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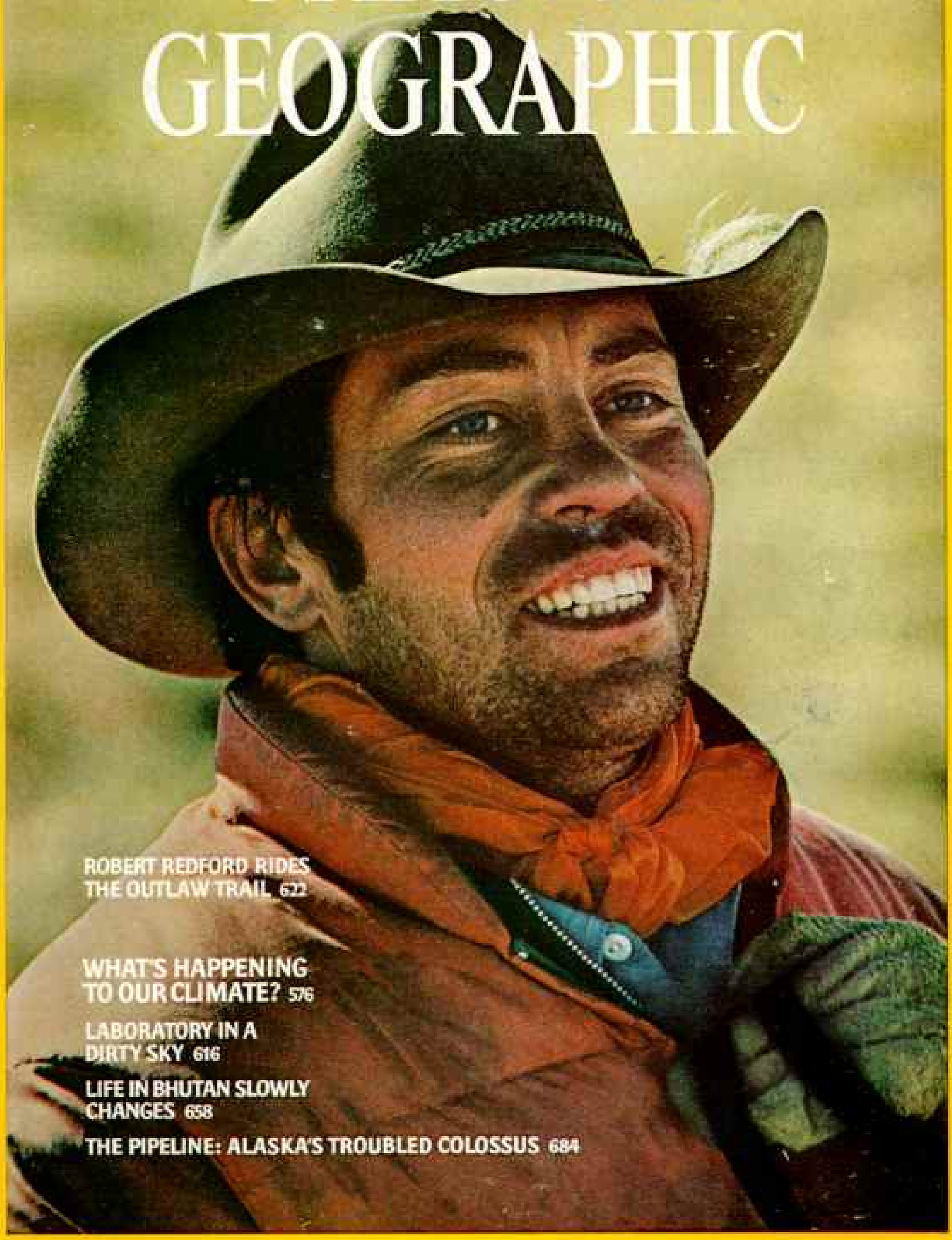
NATIONAL GEOGRAPHIC



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

THIS HAS BEEN a year of extraordinary events—the tall ships sailing into New York Harbor on that marvelous July 4, those unforgettable Olympic performances in Montreal, the pageantry of two political conventions, the successful landing and search for life on Mars. The difference between our own time and any other is that now everyone can vicariously attend these happenings through the powerful medium of television. In conveying their excitement and color, television is unsurpassed—but, unfortunately, these wonderful moments do not make up the bulk of network programming. Much of it is drab, a gray droning in the background of American family life.

More than a decade ago, the National Geographic Society decided there was a place in television for programs characterized by the same qualities we seek to maintain in the magazine. "Americans on Everest" premiered in September 1965 as the grand beginning of what has proved to be among the longest-running and most honored documentary series in the history of television.

Last year our programs found a comfortable home with the Public Broadcasting Service, thanks to a generous grant from Gulf Oil Corporation. We were all delighted when "The Incredible Machine," that stunning film on the human body, accomplished a unique feat, swamping competing programs on commercial networks in New York, Boston, and Los Angeles.

A new series, co-produced with station WQED/Pittsburgh, begins next month. We hope to keep luring millions of viewers to the public side of the broadcasting band with programs that offer high adventure and educational content. On Tuesday, December 7, we share in one of the most fascinating and tragedy-shadowed treasure hunts of modern times as Mel Fisher locates the wreck of the Spanish galleon *Atocha*, battered and sunk off Florida by a hurricane in 1622.

On January 18 we join the crew of the voyaging canoe *Hokule'a* as they cross 3,000 miles of open Pacific, using only the navigation methods—wind, wave, star, and bird—of the ancient Polynesians. On February 15 we take a fascinating, and moving, look at "The New Indians"—four native Americans seeking to preserve their identity in a mass society. And on March 8 we travel the great Volga River, known to the Russians as Matushka, Mother, through the heartland of the Soviet Union.

For these voyages of discovery, the only reservation required is your television dial, turned to public television.

Gilbert M. Grosvenor

NATIONAL GEOGRAPHIC

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November 1976

COVER: *Working cowboy A. C. Ekker travels with author Robert Redford, searching for the ghosts and memories of the Outlaw Trail (pages 622-657). Photograph by Jonathan Blair.*

What's Happening to Our Climate?

By SAMUEL W. MATTHEWS
ASSISTANT EDITOR

Temperatures change, storm tracks and drought belts shift, as scientists search for answers around the world.

NATIONAL GEOGRAPHIC PHOTOGRAPHER STEVE RAYMER

Food supplies could shrink if the planet cools. Nobel Prize-winning plant breeder Dr. Norman E. Borlaug studies a high-yield wheat strain.

THE IRISH AIRLINES 707, westbound from Shannon to Boston, rode 37,000 feet above the cloudless North Atlantic. Inside, boisterous song filled the jet; Dublin's brawny rugby champions were headed for a challenge match in Bermuda. Champagne flowed, the colleens smiled, and the sun blessed that dazzling day in May and the wide ocean below.

Far ahead of us a sharp edge of white broke the dark expanse of sea. As we drew closer, it became a lacy border stretching north and south from horizon to horizon, like a wedding veil thrown across a blue counterpane. Beyond the lace, stark solid white overwhelmed the blue, mantling the world.

What lay below, I realized suddenly, was not cloud but ice. We were over the Labrador Sea, southwest of Greenland. Beneath us the cold Labrador Current, covered almost solidly with floe ice, met the much warmer Gulf Stream at this sharply drawn frontier off the shores of Newfoundland.

Here, in full view, were three principal keys to the climate of northern Europe—indeed, of the world as a whole: the sun pouring down its energy; ice and snow bouncing it back; and varying temperature of the sea surface. These three forces, European scientists had just been telling me, may be the dominant ones controlling their weather.

A noted British historian of climate, Professor Hubert H. Lamb of the University of East Anglia (page 583), was making season-long weather forecasts chiefly from sea temperatures of the northwestern Atlantic. And glaciologist Willi Dansgaard of the University of Copenhagen, reading past climate from snow layers of the Greenland ice cap, sees in them hints about Europe's future.

That earth's climate changes, and even now may be changing quite rapidly, is widely recognized. The questions facing worried experts are: Is the world as a whole cooling off, and perhaps heading into another onset of huge ice sheets? Or are we instead warming the atmosphere of our planet irreversibly with our industry, automobiles, and land-clearing practices? What sort of weather will our children and our grandchildren know? On the answers may rest the fate of nations and of millions of people.

"The mystery of what controls our climate —and which way *(Continued on page 581)*

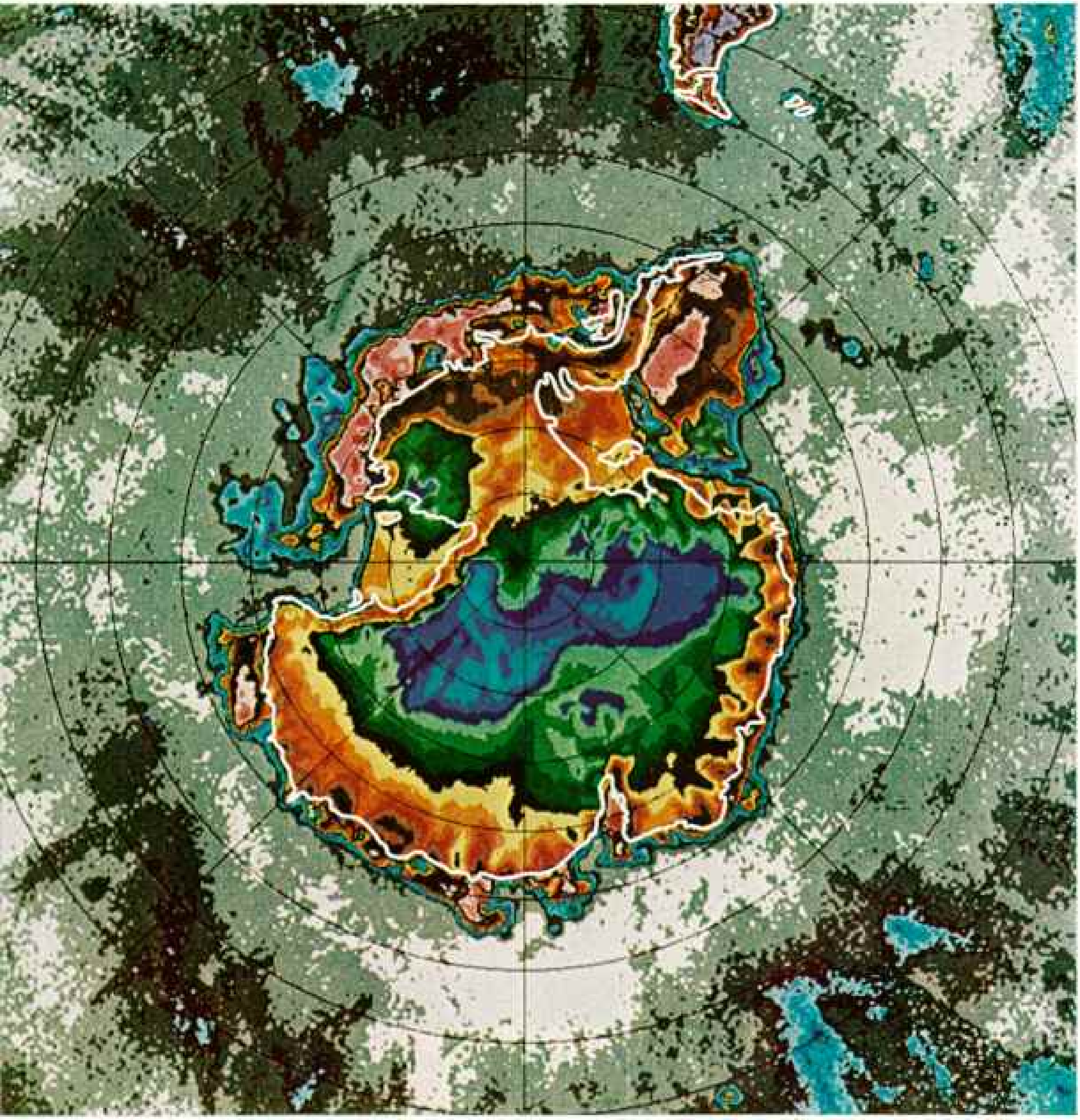
NATIONAL GEOGRAPHIC PHOTOGRAPHER ROBERT W. MADDEN

Weather report from yesterday unfolds as climatologists date annual layers of snow buildup in Antarctica. Worldwide, average temperatures have dropped about half a degree F. after six decades of abnormal warmth, during which world population doubled.

The frigid pulse of Antarctica

EXPANDING and contracting in rhythm with the seasons, the south polar ice sheet demonstrates how quickly vast expanses of ice can form. Microwave radiation images recorded by the Nimbus 5 satellite are color-coded to reveal differences in snow and water surfaces. They show the entire continent, outlined in white, with frozen winter seas doubling the extent of Antarctic ice.

In late January (**left**), high summer at the South Pole, sea ice barely fringes the landmass, whose lofty inland ice dome indicates in shades of green



and dark blue relatively low rates of snow accumulation. Eight months later, before the end of polar winter (**right**), floating ice extends far out to sea, appearing in hues of rose and brown. Offshore winds and upwellings of warm water keep open a gray patch of ocean off the coast at right.

Scientists do not yet fully understand the role of polar ice in climatic change. The West Antarctic ice sheet, for example, southwest of the Antarctic Peninsula, may be gradually shrinking. Is the present warm interglacial climate causing it to melt and raise sea level worldwide? Or will the warmth cause added evaporation and snowfall that will eventually re-enlarge Antarctica's ice cap?

Understanding the mechanisms of sun, ocean currents, and ice remains critical to anticipating future climate. By some cooling process in ages past, ice buildup has triggered huge glacial marches across the planet's face. Climatologists assume it will happen again, but they still lack the data to tell whether we have already entered a major cooling period.

BOTH FROM GODDARD SPACE FLIGHT CENTER, NASA

The ice wall cometh to a forest in south-central Alaska (**left**), where Meares Glacier nudges toward Prince William Sound at 100 feet a year. At triple that pace, other rivers of ice flow down Mount McKinley's vegetation-mantled slopes, red in this false-color Landsat portrait (**below**). Miniatures of the great ice sheets that advance about every 100,000 years, glaciers serve as thermometers for lesser temperature changes. Most scientists agree that today's ice movement may reflect a worldwide cooling trend, but their explanations vary widely.

WILLIAM O. FIELD, AMERICAN GEOGRAPHICAL SOCIETY (LEFT); GODDARD SPACE FLIGHT CENTER, NASA

it will go next—may be the biggest question about the earth yet to be answered," marine geologist John Imbrie told me at Brown University in Rhode Island. Dr. Imbrie helps lead a major U. S. Government-funded effort, nicknamed CLIMAP (for Climate: Long-Range Investigation, Mapping, and Prediction), to chart weather patterns of the past in hope of learning what may happen in the future.

"In the 1970's, really for the first time, we have the tools—satellites, big computers, and so on—as well as the data to attack that question. To me, this is the most exciting and critical challenge facing science today."

And just what is going on with the climate? What changes are taking place around us?

"From 1880 to about 1940 the world—particularly the Northern Hemisphere—went through a period of significant warming," I heard from tall, quiet-spoken Dr. J. Murray Mitchell, Jr., of the National Oceanic and Atmospheric Administration (NOAA); he is one of this nation's most respected climatologists (next page). He went on: "But since about 1940, there has been a distinct drop in average global temperature. It's fallen about half a degree Fahrenheit—even more in high latitudes of the Northern Hemisphere."

England's annual growing season shrank by nine or ten days between 1950 and 1966, Hubert Lamb has noted. In the northern tier of the U. S. Midwest, summer frosts again occasionally damage crops.

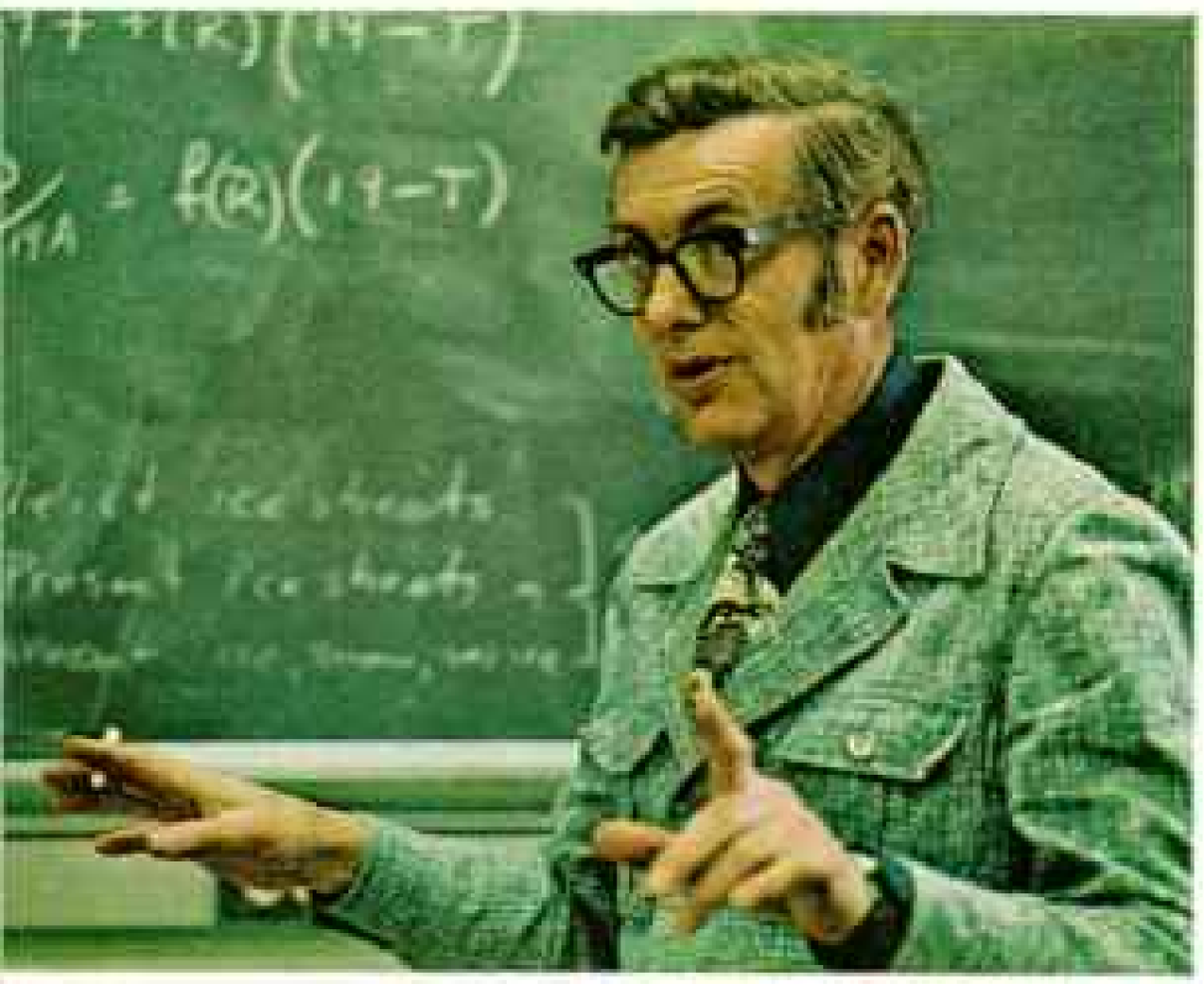
Sea ice has returned to Iceland's coasts after more than forty years of virtual absence.

> ***During the last 20 to 30 years, world temperature has fallen, irregularly at first but more sharply over the last decade.***
>
> U. S. NATIONAL SCIENCE BOARD, 1974

Glaciers in Alaska and Scandinavia have slowed their recession; some in Switzerland have begun advancing again.

Yet, oddly, in the eastern United States, western Soviet Union, and much of Europe the winters of 1973 through 1975 were the warmest in decades. And recent studies have hinted that the Southern Hemisphere may be

Cooling trend of world climate was documented in the 1960's by J. Murray Mitchell, Jr., of the National Oceanic and Atmospheric Administration (NOAA). Now, he notes, carbon dioxide pollution may be contributing to an opposite, or warming, tendency.



BILL MEEMS (UPPER); STEVE RAYMER

"Human volcano": Reid A. Bryson of the University of Wisconsin coined that phrase to describe how an exploding population has flung particulate matter, such as dust from cultivation, into the atmosphere. There it blocks solar rays, and surface temperatures drop. In the complex climate equation, this may be a critical factor, he believes.

warming by at least as much as the Northern has been cooling off.

"It is possible that we are on the brink of a several-decade-long period of rapid warming," observes Dr. Wallace S. Broecker of Columbia University's Lamont-Doherty Geological Observatory. "If the natural cooling trend bottoms out . . . global temperature would begin a dramatic rise . . . this warming would, by the year 2000, bring average global temperatures beyond the range experienced during the past 1,000 years."

A steady buildup of carbon dioxide in the earth's atmosphere from the burning of fossil fuel—coal and oil—has occurred since the industrial revolution began. Higher levels of this colorless, odorless gas tend to warm up

> ***Were the cooling trend to reverse . . . the earth could warm relatively rapidly, with potentially catastrophic effect.***
>
> NATIONAL SCIENCE FOUNDATION, 1975

the planet by the so-called greenhouse effect, holding in the infrared radiation—heat—that would otherwise escape into space.

The CO_2 level is already up more than 10 percent since 1850; by the year 2000, experts say, it may have risen another 20 percent, enough to cause a 0.6° C. (1° F.) rise in average world temperature.

OTHER SCIENTISTS debate whether particles thrown up by man—in smoke from industry and slash-and-burn agriculture, in dust from cleared land, in exhausts from cars and aircraft—also warm the atmosphere, or have an opposite effect, cooling off the earth by reflecting incoming sunlight.

The violent eruption of Bali's Mount Agung in 1963 threw enough volcanic dust into the stratosphere to reduce measurably the amount of solar radiation reaching the ground around the world.

The effect was only temporary. But the sensitivity of climate was pointed up independently by a Soviet and an American scientist, who concluded that a permanent drop of only 1.6 to 2 percent in energy reaching the earth "would lead to an unstable condition in which continental snow cover would advance to the Equator *(Continued on page 589)*

Writing the history of climate before weather records were kept, Hubert H. Lamb of Britain's University of East Anglia scours old journals, farm lore, and ships' logs to chart a thousand years of the past. His work will add insights to puzzling climatic shifts.

A storm of transistors churns simulated weather in a giant NOAA computer for U. S. meteorologist Joseph Smagorinsky. The Princeton-based machine ranks among the world's fastest; even so, to calculate global weather for one day takes it six hours.

MICHAEL HARDY (UPPER LEFT); PETE SOUZA (UPPER RIGHT AND LOWER LEFT); THOMAS NEBBIA

Library from the deep stretches behind James D. Hays of Columbia University's Lamont-Doherty Geological Observatory, where oceanographers add to climate knowledge. Stacks of seafloor cores enable Dr. Hays to "read" seawater temperatures of the distant past, invaluable data for Project CLIMAP (pages 592-3).

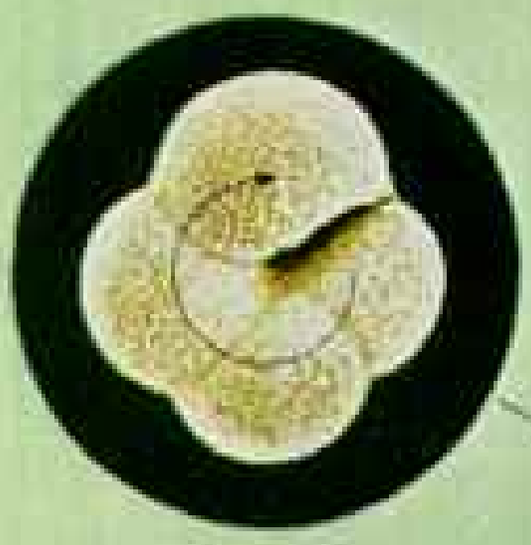
Crystal ball of glacial ice may help Willi Dansgaard of the University of Copenhagen predict Western Europe's climate, which appears to lag 250 years behind Greenland's. If his analyses are correct, Europe could be in for a cooler future, although he cautions that man-made atmospheric pollution "may completely change the picture."

Climatic clues

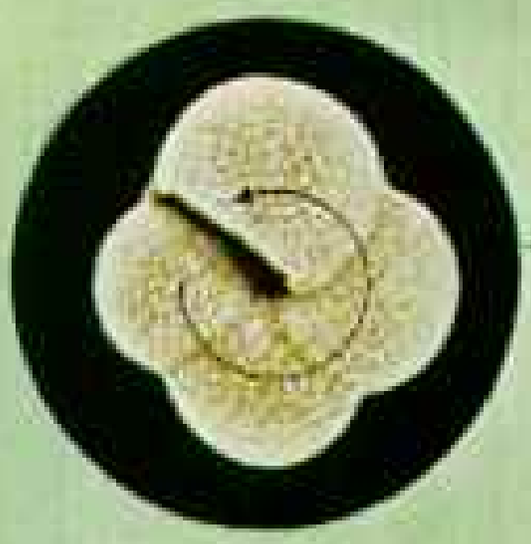
THE HISTORY OF CLIMATE on our planet has been marked by the chilling grip of massive ice ages and the certainty of change. All of human civilization has taken place within one particularly benign period of some 10,000 years. Each climatic era leaves evidence of its presence—clues now sought to help unravel the future by reconstructing the past.

SEA CORES

RAIN OF DEBRIS on the ocean floor offers a record of climate above the surface. The types of tiny fossils found at different levels in the sample show sea temperatures of the far past. Analysis of sediments in this tubular core, taken from the North Atlantic, provided glimpses of world climate over a span of 100 million years.



SEA CREATURE the size of a pinhead, *Neogloboquadrina pachyderma*, forms a shell spiraling one way (above) in water colder than 45° F. (7° C.) and the other way (below) in warmer conditions.



RAPID CHANGE in Northern Hemisphere climate from subtropical to glacial about three million years ago represents a major discovery from this core.

3 MILLION YEARS AGO

EVEN WARMER WATER, above 50° F., is revealed by another species, *Globorotalia menardii*.

5 MILLION YEARS AGO

DRILL SHIP *Glomar Challenger* brings up cores from the ocean floors so scientists can read the story of climate in the sediments.

45 MILLION YEARS AGO

PAINTING BY WILLIAM R. BOND
NATIONAL GEOGRAPHIC ART DIVISION

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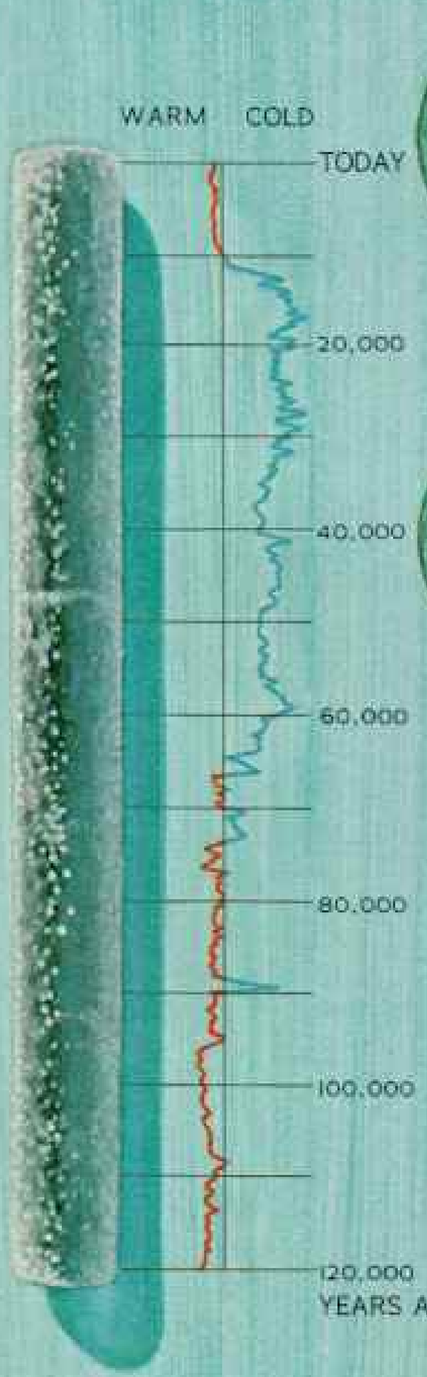


TEMPERATURE CURVE at top portrays current warm period with small polar ice caps.

POLAR SHEETS expanded during major ice ages. The last advance began about 70,000 years ago.

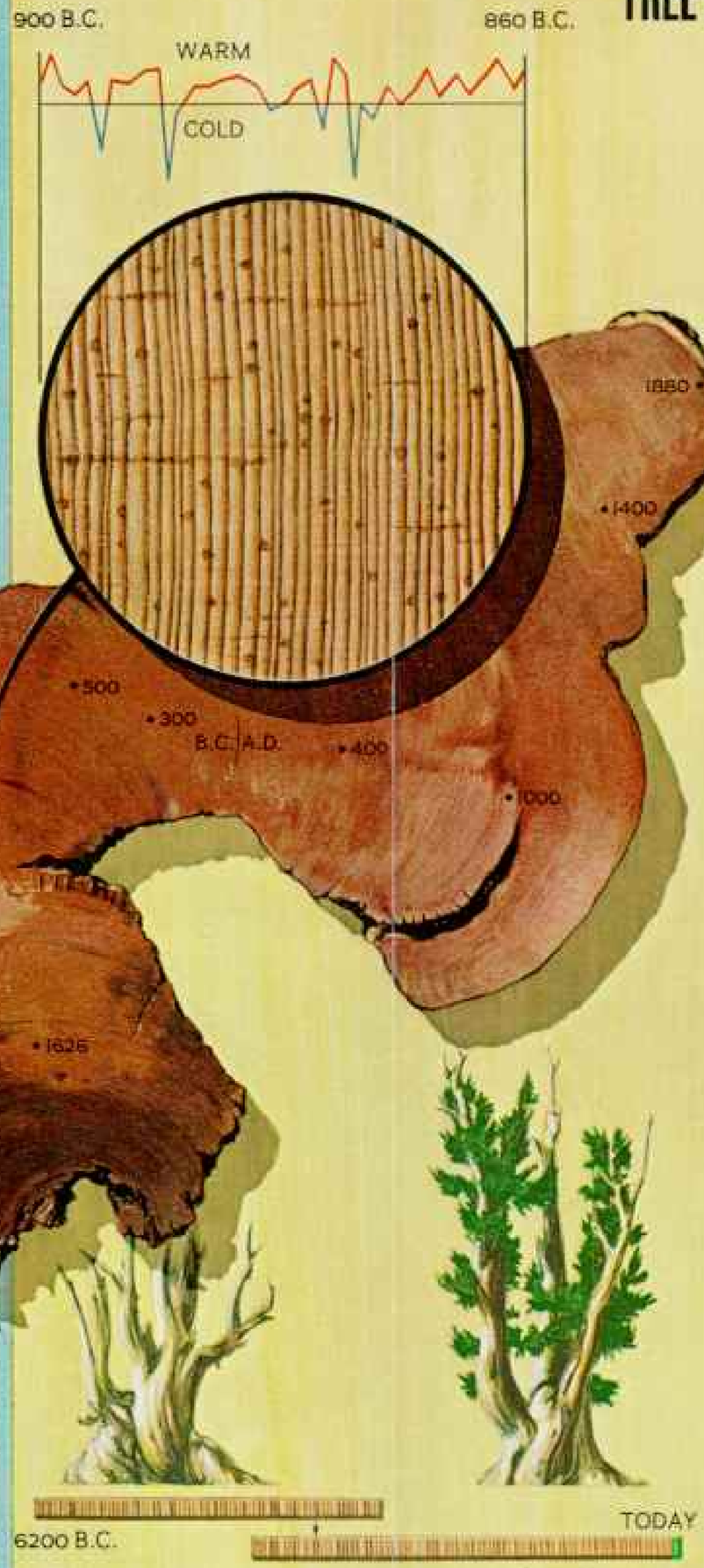
SHARP DROP chilled the world 90,000 years ago.

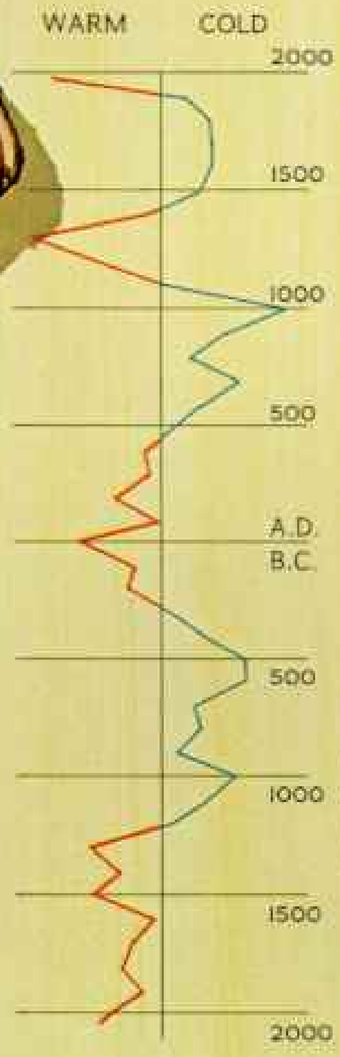
ICE CORES

OXYGEN in glacial ice varies according to the temperature in which snow fell to form the ice sheet. Using a mass spectrometer to measure the ratio of oxygen isotopes 16 and 18 at various levels in the ice core above, drilled at Camp Century, Greenland, scientists chart climatic variations over more than 100,000 years.

TREE RINGS

MOST ACCURATE DATING yet developed for past climate comes from tree rings, whose width, density, and other properties reveal local climatic conditions year by year. From half a century of work in the American Southwest, a continuous record of tree growth extends over thousands of years. The irregular slab (**left**) from a gnarled bristlecone pine that grew in the White Mountains of California contains rings that can be counted back to about 2000 B.C. They show trends of local temperature (**graph, below**) that can be correlated with climate around the world.





1880 — Beginning of 60-year warming; world food output and population grow rapidly; CO_2 in atmosphere rises.

1400-1800 — Cool conditions prevailed in the California mountains during the period known in Europe as the "Little Ice Age."

1000-1300 — Sharp warming in California was later than around the North Atlantic, when Vikings settled Iceland and Greenland.

300 B.C.-400 A.D. — Warm, dry period saw the Romans build the greatest empire of ancient times.

500 B.C. — Glaciers advance in western North America during a cool, wet period.

900-860 B.C. — Magnified tree section (inset) shows yearly climate in California between building of first temple in Jerusalem and founding of Carthage.

1626 B.C. — Thin ring from very cold summer, possibly due to sun-deflecting dust thrown into the stratosphere by volcano Thera in the Aegean Sea.

LIVING TREES rings are cross-matched with those of successively older dead trees to extend bristlecone pine chronology back 8,200 years. This exact yearly growth record has been used to correct the radiocarbon calendar for dating events before written history.

The sun drives the climate machine

FUELED by solar energy, earth's atmosphere churns in constant motion. Heat rises at the tropics and moves toward the Poles, while cold polar air sinks and moves toward the Equator. Surface water evaporates, rises, and travels great distances, until cooling causes it to fall as rain or snow. Earth's spinning motion steers the warm and cold air masses of an ever-changing weather system.

Although day-to-day rhythms of weather are now largely understood, gradual alterations of climate remain mystifying. A downturn of temperature after 1940 brought Iceland more winter sea ice until 1972. In the same period Britain's growing season shrank by nearly two weeks, though the past few years have warmed again. The climate machine seems to be shifting gears.

SOLAR RADIATION may flicker or vary, just as sunspots and solar magnetism fluctuate. But so far, instruments have not detected any regular change in the solar constant — the energy received by the earth.

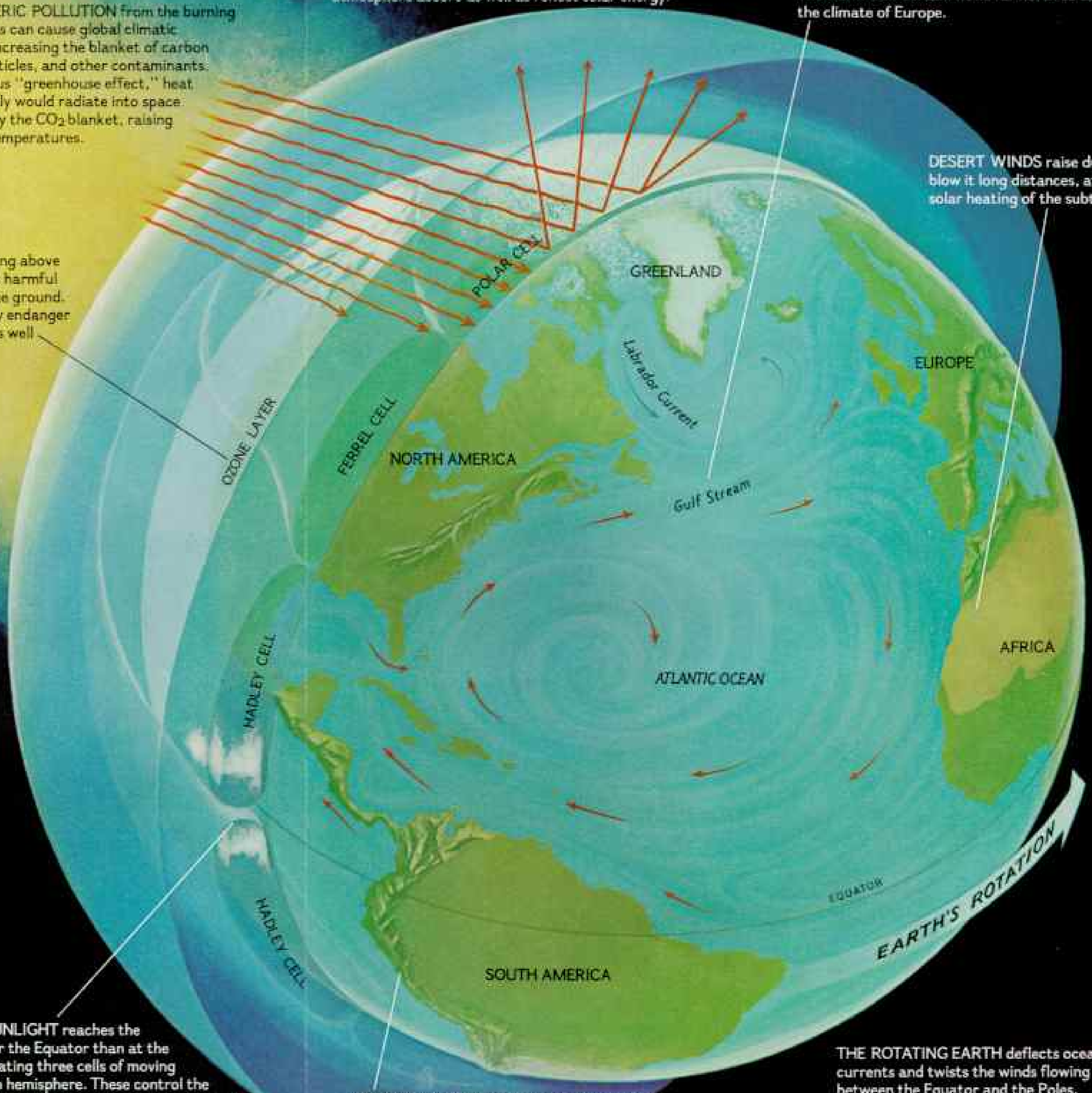
ATMOSPHERIC POLLUTION from the burning of fossil fuels can cause global climatic change by increasing the blanket of carbon dioxide, particles, and other contaminants. In the famous "greenhouse effect," heat that normally would radiate into space is trapped by the CO_2 blanket, raising planetary temperatures.

OZONE LAYER, a band of gas hanging above the earth, absorbs most of the sun's harmful ultraviolet rays before they reach the ground. Depletion of this layer could not only endanger human health, but change climate as well by altering wind circulation.

REFLECTION OF SOLAR RAYS from snow, ice, and clouds affects the amount of heat retained by the earth's surface. Open water, land surfaces, and the atmosphere absorb as well as reflect solar energy.

EARTH'S OCEANS store and transport heat. The warm Gulf Stream flows far north to temper the climate of Europe.

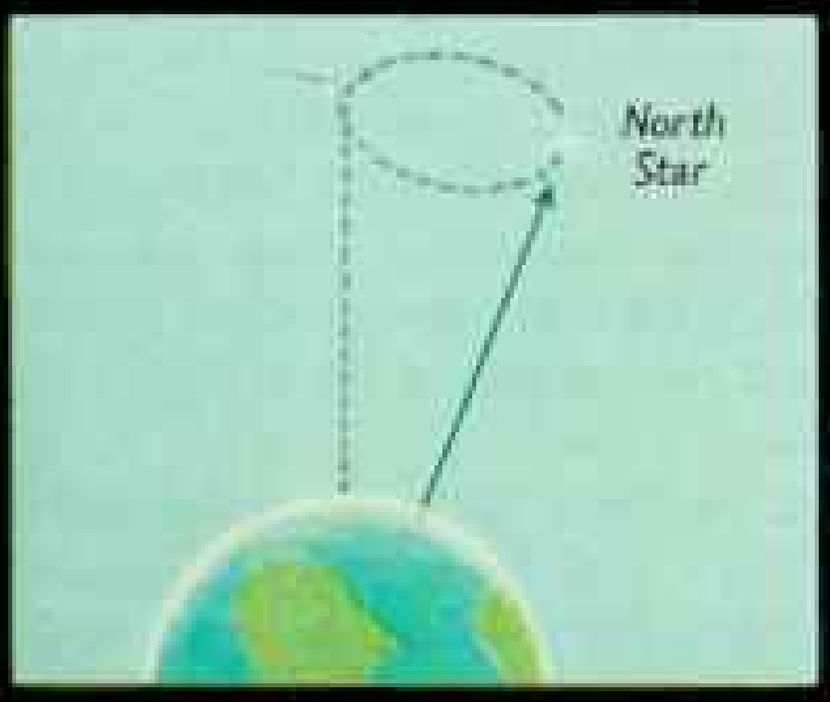
DESERT WINDS raise dust and blow it long distances, affecting solar heating of the subtropics.



MORE SUNLIGHT reaches the earth near the Equator than at the Poles, creating three cells of moving air in each hemisphere. These control the general circulation pattern of the atmosphere. Deflected by rotation of the earth, the Hadley Cells and the Polar Cells form the trade winds and polar easterlies. Large-scale frictional forces drive the prevailing westerlies of the Ferrel Cells.

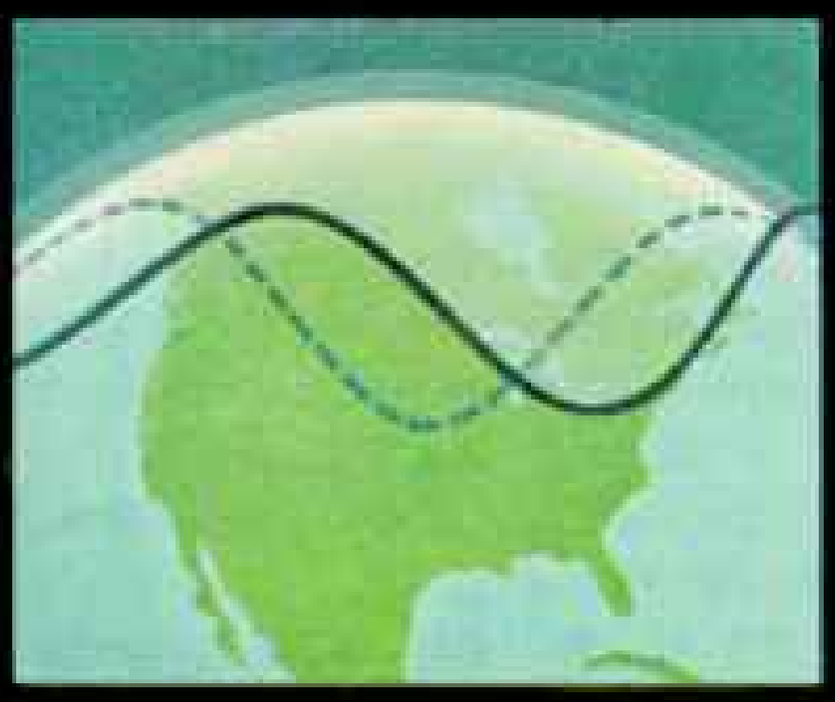
MOUNTAIN RANGES act as baffles when air currents strike them; the resulting swirls of wind can affect weather hundreds of miles away. Fine ash thrown into the upper atmosphere by volcanic eruptions can cool the earth by reflecting some of the incoming solar radiation.

THE ROTATING EARTH deflects ocean currents and twists the winds flowing between the Equator and the Poles.



VARIATIONS IN EARTH'S FLIGHT around the sun alter the amount or distribution of solar energy received. The planet changes in tilt and wobbles on its axis (above), and its orbit slowly changes.

DURING ICE AGES, huge glacial mirrors cool the planet by reflecting more solar heat. The northern polar cap extended into central North America 18,000 years ago.



COLD POLAR AIR extends into earth's middle latitudes like the hem of a wavy skirt — the circumpolar vortex. When the wave shifts, so do our weather patterns.

PAINTING BY WILLIAM H. BOND
NATIONAL GEOGRAPHIC ART DIVISION

(Continued from page 582) . . . [and] the oceans would eventually freeze," according to a recent U. S. scientific advisory report.

Worldwide there has been a rise in volcanic activity since 1950, as against the half century before. Some scientists, Hubert Lamb and Murray Mitchell among them, think that volcanic dust riding the high stratosphere may in the distant past have triggered climatic change—may even have pushed the earth over a fine line into the ice age that has gripped it for more than two million years.

DURING THE PAST BILLION YEARS, less than a quarter of earth's age, there have been at least four epochs of ice covering major portions of the globe. We are still living in the fourth one.

For much of those billion years, climatologists estimate, average global temperature stood close to 72° Fahrenheit (22° C.), and even the Poles were ice free. But today the world averages only 58° (14° C.); ice lies two miles thick on Antarctica and Greenland and covers most of the Arctic Ocean year round.

Ice sheets likewise covered much of earth's land area as long ago as the geologic era known as the Precambrian, more than 600 million years ago. Little is known of that dim period, and virtually nothing of any earlier ones. The record has been scraped clean by more-recent ice sheets, and by changes in the positions and topography of the drifting continents themselves.

But in the long warm spells that followed, which were interrupted inexplicably every 250 million years or so by bitter cold and invasions of ice, warm shallow seas and lush swamps covered much of the land. Today's coal and oil deposits were laid down. Dinosaurs roamed the earth in the last warm stretch; breadfruit trees grew in Greenland.

Then, about 50 million years ago, our planet began again to cool off. Eventually the ice came back. By two million years ago, modern man's ancestors were in the full reign of what is called the Pleistocene Epoch. And except for fairly short periods of thaw every 100,000 years or so—lasting an average of scarcely 10,000 years each—ice has ruled world climate ever since.

At least nine times in the past million years alone, massive ice sheets have mantled much of North America and Europe. Each buildup

of ice and each retreat took thousands to tens of thousands of years, but the climatic shifts that set off those ponderous changes may have occurred quite rapidly—perhaps in only a few centuries. One drop from fairly warm times into full ice-age cold took place in Greenland 89,500 years ago—apparently in less than a hundred years.

As weather turned colder, winter snow did not entirely melt away in cooler summers. New snow then fell on the old, glaciers and ice sheets were born, and the ice began spreading into lower latitudes and downward from the mountain valleys and slopes.

At its greatest extent, the last such advance of ice came far down into North America, northern Europe, and to lesser degree across northwestern Siberia. A mile or more thick, it pushed relentlessly south, carving the Great Lakes basins, bulldozing hills flat, carrying huge boulders and ground-up terrain before it. Eventually, on this continent, ice covered virtually all Canada and reached

> ***The climates of the earth have always been changing, and they will doubtless continue to do so in the future. How large these future changes will be, and where and how rapidly they will occur, we do not know.***
>
> NATIONAL ACADEMY OF SCIENCES, 1975

south into what is now Washington State and Montana, Nebraska, Illinois, Indiana, Ohio, Pennsylvania, and New Jersey. Long Island and Cape Cod are both heaps of glacial debris left behind when the ice withdrew.

That most recent glacial mantle began retreating 18,000 to 14,000 years ago. It has been only some 8,000 years since the last of the ice sheet melted off the Scandinavian peninsula, and scarcely 6,000 years since it disappeared from the northern Canadian mainland. Both regions are still rebounding from release of the weight, rising as much as eight inches a year.

What caused these extraordinary great stretches of cold? What changed to bring on the ice? Are there indeed cycles, some sort of cosmic time pulse, beating every 250 million years, and more recently every 100,000 years? Science simply does not yet know.

A decade ago two Lamont oceanographers, David B. Ericson and Goesta Wollin, wrote wryly: "It has been estimated that a new theory to explain continental glaciations has been published for every year that has passed since the first recognition of the evidence for past glaciation. . . ."

And the eminent British climatologist C. E. P. Brooks, who died in 1960, quoted Kipling's *"There are nine and sixty ways, Of constructing tribal lays, And every single one of them is right."* Added Brooks, "There are at least nine and sixty ways of constructing a theory of climatic change. . . ."

THAT CLIMATE *has* changed, and continues to change, is obvious even in the brief span of man's written history—a mere instant in geological terms.

Human civilization as we know it has arisen almost entirely in the 10,000 years since the great ice sheets last melted back, to leave only those on Antarctica and Greenland.

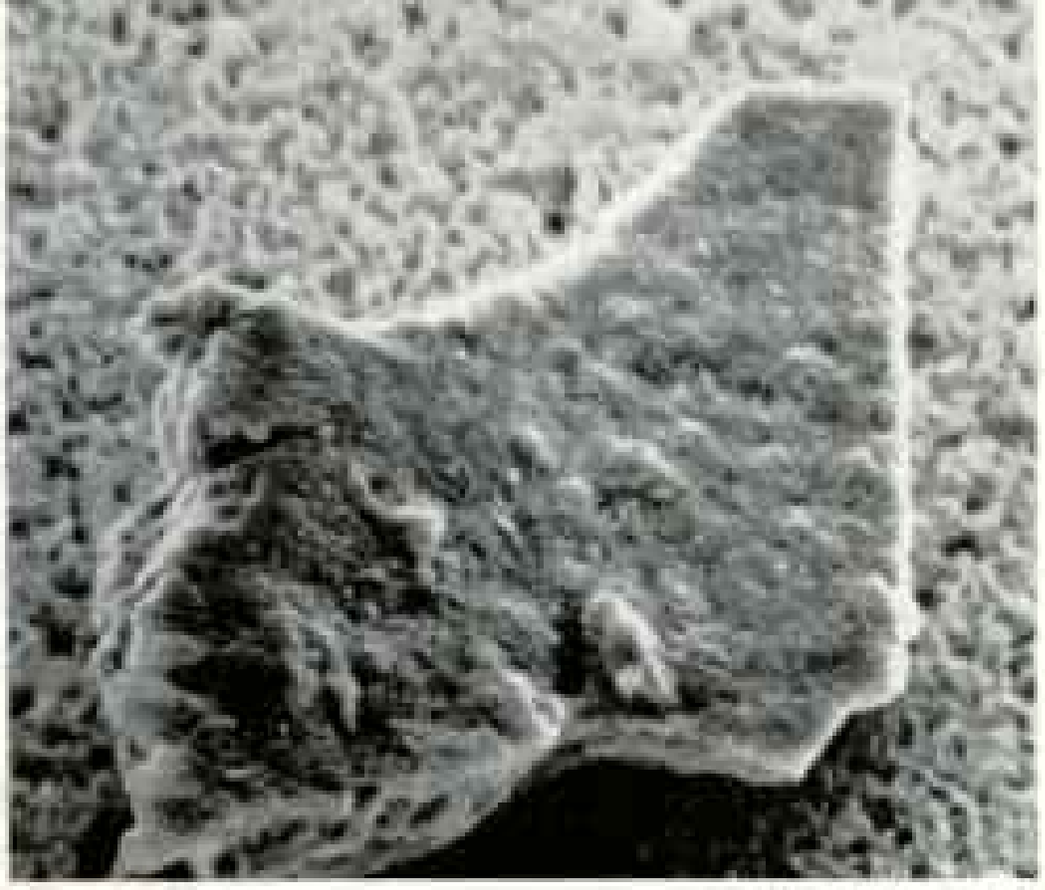
The warmest weather in this whole interglacial period came hard on the heels of the ice. In the so-called Climatic Optimum, beginning about 8,000 years ago, average temperature in the Northern Hemisphere ranged a degree or two higher even than today's.

Man learned in that warm time, across the Fertile Crescent from the Nile Valley to the Persian Gulf, to farm, to live in communities, to write, to travel by watercraft, to tame animals. He built the first great civilizations—the Egyptian, the Sumerian, and others in India and the Orient.

Between about 3000 and 2200 B.C., much drier conditions befell the ancient world; once-lush reaches of North Africa and Arabia turned to desert. Semitic peoples were driven out of the Arabian Peninsula into the Levant. Drought eventually destroyed the advanced Harappan civilization of the Indus Valley. Similarly, inhabitants of a once-wet Sahara disappeared into dry oblivion.

Cooler, wetter, stormier times returned after 2000 B.C., and again a thousand years later. Hittite invaders swept south into Asia Minor, Medes into Assyria, Aryans into India, Dorians into the Greece of Ulysses' day.

