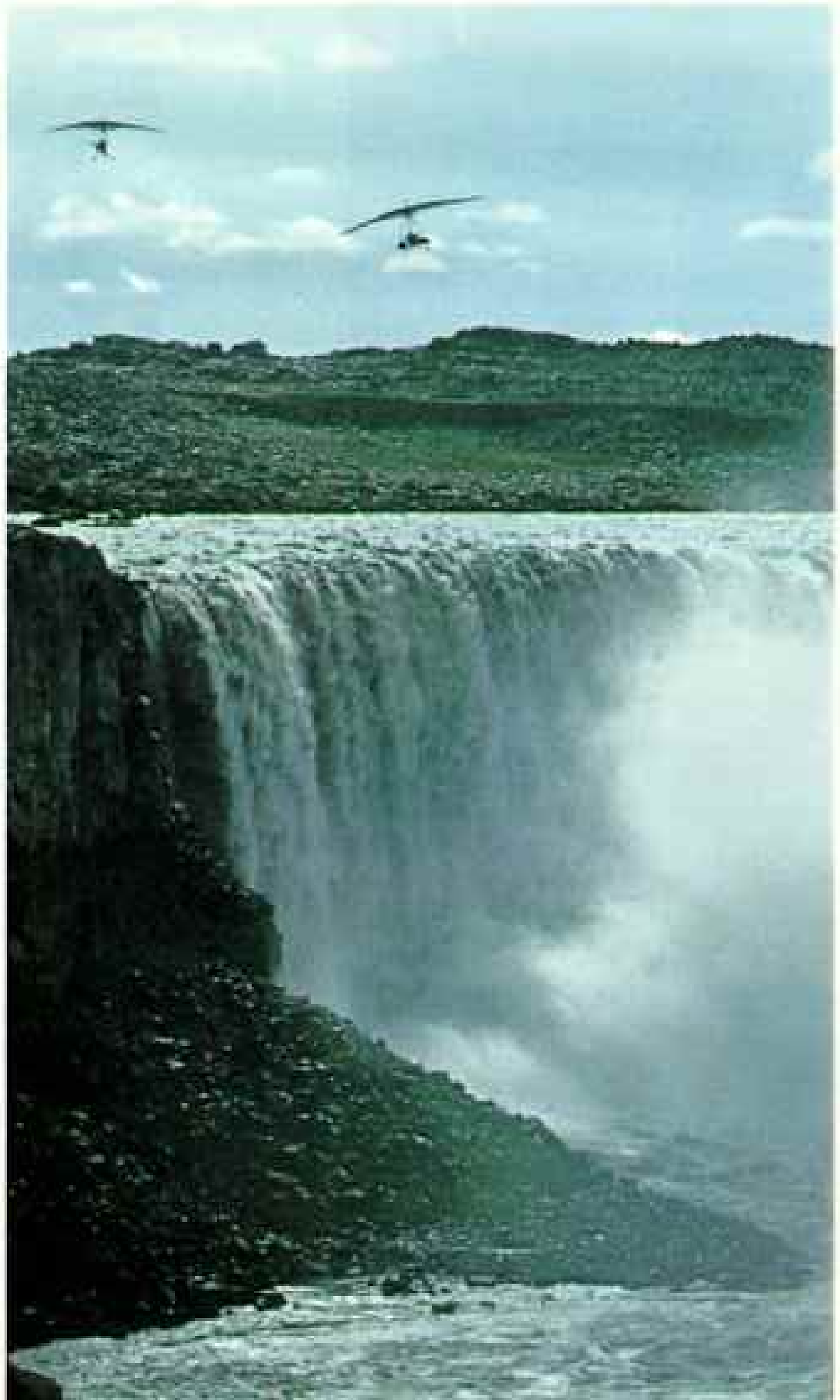
ICY SHAFT OF WATER (**above**) spills from the roof of a chamber inside the glacier. The near-freezing water mixes with the boiling flow from geothermal springs to produce a temperature of about 95°F. Before starting our voyage downriver, we enjoyed our first bath in nearly a month (**below**).

We were a dozen men representing five nationalities—British, Australian, French, American, and Icelandic. Together we combined more than a score of skills and professions. Mick Coyne, seen here at right center, is a geologist and former Royal Marine. American Jeb Stuart, far left, is an expert river rafter from Colorado, and French kayaker Benoit Dabout, far right, studies civil engineering. Our two Icelanders, Guđbrandur Jóhannsson, left center, and Gisli Hjálmarsson, are members of the Life-Saving Association and acted as our guides. British ultralight champion Gerry Breen is a former member of the Royal Air Force and a meteorologist, and our French cameraman and film director, Bruno Cusa, is a licensed helicopter pilot. He was assisted by sound technician Jean Jacques Mrejen. To the role of expedition leader, I brought my training as a British research engineer and practical mechanic, plus many years' experience with kayaks.

Selecting the team, I looked for character as well as skill. All the technical ability in the world cannot make up for poor judgment or failure to put the group ahead of self. In that respect, too, our party was outstanding; I would run the wildest river on earth with any of them.



AIRBORNE KAYAKS, lashed to the undercarriage of an ultralight piloted by Gerry Breen (***below***), leap a stretch of the Jökulsá. Below are four impassable waterfalls, among them the spectacular Dettifoss (page 321). We came ashore two miles above the canyon and unloaded the disassembled ultralight from our 18-foot inflatable raft (***above***). It took only 12 minutes to assemble the aircraft. Meanwhile our Australian pilot Simon Baker scouted the river in our second ultralight. The two machines lifted men and equipment, including the deflated raft, directly over the falls. Four miles downriver we took to the water again. Vertical walls of crumbly basaltic lava (***right***) would have made climbing out of the canyon close to impossible.



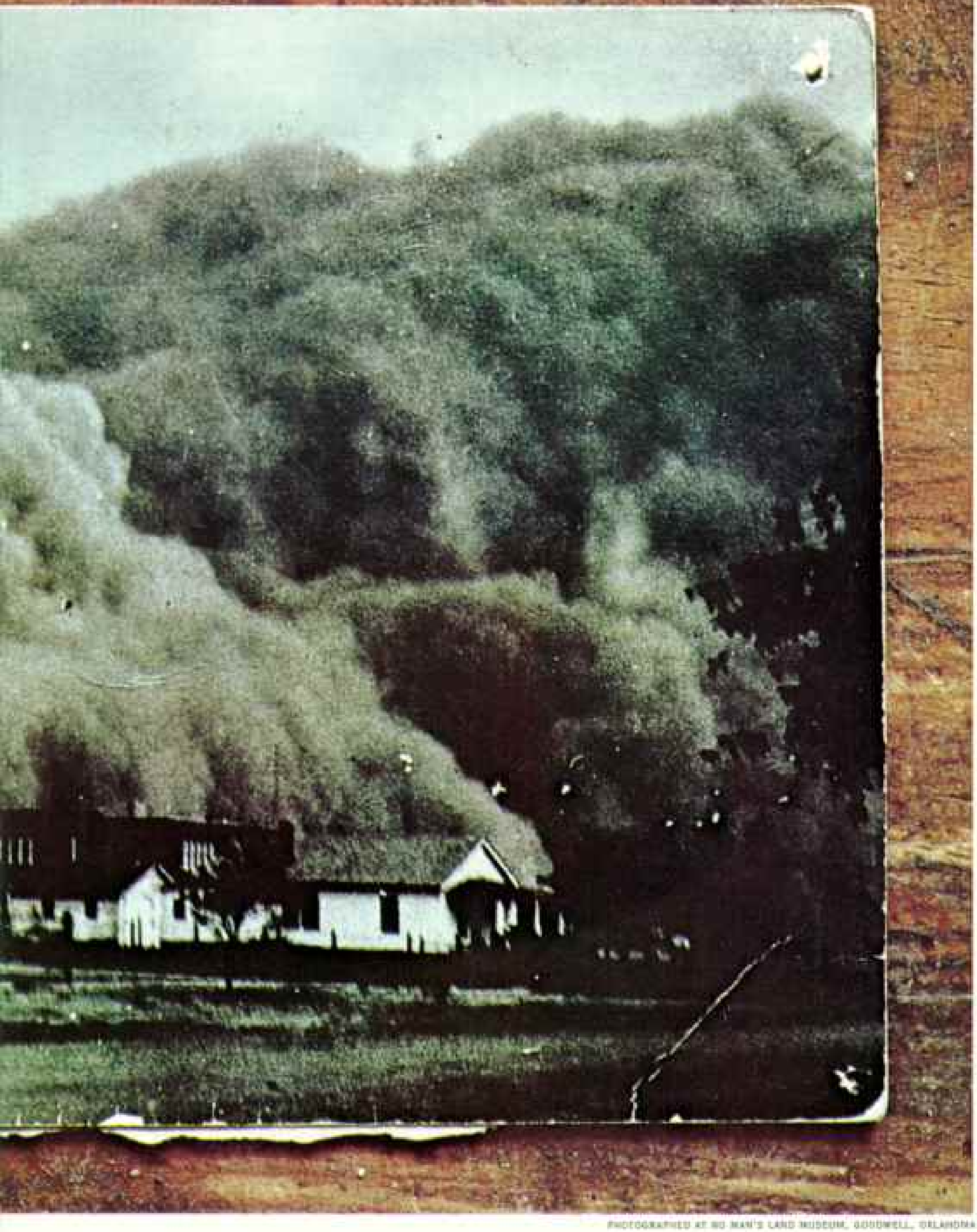
CALDRON of white water (***above***) engulfs Jeb Stuart and his rafting crew as Mick and I paddle alongside. We met these rapids eight miles below the great cataract of Dettifoss (***left***). Despite his skill and experience, Jeb (in baseball cap) was unable to prevent his raft from swamping; only frantic bailing for nearly ten miles kept craft and crew afloat.

We had previously scouted some of these rapids on foot. Ultralight reconnaissance can pinpoint major river hazards, but there is no substitute for close inspection. If we had been totally unprepared, the results could have been disastrous. As it was, Mick (wearing blue life vest) was torn out of his kayak and hurled downriver fighting desperately to stay afloat (***below***). Benoit helped him ashore about a mile downstream, but the cold and constant immersion took their toll. Fortunately the water was about 45°F. A few degrees lower, and Mick might not have survived.

It was our last major crisis. Seven days later we reached the coast. We had pioneered a new technique combining the use of kayaks and ultralights and had become the first to run the wild Jökulsá from source to mouth. □

THE OKIES
Beyond the Dust Bowl

By WILLIAM HOWARTH Photographs by CHRIS JOHNS



PHOTOGRAPHED AT NO MAN'S LAND MUSEUM, GOODWELL, OKLAHOMA

A giant dust storm engulfs Goodwell, Oklahoma, in June 1937. Whipped by cyclonic winds, the "roller" may roil two miles high, a hundred miles wide, and move faster than 50 miles an hour. During the Great Depression such storms destroyed vast areas of Great Plains farmland. Displaced families, often called Okies, headed west to find new lives.

SAM DILLARD greets me at his screen door with a poker-faced "Howdy." Tall and strong at 78, he looks dressed for a day's work on the Great Plains: boots, bib overalls, checked shirt, and a creased felt hat. But this is southern California, as I can tell from his big, cracked hands: One holds a ripe fig, the other a toy poodle.

Sam is an Okie, and in California that label is as fuzzy as his pet dog. Some natives say the word with a smile, others with a sneer. Okies came west as labor migrants during the Great Depression. John Steinbeck fictionalized them in *The Grapes of Wrath;* Merle Haggard gave them a hit song, "Okie From Muskogee."

The real story is hard to find. Okies are not just Oklahomans or "Dust Bowl refugees," as many believe. So today I want to hear Sam's story, in his own words.

"Till the dirty thirties I farmed 200 acres at Stonewall, Oklahoma. Raised corn and cotton; went fishin' when the crops was laid by. At dances we had fiddles and wildcat whiskey—dollar for half a gallon. It'd knock you on your coon-dog hind end. I knowed Purty Boy Floyd when he was robbin' banks. Carried a big ol' thumb-bustin' .45: a good-hearted type, no radical.

"Arrived in California on August 5, 1935. Six of us in an old Pontiac, all our stuff piled on top. Worked in the fields, mostly tractor and irrigation. I've dug potaters from here to Santa Maria. Was in the heavy artillery durin' the war. Just like a turkey shoot—give us an address, and we'd send a round right over there.

"Never had time to get married; took care of Mother and Father when they was old. Don't believe I'd've been happier with more money. Knowed a rich man; he got to drinkin' and drowned in his own swimmin' pool.

"Only went back to Oklahoma once. Things didn't look right. Old place was gone, big oil well pumpin' there by the post oak tree. I wasn't satisfied. Everyone I knowed had gone to California."

Sam and millions like him survived the greatest economic crisis America has ever faced. Images of Depression days still haunt our national memory: Banks failed, factories closed, workers lined up for free bread and soup. The Okies journeyed west with nothing, just hope and a pair of empty hands. To see how they have fared, I retraced their long trek. I talked to elders, met their families. The children are teachers, surgeons, ranchers, poets—all Okies, and no two of them alike.

Some are proud of their heritage, others want to hide it under a vested suit. To a people once poor and despised, money expresses pride. Okies like to get and spend in their own flamboyant style. At "swap meets" they sell tools, chickens, designer jeans—anything listed in the yellow pages—at bargain prices. On racetracks, Okie drivers blast around the turns at high speed, risking $10,000 cars for a hundred-dollar prize.

This reckless spirit sustains the image of Okies as rednecks and stompers, snobbish terms that keep a people down. The people I met are strong and caring. Out of an itinerant past, they have formed tight bonds.

Country music is their gospel, fiddles singing to a high-whine steel guitar. Cars, trucks, and cycles are freedom itself, the chance to pull up and move on. And in that slow western drawl, I swear you can still hear the dust in their throats.

Often I asked: "Where is home for you? Would you ever go back?" No two answers were alike. Home is hard to define, especially for a once migrant people. To Okies the road itself was a destination. They learned to carry home inside themselves. I learned that myself by taking their hard-times road.

Sallisaw, Oklahoma: Cherokee Street— The "green country" of eastern Oklahoma, drained by many rivers and streams, has long been a home for migrants. After the explorers and trappers, Indians of the Southeast arrived, marched west to make room for white settlers. Within three generations, whites came west to lease the Indian lands.

Echo Rider, a schoolteacher and local historian, is directing restoration of a pioneer cabin. She remembers tenant families, people who rented homes on her parents' land. They borrowed tools, cottonseed, and mules to plow 40 or 80 acres. At season's end they shared the crop with landowners. John Steinbeck called *(Continued on page 330)*

Author **William Howarth**, Princeton American Studies professor, retraced the life of Henry David Thoreau in the March 1981 GEOGRAPHIC, and of Willa Cather in the July 1982 issue.

The hard-times road of the 1930s

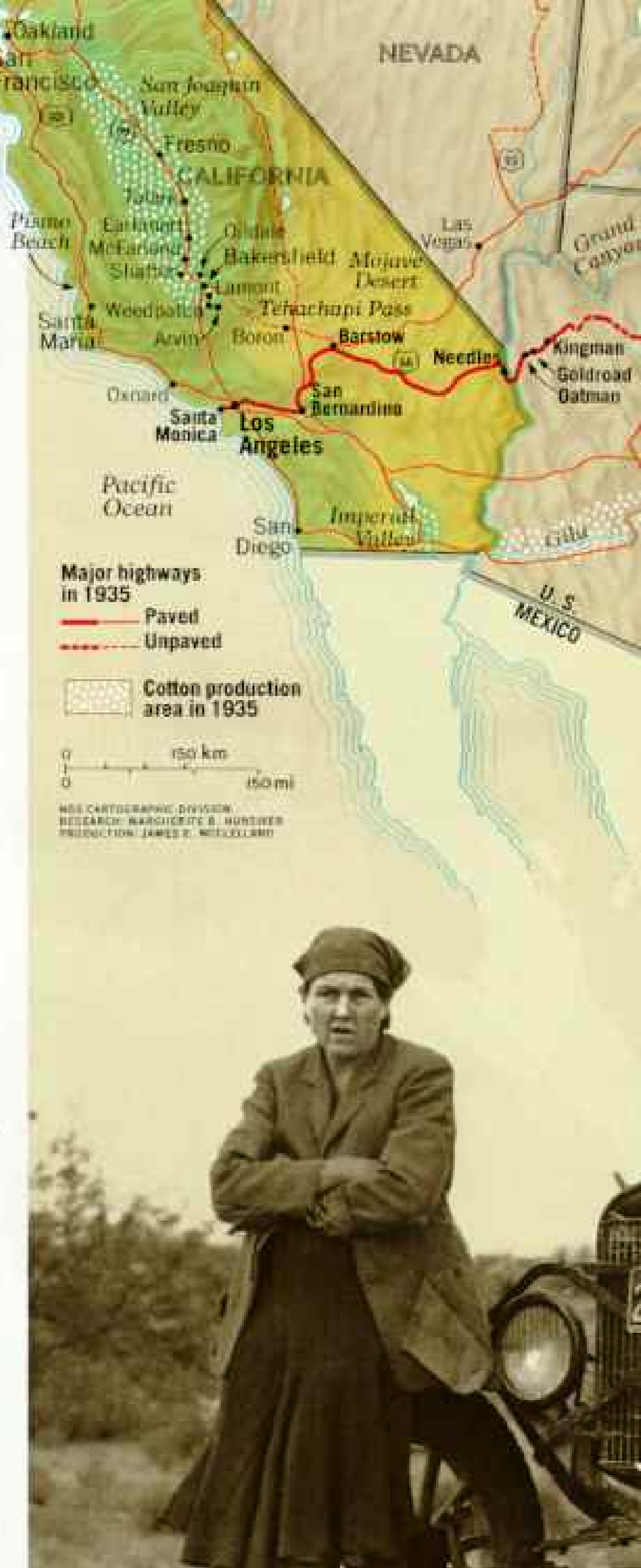
We rattled down that highway
To never come back again.
WOODY GUTHRIE

*OKIES, Arkies, Texies, Dust Bowlers: They had many names, but no place to call home. This family (**right**) was stalled on U. S. 80 near Lordsburg, New Mexico, in May 1937. On the road with them were half a million migrants from rural America, heading west and looking for work. They came from many states: Oklahoma, Texas, Arkansas, Missouri, Kansas—places where they could no longer make a living.*

Many were sharecroppers who worked a few acres with mules or horses—a hand-labor system that new technology was eroding with tractors and combines. Others were homesteaders, forced off their own land by a grim cycle of natural and financial disasters.

The seeds of failure had first been sown decades earlier. Plows had turned up the plains, erasing grasslands that once held the dry, sandy soil. Cotton, wheat, and corn depleted the soil of moisture and nutrients. Marginal land was plowed in a desperate effort to make a profit. Then came drought and dust storms, hard times that coincided with the Great Depression. When crop prices failed, cash ran dry; farmers could not raise loans to pay their debts. Banks foreclosed, and families moved on.

Many were bound for California, a promised land of sunshine and oranges, along U. S. 66, main route of the migrants. But the migrants found there an unfamiliar system—seasonal hiring for low wages, a rootless life. Aroused by strong public concern, many agencies of the Roosevelt Administration worked to provide emergency relief. John Steinbeck made the Okies into tragic heroes in his novel The Grapes of Wrath. *Nevertheless, the real people endured, many prospered, and most managed to keep alive their sense of home.*



PHOTOGRAPH BY DOROTHEA LANGE, LIBRARY OF CONGRESS COLLECTION

UTAH
COLORADO
KANSAS
ARIZONA
NEW MEXICO
OKLAHOMA
TEXAS
Colorado
Arkansas
Red
Rio Grande
Pecos
Brazos
DUST BOWL
1935-38
1938
1935-36
Area of most severe wind erosion 1935-38
ROCKY MOUNTAINS
Main route of western migration
Flagstaff
Gallup
Santa Fe
Sanders
Albuquerque
Tucumcari
Amarillo
Wichita
Hooker
Kenton
Boise City
Guymon
Beaver
Elkhart
Goodwell
Woodward
Enid
Tulsa
El Reno
Oklahoma City
Stillwater
Stonewall
Phoenix
Tucson
Lordsburg
Fort Worth
Dallas
Austin
Gulf of Mexico
COTTON BELT

Home to stay, *Kirby and Martha Houston have lived the Okie story: farming shares, dusting out, and trekking west. But they soon returned to Oklahoma. Here*

in Vian they live modestly, eating out of their own vegetable garden, spending little and saving everything, especially fiddle tunes from Kirby's boyhood.

Rush hour on Main Street *in Kenton, Oklahoma, is so slack that a customer for Kenton Store can park in the middle of the road. Once a boisterous saloon town*

this system oppressive, but Echo disagrees: "Tenants and owners worked and played together, lived as regular neighbors. People aren't half as close today."

Vian, Oklahoma: Star Route—Kirby Houston, 75, is built like a fiddle bow, limber and short. But his memories are long. His cigar box of photos is an Okie family album: Born in the Ozarks. Farmed shares in El Reno, Oklahoma. Dusted, busted, never rusted. Drove west in 1939. Picked peppers and butter beans at Oxnard, California. Came home in 1944 and never went back. "I'd ruther be where people is friendly."

After the talk, out comes his fiddle. "In them Depression days the only fun I had was playin'." His tune is "Old George Gans," and it makes the years roll by. The sound arose in Scotland, crossed ocean and

known as the Cowboy Capital, Kenton thrived on cattle ranching until the 1930s, when drought broke the livestock market and many people moved on.

mountain, finally paused at Star Route, Vian, Oklahoma. The music followed its migrant people.

Kirby and his wife, Martha, live on ten acres in a tiny house crammed with odds and ends. He throws nothing away, feeds scraps to his bluetick pups. Food comes from a two-acre garden: "You know the dirt is good, when it grows weeds like this." Out back, he cuts firewood. Living expenses are less than his Social Security check. "I've got everything a man could want."

Kirby has a formula for success: "I eat corn bread three times a day—didn't know such a thing as flour till I went to California." He prefers simple pleasures, like fishing and walking. On a tour of his property I hope to see jackrabbits.

Long-eared, light in the front legs, strong in the rear, jackrabbits used to crowd this

They faced the wind *and held on. Four generations of Fischers (**above**) live on this 7,000-acre farm near Hooker, Oklahoma—heart of the Dust Bowl. Louis Fischer, 83, center, paid as little as 25 dollars an acre for land in the area during the 1930s. Today his family spread is a thriving enterprise, using high technology and a fortune in farm machinery to boost production of wheat, barley, and sorghum. Standing in a field of ripe milo, Fischer's heirs include son Norman, right, grandson Tom, left, and great-grandsons Aaron, far left, and Nathan—both sons of Tom. At day's end (**right**) Tom heads home in a replica of a classic MG, part of the family's car collection.*

country. During the 1930s thousands were herded into pens and bashed to death. Some thought the jacks were destroying crops and grass. When livestock prices collapsed, rabbits became welcome guests for dinner. Folks called them "Hoover hogs." Kirby and I find no jackrabbits today. "Maybe they went west," he says, "like the Okies."

Enid, Oklahoma: Route 81—Driving northwest, I pass through a land of tin roofs and cottonwoods, the prominent tree. Big tractors pulling gang discs lumber about, stirring up dust. These high plains are flat and dry. In 1541 Coronado explored the region and reported: "If a man lay down on his back, he lost sight of the ground."

Even standing erect, men can lose sight of the land. This highway crosses the Cherokee Outlet, site of America's last great land rush. On September 16, 1893, thousands of homesteaders lined its borders, awaiting a signal.

PHOTOGRAPH BY RUSSELL LEE, LIBRARY OF CONGRESS COLLECTION (RIGHT)

Living out of tin cans, *their old car packed with the few possessions they own, a family camps near Muskogee, Oklahoma, in June 1939. To get money for food and gasoline, the Okies often stopped on their journey west to hire on as seasonal laborers. A day's labor brought around a dollar in wages. Many travelers were plagued by malnutrition and dysentery, although this mother may have coped with the latter by doses of Lacto Dextrin, a remedy "for changing the intestinal flora." Unchanged were the day-to-day realities of feeding the family, repairing the car, and washing clothes.*

*This sharply detailed scene (**right**) was captured by photographer Russell Lee, who traveled 100,000 miles with his cameras, including a Speed Graphic (**above**), for the Historical Section of the Farm Security Administration. Lee, now in his 80s and living in Austin, Texas, and other FSA photographers compiled some 216,000 images of the Depression, America's largest archive of documentary photographs of that era.*

Guns fired, bugles sounded—and they rushed in, scrambling to stake claims. Tent cities sprang up, plows bit into the thick virgin turf.

The underlying soil is mostly light and sandy. It yielded wheat and corn—in good years. Soon tractors replaced mules; seed drills and combines brought mass production to the fields. Small homesteads began to give way to larger spreads. Then, from 1933 through 1937, scant rain fell. High winds blew, and the whole country began to move.

Woodward, Oklahoma: Route 270—"I got a feeling for this situation in 1980. On some fragile, marginal land, we cultivated a field once too often. Before long I almost had a sand-dune park here. And 1980 was not a year of drought." Phillip Sims says "drouth." Since he is a range scientist—and director of a federal research station for the southern plains—I defer to his usage. No matter

Memories for sale: *Dust Bowl trucks await buyers near a weathered farmhouse near Guymon, Oklahoma, on U. S. 54. Men and machines were*

how we say it, no rain means hard times.

Phillip's job is to develop new, hardy strains of grass and cattle. The Okie cross-breed he favors is homely and lop-eared, but also drought resistant, a survivor. Crop farming with plows and pivot sprinklers, he feels, depletes precious moisture: "Drouth comes in regular cycles here, about every 20 years. Today, we are green and lush—but we're on our way toward another drouth."

Guymon, Oklahoma: Route 54—Once this panhandle was called No Man's Land, because no government claimed it. A sign outside town reads "Home of the Most Lied-About Weather in the U. S." The true figures are dismal enough: 17 inches of rain a year, 15 miles of wind an hour. Wind only seems worse in a drought. In 1933-37 Guymon recorded 352 dust storms—one every five days. A reporter gave the region its new name, "dust bowl of the continent."

The No Man's Land Museum in Goodwell, Oklahoma, is full of 1930s souvenirs: battery radios, Kewpie dolls, scrapbooks of newspaper clippings. The Dust Bowl spread across five states, a disaster zone of dead wheat and dying cattle. Dust piled in

luckless partners during the 1930s, as Will Rogers noted: "We are the first nation in the history of the world to go to the poorhouse in an automobile."

drifts, and the debts piled higher. Joan Kachel, museum curator, remembers: "Often we couldn't play outside, the dust was so bad. I had to stuff rags in the window cracks with a knife. Most days I could wipe my name on the kitchen table."

Beaver, Oklahoma: Route 23—Dr. Ed Calhoon looks up the highway, recalling the greatest storm of all—Black Sunday—April 14, 1935.

