

VOL. 153, NO. 4

APRIL 1978

NATIONAL GEOGRAPHIC

CHINA'S
INCREDIBLE
FIND 440

CHICAGO! 463

MAN'S NEW FRONTIER—
THE CONTINENTAL SHELF 495

AFRICAN TERMITES,
DWELLERS IN THE DARK 532

THE YUKON'S CALL OF THE NORTH 548

NATIONAL GEOGRAPHIC

THE NATIONAL GEOGRAPHIC MAGAZINE VOL. 121, NO. 4
COPYRIGHT © 1978 BY NATIONAL GEOGRAPHIC SOCIETY
WASHINGTON, D. C. INTERNATIONAL COPYRIGHT SECURED

April 1978

LONGTIME MEMBERS of our Society will recognize a familiar by-line in this issue's article on the continental shelf—that of Luis Marden. This was Luis's last assignment as a staff member after 42 years of a career so remarkable that he sometimes seems a character out of fiction.

When he appeared at the Geographic in 1934, young Marden had a 35-mm Leica camera around his neck; he had foreseen the revolutionary change that small cameras and color film would make in journalism. He had written, in fact, the first book ever published on color photography with a 35-mm camera.

Luis was soon performing wonders with those cameras. He found and photographed, for example, the remains of Captain Bligh's famous vessel *Bounty* in the waters off Pitcairn Island in 1957. On assignment in Brazil, he discovered a new orchid species (later named for him *Epistephium mardeni*), and he once plucked from Atlantic depths a new species of sand flea—*Dolobrotus mardeni*.

It was Luis, too, who dived into the Maya "well of time" at Dzibilchaltún in Mexico. (On his first foreign assignment, in 1936, he photographed Chichén Itzá, right.) He pioneered in underwater photography and explored the sea with Jacques-Yves Cousteau. He knows Tahiti, Fiji, and Tonga as well as his native Boston, and is at home in five languages—in any one of which he can deliver anecdotes with a consummate actor's skill.

The sense of discovery and adventure that has always marked Luis's writing is matched by a fine sense of scholarship. During his coverage of the Renaissance in Tuscany he turned up the odd fact that President John F. Kennedy was distantly related to the lady who sat for the world's most famous portrait—the Mona Lisa.

Last year, looking forward to an active retirement (as we look forward to articles by him as a free lance), Luis sailed his English-built yacht, appropriately named *Bounty*, across the Atlantic. Some months later, an uncharted current set her on a reef in the Bahamas, where she stuck fast and broke up. It was a blow that would sink the normal heart. But Luis is having a new *Bounty* built and intends to pick up where fate so rudely stopped him. We wish him a heartfelt "Bon voyage."

Silvestro M. Brovarone

China's Incredible Find 440

Audrey Topping and artist Yang Hsien-min tell of the discovery of a 6,000-strong, life-size army in clay buried to guard an emperor's tomb. COVER photograph by Howard Nelson.

Chicago! 463

That broad-shouldered city of superlatives is roamed by Harvey Arden and Steve Raymer.

The Continental Shelf 495

In the watery new world offshore, report Luis Marden and Ira Block, the year is 1492.

Dwellers in the Dark 532

African termites toil in a hidden realm explored by scientist Glenn D. Prestwich.

Yukon Fever 548

Robert Booth and George F. Mobley find the spirit of the Klondike still alive.



THE FIRST EMPEROR'S ARMY

CHINA'S INCREDIBLE FIND

By AUDREY TOPPING

Paintings by

YANG HSIEN-MIN

Up from the grave: A six-foot-tall terra-cotta warrior in armor—one of thousands standing guard for 2,200 years—brings unified China's first dynasty vividly to life. As the Roman Empire was expanding in the West, a king of Ch'in in East Asia was conquering other warring states to create the heart of the Chinese nation. History knows this victor as Ch'in Shih Huang Ti, the first emperor and the builder of the Great Wall. In 210 B.C. he was buried under an earth mound 15 stories high called Mount Li. The site has long been recognized, but like many ancient tombs in China it has not yet been excavated. Recently, less than a mile from this mound, well diggers stumbled on a huge subterranean vault, a part of the grave complex. Now archeologists are exploring its extraordinary treasure: the emperor's guardian army of 6,000 life-size pottery men and horses.

COURTESY AUDREY TOPPING

WE WERE WITNESSING one of the most spectacular excavations of this century. The sight of these powerful figures of men and horses, all life-size, reaching out from the rough, wet earth, was unforgettable. There, semiburied in the reddish soil of China's Yellow River valley, were hundreds of battered but beautiful terra-cotta statues of armed warriors, servants, and horses pulling manned war chariots—the retinue of unified China's first emperor.

Standing in the rain, we were moved almost to tears, as one is when confronted with great art. Some of the astonishingly realistic figures were upright, intact, and poised, as if waiting for a command to attack. Others lay pathetically smashed and scattered; they had been broken and their weapons stolen four years after the emperor's death, when soldiers of the succeeding reign looted and burned this part of the ruler's grave site.

Here and there a hand stretched out of the soil, and a booted foot struck out from its cold turf-prison. Helmeted heads fallen from proud, broken bodies looked up from their ancient grave with fierce eyes brought glisteningly alive by the rain.

We were seeing the first evidence of a stunning archeological discovery. Experts estimate that the figures are the vanguard of an army of 6,000 created 2,200 years ago. It was buried in a huge roofed gallery to guard the tomb of Ch'in Shih Huang Ti, the man who unified China, built the Great Wall, burned books valued by Confucius, and declared himself China's first sovereign emperor.

The history of China in all its struggles and glory is being unfolded by such archeological finds. Here, the grand army we were viewing was only the first revelation. Less than a mile away, the tomb itself is still to be entered. It may hold the greatest imperial secrets and the richest treasures in the history of China.

The underground army we saw was discovered in the spring of 1974 by peasants and workers of the Yen Tsai commune in Lin-t'ung county. So far, less than a tenth of the three-acre site has been excavated. Many wonders lie ahead.

I was accompanied to the excavation by my father, Chester Ronning, and my daughter, sister, and nephew. Our family group had been invited because my father, a retired Canadian

(Continued on page 448)



DAZZLING sepulcher of the first emperor appears in legendary splendor, as visualized by a modern Chinese-American artist, Yang Hsien-min. In the inner sanctum, as yet unexcavated, a wooden dragon—beast of good fortune—bears the copper coffin across a China in miniature, expressing for all time Ch'in Shih Huang Ti's power over his dominions.

"The Yellow River and the Yangtze were reproduced in quicksilver and by some mechanical means made to flow into a miniature ocean," wrote the Han Dynasty historian Ssu-ma Ch'ien a century after the first emperor's death.

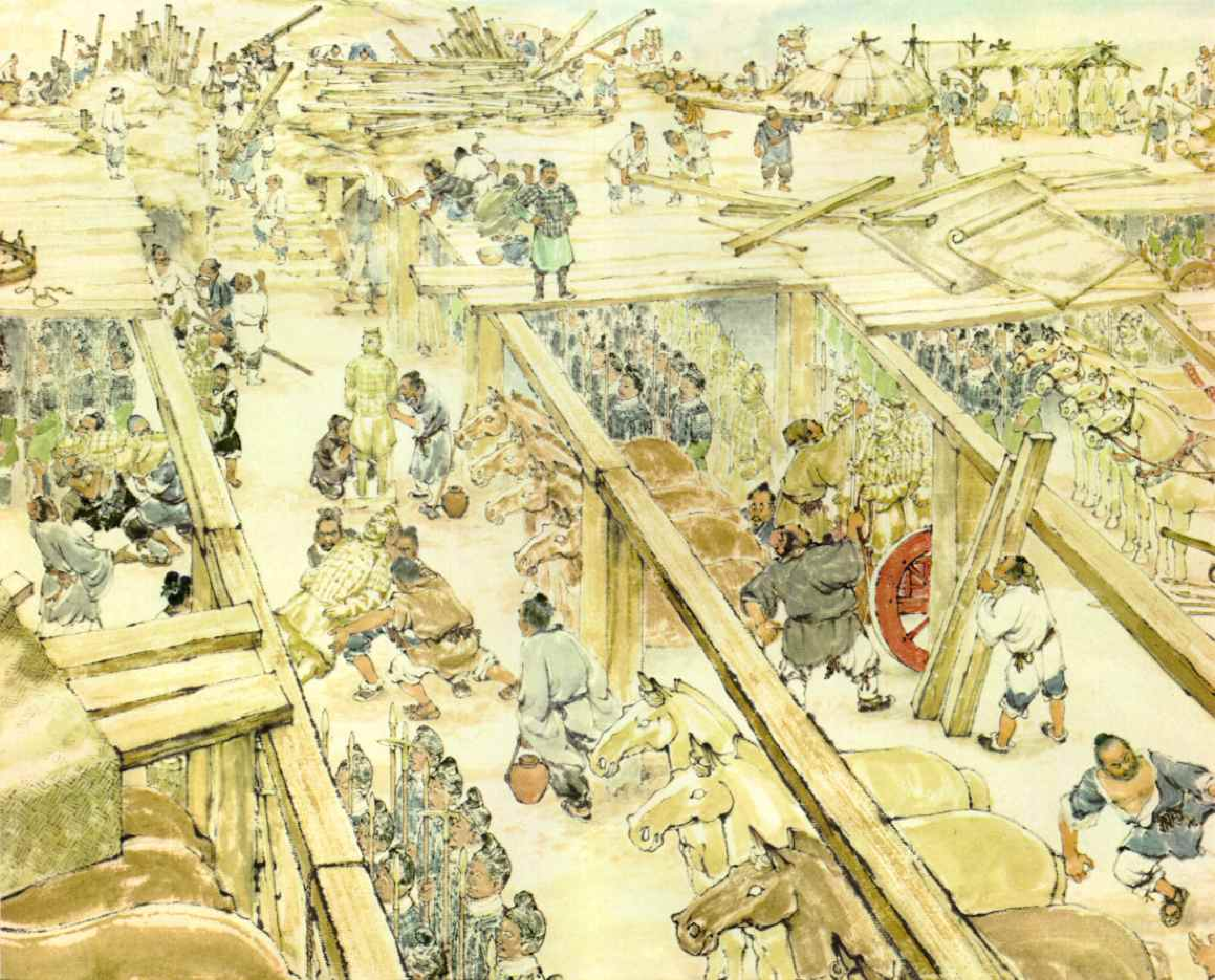
Guarding this glory, painted terra-cotta soldiers proved no match for torch-bearing looters, who, according to Ssu-ma Ch'ien, desecrated the tomb in 206 B.C. Invaders would have had to pass booby traps of hair-trigger crossbows to reach this prize.

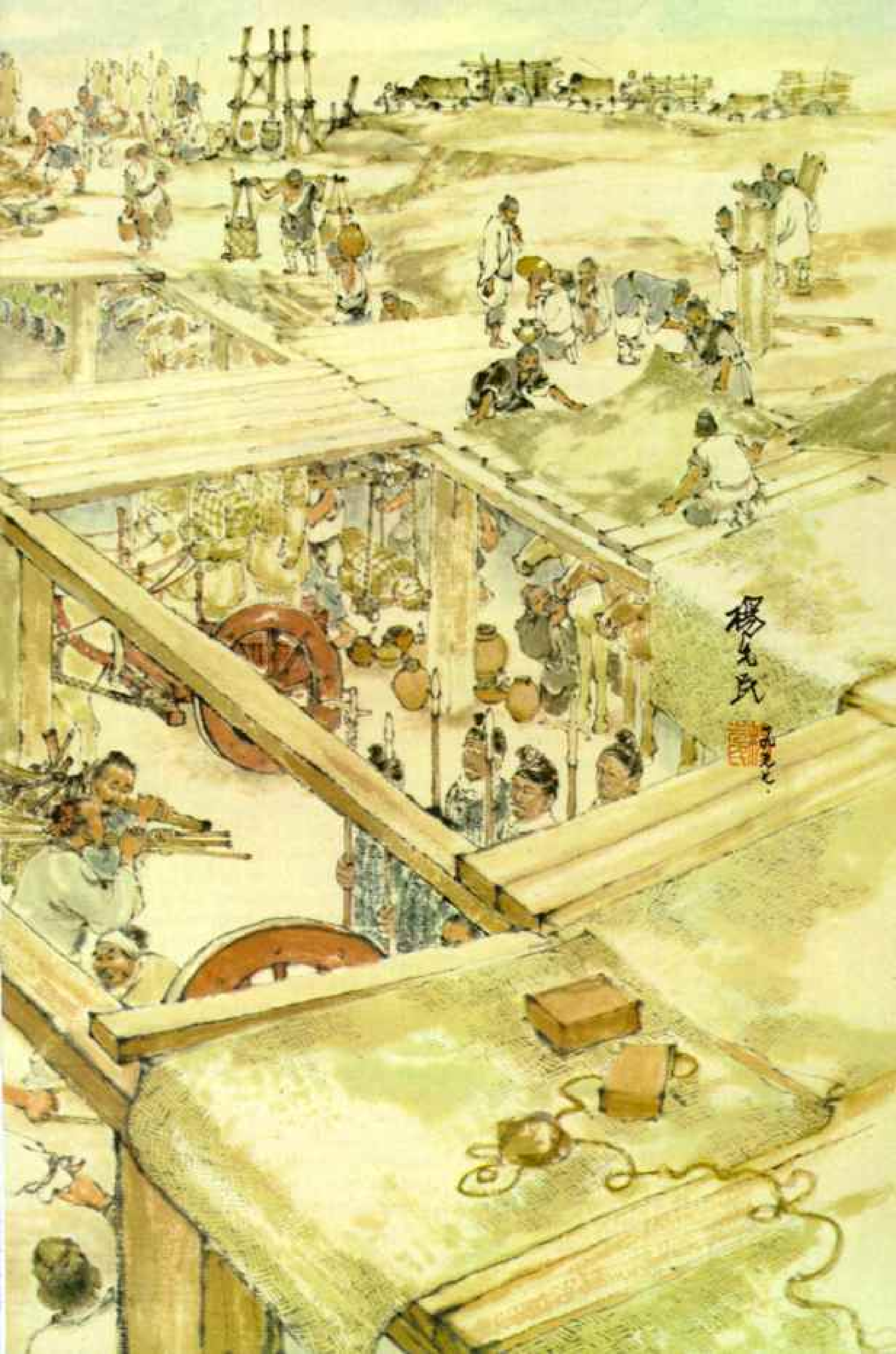
BATTLE READY, an army of 6,000 takes position for eternity in a three-acre, flat-roofed vault (following pages fold out). Alert terra-cotta horses, their forelocks curled, their tails knotted, draw wooden chariots, hitched with leather harnesses and brass fittings. Soldiers in painted armor carry real bronze swords, spears, and crossbows. Iron farm tools, silk and linen fabrics, and jade pieces are stored nearby.

To enjoy such everlasting protection, Ch'in Shih Huang Ti ordered building to begin on his tomb the moment he became king of Ch'in at 13. Some 700,000 conscripts worked 36 years on the project, so history tells.









楊克民



(Continued from page 440) ambassador who was born in China in 1894 and served there as a teacher in the 1920's and as a diplomat in the '40's and '50's, was a longtime friend of the late Premier Chou En-lai.*

We drove to the site from Sian, 40 miles to the east, accompanied by the mayor of Sian and several other officials. About 20 miles out we stopped at a 20th-century restoration of an ancient pleasure palace at the foot of Black Horse Hill to pick up archeologists Ch'en Hsueh-hua and Tu Pao-jen, who would show us around the dig. Their hair was still wet from bathing in the same soothing hot springs that the first emperor enjoyed when the pools were part of one of his luxurious palaces. Now the inlaid marble pools are open to all.

We followed a dirt cart path to the site. There, in the middle of a peaceful field, the earth had been sharply slashed open and rolled back to reveal a dramatic tableau resembling an ancient battleground.

Imperial Tombs by the Hundreds

In this area of Shensi Province in the Yellow River valley, China's earliest emperors lived and died. From the time the king of the feudal State of Ch'in conquered his rivals and became emperor in 221 B.C. until the fall of the imperial dynasties in 1912, the Chinese emperors ruled over what they called Chung-Kuo, the "pivotal kingdom." The seat of their power in Shensi Province is now an archeologist's paradise, with hundreds of unexcavated imperial tombs filled with royal riches and art treasures. Among these tombs, that of Ch'in Shih Huang Ti will undoubtedly prove to be the most wondrous. He spent 36 years constructing a subterranean palace in which he could spend eternity.

