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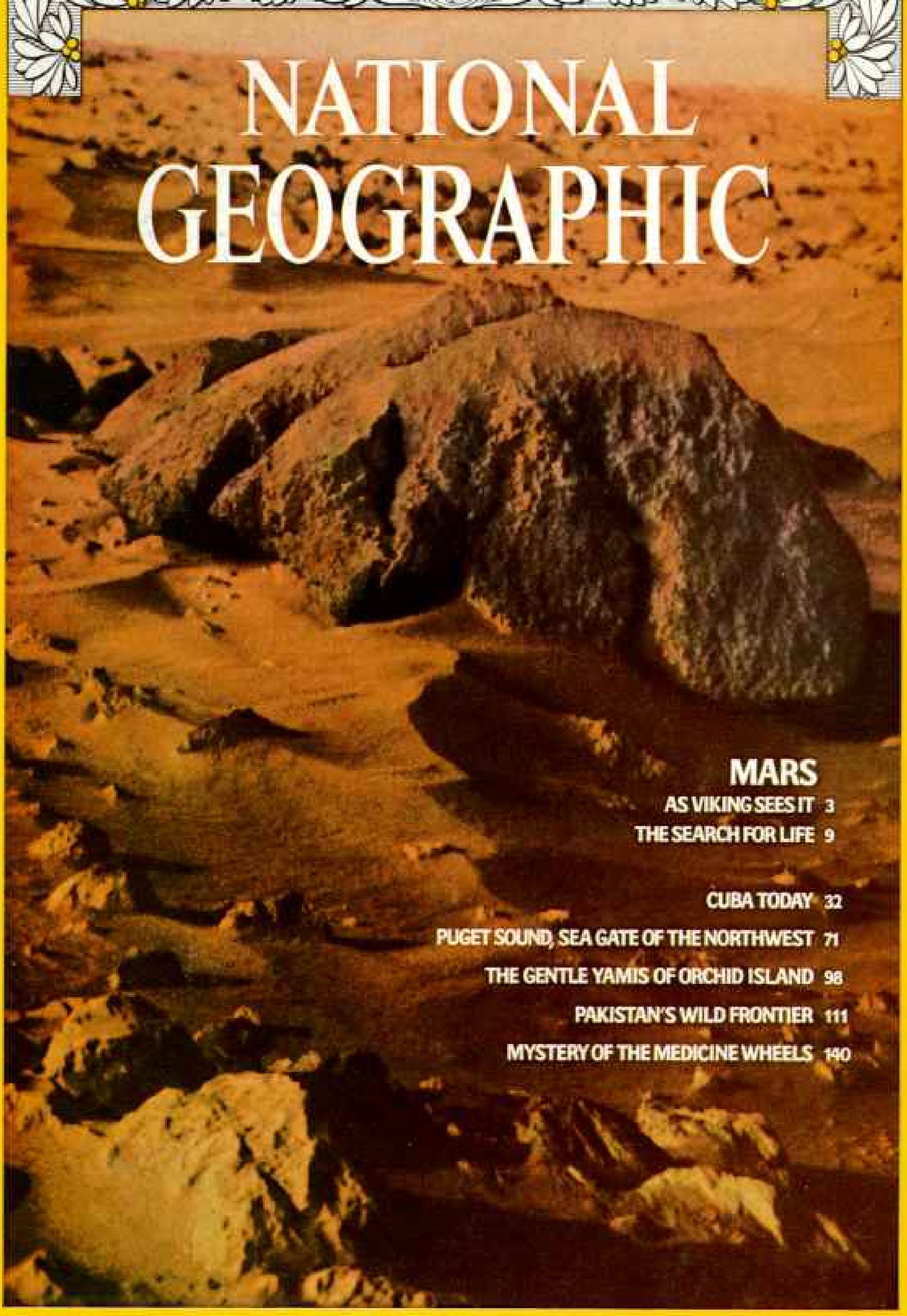

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SEE "VOYAGE OF THE HOKULE`A," TUESDAY, JANUARY 18, ON PBS TV

THIS FIRST ISSUE of our 89th year of publication takes us on a journey to one world never before seen close up—Mars—and to another seldom glimpsed by United States journalists in the past 16 years—Cuba.

The difficulties in reaching Mars were physical, and they were overcome by the highest technology of which our society is presently capable. The results are nothing less than stunning. To look upon this rust-red alien world with the clear eyes of modern space techniques is an experience that ancient mythology reserved only for gods. Then, to probe and assess the Martian soil for signs of life, as far away as 235 million miles, so enlarges human capabilities that we must wonder why we cannot apply some of that power to problems that plague so many earthly cultures.

The difficulties in reaching Cuba were, on the other hand, political. It is, after all, right next door. That door was open to U.S. reporters for only two years after a leftist government in 1959 replaced a regime widely regarded as needing reform. The door was slammed shut by the Bay of Pigs invasion in 1961 and the later confrontation between the U.S. and U.S.S.R. over placement of offensive missiles on Cuban soil.

The years have flown so fast it is hard to grasp that the charismatic leadership of Fidel Castro is now in its 18th year, and that Communism seems firmly anchored in the Caribbean. In 1976 free-lance writer-photographer Fred Ward obtained permission to travel freely in Cuba, to interview whom he chose, and to spend as much time as required. That proved to be nearly three months. We think his article (page 32) is the most balanced and accurate we have yet seen.

Mr. Ward describes life in Cuba today as marked both by commitment to the ideals of the revolution and by frustration. In the end, the many social services, including all medical care, are free, but speech and thought are not; party rule is absolute. While education has gone forward by impressive leaps, shortages of both housing and consumer goods plague the planners, and only continued massive subsidy by the Soviet Union keeps the Cuban economy afloat. Though beset by problems, the Cuban socialist state advertises itself to other small, struggling nations as an alternative to the military dictatorships that abound in Latin America.

I can think of no better way to indicate the possibilities—and problems—of our time than to begin 1977 by portraying these two worlds that have such different things to say about our century.

Gilbert M. Grosvenor

NATIONAL GEOGRAPHIC

THE NATIONAL GEOGRAPHIC MAGAZINE VOL. CLI, NO. 1

January 1977

MARS: OUR FIRST CLOSE LOOK

I—As Viking Sees It 3

A red landscape dramatically shaped by volcano, wind, and water is confirmed by the electronic eyes and arms of NASA spacecraft far from home.

II—The Search for Life 9

Key experiments by the two Viking landers focus on the basic, still unresolved question. Science writer Rick Gore looks at preliminary results.

Cuba Today 32

From three months of unrestricted travel and countless interviews—including one with Fidel Castro himself—photojournalist Fred Ward reports on everyday life in the only Communist nation in the Western Hemisphere.

Puget Is More Than a Sound 71

At the sea gate of the nation's Northwest, William Graves and David Alan Harvey find outdoor-oriented cities, unspoiled shores, and a growing concern for tomorrow.

The Gentle Yamis of Orchid Island 98

Wide ocean and a speck of land frame the world of an ancient people of the western Pacific. A picture story by Chang Shuhua.

Pakistan's Wild North-West Frontier 111

Gunfire and eye-for-an-eye justice still rule tribal enclaves of a border province where the Khyber Pass carries scars of invasion and violence. Mike W. Edwards and J. Bruce Baumann roam Kipling country.

Mystery of the Medicine Wheels 140

Astronomer John A. Eddy believes early Plains Indians used huge spoked circles of stones to keep track of sun, stars, and seasons. Photographs by Thomas E. Hooper.

COVER: *Viking's-eye view of the Martian surface bears out the planet's nickname: It's really red, from a pervasive coating of what earthlings know as rust. Photograph by NASA.*

MARS

As Viking Sees It

Orbiters and landers of two NASA spacecraft photograph and examine the red planet as never before, solving some old puzzles and revealing new ones.

Slanting sunlight accentuates foot-high boulders in the red Martian desertscape (**left**) where Viking 1 landed. The planet shows its pitted face (**above**) to the approaching spacecraft. Clouds mantle the north; frost or haze fills craters to the south.

J. R. CYGNAR

MISSION INCREDIBLE: After curving voyages of nearly a year and almost half a billion miles, the two Viking spacecraft landed on Mars.

On July 20, 1976, Viking 1 set down safely on Chryse Planitia in the northern hemisphere, after three sites had been rejected as unexpectedly dangerous.

Scientists at the Jet Propulsion Laboratory in California had even more trouble choosing a landing site for Viking 2. Orbiting cameras scanned 1.7 million square miles. Utopia Planitia (**below**) appeared to be relatively smooth, partly gentle rolling dunes. Some team members still thought it too risky. As on other major questions (**left**), the team was polled by project leaders. The decision: Land at Utopia Planitia; any delay might overtax the exhausted flight team.

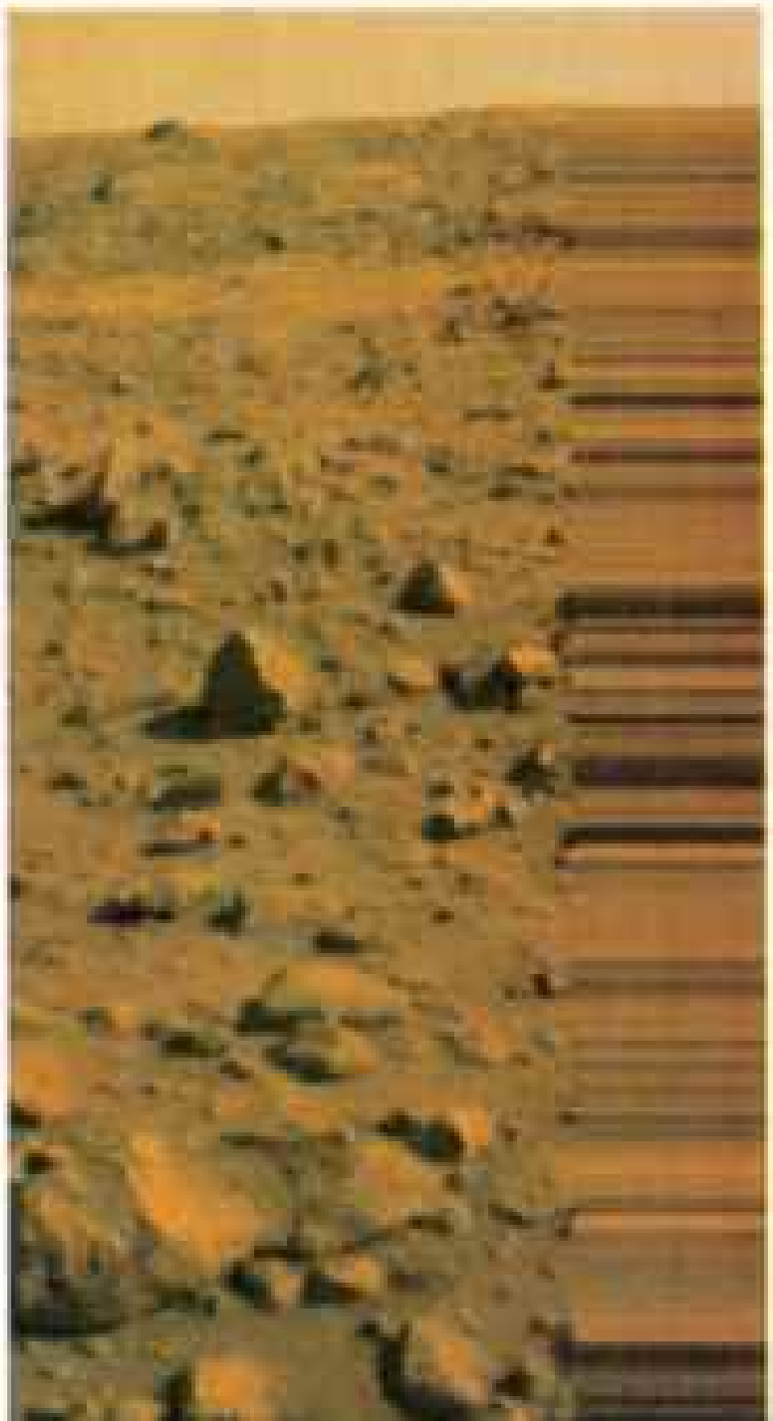
On September 3, 1976, Viking 2 landed tipsily, one leg up on a boulder, facing a jumble of volcanic rocks (**above**).

J. R. EYERMAN AND NASA

MARTIAN DUSK lingers under an eerie false sunset (**above**). Computer augmentation of a dim twilight scene, like turning up a TV brightness knob, shows faint sky colors as apparent bold bands.

If anything moves, Viking cameras can spot it. Recording images slowly, one vertical scan at a time, a camera can endlessly repeat a scan, building a band of light and dark (**right**). Any motion would break the pattern.

A portrait of project members and a spare lander, reflected in a mirror (**left**), was made at JPL by a Viking camera. The left-to-right scan took 12 minutes. Scientists at right were still posing long after colleagues had gone.



Budging a rock called "Mr. Badger" (**left**), the long arm of Viking *2* exposes virgin Martian soil (**right**) that has been protected from destructive ultraviolet sunlight. The ten-inch-long rock, named for a character in Kenneth Grahame's children's classic *The Wind in the Willows*, needed two shoves before soil could be dug and analyzed for organic compounds. Unless they found these crucial substances, biologists could not conclude that Mars had life, even though some tests suggested biological activity. The rock's spongelike texture is thought to derive from bursting bubbles of volcanic gases.

Sifting for Life in the Sands of Mars

By RICK GORE

NATIONAL GEOGRAPHIC STAFF

SUDDENLY the smooth sands of Chryse were not what they had seemed. For almost a year the glittering Viking 1 spacecraft, followed closely by its identical twin, Viking 2, had been on the wing. Behind lay nearly half a billion miles of space. Ahead lay perhaps the most astounding detective story in the history of science: the search for life on Mars.

But as Viking 1 swung into orbit around that small ruddy planet last June, and its cameras began taking close-ups of its prime landing site on the Plain of Chryse, mission planners at the Jet Propulsion Laboratory in Pasadena, California, grew nervous. Mars was showing a far more rugged and bewildering face than had been imagined.

It was not that they had expected a gentle planet. Four years earlier Mariner 9 had dramatically dispelled that notion, photographing towering volcanoes, some perhaps still active. One, Olympus Mons, is three times as high as Mount Everest (pages 28-9). Mariner had also revealed a gigantic canyon system, Valles Marineris, as much as four miles deep and 150 miles wide, and as long as the United States is wide.*

Mariner 9 pictures showed channels that looked like old riverbeds. Some scientists still rejected the idea that water could have flowed on dust-blown Mars. Today the thin Martian atmosphere—a hundred times less dense than earth's—is too cold and the atmospheric pressure too low for water to exist for long, if ever, as a liquid.

However, if in the distant past rivers had indeed flowed in those channels, mission planners reasoned, there should be a smooth basin of sediments near their mouths. Several of these "river" systems flowed onto Chryse Planitia. Finding a safe place to set their craft down was the Viking team's first priority. So a landing site had been chosen near where those channels broke onto Chryse.

Surface Features Tell of Deluges

But in late June Viking's close-ups revealed disquieting features not far from where Viking 1 was scheduled to land, features that left little doubt that Mars had once seen water—incredible amounts of it. Those mysterious channels, Viking photos suggested, had been carved by raging, cataclysmic floods a billion or more years ago.

Upland from Chryse lay a great chaotic region of deep cracks and collapsed terrain. Heating from deep within Mars, geologists speculate, had melted a huge mass of subsurface ice. Millions of tons of water had burst suddenly from the ground. Rivers that may have been 15 miles wide and hundreds of feet deep tumbled and crashed down toward Chryse, carving cliffs and gorges near where Viking 1 was to land.

Viking geologists now saw a hodgepodge of other features nearby—etched tablelands, deep craters, big pits, and odd knobby protuberances—that they could not readily explain.

The cameras of Viking, even at the 950-mile low point of its long elliptical orbit,

*See "Journey to Mars" by Kenneth F. Weaver in the February 1973 NATIONAL GEOGRAPHIC.

would not allow scientists at JPL to detect features smaller than the football field in the nearby Rose Bowl. A rock only a foot high could puncture the electronics-laden belly of Viking's lander. Whatever created the craters and other features now apparent in Chryse could also have littered the landscape with large and jagged boulders as yet unseen.

Anxiety Over Landing Site Mounts

Viking's Fourth of July Bicentennial birthday landing was promptly postponed. For three weeks mission planners, their careful timetables shattered, agonized over alternate sites. They scanned some 800 photographs covering a territory about the size of Texas. They bounced earth-based radar beams off different sites to measure their comparative roughness.

Project planners wanted to land Viking 1 before Viking 2 arrived in Mars orbit in early August. So they finally opted for a best bet—what they hoped was a flat expanse of Chryse Planitia, 560 miles from the original site.

Anxiety skittered through the corridors of JPL when I arrived in mid-July. The National Aeronautics and Space Administration had spent a billion dollars on the Viking missions. The project team, led by James Martin of NASA's Langley Research Center, had invested eight years of their lives.

"What if we land on a big boulder?" worried Gentry Lee, the curly-haired director of science analysis and mission planning. "What if we land on the side of a crater? The lander can't stand up on a slope of more than 30 degrees. What if it just sinks in the dust?"

The landing process itself would be technically complicated. Descending through the Martian atmosphere is much trickier than landing on the airless moon. The Soviets had tried to land on Mars four times, twice in 1971 and twice in 1974. In 1971 one lander crashed and the other stopped sending back data after only 20 seconds. One of the 1974 attempts just flew past Mars. Instruments on the second failed during descent, after transmitting usable data for a few seconds.

At 12:47 a.m. Pasadena time, July 20—seven years to the day after Apollo 11's *Eagle* had landed on the moon—flight controllers ordered the Viking lander, an awkward-looking bird about the size of a jeep, to separate from the orbiter and begin a 30-minute engine burn that would take it out of orbit. Some three hours later the lander popped a parachute for one minute. Terminal-descent engines slowed the craft further to five miles an hour (painting, page 13).

Then at 4:13 Mars time, on an early summer afternoon, the bird alighted, as gently as you or I might hop off a kitchen stool, on a rocky, rolling plain.

It took 19 minutes for the news to travel through space from Mars to Pasadena. When flight controller Richard Bender announced, "Touchdown! We have touchdown!" wild whoops filled Mission Control. Men hugged. Champagne corks popped, and Gentry Lee tugged at his long hair and wept with joy.

Within an hour Viking's first picture from the surface began to form, one thin strip at a time, on television monitors at JPL. "This is 'supernominal'!" said Dr. Thomas Mutch, chief lander-imaging scientist, as the first crisp black-and-white picture of the Martian rocks around Viking's footpad developed. "The cameras didn't work this well on earth."

As he watched the next picture, a panorama of a rolling plain littered by strikingly different rock types, Mutch could not contain himself. "It's just a beautiful collection of boulders. A geologist's delight! I . . . don't feel like talking right now. This is just incredible good luck."

Good luck indeed. Not ten yards from the lander sat a ten-foot boulder, later nicknamed "Big Joe." Ten more yards and triumph would have been catastrophe.

The geologists' luck, however, was in the variety of rocks.

"I'd expected to see maybe half a dozen rocks, all pretty similar," Dr. Alan Binder, a team geologist, told me. "And there was this forest of thousands of rocks. We'll never analyze them all, but I see at least 30 kinds."

Such variety on a site selected specifically for its blandness means Mars must have a rich and complex geological history indeed.

Red Terrain and an Orange-pink Sky

By the next day Viking 1 began sending back color pictures of a rusty vista. A fine orangish dust covered the ground. It lay in drifts behind rocks and mantled many of the boulders. Actually Viking was fortunate enough to be sitting atop two major surface materials of Mars; it had one footpad on

firm ground and one buried in flour-fine silt.

To everyone's surprise, the dust in the air hung like a hazy smog, scattering sunlight and thereby making the sky a creamy orange-pink and a hundred times brighter than the faint blue that was expected.

To my earthbound eyes, the Martian landscape on the TV monitors looked no less hospitable than the deserts of our own Southwest. However, the pictures could not reveal the intense ultraviolet rays from the sun that were searing the landscape but from which the ozone in our atmosphere shields us.

Data soon convinced me how uncomfortable man would find the planet. The atmosphere checked out to be noxious—95 percent carbon dioxide—and on that summery day the air temperature ranged from −86° C. (−123° F.) shortly after dawn to a midafternoon high of −31° C. (−24° F.).

Air May Have Once Been Earthlike

Viking scientists had predicted these harsh conditions. Many felt that, even had life once existed on Mars, its chances of surviving today were not good. Nevertheless, Viking's early data offered a few hopeful signs.

For one, the Martian atmosphere had been thought to have virtually no nitrogen, which is by far the major component of earth's air and an essential element for any life biologists can imagine. Now, Viking's instruments reported that the atmosphere of Mars is nearly 3 percent nitrogen—enough to support veritable jungles of life.

Moreover, atmosphere specialist Michael McElroy of Harvard University quickly calculated, from readings taken as Viking passed through the upper atmosphere, that Mars had once had much, much more nitrogen. Massive amounts of the gas have escaped from the planet into space. In fact, Dr. McElroy concludes, the Martian air was once predominantly nitrogen. And so, perhaps, some three billion years ago, the atmosphere could have been almost earthlike: warmer and heavy enough for rain to fall, for rivers to flow and —just maybe—for life to have developed in some sea that has long since evaporated.

Until recently there was scant reason to believe that Mars had ever had a primordial sea, where life's basic chemicals could become arranged into primitive living organisms, such as most scientists speculate occurred on earth. What would have happened to all that water? Mars appeared much too dry.

Viking has helped overturn such thinking.

"Everywhere we look on Mars we see evidence of water," Dr. McElroy told me. "Almost every question now is water related."

Martian Water Seldom Flows

But Martian water today does not exist in its most familiar earthly state. At low Martian temperatures and pressures, it is virtually never liquid. Like frost, it changes directly from vapor to ice—and back again.

Viking's water-vapor mapping team, led by Dr. Crofton Farmer, has watched Martian ice turn to vapor each day as the sun heats the surface, and then turn back to ice as evening chills the ground. Indeed, Viking's cameras photographed ice fogs forming in Martian craters (page 22). They also saw clouds of water ice.

Most significant, water-vapor mapping by Dr. Farmer and infrared temperature readings taken by Dr. Hugh Kieffer proved that the permanent ice cap around Mars' north pole is made not from frozen carbon dioxide, as many scientists suspected, but of water ice. The minimum temperature on the north polar ice cap during summer, Dr. Kieffer found, was −73° C. Carbon dioxide would evaporate at that temperature. Therefore, while carbon dioxide surely freezes out of the atmosphere to create caps of dry ice on both poles in their respective winters, the massive permanent cap in the north, at least, is all water in summer. That's enough water to form an ice cube an estimated twenty miles on a side.

Water also appears to be locked into the ground like the permafrost in earth's arctic regions. For example, orbiter pictures show a peculiar thick flow from many meteorite craters (page 27). Normally a meteorite ejects rocks and boulders in a predictable pattern. But it looks as if a blazing meteorite, when it made one of these craters, melted the permafrost. The resulting ejected sludge, as it hit the ground, sloshed like a wave across the surface, then refroze.

No one knows how much water is frozen in the ground, but the permafrost layer could be kilometers thick. Water also seems to be bound to minerals in the rocks and in the fine soil particles as well.

Furthermore, upper-atmosphere readings

suggest that water has escaped from the planet over the eons. Ultraviolet light breaks H_2O molecules into energized hydrogen and oxygen atoms in the upper atmosphere, which then have enough velocity to escape the gravitational pull and wander off into space.

Newly discovered upper-atmosphere dynamics can lead to startling speculations. Dr. McElroy, for instance, suggests that Mars could once have had a great deal of oxygen, compared to less than one percent today. "It's a distinct possibility," he said, "that oxygen could have at one time been a major component of the Martian atmosphere."

Ice Age Prevails on Mars

The speculation about climate changes and past atmospheres is critical to Viking's most burning question: Does Mars have life? It would be easier to imagine life there if the climate were occasionally less hostile.

Most scientists believe there have been at least several episodes of different climate on Mars, and many believe that the last was anywhere from a billion to three billion years ago. This belief is largely speculation. There is no reliable way to date accurately the surface features seen thus far from either lander or orbiter.

Viking geologist Harold Masursky, however, believes he can pick out in orbiter pictures "microchannels" that could well have been created by the runoff of rainfalls, including some in more recent times.

The two Vikings measured very different temperatures as they passed through the upper atmosphere. What that means is still unclear, but it might indicate that the forces that govern the Martian atmosphere are delicately balanced. Perhaps Mars experiences brief violent changes in its atmosphere as peculiar to its normal milieu as thunderstorms are in a terrestrial desert.

Probably the freeze-dried Mars we now see is its normal self. Mars clearly seems to be in an ice age, as is, technically, the earth. "Looking back over the earth's history, having glacial ice caps at our poles is very unusual," explained Hal Masursky. "If we have such unusual situations, maybe Mars for brief periods is a very hospitable place."

Even before the biologists had begun their tests, Viking 1 had shown that, as Dr. McElroy put it: "The elements in the chemistry set are there. We have water, we have carbon, we have nitrogen, we have sunlight. The only real remaining question is whether the Great Chemist was there putting the elements together in the right way."

How do you look for life on Mars? Clearly if there were large creatures like Edgar Rice Burroughs's green men or H. G. Wells's oily grayish earth invaders lurking about, or if there were a cactus patch or two, the cameras on the landers could take their pictures.

On earth, big complex creatures cope poorly with harsh conditions or with dramatic changes like the daily Martian temperature swings. But bacteria can live in steaming hot springs or on polar ice. Simple plants and animals can be readily frozen and thawed.

Not only are small organisms more adaptable to harsh conditions, but they might be able to exist in an environment of little or no oxygen. And they could hide under a grain of sand to escape ultraviolet radiation.

Further, small creatures do not need as much liquid water. Perhaps on Mars they could eat the permafrost or the dust grains that have water molecules bound to them. Or swim in the sludge that might sometimes form on summer days when a dust cover absorbs enough heat to melt the ice beneath it.

"Microbes are the last survivors in a harsh environment," said Dr. Norman Horowitz, a biologist at the California Institute of Technology. "All we need to find is that one last species."

Life Search Focuses on Carbon

So, given that Martian life, if it exists, is microbial, how do you detect it? "Sending a microscope to Mars might not reveal anything," said the biology team leader, Dr. Harold Klein, "because the shapes of so many organisms on earth don't say anything about whether they are alive."

Viking biologists had decided that life on Mars, like life on earth, would revolve around the element carbon. We typically think of carbon as the black, sooty remnant of a fire or the tip of a graphite pencil. But it is much more than that.

"Carbon is almost infinitely flexible," explained Viking's chief project scientist, Dr. Gerald Soffen. "Not only can carbon atoms make long chains, but they have hooks that can attach many *(Continued on page 23)*

1 Viking I enters orbit

2 Orbiter releases lander inside aeroshell

Ferry mission complete, the orbiter will continue to circle Mars, snapping high-resolution photographs of the planet's surface for up to two years.

3 Lander flips over; de-orbit engines fire

4 Entry into the Martian atmosphere

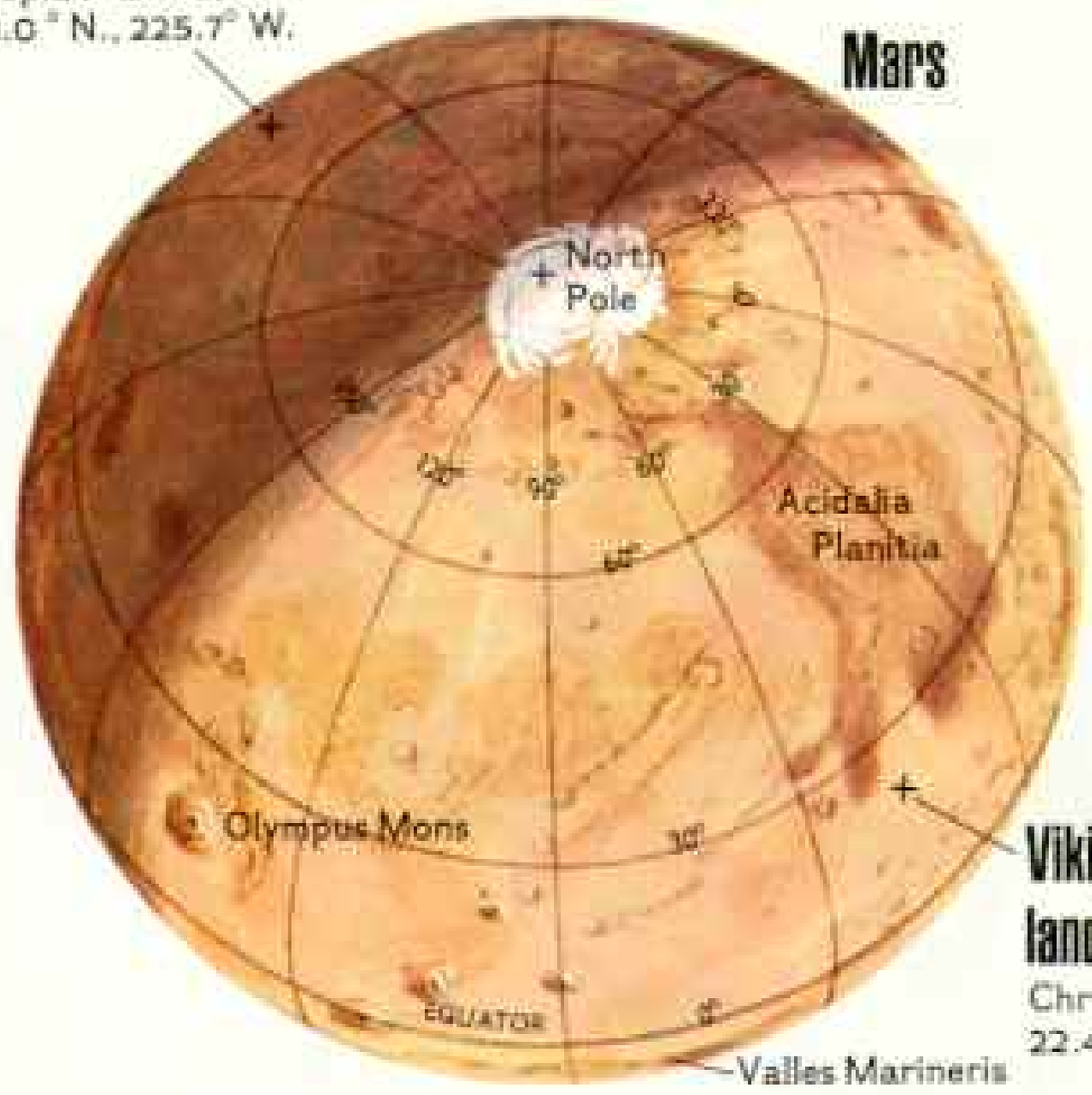
5 Parachute deploys and aeroshell shield jettisons at 19,400 feet

6 Terminal-descent engines fire at 4,600 feet

7 The landing

PAINTING BY PIERRE MION

Viking 2 landing site
Utopia Planitia,
48.0° N., 225.7° W.



Viking 1 landing site
Chryse Planitia,
22.4° N., 48.0° W.

"We have touchdown!"

TO ENTER ORBIT, Viking 1 fires its braking engine (**1**). Landing-site safety check complete, the orbiter releases the lander, cocooned in a saucerlike, protective aeroshell (**2**). Since it takes as long as 22 minutes for a radio signal to reach Mars from earth, a computer in the lander masterminds the landing sequence.

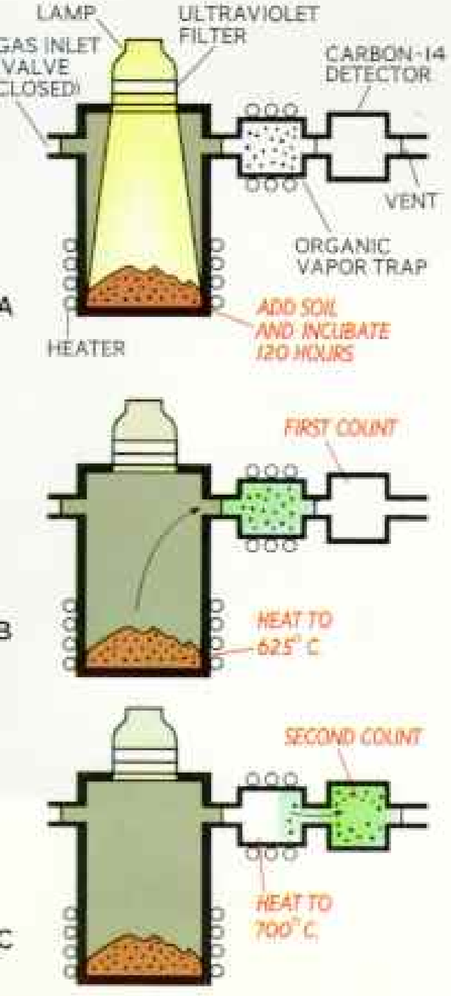
First, it ignites the de-orbit engines that nudge the aeroshell out of orbit and into a landing trajectory (**3**). As the aeroshell plunges into the Martian atmosphere, frictional temperatures up to 1,500° Celsius (2,730° F.) sear the ablative shield (**4**). When the aeroshell has slowed to less than 600 miles an hour, the computer deploys a parachute for further braking and jettisons the protective shield (**5**). Later, the parachute is released.

Terminal-descent engines (**6**) slow the lander to five mph and triumphant touchdown (**7**).

The challenge: Design three biology laboratories and pack them into less than one cubic foot for transport to Mars. Accomplishing the task, TRW Inc. technicians put final touches on one of the mini-labs built to search for microorganisms. The 33-pound instrument performs three separate experiments (**foldout, right**).

DIAGRAMS BY PIERRE WION AND ELIE SABBAH

"I almost expected to see camels," said a Viking scientist of the windswept, rock-strewn landscape at Chryse Planitia, remarkably similar to deserts on earth. Geologists cataloged an unexpected variety of rocks, from basalts to breccias, from pebbles to a ten-foot-long boulder, left. Though Viking 1 landed during Martian summer, weather instruments atop the meteorology boom, center, recorded frigid temperatures: a low of −86° C. (−123° F.) just after sunrise, a high of −31° C. (−24° F.) in midafternoon. Winds were light.

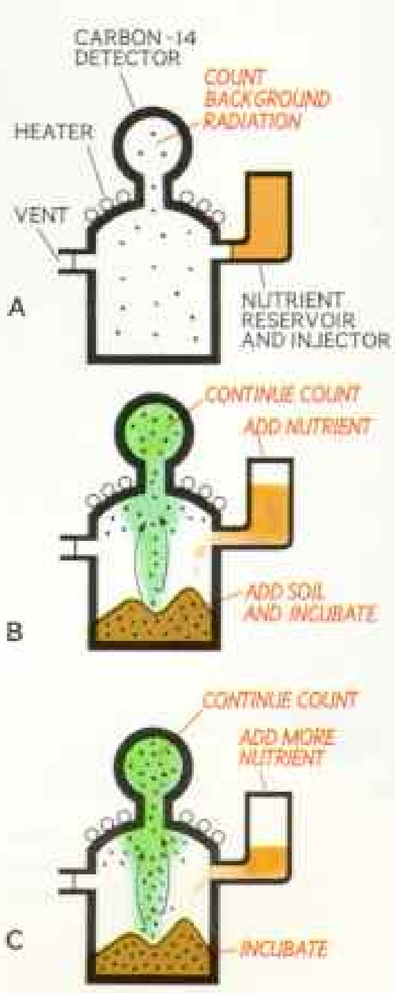


Is food manufactured?

The pyrolytic release (PR) experiment looks for microorganisms which, like plants photosynthesizing on earth, turn carbon gases in the air into carbon-based, organic molecules.

Soil is placed in a thumb-size chamber (A). Carbon dioxide and carbon monoxide are added, made of traceable radioactive carbon 14. The soil incubates beneath a lamp that simulates Martian sunlight, minus its ultraviolet rays. Any microorganisms should take up the radioactive gases. The chamber is heated (B) to pyrolyze, or decompose, any microbes present into organic gases.

These gases are forced into the organic vapor trap, which lets other gases pass through to a radiation detector for a first count. Higher heating (C) then releases organic vapors so that they, too, escape. If these vapors prove radioactive, they probably come from living organisms.



Is food consumed?

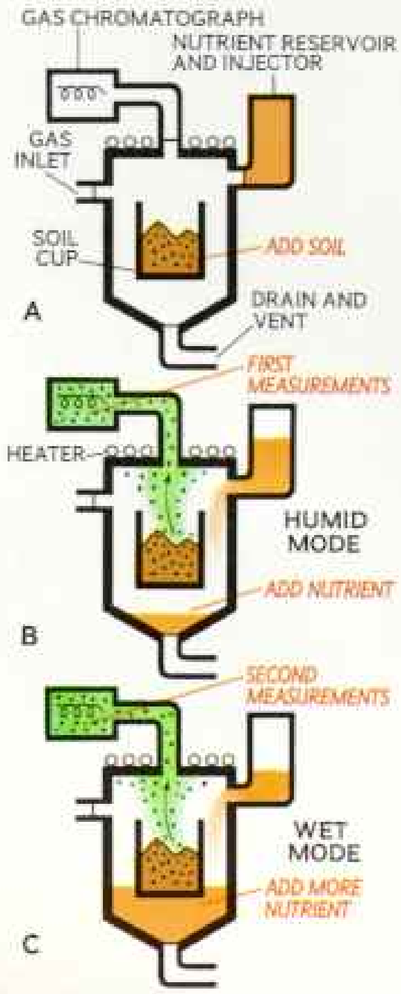
Living organisms must eat to sustain life. As they convert food into energy and tissue, they release gases, including carbon dioxide.

In the labeled release (LR) experiment, radioactive nutrient is added to a soil sample in the hope that something will digest it and give off radioactive carbon dioxide.

A count is made (A) to determine any background radiation prior to the test.

Martian atmosphere and soil are added to the chamber, and the latter is sprayed with tiny drops of nutrient (B). As with the gases in the PR experiment, these carbon compounds contain radioactive carbon 14.

As the soil incubates, a detector looks for a rise in radioactivity, indicating Martian organisms are metabolizing. After a week or two the soil is squirted with a second course of nutrient (C). The detector continues its watch.



Is the air altered?

Just by living, a creature affects its environment. People take in oxygen and give off carbon dioxide. It's the same with microbes. As they metabolize, they consume and produce gases that can be measured.

The gas exchange (GEX) experiment looks for changes that Martian microbes might cause in gas levels over a long period.

Soil is placed in a test chamber (A), sealed to prevent gas leakage. A nutrient is added in two phases.

In the "humid mode," just enough nutrient flows to the bottom of the chamber to humidify the soil (B). If the soil contains dormant spores or seeds, the water vapor might awaken them. A gas chromatograph measures the gases. Certain rises or falls would indicate biological processes.

In the "wet mode," nutrient saturates the soil (C). Measurements last for several months.

For early results of these three tests, see pages 23-26.

J. R. EYERMAN

Practicing a dig, a Viking lander at the Jet Propulsion Laboratory (**above**) extends its surface sampler over simulated Martian rocks—Styrofoam—to scoop simulated Martian soil—earth sand.

In this manner, technicians rehearsed operations on earth before Viking performed them on Mars.

In addition to the biology instrument and two cameras, the jeep-size lander carries other devices (**below**) to sample weather, analyze soil and atmosphere, and record any seismic tremors.

Data from the tests are stored on magnetic tape, then transmitted to the orbiter for relay to earth.

