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A FEW WEEKS AGO I stood on the Normandy beach that will always be called Omaha and thought of the events of June 6, 1944—that terrifying day when the Allies landed in Nazi-held France. It was clear at the time what D day was all about: the defeat of Hitler's war machine and the preservation of a way of life profoundly rooted in the soil of Europe.

In nearby Bayeux I walked around that magnificent 231-foot tapestry depicting the Norman Conquest of England in A.D. 1066. Then I, too, crossed the English Channel, and later visited Canterbury Cathedral, the Tower of London, and Windsor Castle.

Those places symbolize the great cultural achievements of the English: centuries of political development leading through the Magna Carta to modern laws of equity; the literary heritage of Shakespeare, Milton, Keats, and a thousand other geniuses; the intellectual growth that culminated in Newton and Darwin and the industrial revolution; the spirit of adventure mirrored by men like Drake and Cook.

Today that tradition of greatness braces Britain during another time of turmoil. The Commonwealth is no longer the dominant economic force it once was; the European Economic Community—with Britain a member—commands the Continent's markets. Meanwhile, Britain has undergone the radical surgery of decolonialization.

Just a few years ago her economy and her very social fabric seemed in parlous condition, beset by labor unrest, inflation, lowered productivity, and the threat of devolution of Scotland and Wales, as well as the agony of Northern Ireland.

It was fashionable in America to wonder if there *would* always be an England.

The English never wondered, though. They have an implicit trust in their future and are confident they will climb above adversity again. Their rich pool of North Sea oil certainly provides them a breather, a time to put their house in order again.

My brief visit to England's shrines of pilgrimage reminded me of the countless corners the English have turned in their long and often majestic history. I left with the feeling they would find their way around this one as well. That, too, is a part of their tradition.

Silvestre Browner

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October 1979

Pilgrimage Through Two Englands 442

When crisis and crowds weary the spirit of the English, they find renewal in the beauty and traditions of their timeless land. By Allan C. Fisher, Jr., with photographs by Cary Wolinsky. A double supplement map portrays modern Britain and medieval England.

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Light caroming through pliable, hair-thin strands can carry a flood of messages or let doctors look inside an ailing patient. By Allen A. Boraiko and photographer Fred Ward.

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Stunning reentry pictures accompany Australian Tom Riggert's account of Skylab's homecoming.

COVER: Beneficiaries of China's new emphasis on education, primary students take a spring field trip to a children's park in Guilin. Photograph by W. E. Garrett.

Two Englands



A young imitator keeps pace with Grenadier Guards passing

By ALLAN C. FISHER, JR.

ASSISTANT EDITOR

Photographs by CARY WOLINSKY

STOCK, BOSTON



NATIONAL GEOGRAPHIC PHOTOGRAPHER STEVE RAYMER

St. James's Palace in London.

THERE IS an old English saying, "As sure as God is in Gloucestershire." Indeed, aged church towers and spires, enduring monuments of faith, rise from even the tiniest Gloucestershire villages. Here, I do believe, God must have been practicing for the larger handiwork of paradise when He fashioned the Cotswolds, gentle little prominences mostly, hardly worthy to be called hills but worthy of every superlative for beauty. Scattered through them, hidden in their folds beside meadow, woodland, and stream, lie postcard-pretty villages seemingly built of quarried gold, the natural hue of Cotswold stone.

No longer am I young, but how effortless my footsteps seem when treading the rural pathways of England. When you walk with beauty, the miles are shorter, the paths less steep. In the Cotswolds I have wandered through the bluebells of May, the purple clover and yellow vetch of summer, the gold of autumn leaves and grain stubble. And one recent midsummer day I found myself in Slad, a shadowed little place tucked away in a narrow valley. My companion, a local man, pointed to a clock in a spire.

"For months it didn't run," he said, "but they fixed it. We liked it better when it didn't work. Why did they give us time again?"

I understood his feeling. Timelessness seems so right for the Cotswolds. But in a very real sense that area and much of England *are* timeless, or as near to it as our troubled age permits. This is the England of the loved and familiar, of village and countryside, of distinctive counties and regions, rockbound shores and lush green meadows, lakes and hedgerows and sunken lanes, and everywhere the husbandry of old fields and towns, old ways and virtues.

But there is another England, one of fundamental internal differences, of low productivity, of frustrated hopes and prospects for many of her people. England comprises only a part of the United Kingdom, the others being Wales, Scotland, and Northern Ireland. But it is the largest and most populous part, the seat of government, the pacesetter. Since World War II it has undergone a painful decline that may continue despite the current

(Continued on page 448)



Bright modern armor shields a hiker from the elements near Bamburgh Castle in Northumberland. Eastward lies the sea, which so profoundly shaped England's destiny—first as a highway for invaders who melded into the English people, then



as a moat behind which the nation grew as a maritime power and center of a far-flung empire. Though idyllic scenes abound, urbanized England is doing soul-searching over such vexations as inflation, high taxes, restive labor unions, and waning productivity.

Pizza Hut

Pizza Hut.

ALL THE PIZZA AND PASTA

YOU CAN EAT
EVERY TUESDAY

MINI-CAR

MINI-CAR

Pizza Hut

10 DEEP DISH SPAGHETTI FOR ONLY 50¢ MONDAY TO FRIDAY





STEVE RAYMER (LEFT)

Foreign invasions are changing the face of London, where Middle Eastern garb is a common sight and American fast-food restaurants proliferate (left). An influx of

foreign capital has been felt in the city's financial community, although the fashion at noonday on Finch Lane remains decidedly traditional (above).

(Continued from page 443) windfall from North Sea oil.

A quarter of a century ago Britain ranked second only to the United States in world trade; today she has fallen to fifth. In that same period she has dropped from first place to fifth in shipbuilding, from third to eighth in steelmaking, and from third richest nation to seventh. Her gross national product has been growing at a lesser rate than any of her partners in the European Economic Community except Italy. A West German or U. S. industrial worker produces twice as much as his British counterpart.

Next year the British probably will become self-sufficient in oil, and the growing North Sea flow has helped them pay international debts early, has eased their balance of payments deficit, and has saved them billions of pounds they would otherwise spend on expensive foreign oil.

Yet the bonanza may last only twenty years, and today the annual income amounts to only 4 percent of the British gross national product. All admit that North Sea oil is a palliative, not a cure, for the country's malaise. A true recovery awaits increased productivity.

The British election last May once again dramatized the divisive confrontation between socialism and capitalism, between Labour and Conservative Parties. Class divisions, perhaps the oldest problem, remain abrasive. Devolution, the controversial move to give limited home rule and elected assemblies to Wales and Scotland, failed this year in referenda. Welsh voters rejected it by a four to one margin. A majority of the Scottish voters casting ballots approved, but by too small a margin to put it into effect. However, that may not be the end of devolution, and Welsh and Scottish nationalists still seek virtual independence.

Even that great institution, the Mother of Parliaments, finds itself in question. Influential voices want a written bill of rights and constitution because they feel that Parliament, whose acts have no judicial review or veto, threatens basic freedoms.

These days there are two Englands: the England of the countryside, of small villages and sedate provincial cities, timeless, solid, often of remarkable beauty, and still the heart and soul of nearly every region, and

the England of foundry and city, of office, union hall, and political corridors, of confrontation and division. Two levels of existence, virtually two lands, in stark contrast.

LAKE DISTRICT. Ah, perhaps the loveliest part of a lovely land . . . the English lakes, meeting place of tarn and mountain, crag and sky. I take a path that runs through Stool End Farm, a hardscrabble defiance of nature that lies in a huge, bowl-like depression, ringed by steep slopes of grass and heather and topped by jagged rock 2,000 feet above the bottom of the bowl. The loneliness of this gray autumn day seems palpable, as weighted as the wind. Then, on a high outcrop, I see a human figure. Does the climber see me so far below? He does. We wave, and I think: It will be dark before he reaches shelter.

Now a national park, the Lake District graces Cumbria in England's northwest. Windermere, Grasmere, Ullswater—these lakes and a score of other azure mirrors lie cupped among mountains truly majestic in scale and ruggedness. I find this region more reminiscent of the American West's grandeur and openness than any other part of compact England.* Stool End Farm, hidden away like some lost Shangri-la, is a dramatic example. Poet William Wordsworth, who lived out his days in the Lake District, expressed something all its visitors feel:

*. . . 't is the sense
Of majesty, and beauty, and repose,
A blended holiness of earth and sky. . . .*

This is the land beloved not just of Wordsworth but of Coleridge, De Quincey, Southey, Gray, and Ruskin. De Quincey once estimated that his friend Wordsworth walked perhaps 180,000 miles through the Lake District and other parts of England; the loveliness sustained his soul and fed the wellspring of his poetry. Wordsworth lived for some years at Dove Cottage, now a museum, near the village of Grasmere, and his body lies in the Grasmere churchyard.

Unfortunately, many visitors to the lakes never get far beyond the loveliness of Windermere, the lake and bustling town of the same name. It's a delightful area for sailing

*See the double map that accompanies this issue: *British Isles and Medieval England*.

and a good place to make one's headquarters. But the more rugged country, the fells and soaring rock, lies to the north and west.

At Stake and Rosset Gill passes I watched human flies crawling the faces of stark, sheer walls far above. Their number amazed me, but a local companion explained that climbers from throughout Britain come there to practice. So numerous are climbers, hikers, and motorists in most of the park, which includes many very old farms, that I gained new insight into the problems intensive land use creates for conservationists. Great Britain's Countryside Commission, reasoning that hikers and climbers contribute to the decay of farm landscapes, is helping farmers to construct and repair walls, stiles, gates, and ditches.

A look at that program in action first took me to remote Stool End Farm, but I soon became lost to all but the grandeur and isolation of its setting. Keith Rowand, the farmer, had gone to town that autumn day of fitful rain, but I came back another year in summer when his meadows were a palette of cat's-ears and buttercups, harebells and daisies, clover and sorrel. Keith, a young man with brawn to match his mountains, rents the 200-acre farm from the National Trust and keeps some 800 sheep and 70 beef cattle. He grasped, lifted, and turned fat sheep effortlessly while shearing their wool with quick, deft movements.

To spare Keith's trying to talk above the noise of his electric shears, I went into the fields, my eyes continually drawn to the steep slopes and great bulk of rock that give Stool End Farm its sense of enclosure and isolation. There the young farmer joined me. Sensing my absorption in the view, he said nothing until I commented on the splendor that everywhere was his. I cannot render Keith's rich northern accent, as old as the husbandry of upland Cumbrian farms, but his words were touched with poetry and love of land.

"Beautiful now, yes, but it changes all the time. In autumn the bracken starts turning and the trees in the valley turn, and there are lovely views in winter when snow comes to the mountains, and there are beautiful moonlit nights when you wouldn't think you were in the same place as during the day. About November 10 we lose our sun. It



NATIONAL GEOGRAPHIC PHOTOGRAPHER JAMES L. STANFIELD

Britain's first woman prime minister, Margaret Thatcher, with daughter Carol, hails supporters after leading her Conservative Party to victory. Mrs. Thatcher rode a wave of resentment against crippling strikes to defeat Labour Prime Minister James Callaghan. The Oxford-educated daughter of a grocer pledged to curb union power, retard the growth of the welfare state, and stimulate private enterprise. The world watches how her views will affect England's position on such matters as Northern Ireland, Rhodesia, and NATO.

sneaks up the fields and up the mountains to the tops, and it doesn't come back until February. During that period we get no sun at all in our valley."

High up on Kettle Crag, one of the enfolding mountains, I could barely see sheep pouring through a notch, and behind them a shepherd bounded agilely down a steep slope behind his flock. I wondered that any creature, four feet or two, could keep from tumbling down, down, and I asked Keith if he went up the mountains.

"A shepherd goes where his sheep go," he said simply. "I like it on the mountains, so much that I must mind my work, for all the valley is there far below for me to linger and look upon."

At such times and places England's present difficulties seem unlikely and remote. Malaise in Eden? Hardly. Yet it's there, often more real than apparent.

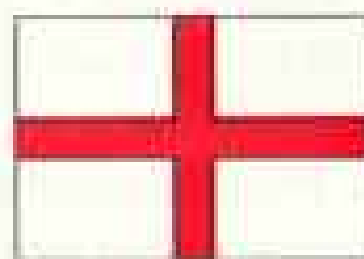
LIKE MOST POLITICIANS who once strode the world stage, Sir Harold Wilson remains a consummate actor, even for an audience of one. Puffing on his omnipresent pipe, gesturing with it, smoothing his silver hair, leaning with a casual pose against a mantel, the former British Labour prime minister paces his study and lectures me professorially on his country's economic decline.

Many Britons, regardless of party, believe the far-flung British Empire was by no means an unmixed blessing. While it gave Britons a sense of mission and accomplishment, some critics see it in retrospect as cumbersome, inefficient, even costly. Moreover, the captive, noncompetitive market led British industry into complacent and inefficient ways. These are views that Sir Harold, a former lecturer in economics at Oxford, holds strongly.

"Some of our economic difficulties are of long standing," he told me. "In the case of iron and steel, they actually date back to 1873, when we started losing ground to the Germans. By 1900 they had surpassed us in steel production, and their industries were more modern than ours. By 1914 we had become slack. We lost a lot of our investments in World War I and more in World War II. By then nearly all our trade balances were gone, particularly in the Middle East.

England

KEYSTONE of an island kingdom off the Continent's northwest flank, England cultivated its small share of geography into a far-reaching military and political power. At its zenith in the late 19th and early 20th centuries, Britain ruled one of the largest empires ever known, spreading its domain to all seven continents. Largest of the four units composing the United Kingdom, England annexed Wales in 1536. Scotland united with England in 1707, although rebellions continued for nearly forty years. For its sovereignty over Northern Ireland, England still stings from violent protest. Political factions in Scotland and Wales also chafe on John Bull's leash and seek greater home rule, others outright independence.

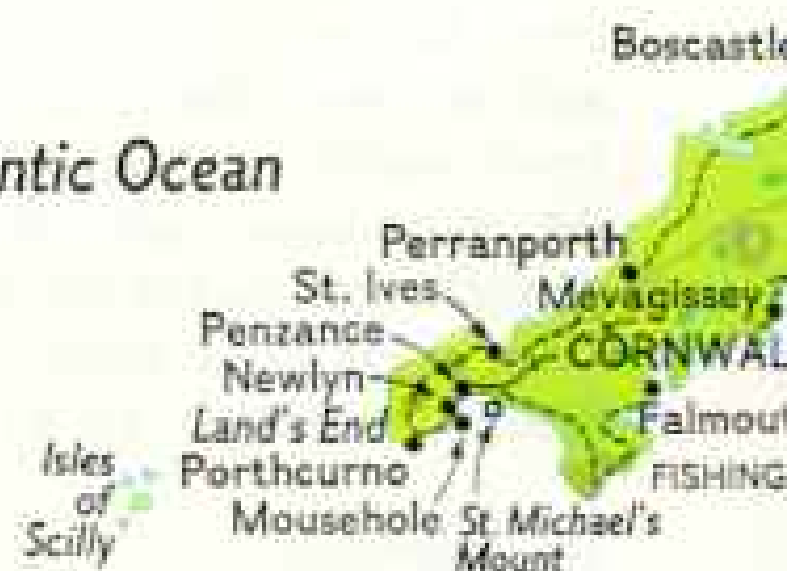


GOVERNMENT: Constitutional monarchy. **AREA:** 50,363 sq mi. **POPULATION:** 46,349,000. **RELIGION:** Church of England. **ECONOMY:** Agriculture, machinery, chemicals, iron

and steel, transportation and electronics equipment, publishing, textiles, tourism. **MAJOR CITIES:** Greater London (6,918,000), Birmingham (1,041,000), Leeds (728,300), Sheffield (547,900), Liverpool (528,000), Manchester (489,300), Bradford (463,100), Bristol (411,500). **TOPOGRAPHY:** Predominantly rolling hills. The Pennine mountains extend from Scotland to the Peak District. The Lake District lies in the northwest, a large plain occupies the Midlands area, and rugged moors are found mainly in the north and southwest. The Thames, Severn, and Trent, major rivers, flow from the central highlands.



Atlantic Ocean





SCOTLAND

- Grassland pasture
- Arable land
- Moor and rough pasture
- Woodland
- Major industrial area
- Road
- Railroad
- Canal

0 75
KILOMETERS
0 75
STATUTE MILES

DRAWN BY OSWALD SADAY
COPYED BY JEFFREY E. HUNTER
NATIONAL GEOGRAPHIC ART DIVISION

NORTHUMBERLAND NATIONAL PARK
NORTHUMBERLAND

Winshields Crag 375 m 1,230 ft
Hadrian's Wall
Chesters Fort
Newcastle upon Tyne
Sunderland SHIPBUILDING

Carlisle CUMBRIA
LANE DISTRICT
NAEL PARK
Dove Cottages
Stool End Farm
Kettle Crag 388 m 1,263 ft
Windermere SHEEP
YORKSHIRE DALES NATL PARK
Durham SHEEP
Raby Castle
Middlesbrough CHEMICALS

Irish Sea

WALES

North Sea

Blackpool
Liverpool SHIPBUILDING VEHICLES
Manchester ENGINEERING CLOTHING
Sheffield STEEL
Leeds TEXTILES
Bradford
Barnsley
York
Kingston upon Hull FISHING
Grimsby FISHING

Stoke on Trent POTTERY
Nottingham TEXTILES VEGETABLES
Leicester IRON ORE
Coventry
Northampton
Lincoln BARLEY
The Wash POTATOES
SUGAR BEETS
King's Lynn
Norwich

Birmingham VEHICLES ENGINEERING
Chipping Campden
Broadway
Stanway
Lower Slaughter
Stow on the Wald
Oxford
Cambridge
Newmarket
Bury
St. Edmunds
Aldeburgh
Dunwich
Westleton
Lowestoft FISHING
Norfolk Broads
ESSEX

Bristol ENGINEERING
Bath
Wells
Southampton SHIPBUILDING
Portsmouth
Brighton
Hastings
Dover
FRUIT VEGETABLES SHEEP

DEVON
Chagford
DARTMOOR NATIONAL PARK
Widecombe in the Moor
Torquay
Plymouth
Berkshire LONDON
Surrey CLOTHING PRINTING ENGINEERING
Hampshire AIRCRAFT
Droxford
West Sussex DAIRY

English Channel

FRANCE



"Though backward in some industries, our advanced technology led the world: radar, jet engines, penicillin. These developments should have brought millions of pounds into Britain, but they were all lost because of the Lend-Lease Act. We couldn't market them as a nation; they went into the war pool. Under Lend-Lease we also lost a lot of foreign markets in the war."

Many people believe such explanations too simplistic and pin much of the blame for postwar decline on British socialism. On this issue the United Kingdom remains a house divided.

Since World War II coal, gas, steel, electricity, railroads, docks, waterways, and communications have all been nationalized by the government. It also owns a mixed bag of companies, among them Britain's largest car manufacturer, Leyland, and the big jet-engine maker, Rolls-Royce. Each takeover has provoked controversy between the socialist Labour Party and the Conservative Party, with power over the years shifting back and forth between them.

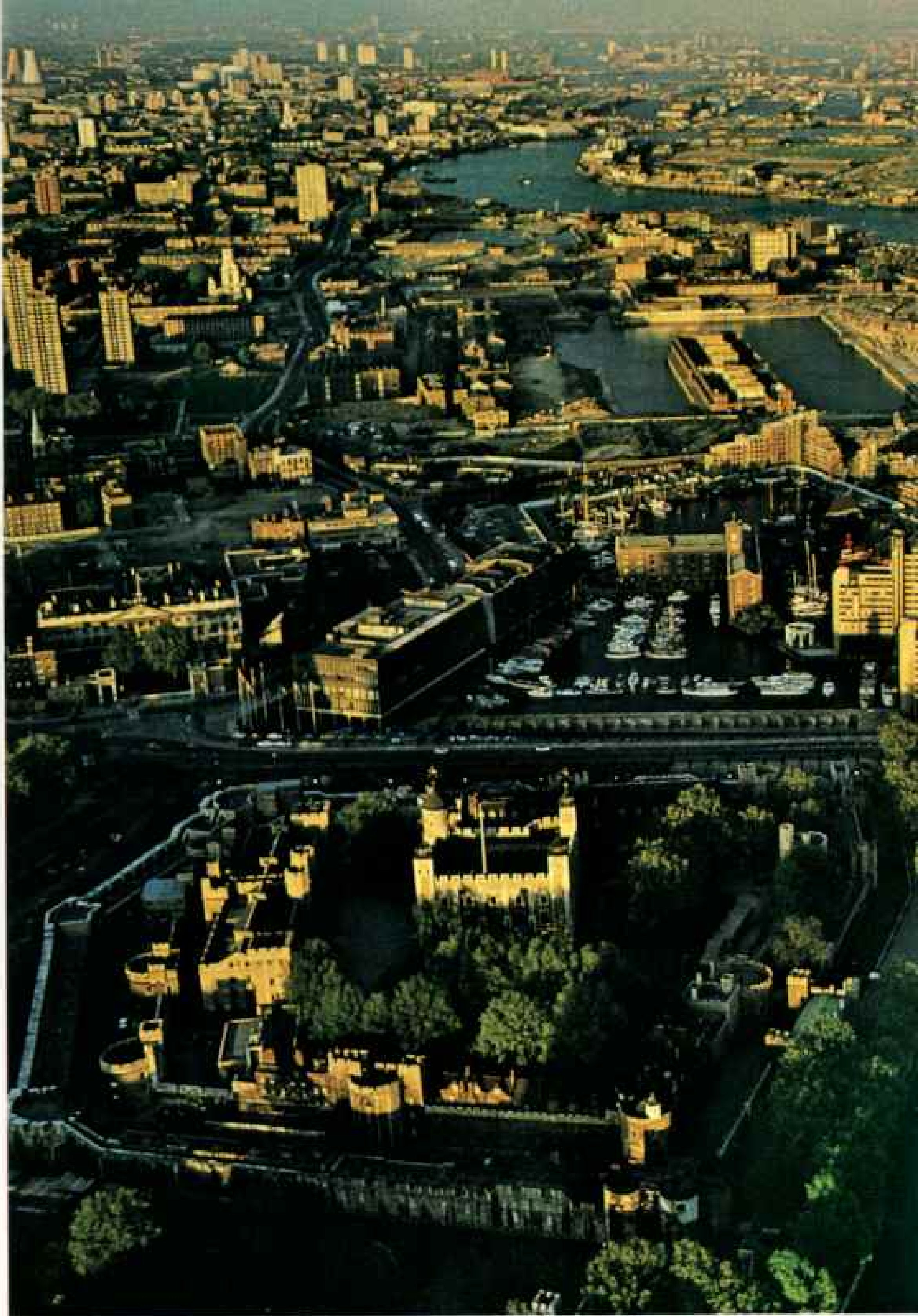
IN THE ELECTION last May 3, the Conservatives ousted Prime Minister James Callaghan's Labour government and won a majority of 43 seats over all other parties in Parliament. The Conservative leader, Mrs. Margaret Thatcher, became Britain's first woman prime minister. She and her party ran on a platform of cutting high income taxes, halting nationalization of industry, ending the enlargement of state powers, encouraging private initiative, and giving more vigorous support to the United Kingdom's NATO allies.

Conservatives charge that socialism stifles initiative, that social programs have proliferated beyond Britain's means, that Labour governments never permit the private sector to retain enough money for modernization and expansion.

"For some years close to 50 percent of everything earned in this country was spent by the state," said Dr. Esmond Wright, a former Conservative member of Parliament who heads the University of London's Institute of United States Studies. "The area of private enterprise has been dwindling for a long time, but that's where the money comes from. Yet to many people profit is a dirty



Uneasy rests the crown when worn by a giggling youngster. At the Tower of London, where the real crown jewels are kept, lecturer Peter Hammond uses copies. Denis Harding, one of 37 yeomen warders, or beefeaters, who live and work in the tower, gets help from his wife, Janet (left), in donning his ceremonial uniform.



Lord of England's rivers, the Thames bisects London as it flows past the Tower of London (lower left) and under Tower Bridge. Just beyond, conversion of the old St. Katharine Dock into the World Trade Centre, with a hotel, office



buildings, apartments, and a marina, has sparked other improvements in dilapidated riverfront areas. Londoners have renewed pride in their river. Fish have increased over the past 20 years because of antipollution measures.

word. As you extend nationalization, the philosophy is: 'We don't make profits.' There has been a dwindling area, therefore, on which everyone has been battenning."

Sir Richard Marsh, Chairman of the Newspaper Publishers' Association, shrugs away criticism of government ownership. A former Labour minister who also has headed the British Railways Board, Sir Richard represents a relatively new breed, a pragmatic manager who has adapted to socialism, and he deplores what he calls "the doctrinal furor."

"There are some people who insist that nationalization is the best thing since the wheel, and others who think it's the work of the Devil," he said. "It's a totally phony argument. There is no disagreement in objectives, and the effect of public ownership on the man in the street is negligible."

Len Murray, head of the Trades Union Congress, well educated, philosophic, but more doctrinaire in outlook, commented: "Nationalization is a means to an end. Capitalism tends to lend itself to exploitation, socialism to cooperation. The answer in our case may lie somewhere between the two. This is our dilemma: We really do not know what kind of country we want to be."

CORNWALL. *Here along this rugged, serrated coast, an island nation is perhaps most at home with the sea. I take the high cliff path near Land's End, where the English mainland's last craggy outpost against the Atlantic yields its matter grudgingly, slowly, to the sea. Mist streams by me in gauzy wisps and tatters. Far below, a rusty, wallowing old freighter rolls the very rats in her bilges, and an aroused sea hurls bleached combers in an unending assault on the shore. Except for the surf's low thunder and the keen of the wind, there is no sound, and I walk a long way in solitude. But the wind freshens, and when even the gulls refuse to breast it, I too turn away for shelter.*

The English, who often compare their "right little, tight little" isle to paradise—

with paradise usually suffering in the comparison—have another saying, "If there is a part of heaven just for hikers, it must be like England." I accept that, particularly in reference to the magnificent coast path that extends around almost the entire perimeter of the peninsula that forms England's seagirt southwest. The path dips, climbs, and meanders for more than 500 miles.

The Countryside Commission and other groups maintain just about every conceivable kind of hiking trail: seaside, mountain, moor, woodland, farm, and byways for special studies, such as botany, birds, history, even geology. Everywhere the footpaths of generations long moldering have become common-law rights-of-way for walkers, most often through private property.

Population pressures have been so great that land must serve multiple uses. Thus farmers and estate owners still hold most of the land in the joint English-Welsh system of ten national parks, but the public has rights of access and use. The Nature Conservancy Council owns or controls more than 150 nature reserves, and the National Trust protects many historic homes and hundreds of miles of dramatic coastline.

"We have been innovative because we had no option," says Reginald Hookway, Director of the Countryside Commission. "We had to make something out of what man raped a thousand years ago."

I find southwest England's Riviera seductive for many reasons, not the least being its climate. Laved by warm ocean currents, Cornwall and much of Devon offer weather gentler than the rest of England: often soft and sunny even in winter, a land where palms and semitropical vegetation thrive. I have often wondered why holiday seekers engulf it in midsummer, when spring and fall offer so much.

In England, Cornwall is unique, an old Celtic land that had its own language, akin to Welsh and Breton, until the late 1600's. By the end of the 18th century, only a handful of people spoke it, and it died out. Today,

Flavor of the past stays fresh at Young's brewery in London, where horse and dray is still the cheapest method of transport to nearby pubs. Keeping traditional methods and shunning artificial carbonization, the small firm brews ale and bitters short on shelf life but long on natural taste.





D. B. ... J. ... T. ... R. ... W. ... E. ... S. ...

M. ... H. ... D. ... W. ... R. ... S. ...

G. ... H. ... E. ... J. ... P. ... M. ...

R. ... R. ... R. ... G. ... B. ... G. ...

L. ... E. ... R. ... W. ... W. ... B. ... C. ... S. ... G. ...

K. ... J. ... T. ... A. ... J. ... A. ... D. ... J. ... C. ...

G. ... E. ... V. ... K. ... L. ... E. ... S. ... J. ... A. ...

however, linguists teach it in a few places. This has nourished a move for separatism among some people, who, like the Welsh and Scots, hearken back to a time when Cornwall was an independent kingdom.

Land's End lies in a district dominated by St. Ives on the north coast and Penzance on the south, both resort towns but with an ineradicable quaintness and charm. In St. Ives I have wandered bemused for hours in a labyrinth of lanes and cobbled alleys with names like Teetotal Street and Salubrious Place, and around the waterfront, where fishermen work oblivious to the cameras of tourists. Penzance lies on a sweeping bay dominated by St. Michael's Mount, a steep

island open to the public and crowned by as fairy tale a castle as one could wish.

Those who like to poke about by car will make a mistake if they go to Cornwall in a behemoth of an auto. It's difficult enough in a small vehicle to worm your way to tiny fishing villages, often at the foot of winding, narrow roadways. But it's rewarding. Boscastle, Mousehole (pronounced Mouzel), Newlyn, Mevagissey are as picturesque as movie sets. If you want to meet and talk to real fishermen, as I invariably do, go to Newlyn and enjoy a pub crawl where waterfront people hang out: the Dolphin, Star, Swordfish, Red Lion, Fisherman's Arms.

TO MY MIND there's no saltier place in Cornwall than the Falmouth area, a fishing center where artisans lovingly build both fishing boats and yachts. On a bright blue and gold day I wandered along a wharf on the Penryn River and came upon Hutley Winnan, skipper and part owner of *Sapphire*, a 78-foot former Dutch trawler modified to dredge for scallops. Hutley and a crew of five take her ten to thirty miles offshore on three-day trips, working around the clock. And if luck rides their trawls they may bring home 3,000 dozen scallops, to use his way of figuring.

Booms for the dredges, including their chains, looked ponderous to me, and Hutley, a wind-reddened man of powerful build, agreed. "We can't work that gear in bad weather—anything above a force 6 wind [25 to 31 miles an hour]. It's the ground swell that gets us. We work in fifty fathoms at most, and each drag takes an hour and a half. When the weather comes up, our big problem is getting that gear aboard."

Like every commercial fisherman I ever met, Hutley was reticent about how much he made from the sea, but he did say, "A lot of people enjoy their work as a hobby, and that's perhaps what I'm doing. There's one thing sure: I wouldn't work the hours ashore that I do at sea."

Then he laughed, and because love of the sea was so obviously a part of this man's life, I didn't believe his next statement: "We don't get seasick any more, we just get sick of the sea." After the exhausting ordeal of a storm perhaps, but for skipper Hutley Winnan there will always be the eager



Heads of state stand neck and neck with other famous and infamous figures from Madame Tussaud's Wax Exhibition (left). These retired busts are kept in storage near Wells. To recapture the head of Mary Queen of Scots, wax will be poured into the mold being fashioned from a sculpture in a studio at the museum's London galleries (above).





expectancy of a new day and a new voyage.

Falmouth Technical College teaches boatbuilding to young men from all over Europe and from several African countries, as well as from Britain. It instructs in fiberglass techniques, but still encourages students to master traditional boatbuilding in that oldest of materials, stout honest wood. Entering a shop room, I found myself sniffing as appreciatively as a gourmet in a master chef's kitchen: no doubt about it, the aroma of oak and mahogany being shaped and worked. And there, nearly finished, a 23-foot launch, with beautiful joinery and planks fitted and fastened with obvious care, sat in her cradle. She would be used by the college to teach navigation to students.

"We will always teach traditional boatbuilding," Ronald Martin, head of the program, assured me. "It is in the heart of every youngster to build a traditional boat, and every man wants to sail one."

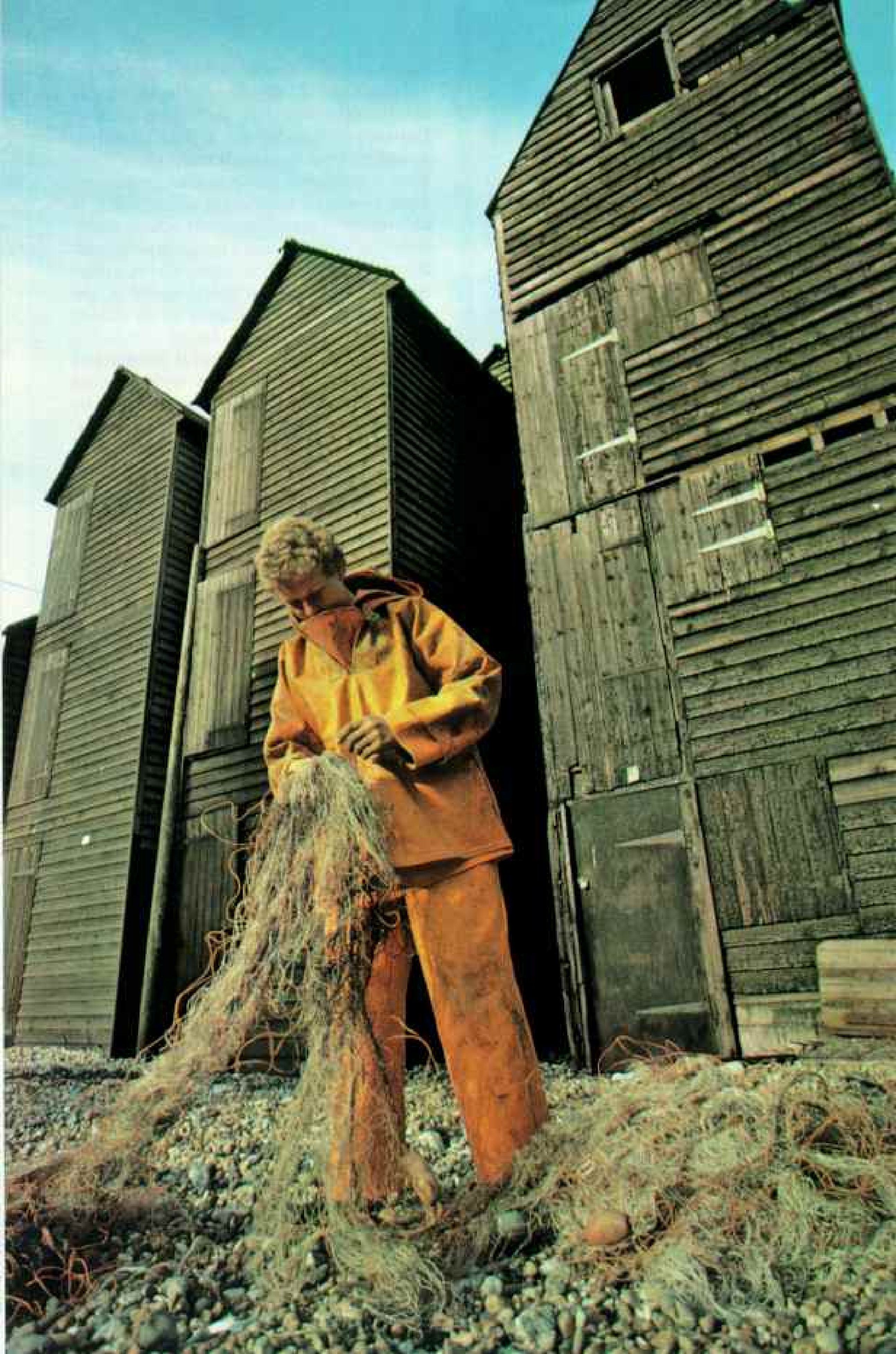
THE SOUTHWEST peninsula's frequent comparison to the Riviera is not just the loose imagination of a publicist. The comparison seems particularly apt at the rather posh resort city of Torquay, built on seven wooded hills that look down upon a protected small-boat harbor reminiscent of Monte Carlo.

Devon's neat, compact farms boast some of the prettiest pastures and fields in England, and you don't know the true impact of calories until you've stopped at a rural inn and devoured Devon clotted cream, fresh scones, and strawberry jam.

But there is yet another Devon, high, bleak, treeless, for many a place to hurry through before darkness falls and dreads too primitive to acknowledge rasp one's nerves. That would be Dartmoor, the storied, wild moorland, an eroded stump of a long-ago volcanic mountain chain, and site of the notorious prison.

Frankly, I love Dartmoor. To explore it, to stay overnight on its fringe, I lodged near

Latter-day Lancelots do battle at one of the jousting revivals held in Hertfordshire between April and October. Injuries—mostly broken bones—occur despite such safety gear as shock-absorbing lance tips.



Chagford at an inn, a mossy stone pile so old that part of it dated back to forty years or more before Columbus reached America. Dartmoor is now a national park, and you can drive through it quite easily, with only an occasional stop to make way for black-faced sheep that wander across the road with the boldness of streetwise sparrows. But it's more rewarding to get out of your car, climb to some massive tor on the skyline, and look out upon that strange, brooding terrain, grassy yet virtually devoid of all else but gaunt ribs of rock, heather, and wind-tortured clumps of gorse or bracken.

Some people take a certain reassurance from being amid trees and hedgerows, fields and meadows. Remove these familiar things and many people feel a vague yet persistent unease; they stand exposed, more vulnerable. But to me a vantage point on a high tor, looking out upon the monotone of a moor, green yet hardly more hospitable than an open sea, induces a sense of isolation and singularity that even gregarious spirits need. Private moments for old dreams and lost years, for reflection and assessment.

Again I felt that strong sense of changelessness that so much of England evokes. Beyond the moor, beyond the distant meadows, beaches and resorts lured gay holiday throngs, and the benign air embraced all.

And once more I thought: Malaise in Eden? Surely not.

MOTHER OF PARLIAMENTS, that admired, even revered assembly, example and model for free men everywhere. I stand expectantly in the Central Lobby of the House of Commons. Suddenly a voice cries out, "Mr. Speaker!" Another orders, "Hats off, strangers!" Then, marching as precisely as Coldstream Guards, six men in somber black pass by: senior doorkeeper; sergeant at arms, carrying the mace; the speaker, resplendent in wig and silk knee breeches, with silver buckles on his shoes; his trainbearer, holding up his elegant robe; his chaplain, and his secretary. None wastes a glance on the crowd gathered to watch this opening ritual, held daily when Parliament is in session. Like sturdy ghosts, the six men pass into the House chamber.

But today in England that which once was unthinkable is now finding voice. A growing number of people want to limit the powers of Parliament.

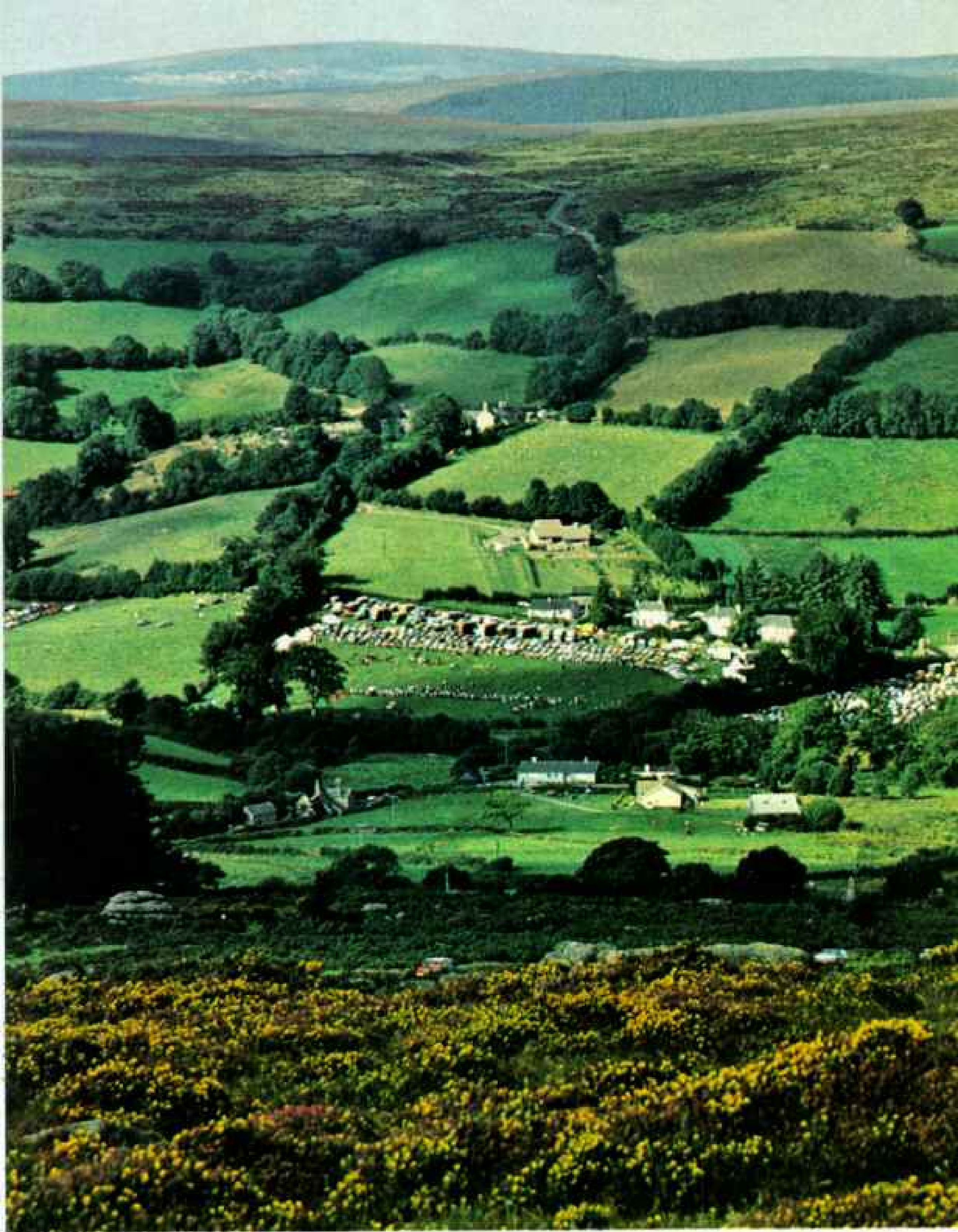
An act of Parliament, if its meaning is clear, cannot be challenged. No court may review its constitutionality. Technically the monarch can refuse to give assent, in effect a veto, but no longer exercises that power. Britain has

(Continued on page 467)

Caught up in a knotty problem, Kevin Bollen unsnarls damaged fishing nets on the coast at Hastings, where net storage sheds have been a fixture for at least two hundred years (left). The sheds were stacked to avoid ground-rent payments and to preserve space on the narrow shore for outdoor work.

At Grimsby, a dock worker unloads cod from a basket (right) just swung from a trawler. The city near the North Sea coast is England's largest fishing port, receiving 71,650 metric tons of fish valued at 54.5 million dollars in 1978.