The terra-cotta figures of the emperor's legions were entombed some 4,500 feet east of Mount Li, the tumulus where the emperor was buried. His magnificent burial chamber was described by Ssu-ma Ch'ien, China's great early historian, about 100 B.C.:

"As soon as the First Emperor became king of Ch'in, excavations and building had been started at Mount Li, while after he won the empire, more than 700,000 conscripts from all parts of the country worked there. They dug through three subterranean streams and poured molten copper for the outer coffin, and the tomb was filled with models of palaces,

pavilions, and offices, as well as fine vessels, precious stones, and rarities. Artisans were ordered to fix up crossbows so that any thief breaking in would be shot. All the country's streams, the Yellow River, and the Yangtze were reproduced in quicksilver and by some mechanical means made to flow into a miniature ocean. The heavenly constellations were above and the regions of the earth below. The candles were made of whale oil to ensure their burning for the longest possible time."

Does the huge tumulus rising above the grainfields still enclose this microcosm of China? The only recorded doubt is cast by Ssu-ma Ch'ien himself, who tells of a "deseccration" of the emperor's grave four years after his death by troops of Gen. Hsiang Yü. No systematic excavation has been attempted. There is good reason to be hopeful.

The position of the underground guards east of the tomb leads to speculation that, in keeping with Chinese ideas of symmetry, equally spectacular treasure-houses may lie the same distances west, north, and south of the tomb, perhaps containing arrays of life-size statues of the officials, ministers, and ladies of the first imperial court. The emperor's warriors carried real weapons and the horses pulled actual chariots. Who knows what gold, jade, precious jewels, and silks may adorn courtiers in three other such vaults?

When we visited the site, 591 men, 24 horses, and four chariots had already been excavated, and hundreds more lay waiting to be rescued. No two men looked alike.

Skeletons found in the royal tombs of the Shang Dynasty (1700-1100 B.C.) show that live warriors, women, servants, and horses had been buried with kings and high-ranking officials. The practice of live burials had been stopped for centuries, but Ch'in Shih Huang Ti revived it symbolically.

Archeologist Ch'en drew our attention to the fact that each face of the pottery figures had distinctly different characteristics. "We believe this is because the emperor ordered the artists to model realistic portraits of each warrior, servant, and footman in his live honor guard, so they could continue to guard him after death." Part of the sculptor's inspiration, and certainly the models' willingness to pose, must have lain in the knowledge

*The author wrote of her "Return to Changing China" in the December 1971 *GEOGRAPHIC*.

that the finished creation would be buried, instead of the people themselves.

All figures stand about six feet tall. They look as alive today as their models were 22 centuries ago. Some appear fierce; others, proud and confident. A few seem to be on the verge of a smile.

The horses stand four abreast before their royal war chariots. Some are incredibly intact, while others sag against one another with broken backs and necks, though their magnificence remains undiminished. Artistically, their classic simplicity and smooth, pure lines have survived the test of time. A thousand years later, the clean, curved jawline of these early creations became the mark of the famous Tang Dynasty horses (A.D. 618-907), which are still imitated today.

The tails of the Ch'in horses are knotted

at half length. The manes are short, standing straight at the crest of the neck, except for the forelocks, which were left long and parted in the middle to curl around the front of each ear. The ears are set forward and appear tense, indicating alertness.

Troops Arrayed for March to War

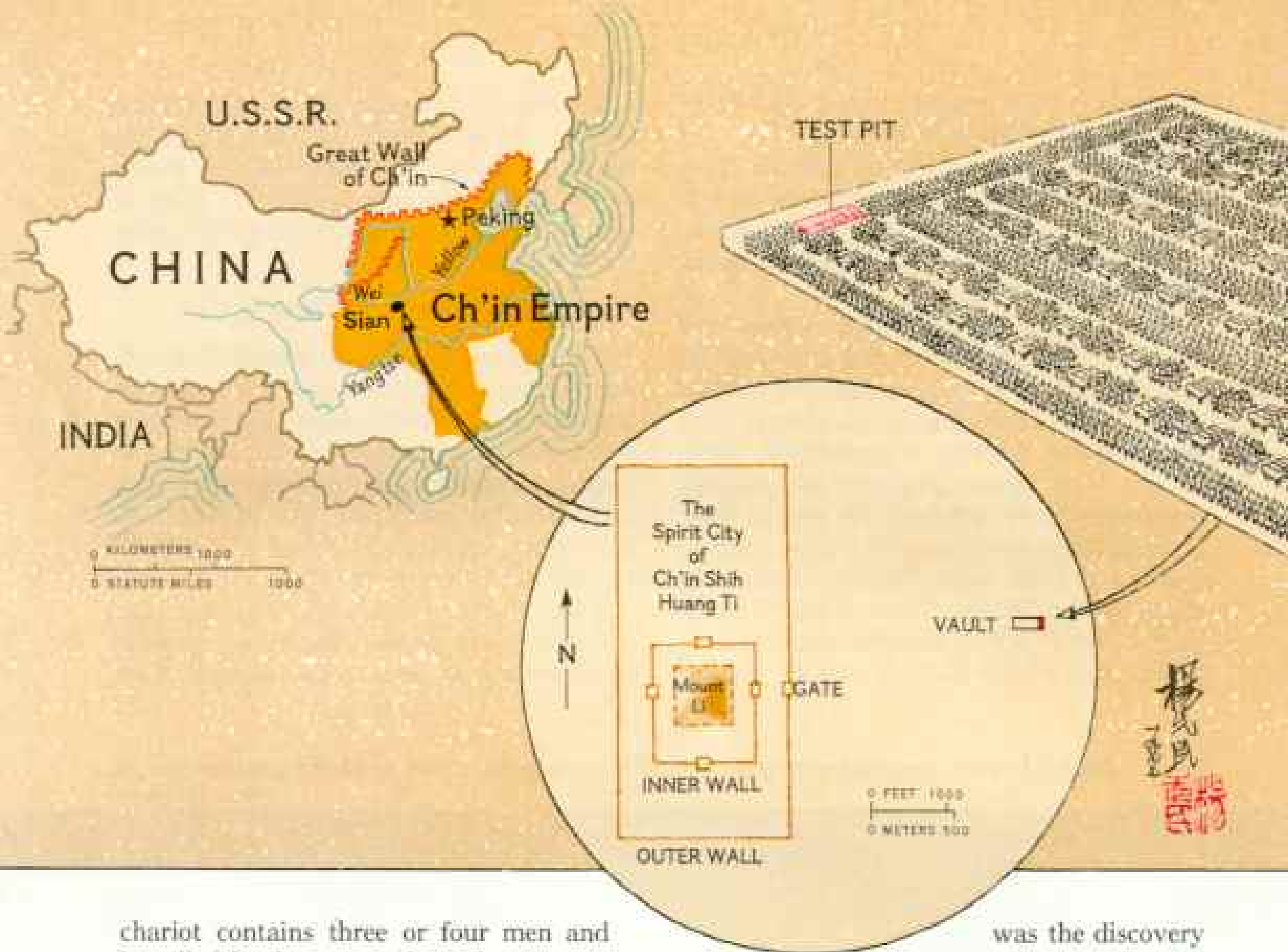
The pottery legions were interred in standing position in battle formation, 15 to 20 feet underground (following pages). They occupied a roofed-over area extending 700 feet east to west and 200 feet north to south. They were arrayed in the same way that the emperor's live honor guard used to line up before it set off on a military campaign.

There are 11 corridors filled with men and horses. In some the men march rank on rank. In others horses draw royal chariots. Each

Four abreast, magnificently modeled horses prance out of their ancient grave.

COURTESY CHINA PICTORIAL





chariot contains three or four men and is pulled by four magnificent horses accompanied by 12 foot soldiers. The army carries real swords, spears, and crossbows.

The floor of the immense underground gallery is still covered with earth, but archeologists say it was paved with cord-impressed bricks. Pillars, long since collapsed, once held up the roof of the underground battlefield. There are four pits: the east, where the main digging is going on, the west, and two middle pits, where work is confined to probes to estimate the size of the pottery army. All are unprotected from the elements.

Six archeologists, including Mr. Ch'en and Mr. Tu, are directing as well as working on the excavation site. Their labor force consists of peasants and commune workers, who earn extra money helping on the dig.

So far, workers have uncovered five sloping passageways leading to the east pit, where they have already unearthed more than a thousand relics. Besides the pottery men and horses with wooden chariots, they have found gold, jade, bamboo, and bone artifacts, as well as linen, silk, pottery utensils, bronze objects, and iron farm tools.

Important to students of military technology

was the discovery of arrowheads and metal swords treated with a preservative that prevented corrosion for 22 centuries. Analysis revealed that the swords are an alloy of copper, tin, and 13 other elements, including nickel, magnesium, and cobalt.

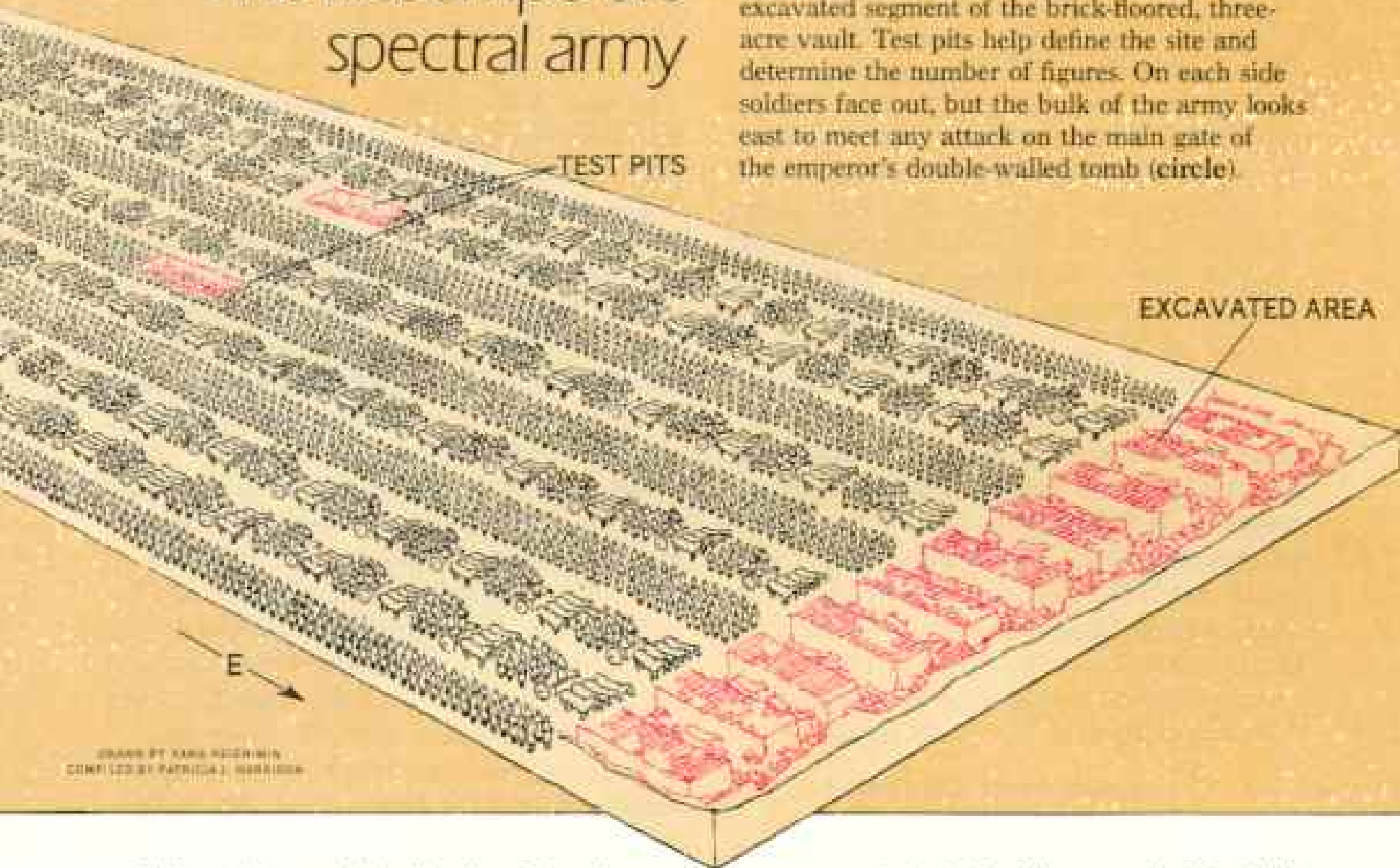
One of the officials with us, Li Chi-tao, of the Standing Committee of the Shensi Revolutionary Committee, said, "Eventually we will erect a museum on the site, and the pottery army will stand once again—clean and proud—on its original ground."

Pines and Blossoms Mask Burial Hill

We drove three-quarters of a mile west to Mount Li. The exterior of the emperor's tomb-mound gave no hint of its mysterious interior. The tumulus, standing unimposingly in a cornfield, looked slightly off balance from perfect symmetry. Pine trees and pink wild flowers hid the original three-layered shape, constructed in conformity with symbolic patterns representing the harmonious cosmos. In the surrounding fields, peasants were going about their planting as usual, unconcerned that their long-horned water buffalo and small tractors were plowing venerated land.

The first emperor's spectral army

Jumble of earth and pottery marks the excavated segment of the brick-floored, three-acre vault. Test pits help define the site and determine the number of figures. On each side soldiers face out, but the bulk of the army looks east to meet any attack on the main gate of the emperor's double-walled tomb (circle).



DESIGNED BY KAREN HEDDERLEY
CONSULTED BY PATRICIA J. WARRICK

Mount Li was visited by three French explorers early in the 20th century. One, Victor Segalen, described the tumulus in 1917 as “the most monumental of all those that exist in China . . . one hundred and fifty feet high . . . each of the sides more than a thousand feet long. The form is well designed with three successive undulations . . . as three hills massed on top of one another.”

Mr. Ch'en explained that the tomb-mound was originally built in the center of an enclosed area, a “spirit city.” It contained sacred stone tablets, inscribed soul towers, and prayer temples. All these constructions were deemed to be in the “inner city,” within a walled square more than a quarter mile on each side. Beyond lay an “outer city,” guarded by a high rectangular stone wall, 23 feet thick at the base, with watchtowers at the corners. The total area enclosed was more than 500 acres.

The walls and temples have almost disappeared, and the sacred objects above ground have long since been carried away by vandals and invading armies, but the earth still protects the silent splendor of the inner sanctuary below.

Today, in the People's Republic of China, Ch'in Shih Huang Ti is a household name to

most of the 850 million people. But Ch'in was a tyrant who buried 460 Confucian scholars alive, let thousands of workers perish while building the Great Wall, and spent more than 30 years building his tomb with forced labor. Why is this once despised prince being hailed as a man whose “positive efforts hastened the progress of history”?

This question burned in our minds as we drove back to the ancient city of Sian. Formerly known as Ch'ang-an, meaning “eternal peace,” the city served as China's capital during various dynasties between the 11th century B.C. and the 10th century A.D.

The rain had let up, and people were drying their clothes on bamboo poles in front of cozy brick and adobe homes with curved “dragon back” tiled roofs. The tinkling of thousands of bicycle bells from rush-hour traffic mingled with the clatter of horses' hooves, the jarring horns of our cars, and the roof-corner wind chimes that drive away evil spirits.

New Capital Populated by Royal Edict

From Sian we drove along the south bank of the Wei River near Hsien-yang, where 22 centuries ago the first emperor erected a new and splendid capital city. To his new

metropolis he transported 120,000 wealthy families from all parts of the empire, thus enfeebling the feudal aristocracy by removing them from the land and people that gave them power. To demonstrate his vast wealth and omnipotence, he built replicas of the palaces and villas they had left behind.

Nothing remains today of their great homes or of the emperor's 270 elaborate palaces and gardens, which were joined by covered passageways that lined the main streets. The greatest of the palaces was the A-fang, constructed by hundreds of thousands of laborers.

In his later years Ch'in Shih Huang Ti became obsessed with security and changed his sleeping quarters every night. The palaces were supplied at all times with servants, concubines, and food, so that all would be constantly ready for him, and no one except his chief eunuch, Chao Kao, and Prime Minister Li Ssu knew where he slept. Any person who revealed the emperor's whereabouts was put to death, along with his whole family.