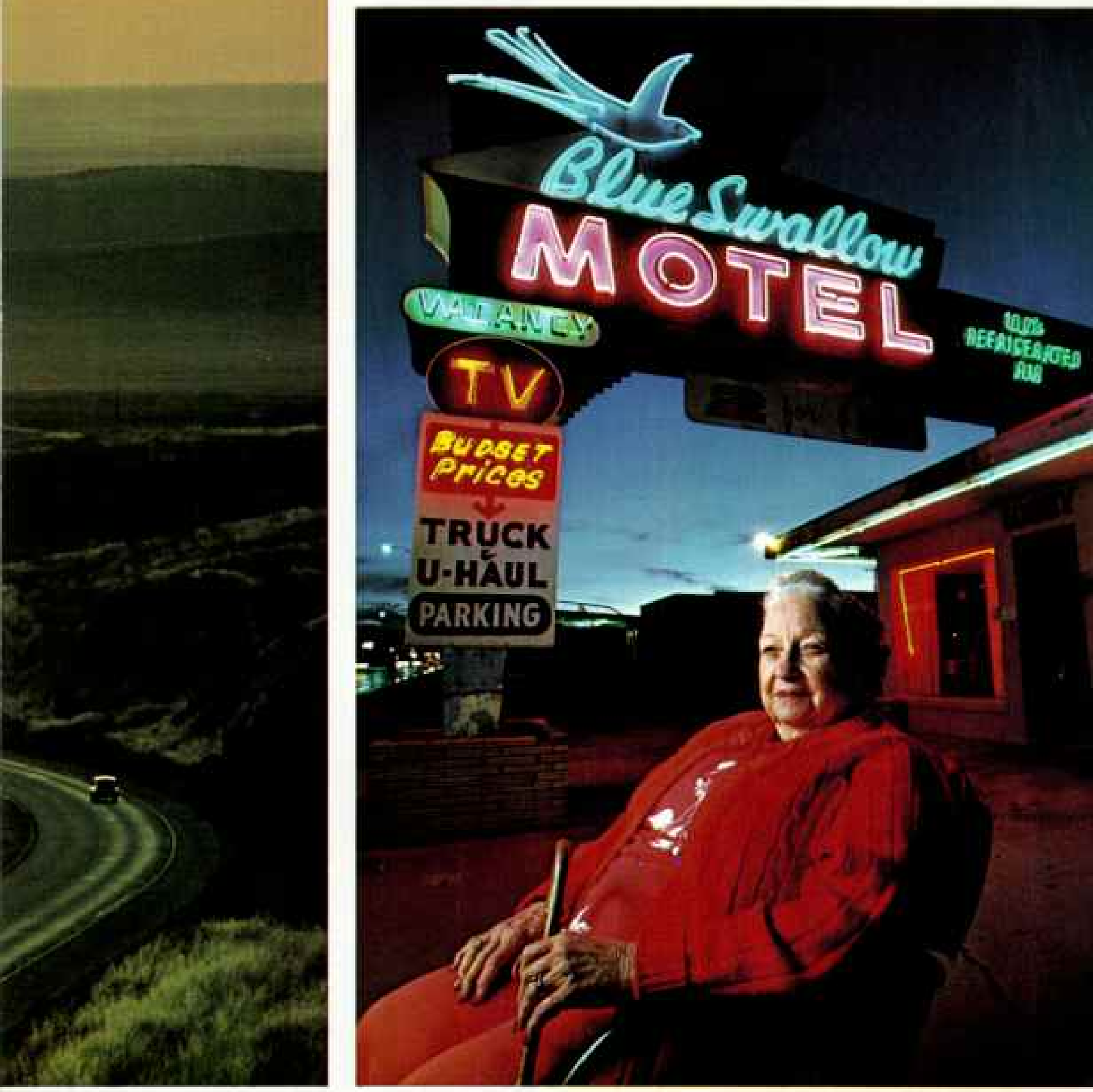
"It was like a tornado running sideways, a boiling wall of dirt, horizon to horizon and several thousand feet high," he remembers. "It overran a house and came rolling on. Birds were flying before it, looking desperate. Then it was on me. Cold, total darkness; static electricity played all over our old Tin Lizzie. I sat there for 40 minutes. For days afterward I heard stories of chickens going to roost and drunkards praying for redemption. Old-timers thought this country never would come back."

I look around at the green horizon, at fields alive with grass and flowers. Good range here for cattle, fine cover for small game. Any jackrabbits about? Not a one. Maybe they blew away.

Rolling west, *traffic on U. S. 58 drops through the Tehachapi Pass* (**above**) *and heads for Kern County, the "golden empire" of California agriculture. For the Dust Bowlers, however, the main road west was U. S. 66, now largely replaced by interstates. Lillian Redman* (**right**)*, roadside hostess for half a century, still offers bargain rates to travelers on Business 66 in Tucumcari, New Mexico.*

We drive to meet Dr. Calhoon's schoolmate Helen Brown. Her family farmed here until 1934, "when our troubles started. We could raise food, but not cash money. Daddy couldn't pay the taxes, and he wouldn't declare bankruptcy—maintained it was dishonest."

The price structure had collapsed. Farmers burned corn in their stoves: Corn was cheaper than coal. Government agents slaughtered cattle, paying ranchers a pittance. Banks repossessed land at a few



dollars an acre. That was long ago, but authorities report that erosion remains a problem and farm bankruptcies are rising.

Most farm refugees came from outside the Dust Bowl, sharecroppers forced into a drifting life. Families went to Washington and Oregon to harvest fruit and lumber. Others trekked to the cotton-growing regions of Texas and Arizona. Mainly they sought California, a promised land of oranges and palms.

Dr. Calhoon stayed put. He mopped floors to pay college tuition; today he owns 5,640 acres of pasture: "I believe there are two trees on that land." A frugal son of the Depression, he drives a battered Olds and wears hospital whites. The knees are patched with surgical tape. "I was born where poverty was invented," he says, and that country remains his home. "California? It's the melting pot and falling-off place of the world."

The migrants told how they auctioned their goods and bought old jalopies, mostly

Chevys and Model A Fords. They tied the doors with baling wire, threw quilts over broken seat springs. The cars had four cylinders, modest horsepower. Every few miles something boiled over, went flat, broke down. Drivers made ingenious repairs, using a piece of pork rind, for instance, to repack an axle bearing. At night the travelers ate from tins and slept in tents. "Tin-can tourists," half a million of them on the road.

Dalhart, Texas: Route 54—Heading west, I have packed my own Ford (Model A+) with food, clothes, books, and music. Merle Haggard is on the tape player, singing country blues and western swing—tunes by Jimmie Rodgers and Bob Wills. I've got poems by Wilma Elizabeth McDaniel and Dorothy Rose, who made the long trek as girls, and a set of state guides by the New Deal's Federal Writers' Project.

These pages bring back a vanished world: road signs for Burma-Shave and White Owl cigars, gasoline at 15 cents a gallon. By my figures, the migrants traveled for about a penny a mile; my costs are 40 times greater. I also have pictures shot for the Farm Security Administration (FSA), another New Deal agency. The images are stark and pure: desolate country and gaunt faces, people who will not yield their dignity.

Austin, Texas: West Avenue—Russell and Jean Lee are recalling their years spent on the road for the FSA (page 334). They visited rural areas by day, shooting photos and interviewing families.

"They saw *us* as migrants," Russell laughs. "One man said, 'I can't afford to buy a picture, but mister, that's a hard life.' And he slipped me a dime." At night the Lees stayed in tourist cabins, preferring bathrooms with no windows. Russell changed film in the darkened bathroom. Jean sat at a typewriter and wrote captions, words that described the pictures. Every few weeks they shipped their work to Washington, for placement in "the file."

Housed today in the Library of Congress, this collection is America's largest archive of Depression-era photographs. The file is public property. For a few dollars, anyone can own a print of works by Dorothea Lange, Walker Evans, Ben Shahn—now

Poor no more, *Hollis Roberts runs an agricultural empire from his sumptuous office near McFarland, California. In*

1939 Roberts arrived with $2.40 in his pocket. He remembers how hard those days were, when "I raised hogs and slept in the cotton rows." Today he controls more than 30,000 acres of fruit and nuts, including grapes, persimmons, and almonds.

regarded as important modern artists. Russell shrugs: "I was taking pictures of history. In time they became art. It was a public job, and I was paid. The file belongs to everyone as a record of those days."

Amarillo, Texas: Interstate 40—Along this road I keep looking for old U. S. 66. Once the Main Street of America, 66 wound over 2,000 miles from Chicago to Los Angeles. Countless migrants once traveled and camped its length. Now 66 lies mostly beneath five segments of the Interstate Highway System. A few unused sections of old roadbed survive, lost at times among tall grass and wild gourd vines.

Tucumcari, New Mexico: Business 66—For miles the signs have boasted "Tucumcari Tonite! 2,000 Motel Rooms." For years highway traffic has nurtured this city, but at the Blue Swallow Motel Lillian Redman has filled only a few rooms with guests today. She remembers worse times, when the migrant families passed through: "They came into town and asked for work, but mostly they kept apart, camping down at Five Mile Park. In winter they went to the

Proud to be an Okie, *Merle Haggard makes his fiddle sing at a racetrack concert in Bakersfield, California. Born in a rebuilt boxcar, this top recording star has spent his life on the move. His songs of freight trains and lonesome roads celebrate the Okie past, when home was the highway or a crowded labor camp.*

power plant and gathered around the hot-air pipes, just to keep warm." She gives me a copy of her prayer for the road: ". . . may your journey be safe. We are all travelers."

Driving straight into the sun, I squint and listen. Haggard is riding a high chorus: "*Whiiite liiine feever. . . .*" The tires clump-clump on tarred road joints. Approaching trucks rush by with a noisy *yeeeowww*. At high revolutions I am playing an old American tune. To find open land and a new life, we always moved west on a long, hard journey. Now the road is lined with "trading posts"—some are giant tepees built of painted concrete. Buy a chili dog, inspect velvet paintings and cactus lamps. Signs promise "Closeouts—Below Cost." Hard times have reached the tourist trade.

Beyond Albuquerque the highway runs straight west for miles, flanked by eroding buttes and mesas. To migrants this country must have seemed ominous, for a breakdown here meant big trouble. Up ahead is an old pickup, parked on the shoulder. A woman and several children have stacked their worldly goods on the roadside. Some drivers slow down for a look, then rush on by.

Sanders, Arizona: Interstate 40—I am waiting to pass an agricultural inspection. These border stations appeared in the 1920s to control plant diseases. In the 1930s inspectors counted the migrant population and queried them as to their destination. No contract work waiting in Arizona? Try California, then. The inspector examines my apples, purchased in Oklahoma. "Sir, I'll have to keep this fruit. It comes from an infested area."

Kingman, Arizona: Route 66—The old two-lane road swings southwest, climbing to Goldroad and Oatman in snaking hairpin turns. A car practically meets itself going the other way. Most of the migrant riders had to get out and walk here, to ease the strain on the engines. By afternoon the sun beat into their eyes; the western hills sank into deep, backlit haze. Hard to see that the worst stretch lies ahead.

Needles, California: Interstate 40—At 6 a.m. the temperature is 86 and rising. On the Mojave Desert I savor some lines by the Okie poet Wilma Elizabeth McDaniel:

> *a man could get religion in a*
> *God forsaken*
> *place like this*

The bleached land is ashen and chalk dry. My car's shadow runs straight ahead, hiding from the morning sun. When I think the scenery can't grow bleaker, it turns to blistered heaps of clay and gravel, bare of vegetation. On these monotonous sands, the prize for best-named town goes to Boron. But hold on. The migrants crawled along this baking road, and not in air-conditioned comfort. In a small gesture of homage I roll down a window and take the desert air. Jackrabbits? Not a chance.

Barstow, California: Santa Fe tracks—This place is a landmark to my father. In 1932 Nelson Howarth joined the nation's migrants and rode the rails to California. As a young law student, he saw how civil rights were denied to the poor and the homeless. Decent men were robbed, beaten, arrested, forced to live in filth. Here in Barstow, Nelson had a bad day, dodging a homicidal railroad cop. Back home in Chicago, my grandmother scolded him for going off to have fun in the middle of a depression.

Beyond the desert lies Tehachapi Pass, and then the broad, green expanse of the San Joaquin Valley (page 338). The Joads, Steinbeck's migrant family, saw a world of vineyards and orchards, bathed in warm sun: "I never knowed they was anything like her," Pa Joad sighed. Many migrants settled in Kern County, the "golden empire" of California agriculture. County population grew by 60 percent in the 1930s. Most of the newcomers were Okies—unwelcome, underpaid, unable to buy land or homes.

Arvin, California: Route 223—I could be in Oklahoma now, ringed by fields of cotton—and tall oil wells. The soil is also light and sandy, but farms have an epic scale. A huge tractor trailer passes by, hauling tons of tomatoes. Here corporations plant cash crops on vast rented tracts. With good sunshine and water, several yields mature each year. Growers need armies of pruners and pickers, but never for long. They must work quickly and then move on.

Hispanics have lived in this peonage for years; today they still dominate the migrant labor force. John Steinbeck condemned the growers for greed, but the Okies were also crowding a labor market, driving down wages and reducing the hours of available work. The road west ended in California, and so did their dreams of family farms. Home? It was here, there—and nowhere.

Bakersfield, California: 34th & Chester—Crossing the Kern River bridge, Dale Scales points downward. "We spent our first night camping there. I was two, nearly dead from dehydration. We had crossed the desert, and that Hooverville was a sorry home." In 1936 many towns had a Hooverville—a sad jumble of cars, shacks, and canvas tents where homeless people camped. People still remember when conditions were declared unsanitary and the sheriff burned out about 1,000 squatters. In 1940 local growers were burning copies of *The Grapes of Wrath*.

Today the Kern River glides past empty banks, lined with grass and willows. Nothing remains of Hooverville, just memories wrapped in a cold fog. A walker passes with her elegant Afghan hound.

Earlimart, California: Route 99—Down the highway center runs a hedge of oleander—miles of blooming red, pink, and white. Dale Scales is taking me to his second valley home, a small auto camp. In 1936 his family rattled up this highway in a '29 Chevy. Today he drives a new Cadillac, upholstered in blue velour. The dashboard blinks with digital readouts: time, temperature, miles per gallon. Our fuel is low.

"My folks picked figs until their hands were cracked and raw," says Dale. He wears a gold watch and ring, the fruits of his labor. A professor turned real estate agent, Dale has never sold a home. He deals in corporate farm tracts, on commission for investors. Clients fly in from Brussels, Munich, Hong Kong; he cooks them gourmet meals.

At Earlimart the cabin is barely as large as Dale's Cadillac. His family used fruit boxes for chairs, papered walls with newsprint. He and his sister, Bonnie, read the walls and dreamed of a larger world. "Imagine seven people camping in that 10-by-12 shanty." He chats in Spanish with the current residents—laborers, a family of five.

That night Dale cooks for me a "genuine Okie meal": pork, okra, potatoes, gravy, black-eyed peas, biscuits. (A hard-times meal was fried dough, period.) Because everything is breaded, fried, or salted, I plan to eat little. But the aromas tantalize. Dale nods: "We call that larrupin' good." Larrupin'? He makes a wolfish noise of deep, contented salivation. I reach for the nearest fork. Perhaps tomorrow a Hoover hog?

Bakersfield: Stockdale Highway—The old man's voice is dry and cracked, but his pride is strong: "I'm a Californian by choice. If you call me an Okie, better say it right." The tape plays on, unreeling memories of Dust Bowl days. In this office at California State, the California Odyssey Project has compiled an oral history of the migrants. "We are asking people who have lived a history to tell it themselves," explains associate director Sharon S. Goldsmith. And they tell it with good humor: "I used to belong to the Elks, but then I got unfinancial and had to drop out." "Dad had quite a bit of psychology about him, but he did like to dip his beak. . . . This was a problem."

Other memories are bitter. Living in camps with poor food and sanitation, Okies contracted many diseases. Dr. Juliet Thorner saw children die, adults age prematurely: "They were in such poor condition that even the bacteria gave up and left."

Tulare, California: North F Street—Wilma Elizabeth McDaniel gave up nothing in those days, and the habit still shows. She writes letters on the backs of junk mail, wraps packages in old grocery bags. For the local paper she writes a column, "Poor Street Journal," telling the Okie past. Her poems are dry and clean, as simple as hard work can make them:

You can
put your trust in gravy
the way it stretches out
the sausage
the way it stretches out
the dreams
from payday
till tomorrow.

Wilma is called the "gravy poet," but

"shoe-box poet" would fit as well. Since girlhood she has stored poems in shoe boxes, too shy to seek publication. Recently she has begun to share these memories of hard times. "As a child I knew how much the land meant to me, though none of it belonged to me and probably never would. It was enough to be an awkward girl, alone, and walking through my own tall grass."

Shafter, California: Lerdo Highway—Leo Hart lives in a cotton field, its long rows blooming pink and white. Two cotton choppers are at work today, thinning out the young plants. Leo understands cultivation. In 1940 he set up the first school for migrant children in Kern County. "Local schools didn't want Okie kids; said they were dumb and dirty. I found them to be bright and hardworking. They came from good ordinary people, down on their luck."

As the county superintendent of schools, Leo changed their fortunes. Using emergency funds, he hired the best teachers from state colleges. They taught the three R's and also skilled trades. "The boys and girls repaired shoes, made clothing, learned to type and keep books. Every year they had a special project: a new classroom, a track, even a swimming pool. After three years local kids wanted to enter our Okie school."

"I have always been a poet," *says Wilma Elizabeth McDaniel of Tulare, California. "It came out of living with and observing my people." Her poems make art of ordinary things—flowers on a table, in a tomato juice can.*

Oildale, California: El Tejon Avenue—On the outskirts of Bakersfield, this Little Oklahoma is the sort of town I have seen throughout the valley. During World War II Okies began to leave agriculture for industry. Their itinerant days seemed over. For a few dollars down—and a few thereafter—they bought quarter-acre lots; with scrap materials some converted railroad cars or truck trailers into sturdy bungalows.

Going down those streets past blocks of brightly painted houses, green and yellow, pink and blue, I sense a complex mood in the community. Oildale had a tough reputation. Blacks stayed away; fights broke out among neighbors. But today the yards are bright with oleander blooms, kids play on bikes as men work at tuning up cars. All radios are turned to KUZZ, the country music station.

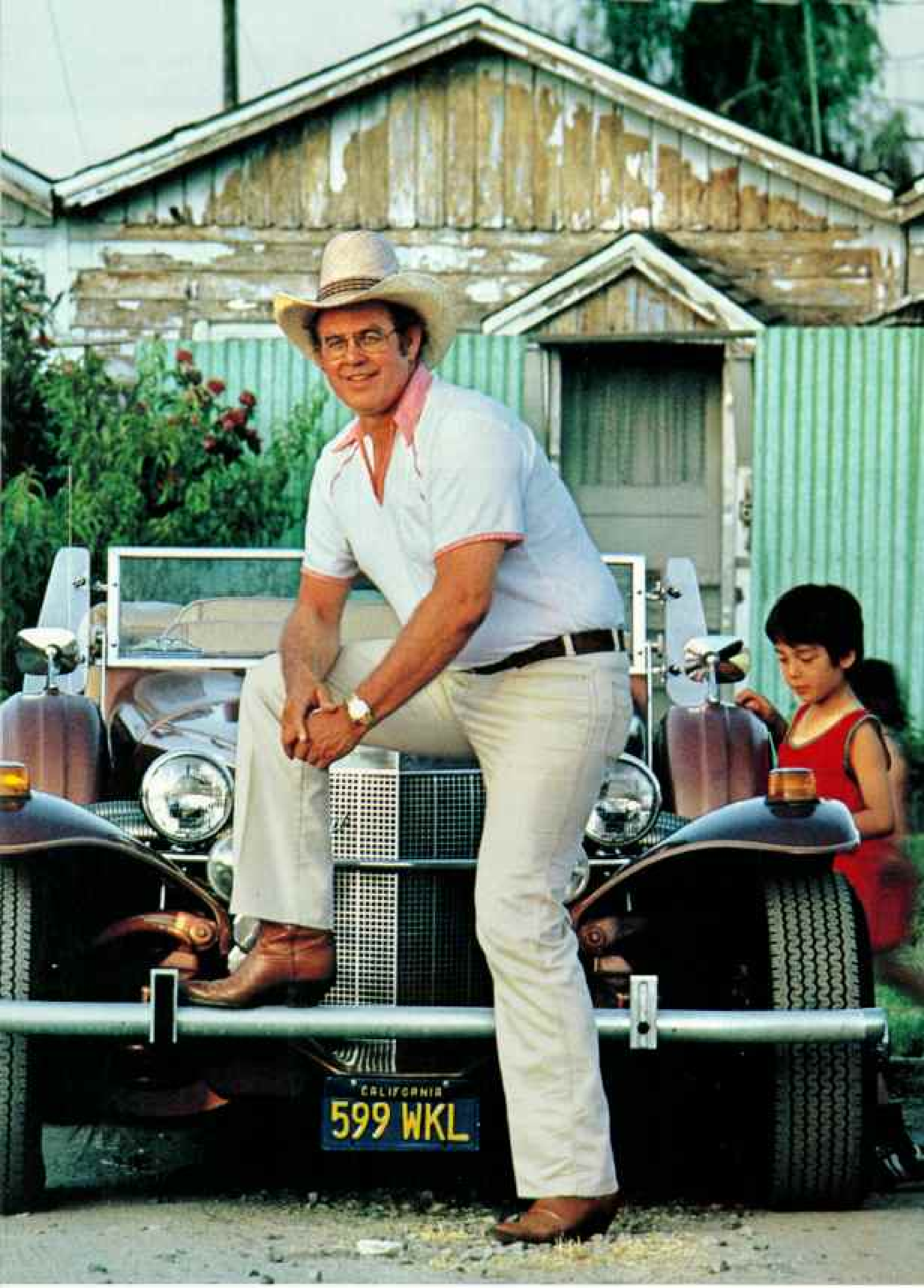
Shasta Lake: Silverthorn Resort—At 6 a.m. Merle Haggard looks just that, haggard. He's had a rough night for a man on vacation, dodging fans and other strangers. Today he launched a fishing tournament, and next week he sings at the White House. I wonder what his tune will be: "Working Man Blues" or "Reasons to Quit"?

We are sitting in Haggard's favorite retreat, a houseboat the size of a locomotive. Down in Oildale, his birthplace was a rebuilt boxcar. He came from a good family, but Daddy died when Merle was nine, and Mama could not hold her rebel child. He became a runaway, a drunk, a thief. At 21 he was behind bars—and came out a different man. Today he is a top star in country music, pumping out songs, albums, concerts at a wellhead rate. On his cap is a solid gold pin: OIL FIELD TRASH.

"You want to see my fishin' hole?" Merle lifts a rug and a hatch; below is a circle of

Fortune's child, *millionaire real estate broker Dale Scales visits his boyhood home, an auto camp at Earlimart, California. In 1936 his family lived in the small cabin behind him, he remembers, picking "figs, oranges, grapes, almonds, driving to the fields in a '29 Chevy." Today he wheels around in a custom-built $45,000 Excalibur, here admired by the children of Hispanic migrant workers, present-day successors to families like the Scaleses.*

*By now most second-generation Okies have left the fruit groves for other trades and professions. Many attribute their success to education, investment, and hard work—in the farms and oil fields of California (**above**).*


CALIFORNIA
599 WKL

cool green water. "Last night we put five dollars on the counter and said, 'See who catches the first fish.'" Who won? "I did. Got a brown trout."

Haggard's songs merge all the strains of western music—gospel and blues, jazz and swing; they relive the Okie past in labor camps and freight trains, on lonesome roads that never end: "I remember when even Okies denied they were Okies. They came from the pea patch and were glad to be out."

If Merle is glad to be out, his face doesn't show it. Fame has given him a bad back, three divorces, too many hours spent riding a bus. As his songs reveal, fame is a cell with no bars; only in music can a man find his way home. Last night he and the band played for hours, just for fun. On one chorus, we all joined in: "Big city, turn me loose and set me free."

Fresno, California: East Byrd Avenue—Clayton Turner goes free through painting, despite a childhood accident that crushed his spinal cord. He paints by holding a brush in his teeth, working slowly in a one-foot compass. For a two-foot picture he turns the canvas upside down, keeping the perspective with fierce concentration.

For Clayton, work defines himself and his people: "I am an Okie, yes. I say it without any self-consciousness. Among older people, the word expresses pride. Those who use it without any sense of our history are

At land's end, *Butch Stroud camps with his children, Stacey and Eddie, by a twilight fire on Pismo Beach, California. Their motor trikes, pickup, and state-of-the-art camping equipment are a far cry from the jalopies and old tents of the Okies, who once fought starvation by hunting the western jackrabbit* ***(above)****.*

wrong. Okies came here from the Middle West and helped put California together."

Lamont, California: Sand Hills Road— Butch Stroud knows how to put things together: He works at an auto yard in Weed Patch, rebuilding cars with salvaged parts. His life is tougher to repair: Recently divorced, he sees his kids when he can. Today he's taking them out to the Tejon Hills, for some riding on the motor trikes.

On a soft fall day the sun beams down on a dozen Okie riders as they roar up and down the tall sand dunes. They make fast, fishtailing turns, swirling in clouds of honey-colored dust. Dust and sand, blowing in the wind. Later, Butch rides along the flats with little Eddie and Stacey sitting up front. Seven and eleven, fair and freckled, the children are as fresh as any promise can be. I wonder what dreams he has for them, what hopes beyond today?

Before I can ask, Butch finds a new challenge: to drive his truck up the steepest dune. He tries twice, each time bogging down in the sand. On the third effort he comes to a gut-wrenching halt. His front-wheel drive has snapped.

At that moment, from the brush just ahead, rises . . . a jackrabbit. A Hoover hog, long-eared, light in the front legs, strong in the rear. The jack stretches his heels and takes the hill in a few bounds. When last seen, he is heading east. □

By BOYD GIBBONS
NATIONAL GEOGRAPHIC SENIOR STAFF

Photographs by
STEVEN C. WILSON
ENTHEOS

DO WE TREAT

How readily we manipulate our soil. We rearrange and restructure it. We pump it full of chemicals, we flood it, we drain it. On its health the fate of empires has rested. Yet we

RIPPING THROUGH CALIFORNIA HARDPAN, SOIL ENGINEERS MAKE WAY FOR A CITRUS GROVE.

OUR SOIL LIKE DIRT?

avoid it. In our cities, rivers of concrete keep us from its touch. Naked, it tends to offend the eye. But a close look reveals that the soil is an essential bridge between the rock below and the life above. It is dynamic and vital, and far too easily—and frequently—abused.