Laced by dark foliage, mottled fields blanket the rolling hills of the Dartmoor region around Widecombe in the Moor. Visitors swell the Devonshire village's population every September, when the Widecombe Fair, celebrated first in ballad and now in tourist guidebooks, hosts livestock displays and craft demonstrations such as roof



thatching. The valley, graced by the 14th-century St. Pancras Church, scrapes a hard farming existence from shallow rocky soil that supports sheep, cattle, and small gardens. Legends found more fertile ground in the misty, craggy moors (background), where ghosts, pixies, and the Devil on horseback are suspected to roam.



no written constitution; it lives under a large body of written law, common law, and ancient custom. Even the most controversial of legislation, passed in Commons by the narrowest of margins, cannot be changed except by Commons itself.

In recent years the Labour government pushed through Parliament by close votes numerous acts with questionable popular support. That has aroused frequent comment from Lord Blake, Provost of Queen's College at Oxford, a Conservative and an expert on Britain's unwritten constitution.

"A majority of the House of Commons can do absolutely anything it wishes," Lord Blake told me. "I think the Labour government pressed its powers beyond what custom and usage have permitted in the past. Five years ago it was put in power by the votes of only 39 percent of the people. Other governments only narrowly in power have not felt they had the moral right to pass highly controversial legislation."

In the cavernous but magnificent chambers of the House of Lords, I sought out another legal expert, Lord Hailsham, a minister in the Conservative government and a leading critic among those seeking a written constitution and bill of rights. Looking very much the British lion behind his massive desk, Lord Hailsham said, "Parliament is an absolute power, an elective dictatorship in legal theory. In actual practice, of course, it has not been a dictatorship, but it has approached in practice what it is in theory. The Labour government ignored the rules of the constitutional game."

Again Sir Richard Marsh, the Newspaper Publishers' Association chairman and former Labour minister, shrugs off such views.

"The majority of front benchers [government ministers] of both parties could be interchangeable," he told me. "Parliament is constantly looking for things to have a phony war about. This is a very stable and conservative country, but its politics are incestuous, and people attach too much importance to the posturings in Parliament."

CASTLE COMBE, an ancient place named in the *Domesday Book*, the census ordered by William the Conqueror, lies on the southern fringe of the Cotswolds, and some say it really isn't in that region at all. No matter. It belongs there in looks and spirit. In the village's center, at the old market cross, where wool merchants once hawked their fleeces and cloth, I reflect upon the fact that Castle Combe was voted the prettiest village in England. And thereby hangs a tale.

"It happened several years back, some sort of poll that was run by the tourist people," recalled Dr. P. J. King, the village physician and former chairman of the parish council. "After the result was announced, we had a deluge of visitors, almost a siege. Thousands of people clogged the roads, and extra police had to be called in to direct traffic."

I hope Dr. King will forgive me if I say that, to my eye, Castle Combe is not the prettiest village in England, or even the prettiest in the Cotswolds.* Bourton on the Water and Lower Slaughter, both with streams running through them; Broadway and Painswick, Stanton and tiny Stanway, all these and others seem prettier.

Even the names of Cotswold villages are lovely and come liltily to the tongue: Chipping Campden and Stow on the Wold, Upper Swell and Lower Swell, Yatton Keynell and Moreton in Marsh, the stones of their cottages glowing in the sunlight as if touched by Midas himself. The limestone hills that hide these villages, like shells protecting pearls, average only 300 to 400 feet high and extend a mere sixty miles from the north to the south. But in days before the motorcar they effectively contained local people and walled out the madding crowd.

The sturdy yeomanry are mostly gone now, their cottages the homes or weekend haunts of sales executives, airline pilots,

*James Cerruti described "The Cotswolds, 'Noicest Parrt o' England'" in the June 1974 *GEOGRAPHIC*.

Eyeball to eyeball, two calves show the pugnacity of Chillingham whites, Britain's only remaining pureblood wild cattle. Fighting determines the sole bull that sires offspring; the herd kills calves touched by humans. A sanctuary near Scotland protects these descendants of a strain reputedly bred for Druidic sacrifices.



Put out to pasture after service at sea, herring boats were halved and boarded

retired stockbrokers. In the English way of life today, the Cotswolds are the shadow, not the substance.

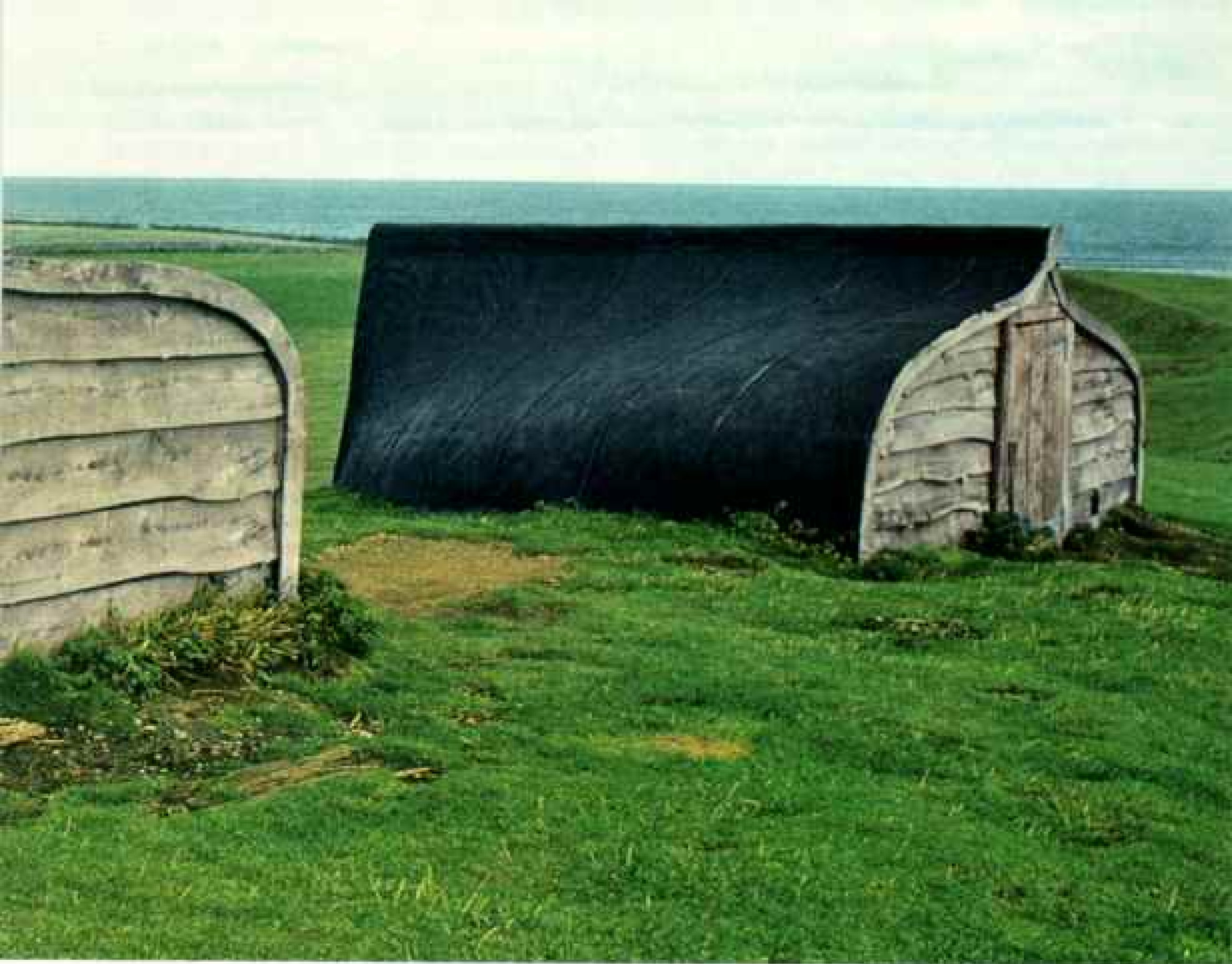
ELDERLY, frail looking, the worker at the Ford assembly plant in Essex says he has a maintenance job. Sadly, he tells me he used to drive for the company, but a heart attack cost him that job. "Inflation is a killer," the man says. "Before my illness I made fifteen pounds more a week. I was able to put money away for a rainy day. But we've been hit by a monsoon, and it's all gone. It's a struggle for me to live. I can never see myself well off. Thank God I've got a wee house of my own."

Not many working-class people own their homes. Thirty percent of everyone living in Great Britain, including more than half the Scots, live in council, or publicly owned, housing. This can vary from massive tower

blocks to tiny, boxy cottages, rebuilt row houses, or compact but attractive contemporary dwellings. Rents are cheap, and there isn't enough public housing to meet the demand.

Britain crowds 600 persons into every square mile, ten times the density of the United States. Four of every five people live in towns; seven million reside in Greater London. Many exist in severely cramped and overcrowded quarters.

To relieve this congestion, particularly in the London area, and to create places of new hopes and new beginnings, the government years ago launched bold, imaginative programs. Expanding towns, old places seeking new blood and an end to stagnation, undertook government programs to help relocate businesses and city workers. Large new towns, ultramodern communities that began as gleams in planners' eyes, were



for second careers as fishermen's sheds on Holy Island, also called Lindisfarne.

built, luring hundreds of thousands to new jobs and new lives.

NORTHUMBERLAND. *Near Winshields Crag, high in the lonely moors just south of the Scottish border, I look down upon mounded stones writhing across the bleak countryside like a snake, with coils slithering down and up a series of ragged bluffs as far as the eye can see. This massive work is Hadrian's Wall; in the second century the Roman Emperor Hadrian ordered it built from North Sea to Irish Sea to seal England off from the warlike tribes of Scotland. At times the wind virtually pins me against the rock on which I lean, and a skylark casting melody away in carefree abandon overhead is my only link with another living creature.*

It's surprising how easily one can find solitude in a land as small and crowded as

England. Nowhere is this more evident than in Northumbria, a modern-day region that includes four northern counties: Northumberland, Cleveland, Durham, and Tyne and Wear. Even in Northumbria's rolling farmlands you get a feeling of sweep and openness quite unlike the scale of tidy Devon and Surrey.

Hadrian's Wall once extended more than seventy miles across one of the narrowest parts of Britain, from near Newcastle upon Tyne in the east to beyond Carlisle in the west. Parts of the wall still stand for great stretches. The Romans originally specified that the wall should be ten feet thick and high enough so the top would be beyond the reach of a man standing on another man's shoulders. As many as 5,500 cavalry and 13,000 infantry were stationed along that outpost, and at a few places like Chesters Fort you can still see remnants of barracks,

Friendly persuasion disguises sly citizen traffic control in St. Ives (**below**). Placers of such signs hope "polite" is misread as "police" by tourists whose cars glut the narrow streets of Cornish villages. Far away in a more isolated setting, Margaret Mudd (*facing page*) and her husband raise sheep on the Yorkshire Dales.



stables, commandant's quarters, and bathhouse facilities. For two and a half centuries Romans patrolled their wall, most of it built in the incredibly short time of six years.

After the Romans went home, ancient Northumbria became an Anglo-Saxon kingdom, and it knew a golden age as a cradle of Christianity. Today it's often called the Castle Kingdom, a region that can boast more grim stone fortresses than perhaps any comparable area in the world. I visited several, but most enjoyed Raby Castle, with its lovely deer park and huge rooms containing elegant but fading furniture, rugs, and wall hangings. Lord Barnard, the 11th of his line to live there, owns much of County Durham, and it takes all his rents just to keep his castle going. Elizabeth Steele, the curator, told me Raby Castle needed a fortune in repairs. Inheriting a barony isn't what it used to be.

In Northumbria you can't go anywhere without brushing up against ghosts. Raby has the persistent shade of Lady Elizabeth Barnard, who sits on the castle roof and knits with red-hot needles. Serves her right too. She and her husband became so spiteful toward their eldest son and heir that in 1714 they removed the castle roof, stripped the place, and sold everything. Ever since, Lady Elizabeth has been known in the family as the "old hell cat."

Even Lumley Castle, now a hotel that most nights stages an Elizabethan banquet, must live with its own female ghost. My dinner companion told me a tale about a beautiful woman known as Lady Lily. Because she wouldn't give up her heretical beliefs, monks at a local abbey tortured Lady Lily to death. Now she wanders the hotel's east wing, where dogs and cats resolutely refuse to tread.

For a respite from ghosts we dropped into the pub of the Lord Crewe Arms in Blanchland, housed in a 12th-century priory. I ventured into a side room, once part of the crypt, and the proprietor followed and told me about Dorothy Forster, whose father owned the place many generations ago. Dorothy occasionally materializes in the side room and asks visitors to take a message to her brother in France, who was exiled after the Jacobite rebellion of 1715. Since I had no time for a detour to the Continent, I retreated to the bar.

Yet another old ghost, one that must be taken seriously, haunts Hadrian's Wall: the spirit of separateness and division that still sets England and Scotland apart nearly 2,000 years after Romans built their barrier against Scottish "barbarians."

DOUGLAS HENDERSON, once a representative of the Scottish National Party in Parliament, speaks quietly but vehemently during our luncheon. "For a long time Scots found emotional satisfaction in the British Empire. In support of the empire, Scots scattered all over the world, and all Scots felt they were playing a role in some larger purpose. But this is over now." Mr. Henderson pauses, his voice hardens. "Power has been drained out of Scotland in both the public and private sectors. We have a revival of confidence in ourselves, but



successions of governments in London have totally failed to come to grips with the problem."

Devolution, the move for home rule, may not be dead; perhaps it merely slumbers. The Welsh nationalist party, known as Plaid Cymru, and the Scottish National Party both supported devolution, but only as an interim step toward even stronger self-government.

Scotland, more than Wales, has long had a measure of home rule. Its law differs from English law, requiring a separate court system, and it has many administrative departments with no counterpart in England or Wales. In England there is an old saying, "Everything is different in Scotland."

Douglas Henderson applauds the differences, but he adds, "It isn't enough, because Scotland doesn't determine any of the policies."

Dafydd Wigley of Plaid Cymru, currently a member of Parliament, joined our luncheon and expressed similar dissatisfaction. "There has not been a coherent economic development of Wales," he said.

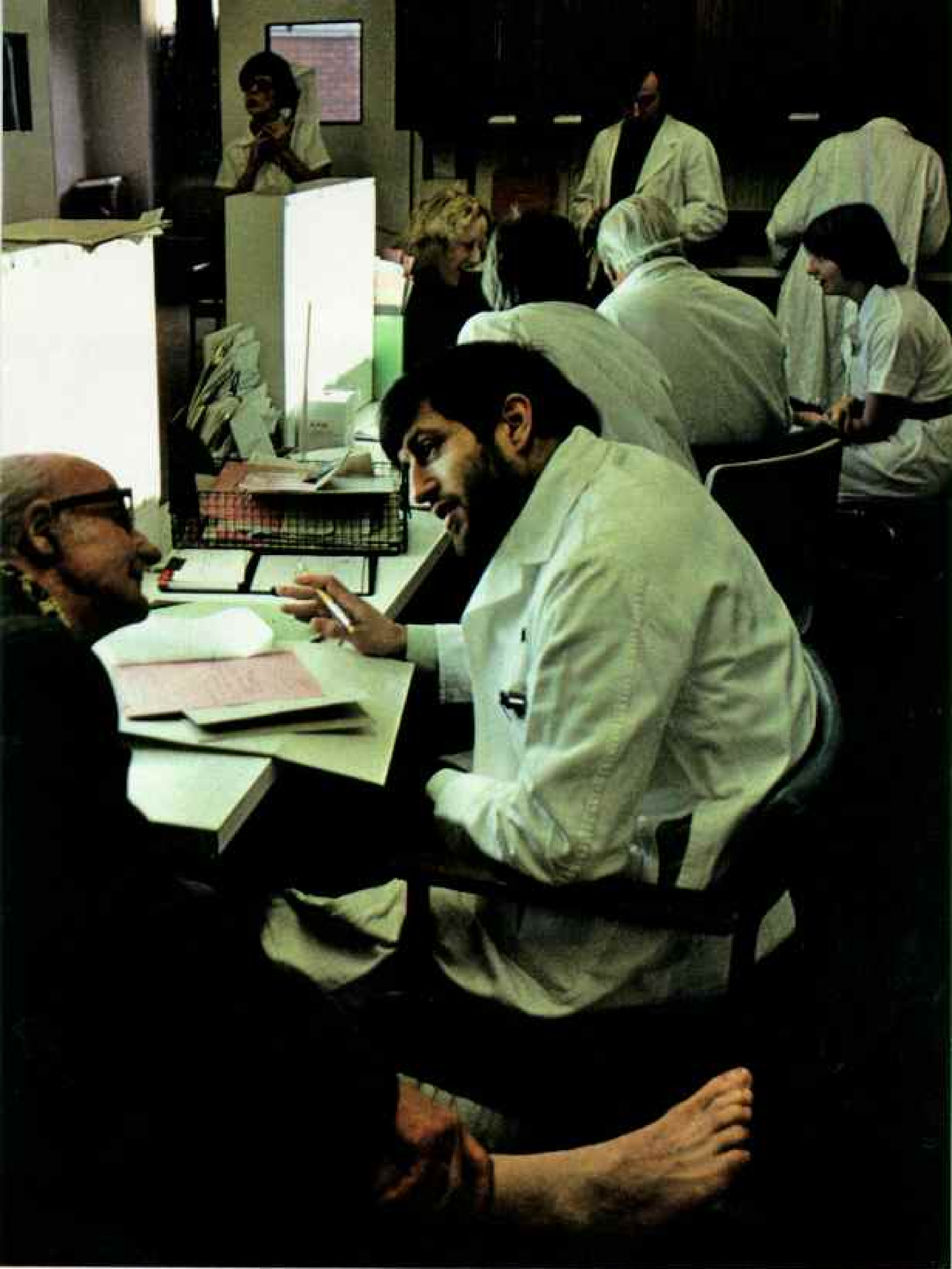
I asked how two such tiny lands could survive financially when at times in recent years the economic viability of the United Kingdom itself seemed in question. Wigley talked about the productivity of Welsh industry, including coal mining, and Henderson had a sweeping solution for the Scots' money problems: North Sea oil, he claimed, was being siphoned from beneath Scottish waters and belonged to Scotland alone.

PERHAPS THE SCHISM represented by devolution is neither as deep nor as general as class differences. They remain a factor in the clash of ideologies. " 'Them and us?' That's purely an attitude of mind today," a prominent Englishman told me. He meant that economic advantage, once virtually assured for anyone born into the upper or middle class, had undergone a leveling. But the Englishman, like the Hindu of familiar doggerel, often "sticks to caste, from first to last," as any foreigner long familiar with England knows.

At times Britain's class differences can be wryly amusing. Union leader Len Murray, criticizing the quality of some industrial managers, told me, "There is still the old



Doctors send no bills to the majority of their patients. Nearly all medical costs,



STEVE BINNER

such as treatment for this injured ankle in Birmingham, are picked up by the National Health Service. But complaints about the quality of care make socialized medicine a hotly debated subject.

Toasts begin when tests end for Oxford university students who take to the streets for traditional champagne celebrations (right). Awarding of a first degree—comparable to a bachelor's—hinges on one two-part exam.

Tradition at Christ's Hospital includes somber bluecoats (below). Founded in the 16th century for needy boys, the school moved from London to rural West Sussex in 1902.



nepotism, the tenth possession of a foolish face." That same week a friend introduced me to a rather pompous factory owner. He said his employees had just gone back to work after a strike, and he confided: "I can't stand the sight of their working-class faces."

During the severe drought of 1976, London newspapers ran big advertisements asking people to conserve water. Labour papers featured an appeal by Len Murray, and Conservative papers ran virtually the same

appeal by Harold Watkinson, then president of the Confederation of British Industry. In England even water conservation becomes "them and us."

EAST ANGLIA. At Bury St. Edmunds I stroll through a public garden, softly aglow with flowers, impeccably groomed, but unusual because it encloses a shrine for free men everywhere. Around me in the gloaming the ruins of an ancient abbey



rise like misshapen specters, and a plaque on an old gate tells their story: "In November 1214 the Barons took an oath before the high altar in the Abbey Church at St. Edmund's that if King John did not yield to their demands they would make war upon him. At Runnymede on 15th June 1215 came the sequel, when the King set his seal on the Magna Carta." Nearby a crumbling remnant of a wall that stood beside the altar bears another plaque with names of the 25 barons

who made the pledge, resolute men still remembered and honored after more than seven centuries.

When I think of East Anglia, the word variety comes to mind. This region offers something for everyone.

Are you a history addict? Commune with the past, as I did, at Bury St. Edmunds, named for King Edmund, slain by invading Danes in the ninth century. Or stand on the lonely shingle at Dunwich, a proud city in



medieval times but now less of a remnant than the abbey church immortalized by the rebellious barons. The onslaught of the North Sea filled in Dunwich's harbor, obliterated its homes, and bore away its churches and the bones of its dead.

Do you like the sporting life? Then go to Newmarket, center of horse racing and breeding, where 1,400 Thoroughbreds are in training in a 2,500-acre complex including barns, rings, and practice runs owned by England's august Jockey Club. Here horses have the right-of-way, just as elephants do in East African parks. Traffic lights in Newmarket even have chains that men on horseback can pull to stop cars.

Are you a music lover? The annual Aldeburgh Festival has long been one of

Europe's premier musical festivals, held in an impressive new concert hall with the improbable name of Snape Maltings. The hall's barnlike exterior stands on the site of a previous concert hall in an old malting house. In a very real sense it is a monument to the late English composer Benjamin Britten, who resided in Aldeburgh.

Do you revel in the color and flavor of a fishing center? Go to Lowestoft. Some seventy deep-sea trawlers more than eighty feet in length, and innumerable smaller vessels, call its stone quays home port. Working the North Sea can be bitterly cold, exhausting, and dangerous. G. J. Y. Thorpe, a fisheries inspector, told me a study by a royal commission had concluded that a crewman on a trawler was seventeen times more likely



The scenery of the sea could upstage the show at the Minack Theatre, nestled among the rocks near Porthcurno, Cornwall (left). The concrete stage and seating were built almost single-handedly by Rowena Cade over the past 47 years. Though 86, Miss Cade, employing her customary chair (above), still works on improvements.

WAVES OF WHITE GOLD surge below the sun at Perranporth beach as a sand yacht glides toward an angler on Droskyn Point. Bathers, surfers, hang-glider pilots, and sky divers also relish this playground on the north Cornwall coast, where lofty cliffs overlook an unbroken swath of sand three miles long and up to a half mile wide.





to be killed than a man in any other job.

"The men are so often tired," Thorpe explained. "You're out there 10 or 12 days at a time, and when you haul fish in, everybody must come up from belowdecks and help. The most sleep you get at one time is a couple of hours, and you're on a heaving platform in some of the worst weather in the world."

Are you a bird-watcher? East Anglia has scores of sanctuaries, places such as marshy Minsmere near Westleton, where a hundred

species breed, including such English rarities as the avocet and bittern.

Is boating your passion? Visit the Norfolk Broads, a series of small, river-connected lakes, formed from pits where men for centuries dug peat. I found the largest, Hickling Broad, so heavily used that engine exhausts and turbidity stirred up by propellers had contributed to the killing of fish and some plants. But such is nature's resilience that reeds still grew in profusion, and bird-watchers could glimpse snipe and redshank, marsh harrier and shy little bearded tit.

Despite recent growth, East Anglia remains the most thinly populated region of England. No big cities confine its people or besmirch its skies, though not far to the southwest the vast conurbation of London, a different and crowded world, sprawls over into Essex.

For a quarter of a century I have been in love with London, and over the years I have seen it draw more and more visitors. They come to see timeless London, the London of Buckingham Palace and Westminster Abbey, of the Guildhall and Tower of London and British Museum, street markets and parks, and the smart shops of Oxford and Regent Streets.

They do not know the other London, the London of confrontation and division. Despite my love of the city, there are times when its crowds, its often bitter political and economic differences make me seek a brief respite, and then I escape to the different, though nearby, world of Surrey or Berkshire or Hampshire—the other England.

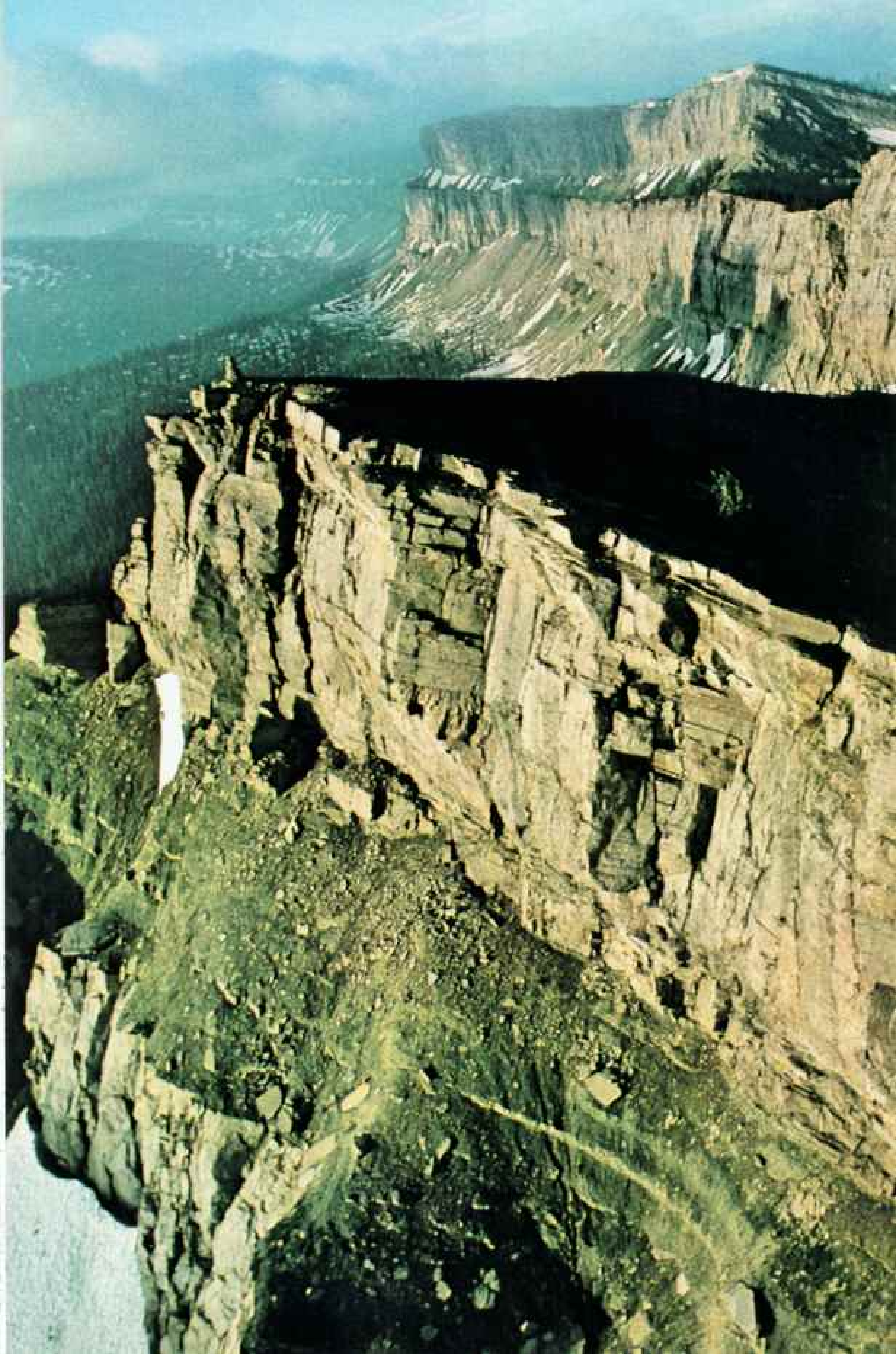
RURAL HAMPSHIRE. *We have dined wisely and well at the White Horse in Droxford, and now we walk in silver, for the mist rises from the meadows and a full moon shines. Silver barn and silver lane, silver air and silver sky: a monochromatic but rich world awash in sterling, and quite magic. Surely on such a night we may hope to see the White Horse ghost, the woman in the gray crinoline dress. But no wraith slips through the mist. Perhaps we have dined too wisely.*


How lovely and evocative the old, unchanging England, the other England, solid and timeless, an ancient rock in the quicksand of the present. □



When your meal stares back, it's Tom Bawcock's Eve in Mousehole. Every December 23 the Ship Inn bakes starry-gazy pie, named for the fish heads looking skyward. The dish honors the Cornish fisherman who, legend says, braved storms to save the starving village. In Clovelly, a porter hauls luggage up the stair-stepped main street, avoided by autos (right).







Along the Great Divide

By MIKE EDWARDS
NATIONAL GEOGRAPHIC SENIOR STAFF

Photographs by
NICHOLAS DEVORE III

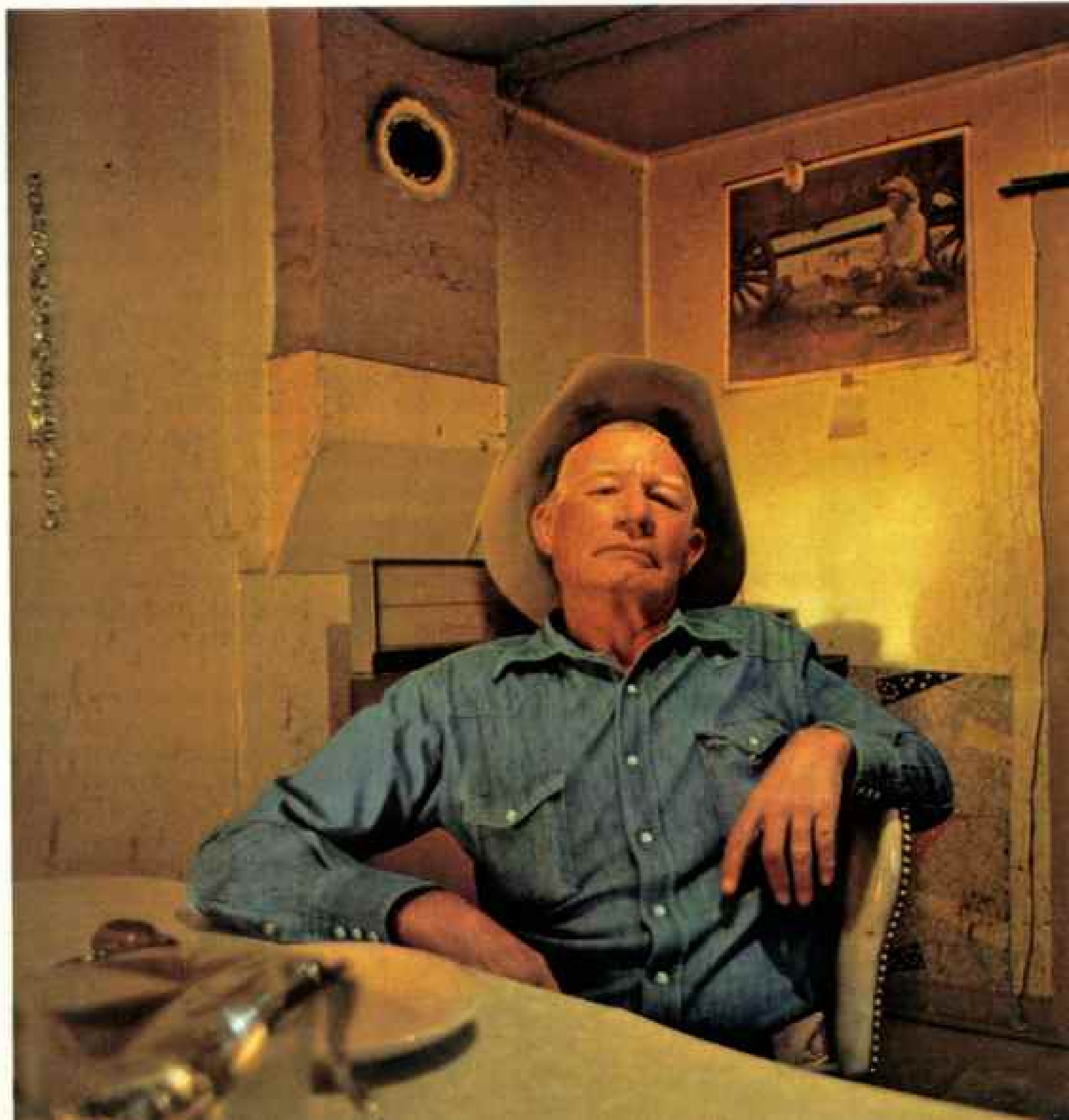
DIVIDE (verb): TO SEPARATE. Scaling mountains and creasing deserts, the Continental Divide gives a destiny to each raindrop, each snowflake. For some, the Gulf of Mexico; for some, the Gulf of California and the Pacific; for a few, Hudson Bay. And for a very few, captured in Wyoming's Great Divide Basin, nowhere at all.

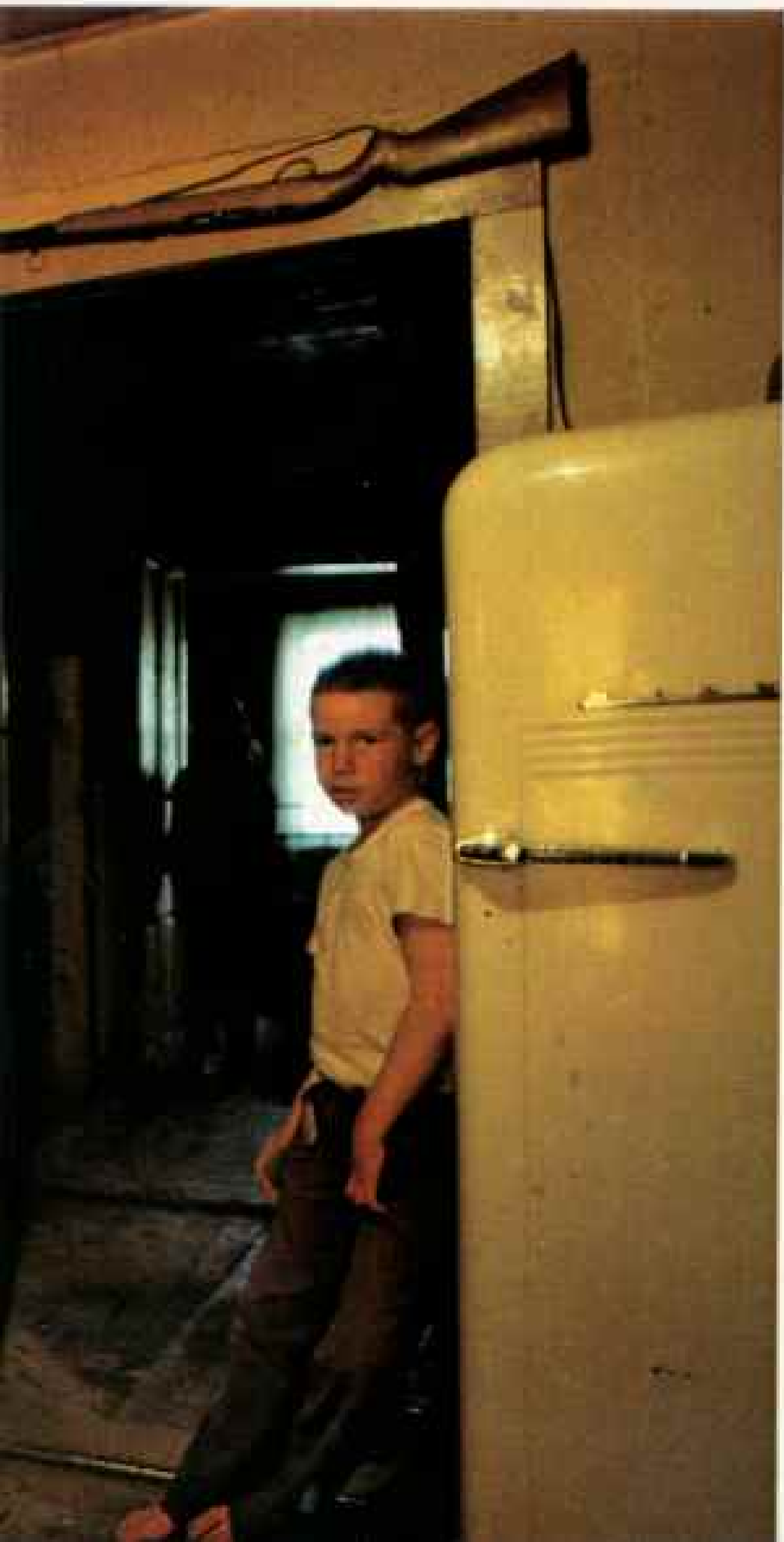
But in March in the southwestern section of Yellowstone National Park, beyond Old Faithful, beyond roads, the snow seems destined only to cloak a wilderness. It is . . . how deep? Six feet? To guide ski travelers, little orange markers have been nailed to trees by a ranger standing on horseback. I see them now at eye level. Great balls of snow in those trees make grotesque shapes. Hunchbacks, gnomes, elves, creatures of a white nightmare.

Five of us have ascended to the divide at 8,000 feet, then descended, only to cross it twice more the next day. In this part of Yellowstone, the continent's backbone needs a

Riding the crest of heroic landscapes, the Continental Divide parts watersheds on a huge scale. Centerpiece of our newest and longest national scenic trail, the divide here courses south on the brow of Montana's Chinese Wall.

NICHOLAS DEVORE III/BRUCE COLEMAN, INC.





chiropractor. I am here to trace the new Continental Divide National Scenic Trail, which wanders New Mexico, Colorado, Wyoming, Idaho, and Montana. Adding this 3,102-mile route to the national trail system in 1978, Congress created a senior partner among pathways—700 miles longer than the Pacific Crest Trail,* 1,100 longer than the Appalachian. Yellowstone is one of three national parks the route crosses, along with 25 national forests, on its serpentine journey between the Mexican and Canadian borders (map, pages 492-3).

We have come up by way of the Firehole, that well-named river that drains Yellowstone geyser fields. The Firehole joins the Gibbon to form the Madison, tributary of the Missouri, which feeds the Mississippi. Firehole snowmelt is thus destined for the Gulf of Mexico. Going southwest, we follow the Bechler, which unites with the Falls, which joins the Snake, which sends its waters to the Pacific via the Columbia. Divide: To separate.

I climb mountains eagerly, but on skis I flounder. "Why did we ever come out here, anyway?" I moaned to Jim Sitton on our second day. Our packs topped sixty pounds. Fresh snow clotted Jim's mustache and my beard. One of Jim's boots had split open.

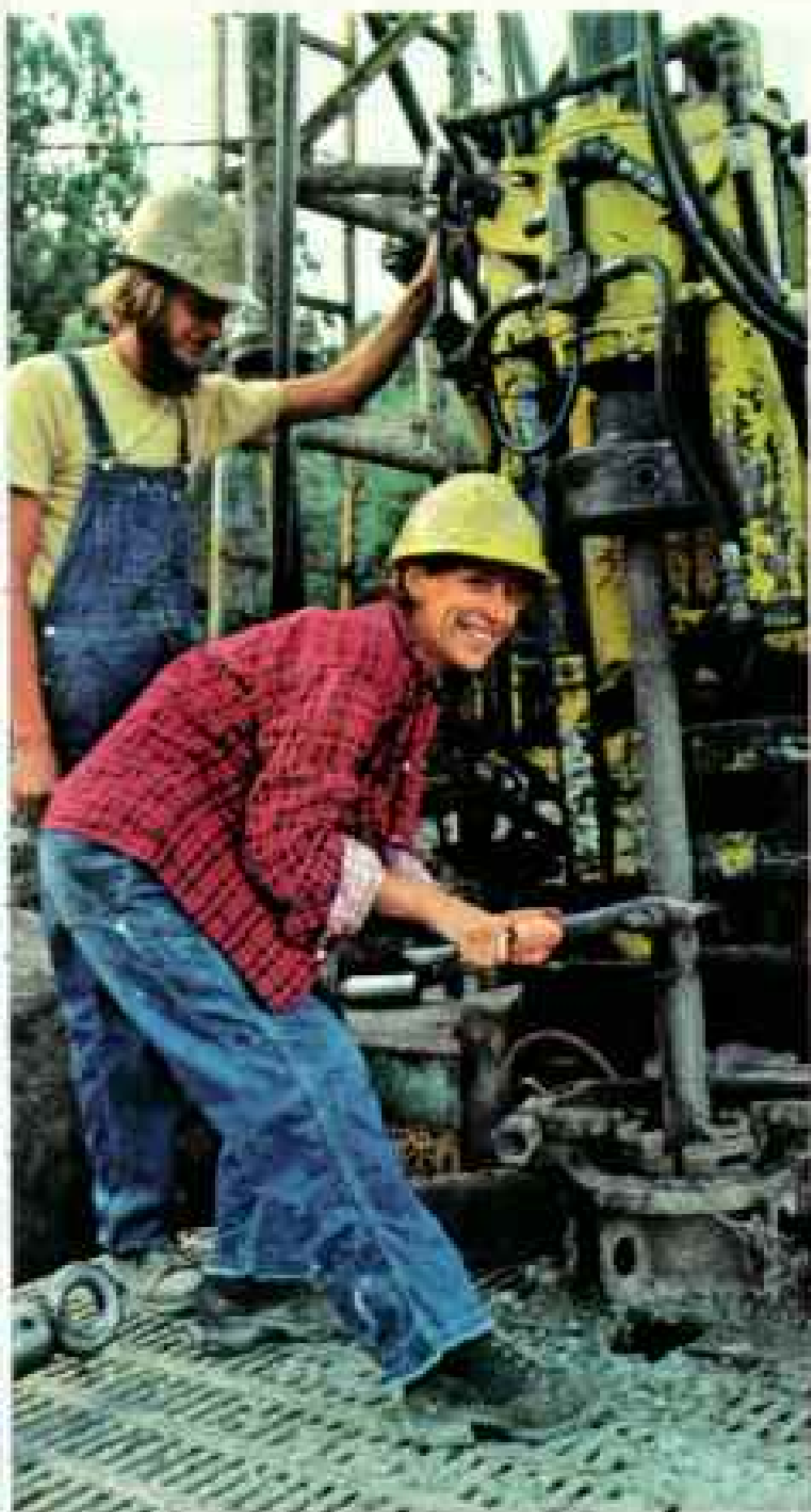
Not because of a shortage of wallpaper in Bozeman, Montana, is Jim's living room papered with topographic maps—for him, a wish book on walls. "This is the best time to see this country," he answered quietly. "When nobody else is around."

*The author wrote "Mexico to Canada on the Pacific Crest Trail," for the June 1971 *GEOGRAPHIC*.

Flat beginning for a trail of vaulting mountainscapes, the U. S. Customs station of Antelope Wells, New Mexico (top), faces another unhurried day as Inspector Ruby Madera-Font opens the border gate to Mexico. On a typical day she may inspect one vehicle.

In the small ranching hamlet of Datil, 200 miles north, Walter Burkhead (left, with son Wesley) remembers when sawmills were a thriving local business. "They just left us with the stumps," he says, adding, "it takes a hundred years to grow a decent tree in these parts."