New Image for an Old Despot

We returned to Sian and soon arrived at our hotel, a modern version of an ancient palace, guarded by stone lions and surrounded by lush gardens. At dinner, after toasts with *mao-t'ai*, a strong Chinese spirit, we talked about Emperor Ch'in. I asked our interpreter from Peking, Miss Lu Wen-ju, if she thought the emperor was cruel or unjust.

"As we look at him now, we can say that he was cruel. But remember, it was not unusual in those days to hold entire families responsible and to punish them all for the sins of one member," she said. "Also we must consider that Ch'in did many progressive things and was the first to unify China."

China was split into warring states when the 13-year-old future emperor inherited the throne of the kingdom of Ch'in, in 246 B.C. The young king spent the first 25 years of his reign in ruthless battles and, finally, in the words of the ancient historian Ssu-ma Ch'ien, conquered all China "like a silkworm devouring a mulberry leaf." After he had overrun six kingdoms, the legends of his supernatural power became so strong that the other kingdoms submitted.

Ch'in Shih Huang Ti built the Great Wall by joining walls and ramparts that had been erected earlier by the contending feudal

states. Six became the lucky number of Ch'in, which is why, according to legend, the emperor had the Great Wall built wide enough for six horses to gallop abreast along the top. The wall was primarily constructed to protect his newly formed empire from the nomad "barbarians" of the Asian steppes.

The emperor created the nation's first standing army, perhaps numbering in the millions, to guard the wall from northern invaders, while a crew of forced laborers—prisoners of war, exiled Confucian scholars, and so-called criminals—extended it to roughly 1,500 miles. Thousands, perhaps millions, of those unfortunate men perished. Their bones were crushed and buried beneath the massive gray rocks—earning the wall the grim sobriquet of "the longest cemetery in the world." When we walked along the top of the wall, their spirits still seemed to cry out in the sharp, perpetual wind, haunting the thousands of grim watchtowers that stand stark and foursquare along the parapets.

The wall was reconstructed in the 15th century during the Ming period and recently by the People's Liberation Army. A serpentine miracle of engineering, it snakes like a dragon's back, rising over the loftiest summits and plunging into the deepest ravines. It is the longest fortification in the world.

Making China a Nation

Ch'in Shih Huang Ti's reign over a unified China lasted little more than a decade, but in that time he accomplished the sweeping changes that made his dynasty a turning point in history. He radically altered the political and social structure of the state by destroying the ancient feudal system and establishing a centralized empire. He codified the laws and standardized weights and measures and the system of writing Chinese characters, so that the written language could be understood all over China.

To ensure communication and the transport of food and other essential goods to all parts of his empire, the emperor ordered a vast network of roads built, radiating from the capital, and he standardized the axle lengths of wagons and chariots to enable vehicles to travel in the same ruts. By a series of canals, he began what was to become the greatest inland water-communication system in the ancient world. Some of these canals are still

used, and one can still travel from north to south by water. Ch'in Shih Huang Ti also reclaimed wasteland for the cultivation of crops and introduced irrigation systems still in use.

Confucians Feel Emperor's Fury

The emperor's military government was progressive, but it was also ruthless. He felt that the scholarly but conservative Confucian philosophy, which supported the old feudalistic system of the previous dynasty, was a threat to his authoritarian, centralized rule. He not only burned all books of the Confucian school, except for those in the imperial library, but also buried alive Confucian scholars who, after warnings, still openly opposed his reforms. The emperor's eldest son, Fu-su, attacked his father's decision to kill the

scholars and was exiled to the northwestern frontier where he spent the rest of his life helping direct the building of the Great Wall.

I asked one of our Chinese companions why he thought the emperor had killed the scholars. His reply probably reflected not only the attitude of the Ch'in Dynasty but also of China today, where Confucianism is again officially disapproved.

"Confucian scholars," he said, "were most conservative. They believed what Confucius approved must always be right and that the old ways of the Chou Dynasty were too sacred to be changed. How can progress be made if nothing can be changed?"

In spite of all his power and success, the emperor could not rest and traveled almost compulsively on his newly built roads.

DAGGER DRAWN, an assassin lunges at Ch'in Shih Huang Ti. The emperor leaps behind a column while he draws his own weapon. The attacking warrior, Ching K'o, had come as a friend, bearing the head of a slain enemy in a box but concealing his dagger in a rolled map. Although he and other would-be assassins failed, they caused the ruler immense concern. To prolong existence, he increasingly sought guidance from mystics; ultimately he even sent missions overseas in search of magical life-enhancing elixirs.



Sometimes he disguised himself as a peasant to find out what the people thought of him. Because of several assassination attempts, he lived in fear of his life and was prey to gross superstitions.

Futile Quest for Immortality

Historian Edward Thomas Williams tells how the emperor spent his last years seeking the fountain of youth. "Charlatans and practitioners of the occult and black magic enriched themselves by exploiting his credulity. Magicians told him of the three fairy islands in the Eastern Seas where old age and death were unknown" because their inhabitants had discovered the elixir of immortality.

Determined to find it, the emperor sent a fleet of vessels loaded with precious gifts in search of the Islands of Immortals. After some time, Captain Hsu returned to say that he had met one of the Immortals but that he had refused to part with the elixir because the gifts were too cheap.

"What do you desire?" asked the captain.

"Young men and maidens and craftsmen of all sorts," replied the Immortal. So Captain Hsu set off again with 3,000 of the empire's finest young people. They sailed away and never returned. Maybe they did find the fountain of youth, but a legend says that they colonized Japan. And indeed a surviving monument in Japan today bears a Chinese inscription about Hsu Fu, a Taoist priest who was on the voyage. He died there in 179 B.C. He is believed to have established in Japan a region known as the "Kingdom of Chin."

The emperor continued to live and work in guarded secrecy. *(Continued on page 459)*

SHOWCASE OF SUCCESS, the imperial capital of Hsien-yang boasted many luxurious palaces that were copies of royal residences in conquered states. Defeated leaders lived nearby, virtually under house arrest. From his capital by the river Wei, the emperor constructed a network of roads across his nation; his canals linking major streams are used today. In other acts to unify China, he standardized laws, script, coinage, weights, measures, and even the gauges of chariot wheels. Yet for all his power, he lived in fear for his life, moving constantly from palace to palace in utmost secrecy.







楊先民

丁巳年



WITH THE CRACK OF A WHIP or the thrust of a spear, the new regime wielded merciless force to consolidate total power in the hands of the emperor. He sent 700,000 conscripts to build his Great Wall (left) as a defense against nomadic tribesmen of central Asia. The laborers linked older barriers across mountain passes into one 1,500-mile barricade, the longest fortification on earth. To protect himself from dissidents within, the emperor ordered the burning of thought-provoking history and philosophy books and the killing of 460 Confucian scholars. Some were buried alive, and others, according to legend, were buried to their necks and decapitated (below).





(Continued from page 454) with only a handful of his most trusted eunuchs and ministers knowing where he was. His life was so secret that, when he died during a journey to the eastern provinces, no one in the imperial cortege knew it, except for the emperor's youngest son, Hu-hai, his chief eunuch, Chao Kao, and Prime Minister Li Ssu. They kept his death a secret for their own ambitious reasons.

Chief eunuch Chao Kao had been steadily gaining power as the emperor grew weaker. He feared that his power would end if he obeyed the dying emperor's decree, appointing his exiled eldest son, Fu-su, as emperor. Instead, the eunuch plotted with Prime Minister Li Ssu to send a fake order to Fu-su to commit suicide. The son immediately did so. They then schemed to give the throne to the weak and corrupt youngest son, Hu-hai, whom they could control.

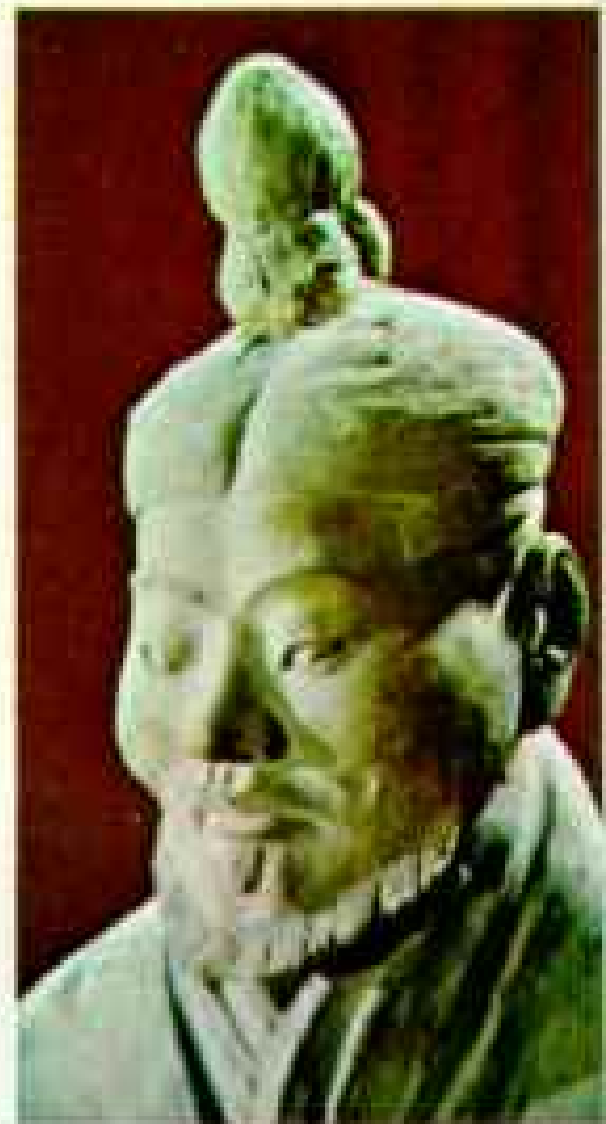
While all this was going on, a weird procession was traveling hundreds of miles back to Hsien-yang, the capital, with the dead emperor's body. It was midsummer, and the chief eunuch and prime minister were obliged to put some rancid fish on a cart following the imperial chariot to hide the odor of the decomposing corpse.

Grim Fate Rewards the Faithful

The first emperor's putrefying body was at last laid to rest in his magnificent sarcophagus, and he was buried with full pomp and ceremony in the splendid subterranean palace he had spent much of his lifetime constructing. Ssu-ma Ch'ien relates that after the faithful pallbearers had placed the casket in the sepulchral chamber and were arranging the furniture on their way out, the new emperor, Hu-hai, ordered the great jade door of the tomb sealed, and the men were buried alive. Since they alone knew how to penetrate the intricate tomb, the dead emperor presumably would thus be safe from grave robbers.

Perhaps the remains of the pallbearers will be found when the emperor's tomb itself is finally opened. Chinese archeologists, historians, and educators are pressing forward, whatever may be revealed, in the belief that the Chinese people should learn both the evils and accomplishments of their ancient imperial forebears. □

STAND-INS for the living sacrifices once offered the dead, men of clay represent real soldiers in the emperor's actual army. Each of the visages appears to be modeled on an individual face, some proud, others ferocious, a few even close to a smile. Sculptors first formed a base from coarse clay, then with finer paste filled in such details as mustaches and braids. The figures are the earliest life-size clay sculpture in China. Their realism startles art historians, who had believed that such naturalism appeared much later there.



COURTESY LUCE-LIM (LEFT)



ONLY A FEW soldiers remain whole after the devastation of looting and collapse of roof (facing page); Chinese archeologists record the damage.

More than an army is being resurrected; the emperor's image in history is being refurbished. Long despised, Ch'in Shih Huang Ti won plaudits from Chairman Mao for unifying China. Continuing excavations promise to keep the emperor in the news.

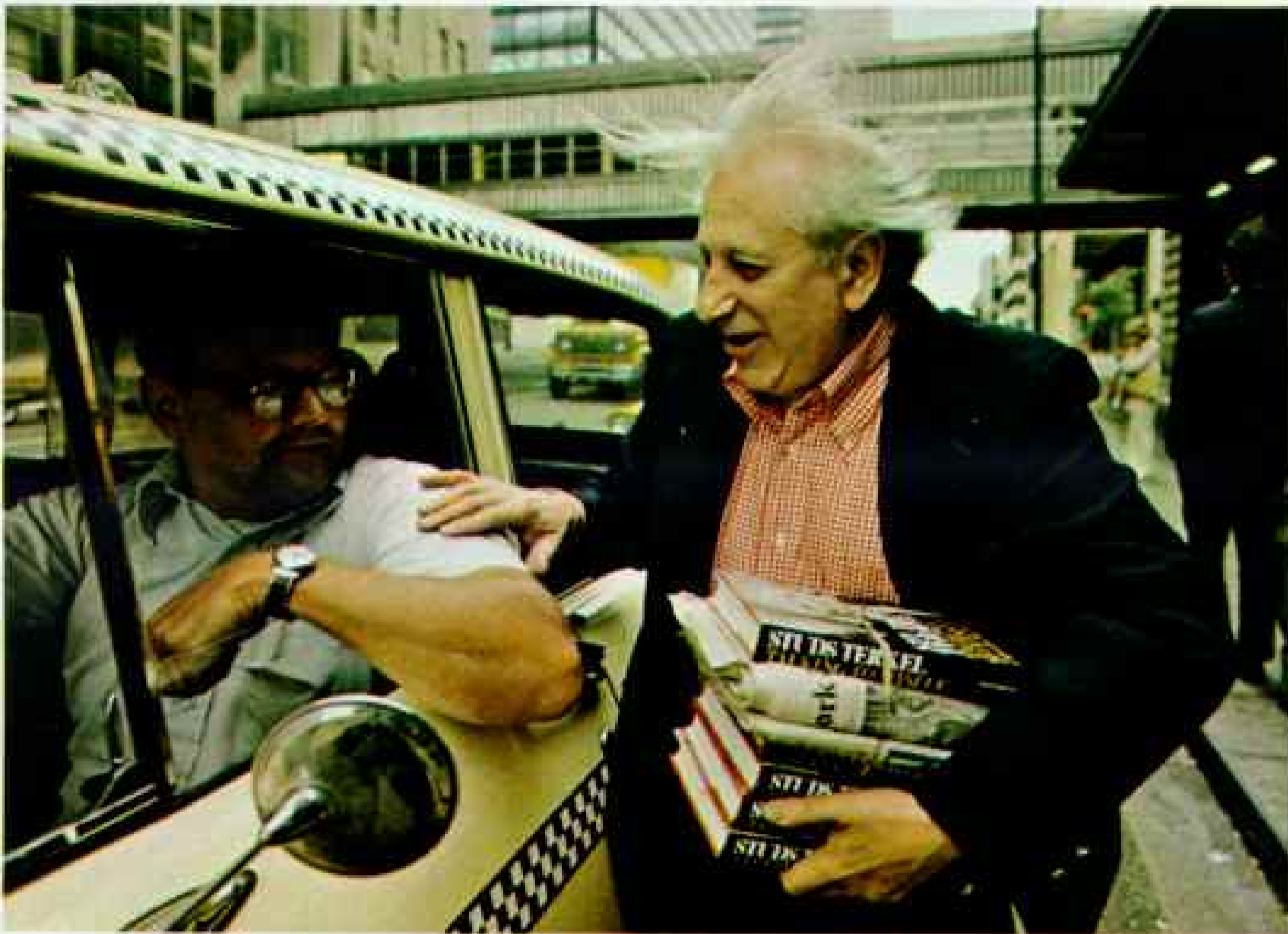


COURTESY CHINA PICTORIAL, TOP AND CENTER; COURTESY AUDREY TOPPING, ABOVE

SHADOW AND SUBSTANCE: *Towers of Chicago, which include three of the world's five tallest buildings, rise through morning fog blowing in off Lake Michigan (foldout, right). Shadow of the Sears Tower—tallest of them all—slants below.*







Giving ear to the common man, Chicagoan Studs Terkel records the accents—and soul—of America in classic books such as *Working* and *Talking to Myself*.



Taking bids on tomorrow, brokers at Chicago's exchanges trade commodity futures—crops yet to be planted, gold yet to be dug, livestock yet to be fattened.

Out where prairie, lake, and
river meet there's a
phenomenon they call

Chicago!

By HARVEY ARDEN

Photographs by STEVE RAYMER

BOTH NATIONAL GEOGRAPHIC STAFF

IT'S A PERFECT SUMMER DAY in the year 1 A.D.—After Daley. I'm sitting on a lemon-yellow park bench at Fullerton Avenue beach on Chicago's north side, just beyond the point where the Great Fire came to a halt in 1871. Looking toward a skyline anchored by three of the five tallest buildings on the planet, my eye sweeps south along the broad blue curve of Lake Michigan.