"I just farmed myself broke. I was farming land that had no business having a plow in it. Seven years ago I had $300,000 and a dream—I wanted to be a farmer. My wife and I spent 13 years in Saudi Arabia, saving that money. We came home because we thought there was something here, and we dug for it. In the end we lost nearly $900,000. We double-cropped, wheat and soybeans. But with the high price of fertilizers and lime, there was no way to get our money back. The last two years I was just farming for getaway money. No way a farmer can make it on this land, and most of them don't have other options. Me, I sell insurance now. We came up from the bottom, and we're fixin' to come up from it again."

Marion "Bobo" Green
Swainsboro, Georgia,
here with wife Jo Ellen
and children

A familiar lament, *this story from the heart of Georgia's old cotton country, where the soils are old, weathered, and poor. As thousands of similar cases each year confirm, more than capital and enthusiasm are necessary to make a go of it as an American farmer. Understanding of soils and their capabilities is at least as important.*

IN 1931, as the Depression strangled the economy, drought began baking the Great Plains. On April 14, 1935—Black Sunday—a clear, warm day suddenly grew chill as a dark curtain of rolling dust advanced across the plains. Behind it came Robert Geiger, an Associated Press reporter, whose story about the "dust bowl" would forever brand the southern High Plains. For almost a decade, the longest drought in memory, the plains cooked and blew, dusting ships 300 miles out in the Atlantic.

Harold Hogue returned from a visit in Oklahoma to his wheat farm at Dalhart, Texas. "It looked like a desert. That wheat was dead. I climbed over the fence and got one hell of a shock, there was so much electricity in the air from the dust storms."

Hogue lived in a shack wallpapered with cardboard, its window a truck windshield. "The first norther come right through the one-by-twelves. My quilt was covered. If I was on the tractor, my eyes would ball up with mud until I couldn't see the furrows."

When Hogue told me this, I was sitting in the living room of his spacious home looking out at his tennis court. From everything I had read of what the 1930s had done to the upper Panhandle of Texas, I expected Dalhart to be tumbleweeds and steer skulls. But Hogue's neighborhood of wealthy farmers could have been lifted out of Beverly Hills.

He had hung on through the drought, plowing for others and putting his earnings back into land no one else wanted. He dragged railroad rails over the dunes and moved dirt for 20 years, gradually leveling his fields. Wary about dryland farming, he drilled down to water trapped in the vast Ogallala aquifer during the Pleistocene. He now irrigates 20 verdant square miles of wheat, sorghum, and pheasants. His pumps run on natural gas. He winters in Palm Springs. His pickup is a Coupe de Ville.

Roughly half the irrigated land in the United States is in the Great Plains, most of it watered from the Ogallala. The Sand Hills of Nebraska lie over its deepest part, though shallow beds of the aquifer reach far down the Texas Panhandle. Irrigation grows lush plants, giving organic matter to soils that once got it from shortgrass prairie. As long as the Ogallala holds out, the soil will be enriched. But Hogue is not sanguine about the Texas end of the aquifer and the costs of pumping:

"A lot of people say we'll never have another Dust Bowl. The hell we can't. With the price of natural gas, we could be back to dryland farming soon. A lot of farmers already are. You have to have moisture to tie this soil together. If not, it's just like White Sands. It'll blow."

From all the soil erosion stories I had read recently, it seemed that the corn belt was

pouring into the Gulf of Mexico and the Great Plains were blowing away. Reporters would troop down to the delta, peer into the muddy Mississippi, do some quick calculations, and announce how much of Iowa or Illinois had just been sent to the sea by farmers. As Bob Ruhe drove me across the corn belt, I asked him what he thought of this man-made disaster.

"That's bull!" he shouted, pounding the steering wheel. "Most of the stuff is still in

the watershed, at the bottom of the hill." Bob Ruhe is a geologist, a geomorphologist, and the acerbic Yahweh of soils and landscape evolution in the Midwest. He is a lean man, tightly wound, his hair short and white, and his assertions vehement. He sets his alarm by geologic time. "I *writhe* when I hear 'man-caused erosion,'" he said. "That's dogmatic and misleading. Erosion in the Midwest during the past 10,000 years has been incredible—far higher than anything man caused. Sure you can see bad examples of guys mistreating the land. But to generalize from that is false."

Erosion may seem a rather straightforward problem, but soils are complicated, and between the apocalypse and Ruhe lies much conflicting opinion. With some exceptions, erosion gradually depletes soils, and eroding cropland may be costing the country nearly a billion dollars each year in polluted and sedimented rivers and lakes. Soil erosion is serious, but not everywhere and not for the same reasons.

Not until 40 years after the Dust Bowl did the U. S. Soil Conservation Service (SCS) begin to determine systematically how much soil is eroding in the United States. The SCS estimated that in 1977 we "lost" about three billion tons of soil from fields under the plow; roughly two-thirds of it washed, the rest blew. But where it goes and how much *(Continued on page 360)*

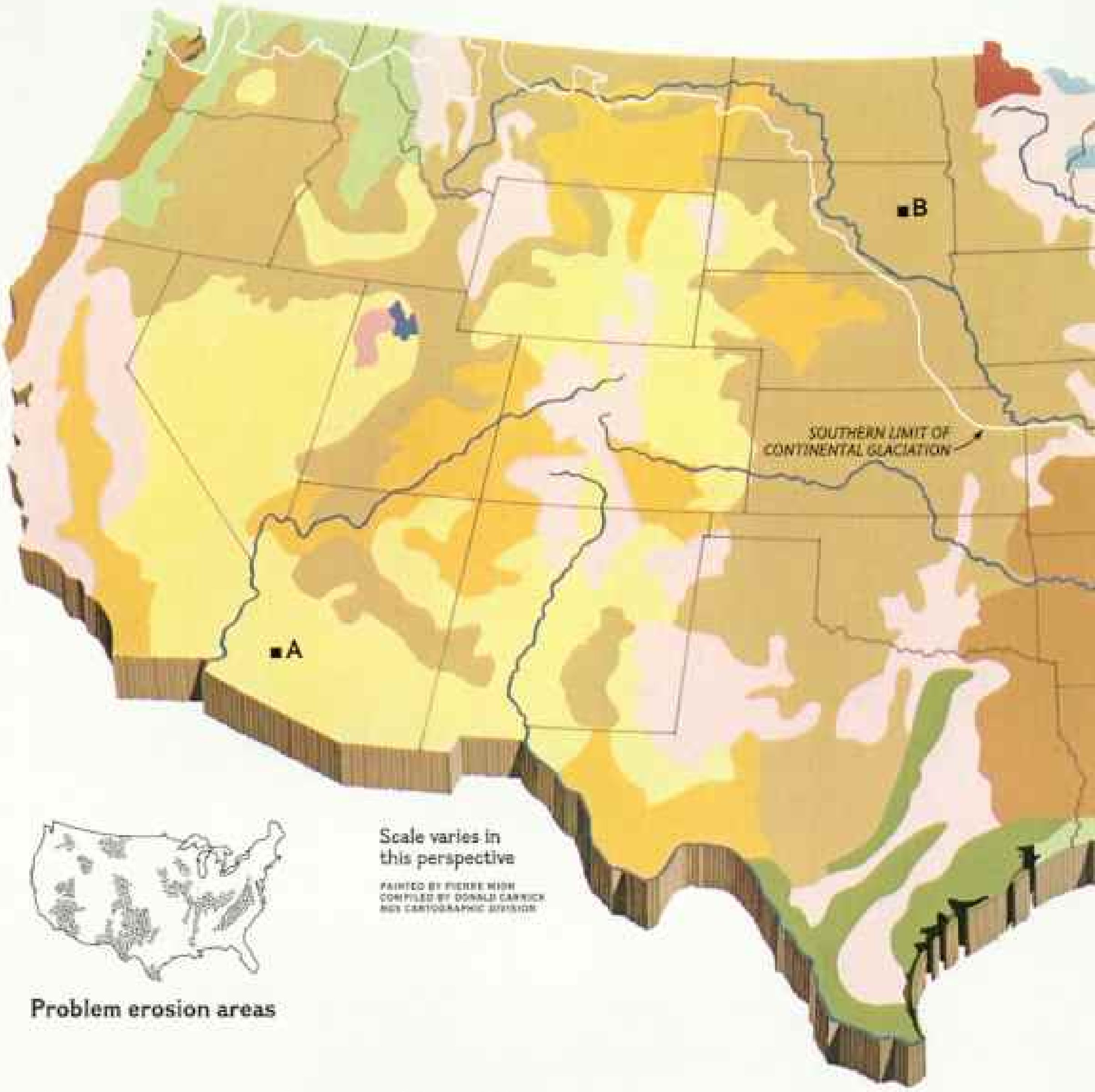
SAM CHASE

An act of God? *"Not totally," said soil experts after the dust settled from a 1977 windstorm in California's drought-seared San Joaquin Valley. Blowing down from the Tehachapi Mountains, at left, 100-mile-an-hour winds stripped millions of tons of soil from the overgrazed foothills and from the valley floor, where farmers had recently plowed and removed windbreaks that had been planted in the 1940s to prevent erosion.*

On the morning after *a windstorm in the Texas Panhandle, one could imagine having awakened in the Sinai desert rather than in one of America's most productive cotton-growing regions. On a Lynn County farm* ***(above)****, during a critical time between harvest and regrowth, the wind lifted the silt and left the sand.*

Several miles away ***(left)*** *machines digging a road pit bared a typical southern High Plains soil profile. The underlying cemented lime, or caliche, is so hard that dynamite would be needed to break through it. If exposed or too near the surface, the caliche renders farming impossible.*

Texas accounts for 17 percent of the nation's cropland erosion, and many here fear another Dust Bowl—land ravaged by wind and drought as in the 1930s. Some even suggest that it is under way now. Wind-erosion damage is being masked by irrigation and technology that keep the ailing land productive.



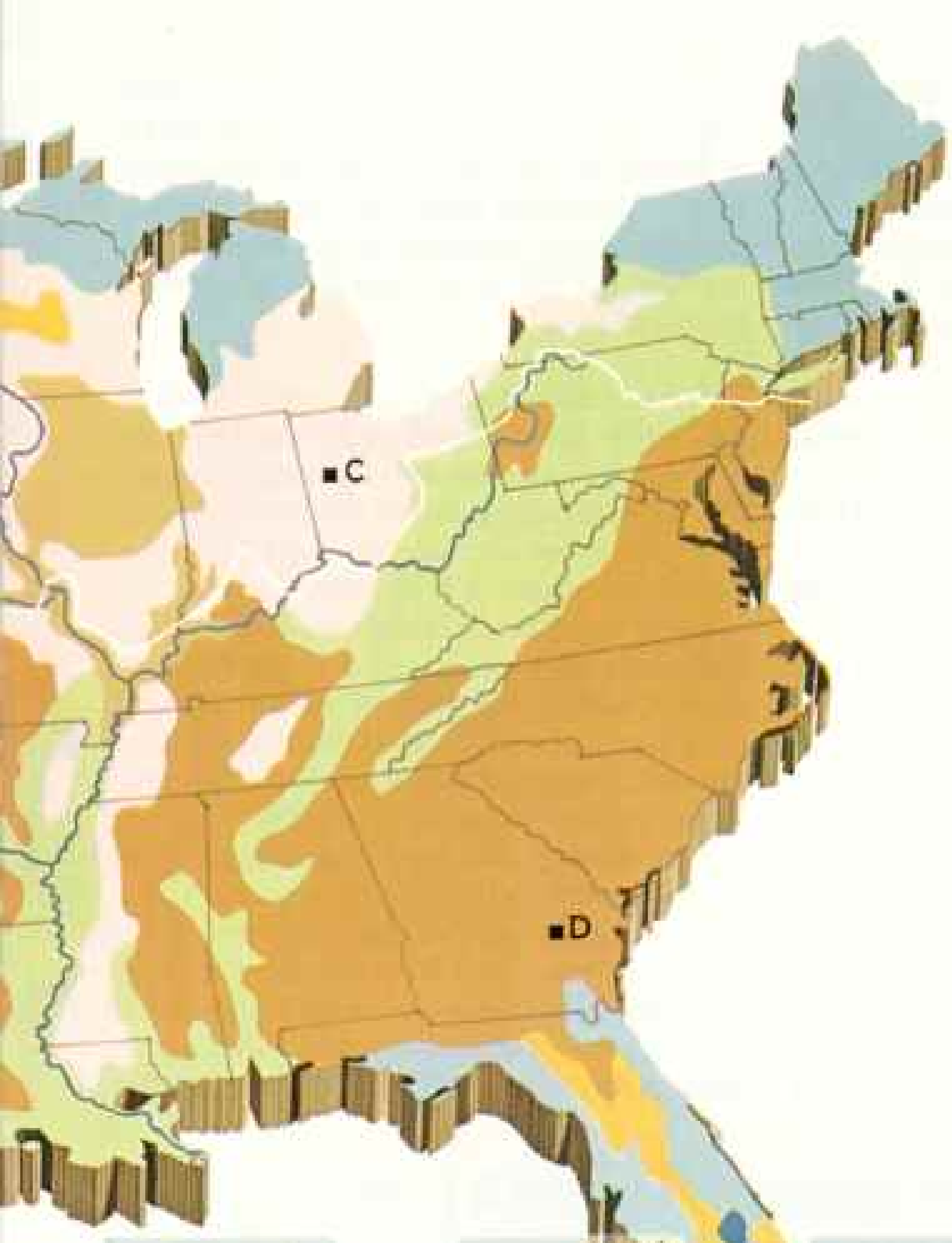
Problem erosion areas

A geography of soils

AN ABUNDANCE beyond reckoning, U. S. soils are often cited as the foundation of the nation's prosperity —though, in truth, a beneficent climate plays an equal role. The heart of the nation's soil wealth lies in the great midwestern grain belt, with its deep layers of glacial till and wind-deposited silt, or loess—products of the past ice age. Relatively new in geologic terms, these soils are classed as mollisols—one of several orders found in the contiguous 48 states.

The soils of most deserts, and the world's most extensive group, aridisols are arable when irrigated. Alfisols are productive soils formed under forest rather than prairie. Though weathered, leached, and generally tired, the ultisols of the Southeast are still productive, thanks to heavy fertilization, a long growing season, and adequate rainfall.

*Soils require centuries or even millennia to form. According to the United States Soil Conservation Service, most topsoils cannot regenerate—and therefore cannot afford to erode—at rates of more than five tons per acre per year. Shown here (**inset**) are those areas of the United States in which both wind and water erosion are causing losses considered to be twice the acceptable rate.*



SOIL GROUPS

ALFISOLS–middle-aged, relatively fertile, medium brown soils

ARIDISOLS–middle-aged desert soils, low in organic matter

ENTISOLS–very young undeveloped soils, pale yellow to reddish brown

HISTOSOLS–very young organic peats and mucks, dark brown to black

INCEPTISOLS–young, few or faint horizons, gray to red

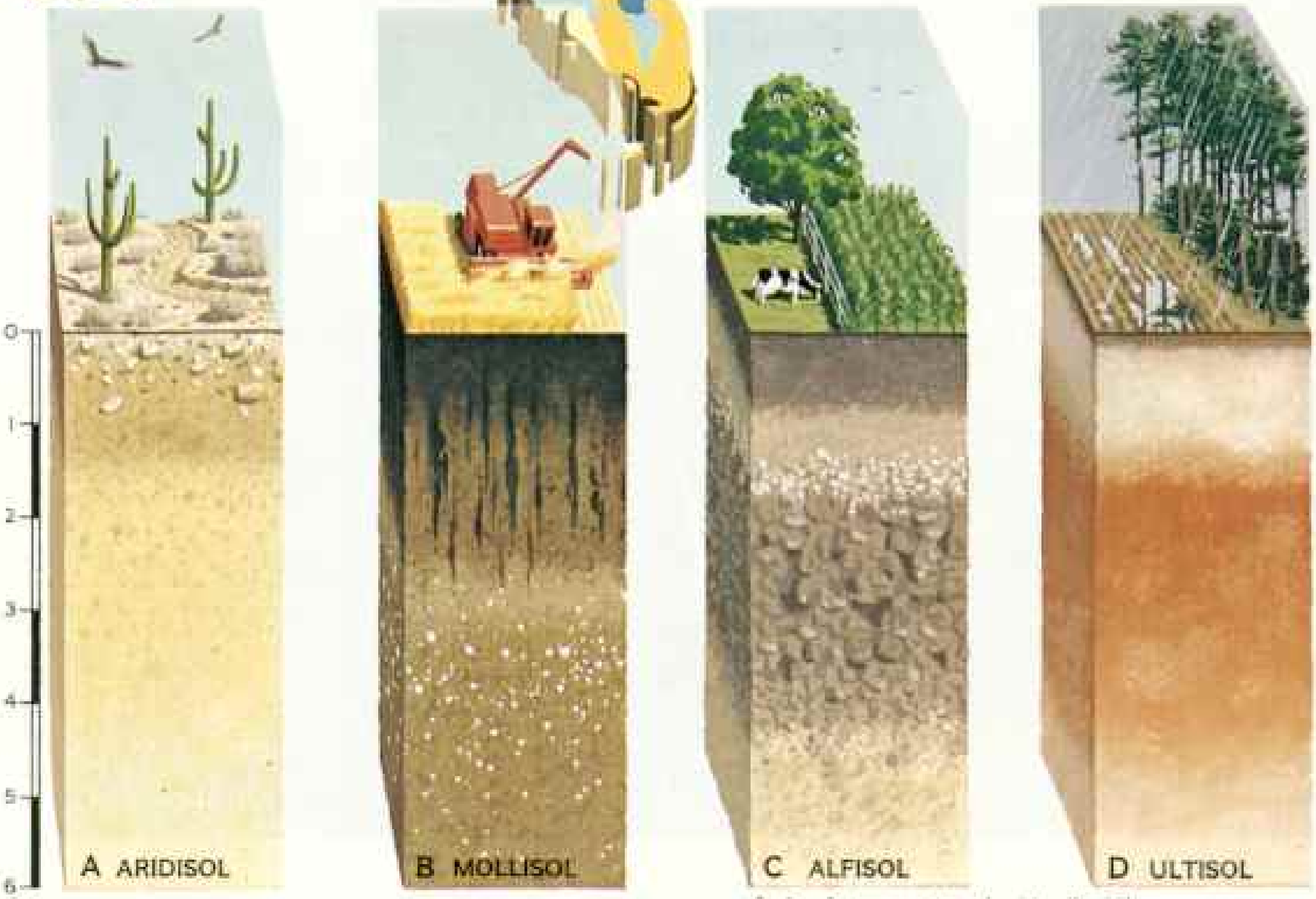
MOLLISOLS–middle-aged to young, very fertile, dark brown

SPODOSOLS–young, nutrient-poor soils, mostly sandy, pale ash color

ULTISOLS–very old, nutrient-poor, distinct horizons, yellow to red

VERTISOLS–middle-aged, clayey soils, crack when dry, dull colors

MISCELLANEOUS–bare rock, salt flats, and ice fields



Surface features not to scale with soil profiles

its departure damages soil productivity, no one knows with much confidence.

I asked M. Gordon Wolman, an eminent geomorphologist at the Johns Hopkins University in Baltimore, how much we should care. "It depends on where in the U. S. you are and whether your time scale is long or short," he said. "Agriculture has perhaps doubled the rate of geologic erosion, but, as Ruhe indicates, you have to be careful what area of the country you talk about. In places we have made a mess of it, but for the U. S. as a whole, erosion is not killing us. Could it? Probably not. Is it important? In some places absolutely."

The 1977 SCS estimates showed that erosion in this country was patchy. Texas alone accounted for one-fifth of all cropland erosion. Rates well beyond what the SCS believes soils can tolerate were confined to about 10 percent of the landscape: the High Plains of Texas, the Palouse Hills of eastern Washington, and the silty hills bordering the Missouri and Mississippi Rivers from western Iowa almost to the Gulf.

On the Great Plains, speculators and hard-pressed ranchers have been plowing up hundreds of thousands of acres of fragile grasslands to grow wheat—more than half a million acres recently in eastern Colorado alone. These soils easily blow when it's dry, and prolonged drought on the plains, like the one that led to the Dust Bowl, is only a matter of time.

FARMERS helped aggravate erosion when they leaped suddenly into the export business. In 1972 massive sales of American grain to the Soviet Union sent prices soaring, and by the end of the decade the value of U. S. farm exports had jumped more than fivefold. A third of our croplands now produce for markets overseas. Chasing the price of grain, farmers plowed up an additional 60 million acres in the 1970s, much of it once protected beneath grass, some of it steep and erodible.

Few farmers still kept livestock, so they stopped rotating their fields in pasture and hay and grew erosive soybeans and corn year after year. And from the factories had come big iron: 16-row cultivators and moldboard plows, and monster discs. No longer a modest red tractor with a coil spring under

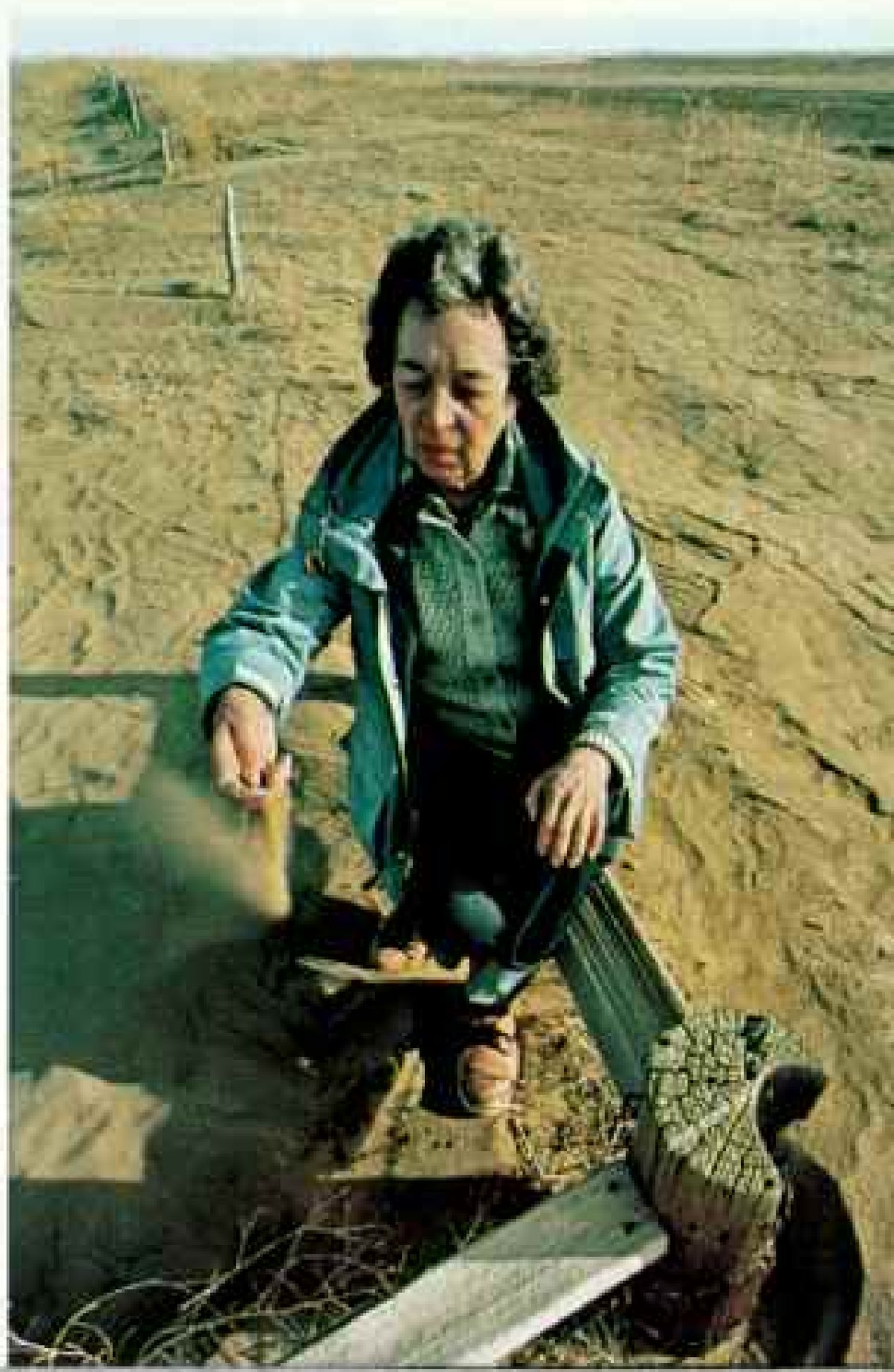
the seat, the wind up your shirt, and the manure spreader flinging chunks past your ears, but a four-wheel-drive behemoth with a wraparound cab, Loretta Lynn on the tape, and enough horsepower to plow straight up hills. Big gear didn't run easily on contours, and terraces built to slow erosion got in the way. Earl Butz, then secretary of agriculture, urged farmers to plow "fencerow to fencerow," but they even plowed out the fencerows, the terraces, almost everything but silos. So-called clean farming set a lot more soil on the move.

But where did it go? "We soil scientists ought to hide our heads in shame," William Larson, head of the soils department at the University of Minnesota, told me. "We had all this data on erosion losses, but we didn't know what it meant. I'm trying to get that word 'loss' out of my vocabulary. Soil isn't lost as such. Very little of it leaves the immediate landscape."

Erosion has been lowering the mountains and cutting and filling the valleys since the first raindrop hit the ground and the wind began to blow. When erosion gets spectacular, as in the Grand Canyon, we enshrine it as a national park and go downstream to farm the sediments. The Mississippi River pours more than a quarter of a billion tons of sediment each year into the Gulf of Mexico. Undoubtedly, some of Iowa's topsoil is in that cocoa, but it's difficult to trace sediment to its source. Luna Leopold, former chief hydrologist of the U. S. Geological Survey, says that much of that sediment comes from easily erodible shales that the muddy Missouri has been hauling off the Great Plains since the Rockies came up.

"It's really the geology and climate that count," he says. "One of the largest sediment producers in the country is the Eel River of California. It's not clear why, because the Eel is covered with redwood forest. Clear-cuts don't explain all that sediment, much of which comes from landslides."

You view soil erosion differently depending on where you are in the country. What may be a crisis to an Ozark family only inches from limestone may be only an inconvenience to a farmer in western Iowa on 80 feet of fertile silt. There are upwards of 30,000 different soils in the United States, which give identity to Black Earth, Wisconsin;



Battling the sodbusters, *ranch owner Edith Steiger Phillips (**right**) helped spark a popular movement now being debated in Congress. On her property near Keota, Colorado, she displays the dirt that buried her grazing land up to the fence tops after 10,000 acres of neighboring range was plowed out and succumbed to the area's notorious winds. Fighting mad, she sued, claiming: "It's not an act of God. It's an act of greed. God doesn't have a plow."*

*Millions of acres of western grasslands have recently gone under the plow, largely to grow wheat. Sodbuster legislation would deny crop subsidies to farmers who break fragile new ground without following conservation practices. One experimental approach to hold down soil is used by Harold Thurow (**left**) of Ault, Colorado, who spreads his fields with onions, hoping their weight will hold the soil between plantings.*

Do We Treat Our Soil Like Dirt?