No boom or bust for modern prospectors Pam and Jerry Spray (below). Paid by the hour to extract test cores of rock for mining companies, the husband-and-wife team never knows what geologists find in their samples. But here, along the divide in southern New Mexico, copper would be a good bet. Near Silver City lie two of the nation's largest copper mines, one of them owned by Phelps Dodge Corporation (right). Asked about special requirements for her job, Pam said: "You have to be able to lift about a hundred pounds. That's all."





"In three winter trips back here I've never seen another human track," declared Bob Schaap, our expedition leader. "What more reason do you need to be here?"

Other tracks, yes: coyote, elk, moose. Bob paused beside a set that ended in a spot of red on the snow. "Snowshoe rabbit," he said. "An eagle got it."

A Bechler tributary, bathtub hot, created a strip of summer between high white banks. Water plants thrived and insects floated the surface. We skinny-dipped in our own Jacuzzi, a steamy rapid.

"Only people who come in winter can enjoy this," Bob said. "When the snow melts, this water is almost too cold to swim in."

"Yeah . . .," mused Bob Lindstrom, another member of our party. "Something I noticed—no beer cans here."

The Continental Divide is in fact a hemispheric divide, splitting watersheds from Alaska's Brooks Range through the Andes to the Strait of Magellan.

To make a route between Mexico and Canada, recreation specialists stitched together paths in national parks and forests. Thus the trail was two-thirds complete at birth. The planners usually borrowed roads where no path exists, though in places a hiker must trek cross-country. The segment joining New Mexico and Colorado follows an old railroad bed.

The national scenic trail coincides with the divide for about a fifth of the way. Elsewhere it meanders within a few miles, crossing from watershed to watershed 475 times. A few hardy souls already have gone the 3,102 miles. The trip requires six months or more, and almost certainly means slogging through deep snowdrifts somewhere in the high country.

Most, like me, will challenge short segments of the trail. I logged 375 miles, south to north, by boot, horse, and unfamiliar ski. Nearly all of the trail is off limits to motor vehicles (including snowmobiles and bikes), but roads make many parts accessible for a walk of a day or two.

This trail divides not only watershed but also opinion—about what land's good for. Forces within the earth squirted a rich stew into cracks and cavities near the divide, spawning mine camps: Silver City, Durango, Leadville, South Pass City,

Butte—all old boomers. Grants, Gallup, Jeffrey City: new boomers.

Water captured by the divide made streams; beavers dammed them. Men came for the beavers. Other men came to build greater dams; more came to harvest the tall timber. And now in some of the most glorious places there are simply too many of us, shattering solitude as we seek its spell.

Yet the divide country is still virginal in some places, gorgeous in many others. Even its tale of human quest is seldom dull. And often it is something more: abiding. I remember the Biblical answer of an old man in Wyoming when I asked why he'd left a city to dwell beneath the great Wind River Range: "I will lift up mine eyes unto the hills, from whence cometh my help."

Desert Walk Draws Curious Stares

A big bird is watching me. As I awaken from a fitful nap in the sparse shade of a mesquite, I see it atop a yucca: a Harris' hawk—dark body, a patch of white on the tail, wings nearly four feet across.

I have walked since sunup. Stung by a hot May wind, dusted by passing pickups, lugging a gallon of water, I have logged 17 miles across the desert of New Mexico's boot-heel—the meanest hiking I've ever done.

"Around here, anyone walking is suspect," a rancher has told me, and I know he doesn't mean just illegal border crossers. Anyone hiking in this sun *has* to be suspicious. Even the hawk knows a body without a vehicle is alien.

A few miles west the Continental Divide rides the Animas range toward Mexico. I wish I were in the shade of the pines and junipers on those peaks, but there is no trail.

It was the road or nothing. So at sunup I touched the border fence and started north from Antelope Wells, the loneliest border station manned by U. S. Customs: one concrete building and two mobile homes on our side (pages 484-5), even less on Mexico's.

Dry and bitter, the desert nevertheless amazes with its abundance of life. At 6:30 a.m., with the sun a soft red ball, pronghorn hour begins. By 7:30 jackrabbit hour is in full bounce. At 8:30 doves are flying and quail walking. Gnat and fly hour buzzes at 11:30. In the afternoon, under my mesquite, I return the stare of the curious bird and

make a note to myself: 5 p. m.—hawk hour.

Two days later and fifty miles north of Mexico, I stopped in Hachita, town of tumbleweed and tumbledown, and got a drink from Virginia Been. A slender woman of 42 years, Virginia pumps gas, serves beer, and hustles the occasional troublemaker out of the Desert Den Bar. "It beats pickin' cotton," Virginia said.

Around 1918 as many as 50,000 cattle were shipped each year from Hachita. Virginia thinks a thousand people once lived in the town. Today, eighty. The rare newcomer is probably an employee of the Phelps Dodge copper smelter, twenty miles away.

Until recently copper prices were low, and only the efficiency of giant earth-moving machines enabled Kennecott Copper to continue pumping paychecks into Silver City, hub of this region, sixty miles up the divide. But watch out. "In a few years we're going to have a copper shortage that will rival anything you see in the energy picture," a Kennecott official said.

No doubt such optimistic predictions encouraged Exxon Minerals Co., U.S.A., to prospect in the pine-and-oak forests near divide-straddling Pinos Altos.

"It's a very good prospect," said geologist Frederick P. "Rick" Schwarz, Jr. "But we don't know how good, or how much it would cost to mine a ton of ore."

Proudly Rick showed me spots where drilling crews had explored and reseeded. Now each plot was a small rectangle of grass. "We tried not to leave any scars," he said. The pits, tunnels, and heaps of tailings here date from the 1860's, when a few men found gold but hundreds more found only disappointment.

Rick and I walked to a shallow pit. "Zinc," he said, picking up a shiny lump. "Maybe a little silver with it." His geologist's eye cruised the hole. "Maybe the man worked a year to dig this—a wasted year." He tossed the lump into the pit. "But if you're prospecting, you've got to believe in that pot of gold. It's still true today."

Barbed Wire Spurs Quick Dismount

A day of misadventure. My companions, Bob Williamson, supervisor of the Gila National Forest, and two district rangers, Mike Howard and Ron Bradsby, cannot find the

trail, using their own maps in their own forest. Pack mules crash their loads against trees. Harness snaps.

As we bushwhack, my horse, Comanche, catches a strand of barbed wire between a rear hoof and shoe and goes wild with panic. "Mike, get off if you can!" Ron yells. Tarzan never swung prettier than I onto the nearest aspen tree.

It's easy to lose your way in the 182,000-acre Black Range Primitive Area, on the eastern edge of the vast Gila Forest. A forty-mile-long trail follows the divide here, but access trails and signs are scarce. In four days we have met only two hikers.

From the North Star Road, northeast of Silver City, we climbed through ponderosas, aspens, and Douglas firs. Bob Williamson, whose sandy hair is phasing into gray, seemed determined to squeeze every drop of pleasure out of this rare escape from administrative responsibilities. "This wouldn't be nearly as much fun if everything went right," he declared the day we were lost.

We camped on a grassy slope at almost 10,000 feet. Panniers yielded steaks, potatoes, salad makings, iron skillet, and Dutch ovens. Preparing his sourdough biscuits, Bob declared with satisfaction, "This experience will last me a long time."

With my sleeping bag under the stars, my window on the universe was a rectangle of sky fringed by newly leafed aspens and a big Doug fir.

The next night we were under ponderosas. I awoke in the dawn mists to hear, close by, the gobble of a wild turkey. "The lordly gobbler—there is no finer game anywhere," Aldo Leopold once declared.

Leopold pioneered wilderness preservation before fathering the profession of wildlife management. In 1924 he prevailed on the Forest Service to set aside 750,000 acres of the Gila Forest as a region without human permanence. West of the Black Range this area remains roadless, fully protected now by the Wilderness Act of 1964.

Conservationists have long hoped that the Black Range Primitive Area could become an official wilderness too, named for Leopold, who died in 1948. But they and the Forest Service disagree on the acreage to be protected, and mining interests object.

Uranium mines cluster in the vicinity of

the divide where it courses between Gallup and Grants, big towns prospering off the bonanza. Approximately half the known U. S. deposits occur in this region. That is not the end of energy potential in northwestern New Mexico.

In the thirsty San Juan River Basin, among rimrocked mesas and scoured arroyos, I met Arthur Sandoval, tending sheep. Seldom have I known anyone more at peace than Arthur, a tall man of 40 years, shaded by the Navajo's wide-brimmed black hat. Tiring of graduate studies at the University of New Mexico, Arthur had returned "to civilization—*our* civilization, being out with nature."

This was Sunday. On Monday Arthur would travel to the Indian school at Pueblo Pintado, where he teaches. "But back here," he emphasized, "I'm home."

A few miles away a coal strip mine may soon heave up miles of land. Miners, construction crews, railroad lines: The impact will be enormous on this remote region. "I know there'll be strangers coming," Arthur said, "but I figure they'll stay on their side of the fence and we'll stay on ours."

I looked up Frank Willetto, who represents the Pueblo Pintado area on the Navajo tribal council. A Marine in World War II, Frank was one of the fabled "code talkers" who radioed orders in Navajo to confound Japanese eavesdroppers.

The strip mine? "I know there's going to be change," Frank told me. "Money is going to be here. Jobs. Violence, crime. All that comes with development."

Because the coal is largely owned by the Santa Fe Railway, Navajos will reap few royalties. That doesn't bother Frank. "No one can repay the Indian for what the white man has done to him. But if mining brings a hospital and new roads or helps us educate our people, that will be good."

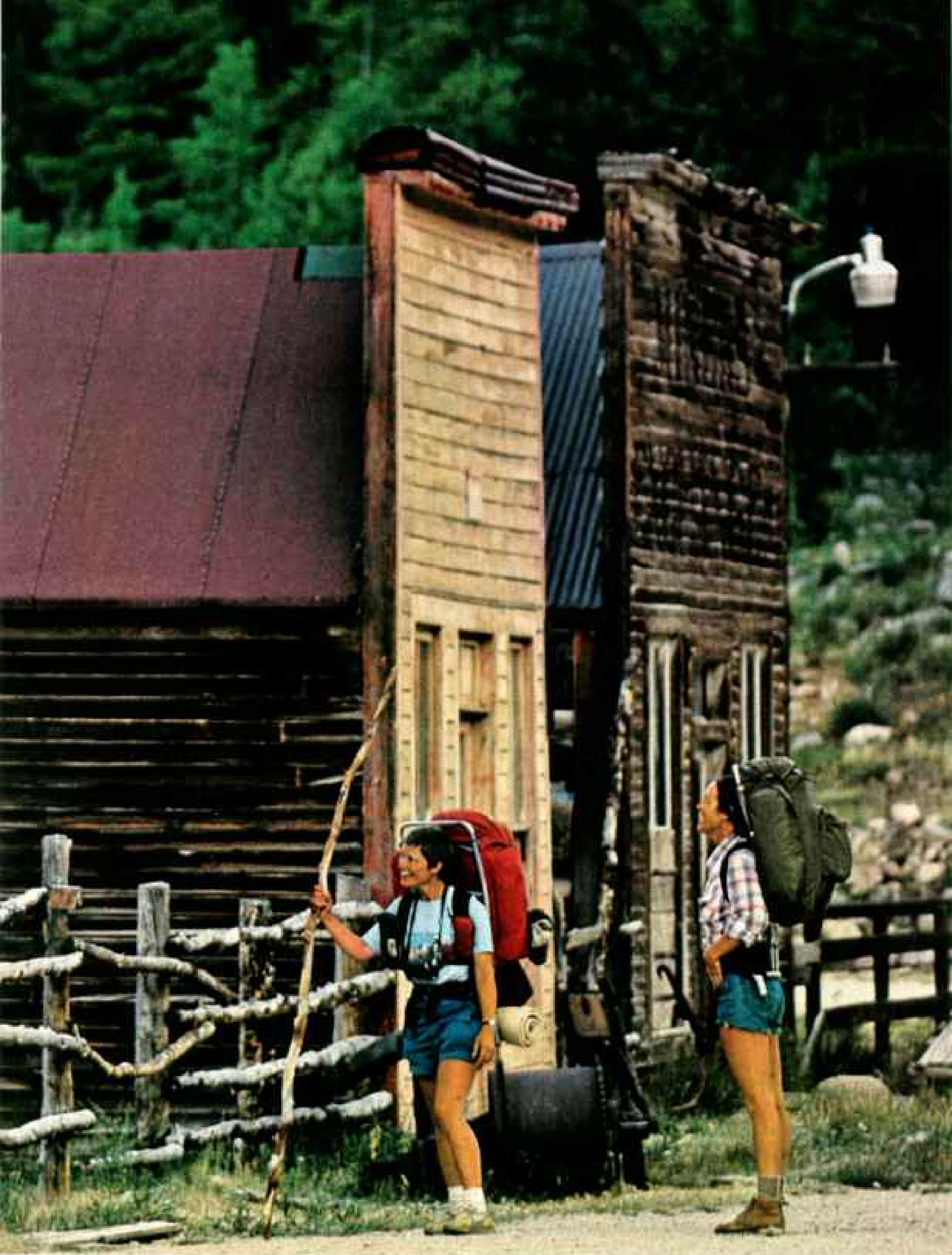
Conquering the Divide

The last six hundred feet of elevation: a terror for lungs and legs. Breathe; pull up a step; breathe. The heights surrender grudgingly in the Weminuche Wilderness of the San Juan National Forest in southwestern Colorado.

But each gain unfurls a new vista. A boggy meadow, lush with white-and-gold



Specter of frontier justice reigns over the main street of St. Elmo, one of



several Colorado ghost towns that now, in their afterlife, serve as vacation communities. Hikers Lynn Wisheart, at left, and Merlyn Jones enjoy the show.

Continental Divide



The new 3,102-mile trail follows the Continental Divide (red line) through the Rocky Mountains. Black dashes mark major places where trail leaves the divide.

Triple Divide Peak sends runoff to three oceans: the Pacific, Atlantic and Arctic.

WATERTON LAKES NATIONAL PARK

WATERTON-GLACIER INTERNATIONAL PEACE PARK



The Wind River Range contains 63 glaciers covering 18 square miles.

During the mid-19th century, between 250,000 and 400,000 westward migrants crossed the divide at South Pass.

To toe the line exactly would prove impossible, but the proposed Continental Divide Trail conforms with the natural divide as closely as is reasonable, crossing it 475 times. Using existing trails, the route was 62 percent complete when

marsh marigolds. Two lakes, blue panes on a greensward. Mountains and more mountains: the Grenadiers, the Needles, other snow-mantled ranges, piled against the sky.

At last, a whaleback of green at 12,700 feet, flecked with stunted yellow cinquefoils and alpine sunflowers. The divide.

There were six of us—including my wife, Lyn, and our son, Mick—who left Durango on the narrow-gauge Silverton train of the Denver & Rio Grande Western Railroad. The doughty steam locomotive chuffed uphill at 13 miles an hour, locked into a sinuous dance with the boiling Animas River.

We dropped off at a meadow called Elk Park, then entered the Weminuche and hiked up a few miles to a shelf of land shining with beaver ponds.

Sunset burnished Electric Peak as Mick, our provisioner, laid out the spices he'd brought to enliven our dried foods: coriander, cumin, oregano, basil, and more. Oh, we would be seasoned travelers! But salt: Where was the salt? No matter; with enough curry in the lentils. . . .

Thunder rattled among the peaks the next day as we continued upward. In the late

afternoon rain chilled our spirits. We came to a one-room relic of a miner's shack and crowded inside. Graffiti recorded earlier visitors: David, Julie, Jim, Paul, Barb, dozens of others.

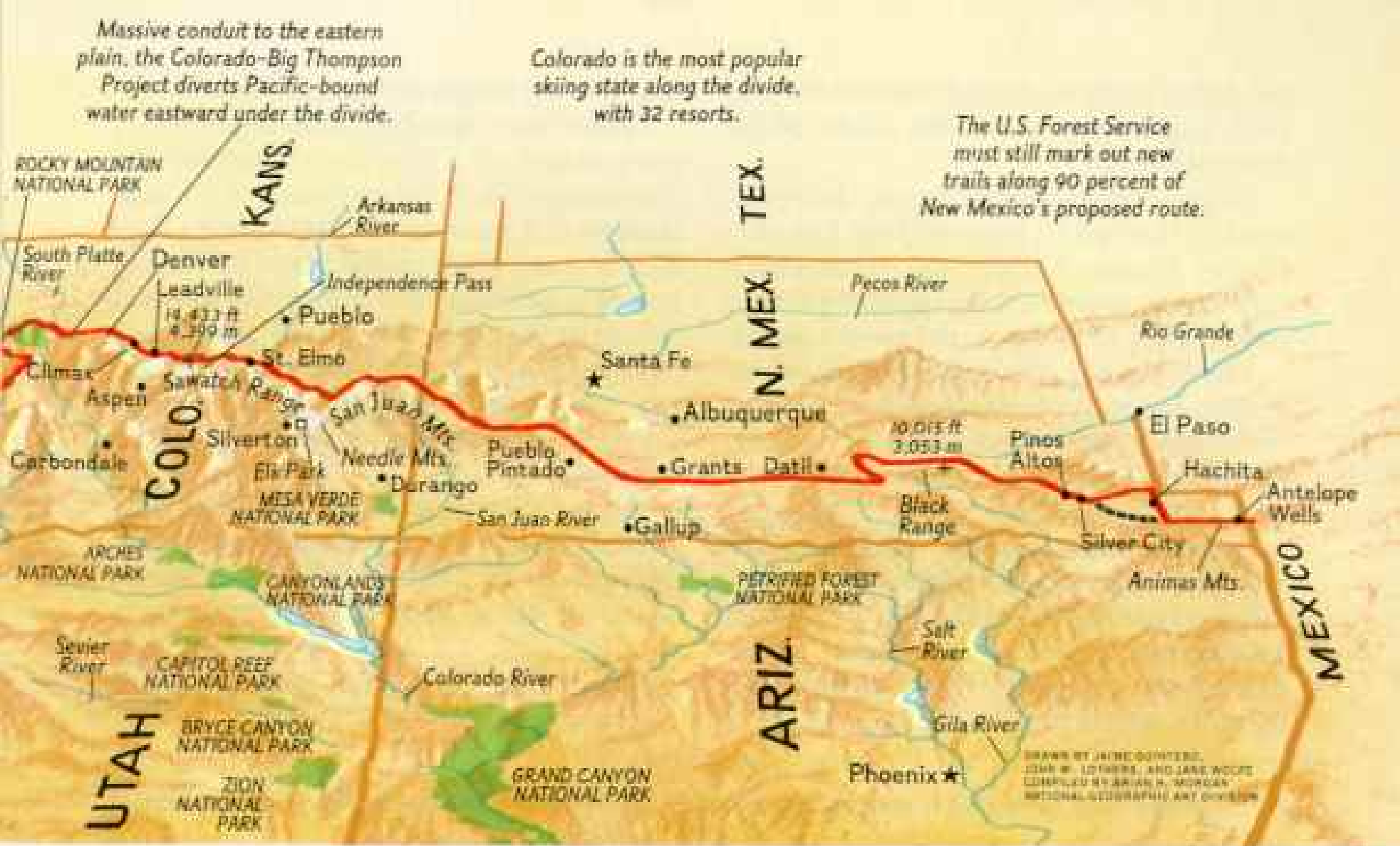
Near dark, a knock at the door surprised us. "Hi," said a young man. "Got room for seven more?" The sodden teenagers laden with gear glanced into the crowded room and moved off to sleep under plastic sheets.

Picking Up Trash in Paradise

Topping the divide next day, we cut south on a path already named Continental Divide Trail, then left it, edging along a mountain-side of talus. We descended to a trail splayed and eroded by hooves and boots.

The Weminuche is a huge wilderness—401,600 acres—but the part we chose, the part of greatest elevation and grandeur, pays dearly for being beautiful. Rangers are planning to limit traffic in the most heavily used areas.

Who left those sneakers . . . that towel carried off from a Holiday Inn? The best that can be said of such thoughtlessness is that it gave Ellen Klaver a summer job with



Congress gave the go-ahead for development in 1978. Even after remaining rights-of-way are acquired, lightly traveled roads and old railway beds will fill in gaps. The U. S. Forest Service hopes to have the route marked and maps published by 1981.

the Forest Service: "I don't mind picking up trash," she said, "because this is a place I care about."

I met Ellen on a trail that climbs along Johnson Creek, under the spikes of the Needle range. Things one doesn't expect in an official wilderness happened along that trail. A helicopter landed at the base of nearby Florida Mountain and collected two men. That night motors rumbled and lights shone on the mountain.

The next day I hiked to the other side of Florida Mountain and looked down on a camp of sheet-metal buildings, the summer home of drillers and geologists. Public Service Company of Oklahoma has been prospecting for uranium since 1975 on old gold and silver claims within the Weminuche.

"This area never should have been designated as wilderness," a geologist said. "It was known there were minerals here." And not only uranium; molybdenum also has attracted prospectors. Under the Wilderness Act, prospecting is legal until the end of 1983, and mining could begin after that.

The helicopter may be noisy, but it doesn't pound trails as mule trains would

—and it flies out garbage. Your modern mine camp—portable buildings, a helicopter, toilets that biodegrade. The West has seen worse. But on the whole, the Weminuche is beleaguered: too beautiful, too rich.

Composer Captures Rockies' Spirit

It had been a fine summer, said the young man with flaxen hair. "I've written six songs. I think they're some of my best."

There's no method in the way he creates. "I get a thought or a phrase, like 'leaving on a jet plane' or 'poems, prayers, and promises,' and build around it." He thinks of himself as merely a vehicle for music: "the guy who was sitting there when a song came floating by and needed somebody to write it down."

John Denver sat on a Victorian sofa in his small office in Aspen, wearing jeans and sandals. Winter skiers were gone, but beneath the window joggers floated past in mindless rhythm. A few miles out of town cyclists strained legs and lungs to reach Independence Pass, where the divide touches 12,095 feet. In Aspen the cult of the body is strong. And the cult of the mind too. Mighty thoughts on oil and the economy spring from

the Aspen Institute for Humanistic Studies. Bach and Beethoven fill the Aspen Music Festival tent.*

Aspen's fundamental appeal, however, remains that which inspired John Denver's "Rocky Mountain High": the conifers soaring like shaggy arrows, the sparkling air, the golden glory of autumn, the snow's gleam.

Aspen in 1945 was a stagnant ex-silver-mining town. As it developed, it became "in"—the premier resort of the Rockies. Ski instructors became millionaires in real estate. Only 1,200 acres, the town burgeons today with 6,000 residents—plus visitors by the thousands. Luxury homes sprinkle the slopes of nearby Red Mountain, and dishwashers commute thirty miles from Carbon-dale. Some older Aspenites complain that the town has attracted too many idle rich,

that the *real* people are being squeezed out.

Mayor Stacy Standley, who came in 1965, campaigned on a platform of taming the "growth gorilla." City and county have now fashioned a growth plan that limits construction and gives preference to builders of homes with resale restrictions; the intent is to hold prices down. The plan is, Stacy said, "our last hope." Aspen's real trouble is that too many people elsewhere look out their windows and see concrete instead of what John Denver sees.

Between Aspen and Leadville the divide jogs in a semicircle, embracing 14,000-foot skyscrapers like Mount Elbert and Mount Massive, second and third highest peaks in

*Aspen's town, mountains, and way of life were explored by Jill Durrance and Dick Durrance II in the December 1973 NATIONAL GEOGRAPHIC.

Shedding long Johns and inhibitions, cross-country skiers in Yellowstone National



the lower forty-eight, ranked behind California's Whitney.

I didn't see anyone in jogging shorts in Leadville. Its mining-camp roots still reach for ore. The view from many a home is of a slag heap where a smelter stood.

Gold, tungsten, lead, manganese, zinc, tin: This high-rise region has proved rich indeed. But it was silver that created instant millionaires in the 19th century and endowed Leadville with 118 saloons, a lush tenderloin, and a population representing most of Europe.

There were the Sixth Street Irish and the Chicken Hill Swedes. There was a Finn Town, a Jacktown of Cornishmen. Charles Fitzsimmons, going strong at 85, remembers Austrians and Italians arriving in the early 1900's, consigned, as it were, to a labor

importer. "They got off the train wearing tags that said 'Frank Zaitz, Leadville, Colorado.' They were shipped like packages."

Edward "Ned" Blair, serious student of his native town, took me for a ride. California Gulch looked as if it had been turned inside out. Ned pointed out the A.Y. and Minnie, mines that founded the Guggenheim fortune. The Accident, the Matchless, the Moyer, the Clear Grit: Ned reeled off the bonanzas. J. J. Brown prospered from the Little Jonny; his wife was the Unsinkable Molly—though she really was called Margaret or Maggie, said Ned.

The Leadville area has yielded ore worth more than two and a half billion dollars. The greatest part of that has come from Climax, under the divide's brow. This mine, and another divide-side mine at Henderson,

Park rejuvenate weary muscles in a creek warmed by waters from a hot spring.

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PAUL CHELLEY



produce half the free world's supply of molybdenum, a steel hardener.

The Climax Molybdenum Company's tailing dumps, smothering subalpine valleys, dismay some conservationists. To the company's credit, seven million dollars is being spent to reclaim a valley near the Henderson mine. A company ecologist, Dr. Larry F. Brown, devised an ersatz topsoil of crushed rock, wood chips, and sewage sludge. It grows grass and conifers.

Climax tailings will be eyesores for decades; the mine holds ore enough for thirty-five years. I expect this is fine with Leadville, which has no wish to wither.

Searching for a Not-so-mighty River

From far off comes the yip of a coyote, making the dawn seem colder. Pink light glows on the peaks of the Never Summer Mountains to the west, but morning has not reached down to our tent in La Poudre Pass.

I shake the water bottle. Ice. We'd like a campfire, but Rocky Mountain National Park forbids open fires in much of its backcountry. I pump up my backpack stove and fumble for coffee. At last, sunlight descends to our camp, bringing a cheeky jay demanding a share of our breakfast.

The day before, Lyn and I had hiked north to La Poudre Pass, following a crystal stream. Presently the trail took higher ground, offering vistas of plunging water.

Determined to see the source, I slogged into a marsh in the pass. Waist-high grass hid the watercourse, but at last I got on it. Here on its North Fork the great Colorado River is puny enough to hop across.

The Colorado would be a good deal mightier were it not for the Grand Ditch. Shuttling a sizable stream from the western slope of the divide to the eastern, this canal transits La Poudre Pass.

Two-thirds of Colorado lies east of the divide; two-thirds of the water is west, dumped by Pacific storms. Some 24 diversions tinker with the imbalance. Other-side water goes to cities like Denver and Pueblo.

By far the biggest project, the Colorado-Big Thompson, carries Colorado River water under Rocky Mountain Park in a tunnel 13.1 miles long. Conceived in the Depression to aid drought-stricken farmers, the "Big T" also produces electricity at five power plants outside the park. Growing cities as well as smelters welcome the energy. That apostle of irrigation, John Wesley Powell, prophesied to Montanans a century ago that their future would be measured in acre-feet. Looking at the whole West today, he might add: And in kilowatt-hours.

In southern Wyoming the divide plunges out of timber and sparkling streams into sage and dry gulches. And then the divide divides. Two ridges enclose the Great Divide Basin, 85 miles across.

The Continental Divide Trail would follow roads along the basin's eastern and northern rims, through country that is largely empty. But not quite. There is Jeffrey City, instant boomtown of 3,500 people lured by yet another uranium strike.

"If a miner can't earn \$25,000 a year here, he's not trying," banker Keith Bourn said.

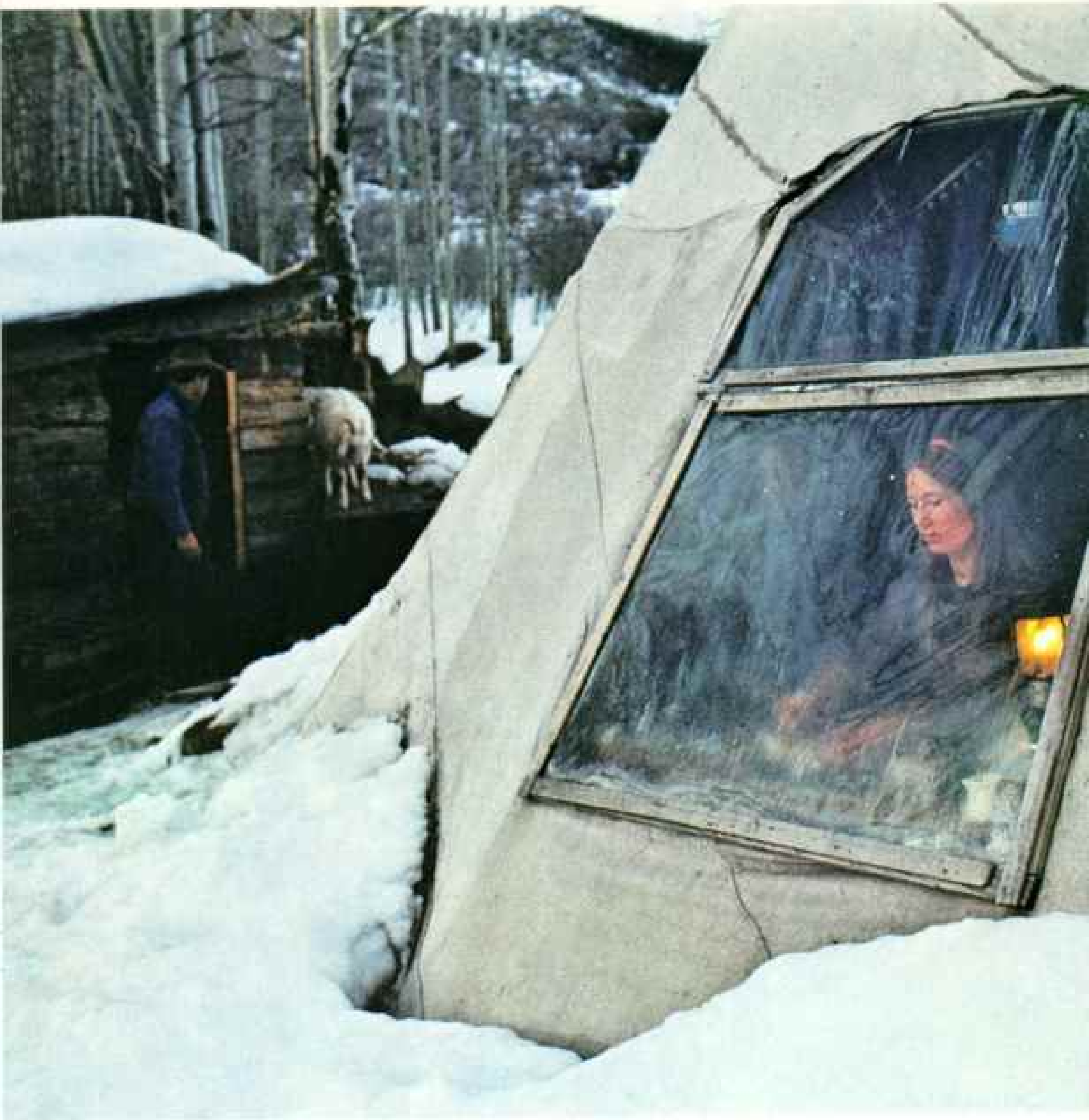
When the price of uranium shot from \$8 a pound in the early 1970's to \$40 and more, mobile homes, prefab apartments, and even tents bloomed in Jeffrey City like desert flowers after a rain. Nearby mines produce four million tons of ore a year.

Harry Estes, oiler of heavy equipment, isn't in the \$50,000 bracket, but \$9.96 an hour, plus other benefits, is pretty good to a man from a Missouri poverty pocket. Harry's Ozark drawl is as long as his drooping mustache. "When we come out here, all we had was a '68 Ford van that looked like somethin' out of a junkyard, three kids, and one twenty-dollar bill. Now we got a trailer house and a '74 Chevy Blazer—and I still got the twenty."

To the west, near where the two divides reunite, I came to South Pass City and Atlantic City. Surely, a century ago, men in these gold-mining towns were as happy as Harry. In 1868 (Continued on page 502)

Snowbirds: Hundreds of thousands of skiers each winter descend on Colorado, where the nation's greatest concentration of ski resorts flanks the Continental Divide. At Steamboat Springs (right) a downfall of "champagne"—the light dry powder for which the area is noted—heightens the mood at one of the resort's 18 lifts.





Life-style pioneer, Jim Auster (left, with youngest daughter Anna) has provided his family with a most unlikely, though comfortable, home near Aspen, Colorado: a three-story tepee. The conservation-minded architect put his principles to work on the 1,400-square-foot tepee (above), which cost him only \$300 in



materials and insulation. It boasts wooden floors, solar-heated water, and a small generator for Jim to power his tools. Professional dancer and mother of four, wife Leah (top, right) entertains in Aspen. In an outdoor shed five-year-old Serafina (right) feeds a kid from the family's small herd of goats.



Like a carnival joyride, Trail Ridge Road loops its way to 10,758-foot Milner Pass,



where it crosses the Continental Divide in Colorado's Rocky Mountain National Park.

(Continued from page 496) South Pass City boasted five hotels and (to cite the usual mine-camp measurement) 13 saloons. Atlantic City had 2,000 people. Today South Pass City is dead, save for a smattering of tourists looking at its restored buildings; Atlantic City is a one-saloon town of 50 souls. Object lessons for Jeffrey City?

Just one of Atlantic City's citizens continues to mine gold. I met 78-year-old "Shorty" Haddenham—real name, David—at the mouth of the St. Louis. "If I'd known you were coming, I'd have cleaned up," Shorty said in his Bogart voice. I think the natural Shorty—grizzled, begrimed, rolling his own smokes—is the better sight. "Mining's in my blood," he said. I believed him.

Shorty says he bought the St. Louis in the 1940's because, having lived through the Depression, he wanted security. At the current price of gold, I imagine he's a lot more secure than most of us.

I went back to Jeffrey City, crossed the Green Mountains—more brown than green in summer—and drove into the basin, also called the Red Desert.

The divide's ridges limn the horizon at 7,500 feet or more. The floor is wrinkled, sunbaked, stubbled like an old cowpoke's visage. Such moisture as falls—a few inches a year—largely vanishes into gulches.

"If you give out of water, there's plenty of beer," someone had told me—meaning sooner or later you would run across one of the basin's oil and gas fields, or meet a prospector.

In a four-wheel-drive van I followed some of the tracks that radiate, intersect, and peter out. Since this is mostly public land, people drive where they please. I noted numerous claim stakes. There is uranium in the basin, as well as other minerals.

Antelope bounded across the scrub, raising whiffs of dust. I parked in the lee of a ridge and watched the basin rim dissolve into the deep blackness of night. When stars appeared, the basin seemed not around me but above, a glittering bowl of sky. I almost

forgot—but not quite—about prospectors' stakes and tracks, and my own van's trespassing on a fragile environment.

The next day I followed a pickup out of the basin and turned north to South Pass, not far from the old town with that name. There are tracks there too, but older ones: More than a quarter of a million people—trappers, California fortune seekers, homesteaders, Mormons bound for Utah—traveled the Oregon Trail to this gentle crossing of the Continental Divide.

Tortuous Trail to Glimpse a Glacier

South of Dubois and west of the Wind River's red-streaked gorge . . . beyond road's end on Torrey Creek . . . up to a meadow purpled by gentians. There, at 11,000 feet, the grand view opens: a sharp, bright glint, like enamel, on distant peaks.

Gannett, Dinwoody, Fremont, Mammoth, Grasshopper, and 58 more: Wyoming's Wind River Range boasts more glaciers than any stretch of the U. S. Rockies. In all, 18 square miles of ice are clasped to its stony bosom.

Part of the nation's first forest reserve, created in 1891, the Winds are parceled today among three national forests, with most of the high country protected as wilderness. In my mind, it equals in grandeur any region along the divide.

But I had to work for that first clear glimpse, scrambling up the rubble of a landslide, switchbacking up Arrow Mountain, burning my lungs to gain 3,500 feet of elevation. I had started from road's end without water—a foolish thing, for this part of the trail was dry.

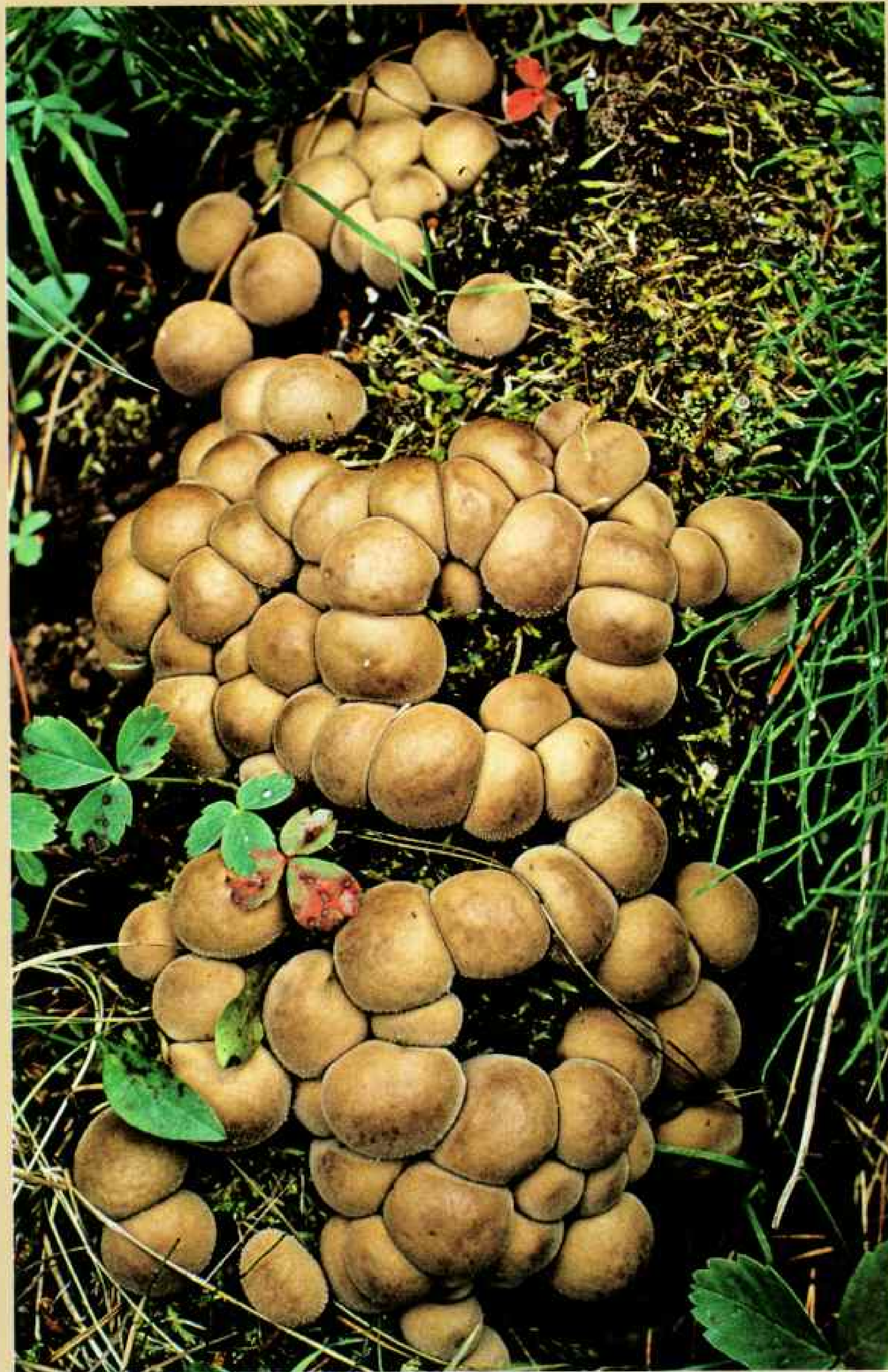
Even from that gentian-carpeted meadow, the promise of the glaciers was not easily delivered. Sixteen trail miles still separated me from the peaks.

At least there was no shortage of water beyond. The trail was bathed and bogged. August sun torching February snow sent gushers down the mountains, bound for crops on the

(Continued on page 510)

First gas-filled balloon to cross the Continental Divide, Columbine II breezes over Colorado's Sawatch Range in July 1978. A month later, one of the pilots, Maxie L. Anderson, would take part in a much more historic flight: the first balloon crossing of the Atlantic in Double Eagle II (NATIONAL GEOGRAPHIC, December 1978).





Hiker's view of the divide...

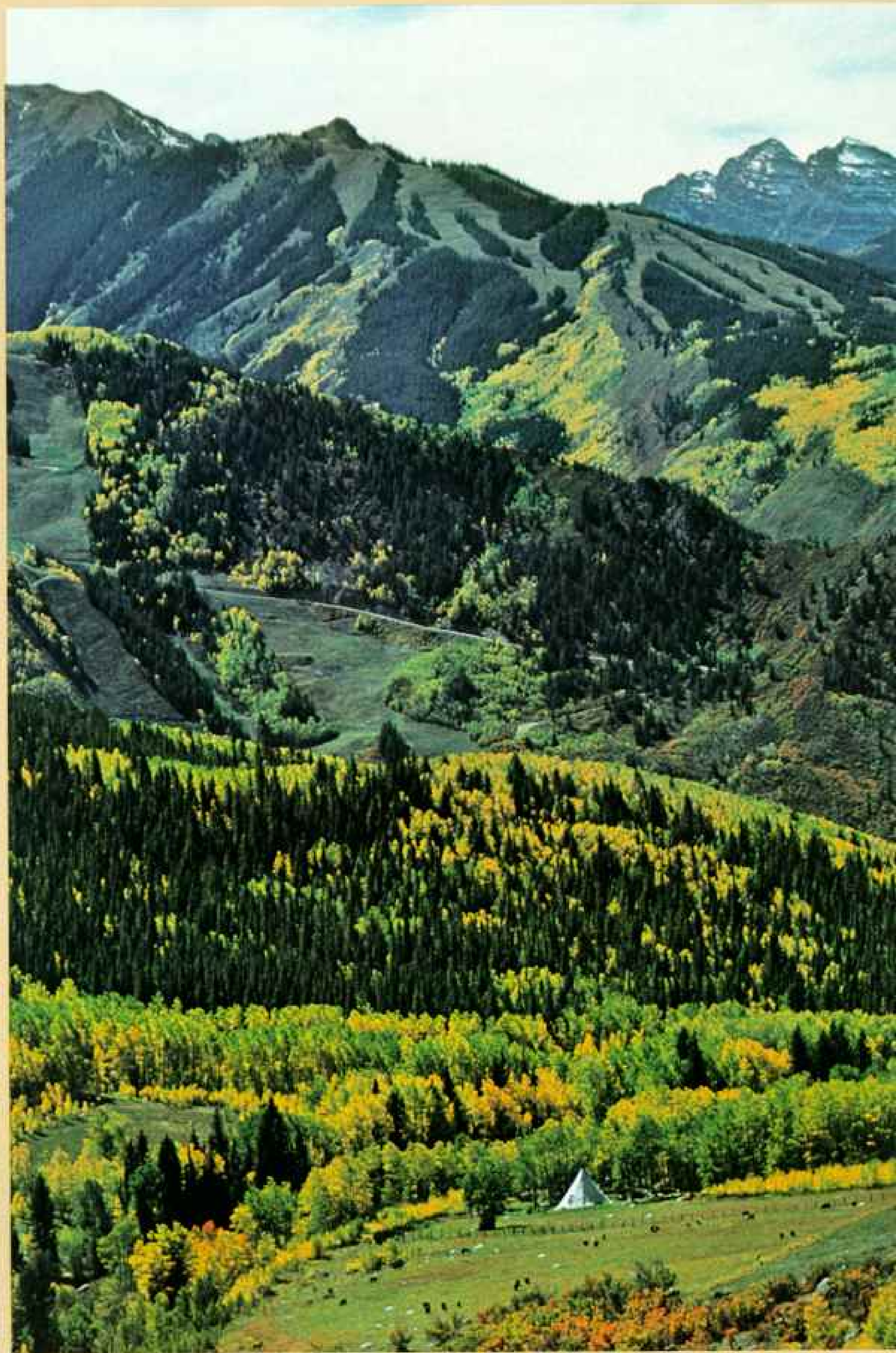
Lush alpine meadows, foot-blistering glacial moraines, deserts, grasslands, and forests: A rich mosaic of terrains abuts the Continental Divide. To complete the new trail, the government must still acquire some 600 miles of right-of-way across nonfederal land. But hikers find no lack of opportunity to explore this greatest swath of wilderness in the lower forty-eight states, particularly along 600 miles of divide trail in national parks and wilderness areas.