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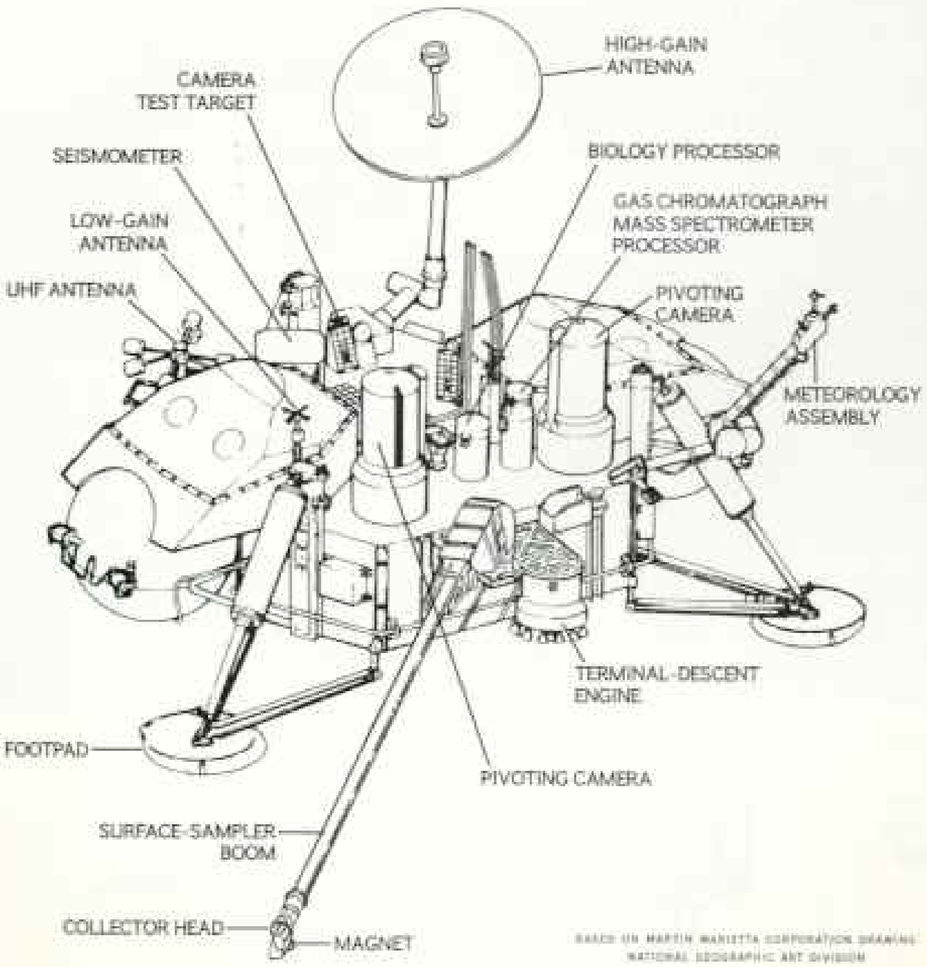
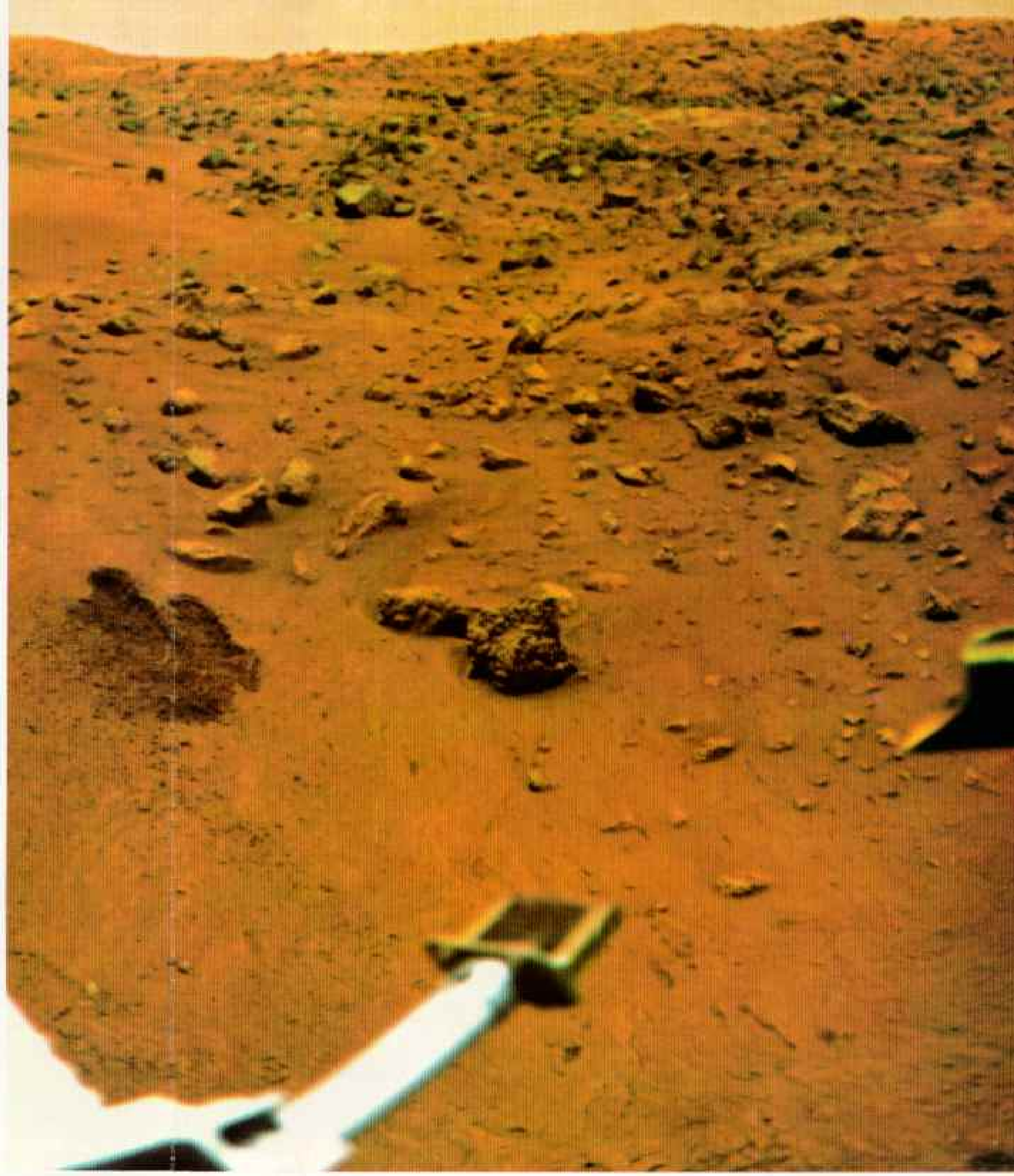


BASED ON MARTIN MARIETTA CORPORATION DRAWING
NATIONAL GEOGRAPHIC ART DIVISION

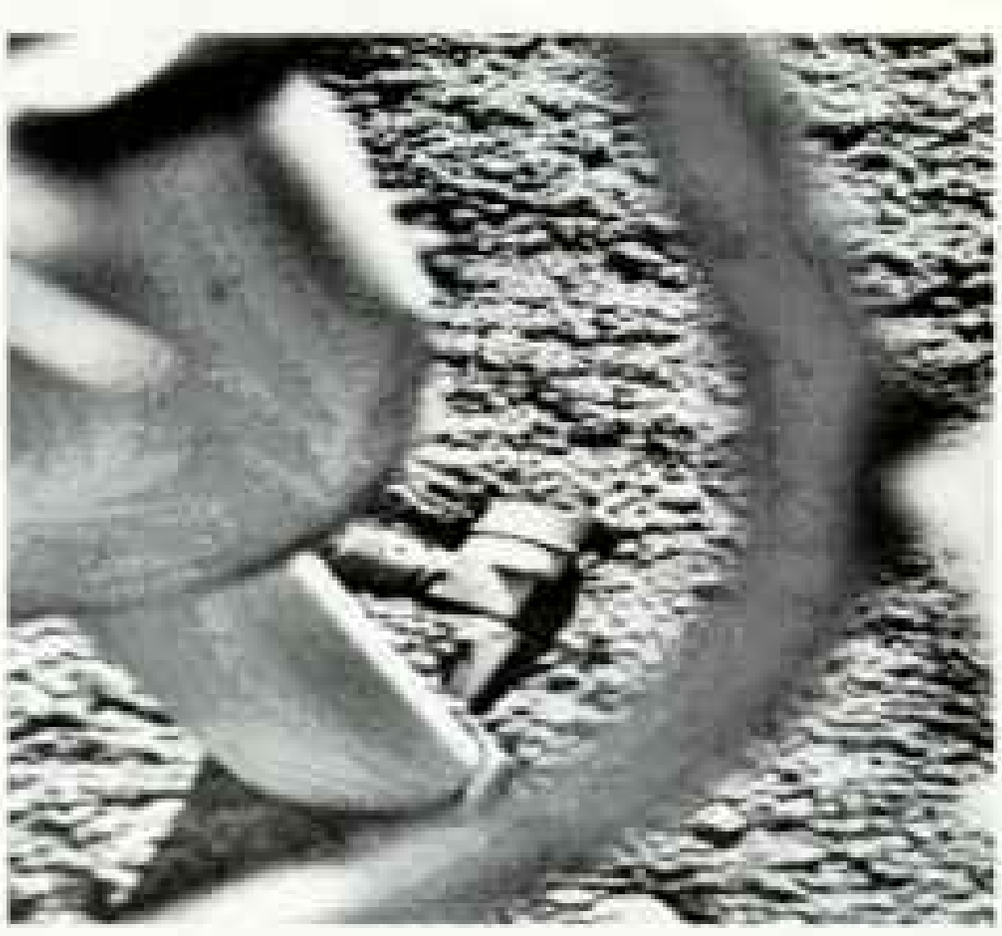


After trenching the face of Mars, far left, the Viking 1 lander's soil sampler quietly awaits further instructions. But the dirt it dug went on an amazing chemical rampage inside the lander's biology instrument. Scientists were

cautious about interpreting early results as evidence of life. Perhaps, they theorized, the nutrients or water used in the tests triggered oxidizing compounds that do not occur naturally on earth but may be present in Martian soil.

Setting foot on Mars, the Viking 1 lander rests one leg on solid, rocky ground (**below**), but another sinks to its "ankle" in powdery dirt (**bottom**).

The happy accident gave scientists a close-up look at two varieties of soil. Oddly enough,



they observed many dust-size particles here and elsewhere at the site, but no sand-size particles. One geologist speculated that grains of sand, whipped by winds up to 250 miles an hour, may be pulverized by colliding with rocks.

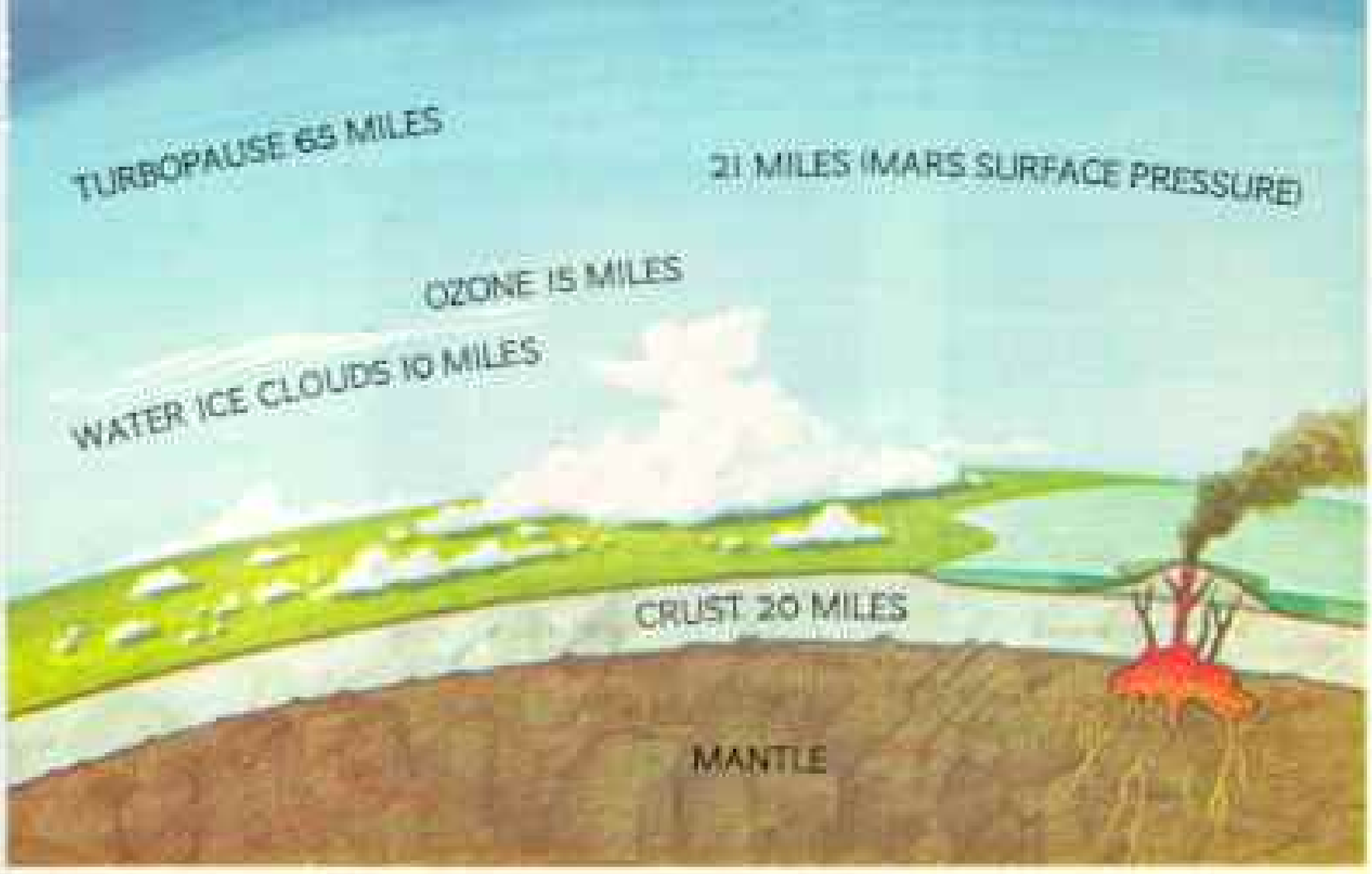
Such windblown particles may have eroded rocks (**right**) at Chryse Planitia and scoured out the depression around the big rock at center. When the lander touched down, small surface fragments scattered and pitted the soil.

Like dust devils gone mad, giant dust storms rage when the orbit of Mars brings it nearest the sun. As seen in these 1973 pictures supplied by Lowell Observatory (**right**), such storms can envelop the planet. Scientists eagerly await a new storm expected this spring so that they can monitor it with Viking's instruments.

BEFORE STORM

FIRST DAY OF STORM

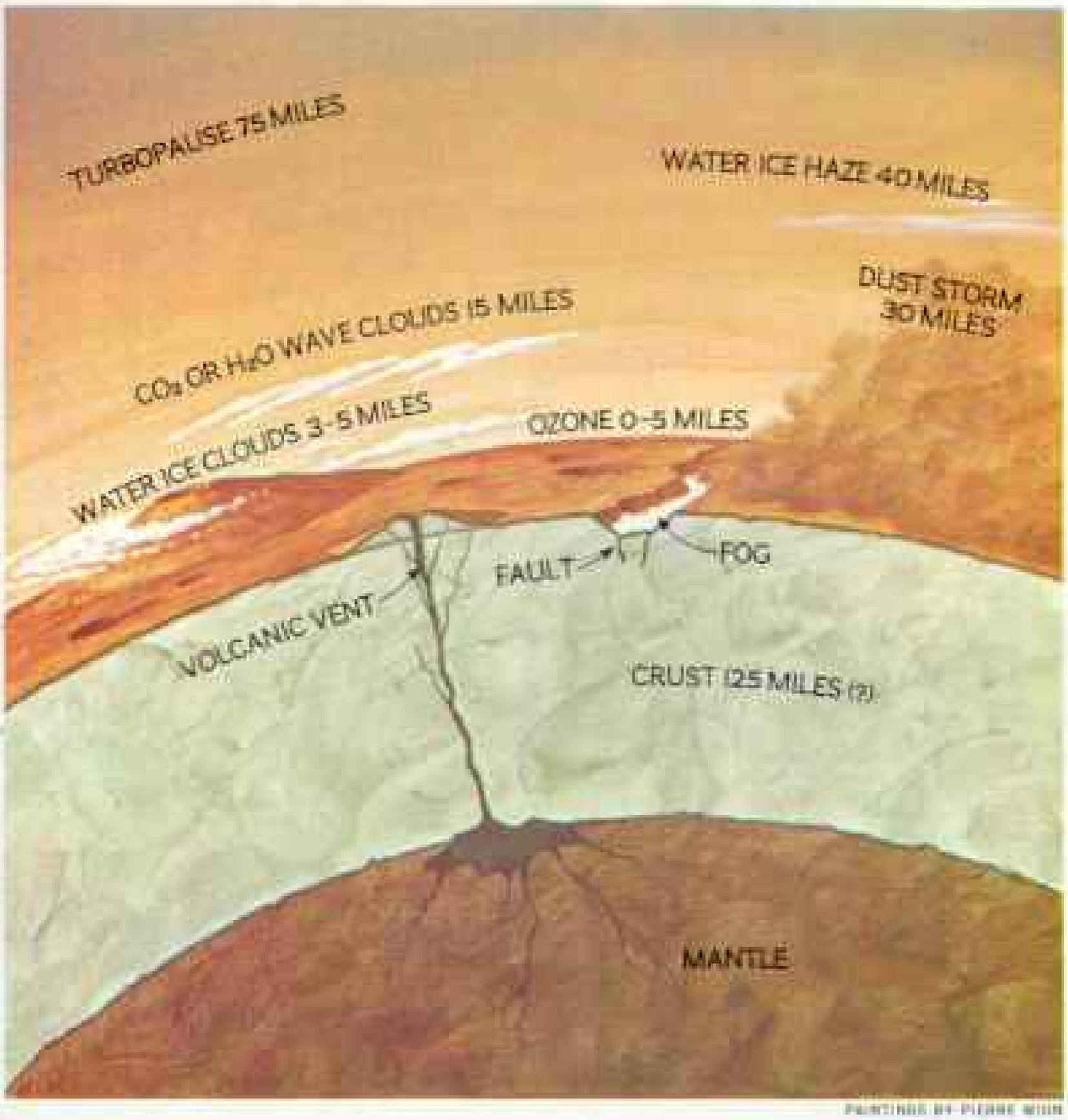
EIGHTH DAY OF STORM



Earth

Six times the volume of Mars, our planet has a dense atmosphere rich in water vapor that protects and nourishes life. A band of ozone, thickest about 15 miles above the surface, shields against the sun's deadly ultraviolet rays.

An earthling must climb 21 miles to experience the atmospheric pressure on the surface of Mars. In such thin air, blood would boil.



PAINTINGS BY PIERRE MION

Mars

The red planet probably has a thick, rocky crust, because, being smaller than earth, it cooled faster.

The Martian ozone region begins at ground level, but there isn't enough ozone to block out ultraviolet rays. Many earthly microorganisms would die in seconds.

Viking gave scientists the first proof of nitrogen in the Martian atmosphere, and detected significant leakage of the gas into space. They deduced that Martian air was once much denser, perhaps dense enough to permit rain to fall.

Scientists also found fast-moving atmospheric "tides," able to propel a gas molecule in a few days from the surface to a level known as the turbopause, where gases cease their turbulent mixing. On earth that takes about a century.

From orbit a camera shows how morning sun warms the ground (**below, left**), vaporizing frozen water that recondenses in low spots as patches of fog (arrows, **below**).

(Continued from page 12) other atoms and make an endless number of configurations. Only carbon can provide the incredible variety of molecules needed by any living organisms we can conceive of."

Molecules built around a carbon base are called "organic." Organic molecules are the stuff of which all living things—microbes and mice, mushrooms and men—are made.

Key Tests Seek Vital Processes

Living organisms process or create organic compounds in two important ways. They break the organics down to derive energy. A chemist would call this process "oxidation." Some organisms synthesize, or create, new carbon compounds. To a chemist this process would be called "reduction." Oxidation and reduction are diametrically opposite reactions. They go on concurrently in living creatures.

So Viking biologists devised three tests that would look for these processes in organic compounds (pages 15-16).

One test detects whether anything in the Martian sands takes carbon gases out of the air, as plants do on earth, and builds organic compounds from them.

A small sample of soil is placed in a sealed chamber. Carbon dioxide and carbon monoxide are pumped in. The carbon atoms are radioactive, so they can later be traced and counted. A lamp simulating the spectrum of sunlight on Mars, except for ultraviolet components, is turned on. If there are Martian organisms in the soil, they should begin turning the radioactive carbon gases into the organic molecules they use.

The sample incubates for 120 hours, and then the radioactive atmosphere is flushed out of the chamber. The soil is heated to pyrolyze, or decompose, any microbes and the organic compounds they might have made into organic vapors. Any of the organics made in the previous 120 hours would be radioactive. If a counter detects significant amounts of radioactive vapors, the biologists could conclude that the "hot" organics were made by living beings. This test, devised by Dr. Horowitz, is called the pyrolytic release, or PR, experiment.

Another test, the labeled release, or LR, experiment, developed by Dr. Gilbert Levin of Biospherics Incorporated, looks for a type of metabolism typical of animals on earth. That is, when we burn, or oxidize, food, we release carbon dioxide in the process.

A soil sample is slightly moistened with a broth of seven simple organic foods, foods that would be rapidly eaten by most microorganisms, or "bugs," on earth. Each food is considered "labeled" because its carbon atoms are radioactive. So if a Martian bug eats the radioactive food, it will release radioactive carbon dioxide, whose emissions can be counted, as a waste product.

Third, there is the gas exchange experiment, or GEX. In GEX an instrument called a gas chromatograph simply measures how the levels of biologically important gases change as, first, a soil sample is humidified, and then submerged in what has been nicknamed "chicken soup." Chicken soup is a solution of almost every nutrient a microbe could conceivably eat. "It's so rich we could live on it," said Dr. Klein.

The GEX sample is merely humidified at first because Martian organisms are perhaps like spores or seeds that can hibernate for centuries, awakening only when there is moisture about. As they awaken, their metabolic processes should alter levels of the various gases. If no important gas changes are seen in a week, the GEX sample is submerged in the chicken soup and the microbial feast can begin. GEX's developer, Vance Oyama of NASA's Ames Research Center, monitors the experiment for 200 days to detect gases that might evolve.

Lab Works Better on Mars Than on Earth

The biology instrument carried by the two Vikings is a masterwork of automation and miniaturization. "Roughly, each of the three experiments would require a ten-by-ten-foot lab plus a six-foot rack of electronics, and two would need bulky radioactive-carbon counters," said Dr. Frederick Brown, a biochemist with TRW Inc., the instrument's manufacturer. TRW built all that into a box about the size of a typewriter.

So complicated is the instrument that engineers never got all three experiments to work in one prototype on earth. Several project scientists confided to me that they would have been satisfied if just one experiment had worked properly on Mars.

The biology experiments almost failed before they began. A human oversight in

programming the computer caused the long, extendable robot arm of the first lander to jam as engineers readied it to dig the biology soil sample. Imagine your car breaking down more than 200 million miles from a gas station and trying to get a mechanic to diagnose and fix it—all by telegram.

Using a replica of the lander that sits in a sandbox at JPL, as well as one at the Martin Marietta Corporation's Denver plant, where the lander was built, engineers duplicated the problem and worked out commands that would free the arm. They radioed the commands to the lander, and the first sample of Martian soil went into Viking's test chambers.

Then, as July became August, seemingly impossible news was breaking at JPL. Viking 1's mini-lab began reporting signs of life. Or, if not life, it had found a soil so exotic that it chemically mimicked life processes on earth.

Biology or a Strange Chemistry?

The first results came from the gas exchange experiment, the GEX. A startling burst of oxygen—15 times more than had been anticipated—flowed out of the soil almost as soon as it was humidified. Also, when the labeled release sample was moistened with its nutrient broth, radioactive carbon dioxide poured out of the sample.

Dr. Levin was excited. "Never had we seen that magnitude of response in any of the thousands of earth samples we tested that did not contain life," he said.

But both the LR and the GEX leveled off. The GEX response in particular could be explained by a surprising chemistry rather than biology.

"Ultraviolet rays may have created some exotic chemical with so much pent-up oxidizing potential," said Dr. Klein, "that it reacts violently when exposed to water. Everything we see in the GEX points toward chemical oxidation. Should we begin to see evidence for reduction—like hydrogen or methane, which are normal waste products of living systems—then we would have to say that those two opposite kinds of chemistry cannot be going on without biology."

Like the GEX, the LR could also be explained by a peculiar Martian chemistry. If the soil has strong oxidizers, they could be reacting with one of the LR's nutrients to release the radioactive carbon observed.

However, the next piece of the puzzle did not fit neatly into a chemical model.

Levin repeated his LR experiment but first heated the soil to 170° C. for three hours to kill anything that might be alive. This time he got none of the lively results he saw the first time. That leaves only two explanations: Either Martian organisms were killed, or whatever chemical caused the reaction broke up when heated to 170°.

What could these chemicals be? Chemists offered only a handful of possibilities—peroxides, superoxides, and ozonides—all of which are too unstable to exist naturally on the earth. They must be created in the laboratory for research uses and specialized industrial needs. More important, however, many would not be destroyed by the temperature Levin used to sterilize his LR soil sample.

Viking biologists have been most hard put to find a satisfactory chemical explanation for the final test, the PR, or pyrolytic release experiment. When the Martian soil was pyrolyzed after its five-day incubation, significant amounts of radioactive organics were detected. Something had to have fixed that carbon in the soil.

When the test was run again, with the sample this time sterilized by heat, no organics were indicated. Once again, either microbes had been killed or a chemical was destroyed by the heat. However, it could not be the same chemical that was destroyed in the LR. The LR chemical agent would be an oxidizer. Whatever had fixed the carbon in the PR had to be a reducer.

Soil Fails to Yield Vital Evidence

No nonbiological material on earth is known to behave the way Martian soil was behaving. Nevertheless, for one primary reason biologists were reluctant to conclude that Mars has life. No organic compounds could be detected in the soil.

A small population of living microbes would not contain enough organics to be seen by Viking's detector, a gas chromatograph mass spectrometer. But in earth soils, for every living microbe there are the remains of perhaps thousands of dead ones that the GCMS could easily detect.

Viking scientists had expected to find some organics, either chemically formed in the atmosphere or left over from impacting

meteorites, which can have a relatively high organic content. They hardly anticipated positive biology tests and no organics.

"It *looked* like we'd detected life on Mars," said Dr. Soffen. "But we biologists would have difficulty explaining life without finding organics in the soil."

But other scientists offer explanations for the lack of organics. Ultraviolet light or the highly reactive Martian surface could destroy the organics, they say. But wouldn't that also kill any living creatures?

"On earth, organic material is so abundant that microbes don't have to be careful about conserving it," suggested Dr. Klaus Biemann of Massachusetts Institute of Technology, Viking's chief organic chemist. "On Mars, bugs may not let that material escape from them. Or maybe Martian microbes have learned to be extremely efficient scavengers or cannibals. So organics don't accumulate in the soil."

Perhaps, too, any large populations of Martian organisms are confined to a few fertile oases on the planet. Smatterings of microbes could scatter with the wind.

Silent Seconds Seem an Eternity

Viking scientists were eager for Viking 2 to land and perhaps resolve their dilemma. After a search even longer and more difficult than that for Viking 1's landing site, Viking 2 was slated to set down September 3 in a more northern region called Utopia. Water-vapor readings showed Utopia to be more humid than Chryse. More water would make life more likely. Also scientists speculated that the colder temperatures at Utopia would cause organics to collect there, for much the same reason that vapors in a refrigerator condense on the colder coils.

Viking 2's descent was hair-raising. When the lander separated from the orbiter, an orbiter malfunction cut communication between its main antenna and the earth. The lander's computer had already been programmed for the touchdown, but the only way now that flight controllers could know their other bird had safely landed would be to monitor, via a second, low-power antenna, the rate of data coming up from the lander. If and when the data rate increased, it would mean that Viking 2 had set down in one piece.

Suspense gripped the dead-silent control room as the scheduled time for Viking 2's touchdown passed; still, flight controllers saw no increase in data.

"I had this slow-motion, agonizing image of our lander smashing against a hillside and exploding into pieces," recalled Gentry Lee.

Then, late by a few seconds that lasted an eternity, the increase came. It was the control room that now exploded. This time Gentry was on the floor, pounding it with his fists.

Within a few hours, engineers restored full communication with the orbiter.

A Quake or Tremor Would Be Helpful

Viking 2's panorama looked strikingly similar to Viking 1's: a red, dusty, rock-strewn field. But almost immediately Viking 2 scored one new success. Its seismometer, sent along to detect "Marsquakes," was working properly. An electrical failure had kept Viking 1's seismometer from deploying.

The seismometer, which can pick up surface movements of a hundred-billionth of an inch at the landing site, so far has heard no hint of a Marsquake. It is too early, however, to say that Mars is geologically inactive.

Over the months ahead, if some geological noise develops, the seismometer could help answer other long-standing questions: How thick is the crust of Mars? Does it have a small molten core like the earth? Or a large cool core? Is Mars a planet that cooled faster than the earth and has therefore already seen its geological heyday? Or is it just a slow starter that is now becoming active?

Once again the most eagerly awaited experiments were the biology tests. And once again the results were mixed.

The organic compounds detector has still found none, even though the lander arm pushed aside a rock and dug a soil sample that had not been exposed to destructive ultraviolet rays (page 8).

"We biologists are perplexed," said Dr. Soffen after Viking 2 results proved as confusing as Viking 1. "You might say we are in the seventh inning and the score is Biology 10, Exotic Chemistry 10."

By mid-November, when Mars went out of earth's communication range behind the sun, shutting off the flow of data for almost two months, evidence was pointing more heavily toward a strange chemistry rather than biology producing the perplexing results. But the question is still far from resolved.

"It looks like we'll have to slug it out in the laboratory," said Dr. Levin. Indeed, in the months ahead, scientists across the nation will be simulating every chemical reaction that Viking could conceivably have observed. There may well be an answer soon, but as Dr. Klein points out, it took nearly two hundred years for science to prove conclusively that the strange little animalcules, or microorganisms, that microscopist Anton van Leeuwenhoek first saw in 1674 were not the artifacts of some exotic chemistry.

Are We Alone in the Universe?

Why pursue the question of whether life exists on Mars? "If we find life, it will be the most important philosophical discovery of my lifetime," said one young Viking scientist.

The existence of even microbes would mean, simply, that we are not alone in the universe. If life emerged and has persisted on so hostile a spot, it must abound on other, more clement planets across the galaxies.

"From a chemical point of view, there is only one form of life on earth," explained Dr. Horowitz. "We will next want to know whether the Martian organism, if it exists, is made the same way we are—with the same DNA, the same genetic code, proteins made of the same amino acids. By answering those questions we can learn a great deal about the origins of life and its abundance in the universe."

While the biologists struggle to answer their profound question, other Viking scientists are reaping a wealth of data. Meteorologists are delighted with the whole new world they now have to play with. They have found daily tidal waves of heat and pressure rippling through the Martian atmosphere. They have watched the air pressure drop steadily as winter begins in the southern hemisphere and the carbon dioxide in the air begins to freeze out on the south pole. So rapid has been the drop that if the rate continued for a Martian year—687 days—instead of for a single season, the entire atmosphere would be gone.

"The outstanding character of earth's atmosphere," said Dr. Seymour Hess, chief Viking meteorologist, "is that the weather varies daily. The outstanding thing about Martian weather so far is that it doesn't vary much from day to day. That's because it is a simpler beast."

The Martian atmosphere is simpler because the planet has no oceans or massive cloud cover, both of which have major effects on the earth's weather. Martian winds apparently are influenced by the heating of dust particles in the air. Once a year the sun heats the Martian surface and the particles enough to get a good convective cell going. The famous dust storms result, with winds that may reach 250 miles an hour. But since the air is so thin, that would feel like only a 25-mile-an-hour wind to an earthling.

The meteorology of both Mars and the earth is driven by solar heating. Meteorologists hope to observe solar-heating processes more clearly in the less complicated air of Mars. This could lead to a better understanding of our own weather.

Same Cosmic Dust Forms Earth and Mars

By comparing the amounts of inert gases such as argon, krypton, and xenon remaining on both Mars and earth, scientists are now working out atmospheric histories of both planets. They can now say more confidently that the two planets must have formed from the same galactic debris about the same time —four and a half billion years ago. They will better be able to resolve how the two planets' atmospheres have changed. Such comparisons will help us understand the processes that determine the fates of all planets.

Viking close-ups shed light on the origin of the two tiny moons of Mars, Phobos and Deimos. Mariner pictures had suggested they were of a basaltic or meteoritic material, and Viking photographs tilt thinking toward the latter. If so, that means that the moons probably were passing asteroid fragments captured by the planet's gravity field.

The Vikings will continue to observe Mars for a full Martian year. The landers will take pictures of the dust storm and perhaps watch the frosts form. The orbiters will compile a much more detailed atlas of the amazing Martian terrain.

By the end of that year, predicts Gentry Lee, "at least 99 percent of our detailed knowledge about Mars will have been learned from Viking."

Mission Director Tom Young ranks Viking's expansion of knowledge with that of Columbus's voyages: "For the first time man has a beachhead in a world beyond his own." □

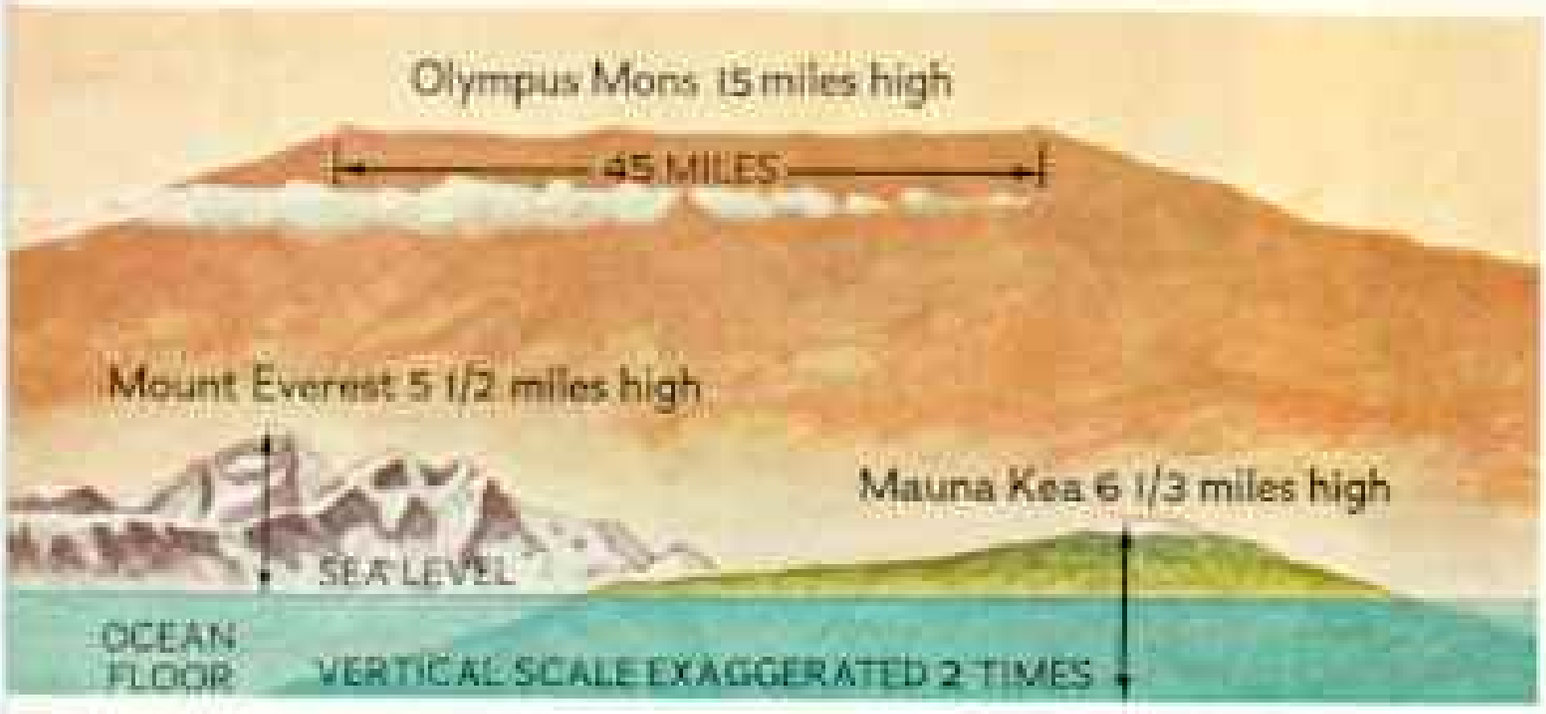
Massive floods, scientists agree, shaped teardrop islands (**right**) in the lee of impact craters in the Chryse region. Ragged outflow from the crater Yuty (**above**) was caused by a meteorite. Its impact may have melted subsurface permafrost and expelled a slurry of rock and water.

Puzzling scars of Phobos (**left**), one of two Martian moons, could have been gouged by fragments of a disintegrated comet. Orbiter 2 made the picture from only 545 miles away.

A long-range view of the other moon, Deimos (**right**), shows numerous craters.

Viking pictures suggest that both moons were asteroid fragments captured by the planet eons ago.

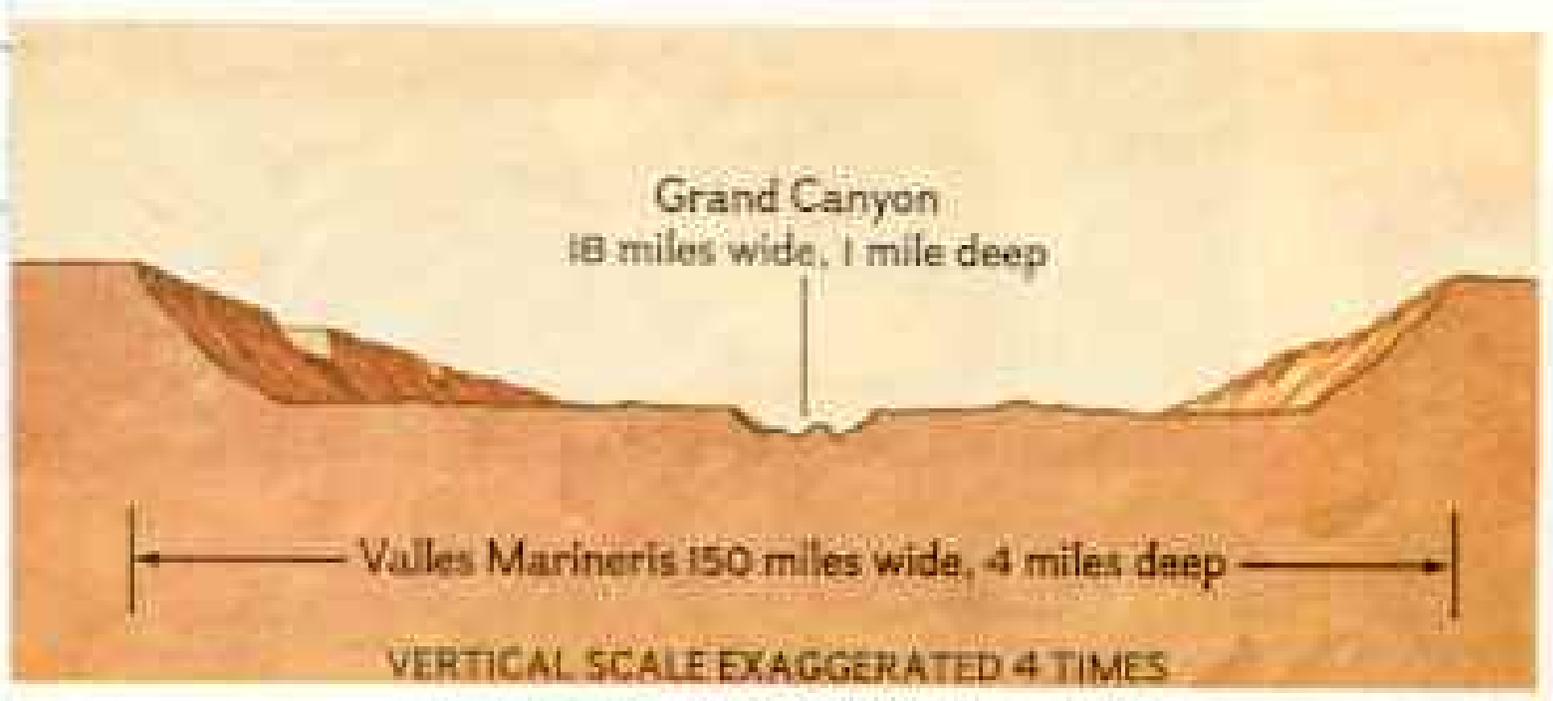
Gargantuan volcano . . . plunging canyons



GIANT OLYMPUS MONS, its western flank wrapped in clouds (**right**), soars 15 miles above its plain. Alongside it, earth's loftiest peaks (**above**) are mere foothills.