The cool and wet were succeeded by the warm and dry once more. Greece and Rome knew their golden ages between 500 B.C. and A.D. 400. But droughts also returned; crops in



MAGNIFIED 1,800 TIMES

MAGNIFIED 2,500 TIMES

MAGNIFIED 2,500 TIMES

MAGNIFIED 1,800 TIMES

Tiny pieces in a global puzzle: Dust particles seen by a scanning electron microscope can tell of climate that existed when they fell on the West Antarctic ice sheet near Byrd Station. Iron in a grayish speck (**top**) indicates it probably blew from the nearby Transantarctic Mountains 5,000 years ago during a warm period of low ice cover. The spherical particle may be part of an iron meteorite that entered the atmosphere 10,000 to 14,000 years ago. Two glassy particles (**bottom**) mark volcanic periods some 15,000 and 18,000 years ago, dated by counting seasonal layers.

LONNIE G. AND ELLEN M. THOMPSON, INSTITUTE OF POLAR STUDIES, OHIO STATE UNIVERSITY (ALL AT LEFT); WILLIAM R. CURTSINGER (ABOVE)

Opening a diary written in ice, a volcano in 1969 and 1970 split deep rifts in a glacier on Deception Island near the Antarctic Peninsula. By reading alternate layers of winter snow and summer wind-blown ash, scientists can compare the region's climatic change with Northern Hemisphere data.

Chilly August, 16,000 B.C.

MANHATTAN ISLAND lies under half a mile of ice, but parts of Alaska, then linked to Asia, are ice free. The Gulf Stream runs almost due east. Sea level stands 300 feet lower than today, extending Southeast Asia nearly to Australia. Typical summer conditions at the height of the last glacial advance have been mapped by scientists for a project called CLIMAP. They analyze geologic data to estimate sea-surface temperatures, extent and thickness of ice, and properties of land surfaces, including different types of vegetation.

Landmasses are keyed (**right**): A, snow and ice (elevations in meters); B, deserts or snow-covered forests; C, steppes and semideserts; D, grasslands; and E, forests and other vegetation. Each surface reflects a characteristic amount of sunlight, thus affecting local climate. Ocean temperatures, plotted in degrees Celsius, color-code from darkest blue (coldest) through lighter blues to yellows and orange (warmest). CLIMAP will next chart the previous warm interglacial period 120,000 years ago.

CLIMAP, INTERNATIONAL DECADE OF OCEAN EXPLORATION, NATIONAL SCIENCE FOUNDATION

1903

1929

1940

1956

North Africa failed; forests and grass vanished from Lebanon and Galilee.

It turned colder and wetter again, and—as some historians have tried to read cause and effect—barbarians came to overthrow Rome. Europe fell into the Dark Ages.

When the climate rewarmed somewhat between A.D. 800 and 1000, the Vikings burst out of Scandinavia. They sailed the North Atlantic to found colonies in Iceland, in a greener Greenland, and even in Vinland in North America. Wine grapes were cultivated in England, farther north than at any time until the present century.

But the cold would return. By 1200 pack ice was besetting Iceland and the Greenland colonies; the Greenlanders, stunted and starved, would die to the last man by the late 1400's. Glaciers in the Alps, Norway, and Alaska expanded. Wet, cold summers ruined European grain crops and brought terrible famine in 1315 and 1316. The Baltic Sea froze over solidly in the winter of 1422-23.

From then until the mid-1800's occurred what is called the Little Ice Age. Around the Northern Hemisphere it was colder than it has been since the big ice withdrew. Famine, plague, and peasant revolt wracked Europe. In the American Revolution, guns were dragged across river ice to Staten Island. From New England to the Carolinas, newspapers called 1816 the "Year Without a Summer" or "Eighteen Hundred and Froze to Death"; snow fell and freezes ruined crops in Pennsylvania that July and August.

It was not without reason: The year before, in the spring of 1815, the volcano Tambora, on the East Indies island of Sumbawa, exploded in one of the greatest eruptions known in historic times. Estimates of the amount of debris and dust thrown into the atmosphere range from seven to fifty *cubic miles*. Sunset skies turned red around the globe by that fall; average temperature dropped 2° F. in the Alps.

Glacial retreat high in the Austrian Alps marks the abnormal warmth that prevailed in the first half of this century. By 1940, the confluence of the glaciers Hintereisferner and Kesselwandferner has broken. Where ice once lay 650 feet thick, only a small tongue of Hintereisferner appears at far left in 1956, nearly a mile from its farthest advance.

F. FEIER (TOP); M. HEISS (MIDDLE TOP); H. HOINKES FROM PINGUIN-VERLAG, AUSTRIA

The climatic trend changed once again by the mid-19th century. The northern temperate zone grew markedly warmer; indeed, the century from 1875 to 1975 is now regarded by some as one of the warmest since the Climatic Optimum ended about 4,000 years ago.

In this time the industrial age boomed, and world population more than doubled. Farming and fishing expanded to keep up with food needs; Canada's wheat line inched a hundred miles north, for example. But this period of climate, which our grandfathers and fathers came to regard as normal, is now recognized by scientists to have been highly abnormal—abnormally warm and beneficent. What will happen to our food output if there is a return to the more truly normal?

> ***Judging from the record of the past interglacial ages, the present time of high temperatures should be drawing to an end . . . leading into the next glacial age. . . .***
>
> NATIONAL SCIENCE BOARD, 1972

HAS A RETURN toward a cooler climate begun? Are we now at the end of a cycle? Or is the present-day northern cooling only a brief pause in that warming trend that began in the mid-1800's? Are there cycles at all in the climate? I asked Murray Mitchell of NOAA, as I did many others.

"Put any two climatologists together," he replied with a grin, "and that's a subject certain to start a fight!"

Since the last interglacial period more than 100,000 years ago, he told me, as ice sheets have grown and melted back, the oceans have fallen and risen about every 20,000 years.

"Glacial studies in Alaska and Sweden," he went on, "have shown what appears to be a 2,500-year pulse as well—a cycle of little ice ages, some lasting 800 or 900 years."

But over shorter periods, variations in climatic evidence occur so erratically that no positive cycles can be pinned down.

"We can't predict statistically whether a climate change is likely in the near future—next year, next decade, next century," said Dr. Mitchell. "We must learn first why climate varies—what the major forces are and how they change, if indeed they change."

Basically this planet's long-term weather—its temperature, rain and snowfall, the stirring of the atmosphere by wind—results from the flow of energy in and energy out over different parts of the spinning sphere. The atmospheric heat engine, or weather machine, is driven by sunlight—radiant energy. That energy is estimated to arrive at the rate of 230 trillion horsepower. It is assumed—but only assumed—to stay absolutely steady. In turn the earth sends energy back into space. Some is directly reflected from clouds, snow and ice cover, the sea, and light-colored land. Other energy re-radiates as infrared waves—heat.

Energy in and energy out must match over the long run, or the planet would grow steadily hotter or colder, and the oceans would either boil or freeze. But what if the sun slowly "blinks," changing by ever so little the amount of incoming energy? Is there any change in the so-called solar constant?

"Galileo in 1611 saw spots that moved across the face of the sun and thus realized the sun was spinning," astrophysicist John A. Eddy told me at the High Altitude Observatory of the National Center for Atmospheric Research (NCAR) in Boulder, Colorado.

"We know now that sunspots vary in size and number. They change in cycles of 11 and 22 years—though for one 70-year stretch in the Little Ice Age, 1645 to 1715, they seem to have vanished almost entirely."

Many have tried to link sunspots to solar-energy output and to climate. Dr. Charles G. Abbot, a former Secretary of the Smithsonian Institution, gave much of his 101-year life span to that question. Other astronomers have tried as well, but their instruments, working under earth's atmosphere, have not been able to detect any significant solar change.

"To me, one of the greatest scientific omissions of the 1960's was that men landed on the moon, drove around, and swung golf clubs, but didn't leave behind an instrument to measure the solar constant." So I heard from Dr. Stephen H. Schneider, young, outspoken climatologist of NCAR.

To which astronomer Keith Pierce of Kitt Peak National Observatory in Arizona replied a few days later: "That was one of the first instruments discussed for the first moon landing. But when you've left it up there, how do you keep it calibrated, working perfectly

for a century? The project wasn't even tried."

Dr. Pierce and others are hopeful that future solar-constant instruments—carried in an orbiting satellite serviced by space shuttle—will resolve whether the sun indeed dims or brightens enough to alter climate on earth.

ENERGY IN may vary for another reason, however—changes in the swing of our planet in space. In the 1920's the Yugoslavian astronomer Milutin Milankovitch calculated changes in solar radiation received by earth caused by the shape of earth's orbit around the sun, its tilt, and the precession of its axis, which wobbles slightly like a child's top slowing down (page 589).

Milankovitch postulated climatic cycles of roughly 95,000, 40,000, and 20,000 years. The first is close to the magic 100,000-year pulse of the ice age in which we still live. Scientists today do not dispute these orbital cycles but doubt that they alone control climate. How, they ask, do they produce quarter-billion-year periods without any ice on earth at all?

For those epochs, others look to changes on earth itself—the rearing up and wearing down of mountains, the slow drift of continents across earth's face.* Such changes, they say, must radically alter circulation of the oceans and the atmosphere—the two vast heat-carrying mechanisms of the climate machine.

Fifty million years ago, for example, Antarctica and Australia were joined; there was no free sweep of ocean currents and winds entirely around the south polar region, as is true today. No isthmus linked North and South America; currents flowed directly between Atlantic and Pacific. The Gulf Stream, if it flowed at all, was far weaker, and the North Atlantic and Europe much colder. There was no link between the Arctic Ocean and early Atlantic. No Sierra blocked Pacific rain from western America.

Such changes *(Continued on page 600)*

*The author described "This Changing Earth" in the January 1973 NATIONAL GEOGRAPHIC.

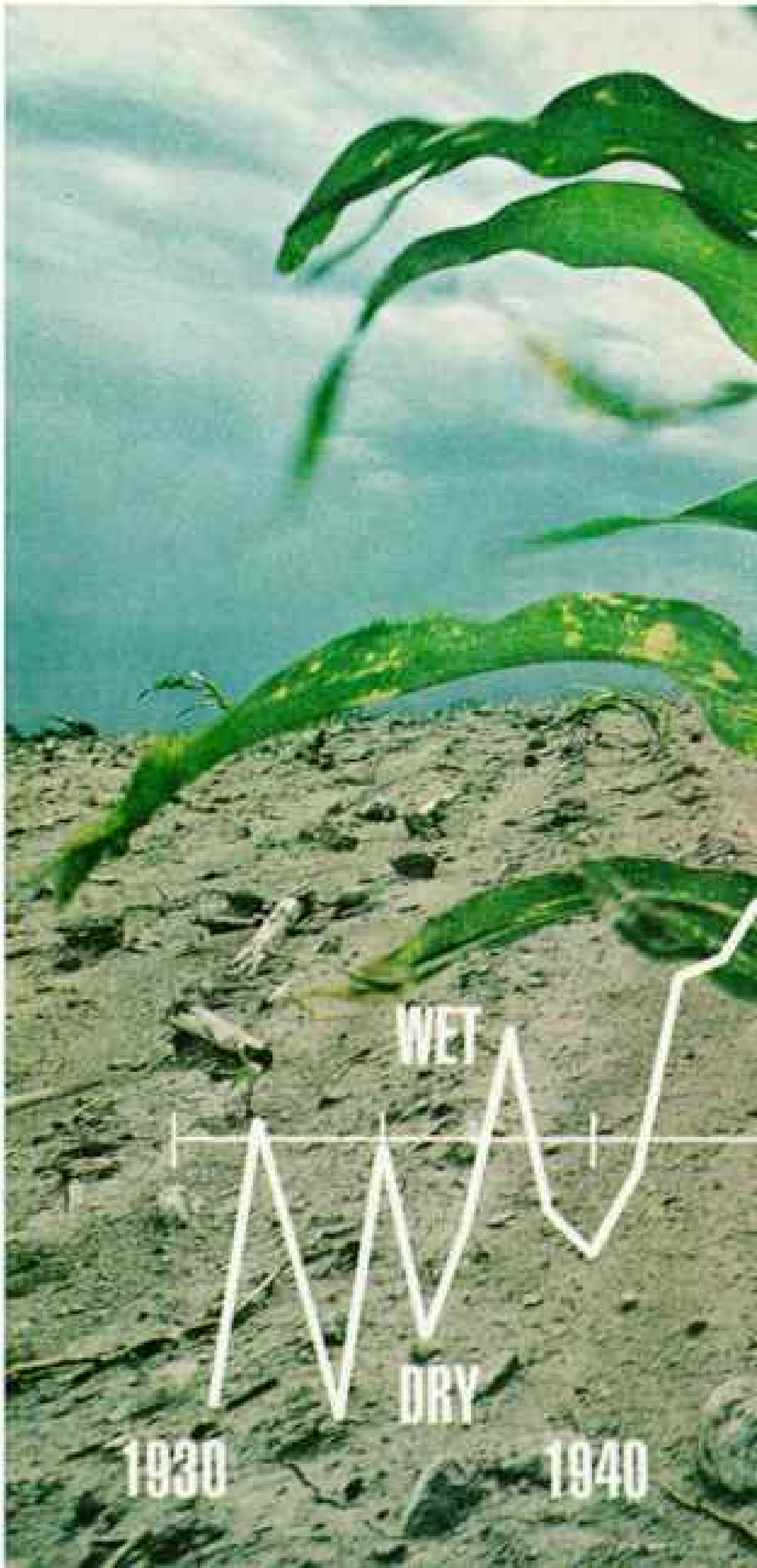
Dusty cough of Guatemala's Fuego Volcano chokes the sky with a powdery cloud that scientists feel may trigger climatic change. Veils of volcanic dust enshrouding our planet reflect the sun's rays, cooling the earth. Periods of intensified volcanic activity may have nurtured glaciers and triggered ice ages.

MICHAEL W. DILLARY

Ample food depends upon the vagaries of climate, and the future of an expanding world population hangs in the balance. In 1972 a Minnesota farmer cultivates a luxuriant field of corn (**right**) as rain clouds water crops in neighboring fields. Four years later a few seared stalks rise above parched soil (**bottom right**) in one of 60 Minnesota counties struck by severe drought. Attempts at cloud seeding to provoke rain have been made by spraying clouds with silver iodide crystals in hopes that moisture will coalesce around them into raindrops. Results have been mixed;

man remains at the mercy of nature.

Does the decreased rainfall represent merely a temporary dip into a dry period, as indicated in the graph at bottom? Or is America's breadbasket being affected by major climatic change that could create more dust storms, like the one that envelops a farmhouse near Cedar Rapids, Iowa (**above**), in March 1976? If the planet has been cooling, as some scientists theorize, the circumpolar vortex may be sending cold air farther south, blocking the usual flow of warm, moisture-laden tropical air. The shift could shorten growing seasons around the Northern Hemisphere



DUANE CROCK, CEDAR RAPIDS GAZETTE (LEFT); JIM ERANGENBURG (ABOVE AND BELOW)

Man tries to culture rain as he cultures pearls. Planes spew silver iodide crystals—

in land and seas had to alter world climate, the CLIMAP people told me. Continental drift could have brought on the Pleistocene.

Atmospheric circulation and heat exchange between the oceans and the air are gradually becoming better understood, Murray Mitchell told me. But trying to measure and reduce to equations the vast swirls of the earth's atmosphere, and to predict from them what may happen far away, imposes on weathermen problems of sheer mathematics and data-handling so complex as to be almost incomprehensible to a layman.

One tiny variation may have vastly multiplied effects. Professor Edward N. Lorenz of the Massachusetts Institute of Technology is famed for his not-so-facetious query, "Can the flap of a butterfly's wings in Peru cause a tornado in Iowa?" He was serious: He argued that a random tiny disturbance to the atmosphere on one side of the globe might kick off others, grow, and change entire weather patterns on the other side.

Despite the sheer size of such problems, scientists are trying to solve them. The coming of the electronic computer vastly extended what they could do. Beginning in 1946 with the late John von Neumann at the Institute for Advanced Study in Princeton, New Jersey, mathematicians set about trying to "model" the weather, and thus predict its course. Eventually they used a computer called MANIAC.

In a federally owned computing laboratory at Princeton I saw von Neumann's heirs working on the same problem nearly thirty years later. Now they were using a machine labeled ASC—Advanced Scientific Computer. Machines such as ASC and ILLIAC IV, at Ames

> ***Will we be able to recognize the first phases of a truly significant climatic change when it does occur?***
>
> NATIONAL ACADEMY OF SCIENCES, 1975

Research Center near San Francisco, can handle more mathematical data, perform more calculations at higher rates of speed, than any other computers yet built.

ASC calculates the dynamics of the entire atmosphere, at nine different altitude levels, as well as the circulation of the oceans. ILLIAC IV, using only a two-level model, can calculate a day's global weather in two minutes.

Dr. Joseph Smagorinsky, dark-eyed, quick-talking director of NOAA's Geophysical Fluid Dynamics Laboratory at Princeton (page 583), told me some of this and let me see the huge, multicabineted ASC. "We do such things as

JIM BRANDENBURG

"grains of sand" for raindrops—in an attempt to water Minnesota's parched fields.

mathematically change the sun's intensity and see what happens to the world weather map," he said. "At the end we have a set of answers. Then we have to find out if we're even close to being right."

So expensive and arcane is this game of simulating global climate in detail that only a few computing laboratories can take part in it: Princeton, UCLA, the Rand Corporation, NCAR at Boulder.

All have a role in a decade-long scientific effort under the United Nations—the Global Atmospheric Research Programme (GARP), set up in part to "provide greater knowledge of basic physical forces affecting climate."

HOW DO MATHEMATICIANS know whether their models are accurate, whether computer simulations of climate give answers that match what actually happens, or has happened?

CLIMAP provides one of the ways. It has drawn a map of the world as it actually was during an average August 18,000 years ago, at the height of the last glacial advance (pages 592-3). The map shows not only the great ice sheets reaching over New York and London, but also sea level some 300 feet below today's. It indicates the sea-surface temperatures of those different oceans. It shows polar waters reaching much closer to the Equator than today, and the Gulf Stream flowing farther south as well, straight east toward Spain.

Surprising and ingenious ways are used to tell what the actual climate was in past times:

Ancient soil layers—windblown dust from arctic or desert plains, for example, versus rich gumbo laid down in swamps—reveal climatic changes. Fossil pollen, in peat beds and lake-bottom sediments, shows what sorts of trees and plants grew where and when.

Growth rings of trees can indicate weather of a region year by year for centuries.

Moraines and till—glacial debris heaped and smeared across the landscape—and buried forests can date the passage of ice.

Samples drilled from ice caps and glaciers show annual snow depths as well as the air temperature at which the snow fell.

Even such esoteric evidence as owl droppings in ancient caves indicate what small animals were being eaten, hence the climate.

"Probably the most important source of CLIMAP data, however," Dr. James D. Hays of Lamont-Doherty (page 583) told me, "is deep-sea cores, or bottom samples, brought back from all parts of the world's oceans."

Tiny shells and skeletons of myriad sea creatures, preserved in layers in the long tubular core samples, are the key to changes of

Grim crop of bones bleaches in the sun as a band of Tuareg plods by in Niger (**right**), victims of persistent droughts in the Sahel, or sub-Sahara. The arid, empty African desert known to the modern world bloomed with life thousands of years ago, as shown by a Stone Age rock painting that depicts people gathering wild grain in a graceful ballet (**left**). Similar paintings portray animals usually associated with lush grassy regions. Their pastures dried when a climatic shift in air currents dropped rain elsewhere; another shift now may be blocking moist winds that once watered the Sahel.

PHOTOGRAPH BY ERICH LESSING, MAGNUM, COURTESY MUSÉE DE L'HOMME, PARIS (©) HENRI LHOTE EXPEDITION; STEVE RAYMER (RIGHT)

sea-surface temperature, and thus of climate.

"By identifying under a microscope plankton called foraminifera—forams—a marine geologist can read right down a long core, layer by layer, sea temperatures as far back as a million years," Jim Hays said.

"There are even forams whose shells coil to the left below a certain temperature, but to the right in warmer water [page 584]. We can tell not only ocean warmth, and thus currents and winds, but also how much ice covered the world at different times."

I must have looked skeptical; he grinned and went on. "Two kinds, or isotopes, of oxygen exist in seawater: O^{16} and O^{18}, the second slightly heavier than the first. Forams build them into their shells in differing ratio. For years it was thought the ratio varied chiefly with sea-surface temperature, giving us another thermometer to the past. But recently it's been realized that a more important factor is how much water is locked up in ice. High evaporation and snowfall onto ice caps takes out more O^{16}, leaving more O^{18} in the oceans.

"Nicholas Shackleton, an isotope specialist from Cambridge University who's working here at Lamont for a year, is using this effect to measure world ice volume—the ice ages—from seabed cores."

Nick Shackleton turned out to be a young, rumpled, friendly Britisher. He showed me how he goes about his magical measurements.

Peering into his microscope and wielding a very fine moist paintbrush, he separated four or five foram shells the size of sand grains from a dried sample of seabed ooze. "These all live in bottom water, very deep, where temperature is almost constant, only a few degrees above freezing even in the tropics," Nick explained. He let me see their beautiful shapes, like tiny chambered nautiluses.

Labeled and sent back to his lab in Cambridge, the shells would be dissolved in acid. An instrument called a mass spectrometer would read the oxygen-isotope ratio; from many such samples from the same core would come a curve of world ice volume over tens, even hundreds, of thousands of years.

NOT ONLY SEABED OOZE but ancient ice as well, buried deep in the Antarctic and Greenland, records past climate.

At the U. S. Army's Cold Regions Research and Engineering Laboratory in Hanover, New Hampshire, experts such as Dr. Anthony Gow study chunks of a 1½-mile-long ice core drilled at Antarctica's Byrd Station in 1967 and 1968. They look for volcanic ash and atmospheric dust and gases, clues to climate as far back as 75,000 years (page 606).

In Copenhagen, Willi Dansgaard, who with Danish, U. S., and Swiss colleagues has drilled deep into the Greenland ice cap, uses a mass spectrometer, much like Nick Shackleton's at Cambridge, to measure oxygen isotopes in the ice layers, and thus air temperatures in

Greenland for a thousand centuries back.

Dr. Dansgaard sees rapid changes, or sharp spikes, in his isotope curves that show extremely rapid falls in average temperature. He discovered the apparently quick drop into full ice-age cold that took place nearly 90,000 years ago, for example.

More recently Dansgaard has seen what he considers a curious time warp between the Greenland temperature curve and weather records from England and western North America. They show that long-term temperature trends in Greenland, at least back to A.D. 850—as revealed by annual samples from the ice core—have anticipated those of England and Europe by 250 years.

England's descent into the Little Ice Age, between about 1300 and 1700, was preceded by unusual cold over Greenland from 1050 to 1450. By the end of that time the Viking colonies were gone, exterminated. Far to the west, oddly, tree rings in California show the same climatic phase or timetable as England's, 250 years later than Greenland's.

If this time warp holds true—more drilling in Greenland in coming years will seek to confirm it—Europe and North America could be headed into much colder weather, such as Greenland had from 1700 to 1900.

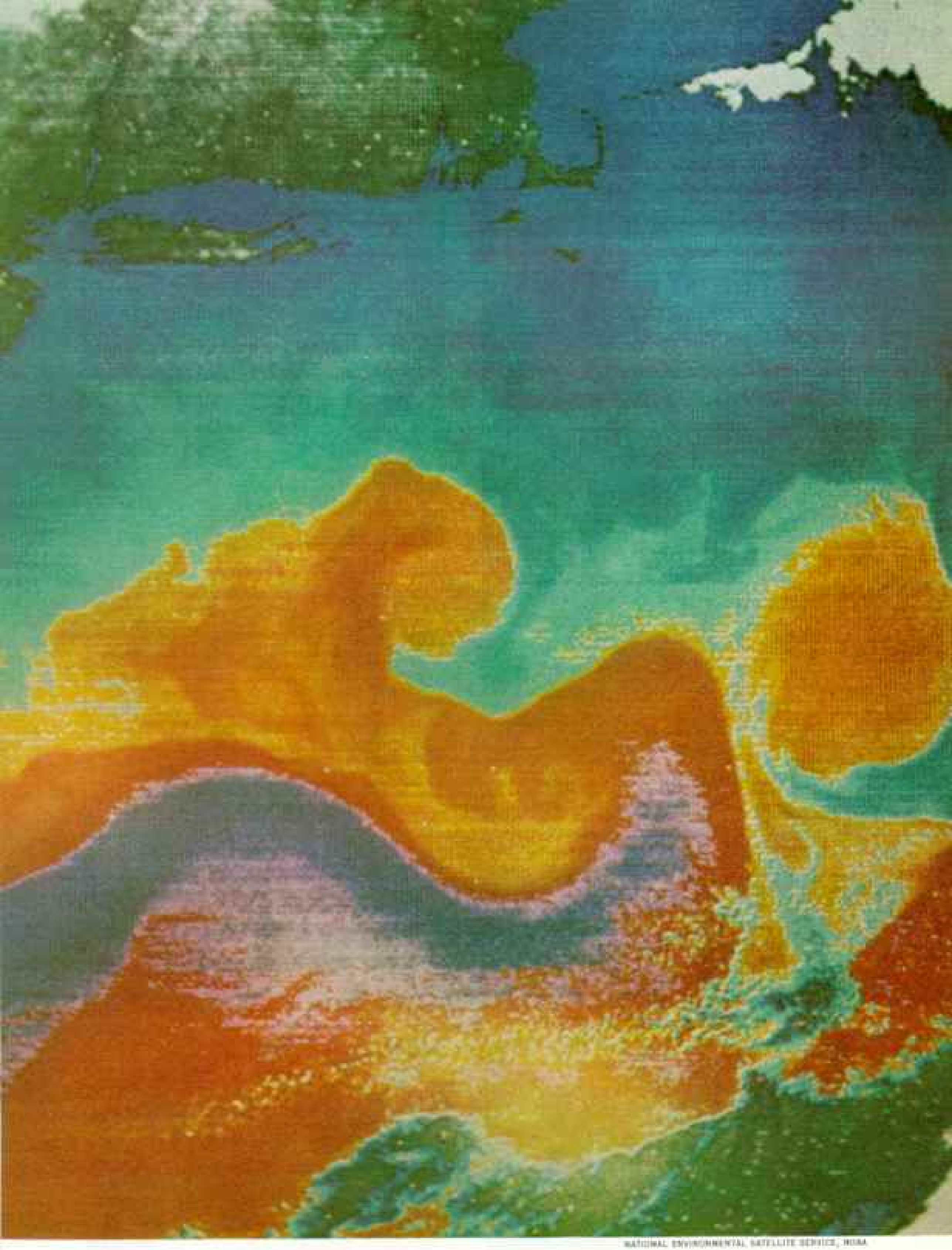
ICE AT THE BOTTOM OF THE GLOBE may hold the power to change world climate as well. Is the Antarctic ice cap, which holds 90 percent of all fresh water on earth, rapidly melting away and raising sea level? Is that enormous ice cap itself (pages 578-9) the crucial control over the climate?

A New Zealand scientist, Alex T. Wilson, has suggested that possibility. As ice builds up on the south polar continent, he theorizes, it reaches a point where its sheer mass, plus heat from below, melts its base and starts it to move. Frictional heat adds to the melting, and it slides faster. The Byrd Station drill hole in 1968 hit water between ice and bedrock.

Surging outward on this lubricating layer of water, the ice may push far across the Antarctic seas. Increased reflection of solar radiation, Wilson thinks, might cool the planet enough to set off another ice age.

Other glaciologists wonder if a general breakup, or "collapse," of sectors of the Antarctic ice cap is now going on. They say that the West Antarctic ice sheet, much of it based

The Gulf Stream, flowing off the U. S. East Coast, brings the Atlantic great swirls of warmth, shown in purple (hottest), red, and



NATIONAL ENVIRONMENTAL SATELLITE SERVICE, NOAA

orange in this color-enhanced portrait by a NOAA weather satellite. Colder water shades to dark blue; clouds show in white (**top**). The vast heat thus moved and the varying sea-surface temperatures of the North Atlantic directly influence the climate of Europe, far to the east.

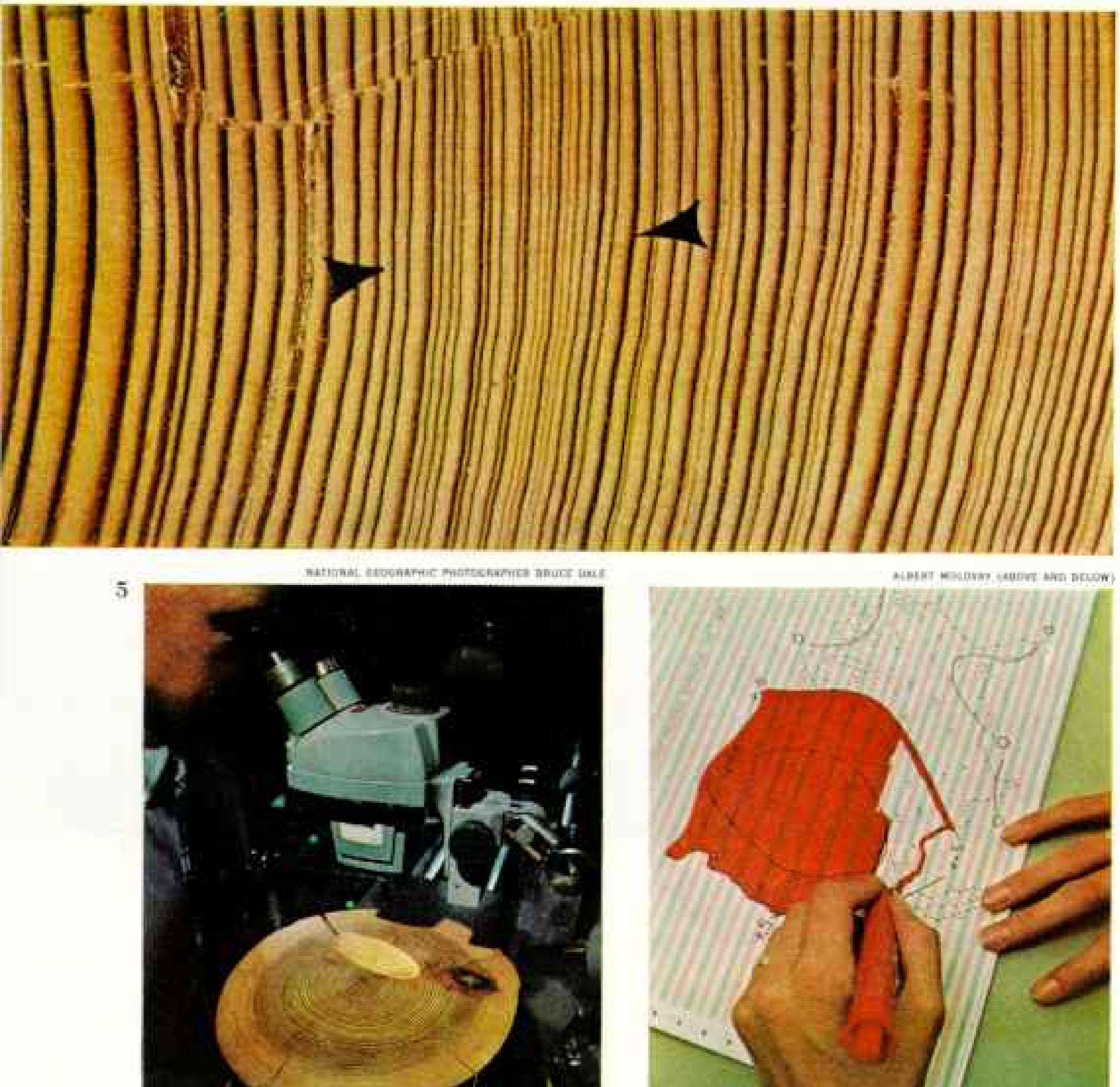
1

THOMAS NEBBIA

2

EUGENE RADNIECKI (ABOVE AND RIGHT)

3



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5

NATIONAL GEOGRAPHIC PHOTOGRAPHER BRUCE DALE

6

ALBERT MOLDVAY (ABOVE AND BELOW)

New tools probe an age-old riddle

ARSENAL of modern instruments helps scientists chart the course of climate. At the University of Copenhagen, Dr. Claus Hammer aims a high-intensity laser beam (**1**) to detect dust particles in a vial of glacial melt from a Greenland ice core. No laser is necessary to spot particles in ice taken at a depth of 2,400 feet from the other end of the globe. Thinly sliced and held over a light table (**2**) at the U. S. Army's Cold Regions Research and Engineering Laboratory at Hanover, New Hampshire, a core sample from Byrd Station in Antarctica displays a thin gray line of volcanic ash. Magnified under polarized light, another section reveals an ash band by a pattern of smaller, more-compact ice crystals (3), sheared and broken into tiny pieces by friction with the foreign particles.

Familiar bands of a tree's growth rings help dendrochronologists at the University of Arizona identify a dry spell that occurred 700 years ago (**4**). A series of narrow rings (between arrows) on a Douglas fir from western New Mexico marks a widespread drought that struck the American Southwest in the late 13th century. Using a stereomicroscope, Dr. William J. Robinson examines a slice of a tree cut in Arizona in A.D. 623 (**5**). Its rings reveal a record of ancient rainfall in the region. By calibrating recent rings with known temperature records, past temperatures may be reconstructed from the width of each ring. Fed into a computer along with tree-ring widths from other areas, the information produces a color-coded map of U. S. temperatures for the spring of 1815 (**6**).

below sea level or actually afloat, as in the Ross and Weddell Seas, has been flowing outward, but breaking off and melting away faster than it spreads.

"The collapse has been going on for at least 16,000 years," Dr. George Denton told me at the University of Maine. "It may have speeded up during the warm spell some 7,000 years ago. If it goes on—as it might well do—sea level could rise another 18 feet, even though northern climate apparently now has turned colder again."

To check what is actually happening, his colleague Dr. Terence Hughes and glaciologists at other universities are planning a West Antarctic Ice Stream Project (WISP) to take measurements over the next few years. It might foretell the fate of Venice, already awash in the Adriatic Sea, as well as of seaports and shorelines around the globe.

> ***We live in an unusual epoch: today the polar regions have large ice caps, whereas during most of the earth's history the poles have been ice-free.***
>
> NATIONAL ACADEMY OF SCIENCES, 1975

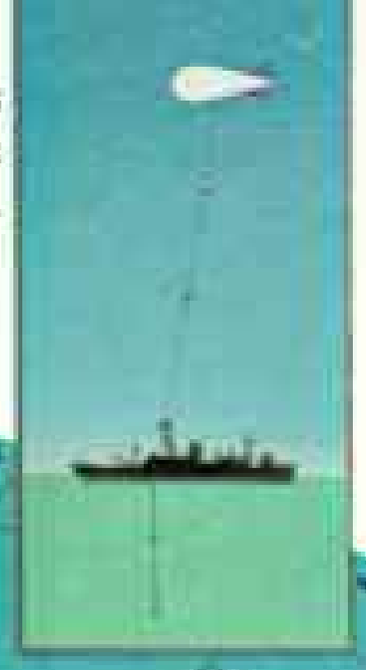
Some scientists believe the Northern and Southern Hemispheres are "out of step."

"We are certain that large regions of the Northern and Southern Hemispheres have experienced opposite changes in surface air temperature during the past three decades," states a 1976 report by Dr. Paul E. Damon of the University of Arizona and Dr. Steven M. Kunen of the University of Utah.

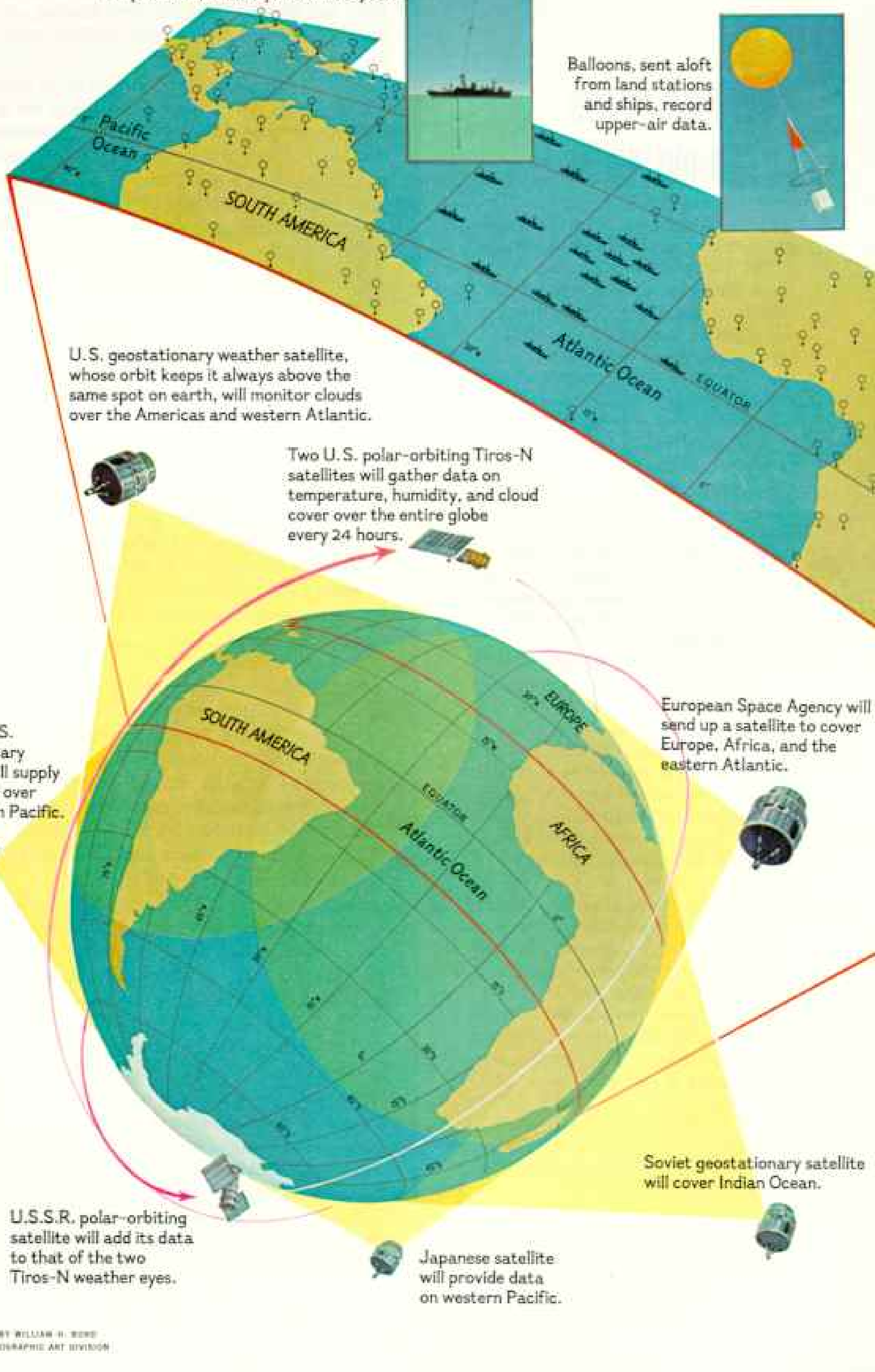
Data for the Antarctic have been accumulated by a Norwegian glacier expert, Dr. Olav Orheim, who has recorded the annual weather of 300 years from winter snow and summer melt on ice-covered Deception Island, off the Antarctic Peninsula (page 591). The island is an active volcano that in 1970 blew a quarter-mile-wide hole through a glacier hundreds of feet thick. The following year, Orheim, suspended on a rope ladder on the wall of the ice crater, read annual weather layers, like tree rings, back to A.D. 1680.

More recently, in Oslo, Olav showed me U. S. satellite maps, shot through polar darkness and cloud cover, that show the entire bottom of the world at a glance. They map

Ships obtain ocean salinity and temperature readings and send up tethered balloons to measure atmospheric temperature, humidity, and wind speed.



Balloons, sent aloft from land stations and ships, record upper-air data.



U.S. geostationary weather satellite, whose orbit keeps it always above the same spot on earth, will monitor clouds over the Americas and western Atlantic.

Two U.S. polar-orbiting Tiros-N satellites will gather data on temperature, humidity, and cloud cover over the entire globe every 24 hours.

Second U.S. geostationary satellite will supply cloud data over the eastern Pacific.

European Space Agency will send up a satellite to cover Europe, Africa, and the eastern Atlantic.

Soviet geostationary satellite will cover Indian Ocean.

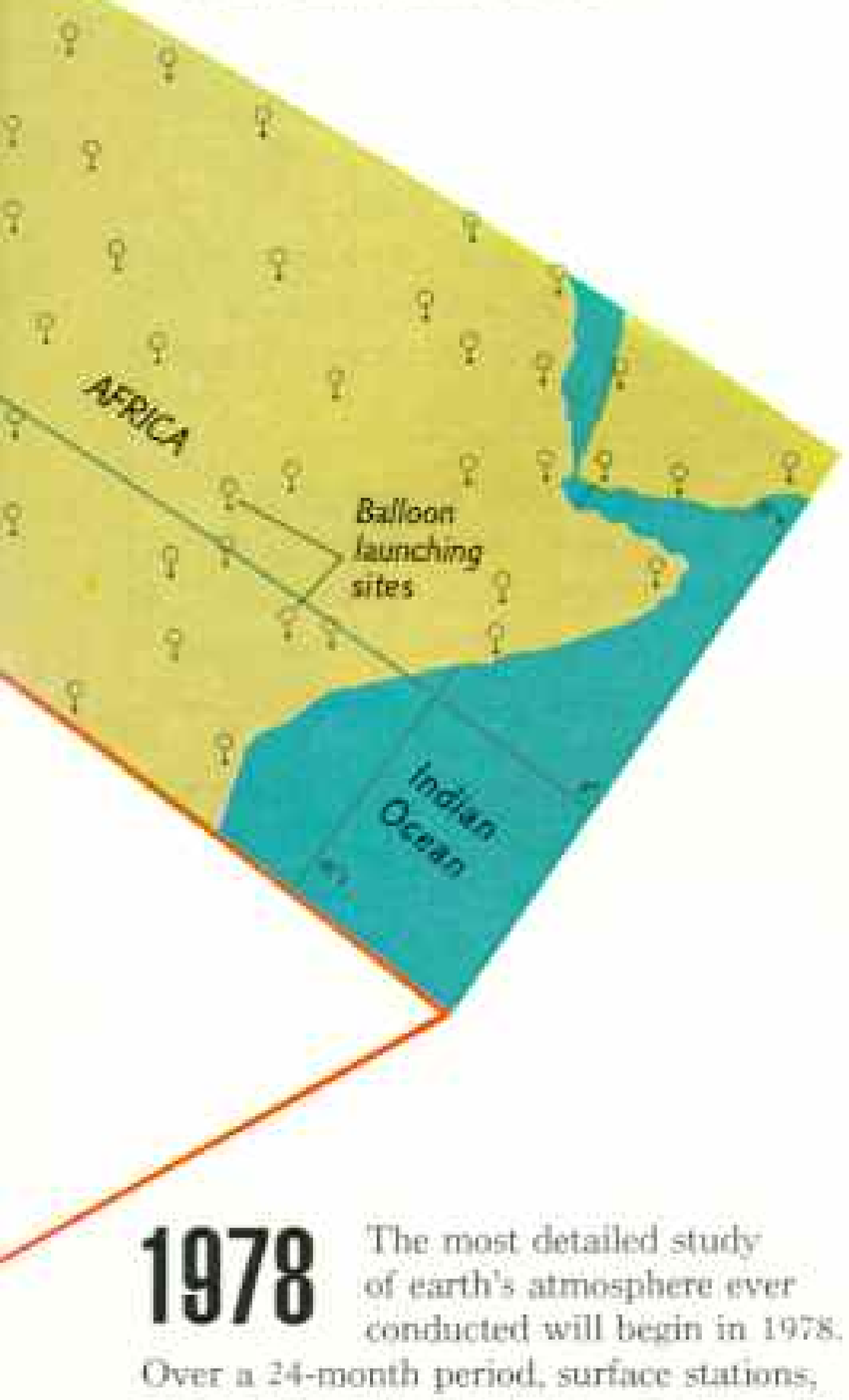
U.S.S.R. polar-orbiting satellite will add its data to that of the two Tiros-N weather eyes.

Japanese satellite will provide data on western Pacific.

PAINTING BY WILLIAM H. BOND
NATIONAL GEOGRAPHIC ART DIVISION

Worldwide weather watch

1974 Electronic eyes and ears were trained on a 20-million-square-mile swath of the equatorial region as 70 nations took part in the Atlantic Tropical Experiment. Its success in monitoring weather systems paved the way for a similar surveillance of the entire globe in 1978.



1978 The most detailed study of earth's atmosphere ever conducted will begin in 1978. Over a 24-month period, surface stations, ships, planes, buoys, balloons, rockets, and satellites will attempt to track air and moisture movements and temperature variations over every region of earth's surface. The project will be part of the United Nations' Global Atmospheric Research Programme (GARP). From the First GARP Global Experiment (FGGE) will come models for better understanding of weather developments, and perhaps some of the reasons for longer-term climatic change.

winter sea-ice buildup that each year more than doubles the total expanse of ice in the Antarctic (pages 578-9)—"like a great beating heart," Olav calls it.

On the other side of the planet, Norwegians are planning to drill on an island north of Spitsbergen, northernmost inhabited land on earth, hoping to obtain a record equivalent to that from Deception. They want to know if cold and warm spells occur simultaneously in north and south polar regions, or if the two hemispheres are really out of step over short time periods—and, if so, by how much.

DURING 15 YEARS as "the only worker on climate change in the whole British Meteorological Office," Hubert Lamb laboriously gathered, studied, and correlated all manner of historical records—old ships' logs, amateur weathermen's diaries, news accounts of crop failures and freezes (page 583). He's still in the process of writing a monumental two-volume work, *Climate: Present, Past and Future.*

So knowledgeable did he become that, as he told me, "in my government post I worked myself to a standstill—all I was doing was answering letters from other scientists."

He left to found the Climatic Research Unit of the University of East Anglia, now supported in part by the Rockefeller Foundation. "We've begun a thousand-year program," he said quite modestly. "We intend to map the weather of all four seasons across Europe year by year, again using just historical records." The project will provide matchless new insight into the Little Ice Age, and perhaps help tell what the decades and centuries ahead may hold.

Another unique look into the climatic past is provided by dendrochronology—tree-ring dating. Pioneered by astronomer Andrew Ellicott Douglass in the early 1900's, with aid from the youthful National Geographic Society, this unlikely science gives the most precise method yet devised for dating past climate changes (pages 584-6 and 606).

American tree-ring sequences now go back thousands of years at sites from Alaska to Mexico. Bristlecone pines from the White Mountains of California establish one calendar line that goes back 8,200 years.

From some 60,000 pencil-thin cores, slices of old beams, chunks of charcoal, and the like,

the Laboratory of Tree-Ring Research at the University of Arizona in Tucson can detect and cross-compare growth patterns in weather-sensitive trees. The rings may be correlated with temperature, barometric pressure, winds, and rainfall to produce weather maps for western North America, as well as far out across the Pacific Ocean, long before men and ships kept records. Tree rings can show runoff of rivers, lake levels in Canada, drought patterns across the West for centuries past.

Valmore C. La Marche, Jr., like his colleague Harold C. Fritts and others in Tucson, is deeply involved in climate study. La Marche helped build the bristlecone pine chronology.

"From pines near the upper tree line," he said in explaining his climate calendar, "we can read growth that's controlled mainly by temperature. Lower down, near the desert, the trees are more sensitive to drought."

Dr. La Marche believes he can see volcanic eruptions in his tree-ring sequences—years in which a summer frost ring may indicate dust veiling the high atmosphere.

"Here, that's Krakatoa, which erupted in 1883 in the East Indies." He pointed to a dark line on a color photograph of tree rings. "And that line was formed in 1626 B.C. It may have been caused by dust from the volcanic explosion of Thera, or Santorin, the island in the Aegean that blew up in Minoan times."

LA MARCHE is not the only scientist looking hard at evidence of volcanic explosions and their effect on weather, both short term and possibly over entire ice ages.

In England, Hubert Lamb has charted eruptions since the year 1500, scaled them against the Krakatoa blast—whose effects on European weather are known—and compared the largest with temperature and sky conditions around the world.

Lamb finds an average of five eruptions as large as Krakatoa occurred in each of the past five centuries. He ascribes many of the coldest, wettest summers in British records to them: 1695, 1725, 1816 (the year after Tambora blew up), and as recently as 1912, when Mount Katmai erupted in Alaska.

Periods of exceptional volcanism, such as between 1600 and 1900, can affect climate over many years, says Lamb. But he is quick to add that volcanic dust may not be the only driving force for the changes. The Little Ice Age was nearly over at the last peak of volcanism; the world continued to warm after Krakatoa cooled it briefly in the 1880's.

A Finnish geologist, Vaino Auer of the University of Helsinki, has found volcanic ash layers in Patagonian peat bogs that indicate extraordinary surges of volcanic activity at other times in our present interglacial—between 0 and 500 B.C., 2000 and 3000 B.C., and 7000 and 9000 B.C.

Even more-ancient eruptions have left their marks on earth. Yellowstone National Park lies within an all-but-obliterated caldera stretching scores of miles across. Crater Lake in Oregon, West Germany's Eifel area, African volcanic fields, and all of Iceland suggest eruptions countless times Krakatoa's power.

Two American investigators, Harry A. Gunther, Jr., and Arthur D. Watt, and a number of colleagues have devoted years to studying the effects on climate of the dust that volcanoes throw into the stratosphere. Gunther looks at such things as earth tides, alignments of the earth, sun, and moon in their orbits, magnetic as well as gravitational forces on the earth. He studies volcanism as an indication of even greater forces producing mountain building, continental drift, wobbles of the spinning planet, and—almost incidentally—the growth and death of ice caps and other changes in earth's climate.

> ***Man may even be able to change the climate of the earth. This is one of the most important questions of our time. . . .***
>
> NATIONAL SCIENCE BOARD, 1972

Recently two University of Rhode Island oceanographers, James P. Kennett and Robert C. Thunell, studied volcanic ash in seabed cores obtained by the drill ship *Glomar Challenger*. They reported that a worldwide surge in explosive volcanism has occurred over the past two million years—the Pleistocene Epoch, with its great fluctuations in ice sheets, sea level, and climate. "This general synchronism is almost certainly not coincidental," they say.

Volcanic blasts may trigger climatic change—or just the reverse may be true. Another Rhode Island geologist, Dr. R. K. Matthews of Brown University, who has studied rise

and fall of ancient sea level, points out that the shift of weight from ice to water and back to ice might cause enough stress on earth's crust to set off volcanic eruptions.

Then, I thought, volcanic dust would cool the earth, ice caps would grow and sea level fall, and. . . .

THUS THE LIST of Grand Theories of Climate grows, the "nine and sixty ways." The oceans warm, and evaporation increases. Snows mount, ice caps build and flow, and the planet cools. Volcanoes trigger ice ages, or ice sets off volcanoes. Inner churnings move continents and build mountains, which block and change circulation of the atmosphere and the seas. The sun may blink in total energy output; sunspots may reveal such variations and be the key to short-term climate changes.

Murray Mitchell says of this, "Sunspots may have no more effect on the circulation of earth's atmosphere than a BB hitting a cannonball." But like other scientists, he is not so sure; some see climatic cycles that may be related to solar variation.

Whatever the answers, all agree there is a new factor in the game of climate change, a "wild card" never there before—man himself. For the first time in earth's long history, climatologists agree, human activities may be beginning to affect weather and climate on a par with natural forces.

"If nature is indeed trying to pull us into another ice age," says Murray Mitchell of the cooling trend since 1940, "we're possibly warming up the world an equal amount with our carbon dioxide. I'd like to know which way it will go, for my grandchildren's sake."