In Montana's Bob Marshall Wilderness, where puffball mushrooms (left) grow in the shade of thousand-foot cliffs, 100 miles of divide trail lead toward another 100 miles in Glacier National Park.

Along the 40 miles of the trail in Colorado's Rocky Mountain National Park, columbine and Indian paintbrush grace the way (right). Look, but don't pick these wild flowers. If some Coloradans had their way, the \$25 fine paid by violators would be followed by public lynchings.

Eighty-five miles southwest of the park, ski trails score the high slopes near Aspen (overleaf): a setting of splendid isolation for the Auster family tepee, seen in the foreground.











EDDIE B'LOONEY / WPC INC/PAGE 1

High-country residents

For some animals the remote backcountry of the nation's watershed represents one of their last refuges in the lower forty-eight states. In Montana's Lewis and Clark National Forest, a young grizzly bear (left) is one of fewer than a thousand scattered along the divide in Idaho, Montana, and Wyoming. One of Glacier National Park's first citizens, a mountain goat (above) feeds on glacier lilies in a high mountain pasture.

Threatened only with easy living, ground squirrels in Rocky Mountain National Park, like this one with its cheeks full of tourist peanuts (right), are veteran panhandlers.





A split in the continent's spine cradles Wyoming's Great Divide Basin, 2,250,000

(Continued from page 502) thirsty plains of eastern Montana.

Entering a horseshoe of steep walls, I shucked wet boots and dozed. In late afternoon I felt ready for the last couple of miles. Up again, across broken granite, then a sloping meadow aflame with Indian paintbrush, then slabs of smooth rock polished by freighted ice.

All around me was the sound of water: a gurgle from a snowfield, a splash from Dinwoody Creek. Finally, the source: ice slabbed against the ridgebone of the Winds, cirque topped by cirque in a scalloped fan. Crevassed and turquoise hued, Dinwoody

Glacier touched the divide 2,500 feet above me and poured a trickle at my feet.

The majesty of soaring rock and ice seemed to demand kettledrums and trumpets. I sat on a boulder, thinking of Musorgsky's *Pictures at an Exhibition*.

What I heard was a whistle. A fat marmot, upon his own boulder, eyed me. He whistled again. A marmot's cheeky call has always reminded me of some street shyster's summons, a call from an alleyway that says, "Hey buddy, wanna buy a watch cheap?"

I whistled back. The marmot considered this response, then turned away. No sale.

Meriwether Lewis on August 12, 1805:



acres of buttes, badlands, and dunes that drain neither east nor west.

“the road was still plain, I therefore did not despair of shortly finding a passage over the mountains and of tasting the waters of the great Columbia this evening.”

It was an Indian path Lewis had found, in his quest with William Clark for the Northwest Passage. Theirs was guesswork travel, through country no white man had ever seen. They knew only that somewhere to the west a river named Columbia, discovered in 1792, reached the Pacific. A continent-long train of ridges separating all great western watersheds? Geographic knowledge was far short of such a concept.

Lewis followed the “plain” road up to a

spring—“the most distant fountain of the waters of the Mighty Missouri in search of which we have spent so many toilsome days and wristless nights.” I, too, reached that spring on an August day, following a road up Trail Creek in the Beaverhead Mountains—modest mountains, 9,000 feet or so, where cattle wander on rolling grasslands.

Across a ridge Lewis found a “handsome bold running Creek of cold Clear water,” and “here I first tasted the water of the great Columbia river.” In fact, it was a tributary of the little Lemhi, which joins the Salmon, which joins the Snake, which—finally—mingles with the Columbia.

Only as later explorers and trappers filled in the blanks on maps did the great continental barrier begin to take clear shape.

In an eastward jog from the Beaverheads, the divide embraces the copper towns of Anaconda and Butte, then Helena, where the gold strike at Last Chance Gulch built Montana's capital.

Then it is back into wilderness—a monumental chunk of wilderness. As we sprawled full-bellied by a campfire, Dick Klick observed: "One way of looking at this big country, it's just a lot of nothing. Some trees and some cricks and that rock up there, the Chinese Wall—but there are things other places more spectacular than that. Still, it adds up to something special."

The Klick family guest ranch, the K Bar

L, nestles between forks of the Sun River. Upstream sprawls the Bob Marshall Wilderness, larger than Rhode Island, with almost no work of man except a few trails. With two adjoining national forest wilderness tracts, the Scapegoat and the Great Bear, plus Glacier National Park to the north, a stretch of wild land survives in which a man can walk north for 200 miles and cross pavement only twice.

Klicks have guided hunters and fishermen for fifty years. Dick's father, Emil, complains at 80 that his knees have "give out"—but he rides all day. Dick, raising a Stetson to six-feet-three, whipped pack ropes like string as eight of us saddled up for a 27-mile journey to the Chinese Wall. That soaring limestone cliff (pages 482-3) carries



the divide for 12 miles in the Bob Marshall.

Marshall himself would have gone on foot. This wilderness advocate of the 1930's walked 30 miles in a day 200 times. At least once he hiked an incredible 70 miles. As chief of the Forest Service Division of Recreation and Lands, he worked to preserve five million acres in a natural state.

Marshall died at 38, but few could hope for a monument finer than the wilderness that bears his name, that sprawling place of tree and creek and rock. I remember Moose Creek, where nearly every fly cast at twilight drew a flash of gold. And Spotted Bear Pass, where we looked into a huge basin of lovely emptiness, doubly satisfying because beyond lay another basin just as empty.

Beneath the Chinese Wall we lunched in a

garden of bear grass and lupine. Nearly a thousand feet above us, mountain goats were puffs of white. Though a hunter all his life, Dick had worked hard to keep part of the Bob Marshall a no-hunting preserve. "Animals need a place where they're not hassled," he said, gazing around him. "Just like people do."

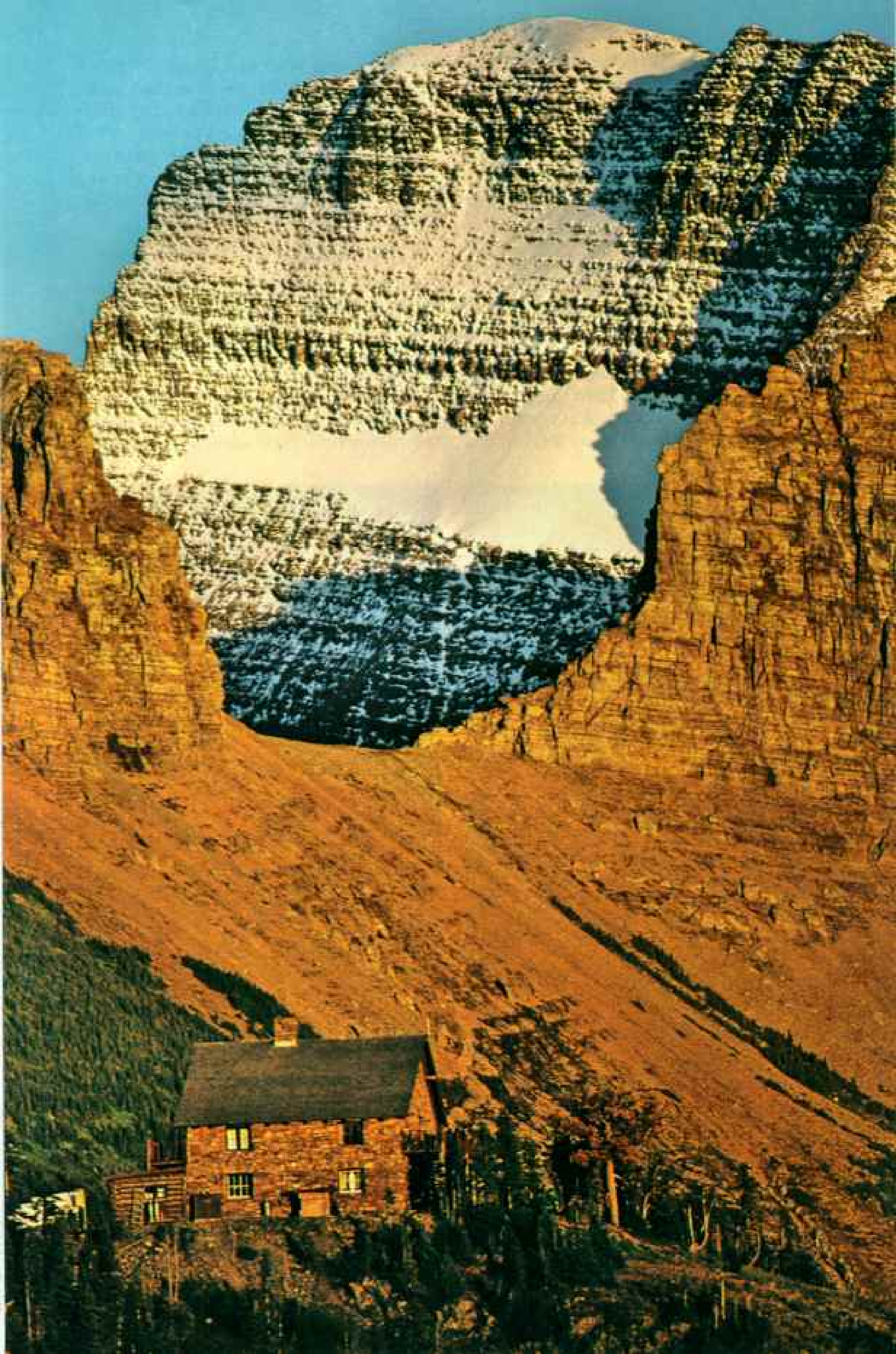
Nature's Answer to Man: More Bears

The storm blew and blew, lashing all the northern Rockies. Glacier National Park lay under seven inches of white. The snow soon melted in the valleys, but there lingered a somber mood of change.

In northern high places around the end of August, there comes a telescoped time that I call summerfall. New snow a few hundred



Bona fide cowboys are still seen along the meadowed segment of the divide that separates Idaho and Montana. Here Idaho ranchers drive their stock to the border town of Monida, Montana, for their big fall sale. To celebrate this annual payday, families (above) join the trail crew for lunch at a nearby café.



feet overhead, willows yellowing at your feet—and asters and columbines preening and praying for one more day of sunshine. That's the way with flowers: They never know when to quit. Sassy ground squirrels beg one more handout from hikers. And the bears are restless. Glacier Park's animal population includes 500 black bears and 200 grizzlies—perhaps more.

"Seems like every grizzly sow has three cubs this year instead of one or two," said Roger Lewis, a bear-management ranger with the Park Service. "Maybe that's nature's way of fighting humans—cranking out more bears."

He was at Granite Park Chalet, a 42-bed wilderness hostelry, when Lyn, Mick, and I arrived on a cool afternoon. Chalet guests were training binoculars on a grizzly sow and cubs in a wooded basin.

Someone exclaimed, "Hey, there are more hikers on the trail, and the bears are going toward 'em!" Roger sped away. His pack held a .44 Magnum for emergencies, but he used only his radio, twirling the squelch knob to emit static and shrieks. "You don't scare grizzlies," he had told us. "You just get 'em to acknowledge your presence." The sow and cubs disappeared.

It was an empty trail that we followed north the next morning, noisy only with the gurgle of water under scree and the rumble of Mineral Creek far below. Canada was only 26 miles distant, and we wouldn't have to walk even that far. Fiordlike Waterton Lake probes three miles into Glacier from Canada's adjoining Waterton Lakes National Park, and in summer an excursion boat, the *International*, makes daily trips.

Wild strawberry plants now bore russet leaves. Summerfall's little cinquefoils and columbines blossomed defiantly, old friends from the Weminuche and the Winds.

We started a steady, laborious ascent. Clouds like cotton batting came over the Livingston Range to the west, and soon we were walking in rain. When the clouds

passed, the Livingston peaks were whiter.

Onward, upward. Around sunset we reached a notch at 7,000 feet. Departing Pacific-bound waters, we took up with streams headed for Hudson Bay.

The rest of the trip would be downhill—to the lowest point on the Continental Divide Trail, 4,200 feet, at Waterton Lake. Strange to realize the low point is in the northern Rockies—I had been 1,500 feet higher on that dirt road in New Mexico.

Dawn, 25°F. A fire helped us get moving. We joined the little Waterton River; its bed of limestone and mudstone shone in rich shades of rust, green, and gray.

We camped that evening by the Kootenai Lakes. A bull moose and three cows foraged. Ludicrous, cumbersome animals, yet majestic, they paid us no mind.

Divide Bestows Most Precious Gift

Mist on the Kootenais at daybreak. I hear geese honking overhead. Lyn starts toward Waterton Lake alone, reassured by spiderwebs across the path; no grizzly has walked there this morning.

I dawdle. The southbound geese have driven home the point: I am northbound at summer's end, at the end of my own migration. On the lake a mother mallard coaxes her young to try to fly. Will they make it, or is it too late?

I am melancholy at the thought of white death on the land, the inevitable concluding act of summerfall. Storms will blanket Glacier with the raw stuff that aeons ago carved this park's cirques, shaved its peaks, flung its rock toward one coast or another.

But next spring there will be a trickle, a gush, then a torrent destined for far ocean shores. Glacier Park's ranges, and those other mountains that stretch to the south, do not really know death. The gifts of the Continental Divide are birth, renewal, life.

I shoulder my pack, walk the easy trail, climb aboard the *International*, and float off to Canada. □

Starkly upthrust vertebrae in the nation's backbone, the mountains of Montana's Glacier National Park appear much loftier than their modest nine- and ten-thousand-foot altitudes would suggest. Reachable only by a lengthy hike, the Granite Park Chalet (left) lies hard against the western wall of the Great Divide, which 26 miles north begins its trans-Canada journey to Alaska.

FIBER OPTICS

Harnessing Light by a Thread

By ALLEN A. BORAIKO
NATIONAL GEOGRAPHIC STAFF

Photographs by FRED WARD
BLACK STAR

Minuscule comets spark the bright new world of fiber optics as light is piped through strands of glass or plastic as thin as human hair and pliable enough to be knotted. Glass optical fibers are already used by doctors to scrutinize the roller-coaster turns of the digestive tract and other inaccessible areas of the body. Their ability to transmit huge amounts of information with the speed of light promises a revolution in communications. Teamed with a laser, a single fiber can, in one second, transmit 200 books letter by letter. "The stage is set for an enrichment of life like that following the invention of the steam engine, the light bulb, and the transistor," asserts Dr. Charles K. Kao, a pioneer in the field.

“DON'T BITE, just swallow slowly and it won't hurt a bit.”

In a Minneapolis hospital I watch a doctor slip a thin flexible tube down the throat of a mildly sedated but fully alert patient. The probe goes down easily, and the doctor peers through it to scan the esophagus, a whitish pink passageway that channels food to the stomach. A sheaf of wispy glass fibers in the probe brilliantly illuminates the tissue, highlighting a cancer too tiny for X rays to detect.

In Chicago, engineers show me a control panel in one of the country's busiest telephone exchanges. Among all the lights, meters, and levers that crowd the panel, one switch in particular intrigues me. Throw it, and you instantly transfer hundreds of calls from a bulging, overloaded copper cable to a single pair of glass fibers, each as fine as a human hair. Sealed in protective plastic, the two glass “wires” can carry 672 simultaneous calls, transmitting them in streams of coded light pulses.

And at a community computer center in a suburb of Osaka, Japan, I join a schoolboy for a push-button Japanese lesson. Seated at a television set, the youngster taps a keyboard to conjure up sketches of a man, a house, and an apple tree. Each drawing is followed by its kanji, or calligraphic character. As the boy drills, a computer relays the lesson over a fine glass fiber to the television screen. Since my visit, cables of glass fibers have been laid to carry such computer services directly into local homes.

Surer cancer detection, better telephone service, and at-home computer instruction are but three of the benefits of fiber optics, a revolutionary new technology based on the transmission of light through slender strands of ultrapure glass or plastic.

These gossamer filaments—called optical fibers—are appearing everywhere:

- Nuclear-power engineers peer into radioactive reactor units with inspection tools containing bundles of optical fibers. At airports mechanics use similar devices to scan the interiors of jet engines for problems.
- Optical fibers save space and facilitate maintenance in automobile dashboards, where they pipe light from one bulb to several switches and instrument displays simultaneously. In some new cars they monitor



external lights, alerting the driver when a turn signal fails or a brake light burns out.

- Thin glass plates made of optical fibers transmit light in night-vision devices that amplify starlight a hundred thousand times. Los Angeles County Fire Department helicopter crews strap on night-vision goggles for after-dark flights. Military light intensifiers have inspired the invention of a pocket scope for victims of retinitis pigmentosa, a group of hereditary degenerative eye diseases responsible for night blindness.

- At some intersections in Miami, Florida, and Nashville, Tennessee, pedestrians heed crosswalk signals containing as many as 160,000 optical fibers. The fiber-optic units are brighter than incandescent or neon signals and operate on less energy.

- Optical fibers are in prototypes of the U. S. Air Force's YC-14 military transport and Army field telephone systems, and the Navy is considering their use in hydrophones. At the North American Air Defense Command Operations Center near Colorado Springs, Colorado, cables of optical fibers link computers that digest data from radars around the globe.

With potentially ten thousand times as much information capacity as copper circuits, such fiber-optic cables are a bright prospect to end communications congestion and clear the lines for dozens of communications services we could never afford before.

"And that," says Dr. Lee L. Davenport, chief scientist and a vice-president of General Telephone & Electronics Corporation, "may bring greater change in our lives than anything since the computer and transistor. It ushers in the fiber-optics revolution."

Mere Specks Produce Light

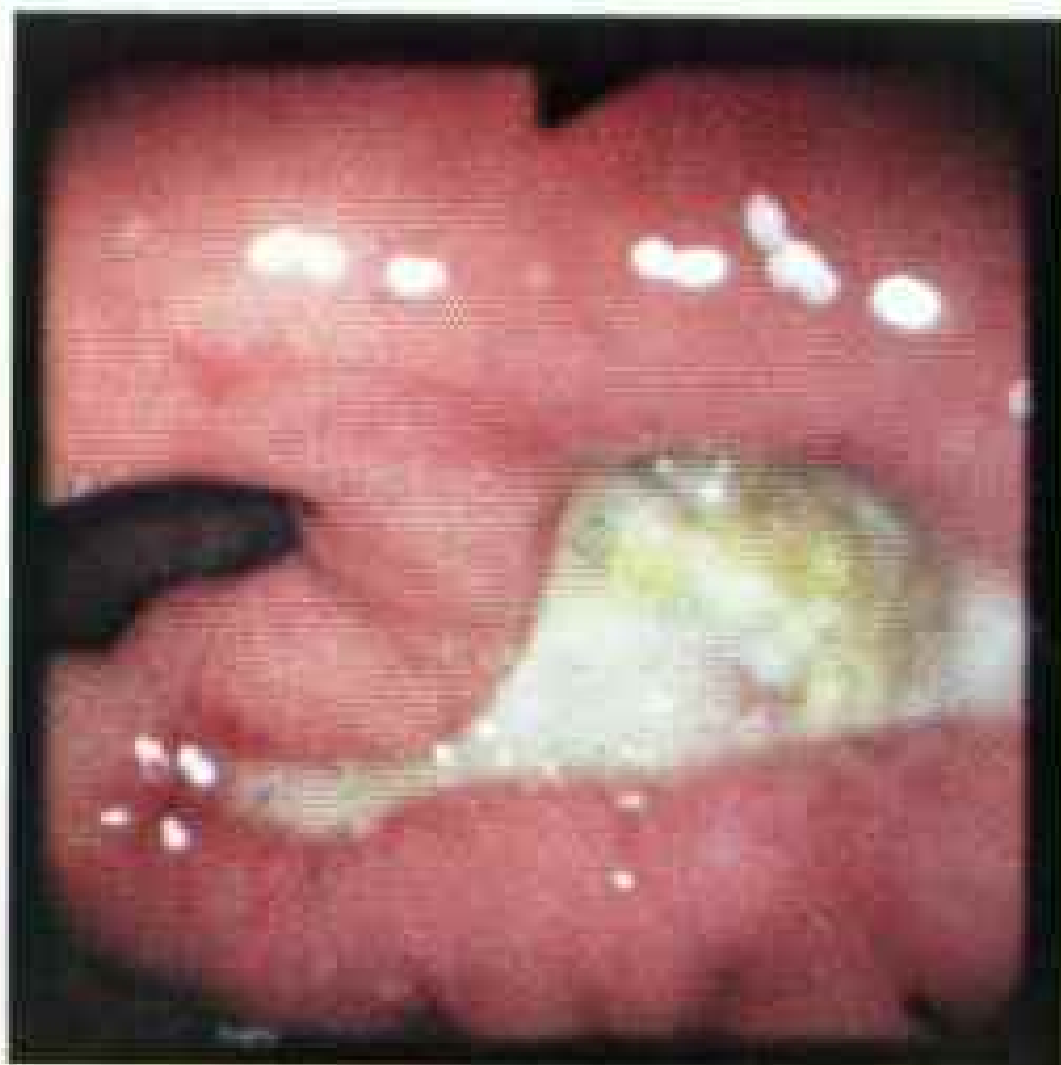
Two key technological advances, both recent, are fueling this revolution. One is the development of tiny light sources smaller than the period at the end of this sentence. The other is the perfection of high-purity glass so flawless that it makes spectacle lenses seem opaque by comparison.

Paradoxically, few things loom larger in fiber optics than exquisitely small semiconductor lasers and light-emitting diodes similar to those that light up pocket calculators; they are typically as small as a grain of salt. Fabricated (Continued on page 523)



Seeing into the body

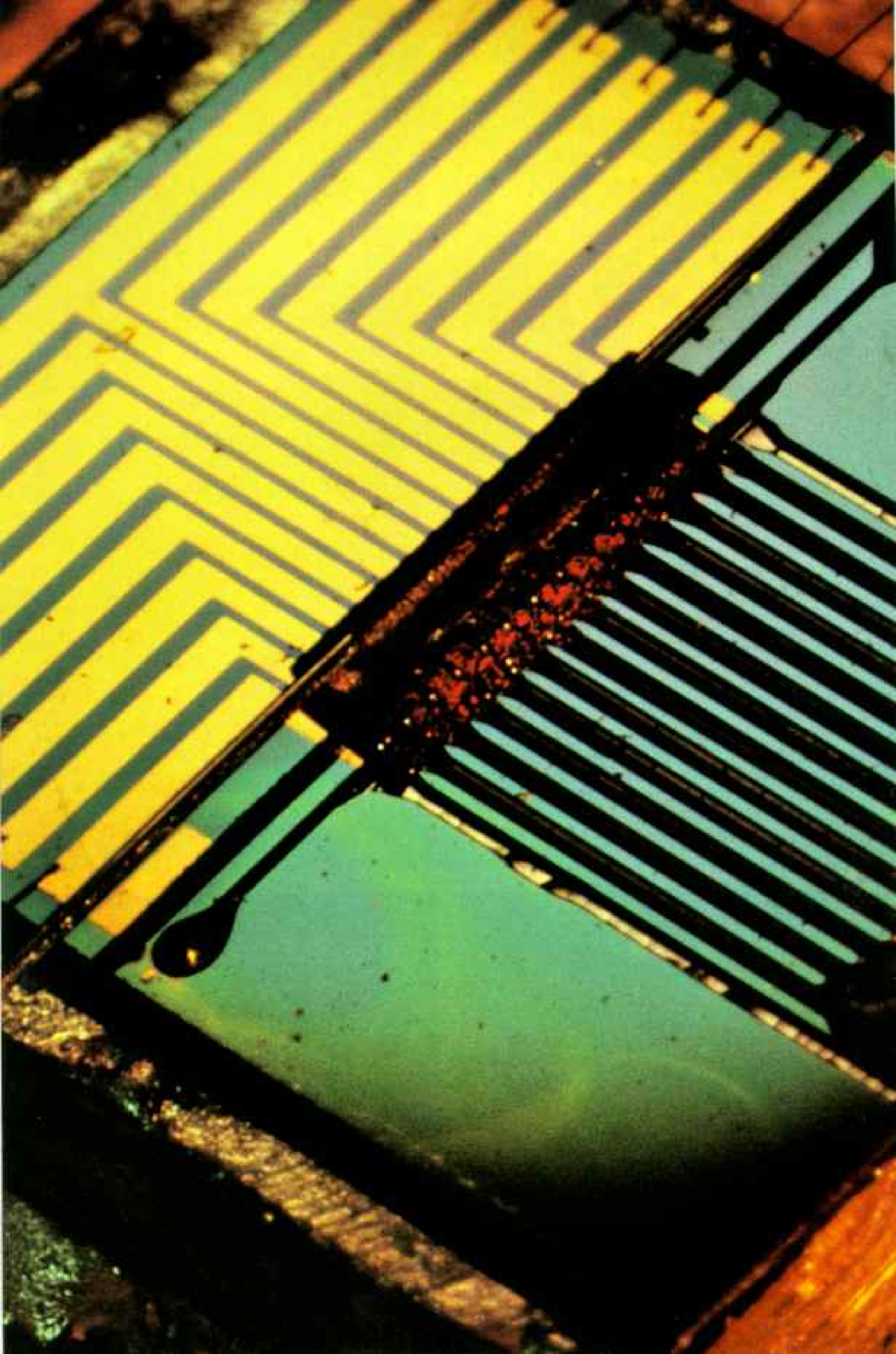
INSIDE JOB: An endoscope—a flexible tube filled with bundles of optical fibers—snakes down to the duodenum and turns corners to survey the pancreatic duct. Dr. Jack A. Vennes performs this diagnostic procedure at the Veterans Administration Medical Center in Minneapolis (above). Such examinations not only save the expense and pain of exploratory surgery, but also pinpoint diseases that X rays may miss. Tools slipped down the scope can snare foreign objects like the coin lodged in a bronchial tube (far right) or snip a tissue sample from a stomach ulcer (right) for biopsy.

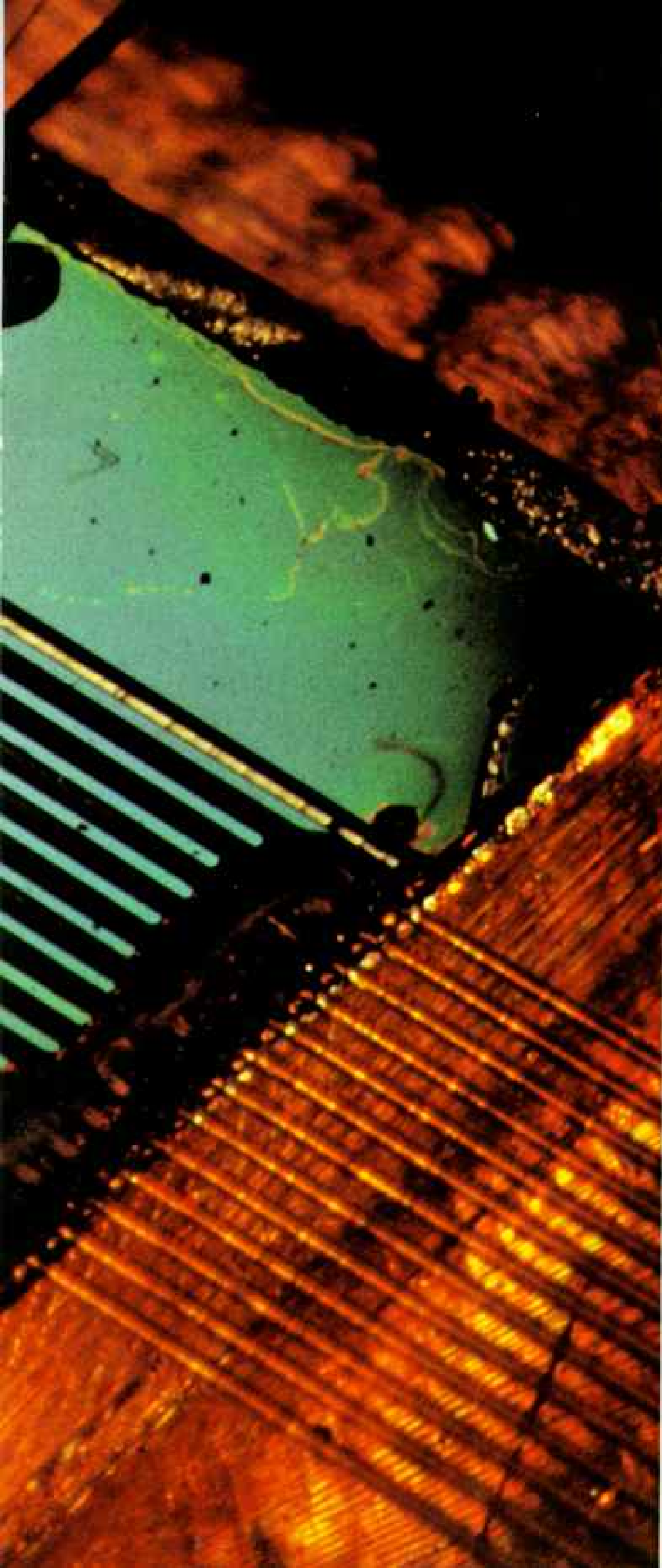


JACK B. VENEZ



MITSUO ENDO, TOKYO WOMEN'S MEDICAL COLLEGE





Realm of miniatures

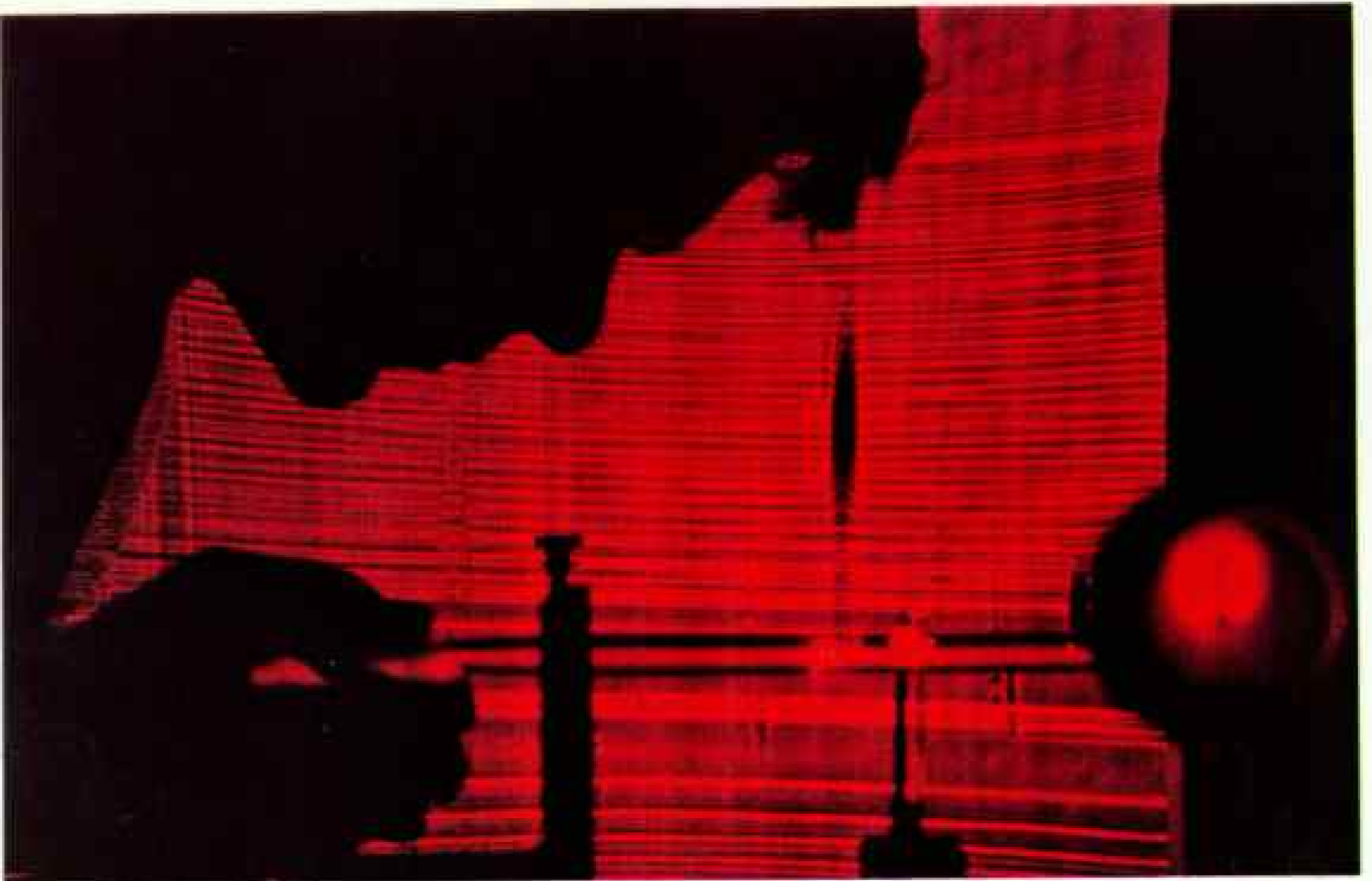
THE SIZE OF A GRAIN of salt, a gallium aluminum arsenide laser (below), built by Bell Laboratories, provides light for optical fibers. A thumbnail-size chip (left) being tested by IBM contains all components needed in an optical transmitter, including an array of 13 lasers, powered by yellow circuitry. A pinhead-size photodetector (bottom), another Bell device, receives light impulses for conversion into electrical signals.





Spinning flawless fibers

TO MAKE AN OPTICAL FIBER: Start with a thin-walled silica-glass tube the diameter of a half-dollar. Feed in gases that deposit a thin film of glass with each sweep of the torch (left). Turn up the heat to about 2000°C (3632°F) and collapse the tube into a thin glass rod called a preform. An engineer uses a laser to check evenness of layers in the rod (below). The break in the striated pattern projected on the wall indicates an imperfection.



Heated in a furnace, the preform is pulled like taffy (left) into fiber so fine that thousands of strands can be bundled into the thickness of a pencil. Fiber diameter varies less than a micron (thirty-nine millionths of an inch).

A fiber cross section reveals the light-carrying core and silica-glass cladding (below).

High-grade fiber costs as little as 30 cents a meter; mass production may one day cut the price to a few cents. One raw material is cheap enough: A thimbleful of silicon dioxide—sand's main ingredient—can make more than a kilometer of fiber.



(Continued from page 518) from specks of such material as gallium aluminum arsenide, these devices radiate invisible infrared light, which is affected least by impurities and imperfections in the glass of optical fibers. Some of these lilliputian light sources can be pulsed a billion times each second to act as miniature modulators, or shutters, for light beams.

Light, of course, is a form of electromagnetic energy like radio and microwaves. Like them, too, light travels in a vibrating wave. By modulating, or varying, the height of this wave, a light beam can be made to carry messages just as does a radio wave.

A beam of infrared light at its highest frequency oscillates nearly a hundred trillion times a second; incredibly, visible light vibrates faster still. Thus modulated light has immense potential to transmit information. Theoretically, one light beam could accommodate every telephone message, radio broadcast, and television program in North America simultaneously. In a tenth of a second, it could flash every word in the thirty-volume *Encyclopaedia Britannica*.

Scientists have sought for years to tap light's capacity to carry vast numbers of messages. In 1880 Alexander Graham Bell demonstrated the photophone, a contraption that used vibrating mirrors to transmit sound on a beam of sunlight. Cumbersome and unreliable, it never caught on as did Bell's much admired telephone.

Bell's dream that we would one day talk on a light beam came tantalizingly closer in 1960, when the laser was invented. For the first time scientists had a device that put out an intense, narrowly focused beam of light, one that could be modulated to carry spectacular amounts of information.

Communications engineers soon found, however, that even bright laser light cannot pierce bad weather for any distance. The problem: Smog, snow, rain, and fog all break up and absorb fine light waves just as dust scatters a sunbeam. The answer, first proposed in 1966: glass fibers to transmit message-bearing beams without disruption.

Optical fibers can be made of the same minerals that go into a windowpane: silica, soda, and lime. But unlike ordinary glass, which will stop a light beam in less than a meter, optical fibers for communication

must be flawless enough to transmit light over distances measured in kilometers.

In 1966 such a standard could not be met. Even the best fibers then contained so many impurities and defects that light signals dwindled to less than one percent of their original strength in traveling through as little as ten meters of fiber.

Such drastic light loss ruled out long-distance communication over optical fibers; signal repeaters would have been necessary every few meters to boost fading light pulses. Then in 1970 Corning Glass developed a fiber good enough to carry light at least one kilometer without amplification. Recently, optical fibers have appeared that transmit, over one kilometer, more than 95 percent of the light beamed into them.

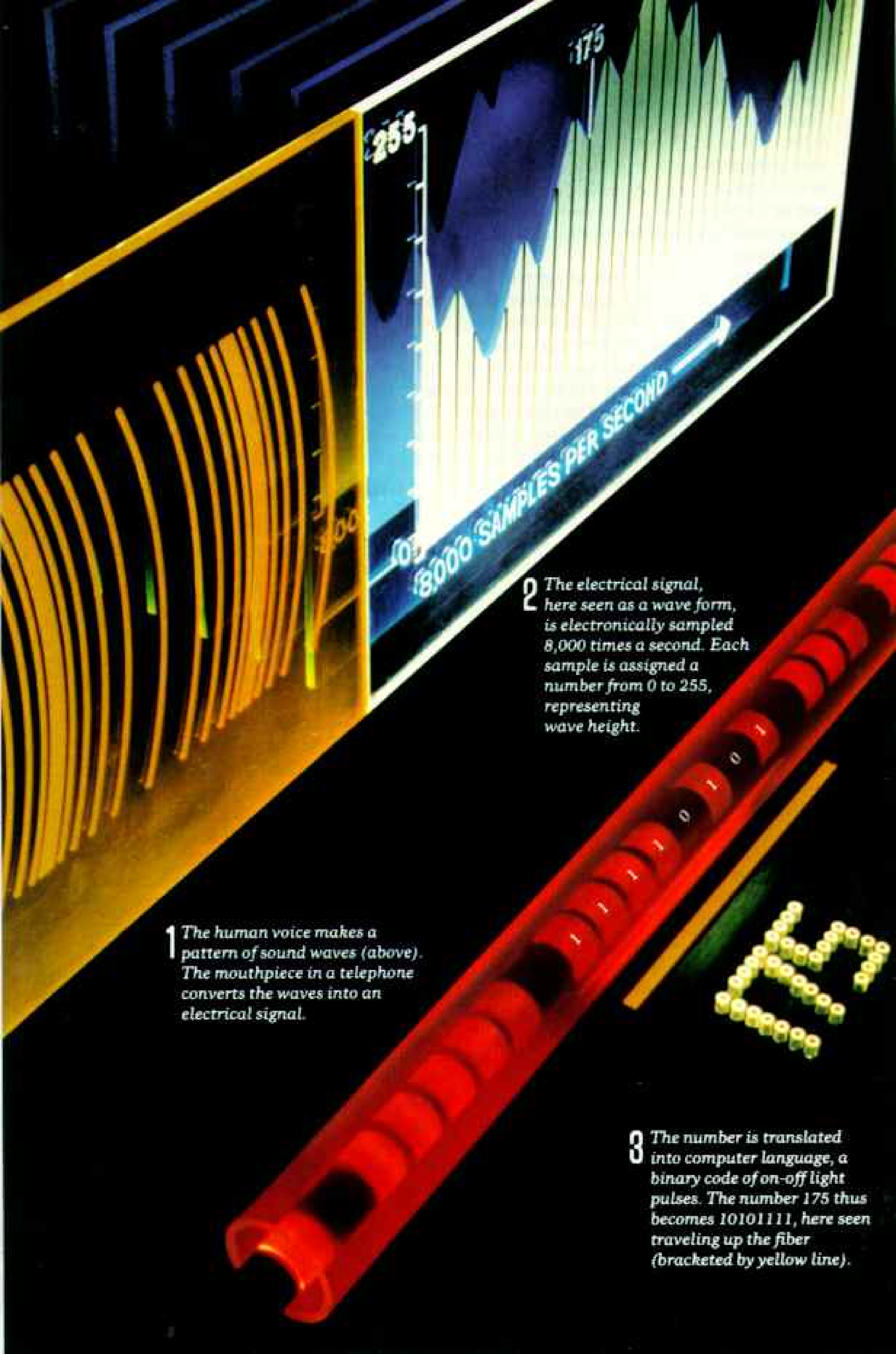
Metamorphosis of a Vacuum Cleaner

Strangely, these dramatic improvements in optical fibers owe something to a second-hand vacuum cleaner. Eleven years ago scientists at the Corning Glass Works in Corning, New York, adapted the hand-me-down appliance to help make the first in a series of ever more sophisticated optical fibers. When I visited the plant recently, production manager Rick Lemker guided me through what had since become a computer-controlled manufacturing operation.