The volcano's 45-mile-wide caldera would extend from Baltimore to Washington, D.C., its 335-mile base from Montreal to New York City. How did it get so huge?

According to Dr. Michael H. Carr of the Viking team, on Mars there appears to be no plate-tectonic activity—the movement of great sections of planetary crust—as there is on earth. "Hence," he says, "the volcano could sit over the same plume of lava and grow forever and ever."



PAINTINGS BY PIERRE MION

AWESOME ABYSS: An 80-mile segment of Ius Chasma (**right**) joins with other rifts to form Valles Marineris, the deepest canyons known in the solar system.

As much as 150 miles wide and four miles deep, Valles Marineris would stretch across the continental United States. In comparison, the Grand Canyon of Arizona (**above**) is merely a ditch.

Faulting created these Martian canyons; vast landslides and wind erosion enlarge them. Geologists believe that a series of episodes over a billion-year span shaped the canyon system. Despite such titanic geological events, Mars appears to be less active tectonically than the earth. No tremors jarred Viking's seismometer in the early weeks of monitoring.

If water once flowed on Mars, where did it go? Viking sheds light on the question by proving that the ice cap remaining on the north polar region in summer (**left**) is entirely water ice, not frozen carbon dioxide. Dark ice-free bands may be wind-carved cliffs.

Water may also be locked in subsurface permafrost, researchers think. Valleys amid hilly terrain in the Nilosyrtis region (**above**) suggest an inexorable, glacierlike movement of ground materials intermixed with ice. Such features continue to intrigue scientists as Viking adds month by month to the mass of new—and often confounding—information on Mars. □

INSIDE CUBA TODAY

ARTICLE AND PHOTOGRAPHS BY
FRED WARD BLACK STAR

MAY DAY THRONGS filled Havana's Paseo. From the reviewing stand in the Plaza de la Revolución I could see the Cuban hierarchy approaching and beyond them a sea of waiting celebrators. Hand-painted signs festooned hundreds of homes and buildings with *¡Viva el Primero de Mayo!* Long Live the First of May!

Prime Minister Fidel Castro and the Central Committee of the Communist Party advanced in a phalanx toward the gigantic tower and sculptured figure honoring José Martí, 19th-century martyr in the struggle against the Spanish, and Cuba's most honored hero. When the leaders arrived at the podium, Castro was introduced. He waved to the crowd, received its warm applause, then listened to the day's speech, given by Roberto Veiga, head of the trade unions.

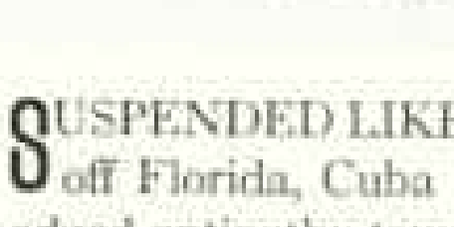
Precisely as Veiga pronounced the last syllable of his address, the first of 130,000 parading participants burst into view, with uniforms, signs, posters, and banners all pounding out revolutionary themes. Educational goals were heralded, the United States denounced, Angola praised, Castro applauded. Thousands of workers passed before their "Maximum Leader," who is almost universally addressed by his first name. The crowd chanted the oft-heard slogan, "*¡Fidel, seguro, a los Yanquis dales duro!*—Fidel, for sure, hit the Yankees hard!" Then formation after formation burst into a unified rhythm: "*¡Fi-DEL! ¡Fi-DEL! ¡Fi-DEL! ¡Fi-DEL!*" *(Continued on page 36)*

Patriotism on parade: Members of Cuba's artists' union (**above**) celebrate May Day on Havana's Paseo, shouting support for their Marxist nation. Banners of workers' groups (**left**) proclaim solidarity. Despite scarcities and rationing, the standard of living of the average Cuban has risen; sugar income, Soviet subsidies, and the charismatic leadership of Prime Minister Fidel Castro help sustain the only Communist nation in the Americas.

The West Indies' largest city, Havana gleams with high rises. A new hospital thrusts

SUSPENDED LIKE A SWORD a hundred miles off Florida, Cuba has lived 16 years in sharp-edged antipathy toward its big neighbor. A Spanish colony for four centuries, Cuba came under U.S. influence after the Spanish-American War. Despite a freeze in relations since 1961, the U.S. maintains a naval station at Guantánamo Bay (**inset**) under terms of a 1903 treaty.

AREA: 44,218 square miles. **POPULATION:** 9,567,000 (est. 1976). **LANGUAGE:** Spanish. **RELIGION:** Nominally Roman Catholic. **GOVERNMENT:** Communist republic. **ECONOMY:** Sugarcane production; nickel, tobacco, fishing, coffee. **PROVINCES:** 14, subdivided from 6 in late 1976. **MAJOR CITIES:** Havana (pop. 2,000,000); Santiago de Cuba (pop. 325,000). **CLIMATE:** Semitropical; average annual temperature 77° F. Rainy season May-October.



skyward at upper center. The old domed Capitolio to its right is now a science center.

In a clean sweep of Havana's once-posh Miramar area, a neighborhood crew works as part of a nationwide volunteer effort every Sunday morning. When the Marxist nature of the Castro government became apparent in the early 1960's, many wealthy Cubans fled to the United States. Their spacious grilled-and-balconied homes became government-owned houses and offices.

I had been in Cuba for almost three months, traveling the 750 miles from Point Maisi, on the eastern tip of Oriente Province, to Pinar del Rio's western end. This was one of the longest and most extensive visits allowed an American journalist in 15 years.

I had come to see the changes brought about by the 1959 revolution that culminated in the Western Hemisphere's first Communist government. Accorded virtually unlimited travel, I saw firsthand how the people, economy, and system were now faring.

I made my way east by car to mountainous Oriente Province, where the revolution began (map, pages 34-5). For a Caribbean island, Cuba is surprisingly flat. Except for relatively low ranges in Pinar del Rio to the west and Las Villas in the center, only the impressive Sierra Maestra and its sister ranges in Oriente break up the terrain. The rugged Sierra Maestra holds a special appeal for modern Cubans and has been romanticized as the motherland of the struggle.

> ***"Massive U. S. exploitation was followed by the dictatorships of the 1930's and beyond. Cuba never controlled her own destiny before the revolution."***
>
> —CUBAN OFFICIAL

Armando Valdés, a Ministry of Foreign Affairs official, accompanied me. On all my trips, except one by boat and two by airplane, I used a government-issued Argentinian Ford; it cost me $20 a day. A foreign-affairs official always came along to make arrangements.

Armando and I rolled into the hot port city of Santiago, capital of Oriente. Here Fidel first struck against the Batista regime, on July 26, 1953. Armando explained his view of events to that point. "Cuba and Puerto Rico were the last Spanish colonies in the Americas. After Cubans fought for independence for half a century, final victory was shared in 1898 with an uninvited U. S. force. Massive U. S. exploitation was followed by the dictatorships of the 1930's and beyond. Cuba never controlled her own destiny before the revolution."

I visited small Siboney Farm, where the rebels gathered, and the Moncada army barracks they attacked. It was a disastrous battle in almost every way, and many of the rebels not killed in the fight were captured, tortured,

and murdered during the next few days. Fidel and his brother Raúl escaped, but Fidel was soon hunted down in the mountains. Using his legal background at their famous trial, Fidel defended himself in a ringing denunciation of the dictatorship and outlined his revolutionary dreams and reformist programs.

After serving 20 months of his 15-year sentence on the Isle of Pines, Fidel was released and soon left for Mexico to prepare for the revolution. He returned to Cuba in late 1956 with 81 men—including the Argentinian revolutionary Che Guevara—on *Granma*, an aging yacht now displayed in Havana. Within two weeks after the initial battle, the force had been reduced to 15, yet Fidel, with that tiny group, captured the imagination of Cuba and the world as a romantic fighter for freedom. Only 25 months after the *Granma* landing, Fidel's revolution found itself, on January 1, 1959, in charge of a government.

Enrique Oltuski, a guerrilla leader, told me: "We were fighters, not bureaucrats. I was appointed Minister of Communications. Not being from Havana, I didn't even know where the building was and had to ask directions. When I got there, I had to ask everyone what he did and what our functions were."

BEFORE LONG, relations between Cuba and the U. S. started to deteriorate, largely because of land expropriations. The U. S. began a trade embargo—later to become total—and American newspapers were repeating what some Cubans had been saying: The revolution is like a watermelon; the more you slice it, the redder it gets. Despite such charges, Fidel insisted his was not a Communist revolution.

The final break with the United States came with the tragic U. S.-supported Bay of Pigs invasion by Cuban expatriates in April 1961. Before and during the invasion thousands of Cubans were rounded up and imprisoned, thus ending effective organized resistance inside Cuba. Afterward Fidel announced on television that Cuba was a socialist state. He suspended elections and nationalized private (mostly religious) schools.

At the end of 1961 Fidel publicly proclaimed, "I am a Marxist-Leninist, and shall be until the day I die." That statement accelerated one of history's largest political exoduses. In the years since 1959, approximately 700,000 refugees have fled to the U. S., mainly to Miami.

After 18 years the spirit of the revolution is ever present. Old advertising billboards are now used for propaganda such as, "Men die, the Party is immortal." At each break in radio segments an announcer repeats, "From Havana, Cuba, first free territory in America."

I asked René Mujica, one of my young guides, how such enthusiasm could be sustained so long. He told me: "Half of Cuba was born since the revolution. We feel this will continue to be a young, living revolution. Every day we contribute to it in the belief that this is the way to build our new society."

One way to maintain this enthusiasm has been a uniquely Cuban invention, the Committee for the Defense of the Revolution. On every street a sign identifies the house of the block-organized CDR. Originally formed in 1960 to counter sabotage, the CDR now is one of Cuba's "mass" organizations, charged with numerous community functions.

The people who run the CDR offices claim their time is spent tending to such everyday details as the Sunday block cleanup, vaccination campaigns, and making sure kids get medical checkups. But the CDR also conducts political discussions, and critics say it has neighbors spying on neighbors. Whether true or not, the prospect of such constant monitoring would tend to deter dissident activity.

Critics of the Committee for the Defense of the Revolution say it has neighbors spying on neighbors. True or not, the prospect of such constant monitoring would tend to deter dissident activity.

Last September 28 I sat on the platform in the plaza before a crowd of half a million at the annual CDR anniversary rally. The people stood hushed as Fidel used the meeting to explain that the sudden drop in world sugar prices had dealt a serious blow to economic planning. After hearing that coffee, imported commodities, and industrial expansion would all be limited—perhaps for five years—Havana's huge gathering dispersed toward home to discuss how the local CDR's would implement the latest directives.

Havana, still the largest city in the Caribbean, with about two million people, has lost

Where demand exceeds supply, waiting lines form; Flogar is one of Havana's largest department stores. Cuban adults receive

some of its glamour since I first saw it in 1955. Alfredo López, who teaches economics at the University of Havana, explained why. "De-emphasizing Havana was a goal of the revolution. It was too much to have a quarter of Cuba's people in one place. We wanted to limit growth and to spend our resources building up the countryside."

It seemed to me to be a matter of priorities. The Cuban system is largely financed by its sugar production plus Soviet aid. Since becoming heavily involved in the 1960's with Cuba's conversion to Communism, the Soviet Union has advanced Cuba as much as two

symbols placing them in a letter and number group (A1, A2, B1, B2). The symbols appear on monthly calendars (**left**) designating the two days allowed for buying non-food items. Mondays and Thursdays are reserved for working women, *trabajadoras.*

million dollars a day in direct grants and long-term loans with no interest, and deferred repayments into the 1980's. By now this debt must be more than five billion dollars, not counting the Soviets' gift of military hardware, including a whole air force.

THESE FUNDS will stretch only so far. They have made for a fully employed population, but the money that might be spent on cities has been deliberately diverted into other projects throughout the countryside.

As a result, Havana has a run-down, almost shabby exterior. Though clean-swept, many buildings in Havana need paint and plaster. An exception is the fancy 35-story Focsa apartment building, with its swimming pool, movie theater, and a rooftop restaurant with the city's most stunning view. Several thousand Soviet and Eastern European technicians are in Cuba, and for most of those working in Havana, Focsa is home.

Friction between these "socialist friends" and Cubans is said to be slight but constant; the visitors often rub their hosts the wrong way. One sore point is their privilege of using diplomatic shops, thus avoiding the Cuban rationing plan in buying local and imported

goods unavailable to Cubans at any price.

There is a bustle to the Havana tempo that belies a Caribbean heritage as cars and people squeeze through the noisy, narrow streets of its old section in a midday mêlange. Except for some new-car imports from Argentina, Italy, and the Soviet Union for government use and for the professional workers who are allowed to buy, most private transportation is vintage Detroit. This coughing, clanking collection of pre-1959 Kaisers, Packards, and workhorse Chevrolets has been so customized with pirated parts as to make their origin almost unrecognizable.

Automotive genius and Latin machismo are at stake when the driver of one of the baling-wire beauties hangs out his window, honks furiously at every passing girl, and publicly stage-whispers, *"Compañera,* with skin as delicate as yours, surely you should be walking on the shady side of the street."

Gone from Cuban speech are *señorita, señora,* and *señor,* having been replaced by the revolutionary *compañera* and *compañero,* "comrade" or "companion." The accepted farewell is now *hasta luego,* "until later," instead of *adiós,* with its religious connotation, "go with God."

"... no member of any religion can become a member of the Communist Party. ... Church attendance is down to about one percent of the population."

—A CATHOLIC PRIEST

Most of Havana's churches remain open. I called on Father Carlos Manuel de Céspedes to learn how Catholicism and Communism are coexisting. His great-grandfather led Cuba's first war of independence against the Spanish, which cost him his life. Father Céspedes's old Jesús del

Oases of glitter and elegance endure in a nation where austerity prevails. At Las Ruinas restaurant, maître d'hôtel Ovideo Chávez serves a rum drink called the Guyana—a bow to another leftist Latin-American country. With goods scarce and health services free, many Cubans spend their low but tax-free incomes on dining out.

Bright lights and gaudy dancers still play to packed houses at the Tropicana, former tourist mecca. Diligent Cuban workers are rewarded with special rates.

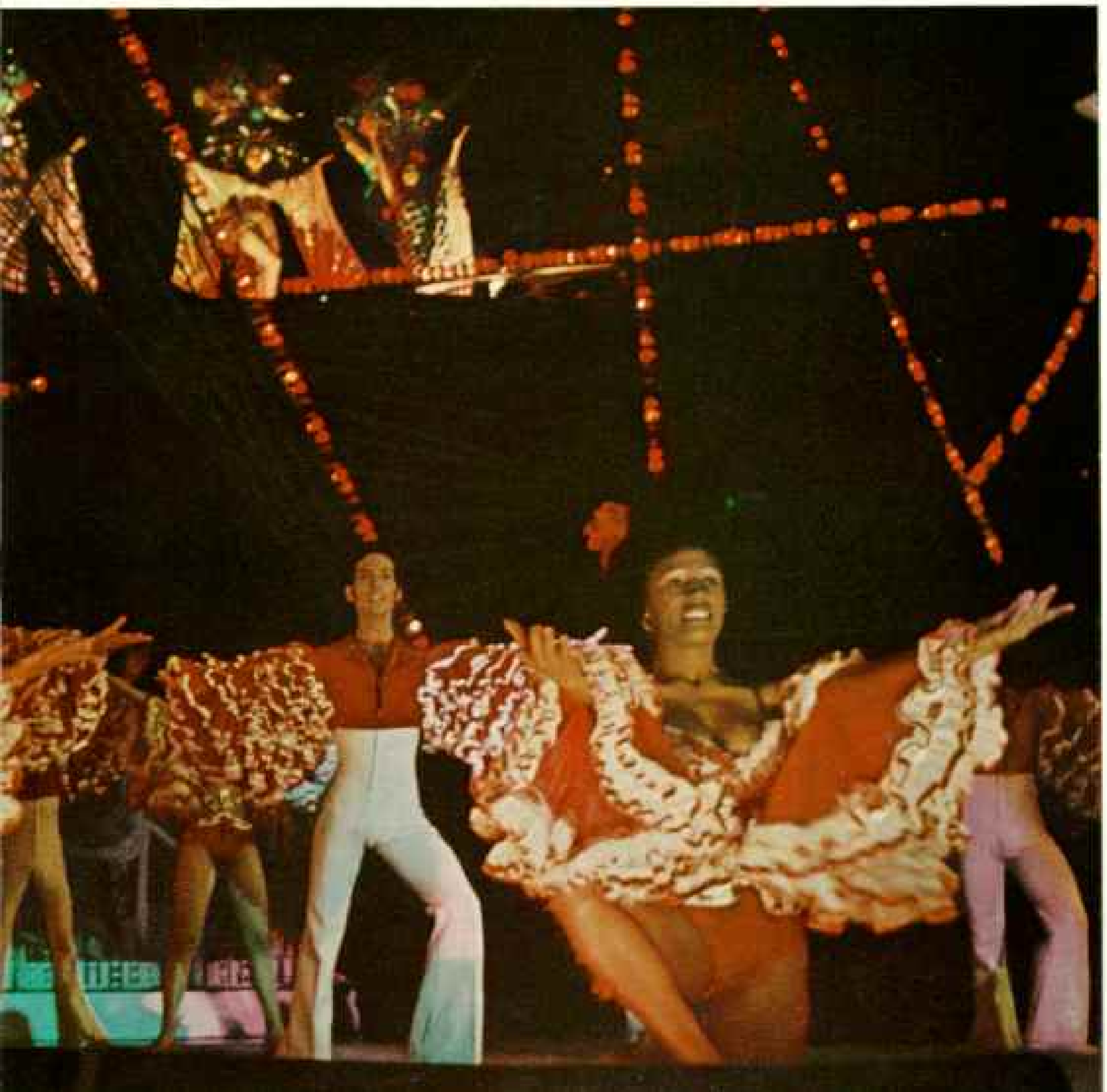
Monte Church, on a small hill, offers a sweeping view of the city. We sat in his airy office beside the crumbling 18th-century church.

"As you know from the new constitution, the government guarantees freedom of religion. But no member of any religion can become a member of the Communist Party. Our only hope now is to keep religion alive. The problem is that atheism results from the controlled educational system. Church attendance is down to about one percent of the population. The five churches in this parish perform only 20 to 30 weddings a year. Naturally, we used to do them all."

To see where bridal couples go today, I visited the Palace of Matrimony on the Prado. Here government notaries perform the brief ceremony in assembly-line fashion. On a busy Saturday when more than forty weddings are common, one couple is arriving to walk up the stairs as the just-marrieds are getting into a waiting taxi. In rented finery the young couples hear an official read the new Family Code with the legal conditions of marriage. Signing the registry book ends the free, five-minute service. There is a short honeymoon, then the necessity of moving in with one set of parents.

Housing is so restricted that it is rare to find a family living apart from relatives. The worst slums were torn down in an early attempt to upgrade living conditions, but additional problems have resulted because of the nation's population increase from six to nine and a half million. Apartments are under construction all over the island, but housing demands cannot be met. Available funds must be shared with factories, education, and other government activities.

I went to see Alamar, Havana's showcase



project about eight miles east of the city. Humberto Ramírez, the construction architect, gestured toward colorfully painted exteriors. "More than 25,000 people are already living here, and we started only in 1971. By 1982 we plan to have a city of 150,000."

We walked through rows of five-story buildings, exact duplicates except for the outside paint. "These were all built by 'micro-brigades,'" Humberto said, "forces of 33 workers elected at their factories to spend one to five years in construction. They receive their regular salaries and work with skilled technicians from the Soviet Union, Eastern Europe, or Cuba.

"When the units are finished, the workers back at the factory vote to award apartments on the basis of output, attitude, volunteer work, and need. The rent is fixed at 6 percent of the household head's salary."

Posadas are one solution for young people who have little immediate prospect of individual housing. Couples queue up at the motel-like complexes and pay less than a peso ($1.22) an hour for a room (food and drinks extra), no questions asked.

WHILE TOURING ORIENTE, I drove west from Santiago on the coastal highway that curves past sandy beaches between the deep-blue Caribbean and the dry southern slopes of the sparsely inhabited Sierra Maestra foothills. I visited an isolated mountain family in their *bohío*. Their contemporary version of an Indian home, constructed over a concrete floor, was a three-compartment dwelling with a bedroom on either side of a central hall. Usually there are no interior doors, no electricity.

In the small thatched-roof kitchen shed behind her bohío, Delia Fernández was tending an open fire. Her husband, Víctor, 50, is a laborer with the National Institute of Agrarian Reform (INRA), and that day he was building cattle fences. All nine members of the family pile together nightly into the two bedrooms. There is no heat against the chill mountain air. Water comes from a well down the road. The toilet is out back. Light comes from a single kerosine wick (pages 56-7).

Delia says, "Our children can all go through school if they want, we have enough to eat, and we like this better than living in the city." Still, except for the obvious advantages of free education, medical care, and a salary, daily life has changed little for the Fernández; their present housing conditions are not too much different from those that helped bring about the revolution.

Elsewhere in the countryside, conditions have obviously changed. I was impressed by the vastness of Cuba's new cattle operations. About forty miles east of Havana I passed thousands of white fence posts surrounding a 122,000-acre Agrupación Genética de la Habana farm. Director Hermenegildo Curbelo took me on a tour. "This is both a dairy farm and a genetic center to improve our cattle. We have 54,000 head and produce 41 times as much milk as we did when we started in 1970."

The new constitution, ratified by 97.7 percent of the voters, formalized the Communist Party as the supreme force in the country.

Compañero Curbelo was one of the few wealthy Cubans who chose to stay. He told me: "Before the revolution we owned 65,000 acres, had 2,000 cattle, and a large sugar holding. I was not a socialist, but while I was in college, I could see that the workers on our farm were not allowed to get an education. When the revolution came, my family supported it. My father gave our entire holdings to the state, even before the agrarian-reform laws, and never took any payment. Now, in spirit, I am richer than ever." He excused himself, explaining that, like many workers, he has evening classes at the University of Havana. He's studying English.

This phenomenal involvement with schooling was my prevailing impression of Cuba. From the beginning Fidel committed the revolution to a maximum effort in mass education. I sat with Max Figueroa, Director of Educational Development for the Ministry of Education, in his office in Havana as he explained: "About a third of the people are enrolled in an educational program. This ministry is spending more than 10 percent of the country's gross national product." (Government expenditure for public education in the U. S. is 6 percent.)

"In the process," the director continued, "we have reduced illiteracy from 25 percent to less than 3 percent. The most revolutionary aspect of our system is the network of 300

new secondary schools in the countryside and the 800 more planned. This is the first step toward training the technicians, engineers, and doctors that we will need in the future."

At Simón Bolivar Secondary School, southwest of Havana, I met 16-year-old Eva Maria Valdés. Her crisp maroon uniform signified that she was studying to become a teacher. We walked to the nearby fields with students on their way to weed strawberries (page 48).

"These schools are now all over Cuba," Eva said. "Each houses about 250 boys and 250 girls from the seventh through tenth grades. Around the schools are approximately 500 hectares [1,235 acres] planted in products suited to the soil and climate. Here we have citrus, strawberries, and guavas. The schools are split into two groups—morning and afternoon—each going to work outside for three hours a day and to classes for four hours, with two hours of individual study.

"School ends at noon on Saturday," Eva continued, "and we are all bused home for the weekend with our families. When the seventh graders first come here, they are only about 12, and there is a lot of crying and unhappiness, and they miss their families. But there is so much to do here that they soon get over it. We all know the large efforts that went into the revolution and what is needed now from us. We want to upgrade ourselves, our future, our culture."

THE MOST ELABORATE secondary-school system operates on the Isle of Pines, the large island about thirty miles off southwestern Cuba. Formerly known mainly for its notorious prison, where Fidel spent his 20 months, it has been designated by the revolution as the "Isle of Youth." More than 11,000 young people study here, while harvesting millions of grapefruit for export; most of them, I was told, go to Canada.

I visited the old circular prison, patterned after one in Joliet, Illinois. Its bars removed, it is now a museum. Today prisoners are held elsewhere, and the whole facility stands merely as a reminder of past abuses. Neither on the Isle of Pines nor elsewhere, however, could I find anyone willing to discuss details of the revolution's own political prisoners. In the mid-1960's Castro admitted that about

Election billboard acquaints voters in Santiago with candidates for their municipal assembly in the first nationwide elections under Castro. Campaigning by local nominees is forbidden. The municipal assemblies elect a National Assembly, which in turn names Cuba's top executives. The Communist Party, however, holds ultimate power.

20,000 people were in various prisons for support of Batista, counterrevolutionary activities, and dissent. Those who recant, authorities say, are usually sent to agricultural work farms and ultimately released. Now, interested international groups estimate the number is down to about 5,000, but some have been in jail since 1959 or soon after.

The agricultural stint for released prisoners makes sense to the government, since Cuba's major industry is still agriculture. I visited the new hilltop headquarters of INRA, about 25 miles south of Havana. As Ilidio Sabatier of the economic section showed me through planning offices, he told me: "We found that before the revolution 8 percent of the farms comprised 70 percent of the land, and a quarter of the best sugar acreage was in foreign hands. The first Agrarian Reform Law, in 1959, limited estates to 1,000 acres. This affected about 10 percent of Cuba's farms—and 40 percent of all farmland." (It also caused concern in the United States because it was the first indication that Cuba was going to expropriate U. S. investments without acceptable compensation.)

Housing is so restricted that it is rare to find a family living apart from relatives. "Workers . . . at the factory vote to award apartments on the basis of output, attitude, volunteer work, and need."

—CUBAN ARCHITECT

"By a second law, in 1963, we nationalized all holdings over 166 acres," Sabatier continued. "We offered to pay for property in 20-year bonds at 4½ percent interest, but most of the big owners fled the country and never received any compensation. This put 70 percent of the land under government ownership."

We were joined for lunch by Angel Estrada, an INRA vice minister and a party member. I asked him about the remaining 30 percent of the land in private hands, and how that operates in a Communist state.

"No one wanted to penalize the small farmer, who had suffered enough during past regimes," Estrada said. "Even though the new constitution guarantees his right to own the holdings he works, he cannot sell that land to anyone but the state. Of course he must buy his seeds and supplies from the state, and, with minor exceptions, he is required to sell his output to *(Continued on page 48)*

Do-it-yourself housing, the Alamar apartments east of Havana provide one solution to Cuba's chronic housing shortage. Construction architect Humberto Ramirez takes a balcony view (**above**) of the giant complex he supervises, now home to some 25,000 factory workers. Brigades of industrial employees are temporarily released from factory duties to build the apartments for workers.

Rents are 6 percent of the household head's salary; a tenant earning $240 might pay a monthly rent of $15.

Near the top of the Cuban income ladder, Dr. Jesús Perea Corral and his wife, Lisette (**right**), relax in the den of their rented house in Havana. As a university professor of medicine and a practicing pediatrician, Dr. Perea earns some $830 a month; top allowable income is $915.

"Sport is a right of the people": The bannered Castro slogan here shares a wall with a portrait of revolutionary hero Che Guevara during Friday-night boxing at the Havana coliseum. Cameras telecast the admission-free matches throughout the island. Sports-oriented, like its Eastern European counterparts, Cuba offers full support and facilities to promising athletes such as heavyweight boxer Teófilo Stevenson (**left**), Olympic gold medalist at both Munich and Montreal. He reads a prepared text of greeting and state doctrine before a match.

Baseball remains the nation's sportive passion despite the United States' trade embargo that cut off U. S.-made equipment. An arsenal of bats (**below**) made of ash shipped from Canada awaits varnish in a Cuban factory.

INRA. Where special expertise is historical, as with coffee and tobacco, small farmers make significant contributions. Interestingly, 60 percent of our tobacco is privately grown."

Cuban tobacco, which enjoyed such great popularity in the United States before the revolution, is still a thriving business. In Pinar del Río Province, where the best tobacco is grown, Orlando Gutiérrez, the local INRA chief, took me by jeep through columns of wide, ripening leaves. They would soon be picked, dried, and hand-wrapped around cigars costing more than a dollar each.

Turning onto a dirt road, Gutiérrez stopped at one of the dozens of large, windowless curing barns. Inside the dark, aromatic building, rich green leaves thickly packed on ceiling poles obscured the thatched roof. Gutiérrez said: "It is the combination of soil and climate in Pinar del Río that gives Cuban tobacco its superior flavor, plus the skilled handling by the workers. This area produces more than 70 percent of the 3,500-ton crop of top-quality leaves that go into the cigars. The remainder are shredded for cigarettes."

The phenomenal involvement with schooling was my prevailing impression of Cuba. "About a third of the people are enrolled in an educational program. . . . We have reduced illiteracy from 25 percent to less than 3 percent."

—CUBAN EDUCATOR

Back in Havana, still operating from the same old factory near the Capitolio, H. Upmann—a name sure to pique the taste buds of any American cigar smoker—produces an expensive and prestigious line, mainly for export.

Production manager Andrés Gavilla showed me around the large, open workroom. "We make about 100,000 cigars a day, double the 1959 figure, most by hand. In a deliberate attempt to offer women jobs and to free men for heavier work," he said, "we now have 216 women hand-making cigars. Before, we had only one doing that work."

In the front of the workroom, Rubén Morales sat before a microphone. Gavilla explained: "Before the revolution, the workers would hire a 'reader' for entertainment. Now the readers get a government salary and read them the Communist Party newspaper *Granma* and various ideological books" (page 52).

Answer to the high cost of education, Cuban boarding schools alternate classroom study with work for the state. Near Ceiba del Agua, southwest of Havana, students from grades seven through ten give half of each day to weeding strawberries in a government field (**left**); the other half day is devoted to classes. Instead of gardening, 16-year-old Mirna Montesdeoca cultivates budding minds in a seventh-grade physics class while also developing her own skills as a teacher (**below**).

At the prestigious Lenin School (**below, left**) high-ranking students assemble transistor radios to be sold by the state. Children in elementary schools also learn the value of manual labor by tending small school gardens. In the belief that all work and no play is bad, the Lenin School includes an Olympic-height diving platform and Olympic-size racing pool (**bottom**).

Cigars are strictly rationed to Cubans. "They are considered luxury items," Gavilla said, "and Cuba does not have the resources to provide many luxuries. Men over 16 can buy four cigars every two weeks at a very reasonable rate and purchase any extras at a much higher price. Anyone over 16 can buy two packs of cigarettes every two weeks at about 20 cents a pack, and an unlimited quantity at about two dollars a pack."

Necessities are also rationed. Every Cuban has a series of ration books for such foods as chicken, beef, pork, rice, beans, bread, flour, and sugar. A liter a day of milk is available at a low price to people under 12 and over 60.

Only in restaurants can a Cuban freely indulge a craving for food. Restaurants are packed, even at a cost of eight to twenty dollars a person (Algerian, Soviet, or Portuguese wine extra), since they offer all the hard-to-buy rationed foods the customer can pay for. The state encourages the practice as a means of draining off some of the extra pesos in circulation.

People wait in lines for everything: food, buses, magazines, taxis, water, movies. Rationing has often been cited as proof that the economic system does not work. The official explanation: "It is our way of guaranteeing equality."

Many of Cuba's restaurant patrons belong to households where several members earn salaries and often have more money in pocket than there are products to buy. To combat unrest, the state has a systematic program for importing limited numbers of expensive items to soak up this extra capital. Soviet black-and-white TV sets cost 775 pesos ($945 U. S. at the official rate). Refrigerators cost 650 pesos; Japanese stereo phonographs, 450; small, portable transistor radios, 180; and a set of glassware, 156. Each product finds a ready market among Cuban wage earners who can find almost nothing else to spend surplus money on except a restaurant dinner. But to get on the buying list for most of these imported luxuries, a worker must be nominated by his fellow workers.

Even some of the less glamorous commodities must be rationed. In department stores, clothing and fabric counters are always surrounded by long lines. People spend hours each day waiting for everything: food, buses, magazines, taxis, water, movies. Surprisingly, there seems to be practically no black marketing; penalties are severe.

Rationing has often been cited as proof that the island's economic system does not work, that it is especially strained because half again as many people must be fed now as before the revolution. The wife of a friend of mine disagreed: "I think lines are mainly caused by inefficiency. Usually there are not enough salespeople."

Ilidio Sabatier gave me the official explanation: "Rationing does not necessarily mean shortages; rather, it is our way of guaranteeing equality. With more money around now, there is more demand, and our rationing system assures everyone the same access to goods no matter how much money he has."

In practice, that access appears limited enough to be symptomatic of some genuine shortages. The shopper has only two days a month to buy rationed nonfood items. Everyone has a number, and the days each number is good for a purchase are posted monthly on a master guide (pages 38-9). Working women receive the additional incentive of being allowed to shop every Monday and Thursday.

The Cuban Women's Federation, beginning in 1960, propagandized women out of the kitchen as a patriotic duty. A federation official told me that 30 percent of all Cuban women are now in the labor force—the highest percentage in Latin America.

The federation established free day-care centers for children 45 days old to primary-school age. Now these centers tend 80,000 children, though the demand for such centers is several times that.

Other free care that makes Cubans very proud is public health. All medical attention, from treating simple infection to performing open-heart surgery, is without charge. Dr. Jorge Aldereguia, Vice Minister of Public Health, said: "In 1959 we averaged one doctor for every 1,000 people. More than half were concentrated in Havana. Some communities had no health care at all.

"When the revolution nationalized businesses, more than half those doctors fled, thus leaving us with a very serious shortage. After intensive training, we now have 11,000 physicians, and the proportion is back up to one per 1,000 people." The United States has

about 1.5 doctors for every thousand people in the civilian population.

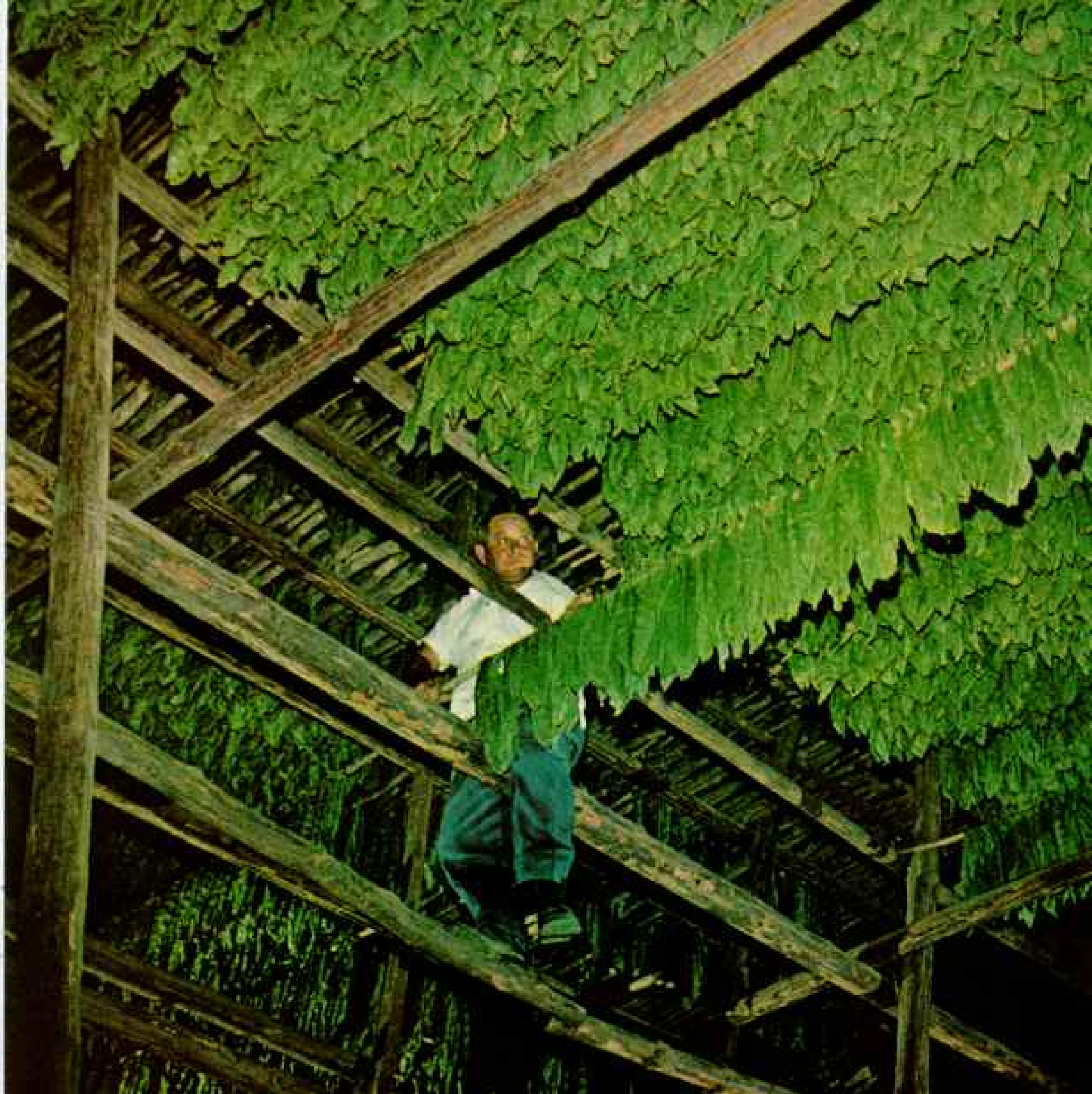
Dr. Aldereguía, leafing through a stack of statistics, said: "We have eliminated malaria, and practically eliminated polio, diphtheria, and tetanus, and we have reduced infant mortality and cut maternal deaths in childbirth by more than half. When people were poor and doctors were expensive, Cuba practiced treatment medicine. No one came until he was sick. Now we can practice preventive medicine."

All medical attention in Cuba is without charge. "There are no taxes, rents are low, and food is reasonable."
—CUBAN ECONOMIST

At one of Cuba's basic health units, the Plaza de la Revolución Policlínico, the director, Dr. Cosme Ordóñez, described the system of socialized care that Cuba has adopted. "We start with the polyclinics at the neighborhood level—more than 300, each designed to serve about 25,000 people. Every time a person visits the clinic, he sees the same doctor, who keeps all his records. When the case requires it, the patient or the doctor can bypass the clinic and go directly to the general hospital or one specializing in, say, gynecology and obstetrics."

Who, or what, is paying for all this "free" service? Economist Alfredo López tried to explain it. "The economy is centrally controlled. The state owns all income-producing enterprises except for some farms, and fixes wages and prices. Wages start at 85 pesos a month for unskilled labor. Many factory jobs pay 200 pesos a month, with 350 for management. The top monthly salary in the country, 750 pesos [$915], goes to doctors who head departments and also teach. There are no taxes, rents are low, and food is reasonable." Wages, paid in cash each two weeks, are usually spent with no thought of saving, unless there is a particular appliance on the shopping list. There is no personal banking, I later found out.

Dolls provide a touch of home in the clinical uniformity of a teacher-training school near Havana. Different dormitory floors compete in cleanliness and scholastics. Alina Alfonso, 12, folds her towel in a manner distinctive of her group.



Tobacco hangs like green thatch in a Pinar del Rio curing shed as farmer Angel Ramos raises more onto the beams. Women now hand-roll most of the Havanas (**right**)—delight of cigar connoisseurs but now illegal in the U.S. To relieve cigar-making monotony, factory "reader" Rubén Morales (**left**), broadcasts excerpts from books and Communist newspapers over loudspeakers. Sign above him extols solidarity with Angola, the African country where Cuban troops supported a leftist takeover in 1975.