Zapping the salt of the earth, *soil doctor Mike Trzebiatowski* ***(above)*** *of Fronteras Nuevas, Inc., injects an Arizona field with sulfuric acid* ***(right)*** *to neutralize salts common in western soils. "We can take raw desert too salty for any crop and make it productive," says partner Al Brown, Jr. The company treats 15,000 acres a year. Beyond such help, an irrigated Colorado beet field* ***(below)*** *is blanketed with salt, a result of poor drainage.*

Redlands, California. Soils thin as crackers, organic mucks that wrinkle the nose, soils of sand, rich alluvial soils, old soils, young soils, buried soils, shrinking and swelling clays that tilt telephone poles toward the road like sabers at a naval wedding.

Without soils there would be no grass, no cows, no bread, no us. When we think that man runs the show on earth, we might recall that earth is mostly rock and life only a veneer on it, sustained largely by a sheet of soils derived from and covering the rock. According to physicist J. D. Bernal, life might have fizzled at sea, where it began, had not the first organic molecules found clay crystals to fasten on to, washed there from weathered rock.

"Nature beats up the landscape," says Dick Arnold, director of the soil survey division for the SCS. "But man accelerates it. Soils are important to survival. Let's not beat them up if we don't have to."

SOIL BEGINS AS ROCK. Pikes Peak, Half Dome, the bedrock beneath my yard in Maryland, all are soils in embryo. Water is the agent, exfoliating boulders like shell off a hard-boiled egg, running over rock, under it, reducing it to sand, silt, and microscopic particles of clay. Water bathes the rubble in carbonic acid, rearranging the chemistry of the rock. This releases minerals to be held by clay and organic particles as nutrients for plants.

Most soils are about half mineral, the rest air and water mixed with a little organic matter—the remains of dead animals and plants. At a roadcut a soil shows its profile of A, B, and C horizons, or what farmers call topsoil, subsoil, and the stuff below (page 371). Organic matter usually accumulates in the A horizon, where seeds germinate. It may not. Below that, the B horizon collects clay, iron, and aluminum. The C horizon is weathered rock, *(Continued on page 375)*

The living soil

VAST AND TEEMING—*continents in breadth, mere feet in depth—soil pulses with life. From microbes to small mammals, plants and animals enrich soil as they live and die.*

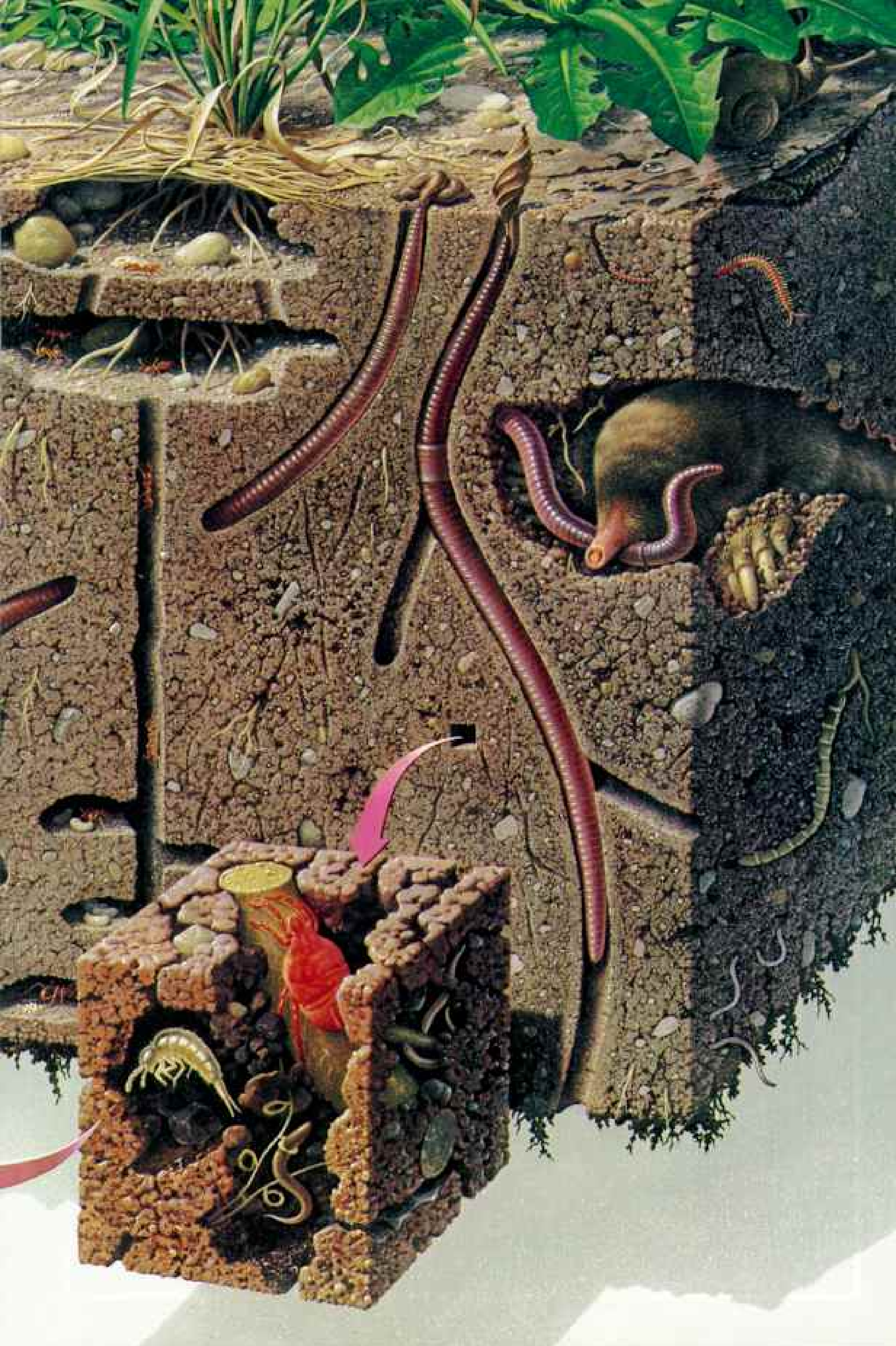
Plants, particularly grasses, are the main source of organic matter in soil. A single rye plant may spread nearly 400 miles of roots underground, which then decompose in the soil.

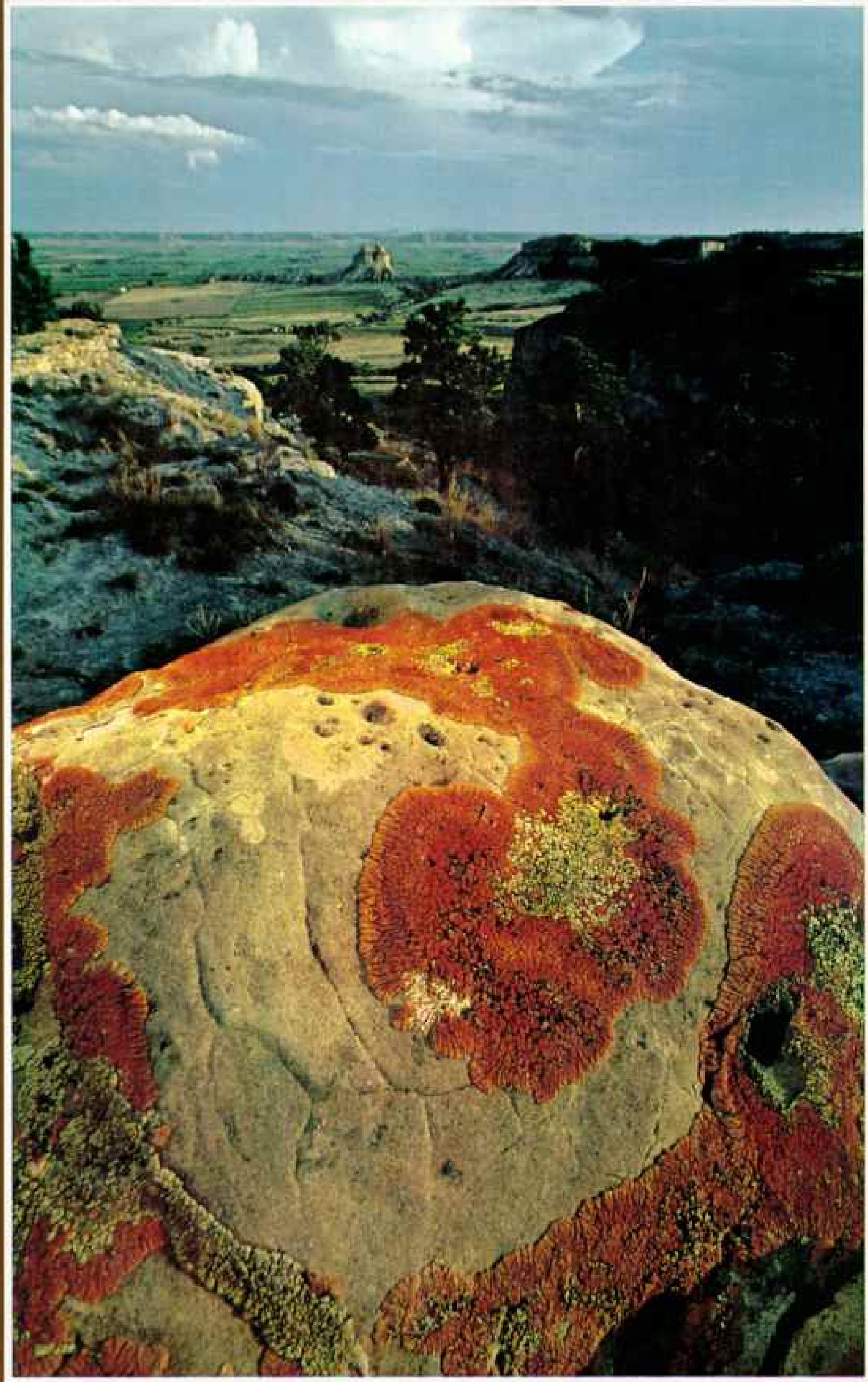
The ant and earthworm are soil's prime movers, creating porosity for air and water. Huge ant colonies forage widely, while earthworms plow closer to home, pulling in leaves and depositing tons of soil on the surface in their castings.

Worms feed the moles, far right, whose tunnels serve as soil highways for many species. Moles and other burrowers, like the shrew eating the beetle, near right, and the sleeping ground squirrel, below right, help mix soil as they tunnel in all directions.

Nematodes, mites, and springtails (enlarged square) live on the threshold of visibility. Among a farmer's worst pests, nematodes are preyed on by fungi, which snare them with tiny tendrils. In the microcosm (lens), bacteria are the great decomposers in most soils, while fungi prefer acidic conditions. Threadlike actinomycetes give off that earthy aroma you smell when a field is freshly plowed. Microbes in soil can give us diseases like tetanus and bring us cures—from streptomycin and penicillin.

PAINTING BY NATIONAL GEOGRAPHIC ARTIST NED M. SEIDLER





Soil genesis: sand, silt, and clay

NATURE'S SOIL FACTORIES, wind and water gnaw relentlessly at earth's rocky crust, creating spectacular scenery and the parent material for soils.

Acid-excreting lichens, like these on a rock near Scottsbluff, Nebraska (left), also contribute to breakdown, as do temperature extremes that freeze water in cracks and also cause rocks to expand, contract, and fracture (above).

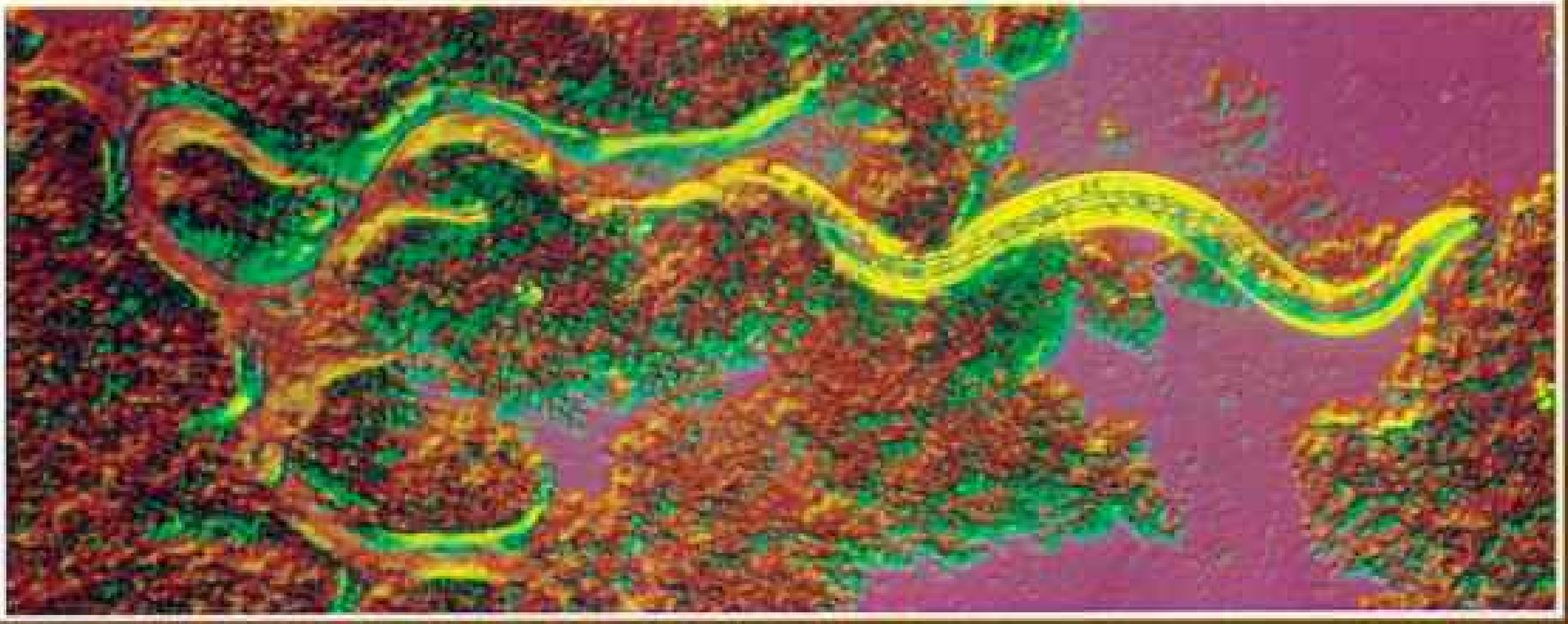
A sample of Mississippi mud (upper right) holds the three particle sizes that make up all soils: microscopically grained clay, at top; intermediate-size silt, at bottom; and larger grains of sand in the middle.

Without life, however, whether microscopic or as visible as this sand hopper (right), dirt is not soil, many experts agree.

Water for life

UNDERGROUND RIVERS, *microns wide, host multitudes of tiny life forms. Threading water-lined channels in search of food, nematodes (below) are among soil's largest microscopic animal population.*

As soil dries, land crabs (right) and other organisms move deeper for moisture.



ICE CRYSTALS *expand silty soil (below), opening it for air and water—two elements that normally fill half a soil's space. Water reacts with soil in several ways. Rain can loosen particles (diagram at bottom). Some water runs off the surface, some percolates down to the water table, and some remains in the soil to nourish plants and animals. For the farmer, information on how much water his soil retains is important in making decisions on crops and irrigation. In Nebraska, soil experts (left) test a field's capacity by sealing samples in plastic, later to be weighed, oven-dried, and reweighed.*

Violent rain loosens topsoil

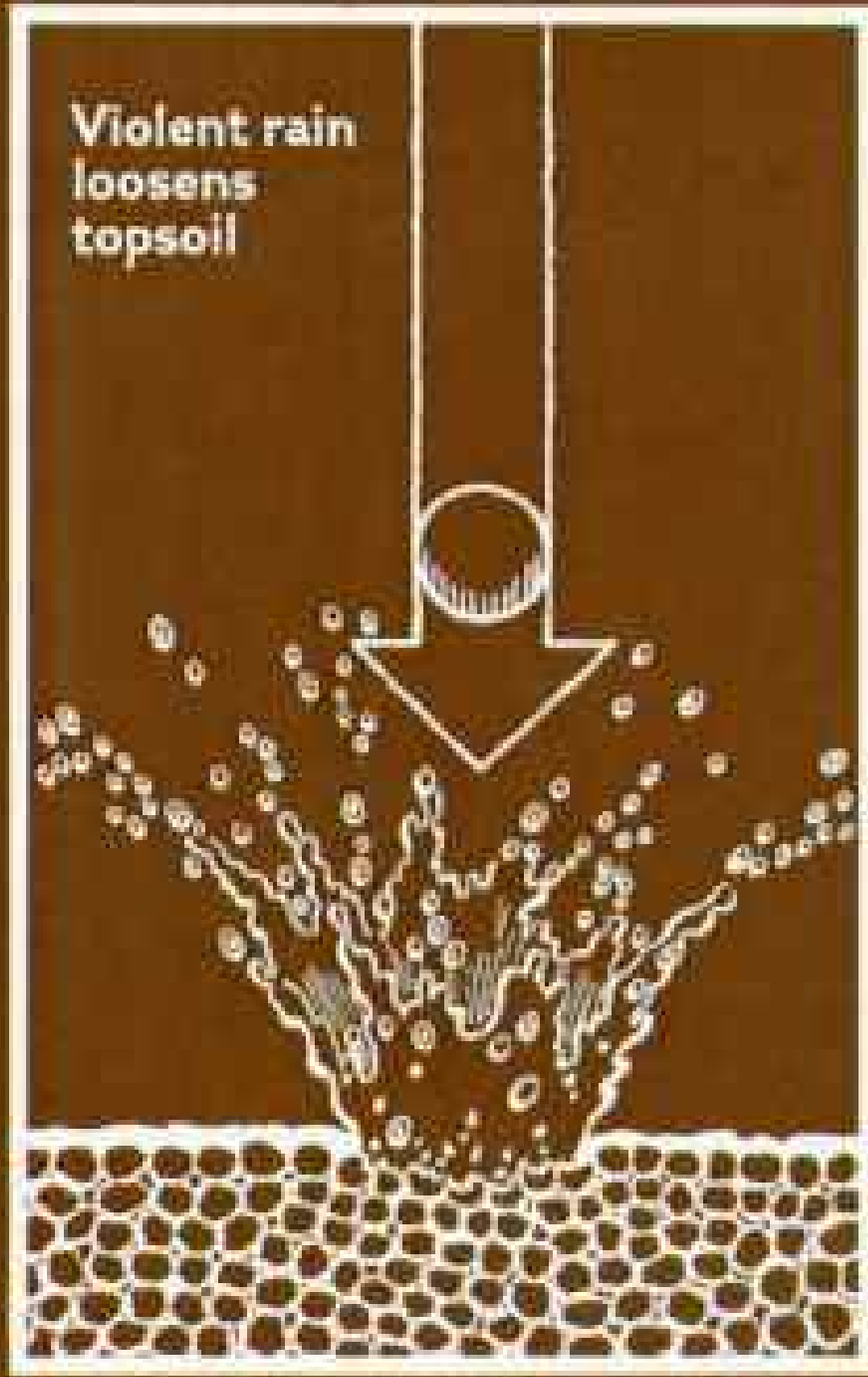


DIAGRAM BY PIERRE WION

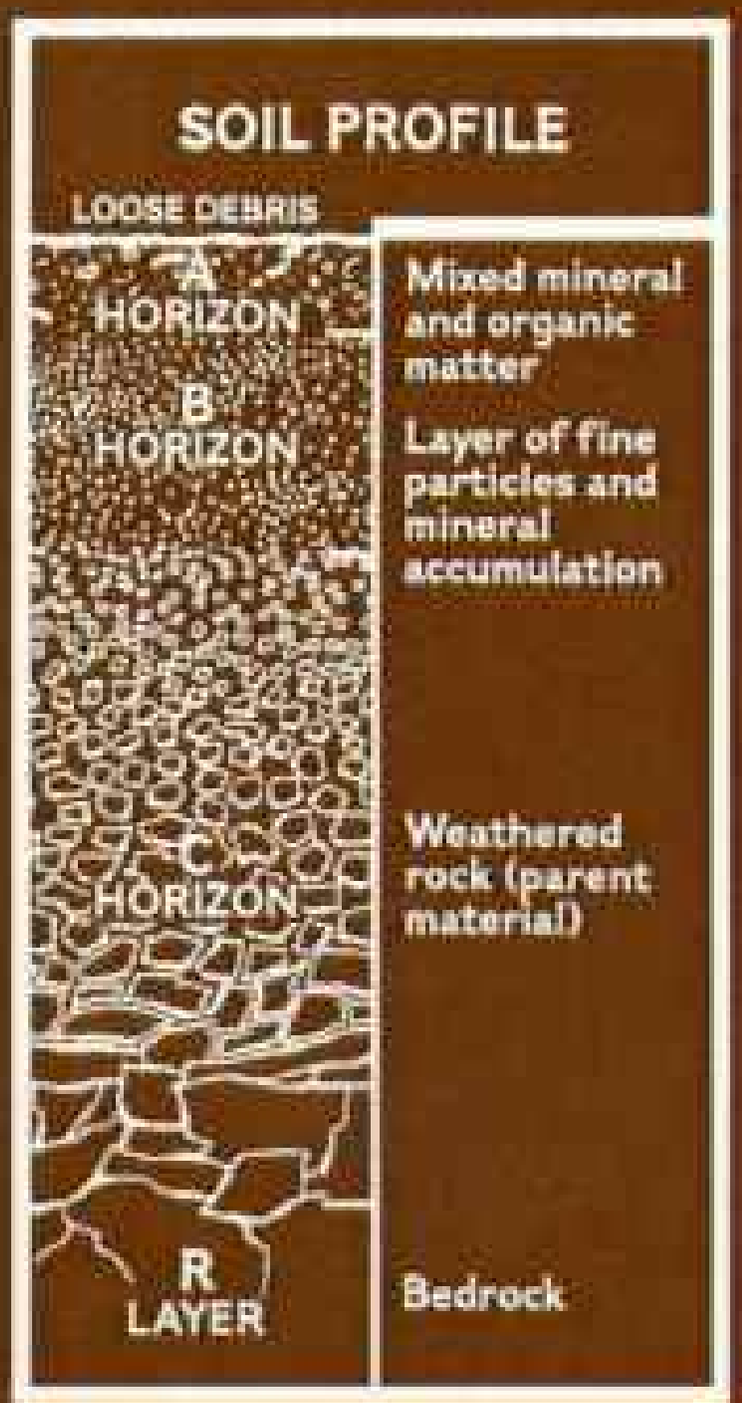
Air: The soil breathes

"A ROBUST SOIL," is the *verdict of Dr. John Doran (left), who uses his home-made soil "breathometer" on a native grass prairie near Sidney, Nebraska. Fashioned in part from a coffee can and simple lab materials, the device is able to gauge a soil's respiration.*

"A soil's health is related to the biological activity in it," says the U. S. Department of Agriculture scientist. "And you can measure that activity by the amount of gases given off. The greater the biologic activity of a soil, the more fertile it is."

In an endless quest for nutrition, multitudes of burrowing creatures, such as this red velvet mite (left, center), aerate the soil and improve its ability to absorb water. But 70 to 80 percent of a soil's metabolic activity, says Doran, is generated by microscopic organisms, like bacteria, fungi, actinomycetes, and algae (left, bottom).

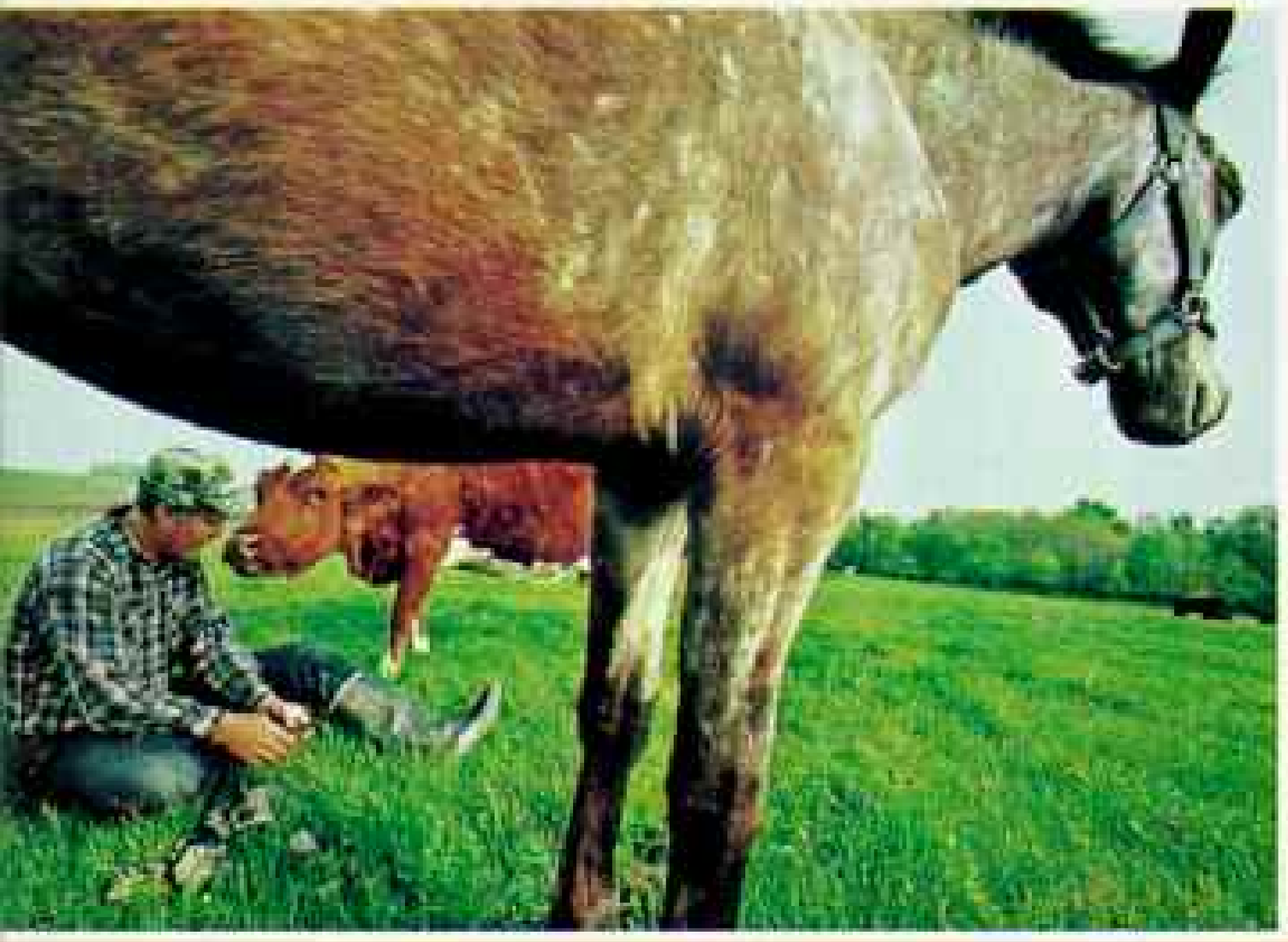
The most important work performed by these microbes—billions in every handful of soil—is to break down organic material into humus, which also aids in a soil's water retention, and to convert nutrients into forms usable by plants.