Rick and I donned protective glasses to watch a hissing gas torch play back and forth beneath a silica-glass tube, heating it to nearly 1600°C (2912°F). One meter long and about the diameter of a half-dollar, the tube was fogged inside by a cloudy chemical vapor. At each pass of the torch some of the vapor fused to the tube's inner wall to form an infinitesimally thin layer of glass. A suction device at one end of the tube drew off excess vapor, a task once handled by the vacuum cleaner.

"We vary the chemical composition of the vapor constantly," Rick told me. "In this way we can line the tube with a hundred or more layers of glass, each one with a different refractive index, or ability to bend light. Then we collapse the tube into a solid rod called a preform. As the tube collapses, it consolidates into a glass core jacketed by the silica cladding—the basic structure of an optical fiber. The final step is to draw the preform into

(Continued on page 528)



1 The human voice makes a pattern of sound waves (above). The mouthpiece in a telephone converts the waves into an electrical signal.

2 The electrical signal, here seen as a wave form, is electronically sampled 8,000 times a second. Each sample is assigned a number from 0 to 255, representing wave height.

3 The number is translated into computer language, a binary code of on-off light pulses. The number 175 thus becomes 10101111, here seen traveling up the fiber (bracketed by yellow line).



4 The coded pulses of light can flash through the fiber at a rate of 44.7 bits, or pieces of information, per millionth of a second. The signals may come from several hundred conversations, a few of which are represented by the blue frames at upper left. At the other end, a decoder translates the pulses back into electrical signals, which are fed into the receiving telephones and heard as human voices.

Talking on a light beam

LIGHTING THE WAY for communications in the future, fiber-optic technology makes it possible to transmit 10,000 simultaneous conversations through a single pair of glass "wires."

Since infrared light vibrates thousands to millions of times faster than microwaves or radio waves, it can accommodate more information than either. In practice, the sound waves are converted to an electrical signal, which is encoded and transmitted as light pulses.

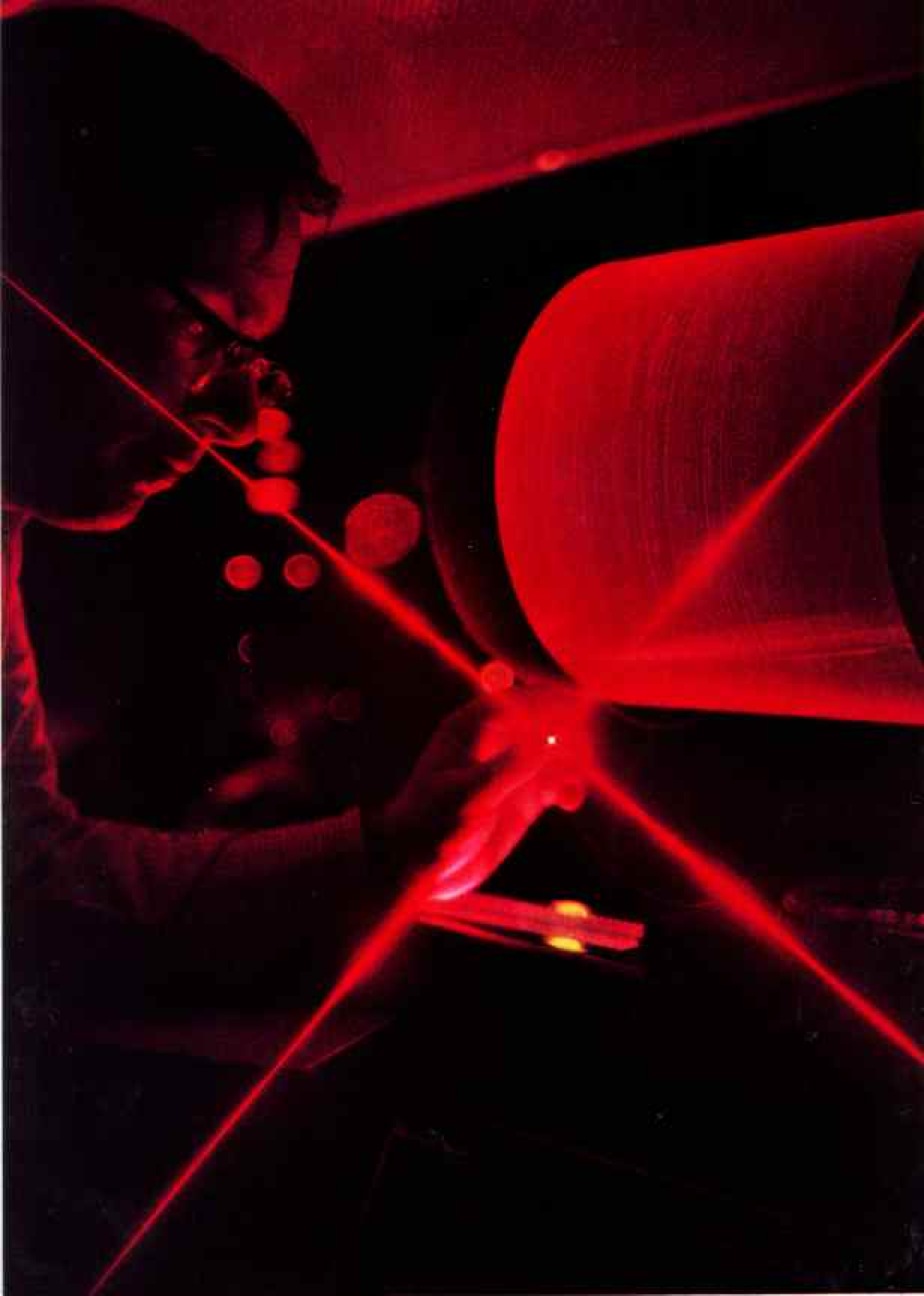
Many conversations can be stacked along the same fiber and unscrambled at the other end. This process, called time-division multiplexing, is comparable to merging cars on a freeway access road into a line of moving cars already on the freeway.

The possibility of using optical fibers in communications was first proposed in 1966 by Charles Kao (below), a vice-president and chief scientist for International Telephone and Telegraph. "Optical communications makes a whole range of new services economical for the first time," he says.

Eventually, low-cost light-wave communications may be used to: receive and print out a newspaper over a home telecopier, shop by television in your home, have the bill automatically charged to your credit card and deducted from your bank account, and remotely climate-control your home.



MODEL BY ASSIR TAKRANIAN; NATIONAL GEOGRAPHIC PHOTOGRAPHER BRUCE DALY



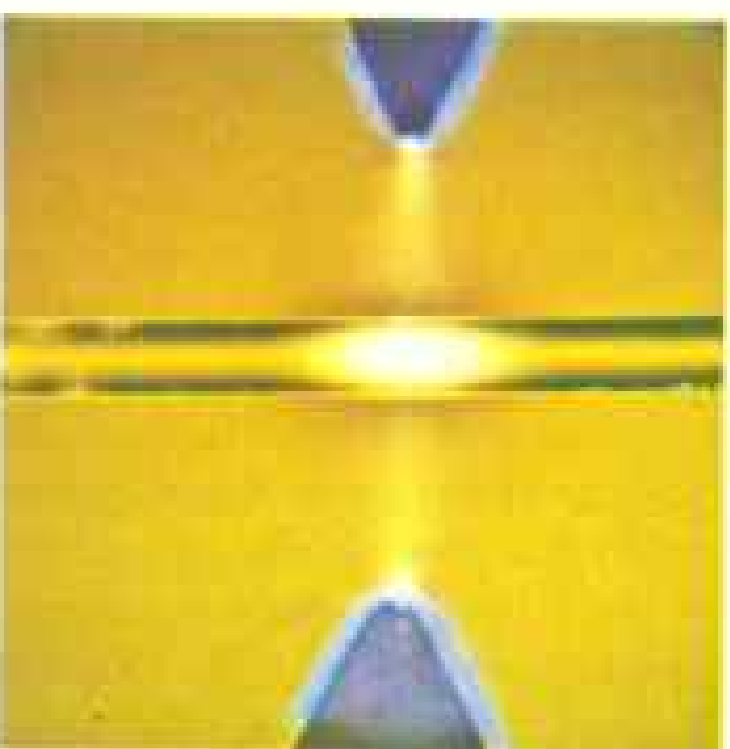
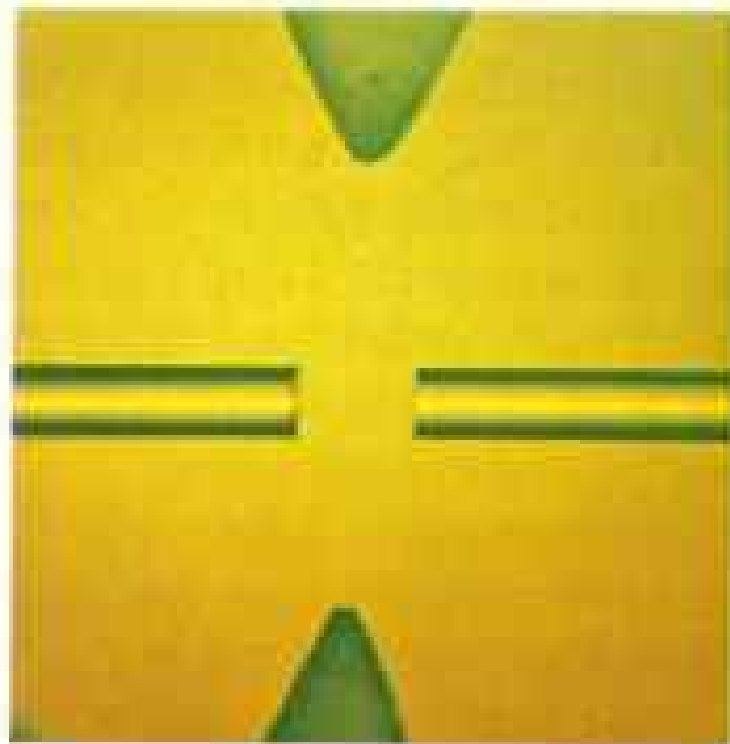
Clearing the lines for communications

IN THE SECOND CENTURY of the telephone, cables with 144 optical fibers, like the one developed by Bell Laboratories (below), will help ease the telephone traffic jam. More than a hundred systems in countries such as Britain, Canada, and the United States now use fiber cables.

Most fibers at present are made in lengths of ten kilometers (six miles). Field use requires splicing longer lengths (sequence, below left). Ends cut with a diamond stylus are aligned, then fused by an electric arc.

A laser beam sent through 2.2 kilometers of fiber wound on a drum measures light loss (left). In actual use, messages are pulsed on a beam of infrared light invisible to the eye.

The idea of using light in telephone communications is not new. In 1880 Alexander Graham Bell invented a phone that used sunlight in place of wires. "I have heard a ray of sun laugh and cough and sing," he wrote.



(Continued from page 523) five or more kilometers of hair-thin fiber."

I saw just such a "fiber draw" minutes later, when a finger-thick preform was fed into the top of a small furnace heated to bright orange incandescence. As the rod crept through, it softened and stretched like taffy, then dropped from the mouth of the furnace in a strand so fine I had to squint to see it. Threaded next through a tiny funnel, the fiber seemed to double in thickness with a coat of fast-drying plastic before spooling onto a reel.

As I watched, I thought of fairy-tale magic and Rumpelstiltskin, the dwarf who spun straw into gold thread.

Before I left the Corning plant, Rick handed me a short optical fiber with instructions to tie it into a loose knot. Amazingly, it did not break; only when I forced the improbable filament into a tight loop did it snap.

A newly drawn fiber has nearly as much tensile strength as some cast-iron pipe. Yet, like a diamond scratching a windowpane, a tiny dust mote can score the fiber with a molecule-deep flaw—the opening wedge in a fatal crack.

Most such damage is forestalled by the plastic coating applied to optical fibers as they are drawn; thus protected, some specially fabricated fibers are stronger than stainless steel. For actual use, fibers are laminated in flat plastic ribbons or sheathed in flexible cable.

More astonishing than the strength of optical fibers is their extreme transparency. Some are so transparent that if the Pacific Ocean were as clear, you could see its deepest point, 11,034 meters down.

Fiber Becomes a Pipeline for Light

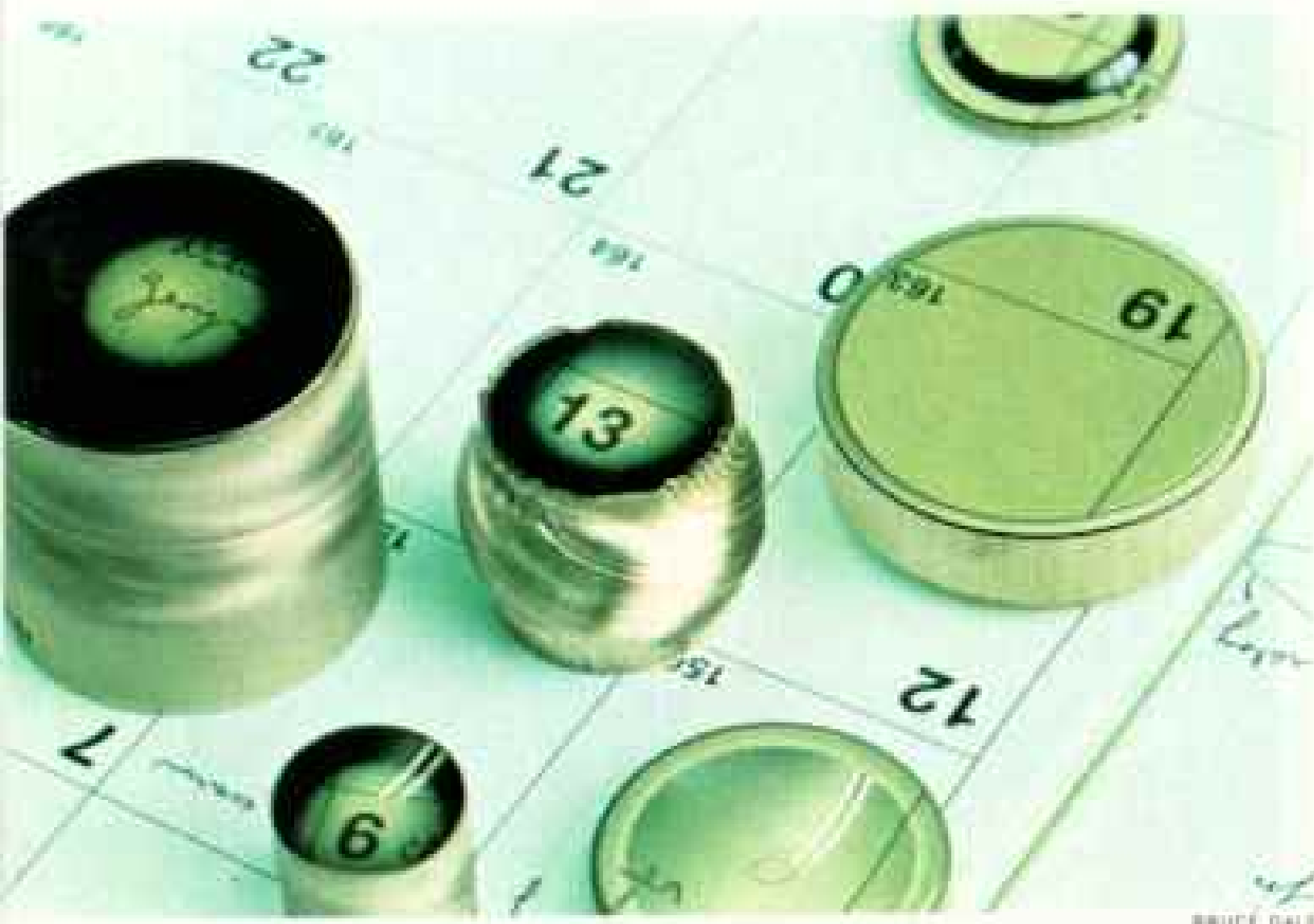
Oddly enough, these fibers "leak" very little of the light traveling through them. Dr. Walter P. Siegmund, technical manager of American Optical Corporation's fiber-optics operation in Southbridge, Massachusetts, explained this paradox.

"A light beam travels through an optical fiber much like a bullet ricocheting down a steel pipe. The beam caroms through the fiber's core, trapped there by the cladding.

"This cladding acts as a cylindrical mirror, turning light back into the core, a principle known as total internal reflection," Dr. Siegmund said. "It is so perfect that you can have millions of such reflections through many kilometers of fiber and still have a light beam emerge largely undimmed."

Not all optical fibers guide light solely by reflection. Some refract, or bend, the light rays, thus refocusing them in the core. This bending causes the light to snake down the fiber in a roller-coaster glide, rather than zigzag. Though the principle differs, the effect is the same: Optical fibers guide light because they behave like extremely efficient light traps.

First use of this optical phenomenon came in the late 1950's, when optical engineers



Millions of optical fibers are bundled, fused, cut, and polished to make up these glass plates produced by the American Optical Corporation (left). Called fused fiber-optic components, they become part of light-amplifying telescopes, rifle sights, and goggles that enhance night vision. Heating and twisting the fiber bundle results in an inverted image, as shown by the reversed number 13.

In another twist of sorts, a single giant fiber an inch in diameter takes the place of the usual light mixer in a photographic enlarger (right) made by the Vivitar Corporation.

and doctors developed fiber-optic medical probes—endoscopes—to peer deep inside the body.

These flexible, tubelike instruments can pass through the mouth, nose, or rectum. Often pencil-thin or slimmer, they contain two fiber bundles. One pipes cold bright light into the patient, the other carries a color image back to the physician's eye.

Doctors trained in endoscopy can thus scrutinize a patient's stomach for ulcers, examine the lungs for cancer, or inspect the vocal cords for polyps. Attachments allow specialists to photograph what they see for later study or flash it on a television monitor for immediate viewing and diagnosis by colleagues or students.

Side channels in endoscopes accommodate a whole doctor's kit of miniature medical tools. The specialist, working with tiny brushes, snares, and forceps inserted into endoscopes, can clear a blocked windpipe, cut precancerous polyps from the colon, collect tissue samples from the intestine, and even free some trapped gallstones, all without major surgery. Little wonder, then, that doctors call endoscopes "revolutionary."

In Minneapolis, Dr. Jack A. Vennes of the University of Minnesota and the Minneapolis Veterans Administration Medical Center showed me how simple an endoscopic examination can be (pages 518-19). While I looked into the eyepiece of a student-teaching attachment, Dr. Vennes guided a one-meter-long gastroscope down a

patient's throat. What I saw recalled *Fantastic Voyage*, a science-fiction journey through the human body.

Directly ahead stretched a narrow, humid corridor of mucus-streaked muscle, the esophagus. Rhythmic throbbing behind one pink wall betrayed an artery; another wall was flecked and mottled, showing where a passing aspirin tablet had irritated it. At the junction of esophagus and stomach, Dr. Vennes rotated the gastroscope to zero in on a patch of pale white tissue about the diameter of a pencil eraser. An early cancer—only its suspicious coloring gave it away.

"Subtle hues of color mean nothing to an X ray," Dr. Vennes said, "and lesions this small may go undetected; X rays miss more than a quarter of all stomach ulcers, for example. With endoscopes, on the other hand, you catch nearly everything."

The gastroscope probed forward again, on into the stomach. There tightly puckered cracks relaxed, then clenched again like powerful fists. Each contraction rippled a shimmering string of acidic globules into the pylorus, a rosette of muscle standing guard as gatekeeper to the small intestine.

Absorbed in this scene, I failed to see Dr. Vennes adjust a knob on the handle of the gastroscope. Suddenly the instrument itself was in view, trailing through the dome of the stomach. Cobralike, the tip of the scope had reared up to look over its own shoulder.

A brief scan of the stomach roof turned up no other lesions, and the gastroscope was withdrawn. The 12-minute examination left the patient with only a tickle in his throat, and he was prepared later for surgery to remove the cancer.

At the University of Washington in Seattle, a unique endoscope developed by Dr. Fred Silverstein, Dr. Cyrus Rubin, and Dr. David Auth stanches bleeding ulcers with light from an argon laser. The red pigment of blood cells readily absorbs the blue green laser light, converting it to heat that cauterizes blood vessels almost instantly. A jet of carbon dioxide piped through the endoscope blows aside excess blood, improving the safety and effectiveness of the procedure.

Of all the uses of fiber optics, none stirs as much excitement as light-wave communications. Not long ago experts in the field doubted whether communications would





The light wave of the future

IN THE ARITHMETIC of optical fibers, weight and space saved equals money saved. The racks (above) hold 200 reels of copper wire that weigh more than seven metric tons (16,000 pounds). The optical fibers on the hand-held spool weigh only 4.4 pounds but have the same message potential.

At Walt Disney World near Orlando, Florida, a new system using fiber cables (right) handles telephones and computer data. Similar cables link 158 homes to a visual information system near Osaka, Japan. Children watch monitors at the system's transmission center (facing page). Using a small keyboard, families can call up train and plane timetables, weather reports, and commercial programs.



BRUCE DALE (RIGHT)



benefit from fiber optics before the turn of the century. But today, as Stewart E. Miller of Bell Laboratories puts it: "Light-wave communications is like the new kid on the block. It's challenging everything in sight."

Backing up the challenge is a fiber-optic telephone line between a long-distance switching station in Long Beach, California, and a local exchange in Artesia, nine kilometers away. Inaugurated in April 1977 by General Telephone Company of California, this is how the line works:

Signal encoders first translate callers' voices into the ones and zeros of digital computer language. Special circuits mimic these digits with "on" (one) and "off" (zero) electrical signals. A light-emitting diode then converts the electrical signals into infrared light pulses that flash through an optical fiber.

En route through the fiber, light pulses are twice detected and rebuilt by repeaters for further transmission. At the end of the line the pulses are transformed back into electrical signals and decoded to reconstruct

callers' voices (pages 524-5). Two fibers in use at Long Beach, which now handle as many as 24 simultaneous conversations, have the potential of carrying 672.

Another system is undergoing tests in Chicago, where Illinois Bell Telephone uses lasers as well as light-emitting diodes to beam telephone messages, Picturephone images, and computer data over a cable of 24 optical fibers. Working at full capacity, this single cable could transmit all the text of a hundred years of NATIONAL GEOGRAPHIC in one second.

Such light-wave communication systems are a boon for engineers trying to keep up with the 525 million local calls Americans make each day. Until recently, coping with surging telephone traffic often meant tearing up city streets at enormous expense to lay huge amounts of bulky copper cable. Bell Telephone, for example, owns and operates more than 8,000 kilometers of cable in Manhattan alone, sandwiched among gas, sewer, water, and power lines. Slender cables of



optical fibers can slip into ducts alongside existing copper cable and enable telephone companies to expand their capacity without extending this underground labyrinth.

Moreover, because the fibers carry light rather than electrical signals, they resist cross talk, the passage of stray signals from one line to another that can occur in ducts where copper cables are jammed closely together. For the same reason, fiber-optic cables are unaffected by random electrical charges such as lightning and thus cannot short-circuit, nor can they be easily tapped or electronically jammed.

These advantages are prompting national telephone companies in Canada, Britain, Belgium, France, and West Germany to turn to fiber optics to satisfy communications demand in those nations. In the United States, both Bell Telephone and General Telephone & Electronics are installing more high-capacity light-wave urban communication networks for the 1980's.

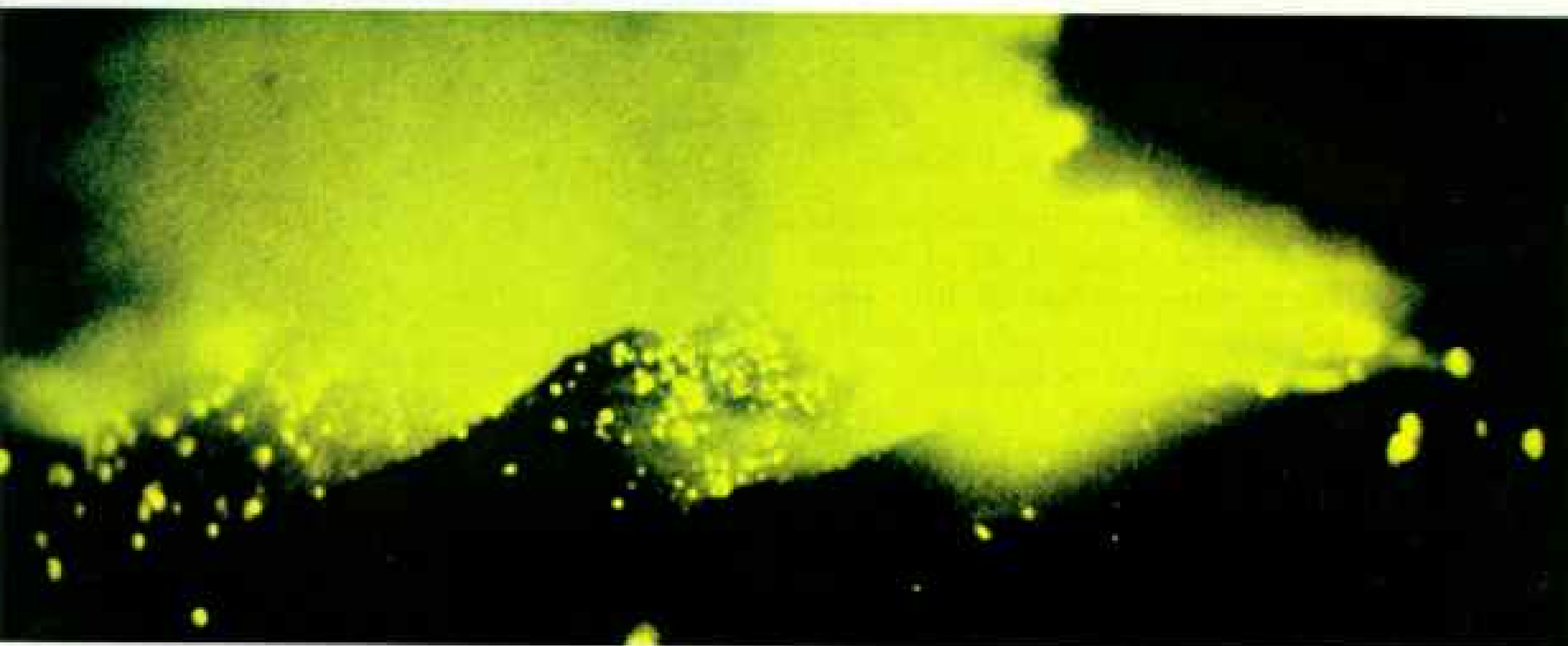
Significantly, fiber optics is moving into

television broadcasting. In New York City fiber-optic cable connects a microwave antenna of Teleprompter Manhattan Cable TV with a television center beaming programs to more than 20,000 subscribers. A similar link serves 34,000 customers near Hastings, England. These systems are but one step from providing revolutionary new two-way home-communication services.

Home Computers Wired to the World

At Higashi Ikoma model town outside Osaka, Japan, that step has already been taken. There Japan's Ministry of International Trade and Industry has opened Hi-OVIS (for Highly Interactive Optical Visual Information System), a computer and transmission center linked by fiber-optic cable with 158 local homes (page 531).

When I visited Hi-OVIS, managing director Dr. Masahiro Kawahata was watching a wall full of television monitors, each carrying a different program available to any home wired with optical fibers.



TOM ROBERTS, USDA FOREST SERVICE

Seeing the unseen

SPECIAL INSIGHT provided by a borescope that uses optical fibers helps assure a solid weld in the space shuttle engine made by Rockwell International (left). In the aviation industry, borescopes allow maintenance inspection without dismantling an engine. JTT's night-vision goggles enable a pilot for the U. S. Forest Service (right) to spot embers that could start a fire, such as the one (above) photographed through an image intensifier.

Fiber Optics: Harnessing Light by a Thread



I asked how many channels Hi-OVIS could accommodate.

"As many as you like, and some of them two-way, too. You can shop by television at local stores or tune in commercial broadcasts, stock-market quotations, train and plane timetables, or a weather report. A hand-held keyboard lets you tap out answers to questions in televised home-study courses; a computer checks your replies to speed up or slow down the course material in step with your learning ability.

"The Hi-OVIS system is almost infinitely expandable," explained Dr. Kawahata. "The immense signal-carrying capacity of a few optical fibers makes it possible to provide many more—and more sophisticated—services than could ever be handled by a like amount of copper wire."

In time Hi-OVIS is expected to enable its users to make and prepay restaurant, theater, and travel reservations; receive newspapers over a home telecopier; and remotely control household heating and cooling, lights, and appliances. It may one day provide instant and two-way visual access—over optical fibers—to hospitals, libraries, and even to city hall.

Scientist Sees Changes in Life-style

When will these fiber-optic innovations reach the average home? I asked Morris Tanenbaum, vice-president of Bell Telephone Laboratories, who cautioned that "fiber optics must not only outperform copper wire and cable but must also provide services people can afford and really want."

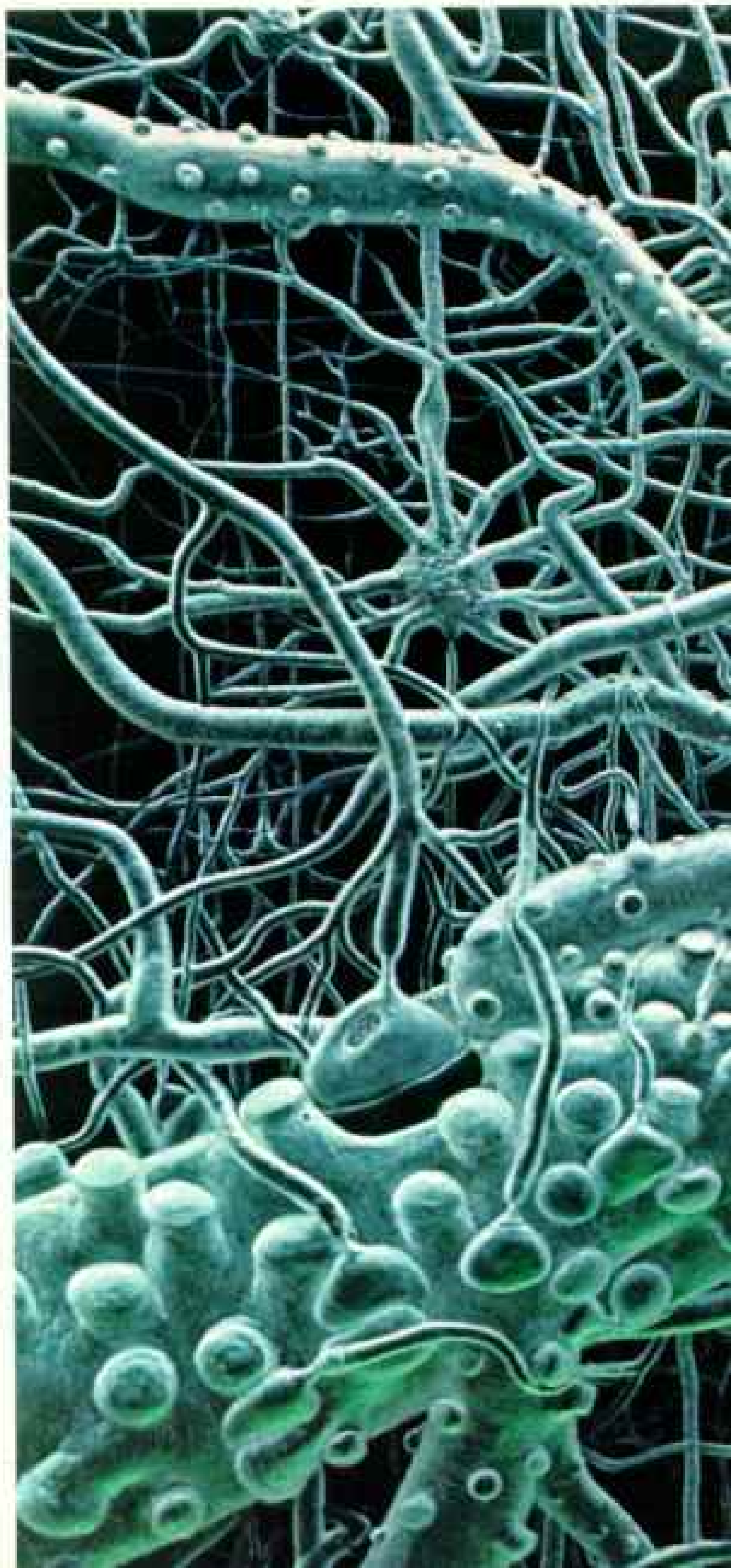
More optimistic is Dr. Charles K. Kao, a vice-president and chief scientist at International Telephone and Telegraph Corporation and the first to suggest optical fibers for communication (page 525). "I think people will need what fiber optics has to offer," he told me, "and in getting it, we'll see fiber optics produce major changes in the way we live and work, perhaps by the year 2000."

Almost a century ago Alexander Graham Bell predicted that his photophone, that earlier means of talking on a light beam, would "prove far more interesting to the scientific world, than the Telephone, Phonograph, or Microphone." Bell was premature, but change photophone to fiber optics and you glimpse truth in his prophecy. □

Brainstorming with fiber optics

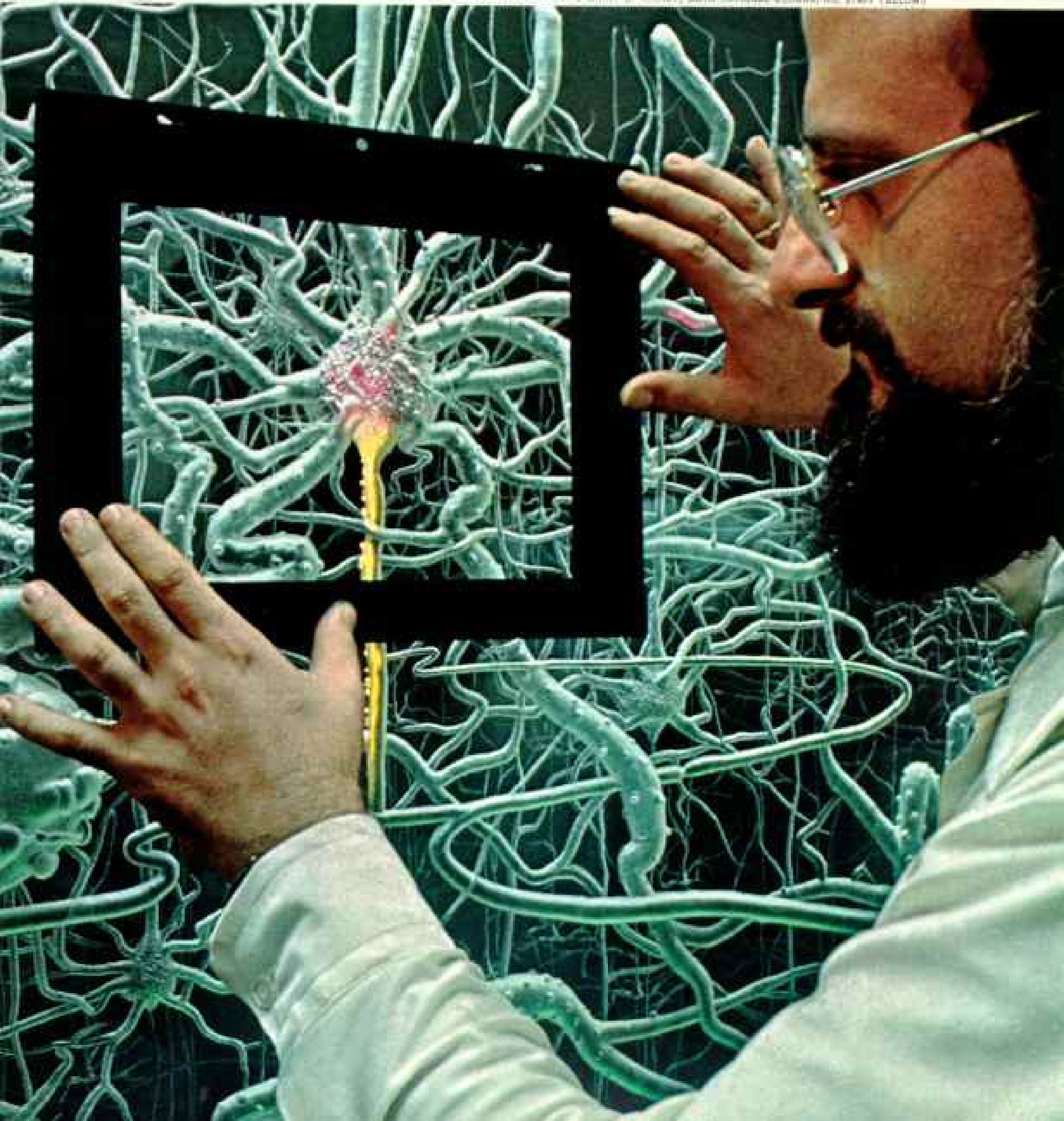
A PLEXIGLAS MODEL illustrating brain-cell action (*below*) is lighted by optical fibers. Staff designer Yeorgos Lampathakis created it for a future Geographic television special.

For space travels in miniature, David Beasley used one light source and 700 fibers to illuminate the windows of the *Battlestar Galactica* (*right*). The ship in the background, the *Rising Star*, was used in the same movie and television series.





JON SCHNEEBERGER AND LAWRY D. RIMNEY, BOTH NATIONAL GEOGRAPHIC STAFF (BELOW)





CHINA'S BEAUTY SPOT

ARTICLE AND PHOTOGRAPHS BY
W. E. GARRETT
ASSOCIATE EDITOR

OUR GUIDE was pretty of face but boxy of form from the bulky clothes she wore against the spring chill. In a singsong delivery as precise and passionless as a tape recording, she recited the official story of the Ling Canal, which flowed beside us. That done, she perked up and cheerfully answered questions.

Unlike briefings at similar Chinese projects, this one included no pro forma credit to the late Chairman Mao for having inspired the workers. For this project, just north of Guilin, was a relic of a different China; it opened for business 2,200 years ago.

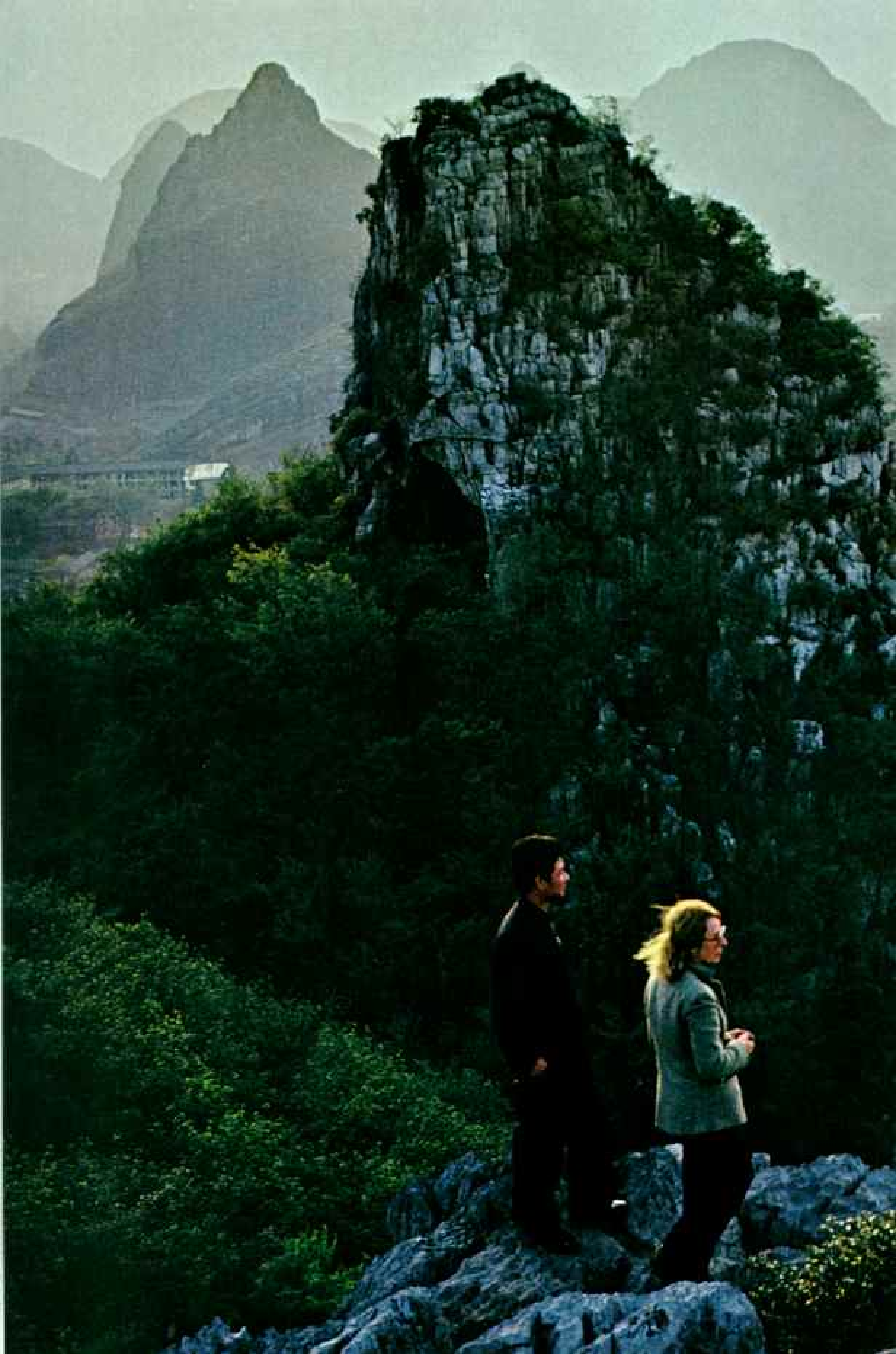
The Ling Canal proved a good introduction to Guilin, just as Guilin—previously spelled Kueilin or Kweilin (see note, page 548)—would prove to be a good introduction to today's China. The ancient project helped to unify China geographically by tying the vast Yangtze River

(Continued on page 547)

With slow-motion swordplay, a young woman in a Guilin park improvises on the disciplined exercises of tai ji quan. After decades of isolation, the ancient city again welcomes foreign visitors.









ABRUPT limestone hills, called tower karst, have inspired poets and painters for centuries. The landscape was formed when limestone in an ancient seabed was uplifted and then eroded. The hills are chambered with caves that sheltered Guilin's residents from Japanese bombing during World War II.

From *Folded Brocade Hill* (many pinnacles have romantic names) the author's wife and a guide look down on an industrial part of the rebuilt city.

The region around Guilin was one of the last areas to accept the Communist revolution in 1949. The cultural revolution of the late 1960's embroiled the region in battles between competing factions of the Red Guard; many were killed and wounded.

Reopened to foreign visitors in 1973, the city drew 50,000 tourists last year to contemplate the stone sentinels.