All this means that everybody earns less but needs to spend less, since the state pays for social welfare. Actually, the welfare system is largely financed by sugar and the millions of dollars in Soviet aid. Sugar, the real earner of hard currency, usually provides more than 80 percent of Cuba's income and foreign exchange.

The world price of sugar in 1959 was three cents a pound. Cuba's fortunes rose as the price skyrocketed to 65 cents in 1974. Although it soon came down, to less than ten cents a pound in 1976, the Soviet Union has agreed to purchase more than half the harvest at as much as 30 cents a pound on a long-term contract.

Thirty percent of all Cuban women are now in the labor force. Free day-care centers tend 80,000 children, though the demand is several times that.

Luis de la Fé, Vice Minister of the Sugar Ministry, told me that annual production of raw sugar has fluctuated from four million to eight and a half million metric tons. Observers estimated that 1976 sugar production, affected by recurrent drought, would be about six million tons. Because of the Soviet price-support agreement, the sugar crop could mean more than two billion dollars in cash and credits even though sales to non-socialist countries will be at the greatly deflated world-market price. This will still allow the Cubans to implement their first five-year plan. What appears to be a gift has some advantages for the Soviet Union too; it grows sugar beets and cannot utilize refinery capacity throughout the year unless it buys Cuban sugar to process during the off months.

Another important income producer is the rich surface veins of nickel ore, among the world's largest reserves, stretching a hundred miles along Oriente's northeast coast. Moa, one of the two centers for the industry, appears to have been hit by some supernatural red blight. The ore dust coats the mining town. Downwind from the refining plant the noxious output has denuded nearby hills. Because the tailings from the process have great iron concentrations, they are reserved in a huge red lake against the day when Cuba becomes a steel producer.

Nickel is a vital *(Continued on page 58)*

Slender pillar of the Cuban economy, sugarcane yields to a cutter's machete in Matanzas Province east of Havana. Preharvest burning has removed the leaves for easier access to the stalk. Mechanical cutters (**above**) may handle 75 percent of the harvest by 1980, alleviating the seasonal mobilization that drains other sectors of the labor market. But oxen (**below**) still haul loaded wagons to the sugar mill.

A mountain of refined sugar (**right**), bound mostly for the Soviet Union and Japan, piles up in the seaport city of Matanzas. The sweet cargo accounts for more than 80 percent of exports.

Refugees from urban life, the family of Victor Fernández (**right**) lives in a home familiar to Cuban peasantry over centuries. In contrast to the rural migration to cities common in other Latin-American countries, the 50-year-old farm laborer moved his family from Santiago because he preferred mountain living.

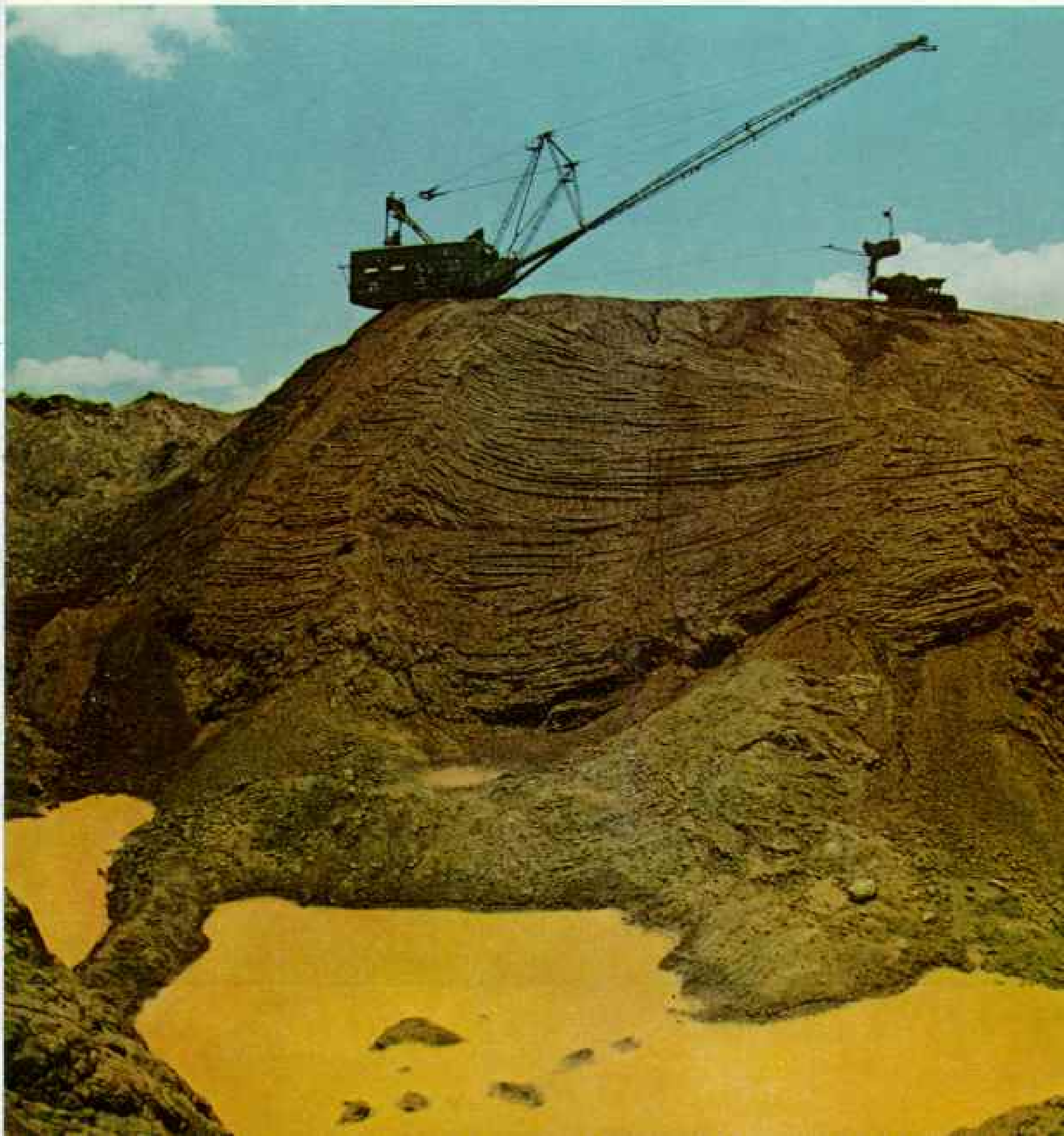
Electricity and running water have not yet reached their thatched-roof house in the Sierra Maestra, staging area for Castro's guerrilla campaign during the Batista regime. Neighbors chat through the open windows of the three-room *bohío* (**below**), shared by the family of nine. Evenings find Victor and Delia Fernández sitting outside with their only source of light, a kerosine flame (**bottom**).

Although their housing may be substandard, rationed food, clothing, and hard goods here are on a par with Havana's. A free medical program safeguards the family's health.

(Continued from page 53) element in steelmaking and other industrial processes, and so Cuba can sell all it produces. Plants at Moa and Nicaro daily turn out more than 600,000 dollars' worth of the metal at the world price —and the Soviet Union was reported buying nickel from Cuba at a price considerably above that amount.

I FOUND no greater contrast than leaving the mine's stifling fumes to motor across the island to the Caribbean's shimmeringly clear waters and breathe sparklingly fresh air. Enrique Oltuski, that old guerrilla fighter who is now with the National Fishing Institute, showed me the island's newest industry. Following the Soviet Union's example, Cuba has made fishing a big business.

Enrique and I were on a well-worn motorboat, plying our way through the Caribbean south of Batabanó to the spiny lobster collection stations moored on piers atop the continental shelf off Cuba. "Basically, we have two fleets, near and far," Enrique said. "Our close fleet catches shrimp, lobster, and the small fish around the island. But three-quarters of the world's fishing is done in cold waters. So we have trawler factory ships

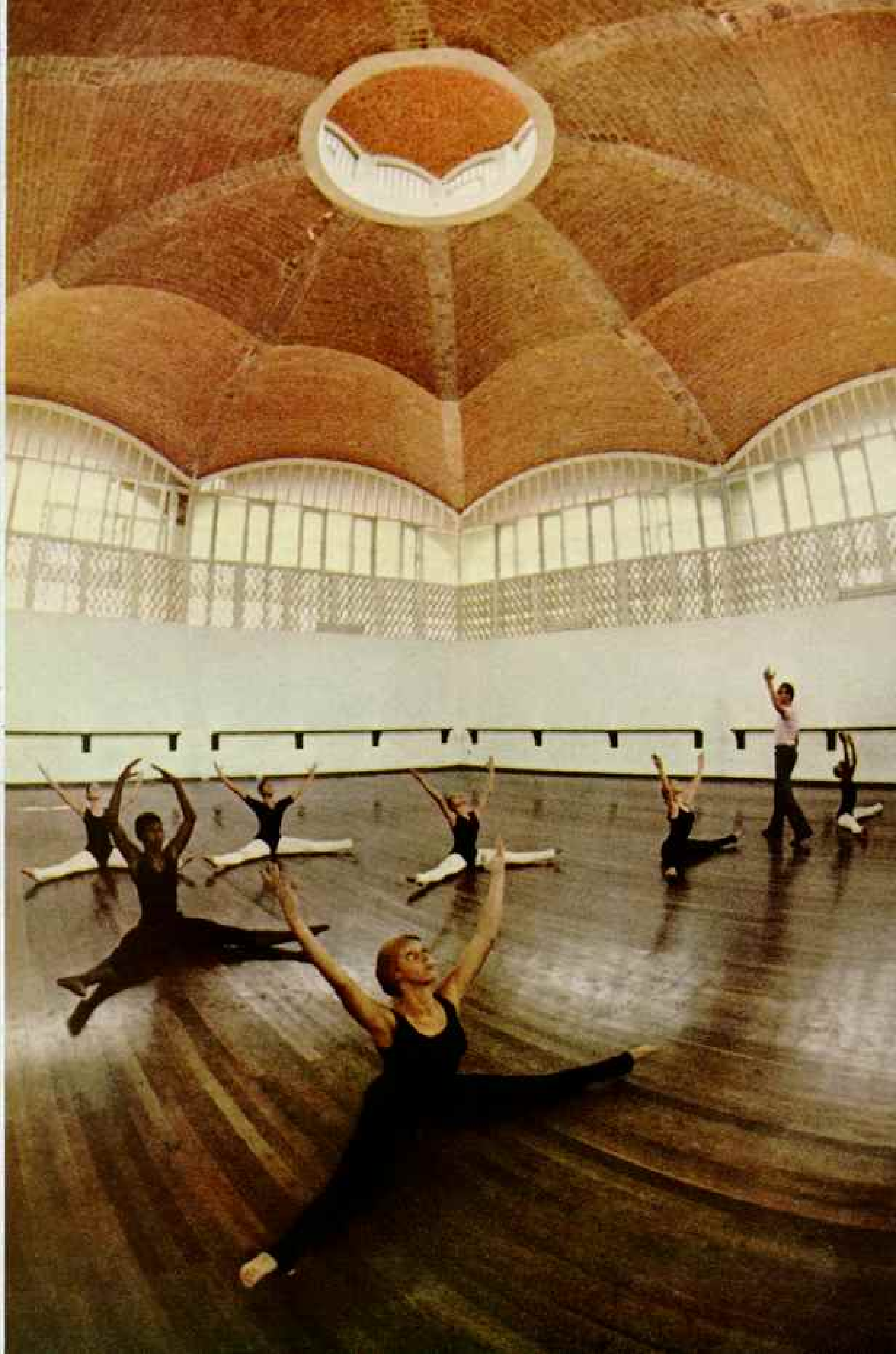


stationed almost permanently in the North Atlantic and in the Pacific. They catch, process, freeze, and box the fish right on board."

Fishermen in small rowboats sculled over lobster traps in the shallow water. Deftly snared by the watermen, the traps came up with flapping delicacies, destined to be frozen and shipped to Europe. Enrique cited his catch figures proudly: "Cuba has gone from 20,000 metric tons to 150,000 tons of seafood already and is building ships and plants to handle 350,000 tons by 1980."

This development of the fishing industry, as well as all other developments since 1959,

Nickel mining's big bite leaves a rust-colored wasteland. A crane fills Soviet-made trucks with the ore in Oriente Province. Nickel deposits provide Cuba with annual exports worth more than 200 million dollars, which Castro hopes to increase. U. S. engineers built the plant at Nicaro (**below**) for World War II nickel supplies. At a Soviet-designed fertilizer plant at Nuevitas (**bottom**) four Russian technicians advise Cuban protégés, with hard hat and pen.



Exaltation of the dance at the National School of Art in suburban Havana reflects Soviet influence on culture. Students of dance, painting, sculpture, and music work here under experts. Artistic director Alicia Alonso (**right**), a leading ballerina of the Western Hemisphere, returned from New York City to help form Cuba's National Ballet. Vestiges of U. S. influence, such as movies and pop music, remain popular in Cuba.

has been brought about by a government that has been, in effect, operating under "emergency powers." Without elections or a congress, an appointed Council of Ministers has run the bureaucracy, with policy made by the Political Bureau, Secretariat, and Central Committee of the Communist Party.

The party, or PCC, is comprised of about 200,000 members. To gain membership, workers must be nominated by their fellow workers, have their backgrounds reviewed by the party, and be voted in by its membership. Election brings prestige and unofficial consideration in jobs and housing, but also time-consuming additional duties, meetings, and responsibilities.

After years of promises the party finally held its First Congress in December 1975, and produced a new constitution. Ratified by 97.7 percent of the voters last spring, the constitution formalized the Cuban Government and set the Communist Party as the supreme force in the country.

It also established an electoral process, which went into effect last October. Under this new system, citizens vote for a municipal assembly where they live. The municipal delegates then elect provincial and National Assembly delegates. The new National Assembly elects a Council of State and a President of the Council of State, who serves both as head of state and head of government. Described by the government as a great step toward democracy, the constitution allows only one citizen vote (for municipal assembly), subjugates the judiciary to the National Assembly, and subjugates the National Assembly to the Communist Party.

Early in my visit I had requested an interview with Prime Minister Fidel Castro. As is his style, no acknowledgement was made. Two days before my departure I suddenly got a call that he would pick me up at the hotel's front door in seven minutes.

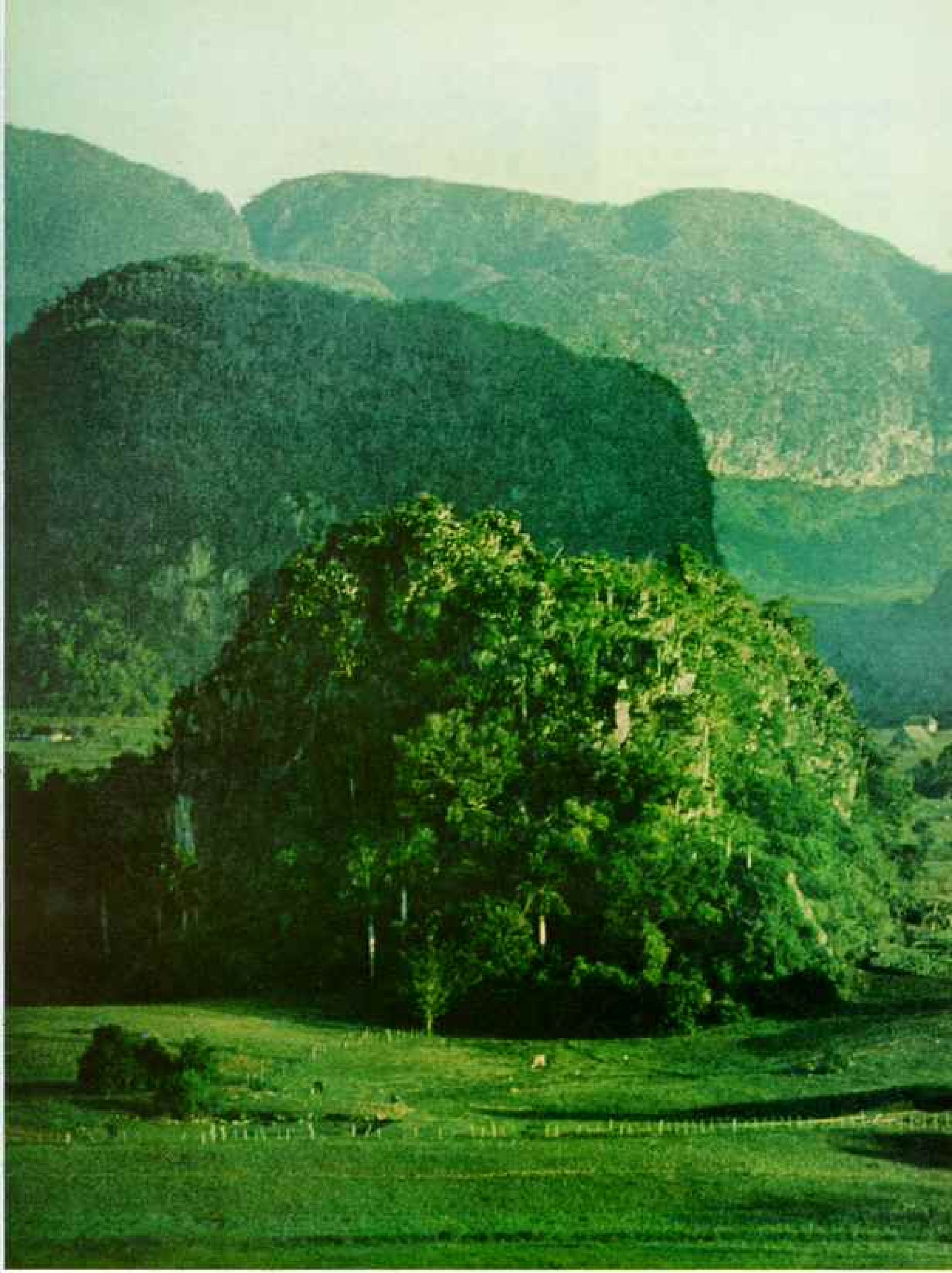
Cameras were all over the room, my tape recorder packed, Castro's Polaroid camera gift locked away, and I needed to shower and shave. But how could I keep him waiting?

When I neared the lobby door, out of breath, I could see the large, familiar figure in green fatigues sitting in the front seat of an open Soviet-made jeep guarded by armed soldiers. After brisk introductions and friendly greetings, Fidel himself decided to drive. I joined him in front, taking note of the Soviet AK-47 automatic rifle in place on the dashboard before me. This was the beginning of a six-hour interview.

With such a strong army organization and tight central control, the drift into military dictatorship may be irresistible.

For the half-hour drive to an experimental farm south of Havana, Fidel asked me endless questions about the U. S. Presidential primaries. He wanted to know what I liked most about Cuba and seemed delighted to relate endless statistics about Cuban industry, education, and economic planning. In comparison with the U. S., he said, "Cuba will never be an

(Continued on page 67)



"The most beautiful island ever seen"—thus an ocean-weary Columbus described Cuba in October 1492. Green-robed bluffs tower above private tobacco farms in

western Cuba's Viñales Valley. Although state collectives handle nearly all the island's agriculture, Castro allows small but efficient farmers to remain independent.

Running camera interference, a drill instructor rushes to stop the author from photographing militia training. Most Cuban adults serve as on-call troops. Sensitivity on military matters dates from the Bay of Pigs invasion by Cuban exiles in 1961. More than a hundred invaders died in the three-day battle before the remainder surrendered. At a museum near the landing site, photographs of defenders who died (**left**) and a captured U.S. tank (**below**) commemorate the event.

(Continued from page 61) automobile society. We could never afford it, and it would be undesirable anyway. Oil is too precious. It should be used in petrochemical industries."

At the farm he showed me the many imported plants and trees that are being tested to see whether they might be useful to Cuban agriculture. Fidel worries about Cuba's economic dependence on a single crop, sugar, but, though still looking, sees no alternative. "We know it is wrong to be this dependent on sugar, but soil and climate are perfect for it. We have looked at many things and always come back to sugar. We ran tests on corn, rice, coffee, and other crops, and found we could get $400 a hectare from them. Sugar brings us $7,000 a hectare. So we will continue to sell sugar and to buy the other things we need on the world market."

AS HE TALKED, the light suddenly fell and menacing rain clouds swirled in. We settled inside a metal-roofed building and watched through open doors as a thunderstorm obscured the nearby trees. The rain beat so strongly that we had to lean close to hear each other. Fidel lit his second cigar of the evening.

I noted that it appeared that Cuba and the U.S. had been inching toward recognition when Cuba's Angola involvement stalled the talks. Fidel agreed and expanded: "Angola is a completely temporary situation. Angola asked for our help, and we will stay only until their army is equipped and trained.

"The U.S. should take the first step toward friendship. After all, we do not have a blockade against you. We have no base on U.S. territory. We are certainly interested in improving relations. Since the U.S. practices the cold war with only a few small countries—Korea, Viet Nam, Cambodia, Cuba—the moral seems to be, it is a problem of size."

In addition to this long-standing external

Palace of Matrimony, a former private club in Santiago de Cuba, offers free state weddings to couples like Maria Rizo and Luis Ruiz, both seated. Family and friends look on as an official reads the Family Code. Despite its official atheism, the government tolerates church weddings but requires the civil ceremony in addition.

FIDEL CASTRO (ABOVE)

Architect of the new Cuba, Fidel Castro trades camera shots with the author (**above**), then gleefully studies the quick-developing image (**below**). It remains for history to record the final impact of "El Máximo Líder."

problem, Cuba's internal problems multiply. "Unquestionably our future problems will be in production," he said. "The economy is expanding so fast that we must work to keep pace. We have few resources besides working people. Iron and nickel are the only minerals. Our only real products are agricultural."

Will Castro stay on under the new constitution to grapple with this difficult future? Acknowledging that he would likely be elected head of state under the constitution, he said: "In some ways that would make me more a slave to the state conscience than I already am. I accept these working posts as a duty and not a pleasure. I wish that I will have enough energy left to do the other things I like. I would like to study. I would like to write. I would like to meditate . . . to think. And, above all, I would like to be the owner of myself."

"The U. S. should take the first step toward friendship. We are certainly interested in improving relations. Since the U. S. practices the cold war with only a few small countries . . . the moral seems to be, it is a problem of size."

—FIDEL

There is some concern about who will eventually take Fidel's place. Under the constitution, the National Assembly decides. The question is whether anyone else can assume his style of leadership and bind the elements together. With such a strong army organization and tight central control already, the drift into military dictatorship may be irresistible.

Then there is the lingering problem of money. Cuba is living on credit, with the assumption that future income will provide the funds, if, indeed, the benefactors really do call in her debts. The prospect of billions coming due before industrialization is complete becomes a serious consideration. As 1976's severe problem with sugar prices illustrates, economic crises will continue to plague the central planners.

Cubans face these prospects with outward calm. The revolution has taught them to think about today and let the government worry about tomorrow. Their fierce individualism is a signal to the world that trade and aid will be welcome, but not control.

Whatever comes, they plan for it to be an all-Cuban future. □

SEA GATE OF THE PACIFIC NORTHWEST

Puget Sound

By WILLIAM GRAVES
ASSISTANT EDITOR

Photographs by
DAVID ALAN HARVEY

CONFRONTING A CREATURE with a five-foot reach and four times as many arms as he has, Frank Wolff wasn't inclined to argue—he surrendered his fish to the octopus.

The encounter took place in the San Juan Islands on the northern approaches to Washington State's immense Puget Sound. Frank, Jim Whittaker, who was one of the first American conquerors of Mount Everest, and I had taken off for a day's scuba diving among the islands.

Dropping anchor in a remote cove, we went overboard and set out to explore a submarine-canyon wall. At 70 feet Frank speared a choice three-pound lingcod. Then he caught a hint of familiar movement in a nearby crevice of the wall. Thinking to tempt the occupant out for a closer look, he dangled the fish on his spear shaft at the mouth of the crevice.

Instantly a mottled brown arm shot from the crevice, stripped the cod from the spear, and vanished back into the wall with the prize. Frank eyed the bare shaft for a long moment and turned to us with a shrug: So much for our seafood dinner.

Fortunately, Frank found a replacement—a large black rockfish—and we returned to the surface. Over preparations for lunch I asked Frank, a veteran diver in Puget Sound, how big the octopus was.

"Probably ten feet tip to tip," he answered. "I figure that one arm at about five feet." He shook his head. "It was a good-size octopus, but I've seen bigger. So will you, if you stay around a while."

Scenic Grandeur Born of Violence

I stayed two months and never saw a bigger octopus, but I encountered other giants in and around Puget Sound, among them the world's largest timber company, the world's largest manufacturer of airliners, and what some say is the world's largest edible clam—a Bunyanesque tidbit that weighs 16 pounds or more and goes by the local name of gooeyduck.

Puget Sound itself is a giant product of earth's convulsions. Clenched in the volcanic fist of the Cascade and Olympic ranges, the huge basin was created by the motion of crustal plates, then scraped and honed by glaciers that buried their handiwork beneath a mile of ice some 14,000 years ago.

Even today Puget Sound echoes to occasional reminders of its violent origin. In the northern Cascades the supposedly dormant volcano Mount Baker periodically looses clouds of steam over its summit and stains its icy slopes with immense mud slides.

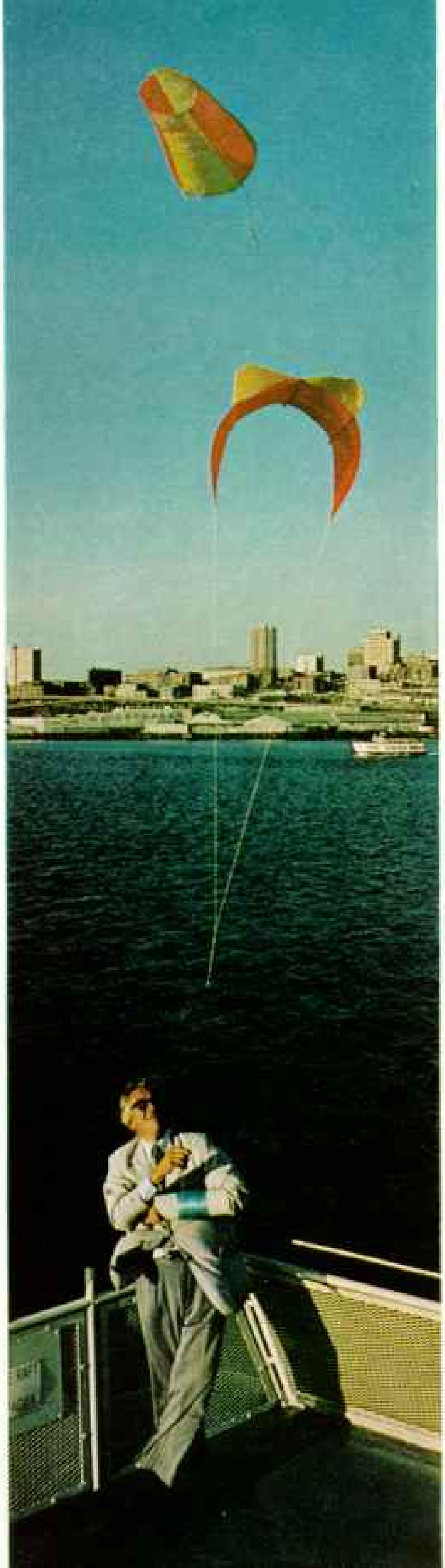
Violence begot beauty on a monumental scale. Puget Sound proper extends over some 700 breathtaking square miles (map, next page), encircled by 1,400 miles of wooded coastline, *(Continued on page 76)*

Salmon to smile about! Bob Hall hefts a ten-pound coho at the Lummi Indians' fish ranch near Bellingham, Washington. The tribe's pioneer venture releases young fish to mature at sea, then traps them when they return to spawn. About 40 commercial aquiculture ventures flourish in the Puget Sound region—citadel of industry and vast outdoor playground.

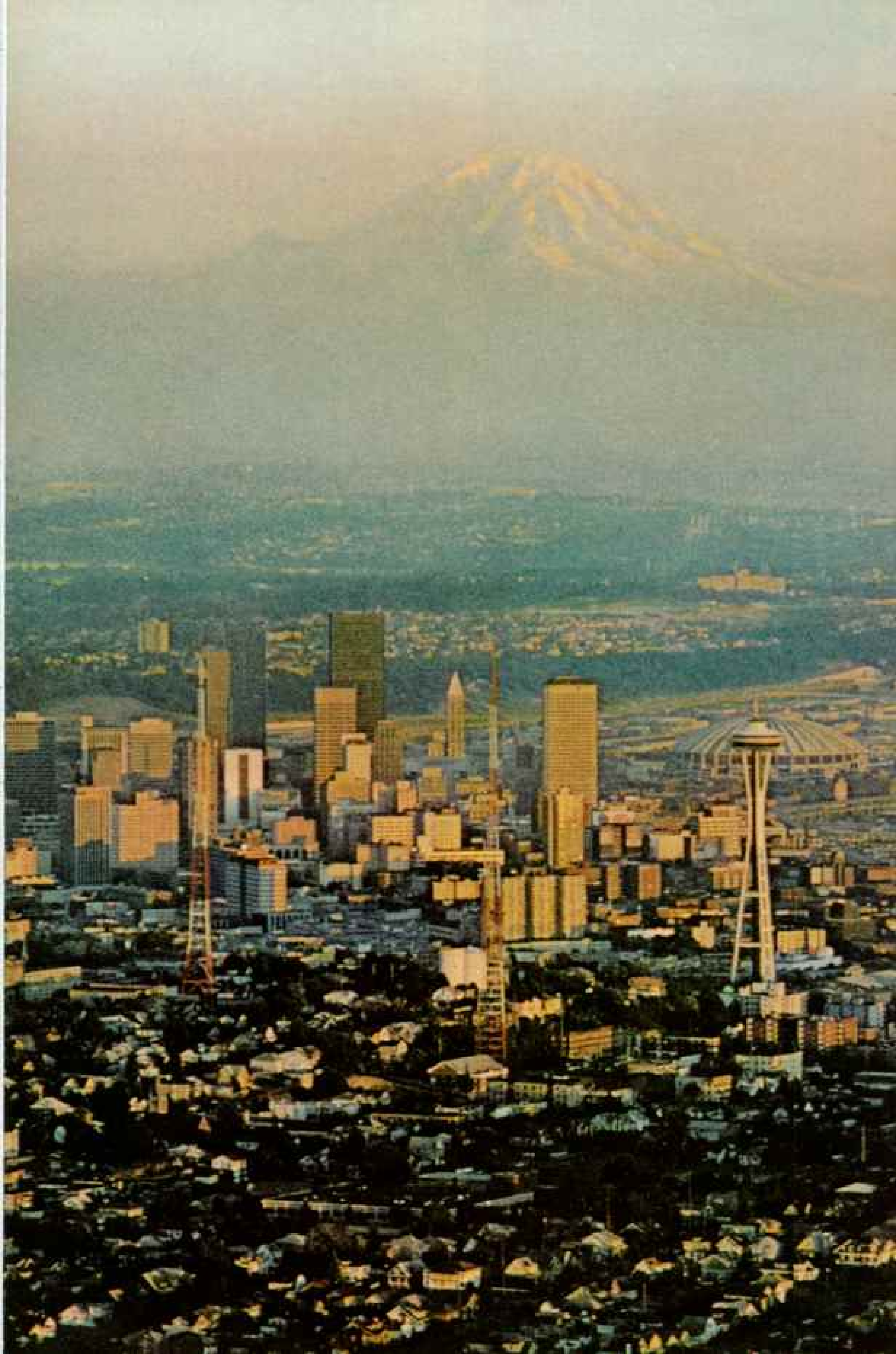
Sailing whisks cares away . . . Year-round boating encourages one in five Puget Sound families to own some kind of watercraft. Sailor of another sort, kite maker Dave Checkley (**right**) tests an unconventional model from one of the 18 ferries linking waterside communities.

"**A country abounding with materials,**" wrote British explorer George Vancouver after entering Puget Sound in 1792. Glaciers 14,000 years ago scoured the bed of this arm of the sea, which geographers define as the area shown in dark blue. Some two million people, two-thirds of Washington's population, live along the Sound.

. . . **But parking brings headaches.** Forest of masts (**below**) attests to marina crowding. Some boaters wait five years to rent a berth.



Fishing's a pleasure on the town pier at La Conner; smoked herring is a local delicacy.



MOUNTAIN OF FIRE AND ICE: *Once an active volcano, glacier-covered Mount Rainier rises through morning fog some sixty miles southeast of Seattle. The city's Space Needle, built for the 1962 World's Fair, pinpoints Seattle Center, showplace for sports events as well as opera, ballet, and theater.*

Bumper-to-bumper crop of minitrucks covers a Seattle pier (**facing page**), shipping only the chassis and cabs of the Japanese vehicles earns importers a tax break. The port, among the first to use computers and containerized freight, claims markets ranging from the Orient to the Midwest. Oceangoing barges based at the port supply Alaska's Prudhoe Bay oil field—3,700 miles away.

BOTH BY LOWELL GEORGIA

Keeping the Sound safe, U. S. Coast Guard trackers (**above**) monitor more than 500 ships daily to prevent collisions in its crowded channels. Environmentalists fear a major oil spill—and resulting ecological chaos—as increasing numbers of large tankers hauling crude to local refineries ply the often-foggy waters.

(Continued from page 71)

dotted by islands, and regarded by more than two million Puget Sounders as nothing short of paradise.

I'm inclined to agree, though paradise has its share of earthly problems. How Puget Sound solves them will affect the future not only of the Pacific Northwest but also of Alaska and neighboring parts of Canada. Stephen Green, for one, has misgivings.

"Sure, we all love the Sound," he told me one day in a Seattle restaurant overlooking the water. A Washington native, Steve writes about natural resources for the highly respected *Seattle Post-Intelligencer*.

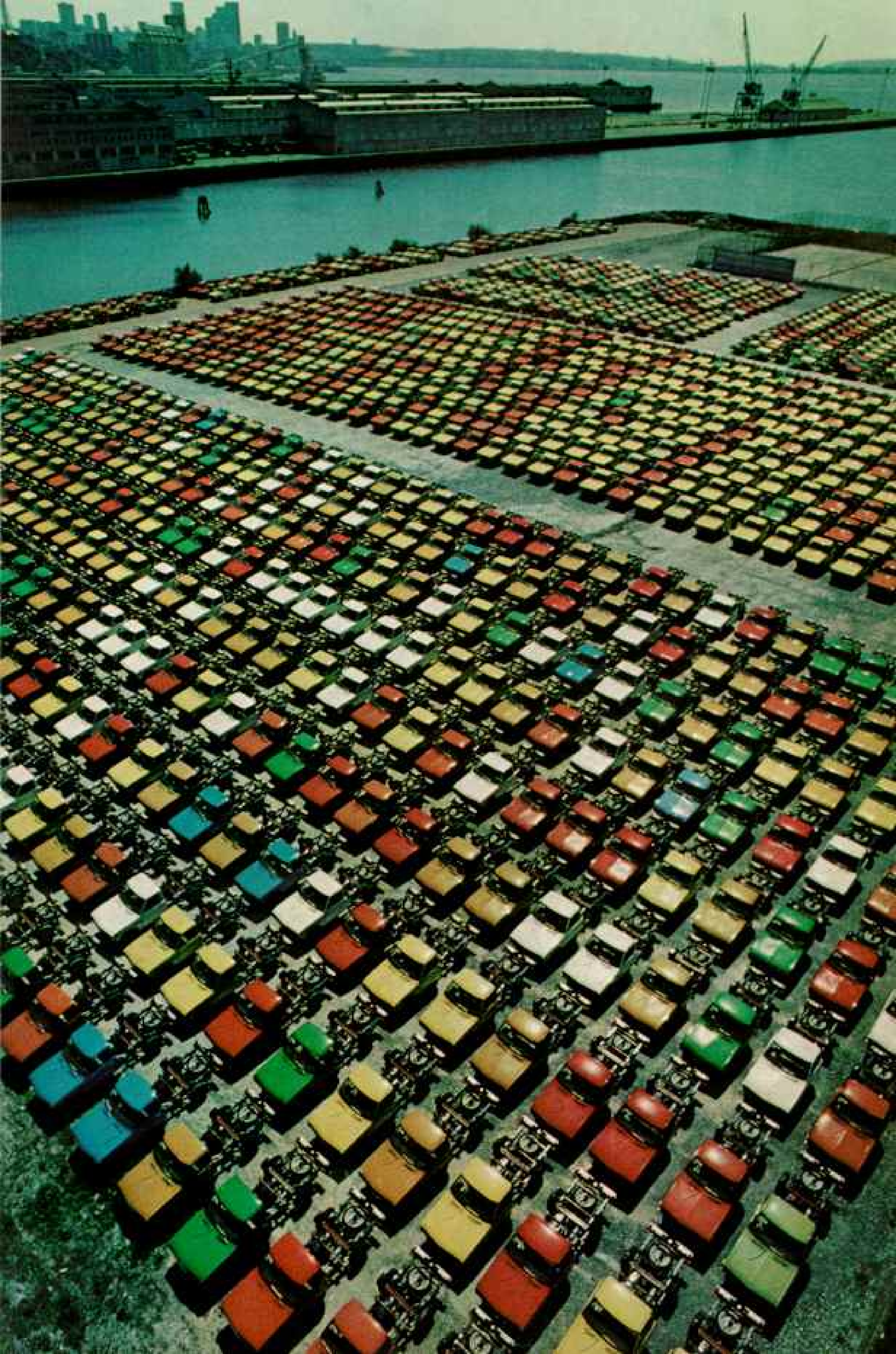
"We're in love with progress, too," Steve continued, "though I'm not sure anymore what that means. Our giant pulp mills and chemical plants employ only handfuls of people, but they affect the lives and health of two million. We argue endlessly about safeguards while we kill off our oyster beds and endanger our salmon fishery with a whole arsenal of industrial poisons." He waved at the Sound below us.

"What's at stake is a priceless natural resource that can stand only so much punishment. The Sound brings in more than a hundred million dollars a year from recreation and other activities dependent on pure water. Technically, our water is still pure. Environmental authorities give it their highest rating: Class A, Nondegraded. But that's only another way of saying 'Yet to be destroyed.' Time is running out on the Sound."

Kites Fly on the Ferries

To many, Puget Sound means not only recreation but a vital highway. With permanent communities scattered throughout their islands, Puget Sounders rely on an excellent state-run ferry system for everything from commuting to the cities to a trip to the dentist. Tirelessly shuttling between ports in the Sound region, 18 ferries accommodate nearly 14 million riders a year.

One afternoon aboard the ferry *Spokane*, bound from Seattle for Bainbridge Island, I watched hundreds of five-o'clock commuters stream along the twin gangways for the 30-minute voyage home. A small group of well-dressed businessmen made a beeline for the upper deck and quickly began assembling a variety of kites (page 73). At a blast from



Spokane's whistle we got under way, and half a dozen kites promptly lifted off astern.

After watching for a time, I fell into conversation with an attractive woman standing near the group. Phebe Sewall, the wife of one of the kite handlers, explained what has become a fairly regular event on the homeward voyage to Bainbridge.

"The men began doing it several years ago," Phebe said, "when someone realized that ferries make perfect kite-flying platforms —no trees in sight, a wide launching area, and at least a 20-knot breeze, courtesy of the ferry company. The only hazard is water, and that's no problem so long as you remember to haul in your kite before docking."

I asked if *Spokane*'s crew didn't object to the kite flying.

"Heavens, no," Phebe said with surprise. "They love it. Last year my husband, Bill, brought a kite aboard that was just plain ornery; it kept diving the way some kites will. It needed a tail, but Bill didn't have one. So the engine-room crew donated an oil rag."

British Explorer Predicts Bright Future

Puget Sounders are like that, generous in small things as well as large, whether toward friends or total strangers. The first European to benefit was a British explorer, George Vancouver, who sailed into the Sound in 1792 and was courteously received by the Indians. Vancouver marveled at this great natural basin and later named his discovery after a trusted lieutenant, Peter Puget.