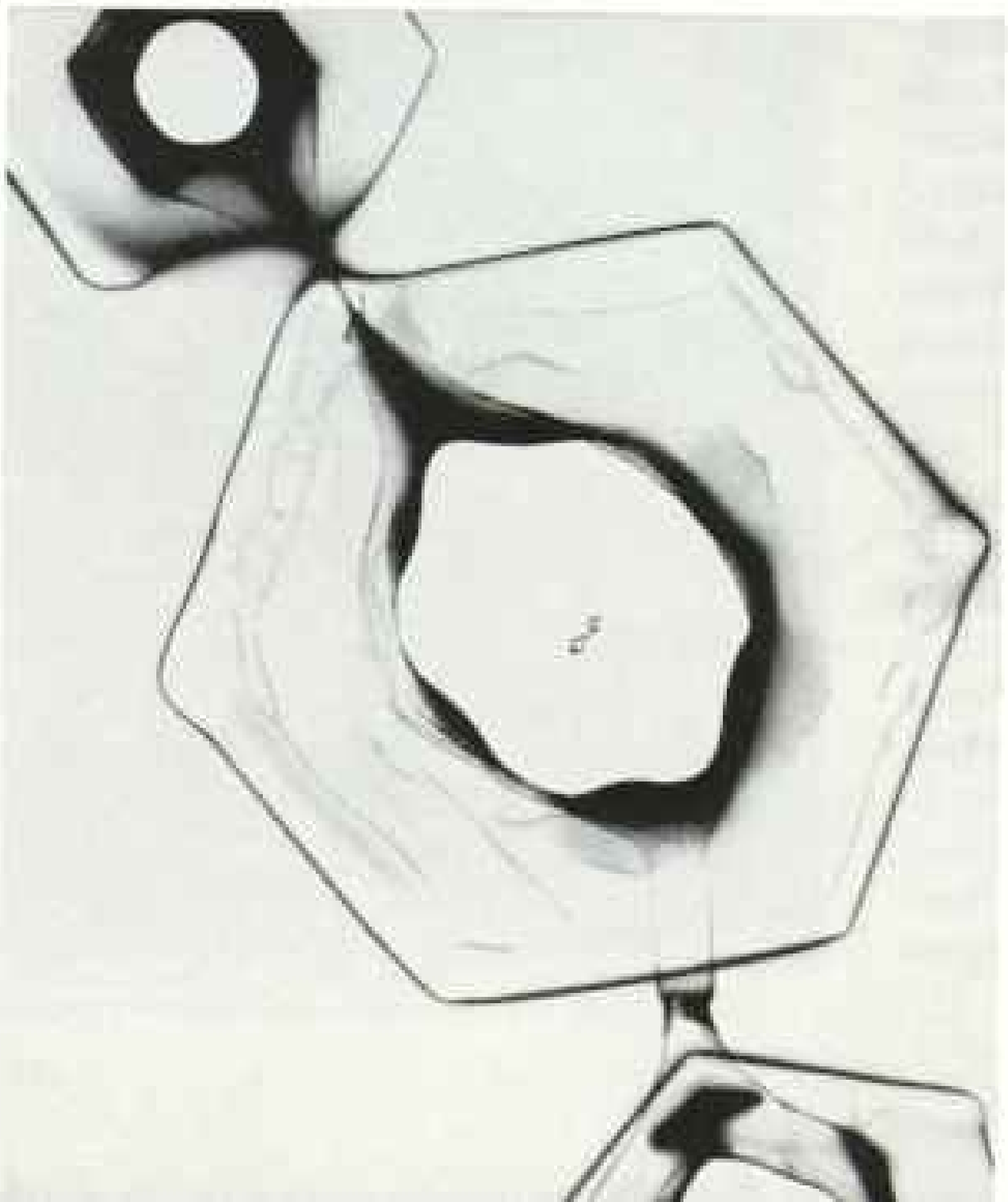
Another noted climate researcher, Dr. Reid A. Bryson of the University of Wisconsin (page 582), calls the overall effect of man's activities—his smoke, tractor dust, jet exhaust, smog from cities—the "human volcano" (next page). We are indeed a factor in the climate equation, he says; we may be the decisive factor. Man may tip the balance and bring on even minor changes that in their effect on agriculture could tip an overcrowded world into starvation and ultimate tragedy.

Many scientific efforts are under way to assess man's impact on climate. Some seek to measure the influence of major cities, heat-producing power plants, and industries on

Once upon a Little Ice Age, as skaters glided on Dutch canals, earth shivered with cold. From 1400 to 1850 climate's chill breath nourished glaciers and ruined crops, breeding famine, plague, and revolt. Converse climatic woes—heat waves and drought—gripped Europe this year. In Britain, the River Thames at Kew above London shrank to a muddy trickle (**below**).

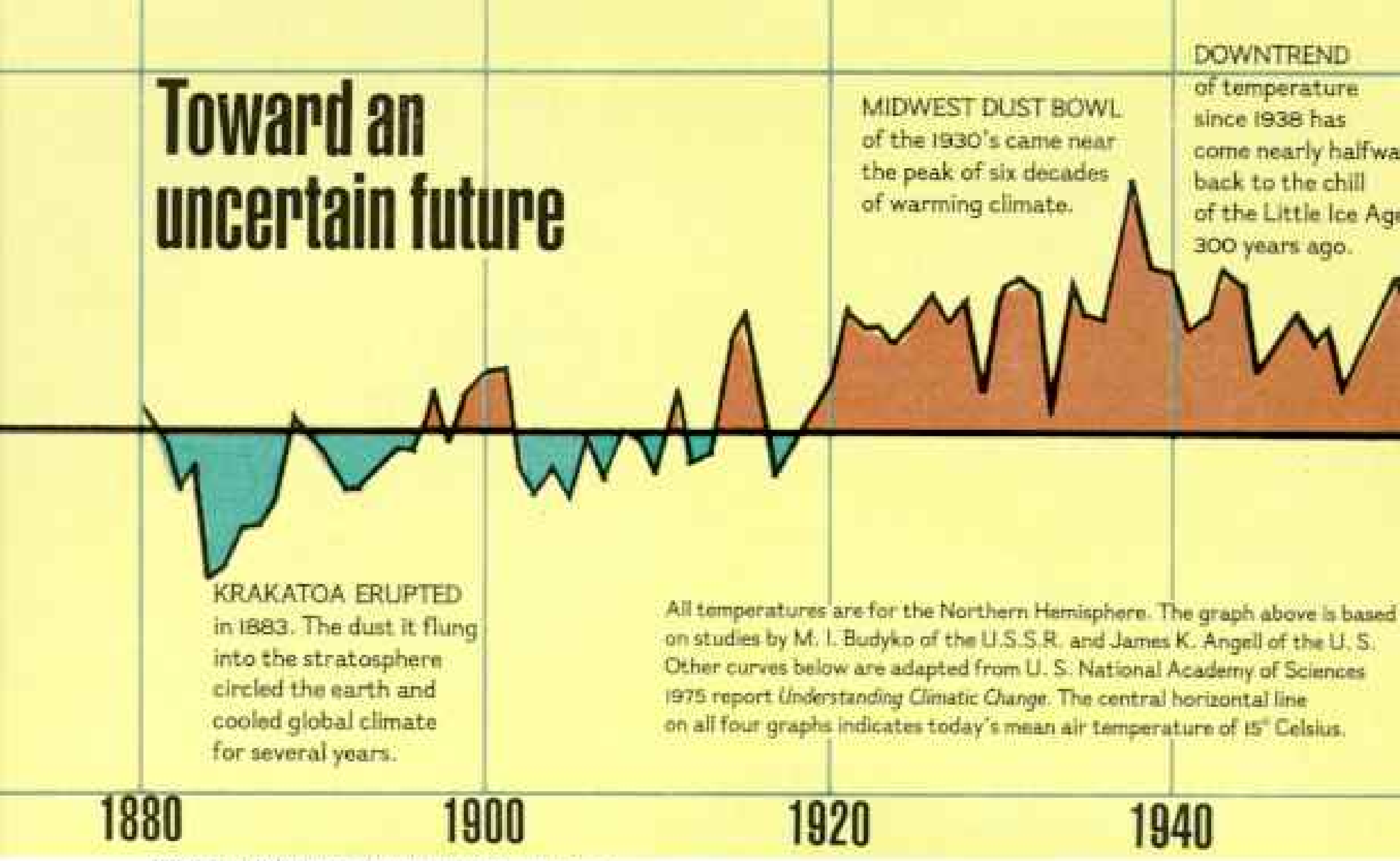
PAINTING BY HENDRICK AVERCAMP, 1585-1634, THE NATIONAL GALLERY, LONDON (TOP); JULIAN CALDER (BOTTOM)

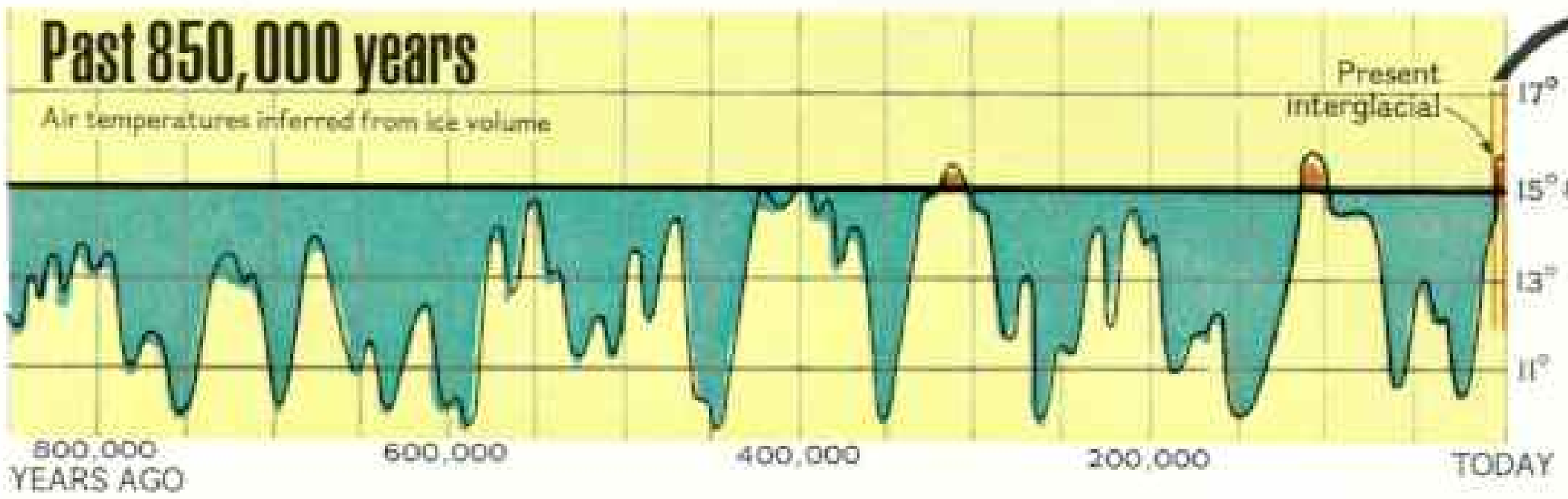
NATIONAL GEOGRAPHIC PHOTOGRAPHER JAMES L. STANFIELD (ABOVE); MICROGRAPH BY ROGER J. CHENG, STATE UNIVERSITY OF NEW YORK AT ALBANY (ABOVE); GODDARD SPACE FLIGHT CENTER, NASA



Progress casts a pall over a heavy-industry complex in the U. S. Northwest, where smokestack effluvium dims the morning sun (**above**). To the possible climatic influences of reflective ice and volcanic dust veils must now be added the influences of the human volcano. Commercial smoke, jet exhaust, city smog—all have become an unknown factor in the planet's future climate.

A view from above reveals how man-made clouds already affect present-day weather (**right**). In mosaic Landsat images, long plumes of pollution sweeping northeast from Chicago and Gary, Indiana, breed snow that falls on Lake Michigan's eastern shore. An electron micrograph shows how it happens (**left**): Ice crystals form around lead particles from an automobile's exhaust.





atmosphere, weather, farming downwind, and human environment. (See "Laboratory in a Dirty Sky," beginning on page 616.)

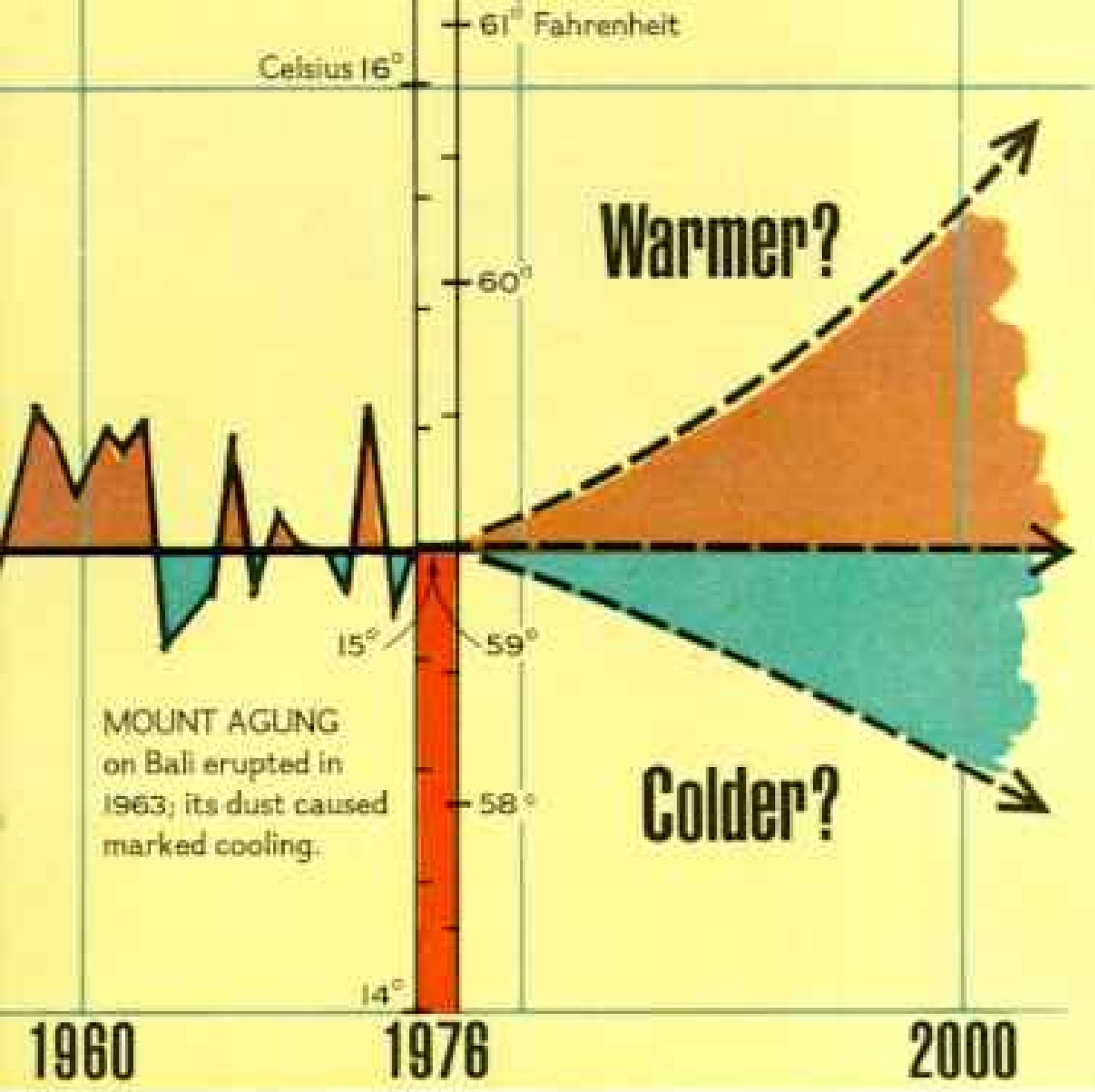
Whether man alters the climate inadvertently, as many now suspect, he is also setting out to do it deliberately. Rainmaking is a direct means of modifying weather (pages 600-601). So, too, are efforts to seed hurricanes to blunt their destructiveness, to disperse fog over airports, to increase snowfall on mountains and thus spring runoff for irrigation.

Though all such efforts are still young—and their effectiveness largely unproved—the potential ability to alter long-term weather, to benefit one area of the earth's surface, possibly to the detriment of another, requires a greater awareness of what man is doing—economically, politically, even irreversibly.

What will be the worldwide effects of clearing more land for farming—the Brazilian rain forest, for example? Of a seeming increase of cirrus cloud cover since 1950 along heavily traveled jet airliner routes? Of major Soviet dam building and canal projects on rivers flowing north to the Arctic?

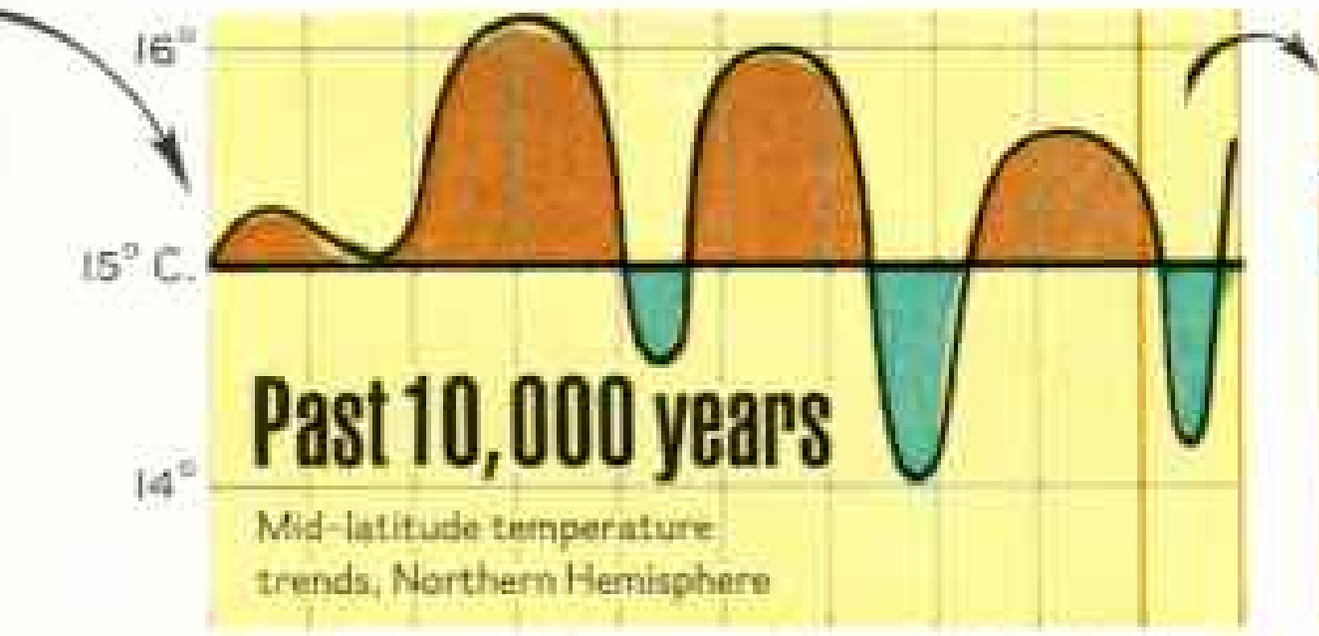
Consider just the last for a moment. Fresh water floats atop salt and freezes more quickly. Less fresh water in the Arctic might reduce ice cover, opening shipping lanes longer each year, perhaps even clearing the entire ocean of ice as more solar energy is absorbed.

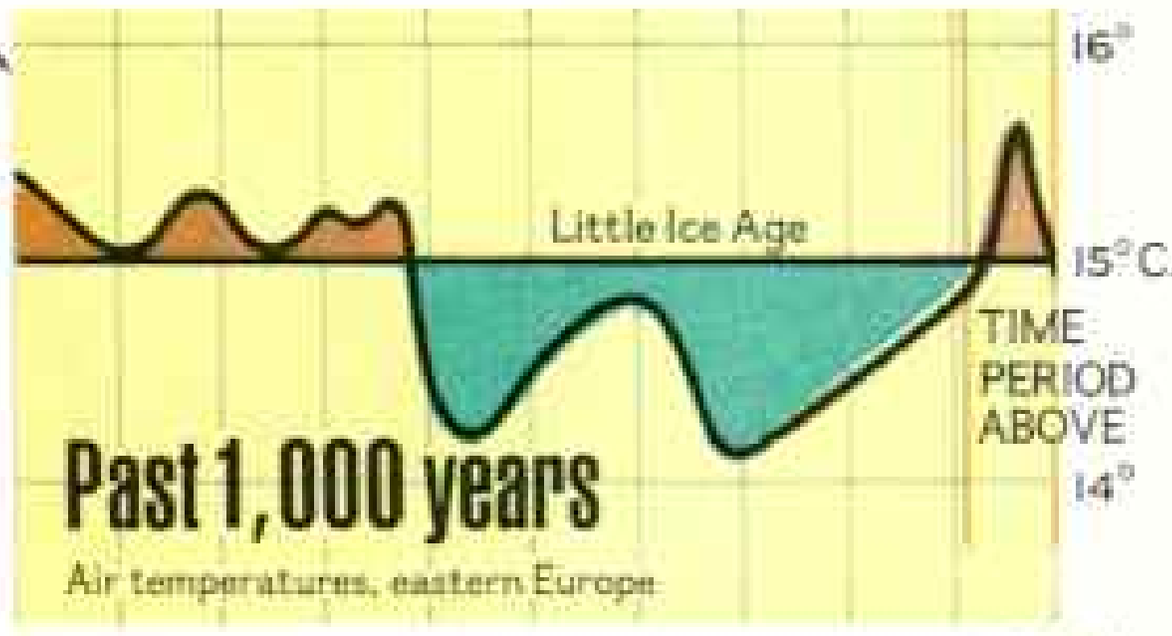
But . . . open water also increases evaporation, boosting snowfall and cloud cover over the Arctic, which conceivably could start glaciers and continental ice sheets growing again. Could another ice age thus ensue? A



IT MAY SEEM that there are as many theories on climate as there are climatologists, but experts agree on one point: They cannot yet predict climatic change with any assurance. Nevertheless, the three lower graphs on these two pages illustrate two important points. First, climatic change moves in irregular cycles. Second, we are living in one of the warmest periods of the past million years.

A change of two degrees Celsius in the annual mean air temperature would have profound effects. Higher temperatures might expand arable land—but only if accompanied by increased rainfall. Warmth, however, might bring drier conditions. Lower temperatures could produce a climate generally wetter and less stable, one marked by storms, floods, and freezes.





mile-high wall of ice advancing down the Hudson Valley toward Manhattan's towers?

If Bering Strait were dammed, would currents change around the Pacific, thereby altering the weather map of North America? Present work on long-range U.S. weather prediction, under Dr. Jerome Namias of Scripps Institution of Oceanography in California, links barometric pressure and storm patterns to changes in sea-surface temperatures far out across the northern Pacific.

Behind such work remains one simple and acknowledged fact: Man still does not really know what controls and changes his climate, his daily weather, his seasonal comfort, his year-by-year livelihood, and the crucial boundary conditions of life.

A recent report published by the National Academy of Sciences, *Understanding Climatic Change*, urges a major U.S. research program to add to our basic knowledge.

"Will we be able to recognize the first phases of a truly significant climatic change when it does occur?" the report asks. It goes on to note what its authors call the problem of "don't know, squared—that is, those who are called upon to implement the program may not know that *we* don't know the answers to the central questions"—or even, says Murray Mitchell, what questions to ask!

To which another climate scientist, W. Lawrence Gates of Oregon State University, added to me: "The question of climatic change is no longer just curiosity. We simply cannot afford to arrive unprepared at the doorstep of climatic catastrophe." □

Laboratory In a Dirty Sky

CHRIS ALLEN (ABOVE) AND NATIONAL GEOGRAPHIC PHOTOGRAPHER OTIS IMBODEN

Afloat in pollution, a manned balloon is used for the first time to study a city's contaminated air. Inflation began in early morning west of St. Louis (**above**). Later, in the gondola, Vera Simons, an artist and balloonist who conceived Project Da Vinci, helps chief scientist Dr. Rudolf J. Engelmann of the National Oceanic and Atmospheric Administration (NOAA) loose a test balloon carrying a Chinese lantern. NATIONAL GEOGRAPHIC photographer Otis Imboden, left rear, trips a remote camera to make this picture. Pilot Jimmie Craig completes the crew.

ST. LOUIS, MISSOURI, sits on the edge of the "eastern pall," where clear air sweeping in from the Great Plains begins to pick up the airborne debris of major population centers. Its atmosphere is one of the most studied in the nation. What better place to launch manned balloon flights to learn how an entire region is affected by urban pollution? Science has long known that emissions from one city may taint the air of another. But how extensive is the problem?

To find out, the Energy Research and Development Administration and its Sandia Laboratories, NOAA, the Environmental Protection Agency, and the National Geographic Society sponsored Project Da Vinci, named for the artist-scientist who 450 years ago envisioned so many of today's innovations.

Aboard the two-level, ten-foot-square gondola, we carry 4,000 pounds of instruments and batteries that will provide data to more than a dozen scientists investigating pollution.

At sunrise on June 8, 1976, St. Louis begins to stir. Light and variable winds and a temperature inversion have allowed the city's particular mix of contaminants to build. It spews into already burdened air. Wood River, Illinois, just across the Mississippi, is under its first pollution alert of the year.

At 8:55 a.m. the 15-story-high laboratory

By RUDOLF J. ENGELMANN, Ph.D., and VERA SIMONS

BOTH BY CHIP MAGSIGN

leaves its moorings and rises to about 2,500 feet to drift like a soap bubble in a dirty bathtub. The crew is exposed to carbon monoxide, hydrocarbons, and oxides of nitrogen from automobiles and industrial sources; sulfur compounds from power-plant smokestacks; and the chemical combinations of all these in the atmosphere.

Instruments literally take it all in, sucking gases into canisters and bags, depositing particles on filters, monitoring sulfur dioxide's transformation into sulfuric acid, recording concentrations of ozone—which in strong doses can kill plants and burn the throat and lungs.

The great plastic bag and its suspended gondola are occasionally lifted to 7,000 feet by rotating thermal columns, making navigation difficult. We release "tetroon" balloons (**above, left**), whose dangling Chinese lanterns help us track them to measure air motion.

Sunset finds us still over St. Louis. Our view of the city's power stacks and the Mississippi River is dimmed by haze. Periodically we fit another canister to a pump (**above**) for samples of the stagnant air.

Later, in the dead of night, the crew takes turns at a few hours of fitful sleep on the lower deck, while a gentle wind blows the devil's brew—and the balloon—off to the east.

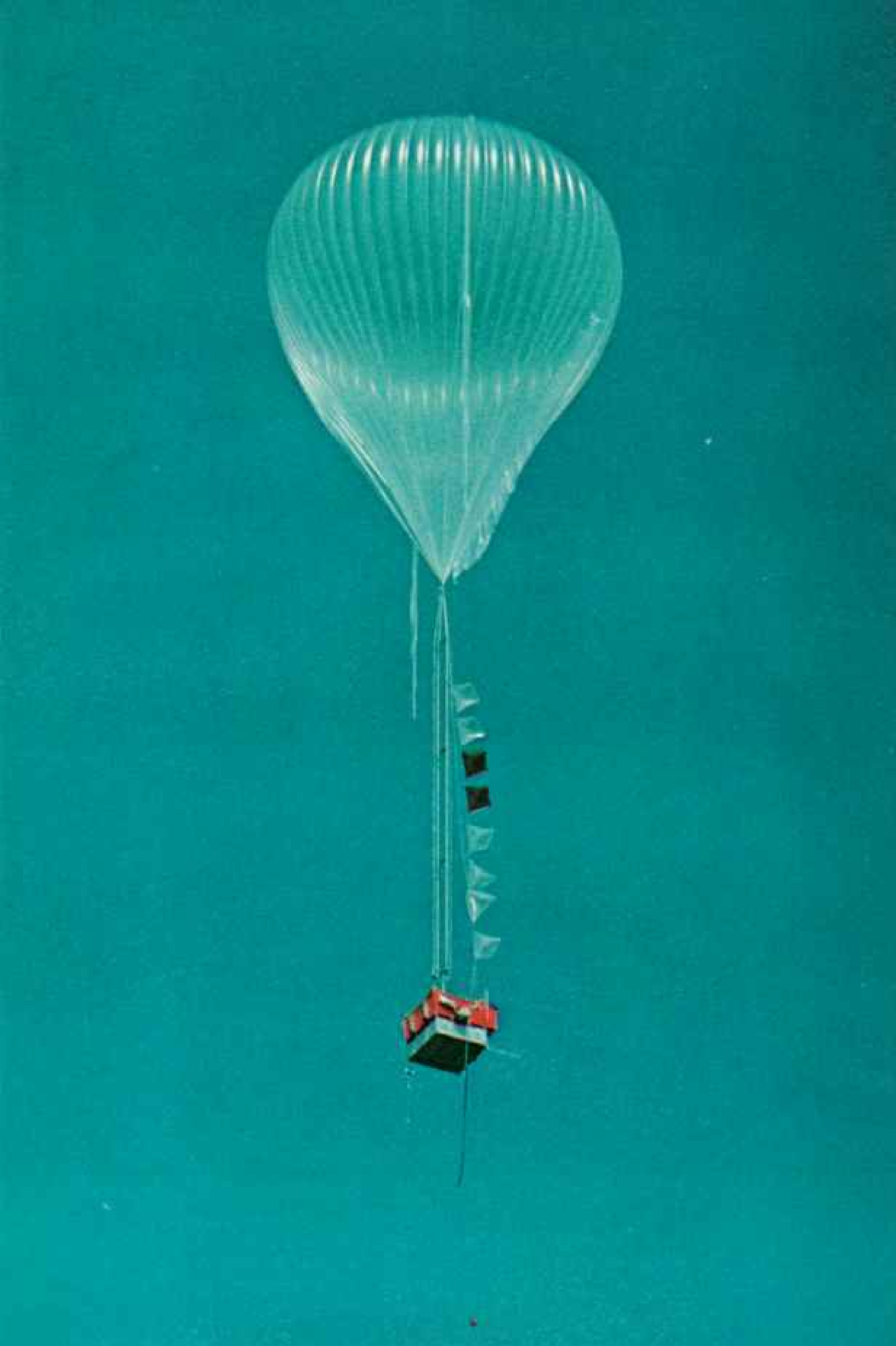
TRACKED BY CHASE PLANES and scientists in instrumented vans, the flying lab drifts over Illinois and into Indiana (**map**), still riding in the same cloud of pollution bequeathed by St. Louis the day before. The drifting platform (**right**) provides a unique method of studying air. Airplanes cannot stay in the air being tested, and fixed, ground-based instruments can measure only the segments of air that pass by.

Now, at 9:05 a.m., 24 hours and 200 miles after launching, we descend by venting helium. The controlled release of ballast gentles our descent, and we touch down softly in the wheat field of farmer James Nash, who extends a welcoming hand (**below**). Foil-covered bags of air samples go to scientific colleagues on the ground (**left**).

Pleasure at having successfully tested an extraordinary means of studying the lower atmosphere is diminished, however, by sobering implications. The balloon has ridden the dirty air of St. Louis to the broad and peaceful fields of Indiana. Tall smokestacks used in St. Louis might be sparing the city people high exposures, but they are also spreading the problem. Moreover, as the pollution travels to distant points, it is changed by the sun into other toxic mixtures.

We had landed, but the polluted air above us was still moving on. □

CHRIS ALLEN (RIGHT) AND OTIS IMBODEN



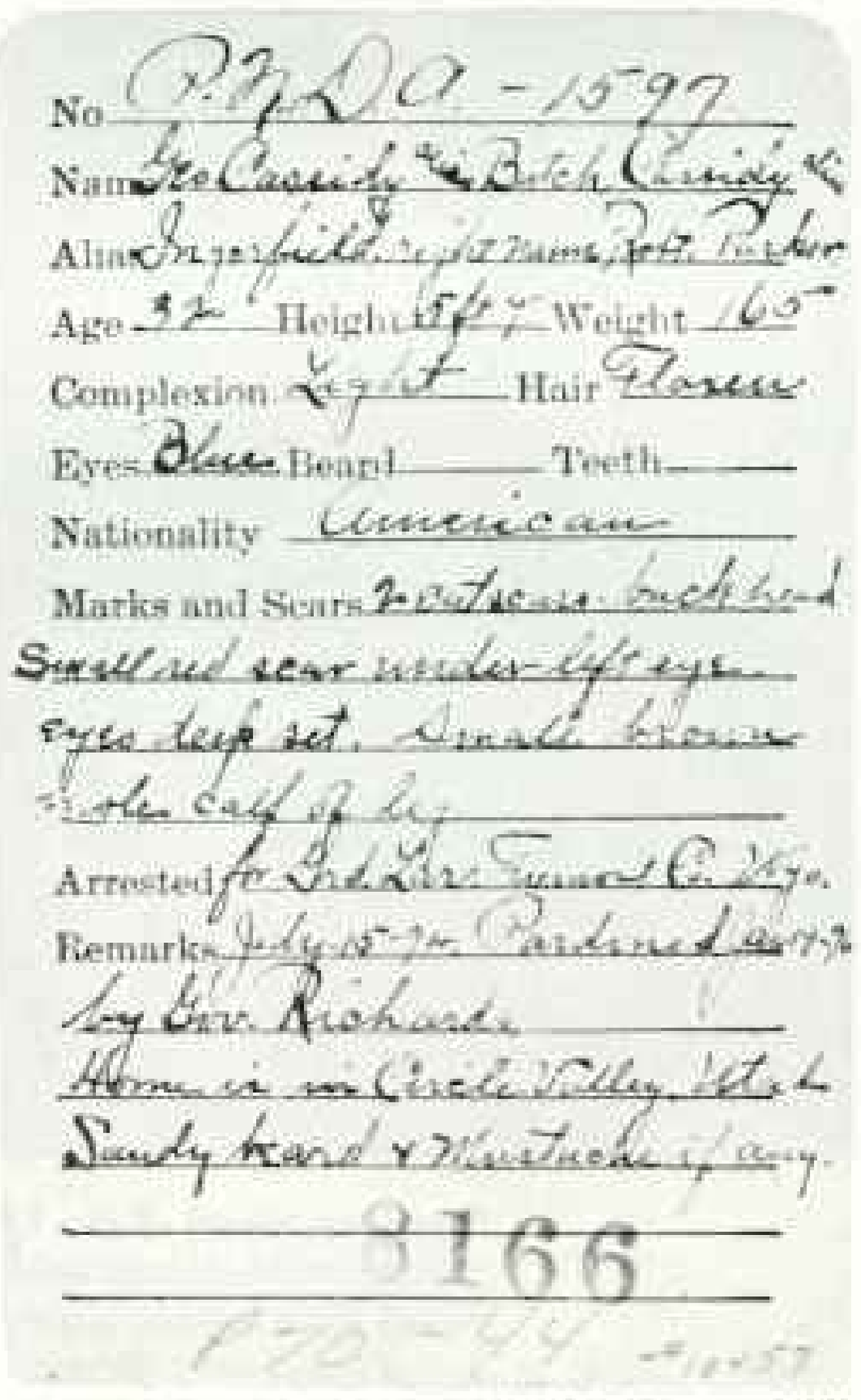
RIDING THE OUTLAW

By ROBERT REDFORD

Photographs by JONATHAN BLAIR

Storm comin' . . . long ride ahead. Leaving Hollywood behind, the author joins Utah rancher Arthur Ekker to follow one of the trails haunted by a badman of yesterday—Butch Cassidy (**facing page**). Redford found the Wild West that was—and in some parts, still is.

TRAIL



1894 PRISON PHOTO (ABOVE) AND INAUGURATION'S PROFILE COURTESY WYOMING STATE ARCHIVES AND HISTORICAL DEPARTMENT

I RODE HARD to reach the campsite near Hole-in-the-Wall before dark. After an intense year of filming *All the President's Men*, it felt good to shake the city dust from my bones. On a distant ridge a few aspens still struggled to hold their awesome yellows against oncoming winter, and the October wind stung me into an alertness I hadn't felt for months.

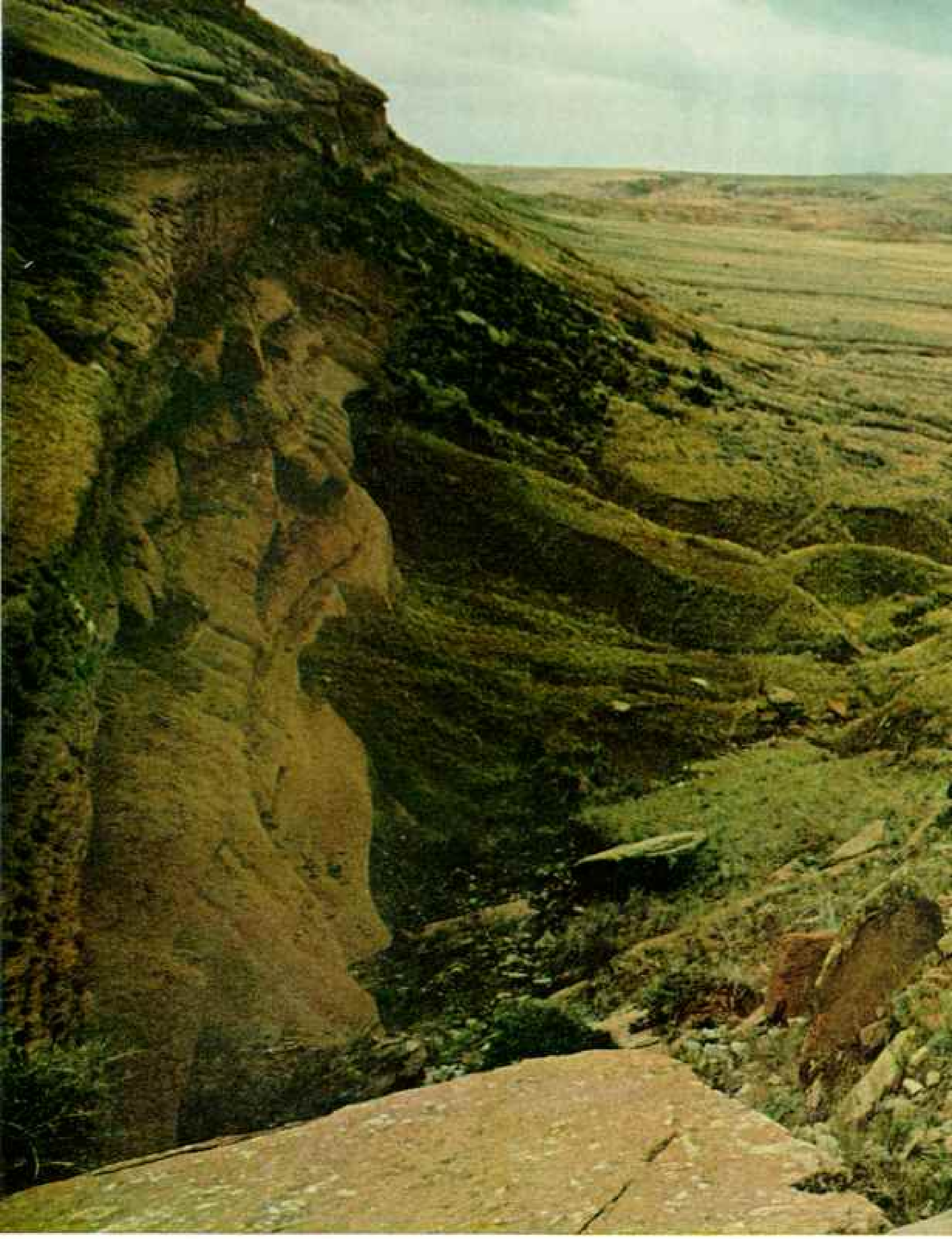
Hole-in-the-Wall, for years a notorious refuge for rustlers, killers, and thieves, is a narrow notch in the great Red Wall of central Wyoming. When I reined up, others were already camped in the dry, sloping valley below, milling around a fire; young faces and old, some weathered by the elements under sweat-stained stetsons curled to the owners' liking.

From this rendezvous we would set out to retrace a major, 600-mile segment of a historic, rugged route—often glorified, in places still mysterious or long erased—known as the Outlaw Trail.

As technology thrusts us relentlessly into the future, I find myself, perversely, more interested in the past. We seem to have lost something—something vital, something of individuality and passion. That may be why we tend to view the western outlaw, rightly or not, as a romantic figure. I know I'm guilty of it, and for years I have been fascinated by that part of the West that offered sanctuary and escape routes to hundreds of colorful, lawless men.

The Outlaw Trail actually ran from northern Montana to Mexico (map, page 630). It had dozens of offshoots, but the main stem wound from Montana south and across Wyoming, through Utah and part of Colorado to Arizona and New Mexico, southeast toward Texas and the Mexican border.

For some forty years, beginning about 1870, it was a lawless area where a man with



One leap ahead of the law, a shadowy collection of bandits and desperadoes once squeezed through here to the safety of an easily defended outlaw refuge. The author picks his way toward the narrow passage called Hole-in-the-Wall, a notch

like a rifle sight in a 50-mile sandstone ridge rearing out of the Wyoming grassland. This hideout and others along a rough route from northern Montana to Mexico became known collectively as the Outlaw Trail.

a past or price on his head was free to roam nameless. But he had to be good with a gun, fast on a horse, and cleverer than the next. On this trail no holds were barred, and old age was a freak condition.

I had heard tales of what survives in this country, forgotten or buried by time: old graves, cabins, caves, saloons, whole towns now untended. I'd heard stories of the outlaw bands and notorious men who rode the trail: the Red Sash gang, Butch Cassidy and the Sundance Kid, Jesse and Frank James, the McCarty brothers, Matt Warner, Big Nose George Parrott, Nate Champion, Tom Horn, and many others.

Inventive Outlaws Made Crime Pay

The most efficient and elusive outlaw gang in the history of the American West was the Wild Bunch, numbering anywhere from three to ten, with up to a hundred hangers-on. They rustled cattle, stole horses, robbed banks and payrolls, and held up trains in half a dozen states for about six years around the turn of the century.

The gang dissolved after its undisputed leader, Butch Cassidy, and his sidekick Harry Longabaugh (the Sundance Kid) sailed for South America. There, according to some historians, the two were cornered and killed by Bolivian soldiers.

Butch Cassidy and his crew were masters of the "pony express" concept for their getaways—using fresh horses and supplies posted at a network of way stations about twenty miles apart. The most important of these on the Outlaw Trail were Hole-in-the-Wall, Wyoming; Browns Park on the border between Utah and Colorado; and Robbers Roost in Utah. Caches of weapons were kept at strategic locations. Outlaw post offices for letters and messages were hollow trees, holes or ledges, or chinks in log cabins.

By this system a robbery could be perpetrated near Rawlins, Wyoming, on Monday, and the outlaws could be 120 miles away in Browns Park, Utah, on Tuesday, leaving the law baffled as to how it was accomplished.

For the trip I had in mind, I had invited eight companions, mostly unacquainted and from different places and backgrounds. But they did share a deep love of the outdoors and an interest in western history.

They included photographer Jonathan Blair and his wife, Arlinka; Dan Arensmeier, a Fort Collins, Colorado, marketing consultant and his wife, Sherry; and Kerry Ross Boren, a western historian from Salt Lake

"Howdy. I'm Tex Raper. That's my name." A Kaycee, Wyoming, cowhand, Tex gave the Redford party plenty of good conversation during the first leg of their ride, to Hole-in-the-Wall. Like many folks in this area, Tex takes pride in a mysterious past. He talks of robbing a bank in San Antonio, Texas, in his youth, and the twinkle in his eye leaves the listener wondering.

"You know, things have just gone crazy around here," laughs Garvin Taylor, right, leader of the author's trail ride to Hole-in-the-Wall. "Saw some of them hang gliders the other day, thought maybe they was from Mars." His son Curt, left, co-owner of the Blue Creek Ranch, is more pragmatic about the future. He laments plans to dam and flood a nearby valley for industrial and irrigation water: "New people will come in—the place will never be the same."

City. Three of the group would join us along the trail: Terry Minger, town manager of Vail, Colorado; Edward Abbey, a novelist and naturalist from Moab, Utah; and Kim Whitesides, a Utah artist and old friend of mine, now transplanted to New York City.

Our guides for Hole-in-the-Wall, starting point of our trip, were Garvin Taylor, 59, and his son Curt, who run the Blue Creek Ranch. Around that first night's campfire, Garvin proved himself an artist of his kind—a nonstop western raconteur with an impressive fund of saddle wisdom. He had led a rich and varied life, and admitted to having been an outlaw once himself.

Someone kidded Garvin about his new Levi's. "Still stiff," he answered. "Got to stand 'em against a tree to put 'em on."

He spoke of the Hole-in-the-Wall area. "Ain't no place like it. This place has its own ways—ways dictated by the outlaws who settled it. Ain't nothin' much changed."

A grizzled old cowhand rode into camp looking as though he had consumed an entire distillery. His name was Tex, and he tends cows for the Taylors. He had tangled with a bank clerk in San Antonio in 1927, I was told, and fled to Hole-in-the-Wall. He'd been in the area ever since.

A bottle made the rounds. Everyone was mellowed out now, the fire, the food, and the drink a settling force. The talk turned to more serious matters.

Curt Taylor seemed to be the spokesman for the group, and he was worried about the future: "What's happening to the rancher in this area? Ranchers are one of the smallest minorities there is—damned few and gettin' fewer. I'd make more money if I sold and lived on the interest."

"Why don't you?"

"Nothin' short of foreclosin' would pry me out. I love the land, I love this place. It has a fabulous history. I guess we feel part of it, me and my dad."

Rising Costs Force Ranchers Out

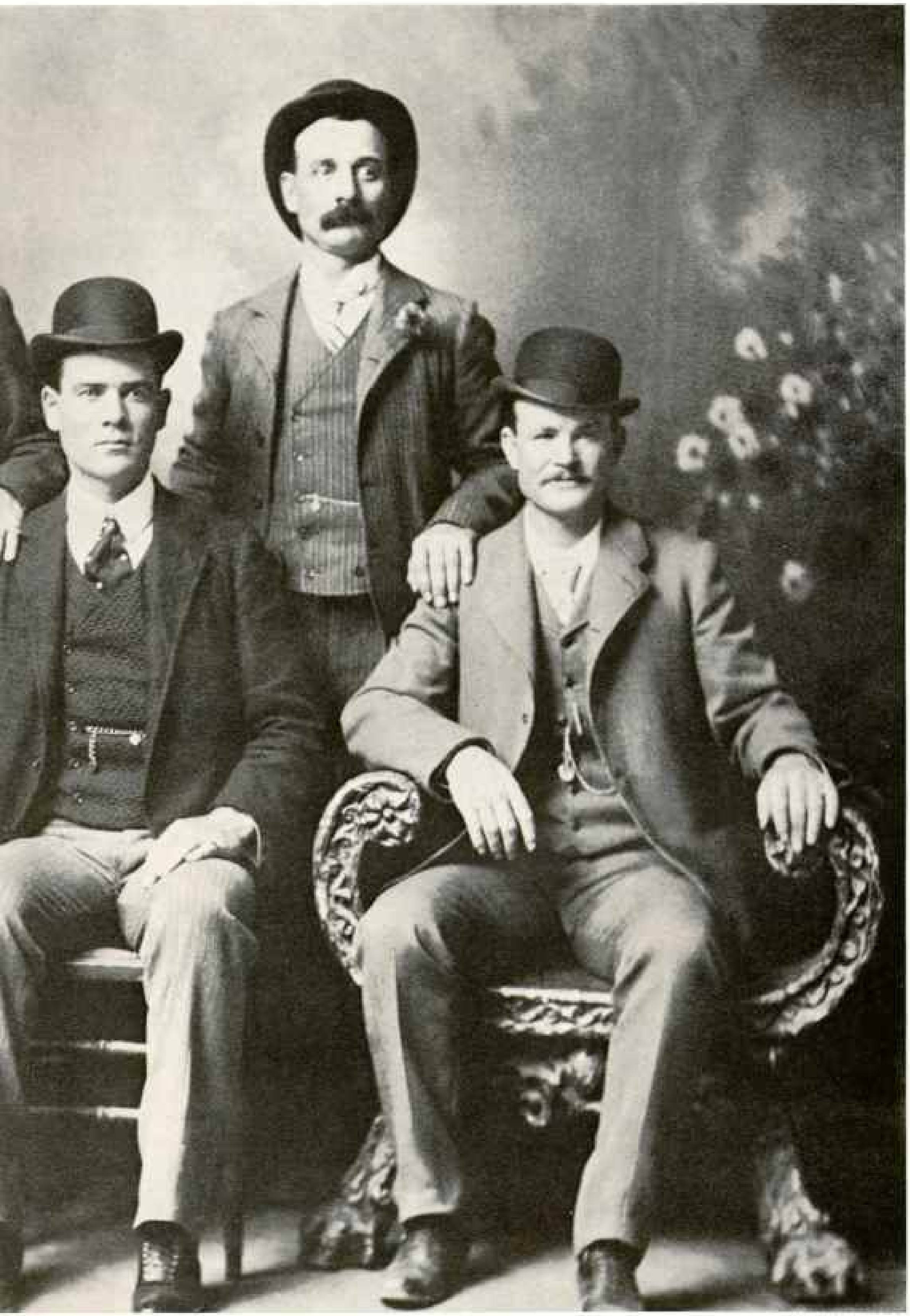
He described a common rancher's dilemma, one we'd hear about repeatedly during the ride: Coal, oil, gas, or power companies will buy up an attractive ranch and trade it for land they really want in mineral areas. They pay the rancher a good price, but this raises the assessed value of his neighbors' land—as well as their taxes. Other ranchers are then tempted to sell, and so a slow squeeze play is set in motion.

"Evaluation is *(Continued on page 631)*

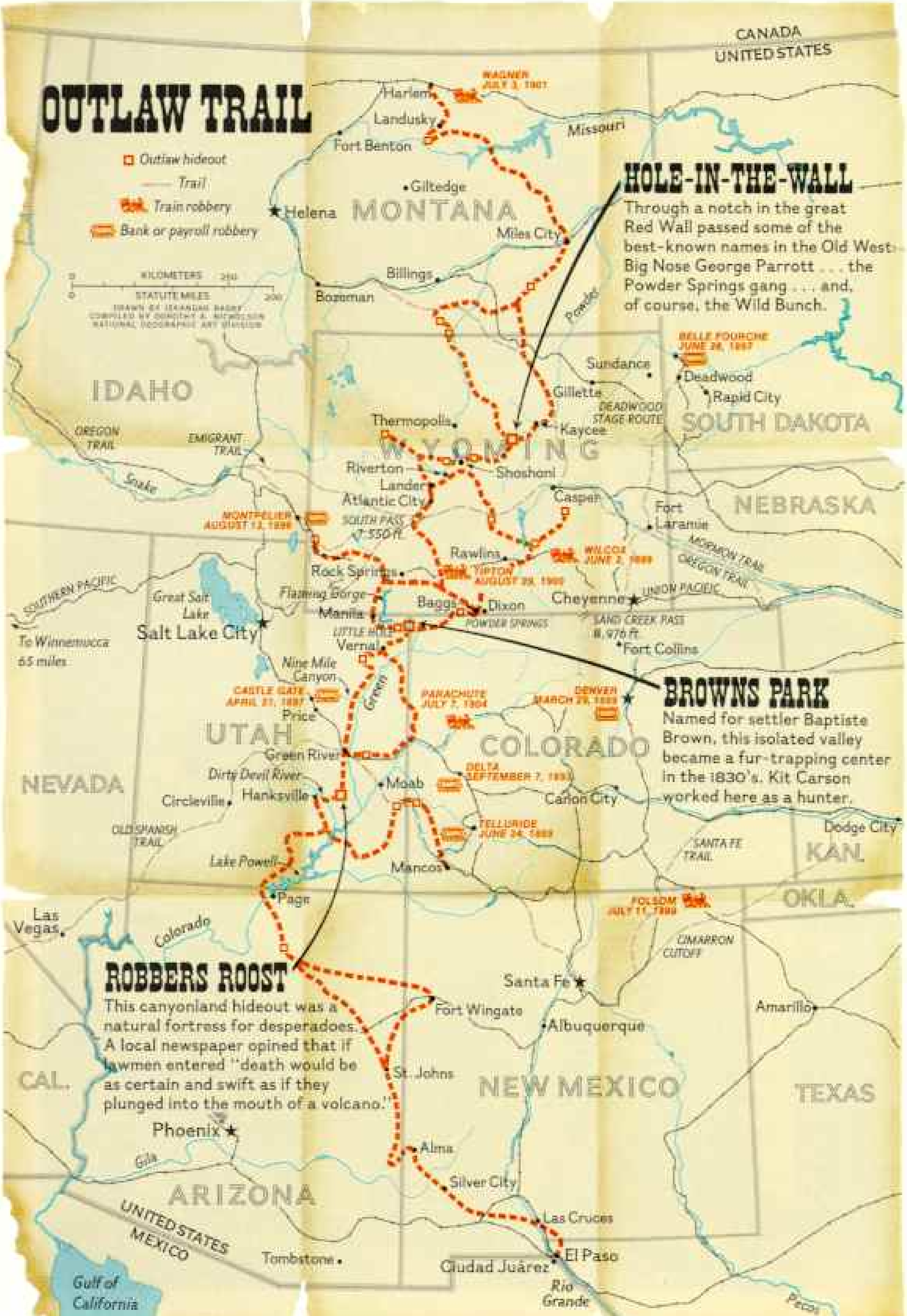
NEW SUITS FROM HOT LOOT

"A good joke," Butch Cassidy decided one day in 1900, would be for him and four members of the Wild Bunch to have their pictures taken in Fort Worth, Texas, wearing outfits bought with money the gang had recently "withdrawn" from a bank in Nevada. Seated, left to right: Harry Longabaugh (alias the Sundance Kid), Ben Kilpatrick (alias the Tall Texan), and Robert LeRoy Parker (alias Butch Cassidy). Standing: Bill Carver (noted for smelling like a skunk) and Harvey Logan (alias Kid Curry).

Seventy-six years later Warren Scott, branch manager of the First National Bank of Nevada in Winnemucca (**below**), displays moneybags from the same bank the Wild Bunch knocked over, now located across the street.



COURTESY PINKERTON'S INC.