IN A SCENE as timeless as China, farmers and water buffalo plow under nitrogen-rich vetch to fertilize the soil at a commune outside the city. Subtropical rains provide water to flood the paddies for planting. Mechanical buffalo (below) are efficient but few, and their fodder—gasoline at two dollars a gallon—is scarce.

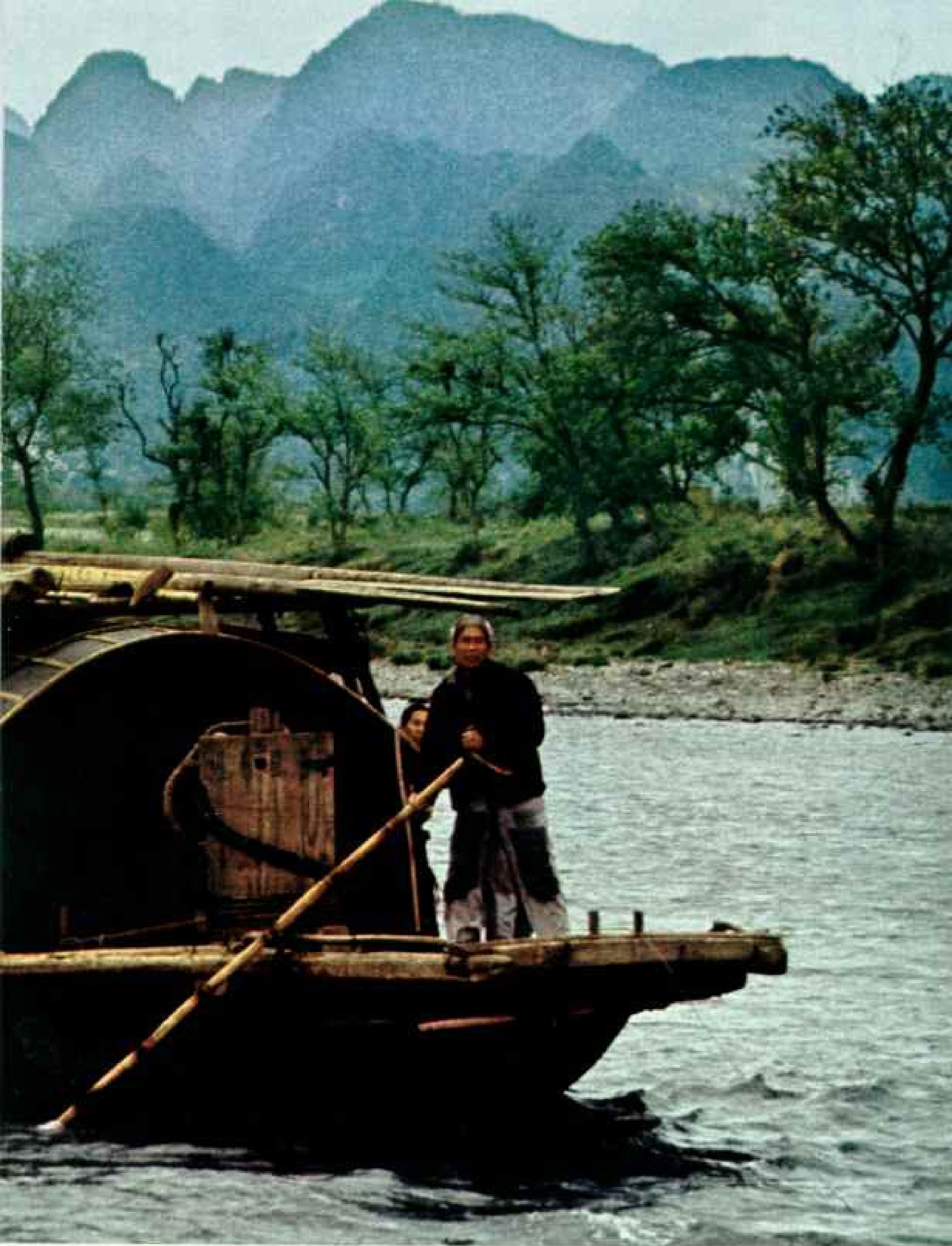
Although agriculture, industry, and crafts are traditional in Guilin's economy, some polluting factories have recently been removed to enhance appeal for tourists.

In the countryside west and south of Guilin, a third of the people belong to minority ethnic groups such as the Zhuang. They were considered barbarians 2,000 years ago by the Hans, who were extending their empire into the region.





A FAMILY CREW poles a cargo sampan against the current of the winding Li River. The large bow windlass is used to winch through rapids. The Li has been part of a river network



connecting central and south China since the first emperor of the Chin Dynasty built the Ling Canal north of Guilin in 214 B.C. Though now used mainly for irrigation, the canal helped extend the borders of the Chinese Empire to the southern coast.





(Continued from page 536) Basin to the Canton area via the Li River, which flows through Guilin. While the Great Wall was being constructed a thousand miles to the north to keep the barbarians at bay, the Ling Canal was being built to supply half a million Chinese troops conquering lands to the south. When we arrived 22 centuries later, China still feared attack from the north while invading a neighbor to the south.

I HAD COME TO CHINA soon after Vice Premier Deng Xiaoping's visit to the United States last January. My wife, Lucille, and I wanted particularly to have a look at Guilin—considered the most scenic spot in China.

Like all China, Guilin was adjusting to Peking's new policy ending the go-it-alone austerity of the Mao years with a frenzied rush to modernize. This policy was highlighted by establishment of full diplomatic relations with the United States after thirty bitter years of political quarantine.

In July 1973 the government, alert to the value of tourism, announced that Guilin, off limits to most foreigners since 1949, would be developed as a tourist center. The decree officially acknowledged an ancient reality; for at least 13 centuries Guilin's enchanting, mist-shrouded landscape of towering limestone hills has inspired poets and artists—and attracted visitors (pages 558-9).

The first recorded Westerners in Guilin, a group of Portuguese seamen, arrived unwillingly in 1550 as prisoners of a Ming emperor who had banned foreign traders. They were treated well, and some were smuggled out to safety.

When the Manchus captured Peking in 1664, the Ming court retreated to the south and lived in Guilin and other cities. Jesuits, who accompanied the court, converted most of the royal household to Christianity. The mother of the last Ming claimant to the throne was baptized Mary, his wife Anne, and his son Constantine. Even the governor

Off duty, on camera, Chinese soldiers record a visit to Seven Star Park. Of the foreign tourists in Guilin last year, two-thirds were overseas Chinese, visiting their ancestral homeland.

of the province and the commanding general of Ming forces were Christians.

Tourism, doubling annually since 1973, has tripled so far this year. The 700-bed Li River Hotel packs in Asian, European, and American tourists every day. Modern shops, apartments, factories, and small hotels, most built since 1960, line the four-lane main street. Broad sidewalks are shaded by osmanthus and cinnamon trees, the latter related to the cassia or Chinese cinnamon that gave Guilin its name: Forest of Cassia Trees (*gui*, cassia; *lin*, forest). Now a city of more than 300,000, surrounded by profitable fruit-, vegetable-, and rice-growing communes and small industrial complexes, Guilin shows no scars of its many wars.

Tourists and residents alike can be thankful that the promise of tourist money keeps Guilin clean. When effluent from factories polluted the waters of the Li River and fumes fouled the air, the government closed zinc, steel, and paper mills and moved a power plant in 1975 rather than hurt tourism. Such consideration leaves Guilin a pleasant diversion from the industrial cities in China, where billowing coal smoke lays down a blanket of eye-stinging fumes.

I was told that during a visit to Guilin the late premier of the People's Republic of China, Chou En-lai, found a wall blocking access to a tourist attraction. His mild criticism had the effect of Joshua's trumpet; the obstacle promptly came tumbling down.

Last year 33,000 of the 50,000 foreign tourists were overseas Chinese. We met one such family, the Leungs. Paul, the father, is a systems engineer for a California corporation. He had left China in 1949, earned a degree in engineering at Rice University, and achieved considerable recognition in his field. Accompanied by his wife, Mabel, and their three children, he had come back to China to conduct engineering seminars at several universities.

"Faculty and students kept me on the podium answering questions until I lost my voice," Paul told me. "I could have returned in 1973, but it would have been a waste of

time then. No one would have dared talk to an American-educated Chinese."

Lucille and I joined the Leung family at Seven Star Park to watch schoolchildren pay their respects at the monument to Chen Guang, a local martyr of the Communist Party. They left paper-flowered wreaths, bowed their heads in three minutes of silent meditation, then sang a song pledging allegiance to China.

For Paul the scene brought back memories. He said that as a youth in 1943 he often used the cave beside us as a bomb shelter. During World War II, Guilin's population jumped from 100,000 to about a million as refugees fled the Japanese advance.

I later asked historian Theodore H. White, a China correspondent in World War II, how he remembered the town. "Plum blossoms, beautiful girls, and brave American boys," was the quick answer.

The "brave boys" were pilots of the famed Flying Tigers, the American Volunteer Group organized before Pearl Harbor to help China. With limited aircraft, no spare parts, and few tools, they harassed Japanese forces from Burma to Canton. White described them as "the most spectacular single striking force in the history of aerial warfare."

Soon after Pearl Harbor they received Army Air Corps status, and their small airfield in Guilin grew to be one of the finest U. S. bases in China.

The "beautiful girls" included some who lived in the city's gaudy red-light districts. In contrast, dozens of missionaries—Catholics, Anglicans, and Southern Baptists—worked in Guilin. In the 1940's thousands of residents professed to be Christians.

Gen. Claire L. Chennault, leader of the Flying Tigers, wrote that "living conditions were bad" in subtropical Guilin. Cholera, typhoid, malaria, and other lesser known diseases plagued the people.

John Alison, a former squadron leader and now a vice-president of the Northrop Corporation, told me, "I saw no hunger, but you had to fight flies for your food. It was appalling to see countless dehydrated cholera victims receiving fluids intravenously."

A mission doctor told John it was all he could do. He had no medicine. "The strong will live," he said. "The weak will die."

NOTE: The GEOGRAPHIC has begun using the Pinyin system of transliterating Chinese, now officially adopted by China and by much of the Western press. Conventional spellings will be retained for historical figures and for well-known place-names.

The living exhibited fortitude, courage, and immense goodwill toward U. S. fliers. Throughout free China they rose, Chennault wrote, like "human ant heaps . . . to turn mud, rock, lime, and sweat into 5,000 foot runways. . . ." They repaired bombed airfields with incredible speed. When American pilots were shot down over enemy territory, individual Chinese risked their lives to hide them and guide them safely back to base. "On two occasions I probably would have died without their help," said John Alison. "One dark night when my plane went down in flames, I was rescued from the river by a young Chinese."

As the Japanese advanced, hordes of residents fled. Americans methodically blasted their base to bits as they pulled out. The end of the war saw the end of old Guilin.

ONLY THE PLUM BLOSSOMS remain of the city White knew. Now Americans come as tourists, not heroes. All missionaries were ordered out in 1951, and no Christians now worship openly in Guilin. Also gone, but not missed, are cholera, smallpox, and other communicable diseases.

The gaudiest entertainment now to be found is in the traditional opera house, the new music hall, and the two movie theaters (admission 22 cents for new films, 17 cents for old films; students pay only 5 cents).

Mixed with the Chinese films billed for the coming weeks were four Charlie Chaplin classics: *The Kid* (1921), *The Circus* (1928), *The Great Dictator* (1940), and *Limelight* (1952). The biggest crowds gathered where the 1978 U. S. film *Convoy*, starring Kris Kristofferson, was showing.

One evening we attended a musical with the Leung family. Paul translated the lyrics. The leading lady danced with a red flower, to be awarded to one of the boys as a symbol of her affection. She seductively withheld it, explaining in song: "For years we have praised the workers and the peasants and ignored the scientists. I am saving my flower

Lesson in English is chalked on a schoolyard, reflecting an eagerness to learn. English has replaced Russian as China's second language.







for the boy studying to be a scientist. He will lead the modernization of China."

In the musical each family aspired to have a refrigerator, a washer, and a dryer. "Then," the star sang, "no one will say that China is backward."

The show could have been scripted on Madison Avenue.

WE MET many students of the local college anxious to "earn the red flower." Each day a cheerful band of them ambushed tourists leaving the hotel, all eager to meet foreigners and practice their English. Their curiosity seemed insatiable. Did we have pictures of our home? What's life like in the United States? How are blacks treated? What's life like in Taiwan?

One student, whom we'll call Chang, offered me money to buy him a dictionary he couldn't get in China. In halting English he talked about his life. Both parents are teachers—his mother in Guilin, his father in a city far away. Because of the separation, they, unlike most workers, are permitted a vacation so they can be together for three weeks each year.

The only private transportation in China is the bicycle. Chang told us they are difficult to buy. "Even if you have the money, you must have a ration ticket. Sometimes the wait is two years. If you have a friend in the right place, you don't have to wait."

Does he have a bike? "Yes."

English has replaced Russian as the most popular foreign language in schools. At a primary school we saw where eager students had chalked English exercises on the playground during recess (page 549). Yet remnants of Soviet propaganda remain. In the library of a Guilin middle school we saw one English text, *Little Tom*, written and printed in the U.S.S.R. It told of a boy who was refused treatment for his broken arm by a white American doctor because he was

Red tickets to the future are presented to children initiated into the Young Pioneers. The most capable pupils are set on a path that can lead to membership in the Communist Party, a status enjoyed by less than 4 percent of the population.

black. The boy wrote to the Soviet Union asking for help.

We were told that before Deng Xiaoping's visit Voice of America radio broadcasts in English were intermittently jammed. Now they are piped into the dormitories.

Not everyone welcomes the new contact with the West. One day a young man walked up behind an American tourist and spat on her. His collar turned up to cover his face, he disappeared into the crowd.

What terrible passion would drive a Chinese to such a discourteous act? Our guide speculated that he might be a follower of the "gang of four." (Four members of the Central Committee of the Communist Party, led by Jiang Qing, Mao Tse-tung's wife, divided China by opposing all liberal moves. Mao warned them to "quit acting like a gang of four." After his death in 1976 their move to seize power resulted in their arrest.) Perhaps to the rude young man Western tourists symbolized a return to the capitalism and foreign imperialism of old China that the gang of four had warned against.

But then, the proud and independent people of this region, many of them not ethnically Han Chinese but Zhuang, have earned a reputation over the centuries for being difficult to govern. Always an outpost of Chinese civilization, the area often split from the central government. Guilin was a center of resistance for seven years after Peking surrendered to the Japanese in World War II. It was one of the last cities to be taken by the Communists in 1949.

Guilin and nearby cities became battlegrounds during Mao's cultural revolution of the late 1960's; by 1968 the fighting had developed into a civil war about which the world knew little. Half the smaller city of Wuzhou, south of Guilin, was reportedly destroyed by two clashing Red Guard factions, both claiming loyalty to Mao. The losing side claimed it alone lost 50,000 in the region. If true, that's as many as the United States lost in ten years in the Vietnam War.

Displays of affection between Chinese friends of the same sex are common, but young unmarried men and women are seldom seen even holding hands.









Although begging is now forbidden, two beggars approached us on the street, eager to capitalize on tourism. In a perverse way these isolated, unpleasant incidents (the spitting and begging) were reassuring—China had certainly not become a nation of automatons.

It is also certain that the old China—where beggars, pickpockets, disease, poverty, starvation, and hatred of “foreign devils” were commonplace—is gone. But rice and cotton still must be rationed. With a billion people to feed, a spell of bad weather could be disastrous. Still, the optimism, enthusiasm, and decent standard of living we found in Guilin indicated that the average man’s entire life is no longer devoted to surviving hunger and disease. He can look beyond today and aspire to an education and a better life for his children.

OUR CHINA TRAVEL SERVICE guide arranged a visit to a factory for a group of us. As is customary, we were ushered into the meeting room for a briefing. Hot tea and cigarettes were served as factory vice-manager Zhang Yingchan extended a “warm welcome from the staff and workers of the Measuring Instrument and Cutting Tool Factory.” Then he clapped his hands. We clapped in return.

The production machines were antiquated. Final adjustments for accuracy on micrometers were made by hand filing. Yet the results appeared to be fine tools.

The average worker’s salary, Mr. Zhang told us, was fifty yuan (about \$30) a month. “Starting this year, an incentive program permits an efficient worker to earn an extra 10 percent. Already we have increased production 8 percent.” He seemed pleased with the results of this neo-capitalistic idea.

In early morning hours we joined joggers running under umbrellas in Guilin’s unending spring rains. We enjoyed excellent food, even a local speciality, dog. On two trips

No baby-sitters are needed in this open-front neighborhood workshop where the seamstresses bring their children.

Working for an urban cooperative, they can earn the equivalent of \$20 a month.

down the Li River we viewed the awesome stone pinnacles wreathed by swirls of gray mist—an unreal stage.

Even with our eyes wide open we could see a China of 2,000 years ago; frail women in harness dug their toes into the gravel banks as their bodies strained to tow ancient sampans against the current. Legend says every sailor who drowns in these rapids becomes a devil clutching at boats trying to navigate the rapids. Fishing cormorants perched on the sterns of small boats—seasonally unemployed since they can't see to fish in the muddy waters of spring.

At Yangshuo, where the Li River trip ended, we visited a 1,300-year-old banyan tree—as ancient as our redwoods. One big difference: The Chinese know who planted this one, and when, and why. It was part of the landscaping for a temple when the Guilin area was a center for Buddhist culture.

WE ESPECIALLY remember sitting atop towering Folded Brocade Hill as the city below us slowed to meet the night. Sounds wafted up like an audible incense to spice the evening quiet. A rooster crowed. A train whistled in the distance. Laughing children batted a badminton bird in a side street. An overloaded cart squeaked along, pulled by a man bent to a draft animal's work. A tourist bus announced its self-importance like a noisy dog by trying to honk cyclists out of its path. Most silently ignored it and continued their leisurely pace.

What we saw we liked, but we left Guilin frustrated. Our eight-day visit generated more questions than answers. Was China's shining new liberalism succeeding? It seemed to be advancing by fits and starts. Dissident posters were coming down in Peking. Yet agreements were being reached with the West for new factories and hotels.

Understanding China can be compared to solving the old Chinese interlocking wooden puzzles. What seems obvious often isn't, and what seems complex may be simple. Unlike the puzzles, designed to frustrate and confuse, the Chinese we met seemed eager for understanding and friendship. But like old friends who haven't spoken to each other for thirty years, the people of China and the U. S. have a lot of catching up to do.

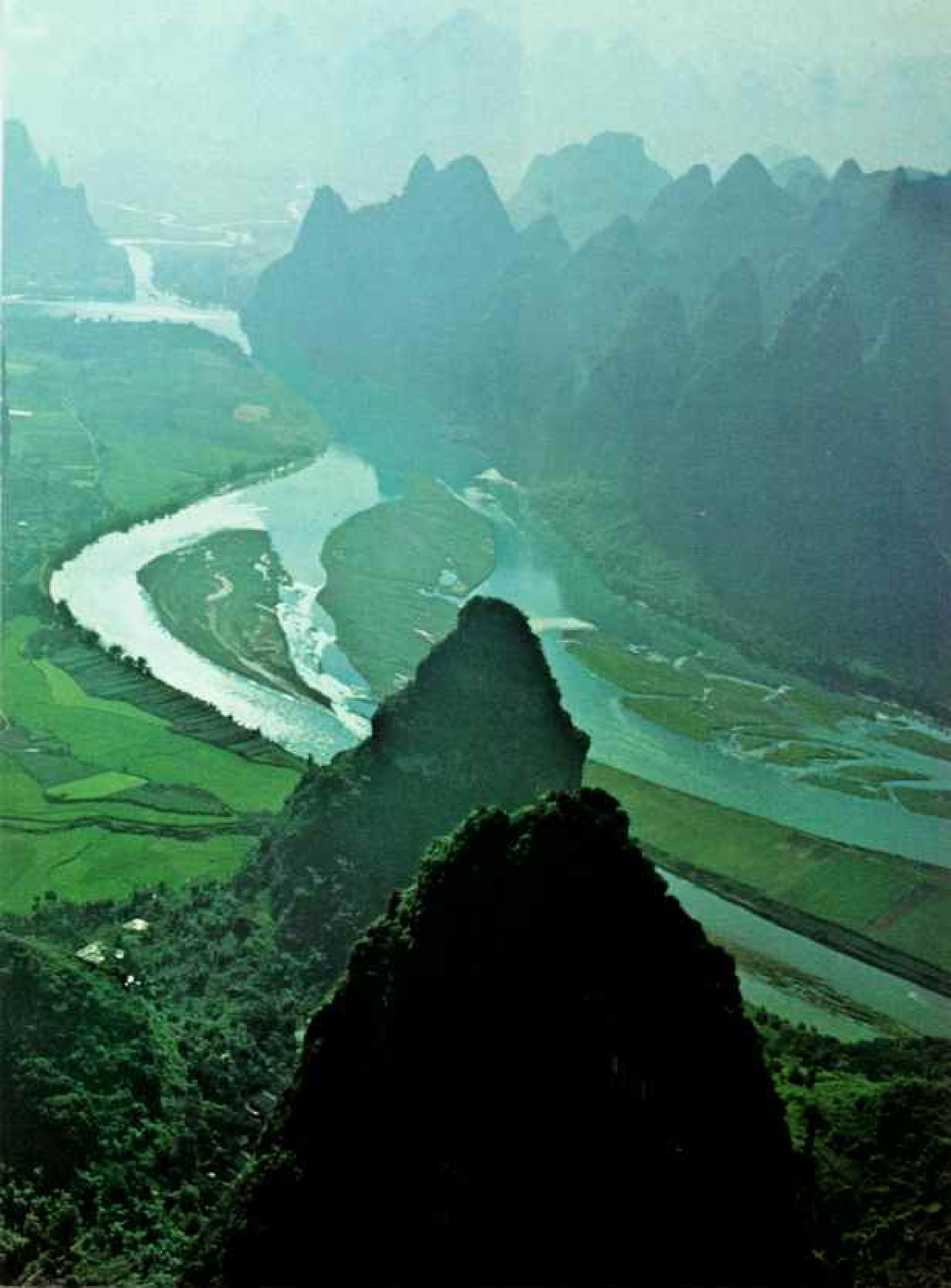


Harlequin lights splash Reed Flute Cave, one of Guilin's prime attractions. Heavy rains filter through the valley



floor and dissolve and erode the porous limestone as they gather in hundreds of underground channels. The Chinese are now installing hydroelectric generators in these streams, as well as pumping water to the surface for irrigation.





as it courses among serrated hills strung in files like dragon's teeth.

RISEN from a devastated town, Guilin blooms again as a place of beauty. The five similar buildings along the Li River (below), the author was told, house veterans of the Long March; this 6,000-mile retreat of Communist forces in 1934-35 is celebrated in China as a national epic.

New housing of stuccoed concrete (right) is all apartment style. Typically, workers from the same factory live together. Bomb shelters are built under the street, since the threat of attack by the Soviet Union is taken with the utmost seriousness.







COMRADES-IN-ARMS stroll the sidewalk along the main street (above). Before the buses and trucks roll, early morning traffic of bicycles and a handcart (right) passes a hotel that caters to Chinese tourists.

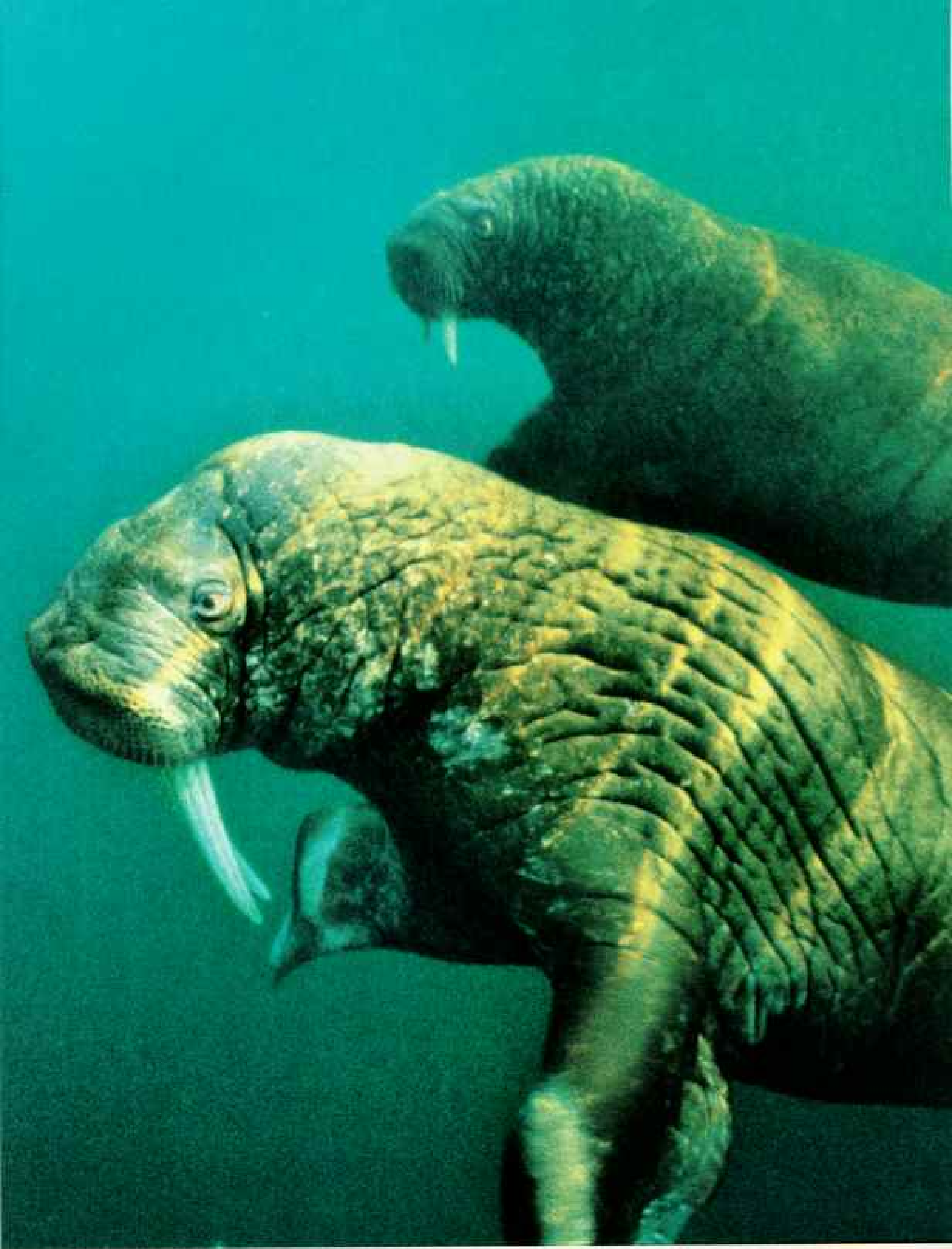
Bicycles are equipped with only one gear but are available in various weights and gear ratios according to their intended use.

The only form of private transportation, bicycles are cherished. When parked downtown, they are guarded by attendants for a two-cent fee.


It now seems unclear just how far and how fast China will welcome Western technology and the monetary debt that goes with it. Group tourism involves minimum expenditure and allows China to showcase progress in selected cities such as Guilin, while helping to build investment capital. □







Streaked by arctic sunlight, two Pacific walrus swim beneath the pack ice off the northwest coast of Alaska. On a diet of clams and snails, walrus reach massive proportions, sometimes weighing two tons. Thick blubber insulates them from the bitter



Learning the Ways of the Walrus

By G. CARLETON RAY

Photographs by

BILL CURTSINGER

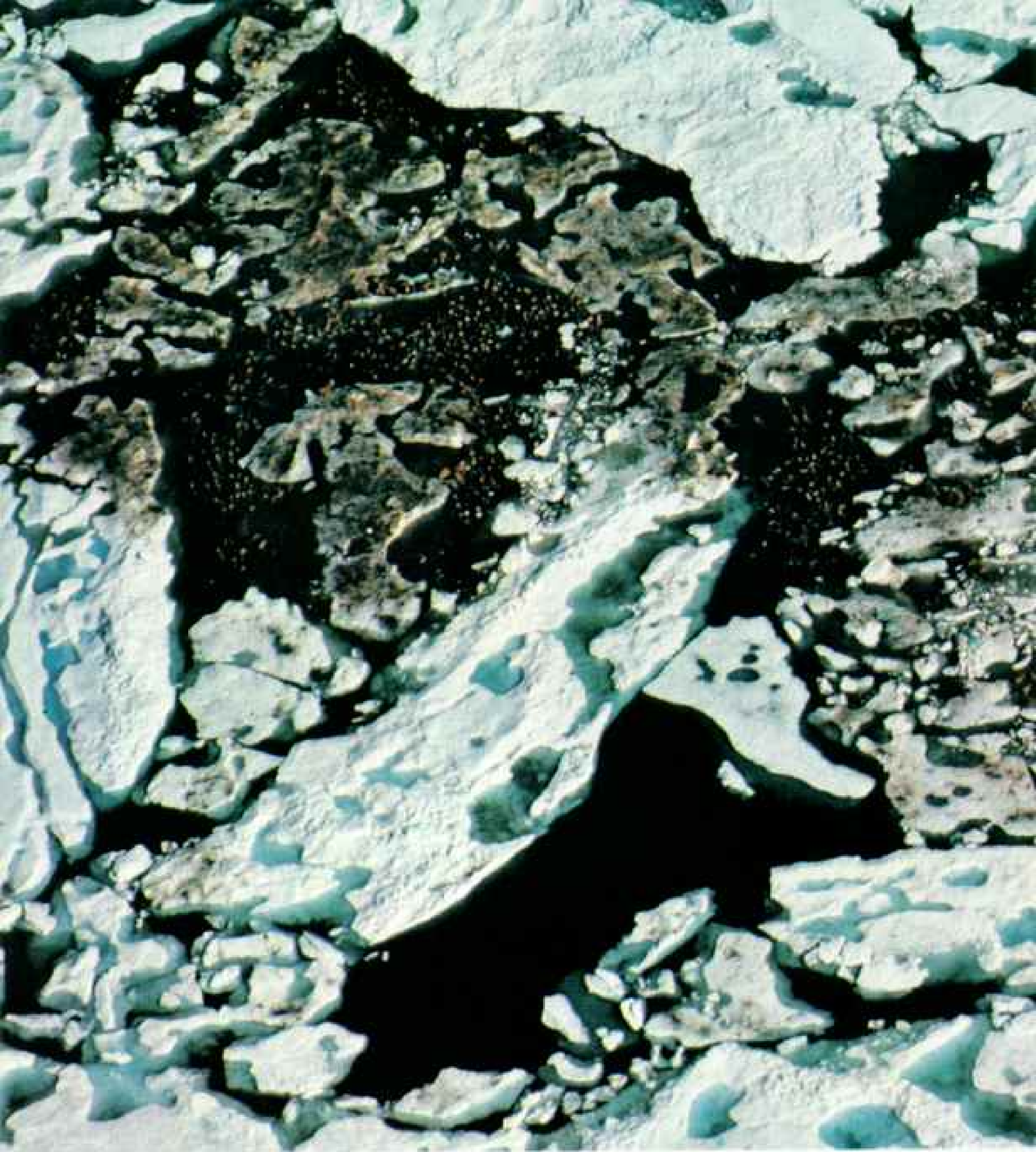
IN A DAZZLING REALM of sea and sky, breathing the tonic arctic air, we sat on bleachers of floe ice watching a conclave of walruses. Indistinct mounds of brown flesh soon resolved into lounging clusters of the largest—whales excepted—of all northern mammals.

On that bright July day in 1977 we were midcourse in a novel experience: Never before had a single walrus herd been followed in moving pack ice for more than a day or two. We kept this group in sight for 12 days.

Having sailed through the Bering Strait into the Chukchi Sea (maps, following pages), we were put overside each day from the U. S. Coast Guard icebreaker *Glacier*. Our research group, ferried to the ice in inflatable boats, included graduate students from the Johns Hopkins University in Baltimore, where I am a biologist.

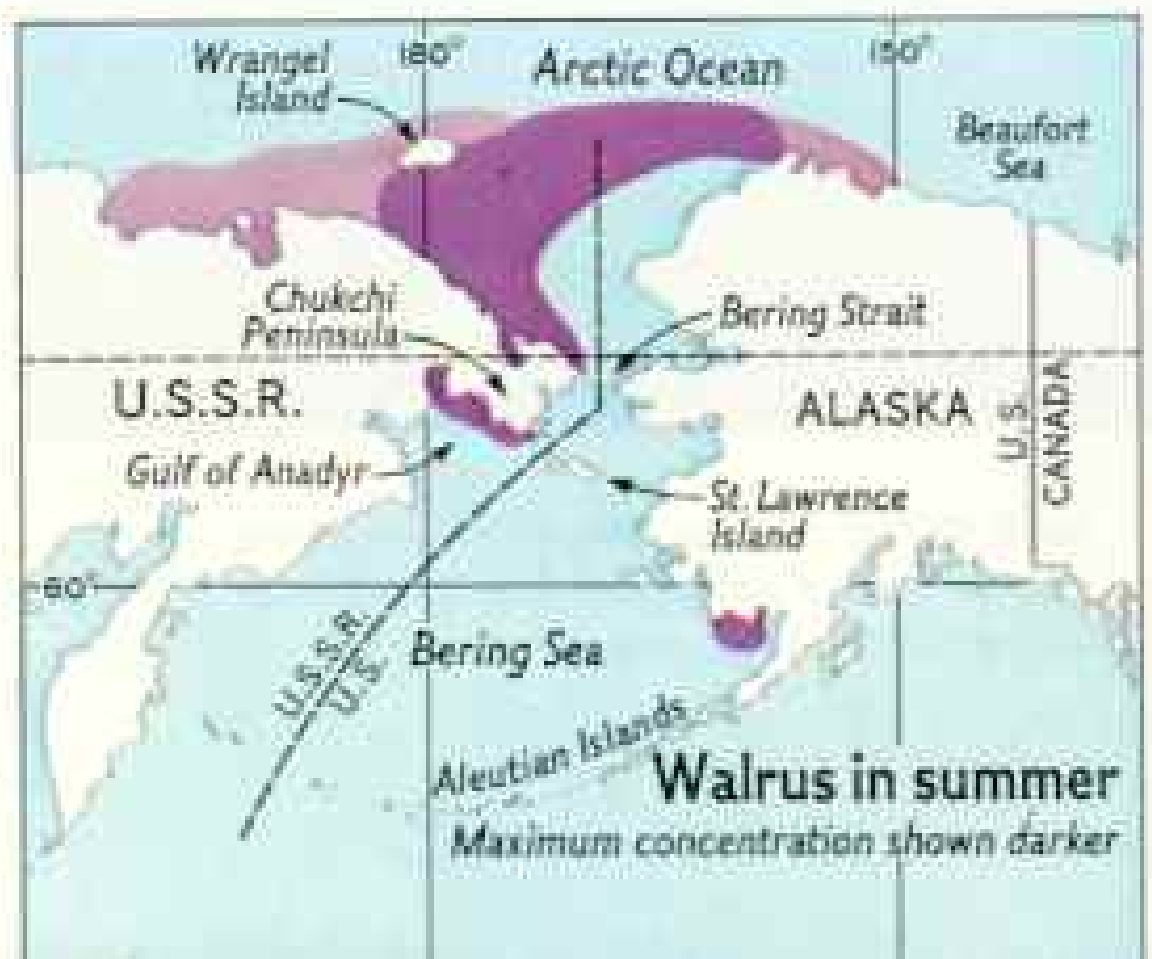
This particular day we were fortunate to see *Odobenus rosmarus*, the "tooth-walking sea horse," in association with the polar bear, its only known enemy apart from man and occasionally the killer whale. Two bears were vastly outnumbered by 426 walruses in 43 groups. One of the bears almost haphazardly charged two of the walrus congregations. (Continued on page 569)

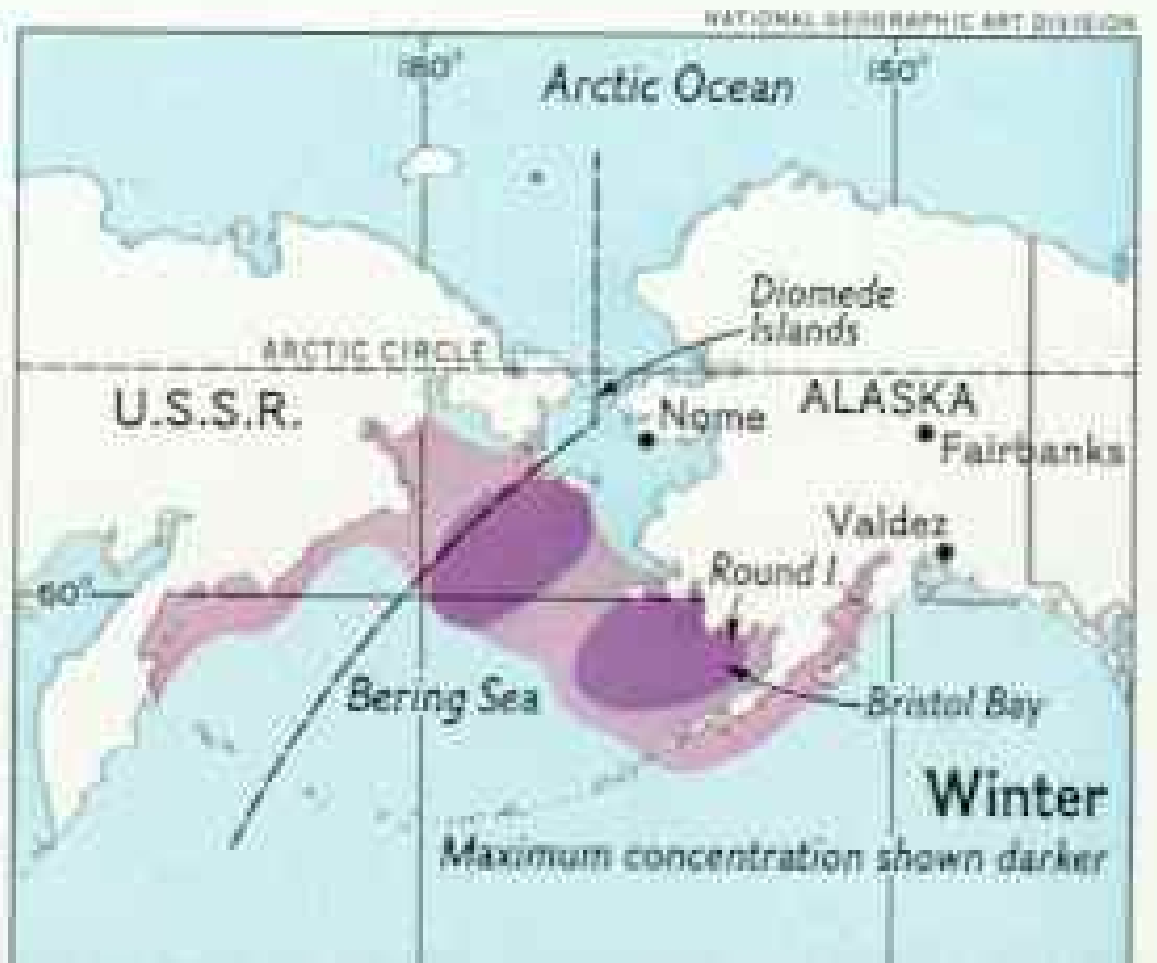
cold of the Bering and Chukchi Seas, whose waters support the greatest density of marine mammals on earth.



"Like hogges upon heapes," wrote Jonas Poole, 17th-century mariner, of a herd of walruses such as this one seen from a helicopter above the ice-filled Chukchi Sea.

After wintering in the Bering Sea, most animals migrate north to the Chukchi's rich feeding grounds. As the weather grows cold and the pack ice closes up, they swing south again, returning to the Bering Sea in late fall and early winter.





NATIONAL GEOGRAPHIC ART DIVISION



driving dozens of the animals off the ice.

Among the walruses, what we observed was mostly a monumental somnolence: Sleeping is the prime activity of out-of-the-water walruses. But we recorded the "woof talk" of females and young, and dominance and appeasement displays—the finest hours I've had in two decades of walrus-watching.

Way of Life Assures Strict Privacy

Walruses are, in truth, Poseidon's creatures. The major events of their lives—eating, courting, mating—occur in a liquid realm where man is ill suited to follow. Fortunately, when walruses haul out onto the sea ice to rest and bear young, they are quite easy to approach in ice-breaking ships.

In recent years, observations by remote-sensing and underwater-acoustic devices as well as by mini-submarine have given us new perspectives on this beast. Still, total walrus behavior remains poorly understood. Like icebergs, they are seen mostly at the surface, and we must infer the rest.

This ignorance could be costly, for the home of the Pacific walrus in the Bering and Chukchi Seas—or Beringia, as the area is called—is important to man. These shallow seas cover a continental shelf largely unspoiled, despite heavy exploitation of its animal resources over two centuries. Marine mammals and birds thrive here in the greatest density and variety anywhere. Beringia's seas also offer rich fisheries and, undoubtedly, vast resources of oil and natural gas.

One way to understand the ecosystem of these fertile waters is to study "indicator" species that affect, or are sensitive to, changes in the marine environment. In taking the ecological pulse of the Bering and Chukchi Seas, the walrus is a prime tool.

I got my start in walrus study gathering calves in 1958 for the New York Zoological Society's aquarium at Coney Island. Soon after, I met Dr. Francis H. "Bud" Fay, now of the University of Alaska's Institute of Marine Science, and he has become my closest colleague in walrus research.

Of the two subspecies of walrus, Atlantic (*Odobenus rosmarus rosmarus*) and Pacific (*O. r. divergens*), the Pacific is larger, with heavier, longer tusks and a broader muzzle. Male Pacific walruses may weigh two tons. The enlarged canines projecting downward from the mustachioed muzzles of both sexes at times appear to get in the way, and many walruses accidentally break them, carrying fractured tusks or only one or none.

Though ungainly on land or ice, the walrus is agile in its preferred environment. Streamlined, supple, and muscular, it swims by means of side-to-side sweeps of the rear flippers, each being used alternately.

For northern peoples the walrus has provided skins for boats, sinew for cordage, blubber for fuel, food for humans and dogs, and ivory for implements and art objects. For me, years of walrus-watching has meant working with Eskimo hunters, mostly at the village of Gambell, Alaska, which clings to the northwestern tip of St. Lawrence Island in the northern Bering Sea. There the annual northward migration of marine mammals begins in April and ends in early June with the start of the brief ice-free summer.

At Gambell one May in the early sixties, I joined a crowd of Eskimos speculating about when the "walrus ice" from the south and west would move in, bearing its heaving herds. Beach pebbles whispered their response to a lazy surf. Sunset silhouetted Siberian peaks fifty miles to the west.

Winnie James, a veteran walrus hunter who had agreed to let me accompany him, sauntered up.

"How does it look, Winnie?" I asked.

"Plenty of ice soon. Lots of walruses."