Unlike cities that turn their backs on their waterfronts, cluttering them with wharves and industry, Chicago faces its lake with arms stretched wide, reserving most of its magnificent 29-mile lakefront for gracious parks and great museums and stately buildings (pages 476-7).

The lake is the fundamental fact of Chicago, spiritually as well as geographically. Here the restless, teeming city, the seemingly unstoppable city, comes to a stop both abrupt and absolute. There's something almost religious about it.

As a boy in Rogers Park on Chicago's far

north side, I would emerge from the city world of honking streets and three-story red-brick buildings to gaze east in silence on the lake's cobalt-blue emptiness. I would drag my sled in winter up the Ridge Boulevard hill—one of the few sleddable inclines in that prairie-flat neighborhood—without the slightest idea that this was a surviving sand dune of an ancient beach ridge of Lake Michigan.

Later, after leaving Chicago, I would always feel a touch disoriented in cities burdened with four sides. My own inner geography, based on Chicago's, has only a north side, a south side, and a west side. To the east—infinity.

Flanking my lemon-yellow bench are benches of salmon pink and lime green. On the bench to my left sits a white-haired man, a solitary observer of the phenomenon of Chicago like myself. We've struck up a conversation, and he compresses a lifetime as a Chicagoan into a few sentences.

"Lived here more'n seventy years," he says. "Used to be in garments—uniforms. I'm



Giving voice to the black experience, John H. Johnson—Chicago publisher of *Ebony* and *Jet* magazines—provides popular media for black audiences.

retired now. Get down here to the lake when I can. Like to look at those big new buildings they've put up. Now if I could add something to Chicago, I think it'd be a few mountains—just for a backdrop, you know. But I guess the big buildings'll do 'til a mountain comes along." He turns, squinting into the diamond-hard glare off the lake to watch a sailboat.

"Oh, yeah, I know, people call Chicago the Second City. Well, I never heard a Chicagoan apologize about it yet. And I, for one, ain't about to."

Daley Made the City Work

Our decorator-color park benches come courtesy of a city administration that for nearly a quarter of a century was all but synonymous with Mayor Richard J. Daley—"Boss" himself—the patriarch whose death at 74 in December 1976 shook Chicago to its political and emotional foundations.

Standing in long lines in the Siberian cold of that winter, the city's blue- and white-collar multitudes paid their final respects to

the man they called "Hizzoner" (that's His Honor in Chicagoese). To millions—if not quite to all—Dick Daley was Chicago.

"He's a guy who come out wid bot' fists swingin'!" a cabbie put it to me. "He's a guy who got t'ings did!"

It was Daley who won for Chicago its reputation in recent years as "The City That Works"—a much-publicized example of fiscal soundness in an age when other big cities, most visibly New York, were skirting the abyss of financial ruin.

And it was Daley, too—as the undisputed "King of Clout"—who headed Chicago's long-rumblings and awesomely powerful political machine. In the tradition of the machines of New York's "Boss" Tweed, Boston's "Jimmy" Curley, and Kansas City's "Boss" Pendergast, Daley's Democratic machine indeed managed, in my cabbie friend's pungent phrase, to "get t'ings did"—though often in an imperial fashion that raised a great many eyebrows and not a few legal questions.

But, this is, after all, the phenomenon called

Chicago—a city of superlatives and extremes. If Chicago is going to have itself a machine, you don't expect a toy locomotive.

Chicago has always emphasized its "biggest" and its "bests," its "firsts" and its "foremosts"—at times to disdainful shrugs from New York. (It was a New York journalist in the 1890's who popularized the phrase "Windy City"—referring not to the gusts off Lake Michigan, but to the braggadocio that blew out of Chicago.)

True, Chicago has fewer than half the people of New York—3,100,000 to 7,500,000, within city boundaries. Even its Second City

status, so far as population goes, is seriously threatened by Los Angeles, whose greater metropolitan area population is rapidly overtaking Chicago's.

But mere numbers cannot measure Chicago's enormous contribution to American and world culture. This is the city that's given you everything from the first self-sustaining nuclear chain reaction (at the University of Chicago in 1942) to Sara Lee cakes; from the *Encyclopaedia Britannica*, the Great Books of the Western World, and *World Book* to *Playboy* and *Ebony*; from the McCormick reaper and the Pullman car to the zipper and the modern lie detector; from the prototype modern skyscraper and the first cafeteria to the great mail-order catalog firms (Sears, Montgomery Ward, Spiegel); from Schwinn bicycles to Zenith TV's and Motorola radios to Wrigley's gum, Quaker Oats, International Harvester, Household Finance, Hart Schaffner & Marx, and—amid a plethora of other American household phrases—McDonald's hamburgers.

A Kup's-eye View

"The sheer variety of things going on in 'Our Town' staggers the imagination," columnist Irv "Kup" Kupcinet enthused as we spoke of his beloved city in his *Sun-Times* office. "Oh, sure, she's been a wicked town in her time. Where's the big city that hasn't? But I get tired of people who throw the old 'Crime City' stereotype at me. They've been seeing too many old gangster movies, too many 'Untouchables' reruns on TV. Me, I emphasize the positive, but I don't ignore the negative. There are enough of both in this town to keep any reporter busy full time."

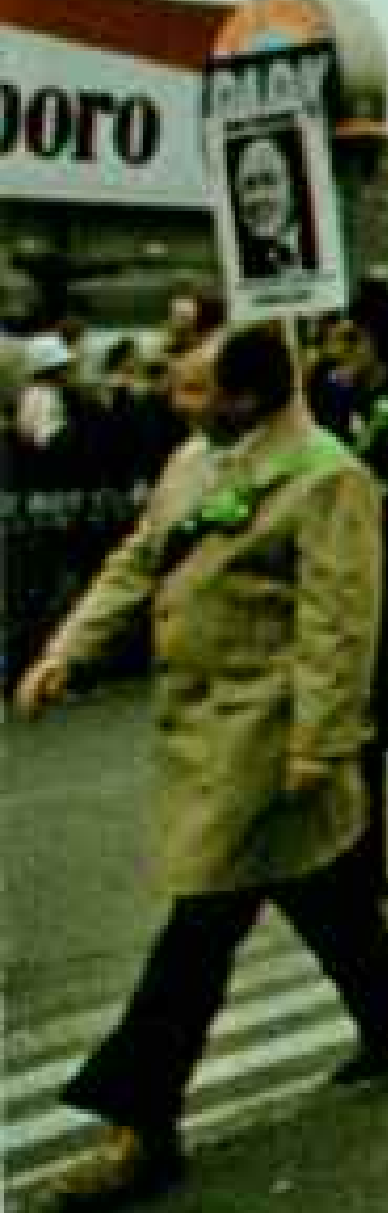
Kup's longtime civic boosterism has won him the unofficial title "Mr. Chicago." He has about him more the look of a linebacker for the Bears than a celebrity-set columnist. (He once did play briefly with the Philadelphia Eagles, and later officiated in the National Football League—"which Chicago's own George Halas helped found, you know.")

"Today . . . well, call me a reporter. People are my beat. It's my job to keep tuned in to what's happening—and what's going to happen—in what I personally consider the greatest town on earth.

"What you have to understand about Chicago is that it's not just some oversize



The best of enemies: Democratic Mayor Michael Bilandic, left, and Illinois Republican Governor "Big Jim" Thompson, with their wives, chat at a street party. Both men's careers entwined with the late Mayor Richard J. Daley's—Bilandic as Daley's disciple, Thompson as the U.S. attorney who rode to fame prosecuting errant members of Daley's political machine. At a St. Patrick's Day memorial parade (facing page), Daley's image smiles benignly.





Towering Chicago

Subway lines and stops in red
Elevated lines and stops in black

1/2 MILE
1/4 MILE

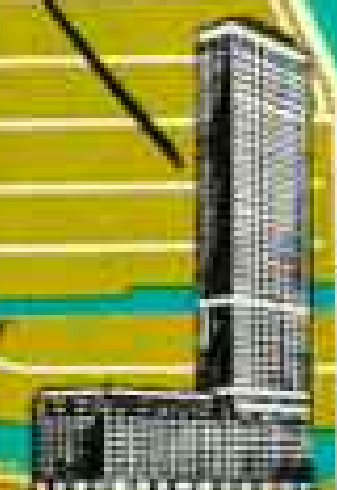
DRAWN BY J. S. DEBARTH AND JAMES L. DEBARTH
MAPS BY COLONIAL MAP, FORT
NATIONAL GEOGRAPHIC MAP DIVISION



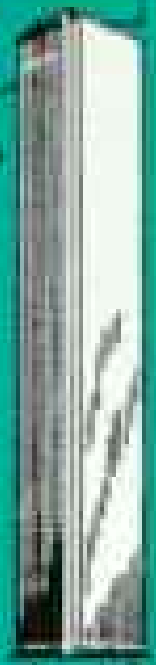
John Hancock Center
1,127 feet



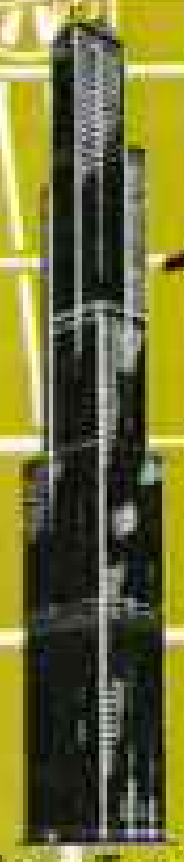
Water Tower



Water Tower Place
859 feet



Standard Oil Co.
(Indiana) Building
1,136 feet



Sears Tower
1,454 feet



First National Bank
850 feet

The Apparel Center

Merchandise Mart

Marina City 69

Prudential Building

Wrigley Building

Sun-Times/Daily News

Hyatt Regency Hotel

Cultural Center

Marshall Field & Company

Carlson-Pine Scott & Co.

Goodman Theatre

Institute

Orchestra Hall

Orchestra Hall

Orchestra Hall

Orchestra Hall

Orchestra Hall

Orchestra Hall

Orchestra Hall

Orchestra Hall

Orchestra Hall

Orchestra Hall

Orchestra Hall

Orchestra Hall

Orchestra Hall

Orchestra Hall

Orchestra Hall

Orchestra Hall

Orchestra Hall

Orchestra Hall

Orchestra Hall

Orchestra Hall

Orchestra Hall

Orchestra Hall

Orchestra Hall

Orchestra Hall

Orchestra Hall

Orchestra Hall

Orchestra Hall

Orchestra Hall

Orchestra Hall

provincial burg. It's a town of international importance."

Kup's ebullient talk called to my mind the typographic style of "Kup's Column."

"Just think of what's happening in Our Town," he went on. "Chicago novelist Saul Bellow wins the Nobel Prize for Literature . . . U. of C. economist Milt Friedman gets the Nobel Economics Prize . . . Sir Georg Solti conducts what many consider the world's greatest symphony orchestra . . . Studs Terkel catches the accent of America in books like *Hard Times*, *Division Street: America*, and *Working* . . . Young Chicago playwright David Mamet is wowing 'em on Broadway . . . Monumental sculptures and artworks by the likes of Picasso and Calder and Chagall have turned Our Town into a fantastic outdoor museum . . . Chicago's a must stop for world jet-setters like *Exorcist* director Bill Friedkin, a local boy made good, and his actress wife Jeanne Moreau, who often stay here when they're not in Paris or Hollywood . . . I could go on and on . . . Believe me, if it's happening, it's happening in Our Town!"

City Builds Up . . . and Up

Growing up in the Chicago of the 1940's, I looked on the 32-story Wrigley Building and the 36-story Tribune Tower as symbols of Chicago's bigness. Today those gracefully aging edifices stand amid the gigantitudes around them like grandmothers in a crowd of basketball players.

That cluster of elongated black rectangles thrusting above the Loop is the Sears Tower, the world's tallest building. At 1,454 feet and 110 stories, it's more than a hundred feet higher than New York's twin-towered World Trade Center (second) and more than two hundred feet higher than the once predominant Empire State Building (third).

Northeast of the Sears Tower soars the white marble Standard Oil Building (fourth), called "Big Stan." And looming above the near north side's "Magnificent Mile" shopping mecca is the huge black pylon of the 100-story John Hancock Center, or "Big John" (fifth)—a self-contained city of condominiums, offices, stores, restaurants, garages, and other amenities. There's a man up there who raised the floor of his 92nd-story condominium by six inches so he could claim to own the world's loftiest apartment. Looking out

their windows, residents often find themselves literally among or above the clouds and have to telephone down to ask what the weather's like at ground zero.

Nestled at the foot of these megabuildings, and looking hardly bigger than a child's toy castle, is the famed old Water Tower, survivor of the 1871 fire (page 473).

If this skyline lacks quite the dramatic compression, the almost Gothic verticality of Manhattan's, it compensates with a broad-shouldered massiveness, a stupendous horizontality that takes second place to none.

A Challenge to Wall Street

I walk through the clamorous congestion of the Loop, Chicago's superbustling downtown, along State Street ("that great street"), and Wabash Avenue, darkly roofed by the L (page 482)—longtime city symbol whose downtown segment may eventually be replaced by a new subway. Tremendous buildings and plazas graced by monumental sculptures give the casual walker an almost dizzying sense of size and space.

That blue-shadowed crevasse slicing between skyscraper walls is La Salle Street, a canyon of mercantile bustle that has been gaining dramatically on Wall Street as the nation's financial center.

Here rises the sleek-lined Chicago Board of Trade Building, a masterpiece of 1920's "Art Deco" architecture. Atop its spire stands a statue of Ceres, goddess of grain—recalling Chicago's historic role as crossroads of supply and demand for the grains, livestock, and other agricultural riches of the American prairies.

The once famed stockyards are gone now—closed in 1971—rendered obsolete in an age of decentralized meatpacking. Only the old stone gate, which saw countless bawling, bleating beasts pass on their way to the nation's dinner tables, still stands—headstone of a vanished era, set in a sea of weeds (pages 470-71). But if Chicago is no longer "Hog Butcher for the World," in Carl Sandburg's phrase, it remains the unrivaled center of American agribusiness.

Today the aroma of hogs and cattle need not sully the air; live hogs and cattle and pork bellies can be bought and sold on paper in the form of futures—contracts guaranteeing delivery of a given amount of a commodity

That's no baloney, but Thüringer summer sausage, being hefted by Hy Abrams, driver-salesman for a Chicago meat processor. Hy, who is Jewish, delivers German and Polish sausage for a company named Busch run by an Irishman named Macnamara—a common state of affairs in multi-ethnic Chicago. In an age of decentralized regional packing, the meat no longer comes from Chicago's once famed stockyards, closed in 1971. Only the old stockyards gate (right) recalls the era when Chicago was "Hog Butcher for the World."



at a fixed price on a set date in the future.

"The new age of futures contracts was launched right here at the Chicago Board of Trade," broker Marc Davis explained. We stood in the visitor's gallery, looking down on the trading floor where hundreds of brokerage personnel milled about, awaiting the start of the day's trading at 9:30 a.m.

"More than half the futures contracts in the nation are traded within these walls," Marc continued. "Up to a billion or more dollars' worth a day, plus millions at the Chicago Mercantile and MidAmerica exchanges down the street—contracts in everything from soybeans to silver to iced broiler chickens to lumber. Chicago's rewriting the very meaning of the word 'commodity.'"

"Why, right upstairs at the new Chicago Board Options Exchange they've been trading *options*—that's right, just options—to buy

blocks of certain stocks at an established price on a future date. It may be the biggest thing since stocks themselves were created.

"Guys from staid old Wall Street are coming here to study our innovations firsthand. Lots of 'em decide to stay because the action's simply hotter here. People who didn't know a pork belly from a piece of plywood a while back are trading in both today and making millions."

Down on the floor the murmur of personnel crescendoed. At precisely 9:30, a loud *GONG!!!* sounded. It was as if someone had tossed a hand grenade into a beehive.

Bidders and sellers coagulated into writhing mobs at each pit, or selling platform—screaming bids and selling prices, flailing their arms, flicking finger signals at each other, jumping and gesticulating.

"Don't worry," Marc reassured me. "It may



look chaotic, but they know exactly what's going on. They'd better. Fortunes are won and lost in a few minutes down there.