OUTLAW TRAIL
Outlaw hideout
Trail
Train robbery
Bank or payroll robbery
KILOMETERS
STATUTE MILES
HOLE-IN-THE-WALL
Through a notch in the great Red Wall passed some of the best-known names in the Old West: Big Nose George Parrott . . . the Powder Springs gang . . . and, of course, the Wild Bunch.
BROWNS PARK
Named for settler Baptiste Brown, this isolated valley became a fur-trapping center in the 1830's. Kit Carson worked here as a hunter.
ROBBERS ROOST
This canyonland hideout was a natural fortress for desperadoes. A local newspaper opined that if lawmen entered "death would be as certain and swift as if they plunged into the mouth of a volcano."
CANADA
UNITED STATES
WAGNER JULY 3, 1901
Harlem
Landusky
Fort Benton
Missouri
Giltedge
Helena
MONTANA
Miles City
Billings
Bozeman
Powder
BELLE FOURCHE JUNE 28, 1897
Sundance
Deadwood
Rapid City
Gillette
DEADWOOD STAGE ROUTE
SOUTH DAKOTA
Kaycee
IDAHO
Thermopolis
OREGON TRAIL
EMIGRANT TRAIL
WYOMING
Riverton
Shoshoni
Snake
Lander
Atlantic City
Casper
Fort Laramie
NEBRASKA
MONTPELIER AUGUST 13, 1896
SOUTH PASS 7,550 ft
Rawlins
WILCOX JUNE 2, 1899
MORMON TRAIL
OREGON TRAIL
Rock Springs
TIPTON AUGUST 29, 1900
SOUTHERN PACIFIC
Great Salt Lake
Flaming Gorge
UNION PACIFIC
Cheyenne
Baggs
Dixon
Manila
POWDER SPRINGS
SAND CREEK PASS 8,976 ft
Salt Lake City
To Winnemucca 65 miles
Vernal
Fort Collins
Nine Mile Canyon
CASTLE GATE APRIL 21, 1897
PARACHUTE JULY 7, 1904
DENVER MARCH 29, 1889
Price
Green
UTAH
COLORADO
Green River
NEVADA
Dirty Devil River
Moab
DELTA SEPTEMBER 7, 1893
Circleville
Hanksville
Cañon City
Dodge City
OLD SPANISH TRAIL
TELLURIDE JUNE 24, 1889
SANTA FE TRAIL
KAN.
Lake Powell
Mancos
Page
FOLSOM JULY 11, 1899
OKLA.
Las Vegas
Colorado
CIMARRON CUTOFF
Santa Fe
Fort Wingate
Amarillo
Albuquerque
CAL.
St. Johns
NEW MEXICO
TEXAS
Phoenix
Alma
Gila
Silver City
ARIZONA
UNITED STATES
MEXICO
Las Cruces
Tombstone
El Paso
Ciudad Juárez
Rio Grande
Gulf of California
Pecos

a hundred dollars an acre here now," said Curt. "Taxes and production costs will kill you. You make only two-thirds of what it costs you to raise a cow."

Other local people around the fire murmured their assent. Someone spoke of growing Government intervention and regulation in the West:

"Gettin' so if you want to spit these days, you need a permit."

"Yeah, and you got to dig a hole first."

"They probably got a handbook on that, too—*How to Dig Your Hole*."

"I don't need no handbook," rasped Tex, suddenly alive again. "My *life* is a dug hole."

It was already 1 a.m. The temperature had dropped below freezing, and snow was beginning to fall. Some had crept away to sleeping bag, bedroll, or tent.

The ground was hard and cold. I had mistakenly brought my son's sleeping bag, and it was too small to stuff myself into. I cursed my carelessness and dozed off thinking of the cowboys who spent months like this, back when there were no down sleeping bags, hand warmers, snow boots, or thermal underwear. I thought about that—about hard ground and hard bones and the saddle for a pillow.

Cowboy Coffee Cures the Stiffness

Morning. We had all gone to bed to the sound of Tex's voice, and now we woke up to it, like musical accompaniment. Except it sounded more like a cattle wagon being dragged over a dry river bottom.

The fresh smell of cowboy coffee to cut the dead chill of dawn. The sizzle of bacon and sourdough pancakes. The awakening of voices, the sound of saddle leather, utensils clattering, stiff-body groans, and a lot of coughing from the old-timers.

Someone was cooking eggs. Tex: "The chicken is the only thing we eat before it's born and after it's dead. . . ."

After breakfast Garvin led the ride up the sloping valley to the actual Hole-in-the-Wall —the V-shaped opening at the top of the redstone escarpment, barely wide enough for a horse. There, two men with Winchesters could stand off an army (pages 624-5).

On the way we saw virtually nothing of the old outlaw "ranch"—once a few crude log huts, tents, a saloon—in which rustlers and other outlaws gathered in the past century. There was good grass here to fatten stolen cattle and horses. Garvin pointed to a spot on the trail where a rustler was shot by a group of cattlemen.

I asked about the famous Johnson County War. In April 1892, Cheyenne cattle barons imported a gang of 20 gunfighters from Texas to clean out this part of Wyoming of rustlers and small cattlemen alike. But the "invaders" were held to a stalemate. It took the U. S. Cavalry to rescue them from a countersiege by a force of irate settlers and outlaws.

I had read a film script that told of at least a hundred people shot in the war. "That's a lot of puckie," Garvin said. "Only four was killed. Nate Champion and Nick Ray was ambushed in a cabin right over there." He

Sourdough pancakes and black coffee satisfy hearty appetites early in the morning near Hole-in-the-Wall. The author and his group also explored two other outlaw strongholds along the trail: Browns Park and Robbers Roost (**map, facing page**).

HARVEY LOGAN ALIAS "KID" CURRY

UNION PACIFIC RAILROAD MUSEUM COLLECTION

BADDEST APPLE IN THE BUNCH

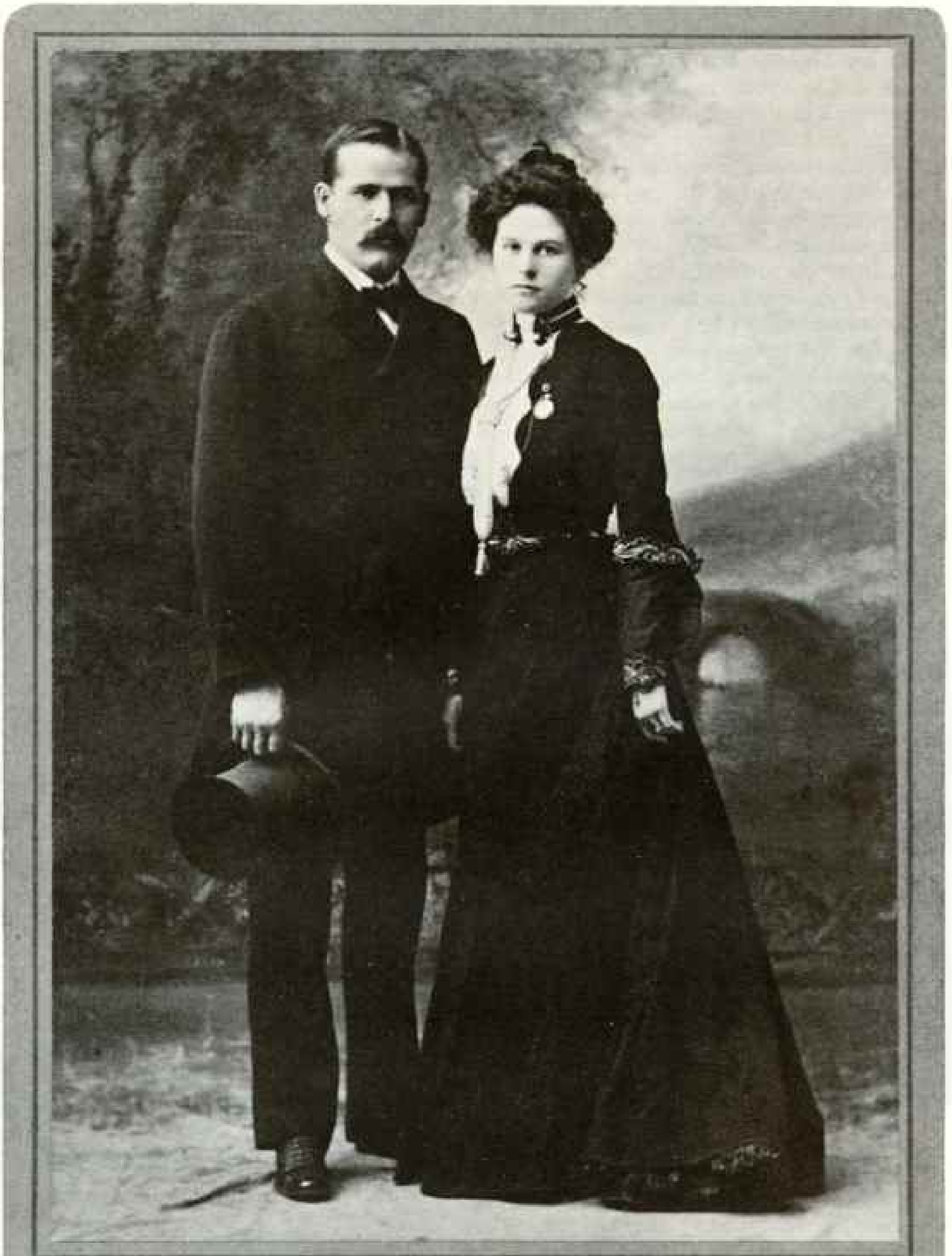
The Tramp. Tiger of the Wild Bunch. Kid Curry. Harvey Logan. They were all the same man (**left**), one of the most infamous of all the outlaws. The record credits him with at least eight murders. Powell "Pike" Landusky was the first, gunned down during an 1894 Christmas party in the Montana town named for him. Today his tombstone lies protected on Tom Kolczak's ranch (**below left**) near Landusky.

Seventeen years and a long, bloody trail later, Kid Curry met his own end in Argentina, where he was double-crossed and murdered by another American outlaw.

THE LADY AND HER MAN

"She appears to be a refined type," noted the file on Etta Place at the famous Pinkerton detective agency. That, and her ability to ride and shoot, were probably how she hooked Harry Longabaugh, the Sundance Kid (**right**). This photograph was made in New York City in 1901, where Sundance, Etta, and Butch Cassidy spent a lot of money before leaving for South America. There they resumed careers of crime.

Etta later fell ill and returned home, but historians dispute the fate of her partners. Some say that Butch, too, eventually came back. Others claim that soldiers surrounded the pair in San Vicente, Bolivia, in 1909, and Butch Cassidy and the Sundance Kid ended their careers in a hail of bullets.



ORIGINAL PHOTOGRAPH BY DE YOUNG'S OF BROADWAY LATER REMOUNTED ON A BUFFALO STUDIO CARD. COURTESY PINKERTON'S INC.

pointed to a distant flat. "One guy shot himself in the foot and got gangrene. Another died from something else. But hell, there was more people shot in a poker game in Gillette."

The climb up the wall to the niche, or hole, was steep and a little dangerous over the loose rubble. The rest of us dismounted and led our horses the last third of the way, but Garvin rode right to the top. A horse can sense when a real horseman is in the saddle. Garvin's horse knew. He never balked.

As we rode across the flats stretching endlessly toward a gray-black horizon, I put up my collar and turned down my hat against the chill wind. Garvin rode gloveless, with only a denim jacket to protect him.

From a mesa we surveyed the Middle Fork Powder River Valley far below—now threatened by development.

"Water is a very big issue here," said Curt. "Oil interests want to build a dam, flood this valley, and send water 75 miles away to Gillette for coal-gasification plants. They'd get more than two-thirds of the water; the rest would be used for irrigation. But the dam would bring more and more people, and Hole-in-the-Wall, as we know it, would be a thing of the past."

He was bitter as he spoke. There is something unhappy here, I thought, something unsettling—a fear that a way of life is dying, and with it, a certain dignity.

MONTANA HISTORICAL SOCIETY, HELENA (ABOVE)

"She swore, she drank, she wore men's clothing. . . . She was just fifty years ahead of her time." That was Calamity Jane in 1897, said a friend much later. Here in a seldom-worn dress (**above**), she hoists a few with the boys outside a bar in Giltedge, Montana.

In the Mercantile Saloon in Atlantic City, Wyoming (**right**), the author finds time for some friendly bull-slinging with the locals. Larry Roupe, right, a retired rodeo star, claims to have "got my neck broke six times."

We went on to the Blue Creek Ranch to meet Mrs. Ethel R. Taylor, Garvin's mother, a sweet, spirited woman in her 80's. You could immediately sense in her a pioneer spirit—a tough, durable sensibility.

"Many people from around here come from outlaw backgrounds," she said. "Sometimes they leave mysteriously . . . we don't ever ask why . . . we're proud of it."

When we said our good-byes, I thought Mrs. Taylor had the strongest handshake.

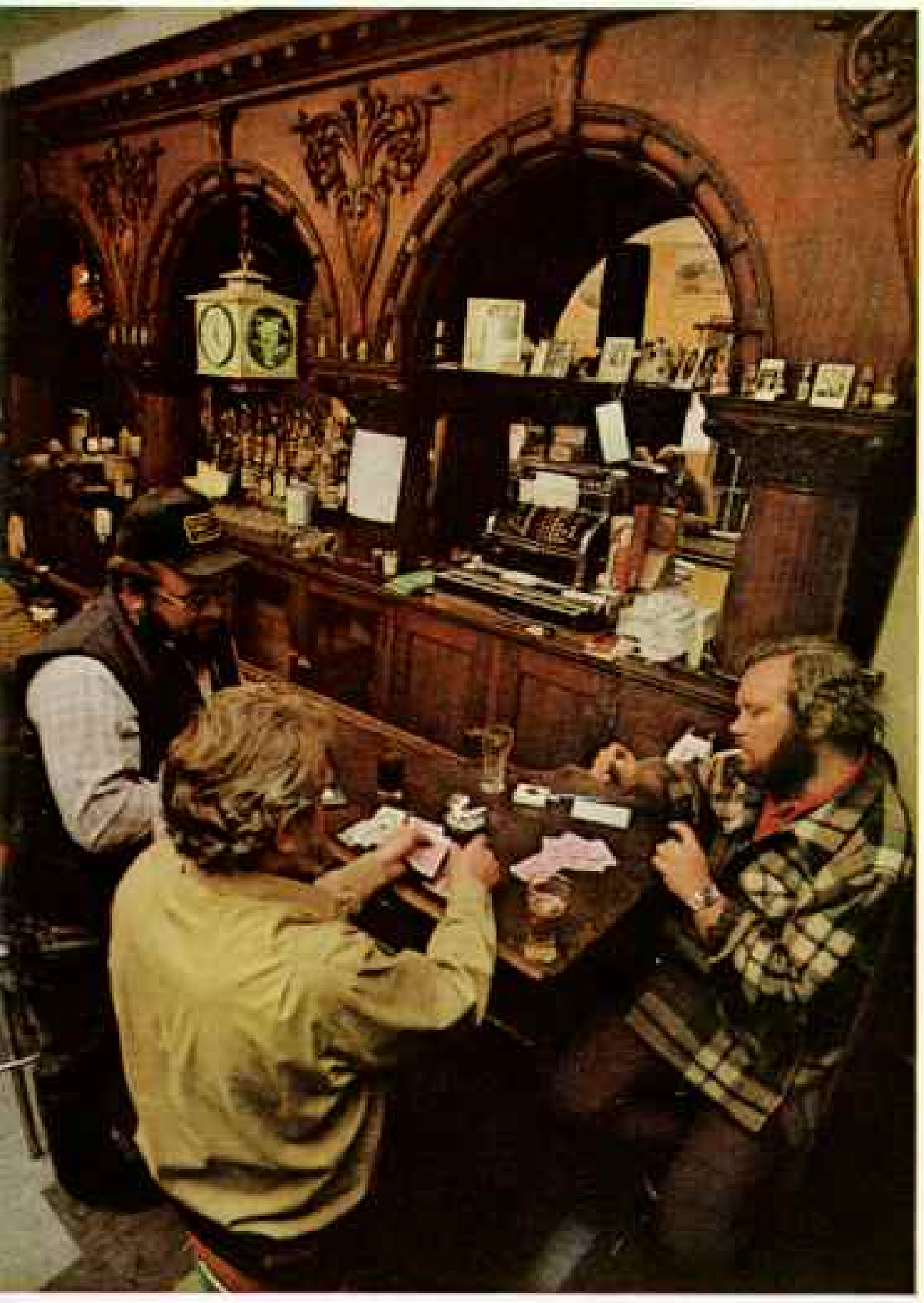
No Seashore in Atlantic City

Our trail took us to Shoshoni, Riverton, Thermopolis, and finally to Lander, at the foot of the beautiful Wind River Range. Around here, early in his outlaw career, Butch Cassidy had passed himself off as a horse dealer; some noticed, however, that he was always selling, never buying. Kerry Boren, our historian, said Cassidy was supposed to have cached $30,000 in these mountains.

Just outside Lander on the climb to the Continental Divide is the small, all-but-forgotten settlement of Atlantic City, an old gold-mining town. A dirt road led us into a cup of a valley where, to our amazement and joy, nothing seemed to have changed for nearly a century. A few tiny cabins stood like wooden sentries against stark brown-and-white slopes.

A few dozen people live hereabouts, but

THERMOPOLIS PIONEER MUSEUM



FANCY BAR FOR A LAWLESS BREED

This den of iniquity and oasis of pleasure—the Hole-in-the-Wall Saloon (**above**)—graced Thermopolis, Wyoming, for many years, and saw its share of pretty ladies, gunfights, poker games, and other diversions. This is how it looked around 1900, with some of the local boys loafing out front.

Its owner, a man named Skinner, served many a whiskey to the colorful rogues who passed through town on their way to the outlaw refuge 75 miles to the east. He even outfitted them for their flights from the law.

When this building was torn down, the handsomely carved backbar and counter top, originally from Ireland, were simply moved to another establishment in Thermopolis. They still provide a comfortable backdrop (**left**) for a friendly game of chance.

there is only one hub of activity in Atlantic City—the Mercantile, a combination bar and general store. We walked up its worn steps and were instantly cast back in time: pot-bellied stove, photographs of suspendered store clerks with high collars and mustaches and cowboys with fresh haircuts that left the ears naked and the scalp pale around them, staring wide-eyed into the camera.

Here Terry Minger was waiting to join our party. Beer in hand, he introduced us to Terry Wehrman, who tends bar and acts as city councilman, mailman, cook, father confessor, and keeper of goodwill in Atlantic City. He is one of many young men and women who are striking out on their own.

Terry Wehrman, a transplant from Iowa, is shy, gentle, and openhearted. "I'm worried about the developing interests, sure," he said. "The Anaconda Company, for instance, took out leases on some of the old gold mines and staked for other minerals as well. U. S. Steel has a mine here for iron ore.

"If the development gets too great, I'll relocate. I'm hoping it doesn't. You see, the good thing about Atlantic City is that it's a ghost town and no one wants it. But it has attracted some good people—young ones who don't want to work for anybody else but are willing to build something for themselves."

Listeners Always Welcome at the Bar

Not all were young newcomers. Over at the bar, in Pendleton shirt, suspenders, and straw hat, was an old-timer named Larry Roupe. I asked if I could buy him a beer. He squinted at me and said, "Who the hell are you?" He sounded like a frog with laryngitis.

I told him I was just passing through the area and wanted to know more of its history.

"Sure, you can buy me one." I wanted to listen; that was enough for him.

"I came from Oregon in 1922 on the Emigrant Trail," Larry said. "My dad was a cattle buyer—he'd go down to Texas, buy steers for two dollars a head, then bring them up to Wyoming and sell them.

"I was just a kid then, but I loved this country. I ran cattle for a while, then took to rodeoin'."

"Were you ever an outlaw?"

"No, I never went that way. I could have—could've been a good outlaw. But I jes' never went that way."

"There were a lot around these parts, weren't there?"

"Oh, yeah—all over."

"Even in 1922?"

"Hell, yes, later'n that . . . I could tell you stories."

The talk turned to Butch Cassidy.

"He was the best, the smartest," Larry said. "Know how he got the name 'Butch'. . . ? Worked in a butcher shop over in Rock Springs. His real name was Parker."

"Yes," I said, "Robert LeRoy Parker."

"Yeah . . ." he seemed surprised I knew. "LeRoy Parker. Butch and his boys hung out mostly over 'round Baggs and Dixon, Wyoming. The ranchers all liked Butch. He was good to them. The real bad one was Harvey Logan. Jes' as soon kill you as look at you. Harvey used the alias Kid Curry. He killed old Pike Landusky up there in Montana . . . then he robbed this train down at Wilcox."

Slow Trains for Quick Holdups

Larry assumed everyone knew who and where these people and places were. The small world of the cowboy.

"Why were there so many outlaws here?"

"Well, there was gold here, and it was easy to rob stagecoaches and trains then . . . they'd jump them trains when they was slowed goin' up a grade, then they'd hold 'em up."

He sipped his beer. "I could tell you lotsa things about this country—like the 'big die-up.' That was the big blizzard in '86-'87—froze damn near everyone here. Some of the old-timers said you could walk across the State of Kansas into Colorado just steppin' on one dead animal after another. Monty Blevins, he's been dead for years, he had 18,000 head of cattle and lost 'em all. Lost two cowboys too, froze to death sittin' in the saddle up on Sand Creek Pass."

I asked what he knew about Tom Horn, one of the most mysterious and fascinating characters in western history (page 641).

"Well, he was a bounty hunter, hired by them big cattle barons to get rid of rustlers."

Horn moved in secret and alone. His past and true story to this day are, at best, shadowy. He died on the gallows in Cheyenne in 1903, accused of murdering a 14-year-old boy.

Did Roupe think he did?

"Don't know. . . . No one knows. . . ."

I said good-bye to Larry Roupe and thanked

him. It had been rewarding. He said, "Sure, lad, anytime."

The free spirit thrives among the area's newcomers as well. A mile or so out of town lives John Mionczynski. Riding toward his cabin, the first thing you can see is a windcharger, a crude wooden tower with a small windmill atop and a wire leading down to a 12-volt battery.

The cabin itself is designed for need, giving it a truly natural warmth. John built it himself —out of logs, dead standing timber, boards from an old highway snow fence, and abandoned machine parts—a snug home made of waste materials.

He is nestled there on ten acres with a stack of firewood for winter and goats for milk roaming nearby. No one can touch him. We were greeted by a tall, slender, dark young man. Later we munched a raw potato from his root cellar, opened a beer, and talked.

"I worry about this becoming fashionable," John said. "People coming in from Rock Springs, where the big power plant is, or from California. I love it here. But if the flow gets too great, I'll pick up and leave."

Someone else came—a young, attractive, green-eyed woman from Kentucky. "What are you doing here?" I asked. "Living," she said. It was said straight and simply. There *is* a return-to-the-land movement, and it is alive and well in Atlantic City.

Ghost Town Offered Cramped Quarters

South Pass City, our next stop, is another century-old tintype, this one restored by the State of Wyoming. It seemed as barren as a Salvador Dali landscape, except for the miniature town with its warped boardwalks. Could it be that so much history happened here? Why did everything seem so small—like dollhouses? Were rooms really that tiny and beds that narrow and stairs that tight?

Through South Pass, a 20-mile-wide niche in the Continental Divide, moved such figures as Jim Bridger, Dr. Marcus Whitman, Kit Carson, Jedediah Smith, and Broken Hand Fitzpatrick—as well as outlaws by the score.

Thousands of emigrants rolled through here in wagon trains between 1840 and 1869, when the transcontinental railroad was completed. In 1868 a gold rush began, and the population swelled from a few hundred to more than 2,000 overnight.

Here John Browning, inventor of the Browning automatic rifle, was an apprentice in a gun shop, and Buffalo Bill "cut his teeth with the pony express." Here, too, lived Calamity Jane and Esther Morris, the first woman justice of the peace in the West.

By the mid-1870's the mines that had produced millions were played out, and the town was given over to outlaws. In 1896 it became a link in the chain of hideouts established by Butch Cassidy and the Wild Bunch.

We walked silently through the old general store, post office, jail, saloon. At the old bar, one could almost hear the faint calliope of voices, music, poker chips, breaking glass. Then the hotel, with hallways barely wide enough to walk through. And the jail cells: small, dark, claustrophobic—I couldn't conceive of spending five minutes in one.

Violence Begets Violence Among Outlaws

Among the jail's former occupants, Kerry told us, was Jesse Ewing, a hardcase outlaw who had been clawed so badly by a grizzly bear that he was nicknamed the "Ugliest Man in South Pass," and Isom Dart, a black rustler and horse trainer for outlaws (page 643).

Ewing didn't take to sharing a cell with a black and forced Dart to kneel while he used his back as a table. Isom, it seems, consented because he feared he'd be lynched were he to abuse the white man. The score was settled later when a friend of Dart's blew Ewing's head off. And, in keeping with those violent times, Dart himself was shot from ambush by the mysterious Tom Horn as the black man stepped from his cabin near Browns Park.

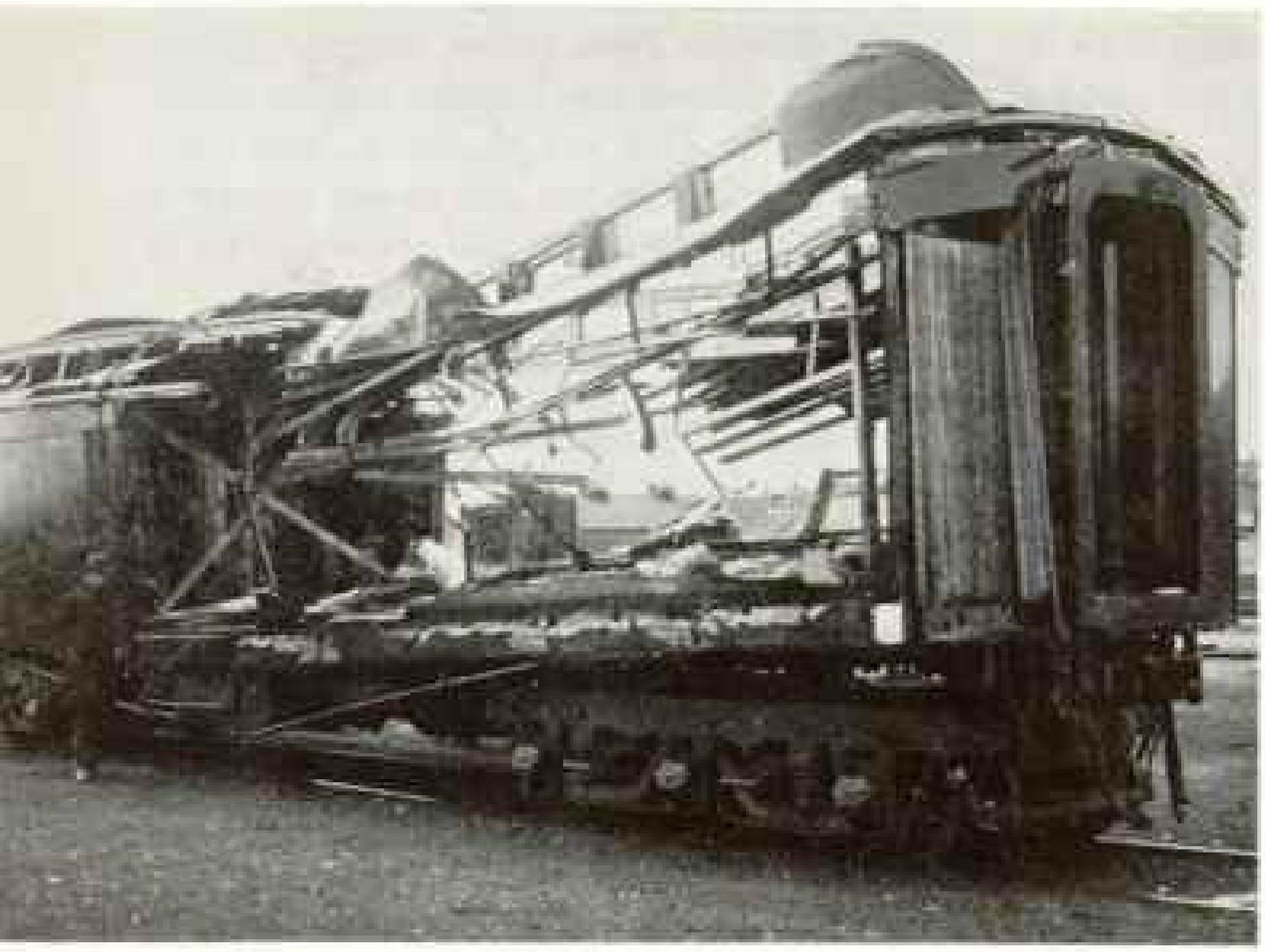
South Pass City had truly one of the wildest reputations in the West, with its steady influx of miners, gamblers, thieves, Pinkerton men, cattlemen, and brawling railroad workers.

As I stood in the center of the main street, looking to the gray-brown hills beyond, I was lost in this memory—a memory of the rich, raucous innocence of the new frontier, of boardwalks and tents and snake-oil eagerness—an indomitable spirit. All quiet now, faded into a still freeze here in the sepia time of late afternoon. All an echo now, of a rich and vibrant part of our heritage.

South Pass City was for me, finally, a sad place.

We traveled now by four-wheel vehicle to our next horse and saddle station, Browns

UNION PACIFIC RAILROAD MUSEUM COLLECTION (ABOVE) AND WYOMING STATE ARCHIVES AND HISTORICAL DEPARTMENT



SUPER POSSE ON CASSIDY'S TRAIL

A band of marksmen—the best in the West—head after Butch Cassidy and the Wild Bunch after the gang robbed the Union Pacific train at Tipton, Wyoming, in 1900. In a previous holdup at Wilcox, Wyoming, the outlaws blew up the safe as well as the railroad car with dynamite (**left**). "It went up with a bang," one gang member recalled—scattering $30,000 all over the place.

Park, Utah. It was about a 150-mile drive from South Pass City to the park via Rock Springs, Wyoming.

This is flat, wide range country with streams flowing from the high passes at the Continental Divide. October here is a gray-streaked sky; a lovely time, the time just before the winter, with a stillness in the air. The calm before the storm.

Tomorrow the hunt will begin. To be sure, many people still hunt out of genuine need, to provide for the family. But they are almost lost in the vast army—from as far as California and the East—who come and kill for the sport. Too many will shoot anything that moves. D day. We hurry south toward the Utah border and Browns Park.

New Energy, New People

Rock Springs, Wyoming, speaks for itself: boomtown. Transmission lines and neon stretching out in the middle of a vast plain. Construction trailers and temporary housing painting a portrait of impermanence.

Nearby the 400-million-dollar Jim Bridger Power Plant is still under construction, and thick, low-sulfur coal seams lie beneath surrounding Sweetwater County. Production was 218,000 tons in 1970; it may reach 12 million tons by 1980. Chemical plants in the vicinity turn out more than half the nation's soda ash for industry, and two new uranium mines are opening. Population has increased from 18,400 in 1970 to 40,000 today.

I wonder. In another century will someone come along and view Rock Springs with the same historical interest we had just given to South Pass City?

Perhaps no location on the Outlaw Trail has such a varied history as Browns Park, located on the Utah-Colorado border just south of the Wyoming line.

In 1825 the famous expedition of William H. Ashley and his fur trappers penetrated this 30-mile-long valley in bullboats along the Green River. In the 1830's Kit Carson traded here among the Ute and Shoshone Indians.

Outlaws used this isolated haven as early as 1860, when they began pilfering horses and cattle from the wagon trains streaming westward along the Oregon-Mormon Trail. Big-time rustling, however, came after the Civil War. Unemployed trail hands and other drifters raided the big herds of longhorns moving from Texas to fresher pastures in Wyoming and Montana. They often wintered the rustled cattle in Browns Park until they could be sold.

Until the turn of the century the only law in Browns Park was that of the fastest gun. The graves of men who died violently are scattered along the river. But most of the other markers, cabins, saloons, and hideouts are gone now.

We headed for the Allen ranch, one of four left in the Utah section of Browns Park. A cowboy had told us to "follow the road to the first left, then go down a long canyon . . . head out to the juniper, turn left again." Needless to say, we got totally lost.

After many wrong turns and with the gas gauge nearing empty, we saw a single light, like some small island in a dark sea—the Allen ranch. We went in and met up with two more of our group who were enlisting late: Edward Abbey and Kim Whitesides.

Ed, an all-around western adventurer, doesn't talk much about the West; he lives it. One suspects that beneath his calm, raw-boned exterior there is a great rage about what's happening to this part of the country. Kim Whitesides is an artist with a voice like a slowed-down phonograph. His movements are slow and his hand is sure.

They had arrived separately and were already ensconced with the Allen family in good talk by a fire, and eating the rancher snack—biscuits, jam, and coffee.

Marie Allen is the daughter of early settlers in the Browns Park valley, and the Allens' home is a pioneer ranch house, simple, warm, and inviting. They are Mormons; with them you are welcome, you can share, no one is going to push you. But you are not going to push them either.

You sense in the Mormons an incredible strength that stems from persecution and survival, both in their struggle with the land and in the history of their religion.

Bassett Sisters a Sturdy Breed

Next morning we set out to explore Browns Park, riding west from the ranch. Kerry Boren grew up in the nearby town of Manila; he knows this area well. His grandfather, he says, used to sell and keep horses for Butch Cassidy when the outlaw rode through.

Kerry took us to meet Esther Campbell, a

lively and untroubled 76-year-old woman who maintains a relic of a limestone building in her backyard as a museum. This was once the property of John Jarvie, who ran the valley's first store and post office; he was murdered in 1909.

Esther told us about the famous Bassett sisters who lived at the opposite end of the park. Josie and Ann Bassett learned to ride, rope, and shoot alongside any man in the area. Ann, refined and well educated, grew up to become "Queen of the Cattle Rustlers." Her sister, Josie, a girl friend of Butch Cassidy, was more domestic, yet did her own fishing and hunting. The Bassett ranch became the social center of the valley.

Esther keeps artifacts from the past at the old Jarvie cabin—ore buckets, tomahawks, arrowheads, and pictures of Josie, Queen Ann, and others. Outside she showed us a crossbar removed from the corral gate of the Bassett spread, from which enraged relatives and friends of a murdered man hanged one Jack Bennett in 1898.

One Outlaw Joined the Opposition

We crossed a wooden bridge that spans the Green River and pitched camp on a shallow bank. After dinner the fire simmered to a purple glow, the night chill surrounded us, and shadows of the park's history came to life. Within a few miles, Kerry told us, stood the old cabin of Matt Warner, one of the Wild Bunch, among the last to survive (he ended his life as the town marshal of Price, Utah). Nearby was the crude rock-pile grave of a drifter named Indian Joe, who was knifed in a poker game.

Next morning we moved deeper into the park, riding on the cliffs that border the Green River about ten miles below the old Jarvie ranch. It was tough going, and one false move would have pitched horse and rider several hundred feet below to the river (pages 642-3).

A long sweep through a grazing valley once used by outlaws and we were winding back to the east, passing below the foot of Diamond Mountain and Cassidy Point. Kerry told us that originally there had been a cabin on the point, concealed beneath an overhanging ledge but commanding a view of the park for miles in all directions. All that remains at the cabin site now is a large trench in which the men proposed to *(Continued on page 646)*

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TOM HORN: MAN HUNTER

Braiding a cow-hair rope, one of the West's most controversial characters awaits the gallows. A lawman and Government Indian scout much of his life, Tom Horn was later hired by persons unknown for one purpose: to kill outlaws any way he felt like doing it. Often Horn would sit for hours, waiting for his victim. Then, *crack*. His rifle spoke. In 1903 the law finally sprang the trapdoor on him for the alleged murder of a 14-year-old boy. Some say he was framed.

BROWNS PARK: OUTLAWS' CROSSROADS

On surefooted horses along the cliffs of the Green River, the author's party explores the area thought by some to have been the most lawless place in the West—a rugged slice of the Colorado-Utah border. The men who hid

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JOHN R. BURROUGHS COLLECTION

out in Browns Park are legion. Isom Dart (**top**), one of the few black outlaws, met his death near here at the hands of Tom Horn. Butch Cassidy and others of the Wild Bunch often stayed at the Bassett ranch, a social center for settlers and outlaws alike. Ann Bassett (**above**), who once said, "I don't want to be a lady. I want to be a cowboy," grew up to become "Queen of the Cattle Rustlers."

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JUSTICE, FRONTIER STYLE

They hung him high. George Witherill shot one man too many, so the citizens of Canon City, Colorado, dragged him out of jail one black night in 1888 and decorated a telegraph pole with him (**left**). Then, as a warning to others, they cut off his mustache and displayed it in a local hotel. An outlaw had to be smart to survive, what with U.S. Marshal John X. Beidler (**right**) and the famed "Cowboy Detective," Pinkerton agent Charles Siringo (**below**), after him. Jim Baker (**below, right**) was an early fur trapper, guide, and pioneer settler in southern Wyoming.

MONTANA HISTORICAL SOCIETY, HELENA

Chas. A Siringo

holding gun that wounded Billy the Kid

WESTERN HISTORY COLLECTIONS, UNIVERSITY OF OKLAHOMA LIBRARY

KERBY RIDE BOWEN COLLECTION

(Continued from page 641) make a last stand if surrounded. It was supposedly here and at the Powder Springs hideout that Cassidy made plans for the "Train Robbers Syndicate," including such Wild Bunch members as William Ellsworth (Elzy) Lay, Kid Curry, and the Sundance Kid. Between 1899 and 1901 they robbed three trains in Wyoming and Montana, though the safe of one express car yielded only $50.40.

We rode down into a flat area near the river, where we saw the remains of an old cabin and a springhouse. This, said Kerry, was old Doc Parsons' place. Doc died in 1881 and is buried nearby. Matt Warner lived in the cabin for a while, as did Butch Cassidy, Elzy Lay, and other outlaws.

In 1972, just as valley residents expected the Utah Division of Wildlife Resources to raze the cabin, Kerry, Marie Allen, and others succeeded in getting it placed on the state register of historic sites. Other places probably won't be so fortunate.

I looked back toward Diamond Mountain and the Parsons cabin, and wondered what would happen to the people who were left here. Much of this land is under a government jurisdiction that seems uninterested in memory or legends. Ranchers have been forced to sell under threats of condemnation.

Fifty Miles by Road, Ten Afoot

We rode back to the Allen ranch, where Bill Allen was waiting with instructions on how to get to Little Hole on the Green River, another historic outlaw hideout of the late 1800's. Little Hole was also where we filmed the opening sequence of *Jeremiah Johnson*, so I had a certain nostalgia for the spot.

There were two routes: either fifty miles by road, or ten miles on foot over a pass. Kim Whitesides and I decided to hike it; the others, led by Abbey, would drive around with the supplies and horses.

It was getting close to 2:30, and the late autumn sun would die behind the mountains soon. A move in the wrong direction would lead us into a labyrinth of canyons and gulleys. Our apprehensions, however, soon gave way to the awesome beauty around us.

As we followed a dry creek bed through twisted piñons and huge rocks alive with orange lichens, it felt good to be footloose and unencumbered by horse and pack. I wondered how many people had taken this route. It seemed virginal, untrampled.

Night was coming hard as we sighted the river and dropped down to the Little Hole region. We had built an entire settlement from historic photographs for the film here: a thriving western town with a river landing, post office, saloon, and encampment. Thinking that it might serve neighboring Vernal and other communities well as a tourist attraction, or a reminder, or simply a point of interest, I had prevailed on the studio to leave it there. But the U.S. Bureau of Land Management, claiming it a nuisance and health hazard, had it torn down. It is now just another bend in the river.

Incredibly, Ed Abbey and the others arrived at Little Hole at the same moment. By the time we had forded the river, finished dinner, and settled down, the moon had come up, full and bright.

A beautiful morning, and a perfect place for an outlaw stronghold. A cabin survives here, that of Tom Crowley, who used to bootleg whiskey to the Indians. Built in 1869 with stolen railroad ties, it has seen many occupants over the past century. An outlaw named Mexican Charlie was shot here for cheating at cards; he lies buried a few yards away.

Crowley's place now stands in danger of destruction through indifference and increasing development.

History Inundated by Progress

We headed for Vernal, Utah, where outlaws on the run often obtained fresh horses. The four-wheel drive took us along the edge of Flaming Gorge, where many cabins, homesteads, caves, and grave sites were drowned when the Green River was dammed to create this vast reservoir and recreation area.

In the distance the Colorado Plateau stretched across the horizon, lean and graceful, encompassing incredible space in perfect harmony with the sky. It rankled to imagine the plans for oil shale and other development that will certainly determine its fate.

Down along the parched, desolate Nine Mile Canyon we came across a pleasant stretch of green—again part of the old trail often used by the outlaws.

I stopped to talk to a leathery, squint-eyed rancher repairing a tractor in a field. I was unprepared for the hostility in his replies.

"How long have I been here? Too damn long."

"It's very beautiful," I offered.

"Yeah? Well, you can have it. You want to take those cows out there off my hands, you got it. This is a hole—a hellhole. Ain't nothin' but dust and rocks and some starvin' cows. Let me outta here and up to Minnesota. That's the only place left where a man can make a livin' farmin' or ranchin'."

"What's wrong around here?" I asked.

"No one cares about it. No water. No one has the money to develop it for ranchin'. All anybody's interested in is buyin' up mineral rights for power development and real estate. We're gettin' starved out."

As we rode on, I thought that this was the real plight of the ranchers in the area. They often don't see the beauty of their surroundings because they feel economically blocked by the same surroundings and therefore resent them.

Rugged Canyonlands Discouraged Lawmen

At Green River we met A. C. Ekker, who runs an outfitting and guide service called Outlaw Trails. A. C. is a hardworking, hard-riding ex-rodeo cowboy who suggests, more than anyone I've come across, the verve, strength, and enterprising spirit of the early settlers. In a shrinking society of worn leather and tired spirits, he stands out.

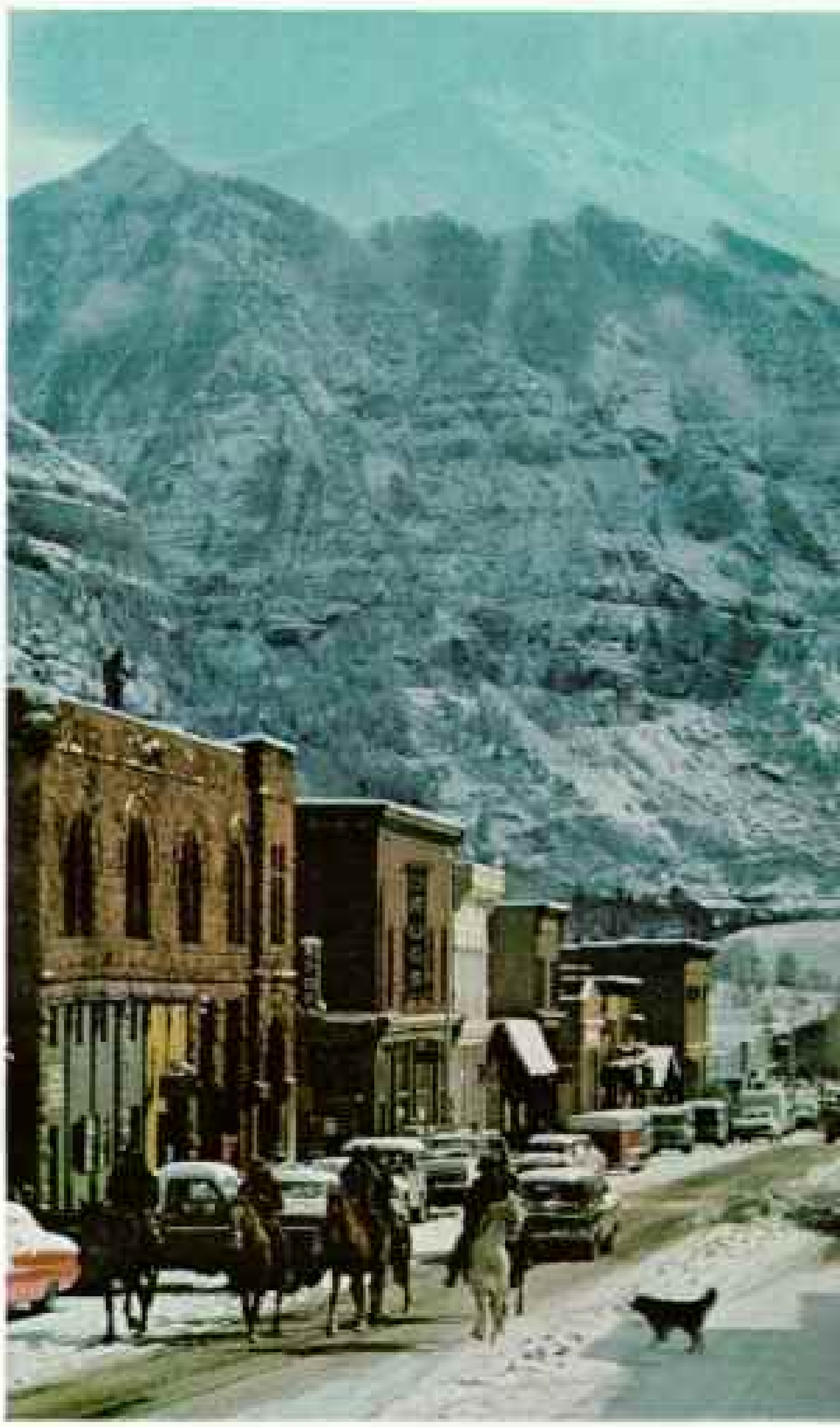
He welcomed us with the friendly but wary eye of one who suspects a tenderfoot and led us to the Ekker homestead, some eighty miles south. There, in a stucco ranch house, we met his father, Arthur, who has ranched the Roost country for almost 40 years. At 65, Arthur is crusty but energetic, with eyes almost hidden in the folds of a squint. As he told us of this region, he spoke in bursts of exclamations, as if he had dozed off between thoughts and didn't want to get caught at it.

Robbers Roost was the last of the three big way stations along the Outlaw Trail. Unlike the others, it was not a secluded valley, but a dry, rugged, thirty-mile-wide plateau sliced by formidable canyons, with lookout points on all sides. This was desolate country. Isolated from settlements by miles of desert, it was almost inaccessible except to the few who knew the route. The outlaws knew where vital springs were and could survive there.

"Yep, ol' Butch was the best," A. C. said as he pried away at his mouth with a toothpick. "Plenty popular in these parts. Him and Matt Warner and the McCartys used to bring in stolen horses from western Utah. No one could follow 'em—too tough. When the coast was clear, they'd move 'em on to Colorado."

"They used to live in sandstone caves or in crude cabins of twisted cedar," Kerry Boren chimed in.

Butch was always leaving something for the ranchers, *(Continued on page 652)*



One of the slickest jobs Cassidy ever pulled was in Telluride, Colorado. As puzzled townspeople watched, he trained his horse to stand still while he catapulted into the saddle from behind. After Butch and his partners robbed the bank, he used his new trick for a quick getaway.

The perfect hideout: Robbers Roost. Within these rugged canyonlands in southeastern Utah, a band of outlaws switched brands on stolen livestock and whiled away the time playing cards and racing horses while the law circled warily about them. Today Arthur Ekker's family owns a ranch near the site of the hideout. Arthur's son, A. C., brands steers (**left**) and bulldogs them (**right**) at roundup time.

MONTANA STOCKGROWERS ASSOCIATION

HARSH WINTERS IN A HARD LAND

"Our losses in cattle are simply immense," reported the *River Press* of Fort Benton, Montana, on March 9, 1887, after one of the worst blizzard-swept winters in the history of the West. They called it the "big die-up." The wind blew so hard, said another newspaper account, that "cattle had to tie their tails to their hind legs. . . ." During the winter, famed western artist Charles M. Russell was working on the O-H Ranch, tending cattle that belonged to ranchers in Helena. When one of them wrote asking for a report on the condition of his cattle, a friend of Russell's tried to write a reply but couldn't find the words. So Russell got an idea. "Send 'em that," he said, tossing a watercolor (**left**) to his buddy. Eloquently, it told what had happened to 5,000 head of cattle. Today snow, ice, and winter winds remain some of the rancher's biggest nightmares. A light snowfall, just six inches, nestles over the Robbers Roost ranch at dawn (**below**), as a cowboy drives trail horses back to a corral after watering them.

(Continued from page 647) taking care of them for their help and always keeping his word. In unspoken agreement, the ranchers never talked about seeing him. The rule of word—if you broke it, then what? "Well," said A. C., "then someone would show up and put a bullet in you to square the deal."

It snowed that night. In the morning we shook several inches from our sleeping bags and headed out into a cold mist for the outlaw stronghold on the edge of Roost Flats. As we rode along on a carpet of fresh snow, our bones as brittle as ice shards, the gray oppressive stillness lifted. Now the air was blue and frosty with white everywhere—a true white, with color in it. It was revitalizing, like tasting mint leaf.

A. C. spotted a band of range horses, and we took out after them as if there were no other task and no tomorrow. The leader of the band was a beautiful buckskin stallion with thick neck and a tail that reached the ground. He led the others for three miles just a step ahead of us until we caught up and raced alongside. The stallion's eyes were alert and wild. Yet I think he sensed, amidst the threat, the feeling of play to all this. After a good look we let them go, and they ran away to the south, led by this untamed Pegasus. I couldn't deny a feeling of envy at the sight.

It was about six miles to the Roost and down into a small cut where Butch Cassidy's hideout was.

The original corral is still here, and we put our horses in it while we ate. Afterward we circled the Roost looking at the remnants of

AMON CARTER MUSEUM OF WESTERN ART, FORT WORTH, TEXAS (LEFT)

TOO ORNERY TO HANG

Big Nose George Parrott was the sort you wouldn't want your sister to marry. Some outlaws, like Butch Cassidy, were only interested in money and never hurt anyone unless they had to. Then there was Big Nose George. Murder came to him as naturally as art did to Charles Russell, who painted Big Nose holding up the Deadwood stage (**above, left**). When George was arrested and jailed in Rawlins, Wyoming, a mob gathered, broke into the jail, removed him, and hanged him from a telegraph pole. It took some doing. First, the rope broke. Meanwhile, he had managed to untie his hands. The second time, they jerked the ladder away and he grabbed the pole . . . until he slowly slipped down . . . to the end of his rope. A local physician, who later became governor of Wyoming, dissected George, partially skinned him, and made a pair of shoes, which he proudly wore, out of the leather. Today a portrait owned by the Union Pacific Railroad (**above**) is about all that's left of Big Nose George Parrott.

an old outlaw society—a stone chimney, caves, and carvings.

Cassidy's camp became the center of all activity in the region. Even people who were not considered outlaws came here to play poker and race their horses with the sporty members of the gang. It is said that Butch was the most amiable of all the western outlaws, fun loving and a gentleman with women. There is no evidence that he ever killed anyone, unless it was at his legendary final stand in 1909 at San Vicente, Bolivia.

Several women lived at the camp; they often shopped for supplies and purchased ominously large amounts of ammunition in the nearby towns of Price and Green River. Maude Davis (wife of Elzy Lay) was there, and the mysterious, beautiful Etta Place—girl friend of the Sundance Kid—was thought to be among them.

We had to jog along at a good clip to get to camp before dark. We had traveled close to twenty miles for the day. Men used to ride like this most of the time, harder and longer, over even rougher terrain, because they had to.

Did Arthur Ekker remember those times? "Sure, when I was a kid, a horse was the only way you could get around. Steal a horse and you was a marked man—like takin' a man's gun away from him. But you could find wild herds all over these flats. Hardly any left now."

Cassidy's Fate Still Argued

We warmed frozen appendages by the fire, beat frozen boots against rocks, drank herb tea, and listened to Arthur reminisce.

On rustling: "Used to change the old brand of a cow with a hot iron. Some of the rustlers came up from Texas—it was a fast way to get into the cattle business."

On Butch Cassidy: "Lots of folks around these parts believe he never died in Bolivia. Fella named Hanks from over to Hanksville, who used to take supplies out here to the Roost, claimed he seen Butch in the '20's."

On his youth: "First time I took this trail

Newfangled trail of power lines marches above the author's party near Page, Arizona. There, the Navajo Power Plant uses Indian-owned coal to generate electricity—some for local consumption, and some for parts of Nevada and for Los Angeles, 450 miles away.

Alone with the past, the author interviews Lula Parker Betenson, 92, Butch Cassidy's sister, at the old Parker cabin near Circleville, Utah. She maintains that Butch was never killed in South America but, years later, visited her, and told her, in a candid moment: "My life has been wasted." Maybe so—but surely not forgotten.

I was 7 or 8. In the old days people were tougher. Why, over in Hanksville they had to ride 50 miles for a doctor. By the time you got there, you was either dead or well. Undertaker did a lot of business."

He also spoke of the future: "Robbers Roost won't change much," he said. "You can't irrigate it, and there's no coal to dig out. There'll be livestock here as always. But the national parks are movin' in on a lot of the ranches, and I suppose much of the land will be used for recreation."

We headed west out of the Roost, down across Dirty Devil River past Hanksville and south to Lake Powell, created by the damming of the Colorado in 1963. The next couple of days we traveled by boat—still on the Outlaw Trail, but here its remnants were submerged. At the lower end of the lake near Page, Arizona, the dependable A. C. Ekker and one of his ranch hands were waiting for us.

Butch Cassidy Lives On in Memory

It seemed fitting that we finish our trail ride at the home in which Butch Cassidy grew up, and celebrate the journey's end with Butch's sister, Lula Betenson, in her 90's now and living in the nearby town of Circleville, Utah. This would complete our story.

Lula Betenson and I had first met in 1968 when she visited the film set of *Butch Cassidy and the Sundance Kid*, in which I played Sundance. She struck me then as an unusual person—spry, witty, strong-willed, and with a gentle feminine spirit. Lula was one of 13 children and only a baby when Butch left home.

Nowadays she sits in her parlor wearing a pink sweater over her shoulders. Always energetic, she jumps up from time to time to get someone coffee or whatever, refusing to let anyone do anything.

She says she has just been to visit 79-year-old Marvel Murdock, the daughter of Elzy Lay, now living in Heber City, Utah. Lula asks why we all move around so much, wants to know what the rush is, and hopes we're getting something out of it.

Later, she led us all to the original homestead and the cabin she and Butch grew up in (above). It was late afternoon and a fall breeze was blowing leaves around the cabin. Lula and I walked along together through the old house and around the land. She talked of losing sight in her right eye and starting to lose it

in the other. She took hold of my arm and looked me straight on.