PIERRE MION

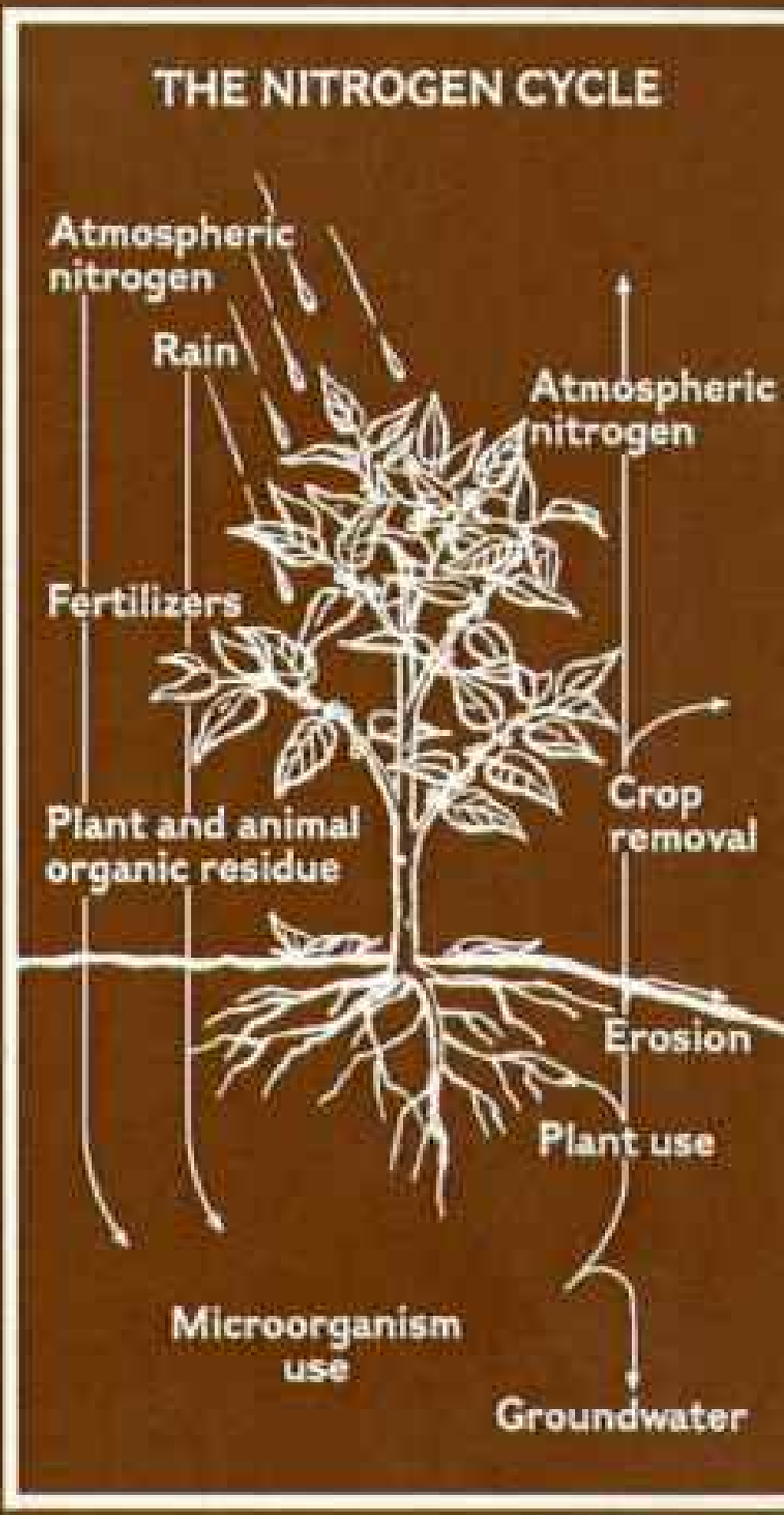
Horizons: a soil's history

TRIPLE-LAYERED, a cake of soil bares its unique profile to experts (above) in a cotton field near Jackson, Tennessee —an area rich in wind-deposited loess. Littered with residue from the previous year's crop, the A horizon (diagram) is high in the organic matter beneficial to the growth of young seedlings. Characterized by its tilth and friability, or crumbliness, and popularly known as topsoil, this eight-inch-thick horizon might be considered deep by a New England farmer, shallow by an Iowan. Mature roots commonly extend well down into the B horizon, where clay and minerals accumulate, and even into the C horizon, here marbled by alternate wetting and drying.



Fertility: Animals make the chemicals go around

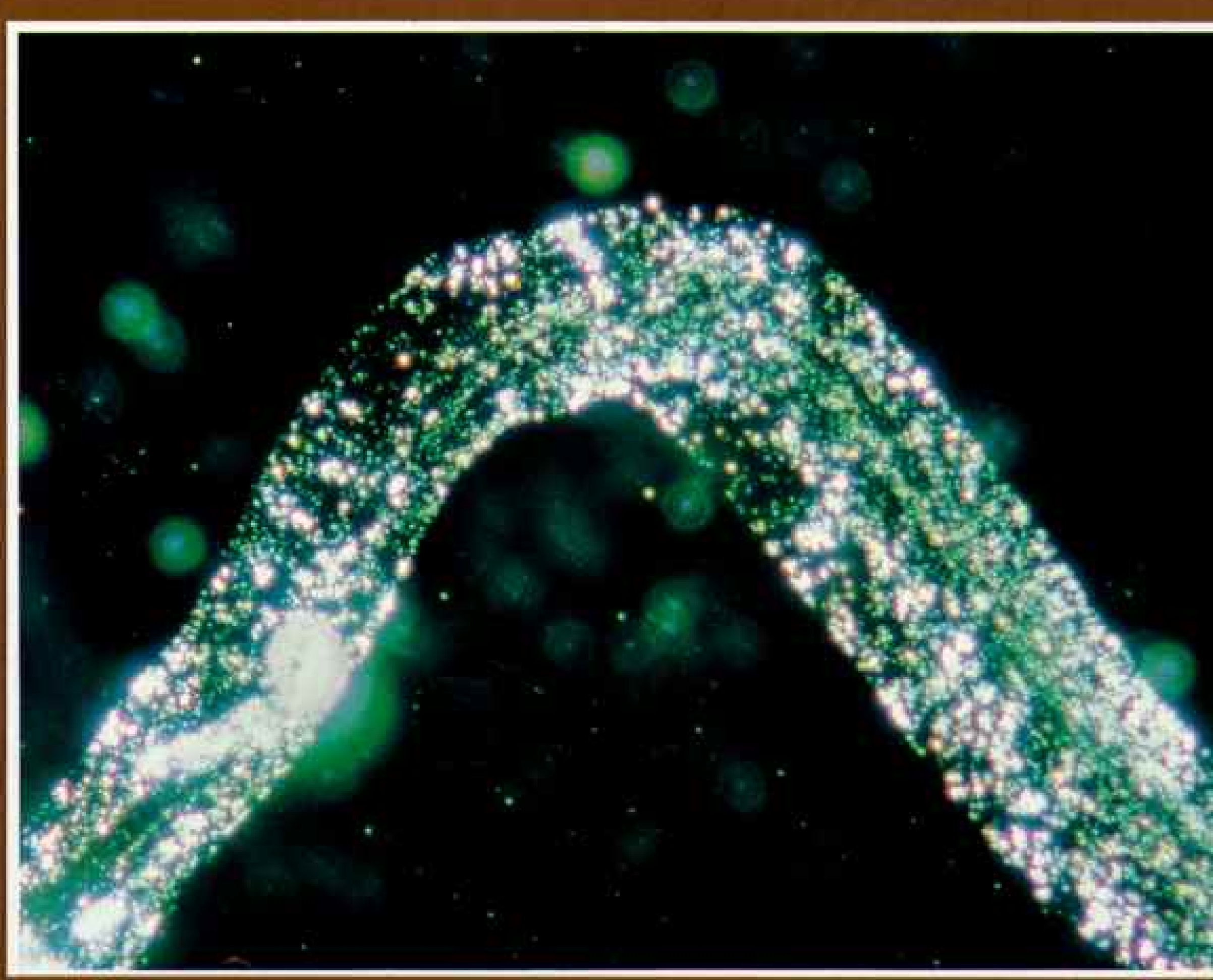
IN THE great chemical stew brewing beneath our feet, one animal's waste becomes another's food. Earthworms, called by Aristotle "the intestines of the earth," constantly refine soil by processing it through their gut (facing page, top). Their fertile castings, like those being fed upon by a pot worm (above right), help sustain vast populations of springtails (right). Chemicals in a pot worm's slime track (facing page, below) may in turn host colonies of bacteria. Some bacteria fix nitrogen from the air for use by plants (diagram). Before the advent of nitrogen fertilizers, livestock waste was the best way to enrich depleted soils —and was usually "free for hauling." Here farmer Gene Logsdon (above) examines a pile of manure on his pasture



PERRY NICK

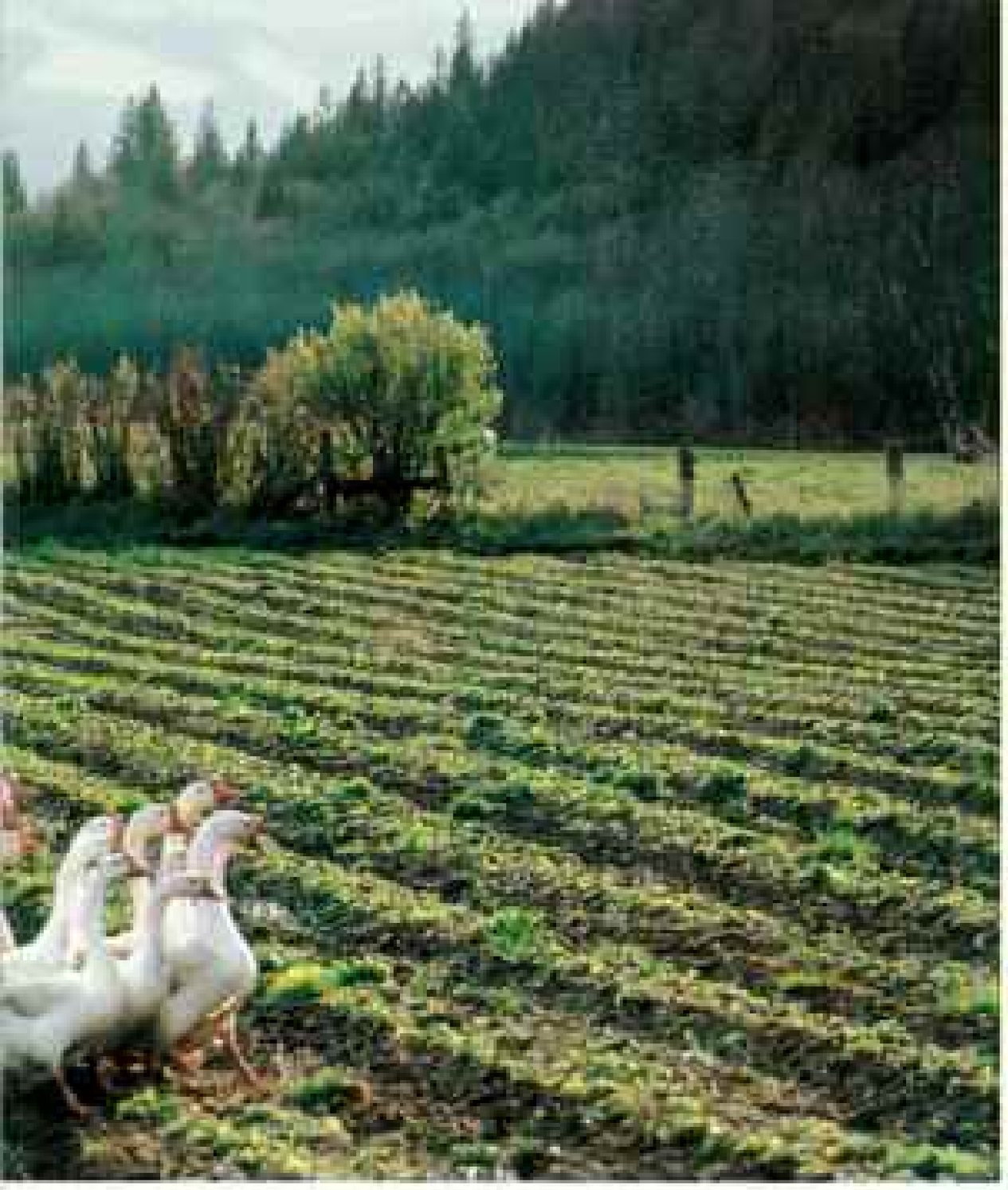
in Wyandot County, Ohio. He believes that "the cow pie may go the way of the buffalo chip" as stock raising becomes ever more concentrated and confined.

Chemical fertilizers provide mineral nutrients lost through farming but are expensive and may be quickly lost into rivers and streams. Animal wastes are lost more slowly. Like time-release vitamins, they dispense their nutrients over a longer period of time.



Organic all the way, *this 100-acre farm in Skagit Valley, Washington, uses geese instead of herbicides to weed the strawberries* ***(right)****. The owners, including a former dancer and a poet, expect to gross $350,000 this year, without subsidies.*

Tradition and price supports buttress U. S. tobacco farmers, like the J. M. Spearmans of Adrian, Georgia. Here, with helpers, they plant seedlings to reap a 75,000-pound government allotment, perhaps worth more than the land itself.



(Continued from page 363)

the parent material from which soil forms. There are soils that stand this little lecture on its head, for soils are as varied as the rocks, climate, topography, organisms, and length of time that create them.

Bacteria—and rain and lightning—pull nitrogen from the air. Plants take root, suck up nitrogen and the minerals leached from rock, throw seeds, and die. Worms, ants, gophers move in and rearrange the soil, opening it up and giving it air. Multiplying beyond count, microbes help release nutrients from dead plants for use by live ones by decomposing organic matter into humus, a dark adhesive embracing clay particles, giving topsoil the feel of bread crumbs and the function of a sponge. Roots can now more easily get water and grow. A soil evolves.

Except for mucks like the Sacramento Delta, most soils have little humus, maybe 6 percent under prairie and almost none in the deserts. But humus is far more important than its proportion in soils indicates. By manuring or plowing under a cover crop like clover, a farmer can return nutrients to the soil for his next rotation of corn.

PLANTS ARE NOURISHED by inorganic minerals, so the corn doesn't care if nitrogen is converted by bacteria from manure or scattered from a bag of commercial inorganic fertilizer, but the farmer may see the difference in his cash flow. About half our 8.6-billion-dollar fertilizer bill is for nitrogen, most of it in the form of ammonia made from air and natural gas, making farmers all the more vulnerable to the volatile prices and politics of oil and gas.

More important, humus helps topsoil hold water against a dry spell, and by absorbing runoff, it slows erosion. But left unprotected on a hillslope, topsoil gradually gives up its organic glue to a thin sheet of moving water. "As slopes erode," Klaus Flach, an SCS scientist, told me, "you get more runoff and less water infiltrating the soil. Out in those areas of the country where water is critical, the crops get starved. We really saw it in the 1983 drought."

The deserts are fertile because there is little rain to leach away the mineral nutrients. That's why Arizona's Salt River Valley bloomed when it was irrigated, and why

salts still plague it. The glaciated Midwest is productive because its soils are young, from rich sedimentary rock, and its climate favored prairie grasses whose mats of roots made deep humus.

Pity the Pilgrims, who stepped ashore to confront a wall of forest and a cruel joke beneath the trees. New England stands on granite. Except for the silted beaver meadows and alluvial valleys like the Connecticut, the glaciers left the colonists only a thin mantle of hilly, stony soil. The Southeast also was of mineral-poor rock, and it had weathered too long in the rain. Save for the river deltas and the limestone valleys, its old soils were largely pooped out before the first ax rang in the forest.

My yard on the rolling Maryland Piedmont of suburban Washington, D. C., is of that tired soil. The rock came up a quarter of a billion years ago, as the Appalachian Mountains rose into the rain and were reduced to hills, the debris washing onto the coastal plain.

FOR MILLIONS OF YEARS rain leached minerals from soils of the southeastern U. S., making them acidic and salting the sea. The rain reacted with carbon dioxide to release hydrogen ions—the source of acid—that replaced nutrients in the soil. In the arid West, with little rain to leach the minerals, salts crusted on alkaline fields as on the rim of a margarita glass. My azaleas prefer acidic Maryland, but most plants like neither extreme. They seek neutrality.

The colonists opened the Piedmont forest and dropped seeds in the sunlight. Crops did well for a few years, then thinned. Trees could exploit these poor soils by recycling nutrients from dropped leaves back through the roots, but fertility was all in the humus and not in these tired kaolinitic clays. With the trees gone, the humus lost its fuel. Stored fertility went up shoots of tobacco, and, so to speak, up in smoke. Deep gullies crawled up hillsides of tobacco and cotton, subdividing farms. Sediment went downhill like melting sugar, filling streams and swamping bottomlands, provoking Patrick Henry to write: "He is the greatest patriot who stops the most gullies." It is no wonder the settlers had an itch to head west.

By the 1930s the Piedmont was eviscerated from Virginia to Alabama, and terraces and contour plowing on clay subsoil seemed like surgery on a red cadaver. Much of the Piedmont has since reverted to forest, and the gullies are difficult to find in the shadows of the pines. "It's not much of a forest yet," said Dick Arnold of the SCS. "It's just holding that landscape together. The Piedmont was unstable and ready to go. We just gave it the nudge and phhhsst! It went."

Unlike Piedmont soils that often form out of the rotted bedrock below them, many soils evolve from rock moved from elsewhere, eroded by wind, by glaciers, by running water. The first soils, formed maybe 400 million years ago, are no more. Other soils have come and gone, eroded from hillslopes and rearranged with new personalities on fields and river bottoms, only to be covered again by the rising sea or buried beneath new sediment on which yet other soils have taken shape. Louisiana is essentially sediment hauled by the Mississippi from as far away as Montana. Winter lettuce gets its head on the flat Imperial Valley of southern California in soils composed of bits of the Grand Canyon, Monument Valley, and God knows what else the Colorado River dug out of the Rockies and the Colorado Plateau and dumped on the Imperial in layers of sediment three miles deep.

But for moving earth, nothing rivaled the ice sheets and winds of the Pleistocene. For more than a million years, North America bent under the frozen weight of four major glaciations—the Nebraskan, Kansan, Illinoian, and Wisconsin. Each advance of the ice deep into the Midwest pulverized its soft landscape, scattering chunks of Canada in new terrain of accumulated glacial till, making good stuff for soil.

Rivers of gray mud poured from the melting ice. In winter the rivers fell, exposing vast bars of sediment to the wind. Clouds of wind-blown silt fell all over the Midwest as loess, piling up in hundred-foot bluffs near the Missouri and Mississippi. Successive soils of loess and till weathered during the millennia between the glaciers and were buried with the next advance of the ice. The frosting on the cake is the young Wisconsin till and loess, little weathered in the brief 10,000 years since the ice melted.

These silty uplands are the source of our worst erosion. Naked on a rainy hillside any soil will move, but loess pours off like cream.

IT WAS MAY, and Bob Ruhe was driving a Chevy Suburban across Illinois on one of his many traverses, examining loess from Mississippi to Minnesota and out to western Kansas. Two of his students from Indiana University followed us in a pickup, a hydraulic soil-coring rig bolted to the bed. Ruhe occasionally wheeled off the wrong interchange, absorbed in what he was saying.

"Everybody ought to thank God for loess!" he shouted. "The breadbasket of the world sits in the middle of the Wisconsin loess and glacial drifts—corn, soybeans, wheat. The most productive soils in the world. If we didn't have this recent glaciation and the loess to bury that old stuff, we'd be having to farm these buried soils, like the Yarmouth, which is what they're doing in parts of southern Iowa where the loess has thinned. The Yarmouth weathered all the way through most of the Pleistocene. It's shot to hell. Its B horizon is heavy clay up to 12 feet thick. Water perches right on it. And that stuff would be on the ground today if it weren't for the Wisconsin loess.

"See that rise up ahead? That's the border of the Wisconsin drift. Beautiful, just like a layer of cake. It goes all the way to Canada." We drove up the leading edge of the last glaciation, past a shack and cattle pastures. North of Champaign-Urbana on U. S. 74 we were vibrating. The country was flat to the eye, but the roadbed was corduroy. An old clay lake bed lay under the loess. Water perched on the clay saturates the loess so that ice heaves up the highway, and our Su-bur-bur-bur-bur-ban.

Loess also covers the Snake River plain in southern Idaho and the wheat fields of the Palouse. Loess laid down on the plateaus of China is hundreds of feet deep. At the end of the Long March, Mao Zedong hid in caves dug in loess.

More than 4,000 years ago the Chinese devised a system of land taxation based on soils, but pedology, the science of soils, is still very young. It was not until late in the 19th century that V. V. Dokuchayev looked out on the A, B, and C horizons of Mother Russia and pronounced that soil formation was strongly influenced by climate. In the U. S., Eugene Hilgard was independently arriving at similar conclusions, relating native plants to soils in the South: beeswax hummocks, buckshot clay, hog-wallow prairies. He showed why soils of the arid West were fertile and how to control alkalinity and salts with gypsum and heavy-flood irrigation.

"In many ways, soils are still a mystery," Dick Arnold told me. "We know some basic physics and chemistry, but we still have a lot to learn about how soils form."

In 1926 Hans Jenny arrived here from

*"**It's not bankruptcy** in your normal sense," says farm lawyer Brett Merrill, displaying a case file, in Swainsboro, Georgia. "Chapter 11 of the 1978 bankruptcy law enables farmers to restructure their debts and continue farming, but it requires a substantial, good-faith effort." He cites drought, low prices, high interest rates, and mismanagement as his clients' main problems. Complained one: "The Farmers Home Administration loaned me $400,000 to put in irrigation, then prices went so low I couldn't farm."*

Everything, *including the kitchen sink, gets thrown in a gully in west Tennessee* ***(above)*** *to slow the flood of runoff erosion. Statewide, however, Tennessee's erosion rate is falling, as farmers adopt measures such as conservation tillage encouraged by the U. S. Soil Conservation Service. With budget cutbacks, the SCS now is focusing its efforts on areas of the most critical concern.*

One such area is Washington State's bountiful wheat kingdom, the hilly Palouse region, where farmers have been plowing the hills for a century. When slopes are plowed, sheer gravity takes a toll. But old-fashioned farming techniques, like cultivation up- and downhill seen at Diamond, Washington ***(above right)****, dramatically increase erosion. Already, a tenth of the Palouse, or some 200,000 acres, has lost much of its topsoil. The SCS estimates that this erosion could be reduced by 40 to 60 percent by using simple conservation methods that would not seriously affect farm income.*

In another targeted area—the Beaver Creek watershed of Macon County, Georgia—SCS official Pete Davis ***(right)*** *points out an example of gully erosion so serious it*

has caused families to abandon their homes. He encourages farmers to curb runoff by constructing terraces and laying down underground pipes to drain excess water off the fields and into small storage basins.

"We're losing 40 tons an acre on some farms," he says. "The high price of soybeans caused a real plow-out. Let's face it: Economics is the name of the erosion game."

Switzerland. For years he occupied Hilgard's chair at the University of California at Berkeley—Jenny is professor emeritus of soils—trying to quantify the factors of soil formation. He might be excused were he to rest on his worldwide scientific reputation and put his feet up on an ottoman. He is not so inclined. Believing that soils highest in organic matter would exist at high altitude near the Equator, he recently climbed up Mount Kilimanjaro and filled his plastic bags with black soil. The Tanzanians were astonished to see this wisp of a man at 14,000 feet. Hans Jenny was 82.

As with most sciences, pedology is full of pigeonholes and considerable fluttering to specialized roosts. The roosts have been shifting from the field to the blackboard, with a growing use of computers and mathematical models. "Modeling is a sort of fashion," Dr. Jenny said. "We need a lot more conceptual work."

If one of Ruhe's students shies from the mud of fieldwork and begins relying on equations, Ruhe will plop a can of Play-Doh on his desk and tell him to make his model of that. Ruhe would rather be out on the landscape, like a wildcatter, clattering across the Midwest in his truck full of drill pipes, punching the country full of holes.

AT A FARM in northeastern Iowa, Ruhe's students backed their pickup into a field. The temperature was in the 40s and the wind put an edge on the rain. The first core came out of the hole. Standing at the tailgate, Ruhe laid the plug of mud on a sheet of white butcher paper. He pinched off a gob, smelled it for humus, and rubbed it between forefinger and thumb like a bank teller checking cash, feeling for the grit of sand and the flour of silt, squeezing out a ribbon of clay. As more cores came out, Ruhe wrapped them like salamis, rubbing ribbons of soil, assaying texture in the rain.

Soils have their own internal construction—from silts like flour to clays as tight as sausage—which determines the pore space for roots and water. A sandy soil can be droughty even in the rain. A heavy clay subsoil or impenetrable hardpan will cramp roots or drown them. Farmers prefer a loam—about equal parts sand, silt, and clay and enough humus for a friable texture of crumbs. Loam is soft underfoot. After a day on clay your feet hurt.

Ruhe wiped his hands. "I've preached heresy—the best thing they could do in western Iowa is let those steep slopes erode down on the valleys where the stuff can be farmed. This doesn't mean I wouldn't be scared if I had to farm a heavy clay B horizon."

Landscapes alternate between cycles of erosion and stability. Sediments gradually build up, then the climate changes, the earth uplifts, or man clears the land, and on this unstable landscape the soil begins to move. The Mississippi Valley has had a number of such cycles.

In a big storm, clay and organic particles may go hundreds of miles, yet there are coarse sediments that eroded into the Mississippi Valley 15,000 years ago that still haven't reached the Gulf. The entire Mississippi watershed is storing and moving sediment in obscure stages from a hayfield ditch in eastern Montana to New Orleans.