"I see it all as a metaphor for the American experience—reaping success and riches from the abundance of the land. And it's all happening here—in Moneytown, U.S.A.!"

Bellow Seeking "Dreamspace"

I catch hard-to-catch Saul Bellow in a hotel lobby where he's been kind enough to spare me a few minutes before racing off to give a lecture. He looks weary and admits he's "bushed" from the crushing schedule fame has brought him, particularly since winning the 1976 Nobel Prize for Literature.

His hair is short-clipped and quite gray. There's something nervous, yet very gentle about him. His gaze is liquid, clear, almost frighteningly intelligent.

"Lately," he confesses, "it seems harder and harder to find what I call my 'dreamspace'—a place where I can find the privacy and peace one needs in order to create. Seems I had more of that living in a three-dollar-a-week room back in Chicago's Hyde Park in the '30's than I do today."

Bellow moved to Chicago from Montreal at the age of 9 and has lived in the city most of his life. His masterpiece *The Adventures of Augie March* (1953) opens: "I am an American, Chicago born—Chicago, that somber city. . . ." In *Humboldt's Gift* (1975) the hero comes from the East to the "sticks" of Chicago to write—what else?—a book on boredom.

"You've taken a few swipes at the old town in your writings," I remark.

Bellow laughs, then turns serious.

"Chicago, you see, has always enjoyed its reputation as a bad town, a place of lust and



violence and power and money, and of raw vitality. It's been proud of its iniquities.

"My attitude toward it, as in any sound relationship, is ambivalent—a love-hate relationship. In any case, I can't quarrel with my fate. It happened that way. I grew up in Chicago. I got it into my bones."

We digress to politics and, inevitably, to the subject of the late Mayor Daley.

"He was like Chicago itself in many ways . . . tough, even crude at times. Yet he had a hidden sophistication and genuine talent and intelligence. I think lots of Chicagoans are like that, living up to the lowbrow image when they're really not lowbrows at all."

He glances at his watch. "Listen, I've got a plane to catch." We shake hands. I apologize for having invaded his dreamspace. Bellow hurries off—just one more harried traveler late for his plane, just one more Nobel Prize-winner looking for a dreamspace that becomes ever harder to find.

Scrubbing the Environment

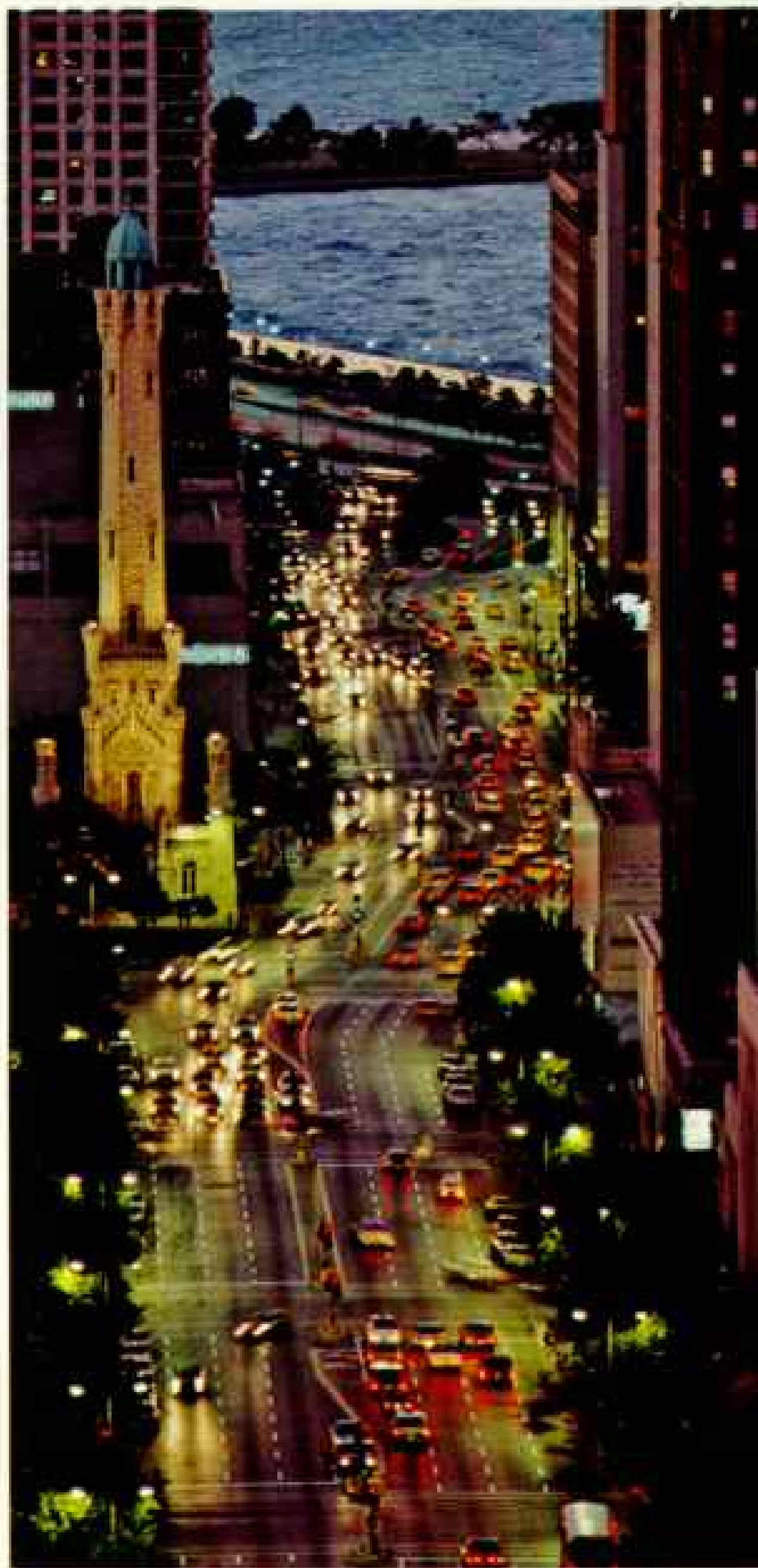
Along the milky blue horizon where Lake Michigan fades into the sky looms the haze-softened hulk of a freighter. She is bound—with Minnesota iron ore or Michigan limestone or Scotch whiskey (via the St. Lawrence Seaway)—for the Port of Chicago, shipping hub of the enormous steel-producing, oil-refining industrial complex stretching from the city's far south side to Hammond and Gary, Indiana, and beyond.

A third of the nation's capital goods are shipped from this area, which outranks Pittsburgh in steel production and dwarfs West Germany's mighty Ruhr Valley in industrial output. It's one of earth's greatest industrial colossuses.

And there was a time when it was one of the dirtiest as well, smearing the skies and fouling the waters of Lake Michigan.

"I can remember, not many years back," steel-company employee Jim Saksa told me, "when I used to take my little fishing boat out to the lake, and there'd be a dirty bathtub ring around her hull when I got back. Fishing was lousy, too. That was maybe ten or so years ago, before the Federal Government got on everyone's tail about pollution."

Jim's a mail runner, one of some 23,000 employees at Inland Steel's Indiana Harbor Works in East Chicago, the biggest single



Glitter and glamour, plus accommodations galore, help make Chicago the convention capital of the world. Lilted arpeggios and hot coffee soothe guests at the downtown Hyatt Regency (facing page), one of scores of plush hotels that each year cater to a thousand conventions and house 2.2 million guests. Exclusive boutiques and department stores flank nearby North Michigan Avenue's "Magnificent Mile" (above), adorned by the old Water Tower, famed survivor of the Great Fire of 1871.



City of the monumental: Matching its megabuildings with mighty sculptures, Chicago has transformed downtown streets into an outside museum—to a mixed local chorus of critical acclaim and catcalls. Chicago-reared Claes Oldenburg's "Bat-column"—100 feet high—mirrors itself in the glassy new Social Security Administration building (above). Alexander Calder's huge "Flamingo" (facing page) came to rest beside a federal building designed by Chicago architect Ludwig Mies van der Rohe.

steelmaking plant in the country—and itself only one of the huge steel mills in this so-called Calumet Region.

"Today," Jim went on, as he drove me out to the mill one morning, "you can see the bottom through twenty feet of water lots of days, and the state has restocked the lake with salmon and trout. Now the fishing's terrific—big 15-pounders right offshore. They've cleaned up the skies, too—most of that smoke you see coming from those stacks is harmless, mainly steam. Why, Inland alone has spent more than two hundred million dollars to fight water and air pollution. Don't have to scrub that bathtub ring off my boat anymore. Things still aren't perfect, maybe, but the difference between today and a few years back is almost unbelievable."

Site Demanded a City

Chicago has been called "a city that had to be" because of its supremely practical location at the point where the prairie and the lake and the Chicago River converge.

Here, at the close of the last ice age, debris from the glacier-gouged lakebed rose just enough from the surrounding prairie flatness—about six feet—to create a watershed dividing the Mississippi and the Great Lakes-St. Lawrence water systems.

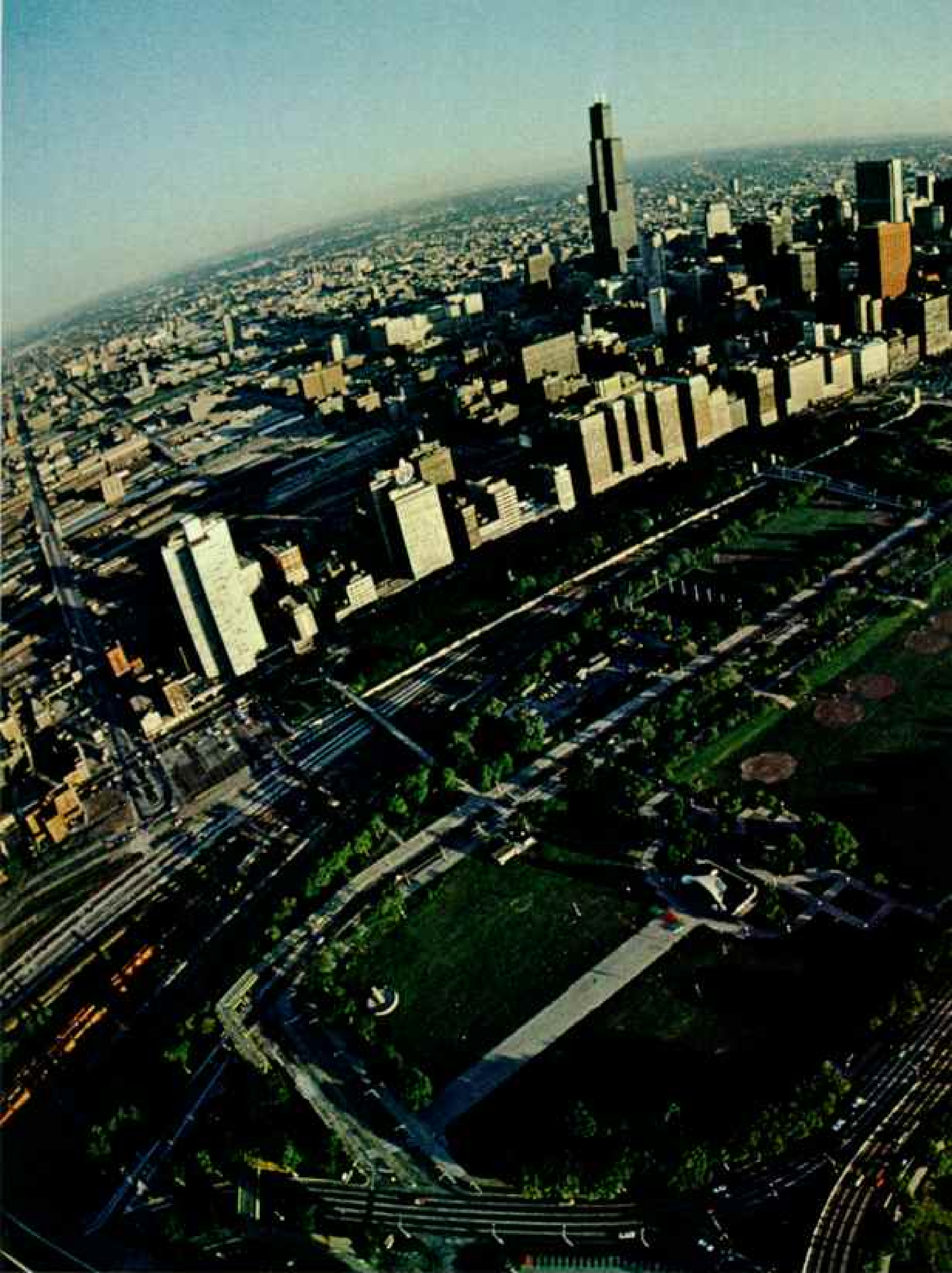
Early explorers found that they could paddle a canoe in time of flood right across the sodden region between the two systems, just to the west of present-day Chicago.

French-Canadians Louis Joliet and Father Jacques Marquette, after traversing the Chicago Portage in 1673, foresaw the potential of the area as a major transportation junction. A canal made the dreamed-of passage a reality in 1848, thus creating an inland water link between the North Atlantic and the Gulf of Mexico.

The canal linked the headwaters of the Chicago River, part of the Great Lakes system, with the Des Plaines River, part of the Mississippi system. Prodded first by the canal builders in the 1840's, then by the railroad builders in the 1850's, the tiny frontier village that had housed only a few hundred souls at its incorporation in 1833 soared out of the mud to become the country's transportation and distribution hub, and one of earth's great cities, within a few decades.

The canal, a (Continued on page 479)





Chicago's "front yard," Grant Park is the centerpiece of the city's 29-mile lake-front and a gracious foreground for a skyline topped out by the 1,454-foot Sears Tower,



left center. Dawn wakens the facades of Michigan Avenue; pleasure craft nestle like gulls inside breakwaters that stretch north to the Chicago River's outer lock.



Foot-stomping rhythms of old-timey musicians bring Appalachian mountain music to the prairie-flat pavements of Uptown, a neighborhood with a large transient population of Appalachian whites, Hispanics, blacks, American Indians, and



elderly poor—many of them on welfare. Such minifestivals help raise spirits and instill residents with a greater sense of community.

(Continued from page 474) relatively modest ditch, was replaced in 1900 by the much wider and deeper Chicago Sanitary and Ship Canal. In the process, at the turn of the century, the flow of the Chicago River was reversed—another of history's great engineering feats—thus turning back the river's sewage-laden (and cholera-causing) waters from the lake. Today the largest sewage-treatment system in the world recycles waste into organic fertilizer for use in agricultural projects elsewhere; effluent still entering the river approaches 95-plus percent pure.

To accommodate a population that was doubling and tripling itself every few years during the city's infancy, Chicago builders developed a quick-to-build form of housing called balloon frame.

Countless thousands of the thin-walled wooden dwellings sprang up throughout the city to house the incoming multitudes, many of them newly arrived immigrants: Irish, Germans, Poles, Bohemians, Jews, Swedes, Italians—the founders of Chicago's multi-ethnic society.

Endless wooden sidewalks were also built to lift the low-lying city above the prevailing muck and mire that made it a veritable mud-hole of the prairies. Chicago was literally a city of wood.

And then came the Great Fire of 1871.

O'Leary's Cow the Scapegoat

Numerous smaller fires had plagued the city in that tinder-dry October before Mrs. O'Leary's cow—so the story goes—kicked over the lantern that started the fire that cinderized more than three square miles of the center city. When firemen originally were sent to the wrong address, the fire gained a start that was never headed. Whipped to a frenzy by a strong southwest wind, the flames reared up from the barn behind Mrs. O'Leary's house (the house itself, to windward, was unscathed) and for some 30 hours roared over the city—leaving hundreds dead and a third of the city's 300,000 homeless.

"Why, heck," district fire chief Ray Antonucci told me, "we'd'a had Mrs. O'Leary's fire under control in minutes flat with today's methods. Which isn't to say fire fighting's easy these days. Only today we've got different problems, nothing so innocent as Mrs.



O'Leary's poor cow. Now it's arson that's plaguing us, much of it fire-for-hire arranged by owners who'd just as soon collect on a fire insurance policy as fix up a rundown building in a deteriorating neighborhood.

"And, listen," he said, "people have been killed in these fires. The firemen arrive in plenty of time, but the people—many of 'em are Spanish-speaking, you know—can't understand their instructions. Sometimes firemen have yelled, 'Don't jump!' and—my God—they've gone ahead and jumped!