"I don't mind dying," she said. "I'm just afraid it won't be soon enough. I'm fightin' the melancholy. Don't like good-byes . . . can't stand 'em. . . . Never used to bother me."

She seemed cameo pretty standing there amid the poplars—with a youthful countenance and eyes that seem unfairly framed in the wrinkles of age.

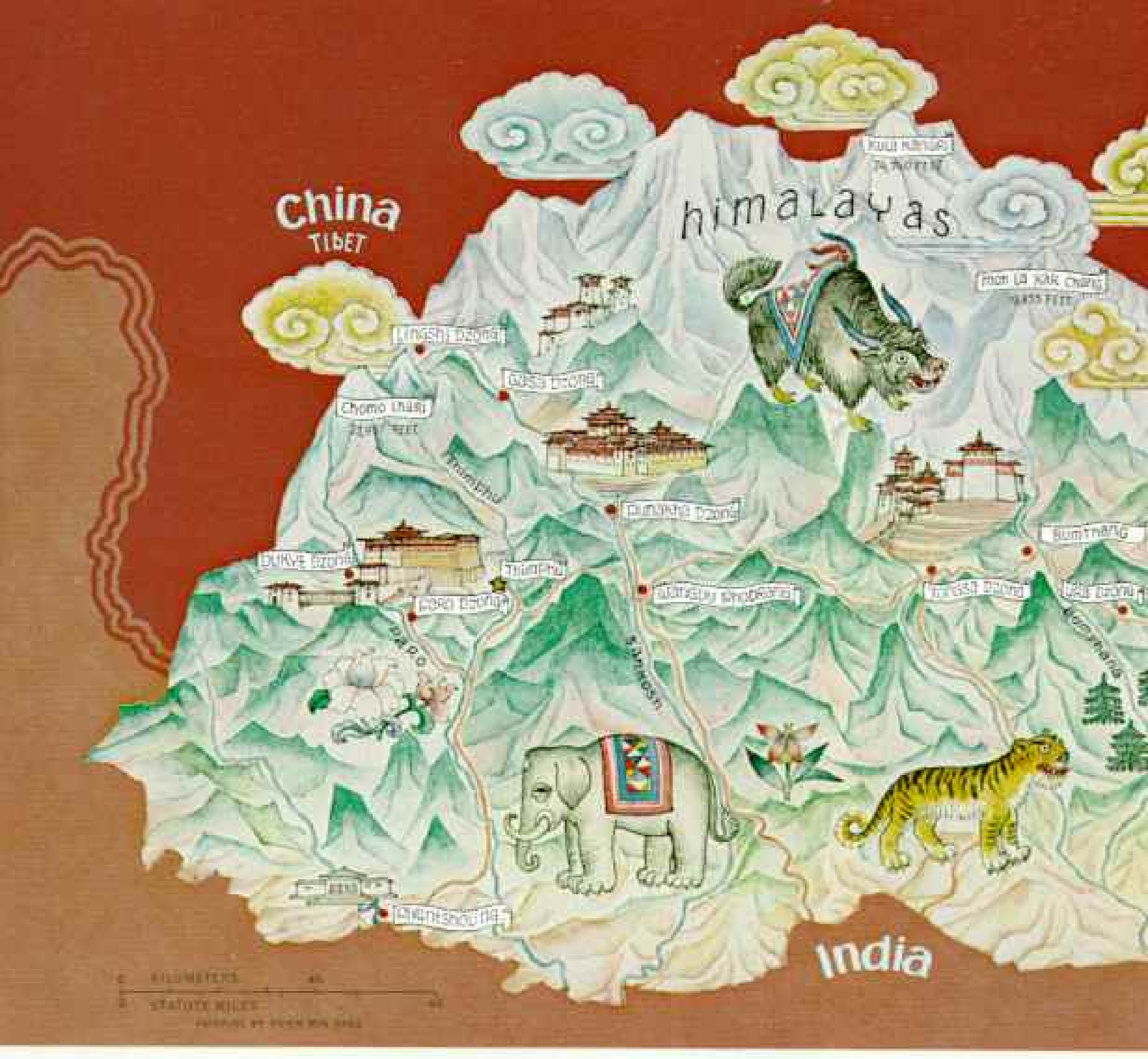
The house is old. Gray-splintered sagging wood. The window frames are bleached. The rooms are small, as in all the buildings of this kind we have visited. Burglars have looted the original furnishings. Out back are the corrals—the original ones—tired and tilted against a background of burnt-yellow and gray hill.

It's all that's left. Lula and the corrals and the hills. There's no more. □

Life Slowly Changes in a Remote Himalayan Kingdom

ARTICLE AND PHOTOGRAPHS BY JOHN SCOFIELD
ASSOCIATE EDITOR

BHUTAN reaches eagerly for the future, but her leaders are determined not to lose their rich heritage in the process. Here in Tashigang, paved roads, power lines, and telephones link a fortresslike *dzong* with the outside world. But within the castle's massive walls, Bhutanese still gather annually for an age-old celebration of faith and tradition. The tall gold-masked figure (**left**) represents Padma Sambhava, the Indian mystic who introduced Buddhism to the snow-crowned land 1,200 years ago. As a boy, local legend has it, the saint's face was cleansed only with butter. A teenage monk wearing a mask takes the part of the young Padma (**above**) while one of his fellows ritually applies butter to the sage's mouth, ears, and eyes as a gesture of love and respect.

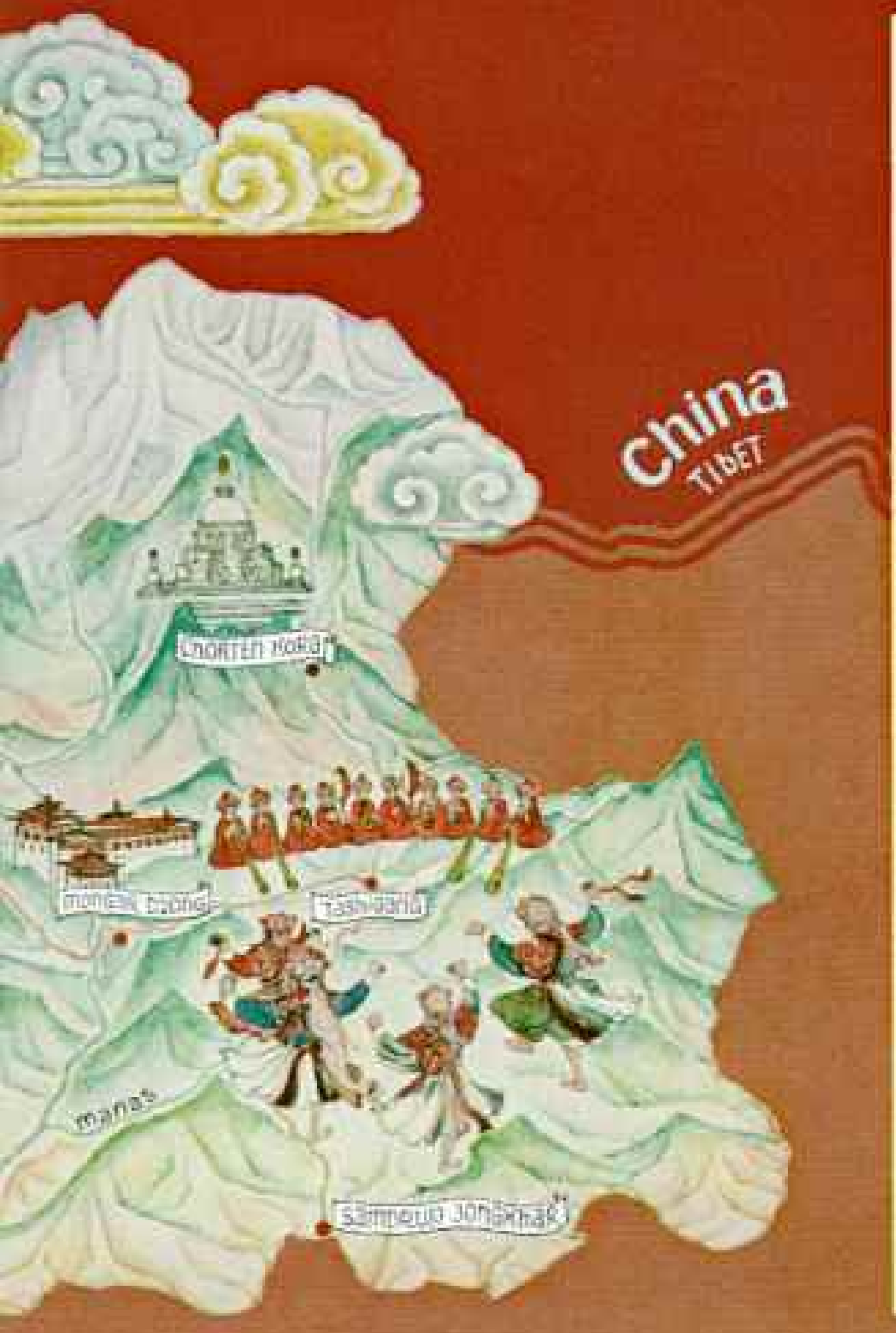


DAWA TSERING, Bhutan's able and articulate Minister of Foreign Affairs, wanted to be sure that I kept my eyes open. "Please don't describe our country as some kind of romantic Shangri-La lost in mysticism and witchcraft and unaware of the world around it.

"The fact is," he insisted, "we are a small and poor nation struggling to move out of our feudal past. We want to modernize as quickly as we can, and we *are* moving. We know where our problems lie, and we have begun to solve some of them."

After a month and a half of crisscrossing Bhutan—a privilege that has been granted to only a few Westerners—by every means from the king's little jet helicopter to saddle yak, I concluded that Dawa Tsering was both wrong and right. Wrong only because, Shangri-La or not, Bhutan is undeniably a romantic and otherworldly place, one of the few genuinely different places left. Consider:

- No other Asian nation has so completely escaped the airplane. One small runway exists, but planes can reach it only on rare days when surrounding peaks are not thickly wrapped in cloud. Visitors must ride jeeps half a day from an airfield in India, and spend another day twisting and climbing northward inside Bhutan to reach Thimphu, the capital.
- Barter is still so traditional and coinage so scarce that I was sometimes asked to take my change in *choogo*, cubes of rock-hard yak cheese strung like so many beads on a thread of black yak hair.
- Within this tiny kingdom (only half the size



Bhutan

MOUNTAINOUS DRUKYUL, the "Land of the Thunder Dragon," is slightly larger than Switzerland, but has only a sixth as many people. Traditionally, fortified castles called dzongs house each district's civil and religious authorities. Now Bhutan's first towns have sprung up at Thimphu, the capital, and Phuntsholing, on the Indian frontier.

India guided the nation's foreign affairs until 1971. Full independence and membership in the United Nations have swelled outside aid (largely from India), and Bhutan warily increases her contacts with the outside world.

GOVERNMENT: Constitutional monarchy. **AREA:** 18,147 square miles. **POPULATION:** Approximately one million. **ECONOMY:** Farming and animal husbandry. **RELIGION:** Buddhism. **CURRENCY:** One ngultrum equals about 11 U. S. cents. **CAPITAL:** Thimphu (pop. 20,000). **CLIMATE:** Varies with altitude, from lowland jungle to year-round snow.

of Indiana) I was able to travel—once by helicopter in little more than an hour—from high pastures where yaks graze amid glistening snow to green and humid jungle where elephants and tigers roam.

And yet, as Dawa Tsering wanted me to realize, such things represent only one side of the picture. Bhutan's leaders are working hard and realistically. But the problems to be resolved are enormous:

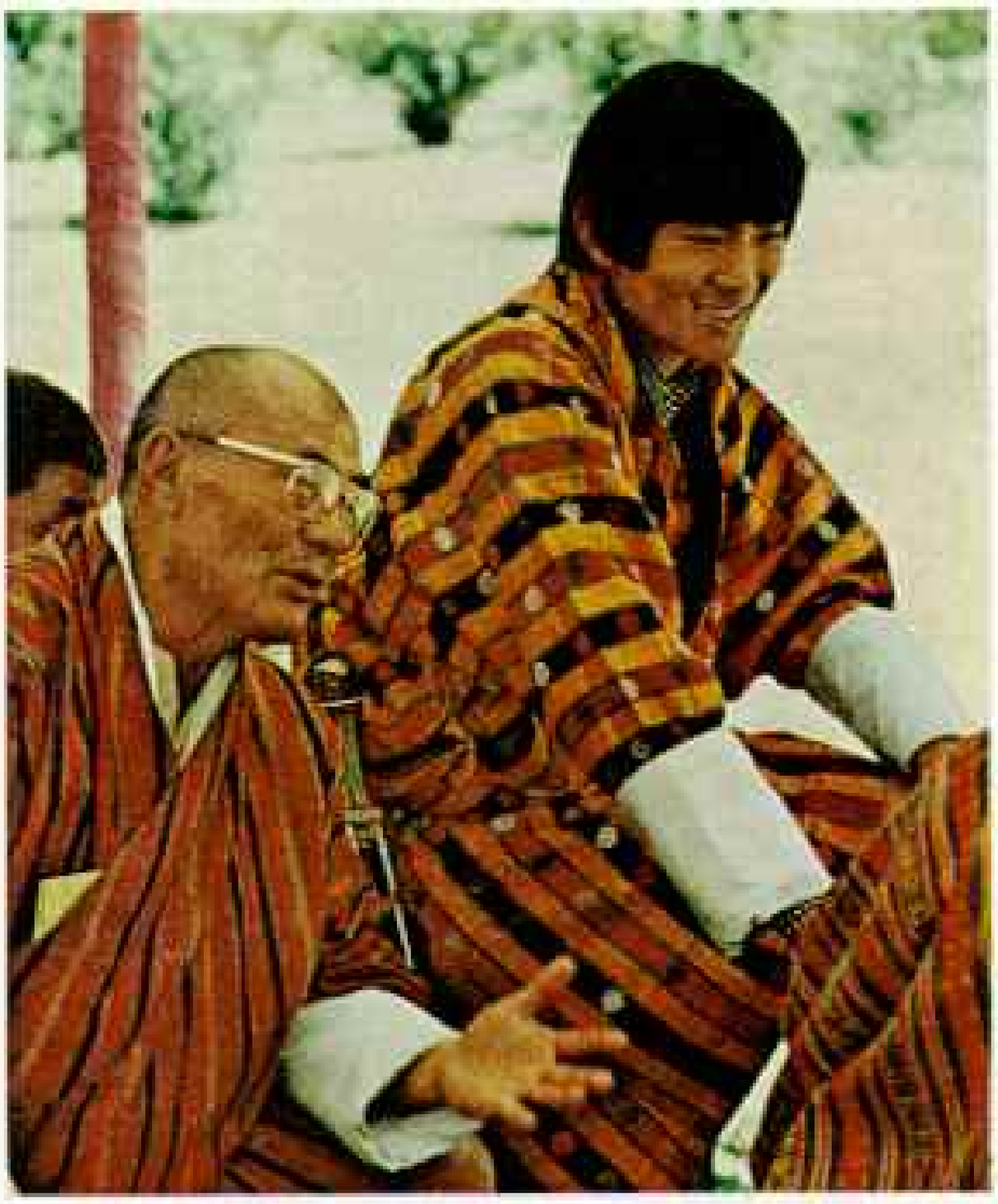
• At least one child in four dies of gastrointestinal disease in its first year. A third or more are dead before they are 5.

• In this incredibly mountainous nation, it is possible for only a part of each year to cross the country from east to west. I made the round trip by jeep, probably the first journalist allowed to do so, over a terrifying and still-unpaved road. But monsoon-spawned landslides rip the road apart in summer, and snow blocks its lofty passes in winter.

• Most of Bhutan's million or so inhabitants are so scattered that education cannot go to them. Children must forgo family life for much of each year if their parents elect to send them to one of the country's half a dozen central schools.

• The nation takes in almost no foreign currency other than that brought by tourists, and from the sale of postage stamps to collectors. (One stamp, actually a tiny phonograph record, plays the Bhutanese national anthem!) Fortunately, Colombo Plan and United Nations funds help make it possible for a limited number of young Bhutanese to receive advanced education *(Continued on page 666)*

Earth's youngest reigning monarch, 20-year-old King Jigme Singye Wangchuck (**below**, right) heads a government remarkable for the youthfulness of its officials. One of the exceptions, Lyonpo Chogyal, below, left, serves as Minister of Finance. Mindful of the problems that beset neighboring Nepal when she suddenly ended her isolation and let Westerners flood in, Bhutan opens her doors with deliberate slowness. "We have time," says the king, "to wait until our people are ready for the changes the outside world will bring."



Democracy at work amid royal splendor, Bhutan's 150-member National Assembly (**above**) meets twice a year in the capital's huge Tashichhodzong (**left**). Delegates check their ceremonial daggers outside the door (**right**), then step into the huge hall to discuss problems in a harmony many a Western legislature might envy; voices are seldom raised, and speakers hold forth without fear of interruption. The king presides from the curtained throne at far left. His father, who died in 1972, initiated popular rule by voluntarily giving up his absolute powers.

Once an asset, now an adversary, Bhutan's jumbled terrain long discouraged invaders. Today it hinders development. Takeover of neighboring Tibet by China in the 1950's triggered Bhutan's decision to build an east-west road—a staggering challenge in this land of soaring north-south ridges and valleys. Workers were first conscripted from among the nation's own sparse population, each family providing four weeks' labor. When that failed, some 25,000 people were imported from Nepal. Paid under an Indian aid program, the men felled trees and graded mountainsides while wives and children made gravel fill by hand (**above**). Roughly 500 miles of road now span 120 crow's-flight miles (**left**), carrying Bhutan's new National Highway across cloud-masked two-mile-high passes and down again to valleys cloaked in lush jungle.

(Continued from page 661) in Australia, New Zealand, Japan, Singapore, Great Britain, and the United States.

"And the students come back," Secretary of Development Lam Penjor told me in Thimphu, "completely out of touch with Bhutanese ways: economy, religion, social values, customs—everything. They want us to buy airplanes, build tunnels, get big loans from the World Bank.

"Before we let them take the government posts for which they have been trained, we make them spend six months working in some rural area to get their feet back on the ground."

Same Pace for Schools and Jobs

It was my first lesson in the realism and practicality that characterize Bhutan's approach to the future. I gained another such insight when I talked with the people in charge of Bhutan's school system. Education is available to all, but not compulsory. There are few jobs to be had in a land where 95 percent of the population are farmers, and the system has been tailored to that reality. Competitive examinations in grades five, eight, and ten pare classes down to the very brightest students. In the whole of Bhutan, only the top 200 may carry on at government expense after the eighth grade.

"That must seem strange by your standards," a school official admitted. "But remember what happened in parts of India, where thousands of educated young people graduated into frustrated idleness because there were no jobs for them. They became the troublemakers, the radicals—and who could blame them? Here we will raise the output of educated men and women as our country raises its ability to absorb them."

Bhutan has her own ideas about tourism, too—ideas that make a visit to this still largely off limits land the *in* thing, a goal to be sought at almost any price. And the price, Bhutan freely admits, is high.

Only a few tourists have been permitted to sample Bhutan's sights—perhaps 500 by the time you read this. And though they pay

PEGI WARD, BLACK STAR

Life remains simple for most Bhutanese, who subsist on the fruits of their own labor—rice, barley, buckwheat, and chilies, washed down with *chhang*, a mild beer, or nourishing salted tea into which yak butter has been churned.

roughly a thousand dollars for a week in what travel brochures call "earth's last forbidden kingdom," even this affluent handful must be content with conducted minibus tours of the Thimphu and Paro Valleys, which can be reached by narrow but comfortably paved roads. But such is the allure of Bhutan's dramatic landscape and her handsome and friendly people that I heard only one complaint. "There is nothing to buy," lamented an obviously well-heeled visitor.

I hope it stays that way, though it meant that I also went home almost empty-handed from a nation still capable of producing superb traditional art. Few of Bhutan's craftsmen, and certainly not the best ones, work merely to stock the shelves of shops.

If one wants a true expression of the Bhutanese spirit—a religious painting or one of the intricate silver-and-gilt boxes in which men carry their betel nut—it is necessary to make an arrangement with the artist, and be prepared to wait many months while he executes it. And then it may be not what was expected, but what he wanted to create. As was true during Europe's glittering Renaissance, there must still be personal contact between artist and patron.

In fact, much remains of an old feudal structure that has only begun to give way to a money economy. Great landowners still maintain their silversmiths and painters, their masons and carpenters, their staffs of farmers and servants, and their herdsmen who care for the family's yaks and cattle in return for a portion of the butter and cheese.

Realism Rules in Land Allocation

I asked why land was not being taken from these wealthy proprietors and redistributed to the landless. Again a lesson in the practicality exercised by Bhutan's young officials:

"We began distributing land in 1956, during the previous king's rule," agricultural director Dorji Tenzing told me, "at the same time that His Majesty abolished serfdom. But it was public land, five acres per family, plus loans for fertilizer, seeds, and tools.

"The wealthy landowners? We left them alone. First we must lift the poorest of our people, those who have neither land nor landlords. In the meantime, the big landowners will give livelihoods to thousands of people. We must build on what we have instead of tearing it down before there is something better to take its place."

After a few days in Thimphu I packed for the trip that had drawn me to return so soon to Bhutan,* and for which the Bhutanese had been nervously preparing—the thousand-mile round-trip journey by jeep between the capital and Tashigang (map, pages 660-61). It was not that they didn't want me to go. But their hospitality and concern for visitors leads them to worry endlessly about *any* outsider attempting to use this not-yet-completed road, with its constant threat of landslides and its total lack of facilities for vehicle repair. As it turned out—despite days of jouncing over loose rock, mud, and surfaces of logs laid crosswise atop the mud, and half a dozen delays while landslides were cleared—the entire trip came off without so much as a flat tire.

Trail Once Led Through Castle's Courts

The National Highway, blacktopped for the first 50 or 60 miles, snakes eastward from Thimphu, up and down pine-clothed ridges, across cloud-hung passes, and over noisy torrents. In Bhutan one is never far from the sound of rushing water. The road covers nearly 160 miles to span the 50-mile straight-line distance to Tongsa Dzong. Until recently, only mule and foot trails led to this great castle, which once controlled trade and human traffic between eastern and western Bhutan. The trail, in fact, led through a gateway that still pierces the huge building's western wall, then angled across its richly ornamented courtyards and went out through another gateway on the eastern side.

When British political agent John Claude White early in this century made the western world's first extended survey of Bhutan, he found the Tongsa district enjoying a rare moment of calm under a powerful and far-sighted governor named Ugyen Wangchuck. White and Wangchuck became fast friends.

In 1907, Bhutan's leading monks and often-warring district governors, encouraged by White, suggested that Tongsa's stability might be extended to the whole of Bhutan if a hereditary monarchy were created, with Ugyen Wangchuck as the country's first Druk Gyalpo, or Dragon King. Thus was born both

*The author photographed the coronation of Bhutan's present king for the October 1974 GEOGRAPHIC.

modern Bhutan and the Wangchuck dynasty. Ugyen Wangchuck's great-grandson is the nation's present ruler.

Today the power has moved away from Tongsa; only a handful of red-robed lamas remain to care for the dzong's usually deserted shrines and chapels and to duplicate their sacred books from thousands of intricately carved printing blocks (page 671).

One Sunday I watched the monks shape an elaborate offering of dough and colored butter and put it atop a roof (now, alas, of corrugated iron instead of hand-split shingles held against the wind by rows of white stones) as a treat for the ravens.

"All living things are sacred," a monk explained, "but especially the ravens. They spend their days repeating one of our holy syllables, *'Ah! Ah! Ah!'* " Killing a raven, he informed me, would be as great a sin as slaughtering a thousand monks—a notably tolerant way of thinking, it seemed to me.

Himalayan Buddhism's attitude toward the taking of life is one of the most puzzling aspects of this complex faith. Bhutanese, for instance, share the monks' abhorrence of killing, but they will countenance the slaughtering of pigs. The farmers believe that, when they appear for judgment in the period between death and rebirth, a chicken will put

To reach the Paro Valley's chief wonder, visitors mount stocky ponies at 8,500 feet, then hang on as the animals labor another half mile skyward to the Tiger's Nest (**below**). Inside, a huge image of Padma Sambhava

white pebbles onto a scale to represent their good deeds, while a pig shovels on black pebbles to signify the evil one has done. Thus almost any Bhutanese will happily eat pork (unfortunately for the visitor, heavily laced with searing chilies), but dislikes the idea of harming a chicken. In older, less stable days, travelers tried to ensure their safety by carrying live roosters on their backs.

Even worms benefit from the Buddhist injunction against taking life. Silkworms thrive in areas around 3,500 feet, and there are plentiful mulberry trees for them to feed on. But pious Bhutanese balk at the idea of plunging the cocoons into boiling water. They would rather wait until the moths chew their way out, with the result that much of the silk is of inferior quality.

Though a wealthy farmer's hunger for that most favored of Bhutanese delicacies—dried yak meat—may overcome his feelings, there are no butcher shops he can turn to. Anybody who opened one would be immediately ostracized. So he has someone else take over the sin of slaughtering an animal. Usually the job is done by one of the Moslems who performed the same service in Lhasa and other Tibetan cities before they fled from Chinese rule. Their fee: a share of the meat and the equivalent of about three dollars an animal. Even this is

reflects the belief that the saint selected a spot for the shrine by reaching it astride a flying tiger. Reminder of days when only foot trails threaded Bhutan, a bamboo bridge (**below**) crosses a torrent near Bumthang.

Power of faith ordains lavish shrines, and the pursuit of knowledge makes monks become printers. Yearning for a son and heir, King Jigme Wangchuck (page 683) directed that this shrine to Buddhism's "angry" deities (**left**) be created at Tongsa. He saw his prayers answered with the birth of Jigme Dorji Wangchuck, father of the present monarch.

Tongsa's venerable halls also house thousands of laboriously carved printing blocks, which monks ink by hand (**right**) to produce Buddhist scriptures in sets of 100 or more volumes.

usually a once-a-year affair. For the rest of the year the Bhutanese farmer—and the occasional Westerner who visits him—subsists largely on rice and buckwheat, chilies, fried bread, eggs, and tea.

The Bumthang Valley, a jolting day east of Tongsa, is Bhutan's point of no return. It is no more difficult to continue on to Tashigang than it would be to turn back again toward Thimphu. Bumthang remains an isolated, self-sufficient area only tenuously connected with the rest of the nation. One measure of that isolation: Letters to and from parts of this central region still travel by postal runner, who spends two weeks on each round, continuously climbing and descending rocky ridges and jungled slopes.

Health care will inevitably be, for a long time, one of Bhutan's chief problems. And nowhere did I find its lack more poignant than in this beautiful and seldom-visited region, where one young Swiss doctor and his wife struggled to help people who often did not want to be helped.

"Only when they can no longer stand the pain," the doctor lamented, "do they come to me. Then it is often too late." He wagged his head sadly. "I must say to them, 'Go home. It is not good that people should come to me only when they are ready to die.'"

I remember Bumthang not only for its dedicated doctor and his lonely struggle, but for the kind of romantic image Dawa Tsering had warned me against: the leopard that flashed across the road one evening ahead of my jeep; shrines of unbelievable splendor; the great Byakar Dzong hulking cloud-mantled atop its hill; and, at night, a necklace of twinkling fires where farmers slept in their mountainside fields to protect ripening buckwheat from marauding bears.

Tiny Shops Herald a Town Aborning

Tashigang, eastern terminus of the infant National Highway, came as the perfect antidote to Bumthang's romanticism. Here was one of earth's least-visited settlements. I arrived expecting . . . what? Certainly not paved streets, or a hydroelectric plant that makes possible house and even street lighting. Nor a hospital, a central school, and least of all that newest of phenomena in this traditional land of barter: a double row of cubbyhole shops.

Father William Mackey's eyes twinkled when I asked about the shops. After 13 years in eastern Bhutan, the personable Jesuit is known far and wide for his Sherubtse Public School—the best, all agree, in the country.

"It was incredible," Father Mackey chuckled, "the change the first shop created in Tashigang. Suddenly coins and pieces of paper appeared that would buy a new kettle or a length of the region's beautiful handwoven cloth, which up to then had changed hands in return for a week's supply of rice or buckwheat, some *(Continued on page 675)*

Once a mighty fortress guarding the chief trade route from Tibet, Dukye Dzong (**above**) now stands fire-gutted and abandoned.

Mosaic masterworks, rice fields near Thimphu are among the world's loftiest. Farmers whose paddies lie at 7,500 feet or higher explain apologetically that they can harvest only one ample crop each year of the country's distinctive red rice. In lower areas a longer growing season makes possible two crops.

farm animals, or a few back loads of firewood. Salt had been the closest thing we had to money: a handful for half a dozen eggs, another for a basket of corn.

"I remember going home to Canada and taking some cloth. The customs people asked how much I had paid for it. They didn't believe me when I said, 'A cupful of salt.'"

Though Tashigang's clutch of tiny shops has already begun to create something very close to a village, the dzong still functions much as did the castles of medieval Europe. Peasants live in loose communities on the slopes around it, and the dzong still houses civil authorities—the *dzongda* and *thrimpon* and their staffs—and a group of monks headed by an abbot. And, as did the peasants of medieval Europe, the populace assembles periodically in the castle's shadowed inner courtyards to see and be seen by the district authorities, and to witness a morality play.

Clowns Create a Puzzling Note

For three days dancers in rainbow brocades acted out ancient tales of the high Himalayas: triumphs of good over evil, and the dangers each in the audience would face during Bardo. In this perilous time after death, pious Buddhists believe, one's spirit can influence its emergence into a higher life or bring on the disaster of rebirth on a lower plane—as a burden-carrying donkey or (the gods forbid!) as a pig.

I found the performance often difficult to follow, and curiously disquieting. Suddenly it dawned on me. I remembered circus extravaganzas with lines of chorus girls in dazzling costumes, dancing to a soaring waltz while wheeling lights turned a drab tent into a fairyland. Always in another ring or another corner were the clowns, seemingly mocking the pageantry, as if they wanted to bring the whole illusion crashing down to reality.

In Tashigang, too, half a dozen masked jesters made fun of every motion, every symbolic act in the drama. No one among actors or audience was safe from their openly disrespectful and often obscene parodies. And yet the abbot of Tashigang watched tolerantly from a high window, and the people laughed uproariously at the jesters' disruptions.

Bhutanese see nothing at all strange in poking fun at organized religion, though no one I asked, from *(Continued on page 680)*

Girls in the front row measure the march of women's rights in Bhutan. But comparatively few youngsters of either sex get an education; population is so scattered that students must board at one of the country's half a dozen central schools. This Indian teacher instructs in English and Dzongkha—the "speech of the dzongs." Both are official languages. Young yak herder (**facing page**) from Bhutan's snowy northern frontier may never see the inside of a school. "Horns" on his yak-felt hat divert rainwater from his neck and face.

Yak caravans once threaded their way through this precipitous maze (**above**), bringing wool and salt from Tibet's Chumbi Valley and returning with tea from India's warm plains to the south. Lingshi Dzong, foreground, sheltered the lofty region's few settled residents. Otherwise there were only shepherds, who took their herds of yaks down to warmer slopes when winter came. The author's saddle yaks (**right**) top a ridge studded with prayer flags at 15,000 feet. Beyond, cloaked by November's snows, rise 22,300-foot Kungphu, left, on the Chinese border, and a sister peak, Takaphu.

High drama and low comedy compete during the Tashigang *tsechu*, a religious festival that draws devout Buddhists from all of eastern Bhutan. As young Bhutanese watch from windows high above the *dzong*'s

inner courtyard (**above**), a dancer swirls to the rhythms of drum and cymbal (**left**). His long-sleeved costume recalls the story of King Langdarma. A courageous monk concealed a bow and arrow in one of the sleeves of his gown. Dancing before the evil monarch, he approached close enough to draw the bow and slay him. Adding comic relief to the annual festival, a clown in ragtag costume parodies the story (**upper left**).

(Continued from page 675) Father Mackey to the abbot himself, could give me a satisfactory explanation. My own guess (and it is only that) is that the jesters were saying in effect, "After all, even the most serious rituals are the inventions of men, not of gods."

Tashigang marked the end of my west-to-east sampling of Bhutan. I had driven some 500 miles to span a raven's-flight distance of only 120. One major goal remained: the Tibetan border region.

For years journalists have been barred from Bhutan's inhospitable northern heights because of the very real fear of a shooting incident if someone should stray across—or even too near—this sensitive frontier. "Our relations with China have been very correct," Minister of Foreign Affairs Tsering had told me shortly after I arrived. He made it clear that Bhutan does her best to keep them that way.

Fortunately, the border almost everywhere follows an easily definable course—the main ridgeline of the Himalayas—so there are few places where a mistake can be made. "As long as you're going uphill," a Bhutanese official half seriously summed up, "you're in Bhutan. If you start downhill again, you're in China."

Despite the "no journalists" rule, Bhutan's young monarch lent me his helicopter for a visit to Lingshi, an isolated hunting camp just inside the frontier from Tibet's Chumbi Valley. The camp lies at 13,500 feet, almost literally in the shadow of snow-mantled 21,430-foot Takaphu and its sister peak, Kungphu, which rises some 900 feet higher.

It was a memorable experience, for in Bhutan one rarely has snow peaks in view. Intervening ridges cloaked in tropical green usually screen them, or clouds wrap them in featureless gray blankets. But here, from the moment sunrise cast its first orange glow on the peaks until the last blue light of dusk, we were guarded by towering, silvery sentinels.

As the temperature plummeted on our second night in the little camp, turning the brook that had gurgled happily all that sunny afternoon into an icily silent cascade, we sat around a blazing pyramid of rhododendron

Yak herders feast on the wonders of Tashigang, where small shops and other amenities have recently appeared. In the cloud-wreathed village of Ura (**right**), Indian merchants come to buy Bhutan's chief export crop—potatoes. This porter, who must be helped up with his 100-kilogram (220-pound) load, puffs as he carries it in the thin air of 11,000 feet.

twigs. Save for smoldering, smoky yak dung, no other fuel exists in this windswept, almost treeless region.

Rinzin Dorji, a handsome and personable aide to Bhutan's Queen Mother, had casually strolled into camp the day before on a walking tour of this thinly populated region. "I can go faster without a horse," he insisted. Now, contemplating the inevitable rice and eggs, he gazed moodily into the flames and wished aloud that there was a blue sheep to barbecue. That afternoon we had watched a flock of these beautiful animals, which—to their misfortune—often run only fifty yards or so even when a hunter fires at them.

No September, but Two Augusts

Rinzin Dorji continued his introspective musing. "In these mountains," he said, as if to no one in particular, "I feel like—what you call in Western movies?—cowboys. I am 32," he added, as if in answer to a question. "Thirty the way you count." Then, for an hour, with my face flushed by the fire's glow and my back chilled by the bitter mountain night, I was held fascinated by the intricacies of the Bhutanese calendar.

"We count the nine months a child spends in its mother's womb," Rinzin explained, "and everyone considers himself a year older on the same day, New Year's, which comes in your January or February." Thus a child born in October will, no more than five months later, be considered 2 years old.

Rinzin defended the idea of one birthday for all with a certain logic. "How could you have a birthday in October if there is no October?" Astrologers, he explained, review each year in advance; when they come to a particularly unlucky coincidence of signs for a combination of day and date, they simply leave it out. A year may have two Augusts and no September. And periodically a few days must be added to the 360-day Bhutanese year so it doesn't get hopelessly out of phase with the seasons.

Rinzin conceded that all of this might be a bit confusing to a newcomer.

Miraculously, Bhutan's fickle weather allowed the helicopter that had brought me to Lingshi to return on schedule. I hurried back to Thimphu in time for the closing session of the National Assembly (pages 662-63).

The canopied throne from which Bhutan's 20-year-old king usually presides stood empty. I spotted him in a shadowed corner, listening from a bench normally set aside for visitors. He motioned me to join him.

"They have complete freedom of speech," His Majesty explained. He made it clear that the 150-member assembly makes no rubber-

Yesterday's small world pays homage to Bhutan's second king, Jigme Wangchuck, at his coronation in 1926. Emissaries bring gifts: elephant tusks, leopard and tiger skins, guns, gems, and rare fruits. Only hint of the outside world is a jacketed Englishman.

Bhutan's isolated past, reflected in this mural in Tongsa Dzong, holds few clues to the future. Now she must mingle with a larger society of nations, build transportation and communication facilities, create a viable economy, and bring social services to her people. For all of this, Bhutan needs time—and intends to take it.

stamp approvals of legislative proposals, royal or otherwise. "Even the least educated among them are very shrewd," the young monarch said. "Most issues are decided unanimously, by voice vote. But when a controversy develops, it is always settled by secret ballot." He pointed to a draped alcove where members could cast their votes in comfortable anonymity.

Work May Make a Dream Come True

I saw the king once more before leaving Bhutan. We talked for an hour on the lawn of Dechhenchholing Palace, sitting in the pleasant autumn sunlight on leopard-skin rugs and lunching on dried yak meat, leaf-green (and delicious) pancakelike bread, and crisp red apples from the palace's own trees.

Both dress and manner expressed the king's simplicity. Jigme Singye Wangchuck rarely wears royal insignia, and his ideas for Bhutan's future reveal the same quiet realism and patience I had heard reflected in the words of so many of Bhutan's government officials.

"Perhaps we have moved too fast in some directions," he said. "Small hydroelectric plants, for instance, when there are so few who really need electricity. Now we will consolidate. Slow, basic improvements in agriculture and animal husbandry will help our people just now far more than will grandiose projects when there are no Bhutanese trained to run them." He reiterated what so many others had told me: Self-sufficiency must be the first priority of his small, isolated nation.

"We want to move forward," His Majesty said as we shook hands, "but only when we are prepared. We have the time to go slowly, and all of us must move ahead together."

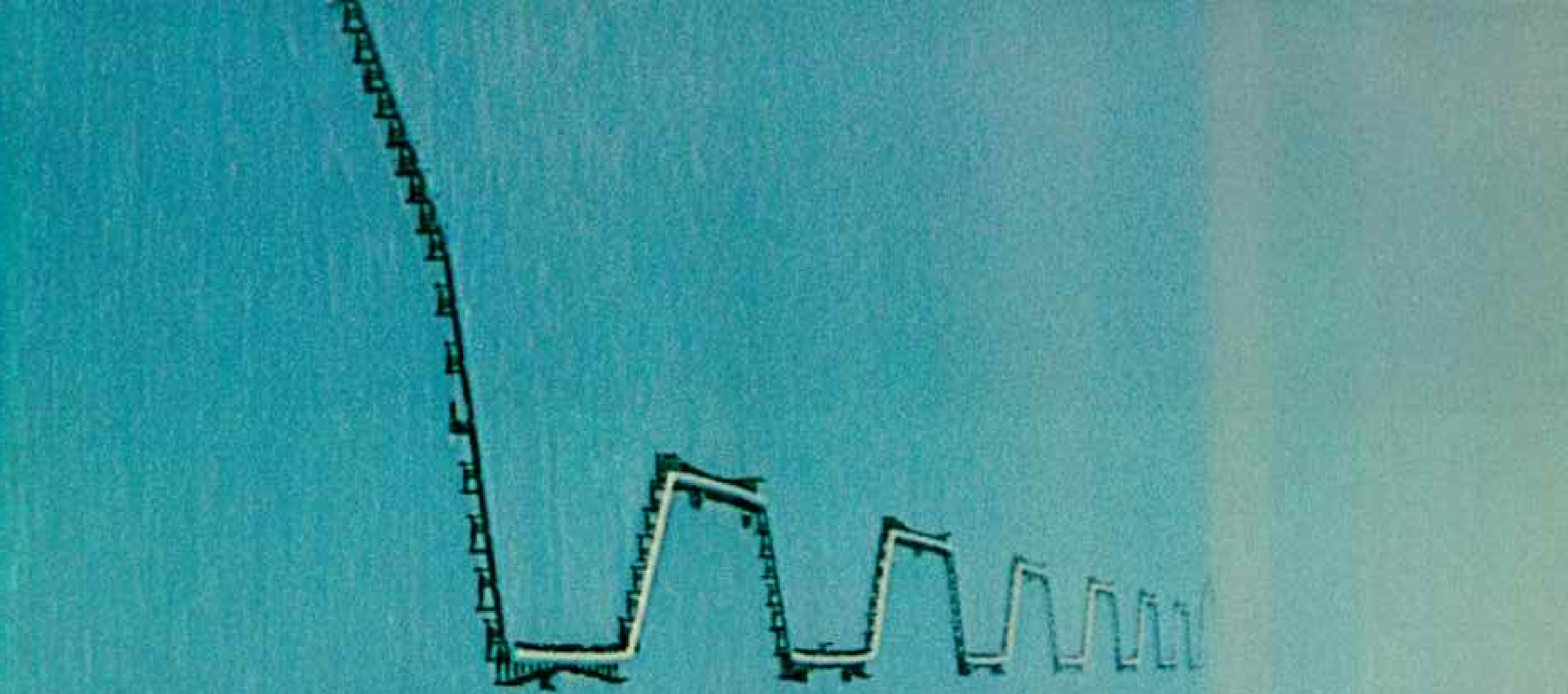
Today's Bhutan is no one's paradise, as Dawa Tsering had insisted. But, with hard work and a fair amount of luck, her realistic leaders may yet turn their country into something close to that—a Shangri-La where western technology works happily in tandem with hallowed tradition. □

The Pipeline: Alaska's Troubled Colossus

By BRYAN HODGSON

Photographs by
STEVE RAYMER
BOTH NATIONAL GEOGRAPHIC STAFF

SNAKING SOUTH *over bleak tundra, the trans-Alaska pipeline crosses the North Slope on its 800-mile journey from Prudhoe Bay to the port of Valdez. The zigzag construction is designed to allow the pipe to contract and expand safely as the temperature changes, and to survive unbroken should an earthquake strike. Challenged initially by environmentalists and many Alaskans, the line now faces mounting construction problems that could delay its scheduled opening next year.*



IT IS FIFTY-SIX BELOW ZERO, and the night lies still as crystal on the Arctic plain. From the east a bridge of light builds solemnly across the sky, then spills its glory in cataracts of pale fire that ripple and flow in the silent wind of space. I have never seen the northern lights before, and I stand dreaming in the frozen road, forgetful of the cold.

The big Kenworth diesel mutters patiently behind me, spewing dense white vapor from its exhaust. Butch Rohweder grins as I climb aboard, and puts the truck in gear. Ahead, our convoy's beacons flick yellow warnings across the snow. On the horizon another man-made light flares in the sky.

"That's a gas flare at Prudhoe Bay, the end of the line," explains Butch. "Hope you enjoyed the ride."

"Enjoy" is too mild a word. For three days we have traveled the nation's northernmost highway, the 360-mile gravel haul road that breaches Alaska's wilderness north of the Yukon River. We have crossed the Arctic Circle, climbed icy palisades of the Brooks Range, and chased mirages down the shimmering valley of the Sagavanirktok River to the shore of the Beaufort Sea.

And along the way I have had a rolling grandstand view as thousands of workers battle climate and the calendar to complete the most costly and most controversial privately financed construction job in history—the 7.7-billion-dollar trans-Alaska pipeline.

Sometime next year—if nothing else goes wrong—the pipeline will start to carry 600,000 barrels of oil a day on an 800-mile journey across three mountain ranges, beneath some 350 rivers and streams, and across zones of intense earthquake activity. For more than half the way, the danger of melting the permafrost has forced building of the pipe aboveground.

At the huge new terminal in Valdez, the oil will be transferred to United States-built tankers for delivery to refineries in Washington and California, where it will "back out" some of the 925,000 barrels of foreign crude oil now being imported daily to the West Coast.

Eight years of political and legal battles will finally be ended, and the 9.6-billion-barrel reservoir of Prudhoe Bay—the largest field yet discovered in North America—will begin to slake the United States' tremendous thirst for oil.

Pipelining's no picnic, but at least it's warm for welders working on gathering lines that feed Pump Station 1 at Prudhoe Bay. Their steel-walled "push shack" and electric heaters shield them from sub-zero cold that could also flaw the welds. Nearly 4,000 welding irregularities were discovered on the pipeline itself. Repairs already have helped rocket the cost from 1.5 billion dollars to a staggering 7.7 billion.

THE CONTROVERSIES will not soon be ended. By late 1977, if production reaches the planned level of 1.2 million barrels a day, conservationists and economists may have the bitter satisfaction of seeing their predictions fulfilled. West Coast refineries will not be able to handle the added flow. Some 500,000 barrels a day may go to Japan in exchange for foreign oil delivered to East Coast ports—which would require both Presidential and Congressional approval—or else be shipped at great expense to the Gulf Coast through the Panama Canal. Meanwhile, industry and Government alike ponder additional pipelines to deliver the crude oil to Texas, or to the northern border states that might have been better served by the trans-Canada route so firmly rejected in 1973.

As I traveled north, I heard undercurrents of another controversy that would erupt in the months ahead—allegations that the builders' haste to complete the pipeline project had resulted in extensive violations of strict environmental and technical regulations.

But a sense of sheer adventure cleanses such dreary matters from my mind on a bright and frozen February day as our Bell JetRanger helicopter swoops low across the new 28-million-dollar Yukon River bridge (pages 698-9), and we land near the waiting truck convoy in a blizzard of our own making.

A security truck races up, its blue emergency light spitting alarm, and a burly guard captain demands our "visas." They are in order. GEOGRAPHIC photographer Steve Raymer and I have joined a veteran crew of drivers for Weaver Bros., Inc., hauling a pair of giant 158-foot bridge sections from Valdez to Prudhoe Bay. The 20-foot-wide loads must wait until scout cars clear traffic for miles ahead. We travel slowly, with many stops, and there is time to enjoy the drama and mystery of the land. Someday this 250-million-dollar highway may be opened to public travel as a state parkway. But now it is guarded against outsiders—including unchaperoned journalists—and we savor our special privilege.

Traffic is heavy, and there is much irreverent citizens' band radio chatter from Iceworm, Dudley Do-Right, Dirty Diesel, Mudflap, Tepee Creeper, and other jovial teamsters whose good humor is enhanced by earnings of as much as $80,000 a year.

At night we learn the folkways of the construction camps, those strange and transient colonies called Five Mile, Old Man, Happy Valley, and Atigun, where pretty secretaries operate batteries of telex and Xerox machines in the wilderness and plump executives live side by side with $1,600-a-week skilled craftsmen and $1,000-a-week laborers.

"I came up here from Washington State just to get that big paycheck," Butch Rohweder confesses one evening as the truck labors up the 10 percent grade of Atigun Pass. "But hell, this is great country. Darned if I'm not tempted to stay. Sure, it gets a little rough at 60 below. Your brakes can freeze to the drums, or you can pop a drive shaft like a candy cane if you're not kind of tender with the gears. Make a wrong move on a hill, and suddenly you're drivin' an 18-wheel toboggan. That's how come some guys call this road the Kamikaze Trail. But it's the best truckin' in the world, if you know what you're doin'."

Butch would be a frontiersman in any age. In contrast, I recall the terse comment of a hefty pipeliner, digging into his third consecutive sirloin steak at Five Mile Camp:

"You can talk all you want about the last frontier. To me, it's just plain Fat City."

I AM STARTLED to hear Alaska described in so cynical a metaphor. But booms are not conducted in the best of taste, and manners have suffered somewhat since 1973, when thousands of new residents and transient workers began swarming north in search of fabulous pipeline paychecks.

"HAPPINESS IS . . 10,000 Okies going south with a Texan under each arm," proclaims a bumper sticker popular on Fairbanks streets—a surly codicil to the state's official motto, "North to the Future," which once adorned Alaskan license plates.

Light at the end of the earth, a gas flare illuminates forbidding Prudhoe Bay. To help the 4,500 workers at Prudhoe fight stress and boredom, self-contained camps function like space stations of the future, offering daily movies, college extension courses, videotape television, saunas, and food fit for a king.

But the "pointy-toes"—so-called for the cowboy boots they wear—will not be leaving soon. Each day a new contingent arrives aboard the Alaska Airlines Pipeline Express, direct from Houston and Dallas. These are the oil industry's soldiers of fortune, the professional drillers, welders, and pipeline layers who follow the oil action from the North Sea to the Persian Gulf, from Africa to the rain forests of Brazil. Today the action is in Alaska, and Prudhoe Bay and the pipeline are only the beginning.

Experts speculate that a fifth of the nation's undiscovered recoverable oil may lie on Alaska's continental shelf (map, pages 702-703). The U. S. Department of the Interior has already sold 409,057 acres of leases in the Gulf of Alaska, and is considering 1.6 million acres in the Bering Sea for lease next year. Beaufort Sea leases are planned for 1978.

On "Pet 4"—the 23-million-acre U. S. Naval Petroleum Reserve west of Prudhoe Bay—five 12,000-foot wells are being drilled by the Navy, with predictions of at least five billion barrels of recoverable oil, plus vast quantities of natural gas. Doyon, Ltd., a native corporation, has commissioned exploratory drilling in the Yukon-Kandik Basin, estimated by state geologists to contain 1.7 billion barrels of oil and 11.4 trillion cubic feet of natural gas.

And now, as oil companies prepare for offshore drilling, many Alaskans fear that boomtime sprawl will engulf vulnerable coastal communities like Yakutat, Cordova, and Kodiak. Fishermen in Homer, on the Kenai Peninsula, have persuaded the state legislature to negotiate repurchase of leases in Kachemak Bay, one of the richest marine spawning grounds in the world.

"We've spent a lot of time worrying about bears and bald eagles," said a thoughtful Fairbanksan. "We should take a look at what's happened to our Alaskan way of life. We've had enough get-rich-quick. We need to plan for get-rich-slow—otherwise the money will all go south with the oil, and we'll be left with some new ghost towns for tourists in 2076."

DAN MURY

Taking his life in his hands, a welder offers a morsel to a grizzly bear. No pipeliners have been seriously injured by wild animals, though several men were bitten by wolves seeking handouts. Transplanted to outlying wilderness, some brown bears quickly returned—compelling officials to shoot them.

THERE ARE NO GHOSTS—and very few warm bodies—on Fairbanks streets at minus 30° F. The garish neon lights on Second Avenue—the notorious "Two Street"—reflect from ice turned black by a winter's dirt. A tavern door crashes open, emitting two disheveled men who grapple each other for support. Inside, electronic cowboys bawl unlikely sentiments, competing with the wheedling of women and the incoherent bravado of six pipeliners who are—like children with toy guns—demonstrating fast draws with heavy, brass-hilted pocketknives.

A block away, a guarded door with a bing-bong bell opens on a pleasant room with shag carpet and mirrored walls. There is a tidy bar, a giant bowl of hard candy, and a group of quiet men around a dice table. One of them has 75 black chips. The hundred-dollar ones. He bets impassively, loses and wins, while I husband my shameful pittance for half an hour. Back to the $50-a-night motel room then, to find two communications: a $22 laundry bill for three shirts, two pairs of jeans, and some underwear—and a card slipped under the door that promises "Gorgeous Girls—Licensed and Bonded—No Dogs, No Duds, No Rip-offs—Your Friend in Fairbanks."

By daylight the boom looks different. Two Street boasts the best bookstore and the best

barbershop in town. And it boasts Dr. Mim Dixon, a 27-year-old anthropologist who is information officer for the Fairbanks North Star Borough Pipeline Impact Information Center. For almost two years, in a series of painstaking reports, she has provided Fairbanks citizens with useful information for dealing with the enormous change.

"Everyone knew the pipeline was coming, but nobody was ready for it," she says.

Almost all statistics are dramatic in Alaska's premier boomtown, where the pipeline company pours out $800,000 a day in wages and purchases, and population has soared from 45,000 to 65,000 since 1973.

Estimates put the city's cost of living 12 percent above that of Anchorage—which in turn is some 40 percent higher than the urban average in the Lower Forty-Eight. In 1976 a Fairbanks family of four spent an average of $1,500 a month on basic needs. Rents ranged as high as $750 for two-bedroom apartments. Senior citizens have been hardest hit, unable to compete for housing and services; a survey shows that two-thirds of them live on less than $700 a month—defined as low-income status in Fairbanks. Many could not afford to remain in Alaska but for the state's longevity bonus of $125 a month to those 65-year-olds with 25 years' residence.

City workers were given a 50 percent pay increase in 1974, plus 15 percent in 1975, to stem the enormous turnover as workers signed up for pipeline jobs.

Paradoxically, unemployment claims are up more than 100 percent as well. At the Teamsters Union hiring hall, I find out the reason why.

The construction season has barely begun in mid-February, and the hall is packed solid with members who have not worked since the big winter layoffs of November and December. Many who might have gone south for the winter have remained in Fairbanks to qualify for a state-residency card. This year, few jobs will go to "Outsiders."

"I'll drive anything they've got," says Wayne Arnold, of Eureka, California. "I've worked up here on and off since 1951, and I want to retire out of this local. With 20,000 hours a man can retire at 45—and continue to get full medical, dental, and legal care for his whole family to boot. That's as good as another paycheck right there."

THE TEAMSTERS have grown to 23,000 members in Alaska since pipeline construction began. Employers kick in as much as $3 an hour per worker for benefits and a pension fund that has topped a hundred million dollars—one of the state's largest sources of private capital.

Many members will never earn a pension, but pay $17 monthly dues to stay eligible for jobs, plus up to $35 a week in special assessments on their huge pipeline paychecks.

"I'm not out to make a million," says Craig Paradise, of East Hartford, Connecticut. "I'm saving for a house back home. One more season and I may have it made."

In the plush new offices of Alaska International Industries, 40-year-old Neil Bergt sits gazing cheerfully out the window at one of the seven shiny Lockheed Hercules transports that almost flew the company into bankruptcy before they made him a success.