Arroyos in the Southwest are usually blamed on overgrazing, since shortly after big herds hit the range in the late 1800s gullies began debouching from the foothills like spaces between the toes. The cow was probably the trigger, but the valleys were full of sediment poised to go, just as they had gullied dramatically thousands of years ago when climatic shifts removed vegetation, exposing soil to summer cloudbursts.

Landscapes do not evolve gradually, according to Ray Daniels, former director of soil survey investigations for the SCS. "I think you get them steady by jerks. Most people have no idea how fast landscapes can change. In some cases man-made erosion may be faster, in others slower, than geologic erosion. Our landscapes are largely shaped by erosion.

"A lot of people want to hold those loess hills in western Iowa forever. You can't. There's been tremendous cutting the past 1,500 years. Sediment helps dissipate the energy of a river. Take sediment out, and the river starts cutting like hell, as the Missouri has done below its dams. In the tropics some of the most fertile soils are from fresh material exposed by erosion. I'm not advocating we erode everything, but I'm also not saying that all erosion is irreversible damage. I don't know of any such thing in soils."

John Peterson, former head of agronomy at Purdue University, is less sure. "No ordinary farmer could afford to reclaim large areas of subsoil," he said. "Even discounting extravagant claims of the doomsayers, we can't afford to lose productive topsoil."

IN 1955 a family on the loess hills of western Tennessee hoed 30 acres of cotton. Ten years later one man with big equipment could handle a thousand acres.

"In about 1974 soybeans went up to $12, and people just went wild clearing land," said Bruce Calhoun, an SCS technician at Union City. "After a few years there isn't enough humus to hold the loess, and the soil just goes. Farmers say, 'I've got to pay for the combine.' I can understand their reasoning, but they're shortsighted."

We drove past eroding fields where farmers had ignored contours and driven their big rigs uphill and down. Road culverts were filling up, and a small dam built in 1963 to trap sediment for 50 years was already choked with silt and box elders.

We parked on a high loess bluff above the Mississippi. Below was Reelfoot Lake, shaped in 1811 and 1812 by the powerful New Madrid earthquakes and silting in from these hills ever since. In 50 years Reelfoot could again be a marsh.

Maury Headden farms near Newbern, Tennessee. He is in his 70s. He breathes life into the dry language of soils classification. Eroded rills are "shoestrings," steep land is "all rolled up." He pointed to a rise in a plowed field—a Typic Hapludalf according to the SCS—and said, "That's good land, yellow poplar ridge ground." A damp depression: "That's buckshot—white gum ground, and it's sticky way down."

We walked down his terraced pasture to a cattle pond by the woods, where silt from neighboring fields had almost buried his fence. "The land back when we was younger grew red clover and made a lot of humus," Maury Headden said. "You don't see that any more. My daddy's farm was level land. He said I'd lose this up here in five years to erosion, and I darn near did. It started to leave as soon as we worked it for cotton. I didn't like terraces, but you've got to have them on this steep ground. I want to leave this ground as good as I found it."

What is excessive erosion? According to the SCS, it is anything over five tons per acre per year on most soils, down to two tons on others. The maximum soil tolerance, or "T-value," apparently evolved from SCS estimates from the 1930s that topsoils deepen an inch in 30 years—five tons an acre each year. Keeping erosion below the T-value supposedly would enable farmers to grow high yields economically and indefinitely. But the scientific basis for T-values remains controversial.

"We just came up with a figure," said Bill Brune, former SCS state conservationist for Iowa. "I don't think any scientist knows how long it takes to generate soil." Research is spotty, but it shows some topsoils deepening an inch in only 15, not 30, years. Yet soils aren't likely to be created at the bottom from unconsolidated material any faster than an inch in 300 years, and a lot slower from hard rock. No farmer is likely to get his erosion rates that low. The five-ton T-value may be too low if it is meant to approximate the formation of topsoil, but it is too high to keep the rooting depth of soils from gradually shrinking. Nor does it take into account the damage done by eroded sediments to streams and lakes.

To Klaus Flach, an SCS scientist responsible for reexamining T-values, "It's a pretty good expression of averages. But I can't prove it. It's intuitive. A lot of loess soils probably aren't hurt all that much by some erosion, but if there's a clay pan exposed, you've got real trouble."

Walter Wischmeier, who developed the equation for measuring water erosion, told me, "A soil tolerance has to be low enough to protect productivity, but it has to be attainable by farmers. A good sod will prevent erosion, but we can't eat grass." To many scientists like Tom Dunne, a hydrologist at the University of Washington, there is little scientific basis for the five-ton T-value. "The mistake," he says, "is to try to give people a warm feeling that preserving soil is good. You've got to find out how erosion is damaging production, if it is."

Unfortunately, it is difficult to isolate what erosion does to soil productivity from all the other variables—weather, fertilizers, the farmer's skill—that influence crop yields. Neil Sampson, a former official with

the National Association of Conservation Districts, says, "In my judgment the economics of erosion on soil productivity is serious. The thinner that topsoil gets, the higher the productivity loss for each additional inch that erodes. But you can't prove it with much intellectual rigor. We can't always tell you if the deposited soil is damaging or beneficial, although it is damaging in some cases."

Despite erosion, crop yields have been increasing for years. Scientists believe erosion damage has been masked by technology, particularly the tenfold increase in commerical fertilizer use since World War II.

In shallow soils or in those where erosion has cut the capacity of topsoil to hold water, crops can't be helped by more fertilizer. That's why William Larson, at the University of Minnesota, pays less attention to high erosion rates—and T-values—than to the vulnerability of the soils that remain.

He has compared eroding loess soils of western Iowa with similar ones of western Tennessee and Mississippi. Unlike Iowa, those in Tennessee and Mississippi are often underlain with dense pans that block roots and water. At current erosion rates, Larson estimates that productivity losses in a hundred years could be minimal in western Iowa, but substantial in Tennessee and Mississippi, while the drop in yields nationwide may be no more than 5 to 10 percent.

Farmers know how to control erosion, but soil conservation is still dictated more by economics than by good intentions. In recent years, when fuel, fertilizer, and interest rates headed for the stratosphere, farmers began thinking twice about exercising their big tractors. Instead of burying weeds and crop residues with heavy moldboard plows—and burning a lot of fuel—they could kill weeds with herbicides and drill through mulch with a "no-till" planter behind a smaller tractor.

No-till farming has its drawbacks on colder and poorly drained soils—such as diseases and some lower fertility—so many farmers mulch-till instead with a chisel plow or disc. A wet spring won't delay their planting as much, and the mulch of dead weeds and crop residues holds the soil, and moisture should drought occur. Roughly one-third of all U. S. cropland is now in some form of conservation tillage, and half could be by the turn of the century. During recent years Tennessee's annual erosion rate has dropped from 14 tons an acre to about 10, probably because of reduced fall plowing. Mulch on the fields and less plowing means less runoff and erosion, but farmers are having to lay on more herbicides.

BUT ON THOSE STEEP loess hills, farmers can't hold soil with only mulch. They also need grassed drainageways and terraces, and that takes bulldozers and a lot more money than most farmers can justify. Unfortunately, such conservation doesn't usually repay a farmer in improved yields what he spent to save soil, at least maybe not for 20 years, and that's a good part of a farmer's productive life. "The farmers around here want to control erosion," an SCS man told me in western Iowa. "They come in and ask for help, but it's a matter of costs."

Iowa puts up conservation funds along with those from the U. S. Department of Agriculture. The money never goes far enough, in part because until recently half the federal effort had been spread on soil with low erosion rates. Yet in 1983, with erosion control at a billion dollars, the President's Council of Economic Advisers estimated that federal subsidies to farmers blew right off the chart: from 7 billion to 28 billion dollars in two years. Taxpayers were forking over $12,000 per farm to subsidize production, and $400 to hold the soil.

The Reagan Administration and Congress have agreed to target some erosion control where it is needed most—not only where erosion rates are high, but also where shallow soils and hardpans can affect productivity. Peter Myers, chief of the SCS and

New horizons *in the nation's soil profile, man's garbage can dramatically alter a soil's structure and chemistry. As seen in this cutaway of a small landfill in Nebraska, space for rooting after "reclamation" is often limited to grass. Asks one expert: "How much longer can we pile our sweepings under nature's carpet?"*

Zen and the art of soil making *have helped a gray-bearded "rubble rouser" known as Adam Purple create a "Garden of Eden"* ***(opposite)*** *from the urban decay of Manhattan's Lower East Side. "As the city removes buildings," he says, "I follow behind with pick, shovel, and rake, converting their rubble into soil."*

Brick sand, sifted from the debris of demolition sites ***(below)****, serves as the parent material for his soil, while horse manure from Central Park* ***(right)*** *provides organic material. Popular with area residents, Purple's garden has been difficult for city officials, whose plans to supplant it with low-cost housing are currently under way.*

a grain and hog farmer from southeastern Missouri, told me: "Targeting is causing people to concentrate on erosion where it is worst. Politically it isn't easy. They'd like the money spread around as it always was. We know how to control erosion. But cost effectively? Most soils yes, others no. We need a lot of answers, particularly to show the farmer what he's losing in terms of productivity. The trick is to crack the big-equipment syndrome and get the farmer off that big breaking plow. He's been doing things for years that his father did. When I started conservation tillage, my neighbors scratched their heads. They thought I was being sloppy.

"We've always gone at erosion as a moral issue, but now we also want to appeal to the farmer in dollars and cents. We have to be careful not to paint a distorted picture. Soil erosion is not a today problem; it's a tomorrow problem, but you have to work on it today. Why squander what we have?"

THE HIGH PLAINS OF TEXAS appear to have been ironed. When the Rockies first wore down, a slurry of broken mountain washed onto the plains. Winds sifted the fine stuff around and dusted the plains to make soil. The soils still blow. During droughts, sand blows across the fields, shredding crops to confetti and piling up in dunes. The dust of fertile silts, clays, and humus winnows into the sky and moves east.

Water erodes more soil in the U. S. than

***Intensive use** of the land, whether by human or prairie dog **(below)**, can leave the soil unprotected. The naked soil of a Nebraska prairie dog "ghost" town **(left)** may require years to recover.*

wind, but one bad High Plains storm can crater a field. A third of American cotton comes off the dryland fields between Big Spring and Amarillo, Texas, and with it maybe a quarter of U. S. soil eroded by wind. Cotton farmers plow often and deep to bring up clods of silt and clay to hold moisture, but winds suck up the fine particles. Yields keep dropping as the soil gets sandier.

R. C. Thomas, a farmer near Big Spring, told me, "We're cutting our own throats by going cotton all the time, but it's simply survival. A lot of range has been put in cultivation that shouldn't have been. There's nobody to our soil. They have all those cornstalks up on the prairie. What I wouldn't give for some of that organic stuff here."

Driving to Seminole with Bill Fryrear, head of the USDA Agricultural Research Service station at Big Spring, I passed fields littered with white rock, where plows had clipped caliche. In dry country, lime leaches down only a few feet, where it hardens like concrete. Hit caliche with a shovel and your elbows ring. In the Central Valley of California—the national grocery—D-9 Cats drag huge breaking plows to fracture similar hardpans of silica. Growers used to blast holes in it with dynamite and plant fig trees. Much of the High Plains of Texas sits on a caprock of caliche as thick as 30 feet. When the soil blows down near that, your next rotation better be oil.

We walked into a cotton field that resembled the Sinai desert. Dunes 15 feet high buried the fences. Farmers have built as many

as three fences, one on top of the other, as sand covers them up.

"The potential for erosion now is worse than in the 1930s," Bill said. "If it gets as dry as it was in the 1930s, we're in for some real trouble. You're in country now that man in his infinite wisdom did not improve upon."

AS A HUNGRY WORLD keeps crowding onto worn-out soils, Americans are fortunate to possess so many good ones. Although we pave fewer than a million acres of farmland each year—not a rate suggesting a national shortage in even the foreseeable future—California continues putting a lot of soil under macadam and Mr. Taco. In a few decades the orange groves of southern California have approached a memory, and the sprawl of Silicon Valley has chased 80,000 acres of prune and walnut orchards east to the Central Valley, where the cost of water continues to rise with the salts.

Soil scientist Roy Simonson suggests that on the whole our better soils have lost some fertility as we have improved the poor ones with fertilizers, so that the weathered coastal plain of the southeastern U. S. now competes with the corn belt.

High costs of labor and land have caused farmers to turn more to science and technology for their high yields, using soils to prop up crops in the sun. In trying to reduce the risks of weather and disease, science and economic pressures have helped encourage a riskier way of farming: away from rotations that hold and restore soil and toward erosive beans and grain for unstable export markets. Although half of America's farmers have almost no debt, many are in serious trouble, heavily mortgaged. These are the guys who lean hardest on their soil.

For all its Byzantine subsidies and distorted markets, American agriculture is no small success, but to maintain high yields will require scientific advances—better plant breeding, maybe perennial grains—and more sophisticated farming. Erosion may not gouge big holes out of soil productivity nationally in the next hundred years, but a century is a short time in the life of a nation. Eventually our descendants may wish we had taken a longer view.

But that doesn't make today's choices obvious. We still know too little about how much erosion is too much. How much money should we spend, and where should it go? Should we continue subsidizing conservation tillage when fuel bills already give farmers incentive to leave the plow in the shed? Is our goal to protect soil productivity, or keep silt and pollutants from getting in reservoirs—and if both, what is an economic use of scarce tax money?

Sodbuster bills now before Congress would deny certain crop subsidies to landowners who plow up erodible range. It makes sense not to pay for dust storms, but some economists doubt that this will stop the plows, when cattle ranchers are desperate and speculators can transform $100-an-acre rangeland into $300 wheat fields and walk away with a killing.

There is a nostalgia for the family farm with Pa in the barn milking the brindled cow, and an uneasiness about the trend toward big corporate farms. On the other hand the Piedmont was gullied by thousands of desperate families, and more profitable farms may be better able to afford costly soil conservation. Maybe our nostalgia is for the family, not the farm or its hard life few of us ever led and many willingly fled.

Economics, not nostalgia, governs the plow. The world's appetite drives our production of grain and soybeans; consequently, if exports and prices soar again, another big plow-up of erodible soils of the Middle West is inevitable. Those men on the plows churning up High Plains range are hoping for rain and a few bumper wheat crops to pay off a gamble in country where grass returns slowly and drought holds the cards. "I'm not opposed to people making money," Peter Myers told me, "but I am opposed to another Dust Bowl." □

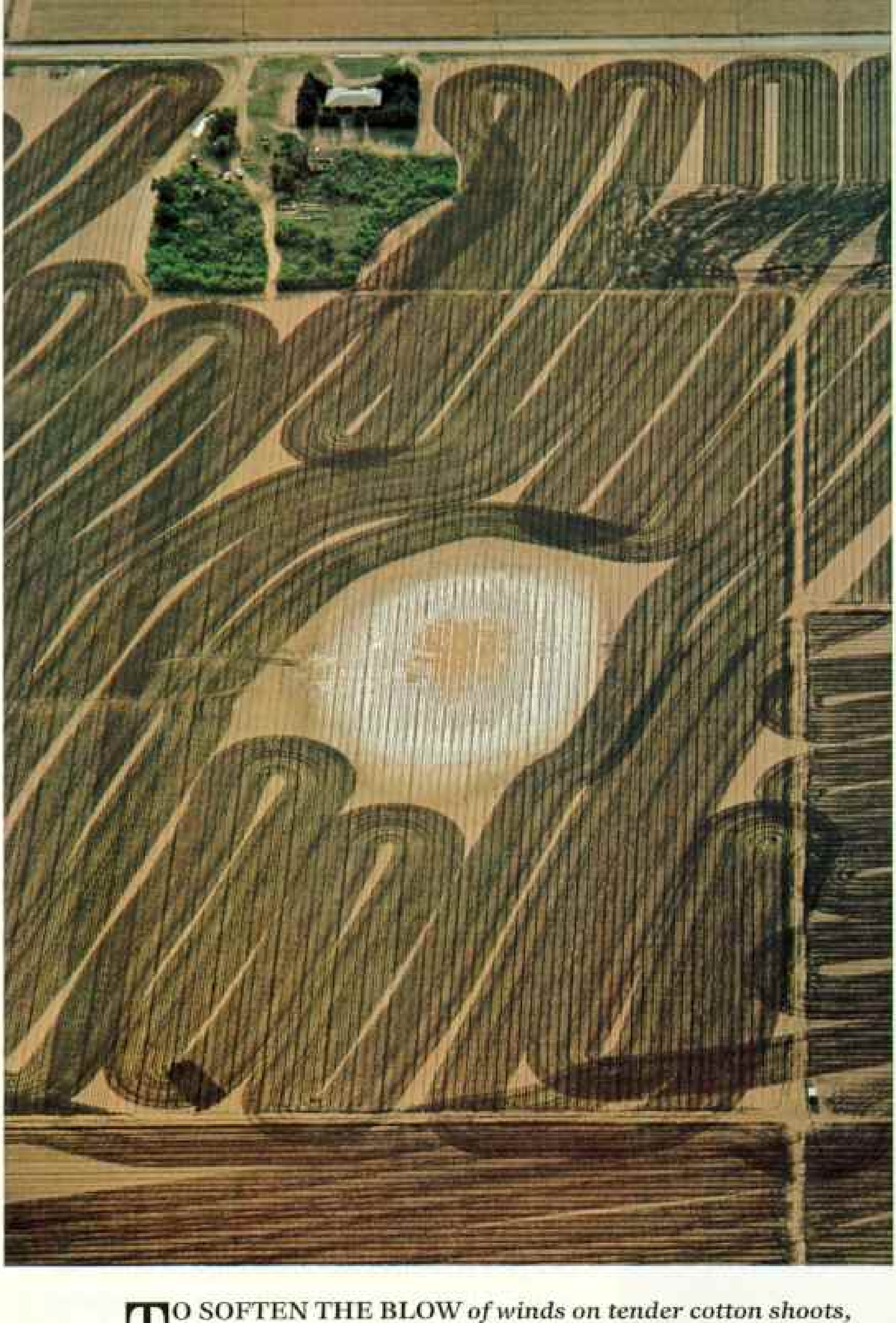
Islands of earth *in a badly eroded section of Tennessee seem to hold the trees on pedestals. The protective cover of plants, in fact, holds the soil—a basic truth too often ignored. "If we ever get serious about conserving our soil," says Dr. Steven Holzhey, director of the National Soil Survey Lab, "we have a lot of the facts to do it."*

Patterns of Plenty: The Art in Farming

PHOTO ESSAY BY GEORG GERSTER

THE PAINT is golden corn and emerald alfalfa, nourishment for livestock in this rolling northeast corner of Iowa (left). The design emerges by planting alternating crops across the slope of the hill to battle water erosion. Connecting grass waterways drain excess rainfall. From a ground-level view this farmer is husbanding his land with contour strip-cropping. But from my vantage point in a single-engine airplane some 1,000 feet above his work, the farmer is also an artist.

As a Swiss photographer who specializes in aerial images, I never stop marveling at America's diverse and productive farmlands. While coaxing bounty from the earth to feed the U. S. and other nations, farmers coincidentally offer up a visual feast for the eyes of an airborne viewer. In an age when sweeping satellite imagery enhances our knowledge of land and water, I believe that low-altitude perspectives can also serve us, giving intimate reminders of our vital relationship to the land—and our responsibility to sustain its wealth.



TO SOFTEN THE BLOW *of winds on tender cotton shoots, Texas Panhandle farmers roughen the soil with a 60-foot-wide implement called a sand fighter. An old wind-carved depression filled with water creates the centerpiece.*

Oil leases boost farm income in western North Dakota, where, to counter erosion, fields of grain and fallow lie perpendicular to prevailing westerly winds. The August harvest dries in windrows. Dark potholes are wind-eroded.

GREENING THE DESERT *with irrigation, Arizona farmers produce some of the nation's highest crop yields per acre. A quilt of dark green alfalfa, light green wheat, and brown fields—awaiting spring cotton—covers the Salt River Project*

near Phoenix. Center-pivot irrigation near Yuma annually rains some 400 million gallons of well water on each 130-acre wheel of alfalfa or grain, harvested as often as ten times a year. Colorado River water nourishes distant fields and citrus groves.

FLOODED RICE FIELDS *shimmer in humid southeast Texas (left), where contour levees maintain the needed water level and prevent drainage into the snaking gully. On rolling terrain near Wichita, Kansas (center), gradient terraces, 40 to 50 feet wide and one foot tall, break the energy of flowing water to control erosion and help direct excess*

rain into grass waterways. Darker green strips hold winter wheat. Stubble from fall-harvested sorghum remains on the fields to conserve moisture until May planting. Feed corn for dairy cattle (right) veers around grass-covered stones pulled from the rocky soil of a Vermont farm, deeded to its owners' ancestors by the brother of Revolutionary War soldier Ethan Allen.

ZEBRA PATTERNS *signal soil-conserving strip-cropping in southeastern Washington's hilly Palouse, one of the nation's major winter wheat regions. Golden strips hold stubble from the recent August harvest. Planting will soon begin on dark strips that are allowed to lie fallow for a season to collect moisture. Though strip-cropping and contouring*

greatly reduce erosion on this fertile, vulnerable soil, less than 10 percent of the area's farmers do so, citing greater expense and work time. But one farmer was apparently won over after he studied one of my photographs hanging in his local U. S. Soil Conservation Service office. "If you can turn my farm into such a beauty," he told the agent, "go ahead." □

Man and Manatee:

By ALICE J. HALL
NATIONAL GEOGRAPHIC SENIOR STAFF

GARGANTUA of the shallows, the manatee, or sea cow, finds sharing Florida waterways with human beings an increasingly dangerous predicament. As boaters grow in number, dozens of these gentle, elephantine mammals suffer disfigurement or death. In the Crystal River ***(right)*** *an inquisitive adult, ten feet in length, swims toward an anchored motorboat that under power could bounce across its back, leaving scars. A head injury could kill. The huge propeller of a larger boat sliced the fluke of a female called Sadie* ***(below)****, whose calf is untouched so far. Scar patterns help identify individuals for researchers struggling to save the endangered manatee. Their pioneering efforts bring together federal and state agencies, power-plant operators, conservation groups, and oceanariums in innovative programs that include Dr. Jesse White's captive-breeding plan described on pages 414-18.*

Can We Live Together?

Photographs by FRED BAVENDAM

PETER ARNOLD, INC.

WARM WATERS *of the Crystal River, heated by 74°F springs, attract more than a hundred manatees each winter; in summer the animals disperse. A sanctuary beyond the orange floats protects shy animals from human activity. Three no-entry areas at Crystal River* ***(map)****, one at Blue Spring, and reduced-speed boat zones in other manatee-favored areas have been designated in attempts to lower the death rate—close to a hundred a year—since half the investigated fatalities are caused by humans. Florida also maintains a 24-hour hot line to report manatees in distress, levies fines on vandals harassing the mammals, and seeks to protect the manatees' grassy habitat from new waterside developments.*

Estimated at more than a thousand, Florida's manatees belong to the West Indian species once heavily hunted for its tasty meat. It belongs to the order Sirenia, the only aquatic mammals that subsist on vegetation. Australia's dugong inhabits ocean shoals where it is harvested legally by Aboriginals, despite dwindling numbers. Another sirenian, Steller's sea cow, was hunted to extinction in the Bering Sea by whalers and sealers.


North America
South America
Atlantic Ocean
Africa
Asia
Pacific Ocean
Indian Ocean
Australia
EQUATOR
TROPIC OF CANCER
TROPIC OF CAPRICORN
VIRGINIA
NORTH CAROLINA
SOUTH CAROLINA
GEORGIA
ALABAMA
FLORIDA
Suwannee River
Tallahassee
St. Johns River
Gainesville
Crystal River
Blue Spring
Homosassa River
Lake Okeechobee
Fort Myers
Sanibel Island
Lake Worth
Ft. Lauderdale
Miami
Gulf of Mexico
Atlantic Ocean
0 200 mi
NGS CARTOGRAPHIC DIVISION
RESEARCH: DAVID C. CHANG
PRODUCTION: E. RAMSEY MURRAY
Shaded areas show estimated ranges
WEST INDIAN MANATEE (Trichechus manatus)
AMAZONIAN MANATEE (Trichechus inunguis)
WEST AFRICAN MANATEE (Trichechus senegalensis)
DUGONG (Dugong dugon)
Dashed areas show occasional sightings
WEST INDIAN MANATEE in the southeastern United States
Summer range
Winter range

ROBERT RATTNER

MUNCHING *on water hyacinths, a manatee uses a flipper to push in the food; the appendage is useful too for cleaning irritating matter from the mouth. Manatees also graze on a variety of bottom-growing vegetation, daily consuming 5 to 10 percent of their body weight, which can reach 2,000 pounds.*

A doting mother (**upper right**) *nurses a yearling, on her left, as well as an older calf in this unusual scene*

*at Crystal River. Females in the wild mature as early as four years and generally produce a single calf every two to three years, but rarely nurse two at once. Playful as puppies, manatees often nibble and groom each other (**above**).*

*An algae-coated female in estrus (**overleaf**) wards off a tumbling entourage of pursuing males for weeks. Then, when ready to mate, she accepts several suitors.*

SNOOZING at Crystal River, manatees enjoy the warmth of a freshwater spring. Every 10 to 15 minutes, they surface for a breath of air.