"The serenity of the climate," Vancouver wrote, "the innumerable pleasing landscapes, and the abundant fertility that unassisted nature puts forth, require only to be enriched by the industry of man . . . to render it the most lovely country that can be imagined. . . ."

Puget Sound lived up to Vancouver's expectations, though at heavy cost to the original inhabitants. Less than seventy years after the discovery, in 1855, Chief Sealth, sometimes known as Seattle, of the Duwamish Indian tribe voiced his people's bitterness over loss of their ancestral lands to white settlers.

"My people are few," Seattle declared. "They resemble the scattering trees of a storm-swept plain. . . . There was a time when our people covered the land as the waves of a wind-ruffled sea cover its shell-paved floor, but that time long since passed away with the greatness of tribes that are now but a mournful memory. . . ."

Seattle closed with a ghostly warning to his enemies. "At night," he assured them, "when the streets of your cities and villages are silent and you think them deserted, they will throng with the returning hosts that once filled them and still love this beautiful land. The white man will never be alone."

Ironically, the site where Seattle delivered his lament today bears his name and the acknowledged role of leading community on Puget Sound (pages 74-5).

It is a curious city, Seattle, blessed with an endless variety of gifts, yet beset by a lingering sense of inferiority. The mere mention of San Francisco can reduce Seattleites to injured silence or provoke a well-rehearsed lecture on their city's virtues.

Not every outsider absorbs the lecture or stays long enough to be convinced. After a visit in the 1960's the celebrated British author Alistair Cooke dismissed Seattle as "a rain-soaked city halfway to Alaska."

Seattleites weary of slurs on their weather, most of them based on ignorance. The city actually has less annual precipitation—36 inches—than New York's 40 inches or Miami's 60. "Ours is just differently distributed," runs the explanation. Three-fourths falls between October and March, and Seattle rarely has the torrential downpours familiar to many eastern cities. To some 504,000 residents of Seattle, their weather is as ideal as any in the country.

Seattleites still cling to small-town values. It is no accident that in 1975 the city was among the first in the country to open its doors to large numbers of homeless Vietnamese. And whatever the crisis, Seattle tends to find humor in it. During a recent recession, when the giant Boeing Company was forced to lay off thousands of employees, a group of residents rented a conspicuous billboard near the outskirts of the city and put up the sardonic request:

WILL THE LAST PERSON LEAVING
SEATTLE TURN OUT THE LIGHTS?

At other times Seattle's sense of humor fails disastrously. The city has one of the highest suicide rates in the country—21.8 per 100,000 people—and an unenviable record of

alcoholism. The latter is associated with a Seattle expression long since adopted by other Americans: "skid row." The name—originally "skid road"—applied to a steep slope along the Seattle waterfront where logs were once skidded to waiting ships and where bars and flophouses did a roaring business.

Roaring business still occupies Seattle, though today's products are more diversified—newsprint, jet aircraft, icebreakers, space hardware, smoked salmon, and a brand-new professional football franchise appropriately named the Seahawks. In addition Seattle furnishes a welcome measure of hope in the battle against human illness through pioneer research at its renowned University of Washington Medical Center.

City Goes Waterborne on Weekends

For recreation Seattle turns instinctively to Puget Sound. With one of the highest per capita ratios of boat ownership in the country, the entire city seems to weigh anchor on weekends to explore the Sound.

A few take their yachting less strenuously. Along the shore of Lake Union, not far from downtown, a fleet of sedate houseboats lies moored in permanent residence.

"At least we're *supposed* to be permanent," one owner told me not long after a heavy midnight storm swept Lake Union. "But at the height of the storm old Mr. Farley—he's the end house out there in our row—lost his mooring and started off down the lake.

"Well, sir, we had a time of it! All the neighbors running around in pajamas and bathrobes, shouting and trying to throw Mr. Farley a heaving line. And Mr. Farley shouting back and not catching it and trying to keep from being blown overboard while he sort of passed the neighborhood in review.

"We finally got a line to him, and everybody lent a hand to haul Mr. Farley back home. He was shaken up a little, but there was no damage to speak of. We're thinking of entering him in a regatta next year."

Mr. Farley's voyage would seem tame to Don Bostdorff and his shipmates on the Prudhoe Bay run. Don's voyages take an average of three months, and storms are commonplace. So are pack ice, blinding fog, 20-foot seas, and freezing temperatures. The company for which Don works, Crowley Maritime Corporation, delivers trans-Alaska pipeline supplies and equipment from Seattle to Prudhoe Bay on the Arctic Ocean—3,700 hazardous miles through the Aleutian Islands and Bering Strait.

I met Don one morning in late July at the Port of Seattle, where as Crowley Maritime's assistant operations manager he was planning the yearly run. Outside his window on Elliott Bay a flotilla of giant barges, each larger than a football field, rode at anchor with cargoes ranging from steel pipe to complete buildings standing nine stories high.

"They'll shove off with the tugs in a week," Don said. "Anything later, and we've got trouble. Between early August and mid-September the tugs have their only chance of getting through the pack ice around Point Barrow. By late summer there's usually an open corridor along the coast, but the wind can slam it shut in hours. When it does, you don't want to be inside."

As a veteran of the 7,400-mile round trip, Don has endured sub-zero weather that turns Manila lines into rigid bars and guarantees death for any man lost overboard. I asked if he planned to make this run and his face fell.

"Not this one," he said, "and probably not the next. I've been transferred from tugs to the management side. It's a bigger job with more opportunity, but I kind of miss the excitement."

Historically, Puget Sound has served as the gateway to Alaska, more than once at a handsome profit. Alaskans still claim that in the gold rush of 1898 little of their hard-earned bullion got beyond Seattle.

The Sound will continue to be a vital link to Alaskan development as pipeline oil comes to Pacific Northwest ports by tanker.* The actual volume of tanker traffic, however, is not expected to increase in Puget Sound, because its refineries are already running near full capacity with oil from overseas.

The concentration of large tankers, foreign or domestic, does bring increased threats of a major oil spill, a catastrophe Puget Sound has so far avoided. But the odds are narrowing. Tanker deliveries have increased almost twenty-fourfold in recent years, from an average of 14,000 barrels of crude oil a day to some 335,000 barrels. Ominous signs have already begun to appear.

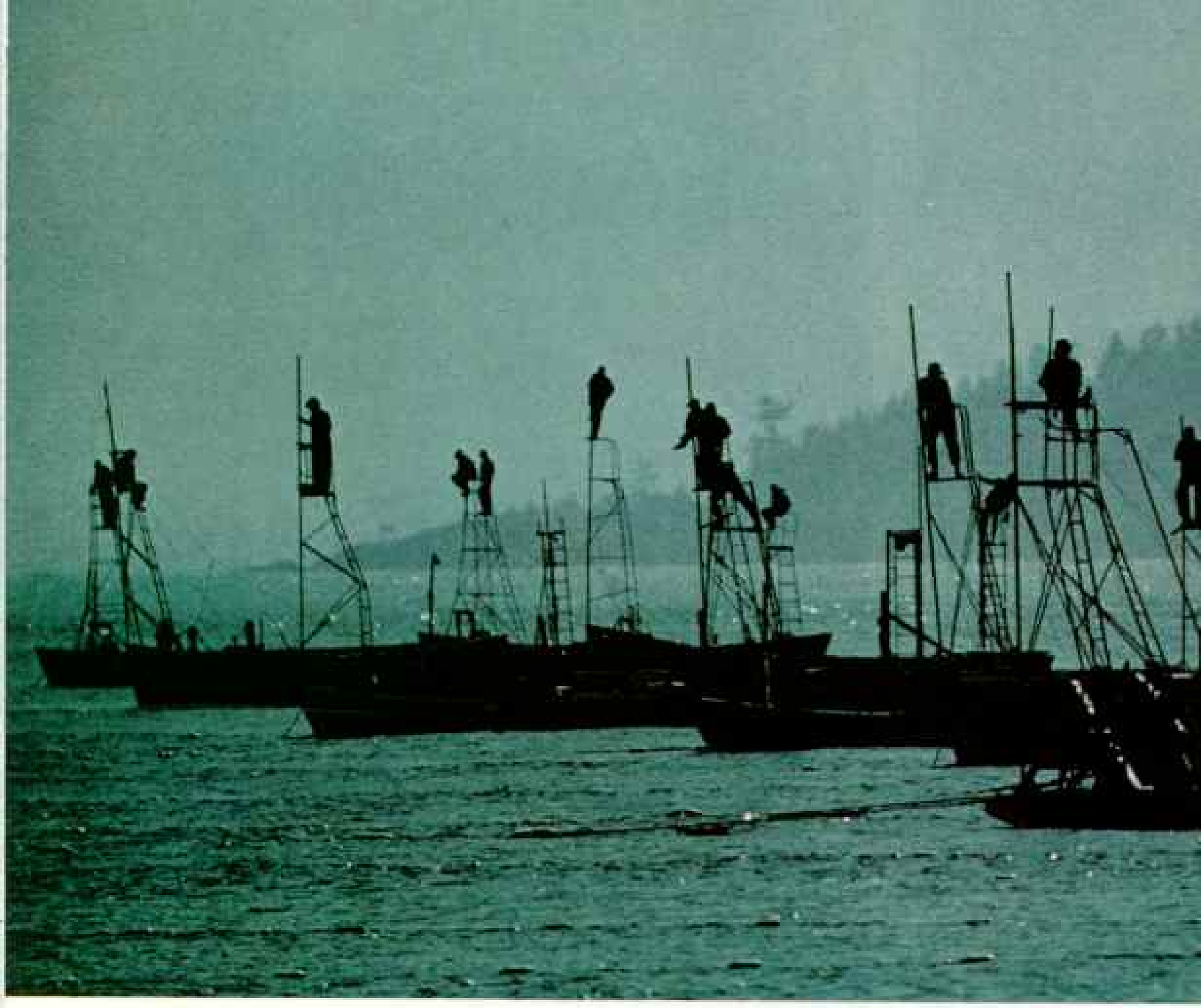
*See "The Pipeline: Alaska's Troubled Colossus," by Bryan Hodgson, GEOGRAPHIC, November 1976.

The wild blue down yonder awaits a Polaris submarine (**above**), knifing through broad Hood Canal on a training mission. The waterway's ample depth and easy access to the Strait of Juan de Fuca led to the selection of Bangor, on the canal, as home for the U.S. Navy's Trident fleet, designed to replace the Polaris subs. A group of citizens recently sued to block construction of the base, fearing the impact that a large installation would have on the rural area, popular as a vacation and retirement retreat.

The Navy employs 10,500 workers at its huge Bremerton shipyard, where a cake-cutting ceremony aboard the destroyer *McKean* (**left**) signals a change of command.

LOWELL GEORGIA

Rare gift of winter, a snowfall dusts Seattle rooftops (**left**). The city owes its gentle clime to the moderating effects of maritime air from the west and mountain ranges to the east. In the coldest month—January—temperatures average 40° F.



What they see is what they net. Using an old Indian technique, fishermen off Lummi Island wait on high perches to spy migrating salmon swimming into their

At the invitation of the U. S. Coast Guard I boarded a helicopter one morning at Port Angeles, forty miles west of the Sound, for a routine pollution-control flight. Strapped in behind the pilot, Lt. Comdr. Bob Ferguson, I got a sweeping view and an occasional comment over the intercom.

"We run this check twice a week," Bob said as we skimmed eastward 200 feet above the Strait of Juan de Fuca. "Naturally we're concerned with spills of all sizes, though major ones would be caught very quickly at the surface. Our main interest is in smaller spills, such as oil leakage from a ship or the gradual release of industrial waste, that can be seen best of all from the air."

Beyond the strait we turned south along the great upturned saw blade of the Olympic Mountains, a massive barrier that contributes to the Sound's weather patterns. Winds surging in from the Pacific release their moisture on the mountains' western slopes, creating a dry corridor downwind known as the "Olympic Rain Shadow."

Warships Now Lie at Ease

Over the huge U. S. Navy base at Bremerton I caught a glimpse of old friends—the battleship U.S.S. *Missouri* and several cruisers, part of the fleet I had served with prior to the Japanese surrender at Tokyo Bay in 1945. Now retired from the sea, the gray ladies of World War II lie mothballed and silent amid the present-day bustle like a row of elderly chaperones at a dance.

Over Tacoma, the Sound's largest port after Seattle, Bob's practiced eye caught a flash of iridescence in a waterfront slip. We swung

nets before raising them. A controversial court ruling, based on 19th-century treaties, entitles Washington's Indians to half the state's annual salmon catch.

down for a closer look. "It's a small spill," he said. "Probably bilge oil from a ship, or maybe waste from some waterfront plant. It's tough to control and nobody does it deliberately; whoever's causing the spill may not even realize it. We'll just check this one out from the surface."

Radioing Coast Guard headquarters in Seattle to send a local ground inspector, Bob climbed once more and headed north along the Sound's eastern coastline. Farther east rose the mighty Cascade Range, shawled in the dark-green weave of cedar, hemlock, and Douglas fir and dominated by the eternal white cone of Mount Rainier. Below us the Sound lay cobbled in a morning breeze and strewn with the bright confetti of yacht sails.

Beyond Seattle we sighted a second spill, a minor slick inside Ballard locks, connecting Puget Sound with the fresh waters of Lakes Union and Washington.

"That's one of the most heavily traveled waterways in the Pacific Northwest," Bob remarked after radioing for another surface check. "Tens of thousands of pleasure boats use the passage every year and the potential for spills is high. Yet with all that traffic the locks are amazingly clean. Seattle aims to keep them that way."

An Aircraft Built for Disaster

Before turning for home, we landed to refuel at Everett, site of the giant Boeing Commercial Airplane Company 747 Division Plant. Parked in a gleaming row along one side of the field stood more than half a billion dollars' worth of Boeing skill and effort: sixteen new 747 jet airliners, each valued at 35

Trimming a giant down to size, a faller bucks a 250-year-old Douglas fir (**left**) in a Weyerhaeuser Company forest near Mount Rainier. With hand planting, thinning, and fertilization, the firm expects to harvest an equal amount of wood on the site in sixty years. Hormones injected into a young fir (**below**) will stimulate it to produce seeds in five years instead of ten.

Hemlocks nurtured in greenhouses (**bottom right**) show improved survival and growth rates. Cross sections of two logs (**bottom left**) demonstrate the boon of the new methods of forestry: Wider annual rings on a tree planted in 1947 and grown in a managed stand indicate faster development than a similar-size tree from 1898 that grew unassisted.

ALL BY CORNELL WATKINS

Octet from the jet set serves up music during its lunch break (**right**) at the Boeing Company's 747 plant at Everett. The nationwide recession in the late 1960's took its toll of the firm, largest employer in the Northwest. Radical belt tightening—including reduction of workers by 60,000—caused economic woes but helped keep Boeing solvent.

Founded in 1916, the World War II bomber builder now dominates free-world commercial jet sales. Its first factory, now a museum, rides by barge (**left**) to a new site at Boeing Field.

million dollars. All but one bore the trademarks of international airlines.

The lone exception stood at the end of the row, a blue-and-white 747 with "United States of America" painted on the fuselage. I had seen the jet several days before, during a visit to the Everett plant.

"Our employees nicknamed it the 'Doomsday Machine,'" a Boeing official told me. "It's built to carry tons of electronic communications gear so that in the event of a nuclear attack on the United States or other national emergency the President or somebody else can use it as an aerial command post. Me, I like it where it is, on the ground."

Oil-spill Peril Poses Major Concern

On our return flight to Port Angeles we veered north over the San Juan Islands, moored in splendid formation between the Washington mainland and Canada's Vancouver Island (pages 90-91). Above the coastline near the city of Anacortes I had a view of several large oil refineries, one with a large tanker approaching through what seemed a maze of islands.

Here environmentalists see the greatest threat to the Puget Sound region, in the form of narrow channels daily threaded by incoming tankers. Oceanographers estimate that a major spill in the area could blanket the Sound with crude oil in two 24-hour tidal cycles. According to Bob Lynette it's strictly a matter of time.

I met Bob soon after the helicopter flight, at his home in Redmond just outside Seattle. As an aeronautical engineer he spends his professional life looking for trouble. Before a new type of aircraft goes into service Bob "flies" it by computer through all possible conditions and tells the company how the plane measures up. In 15 years he has rarely been wrong.

When the trans-Alaska pipeline was proposed in 1969 Bob grew concerned over the possible effects of increased oil deliveries in bigger carriers to Puget Sound. He gathered all available data on oil spills throughout the world and applied them to conditions on the Sound. With mathematical precision he worked out the odds.

"We're talking probabilities," Bob told me over coffee in his living room, "but my statistics indicate that there will be three major spills here in the next 21 years if heavy tankers continue to come into the Sound. Of course, the size of the spills will depend on the tankers' tonnage and various other factors, but one thing is certain—the Sound is headed for serious trouble."

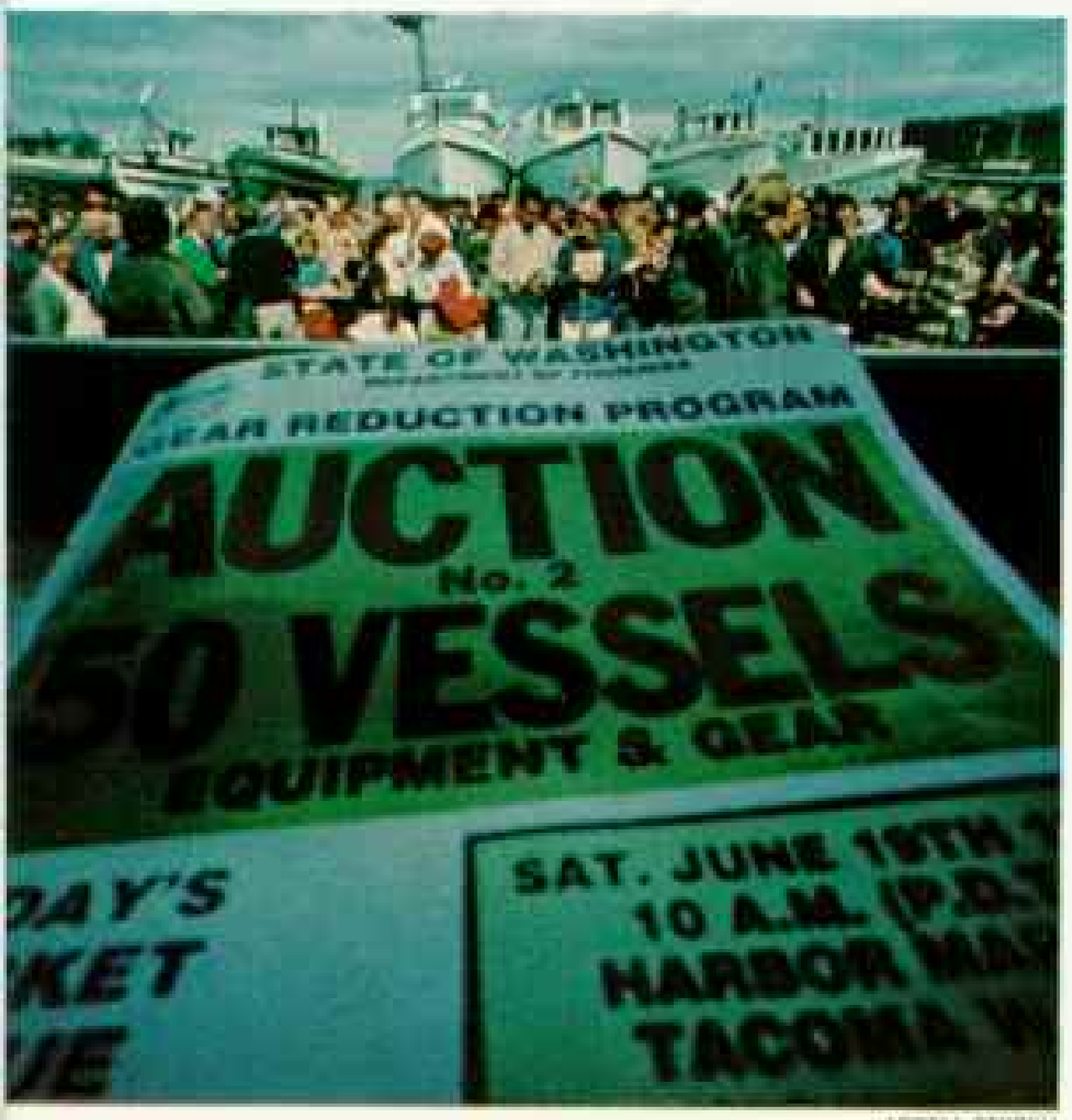
Oil companies disagree, pointing to the previous tanker safety record and to the high cost of delivering oil by other means, such as an underwater pipeline running across the mouth of the Sound.

"We don't say there are no risks," declares an official of a major oil company, a man respected even among conservationist opponents. "We say the risks are *acceptable* in light of our record and the absence of any practical alternative. Find us one, and we'll use it tomorrow!"

(Continued on page 92)

A longtime fighter for Indian rights, Al Bridges, a Nisqually-Puyallup (**above**), now raises doves. He has been arrested some seventy times in a successful twenty-year battle to protect tribal fishing rights.

To encourage non-Indian fishermen to leave the now-restricted commercial salmon industry, the state buys their vessels and gear for auction (**below**). One crew still working the salmon banks off San Juan Island harvests its share by purse seining (**right**), a method increasingly used by Indian fishermen as well.



LOWELL GEORGIA

AS IN THE DAWN OF CREATION, *stillness enfolds the tide-washed San Juans, 172 islands clustered just north of Puget Sound.*

(Continued from page 86) Meanwhile, the conservationist lobby has secured passage of a Washington State law limiting tankers inside Puget Sound to 125,000 deadweight tons, although the law was recently voided by a federal district court. To many residents of the Sound, their priceless natural resource is increasingly threatened.

"Let's face it," a veteran Puget Sound pilot told me candidly, "a 125,000-ton tanker takes up a lot of room, in more than just displacement. To make a crash stop with a ship that size requires a minimum of two miles. That means not only reversing engines but also 'slaloming,' or fishtailing back and forth, to cut momentum.

"Well, mister, you can't slalom in waters like these where you're bucking currents and running channels maybe less than one mile wide. You have to make a 'controlled stop,' meaning reverse engines and hold your course. That takes about seven miles, and by the time you've done it, you're sitting in downtown Anacortes."

"Ranchers" Raise a Silvery Herd

Or possibly aground in Sam Cagey's "back forty," spelling ruin to a unique experiment. No one stands to lose more from a major spill than Sam and his fellow "ranchers." What amounts to their back forty is a huge pond beside the Sound stocked with more than a million chum and coho salmon.

Aquiculture is widespread on Puget Sound, especially "farming," the technique of raising salmon from eggs to market size in underwater pens. Only Indians, however, are permitted by law to ranch salmon, whereby the fish are raised to intermediate size, then released to sea to be harvested on their return 18 months later. Sam's first group arrived on schedule.

I found him planning for arrival day at the Lummi Indian Reservation northeast of the San Juan Islands. There in 1969 with federal help the 2,500-member Lummi Tribe set to work with picks and shovels and a borrowed bulldozer to establish the first salmon ranch in the Puget Sound area.

The result is an immense tract of submerged land surrounded by an earthen dike equipped with sluice gates for passage of the salmon to and from the adjoining Sound. As a tribal leader, Sam Cagey helped establish the ranch along with Dr. Wallace Heath, a distinguished marine biologist. Dr. Heath conceived the project and is its non-Indian director.

Sam took me on an inspection of the pond, where the first half-million salmon were released in 1973 and where the next generation was being raised. Among rows of submarine feeding pens made of nylon mesh, Indian scuba divers were inspecting the fish and repairing holes in the nets.

Fish Fatten in Aquatic Pastures

"We used to buy our eggs from state hatcheries," Sam explained, "but now, most of them come from our own newly established salmon runs. After we incubate them, we transfer the fry to the pond and fatten them up on fish meal for three months until they weigh about an ounce each.

"Up to that point we're no different from a farm, and in fact we keep a few of our fish permanently to raise for smoked salmon. But the rest are released, and that's the last we see of them for more than a year."

In fact, that's the last the Indians ever see of most of them, for only a small percentage of ranched salmon return home. Between their feeding grounds far out to sea and their birthplace the fish run a gantlet of natural predators, diseases, and fleets of sport and commercial fishermen.

"In 1974," Sam said, "we got back about 20,000 fish, or 4 percent of the original half million. That sounds like nothing, but remember it's all profit from the moment of release. Fish farmers have to tend and feed their stock year round, but ours will feed themselves at no cost and show up weighing roughly eight pounds each, making a total harvest of 80 tons. At a wholesale price of $1.50 a pound, that's nearly a quarter of a million dollars' worth of salmon."

Sam's ranch and others like it may one day offer hope in solving a bitter feud. As the Sound's natural stocks of salmon decline, commercial fishermen argue heatedly over the right to harvest them (pages 88-9). For years non-Indian fishermen took the lion's share of the catch with large seiners and expensive gear.

In 1974 a federal judge decreed that Indians were entitled by old fishing rights to 50 percent of the salmon catch. Restrictions

were promptly imposed on non-Indian fishermen, and some spoke of racial war. To Ramona Bennett it was a familiar story.

"You Anglos never learn," she told me one day at her office in a former Tacoma public school. As the chairwoman of the 1,500-member Puyallup Tribe, Ramona wields far more influence than her 36 years and diminutive size suggest. I had called on her to discuss the fishing controversy, but soon found the subject broadened to include a list of Indian grievances. As Ramona traced her people's history among whites, she spoke with a calm, cold voice.

"What you call Indian 'rights,'" she said, "were written by your own people, in the treaties you signed and then broke every time it suited you. Now one of your own judges tells you to live up to your word, and all you can think of is another massacre.

"It was the same with land in the early days," she added. "Any Indian who refused to sell at the Anglo's price was shot or stabbed and dumped on the railroad tracks to make it look like an accident."

Ramona's list of complaints is long, including many federal programs aimed at benefiting her people. "If our rights and resources were protected," she ended bitterly, "there would be no need for poverty programs."

Industry Owns Vast Forestlands

By Ramona's standards one of the chief offenders on Puget Sound would be the Weyerhaeuser Company. In fact, the giant of the Pacific Northwest timber industry has paid the fair market price for every acre of forestland it has acquired. The total is staggering—5,800,000 acres in seven states, 1,700,000 in Washington alone.

I joined Howard Millan, a veteran forester, on an inspection of logging operations 4,000 feet up in the Cascades. As we drove upward through a labyrinth of narrow logging trails, Howard gave me a short course in forest management.

"One of the major complaints against timber companies," he began, "is clear-cutting, the technique of harvesting all the timber on a given area. Clear-cutting makes for a real eyesore the first few years, until reforestation takes hold and begins covering the scars."

Conservationists, I mentioned to him, doubt that the scars will ever heal completely.

"Don't misunderstand," Howard replied. "Nobody claims he can reproduce virgin forest; that's a monopoly of nature, and it takes centuries. Weyerhaeuser works the forestlands like any other commercial crop. With modern techniques we can plant a stand of Douglas fir today and harvest it in less than sixty years" (pages 84-5).

I asked why timber companies didn't simply thin their forests and plant seedlings among the remaining trees.

"Partly because of cost," Howard answered. "Alternative methods of growing and cutting are more costly and in some cases prohibitive in terms of labor and heavy equipment. In the case of Douglas fir, our mainstay in the Northwest, it's downright impossible. Doug fir won't grow well in its own shadow, so the seedlings would never mature. But we regenerate all clear-cut areas within a year of harvesting."

Near the 4,000-foot level we caught the whine of chain saws and before long came to a wide clearing where two "fallers" were at work. After watching several huge Douglas firs thunder to earth, I asked if I could try my hand at the saw.

One of the fallers lined me up at the base of a 200-foot giant and showed me where to make the necessary cuts, one a wedge-shaped slice a foot above ground level and the other slightly higher up on the reverse side of the tree. Presently six tons of Douglas fir toppled in the predicted spot.

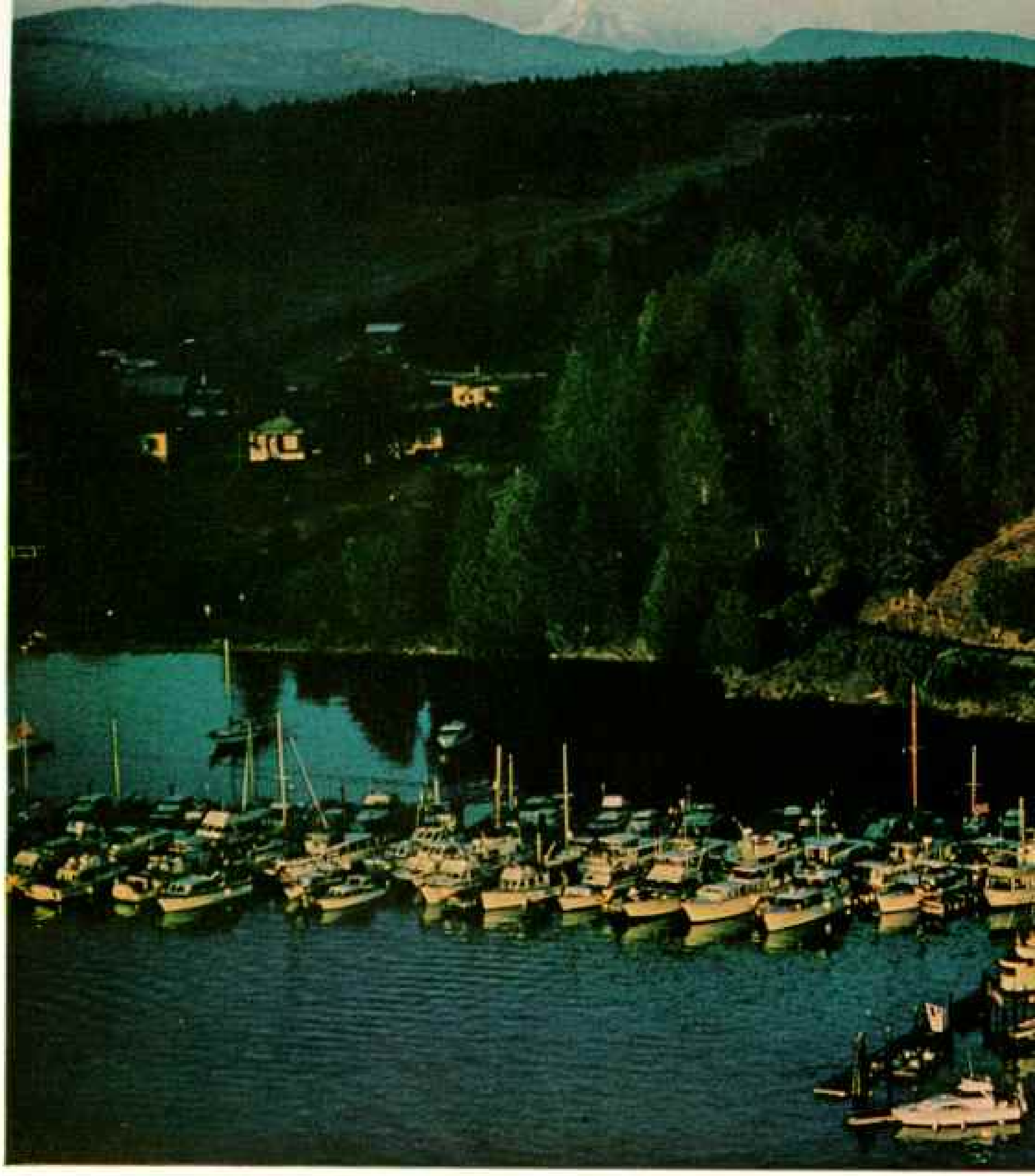
"Now," said Howard when the echoes had died, "you owe Weyerhaeuser nine Douglas fir seedlings in return."

I objected that I had only cut a single tree, and he nodded agreeably. "We allow for disease and natural attrition, then add a safety margin and plant nine for one. If you want to be sure, you'll do the same."

I accepted his offer of nine seedlings from one of Weyerhaeuser's huge nurseries. We planted them in a clear-cut site where others had already taken hold and where Howard assured me mine would have an excellent chance of growing.

San Juan Islanders Resist Change

I ended my stay on Puget Sound where I had begun it, in the solitary reaches of the San Juans. The great crescent of 172 scattered islands spans the northern straits leading to the



Refuge for the harried, San Juan Island offers quiet coves and picturesque villages for vacationers from bustling Seattle, less than four hours away. But as the island's popularity grows, bringing hundreds of new residents and sending land prices skyward, tranquillity shortly may be just a twilight memory at places like Roche Harbor (**above**). Already, passengers line up as much as five hours ahead of time for the ferry at Friday Harbor, largest town on the 15-mile-long isle.

For carpenter Michael Moss, laying a cedar-shake roof on his cabin at Eagle Point (**left**), the island is still "close to paradise." He built his dream home for $3,000, using logs that washed ashore while being towed to nearby mills. Moss and his wife want to raise their son there—if the privacy they seek isn't spoiled by new homes: "We can't see 'em yet, but they're creeping up on us."

Sound like the remnants of some vast breakwater long dismantled by the sea.

Beneath cathedral stands of virgin hemlock and fir, occasional deer, fox, otter, and raccoon forage a wilderness area still only lightly touched by man and his machinery. Offshore among the sheltered coves and winding channels, pods of killer whales endlessly patrol the kelp forests in search of salmon, escorted overhead by whirling canopies of puffins, cormorants, and gulls.

To 5,500 San Juan Islanders, theirs is a unique sanctuary to be preserved against misfortunes that threaten other areas of the Sound. While welcoming yachtsmen and campers for brief visits, the islanders stoutly resist commercial development and cling to simpler ways and leisurely habits that seem to prolong human life. "After you reach 75 in the San Juans," runs a local saying, "you forget how to die."

Doctor Must Be Mechanic, Too

Not quite, or there would be little need for Malcolm Heath. "The Flying Doctor," as islanders call him, has spent more than a quarter of a century tending a practice spread over the San Juans' dozen inhabited islands, encompassing some two hundred square miles. I found him at the small airstrip in Friday Harbor on San Juan Island, westernmost major island of the archipelago, tinkering with his single-engine Piper.

The addition of three other doctors to the islands and a partner to work with him in his own practice now give Dr. Heath an occasional day off, but he generally remains on call for emergencies.

"None of the other doctors has a pilot's license," he explained to me, "because of the excellent air charter service today."

Back when airplanes were harder to get, Dr. Heath managed to make calls with a 20-foot outboard. Now at 63 he treats most of his patients in a modern clinic at Friday Harbor and only infrequently makes calls in the Piper. After a time he closed the engine cowling and offered me a short flight, "just to see if things are in order."

They were, and we lifted off smoothly from the airstrip, turning north toward the outer limits of the islands. Passing over familiar landmarks, Dr. Heath recalled many in terms of past emergency cases and remembered

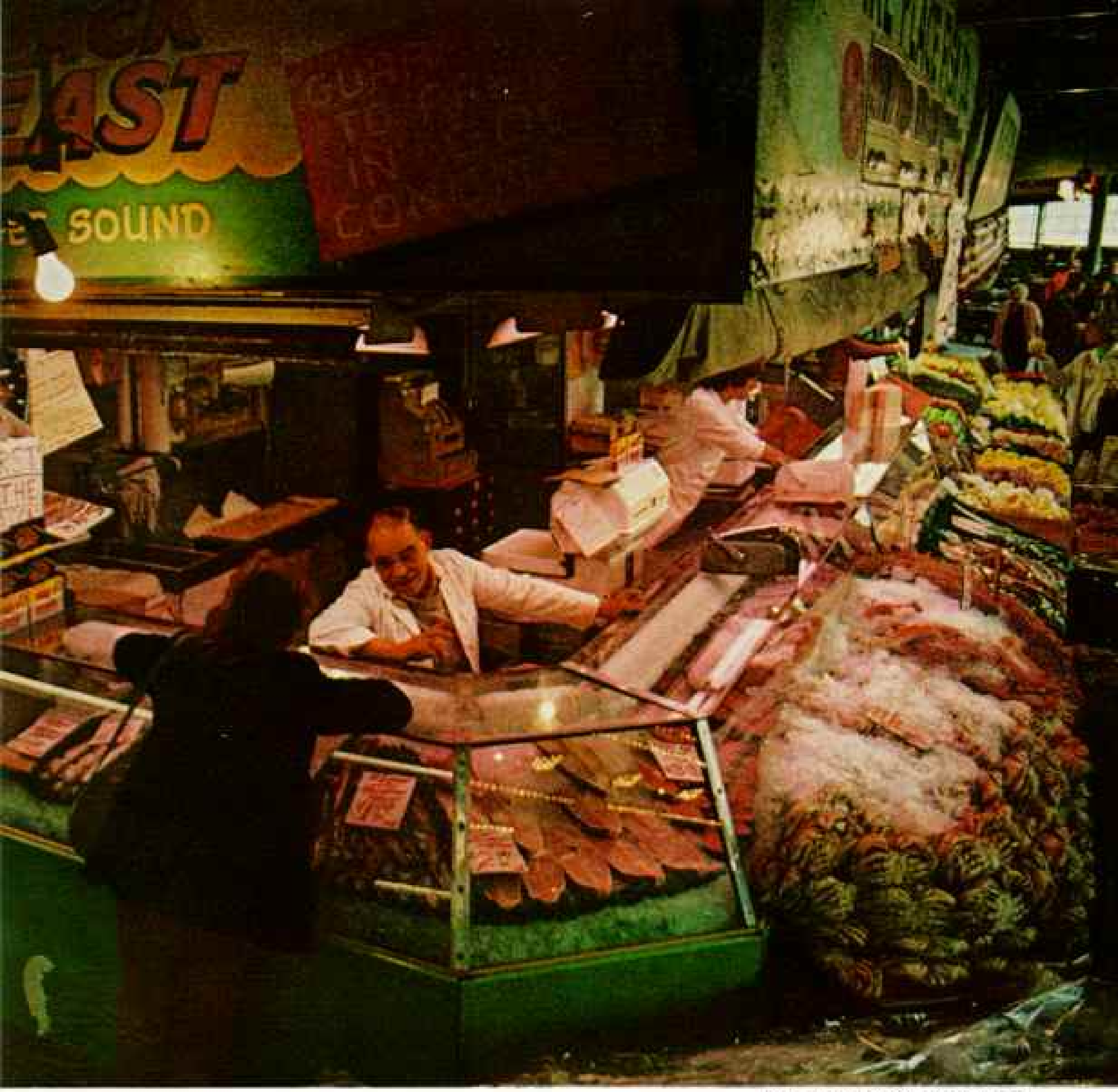
Voters rescued Seattle's 70-year-old

one or two from emergencies of his own.

"Right about here," he said suddenly, "I blew a cylinder head once—in midair at a thousand feet. I was on my way to visit a cancer patient, and I had my nurse with me. She never panicked, just sat there beside me without a word while I looked for something nice and flat below.

"I settled for a pasture at the head of a small valley, and we coasted in. It was over the trees, follow the valley, jump the fence, and dodge the sheep, but we made it."

I asked what the nurse said afterward, and he gave me a grin.



MARCO CHIARINI, NATIONAL GEOGRAPHIC STAFF

Pike Place Market after the city made plans to raze it for a parking garage.

"Exactly what I said—'Wow!' "

The Piper checked out to Dr. Heath's satisfaction, and we turned back toward Friday Harbor. Half a mile below us I caught sight of a familiar shape, the island where Frank Wolff and Jim Whittaker and I had encountered the octopus some weeks before.

Will Nature's Balance Survive?

After lunch that day we had snorkeled beside a surface ledge where a herd of harbor seals lay sunning. With the assurance of creatures unused to man, the seals had joined us for a time in the water, darting gracefully among us and now and then approaching within inches to peer curiously and innocently into our face masks with luminous brown eyes. The experience had been memorable for all three of us.

From the Piper high overhead I failed to make out any forms on the ledge; perhaps the seals were off foraging in some nearby kelp bed for a meal of bass and lingcod. I thought briefly of their chances for survival in an incomparable wilderness both beloved and increasingly threatened by man.