"Now lots of Spanish-speaking candidates are being put on the force. And we're giving the other men special Spanish classes."

I listened to firemen reciting their phrases. "How do you say 'Don't jump?'" an instructor asked.

"*¡No brinque!*" came the answer.

"Now, 'Where are your children?'"

"*¿Dónde están sus niños?*" they chorused.

An alarm sounded. The group dissolved into a blur of movement. Within seconds the shrilling sirens of engine 35 were wailing down the street. Now, if Ray Antonucci's boys had only been around in 1871. . . .

Holocaust Spawns a Phoenix

As it was, Chicago rebuilt itself with incredible speed and optimism. Much of the



blackened rubble of the city of 1871 became landfill for the lovely parks and beaches that rim today's lakefront.

"The fire cleared the way for a new era," Ira Bach explained during a walking tour of Chicago's architectural heritage. Ira, author of *Chicago on Foot*, strides these streets with contagious enthusiasm, continually spotting gems of American architecture where the uneducated eye may see only a rundown, soot-blackened edifice ripe for the wrecker's ball.

"The smoke had hardly settled in 1871 when a new breed of architects began rebuilding the city," Ira told me as we legged it through the Loop. "Men like William

Byways graced by genius: Gabled early masterpiece by Frank Lloyd Wright (left) is one of 24 homes tracing the architect's youthful development in the near-in suburb of Oak Park. Ernest Hemingway, coincidentally, grew up in the same Oak Park streets.

Wright's master was Louis Sullivan, whose ironwork on the Carson Pirie Scott building (above) overlooks State and Madison, "the world's busiest corner."



LeBaron Jenney, who was the father of the modern skyscraper, and Louis Sullivan, whose 'Form follows function' dictum revolutionized modern architecture, and Frank Lloyd Wright, who worked for Sullivan in the 1890's just as Sullivan had worked for Jenney before him. And, Lord, there were so many others . . . Adler, Holabird and Roche, Burnham, Root—the so-called Chicago School. Libraries have been written about it. In its own way it was as great a period of architecture as the 13th-century period of cathedral building in France.

"Then fashions changed. The World's Columbian Exposition held here in 1893 featured mostly stylistic copies of Greco-Roman buildings. What came to be called the beaux arts style temporarily eclipsed modernism. Sullivan himself died in poverty, a broken man, almost forgotten. It wasn't until a generation later that the city once again became a focus of modernism. That was after Ludwig Mies van der Rohe came here from Nazi Germany in the '30's and founded the Second Chicago School. Mies's principle that 'Less is more' produced the clean-lined, glass-and-steel skyscrapers that became almost synonymous with modernity.

"Chicago may be the Second City in population or art or theater, but when it comes to architecture, we're very emphatically the First City!

"I only wish our city fathers could see it this way. The number of classic American buildings torn down here in recent years is enough to make an architectural historian cry. Many have been replaced by parking garages and undistinguished office buildings.

Stopping the Wrecker's Ball

"There's a University of Illinois law professor named John Costonis who, along with a Chicago real estate man named Jared Shlaes, has devised an ingenious plan for saving what classic buildings we have left. Their plan would allow owners of designated 'landmark' buildings to sell their development rights—that is, the right to construct a taller, more profitable building on the same site—to owners of property in other areas of the city where current zoning laws restrict construction beyond a certain height. This would give both owners a profit and take the financial sting out of owning an older landmark building.

"They call it the 'Chicago Plan,' and it's been used elsewhere, but, alas, not in Chicago itself.

"We're hoping against hope that the mayor and city council here will see the merit in the plan and act quickly to adopt it, or Chicago's architectural heritage may soon be something to be studied only in history books."

Along the lakefront rises the Gold Coast. In generations past this miles-long massif of



Change is changeless in Chicago, a city forever fixin' up and tearin' down. In a fast-renovating area on the north side, Jim and Donna Cook get into the spirit of things by "rehabbing" their row house.

The L, or elevated (facing page), still squeals around the Loop—defined by its tracks—but its downtown segment may be torn down and replaced by a subway.



Mowing 'em down, Mike Royko pitches for a local semipro 16-inch softball team when not hurling fastballs at the city "Machine" as a Pulitzer Prize-winning Chicago newspaper columnist.

luxury living was a fashionable pleasuring ground for many of Chicago's great families like the Potter Palmers and the Swifts, the Montgomery Wards and the Armours, the Kimballs and the McCormicks. Most of the elegant old mansions have given way now to glassy high-rise condominiums where the well-to-do of today—those who haven't fled to the suburbs (or those who have fled and returned)—turn their faces away from the smoke and rumble of the city to look out on the lake.

If this thin strip of Gold Coast is the city's upper crust, then what lies behind is the pie of Chicago itself. I mean, of course, the Neighborhoods—a proper noun hereabouts.

Fanning out on a horizon-to-horizon grid

from the lake, with bustling shopping strips every eight blocks or so, it's a crazy-quilt world. Here you find stylishly rehabilitated neighborhoods like Old Town or Hyde Park and, just a short distance away, decidedly unstylish and unrehabilitated neighborhoods brooded over by some of the country's grimmest low-income housing projects: streets that look as if they've been bombed out by arson and slum clearance.

People live in these neighborhoods, too, of course—most of them blacks, but also many Hispanics and poor whites. Since 1950 the city's black population alone has grown from 500,000 to 1,200,000. The number of blacks today is approaching the number of non-Hispanic whites.

Chicago Hub of Black Culture

"Many people overlook the tremendous contributions of black Chicagoans to American culture," publisher John H. Johnson told me during a visit to his office on South Michigan Avenue (page 465). One of the most successful black businessmen in the United States, Johnson publishes *Ebony* and *Jet* magazines and a distinguished line of books on black subjects.

"Think of the field of literature, not to mention jazz and entertainment," he pointed out. "Chicago's been the home base for black writers like Richard Wright, author of *Native Son*; Willard Motley, author of *Knock on Any Door*; Gwendolyn Brooks, the Pulitzer Prize-winning poet; playwright Lorraine Hansberry, author of *Raisin in the Sun*; and many, many others. The black people of this city have a right to be tremendously proud of their contributions to the nation's culture."

I step into the main mosque of the World Community of Al-Islam in the West—formerly known as the Nation of Islam, or, more popularly, the Black Muslims. The group, which numbers heavyweight champion Muhammad Ali among its members, has its national headquarters here in Chicago.

Upon entering, one passes through a metal detector booth like those used in airports. A bit unnerving, perhaps—but, once inside, a palpable spiritual peace prevails.

At the pulpit stands the chief imam, Wallace D. Muhammad, whose late father, Elijah Muhammad, once preached a harsh anti-white, black-separatist philosophy. Today

things have changed radically; I heard a different message coming from the pulpit.

Wallace Muhammad poises lightly on his feet, not unlike a graceful boxer himself.

"God created night and day!" he proclaims.

"Yessir!" the congregation responds.

"And God—Allah—He created black and white, too!"

"Yessir!"

"Now, don't you see, brothers and sisters, we need day and night just as we also need black and white?"

"Yessir! Yessir!"

He preaches in similar vein for nearly an hour. Afterward, a young Muslim man comes up to me and shakes my hand vigorously.

"You know," he says, "a couple of years ago I would not have spoken to you, a white man, or shaken your hand. But now we welcome white members to the community."

He introduces me to his young children, a boy and a girl. I remark that my own children, Mark and Elisa, are about the same ages as his. He smiles and hands me a coloring book entitled "Muslim Children Prayer and Coloring Book."

"Two peoples," he says. "One God."

We shake hands once more and I walk out of the mosque. Enriched.

Neighborhoods an Ethnic Hodgepodge

Stepping past an alleyway in a northwest-side, mixed-ethnic area, I look up to a third-story back porch and witness one of the minor dramas of Neighborhood life.

A matron stands at the porch railing and calls across the alley to an Oriental man putting out his garbage on the porch opposite.

"Oh, Mr. Nakopoda!" she calls, "yoo-hoo, over here, it's me, Mrs. Bernstein again! About the noise—I mean your son's electric guitar—I don't want to be obnoxious, Mr. Nakopoda, but do you remember what we talked about last time? It's Shabbos, you know—the Sabbath. I have to light the candles and say the Sabbath prayer. The noise—" she pauses as a loud electronic twang ripples unchallenged over the rooftops—"do you think, Mr. Nakopoda, that your son could stop practicing his guitar for a while, maybe take a walk down Devon Avenue for twenty minutes or something. . . ?"

I walk on, scenes from Neighborhood life playing around me like clips of film.



"Mr. Cub": Towering in Chicago affections as his long drives once towered over the ivied walls of Wrigley Field, slugger Ernie Banks—512 lifetime homers—recently was voted into baseball's Hall of Fame.

Stopping by a tavern called Schaller's Pump on St. Patrick's Day night, I share the revelry of the local crowd from Bridgeport—the predominantly Irish neighborhood whose tough but tidy streets have sired every mayor of Chicago for nearly half a century.

Across South Halsted Street stands the plain-looking storefront headquarters of the 11th Ward Democratic Party, key bastion of the political apparatus commonly called the "Machine."

"We prefer the word 'Organization,'" a Bridgeport native informs me. He shoves a mug of bright green beer into my hand and corners me between a coatrack and a jukebox to propound the virtues of Chicago-style machine politics.

"I am somebody!" Raising fists of black aspiration, members of Operation PUSH (People United to Save Humanity) recite a "litany of personhood" inspired by Chicago-based national leader Jesse Jackson. His message: "Have pride in what you are! Excel at what you do! *You are somebody!*"



"Now, look, I ask you, is a little bit of organization necessarily a bad thing? Say that Mrs. Grundy ain't getting any hot water from her landlord. Is she better off trying to make her gripe through some impersonal bureaucracy downtown or by going around the corner and talking to her alderman, who knows her first name?

"OK, so if her son also has to go to the same alderman to get a recommendation for a city job, is there something wrong with *that*? Machine politics actually means *personal* politics. It's a matter of people who know each other helping each other out. You vote for me,

and me and the Organization see to you and your needs. That's the essence of democracy, ain't it?"

Bridgeport Youth Made Big Time

For 22 years Bridgeport residents looked on with pride whenever a long black limousine slid by carrying Hizzoner, Mayor Daley, to and from his modest home on Lowe Avenue. The limousine bore the license plate 708 222—the number of votes Daley tallied in his first mayoral victory in 1955.

Daley never abandoned his roots in Bridgeport. Nor has his successor, Mayor Michael



A. Bilandic (page 466), who, like Daley before him, made his way up through the 11th Ward to the city's top job. Of Croatian ancestry, Bilandic has proved that you don't have to be Irish to become Hizzoner (though it helps).

To the new mayor—who won a special election in June 1977 to finish out Daley's sixth four-year term, ending April 1979—falls the task of steering the city through times of extraordinary difficulty. Charges of public corruption—nothing new in the politics of Chicago—have been rocking the city in recent months.

Daley's charismatic power to hold together the city's delicately balanced coalition of interests was not something that could be automatically passed on to a political heir.

And even more basic problems loom: Whites continue migrating in alarming numbers to the suburbs, where more than half the metropolitan area's 7,000,000 residents now live. Those left behind are increasingly on welfare rolls (one family in five, compared to one in eight in New York City).

Industries, too, are departing Chicago for more profitable areas, further eroding the city's tax base. Racial tension troubles a





"That toddling town": Zorine's, a disco club for members only (left), rates as one of Chicago's most fashionable after-hours "in" spots. Here the city's B. P.—"Beautiful People"—come to see and be seen.

Things are less posh but no less lively at local pubs like Schaller's Pump (above) in Bridgeport—the blue-collar, largely Irish neighborhood that has produced every mayor of Chicago since 1933.

school system that grapples with desegregation. Crime, both the organized and street varieties, remains a formidable problem.

"It's not as if Mayor Bilandic, or Mayor Daley before him, could simply snap his fingers and solve these problems," points out urbanologist Pierre de Vise of the University of Illinois's Chicago Circle campus.

"The simple fact is, the suburbs have the space for the kind of sprawling one-story industrial plants that modern industry requires; the city doesn't. The sun belt in the Deep South has the lower wage structure that industries prefer. Plus they don't have the kind of congestion you have to contend with in Chicago.

Tax System Hides the Red Ink

"To be sure, Chicago remains the City That Works—if you're referring to the fact that the city government has not been going deeply into the red like New York. But that's partly because of the way Chicago's tax structure is set up.

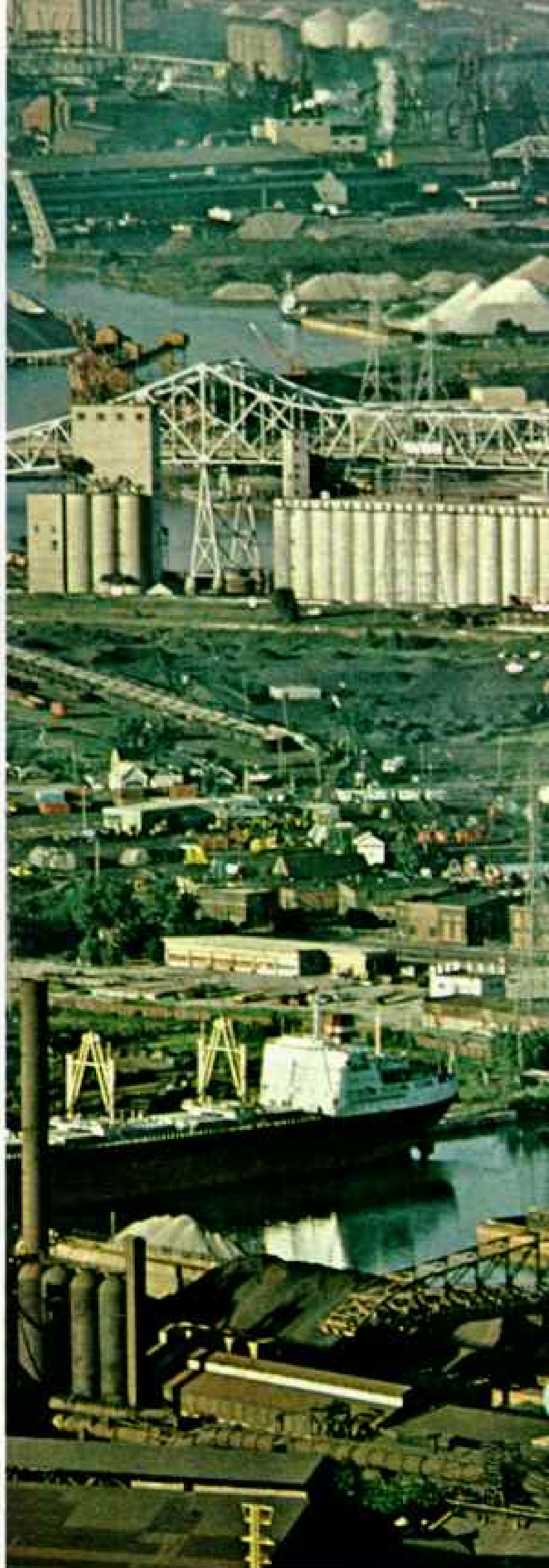
"The city government proper accounts for only a third of all municipal expenditures. The other two-thirds are accounted for by other tax agencies for schools, the transit system, parks, and so on. It's true that the city government proper has managed to stay in the black, but some of the other agencies have operated in bright red.

"What's more, Chicago doesn't have to pay directly for its own welfare costs—that's shared by the state and federal governments. In New York, the city itself pays directly for 25 percent of welfare costs. So, you see, it's as much a matter of complex bookkeeping as of efficient administration that helps make Chicago 'work.'

"We're dealing here with problems that transcend the ability of any one mayor or political party to overcome, problems faced by every big city in the country. No slogan can change that."

Mike Royko's Pulitzer Prize-winning column in the *Chicago Daily News* for years has alternated between delightful whimsy and

Industrial muscle flexes by the winding Calumet River on Chicago's far south side. The industrial colossus sprawls across city and state lines into northwest Indiana.





hard-punching political articles, body blows to the local political establishment. Mike, a *Daily News* ad once said, "comforts the afflicted and afflicts the comfortable."

"The Machine," he explained to me, "has survived in Chicago in good part because of the city's ethnic base. Find an ethnic group and you find a handle for delivering the vote. Deliver the vote and you've got the power. Then use the power to dole out jobs and favors to ensure that you keep getting the votes.