And when the walruses did come, we climbed into clothing of down and wool and headed for the boat racks, our dogs pulling sleds piled with outboard motors, rifles, sealskin pokes, and assorted paraphernalia.

Silently our skin boat slipped into the gray green water, strewn with broken sea ice. Ice, in fact, was a big part of the poetry of this day—ice and the dark, clear water, the

An underwater blimp at cruising speed, a bulky cow glides beneath the surface. Plankton gives a white coating to the bottom of the ice and clouds the water. Although ungainly on land, walruses are adept swimmers, diving as deep as 300 feet and remaining submerged for perhaps half an hour.



HOLLIE GETERMICK

Long ivory tusks distinguish the adult walrus (above); both males and females grow these enlarged canines. Scientists believe that tusk size helps determine an individual's status in the herd.

During deep dives, blood is pumped from the blubber to underlying tissue to maintain body temperature. Thus, when the animal emerges, the skin is a bleached color (below), which turns a reddish brown as blood flushes back to the surface.

The author speculates that walrus feed by rooting along the bottom, feeling for mollusks with their sensitive whiskers, as this painting portrays (right).



TOM WALKER (ABOVE); PAINTING BY ROBERT HYNES





panoply of birds, and the Eskimo's easy harmony with it all. Many boats returned laden with walrus meat and hides; the crews left unwanted parts of the carcasses to the sea.

Walrus pass Gambell midway in the spring migration. The procession includes seals, whales, porpoises, and countless birds, chiefly eider ducks, auklets, fulmars, and murre. Some tarry, some turn west to Siberia, but most travel on north. In one of the great sea mammal and bird migrations on earth, thousands of tons of living creatures pass through the Bering Strait for brief summer pasturage in the Chukchi or Beaufort Seas, or to nest along their shores.

Southbound in fall, the walrus are back in the Bering Sea by December and January.

Considerable numbers of walrus stay behind in the Bering Sea; some ten thousand males remain far to the south among the Walrus Islands of Alaska's Bristol Bay. Perhaps twice that number summer in Siberia's Gulf of Anadyr.

Walrus lead double lives, adapted to both air and water. Since seawater conducts heat about twenty times better than air, marine mammals need extra insulation. The walrus's blubber, between skin and muscle, may exceed three inches in thickness.

To maintain a stable body temperature,

Huddled against their mothers, 2-week-old calves find relief from



however—about the same as humans' 98° to 99°F—insulation is not enough. On land the problem is often one of dissipating excess heat, contrary to the need in the water for conservation of the body's warmth.

The walrus copes through a special kind of thermoregulation, or temperature control. The animal is able to vasodilate—to shunt hot blood outward to the skin where it can be cooled. Walruses vasodilate when the apparent temperature (the combined effect of radiation, wind, and moisture) rises above about zero degrees Fahrenheit. The converse occurs when they enter the more heat-conductive water. Through vasocon-

striction, most of the blood is pumped out of the blubber, which then insulates the body from the sea's penetrating chill.

Although the Pacific walrus is not endangered, the controversial Marine Mammal Protection Act of 1972 gave it full protection from commercial hunting, exempting only Alaska's native peoples, who kill perhaps 3,000 animals a year. Limited sport hunting has been permitted since the spring of 1976, under strict Alaska state control. The kill on the Soviet side is apparently less than our own. The impact on the walrus population of this legal toll is uncertain, since their total numbers can only be estimated.

chill Bering Sea winds. Without such protection, they would soon perish.

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G. CARLTON RAY





BOLLIE OSTERNICK

Summertime resort for bull walruses, Alaska's Round Island (facing page) is an *ugli*—an Eskimo word meaning "hauling-out place."

On beaches as well as ice floes, walruses constantly jockey for preferred spots to rest. During disputes, the animals often feint and parry with their tusks, occasionally jabbing each other (below). The bulls quarrel frequently, but their wounds are seldom serious since males are armored with thick skin covered with lumps called tubercles.

Once comfortably reclined on the beach, walruses assume a variety of relaxed postures (above).

TOM WALKER (BELOW AND FACING PAGE)



U. S.-Soviet aerial surveys in 1975 put the Pacific walrus population at between 140,000 and 200,000 animals. Certainly the Pacific walrus has made a remarkable recovery from 19th- and early 20th-century slaughter. In fact its numbers may be nearing carrying capacity—the maximum number its environment can support.

But the walrus still is highly vulnerable. A growing demand for scrimshaw—the carved ivory that commands such high prices in the souvenir and art trade—could lead to annual kills in excess of sustainable losses. The population could also suffer a catastrophic decline because of environment degradation, pollution, or exploitation of rich mollusk beds, the walrus's major food source. No binding international treaty for management yet exists.

Walruses No Clock-watchers

Only four days out of Nome on our July 1977 study, we contacted Herd 111.* (Already on this trip we had made 110 walrus sightings.) Following the animals for almost two weeks, we observed that the herd moved only a few miles relative to their original floes, but the assemblage drifted sixty miles northeast on the shifting ice.

The movements of Herd 111 contradicted our assumption that walruses haul out onto ice every day, mostly at night and midday. The herd emerged on the ice as a unit—continuously out of water for about forty hours, then constantly in the water for one to three days, without any sign of a 24-hour rhythm.

Instrumenting marine mammals is extremely difficult. But during the summer of 1974 Dr. Douglas Wartzok (my colleague at Johns Hopkins), Bud Fay, and I traveled on the research ship *Alpha Helix* to Round Island in Bristol Bay, where we intended to try radiotracking the walrus. *Alpha Helix* is operated by the Scripps Institution of Oceanography with National Science Foundation support. As we cruised, we laid our plans for testing "limpet" transmitters on three big bulls.

The limpet, which "pins" itself to the tough walrus hide on contact, is applied

*Support for the author's walrus studies came from the National Geographic Society, the U. S. Marine Mammal Commission, the Office of Naval Research, NASA, and the U. S. Coast Guard.



from the end of a six-foot pole. The scent of man sends walrus into a panicky rush toward water, so I had to stay downwind and clear of the animals' access to the sea to avoid being squashed like a grape should they stampede. Another hazard was less terrifying: One good whiff of walrus on a warm summer's day is nearly enough to unseat my emotional attachment to the creatures!

The limpet worked. We tracked one burly subject for half a day—a record, although he slept most of the time. Three years later we tried an “improved” limpet, but—alas!—the walrus easily rid themselves of it. Nevertheless, I am convinced that one day we will follow marine mammals, including the walrus, by radio and even by satellite for long periods—perhaps for many months.

Big Tusks Tell Who's Boss

Observing herds at Round Island, Dr. Edward “Ted” Miller has established that the walrus's tusks are important in asserting dominance. Within each herd the largest animals with the longest tusks are more aggressive and more successful in disputes.

I am convinced that walrus do *not* use their tusks to dig food. This legend took root two and a half centuries ago, although no

one has ever seen a walrus use its tusks to dig. A walrus, like a man, is almost weightless underwater; digging with tools would be as difficult for it as for any diver. Also, animals that have lost one or both tusks are just as fat as those with a full complement.

I conjectured years ago, watching captives, that the walrus feeds by rooting with its sensitively bewiskered muzzle in the soft seafloor, where the animal's food resides (pages 570-71). Bud Fay has also concluded that the walrus's head structure favors muzzle rooting. I am sure that one lucky day we will see it with our own eyes.

In fact, in 1972 in the Bering Sea we came very close. In the small research submersible PC-8B we descended about 125 feet to the dark bottom. Our searchlights probed ahead over a silty seafloor strewn with crabs, starfish, brittle stars, anemones, and the mounds and tracks of burrowing organisms. Occasionally a fish drifted by.

Through the forward plastic window, an odd pattern on the gray brown ocean floor came into view. “Look at those furrows!” I exclaimed to pilot Mike Adams. Our lights revealed a tangle of foot-wide troughs, tracing off across the bottom as though something had been trenching with a giant

Stealth and a downwind approach allow Johns Hopkins University student Rodney Salm to inch close enough to “pin” a radio transmitter to a walrus. Designed to



trowel. Everywhere was the litter of broken and empty clam and snail shells.

Sam Stoker, a marine biologist with the University of Alaska, had emerged from the submersible a few days before, reporting that "the bottom looked as if a bunch of pigs had been working it over."

"Those must be the trails Sam told us about," I said. "Assuming that walrus made them, there'd be no way they could dig such patterns with their tusks. They could do it only by rooting with their muzzles."

Naturalists early identified mollusks as the main item of walrus diet, but many other bottom-dwelling, or benthic, invertebrates are eaten too—sea squirts, worms, some crustaceans. Now and then walrus catch fish, and sometimes they accidentally swallow bits of plants and ocean-floor sediments.

The implications of this diet are staggering. Consider each adult walrus's daily need for a hundred pounds of food. This would mean eight hundred large soft-shell clams, or as many as ten thousand of the smaller hard-shell clams. Shell fragments are rarely found in walrus stomachs; they apparently tear off only the siphons from the soft clams and feet from the hard clams.

Bud Fay believes, as I do from study of

captives, that the walrus uses its muzzle and whiskers to root and *feel* for food. When it finds a morsel, the lips are pursed about the shell and powerful sucking action of the tongue slurps out the flesh.

Walrus are among the biggest creatures in their environment. But what eats *them*? We knew that polar bears occasionally take a young walrus. Our work with Herd 111 indicated that interactions between these two powerful mammals may be far more frequent than was previously believed.

Bears Snack on Not-so-fast Food

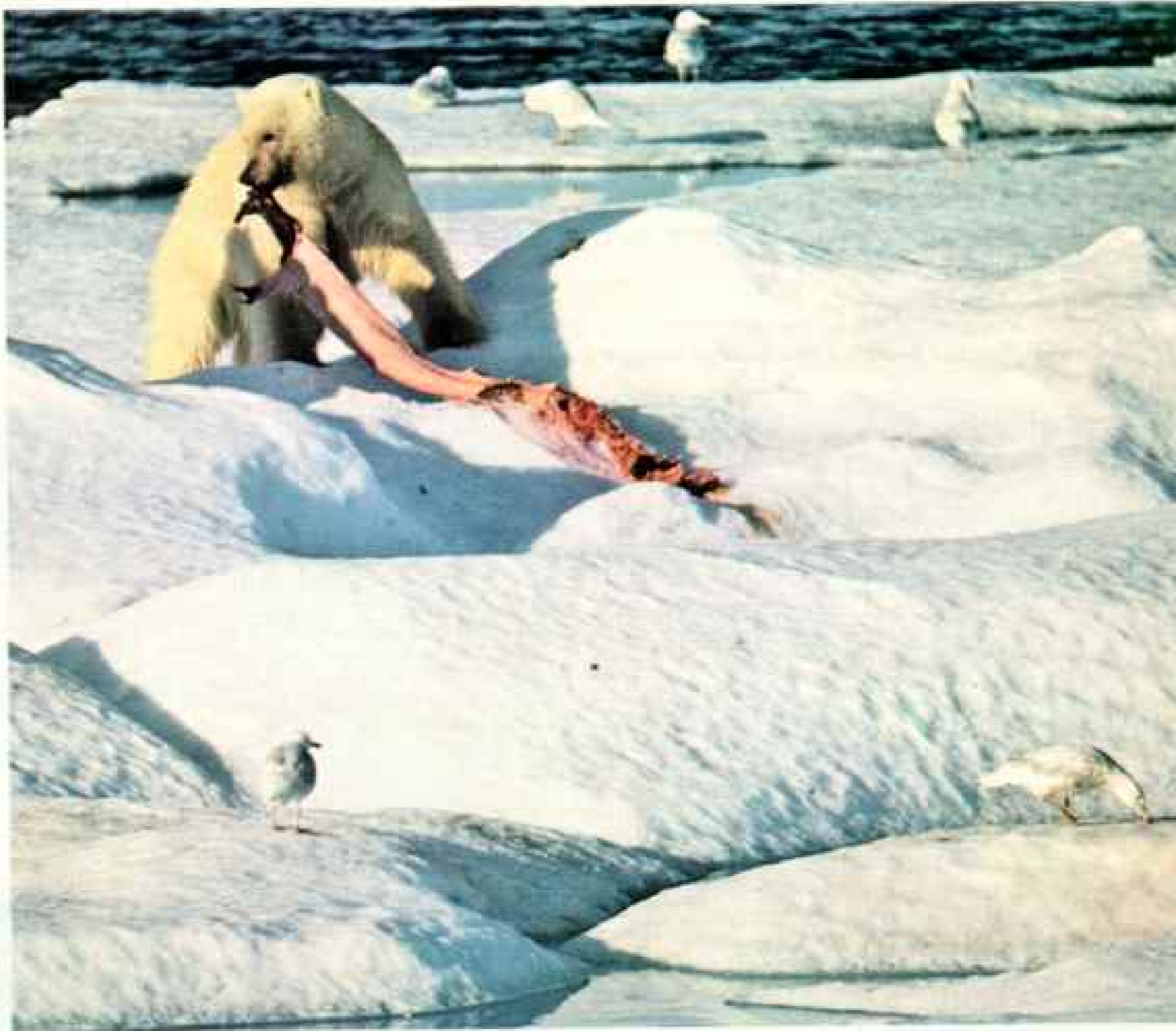
We repeatedly saw polar bears chase walrus, and we observed one bear consuming the remains of a calf. If the calf is the quarry, how does the polar bear separate it from its exceedingly protective mother?

Watching herds spooked by polar bears gave us a clue. In the mob's frantic dash for water, a calf is often the last in. We hypothesize that polar bears charge walrus groups on the random chance of seizing a calf as it heads for the water (following pages).

However incomplete our knowledge of the walrus's feeding and being fed upon, we know little more of courtship and reproduction among these animals. Bud Fay long

enable scientists to follow the movements of a single animal, the device—called a limpet—worked for only a few minutes before the walrus raked it off beneath the ice.

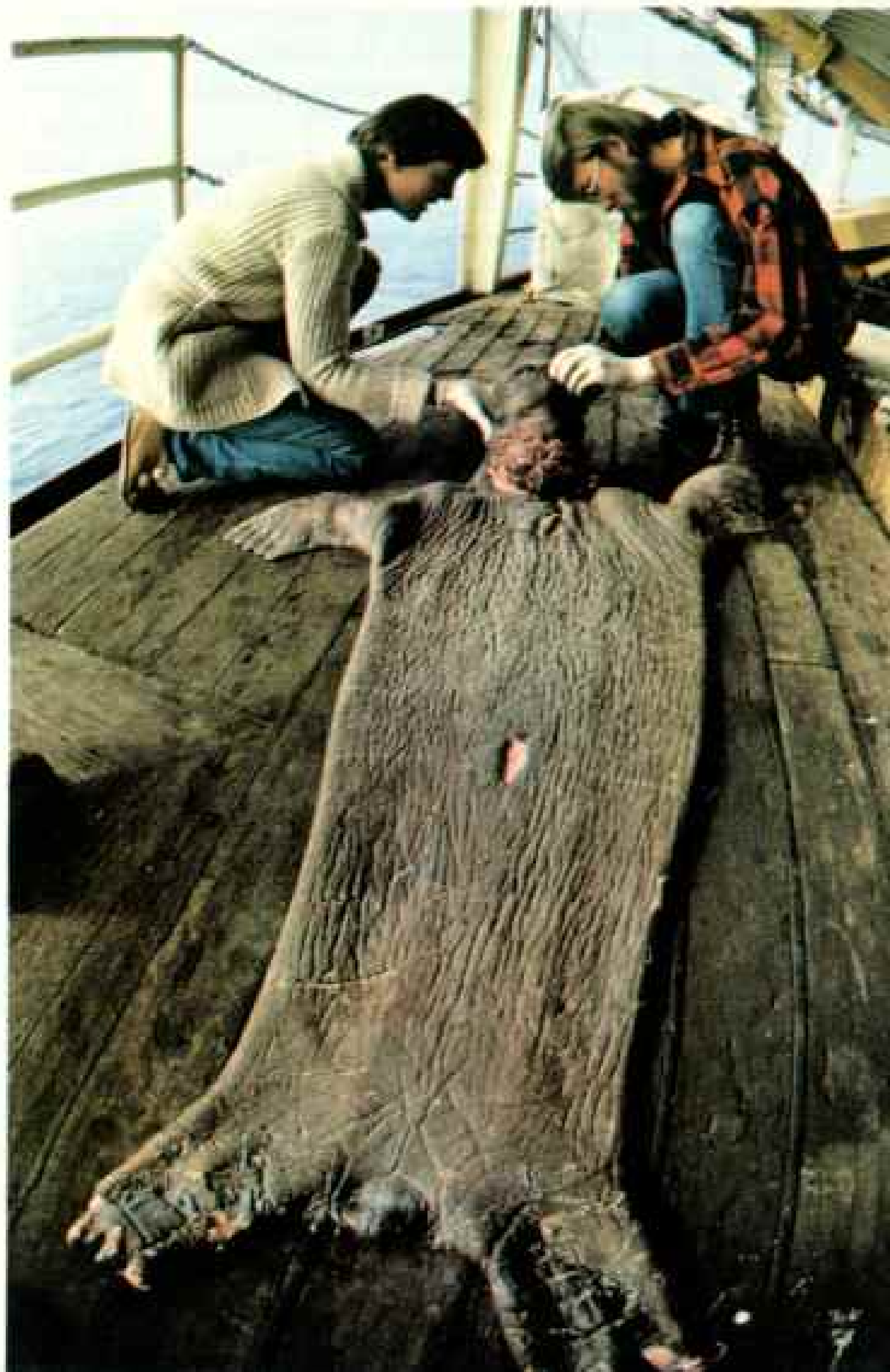






A charging polar bear scatters a herd on a Chukchi Sea ice floe (above). The author and his colleagues speculate that bears rush whole groups, hoping to seize the slower calves before they reach the water. On a 1977 expedition they saw a young polar bear drag the remains of a calf across the ice (left). Upon retrieving the carcass, they made a remarkable discovery. After killing the calf, the bear had incised a hole in its neck. Gradually, as it devoured the walrus, the bear had peeled the skin back and turned it completely inside out, like a coat sleeve. When the researchers righted the skin, all they found was an empty hide (right).

Eskimos have hunted walrus for centuries, using nearly every portion of the animals, from hides for boats to whiskers for toothpicks. Protected from unrestricted hunting, walrus populations now appear to be increasing. Future oil exploration in the Bering and Chukchi Seas, however, could pose environmental threats.



suspected that female walrus ovulate in mid or late winter and that courtship also takes place at that season, far from land in the southern Bering Sea. To observe them there, in 1972 we joined a U. S. Coast Guard icebreaker. One March morning, sixty miles south of St. Lawrence Island, Bud and I traded the steel decks of the *Burton Island* for Bering Sea ice, which squeaked and crunched beneath our boots.

We walked upwind toward a walrus herd and hid behind a pressure ridge. The small herd of about fifty animals consisted of females, subadults, and young. Fewer than a dozen rested on the great floe. A number of young splashed at the edge of the ice. The rest were diving to feed. Then we saw, among those in the water, a huge bull.

From time to time we heard a peculiar knock. The sound came from the water. And now and then our ears picked up a light, mellow whistle. I tossed my hydrophone into the water. Immediately, the instrument brought to my ears an eerie chorus of knockings and bell tones.

Following a louder series of knocks, a huge bubble of air bursting on the water's surface presaged the appearance of a bull. He rose to breathe, with mouth open and nostrils wide. Almost at once we heard a sound as of a fist striking a wooden door. Then followed a light whistle, produced between pursed, beefsteak lips. After a minute or two, the big male inflated the beach-ball-size pharyngeal pouches on the sides of his neck, threw his rear flippers into the air, and vanished downward.

His behavior was remarkably consistent. Always after he dived, I heard a double knock, followed by a resonant bell tone—"knock, knock, boing!" After a few seconds came another two or three "knock, knock, boings," then a series of knocks, slow, then faster, and ending in a phrase reminiscent of the familiar folk drumming "shave and a haircut, two bits!" Another series, a final loud knock, the air bubble, and the bull emerged gulping for air.

Over and over he performed. His average surface time was 23 seconds; he submerged for a bit more than two minutes.

What we observed was clearly involved with the ceremony of courtship. Yet I know of no one who has seen walrus mating. I

feel sure, however, that they mate in water and that underwater sound—the repetitive "song" of the male—is the primary means of courtship display. This song must be understood not as an expression of joy or love of life, but as a highly stereotyped, seasonal, sexually distinctive call.

The Walrus: Whose Responsibility?

The walrus has been chosen for special attention in joint investigations of the United States and the Soviet Union under their 1972 environmental protection agreement. The animal also figures strongly in studies of the Outer Continental Shelf Environmental Assessment Program in Alaska.

The 1972 Marine Mammal Protection Act placed the walrus and other marine mammals in U. S. waters solely under federal authority. The act brought proper national perspectives together in policy, but in some ways it proved retrogressive. It essentially released native peoples from management authority, and it abrogated a state restriction on walrus hunting in Bristol Bay. Alaska had to surrender its emerging program of research and its important marine mammal responsibilities. True, some authority has recently been restored to the state.

Wherever the authority may lie, protection of walrus and other marine mammals is an empty gesture without equal concern for maintenance of the animals' environment—the seas and their total biomass. We must guard the natural inhabitants' "equal rights" in a benthos that may be underlain with coveted oil and natural gas.

I cannot fault a hunter who takes his prey and then, in Melville's words, "furls his sails, and lays him to his rest, while under his very pillow rush herds of walrus and whales." Unfortunately, efficient modern weapons can tempt their users into wasteful exploitation of the animals of sea and land.

How difficult, from an urban vantage, to place a value on wild creatures of arctic seas! As I study walrus, my companions are the Eskimos who kill them and eat their meat. While subsisting on living things, man seeks a clearer perception of his niche in the natural world. Toward this understanding, as also of the walrus's place, science informs our insight, as conscience and wisdom guide our hands and minds. □

Skylab's Fiery Finish

By TOM RIGGERT
AUSTRALIAN ECOLOGIST

WHAT ROSE IN THE SOUTHWEST, a spectacular streak of color. In about two minutes, before reaching the opposite horizon, it had broken up into about 20 big pieces."

That is how sheep-shearing contractor Len Wright described to me the apocalyptic sight that sent him bolting for his camera at 12:30 a.m. on July 12, 1979, to record the nervously awaited homecoming of the largest, most complex piece of equipment ever sent into orbit.

Out of 16 possible reentry orbits, Skylab chose, on its own, the safest: 80 percent over water, with much of the balance over Australia's virtually unpopulated interior. Despite the best efforts of NASA to contain the fall over sea, Skylab was to scatter some of its fiery scrap over the southern Australian coast. Fortunately, no injuries were reported.

A week later on a sheep station two miles inland, blue-uniformed NASA scientists of a U. S. inspection team identify one of the ten water tanks that once ringed the space lab's workshop—perhaps the very one seen here above the hand of Navy Capt. Alan L. Bean, floating weightless as commander of Skylab's second crew of astronauts in 1973 (right).



ALP DORRILLO (TOP) AND NASA (SEE NATIONAL GEOGRAPHIC, OCTOBER 1981)





BLAZING THROUGH the high stratosphere toward the Australian coast, Skylab has already begun to disintegrate, as seen in this six-second time exposure taken by Len Wright near Wellstead. (Distorted by movement of the hand-held camera, flaming fragments streaking forward appear as scrawls of light.) Minutes away, in the only community of any size under Skylab's "footprint," citi-

zens of Esperance will witness a kaleidoscopic, frightening fallout.

Six days later, U. S. Department of State representative Robert Grey (*below*) is handed a \$400 ticket for Skylab's litter: a pleasant occasion only because none of Esperance's 9,000 inhabitants was injured by the falling debris.

Bigger pieces—such as this one-ton oxygen tank covered with shredded





LEONARD W. WRIGHT (ABOVE) AND ALF DONNELLY



insulation (*left*)—plunged inland to lonely outback areas of Balladonia and Rawlinna. Decelerating to the speed of sound, they created nerve-shaking sonic booms along the way.

Though NASA had predicted a trail of debris 4,000 miles long, plottings (*below*) of actual findings suggest a much shorter range. What fell unseen on water or desert, however, may never be known.





ALF BONNELLO (40018) AND JOSEPH D. LAVENBERG, NATIONAL GEOGRAPHIC STAFF

FINDERS KEEPERS was the rule after the dust settled. Feelings of relief gave way to Skylab fever. Fired by reports—many false—of huge cash rewards, hundreds of space-junk scavengers set out over the outback by Land-Rovers, trail bikes, and small planes. Most tantalizing was the prospect of finding Skylab's heaviest components, such as the telescope mount and the lead-lined film vault.

The heftiest discoveries, as of mid-August, were two oxygen tanks found near Rawlinna. One of these proved a publicist's dream come true for the Miss Universe contest (*above*, at rehearsals), telecast from Perth on July 20. By this time the treasure fever had cooled, and citizens of Esperance generously donated to the National Geographic Society a chunk of a charred fiberglass-and-plastic beam found on the beach near their town. □



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How to select a sound system for your car, boat or plane.

Audiovox candidly reveals what you should look for, listen to and beware of.

By Robert Harris, Technical Director

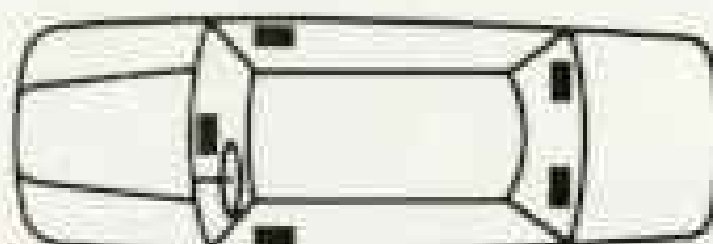
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complete line of "state of the art" components, available through car stereo specialists.

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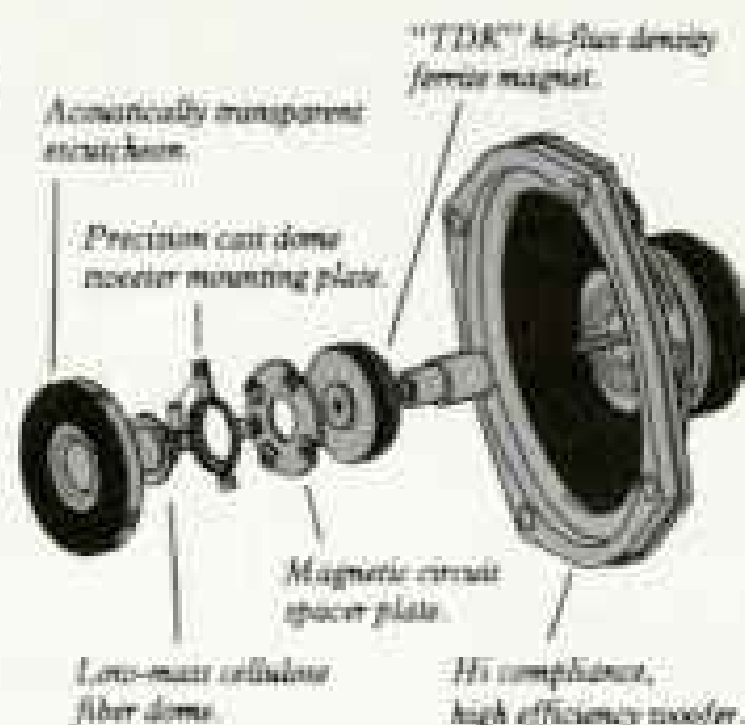
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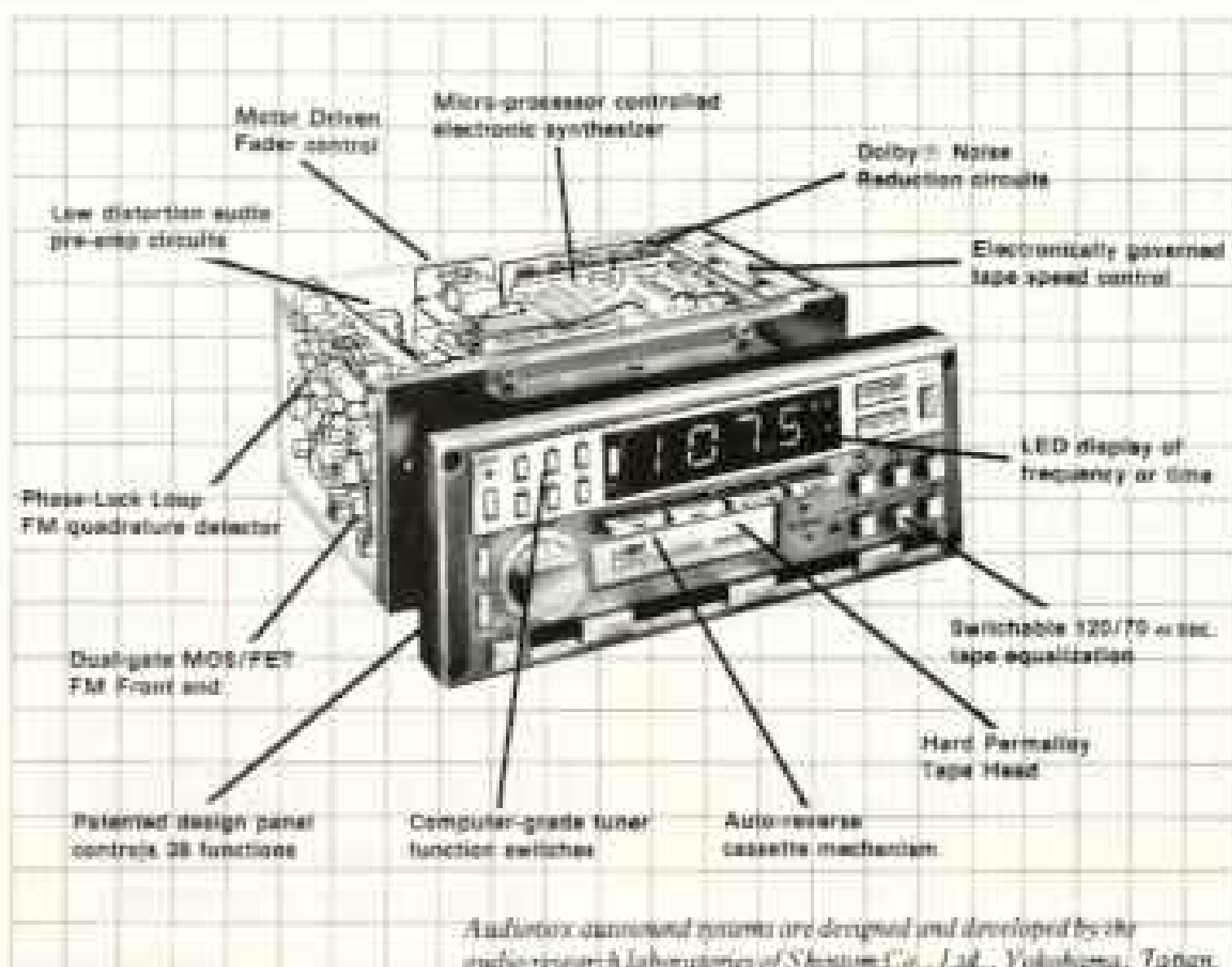
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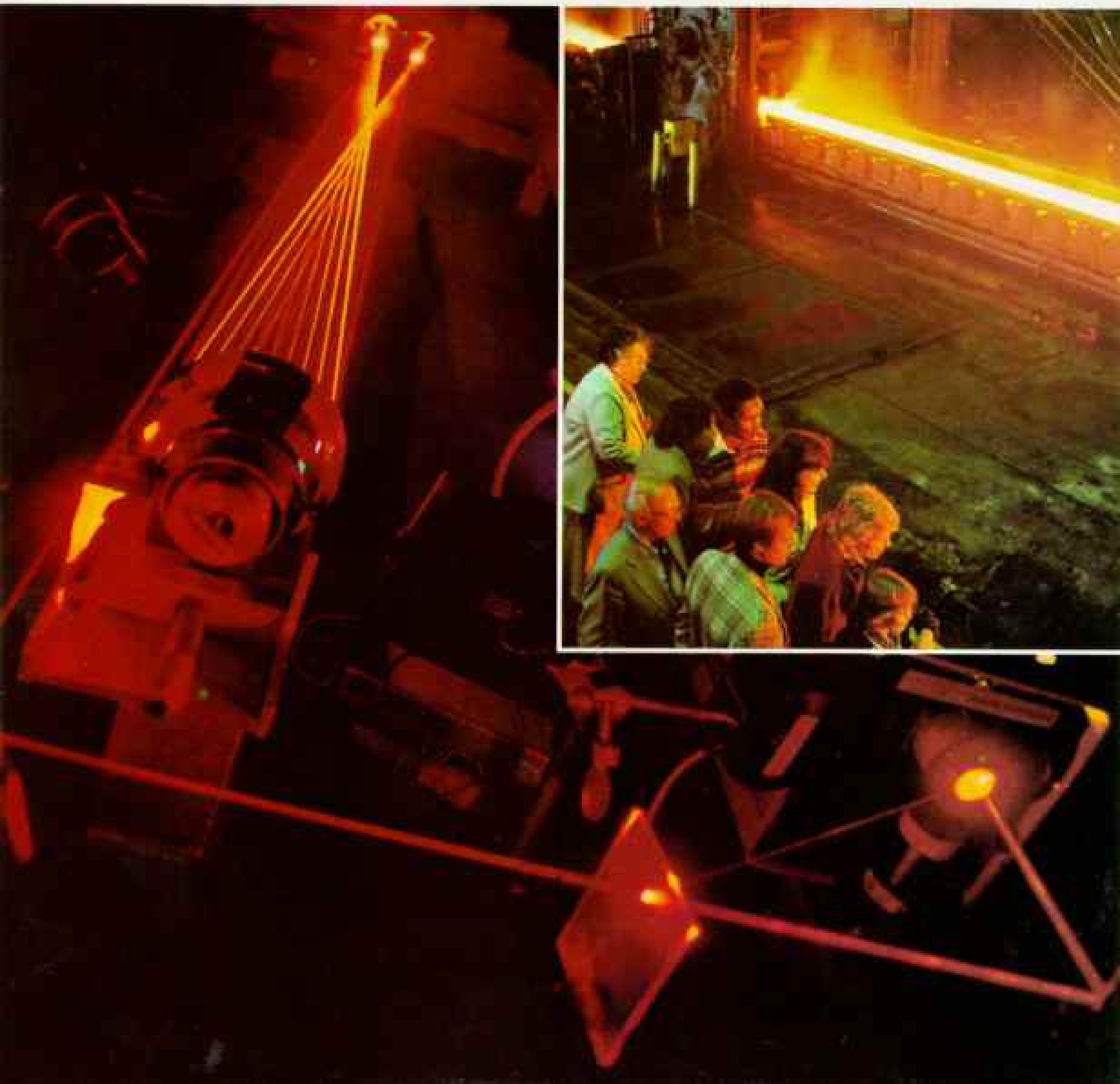
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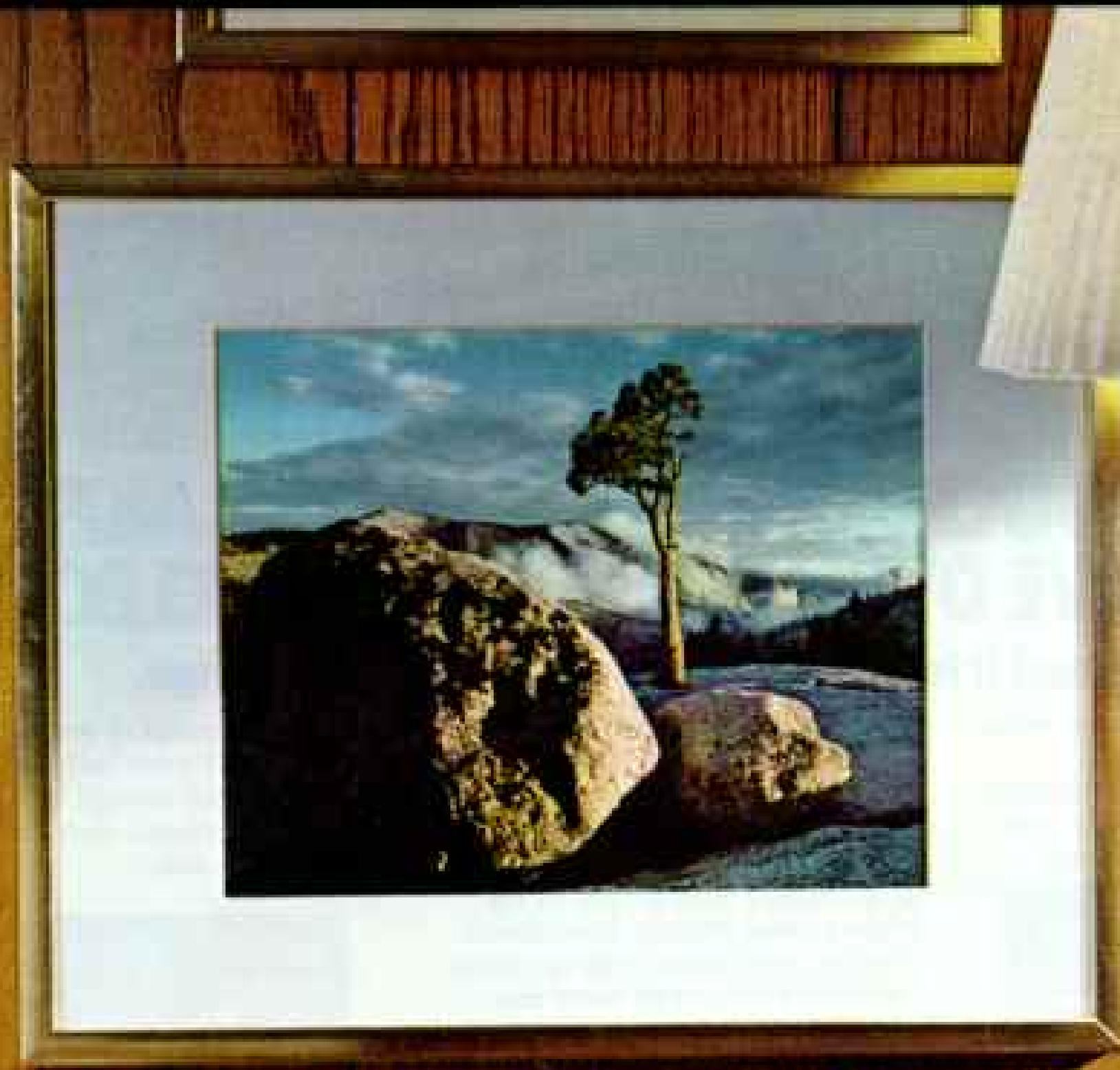
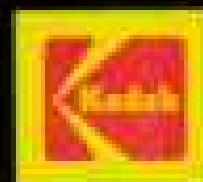
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Here are 28 ways
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Strong, lightweight aluminum alloys can help cars become lighter. And reduced weight in cars can mean more miles per gallon. That's why many aluminum parts are now being used in various American cars. And why many others are under serious consideration. Someday, perhaps, they'll all be included in the same car. And America will go a lot further on a gallon of gas. For free booklet write Alcoa, 359-K Alcoa Building, Pittsburgh, PA 15219.

We can't wait for tomorrow.

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NG-10

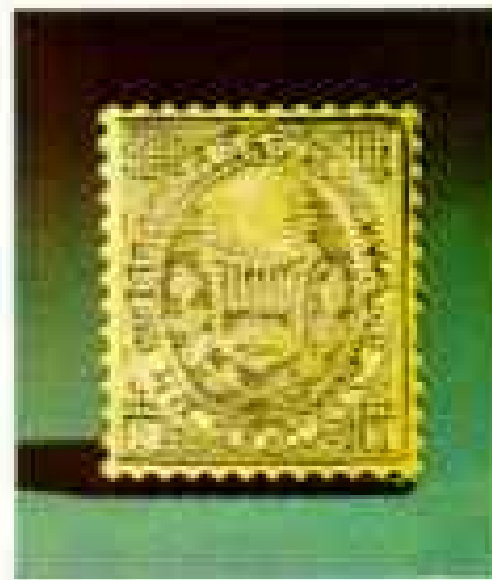
Please rush my free full color Landau Icelandic wool catalog and free wool swatch.

Name _____

Address _____

City/State/Zip _____

Retail Shops in Princeton, NJ / Manchester, VT.



Guatemala's first stamp is based on its Coat of Arms. The sun symbolizes liberty. The branch of live oak, patriotism. And the laurel branch, victory.



The famous Penny Black of Great Britain, the world's first postage stamp. It bears a classic portrait of the young Queen Victoria.



1-shahi "Tiger's Head" of Afghanistan.



"Liberty Seated" is the theme of the first stamp of Liberia. Based on a British colonies design, it differs in that the helmet has become a cap, and the figure is on a stone jetty.



The 2-skilling "crowned numeral" design of Iceland was based on a Denmark stamp. Only 40,000 were printed - and they are extremely difficult to come by today.



The steamship on the 1 real stamp of Peru represents the method by which mail was delivered in that country when its first stamp was issued in 1857.



The 1-candareen stamp of China is identified by its "Imperial Dragon" motif. The Chinese characters stand for the Great Tsing Dynasty.

Gold on sterling stamps shown actual size.

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The International Society of Postmasters announces

OFFICIAL GOLD ON SILVER PROOFS OF

The World's First Stamps

A definitive collection of 73 historic stamps — the first stamps ever issued by the 73 nations that were the first to issue postage stamps. Authentically re-created in 24kt gold on sterling silver.

IN THE YEAR 1840, the first postage stamp in history was issued. It was a stamp of Great Britain, which came to be known as the 'Penny Black'. This historic stamp was destined to change the course of life throughout the civilized world. For it heralded the issuance by *other* countries of their *own* stamps — and eventually resulted in an international postal network linking peoples in every corner of the globe.

Now, the International Society of Postmasters will pay official tribute to the first stamps of the world by issuing an unprecedented collection.

Authentic re-creations of world's first stamps

Working from the *actual stamps* themselves, the sculptors of The Franklin Mint will *re-create* the designs for these historic stamps, capturing all of their distinctive features. Then the mint's master craftsmen will strike each gold electroplate on sterling silver stamp in flawless Proof quality.

The result will be a collection of *entirely accurate* replicas of stamps that are among the most significant in history. Stamps considered among the world's most interesting philatelic treasures.

Officially authorized and authenticated

To certify that each gold on sterling stamp bears the approval of the International Society of Postmasters, the official symbol of the Society will appear on the reverse of each minted stamp — and the designation *24kt gold on sterling silver*.

So that each subscriber will be able to display the collection at home, a custom-designed hardbound album will be included as part of the collection. And a special magnifier will be provided to study the stamps in detail.

Issued in limited edition

The World's First Stamps will be issued in limited edition — and it is being made available *only* until December 31, 1979. After that date, it will never be offered again — anywhere in the world.