The island drifted behind, but the question remained. □

The Gentle Yamis of Orchid Island

A PICTURE STORY BY CHANG SHUHUA

SAILING in the wake of their past, Yami fishermen of Lan Yü—Orchid Island—put out to sea in an elaborate ceremonial canoe (**above**) hewn from trees of their densely forested homeland in the western Pacific, off Taiwan. One hundred years of alternating and casual rule by Chinese and Japanese have done little to pry these people from the ways of their Southeast Asian ancestors, who, according to one ancient legend, emerged from the sea.

Strangers to any formal authority, they have neither chief nor priest, but practice instead a primitive kind of democracy, settling their disputes by argument and sharing in the wealth of the sea that surrounds their orchid-strewn little island. At the close of the day these men may haggle over who was to blame for poor fishing, but will nonetheless end by scrupulously dividing their catch into even shares.

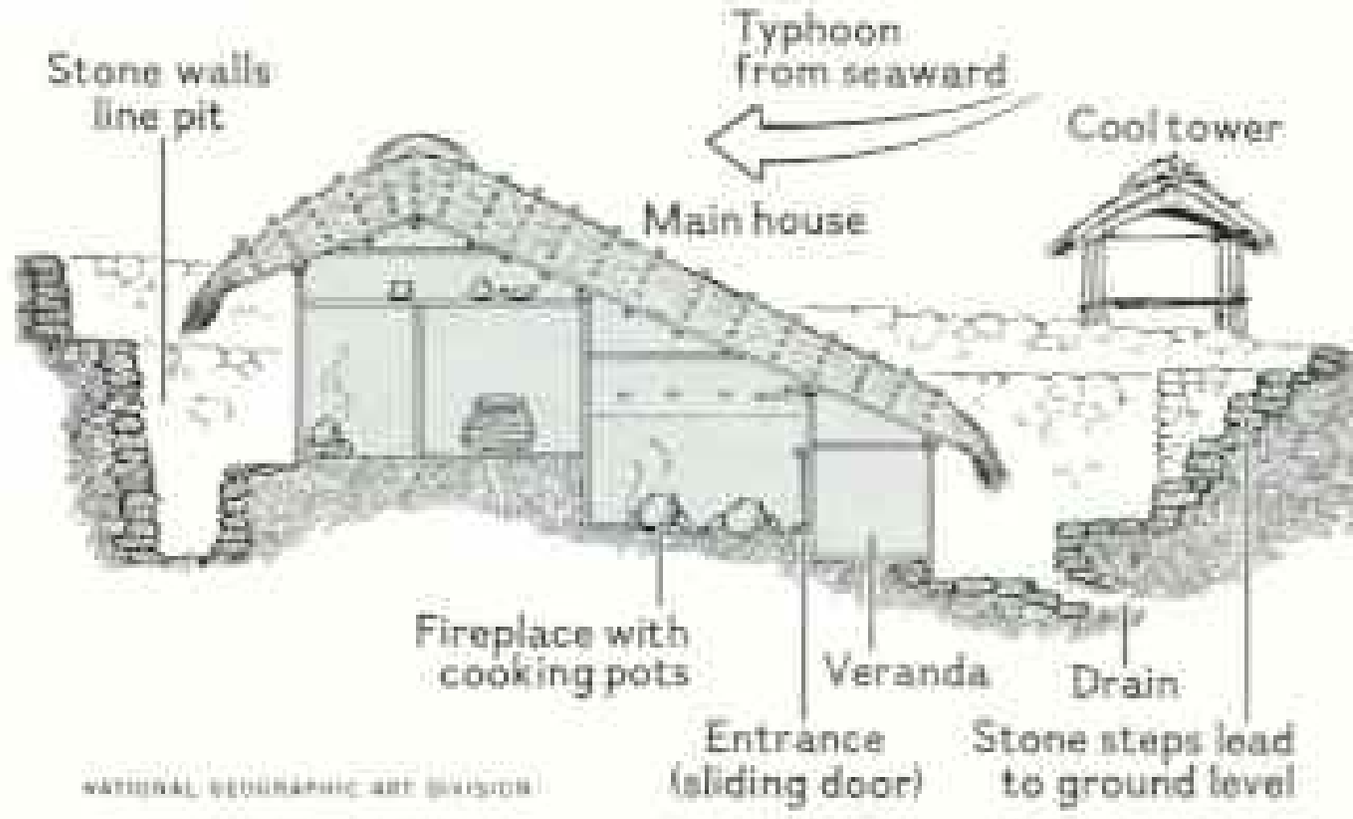
During flying-fish season, which lasts from February to June, the Yamis are able to net their most abundant seafood delicacy in mid-air. But the rest of the year is not so bountiful, and the men must supplement their often meager catches by diving along the coral reefs with crude spear guns (**left**).

HOISTING HIS NET from the sun-shot sea, a young islander (**above**) hopes for a few of the fish that hug the shore. A senior tribesman (**left**) searches a coral cave for fish which have been stunned with native poisons. Superstitious eaters, the Yamis distribute each catch according to size and color: brightly colored fish for the women, dark-colored for the men, and (what else?) small fry for the children. After skinning a leathery filefish with his teeth (**right**), this man will eat its liver on the spot and give the much-savored raw eyes to the youngsters.

WITHIN SIGHT of Taiwan on a clear day, 18-square-mile Orchid Island lies some 40 miles off the coast of its Nationalist Chinese protector, which built and maintains six schools for islanders and a prison camp for Taiwanese convicts here. The Yamis have only recently begun to join the mainstream—much to the chagrin of this woman dressed in ceremonial finery (**below**) and other elders, who remain fierce guardians of the island's heritage.

TOSSING THEIR HAIR to the sky, Yami women joyously celebrate the annual flying-fish festival. The women of Orchid Island share equally in inheritance and expect much help from their men with domestic chores and child rearing; they choose their own husbands and have the option of trial marriage, which only they themselves can dissolve. If a Yami couple remains childless, the husband, not the wife, is held accountable and has to bear the disgrace of divorce. The husband must also be a good provider, since a shiftless groom can be shown the door. But while it lasts, marriage is sacred and adultery taboo.

High on the list of auspicious occasions, house christenings draw kinfolk from all over the island to feast with their proud hosts and display family wealth. Hair is being seared from a fattened pig (**right**), which will later be cut up and passed out raw for the enjoyment of the guests. But no liquor! The Yamis drink no spirits—home-brewed or imported. Though children now learn the Chinese language and are slowly adapting to modern dress, the island diet remains inviolate: meat only during ceremonies; fish, taro root, and sweet potatoes at all other times. Perhaps in part because of this limited fare, a high child-mortality rate has kept Orchid Island's population stable for the past hundred years—between 1,300 and 2,000.

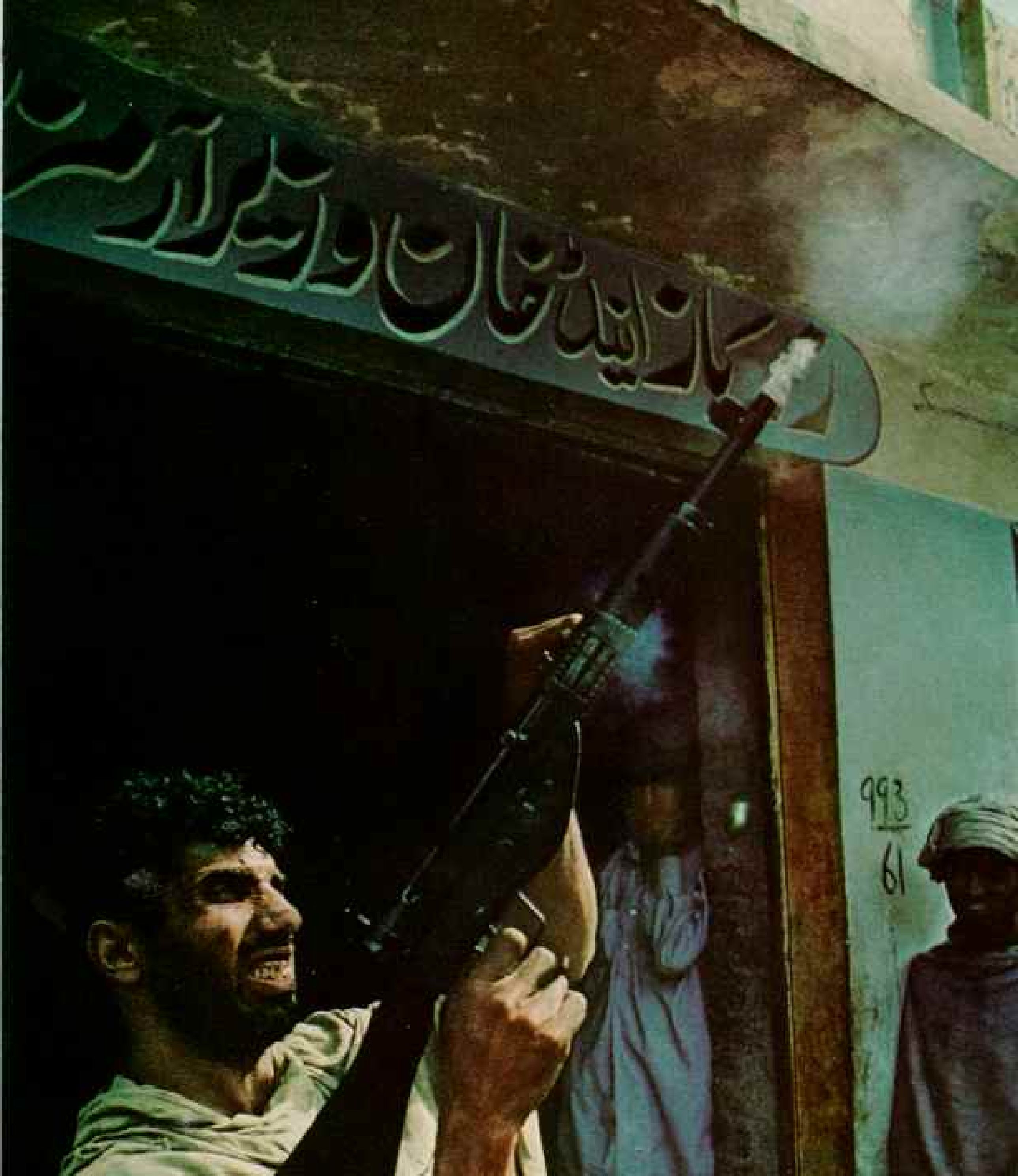


"VERY HUMBLE," is how this gentle Yami couple (**left**) characterize their people. Humble, yet resolute, for they spurn such inducements of civilization as modern housing, offered free by the Taiwan Government. The Yamis know that their traditional homes, built mostly below ground (**top left and diagram above**), will protect them from typhoons. To escape the midday tropic heat, each family has a "cool tower," where the women spend much of their time weaving, gossiping, and preening their family members' hair (**top right**). Painted wall carvings reveal an Austronesian influence.

THE FEARSOME silver helmet (**right**) is the most prized symbol of wealth on Orchid Island. Forged from coins acquired through barter, helmets are passed from father to son, with each successor adding at least one coil. For more than one son, the coils are divided and new helmets begun.

The Yamis turn to ritual instead of battle

when tempers flare, limiting themselves to throwing an occasional stone. Proper trappings for such sham fights include a rattan helmet, sword, staff, and leather tunic (**above**). In the past, when actually threatened, the Yamis have reacted with ferocity. For instance, in 1903 they battled shipwrecked Americans who, they claimed, had fired on them. Responding to U. S. complaints, Japan sent a force to the island; it took several prisoners and burned many homes. Bitterness reigned for years, but memories fade, while the silver helmets grow . . . and grow. □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Deadly weapon in hand, a Pathan tribesman test-fires a copy of a British Sten gun in Darra, firearm center of Pakistan's North-West Frontier Province. Guns still decree justice in the tribal area, where clansmen prize their independence.

An Eye for an Eye: Pakistan's Wild Frontier

By MIKE W. EDWARDS

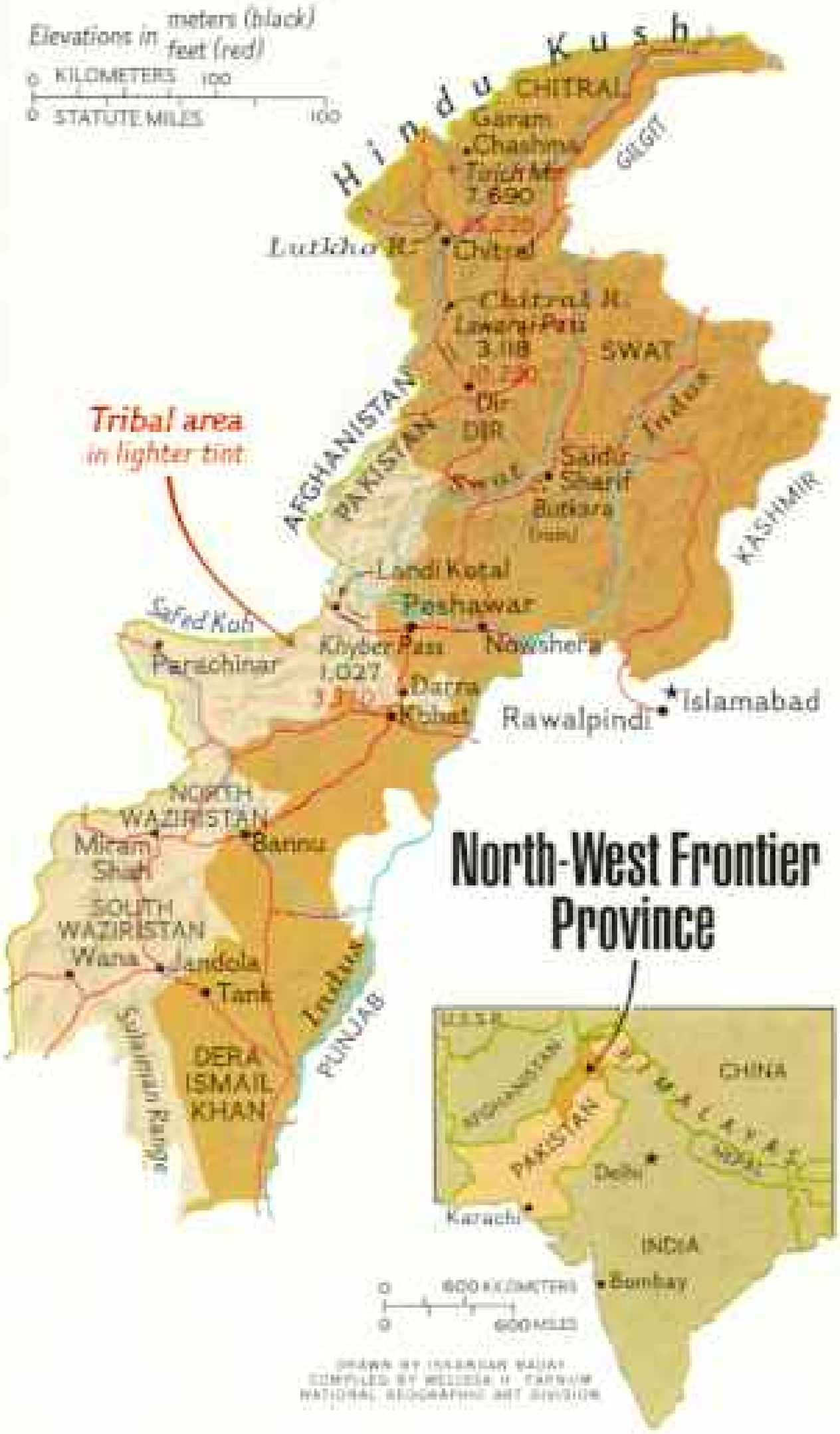
Photographs by J. BRUCE BAUMANN

BOTH NATIONAL GEOGRAPHIC STAFF

A FEW MINUTES before eight on a May morning, the South Waziristan Scouts loaded up: fifty riflemen in slate-gray uniforms, machine guns mounted over the cabs of two trucks. With our van between, the little convoy pulled out of the old British fort at Jandola and turned west on the asphalt ribbon that penetrates the tribal area. Our escort into this infrequently visited part of Pakistan's North-West Frontier Province backed up the government's hope that the trip would be uneventful.

A mountainous belt 20 to 80 miles wide along a 350-mile border with Afghanistan, the tribal area is a stronghold of the Pathans, those wily and warlike tribesmen who, in a thousand skirmishes and ambuscades, earned grudging admiration from the British as the best guerrilla fighters in Asia. That was in the days of the British Empire—until 1947, when independent Pakistan and India were born. Some of the old spirit remains; there had lately been two armed fights along the road we took from Jandola.

LIKE A MIRAGE *amid rugged peaks of the Hindu Kush, a pocket of grain fields softens a high valley in Chitral. Farming is a stern challenge in the mountains of the North-West Frontier, long the home of feuding warriors.*



Stepping-stone between central Asia and India, this frontier zone has been a corridor of invasion since 1500 B.C. The present government administers a divided province: "settled districts," and a semiautonomous tribal area where many of the Pathan groups reside (**above**). Inhabitants of both sections live mostly in houses built of mud and stone (**facing page**).

Conflict is the dominant theme of the North-West Frontier Province. Bordered on the southeast by the River Indus, picketed on the west by the Safed Koh mountain range and on the north by the Hindu Kush, this Virginia-size region has been for 35 centuries a passageway between central Asia and the Indian subcontinent. Often it conveyed armies, including those of Darius, Alexander, and Genghis Khan. The 10th century bore the tide of Islam; the 16th, the Moguls, founders of the empire that graced India with the Taj Mahal. Sometimes some of the fifty or so tribes threw in with the invaders—but only if it suited them. Often they resisted bitterly, and many were never truly conquered.

The British used the collective name of Pathans (rhymes with "batons") for the tribes, although they call themselves Pukhtuns or Pushtuns. The last invaders also named the province and solidified the boundaries around a region of stunning extremes. When, for example, wild flowers are beginning to fleck the towering ranges of the Hindu Kush in the coolness of spring, the southern plain is stupefied in 110-degree heat.

Heavy Price for Talking to Women

I wandered this contrasting crossroads for two months last year with Aman-i-Room, a Pathan, a gentleman, an adventurous spirit, a friend. He was guide and interpreter, and he often kept me out of trouble. When I wanted to stop and talk to women tending flocks beside the road, he gave advice I found compelling: "Their men would shoot you."

Aman also helped obtain rare government permission for us to enter some of the most remote parts of the tribal area. Pakistan's wary administration of that turbulent region continues vestiges of a British policy, in effect dividing the two million people of the tribal area from their eight million kin in the "settled districts," as the rest of the province is called. Written laws and ordered government may be all right for the oft-conquered people of the plains and valleys, but among the freedom-loving Pathans of the Safed Koh and the Sulaimans, it still is an eye for an eye. Direct Pakistani control, like British control, extends only to main roads and a handful of villages and forts.

To be sure, the government is gaining ground. Many tribesmen are settling down to profitable commerce—some of it illegal, though winked at—along the passes that brought invaders. Many tribal sons are going to college. More and better roads are welding the tribal area to the nation—an important political consideration, for the region has periodically been coveted by Afghanistan.

"I think the tribal ways will disappear before many years," a government official told me. Another said unhappily: "The changes

may be coming too fast. It is hard for the old people to adjust."

For now, at least, tradition holds the upper hand. Hamid Shah, a tall man with a classic Pathan face, narrow and sharpened by a hawk's bill of a nose, told me about justice in his village. "Recently a man came at night to the home of a married woman. Her brothers shot him dead. Then a jirga, a council of leaders, was convened. Of course the jirga decided the shooting was justified."

That was not the end of it. "There also was suspicion upon the woman. The jirga ordered her divorced from her husband and given to the dead man's family as a ward."

Violence Haunts Mountain Road

I met Hamid in Landi Kotal, a town in the Khyber Pass. As avenue of conquest and battleground, the Khyber ranks as the world's most fabled mountain gateway. To me it is simply the meanest-looking stretch of country I have ever seen. Not a high pass—it climbs only to 3,370 feet—the Khyber envelops more than twenty miles of road in a bitter, rocky landscape, almost treeless, with gravelly, often dry streambeds below and sun-blistered peaks above (pages 124-5).

The pass bristles with reminders of violence: forts, picket posts atop every dominating crag, even concrete dragon's teeth, planted to stop German tanks when Britain feared a strike into India in World War II.

Many men here, as elsewhere in the tribal area, carry guns. Perhaps, as several Pathans lightly suggested, it is natural for a warrior people to go around armed. Still, I wondered: Are guns really necessary? I put the question to a tribal leader who wore a pistol. "Why do you Americans have the atomic bomb?" he countered. "Is it not to keep peace in the world? I carry a gun so no one will bother me."

He told me his family, like many in the

Passengers on a camel train, mother and child huddle in the nest of their belongings —including a sleeping goat—as they cross Waziristan. The family belongs to a nomadic group of Pathans called *powindahs*. After a spring of harvesting wheat in Punjab, the band, in a three-mile-long caravan, passes the town of Miram Shah (**following pages**) en route to grazing land in Afghanistan.

tribal area, is involved in a feud that has continued for a century; 102 people have been slain. Some years ago a jirga compelled a *tigah*, or truce. "But," he said, "there is always the chance that some hothead will start the killing all over again."

The causes of Pathan feuds are usually women, land boundaries, or water rights. Revenge is essential; a weak man may soon find others taking advantage of him.

Yet tribal elders told me that the eye-for-an-eye tradition, upheld by the jirga system, acts to discourage violence, not perpetrate it. "A dispute outside the tribal area might lead to the courts," one said. "Here it leads to the graveyard. So a man will think carefully before he acts."

My host by the Khyber road one afternoon was a *malik*, or chief, of perhaps the most famous Pathan tribe—the Afridi. Rudyard Kipling, who mined the frontier for many stories and poems, cited this band in "Arithmetic on the Frontier":

With home-bred hordes the hillsides teem,
The troop-ships bring us one by one,
At vast expense of time and steam,
To slay Afridis where they run.

We sat outside Haji Rehmatullah's house, which, like all houses in the Khyber realm, is built of mud and stone. A table was laden with raisins, cakes, almonds, and cups for tea. Interpreting for me, Aman deferentially addressed this clan leader as Malik-Sahib. As the grizzled leader spoke, his fingers fished among the almonds, selecting those with soft shells that we could crack easily. He pushed them toward us. When tea arrived, he spooned in sugar and poured milk. By serving us, he emphasized his humility and our welcome—and reminded me that hospitality is as much a tribal tenet as revenge.

We talked of a famous battle of the 1600's, when Afridis and other tribes slaughtered a Mogul army of 40,000. He sent into the house for a gun, an early breechloader captured from the British. He spoke of a great Afridi leader slain by treachery. "There is a legend that the British took his heart in a silk-lined casket to a museum in England. They say the heart weighed ten pounds." He remembered that in his youth tribesmen shot down British biplanes with rifles.

"But it is peaceful now," he said. "The government has airplanes we cannot shoot down. They have tanks. So the tribes are gradually coming under control. Besides, it is *our* government now. The cause for fighting—independence—no longer remains."

It was sunset when we said good-bye. The midday harshness had departed the Khyber's mountains. Along the dry streambed, women were homeward bound with bundles of fodder on their heads. The Khyber seemed timeless, and gentle in this golden hour.

Tribesman Owns 136 Chevys

Generations ago the Khyber tribes lived in part from revenue extracted from passing caravans. Now tribesmen are the haulers, plying the road in trucks painted with cameos of mosques, jet planes, ships, telephones—a folk art that seems to compensate for the monotone of the landscape.

One fleet owner is Maider Khan, a garrulous entrepreneur whom I met in Landi Kotal. Besides his 35 trucks he had 136 automobiles, all Chevrolets, none older than 1953, none newer than 1959.

Maider, who controls the taxi business on the Khyber road, was loading a 1955 Chevy: five people in front, eight in back, others in the trunk, more on top, a few on the fenders. He nudged and pushed, making room. When I said I was amazed that any car could take that kind of punishment, Maider had one of his drivers jump up and down atop another Chevy. "See," he said, "sturdy! They don't make them like that anymore."

Landlocked Afghanistan receives much of the goods that tribesmen's trucks pick up at Karachi, Pakistan's seaport. But such contraband items as radios, cigarettes, and bolts of

Chugging out of the past, a spit-and-polish London-made fire truck, vintage 1920's, carries a fire brigade in Peshawar, capital of the frontier province. Britain ruled Pakistan from 1849 to 1947, but its troops never subdued all the Pathans, who even now retain some autonomy. In the tribal area they pay no taxes, and most disputes are settled by tribal councils called jirgas. Outsiders rarely venture from the main roads.


No 4 PESHAWAR FIRE BRIGADE No 4
MERRYWEATHER
LONDON

cloth soon are back in Pakistan. One day in the tribal area I saw a caravan of mules coming from the direction of Afghanistan laden with crates—just the size of small refrigerators. Another day it was camels carrying auto parts. Pakistan bans these foreign goods either to protect local industries or to hold down the deficit in the balance of payments.

"*You* might call what we do smuggling," an Afridi said. "But to us it's just trade."

Acknowledging this "trade," a government official remarked, "If we didn't provide the tribes with a source of living, they would become criminals." But the ground rule is that smuggled goods cannot be hauled on main roads; thus the quantity is limited to what can be carried on caravan tracks.

"Now our tribesmen can't afford not to be a part of Pakistan," the official added. "They are too much committed through trade and the real estate they have been able to buy outside the tribal area."

Heavy Fines Keep the Peace

Government presence among the hill Pathans is maintained by a civil servant, the political agent, usually called the PA, and his assistants, the APA's. In spite of the anomaly that he is in effect a "governor" of a semi-independent people, the PA exercises considerable power.

To stop a fight, he can call out the troops of the Frontier Corps. Usually he gets results with fines. "For example, we have a tigah on the Khyber road," said Akhtar Munir Marwat, the APA of Khyber Agency. "If any tribesman commits a crime on the road, the fine will be very high—50,000 rupees [about $5,000]." The tigah makes it possible for the Khyber to serve as an international road link; it also enables a man involved in a feud to walk the right-of-way in the fair assurance that his enemy will not shoot him.

"The British continued the Moguls' system of allowances," Akhtar related. "They paid a chief a certain sum according to his status." The system has been criticized as an effort to buy allegiance and defended as fair compensation to the maliks and elders for keeping peace. Perhaps it is both.

I attended a jirga one morning at which some 200 Mullagoris came to collect their semiannual stipends, which ranged from a dollar or so to several hundred. Money, however, was not all they wanted; the jirga began with a request to the PA for electricity and a water system. The government eagerly grants such requests. I saw not only new roads, clinics, and schools, but even small factories in the tribal belt.

I particularly remember a trip north of the Khyber to visit the Mohmands. A British campaign against this tribe in 1897 was accompanied by a 22-year-old officer who was doubling as a correspondent—and also, as he happily recorded *(Continued on page 126)*

Open drug deals thrive in Darra, where there are no narcotics laws. A half-pound cake of hashish (**left**) brings the equivalent of four U.S. dollars; in New York City it would sell for at least $5,000 on the street. Local tribesmen sometimes lace their cigarettes with the drug, though it is forbidden by Moslem law.

As the world market in opium-based drugs booms, poppies flourish as a cash crop. Harvesting his half-acre field near Peshawar, a farmer scrapes the opium gum from pods he slit open the previous day (**right**). By law he must sell the gum to the government, but most opium growers prefer the lucrative black market.

Terrain as fierce as its history, the Khyber Pass cuts a sinuous 20-mile path across the Safed Koh, opening a trade route from Afghanistan to the Vale of Peshawar,

at upper left. Fortifications still glare from crags, reminders of battles waged against invaders and made famous by the poems and tales of Rudyard Kipling.

later, learning to appreciate Scotch whisky. The world might be different today if Winston Churchill had been felled by a Mohmand bullet.

The road into this area passed over a rocky spine where another British expedition was stopped by Mohmand riflemen in 1935. From that time no government official had crossed the ridge until 1973, when a helicopter set down amid gunfire.

The Mohmands' distrust of outsiders was soon allayed. In fact, the official who led me in disdained an armed escort. The only complaint I heard was that the government well-drilling crews were not drilling fast enough.

By and large, I think, fear is the attitude of people in the settled districts toward the gun toters of the tribal area. "Uncivilized" is a word often used to describe them. But I never heard a PA or any other person who has had contact with the tribes call them that. Rather, their view is one of respect for the hardiness of these people and for the way they have clung to their traditions.

The jirga system, as one former PA told me, is efficient and democratic. "I'd rather be tried by a jirga than in our own courts," he said. No single chieftain dominates a jirga, and any member can have his say.

Justice Speaks in Gunfire

There are, to be sure, lawless elements among the tribes. In fact, one tenet of *pukhtunwali*, the Pathan code, requires that asylum be granted to anyone who asks for it, even outlaws, if they pledge themselves to good conduct. Such a pledge was broken some months ago near Darra, the settlement where Afridis make and sell guns (pages 134-5). Outlaws who had taken refuge with the Afridis

shot a man on the highway. Vengeance came swiftly. The tribesmen cornered the seven outlaws in a wheat field and mowed them down as if they had been stalks of grain.

The goal of eastbound travelers through the world's most famous pass is one of the world's oldest living cities. Situated on a broad plain in the settled districts, surrounded by wheat fields and orchards, Peshawar has seen at least twenty centuries.

Its centerpiece, as of old, is Bala Hisar, the High Fort, a great brick dreadnought on a sea of roofs and treetops. I stood on the highest battlement one morning with Col. Ata-ur-Rahman Kallue of the Frontier Corps.

"What you see now is British," he said. "They reconstructed a Sikh fort. There were other forts beneath that one, possibly going back to before the time of the Moguls."

Somewhere in the rubble depths of this

Storm's over, and the first in a line of buses gingerly fords a flooded road near Peshawar. The number of vehicles a tribesman owns adds to his status, as commercial hauling grows. Brightly painted trucks pass daily through Peshawar, the frontier's main trade depot. Lacking a bridge, a family moves grain by cable car across the Chitral River (**above**).

archeologist's bonanza there is perhaps a brick or two of the hall where the kings of Afghanistan held court in the late 1700's and early 1800's, when Peshawar was their winter capital. A British envoy received in Bala Hisar in 1809 was dazzled by the monarch's finery: emeralds, pearls, gold, and the huge Koh-i-noor diamond, flashing from a bracelet. The gem is now part of the British Crown Jewels. Pakistan has officially asked for its return.

Driving out the Afghans in 1823 (and also gaining possession of the jewel), the Sikh general Ranjit Singh destroyed the fort and much of its surroundings, even felling the trees, to terrorize the city. Peshawar has not forgotten. "A whimsical decree," Colonel Kallue said, "is still called 'a Ranjit Singh decision.' "

Peshawar Keeps Split Personality

I looked out over what seemed two cities. The cantonment that the British built when Peshawar was their frontier headquarters is a gracious tract of wide avenues and flaming bougainvillea. The other part, known as the City, is the heart of hearts, the bazaar: a place of winding alleys and noise and intense aromas, nearly treeless, dense with shops, cyclists, horse-drawn tongas, carts pulled by water buffaloes, and put-putting three-wheel taxis.

I like it all. There are few landmarks in the City and no street signs. But this baffling warren knows a logic of arrangement. For copper and brass goods, you seek out Misgaran Bazaar at one end of Qissa Khawani, the Street of the Storytellers. Namakmandi, the salt market, is also the home of the false-teeth makers; you can't miss their ludicrously grinning signs. The Pathan bazaar specializes in cheap but utilitarian things: grass prayer mats, pitchforks made of bent sticks, and charpoys, the wood and grass-rope cots that are both the bed and settee of the country.

The jewelry bazaar stretches along a narrow walkway. Is it diamonds you want? Silver necklaces ajangle with the coins of some bride's dowry? Just ask. Or don't ask; stop and look and all will appear.

Kipling wrote of laden caravans winding through the Khyber:

As the snowbound trade of the North
comes down
To the market-square of Peshawur town.

He may have had in mind the caravans that the Sethi family once sent out. "I believe the business was started about 1800 or earlier," said Mohammed Ismail Sethi, a bespectacled man of gentle demeanor. "Our caravans brought silk, gold thread, carpets, and furs from Samarkand and Bukhara. We sent up cloth, indigo, and tea."

The family had offices in Shanghai and Bombay as well as southern Russia, and their fortune was immense. Much of the money was in czarist rubles. "That was the most valuable currency in the world then," Mr. Sethi said. He sighed a little as he passed me a few hundred-ruble notes to examine—some of a closetful, all worthless since 1917.

Poppy Farmers Do Brisk Trade

Aman and I started east out of Peshawar one dawn for the district of Swat, in the upper central part of the frontier. At Nowshera we turned north, then zigzagged—east, north, east again—honking through villages. Orange groves spread heavy sweet fragrance on the morning air.

Then we were off pavement, eating dust, bouncing into a rocky mountain range. We came upon a village that seemed to rise from a carpet of red and pink poppies. The men welcomed us as frontier villagers always did, taking us to the shaded porch of a *hujra*, their sitting-and-talking place.

"We have grown poppies here for about fifty years," a man told me. Do the villagers use opium? "Oh, no, it is bad for the health."

I ventured that some of the opium from these poppies may end up in the United States. He grinned shortly: "It's possible."

A man who dealt in liquor would be condemned in the frontier, but one who profits from opium suffers little stigma. And the

Wading the unruly waters of the Swat River, a fisherman hauls in his net and, with luck, a squirming catch. When Alexander the Great marched through verdant Swat in 327 B.C., he found a thriving civilization, Gandhara. In 1926 Swat changed from a tribal system to a princely state under a succession of potentates known as walis. Feudal rule ended in 1969 when Swat was merged with Pakistan.

profit is great, just as the profit from heroin, one of the main derivatives of opium gum, is great on Western streets. One man with a good half acre of poppies may collect $400 for the gum he scrapes from the punctured flower pods—this in a region where the average farm income is less than $200 a year.

A farmer is supposed to obtain a permit to plant poppies, then sell his gum to the government. These farmers had no permits and, speaking openly, said they would sell their crop on the black market, where the price is far greater than the government's. Although some opium and hashish are seized at Pakistani airports, most of it is assumed to make its way out of the country.

The village of the poppy growers is in lower Swat. We roamed higher in that district, driving along the Swat River into the snow-mantled outriders of the Himalayas.

Relics of Ancient Realms Abound

Everywhere in Swat the sound of water is the sound of life: the river's thunder in its mountain trough, the trickle of water sluiced to fields where the land smooths out. Water to nourish yellow carpets of mustard, expanses of sugarcane, emerald slivers of wheat on the hillsides. Swat in spring is a far cry from the Khyber's bitterness.

This valley has been grazed and cultivated for more than 35 centuries. The civilization called Gandhara thrived at the time of Alexander the Great's invasion in 327 B.C., and later dotted the frontier's valleys with thousands of stupas, shrines, and Buddhist monasteries. But Swat seems to have been especially important.

Near Saidu Sharif, Swat's administrative town, archeologists have uncovered the remains of Butkara. The rock piles reveal what must have been an awesomely tall stupa, surrounded by 60 small votive stupas. On one I saw a carved Corinthian column, a reminder that one of the cultural waves that washed the frontier was freighted with the influence of Greece—or possibly of Rome.

Most of the 600,000 inhabitants of Swat are Yusufzais, clansmen of one of the frontier's largest tribes. During four decades in this century they switched from a tribal system to a princely state, under rulers called walis who had life-and-death power. Pakistan ended the walis' rule in 1969, merging Swat into the national government.

New System Brings Mixed Results

Supported by a Pakistan Government stipend of about $100,000 a year, the last Wali of Swat, Miangul Jahan Zeb, resides in his former palace in Saidu Sharif. Arriving for my interview, I met a man with gentle brown eyes. The skin of his face sagged a bit —the wali is almost 70.

"It was a very personal type of rule," he said. "For example, I personally inspected all state construction. I was also the highest judge. Criminal cases were decided by local magistrates, and then I had to decide whether to pardon the man or shoot him."

The walis provided security, keeping an army against the depredations of other feudal lords on Swat's borders, and ran a progressive administration. However, as the former ruler observed, "There were some people who thought we should have democracy."

A khan who had been one of the dissidents told me of his mixed emotions about the result, even though he had once been jailed for expressing opinions against the wali in the old days. "The police in the walis' time were much better," he told us. "Now the country is full of absconders. No one looks after the roads. There is no medicine in the hospitals. The schools are always closed because the teachers are striking. These things would not have happened under the walis. Still, we have hopes for democracy. At least, if a man sees wrong now, he can speak out."

One difference between Swat and Chitral, another former princely state of the high mountains, is that Swat is united with the rest of the frontier by an all-weather road. For six months of the year, when snow closes the

A stranger is good reason to stop work; a group of Chitral shepherds and farmers strike a pose for the photographer—one of the few Westerners they have ever seen. They live in an isolated part of the Hindu Kush and use a dialect spoken nowhere else. Though far from the economic mainstream, Chitral is nonetheless beset by inflation. Even its traditional game of polo has suffered, victim of the cost of raising horses.

10,230-foot Lawarai Pass, Chitral must fall back on its own meager resources.

One hears, too, in Chitral the sound of water pouring from snowfields. But there is little valley land where it can be used; the terrain is peak crowded by peak, rising toward the greatest eminence of the Hindu Kush, 25,230-foot Tirich Mir. With a population grown to 200,000, not enough farmable land exists to feed people and horses—this in a region famous for its polo players.

We flew into Chitral District, lucky in April to wrangle seats on the twin-engine Fokker that aspires to, but can't keep, a daily schedule from Peshawar. The snow-imposed embargo was serious; Chitral was low on gas.

We used some of the dwindling stock to wander along a muddy track hugging the Lutkho River, in the direction of Afghanistan. We stopped to talk to a shepherd tending his village's sheep and goats. His name was Zal Mohammed, and for shoes he wore strips of shaggy goat hide. He owned about an acre of land. "But it is poor," he said, too poor to support his family. When there is no food, he walks the twenty miles or so to Chitral town to sell wool and skins, returning with a sack of wheat or rice.

The Lutkho was dirty brown and boiling. We steered gingerly at the river's edge, following the knife cut of a valley. At the village of Garam Chashma I met a hunter dressed in homespun wool. The British Army muzzle-loader on his shoulder bore a date, 1856. I was amazed that such an antique was still in use. The explanation is economy: Cartridges for a modern gun cost about 40 cents, while a muzzle-loader can be fired for two or three.

Isolated Valley Has Own Language

We four-wheeled on up the Lutkho's valley, toward brooding, jagged peaks. The sky began to spit snow. Finally the track was washed out, and we stopped near a water-turned gristmill. A crowd of men and children gathered to stare at the foreigners. They spoke among themselves in a dialect that Mohammed Akram, a Chitral native who was my interpreter this day, could not understand. Speaking in Chitrali, they identified it as Lutkhowah, the tongue of their valley, preserved in isolation as if it had been a laboratory specimen in formaldehyde.

On the way back, we stopped and bargained for a chicken, since there was no fresh meat in town.

It is too bad that the rivers of Chitral don't flow into Dera Ismail Khan. In that district

Business awakes at dawn in the cramped marketplace at Chitral (**left**) as shoppers begin to stream past the opening stalls. Such bazaars make up the bustling trade and social centers of frontier towns. Customers haggle over items ranging from homespun wool and goatskin rugs to spices and rice.

In the mile-high valleys nearby live the Kafirs—the "unbelievers," a sect that clings to pagan beliefs within the frontier's Moslem majority. Their women dress in dark colors, like this tiny Kafir shepherdess (**right**).

Arsenal for the Pathans, Darra has produced guns for 100 years. In this lively one-road village, exempt from national gun-control laws, more than a hundred shops sell firearms, ammunition, and knives. Families often fashion individual gun parts at home, then take them to local assembly factories. In one work area an apprentice learns with hammer and vise (**left**).