"But the price you pay is that you abandon participatory democracy. As a result of a 1972 court case, which challenged the whole patronage system for city jobs, city workers cannot be required to perform political work as a condition of employment. Maybe the handwriting's on the wall for the Machine. Then again, maybe not."

When he's not mowing down politicians, Mike pitches fancy slow balls for a local 16-inch softball team (page 484). And here, too, his instincts for right and justice prevail.

"Chicago's the home of the 16-inch ball, you

know. Most people elsewhere hardly know what a 16-inch softball is—they mistake it for a cantaloupe.

"When the city park district a while back decided to allow players in their leagues to use gloves like they do in hardball or 12-inch softball, I had to object. This is a barehanded game or it's no game at all. Tampering with the purity of our municipal sport was going too far. I filed suit in court, and they got rid of the gloves. If I'm remembered by future generations, maybe it'll be for that.

"Say, we've got a guy playing here today, name of Benny Holt, who's put major-league home-run hitters to shame in contests using the 16-inch ball. Benny's fly ball has been tape measured at 380 feet—and, remember, it's twice as heavy as a 9-inch hardball."

And so, should you happen to be in Chicago some summer evening and look up to see a full, fat moon—that may not be the moon at all you're seeing, but a full, fat 16-inch softball traveling east toward Pittsburgh off the legendary bat of Benny Holt.

"Subway Series" Still a Dream

I return to my lemon-yellow bench at Fullerton Avenue beach to continue my observations of the phenomenon of Chicago. Suddenly, among the sunbathers on the sand, a cheer goes up. Transistor radios announce that both the Cubs and the White Sox have won their games today and remain in first place in their respective divisions this early August.

Everyone is talking about a "subway series"—the first intracity World Series here since 1906. Oh, I know, I know . . . hard experience tells me that both Chicago teams will slide into their accustomed oblivion in the standings by September. But hope springs eternal . . .

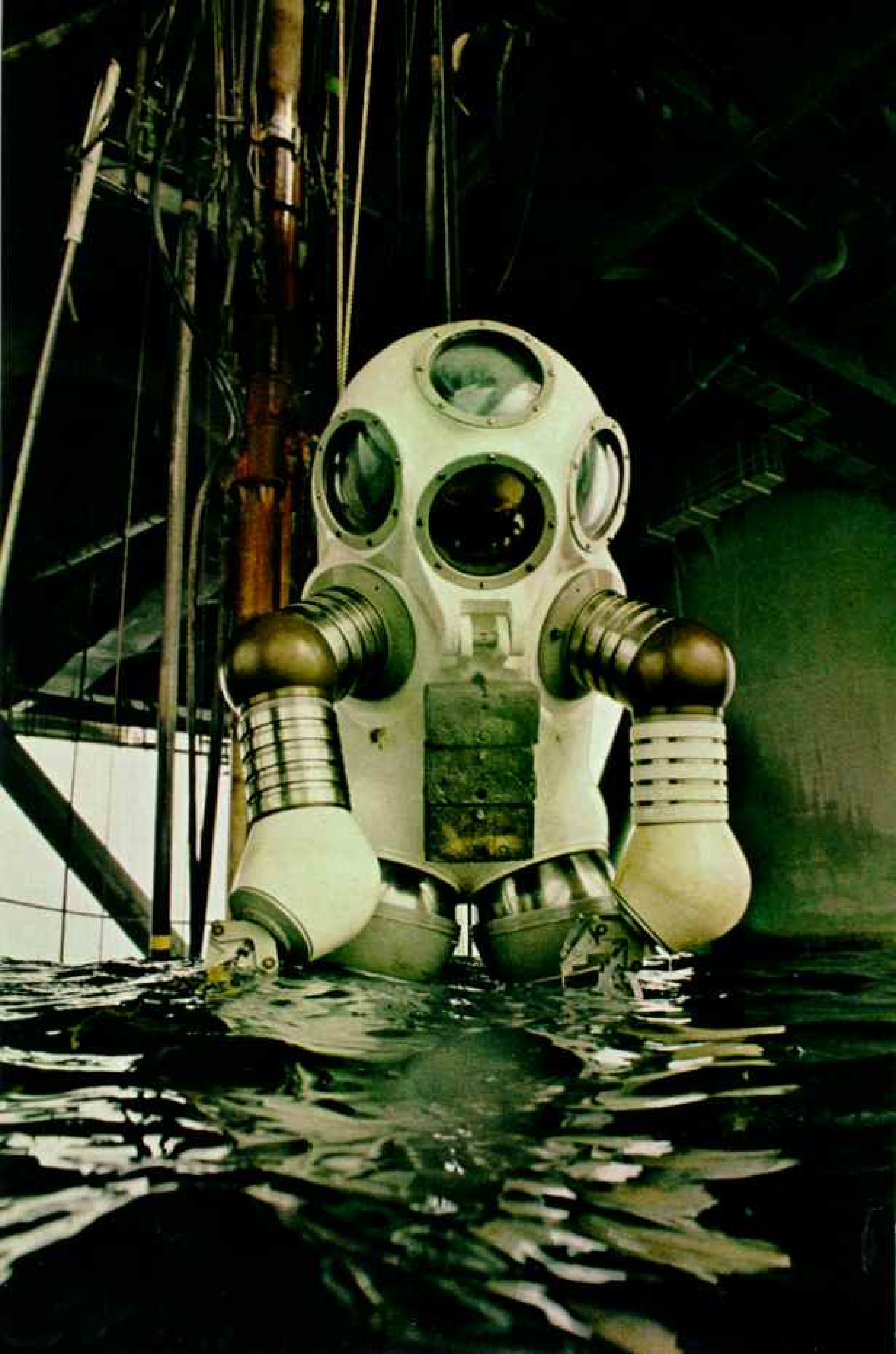
And why not? This has always been a city of optimism, of belief in itself and in America. It's not for nothing that Chicago has been called the "All-American City." For here, in this great urban crucible, a nation in flux is working out its problems, continually separating out the gold from the dross in its system. Here the passions and triumphs and agonies of a people are on display, unconcealed, writ large for all to see.

And, oh, yes, if anyone happens to ask you, be sure to tell them . . . America is alive and well, and living in Chicago. □



Axis of aviation, O'Hare International, handling 44 million passengers a year, is the world's busiest airport. Keeping track of 2,000 takeoffs and landings a day can be an ulcer-inducing job for air-traffic controllers such as this trainee. Hub of mid-America, Chicago maintains its historic role as the nation's transportation center—its influence radiating for thousands of miles.





THE CONTINENTAL SHELF

Man's New Frontier

By LUIS MARDEN

Photographs by
IRA BLOCK

IT IS a soft and gentle land, softly lighted and gently contoured, though cold and alien. Even at high noon the dim green sun is pale and distant. A rain of minute particles falls endlessly, mantling the silent plains and valleys with a thick blanket of sediment.

This is the drowned continental shelf, ten million square miles of undiscovered country, the new frontier of earthbound man.

In 1818 the poet Byron could write:

*Man marks the earth with ruin—
his control
Stops at the shore.*

One hundred and twenty-seven years later a stroke of the pen breached the boundary of man's domination—and sometime spoliation—of his planet. On September 28, 1945, in an executive order forgotten by most of his countrymen but noted as a landmark decision by historians of the sea, that remarkably farsighted man, President Harry S. Truman, stated: "...the natural resources... of the

continental shelf beneath the high seas but contiguous to the coast of the United States [are] declared... to appertain to the United States and subject to its jurisdiction and control..."

This nation had declared dominion over land beneath the sea, but the world had to wait another generation for the tools and techniques that would enable man to exploit what he had claimed.

Unrestrained growth of population and dwindling resources of space, food, and energy on land inexorably force mankind to look seaward. The platform of submerged land rimming the world's landmasses, a flat expanse the size of Europe and South America put together, holds 90 percent of the earth's fish resources and probably comparable stores of undiscovered oil and gas.

The food and energy are there, to be taken with travail, but the cost grows less important as man proliferates on his planet. We must go down to the sea, ever deeper and ever more hungrily. *(Continued on page 502)*

Armored for inner space, a diver begins a 600-foot descent to retrieve oil-rig equipment dropped into the Gulf of Alaska. His suit, dubbed Jim after the diver who first tested it, enables him to work at depths as great as 1,500 feet. Using such suits, submarines, underwater habitats, and innovative methods of deep scuba diving, man grows increasingly familiar with the continental shelf, a treasure-house of food and minerals.

A crowded earth looks to the shelf

IN A WORLD hard pressed by mushrooming populations and dwindling resources, the continental shelves beckon like promised lands. Built by eroded soil and the remains of countless sea

creatures and plants, they stretch beyond the shores of every continent and cover an area almost one-fifth as large as earth's dry land. Beneath the shelves lie great untapped reserves of oil and gas. Above them swim 90 percent of the fish we eat. Today the promise of the shelves is being explored, as man launches bold new ventures in search of the food and fuel they hold in such abundance.

From ancient times the vessels of maritime commerce have crossed the shelves. Many made



their final stop upon the bottom, leaving cargoes of treasure still awaiting discovery. Fishermen find their livelihood on the shelf; divers seek pearls upon its floor. Sailors with sounding lines long read its features as if by braille. But little was really known of the region until the tools of modern science penetrated the ocean's concealing blanket.

What is the portrait they paint? This look at the area off the northeastern coast of the United States shows one of the world's busiest sections of shelf.

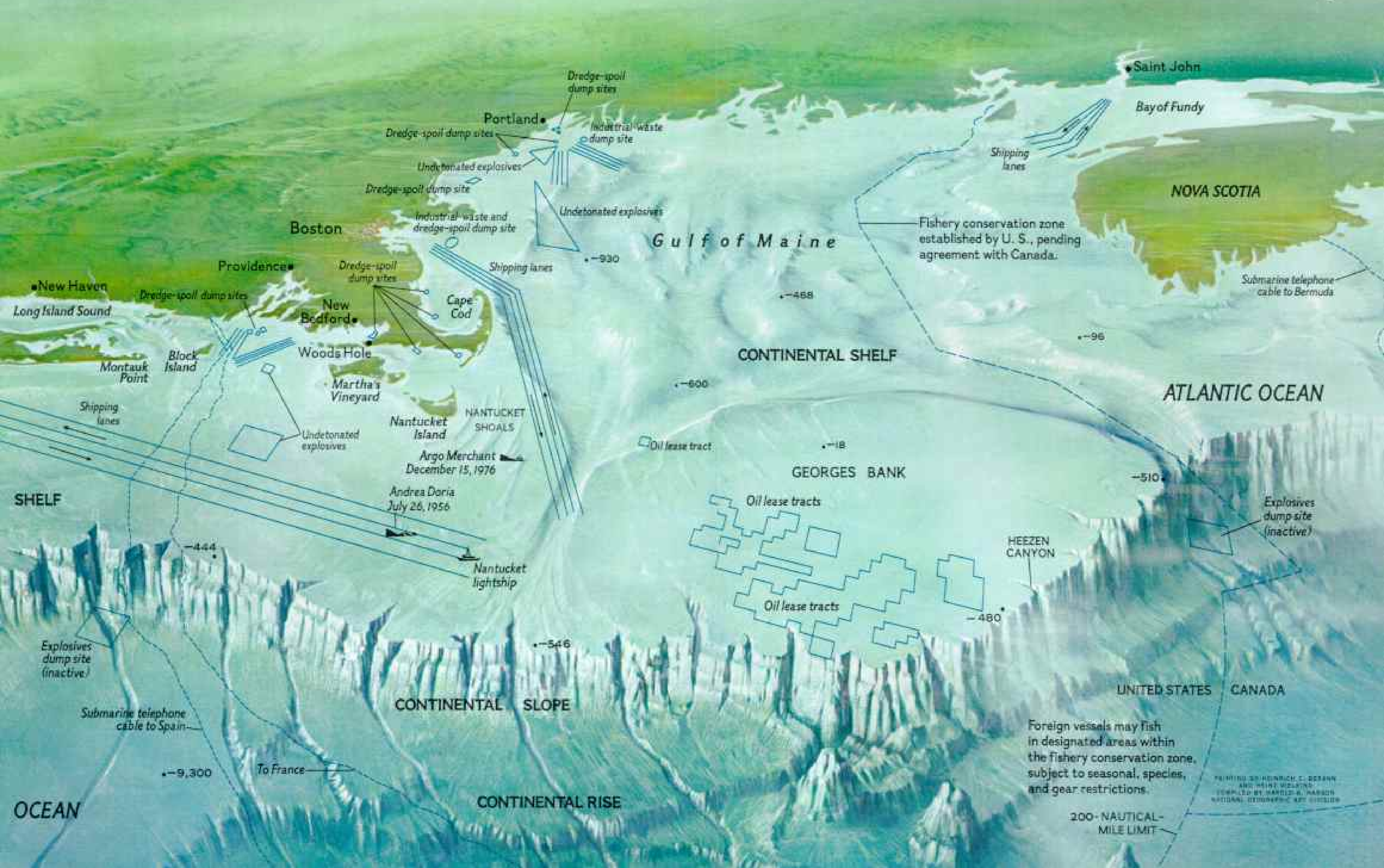
Ships funnel into crowded sea-lanes leading to and from the great ports of the Eastern Seaboard. Wrecks, sewage sludge, and undetonated military explosives litter the bottom, sometimes uncomfortably close to aquatic playgrounds for swimmers, surfers, sailors, and sport fishermen. Acids and other chemicals foul dumping sites both on the shelf itself and on the slope and rise that lie beyond it. The shelf is both used and abused, and the question now asked by citizens and scientists

alike is: At what cost will the riches of the shelf be obtained?

Geologic evidence pointing to what may be major oil and gas fields off the coasts of New Jersey and Cape Cod has brought a new urgency to the question. Environmental and civic groups have opposed plans for immediate development, fearing oil spills and other forms of pollution, as well as the buildup of onshore industry that would accompany large-scale

drilling. Some groups argue that exploration should be done by the U. S. Government rather than by private oil companies. Oilmen point to the expertise and experience required by the endeavor, and to the now-pressing need to develop new sources of fuel.

A court ruling in August 1977 validated the sale of lease tracts in the Baltimore Canyon area to 31 companies. Legal challenges continue, but drilling is scheduled to begin in 1978.



Foreign vessels may fish in designated areas within the fishery conservation zone, subject to seasonal, species, and gear restrictions.

PRINTED BY HEINRICH C. BOHANN AND HEINRICH BOHANN
 COMPILED BY HAROLD W. HARRIS
 NATIONAL GEOGRAPHIC ART STUDIO

200-NAUTICAL-MILE LIMIT



Food from the teeming land beyond

A BOUILLABAISSE of ocean delicacies draws its variety from far-flung shelf fisheries. The warm, shallow Gulf of Mexico swarms with shrimp (**bottom, right**), which bring in more money than any other species caught by U.S. fishermen. Cod, flounder (**middle, right**), and other bottom fish form the backbone of the New England fisheries. They are netted in great numbers on the flat banks where they live. Predators that gather to feed on them are caught by trawl, hook and line, and even, in the case of swordfish, by hand-thrown harpoon. American lobsters (**bottom, left**) thrive abundantly in canyons on the edge of the northwestern Atlantic shelf, where they are trapped in lobster pots. They are also caught on rocky bottoms closer to shore.

Future fisheries may take a different direction, if scientists succeed in developing new methods of farming the sea. In an experiment in abalone culture, a cage (**left**), suspended in a cloud of rockfish beneath an oil production platform in California's Santa Barbara Channel, houses 250 red abalone. Two thousand young spawned in tanks ashore were transferred to several such cages after growing to 50 to 75 millimeters (**right**). There they mature and fatten on chopped kelp. The project, conducted by California Marine Associates and Atlantic Richfield Company, may make commercial production possible. As a side benefit, spawn from caged adults may replenish stocks on nearby rocky bottoms.

Even without scientists' help, mobile drilling rigs like one in the Gulf of Mexico (**top**) provide a habitat for many marine creatures. Mussels grow thickly on their submerged legs, and fish of all sorts congregate there for both shelter and food.



BOB EVANS, LA MER BLEU (SPACING PAGE AND CENTER LEFT); WILLIAM W. CURTIS (CENTER RIGHT); RICHARD COOPER (LOWER LEFT)



(Continued from page 495) There are no new sources of energy. Whatever they are—sun, wind, water, coal, oil, the atom—what we seek are new ways of tapping them and yet undiscovered deposits. In this search the continental shelf beckons like the New World before the caravels of the discoverers—fraught with dangers, some known and some unknown, but we must brave them.