Displaying a curiosity that can be deadly, a yearling calf mouths a rope from an anchored boat used by researchers at Crystal River. Animals are often rescued after

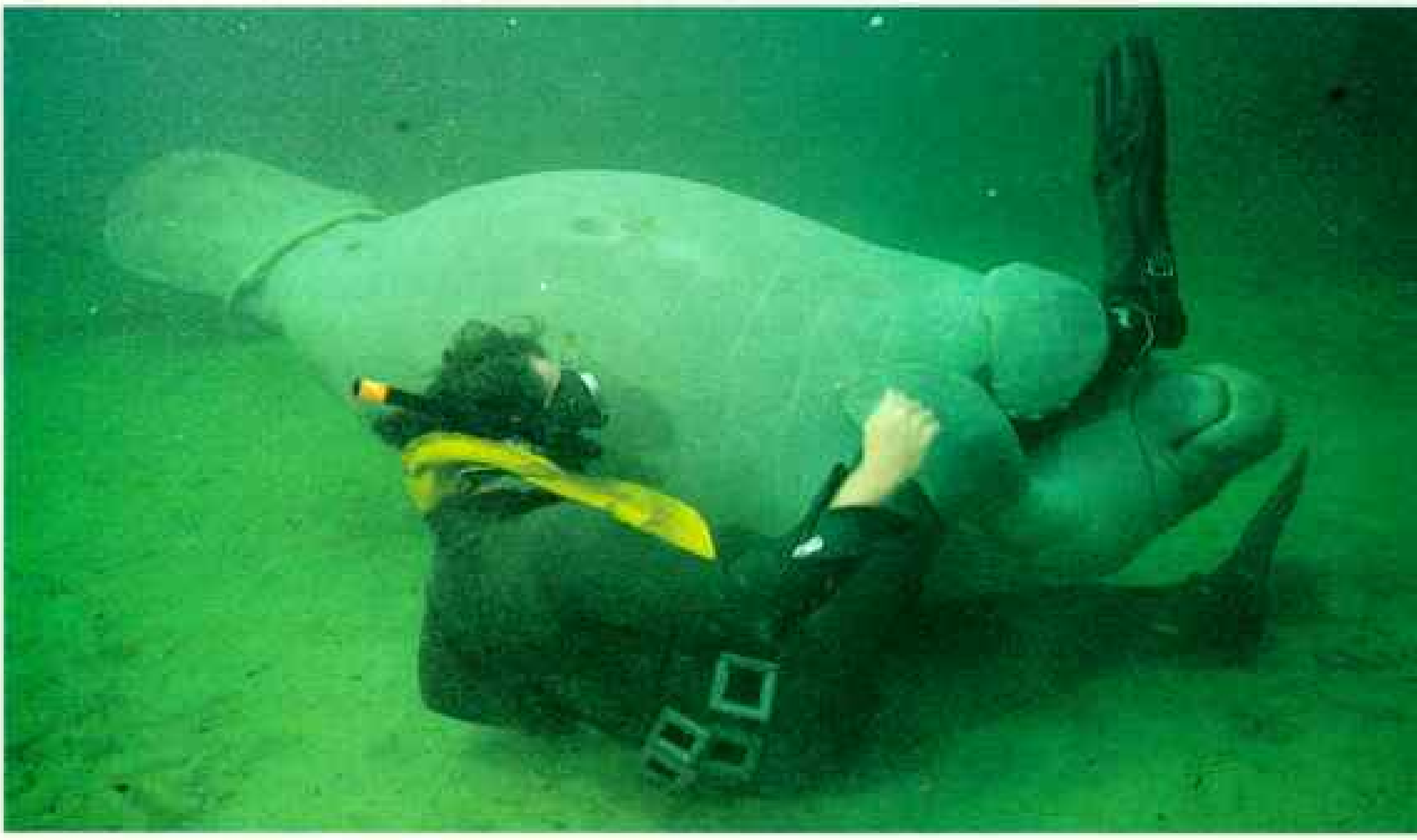
entangling flippers in crab-pot lines.

For a male named Howie, nothing satisfies like a good scratch and a stretch. A radio transmitter on his tail tracks him around his St. Johns River home.

Ordinarily cruising at two to four miles an hour, manatees can sprint from danger with rapid tail strokes.

HER MONA LISA SMILE
a matter of anatomy
not emotion, Piety nurses
a yearling calf from a
thumb-size teat under
her flipper. The cow-calf
bond, the most stable
manatee grouping,
lasts until weaning at
one to two years, and
sometimes beyond.

PLAYFUL *tussle: Howie grabs biologist Pat Rose* (**opposite**), *flips him* (**left**), *and briefly holds him down* (**below**). *During play or when alarmed, manatees emit a squeak or squeal but apparently do not use sound for echolocation in turbid waters. Coordinator for state manatee programs, Rose found this animal the exception among the 30 or 40 winter residents of Blue Spring. Most, he says, are so shy they flee human contact—action that may in the long run aid their chance for survival.* * * *



Man Can Save the Manatee

By JESSE R. WHITE

***Veterinarian** at the Miami Seaquarium and adjunct professor at the University of Florida, Dr. White befriends subjects of his captive-breeding program.*

SUDDENLY the young manatee seemed to bend double. For some time she had been nuzzling up to her mother on the bottom of the tank, sleeping. Every few minutes she would surface for air, as marine mammals must. It was now about 5 a.m., more than 24 hours since her labor pains began.

Certainly I hoped Ariel's time had come. After 18 hours in the tank at the Miami Seaquarium, I felt cold in my wet suit, even with the water temperature in the 70s. This would be the first manatee birth to be fully observed. As the Seaquarium's veterinarian, I was determined to witness it, having missed seeing the three previous ones.

Ariel and her mother, Amanda, and seven other West Indian, or Caribbean, manatees compose a successful captive-breeding enclave—the only one anywhere. Manatees appear to be losing the battle for existence in Florida's inland waters and coastal shallows. An estimated thousand remain—an educated guess at best. The salvation of these large, gentle creatures, I believe, depends on captive breeding and introduction into natural habitats.

Ariel was doubly important to us. Little is known of the manatee's reproductive biology. The birth of Ariel's baby, her first, would enable us to pinpoint sexual maturity, at least in one individual.

We had rescued Amanda with Ariel as a newborn, suckling infant. A call from the Florida Marine Patrol told me the old, sad story: "There is a badly cut-up manatee in the shipping port at Lake Worth." With six large propeller slashes, the mother was weak from loss of blood. Her baby was swimming vigorously alongside; if the mother died, so would she.

Our four-man team trapped Amanda in a large net and caught the baby by hand. A crane hoisted the 1,300-pound mother onto a stretcher, and we lifted her into our truck. We cleansed the wounds and applied topical antibiotics. Subsequently, systemic antibiotics were administered. Within six months Amanda was healed.

And now, eight and a half years later, her offspring was giving birth. Ariel's activity had aroused the tank's other sleeping animals. They ignored me as I swam about. I could easily keep in view the pregnant manatee, who would not leave her mother's side. The tank is only 30 feet wide.

In a single explosive contraction an elastic, grayish bubble, about 12 inches in diameter, appeared. During each successive contraction it grew bigger and more oblong.

At 6:15 a.m. the amniotic sac burst. Minutes later, in a frenzy of movement and an extreme flexed contraction, the baby was born, tail first. With Ariel's mother beneath him, the infant swam to the surface, making loud, high-pitched cries.

I positioned myself beside the tank, where the baby would pass just below me. When he swam by, I grasped his pectoral flippers and gently brought him out, squealing like a frightened rabbit. Taking the plump, wrinkled infant in my arms, I stepped on a bathroom scale. He weighed 63.1 pounds and measured 46.9 inches from the tip of his muzzle to the end of his fluke. He was born as a beautiful dawn broke. We named him Sunrise.

When it comes to comeliness, these placid, harmless animals win few admirers—no external ears, deep-set eyes, whiskered lips, and a bloated sausage for a body that slims to a paddle-like tail. Christopher Columbus thought them mermaids, adding "they were not as beautiful as they are painted, although to some extent they have a human appearance in the face." A writer friend expressed it differently: "They look like overstuffed seagoing sofas with movable manhole covers for tails."

Scientists believe that manatees are distant cousins of the elephant, and forsook land for water millions of years ago. They can weigh more than 2,000 pounds and range from 8 to 14 feet in length. Mighty consumers, these herbivores may daily ingest as much as a pound of aquatic grasses for every ten pounds of body weight. They are also known as sea cows; browsing takes up a fourth of their time.

Three species of manatees and the marine dugong of the Indo-Pacific region make up the order Sirenia. In addition to Florida, the West Indian manatee is found in the waters of the Caribbean, and along the coast from southern Mexico to northern Brazil. Other sirenians are the Amazonian and West African manatees.

All face extinction, principally at the hands of man. In Florida, encroaching civilization—dredging, water pollution, filling of swamp and marsh for housing—devastates wild habitats. Large commercial and recreational boats are mainly responsible for high fatalities. The propellers of freighters and barge-towing tugs can cut a manatee almost in half.

Manatees have long been protected by state and federal laws. All Florida has been declared a sanctuary. The Florida Marine Patrol specifically monitors 21 areas where boat traffic is strictly regulated. The patrol also responds to a 24-hour hot line for people to report manatees or other sea creatures in distress. The appropriate oceanarium is immediately notified for rescue and treatment.

Airy outline *of an aluminum sculpture reminds boaters that manatees in winter seek the warm outflow of this power plant near Fort Myers.*

MY CLOSE ASSOCIATION with manatees began in 1969 with the rescue of a young male trapped in a Fort Lauderdale storm drain. The half-ton animal was close to death from exposure and lack of food. Carefully removed, he was brought to our treatment facilities. There I took a blood sample from a flipper to determine condition and guide treatment.

We later searched the limited literature but found no record of manatee blood samples. Finally we concluded that blood could indeed best be taken from a flipper, thus establishing a blood-sampling technique.

We placed Sewer Sam in our tank with the other resident manatees, Romeo and Juliet. They had been on exhibition at the Seaquarium since 1957. Routine blood sampling was conducted on all three over the ensuing year. In this way we discovered normal blood values for this little-known marine mammal.

A couple of years after Sewer Sam joined us, when he was long recovered from his ordeal, we reintroduced him into the wild—the first captive manatee to return to his natural existence. But Romeo, a healthy, vigorous male, and Juliet, a mature female, posed a question for us. We had observed them mating on many occasions. Why were no baby manatees being produced?

We suspected their diet—iceberg lettuce and cabbage, without supplemental vitamins or minerals. We knew that a deficiency or imbalance of calcium or phosphorus or both could cause fertility problems in other herbivores. I began administering a daily supplement of both calcium and phosphorus. We also supplemented their lettuce-cabbage diet with commercial trout food, and daily apples, bananas, and carrots.

To our delight, Juliet became pregnant. Unobserved and without warning, she gave birth to Lorelei, the first manatee ever conceived in a captive, controlled environment.

With Lorelei and Ariel, we had animals of known age from which to learn. A much larger tank with underwater viewing windows permitted us to observe their behavior constantly. In cooperation with the U. S. Fish and Wildlife Service at Gainesville, we have assisted in painlessly freeze-branding animals for identification in the wild, collected growth data, conducted aging experiments. We have found, among other things, that captive females become sexually mature at seven or eight years and that the term of pregnancy is around 14 months.

The special nutrition program has proved vital. We grow, hydroponically, an excellent aquatic food, a mixture of oats and wheat. The hydroponic sprouts contain three times more protein and other important nutrients than natural grasses.

SEQUENCE BY GARY MORTENSEN

MIAMI SEAQUARIUM, ABOVE

Birth of a manatee *was photographed close up for the first time when Juliet produced her fourth offspring at the Miami Seaquarium last November. The infant broke the amniotic sac with its nose (***left, top***). Two hours later, after Juliet twisted violently, it popped out (***middle***) and rose to take a breath of air. Juliet then accompanied her 75-pound son, named Hurricane, to the surface but did not push or support him (***bottom***).*

*Juliet has also served successfully as foster mother—for a lettuce reward. But this weeks-old orphan (***above***), rescued from the surf, refused her teat and later died.*

*Dr. White attributes his success in breeding captive manatees to the highly nutritious diet he feeds them. This year he plans to introduce two youngsters into a river pen; they will be released next year with radio transmitters attached to their tails. A similar device was placed on a Crystal River male called Gus (***right***). Four months later it broke off, perhaps on a snag, and washed ashore on Sanibel Island, 170 miles south.*

This diet, supplemented with multivitamins and minerals, has resulted in the birth of seven manatees in the past eight years, the most recent in November 1983.

Public awareness and concern for the sea cow has increased greatly in recent years. Educational programs such as the Save the Manatee Clubs, sponsored by the Florida Audubon Society and the state's Department of Natural Resources, spread the message. In a manatee rescue, municipalities respond immediately to requests for help, and people freely contribute blankets, pads, and towels for the animal.

We are now taking a large step with plans to introduce two manatees, a male and a female, into a large, fenced-off section of the crystal-clear Homosassa River on Florida's west coast. The manatees, Sunrise and Savannah, will be closely monitored. Observers will follow their visual and vocal communications with the local wild herd, which will be outside the fence.

Next spring, with radio-tracking devices safely fitted on their tails, Sunrise and Savannah will be released. Their movements will be compared with those of the wild manatees, giving us some knowledge of their interaction. Radio tracking will be conducted under the Sirenia Project of the U. S. Fish and Wildlife Service, which for a decade has carried out wide-ranging studies of the Florida manatee.

The large-scale breeding-release program we envision seems to us a logical supplement to the effective public-awareness programs. If enough calves can be produced, their release into the wild will extend the survival potential of the species, offsetting a percentage of manatee fatalities—almost a hundred known deaths a year.

Dr. Paul T. Cardeilhac of the University of Florida Department of Reproduction participates in the Miami Seaquarium's program. He believes that if, in time, twenty or more calves can be produced yearly, a positive reproductive balance of Florida's manatees will be ensured.

Captive breeding and introduction into the wild are controversial. Some scientists cite inbreeding as a possibility and question whether captive-bred animals can succeed in the wild. Dr. Galen Rathbun, leader of the Sirenia Project, maintains that the salvation of the wild manatee lies first and foremost in alleviating man's encroachment on its environment.

It is true that as the human population continues to explode and the manatees' habitat is swallowed, their decline seems inevitable. I am convinced that restocking wild herds with captive-bred animals, coupled with public-education programs, will enable future generations to enjoy the manatee, the world's gentlest giant. □

Adept student, *a captive male, Romeo, learns to discriminate between objects of different shapes, colors, and sizes for a food reward and remembers such lessons for as long as a year. The tests by psychologist Dr. Dale Woodyard of the University of Windsor, Ontario, prove that manatees are not mental dullards.*

NATIONAL GEOGRAPHIC SOCIETY

WASHINGTON, D. C.

Organized "for the increase and diffusion of geographic knowledge"

GILBERT HOVEY GROSVENOR
Editor, 1899-1954; President, 1920-1954
Chairman of the Board, 1954-1966

THE NATIONAL GEOGRAPHIC SOCIETY is chartered in Washington, D.C., in accordance with the laws of the United States, as a nonprofit scientific and educational organization. Since 1890 the Society has supported more than 2,500 explorations and research projects, adding immeasurably to man's knowledge of earth, sea, and sky. It diffuses this knowledge through its monthly journal, NATIONAL GEOGRAPHIC; its books, globes, atlases, filmstrips, and educational films; *National Geographic WORLD*, a magazine for children age 8 and older; information services; technical reports; exhibits in Explorers Hall; and television.

Photographed by John R.H. Gibbons. ***Fijian Crested Iguana:*** *Genus: Brachylophus Species: vitiensis* ***Adult size:*** *90cm including tail, about 22cm body length* ***Adult weight:*** *Average 350—400g* ***Habitat:*** *Lives in forest trees on a small number of tiny islands in western Fiji* ***Surviving number:*** *Most privalent on Yanuyatamba Island, populations elsewhere are low, seldom exceeding 100*

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

The crested iguana was first discovered in 1979 on a tiny island, which has since been declared Fiji's first wildlife reserve. The occurrence of the crested iguana and its relative, the banded iguana, on the remote and geographically isolated Fiji islands has intrigued biologists for years. One theory suggests that their ancestors drifted to the South Pacific from Central or South America on floating vegetation. The crested iguana today is one of the world's rarest reptiles.

Nothing could bring the crested iguana 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.

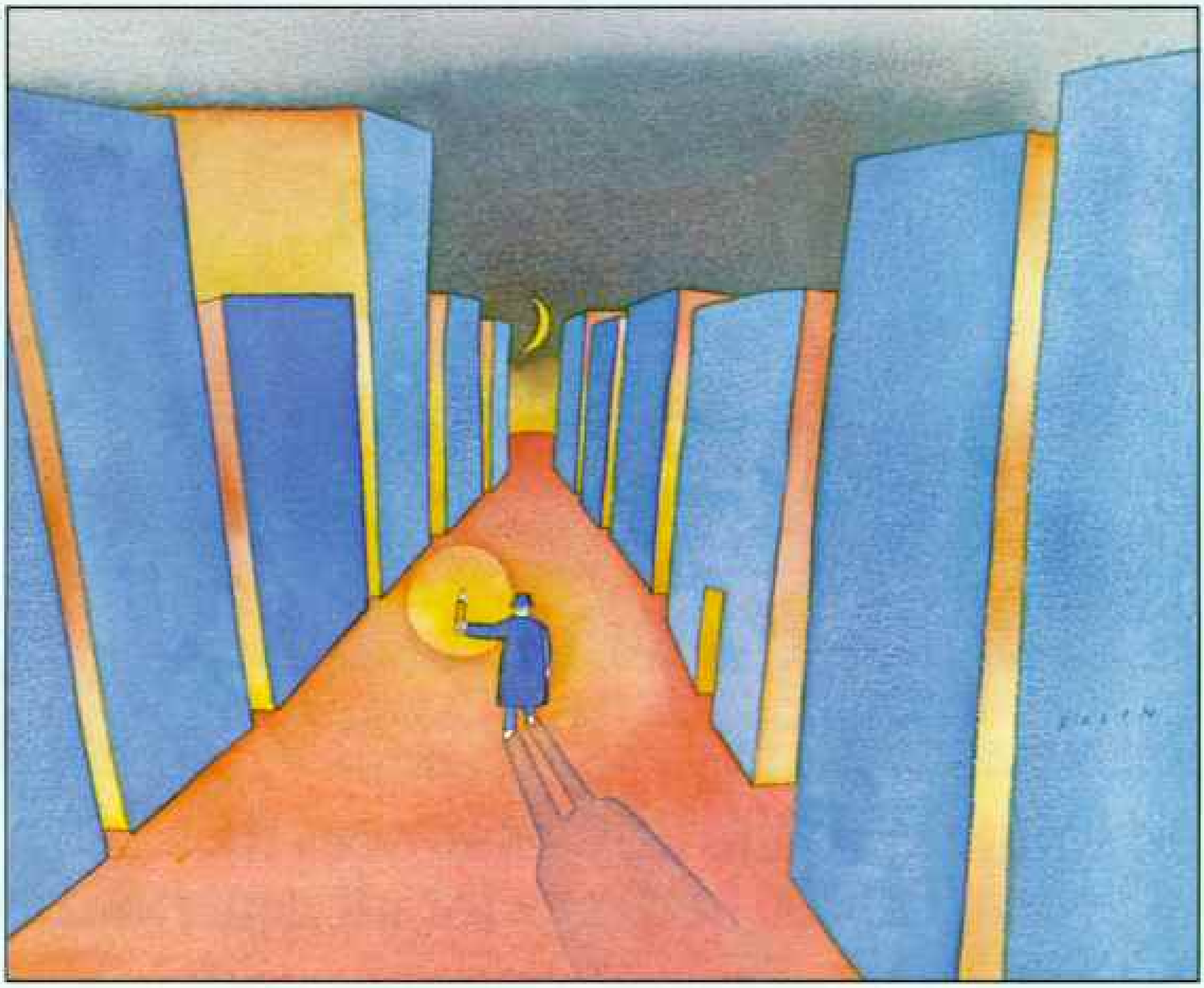
Photography is an invaluable research tool which can assist scientists and conservationists in their efforts to save the crested iguana. In addition, photography is a very effective means of communication which can inspire people's interest in the crested iguana and promote a better understanding of this newly found yet ancient species.

And understanding is perhaps the single most important factor in saving the crested iguana and all of wildlife.

Canon

Images for all time

THE NEXT ENERGY CRISIS
Will we have enough electricity?



With our economy growing again, the demand for electricity is increasing rapidly. Unless plans are made now to satisfy this growing demand, we could have electricity shortages—certainly shortages of reasonably priced electricity—in the early 1990s.

It's hard to imagine shortages of electricity since it's always there when we need it. Recently some regions of our country have had more than the minimum 20 percent reserve generating capacity needed to assure reliable service. But these reserves are shrinking, and they could become inadequate as our demand for electricity grows faster than the utilities' ability to provide it.

Economic growth increases electricity use

For decades, our use of electricity has grown along with our economy. In 1983, both the GNP and electricity use grew over 3 percent. So far this year, they're growing at about 8 percent. Our homes, businesses, and especially our industries are turning increasingly to electricity.

Most estimates of future electricity growth range from 2 to 4 percent per year, even with conservation. At just 3 percent growth per year, we'll need 50 percent more electricity by the year 2000. Even if all the plants now under construction are completed, that's only about half of what we'll need.

Electricity is revolutionizing surgical techniques through lasers. A tear in this patient's retina is repaired painlessly, without costly hospitalization.

How to avoid costly shortages

Electricity shortages would hurt our lifestyles and our economy, reducing industrial output, driving industries to other countries, putting people out of work, and limiting our ability to compete worldwide.

Some measures can postpone shortages, but they are costly:

- Delaying the retirement of older, less efficient power plants, some of which use expensive oil.
- Building new oil- and gas-fired turbines, but this would boost the cost to customers and increase our dependence on foreign suppliers.
- Importing more electricity from Canada and Mexico, which sends billions of dollars and thousands of jobs out of our country.

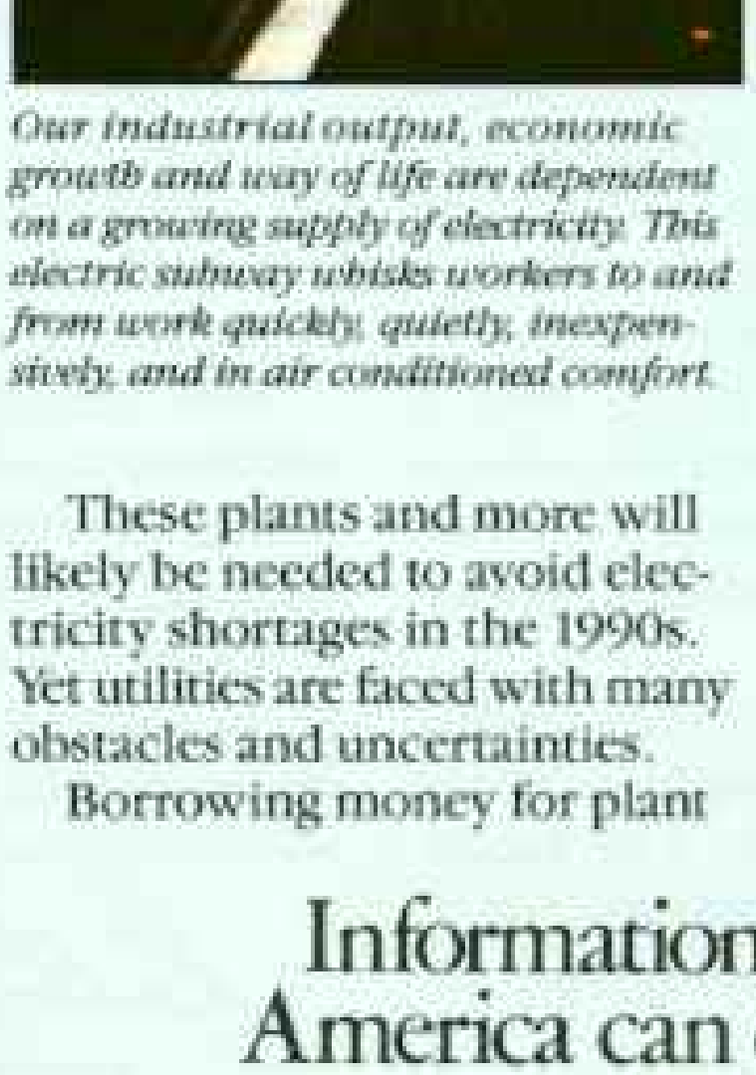
To *avoid* shortages of reasonably priced electricity, we need to finish the plants now under construction and plan for more new plants—primarily coal and nuclear plants since these use economical domestic fuels that provide the capacity, economy, and security we need.

We can't count on a major additional contribution from hydropower. And the U.S. Department of Energy estimates that the other renewable energy resources, including solar power, will meet only about 3 percent of our electricity needs by the year 2000.

We're in a planning crisis

Because it takes 6-12 years to build coal and nuclear plants in the U.S., they must be ordered long before they're actually needed. But no new major plants have been ordered for several years and few are being planned.

Due to energy crises, recessions and inflation since 1973, scores of coal and nuclear plants were canceled in the planning stage. Financial problems caused many utilities to cancel partially completed plants.

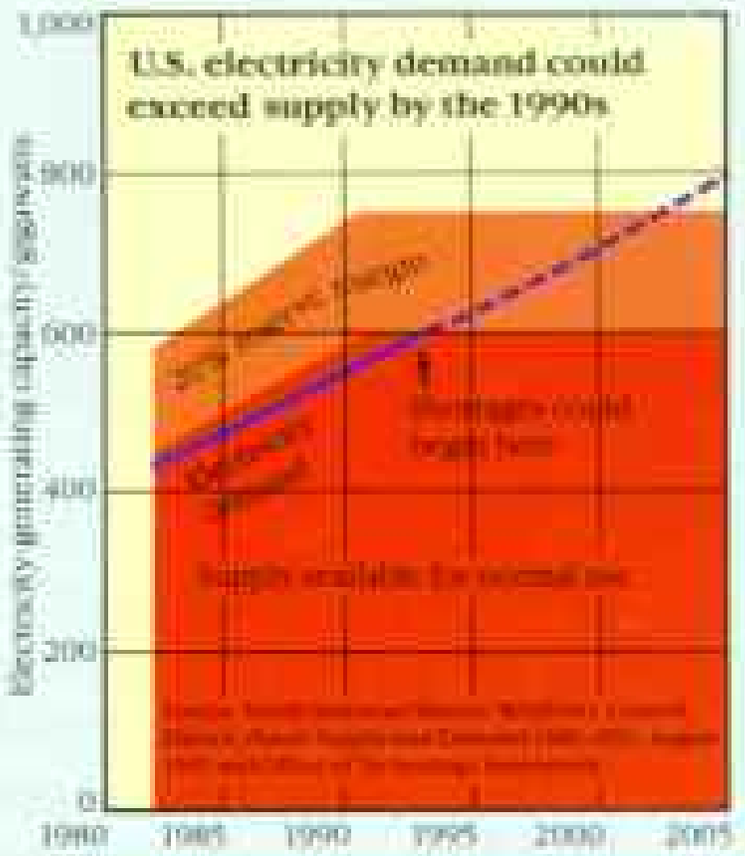


Our industrial output, economic growth and way of life are dependent on a growing supply of electricity. This electric subway whisks workers to and from work quickly, quietly, inexpensively, and in air conditioned comfort.

These plants and more will likely be needed to avoid electricity shortages in the 1990s. Yet utilities are faced with many obstacles and uncertainties.

Borrowing money for plant construction is increasingly difficult; state rate-setting procedures often discourage new capacity; opposition groups are continuing to block construction; Federal regulations continue to change and multiply, often causing the repeated tearing down and rebuilding of plant systems; and high interest rates and prolonged construction periods force electricity bills up.

These problems need to be solved through the understanding and cooperation of the industry, government, and the public. Only then will the utilities be able to take the steps needed to prevent electricity shortages and sustain a growing economy.



If demand for electricity continues growing at an average 3% per year (so far this year it's around 8%), in the 1990s the utilities' reserve margin could drop below the 20% necessary to assure a reliable electricity supply.