A typical gun emporium (**below**) features rifles, shotguns, submachine guns, and pistols —all copies of foreign makes. For secret-agent fans, the shops also sell lethal novelties such as shotguns disguised as canes and 25-caliber ballpoint pen guns (**right**) that can kill a man.

Demand for weapons runs high in a land where quick, violent retribution is still tolerated. Many tribesmen carry arms to protect themselves in the endemic feuds involving land boundaries, water rights, or women. The Pathan code of honor, nevertheless, allows such amenities as generous hospitality.

WEAPON (LEFT), FOUNTAIN PEN (RIGHT)

in the southern portion of the frontier, burning with a temperature of 100 degrees when we went there early in May, there could be a 1,200,000-acre hothouse.

There is that much cultivable land in the dusty plain called the Daman, Inayatullah Khan, an agricultural official, told me. But only a quarter is farmed. "Water is the foremost problem of this district," he sighed. "If it were available, farmers could reap two crops a year—wheat and vegetables." Several irrigation schemes have been proposed, but most exist only on paper.

Along the single lane of asphalt that arrows across the Daman to the town of Tank, I stopped to talk to five plowmen. Mehr Khan Baluch, who wore only one sandal, told me they would plant *kharbuza*—muskmelons. A harvest, he said, depended, first, on whether it rained in the mountains, and second, on whether any of the runoff got to their fields before someone diverted it.

I asked if the harvest had been good the previous year. "We haven't reaped anything for two or three years," Mehr said. "Do you think I would be out here with one bare foot otherwise?"

Kidnappings Profitable in Mountains

We headed now for the mountains of South Waziristan, still one of the most isolated and troublesome of the tribal areas. The Mahsud tribe in particular has a reputation for mischief; for years a minority profited from raiding the settled districts and kidnapping schoolteachers, merchants, even policemen.

With our escort of men from the South Waziristan Scouts, a unit of the Frontier Corps, we started from Jandola toward Wana, forty miles away, almost at the Afghan border.

A dozen miles into South Waziristan our little convoy passed beneath the rock walls of Shahur Tangi, a defile only wide enough for a small stream and the road. Tribesmen trapped a British convoy here in 1937 and killed or wounded 97 men.

The roadway penetrated a grassy valley, veined with glistening streams. The country here seemed gentle—country, the thought suddenly came to me, worth fighting for.

In fact, there had been two fights along this road in the previous ten months. Men of the Mahsud and Wazir tribes staged a shootout at the streambed that demarks their territories. Five months later the Wazirs blocked the road. A detachment of Scouts sent to reopen it suffered four killed and nine wounded; the Wazirs had about thirty casualties.

There has been bad feeling between these tribes for years. "The Mahsuds harass us," a Wazir told me later. "In their area they stop our trucks and rob us."

A Mahsud said the cause of the recent trouble was an attempt by the Wazirs to get a larger share of the profitable timber-hauling business that utilizes this road. The British allotted 75 percent of the business to the Mahsuds, 25 percent to the Wazirs, based on population. Pakistani political officers continued the arrangement.

A Price for Each Violent Act

When we went into Wana to meet Wazir maliks, we were escorted by a *badragga*, or bodyguard, of five armed men. A strange circumstance for paying a call, I thought, but our hosts acted as if it were natural.

"We are happy to have you here," Malik Jalat Khan said. He put a feast before us: sweets, rice, boiled eggs, chickens that we pulled apart with our fingers. The meal had a significance beyond hospitality. By dining us, this influential man signified that we were under his protection.

Traditions are so well established in South Waziristan that there are precise, though unwritten, fines for violence: for murder, 30,000 rupees, or about $3,000; for taking a man's eye or causing him the loss of a limb, half that much; for a broken tooth, 100 rupees.

When we left Wana for Miram Shah in North Waziristan, we were again escorted by two truckloads of Scouts, some of whom fanned out with their rifles when we had to stop for repairs.

The road undulated through grasslands

Defying the surroundings, a patch of wheat survives high in the gnarled mountains of Dera Ismail Khan. Such rugged terrain wrinkles roughly three-quarters of the frontier. To coax life from dry, inhospitable land in flatter areas, farmers rely on irrigation canals stretching as far as ten miles from the water source.

and rumpled ranges stippled with the darker green of trees. The villages we passed were picketed with towers, as if many homes had clocks to toll the time. The towers are for watching—so, as an old man told me, "everyone can keep an eye out for his enemies."

There was much violence along this road, too, in the 1930's. It began when a Hindu girl eloped with or was kidnapped by a tribal youth: Take your choice. But the outcome was definite. British authorities got her back, and her marriage was dissolved. Fired by a religious leader, the Fakir of Ipi, the tribes went to war. From their towers riflemen sniped at convoys. The British retaliated by setting fire to villages or bombing them from planes. One tribesman estimated that 10,000 Pathans were killed; he added confidently (though incorrectly) that British casualties were three times that many. Ipi became—and remains—a folk hero; the British are still despised.

Students Look Beyond Their Tribal Past

I went to the college at Miram Shah and met a roomful of students. What did they want to be in life? The answers were those you might expect in any classroom: an engineer, a teacher, a doctor. "Politician," two replied, indicating an outlook broader than the tribal belt. One talked of someday running for the National Assembly. "Or maybe I will be Prime Minister."

I was the first foreigner these dozen young people ever had talked with, and as they gained confidence in their classroom-learned English, they peppered me with questions about the United States. What are our crops? Are politicians respected in America? Why did I have a beard? They clung to me. Would I stay for tea? For dinner?

When I had to leave, they asked if I would take their picture. "But wait," said a slender lad who hoped to study medicine. He returned a minute later with a pistol strapped on his shoulder. "I have a feud," he said when I asked why. "Years ago my family killed a man. It has never been avenged."

Like a man straightening his tie, he adjusted the holster strap and then, satisfied that he was properly turned out for a photograph, posed stiffly: a young man of two worlds, on the threshold of a career beyond the tribal horizon, yet bound to old ways—and proud of them. □

After a day in the desert a powindah boy rocks his nephew under a quilt tent. Normally a sister would watch the child, but

Moslem custom discourages women from appearing before outsiders. Had the child been born a generation ago, he would have automatically inherited a nomadic life. Now the government's introduction of schools and factories in the frontier may give him a choice.

Probing the Mystery of the Medicine Wheels

By JOHN A. EDDY, Ph.D.

Photographs by
THOMAS E. HOOPER

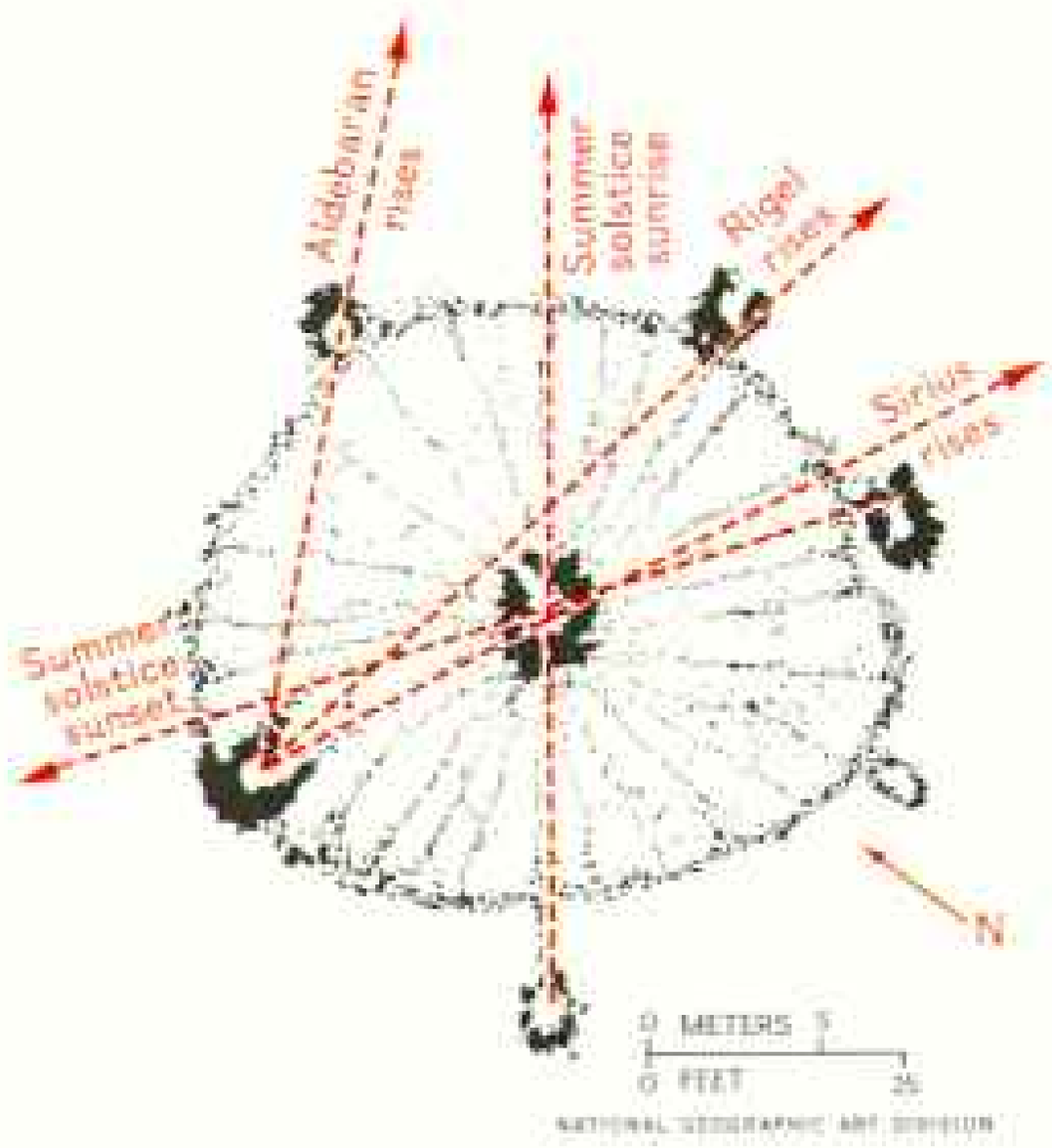
EARLY PROSPECTORS first found the strange structure on a remote peak high in Wyoming's Bighorn Mountains: an elaborate pattern traced out in stone on a flat shoulder near the top of a 10,000-foot mountain. It resembled a large 28-spoke wheel, 80 feet across, with six rock piles, or cairns, spaced unevenly around its rim.

The range, rich in game and tumbling streams, was a favorite summer hunting place for Indian tribes—Crow, Cheyenne, Shoshone, Arapaho—and so the medicine wheel, as it came to be known, was deemed the work of one or another of these.

But no one really knew who made it, or when, or why. When archeologists came to see the site early in this century, they asked the local Crow tribesmen what they knew of the formation. The answers were enigmatic: "It was here when we came." "It was built by people who had no iron." "The sun built it to show us how to build a tepee."

In time, legends grew. Fanciful explanations attributed it to Aztecs, Hindus, errant Chinese, Phoenicians, even to pre-Columbian members of the Masonic lodge. To the Shoshone Indians it was the home of the "Little People," who supposedly lived in caverns beneath the wheel and survived on the meat of bighorn sheep.

In 1922 ethnologist G. B. Grinnell offered a more reasonable explanation, noting that the pattern of the Bighorn Medicine Wheel resembled the floor plan of a Cheyenne medicine lodge—a temporary wooden structure built for the traditional sun-dance ceremony.



Like a cosmic rifle sight, two rock cairns of Wyoming's Bighorn Medicine Wheel zero in on the rising sun, just as they have for perhaps 300 years. Time: sunrise of summer's first day—the summer solstice—when the sun reaches its northernmost rising point on the horizon.

Aided by a National Geographic Society grant, the author, a Boulder, Colorado, astronomer, finds evidence that medicine wheels were used by early Indians as primitive instruments to set the time for ritual ceremonies, such as the sun dance. Alignments of other cairns (**left**) point to the solstice sunset and the rising points of three bright stars.

In one Cheyenne version, 28 pole rafters, like the 28 spokes of the medicine wheel, radiated from a central post. Grinnell felt that the wheel could be a symbolic replica in stone, built where wood was scarce.

More recent investigations have found evidence of use of the medicine wheel in the past few centuries. From the thin layer of soil between the spokes came a handful of arrow points and beads dating from before white settlement of the West. The same survey found indications of a small cavity in the soil beneath the central cairn. But had it been made by early pothunters, or by the original builders to make a socket for a vertical pole?

A broken branch in one of the cairns has been dated by tree-ring analysis to about 1760. It could not have been put in the cairn before that date; but was it there originally or added later?

Wheel Hints of Astronomical Use

Was this wheel used in even earlier times? And if so, for what purpose? As an astronomer, I became interested in it as possible evidence of the early Indian's use of the sky. The number of spokes, 28, is close to the number of days in a lunar month—a "moon"—by which the Indian reckoned time. And two of the cairns are placed symmetrically on either side of a north-south line, making it possible that they served as horizon markers for sunrise and sunset. Could it be that they were placed to mark distinctive directions where the sun rises and sets, just as parts of Stonehenge are thought to have been used on another continent and in another age? If so, it would shed some light on a dim and distant people—the early Indians of the plains—about whom we know but little.

In fact, we know less about the early plains dweller than about many of his contemporaries on the continent, including the Mesoamericans of Mexico and Central America. Both were here for about the same period. Both are presumed to have been descended from Asians who crossed the Bering land bridge more than 10,000 years ago. Both were briefly observed in situ by Europeans in the 16th century.

But unlike the Mesoamericans, the Indians of the plains left no written language and little well-developed art. Unlike their neighbors to the south—the cliff-dwelling Anasazi,

or "Old Ones"—the plainsmen didn't build much. And intensive observation of these Indians did not begin until more than two hundred years after their first contacts with Spanish explorers. Between Coronado and Lewis and Clark, the life of the plains people changed dramatically, and the ways of the equestrian Indians may shed little light on the ways of their pedestrian ancestors.

These nomadic people did leave behind a great many—perhaps five million—stone circles, 5 to 30 feet in diameter, which we now call tepee rings. They are simple circles, made with loaf-size rocks, sprinkled on all the Great Plains and foothills from Texas to southern Canada.

Most archeologists accept that they are stones that were used to hold down the hide covers of tepees—like tent stakes today—and were left behind when the camps were moved. The inhabitants also left a few large effigy figures traced out in fieldstone on the surface of the ground, and a number of enigmatic large wheel patterns, of which the Bighorn wheel is a good example.

Sun Stands Still Twice a Year

It seemed to me that the Bighorn wheel could have been used as a rudimentary observatory. To test that idea, I needed to measure the positions of the cairns and note their directions from the central hub. These could be compared with directions of sunrise and sunset for any day of the year.

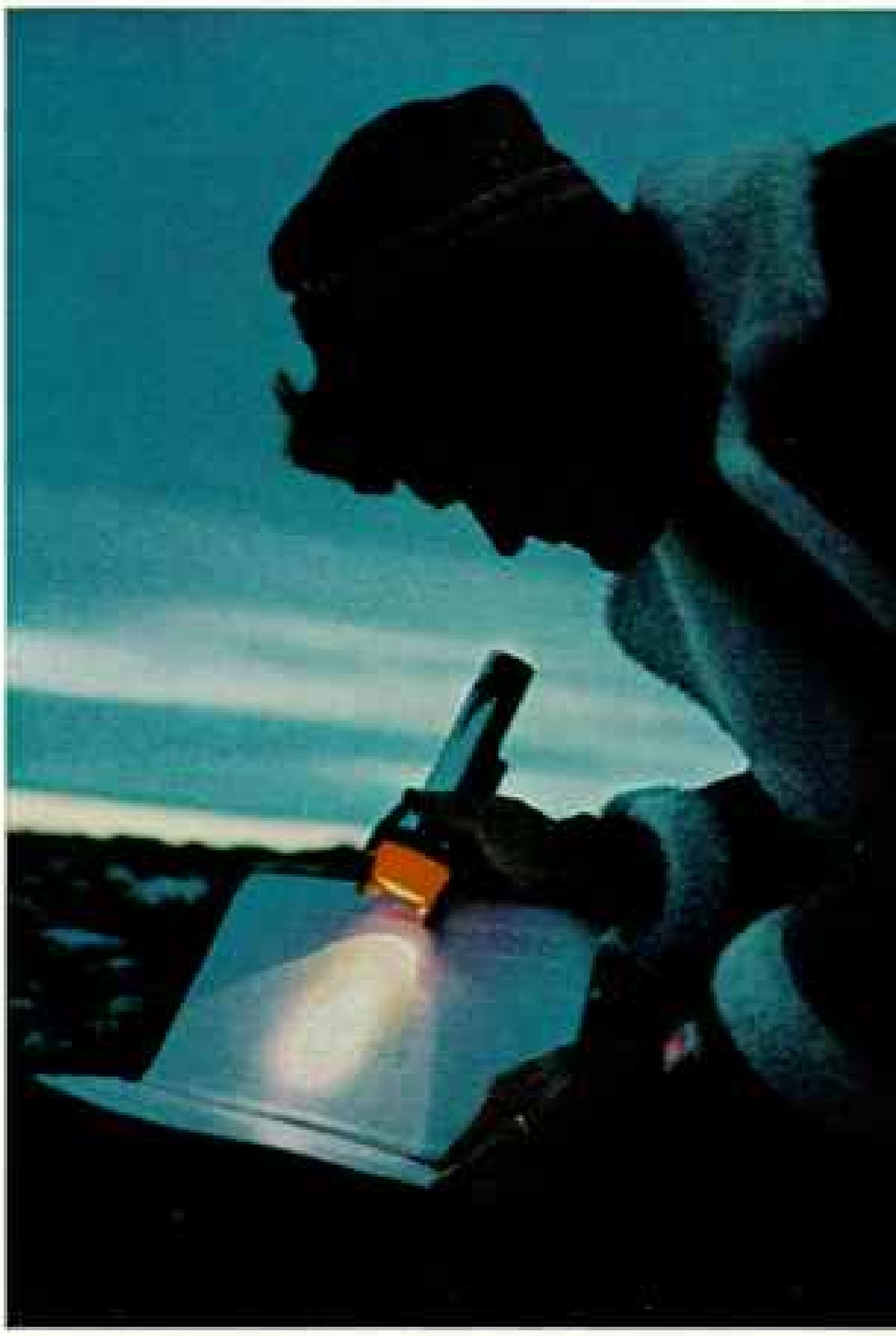
In the course of the year sunrise and sunset shift along the horizon. On the first day of both spring and autumn, the sun rises exactly east and sets exactly west. As spring wears on, sunrise moves farther north each day until late in June, when it slows, stops, and begins to move southward again.

The day its northward motion stops, June 21, is the summer solstice. The winter solstice, six months later, marks the end of its southward march along the horizon. The two solstices are the only times of the year when sunrise and sunset directions mark a single, definite day—reference points for a solar calendar. It seemed clear to me that if a solstice had been marked on this mountain, where winters are severe, it must have been in summer.

Unraveling the case was a family adventure. My wife, Marjorie, and our four children would help make our survey in June, a few days before the summer solstice. But when we awoke on our first morning in the Bighorn Mountains and looked out our lodge window, our hearts sank. During the night ten inches of snow had fallen. The 30-mile road to Medicine Mountain was closed.

But the sun likes the Bighorns, and within a day we picked our way to the top. A surprise awaited: The old rock wheel was clear of snow—scoured by the winds that sweep the mountaintop and bleached by a high sun that knew it was summer.

Together we measured the cairns and wrote



Predawn rising of stars, pinpointed by two cairns, may have helped Indians determine the time of solstice. In a time exposure, the planet Venus (**facing page**) rises at the point on the horizon where the star Aldebaran—the solstice harbinger—rose when the wheel was probably built. Dr. Eddy (**above**) consults his data at day's first light.

down the numbers that told the secret of the wheel. A distinctive lonely cairn that lay at the end of a spoke outside the rim marked a line with the central hub that would point to the exact place of sunrise on the first day of summer.

In darkness the next morning we trudged up the snowy slope again. We followed our own cold trail in boots still wet from the day before. Three hours later, as a pink sky slowly brightened, we crouched nearly frozen behind the lonely outer cairn and awaited the coming sunrise. The direction of the first glow told us we could not be far wrong. And then, in majestic quiet, the great red ball of the sun appeared, exactly in line with the cairns. In the biting cold we felt happily warm. For all the summers since the wheel was built, sunrise had moved along the horizon to perform this striking solstice spectacle—with no one there to watch.

Could Stars Presage the Solstice?

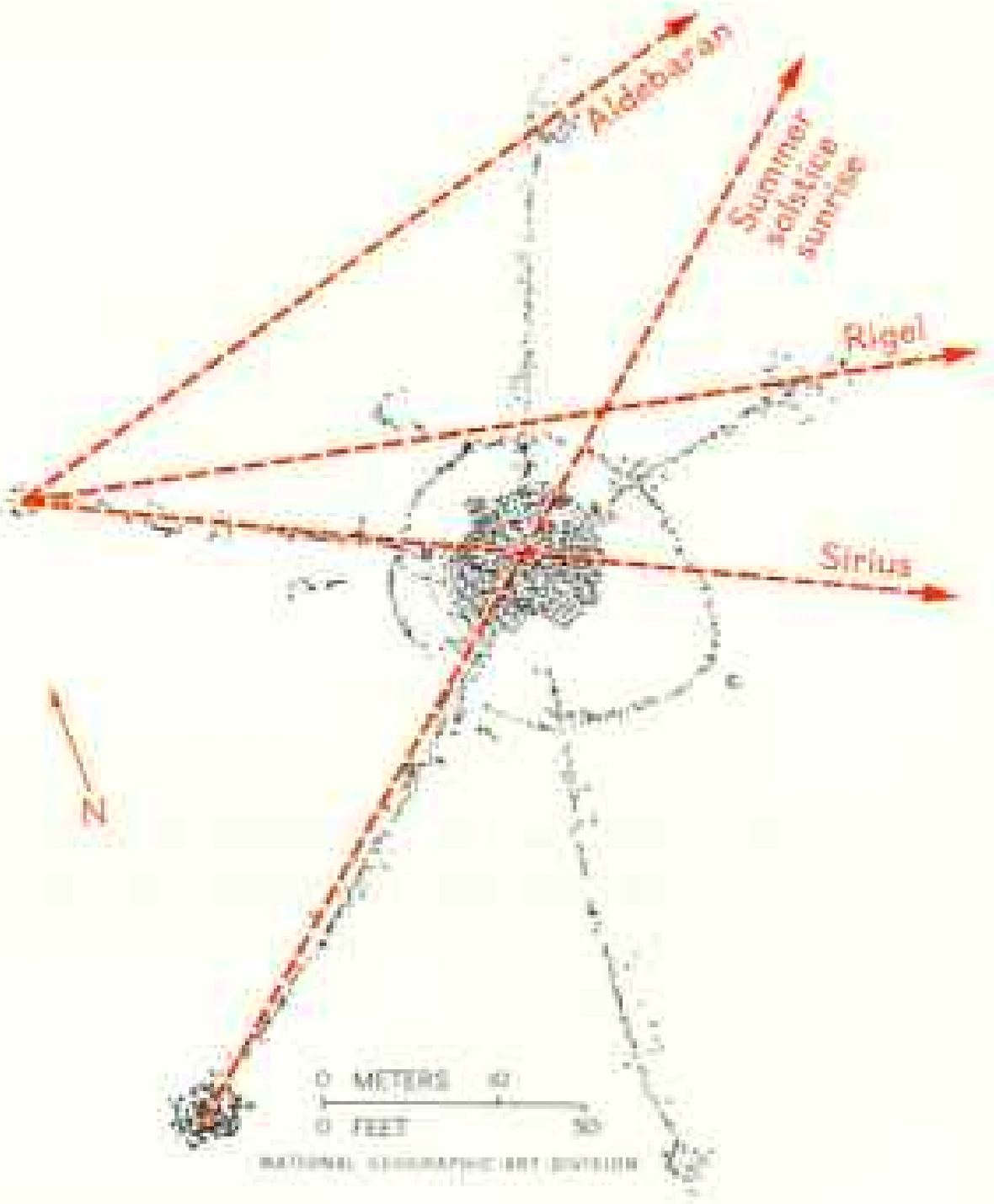
How many had known what we now knew? Was it the secret of a few who climbed the trail, as we did, to note the time of solstice, when, as the Indians noted, "the sun is highest and the growing power of the world is strongest." Did it signal the sun dance with a message from the sun itself? Perhaps this medicine wheel and the others like it were models for the sun-dance lodge—instead of the other way around.

During evenings of the following winter I tried to work out the possible functions of the other cairns. I now think that one of them, a "sighting" cairn, was aligned with three others to mark the rising of three of the brightest stars that shine on the medicine wheel: Aldebaran in Taurus, Rigel in Orion, and Sirius in Canis Major (page 141). These three stars are also the brightest in the region of the sky through which the sun passes in summer.

In the years between 1500 and 1900—in agreement with what archeologists know of the age of the wheel—the rising of Aldebaran could have announced summer's first day. Throughout most of that time there was one day and one day only—the summer solstice—when Aldebaran's rising was just near enough in time to the sun's that the star was visible only momentarily, almost as a flash, before the brightening eastern horizon extinguished it from view. The same phenomenon would

Like a sun symbol built by a child, the Moose Mountain Medicine Wheel in Canada spans 200 feet on a hilltop in Saskatchewan. Yet no child shaped this sophisticated pattern of stones, whose alignments (**below**) closely match those of the Bighorn wheel in Wyoming. The author estimates that this wheel, one of many laid out by the plains people, was in use more than a thousand years ago. Others may be as old as Egypt's Pyramids. All are relics of an Indian heritage eclipsed and forgotten after the white man's arrival.

GEORGE STROTHER



have occurred with Rigel 28 days later—the same as the number of wheel spokes—and with Sirius after an additional 28 days.

Were these alignments chance, or the work of early Indians who knew more of the sky than we may have thought? The answer might be found in examining similar medicine wheels. I learned that a number exist all along the eastern slope of the Rockies and on rolling plains to the east. More of them lie in Canada, in the Prairie Provinces of Alberta and Saskatchewan. If we could find other wheels that also marked the solstice, the case would be that much stronger.

Archeologist Dick Forbis at the University of Calgary knew the wheels in Canada well. Aided by a National Geographic Society grant

in support of the research, we have now studied about twenty of them.

The popular term "medicine wheel" describes a catchall collection of stone patterns, mostly on the plains. Many are simply huge central cairns, surrounded by rings of stones 100 to 200 feet across. Some have spokes—in almost any number—and others do not. The central cairns can contain as much as a hundred tons of piled rocks.

Circles Date From Pharaohs' Time

The Majorville wheel on the grassy, treeless plain of central Alberta is a good example. Much like the Bighorn wheel, but somewhat larger, it has a high central cairn, a rim of rocks, and remnants of spokes; through the years it has been badly damaged, and it is almost impossible to define its original form or spoke alignments. Several years ago Dick Forbis and his colleagues, examining the cairn, found artifacts establishing that its building had probably begun as early as 4,000 or 5,000 years ago. The first stones of the Majorville cairn had been laid when the Egyptian Pyramids were under construction!

All the wheels that we examined had one point in common: They were built on the highest land around, with clear, commanding views of the horizon.

Many of the other, simpler wheels with only a few spokes fit another pattern that Dick and I think significant. Nearly always the spokes point to other medicine wheels and cairns, from ten to as many as fifty miles away. These rock mounds on distinctive hills on the bald plains could have served as a simple network of landmarks in a land where distinctive features do not exist.

Tom and Alice Kehoe, archeologists in Milwaukee, showed me the most interesting medicine wheel of all. It lies atop Moose Mountain, in the low, rolling hills of southern Saskatchewan, where Tom was once the provincial archeologist. Legends tie it to the sun and sky. Although 425 miles from Wyoming and Medicine Mountain, it bears so strong a resemblance to the pattern of cairns in the Bighorn wheel that it could have been built from the same set of plans. To my mind it confirms, without much doubt, the astronomical use of these mysterious structures.

A large central cairn, typical of all the Canadian wheels, is at the middle of five long spokes; at the end of each, as at the Bighorn wheel, is another cairn. Their positions match, like fingerprints, the cairns of the Bighorn wheel. At the end of the longest spoke, the largest and most prominent cairn lines up with the hub to mark the direction of sunrise at summer solstice. Other cairns, just as at the Bighorn wheel, mark where Aldebaran, Rigel, and Sirius rose (page 144).

At the time of summer solstice, with the Kehoe family, I walked up the mountain in the gathering light of dawn. What we saw confirmed our transit measurements: The line of sunken stones was directed to the first flash of summer's first sunrise. The directions indicated by the star-alignment cairns were a few degrees off the present location of the three bright stars, but would not have been in an earlier age; time had shifted their relative positions.

If we presumed that the Moose Mountain wheel had been built about 1,700 years ago, the alignments were nearly perfect. And at that time, about A.D. 300, Aldebaran would have served as a perfect harbinger of the summer solstice at the site. This meant that for more than 1,000 years the early Indians of the plains were using the same star risings, and the sun's, to mark the summer solstice.

Did New Ways Kill Old Customs?

We know that early man walked the plains of western North America for thousands of years before Coronado first saw him hunting buffalo. We know that with the horse, and other acquisitions from later Europeans, the life of those Indians was drastically altered and modernized. In this revolutionary change did they lose an astronomical heritage?

Depositions taken from their descendants in this century and the last recall little practical use of the sky. Yet in the Bighorns, and on Moose Mountain, and at a number of other sites, relics remain that more strongly than words seem to prove that the early Indians of the plains made use of the sun and stars in fairly sophisticated ways. The absence of this sky lore in historical records of the American Indian of the plains surely tells us how fragile is learning without the written word, and how quickly it can be forever lost. This may be the message of the strange, mute wheels that were left on western mountains and the highest hills around. □

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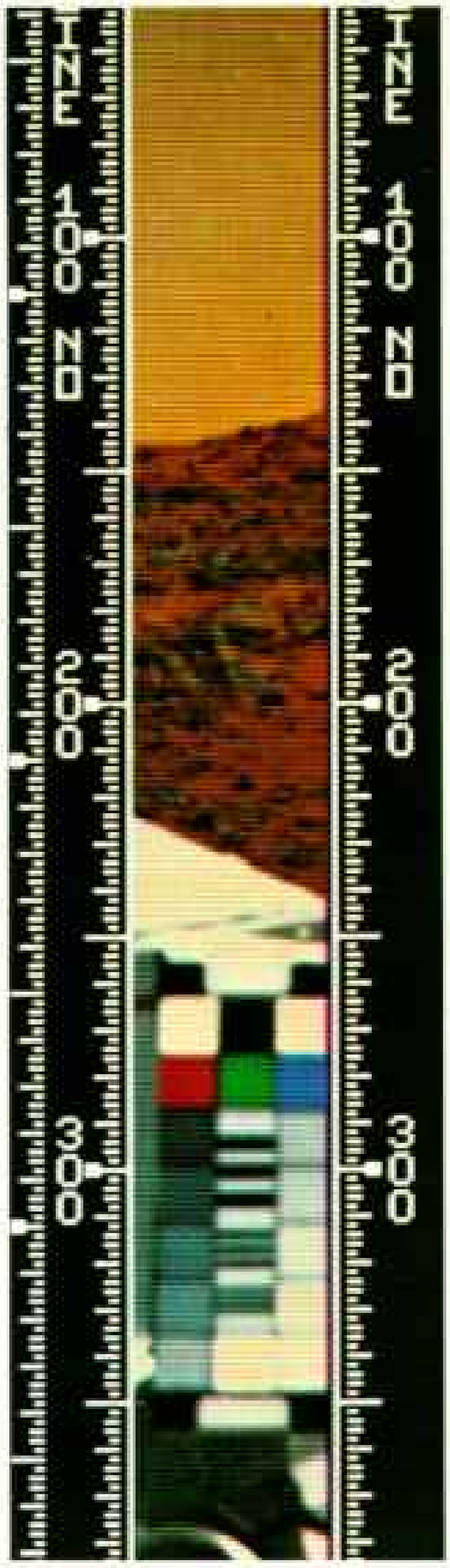

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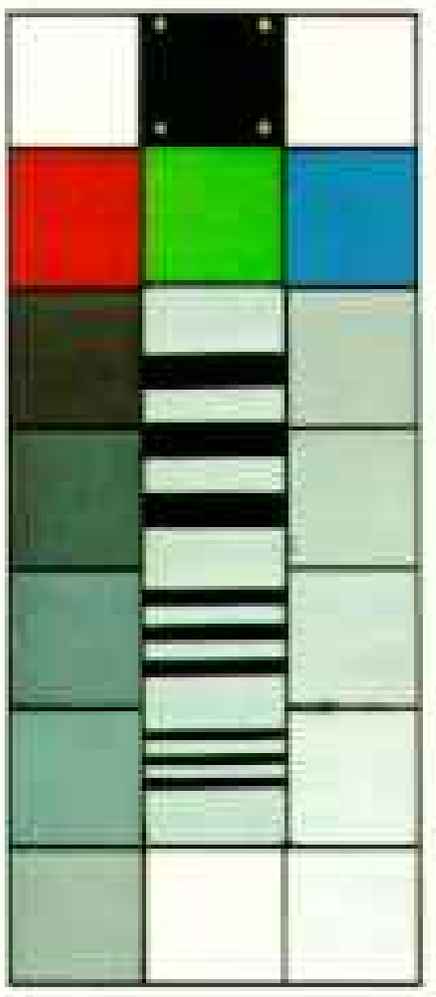

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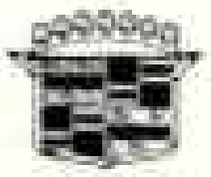

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Subscription rolls close: February 22, 1977.

the United States

and produced in limited edition by Fleetwood

From the time of George Washington, the Presidency of the United States has been a place for a brave heart and a strong spirit. An office of awesome responsibility. For the President is defender of the Constitution and guardian of the ideals first proclaimed in the Declaration of Independence.

The thirty-seven men who have shouldered this burden have been ordinary people, called by their countrymen to be shapers of America's destiny. Each the hope of future generations. The holder of what has become the most powerful office on earth.

Some strong and truly titans of their times, some weak; some movers of history, others swept by its tide; their story — the history of the Presidency — is the heritage of every American.

An official commemorative collection.

Now, on the eve of the inaugural of the first President of America's third century as a Nation, it is fitting for us to remember — and to honor — those men who, far surpassing even the most optimistic dreams of our Founding Fathers, have made the White House the focus of our history. The citadel of our freedom. The living symbol of America to us and to all the world.

To do so, in a lasting and significant way, The White House Historical Association — dedicated to enhancing every citizen's appreciation of the White House — has authorized the renowned Fleetwood Company to issue a collection of thirty-eight engraved Philatelic Commemorative Covers individually honoring all of *The Presidents of the United States*.

This is the first and only such collection ever to be authorized by the White House Historical Association and will be extraordinary in every respect.

A dignified and worthy tribute.

Historically accurate to the smallest detail, each Cover will focus on one President. Superbly produced on luxurious laid-fiber paper — the traditional paper of our Nation — each will be vividly cacheted with the President's portrait from the Official White House Collection. Masterpieces by such greats as Gilbert Stuart, Rembrandt Peale, Samuel F. B. Morse, they capture each President's character and vision with uncommon sensitivity.

Moreover, they will be handsomely engraved with the Presidents' signatures. Signatures that have been written with firm and determined hands in testament to the aspirations of a whole Nation; in witness to the great turning points of our history. Abraham Lincoln's, which freed the slaves. Thomas Jefferson's, which doubled the Nation's size. Theodore Roosevelt's that busted the trusts. And John F. Kennedy's that set America on course for the moon.

Appropriately, each will be officially issued and postmarked during 1977 on the *exact* anniversary of the President's birth at the place where he was born. Places now enshrined in our history.

The complete collection will be a dignified and worthy tribute to the lives, the times, and the achievements of our Presidents. From the youngest, John F. Kennedy, to the oldest, William H. Harrison, they are men who have had unshakable faith in America and its future, in its people and in its principles. Men who became part of our proud heritage as *The Presidents of the United States*.

One single, strictly limited edition.

The Presidents of the United States will be issued in a single, strictly limited edition. And the total number will be forever limited to the exact number of original subscriptions postmarked not later than February 22, 1977, with a limit of one collection per subscriber.

To assure the authenticity of this limited edition, each Cover will bear the imprimatur of the White House Historical Association and the distinctive hallmark of The Fleetwood Company — recognized since 1929 as America's foremost purveyor of Philatelic Commemorative Covers — which has been authorized by the White House Historical Association to produce the complete collection.

Handsome Collector's Album included.

Collectors who take advantage of this opportunity to acquire *The Presidents of the United States* will also receive, without additional cost, a handsomely bound collector's album. With narrative by historian David C. Whitney — one of America's most prominent authorities on the Presidency — this lavish, over 200-page album will bring each President and his times into vivid perspective. Privately prepared *exclusively* for individual subscribers to this collection, it will be a truly impressive addition to your library and a superb way of appreciating and protecting this most significant collection.

Convenient plan of acquisition.

Subscribers to *The Presidents of the United States* will receive issues at the convenient rate of three per month, beginning in late February, 1977, and concluding in January, 1978, with five issues. The original issue price of $2.50 per Cover ($7.50 per month) will be guaranteed for the entire collection. And to ensure the highest standards, each shipment will be delivered, unblemished by addressing, in a protective package. The album, provided at no additional cost, wil be shipped in August, 1977.

Subscription Deadline: February 22, 1977.

An Official Collection and one of historic importance to all Americans, *The Presidents of the United States* is certain to become a highly prized and admired collection in future years. One that will in a real sense be inspiration and pleasure for you to own; and an heirloom your children and their children will appreciate in years to come.

But please remember that there will be *only one*, limited edition of this collection, and that this is the *only time* that you will be able to acquire it. To take advantage of this opportunity, postmark your application no later than February 22, 1977. And mail it directly to The Fleetwood Company, 1 Unicover Center, Cheyenne, Wyoming 82008.

Official Subscription Application

The Presidents of the United States

Deadline for application: February 22, 1977
Limit: One subscription per person.

Fleetwood
Cheyenne, Wyoming 82008 C3

Please accept my subscription for the Collection of Official Philatelic Commemorative Covers of *The Presidents of the United States* authorized by The White House Historical Association. The collection will consist of 38 covers which will be sent to me at the rate of three per month beginning in late February, 1977. The total price of $2.50 per cover ($7.50 per month) is guaranteed for the entire collection. A handsomely designed collector's album will be sent to me at no additional cost.

☐ I enclose $7.50 for the first month's shipment. I will be billed for future shipments as made.

☐ Please charge $7.50 for each month's shipment to my credit card account below at the time the shipment is made:

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All applications subject to acceptance by Fleetwood

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honoring the
men who have led
the United States
to its third century.

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The 1977 Ford LTD has
but is priced like a

Ford LTD Landau
Wheelbase 121"

Cadillac deVille
Wheelbase 121½"

FORD

When America needs a better idea, Ford puts it on wheels.