The collection will be issued at the convenient rate of one per month, and the guaranteed issue price for each 24kt gold on sterling stamp is just \$19.50.

To acquire this important new collection, your subscription must be entered by December 31, 1979. Mail the application at right to the International Society of Postmasters, c/o The Franklin Mint, Franklin Center, Pennsylvania, by that date. If your application is post-marked later than December 31st, it will have to be refused and returned.



A custom-designed display album and special magnifier are included as part of the collection, at no charge.

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Subscription Application

OFFICIAL GOLD ON SILVER PROOFS OF The World's First Stamps

Must be postmarked by December 31, 1979

The Franklin Mint
Franklin Center, Pennsylvania 19091

Enter my subscription for The World's First Stamps, issued by the International Society of Postmasters, and consisting of seventy-three 24kt gold on sterling silver proof stamps to be sent to me at the rate of one per month.

I need send no money now. Bill me \$19.50* for each gold on sterling silver proof stamp in advance of its shipment.

**Plus my state sales tax.*

Signature _____

ALL APPLICATIONS ARE SUBJECT TO ACCEPTANCE

Mr. _____

Mrs. _____

Miss. _____

PLEASE PRINT CLEARLY

Address _____

City _____

State, Zip _____

Limit: One collection per person

70

Orders from outside the U.S.A. will be billed for each stamp at \$24.00.

THE FRANKLIN MINT IS THE WORLD'S LARGEST PRIVATE MINT. IT IS NOT AFFILIATED WITH THE U.S. MINT OR ANY OTHER GOVERNMENT AGENCY.

Sunday: noon

Guests are gathered. A toast or two. And brunch begins... a steaming slice of Swiss Omelet Roll adorned with a bit of mustard sauce. Both made rich with KRAFT Real Mayonnaise. And both fine company for Sunday's best.

SWISS OMELET ROLL

1 cup KRAFT Real Mayonnaise
2 tablespoons KRAFT Pure Prepared Mustard
2 tablespoons chopped green onion

1/2 cup KRAFT Real Mayonnaise
2 tablespoons flour
1 cup milk
12 eggs, separated
1/2 teaspoon salt
1/8 teaspoon pepper
1-1/2 cups finely chopped ham
1 cup (4 ozs.) shredded KRAFT Natural Swiss Cheese
1/4 cup chopped green onion
Watercress

Combine first three ingredients; mix well.

Combine mayonnaise and flour. Gradually add milk and beaten egg yolks; cook, stirring constantly over low heat until thickened. Remove from heat; cool 15 minutes. Fold mayonnaise mixture and seasonings into stiffly beaten egg whites. Pour into 15-1/2 x 10-1/2-inch jelly roll pan lined with wax paper, brushed with mayonnaise. Bake at 425°, 20 minutes. Invert pan on towel, carefully remove waxed paper. Cover with combined ham, cheese and green onion. Roll from narrow end, lifting with towel while rolling. Top with mustard sauce. Garnish with watercress.
6 to 8 servings

KRAFT

© 1979 Kraft, Inc.



This country must get more involved in resource recovery. And the steel can is the easiest resource to recover.

Every day, Americans throw away the staggering total of 800 million pounds of trash. Most of this represents valuable resources we could – and should – recover and put back to work.

One valuable resource is the steel can, the most widely used can for food and beverages. Steel is the easiest of all materials to recover because it can be separated magnetically from other trash.

If all America's steel cans were recovered, nearly five million tons of steel could be recycled annually to build bridges and buildings and hundreds of other necessary things. And, by recycling all of this steel, we'd also be conserving tremendous amounts of energy, since it requires only about half as much energy to make steel from scrap as it does to make it from scratch.

We're off to a good start. Many cities are already recovering billions of steel cans for recycling. Many more, including New York City, have resource recovery plants, with magnetic retrieval of steel cans, in the planning stage. To help your own community get involved, send for our free, fact-filled booklet.

**Nothing recycles
as easy as steel.**



United States Steel

1980

United States Steel, Box 86, Dept. C 1100
Pittsburgh, PA 15230

Please send me your informative guide,
"Turning Trash into Cash."

Name _____

Address _____

City _____

State _____ Zip _____

"This road system is a marvel."

One looks at a map, marveling at the system. Another checks potholes and despairs. Which picture's real?

The map shows a 3.8 million mile network uniting every city and town in our nation. Sweeping, fuel efficient, multi-lane Interstate Highways touch 90% of all cities, over 50,000 people. 3.2 million miles of rural roads speed food and fiber to market. Urban streets and boulevards bring vibrancy to the city. It's easy to conclude, "We've the world's best road system."

On-the-spot examination of those roads might create another image. Most were built 40 years ago. Early Interstate sections are 20 years old. The scene of 17 million accidents last year, potholes, patches, pavement breaks and shoulder drop-offs seem to rule out roads. Drivers jouncing over those obstacles cry out, "Our roads are in terrible shape!"

True, the system is outstanding. But roads take a beating from traffic and the elements. After years of use they need maintenance, upgrading, repair. The Highway Administration calculates up to \$329 billion would be needed to restore worn-out roads to 1975 condition and maintain that condition through 1990. Costs are rising as accelerated deterioration and inflation take their toll. Meanwhile, fuel shortages restrict highway use revenues. Roads are vital to commerce, essential for emergency services, and important to recreation. We must support state and national programs to preserve our valuable highway asset.

Caterpillar machines and engines are used in road construction and maintenance—our engines power trucks. We believe the nation must give top priority to maintaining and upgrading our highways.

**There are
no simple solutions.
Only intelligent
choices.**



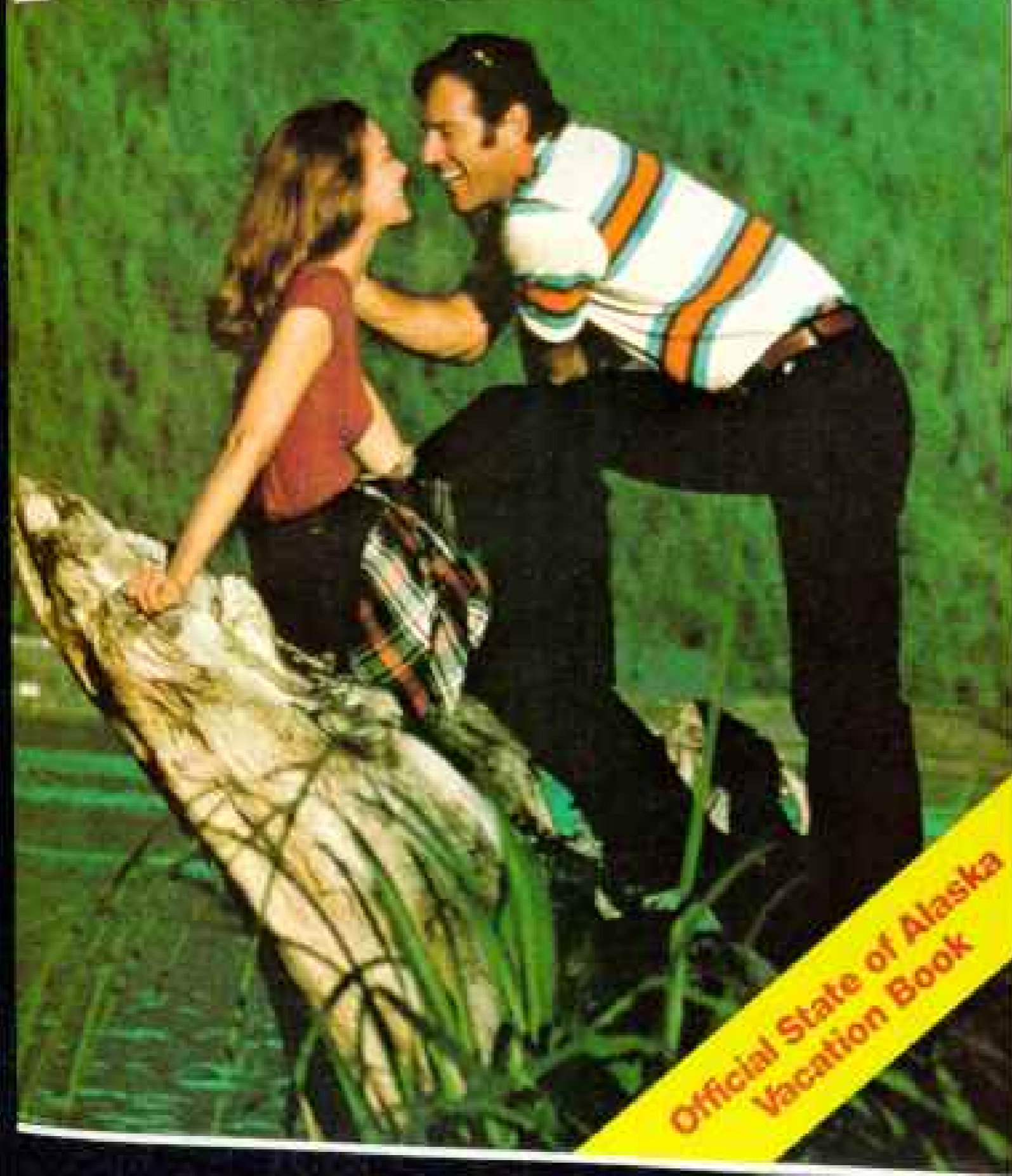
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"Many of our roads are falling apart."



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Additionally, I am interested in more specific information on:

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|---|--|
| 1. <input type="checkbox"/> Car, Camper, Motorhome | 12. <input type="checkbox"/> Fishing |
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and Scenic Wonders |
| 3. <input type="checkbox"/> Cruisehip from California | 14. <input type="checkbox"/> Adventure Travel (including
hiking & trekking, canoe &
raft trips, boating) |
| 4. <input type="checkbox"/> Cruisehip from
British Columbia | 15. <input type="checkbox"/> Special Interest Travel
(birding & wildlife tours,
nature photography) |
| 5. <input type="checkbox"/> State Ferryliner | 16. <input type="checkbox"/> Winter Sports |
| 6. <input type="checkbox"/> Motorcoach or Rail | 17. <input type="checkbox"/> Winter Vacations |
| 7. <input type="checkbox"/> Hotels and Motels | 18. <input type="checkbox"/> Alaskan Arts & Crafts |
| 8. <input type="checkbox"/> Lodges, Resorts and Cabins | 19. <input type="checkbox"/> Conventions and
Incentive Travel |
| 9. <input type="checkbox"/> Tours to Alaska from
U.S. and Canada | |
| 10. <input type="checkbox"/> Tours within Alaska | |
| 11. <input type="checkbox"/> Camping (campsites,
national & state parks) | |

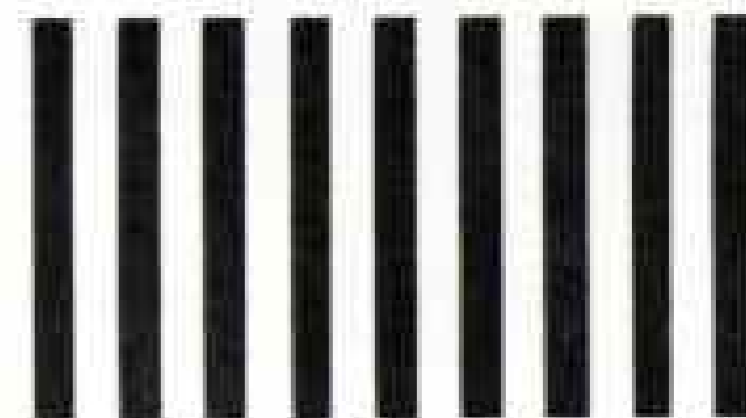
We would like to learn more about people who are
interested in Alaska. We'd appreciate your help by
answering these optional questions.

- Likelihood of your visiting Alaska in next 5 years.
 Extremely likely Somewhat likely Very unlikely
 Very likely Somewhat unlikely
- Your age. Under 18 18-29 30-49 50-65 Over 65
- Level of education completed.
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- In the past 3 years have you taken a vacation trip outside the
North American continent? Yes No

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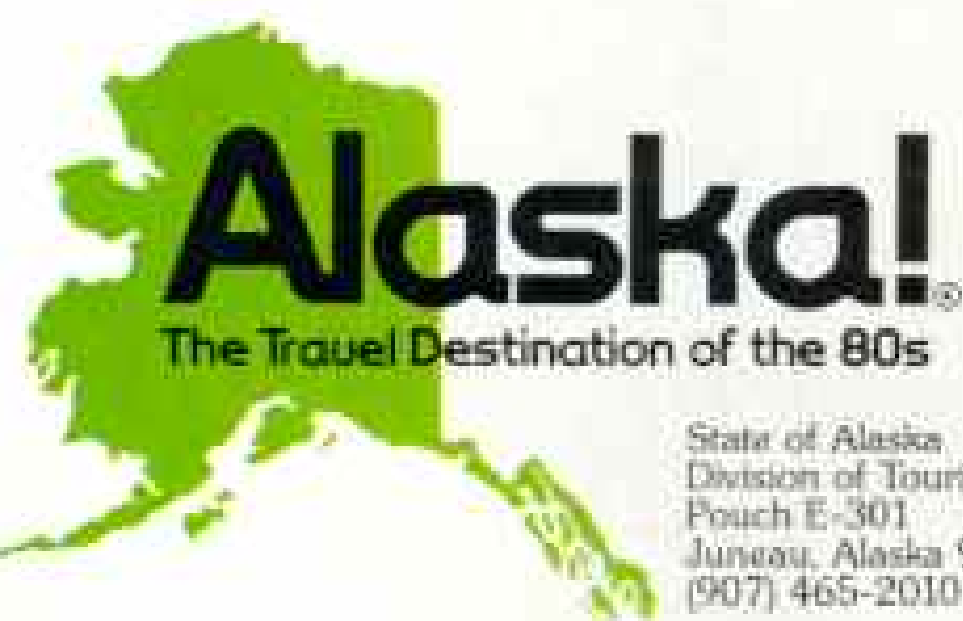
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6:00

TIME

Introducing The Great Awakening from General Electric. For starters, it's smart enough to let you set the time directly... no flipping around the clock.

6:15

WAKE-UP 1

You can program it to change stations for you. So it will rock you to sleep with Strauss, switch to your news station, and wake you at 6:15.

7:53

WAKE-UP 2

Then it comes back on to wake up your better half to Beethoven at 7:53. All with push-button ease.

OFF

ALARM OFF

When you forget to set the alarm... The Great Awakening remembers to remind you.

1410

RADIO AM

You can scan all the AM or FM stations by pressing a button or, to tune in one station, just punch in the frequency of your choice on the keyboard.

102.7

RADIO FM

You can also program up to six stations into the memory. And recall any one with the touch of a finger.

15

SNOOZ TIME

For a little extra sleep press the Snooz bar. It lets you sleep an extra minute or an extra hour. You tell the memory how long.

E

ERROR

The Great Awakening is so smart it even tells you when you've made an error. But it's easy to correct... just press a button.

WE BRING GOOD THINGS TO LIFE.



Model 7-4880

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NEW COMPUTER SPACE COMMAND. NOW THE BEST ZENITH EVER IS EVEN BETTER.

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ZENITH

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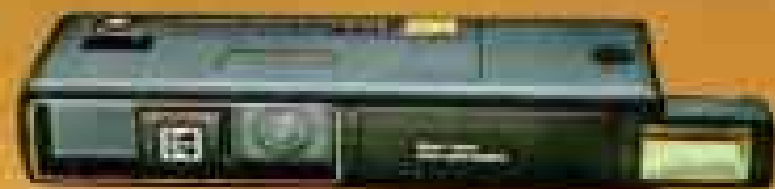
SYSTEM 3

Shown: The Showcase, SL25812. Ultra-contemporary styling in a bronze-tinted acrylic cabinet. Metal finished frame on top and ends. Brushed aluminum base. Simulated TV picture.



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New Kodak Ektralite cameras.



Kodak Tele-Ektralite 20 camera: Built-in, flip-out flash. Tele lens.



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Kodak Tele-Ektralite 40 camera: Built-in, flip-out flash. Tele lens. Auto-exposure.

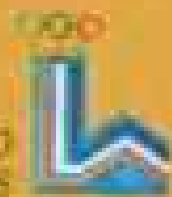


Brand-new Kodak cameras with a flash that flips out at the touch of a button. So you're always ready in a flash for sharp, clear pictures. Three cameras, and one is right for you.



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And this year the kit has been updated and expanded with pertinent new information to make it even more helpful. Information like:

Up-front answers to your most important questions about owning an airplane: Do I need one? What size should it be? Who will fly it?

An inside look at dozens of creative ways companies use business airplanes to solve problems and create new opportunities.



An independent study of the relationship between business flying and corporate profits.

And you can even figure the net capital cost of a company airplane, like the new T-tailed Beechcraft Duchess, shown here.

Truth is, a company airplane isn't always the answer. But with this kit you'll know the right questions. And that's the first step to making a rational decision on a

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ALMOST DIRECT

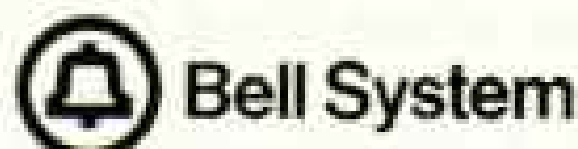
Until your area has International Dialing, here's the next best way to save time on overseas calls: Dial 0, and tell the Operator the country, city and local number you want. Have all your information at hand, because the fewer questions the Operator asks, the faster you'll reach your party. Be sure to specify Station or Person call. And on Station calls not requiring special operator assistance, you can get the same low rates as International Dialing.

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Bonn	234	Essen	201	Munich	89
Darmstadt	2221	Frankfurt	611	Nuremberg	911
Germany	421	Hamburg	40	Stuttgart	711
Darmstadt	231	Hannover	511	Wuppertal	202



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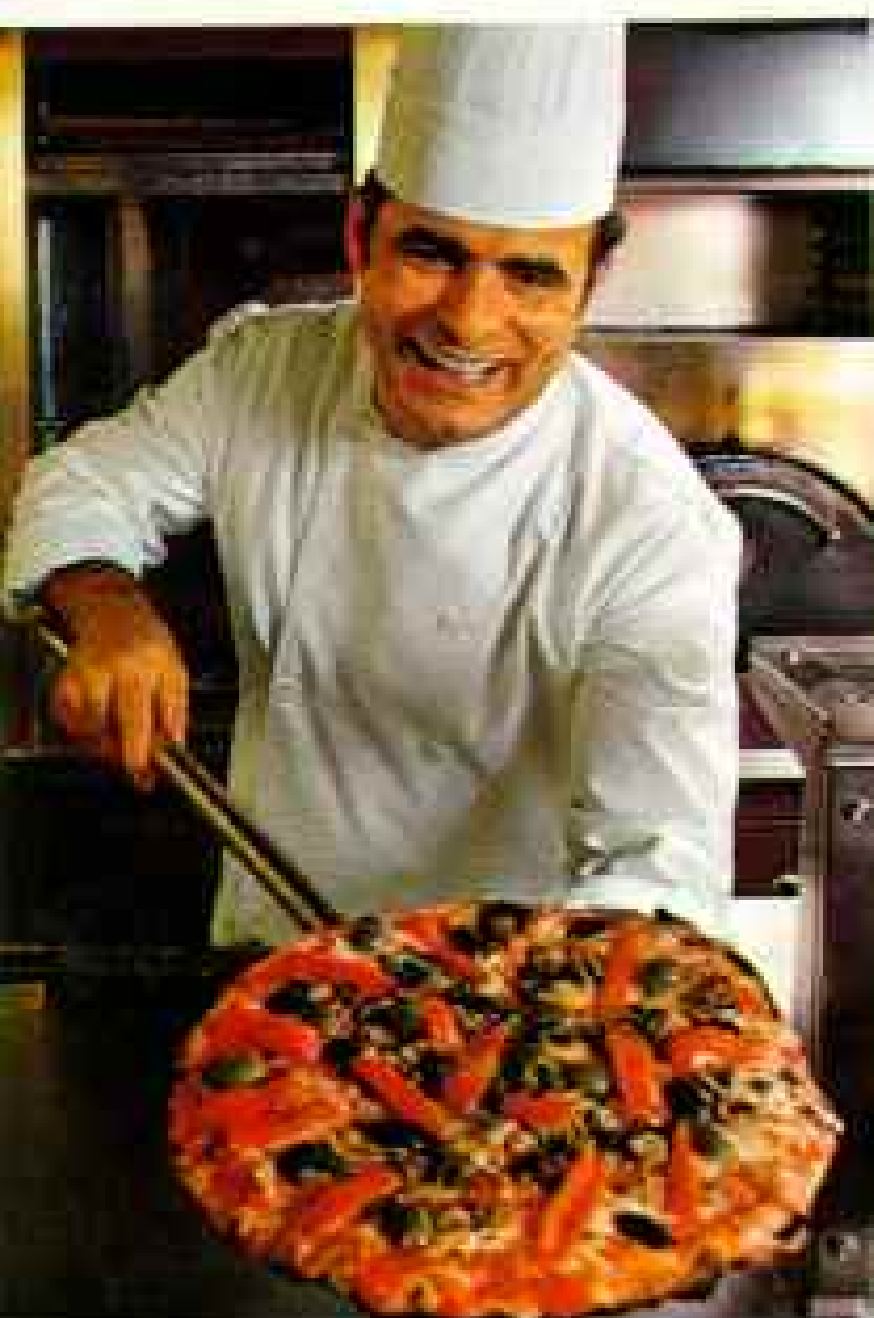
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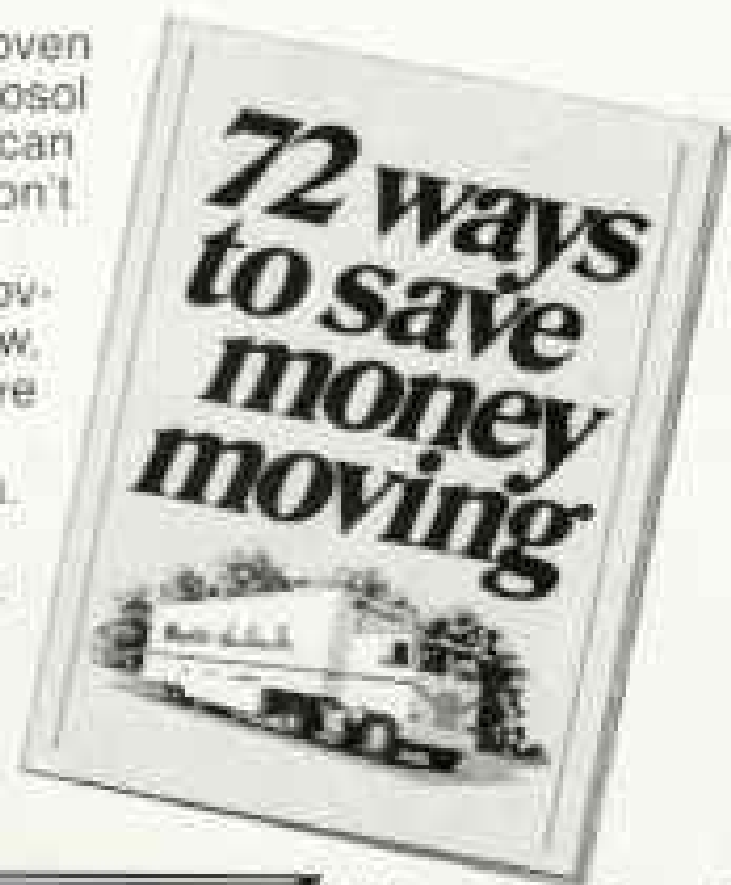
“Don't risk all for a can of oven cleaner.”

Sounds silly, doesn't it? Who'd risk all they own for a can of oven cleaner? Lots of people. Because they don't realize that aerosol cans are very volatile. The heat in an air-tight moving van can cause them to explode, endangering a whole shipment. Don't ever move flammable items or aerosol containers.

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You'll probably learn a lot that other movers don't tell you. And that should tell you a lot about Wheaton.

For your copy of money-saving tips, call your local Wheaton agent or send 50¢ with your name, address and zip code to Wheaton Van Lines, P. O. Box 50800, Indianapolis, Indiana 46250.



Wheaton Van Lines.
The Mover people
talk about. Nicely.



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anything more.

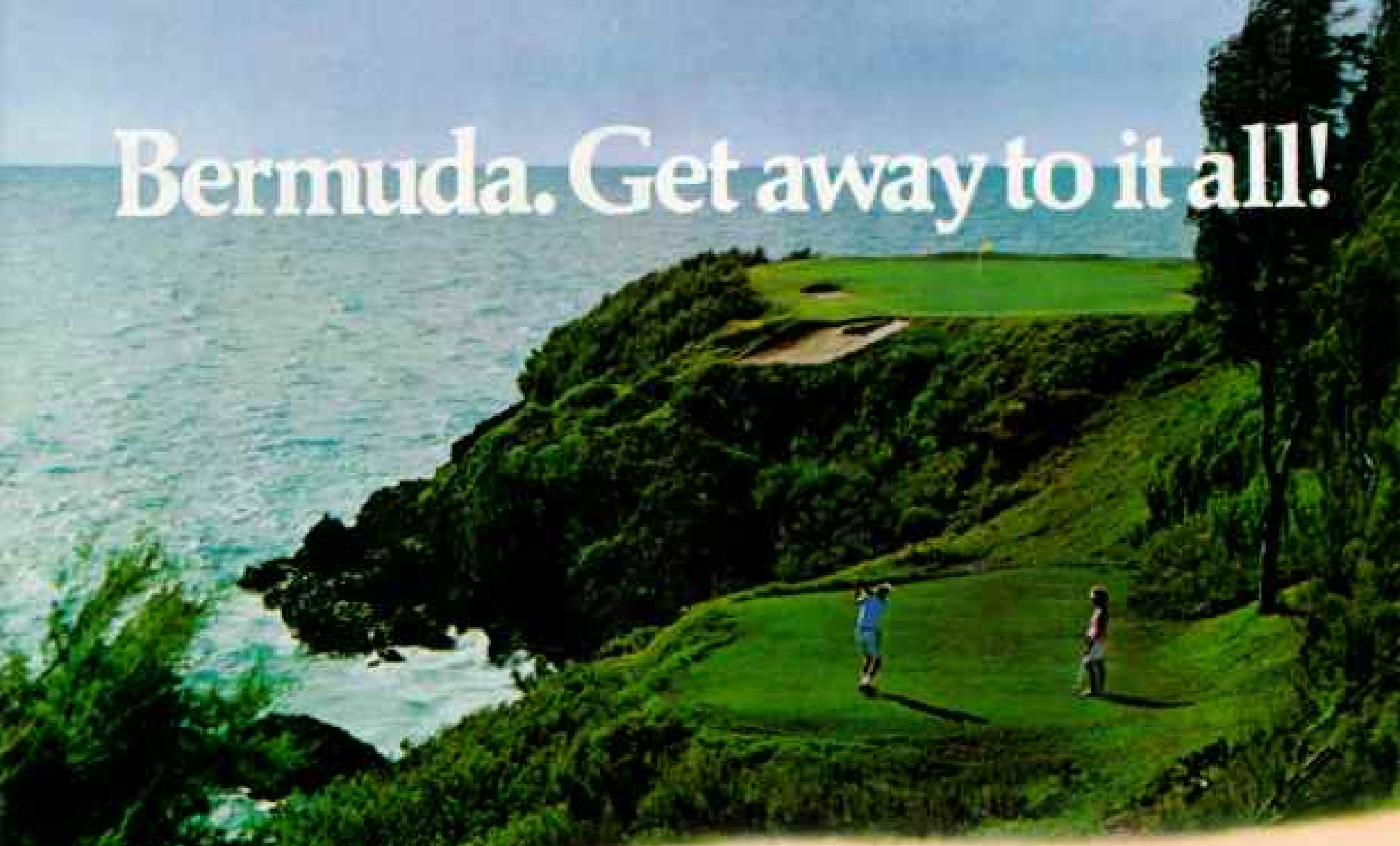
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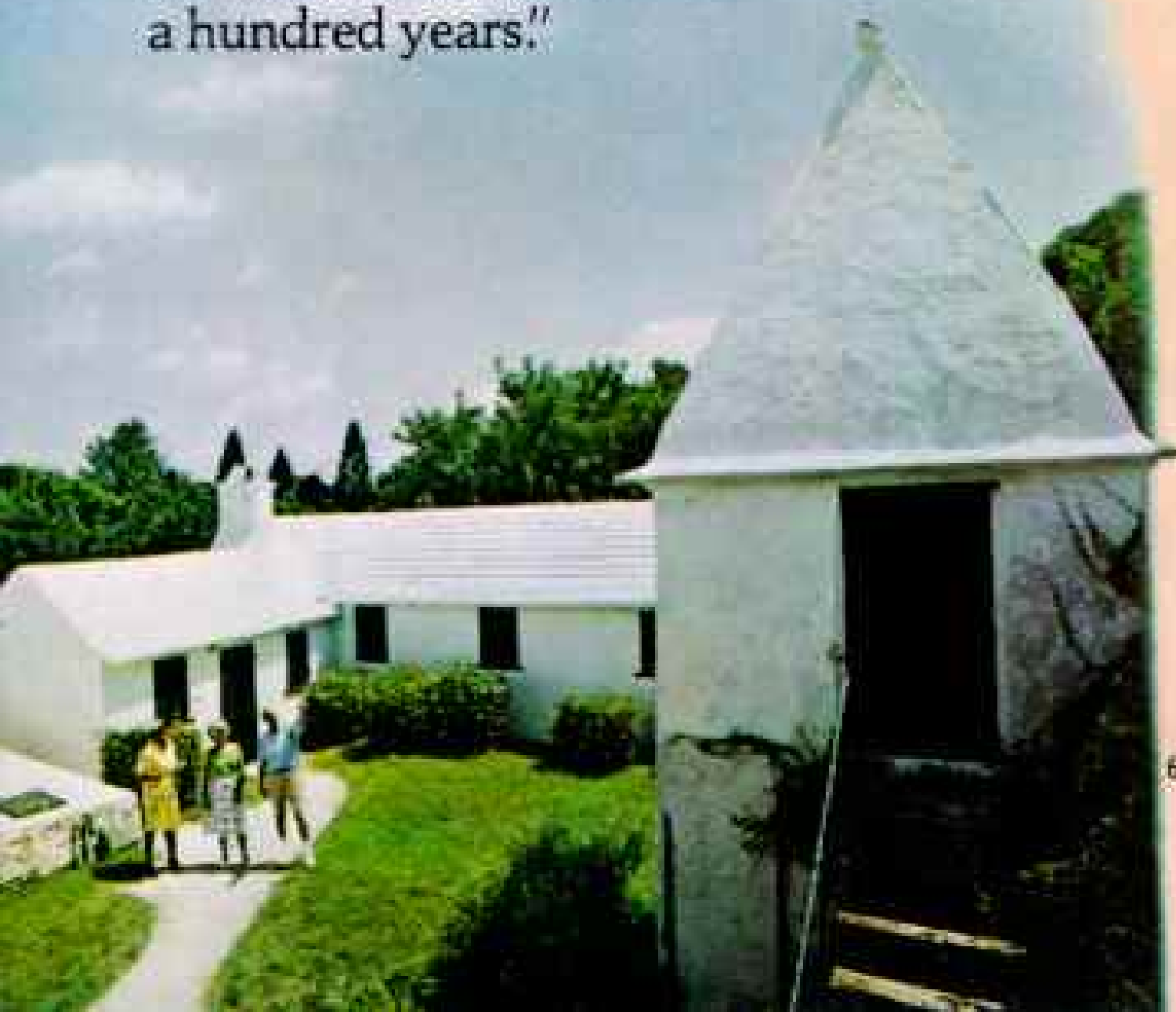
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Stephen and Ann Bell talk about the Bells' second visit to Bermuda.

"The architecture is a delight. It's nice to see a house exactly as it was. Like stepping back a hundred years."



"I don't see how Bermuda can be improved upon. This is only the second time we've been here. But it's not going to be the last!"

See your travel agent or write Bermuda Dept. 315
630 Fifth Avenue, N.Y., N.Y. 10020 or Suite 1010, 44 School St., Boston, Mass. 02108
or 300 North State Street, Chicago, Ill. 60610

Myth:

Railroads waste a lot of energy.



Fact:

America's freight railroads are in the forefront of energy conservation.

With energy a scarce commodity, America's freight railroads are leaders in tapping new technologies to conserve our dwindling energy resources. A new and innovative throttle control device that matches a train's power to its needs can help reduce railroad fuel consumption by up to 15%.

Sophisticated locomotive fuel injection systems, automatic shutoff valves at fueling stations and improved maintenance practices are significantly trimming energy consumption. This at a time when freight railroads use only 3.27% of the petroleum consumed by the transportation industry while handling 36.2% of the nation's intercity freight.

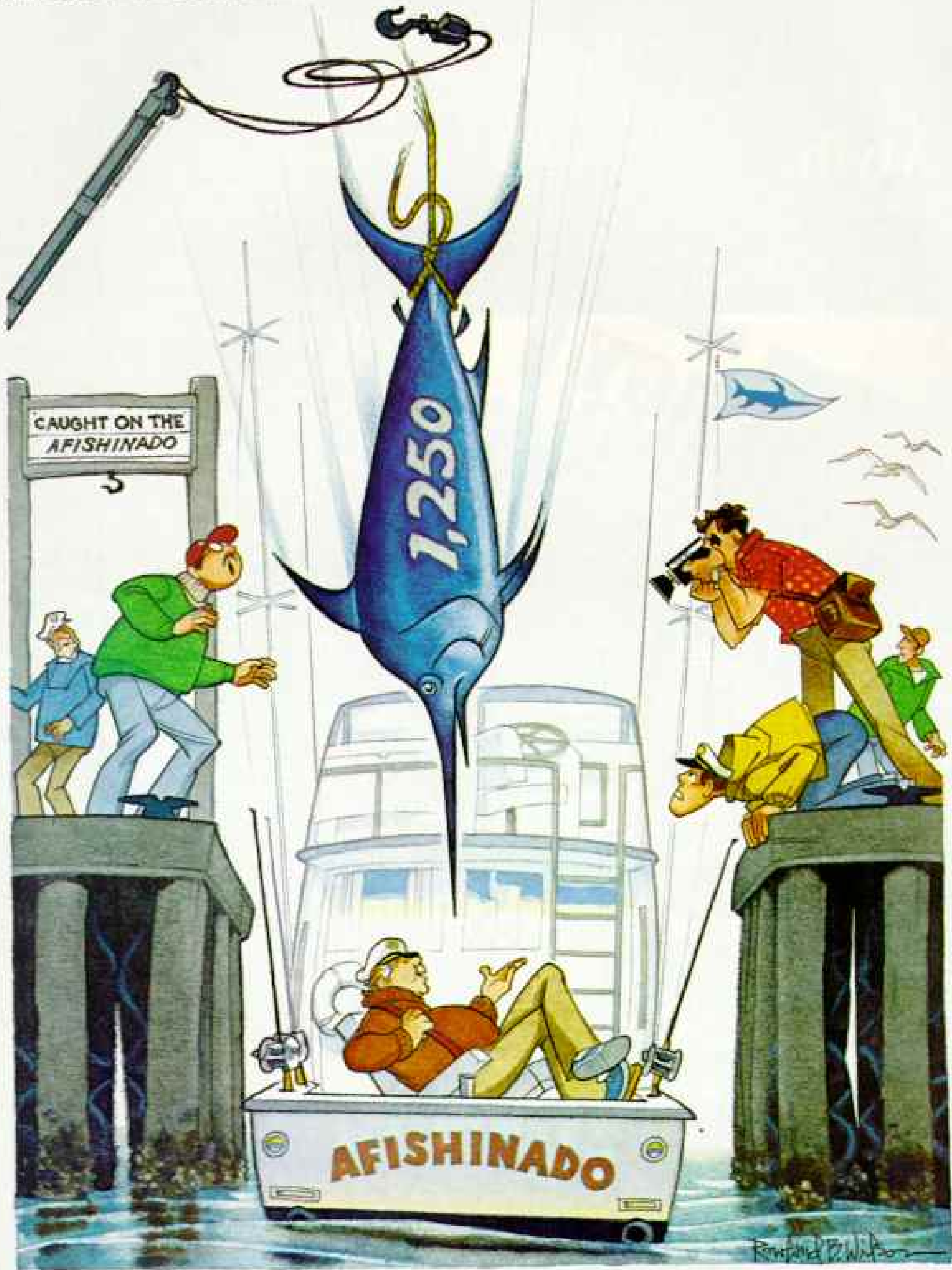
Today, the railroads' search for energy saving measures is reaching beyond fuel conservation. Maintenance-free solar batteries are being tested to replace power lines to remote grade crossing systems, an energy saving innovation that has far-reaching potential.

Railroads have always been the most energy-efficient way to move bulk cargo overland. Now, with fuel at a premium, America's freight railroads are more important than ever to the nation.

For more information about railroad energy efficiency, write: Energy, Association of American Railroads, American Railroads Building, Washington, D.C. 20036.

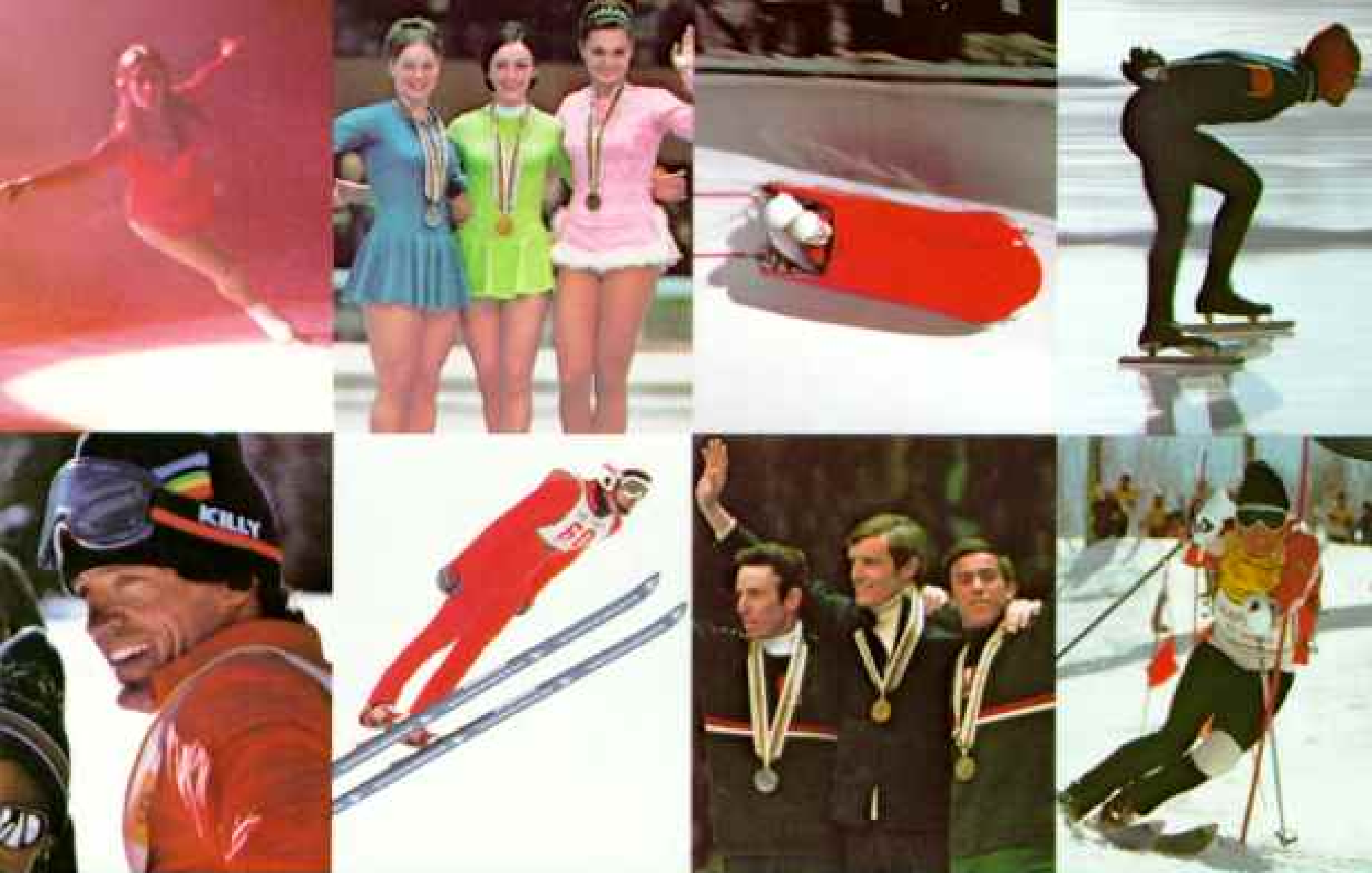
Surprise:

Railroads use less than one percent of the nation's energy resources each year.



"My insurance company? New England Life, of course. Why?"

Of course, you'll find the low net cost of our Vanguard policies a great catch, too.



Only the best go to the Olympics.

Nothing in the world of competitive sport can match the Olympic challenge. It is a challenge that demands not only the best in human athletic achievement, but a determination that can be summoned up to overcome seemingly impossible obstacles. Yet with all the talent, skill and dreams the Olympic Games focus into crystal clarity for a brief instant, there can be only a few who wear the gold.

For Peggy Fleming and Jean-Claude Killy the intensity of their gold-medal-winning performances on the ice and the slopes passed through them for a few moments of heart-stopping action most of us never feel in a lifetime. But the memories of the day live for them forever. In photographs.

It is because of the vital importance of the lasting visual record of these events that Canon has been selected Official 35mm Camera of the 1980 Olympic Winter Games. Under conditions of utmost sever-

ity, in a situation that decries compromise, Canon photographic equipment will be expected to deliver images that comply with one unyielding standard. They must be the best attainable.

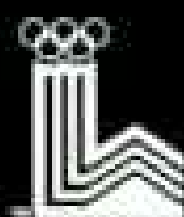
Canon's support for the 1980 Olympic Winter Games goes far beyond the intimate sorcery of eye, hand and camera. It extends to every aspect of the photographic obligations that the Games entail. Supporting photographers whose

livelihood depends on the images they record for posterity. With professional service and repair, systems support and supplementary or emergency equipment. Standing behind our commitment to being best, by offering the best assistance money, skill and human dedication can provide.

The quality standard for all Canon photographic products is something you may not see on the outside, but you'll come to appreciate as the years go by. It's the big difference between Canon cameras and others that seem to offer equivalent performance. And it's something that simply can't be faked.

It's inevitable that considering Olympian achievement calls to mind superlative statements. At Canon, we don't use superlatives lightly. We take being "best" very seriously.

And we'll be at Lake Placid to prove it.



THE OFFICIAL
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Canon