Like many Alaskan businessmen, Neil got caught in the false boom of 1969, investing in equipment only to find the pipeline delayed. He found clients for his "Hercs" as far away as Oman, Botswana, and Zambia until the massive pipeline airlifts of 1974 and 1975.

Neil is Alaska-born, and was earning $1,900 a month running two milk delivery routes.

"I stopped at the airport one morning and it occurred to me that the airline pilots really had it made," he said. "So I went out and bought a plane, hired an instructor, and in six months I had my license, my instrument rating, and a job with Interior Airways."

After 13,000 hours as a line pilot, he took over the company and changed it to Alaska International Air, Inc. Now he heads a conglomerate that includes the Weaver Brothers trucking firm, and a new company, Alaska International Construction.

Across town, at the University of Alaska Museum, Mim Dixon's husband, E. James Dixon, Jr., studies a boom of a much earlier time—the migration of Asian hunters from Siberia before the Bering land bridge was flooded for the last time 14,000 years ago.

In 1974 Dixon made an important discovery—a 10,500-year-old site known as the Gallagher Flint Station in the Brooks Range near the Sagavanirktok River. The find was part of an extensive archeological study of the pipeline route, required by law before construction could begin.

Now he is conducting a sophisticated $240,000 study of the drowned land bridge itself, financed by the U. S. Bureau of Land Management.

Dixon's co-workers are Dr. Russell D. Guthrie, of the university's Institute of Arctic Biology,* and Samuel Stoker and Dr. G. D. Sharma, of the Institute of Marine Science. They assembled all available research on Pleistocene landforms, weather, and wildlife populations in Siberia and Alaska. Projecting the data on the now-flooded land, they have plotted areas most likely to have attracted human activity. This year they will finish an ocean-bottom survey from aboard the university's research vessel, *Acona*.

"The odds against discovering human habitation are astronomical," says Dixon, "the greatest long shot in prehistory, you might say. But we have learned something about early hunting patterns. Who knows. . . ."

His eyes reflect a dawning of that very old day when the ancestors of Alaska's Aleuts, Eskimos, and Indians first possessed the land.

Just another pipeliner, 20-year-old Karen Wike (**facing page**) helps position polyurethane insulation (**above**). Women earn the same wages as men—an average $1,200 a week—and hold 10 percent of the jobs. While the majority work in camps, many are truck drivers, crane operators, and drillers. Hassles from male co-workers generally end after women show they can do the job.

A NEW DAY for Alaska's natives dawned on March 13, 1968, when Atlantic Richfield announced discovery of rich oil deposits some 10,000 feet beneath the tundra at Prudhoe Bay.† A year later a similar announcement was made by British Petroleum, which owned leases that proved to contain some 53 percent of Prudhoe's oil and about 27 percent of an estimated 26 trillion cubic feet of natural gas.

Ownership of public lands was already frozen in political debate of native claims. Until the claims were settled, a pipeline could not be built. Oil companies fervently lobbied on behalf of the Alaska Native Claims Settlement Act of 1971, which created 13 native corporations, provided them with a billion dollars in revenues, and allowed four years for selection of 40 million acres.‡

Meanwhile, the oil companies formed the Alyeska Pipeline Service Company to build and operate the line. Some 800 miles of 48-inch pipe was bought for 100 million dollars from Japanese mills.

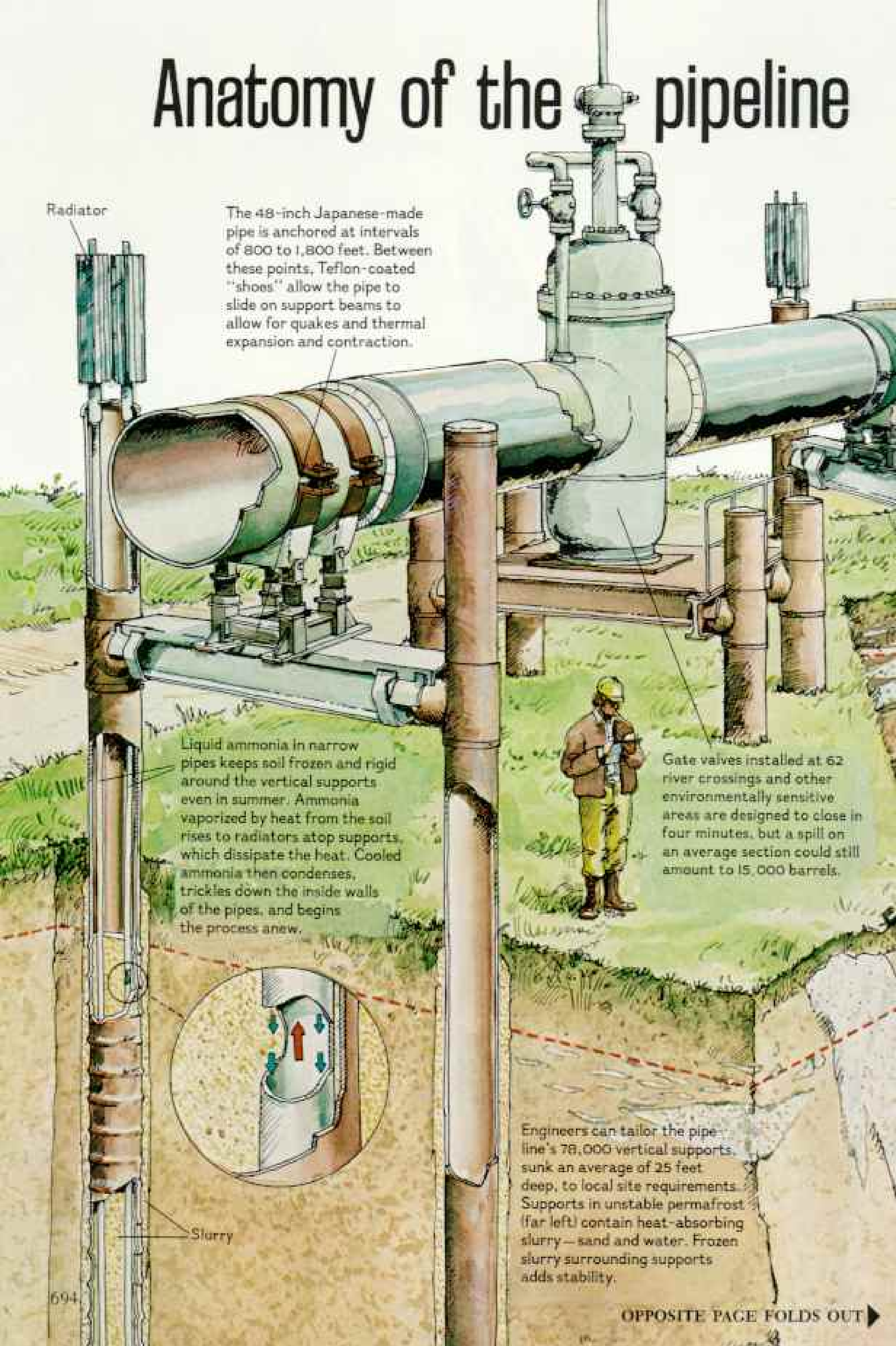
For almost four years the pipe remained stacked in huge geometric piles at Valdez, Fairbanks, and Prudhoe Bay while environmentalists waged a series of legal battles against the pipeline. Not until November 1973, at the height of the Arab oil embargo, did Congress authorize construction. But environmentalists had won an important battle by forcing the Department of the Interior to *(Continued on page 700)*

*Dr. Guthrie wrote of Alaska's Ice Age wildlife in the March 1972 NATIONAL GEOGRAPHIC.

†See William S. Ellis's "Will Oil and Tundra Mix?" in NATIONAL GEOGRAPHIC, October 1971.

‡Joseph Judge assessed the people, problems, and promise of the 49th State in "Alaska: Rising Northern Star," NATIONAL GEOGRAPHIC, June 1975.

Anatomy of the pipeline



OPPOSITE PAGE FOLDS OUT ▶

Fiberglass sheathing as well as polyurethane panels at each support insulate the pipe to keep oil hot enough to be pumpable through winter shutdowns lasting as long as 21 days.

"Snoopy" travels on rollers inside the empty pipe, allowing its operator to make internal weld repairs and inspections. Welding and exhaust fumes are vented behind the diesel-powered, gyroscope-stabilized vehicle. Once oil begins to flow, a sensor-equipped device will be regularly pumped through the pipe to check for flaws.

Stable permafrost permits conventional pipe burial for about 350 miles at depths from three to twelve feet. Twin ribbons of zinc wire are laid with all buried pipe to prevent electrochemical corrosion; polyethylene coating on pipes further resists pipe deterioration.

Sections of pipe are buried where above ground they would block caribou migration routes. In areas of unstable permafrost, insulation and refrigerated brine, pumped through small pipes, keep the ground frozen.

Active ground layer above the permafrost alternately thaws and freezes. Wherever possible along the pipeline route, vegetation is left intact, or replanted.

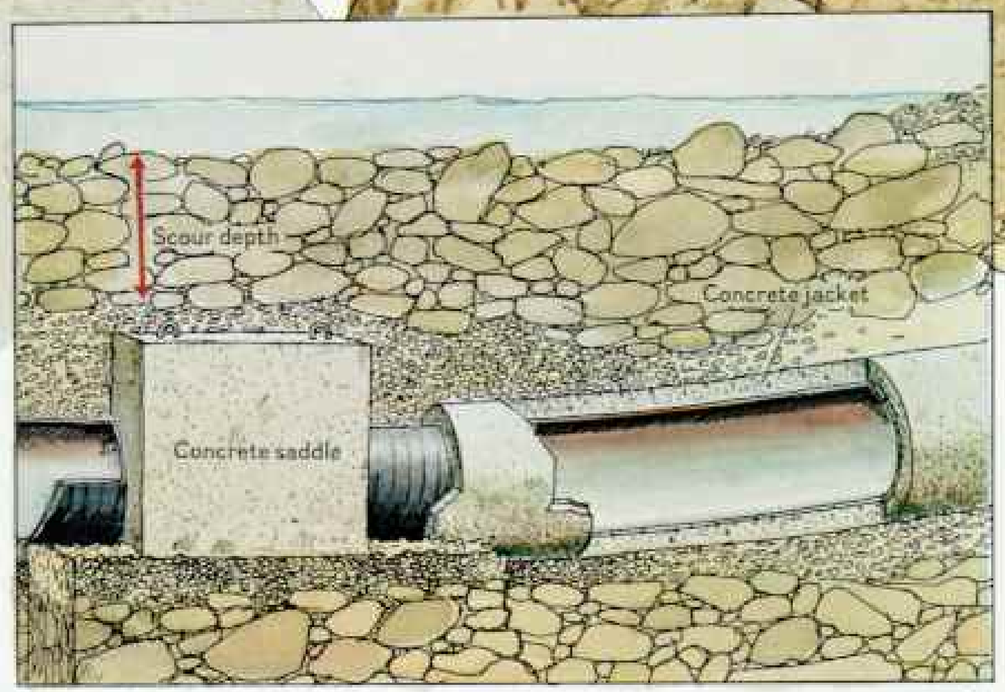
Frost heaving

Active zone

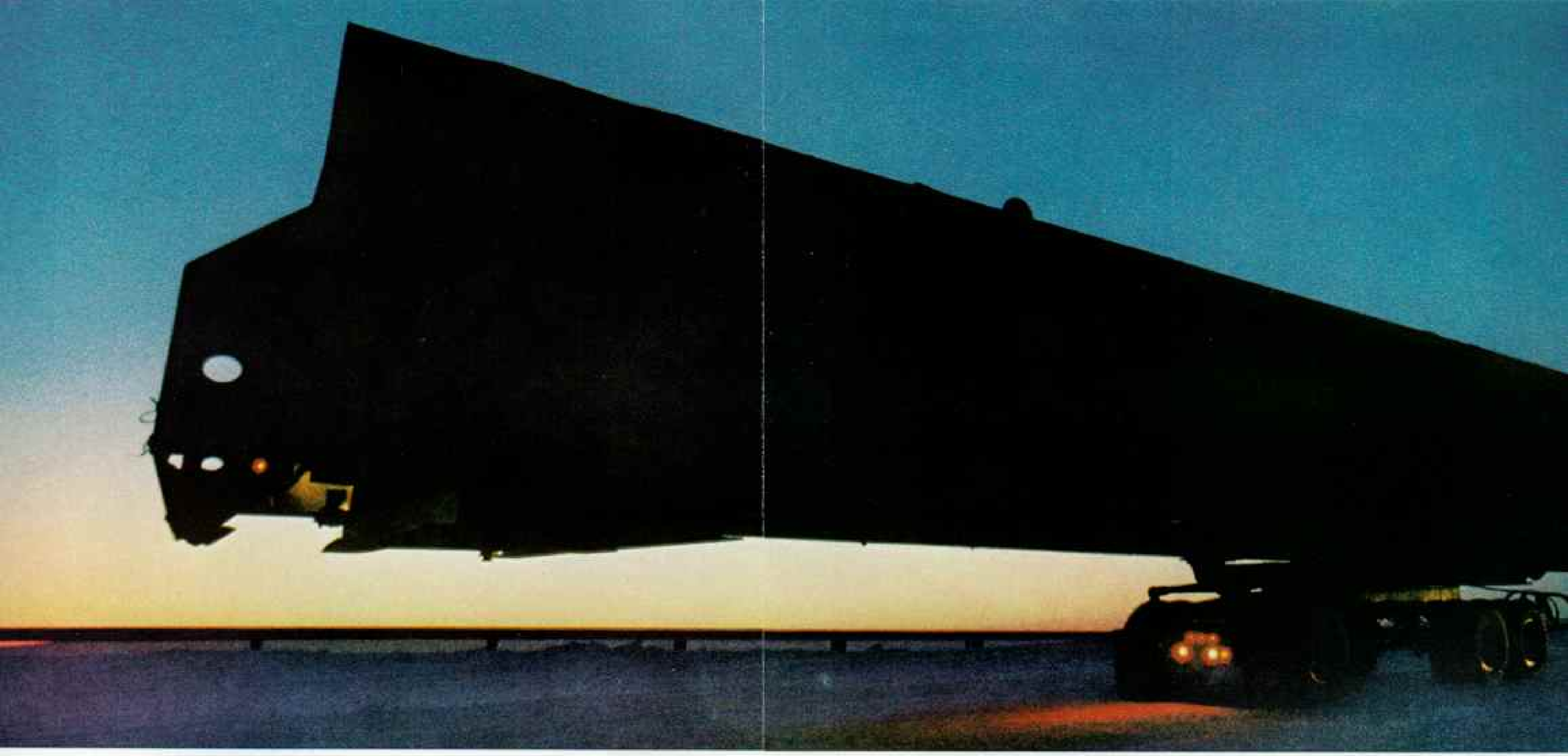
Refrigerated brine

Permanently frozen ground beneath the earth's surface, called permafrost, posed pipeline designers' most critical challenge. In stable permafrost, made up of sand, gravel, and other aggregates, stability of buried pipe is easily maintained. But in unstable, ice-pocked ground, oil's heat could thaw the permafrost, causing the pipe to settle and rupture. Blue arrows (above left) show frost heaving, a stress-producing, upward ground movement caused by freezing of subsurface water.

Pipeline that crosses under streams and rivers is jacketed with a five-inch layer of concrete, or weighted with nine-ton concrete saddles. To further prevent floating, the pipe is buried a minimum of five feet below streambeds, well under the scour depth (arrow), the level safe from maximum floodwaters. Some of the line's 800 stream and floodplain crossings, however, utilize aboveground techniques. On 13 crossings, including the 2,300-foot-long span over the Yukon River, the pipeline is supported on bridges.



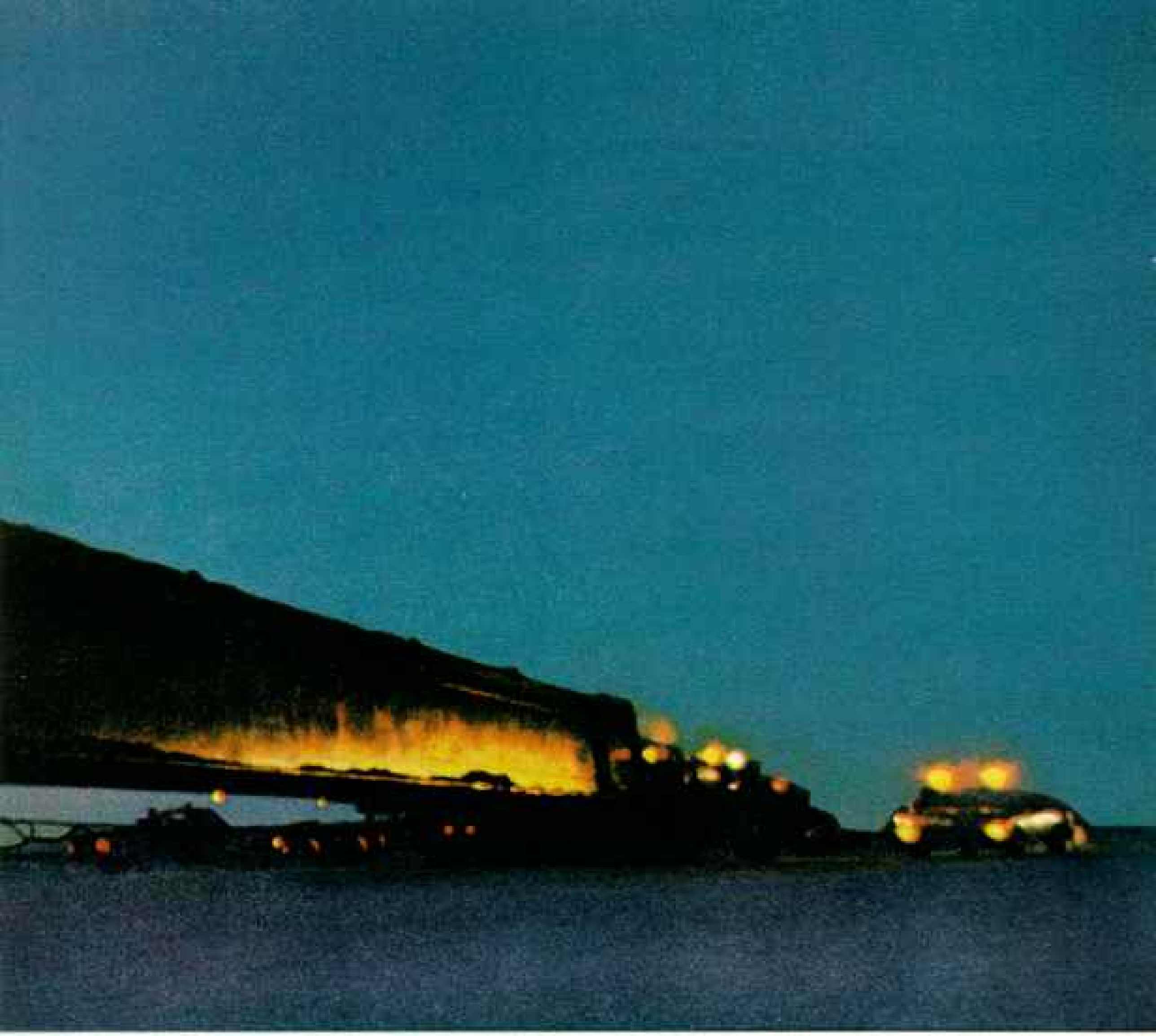
PAINTING BY RICHARD SCHLECHT



"**You can run this road** and make a job out of it, or you can run this road and have fun." For trucker Butch Rohweder (**left**), wrestling his dependable rig across Alaska beats logging in Washington State.

As much as the "superbucks" he earns—more than $60,000 a year—Butch relishes the glory and challenge of carrying big loads. He helped haul five 158-foot bridge beams, such as the one above—the largest loads ever trucked across the state.

His 860-mile route to Prudhoe Bay includes Alaska's first permanent Yukon River crossing (**right**) and the pipeline haul road, a 360-mile path that winds over the Brooks Range and miles of permafrost.



(Continued from page 692) prepare a vastly expanded environmental-impact statement. Knowledge gained in the study was reflected in some two hundred technical and environmental stipulations in the right-of-way agreements signed by the oil companies, the State of Alaska, and the Interior Department.

One such "stip" sums up the agreements' intent. "If any standard contains a provision which is inconsistent with a provision in another standard," the stipulation warns, "the more stringent shall apply."

The oil companies had already discovered that the original plan for a 1.5-billion-dollar pipeline was, literally, a pipe dream.

"We found we had a lot to learn," says Peter DeMay, Alyeska vice president in charge of construction.

"They didn't have a single foot of pipeline designed when I came here in 1972. By 1974 we had a complete mile-by-mile blueprint."

The rugged terrain required the most sophisticated pipeline ever designed (diagram, pages 694-6). For 425 of its 800 miles, the pipe must travel on a "high-rise ditch" made of 78,000 18-inch-diameter vertical supports planted in permafrost so delicate that a one-degree temperature increase can turn it to slime. Friction generated by pumping pressure of up to 1,180 pounds per square inch keeps the oil at about 135° F., and the pipe itself must endure incredible stress from air temperatures ranging from 90° F. to minus 60° F. Heavy insulation is required to keep the oil at a pumpable temperature for as long as 21 days in case of a winter stoppage.

Some 30 violent earthquakes have struck within 50 miles of the pipeline route since 1898, and the *(Continued on page 705)*

Flattened by natural forces, sections of pipeline (**right, above**) floated to the surface of the Sagavanirktok River only months after being buried beneath the riverbed. State officials, who invited photographer Steve Raymer to inspect the damage, linked the mishap to ice formation between the pipe and a concrete jacket; the jacket broke under the intense pressure of the expanding ice. Replacement sections, which will be buried in the water-filled ditch spanning the temporarily dammed river (**right**), will be jacketless to avoid the problem, but will be covered by greater amounts of backfill.

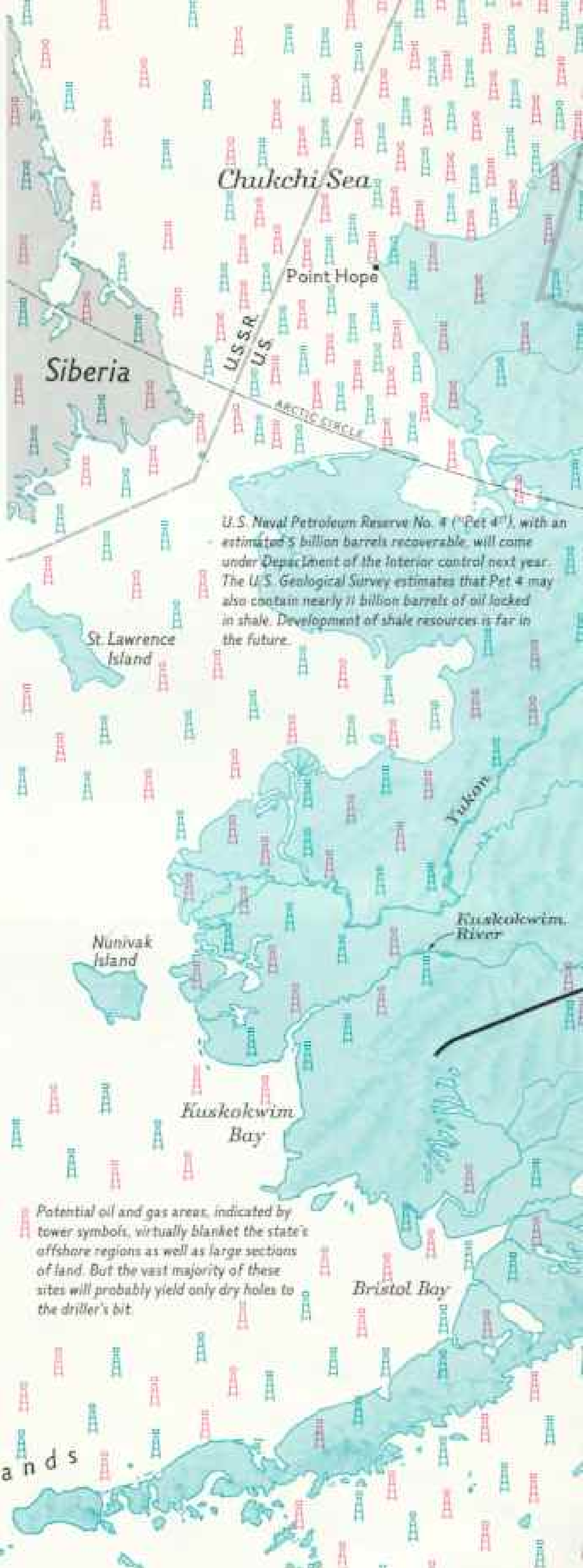
Alaska: a vault of potential energy

BEFORE THE TURN of the century, Eskimos unknowingly hinted at the immense energy stored beneath Alaska. To Russian and American whalers they described mysterious black lakes that burned.

The discovery of North America's largest oil field at Prudhoe Bay in 1968 dramatically confirmed the 49th State's energy stores. Yet the 200-square-mile field, with estimated reserves of 9.6 billion barrels, would not satisfy our nation's oil appetite for even two years.

No one really knows the extent of Alaska's total energy resources. Estimates of the amount of undiscovered recoverable oil range from 12 billion to 76.1 billion barrels, and natural-gas estimates vary from 29 trillion to 439.6 trillion cubic feet. In addition, the state contains enormous amounts of coal, as well as uranium and geothermal and hydroelectric energy.

A consortium of eight oil firms is building the 800-mile trans-Alaska pipeline. To convert more of the state's energy potential to man's use, some Government officials believe 7,500 miles of pipeline and 6,000 miles of highways may be needed in the future—"a future we may not want to see," says Governor Jay S. Hammond, who advocates a cautious approach to development.



U.S. Naval Petroleum Reserve No. 4 ("Pet 4"), with an estimated 5 billion barrels recoverable, will come under Department of the Interior control next year. The U.S. Geological Survey estimates that Pet 4 may also contain nearly 11 billion barrels of oil locked in shale. Development of shale resources is far in the future.

Potential oil and gas areas, indicated by tower symbols, virtually blanket the state's offshore regions as well as large sections of land. But the vast majority of these sites will probably yield only dry holes to the driller's bit.

The largest offshore oil and gas deposits in Alaska probably are on the continental-shelf areas of the Chukchi Sea and the Beaufort Sea, the U.S. Geological Survey believes.

Barrow

Beaufort Sea

Prudhoe Bay

Sagavanirktok R.

Prudhoe Bay

Deadhorse

NAVAL PETROLEUM RESERVE NO. 4

NORTH SLOPE

Colville

Happy Valley Camp

Gallagher Flat Station

ARCTIC NATIONAL WILDLIFE RANGE

Brooks Range

Noatak

Atigun Camp

Atigun Pass

PROPOSED WILDLIFE ADDITION

Porcupine R.

Kobuk R.

HAUL ROAD

Old Man Camp

Yukon-Kandik Basin

Koyukuk

ARCTIC CIRCLE

YUKON TERRITORY

NORTHWEST TERRITORIES

Five Mile Camp

Trans-Alaska pipeline

Yukon R.

Yukon

Yukon R.

CANADA

U.S.

Fairbanks

Fairbanks International Airport

ANCHORAGE-FAIRBANKS HIGHWAY

Usibelli Coal Mine

Delta Junction

Donnelly Dome fault

McGinnis Glacier fault

Clearwater Lake fault

ALASKA HIGHWAY

Mt. McKinley+
6,194 meters
20,320 feet

Delta R.

Susitna

Denali fault

Alaska Range

GLENN HIGHWAY

RICHARDSON HIGHWAY

Anchorage

Chugach Mountains

Copper R.

Valdez

Cordova

Kenai Peninsula

Cook Inlet

Homer

Kachemak Bay

Kodiak

Kodiak Island

Symbols identify proven areas of energy wealth as well as sedimentary basins where geologists speculate energy resources may be found. Densest concentrations of symbols depict greatest oil and gas potential.

Oil — PRODUCING — PROVEN — POTENTIAL

PIPELINE — ABOVEGROUND — UNDERGROUND

Gas — PRODUCING — PROVEN — POTENTIAL

PIPELINE — EXISTING — PROPOSED

Active geologic fault line

Whitehorse

YUKON TERRITORY

BRITISH COLUMBIA

Yakutat

Haines

Juneau

If construction is completed on schedule, 600,000 barrels of oil a day will begin flowing next year to the pipeline terminal at Valdez. The life of Prudhoe Bay's 9.6-billion-barrel field will be at least 25 to 30 years.

U.S. Geological Survey estimates place the lower Cook Inlet area's oil potential at from half a billion to 2.4 billion barrels, and its gas from one to 4.5 trillion cubic feet. The Department of the Interior may auction offshore leases here in the near future.

Gulf of Alaska

0 KILOMETERS 200

0 STATUTE MILES 200

DRAWN BY LEO ZEBARTH
COMPILED BY PAMELA CUTT
NATIONAL GEOGRAPHIC ART DIVISION

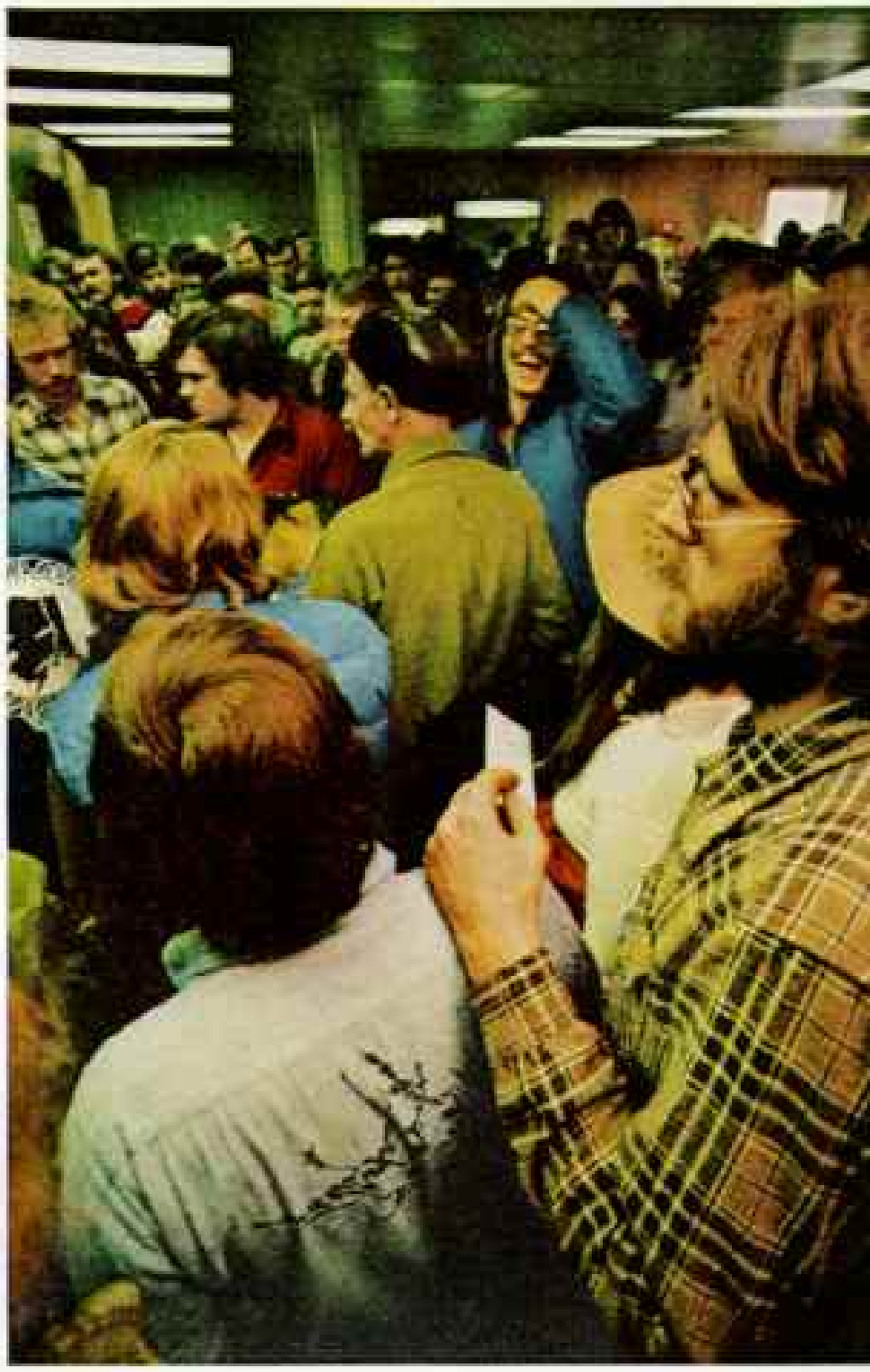
(Continued from page 700) stipulations require that it be designed to withstand shocks ranging to 8.5 on the Richter scale. More than 140 automatic or remotely operated valves will limit oil spills to an average of 15,000 barrels if a break occurs. At Valdez terminal, storage tanks are designed to support snowfall as deep as 14 feet, and tankers will moor in a harbor protected against tsunami (quake-generated waves) such as the one that destroyed Valdez in the 1964 earthquake.*

The terminal includes a water-treatment plant that will purify oily ballast water from incoming tankers to concentrations of eight parts per million. The entire line will be monitored and remotely controlled by microwave signals from Valdez and by satellite.

FROM THE BEGINNING, pressure was enormous. Even before the formal agreements were signed, hundreds of men and machines had swarmed across the frozen Yukon River to build a temporary highway of ice and snow that would carry heavy construction equipment northward. Overhead, a military-style airlift delivered more than 600 portable dwelling units plus thousands of tons of food, fuel, and supplies for the construction crews. By late April 1974, seven task forces had begun building the vital all-weather haul road. The entire job took only five months. Now trucks could haul the thousands of loads of 80-foot pipe sections, which had been "double-jointed" in automated welding shops in Valdez and Fairbanks from 40-foot factory lengths—a technique that halved the amount of difficult field welding required. A 50-foot-wide gravel "work pad" was built to protect the land during actual installation of the pipe.

In the meantime, state and federal governments organized teams of experts to monitor construction. Alyeska assembled a complex pyramid of administration: five joint-venture companies to serve as execution contractors on the pipeline's six sections; the Fluor corporation to build 12 pump stations and the huge Valdez terminal; 200 subcontractors ranging from caterers to X-ray testers; and in command of the pipeline, responsible for production and quality control, the giant Bechtel corporation. Alyeska kept

*That devastating quake was described by William Graves in the July 1964 NATIONAL GEOGRAPHIC.



Sweet smile of success blossoms in the Teamsters' ever-crowded Fairbanks hiring hall (**above**). More than 23,000 members give political clout to Alaska union chief Jesse L. Carr (**facing page**), standing beside a model of his wealthy union's new Anchorage recreation complex. Sign of the times, a bumper sticker (**below**) says what many residents of Fairbanks feel.

control of engineering and budget, and established its own quality-assurance plan. A contract was signed with 15 international unions and 24 locals, granting them full control of pipeline hiring in return for a three-year no-strike agreement.

BY MIDSUMMER of 1975 the enormous project was in full swing, with 20,000 men and women working 12 hours a day, seven days a week, racing to complete 50 percent of the pipeline by year's end.

"It was sort of like landing in Normandy," Alyeska's chairman, Edward L. Patton, said in June 1976, in testimony before the House Subcommittee on Energy and Power.

The strain began to take its toll. Violence erupted between rival unions. Massive thefts and abuses of equipment were reported. Equipment shortages and breakdowns delayed the work. Hiring and overtime abuses became widespread.

And in the critically important welding of pipe sections, on which the integrity of the line depends, 30 percent of the welds required repair or replacement.

In July 1975, auditors from the U. S. General Accounting Office reported that failures in the quality-control system had resulted in burial of pipe known to be defective.

In September a disgruntled employee revealed falsification of X rays of pipe welds on one section of the pipeline south of the Yukon River, and a confidential Alyeska report acknowledged intimidation of quality-control inspectors by production managers. State and federal officials reported chronic violations of stipulations covering protection of waterways and fisheries.

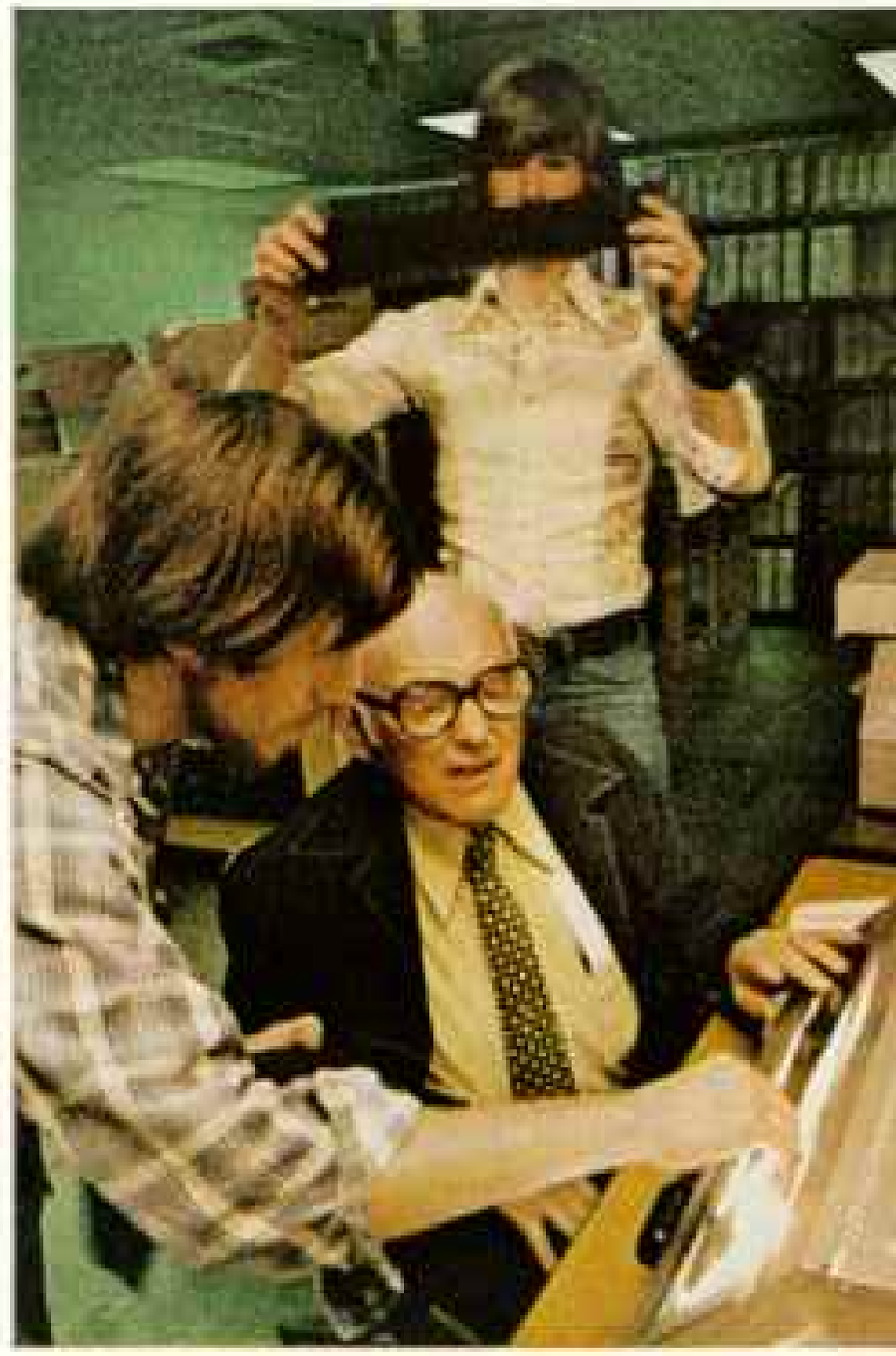
Looking to future pipelines, Allan Carson, supervisor of pipeline surveillance for the Alaska Department of Fish and Game,

Open-pipe surgery will replace dented and damaged sections atop lawnlike tundra near Happy Valley Camp. Heat expansion on an unanchored, mile-long stretch caused the pipe to creep forward several inches until its steel "shoes" slipped off horizontal supports, letting the pipe crash onto the beams. Construction traffic flows on both the gravel haul road (background) and the work pad beside the pipeline.

Digging for trouble

TUNDRA TAKES A BEATING as workers gouge holes in the permafrost (**left**) to expose welds for new X-ray examinations, or repair. To cut through the rock-hard ground, they use steam, explosives, high-pressure water, and rock saws. In their wake erosion-causing bogs are left atop the delicate tundra. "The environment's the loser," says State Pipeline Coordinator Chuck Champion (**above**), who attributes the majority of the digging to "overcautiousness." Some nine

hundred welds were scheduled for excavation north of the Brooks Range, part of a multimillion-dollar repair program to raise the troubled pipeline to federal standards. New radiographs, such as those being read by state inspector Gordon Tyree (**below**), were ordered to replace scores of missing and falsified X rays. Despite such problems, officials credit the project with significant innovations in the art of arctic pipeline construction.



warned: "Beware of tight construction schedules . . . when things go wrong the first place to make up for lost time is by cutting corners environmentally."

Not until May 1976 was the full impact reported: An audit of 30,800 field welds made in 1975 disclosed that 3,955 were questionable; the most serious findings included 154 duplicated or falsified X rays, 298 missing X rays, and some 1,000 dubious welds buried in so-called critical locations, such as river crossings, floodplains, or in permafrost, where pipe could be dug up only at great cost and risk of environmental damage.

Alyeska presented the audit with a strong argument that many of the flaws were insignificant, citing research data to prove that the pipe had far greater resistance to damage than was envisioned in the welding specifications. Repairing or reexamining all the welds could cost 55 million dollars and delay completion of the pipeline as much as a year.

Congress began an immediate investigation. And serious doubts were cast on the validity of the audit itself when the accounting firm of Arthur Andersen & Co., hired by the Interior Department to report on Alyeska's figures, found that it was impossible to determine from Alyeska's records if all 1975 welds had been accounted for, if all defects had been reported, or if all duplicate X rays had been identified.

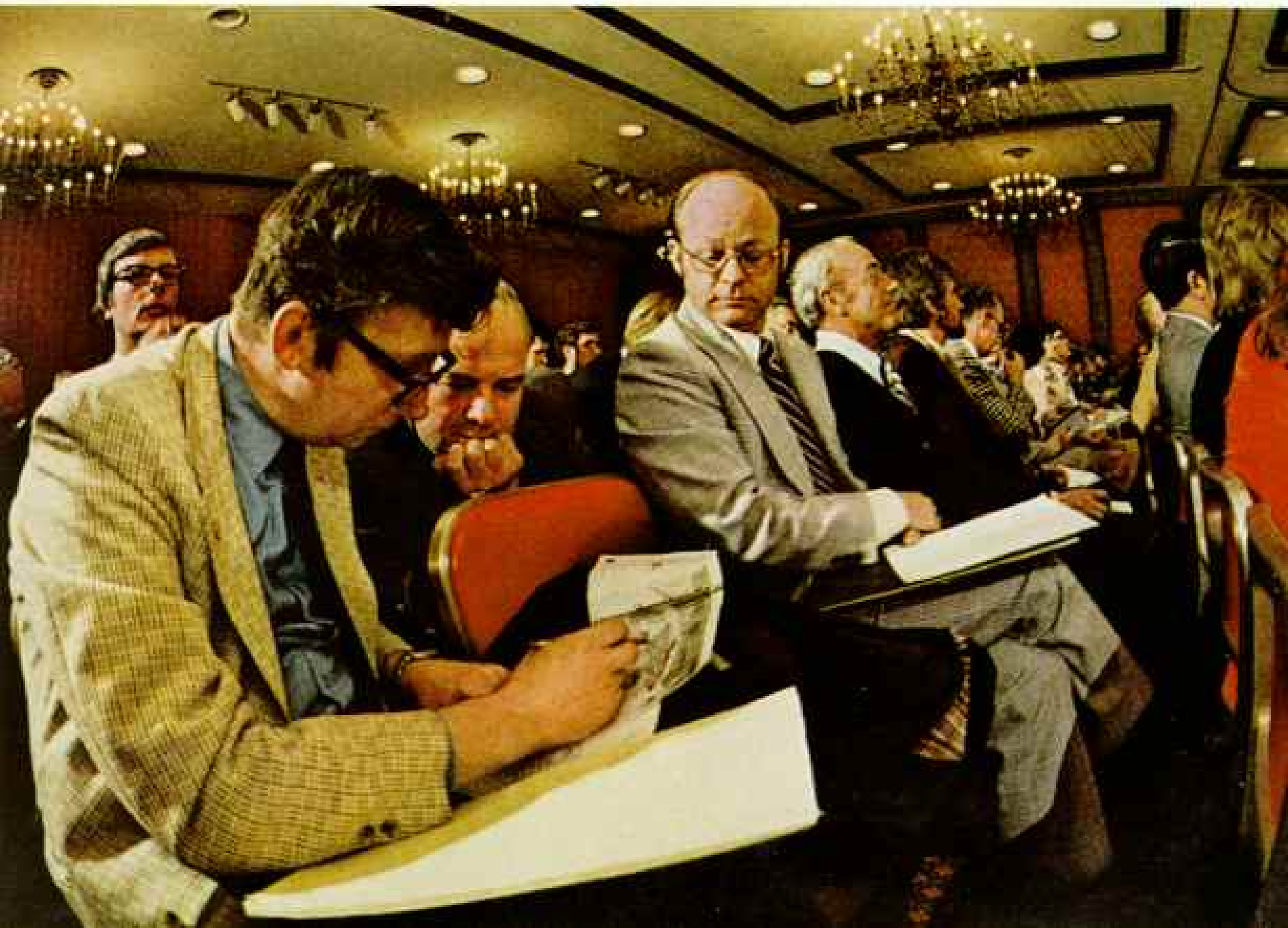
The Andersen report stirred an already boiling controversy. On July 6, President Ford dispatched a fact-finding commission to Alaska. The prospect of delay made numbers flicker like northern lights on the electronic calculators of investors, oil executives, and government officials alike.

More than 85 percent of the pipeline is financed by loans, and interest costs are 650 million dollars a year—more than $1,750,000 a day. Industry experts forecast net profit of $4.42 per barrel of oil delivered on the West Coast—so a single day's delay in production means postponement of $2,600,000 in earnings by Alyeska and the oil firms, and almost as much in royalties and taxes for the state.

WELDING HAD BECOME a very important subject indeed.

"You go out there plain vanilla, and that welding'll eat your lunch for you!"

Harold Mehail doffs his immaculate stetson, props an expensively booted foot on a desk, and delivers the judgment with the



impatience of a man who suffers fools badly. "Vanilla" is his metaphor for ignorance; 36 years in the pipeline business, from welder's helper to project manager, taught him that ignorance is the kiss of death for profits.

His credentials deserve respect. He managed the double-jointing operation on the main pipeline, completing 42,000 welds with only eight weld X rays unaccounted for. At Prudhoe Bay his crews are welding 126 miles of gathering lines, which deliver oil from the wells to the main pipeline and return natural gas to a plant that pumps it back into the earth to await construction of a natural-gas pipeline. Their rate of repair is 4 percent—and the job is on budget and on schedule.

"No mystery about it," says Mehail. "We're using the same welders as anyone else. They're all out of the Pipeliners Local Union 798 down in Tulsa. The difference is the way we operate. We go to Tulsa ourselves and test each man before we'll send him out. On the job we treat him right. We get rid of all the 'outs'—the excuses. That way, when he stands up to the pipe, he's got only one thing to worry about, and that's to do the best job he can. His pride's on the line. He knows we respect him—and he knows he'll get run off if he doesn't do the job. But we do the running. If anyone else bothers that man, I'll raise more hell than you can say grace over."

Howard Rush likes that just fine.

"We'll make money for anyone who treats us right. Otherwise—watch out," says the mild-mannered man from North Zulch, Texas. Howard is a top "bead hand" who has plied his trade all across the Lower Forty-Eight, plus Brazil, Nigeria, the Persian Gulf, and the stormy North Sea off Scotland. He finds the North Slope more comfortable.

"I'll tell you, welding on a barge in fifty-foot waves gets a little tricky," he says.

Even on dry land it never gets easy. First the pipe must be heated to 250° F. to lessen the heat shock of the 6,500° F. welding arc. Then two bead hands make the critical first weld—a flawless seam in the bottom of the V formed by the beveled pipe ends. Next comes the "hot pass," which must be done within ten minutes, before the pipe cools below 200° F. A second crew, called the firing line, follows with the "filler passes"—from three to seven welds, depending on pipe thickness—which fill up the V, and then finishes off with a final weld called the "cap."

"Each man signs off on his welds," Howard

High-stakes gamblers in the oil game: Some 800 men and women follow the action (**left**) in the ballroom of an Anchorage hotel as the U.S. accepts bids totaling 571.8 million dollars on drilling leases in the Gulf of Alaska. The April sale went forward despite efforts by the state, and some citizens (**right**), to require further environmental-impact tests in the stormy gulf's waters.

While state coffers didn't gain from the gulf leases, they netted more than 900 million dollars from those at Prudhoe Bay. Once that field hits full production, royalties and taxes will earn Alaska a billion dollars a year—more than the state's present annual budget.

IT'S TOUGH ON THE MEN *but safer for the salmon to blast along the Delta River floodplain in winter, when red-topped charges can't cause siltation of spawning grounds downstream. Elsewhere, work was halted during Dall sheep lambing, and a pump station was moved to save peregrine falcon nests. Such efforts win praise. But problems still abound, from chronic minor oil spills to widespread erosion.*

says. "You get a one-eighth-inch gas pocket, that means a repair. If more than 8 percent of the girth shows defects, that means a cutout —and a ticket home for the man that did it."

For "798'ers"—as members of Local 798 are known—home is a sometime thing. Howard spends some 320 days a year on the job.

"I tried ranching for a while," Howard says. "But seems like I'd just work from 'can' to 'cain't' and never get to a catch-up place."

His $1,560-a-week paycheck shrinks to $860 after taxes. He keeps a few dollars for such luxuries as snuff and sends the rest home. Not all his co-workers follow suit. Next door a poker game is in progress, and the pot is a tossed green salad of $20, $50, and $100 bills.

"That's what you might call 'easy go,'" says Howard. "But I'll tell you, in this business there ain't any such a thing as 'easy come.'"

Prudhoe Bay's riches will not come easy either. As summer edged toward autumn in Alaska, hundreds of men and machines started the difficult and frustrating job of digging huge holes (pages 708-9) in the iron-hard permafrost so that questioned welds could be X-rayed or repaired. North of the Brooks Range alone, more than 900 holes were dug. Meanwhile, on the Sagavanirktok River, some

Superport with a super view, Valdez terminal will store nine million barrels of oil in the upper tier of tanks as it awaits shipment by tankers. Trio of tanks below will hold oily

1,800 feet of improperly buried pipe floated to the surface, its concrete jacket crumbled by intense ice pressure. Such problems have in turn delayed the critical hydrostatic testing of the pipe—filling miles-long sections with water at more than 1,400 pounds per square inch for 24 hours. Winter prohibits such testing.

Alyeska officials also announced they would ask waivers of welding stipulations on questionable joints buried beneath rivers and floodplains—a prospect that brings State Pipeline Coordinator Chuck Champion to a rapid boil.

"I think both sides have overreacted on this welding business," he fumes. "As far as the state's concerned, there are exactly 148 welds that need repair, and 82 more with missing or duplicated X rays that need verification—regardless of their location. When these are taken care of, we'll have the safest pipeline ever built."

By 1980, welders will be coping with the even tougher job of building a pipeline for Prudhoe Bay's natural gas. Three routes have been proposed. One would travel across the Arctic National Wildlife Range along the shore of the Beaufort Sea, and then through Canada's Mackenzie River Valley to Alberta

ballast water to be purified. All tanks and the pipeline's computerized leak-detection system sit beyond reach of quake-caused waves, which wiped out much of old Valdez in 1964.

and the United States—the route once proposed as an alternative to the Alaska oil line. A second route would follow the present oil line to a point near Valdez, requiring a huge gas liquefaction plant in Alaska and a regasification plant in California, plus a new fleet of tankers to carry the supercooled gas. The third proposal would pipe gas to Delta Junction south of Fairbanks and then along the Alaska Highway toward Alberta.

EVEN MORE PRESSING is the question of utilizing the 500,000-barrel-a-day West Coast oil surplus predicted for 1978. At least three proposals are being considered:

- A 750-mile pipeline that could carry 750,000 barrels of Alaskan and foreign crude a day from Kitimat, British Columbia, to Edmonton and then through existing lines to the United States; this proposal would most quickly solve the critical problem created by Canada's decision to phase out oil exports to the northern border states.
- A 1,500-mile pipeline that could carry 800,000 barrels a day to the same areas from Port Angeles, Washington. Both proposals would also serve the Central States.
- A 1,000-mile pipeline from Long Beach, California, to Midland, Texas, which would use an existing natural-gas pipeline; this line would be operated by Standard Oil of Ohio, which will be 54 percent owned by British Petroleum when production from Sohio's lease area reaches 600,000 barrels a day.

None of these lines is likely to be completed before the end of 1978.

Whatever is decided, Prudhoe Bay's oil production will not match the 60 percent increase in U.S. crude-oil imports recorded between July 1973 and July 1976. Americans currently use almost 17 million barrels of oil daily. Domestic production is shrinking steadily, while demand is rising again after a brief slowdown following the oil embargo.

It seems a story without end. Somehow what began for me as an adventure in the frozen arctic night has become a flickering of numbers and discord.