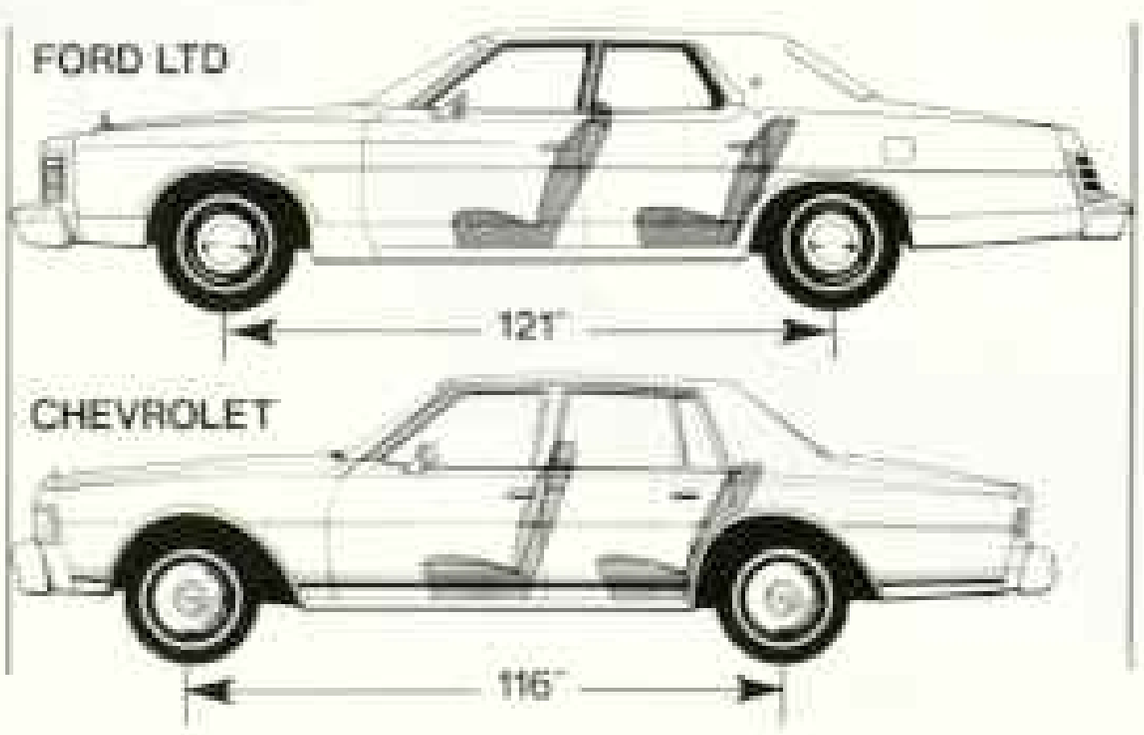
This year's "down-sizing" of General Motors full-size cars has created some surprising differences for the car buyer. For instance, the quiet-riding 1977 Ford LTD has a 121-inch wheelbase that is virtually the same as Cadillac's 121.5 inches. In fact, LTD is longer and wider than Cadillac and has a wider tread. And LTD trunk space of 21.9 cubic feet exceeds Cadillac's by more than 10%.

Interior space? Ford LTD has more front and rear hip room as well as more front and rear shoulder room.

Full-size Ford versus Down-sized Chevrolet

Compared to Chevrolet, Ford LTD is longer, wider, has a longer wheelbase, a wider tread, a bigger trunk, a bigger standard engine (V-8 versus 6-cylinder) and more hip room and more

the full-size of a Cadillac, down-sized Chevrolet.*



*Sticker prices for comparably equipped vehicles.

shoulder room in front and in back.

Yet, in spite of all these advantages, the full-size Ford is *priced about the same* as a comparably equipped down-sized Chevrolet. So when you pay a full-sized price, make sure you get a full-sized value like Ford LTD.

Test drive it at your Ford Dealer soon.

FORD LTD

FORD DIVISION

Enjoy a bigger world of good times. Start with our free adventure kit.

Chances are, you've already enjoyed most of the good time adventures within a 300-mile radius of your home.

Now, you'd like some new experiences. Something beyond the limits of earthbound travelers.

Beechcraft's far-reaching Baron can expand your adventure horizons. Sweep you to a wide new spectrum of events, activities and experiences.

The solitude of a wilderness camping trip. The nostalgia of a ride on a romantic old riverboat. The savory delight of a regional dish cooked where the recipe was born. The fulfillment of seeing unseen sights for the very first time.

The Beechcraft Baron can take you to good times located near all the major airports in this country... or those thousands of airports the airlines don't serve. And, on many of those trips, you'll use less fuel than a standard size car.

The Baron is a limited-production aircraft. Beech carefully blends meticulous handcrafting with the most advanced manufacturing processes. The cabin can be styled to reflect your individual taste in matters of elegance, comfort and convenience.

What better way to get your good times off the ground.

Just to get you started, we've put together an updated and expanded version of our popular Beechcraft Adventure Kit.

You'll find it an informative, entertaining guide to out-of-the-ordinary places and events in the U.S. We'd like to send you one free of charge.

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But we do urge you to write to us on your letterhead instead.

We'll send your Beechcraft Adventure Kit by return mail, absolutely free. And we know you'll like it.

Write to Beech Aircraft Corporation, Department A, Wichita, Kansas 67201.

Please include name, address, occupation, and title. Also, please let us know if you're already a pilot.

Beechcraft Baron 58P

Announcing

THE MASTERPIECES OF RUBENS

in 24 karat gold on sterling silver

The Franklin Mint presents

THE MASTERPIECES OF RUBENS

One hundred fine art medals
capturing the beauty and grandeur of the greatest works
of one of history's supreme artistic geniuses.
Issued in commemoration of the 400th anniversary of Rubens' birth.

First Edition Proof Sets available by subscription only.
Limit: One Proof Set per subscriber.
Subscription deadline: January 31, 1977.

FOR CENTURIES, PETER PAUL RUBENS has been universally acknowledged as one of the greatest artists who ever lived—a towering genius whose work stands proudly beside that of Michelangelo, da Vinci, Rembrandt and Raphael.

For Rubens was an artist of power and vision,

who could make even the most traditional subjects *come alive* with remarkable freshness and vitality. A brilliant artist who could capture the graceful beauty of the human form with a skill *unsurpassed* in the entire history of art. A master whose bold yet incredibly beautiful style ushered in the glorious Baroque era of great art—and whose work still stands as the ultimate achievement of that immensely creative period.

Now, at the 400th anniversary of his birth in 1577, the genius of Rubens will be captured for all time in a superb collection of one hundred fine art medals. The *first* such collection ever created to honor the achievements of this world-famous artist.

The First Edition of this historic collection, moreover, will be issued *solely* in 24 karat gold electroplate on sterling silver. It will be the *only* gold on sterling edition of The Masterpieces of Rubens that will *ever* be created. And it is being made available in *strictly* limited edition.

A magnificent treasury of fine medallic art

An artist of boundless creative energy, Peter Paul Rubens created more than a thousand brilliant works of art during his lifetime. It is the *one hundred greatest* of these works that will be portrayed in this superb new medal collection. Timeless masterpieces such as *The Raising of the Cross*, the sublime altarpiece considered one of the most inspiring creations in the history of art . . . *Rubens with His Wife Isabella Brant Amidst Honeysuckle Bower*, the exquisite wedding portrait that so perfectly captures Rubens' deep love for his wife . . . and *The Rape of the Daughters of Leucippus*, in which Rubens' genius for bringing realism and vitality to mythological themes reached its fullest expression.

Exquisitely sculptured, exacting detail

To capture both the exquisite detail and the scope of these immortal works, each medal in the collection will measure 44mm (1¾ inches) in diameter. Each medal, moreover, will be a work of art *in its own right*, sculptured and engraved by the renowned artists and craftsmen of The Franklin Mint, and struck with a flawless Proof finish, so that the dramatically frosted sculpture is set against a background of mirror-like brilliance.

Furthermore, a special collector's chest—handcrafted of the finest hardwoods in the rich Baroque style of Rubens' own time, fitted with velvet-lined drawers, and individually personalized with a nameplate bearing the name of its owner—will be furnished to each subscriber as part of the collection. In addition, an authoritative commentary that discusses the work of art portrayed and its importance in the history of art will accompany each medal.

Convenient acquisition plan

The Masterpieces of Rubens will be issued systematically at the rate of one new medal each month. The original issue price for each 24 karat gold on sterling silver medal is $29.50—and this price will be *guaranteed* for the complete collection.

To acquire your First Edition Proof Set, you must mail the accompanying Subscription Application by January 31, 1977. The total number of these sets to be issued in the United States will be permanently limited to the number of valid subscriptions postmarked by that date. Because of world-wide interest in the art of Rubens, this collection will also be made available later to collectors in other countries.

An heirloom collection of lasting value

The collector who acquires The Masterpieces of Rubens will possess an extraordinary series of fine art medals, capturing forever the exquisite beauty of one hundred of the greatest works of art ever created. A collection to own and display with pride. To treasure for a lifetime. To pass along to future generations as a cherished family heirloom.

So do be sure you mail your Subscription Application to The Franklin Mint, Franklin Center, Pennsylvania, no later than January 31, 1977.

SUBSCRIPTION APPLICATION

THE MASTERPIECES OF RUBENS

Must be postmarked by January 31, 1977

The Franklin Mint
Franklin Center, Pennsylvania 19091

Please enter my subscription for a First Edition Proof Set of The Masterpieces of Rubens, consisting of 100 Proof-quality medals in 24 karat gold on sterling silver.

These medals are to be sent to me at the rate of one per month. I need send no money now. I will be billed $29.50* for the first medal in advance of its shipment, and I agree to pay for each subsequent medal as it is sent to me. A custom-designed hardwood collector's chest will be sent to me separately at no additional charge.

**Plus my state sales tax.*

Signature _____
ALL APPLICATIONS SUBJECT TO ACCEPTANCE

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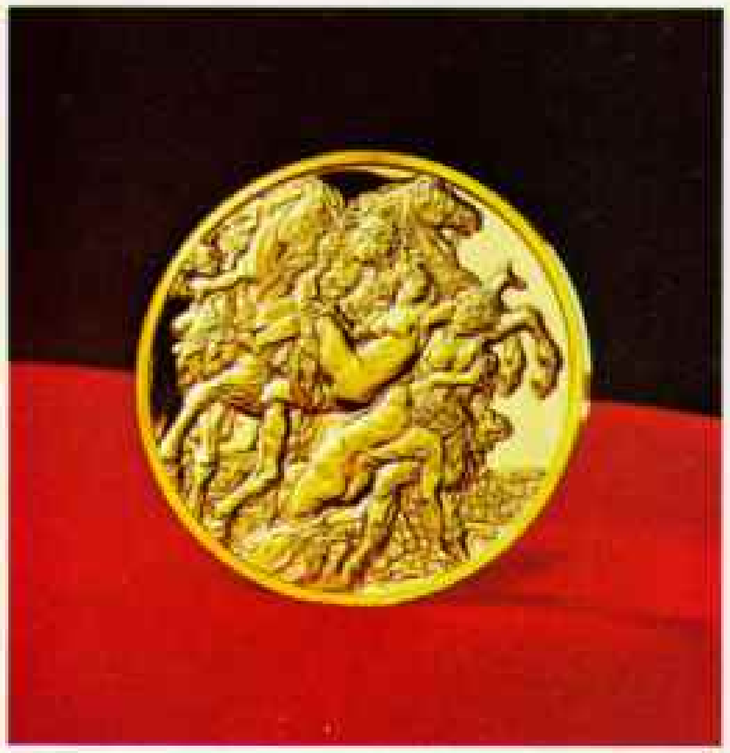
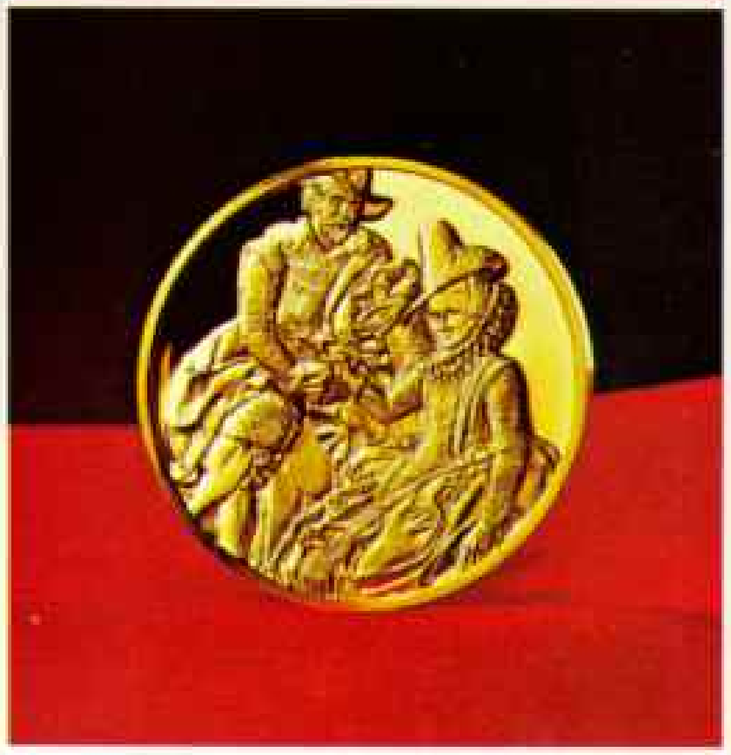
Also available in Canada at $39.50 per medal, plus provincial sales tax. Mail application to The Franklin Mint Canada Ltd., 70 Galaxy Boulevard, Rexdale, Ontario M9W 4Y7.

NATIONAL GEOGRAPHIC



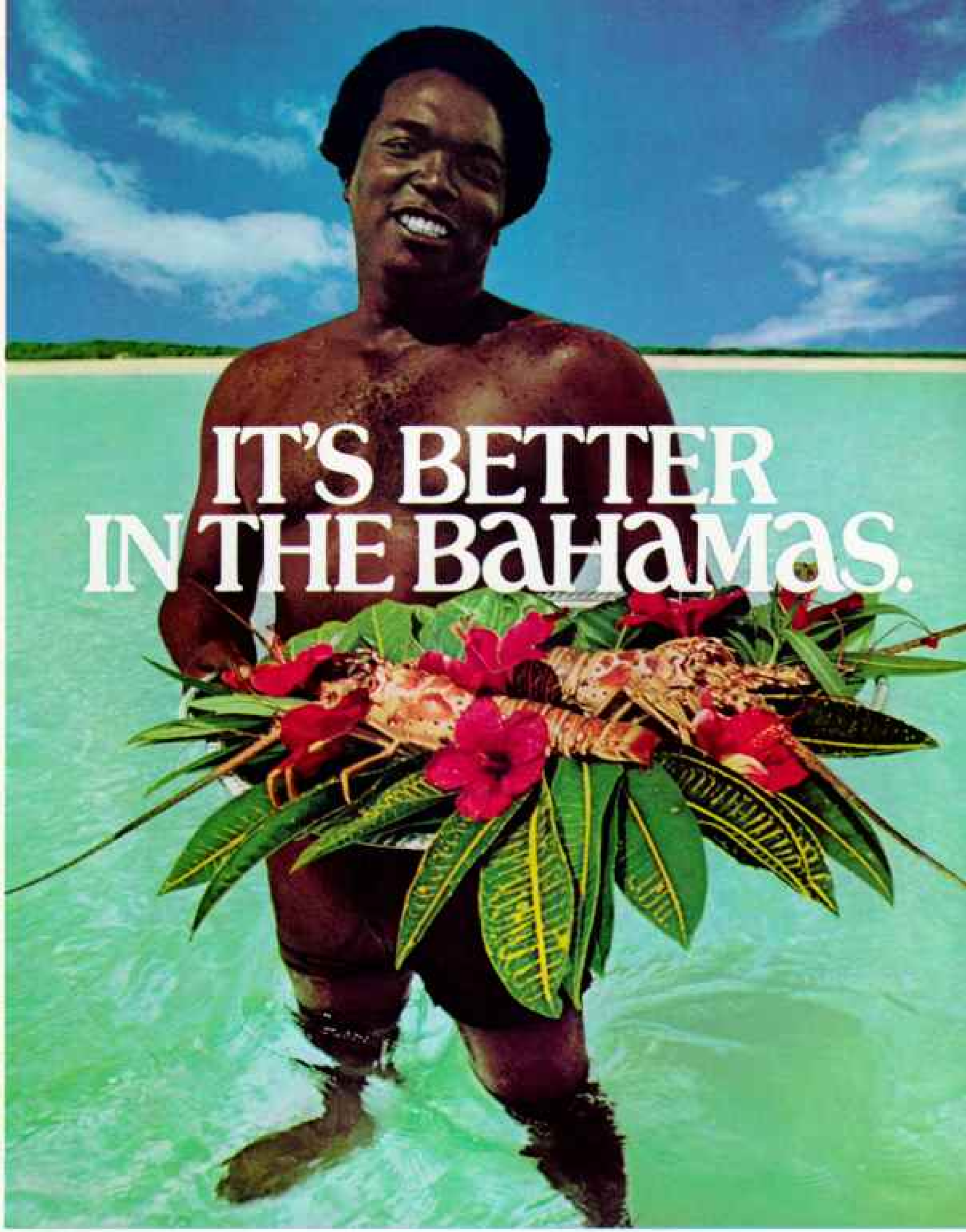


MEDALS SHOWN ACTUAL SIZE.

TOP: THE RAPE OF THE DAUGHTERS OF LEUCIPPUS

MIDDLE: PORTRAIT OF SUSANNA FOURMENT

BOTTOM: RUBENS WITH HIS WIFE ISABELLA BRANT AMIDST HONEYSUCKLE BOWER



There are places where food seems to taste better.

Where an afternoon of snorkeling, tennis, golf or just lying on a pure white sunny beach can work up an appetite like you never had before.

Where conch chowder, turtle pie and Bahamian lobster are seasoned with the kindness and laughter of the waiters.

And for dessert, there's guava duff, soursop ice cream or an evening in an elegant casino.

If you're beginning to get hungry for a different kind of vacation, come to Nassau/Paradise Island, Freeport/Lucaya or the easygoing Out Islands of The Bahamas.

See your Travel Agent for reservations. Or call us toll free at 800-327-0787. In Florida 800-432-5594. In Dade County 443-3821.

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BAHAMAS

Nassau/Paradise Island Freeport/Lucaya The Out Islands

Bran may be the richest source of food fiber in the American diet.

Food fiber's importance to our nutrition is rapidly gaining recognition. But we've known for years that Kellogg's fiber-rich cereals help the digestive system regulate itself.

Sources of fiber.

Generally speaking, food fiber is found in fruits, vegetables, and whole grains. But many Americans don't eat these foods in quantity anymore.

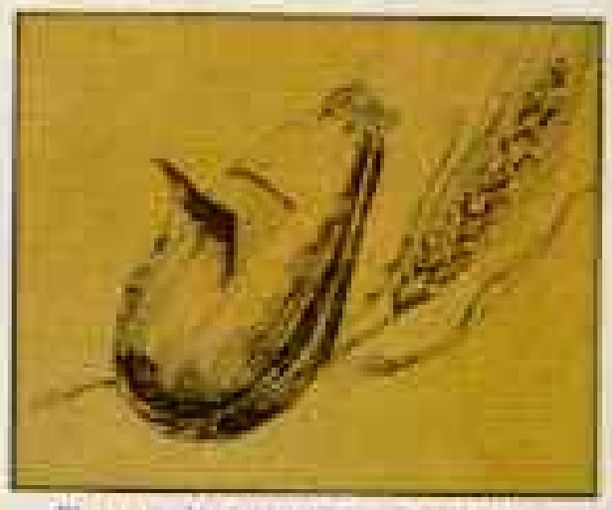
So while there are many American foods with some fiber content, there are few that are fiber-rich. Kellogg's® All-Bran® and Bran Buds® are an exception, for bran is one of nature's richest sources of food fiber.

How much fiber is enough?

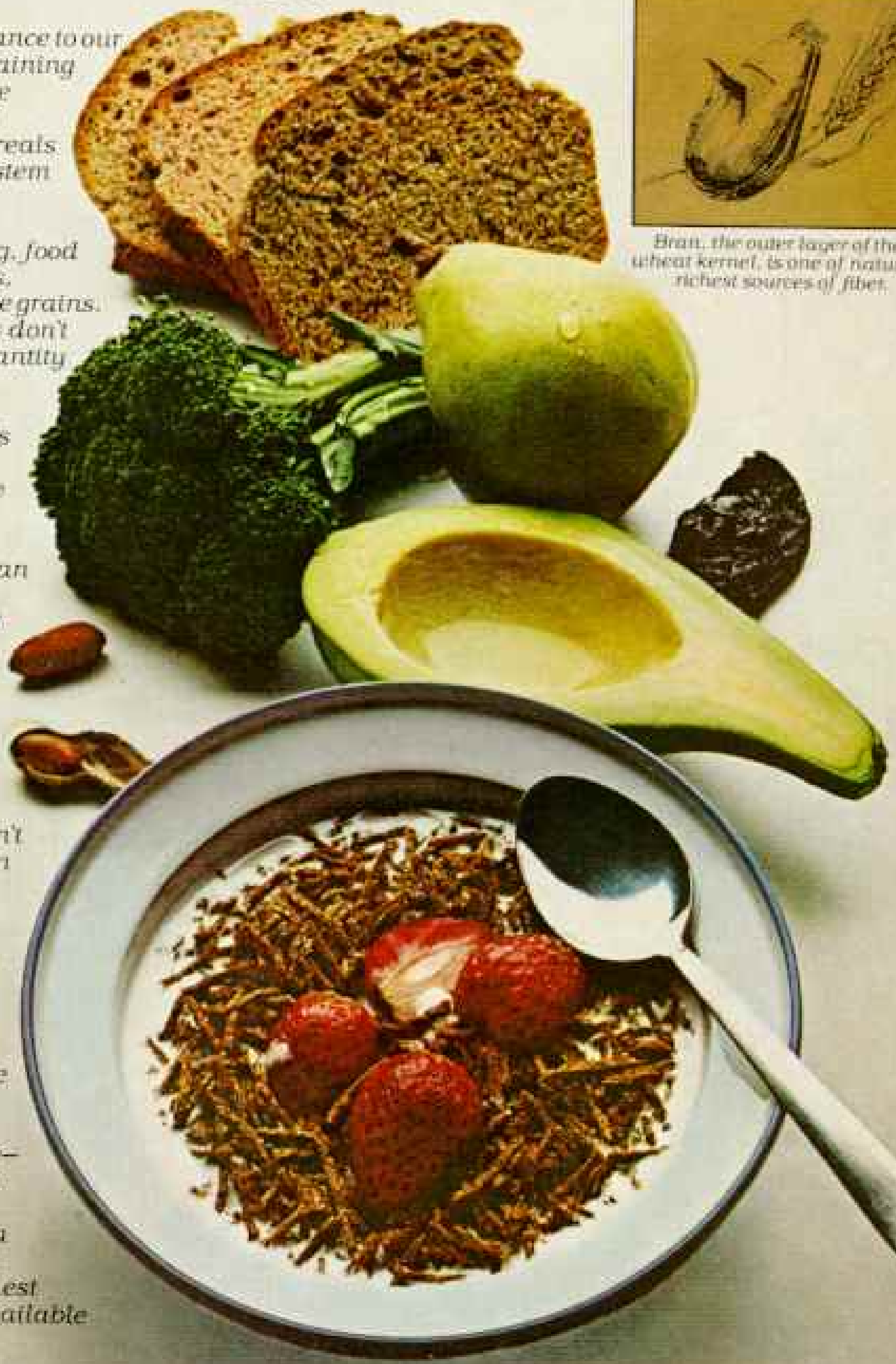
The clinical evidence isn't in. But what we do know so far suggests that many Americans aren't getting enough fiber in their normal diet.

If you're concerned about food fiber and your health, consider adding Kellogg's fiber-rich cereals to your diet. They have an honest wheat taste that stays crunchy in milk.

So take your choice—All-Bran, in shredded form, or Bran Buds, morsels of bran with a slightly sweeter taste. They're one of the richest sources of food fiber available to Americans.



Bran, the outer layer of the wheat kernel, is one of nature's richest sources of fiber.



All-Bran and Bran Buds.
The high-fiber cereals from
Kellogg's®

Ten things that will happen when you test drive Oldsmobile's new Delta 88.

1. Your first look will impress you.

The new proportions. Crisp. Contemporary. Clean. And the practicality of those lines will come to you as you drive this roomy new car.

2. Getting in is easier.

It's the way we've redesigned the door openings. Which also makes getting out easier. Which you may not want to do once you've experienced driving it.

3. You'll sit comfortably.

The chair-height seats are designed to provide a more comfortable driving position than you may ever have experienced before.

4. You'll like the visibility.

Look around you and you'll see that the generous glass area makes the new 88 easy to see out of. And also makes it easy for people to see how great you look in a new 88.

5. You see all instruments.

The instrument panel is designed to put all instruments in easy view and easy reach. So there is a distinct feeling of control in the driver's seat.

6. The ride is smooth and comfortable.

Olds engineers used computers to select the right combination of springs and shock-absorption rates. Result: a ride that's smooth and stable even over rough roads.

7. Suddenly it is very quiet.

Drive over a bumpy road or past a noisy construction site and give Delta 88 a real test. New body and engine mounts help isolate vibration, while new sound-absorption materials help insulate the passenger compartment.

8. Find a place to make a U-turn.

It's the best way to see and feel the 88's new tighter turning radius. You'll really appreciate it in a tight parking situation.

9. Make sure you take your family along.

Because you'll want them to experience (along with you, of course) the improved head room, and the increased leg room in back.

10. Improved gas mileage.

You can't experience it in a test drive. But smaller, lighter engines provide improved fuel economy in the new Delta 88: 25 mpg in the EPA highway test and 18 in the city test with the standard 231 V-6 engine, automatic transmission and rear axle. (EPA estimates. Your mileage depends on how you drive, your car's condition, and its equipment. In California, EPA estimates are lower.)

P.S. Some things you can't see. Like improved corrosion resistance. Or our new Central Diagnostic Connector that your Olds dealer can plug into and quickly check many electrical functions. It's all there in the 1977 Delta 88. The car it took Oldsmobile over 3 years to build for you.

Now take a few minutes to discover in a test drive its efficient new combination of roominess, comfort, and maneuverability.

Oldsmobile

DELTA 88.

Can we build one for you?

"That dam cost $90 million."

Dams! Extravagance or benefactor? An opportunity to enrich life, land, our economy. Or ecologically wasteful. How should water management projects be viewed?

Dams are costly, in dollars, and in change they bring. Flooding out valleys, submerging vegetation, driving out wildlife. In some places displacing families, whole communities. A region that lived one way must now live differently. To some the price of these changes outweighs the gains.

But dams can do great good. A case in point is the Cochiti Lake Dam near Albuquerque, New Mexico. It traps water that once flashflooded Rio Grande Valley towns for 120 miles and releases it slowly, harmlessly. The dam traps a thick red sediment that once polluted the Rio Grande River, settling out of flood waters to suffocate plant life in neighboring fields.

A 1,200-acre permanent "pool" was called for by the state. The resulting year-round lake brings recreation to the city of Albuquerque an hour's drive away.

Projects like the Cochiti Lake show the opportunities creative water management can provide.

There is no doubt that environmental, economic, and social consequences should be considered with every water project. But those consequences should guide rather than detor the development of America's water resources.

Caterpillar machines are used to build dams, levees, irrigation systems. Our engines power pumps and dredges. We believe responsible water management benefits all Americans.

"That dam protects property for 120 miles."

There are no simple solutions. Only intelligent choices.

CATERPILLAR

Caterpillar, Cat and the Cat are Trademarks of Caterpillar Tractor Co.

Put winter in its place.

Put the cold and gloom far behind you. Eastern's got an exclusive Second Vacation Bonus that gets you 8 days/7 nights at luxury hotels in Florida, the Bahamas or the Caribbean.

Then a bonus 4-day/3-night vacation to enjoy between May 1 and Dec. 15, 1977. Stay at the same hotel or another participating hotel. All you pay for is your Eastern ticket. For example: Take 8 days/7 nights at the El San Juan Hotel in Puerto Rico. Includes admission to Folkloric Ballet, greens fees at selected courses, Light & Sound spectacle, and more. $224-$266* plus airfare.

Or enjoy 8 days/7 nights at Miami Beach's Fontainebleau Hotel. $246-$288* plus airfare. Later enjoy your 4-day/3-night bonus at either hotel or others in Florida, Freeport or the Caribbean. See your travel agent for details. Or call Eastern. We've got the right time and the right place for you.

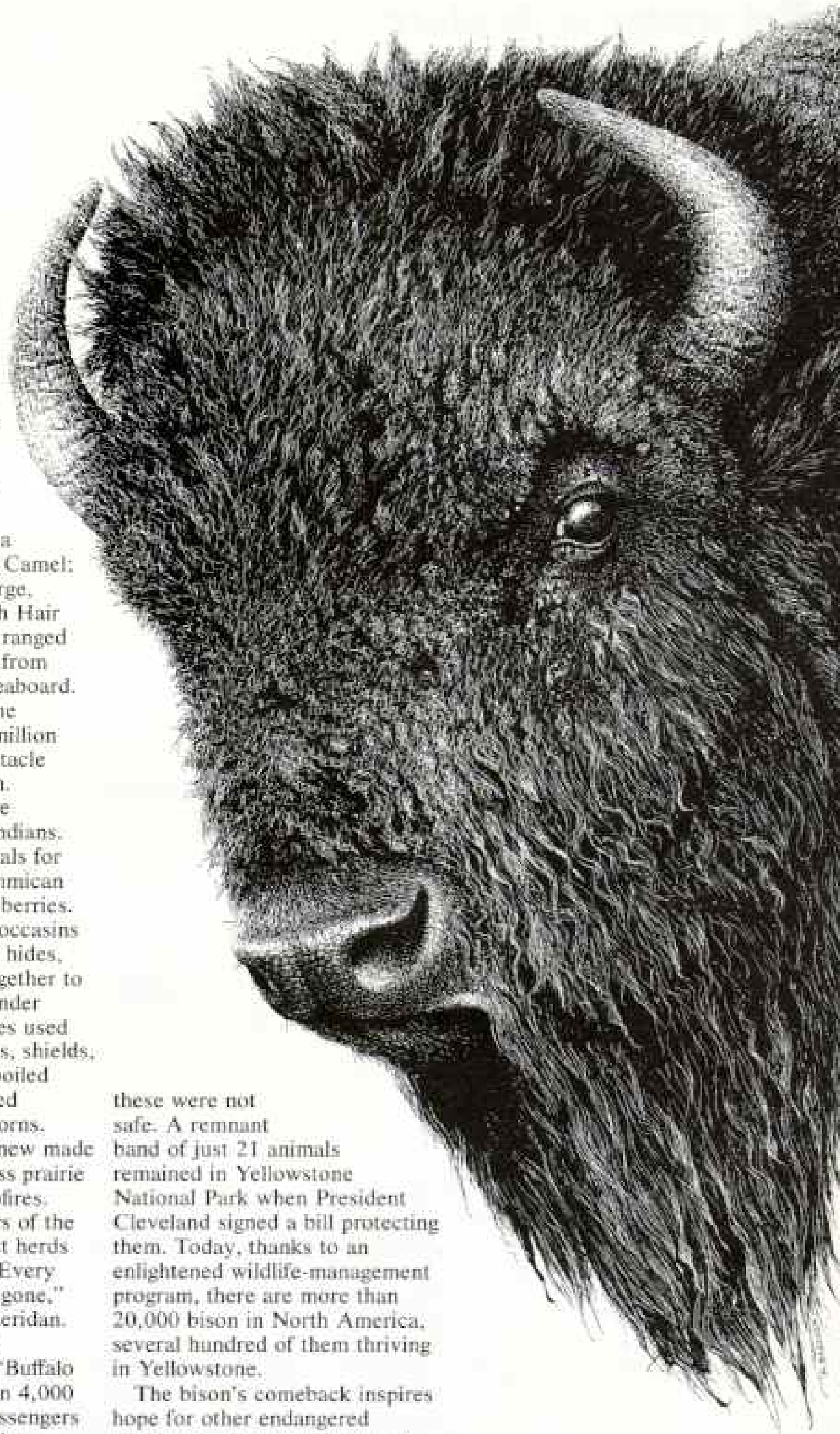
Take 8 days now. Get 4 bonus days later.

EASTERN
THE WINGS OF MAN

We've got your sunshine

*PRICES ARE PER PERSON, DOUBLE OCCUPANCY AND DON'T INCLUDE AIRFARE, TAXES, MEALS AND TRANSFERS UNLESS INDICATED; MINIMUM PRICE AT EL SAN JUAN NOT AVAILABLE OVER CERTAIN PERIODS. FOR BONUS VACATION HOTEL CHOICES AND RESTRICTIONS SEE YOUR TRAVEL AGENT OR EASTERN. EFFECTIVE: 12/10/76-4/30/77. PRICES SUBJECT TO CHANGE. "THE WINGS OF MAN" IS A REGISTERED SERVICE MARK OF EASTERN AIR LINES, Inc.

The bison's comeback, a saga of survival



"A wonderful composition of divers Animals," the bison was described by an awed 16th-century conquistador. "It has crooked Shoulders, with a Bunch on its Back like a Camel: its Flanks dry, its Tail large, and its Neck cover'd with Hair like a Lion." Bison once ranged from Mexico to Canada, from Oregon to the Eastern Seaboard. They thundered across the western plains some 60 million strong—the greatest spectacle of herd animals ever seen.

The shaggy beasts were indispensable to Plains Indians. They butchered the animals for fresh meat and made pemmican of it dried and mixed with berries. The Indians fashioned moccasins and leggings from tanned hides, stitched scraped hides together to cover tepees, and slept under warm buffalo robes. Tribes used rawhide for saddles, ropes, shields, and cooking pots. They boiled hooves for glue and carved spoons and ladles from horns. Bones served as tools; sinew made bowstrings. On the treeless prairie buffalo chips fueled campfires.

In the great Indian wars of the late 19th century, the vast herds were all but wiped out. "Every buffalo dead is an Indian gone," calculated Gen. Philip Sheridan. Professional hide hunters continued the slaughter. "Buffalo Bill" Cody shot more than 4,000 animals in 18 months. Passengers on trains fired at stampeding herds—a popular sport.

Hides sold for $1.25 each, tongues for 25 cents. Most of the rest was left to rot. By 1889 fewer than 1,500 bison survived in the United States. But even these were not safe. A remnant band of just 21 animals remained in Yellowstone National Park when President Cleveland signed a bill protecting them. Today, thanks to an enlightened wildlife-management program, there are more than 20,000 bison in North America, several hundred of them thriving in Yellowstone.

The bison's comeback inspires hope for other endangered creatures—the whooping crane, for example. Conservation of wildlife remains a continuing challenge. That fact of life—and death—is stressed repeatedly, as members know, in the pages of NATIONAL GEOGRAPHIC.

Thirteen beautiful fine American porcelain china collector's plates depicting the coats of arms of each of our original thirteen states...

To be issued in strictly limited edition. Limit: One subscription per person. Subscription deadline: January 31, 1977.

200 years ago, thirteen American colonies united to form one independent nation. Now, to permanently honor that historic event, The Silvermark Society has directed The Humphreys Asburn Middaugh Archives to commission and distribute its **official commemorative tribute** to the Thirteen Original States of the Union—an original series of thirteen magnificent collector's plates to be crafted in fine American porcelain china and decorated with 24 karat gold. This superb *First States of the Union Plate Collection* is the **first** and **only** series of collector's plates ever authorized by the Society—a prestigious group of collectors of fine art works.

Depicting the coats of arms of our thirteen original states, this incomparable collection will surpass other less significant series now selling for much more on the collector's market. (Naturally, the accompanying illustration can only hint at the beauty of the plates in this collection.)

The First States of the Union Plate Collection will be issued in a strictly limited edition—exclusively for individual subscribers. None of the plates will be sold in art galleries or even in the finest stores. They will be available **only** as a collection and **only** by direct subscription, and will be accompanied by **a remarkable bicentennial gift** and **an exceptional investment guarantee** for subscribers.

A collection of historic significance

The original "coat of arms" was the surcoat, a garment worn over body armor in the Middle Ages, on which knights emblazoned devices so their soldiers could recognize and rally around them in battle. In time coats of arms came to signify the achievements and enterprises of individuals and families, nations and states. *The First States of the Union Plate Collection* faithfully captures the colorful, historic, and strikingly beautiful designs of each coat of arms of our thirteen original states. Complete descriptive notes fully explaining each part of the design will be included with every plate.

Crafted in fine American porcelain china

These outstanding plates will be crafted to the most exacting standards in fine American porcelain china. This noblest of chinas combines surpassing antique whiteness, translucence, and strength unequalled by other porcelains. Each plate will be impeccably crafted by Ridgewood of Southampton, Pennsylvania, premier fabricator of fine-art American porcelain china.

Each exceptional plate will measure a full 10½ inches in diameter. Every detail of every coat of arms will be precisely and accurately depicted. A virtual "rainbow" of colors will be used in the creation of each of these spectacular plates, to achieve the exact tones, shades, and hues of each coat of arms. In addition, to further increase the elegance of the collection, every plate will be **decorated with a border of precious 24 karat gold.**

To insure the flawlessness of this monumental collection, every fine American porcelain china plate will be meticulously inspected at every stage of its production—35 painstaking hand operations and 3 individual firings, at temperatures up to 2,150 degrees. And each plate **must** meet the high quality standards established by Ridgewood, The Silvermark Society, and The Humphreys Asburn Middaugh Archives before it will be accepted for issuance to subscribers.

Delaware

"The First State"

A strictly limited edition

The First States of the Union Plate Collection will be issued in **a strictly limited edition—with an absolute limit of one set per subscriber.** The total number of complete sets will be permanently limited to the exact number of individual subscribers. Once the issuance of the plates to the subscribers has been completed, **this collection will never be issued again.** Therefore, anyone who wishes to obtain this collection at a later date can only acquire it from an original subscriber, at whatever price he chooses to require.

Because of the consummate artistry and craftsmanship required to create these stunning plates, production will necessarily be slow. The first plate will be sent to subscribers 8 to 12 weeks after the subscription rolls close, and subsequent plates will be issued at the rate of one every other month.

The original issue price for each fine American porcelain china plate is $50, to be billed in two equal monthly installments.

An heirloom collection

All who love fine works of art will treasure these unparalleled fine American porcelain china collector's plates, for the significance of their design, for their brilliance and accuracy of color, for their extraordinary craftsmanship. And for their uniqueness as the **first** and **only** collector's plates authorized by The Silvermark Society—as an unprecedented commemoration of our nation's bicentennial and the commencement of its second 200 years.

Displayed proudly in the home, this valuable collection will be enjoyed and admired by family and friends alike. Moreover, they will become cherished collector's treasures to be prized by future generations as well.

A bicentennial gift to subscribers

Upon completion of this magnificent collection, The Silvermark Society has authorized The Humphreys Asburn Middaugh Archives to send each subscriber **a fourteenth plate,** depicting the coat of arms of the United States. This additional plate will not be available to anyone, anywhere, in any other way, and it will be **a free bicentennial gift to subscribers only.**

An exceptional investment guarantee

While no one can promise that the worth of any work of art will increase, fine porcelain china collector's plates have traditionally been outstanding investments. So confident are we of the enduring value of *The First States of the Union Plate Collection* that The Humphreys Asburn Middaugh Archives will **guarantee to repurchase,** for its full original purchase price, any complete collection at any time within five years after its completion, provided all plates are in their original condition and packaging. So far as we know, this repurchase guarantee is unique.*

Subscription deadline: January 31, 1977

To take advantage of this opportunity to acquire *The First States of the Union Plate Collection*, your subscription application **must** be mailed by January 31, 1977. Applications postmarked after that date **must,** regretfully, be returned. Do not send any payment at this time, but be sure your application is postmarked no later than January 31, 1977.

Advance Subscription Application
Valid only if postmarked by January 31, 1977
Limit: One collection per subscriber

The Humphreys Asburn Middaugh Archives, Inc., 429 Meeker St., South Orange, N.J. 07079

Please enter my subscription for *The First States of the Union Plate Collection*, consisting of thirteen collector's plates in fine American porcelain china, depicting the coats of arms of each of the original thirteen states. The plates are to be shipped to me at the rate of one every other month, beginning 8 to 12 weeks after the subscription rolls close.

I understand that I need send no money now. I will be billed $50* for each plate in two equal monthly installments of $25* each, beginning with its shipment.

Upon my completion of the collection, I will receive a fourteenth plate, depicting the coat of arms of the United States, absolutely free. In addition, I will receive your unique 5-year repurchase guarantee.

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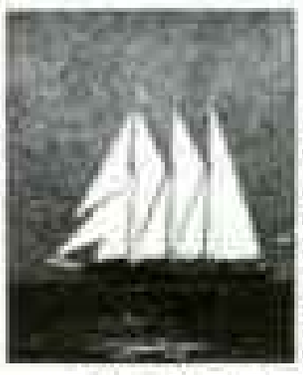

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