For more information on America's electrical future and the energy sources that will help fuel it, fill out this coupon and send it to:

U.S. Committee for Energy Awareness
P.O. Box 37012
Washington, D.C. 20013

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Information about energy America can count on today

U.S. COMMITTEE FOR ENERGY AWARENESS

No Mondays of the mind for these students

IT'S SUMMER'S LAST INNING; school buses are starting to roll again—time to get back to the old school grind. But is it a grind?

That is an attitude of grown-ups who hate Mondays and ask children, "What do you want to be?" as if children didn't already have an occupation. They are learners, in school and out, by instruction, example, and experience. They *will* learn. It is the what and the how that concern us all.

In recent years the Society has expanded greatly its offerings for children. Some of these, such as filmstrips, films, video, and "Wonders of Learning Kits" are designed mainly for use in schools. Our children's books, atlases, and National Geographic WORLD magazine are educators in homes, as well as being at home in schools.

While all the Society's educational materials can be readily understood by children of appropriate ages, they really come alive when put to use by imaginative teachers.

As a teacher of gifted children in Queens, New York, about 15 years ago, Minta Spain used the GEOGRAPHIC and maps with her students for the "multicultural aspects that stressed different backgrounds, anthropology, and archaeology." She later became principal of P.S. 91 in Brooklyn, and while working on her doctorate contacted the Society to develop her ideas. With the help of Wendy Rogers, manager of our Educational Services department, and others, Dr. Spain launched the National Geographic Gifted Program at her school.

The effect was immediate. As one teacher put it, "I had 32 children running to the shelves borrowing materials. The excitement was electrifying and to date has not let up. The materials are being devoured."

Dr. Spain cites Society publications and audiovisual media as being excellent "springboards" to develop map skills, to stimulate interest, and to encourage students to pursue independent research and total immersion in a topic. With the success of the pilot program, she involved other New York City schools—now a total of 27 with some 1,100 students from the fourth through the eighth grade. The students, as well as the subjects, are multicultural and come from black, white, Haitian, Hispanic, Asian, and other backgrounds. The program appears to be succeeding with them all, and more schools are on a waiting list to join as Dr. Spain tries to raise private funds to expand its scope.

STUDENTS AT BROOKLYN'S P.S. 397 STUDY JAPAN. PHOTOGRAPH BY MARTHA COOPER

Also through private donations, student representatives have traveled to Mexico and Africa and reported back to their classes, becoming, in effect, auxiliary teachers.

There are no Mondays of the mind for these students. Their occupation is defined by continents, not days, and we are delighted to help chart their journeys.

Gilbert M. Grosvenor

PRESIDENT, NATIONAL GEOGRAPHIC SOCIETY

A renowned Western artist creates a powerful new work in the rich tradition of bronze horse sculpture

Available in a single, limited edition. Individually crafted to order. Advance ordering deadline: September 30, 1984.

In the demanding field of bronze horse sculpture, Lanford Monroe stands out as an artist of surpassing talent and skill. A Western artist of enormous accomplishment, who has exhibited at prestigious showplaces ranging from the Cowboy Hall of Fame in Oklahoma City, to the Sportsman's Edge gallery in New York. And whose works are included in many important private collections as well.

Now, The Franklin Gallery takes pleasure in offering you the opportunity to acquire a compelling new work by this most gifted sculptor.

"Challenging Stallions" is Western art of astonishing impact—capturing perfectly a moment of high drama. Two rival stallions, vying for territorial dominance, are locked in combat. The fury of their encounter is evident in the powerfully muscled haunches . . . the thrashing hooves . . . the thrust of their proud heads. All portrayed with stunning realism —the quality most highly valued by knowledgeable collectors of bronze horse sculpture.

To capture every dynamic detail of the artist's work, "Challenging Stallions" will be crafted in cold-cast bronze. Each piece will be *individually* shaped from a carefully prepared sculptor's blend of powdered bronze and resins, then meticulously *hand-finished* to achieve the lustrous patina that is characteristic of the finest Western bronzes.

Shown smaller than actual size of approximately 10" high × 10½" wide (including base).

This important original sculpture will be issued in a single, limited edition. It is available only from The Franklin Gallery, only by direct subscription and only until the end of 1984. There is a further limit of one per order.

Displayed in the home, this vibrantly life-like work will be enjoyed, admired—and talked about—by all who see it. A superb example of Western art at its exciting best.

To acquire "Challenging Stallions," simply return the accompanying Advance Order Form no later than September 30, 1984. You need send no payment now. But be sure to mail your order to The Franklin Gallery, Franklin Center, PA 19091, by September 30th.

The Franklin Gallery

A FRANKLIN MINT COMPANY

ADVANCE ORDER FORM

"Challenging Stallions" by Lanford Monroe

A limited edition.
Valid only if postmarked by September 30, 1984.
Further limit: One per order.

The Franklin Gallery
Franklin Center, Pennsylvania 19091

Please accept my order for "Challenging Stallions," an original sculpture by Lanford Monroe, to be crafted in cold-cast bronze and hand-finished, at the issue price of $195.*

I need send no money now. When my sculpture is ready to be sent to me, I will be billed for a deposit of $39.* and, after shipment, for the balance in 4 monthly installments of the same amount.

**Plus my state sales tax and a total of $2.50 for shipping and handling.*

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ALL ORDERS ARE SUBJECT TO ACCEPTANCE

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Members Forum

Magazine Award

I read recently that the NATIONAL GEOGRAPHIC won the 1984 National Magazine Award for General Excellence, sponsored by the American Society of Magazine Editors and administered by Columbia University's Graduate School of Journalism. The judges said that our 96-year-old magazine had "the energy and look that are as young as any magazine born in the last 12 months." Congratulations! I always knew you were the best.

Mrs. William S. Parkinson
Little Rock, Arkansas

We are proud to have received this highest honor in magazine publishing with its trophy, a copy of an Alexander Calder stabile.

India's Railroads

"For each train leaving Dhaka, three arrive from the port of Chittagong," says a caption on page 741 of the June issue. Logically, this means that two-thirds of the trains that arrive at Dhaka don't leave! What happens to them?

Richard F. Olson, S.J.
Dorchester, Massachusetts

How can Chittagong afford to send three trains, knowing that two will never come back? Do the good people of Dhaka take these two trains apart and ship the parts back on the one that leaves?

James H. Wareham
Ludlow, Massachusetts

See next month's issue for "The Missing Trains of Bangladesh." Seriously, tightness of space caught us again as we tried to tie Bangladesh's ratio of exports to imports to train traffic. We should have made clear that we meant train-loads of goods. Undoubtedly, many cars make the return trip to Chittagong empty.

Eskimo Hunters

As I read "Eskimo Hunters of the Bering Sea" (June 1984), a question came to mind. Several years ago our class studied the people of the North and were taught that these people were called Inuit, not Eskimo. Could you explain?

S. Kuttner
Richmond Hill, Ontario

While Canadian peoples prefer Inuit, Alaskans accept the term Eskimo but distinguish between two linguistic groups, the Yupik and the Inupiat.

What a pleasant surprise to find a story illustrated with genuine black-and-white photographs! As an 11-year working professional photographer, it's nice to see the old basics tastefully trotted out again. In the future, I hope you will publish black-and-white work on a more frequent basis, as long as it is on a par with Don Doll's work for the Eskimo hunters' story.

W. Patrick Hinely
Lexington, Virginia

Ants

I love your magazine, especially your articles on wildlife and nature. I am so disappointed with your June 1984 issue. I don't understand why you used drawings of the ants instead of your usual superb photographs.

Ursula Chase
Bangor, Maine

Given the extremely complex behavior of ants, it would have been impossible to portray as many aspects with the clarity of detail in photographs as we were able to show in the artist's renderings.

Vesuvius

In your riveting article "The Dead Do Tell Tales at Vesuvius" (May 1984), you referred to the recent eruptions of Mount St. Helens. During 1982-83 I worked just north of Mount St. Helens at the Spirit Lake Pumping Facility. I was struck with the incredible resemblance of Vesuvius to Mount St. Helens from the north and became even more keenly aware of the great danger I had been in. I don't have to let my imagination drift far to replace the stumps and other scorched forest remnants with "many charred items of everyday life" and to understand the horrible, trapped sensation experienced by the people of Herculaneum and Pompeii.

Galen A. Hunt
Woodland, Washington

Since Nero started persecution of Christians around the year 60, I have found it hard to relate what is depicted as a cross in the House of the Bicentenary at Herculaneum with a religious symbol. It looks more like a holding set for a mirror or something. During these years a Christian symbol might mean imprisonment and death for a whole family. It is difficult to think of someone displaying a cross in his chambers.

Jorge Sifuentes
Mexico, D.F.

Because the imprint is controversial, we purposely said "perhaps of a cross." There is evidence of Christianity in the area at this time and of the cross being used for private devotion. However, early Christians usually avoided displaying the

cross in public, both from fear of persecution and of the symbol's being profaned by nonbelievers.

The story about Vesuvius was outstanding. The only problem I could find was when you referred to the Ring Lady as tall and the Helmsman as short. Relative to which society, theirs or ours? What about the average Roman: How tall or heavy was he or she? I was once told the average Roman soldier was only 5 feet 3 inches tall. Am I wrong?

Al Wagner
Gardnerville, Nevada

Study of Herculaneum skeletons indicates the mean stature of Roman males was about 5 feet 6½ inches; of women, 5 feet 1½ inches.

In the description of the Helmsman, the abnormalities this individual suffered are identical to those we have demonstrated in medieval burial sites in the United Kingdom and in Egyptian mummies, and correspond to the disorder of modern man known as DISH (diffuse idiopathic skeletal hyperostosis). This has no connection with any particular occupation or exposure; indeed, it may be associated with obesity and the good life. Our best examples came from the Saxon bishops of the cathedral in Wells, Somerset.

Juliet Rogers, Paleopathologist
Paul Dieppe, Rheumatologist
Iain Watt, Musculoskeletal Radiologist
University of Bristol, England

Your article illustrates how modern science can help solve many of the unanswered questions of the life and death of Pompeii and Herculaneum. However, Dr. Sara Bisel's statement, "A slightly crooked back and fused vertebrae could have been caused by years of slave labor," is speculative. I am not aware of hard, physical labor resulting in fusion of the vertebral bodies. Osteoarthritis does develop, but its pattern is quite different from fusion of vertebrae. Her comments that Portia's "pelvic bones show rather unusual and unexpected changes," similar to "those I once saw in a modern prostitute," simply lack orthopedic credibility.

Michael J. Goldberg, M.D.
Tufts University School of Medicine–
New England Medical Center
Boston, Massachusetts

Dr. Bisel's interpretations are preliminary. She is planning to meet with orthopedists to examine and discuss her findings. She is still analyzing her own supposition concerning the effects of heavy labor and repeated stress.

Regarding Portia, the pelvic region displays signs beyond normal aging and childbirth, a condition Dr. Bisel saw once before in the skeleton of a modern prostitute.

Kayapo Indians

If reports that Brazil's Amazon region contains possibly hundreds of billions of dollars' worth of gold are correct, there would be little hope for any Indian inhabitants of that region, the Kayapo (May 1984) included. The present quarter million or so miners in the Amazon could increase substantially. While one might wish that the Amazon Indian population could somehow resist this onslaught and survive, the history of Brazil would seem to argue against it.

Frank W. Goheen
Camas, Washington

Lasers

In your otherwise fascinating article on lasers (March 1984), you state on page 343 that ". . . ultimately lasers on satellites may make even 30-day weather forecasts accurate and detailed." As professional meteorologists we must take exception to your forecast. We find it mind-boggling just to enumerate the multitude of atmospheric processes that one would have to observe and understand. One would have to predict the precise location and intensity of all thunderstorms at all intermediate steps, and be able to simulate the physical impact of these energetic but localized disturbances on the global wind patterns with a precision that we are not likely to approach until the next century, if then.

Stanley L. Barnes
Charles A. Doswell III
Boulder, Colorado

Meteorological observation systems in space give us a more complete picture of pressure fields, temperatures, moisture—information needed for long-range forecasts. However, because of interviews with NOAA meteorologists, we advisedly used the words "may" and "ultimately."

Members Forum

In the letter regarding Laodicea, the last book of the New Testament is referred to as "Revelations." This is a rather common error, but I was quite surprised to see it repeated in your editor's response.

Edwin Norris
San Jose, California

You and many other readers spotted our slip. We should not have put an "s" on Revelation.

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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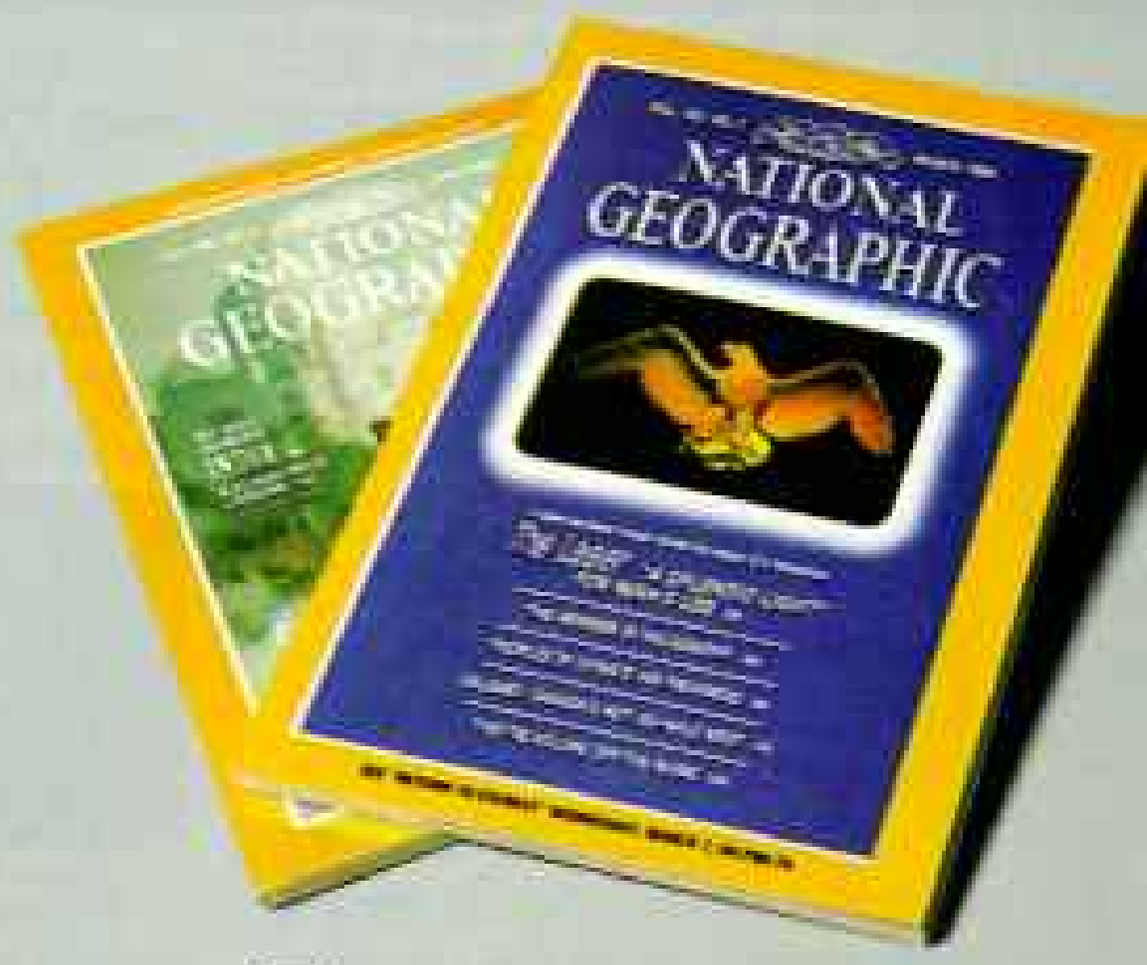

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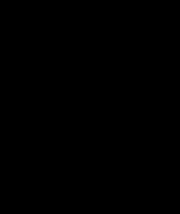

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The all-new Toyota 4x4's are turning the truck world upside down!

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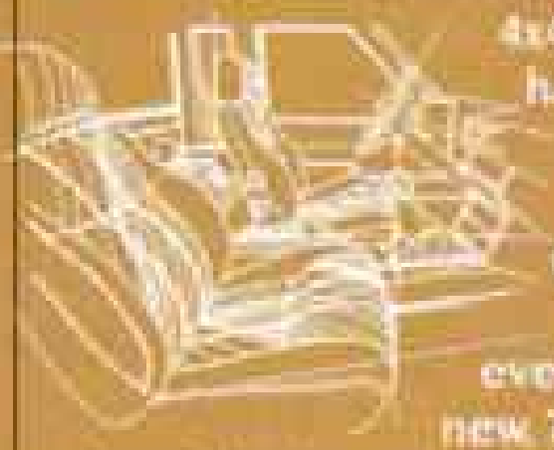

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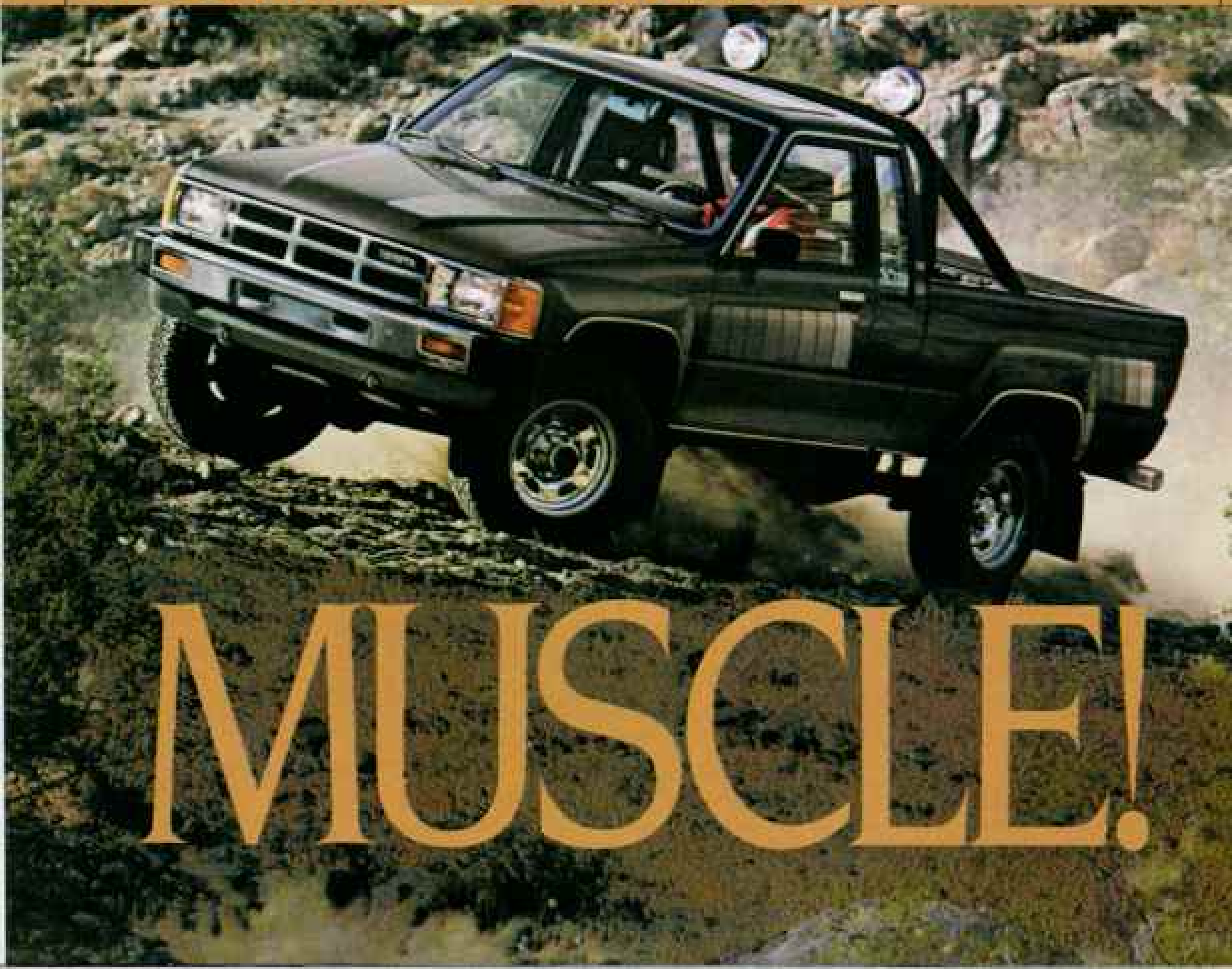

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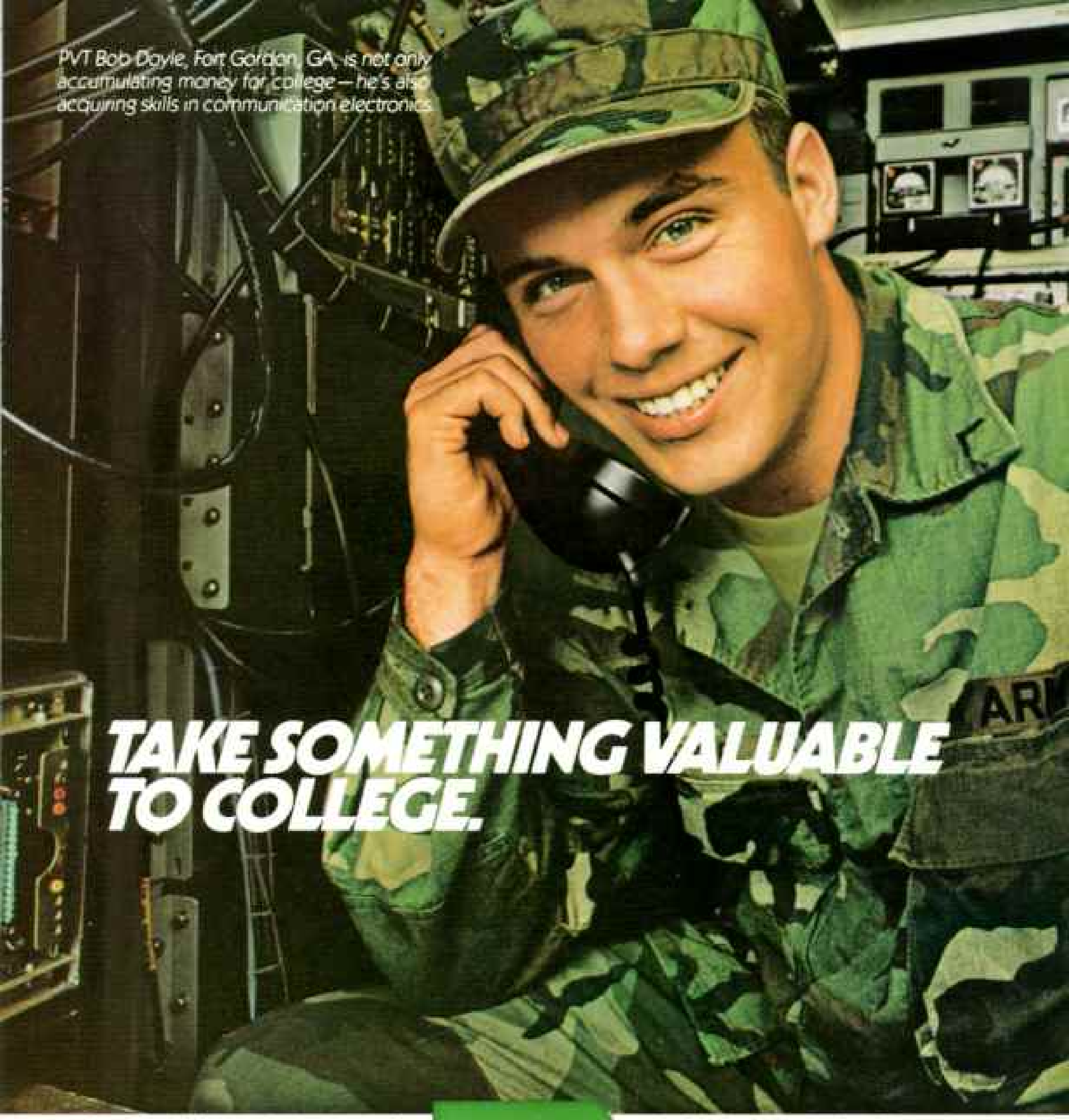
On Assignment

KAREN C. HAYDEN (BELOW); ROBERT GRESSMOIRE AND JEAN-LUC CHERON

SELECTING A GIFT for the president of Iceland was difficult for the river runners who had just completed the first journey down the wild Jökulsá á Fjöllum—from under-glacier source to Arctic Ocean. So they settled on a propeller from one of the ultralight aircraft that set this river expedition apart. Here the gift is presented to President Vigdís Finnbogadóttir by leader ***Paul Vander-Molen,*** at her left, and other members of the team. "Pack-away aircraft ensured the expedition's success," Paul says, "acting as our eyes to scout dangerous rapids and enabling us to lift boats and crews over waterfalls."

Using ultralights was Vander-Molen's brainchild when he and fellow British kayaker Mick Coyne, near right, decided to plan a trip combining paddling with other skills. They assembled a multinational team that included expert kayakers, rafters, pilots, Icelandic glacier guides, and cameramen.

FOR FARMER and photographer ***Steven C. Wilson,*** a comprehensive survey of the nation's soils proved to be an adventure underground. During his 40-state coverage for this issue, he took a firsthand look at teeming communities underfoot. Here, in a hole dug through an ant colony, the sun's reflection from a mirror lights a specimen for his camera-mounted microscope. "The real trick," he said, "was to get the picture before the sun fried my samples." A marine biologist and owner of a successful tree farm in Washington's Kitsap Peninsula, Wilson has an overriding interest in ecology, reflected in previous NATIONAL GEOGRAPHIC articles on Texas Gulf Coast wildlife and the Aleutian Islands.



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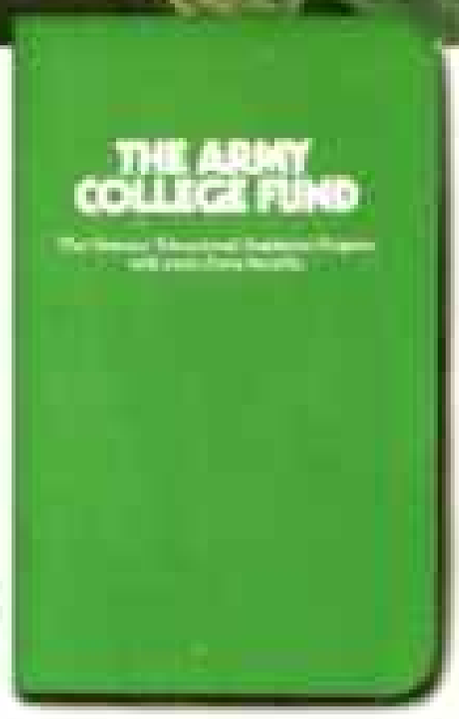

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