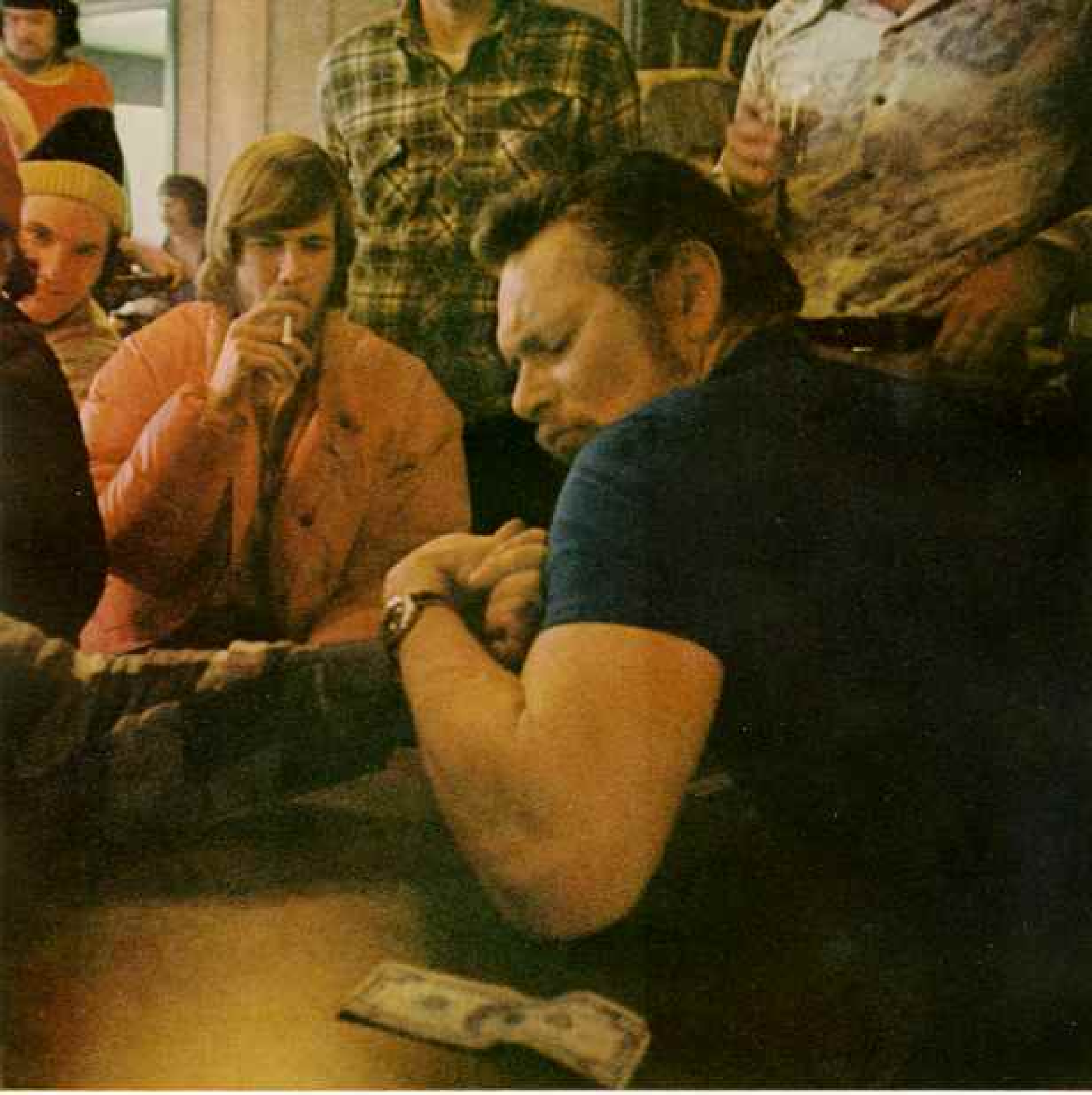
I prefer to remember my last view of the pipeline: It is winter still, and flying south from Deadhorse I see the zigzag pattern on the snow, like a hair on a wedding cake. Soon the boomers will be gone, the construction camps trucked away, transient legends

in the Alaskan saga. The pipe will remain, carrying its enormous weight of wealth until the earth runs dry of it.

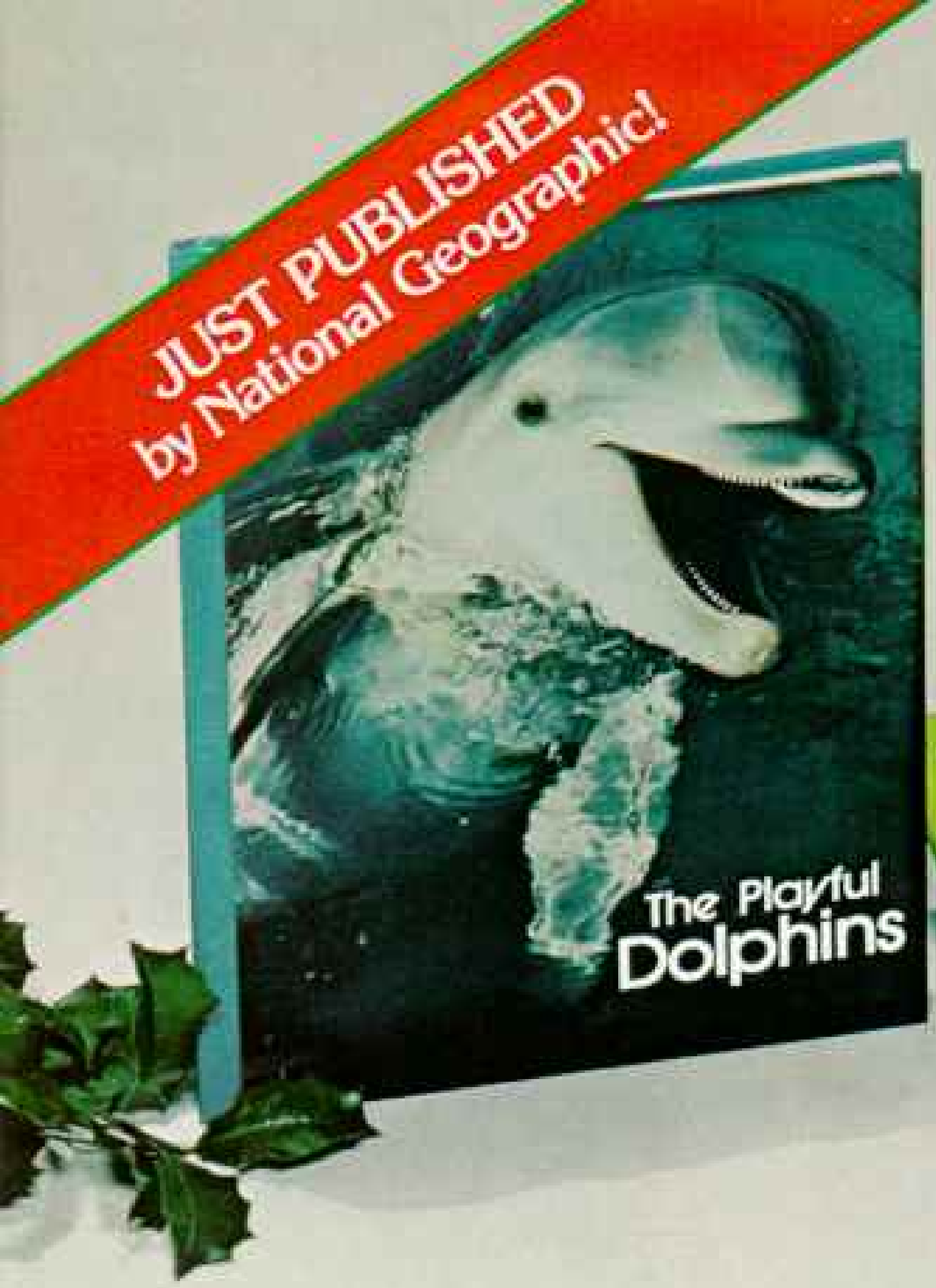
And the highway will stay as well. Perhaps someday I may drive it again, and marvel at the northern lights, or hear the voice of a bygone wind sighing in frozen snowdrifts beneath my feet. Or I may see again a fox and a raven fight a duel of appetites, black and white upon the wilderness.

The Brooks Range passes beneath the wing. I open the small souvenir bottle and sniff the crude oil it contains.

"Prudhoe Bay cologne," it's called. It smells like city streets on a hot summer day. □



Sunday struggle for a hundred-dollar bill pits man against man in booming Valdez (**above**). Struggles with the beleaguered pipeline, however, may be just round one of the environmental fights ahead as oilmen and miners seek to exploit Alaska's resources. For well-paid pipeliners, and cocktail waitresses like Debra Smith (**left**), the future promises more bounty. And for the once-quiet fishing village of Valdez, there's no return to yesterday.



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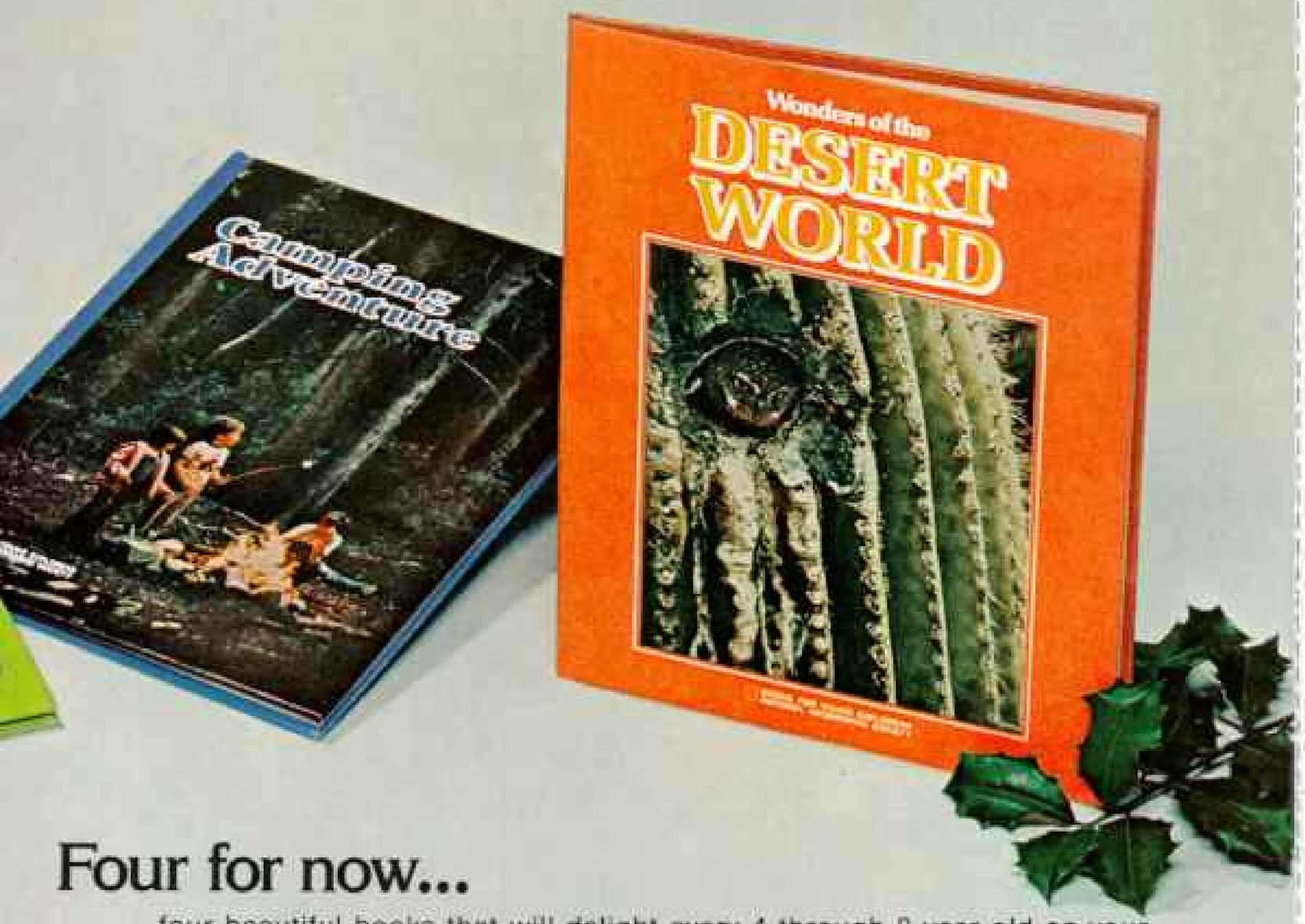

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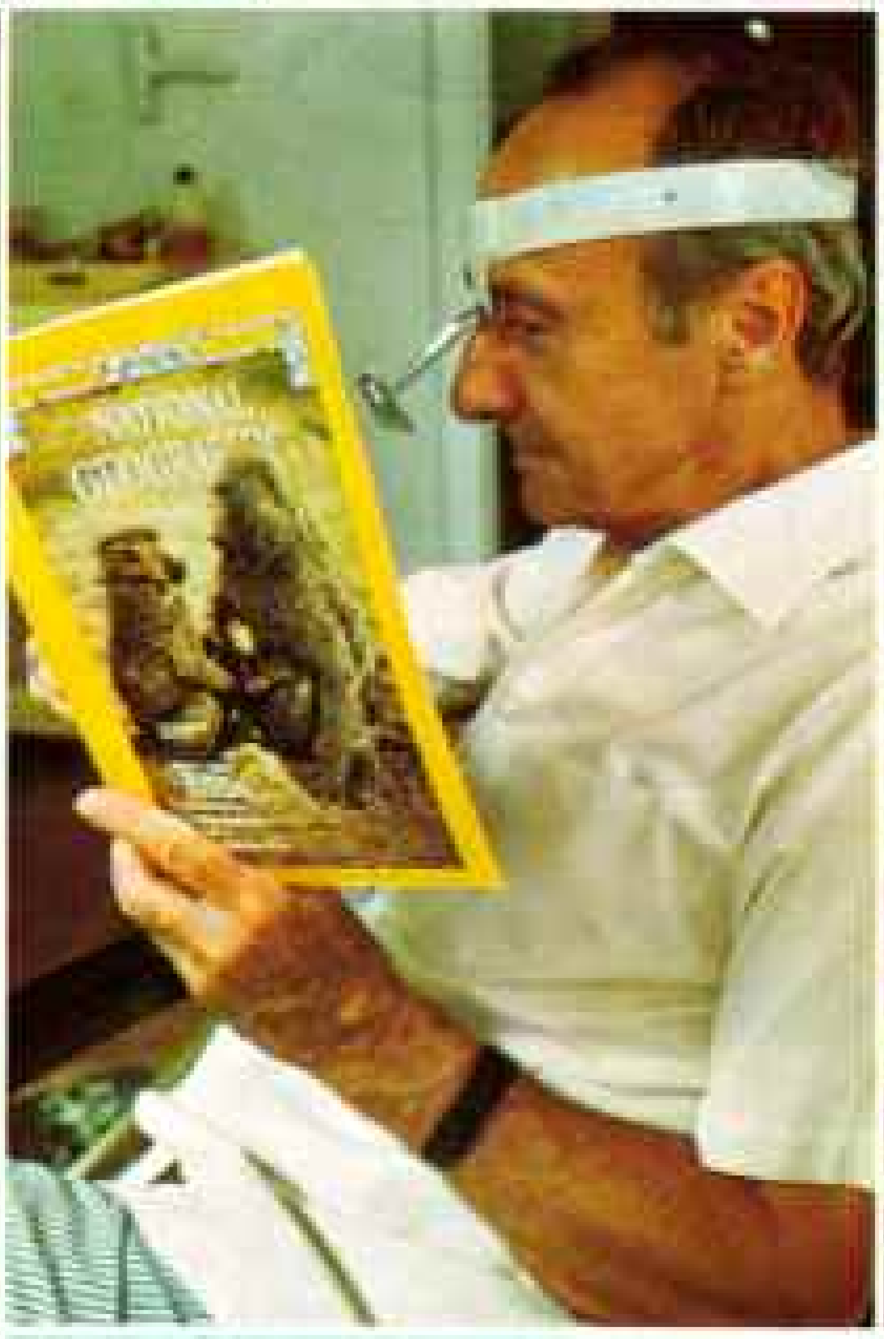

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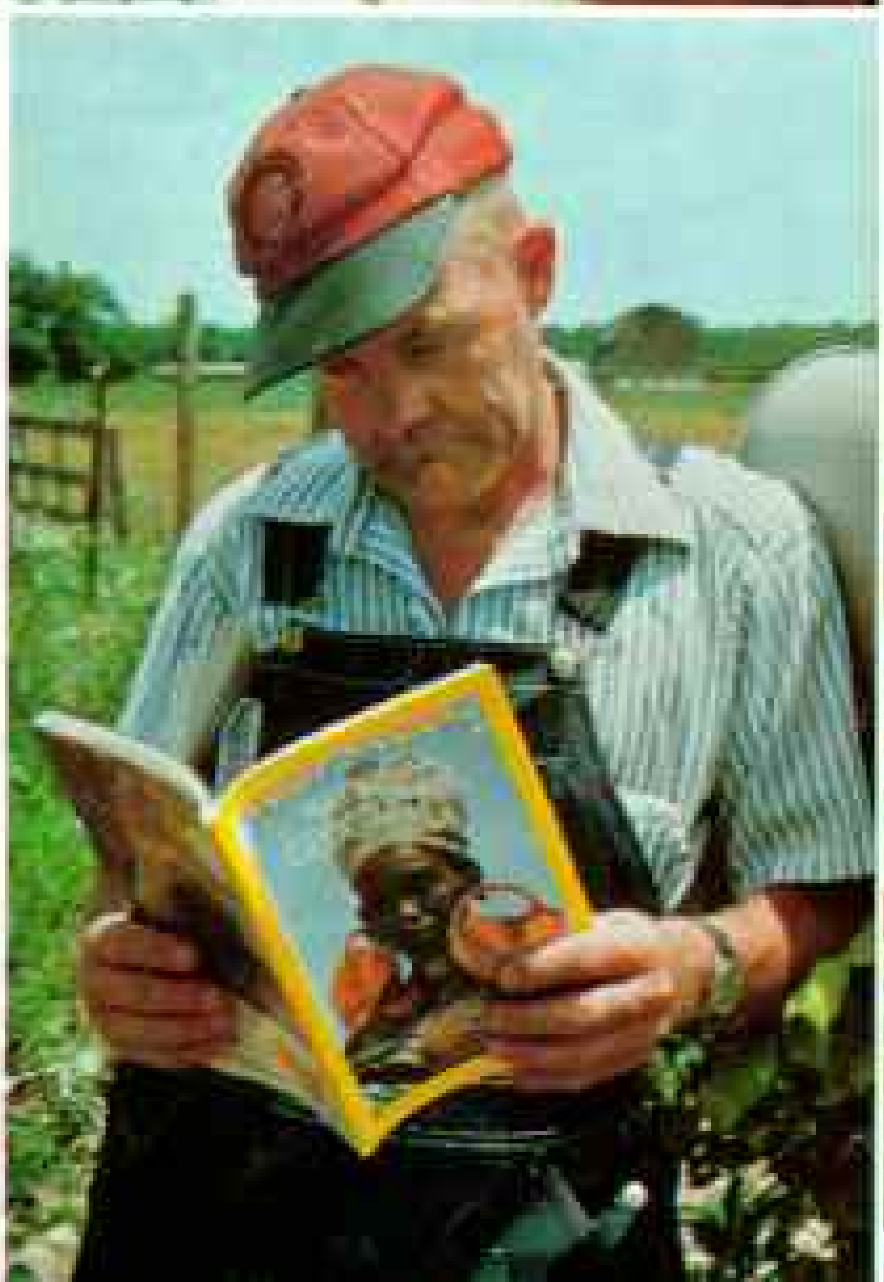

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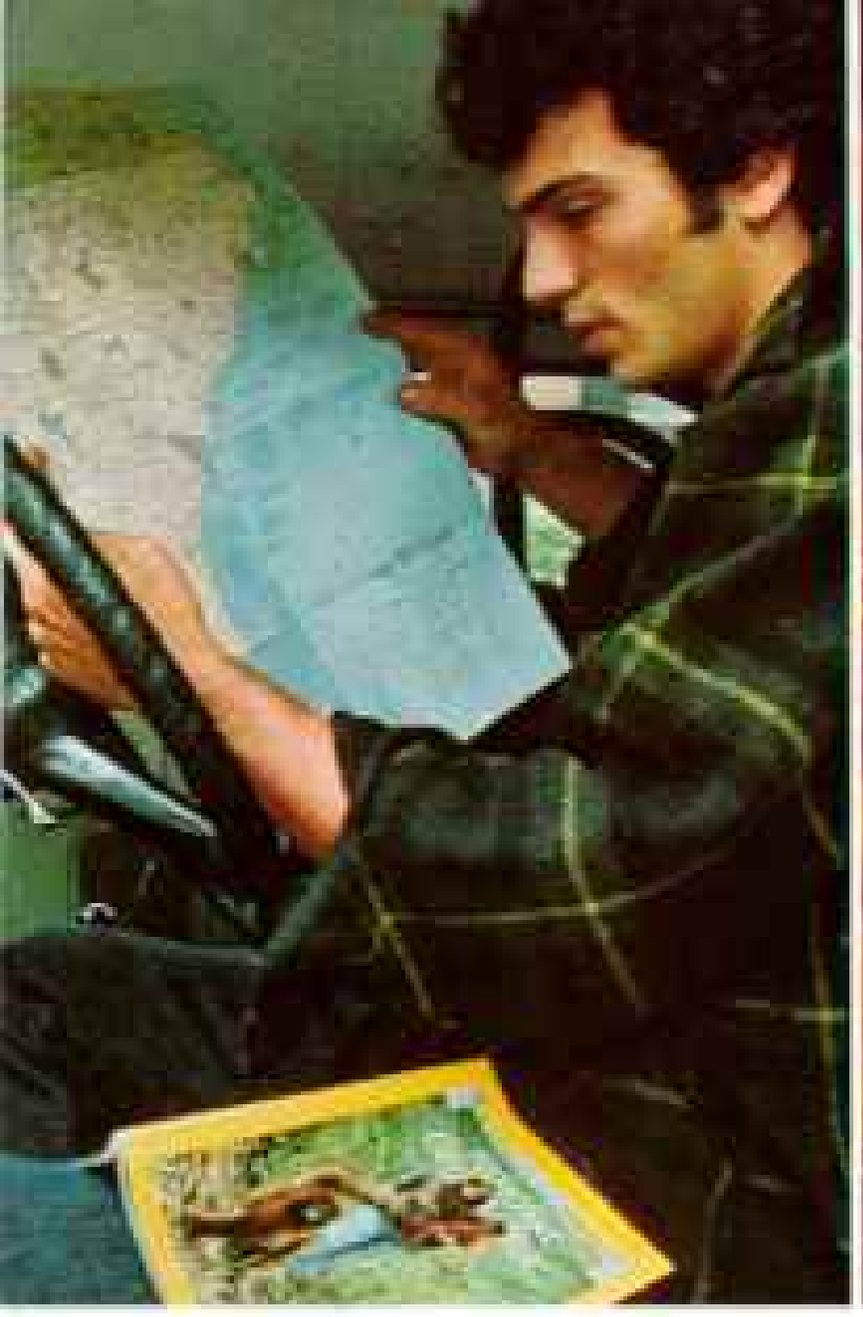

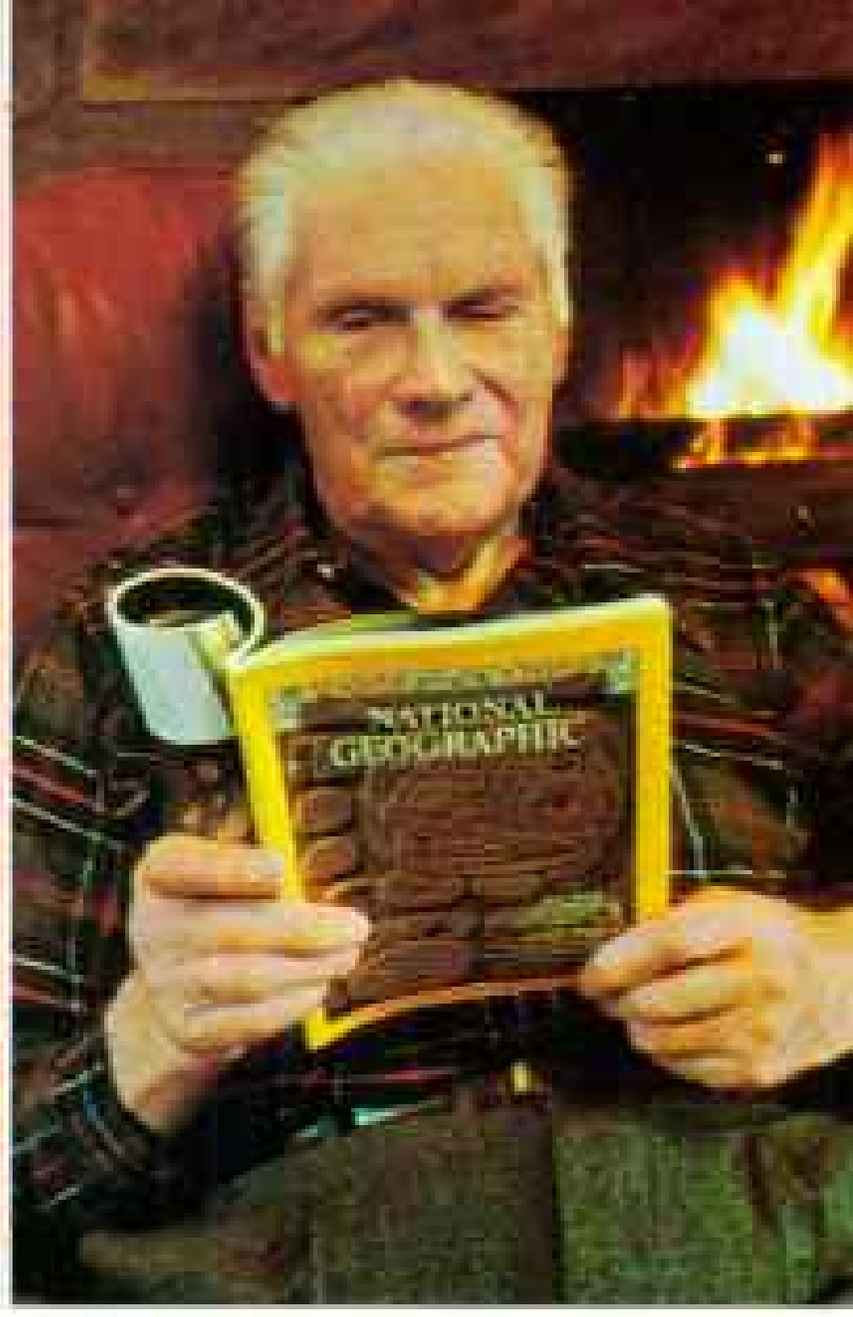

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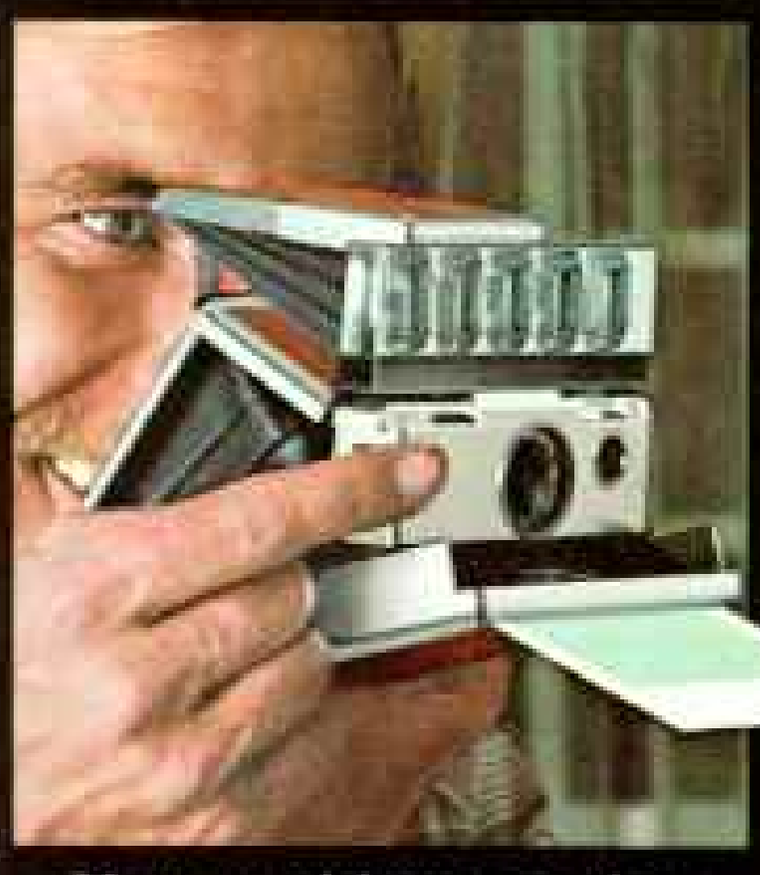

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MIAMI/SOUTH FLORIDA. We've got your sunshine here in the Sunshine State. In so many kinds of places, you could stay for years and never really take it all in.

From the big-time elegance of Miami Beach hotels to the awesome lushness of the Florida Everglades.

From a town with more boats than cars (Ft. Lauderdale) to a chain of little islands with 600 kinds of game fish (The Florida Keys).

From a sunny day of golf to a blazing night at Jai Alai. From fishing to snorkeling to waterskiing.

Our sunshine is yours. And you can have it for 8 days/7 nights at selected Miami Beach hotels ($110-$169*) or Ft. Lauderdale hotels ($93-$159*). When you stay 7 nights, your 7th night is free. Plus sightseeing cruise and admission to Dog Track, Race Track or Jai Alai.

Or enjoy 7 days/6 nights at the Fontainebleau Hotel where big stars appear at night and tennis players like you appear by day. $223*.

Or go all out for sports at the Doral Country Club for 7 days/6 nights. Get unlimited golf on four championship courses. Unlimited tennis on 19 courts (some lit for night play), and a cruise of Biscayne Bay on the Island Queen. $225-$264*.

How about Key Biscayne, just minutes from Miami? Take 7 days/6 nights at the Royal Biscayne Hotel. You get round-trip transfers, welcome cocktail and unlimited tennis. $220*.

Or try your luck with a Florida Keys fishing vacation at the Sombrero Reef Resort in Marathon for 7 days/6 nights. Includes two days of party boat fishing, a day of deep-sea fishing and two, 3-hour seminars on light tackle fishing. Plus day and night tennis, and a subcompact rental car with unlimited mileage (gas and insurance extra). $256*.

CENTRAL FLORIDA. Nobody knows Florida like Eastern does.

And right in the heart of Florida is Walt Disney World. An unforgettable place to see. And a smart place to start any Florida vacation. As you'll see in a moment.

To the east of Walt Disney World lie Stars Hall of Fame, Cape Kennedy Space Center and Sea World. And the famous beaches of Daytona and historic St. Augustine.

To the west, lie the Gulf Coast and St. Petersburg with its snow-white beaches. And Tampa with its fascinating zoo. Busch Gardens, where big game from Africa run free. And Sarasota, home of the Ringling Museums.

Eastern Airlines can show it all to you, with a special vacation we call the Florida Fly/Drive Express. Take your choice of accommodations at scores of selected hotels and inns throughout Florida for as long as you like. And get around to all the sights in a subcompact rental car with no mileage charge (gas and insurance extra**).

For example, you can start an 8 day/7 night Fly/Drive vacation in Orlando, stay 2 nights at your choice of selected hotels, and get Eastern Airlines' exclusive Walt Disney World ticket book, good for one admission to and transportation within the Magic Kingdom and nine attractions. Then go on to see great places like Clearwater, Fort Myers, Miami Beach. $140*.

WALT DISNEY WORLD. Welcome to Eastern's world of family fun. A world so real, it's unreal. With so many ways to touch your mind and heart, you'll never forget you've been here.

Walt Disney World is a lot of things you grew up loving. And a lot of things your children shouldn't grow up without.

It's a Magic Kingdom with Mickey Mouse and a towering Cinderella castle. It's Captain Nemo's submarine, a wild jungle with animals that do everything but breathe. It's Walt Disney's own beloved characters ready to shake your hand.

It's a luau on a South Sea island. A journey through space in Tomorrowland. It's Frontierland where you and Davy Crockett scout for danger and excitement. Or take a big splash in the old swimmin' hole down in River Country. Then end it all at a Country Bear Jamboree in a place called Grizzly Hall.

And don't miss Eastern's own free exhibit, "If You Had Wings."

As the official airline of Walt Disney World, Eastern proudly offers a wide range of Walt Disney World Vacations. Some let you spend your entire vacation at Walt Disney World. Others give you Walt Disney World plus your choice of the best of the Gulf Coast, Gold Coast or Central Florida.

Stay 5 days/4 nights at selected hotels in nearby Orlando. Get an exclusive Eastern Airlines' ticket book for admission to and transportation within Walt Disney World for one day with tickets for nine attractions. Round-trip transfers included. $49-$55*.

Our Walt Disney World Bonus gives you your 6th night at no extra charge when you stay 7 days/6 nights at a selected hotel. Plus one exclusive Eastern Airlines' Walt Disney World ticket book, including admission to and transportation within the Magic Kingdom and nine attractions. You also get admission to Sea World, Stars Hall of Fame, Cypress Gardens. And a choice of Busch Gardens, Silver Springs or St. Augustine. $103-$130*.

Or mix the best of Walt Disney World and Daytona Beach. Enjoy a selected hotel for 3 nights

*Unless otherwise indicated, prices are per person, double occupancy, effective 12/20/76 through 4/15/77, and do not include airfare.

**$20 drop-off charge when car returned to other than arrival airport.

in Orlando. Includes one-day admission to Walt Disney World with Eastern Airlines' exclusive nine-attraction ticket book. And a subcompact car for seven 24-hour periods with unlimited mileage (gas and insurance extra). Then enjoy a selected hotel or motel for 4 nights in beautiful Daytona Beach on the Florida Gold Coast. $120-$164*.

Or enjoy the Gulf Coast and Walt Disney World. 4 nights at a selected hotel in Tampa, St. Petersburg, Clearwater, or the Sarasota area. Plus 3 nights at a selected hotel near Walt Disney World. One-day admission and nine Walt Disney World attractions with Eastern Airlines' exclusive ticket book. Plus an unlimited mileage subcompact car for seven 24-hour periods (gas and insurance extra). $114-$208*.

BERMUDA. Since the early 1600's, Bermuda has remained very British, very charming and very inviting. From its quaint little lanes and classic Georgian houses to its lovely little coves and pink-sandy beaches, Bermuda has always been a civilized place to enjoy your sunshine.

Eastern offers dozens of guest houses ($96-$126*), cottages ($102-$265*), hotels ($180-$265*) to choose from. All of them offer you 7 days/6 nights of Bermuda. And a choice of one of the following: a five-hour cruise around the Great Sound with barbecue lunch, swimming at a secluded island, calypso entertainment, a rum swizzle party; or a land tour by car with admission to Devil's Hole Aquarium, Crystal Caves and a perfume factory. (eff. 11/1-3/1).

For golfers, we offer no less than ten hotels and country clubs to choose from. With a special 7 day/6 night golfing package that gives you a variety of ways to enjoy the best of Bermuda golf, depending on which hotel or country club you select. Breakfast, dinner and round-trip transfers also included. $199-$276*. (eff. 11/16-3/15).

BAHAMAS. The Bahamas. 700 sunshine islands just waiting to greet you and make you forget all the winter cold and gloom back home.

Two of our favorites, Grand Bahama Island (Freeport) and New Providence (Nassau).

You can learn how to skin-dive at the International Underwater Explorers Club on Grand Bahama Island.

There's championship golf, tennis, horseback riding. And the famous casinos of Freeport.

And, of course, duty-free shopping at Freeport's 10-acre international shopping bazaar.

Spend 8 days/7 nights at Castaways Resort. Get a welcome cocktail and choice of one: West End tour, Taste of London tour or glass bottom boat tour. $126*. (eff. 1/1-4/17).

Take advantage of our Freeport Sports Spectacular for 8 days/7 nights at selected hotels. Enjoy a cocktail and entertainment in a Princess Hotel nightclub and a sightseeing tram ride through the Princess Hotel Estate. Plus tennis time during the day. Or greens fees on a choice of two championship courses. Or a half-day deep-sea fishing trip. Or a reef snorkel trip. Or admission to Casino's El Kasbah Night Club, including cover and two drinks. $266-$322*.

Over on Paradise Island, just across the footbridge from Nassau, we have a vacation you can enjoy, whether you're a golfer, a swinging single or just a stranger in paradise. Depending on your choice of hotel for 8 days/7 nights, you'll get over 15 features including: Manager's Cocktail Party, glass bottom boat tour, day and night tennis, and a Goombay Party at the Paradise Festival. Golfer's vacation also includes daily greens fees and transfers to the course. $165-$298*.

PUERTO RICO. There's almost nothing that Puerto Rico can't do to make you happy. When you're feeling lucky, San Juan has casinos by the dozens. When you're hungry, you can take your choice of six international cuisines.

When you're feeling energetic, Puerto Rico can give you all the championship golf and tennis you can handle.

There are so many sides to this sunshine island. The active side, like San Juan. The peaceful side, like Palmas del Mar, one and a half hours by car from San Juan.

You can hire a sloop with crew for a day to take you sailing, skin diving or swimming.

You can walk in a rain forest, you can watch thoroughbred horse races, sail off to a castle, doze on the beaches, and dance the tropical nights away.

You can swim and fish. Take part in a year-long national festival called LeLoLai. Or sit back and enjoy some of the top stars in all of show business.

A few examples of how Eastern can put you in the middle of it all:

San Juan LeLoLai Celebration. 7 days/6 nights at a selected hotel gets you admission to El Comandante Race Track, a Puerto Rican folklore exhibition, discount book for shops and attractions in Old San Juan, admission to Fiesta de la Danza, and more. $90-$174*.

Or see a Sound and Light show tracing the history of Puerto Rico. Get other exciting LeLoLai festival features. Plus a trip to St. Thomas for a day of duty-free shopping in the bargain center of the Caribbean. Air transfers included. 8 days/7 nights at selected San Juan hotels. $121-$151*. (eff. 1/1-4/29).

Golf and Tennis Vacations of 8 days/7 nights at Palmas Del Mar on the other end of Puerto Rico include Manager's Cocktail Party, sightseeing tour, golf and tennis strategy sessions, supervised youth activities, nightly entertainment and dancing. You'll stay in a luxurious villa from $318* for the tennis vacation with complimentary court time. And $381* for the golf vacation with unlimited daily greens fees.

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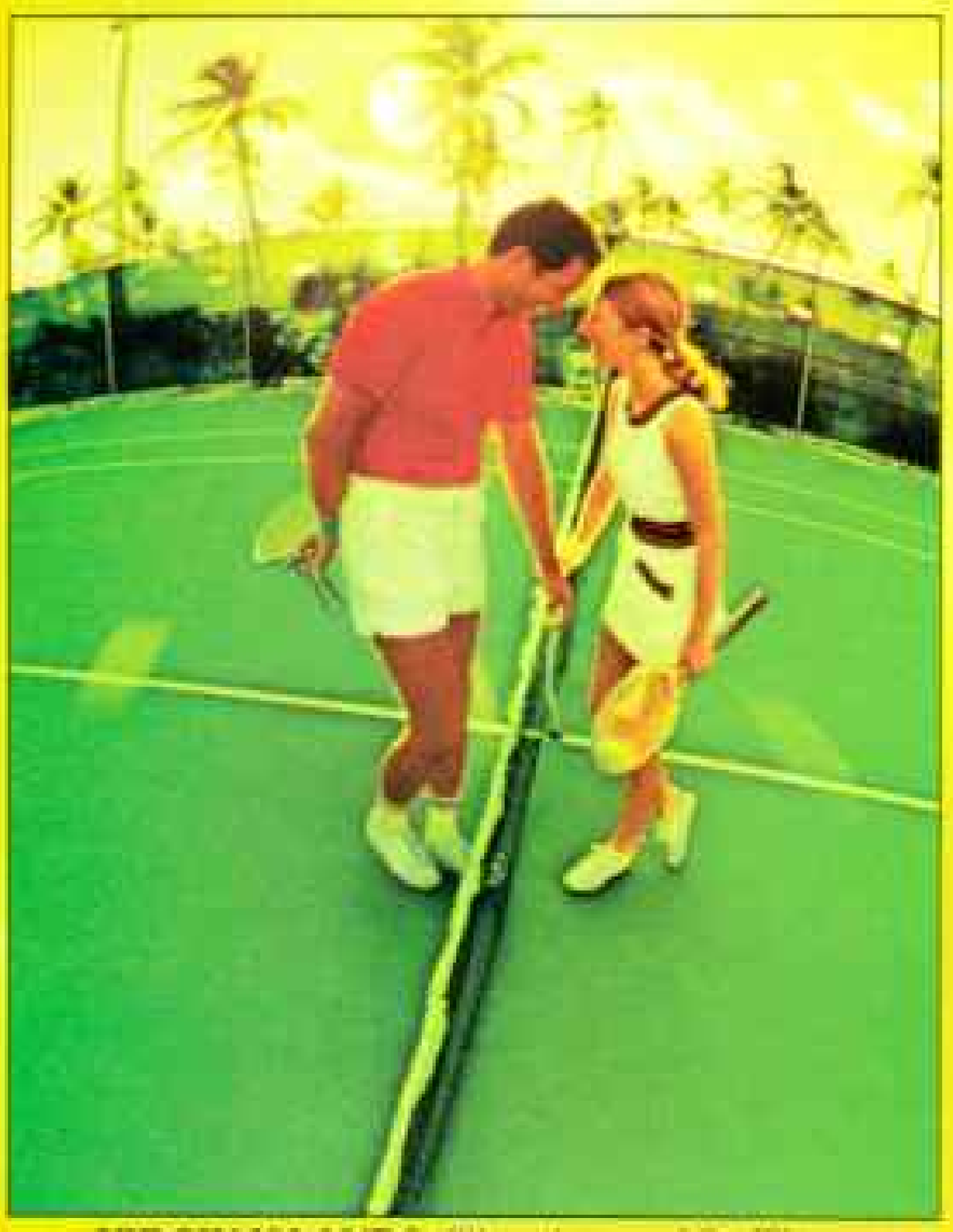

VIRGIN ISLANDS. The shops of St. Thomas offer the best bargains in the Caribbean. And we think our Virgin Islands vacations are some of the best bargains you'll find anywhere. Stay 8 days/7 nights at the Island Beachcomber Hotel in St. Thomas and get a gift box of five fifths of duty-free liquor. Sunset Cocktail Cruise or island sightseeing tour, and complimentary snorkel lesson. $172-$189*. (eff. 12/20-5/1).

Speaking of snorkeling, the brilliantly clear Virgin Island waters around St. Croix were made for swimming under. See Buck Island Reef National Monument, an underwater paradise. There's an underwater trail here with fantastic coral formations, and schools of parrot fish, blue tangs, wrassea, and french angelfish to enjoy in all their colorful glory.

Take our St. Croix Island Spree. 8 days/7 nights at the Jockey Club on the Cay and enjoy yourself with complimentary tennis, use of snorkeling equipment, bottle of rum, half-day trip to Buck Island Underwater Trail, nightly entertainment and dancing. $185-$220*.

OTHER VACATION ISLANDS OF THE CARIBBEAN: JAMAICA. Mountains reaching up to the sun. Jungle rivers where time flows slowly. A snow-white beach you can call your own. Private villas and grand hotels. Grass court tennis. Polo. A tour of plantation great houses. A round of golf in a Garden of Eden. Rafting down the Rio Grande. A calypso feast with the friendliest of people. And the pounding beat of a reggae band.

Jamaica is a long way from the world you left behind. And about ten million miles from winter.

Come to Montego Bay's Beachview Hotel for 8 days/7 nights, get admission to famous Doctor's Cave Beach every day, see the sights at your leisure, enjoy a Manager's Cocktail Party. Round-trip transfers also included. $116*.

Or take your choice of a dozen Ocho Rios or Runaway Bay hotels, stay 8 days/7 nights and get a discount coupon book for shopping, glass-bottom boat ride, romantic boat ride to a Jamaican feast with drinks, floor show and dancing under the stars and round-trip transfers. $183-$295*.

DOMINICAN REPUBLIC. Christopher Columbus called it Hispaniola when he discovered it in 1492. It's the second largest island in the Caribbean. With the tallest mountains (some over 10,000 feet). Miles of untouched beaches. And some of the best spearfishing in the world.

This island country in the sun is perfect for lovers of golf and tennis. And we have a perfect vacation for both. 7 days/6 nights of golf or tennis at Casa De Campo or Hotel Romana. Unlimited greens fees with cart and caddy daily for 18 holes. Or unlimited daylight tennis on 13 courts with four 1-hour group clinics. Round-trip transfers also. $250-$325*, depending on choice of hotel.

ST. MAARTEN/ST. MARTIN. The French and the Dutch share this gem of a little island that lies 150 miles east of Puerto Rico. The French side offers extraordinary dining on fresh fish, lobster and fresh local vegetables. The Dutch side offers international shopping, marvelous eating like rijsttafel, an elaborate and delicious buffet of Dutch East Indian curries and condiments.

Enjoy 8 days/7 nights with many complimentary extras at LeGalion Beach Hotel. To name just a few: sailboats, tennis, snorkeling equipment, daily trip to casino, fishing rods and bait. You'll also get seven full breakfasts, four dinners and round-trip transfers between airport and hotel. $299-$352*.

ANTIGUA. A bit farther south is an island with such perfect beaches and gentle climate that a group of millionaires has built a club here. Some of Antigua's highlights: An impressive 18th century restoration of Nelson's Dockyard in English Harbour. Snorkeling and scuba diving, picnicking by Devil's Bridge, day sailing with amenities like cocktails and beach barbecues.

Stay 8 days/7 nights at Halcyon Cove Hotel. Get breakfast and dinner daily and enjoy complimentary tennis even at night, waterskiing, pedal boats, sunfish sailboats, snorkeling and scuba equipment, Manager's Cocktail Party. Round-trip transfers. $217*.

BARBADOS. Believe it or not, Barbados was George Washington's favorite resort almost two hundred years ago. And it's easy to see why. Just 21 miles long and 14 miles wide, Barbados is rimmed with beautiful beaches, beautiful water, beautiful fishing and beautiful sights to see. Colonial mansions, banana and pineapple plantations, gentle green hills and lovely places to stay.

A best bet is the Barbados Hilton. 8 days/7 nights which gets you among other goodies: Rum Cocktail Party, escorted bicycle tour, complimentary group tennis lessons and skin diving. $256-$308*.

TRINIDAD. A glorious sunshine place with more than its share of beaches, sights and nice warm things to do. Trinidad is a lively and exotic blend of East Indian, African and Afro-European people. The marketplaces of the capital city, Port of Spain, are filled with excitement and fascinating things to buy. Elsewhere you'll see everything

from Hindu temples to British mansions to incredible sunsets.

8 days/7 nights at the Trinidad Hilton puts you in touch with all of the fun and gets you daytime tennis, Happy Hour Rum Party, tour of Botanical Gardens, fruit and flowers in your balconied room. $116*.

WINGS AND WATER. Fly Eastern to Miami and enjoy a 3-day Costa Line S.S. Flavia† cruise to Nassau. With nightclubs, discotheques, swimming pool, movie theater, casino, duty-free shopping aboard. Ashore: all the fun, sun and excitement Nassau is famous for. 3-day cruise leaves each Friday. Returns to Miami Monday. Also 4-day S.S. Flavia cruise same as above, plus pleasure stop at Freeport. $269-$475*.

Want to see more? How about 8 days/7 nights with Costa Line's S.S. Amerikanis‡ from San Juan every Saturday. You'll make pleasure stops in Curaçao, Caracas, Grenada, Guadaloupe, St. Thomas. And while you're not ashore having the time of your life, you'll be enjoying parties and social activities of all kinds and the extensive facilities on board this beautiful cruise ship. $590-$1,055*.

These cruise prices include airfare and vary according to length of cruise, accommodations and city of origin.

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†SS Flavia is of Italian Registry.
‡SS Amerikanis is of Greek Registry.

MEXICO. The sun has been supreme here for centuries. The ancient Aztecs worshipped it. Contemporary Americans still do.

In Acapulco, possibly the most beautiful sunshine resort anywhere.

In Mexico City, a crowning achievement of many cultures and certainly one of the great cities on earth.

And in enchanting places like Taxco, the city of silver. Cuernavaca, the mountain retreat of Mexico City's rich and famous. And Teotihuacan, the ancient Toltec site of the Pyramids of the sun and moon.

Great civilizations flourished here long before the ancient Greeks. Great sunshine and a truly unforgettable escape from winter flourish here in Mexico now.

Spend 4 nights at a selected Mexico City hotel. The list of city cultural attractions to be seen is endless. And day trips to other fascinating places can easily be arranged. Continue on to Cuernavaca and Taxco, spending the night at a selected Taxco hotel. Then on to two relaxing days and nights at a selected Acapulco hotel. $146-$319*.

SECOND VACATION BONUS. Get two vacations instead of one. It's easy with Eastern's Second Vacation Bonus Program. This winter take 8 days/7 nights at any of 14 selected luxury hotels in Florida, the Bahamas, or Caribbean. And you'll receive a bonus 4 day/3 night vacation you or your friends can take between May 1 and December 15, 1977. You can take your second vacation at the same hotel where you took your first one. Or at one of the other participating hotels depending on where you spend your first 8 days. All you pay for on your bonus stay is your Eastern ticket. For example, enjoy 8 days/7 nights at the Diplomat East in Hollywood, Florida. Get unlimited day or night tennis, entertainment in five lounges and clubs and a cocktail party. $249-$305*. Then take your 4 day/3 night Bonus Vacation at such great hotels as the Fontainebleau in Miami, El Conquistador in San Juan, Bluebeard's Castle in St. Thomas or St. Tropez in St. Maarten.

LUXURY APARTMENT IN THE SUN. Maybe you'd like a change from hotel living when you take your Eastern sunshine vacation. Then our exciting new concept in luxury winter vacations is just what you've been waiting for. It's yours at one of America's most enjoyable resorts.

Get all the comforts of home for two or four weeks in a luxurious Inverrary apartment at Lauderhill, near Ft. Lauderdale. Choice of studio, one-bedroom or two-bedroom apartment. All have color TV, modern kitchens. Enjoy Inverrary's fabulous resort facilities: swimming, tennis, saunas, exercise and game rooms. Golf privileges nearby. Plus optional tours to Walt Disney World, Busch Gardens and more. Rental cars right on the premises. Airport transfers included. From $210* for two weeks in a studio to $435* for four weeks in a one-bedroom apartment.

CHARGE IT ALL ON WINGS. These vacations, or any airline travel on Eastern, can be charged on your WINGS credit card with optional extended payment plans available. A WINGS card can make flying easier and more convenient. If you would like to apply, just write WINGS, Eastern Airlines, P.O. Box 480787, Miami, Florida 33148.

NOBODY HAS LOWER AIRFARES THAN WE DO. See the people at your local travel agency soon. They can show you over 300 very affordable Eastern sunshine vacations. They're travel experts so let them help you find your sunshine this winter. Or call Eastern. Nobody has lower airfares than we do. And all Eastern's vacations are backed by Eastern's own Tour Warranty Program.

We've got your sunshine. And the right time and the right place for you.

*Unless otherwise indicated, prices are per person, double occupancy, effective 12/20/76 through 4/15/77, and do not include airfare.
All prices quoted do not include meals, taxes or hotel service charges, gratuities, unless otherwise specified. Tour prices subject to change.

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THE
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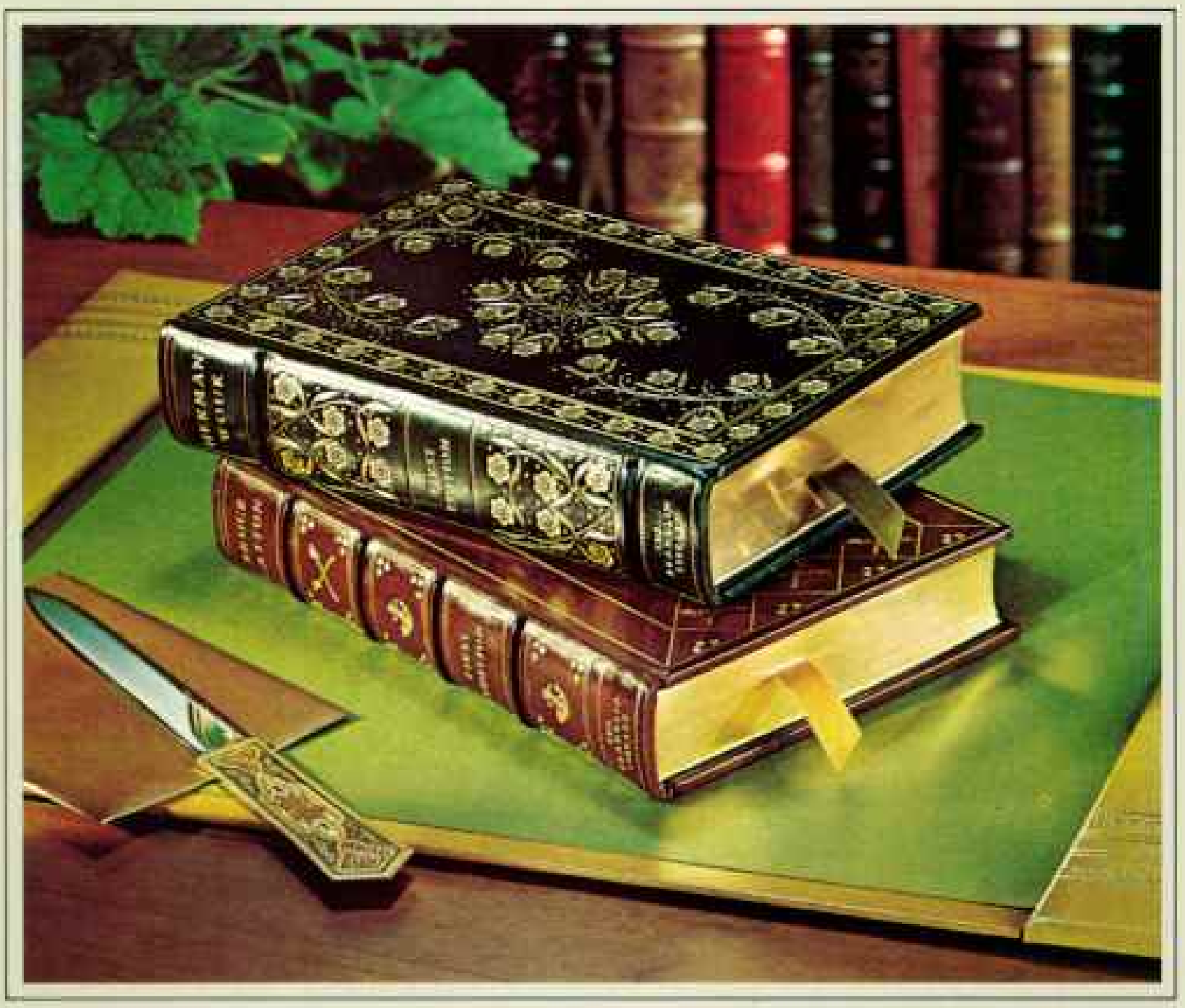
announces

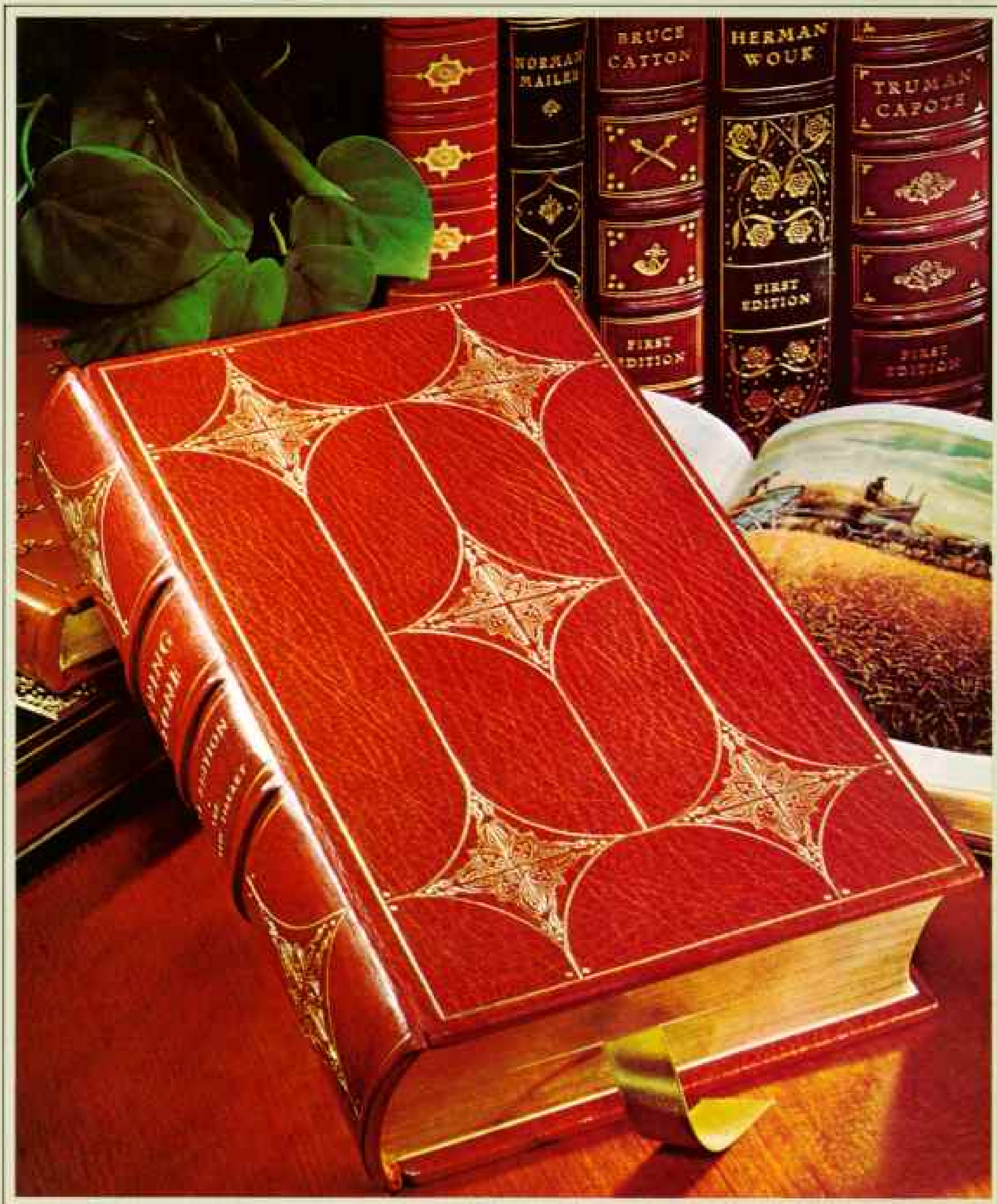
the opening of its membership rolls

for a limited time



Membership rolls
are now open for a limited time in

THE FIRST EDITION SOCIETY



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The Society is now planning to publish the First Editions of forthcoming new books by great authors—books that are being written at this very moment. Among them . . . a new novel by Herman Wouk set in the chaotic period of the Second World War. A monumental history of the United States by the Pulitzer Prize-winning author Bruce Catton. A penetrating psychological study of the criminal mind by Truman Capote. A new novel by James Jones, author of *From Here to Eternity*. Irwin Shaw's exciting sequel to *Rich Man, Poor Man*.

In addition—an autobiographical work by the great Russian author Aleksandr Solzhenitsyn. A new collection of poems by Robert Penn Warren. A major historical novel by Norman Mailer, author of *The Naked and the Dead*. An important biographical novel by Irving Stone, who wrote *The Agony and the Ecstasy*. And a brilliant new work by James Dickey, author of *Deliverance*.

The First Editions of all these new books—and others by authors of equal renown—will be published exclusively for members of The First Edition Society.

Books of incomparable quality and beauty

Each work selected for publication by The First Edition Society will be printed and bound with a degree of quality lavished only on the finest handmade books of the past. Thus, each book will be a volume of exceptional beauty designed by masters of the book-maker's art. They will select the leather for its cover, create the design that cover will bear, determine the typography, commission original art, choose the fabric for the endsheets—and combine *all* these elements into a truly exquisite book.

Because each First Edition will be designed individually, no two will be alike. Even the sizes of the different books will vary, and each will be totally distinctive. The bindings will be of genuine leather, and only the most luxurious leathers will be used. Each volume will have the rich feel, the lustrous texture and the unmistakable aroma that only genuine leather provides.

To enhance the beauty of each book, the cover design will be worked into the leather in 22 karat gold—on the front cover, the back cover and the spine. The spine itself will be "hubbed" with raised horizontal ridges that further set these leather-bound volumes apart from ordinary books. The endsheets will be of exquisite moiré fabric. And the pages of each book will be *fully edged in gold*—offering protection for the leaves as well as embellishment.

Leading artists of today will create original works of art for many of the Society's First Editions—and such illustrations will appear *only* in the privately printed volumes of The First Edition Society.

Furthermore, *special forewords* will be written by many of the authors *exclusively* for these First Editions.

Produced in strictly limited edition

To assure the rarity of the collection, there will be only *one* printing of each First Edition. This strictly limited edition will be reserved *exclusively* for individual members of the Society. No one else will be given the opportunity to acquire these First Editions.

As a member, you will receive each First Edition published by the Society during the next three years, with no more than twelve books issued each year. In addition, you will have the right to cancel your membership at any time upon thirty days' notice.

Your price for each of these leather-bound, gold-ornamented First Editions will be $37, and this favorable price will be *guaranteed* to you for the full three-year membership period.

The membership rolls in the First Edition Society are now open—but will remain open for new members only until December 15, 1976. Then the Society's rolls will be closed for another full year. To build your private library of leather-bound First Editions, mail your application to the First Edition Society, Franklin Center, Pennsylvania, no later than December 15, 1976.

Enrollment deadline: December 15, 1976

THE FIRST EDITION SOCIETY

SPECIAL MEMBERSHIP APPLICATION

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Franklin Center, Pennsylvania 19091

Please enroll me as a member of The First Edition Society, and send me the First Editions to be issued by the Society during the three-year period beginning in January 1977. Each of these First Editions is to be privately printed and custom-bound in genuine leather expressly for me, with no more than twelve books to be issued each year.

I will be billed $37.* for each leather-bound volume in advance of shipment, and this price will be *guaranteed* to me as a member for the full three-year period of my subscription. However, I have the right to cancel my subscription at any time upon 30 days' written notice.

*Plus my state sales tax and $1.75 per book for shipping and handling

Signature _____
All applications are subject to acceptance

Mr.
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Miss _____
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Must be postmarked by December 15, 1976
Limit: One membership per subscriber

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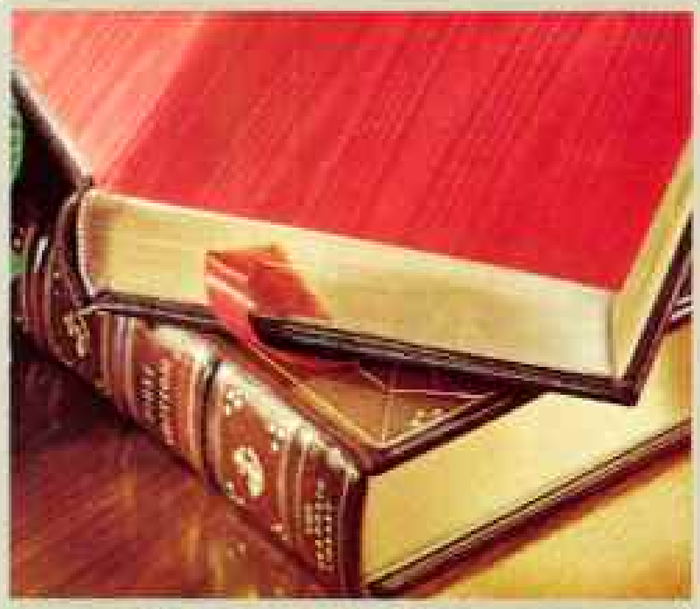

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PHILADELPHIA	ON TIME
PHOENIX	ON TIME

Jamie Pepper, Reservation Agent

Best because TWA's Reservation System has extra fast response time.

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TWA's Reservation System is fully automated and computerized on a worldwide, 24-hour, 7-day basis.

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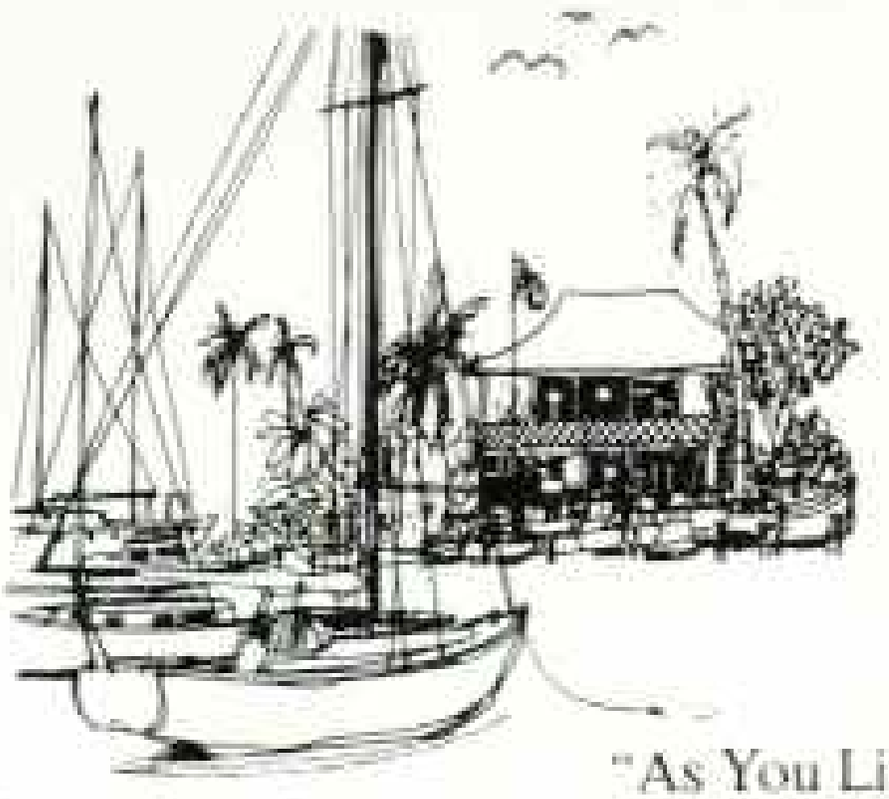

"As You Like It" vacations give you a maximum choice of islands, hotels, and sightseeing options. You create the Hawaii you want, as you like it.

Each two- or three-day segment concentrates on a particular bright spot in the Islands, such as lively Waikiki, or the "Garden Isle" of Kauai with a visit to the exquisite Fern Grotto.

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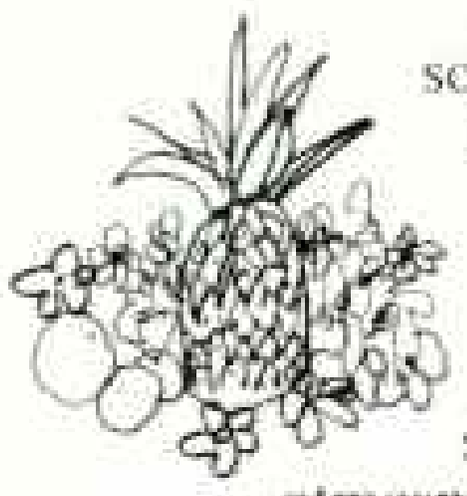

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Energy for a st

EXXON ANSWERS QUESTIONS ABOUT ONE OF THE NEWEST SOURCES OF ENERGY UNDER THE SUN—THE SUN!

Exxon is putting its years of energy experience to work to turn sunlight into a practical form of energy. We've learned a lot about its potential and its limitations, and we'd like to answer a few questions people have asked.

"What kind of energy do we get from the sun?"

Two kinds—heat and light. The heat can provide energy for heating, cooling and hot water systems. The light can be turned directly into electricity.

The basic technology for using the sun's warmth is known. In fact, solar energy is already being used to heat buildings and homes—almost always along with conventional systems.

Our photo shows an example of a solar project initiated by the Bay State Gas Company. The solar panels on the roof of this Massachusetts house capture the sun's rays for heating and hot water.

"What does it cost to heat a house with the sun?"

Right now a solar heating system can cost you anywhere from $8,000 to $20,000. This is in addition to the conventional heating system you'd also need, which would cost about $2,600 for the average-size house. An auxiliary system is necessary because no one has perfected a way to store enough solar heat to get you through several cloudy days.

"How much do solar systems cost to heat water for sinks, tubs and washers?"

Around $2,000—about three times more than conventional systems. They would be particularly suitable for people who live in high energy cost areas.

"Why don't more people use solar heating?"

The systems and storage facilities are still expensive to manufacture. And there are other problems.

For instance, installers, maintenance people and distributors have to be established and trained. Financing methods and warranties have to be worked out.

Building codes have to be adapted. And cities have to deal with "sun rights." (What happens if someone builds a tall building that overshadows a smaller one?)

"How much does electricity from the sun cost?"

Systems that turn sunlight directly into electricity are not as widely used as solar heating systems. Because the solar cells required are costly to make, the electricity they produce is quite expensive. At current prices, solar electricity costs roughly $1.00 to $3.00 per kilowatt-hour. Compare this to the 2¢ to 6¢ you may now be paying for conventional electricity.

"When will solar power become a major source of energy?"

Possibly in the next century. That's because a considerable amount of technology still has to be developed.

But you may not have to wait that long to get solar heat. Exxon is working to make solar heating systems more economical and available within the next few years.

"Why is Exxon involved in solar energy?"

Because we're more than just an oil company. We've been conducting productive research for over 50 years. During that time, we've gained experience, expertise and management skills in energy technology. And we're putting it to work today so that you can put solar energy to work in your home someday.

rong America

An American Portrait 2076.

Several months ago we started our Tricentennial Program by asking for your thoughts on life in America by the year 2076. Instead of a lot of ideas about space ships and robots of the future most of the more than 50,000 responses we've received have been about people's visions of our future as a nation.

The main point that came through, letter after letter, was that most people believe a lot of the things that made America what it is today will shape our future as well.

An overwhelming number of you – ninety-one percent – told us you want the family to remain our basic social unit.

Sixty-two percent feel the nation will be better off when there is no racial, sexual, or religious discrimination.

Seventy-three percent of you told us you expect a reaffirmation of religion and faith by the time of our Tricentennial.

There is a strong desire – almost two-thirds – for more individual participation in government through better communication.

Nearly three-quarters of you are in favor of a slower paced, more rural life.

What's better than statistics is the feeling that the majority of people believe that life in the future can be better than it is today. But we've always been like that. It's what's been called the American Dream.

You've shown us that the future of America lies not in the land or the technologies we master but in the hearts and minds of the people, our greatest resource.

We didn't intend to do a scientific survey but your responses show significant insight into the problems and opportunities that face our nation. We plan to make those thoughts available in a book reflecting many of the interesting letters we've received.

Please note that all ideas submitted shall become public property without compensation. Tricentennial P.O. Box 2076, Los Angeles, California 90053

ARCO

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AtlanticRichfieldCompany

Thank you for helping us celebrate America's Tricentennial 100 years early.

Like you, it's an original.

1977 Monte Carlo.
Personal. Original. Affordable.

Chevrolet

Kodak sound movies.

To the family, from the family, for the family.

The unique microphone makes shooting movies easier than ever.

The new Kodak Ektasound movie camera has a microphone right on the handle. It's big news and it's so convenient. It gives you freedom of movement. You can take sound movies without microphone cords and without placing a microphone.

The on-camera microphone is only one of many features designed to make it easier than ever to take sound movies indoors or out, without movie lights.

You hear what the camera records.
A new sound monitor allows you to hear what the camera hears—both before and during filming.

A camera-on light lets your subjects know when movies are being taken. New signals include a viewfinder film gauge that lets you see how much film you have left. There are two models you can choose from—one with a zoom lens.

The new Kodak Ektasound movie camera is one Christmas gift that keeps on giving as the family keeps on growing.

Ask your photo dealer for a demonstration.

New Kodak Ektasound movie cameras.

Now showing sound movies is as easy as taking them.

Watch your movies two ways.

The new Kodak Ektasound Moviedeck projector is so easy to use. You can even watch your movies without setting up a screen or turning down room lights. Just pull out the built-in viewing screen. It's ideal for small audiences. Of course, you can project onto a regular screen, too. Every time you show your movies, you will enjoy the easy-to-use automatic threading and automatic rewind features.

Simulated projected image

Shows super 8 and 8 mm film.

The Kodak Ektasound Moviedeck projector is so versatile, you can show super 8 sound and silent film and 8 mm silent film at the flip of a single switch. And an instant rerun feature lets you replay previous scenes in just seconds. The design and finish of this projector are so handsome, you'll want to leave it out on a bookshelf or next to your stereo equipment. There are two models to choose from. One offers sound playback. The other offers both playback and recording capabilities.

Go see your photo dealer right away. Ask for a demonstration, and be convinced.

New Kodak Ektasound Moviedeck® projectors.

Kodak

"A few strands of glass fiber can carry as many phone calls as this copper cable."

Here you see laser light projected through a glass fiber, a revolutionary new way to transmit phone calls.

Some telephone calls will soon be carried on pulses of laser light through a tiny glass fiber about the size of a human hair.

The system is called Lightwave Communications. It's being developed by our research and manufacturing people as an alternative to the copper wire used to transmit phone calls today.

It's so superior to copper that a few strands of the ultra-transparent glass can carry as many calls as a big, bulky, copper cable. That can make much more room available in already crowded underground conduits to expand service when it's needed.

Lightwave Communications may also help us bring new communications services to your home or business in the future.

And unlike copper, we'll never run out of the natural resource needed to make glass. It's called sand.

The Bell System–people using technology to improve service and keep down costs–**Keeping your phone system the best in the world.**

Bell System

Hold a Minolta.
Release your imagination.

A Minolta 35mm SLR will help you quickly and easily translate the vision in your mind to film.

From the moment you pick it up, a Minolta feels comfortable in your hands. Your fingers fall into place naturally. Everything works so smoothly that the camera becomes a part of you.

With a Minolta SLR, you never have to take your eye from the viewfinder to make adjustments. So you can concentrate on creating the picture without losing sight of even the fastest moving subject. The image remains big and bright until the instant you shoot. And your pictures are always properly exposed because Minolta's patented "CLC" metering system handles even high contrast situations with incredible accuracy.

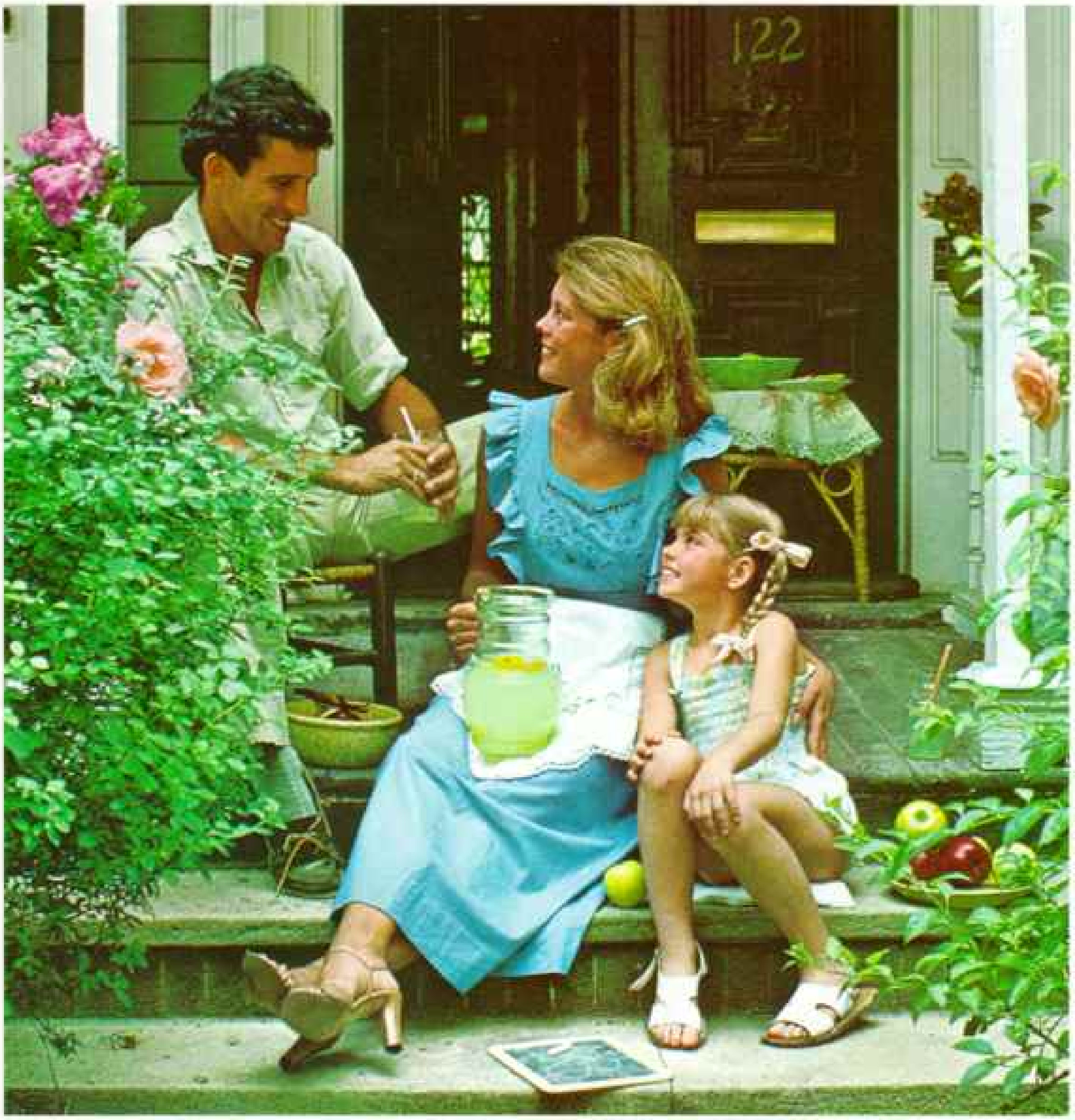
You're free to probe the limits of your imagination with a Minolta. More than 40 lenses in the superbly crafted Rokkor-X and Minolta/Celtic systems let you bridge distances or capture a spectacular "fisheye" panorama.

Minolta offers a wide choice of electronic and match-needle SLRs. With features to match your needs and budget. Regardless of the model you choose, you get the superb Minolta handling that lets you effortlessly make the transition from creative vision to captured image.

For more information about Minolta 35mm single lens reflex cameras, see your dealer or write Minolta Corporation, 101 Williams Drive, Ramsey, New Jersey 07446. In Canada: Anglophoto, Ltd., P.Q.

Minolta

When you are the camera and the camera is you.



All the time you're protecting your family's future, you could be building your own.

Most of us are happy to put our families at the center of our lives. But there's another part, our dreams that sometimes get pushed aside.

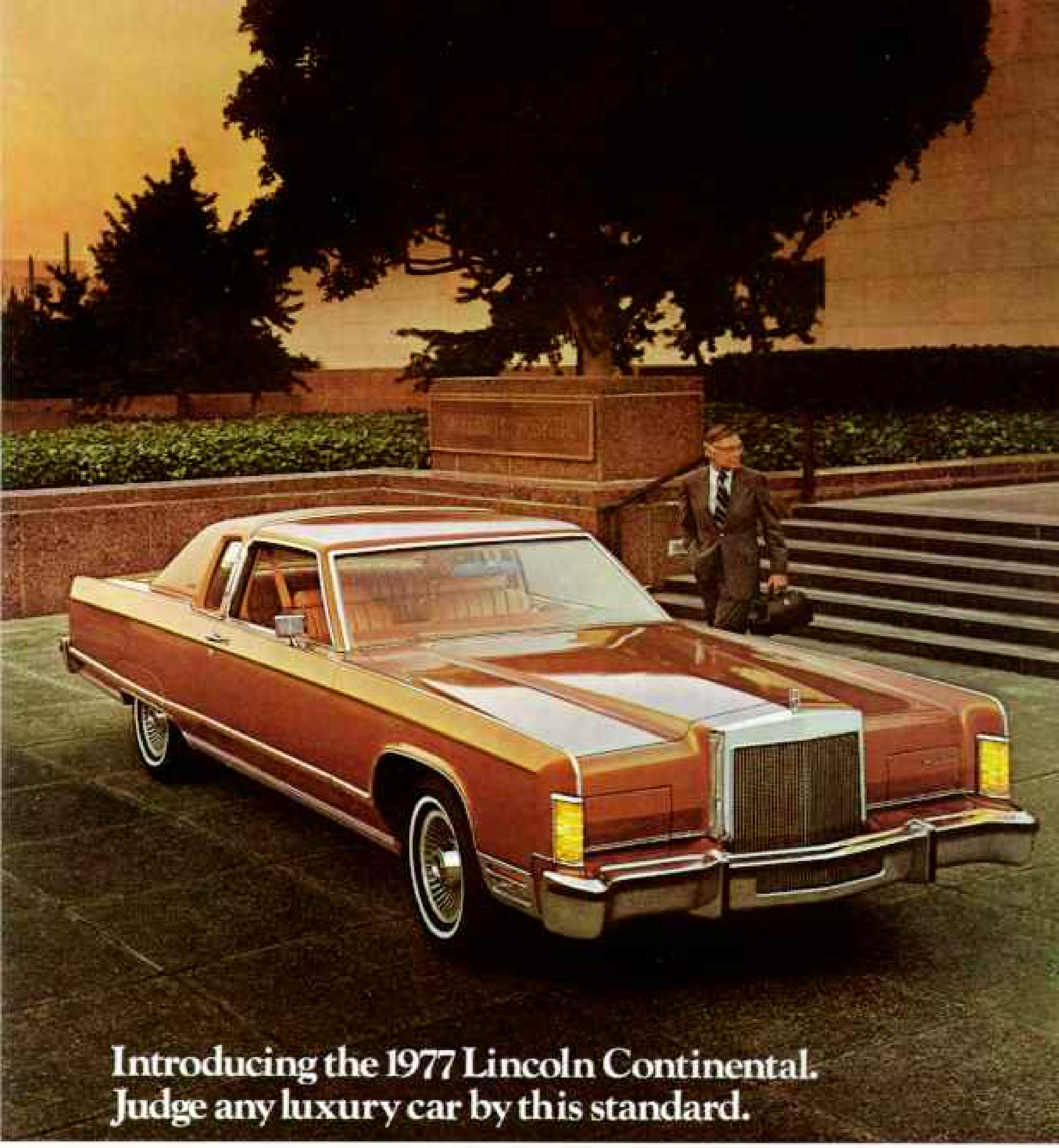
Well, at Metropolitan Life you can be insuring not only your family's future, but your own, at the same time.

Of all the money Metropolitan paid out last year, one-third did go for death benefits. But the other two-thirds, over 3 billion dollars, went to policyholders like yourself, while they were still very much alive. To help pay for such things as retirement, your children's education, or maybe even starting a business of your own.

So take the time to listen when a Metropolitan representative calls. At Metropolitan, we feel when you pay for insurance the better part of your life, your insurance should help pay for the best part of it.

Metropolitan

Where the future is now



The 1977 Lincoln Continental sets a high standard for luxury cars. Full-sized, full-luxury, to give you the pleasures of space, of comfort, of superb handling on the highway.

That's because it's a Continental. Unmistakable from its redesigned front end to its winning Lincoln ride.

For 1977, some luxury cars are smaller than last year.

For 1977, Lincoln Continental retains its traditional luxury car size.

We believe it's a luxury car that meets your standards.

Lincoln Continental. A standard by which luxury cars are judged.

LINCOLN CONTINENTAL

LINCOLN-MERCURY DIVISION Ford

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Kodak instant cameras and film

Kodak instant print film can be used only in Kodak instant cameras.
Price is subject to change without notice.

Kodak

For 1977 some car makers narrower, lighter full-size cars.

will offer you only shorter, Ford has a better idea. Choice:

Ford LTD. The full-size car that kept its size.

This year some car makers are making their full-size cars smaller. But Ford believes that people who want the traditional full-size car they're used to should have that choice. So the 1977 Ford LTD hasn't been reduced by a single inch!

You'll find Ford LTD has a *longer* wheelbase than cars like the down-sized Olds 98 and Buick Electra and about the same size wheelbase as Cadillac de Ville.

And Ford LTD now has a longer wheelbase than Chevrolets (both Impala *and* Caprice) which have come down to the same wheelbase as the *mid-size* Chevelle.

Ride, room and trunkspace—unchanged

Ford LTD has retained its traditional smooth, quiet ride. Interior spaciousness, deep-well trunk, road-hugging performance, long wheelbase and 3½-ton rated towing capacity (with optional trailer towing package) *are all unchanged*. Keep all this in mind when you go shopping for a new car this year.

Will "down-sized" cars have "down-sized" prices?

As this magazine goes to press, 1977 prices are not available. When they are, compare LTD's value to its down-sized competitors. Compare with test drives. What you may really want is the quiet ride and roominess of Ford's full-size 6-passenger car: the 1977 Ford LTD.

SIZE COMPARISONS

Cars with full-size wheelbase

4-DOOR MODELS	1977	1978
Ford LTD	121.0"	121.0"
Cadillac de Ville	121.5"	130.0"

Cars with mid-size wheelbase

Ford LTD II	118.0"	—
Caprice	116.0"	121.5"
Impala	116.0"	121.5"
Chevelle	116.0"	116.0"

Stylish Ford LTD Country Squire, LTD Landau 2-Door

And the new trimmer, sportier LTD II.

If you prefer a 6-passenger car that's trimmer in size and price than LTD, Ford gives you that choice, too. Ford introduces a sporty new line of cars for 1977—2-doors, 4-doors, station wagons—called LTD II.

Trim LTD II Squire, Sporty LTD II Brougham 2-Door

A new idea that's a better idea

Ford's new quieter-riding LTD II combines LTD's traditional high-level of workmanship with a unique sporty spirit that's all its own. The result: a comfortable new car that's trimmer in size and price than LTD.

A new kind of value

Ford will price LTD II to strongly challenge all competitors. So as soon as 1977 prices are announced, compare LTD II value not only with other mid-size cars, but even with GM's cut *down* "*full-size*" cars.

And you should know that all LTD II and Ford LTD 1977 prices *include* V-8, automatic transmission, power steering, power front disc brakes, *steel-belted* radials, Dura-Spark Ignition system, and more.

Shop where you get a choice

Full size or trim size? Some car makers won't give you this choice of car sizes in 1977. But Ford will: full-size Ford LTD or trim-size LTD II.

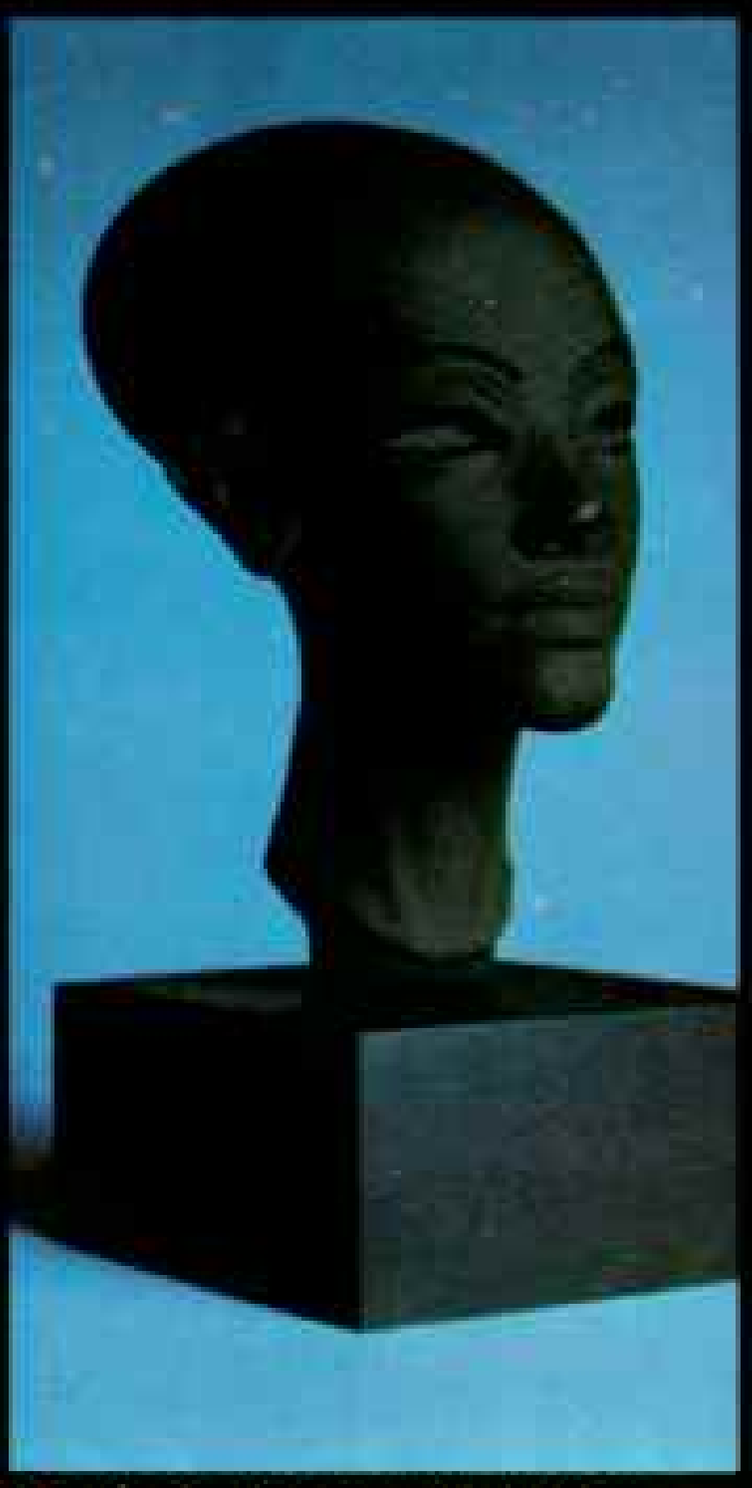
So this year, before you decide on the car size that's best for you and your family, take a comparison test drive. And compare prices at a dealer who offers you a choice: your local Ford Dealer.

FORD

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

THE GREAT ART OF MAN
HOLIDAY GIFT COLLECTION

Asklepios (Aesculapius, God of Medicine) (LO4-A). Orig. marble, Island of Milos, circa 300 B.C. British Museum. 11". $49.95.



Head of a Princess (B-1). Orig. dark brown stone, Egyptian, 1400-1300 B.C. 12". $39.95.

Statuette of a Cat (C-4). Orig. greenish bronze. Egyptian, 663-332 B.C. Walters Art Gallery. 6¼." $19.95.

Rhython in form of a Ram's Head (MAC-4). Orig. bucchero ware, Etruscan, circa 400-350 B.C. Milwaukee Art Center. 8". $39.95.

Mother and Child (WH-1). By Walter A. Hannula. American Contemporary. Stone original. 8¼". $49.95.

Lion Hunt Scarab of King Amenhotep III (SM-5). Egyptian, 1580-1100 B.C. Shown here, top and underside. 3⅜" long. $19.95.

Horus Falcon (FM-5). Orig. greenish bronze. Egyptian, Saite-Ptolemaic, 663-332 B.C. The Louvre. 11." $34.95.

FOR CENTURIES, FINE ARTISTS HAVE BEEN DESIGNING THE GIFTS YOU CAN GIVE THIS HOLIDAY SEASON.

Sculptors, goldsmiths, potters, carvers. Throughout the centuries, inspired designers, artists and craftsmen have dedicated themselves to creating works of great beauty.

And now, The National Society of the Fine Arts is making available, in the form of the most respected museum reproductions ever created, seven revered sculptural pieces representing a range of cultural periods, from antiquity to contemporary times.

These important works of art and history were once confined to museums or to specialized private collections. Now they can be brought into the home, not as ordinary "copies" but museum quality reproductions of great integrity, crafted by Alva Museum Replicas, a division of Time-Life.

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THE NATIONAL SOCIETY OF THE FINE ARTS, INC.

6 good reasons (and 1 super reason) why your new refrigerator should be a Kenmore®.

1 Vegetables, fruit stay fresh without wrapping.
Instead of a regular crisper, this Kenmore Refrigerator has an *airtight* compartment called a *Humidrawer.*™ Bread and cakes keep as long as a *week.*

2 When we say "frostless," we mean frostless.
In many so-called "Automatic Defrost" models, the refrigerator section stays frostless—but the freezer section does *not.* With this 22.1-cubic-foot Kenmore, there's no defrosting ever—refrigerator or freezer.

3 A great automatic ice maker, and cold water any time.
This ice maker *automatically* replaces cubes as you remove them. Our automatic water dispenser refills itself, too—*and* holds a pitcherful.

4 A freezer twice as large as on our lower-priced models.
This Kenmore Refrigerator has a 7.6-cubic-foot freezer to let you stock up on supermarket specials.

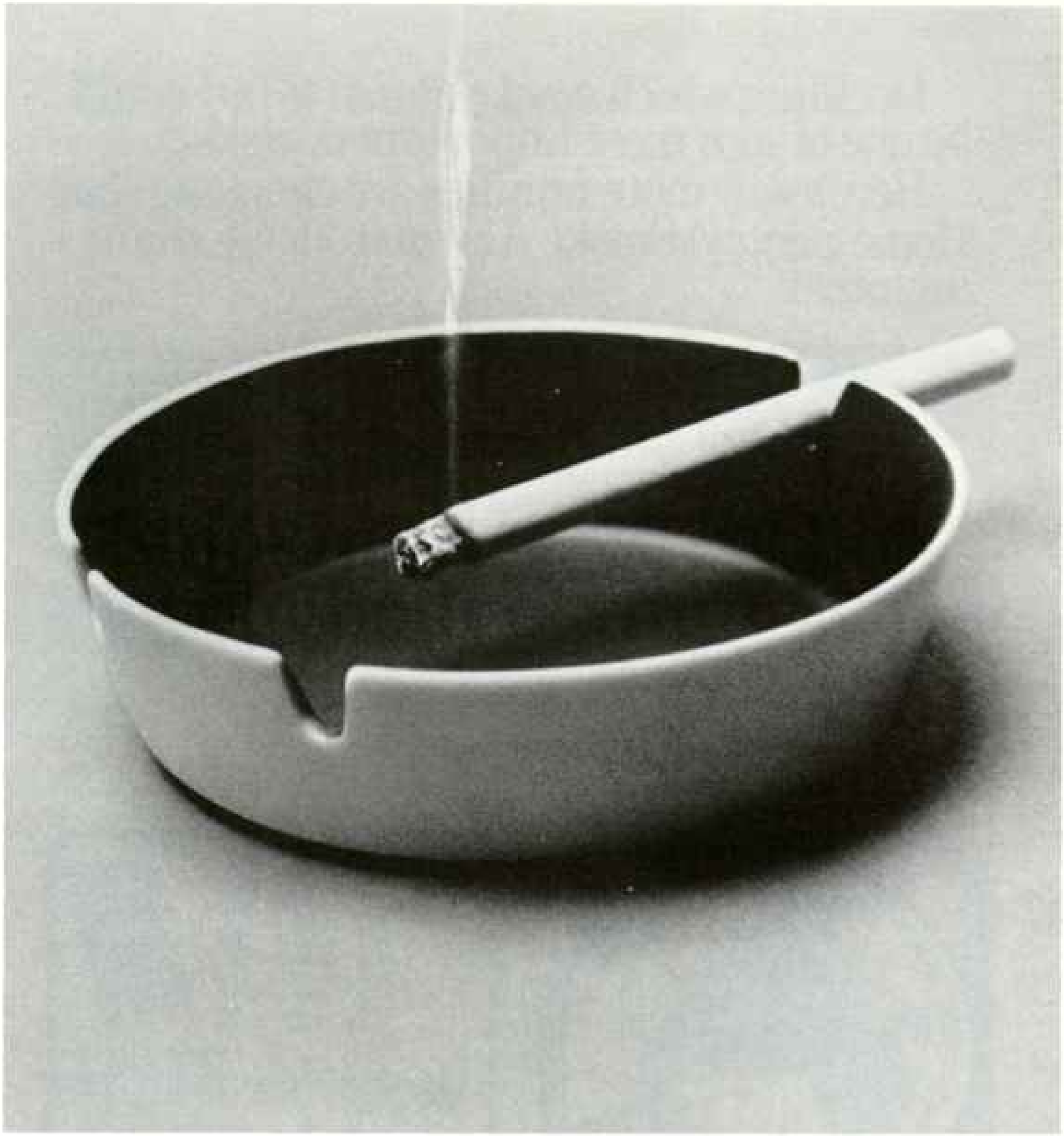
The six good reasons apply to Model No. 66561. Also through the catalog.

5 A porcelain-on-steel interior.
We've found no other coating that's more durable or easier to clean. And, our adjustable shelves are coated with epoxy. This makes them easy-to-clean, too—and almost impossible to scratch.

6 Saves on electricity.
This Kenmore has polyurethane insulation. And a Power-Miser Switch that helps save electricity.

7 The Super Reason: Kenmore means Sears service.
We've just developed Quik Chek,™ an ingenious little box that plugs into a Kenmore Refrigerator and tells the repairman *instantly* where the trouble is. We usually finish the job on our very first visit. *And* remember Sears convenient credit plans, too! Only at Sears, Roebuck and Co.

Kenmore. Solid as Sears



Smoking may be robbing your body of vitamin C.

For the past several years, there has been considerable concern about smoking and its effects on human health.

Now, scientific research indicates that smoking may also reduce blood levels of vitamin C. According to recent studies, blood levels of this important vitamin are as much as 30 percent lower in smokers than in non-smokers.

Fortunately, there are several ways to assure adequate vitamin intake. When you're shopping for food, read the labels, because today many foods are enriched and fortified with vitamin C.

One sure way to get enough. Buy a bottle of vitamin C tablets—and make sure you take them daily. There are also a number of different multivitamin formulations to meet your needs, including daily multiple vitamins and B-complex with C.

For a few cents a day, vitamins are really low-cost insurance. And since adequate vitamins are essential for good health, what could be a better bargain.

For a free booklet: "Are you robbing your body of vitamins?", write Vitamin Information Service, Department N-116 Hoffmann-La Roche Inc., P.O. Box 288, Nutley, New Jersey 07110.

ROCHE

Your health is our concern.

Deciding which smoke alarm to buy could be one of your most important decisions.

Here's why more families are choosing the Home Sentry® Smoke Alarm from GE than any other.

The GE Home Sentry Smoke Alarm is an early warning system that "sniffs" the air for the presence of smoke and sounds an alarm when smoke reaches it.

The battery-operated Home Sentry is the *only* smoke alarm with a 3-point checking system to assure you the alarm and the entire system are in working order. It features a 12.6-volt Duracell® battery made especially for smoke alarms by P.R. Mallory & Co. Inc. And because it's battery-operated, the Home Sentry can continue to function even if household power fails.

Of course, no one can guarantee against injury or loss of life in a fire, but the Home Sentry Smoke Alarm has already helped people save their lives. Every Home Sentry Smoke Alarm is backed by the General Electric name and the quality and reliability it stands for. Now's the time to buy one—or as many as your home may need.

The Home Sentry Smoke Alarm could help you save your home and your family's lives.

Home Sentry Smoke Alarm

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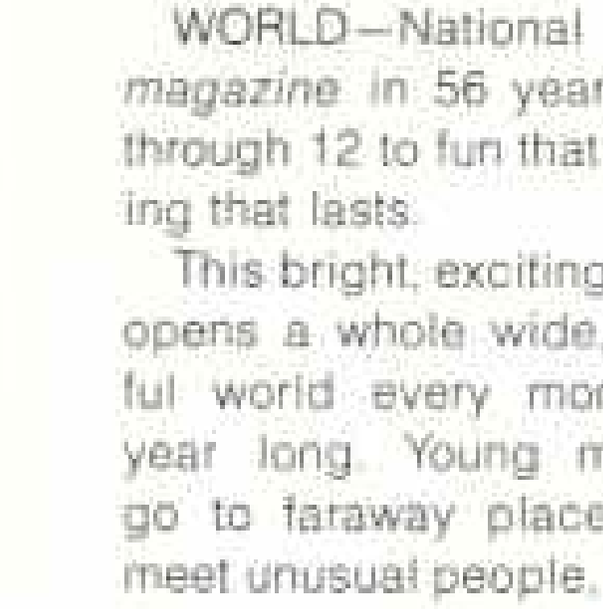

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First Day Cover-of-the-Month Society®

A First Day Cover of the Month in September, 1975, this issue devoted to Liechtenstein's architectural heritage demonstrates true excellence.

Stamps approximately half-size.
Actual size: 7½" by 4½"

Members were fortunate in obtaining this British sailing series. For complete sets were sold out entirely on the First Day of Issue. It was a selection for June, 1975.

By long-established tradition throughout the world, each First Day Cover bears an original *cachet* harmonizing with the theme of the stamp.

Relatively few of a country's stamps are available abroad. Most are used in the country of origin. The Society obtains *first editions* only of the most outstanding.

Official First Day of Issue Postmark, available only on the First Day of Issue, certifies the *first-edition*. It is *officially* applied at the city of issue, in the country of origin.

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Each month the Society will obtain three
of the world's most important First Day Covers exclusively for Members.

Memberships are now open for a limited time only.
All applications must be postmarked by December 31, 1976.

In no small part because of their beauty, International First Day Covers are widely regarded as the most significant and important collectibles of our time. And for good reason. They are the first editions of the world's postage stamps. Forever limited to the precise number *officially* postmarked by each issuing nation on the *precise* First Day of Issue.

Truly, few things in the world inspire more favorable comment than the world's fascinating stamps. They are a nation's monuments in miniature. Masterpieces of the designer's and the printer's arts. Mirrors of the world's culture and history; wildlife and geography; art and architecture; men and women; hopes and aspirations.

Yet, relatively few ever reach collectors in the United States. Of them a small percentage are First Day Covers.

An old tradition.

The tradition of collecting International First Day Covers is a rather old one, dating back to the late 1800's. Over the years, wealthy collectors, diplomatic officials, and members of royalty have built excellent collections.

They have prized them as the most *desirable* specimens of a Nation's stamps; for, unlike the entire printing of a new stamp, the First Day Covers are issued for *one* day only . . . and so certified by postal authorities of the issuing nation with the official "First Day of Issue" postmark.

A rare collecting opportunity.

The First Day Cover of the Month Society has been instrumental in overcoming the barriers of time, distance, language, and geography to make it possible for the collector of *modest* means to enjoy this same privilege of building an outstanding private collection of First Day Covers of the world's most significant stamps. And, of receiving them automatically through a convenient monthly acquisition plan, as they are issued, from wherever they are issued.

A Collection of world-wide importance.

Each month the Society obtains First Day Covers of three — and only three — of the world's most important First Day Covers. Exclusively chosen for the Membership, they are the handful which achieve a unique combination of artistic, historical, and technical perfection. The issues which, the Society believes, are the most likely to stand the test of time.

Selections of great merit.

Significantly, a number of First Day Covers selected by the Society have later become highly rated and eagerly sought after by collectors. An outstanding British Sailing issue of June, 1975, for instance, *(illustrated at left)*, took the philatelic world by storm and complete sets sold-out on the very First Day of Issue. Certainly, there can be no guarantee that any particular First Day Cover will increase in value or merit with the passage of time. But this example points to the quality of the Society's selections.

All Society selections are carefully chosen according to the same rigorous criteria. And chosen *before* their merits are widely discussed; when they can be obtained by Members of the Society at the original issue price.

Authentic issues.

Each First Day Cover you receive will be authentic in every respect. Every one will be designed, printed, officially postmarked and issued according to each nation's established philatelic traditions. No two will be alike.

Knowledgeable collectors recognize that this rich diversity is the hallmark of *authentic* International First Day Covers. Those who enroll as members of the Society will experience first-hand these same qualities which have fascinated collectors of International First Day Covers for nearly a century.

The Benefits of Membership.

As a Member, you will receive each month three First Day Covers of the world's most important new stamps. The total price of $2.75 per cover ($8.25 per month) will be firmly guaranteed to you for a full eighteen months — a most unusual and significant guarantee. In addition, you may cancel your membership at any time upon thirty days' notice. However, those who do will forfeit the opportunity of building a complete collection *from the beginning* of 1977.

A handsomely-designed album to protect and display the collection will also be provided *at no additional cost*. And to enhance the educational value of the collection, an authoritative commentary will accompany each issue.

Memberships close December 31, 1976.

Never before has it been possible for the average person to so selectively acquire a collection of such breadth. As a Member you will be able to build an excellent, private collection of International First Day Covers. An authentic collection which you, your children, and their children will appreciate for generations to come.

Your application must be postmarked no later than December 31, 1976. After that date, applications will be accepted only once each year, only for a short period of time, and only at the prices *then* prevailing.

To apply for membership, mail your application directly to Fleetwood, 1 Unicover Center, Cheyenne, Wyoming 82008, America's oldest purveyor of First Day Covers, under whose auspices the Society was established.

To protect and display the International Collection of First Day Covers of the Month, a handsome collector's album will be provided to each Member at no additional cost.

MEMBERSHIP APPLICATION

First Day Cover-of-the-Month Society

Deadline for application: December 31, 1976
Limit: One membership per person.

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Cheyenne, Wyoming 82008

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NATIONAL GEOGRAPHIC

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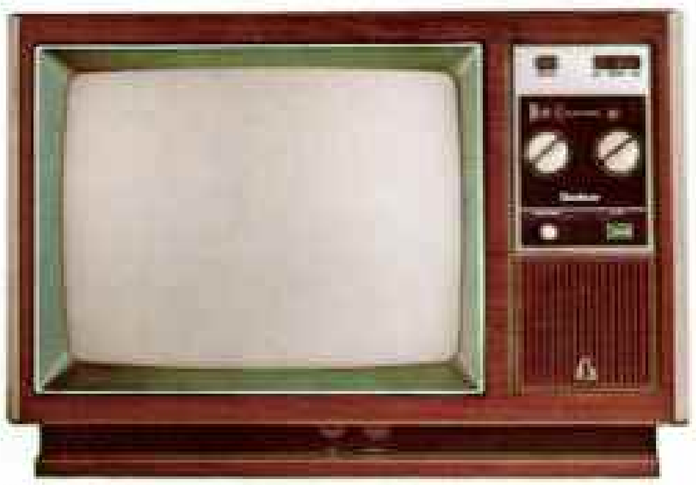

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