VAST AREAS of continental shelf fringe the United States, as in the Gulf of Alaska, along the Pacific Coast, and in the Beaufort Sea. But in my investigation I took the shelf along the east coast of North America as my paradigm (map, pages 510-11). The world's most highly industrialized, hence most energy-hungry, nations surround the North Atlantic, and it is here that the first major steps toward exploitation of the shelf are being taken.

At Woods Hole Oceanographic Institution in Massachusetts I talked with the eminent geologist Dr. Kenneth O. Emery.

"Hydrographers conventionally use a depth of 600 feet, and lawmakers 200 meters, as the outer limit of the continental shelf," he said, "but actually it varies greatly both in width and in depth. On the Atlantic Coast the depths range from about 10 meters to 150 meters, but the average worldwide is about 130 meters. The width also varies from only five

miles to more than 800 miles, off Siberia."

The geological definition of the shelf's limit, Dr. Emery said, is the drop-off line, the point where the seabed steepens into the continental slope, to fall to the lesser incline of the continental rise, thence to the great depths of the abyssal plains, which are 5,000 meters (16,400 feet) deep on the average.

How were continental shelves formed?

"Geologists now agree that the continents are masses of light—if you can call granite light—rock floating on denser basalt. About 200 million years ago there was only one great landmass in the primeval sea. Perhaps about 180 million years ago that proto-continent began to break up, and Africa, North America, and later Europe, drifted apart.*

"With this separation, rivers could now bring sediments down to the sea at the newly formed edges of the landmasses. This was the beginning of the buildup of the continental shelves, which are merely prisms, or wedges, of detritus and sediment covering a granite base [diagram, page 511]. Glaciers that covered the northern portions of the continents also brought sand, gravel, and boulders to the shelves.

"In the Pleistocene glaciation that peaked in North America only 18,000 years ago, the sea level was some 100 meters lower than it is

* "This Changing Earth," by Samuel W. Matthews, appeared in the January 1973 NATIONAL GEOGRAPHIC.

To help fight pollution, scientists study the interface, or contact point, of two kinds of water. As the tide flows out in Florida's Destin Inlet, warmer, darker river water encounters the denser, clearer water of the Gulf of Mexico. In an experiment, purple dye is dropped on both sides of the "front." On the Gulf side it remains fairly stationary, but on the river side it is driven underwater and streams backward, at right. Such resistance between the waters could slow an oil slick headed for shore. Conversely, it could delay onshore pollution from spreading into the open ocean.

COASTAL STUDIES INSTITUTE, LOUISIANA STATE UNIVERSITY



now," Dr. Emery continued. He held up a yellowed piece of ivory. "Much of the shelf on the Atlantic side of North America was exposed. We have found mammoth teeth and giant sloth bones 90 meters down, as well as peat that contains grasses, pollen, and twigs."

IF THE SHELVES are part of each continent, who owns them? The Truman declaration back in 1945 settled that for the United States, with regard to resources on or under the seabed, but when you talk of what the lawyers call the superjacent, or overlying, waters, you open a can of sea serpents.

There is no legal precedent for some questions raised by "ownership" of the sea, but the real storm of controversy arises because exploitation of the sea and seabed concerns the most fundamental of human instincts: survival. While the earth continues to shrink, so far as its inhabitants are concerned, conferences on law of the sea continue to find more difference than agreement.

John Donne, writing in the early 17th century, said: "If a Clod bee washed away by the Sea, Europe is the lesse. . . ."

Europe, and all the other continents, now want that clod back.

In 1958 the United Nations convened the first Conference on the Law of the Sea, in Geneva. Delegates representing 86 countries agreed that coastal nations control the seabed

resources of their adjacent shelves, and added that they might exploit resources beyond the 200-meter depth where feasible. Burgeoning technology, however, promised to enable man to work so far beyond that limit that some states objected, and until all members agree on all questions, treaties signed do not yet have the status of law.

The second conference, meeting in 1960, did not resolve the question of how far beyond the 200-meter depth nations might claim jurisdiction. Nor did the recent third conference, which met in New York and Caracas, Venezuela, settle the matter. Arguments continue over exploitation of minerals on the floor of the abyss, in international waters.

Meanwhile, there is wide acceptance of a territorial sea of 12 nautical miles from shore and an "economic zone" of 200 nautical miles.

EVEN BEFORE they named Columbus admiral of it, the Spaniards knew our planet had only one body of salt water, the Ocean Sea. But down the ages men have named segments of the world ocean to suit their fancies and their needs, linking ownership to the lands the seas bathed. Did not Julius Caesar call the Mediterranean Mare Nostrum—Our Sea?

After the defeat of the Spanish Armada in 1588, England became the world's leading sea power. In 1604 King James I claimed most

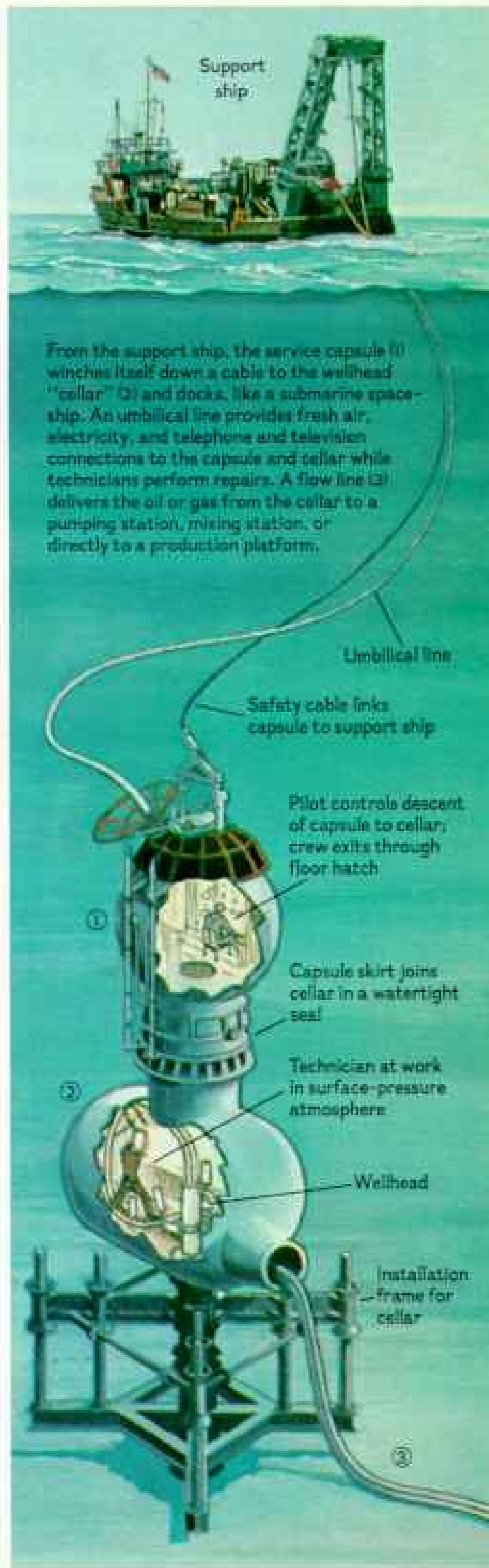




Working dry in the depths

AS THE ENERGY SQUEEZE tightens, new technology produces offshore oil in deeper and deeper water. On the shelf, undersea production platforms rise to great heights; one even rivals the Empire State Building. Costs skyrocket as do dangers to divers who repair equipment. One alternative is a system (right) developed by Lockheed Petroleum Services Ltd. To use it, oilmen drill a well and top it with a dry chamber, or "cellar," that allows them to make repairs in shirt-sleeve conditions after being delivered by a deep-sea "elevator"—a service capsule.

Off Houma, Louisiana, a capsule (left) is readied aboard a support ship for its descent to a cellar 100 feet below. Carrying a crew of four, the capsule docks with the cellar, where technicians (below) adjust equipment controlling the flow of oil. This cellar, connected to a production platform, is one of seven in the Gulf of Mexico. Less expensive than platforms, which can cost more than 100 million dollars, cellars can be put into operation quickly, especially in water too deep for platforms.





JUSTIN S. PATTON



Where German U-boats failed, fisheries scientists succeed, as 642 pounds of plastic explosives sink the World War II Liberty ship *Edgar E. Clark* (left) off Cape Henry, Virginia. The vessel that once hauled aircraft and tanks slides toward the bottom (below) to join three other ships as part of an artificial reef designed to increase marine life. Mussels growing on the wrecks are relished by sea bass and tautog; eventually, fishermen hope, the new reefs will draw big billfish like marlin. Similar projects dot the continental shelf off North Carolina, Georgia, Florida, Texas, and California.

of the waters round Great Britain, cozily calling them the King's Chambers. Other nations staked even more grandiose preserves: Sweden the Baltic, Portugal the southeastern Atlantic and Indian Ocean, and Spain the western Atlantic and most of the Pacific.

The Dutch, refusing to accept Portugal's hegemony, challenged the claims.

IN 1608 Hugo Grotius, Dutch jurist and statesman, published *Mare Liberum—Freedom of the Seas*—in which he argued eloquently for the right of all mankind to free passage and use of the seas. In words that might have been written for today's law of the sea conferences, he said: "... water ... is classed by the jurists among the things common to all ... Ovid [said]: 'Why do you deny me water? Its use is free to all. Nature has made neither sun nor air nor waves private property; they are public gifts.' ... the sea seems by nature to resist ownership."

Despite the eloquence, maritime states clung to claims on adjacent waters. Thomas Jefferson proposed in 1793 to warring Britain and France that American neutrality be respected within the "range of a cannon ball, usually stated as one sea-league"—three nautical miles. Later, most maritime nations claimed exclusive fishing rights 12 miles from shore. After World War II, in a move against the U. S. tuna-fishing fleet, countries bordering the fish-rich Peru, or Humboldt, Current on the west coast of South America

said their sovereignty reached out 200 miles.

With conferences on the law of the sea finding little agreement, the U.S. Congress passed a law making a unilateral claim of fishing rights (although not sovereignty) to 200 miles from the low-water mark. By this act, effective March 1, 1977, the United States joined 36 other countries of the world.

ALTHOUGH MOST nations now accept a 200-mile zone in one form or another, mining or drilling of the seabed is another matter. According to the 1958 conference, islands, like continents, have shelves. If so, then a nation like Greece, sovereign of a host of islands in the Aegean, could draw overlapping circles around islands of the archipelago and claim exclusive exploitation rights to an entire seabed.

When President Truman annexed the seabed resources of the American continental shelf for the United States, most nations viewed the declaration only as a legal curiosity, but recent discoveries of huge quantities of oil offshore soon made others scramble to follow suit. Already more than 50 billion dollars is invested in the world's offshore oil and gas industry, which supplies nearly 20 percent of the world's oil.

Dr. Emery had said:

"There is far more oil to be found under the sea than on land. Because wherever you find oil, even under a desert, must once have been sea bottom. Petroleum is formed mainly from the remains of marine plants.

"We still do not know the precise process of oil formation, but we have a general idea. You must have organically rich layers of microlife deposited as sediment in an oxygen-free environment. If the first fine-grained sediments are covered by other layers and so are oxygen starved, or if they fall in deep water that has little oxygen, only the anaerobic bacteria can survive. These, with heat and pressure, over the eons somehow turn this organic rain into oil. The oil is most likely to be found in sediments two to three kilometers—two *miles*—thick."

What else can we hope to find on the shelves?

"Oil and gas are so far ahead that, economically, hardly anything else is worth mentioning. Second in importance is something unglamorous, construction sand and gravel,

which is dredged up off our East Coast as well as off Britain. The Thais mine tin off their shores, the Nova Scotians tunnel out from shore to dig coal.

"The total value of all mineral resources exploited last year on the shelves is around 70 billion dollars. Of this, nearly all is in oil and gas, almost four times the value of the fisheries. The disproportion will grow as we discover more oil."

A British oilman had told me:

"The future of the world's oil industry lies underwater. We're never going to find another Middle East on land. Right now we can drill in 6,000 feet of water. Seismic exploration goes much faster on water—it's flat, and there are no obstructions."

THERE MAY BE as much as four billion barrels of oil and 14 trillion cubic feet of gas under the continental shelf of the U. S. Atlantic Coast. In the end, only actual drilling will determine how much, but the oil companies are willing to gamble on information they already have gathered.

On August 17, 1976, the United States Department of the Interior auctioned off the first underwater oil leases on the Atlantic Coast. Thirty-one oil companies paid 1.1 billion dollars for 93 tracts off the coasts of New Jersey and Delaware, in the Baltimore Canyon area (map, pages 496-8).

Recently, the Interior Department announced that 136 more tracts in the same area would go on sale in February 1979.

Conservationists fought a lengthy legal battle, but a court order last August opened the way to exploratory drilling, and the Environmental Protection Agency granted permits to ten oil companies in late November. It was clear, however, that the beginning of drilling would not mean the end of debate.

Biologist Keith Hay, conservation director for the American Petroleum Institute, says:

"To an oilman conservation means one thing: getting as much oil as possible out of a stratum. Using conventional methods, we take about 35 percent of the oil from a deposit. That's the easy oil; a lot remains, and we are increasingly concerned about getting it.

"In the 1960's, even before the youngsters discovered ecology, the major oil companies joined to form a conservation committee. They could see (Continued on page 514)





Roving factories scour the sea

WHOLESALE harvesters far from home haul a netful of redfish over the stern of the West German trawler *München* in the Gulf of Maine. Vessels from ten nations hunt herring, hake, mackerel, and many other species on the grounds off North America. Ships capable of landing and carrying large catches are essential to these long-range operations.

The West German factory ship *Scrombrus* (far left, below) stays at sea many months, catching and processing up to 1,000 tons of fish on each trip. Banks of electronic equipment surrounding Capt. Paul Martin Joswig on the bridge (left, below) track schooling fish far below the surface. Once netted and brought aboard, the fish are cleaned, filleted (center, below), and frozen for the return trip.

Such devastating techniques have severely depleted stocks of many species. To control overfishing, the United States declared all waters within 200 nautical miles of its shores to be under Government jurisdiction as of March 1, 1977, and set quotas for leading food fishes. Some stocks appear to be reviving, but years are needed to build healthy populations at all stages of growth.

ALL BY LEROY WOODS, JR.



Eastern shelf spreads a feast of life

0 KILOMETERS 400
0 STATUTE MILES 400

Scale at middle of map
 • -394 Depth in feet below sea level
 Fishery conservation zone established by U. S., pending agreement with neighboring countries.

PAINTING BY HEINRICH C. BERATH AND HERB VEEHARDT
 COMPILED BY ROSE W. SMITHSON NATIONAL GEOGRAPHIC DIVISION



Sewage, chemicals, and debris foul the New York Bight, probably the most heavily polluted area on this shelf.

Preliminary exploration indicates possible oil deposits in the Baltimore Canyon area. Drilling on lease sites is expected in 1978. Other fields may be found on the Georges Bank.

Seismic studies of the Blake Plateau and Southeast Georgia Embayment show deep sediments that could contain oil, but results of preliminary exploration have been discouraging.

Thousands of wells in the Gulf of Mexico pump oil and gas from the most productive offshore fields around North America.

GULF OF ST. LAWRENCE

CONTINENTAL SHELF -228

BROWNS BANK

GEORGES BANK

Boston

Saint John

Long Island

New York

HUDSON CANYON

BALTIMORE CANYON

GULF STREAM

FISHERY LIMITS (BERMUDA)

Washington

Cape Hatteras

-17,400 HATTERAS ABYSSAL PLAIN

OUTER RIDGE

FISHERY CONSERVATION ZONE (U. S.)

BLAKE PLATEAU -3,600

FISHERY ZONE (BAHAMAS)

Bahama Islands

-18,150

MISSISSIPPI

New Orleans

Miami

CONTINENTAL SHELF -120

GULF OF MEXICO

MISSISSIPPI CONE

ECONOMIC ZONE (CUBA)

Havana

Cuba

NORTH

Cold plankton-rich Arctic currents meet the warm Gulf Stream off the Atlantic banks, helping to make them some of the world's richest fishing grounds.

GRAND BANKS OF NEWFOUNDLAND

SHelf

Sable Island

FISHING ZONE (CANADA)

SOHM ABYSSAL PLAIN

ATLANTIC OCEAN

Bermuda Islands

200-NAUTICAL-MILE LIMIT

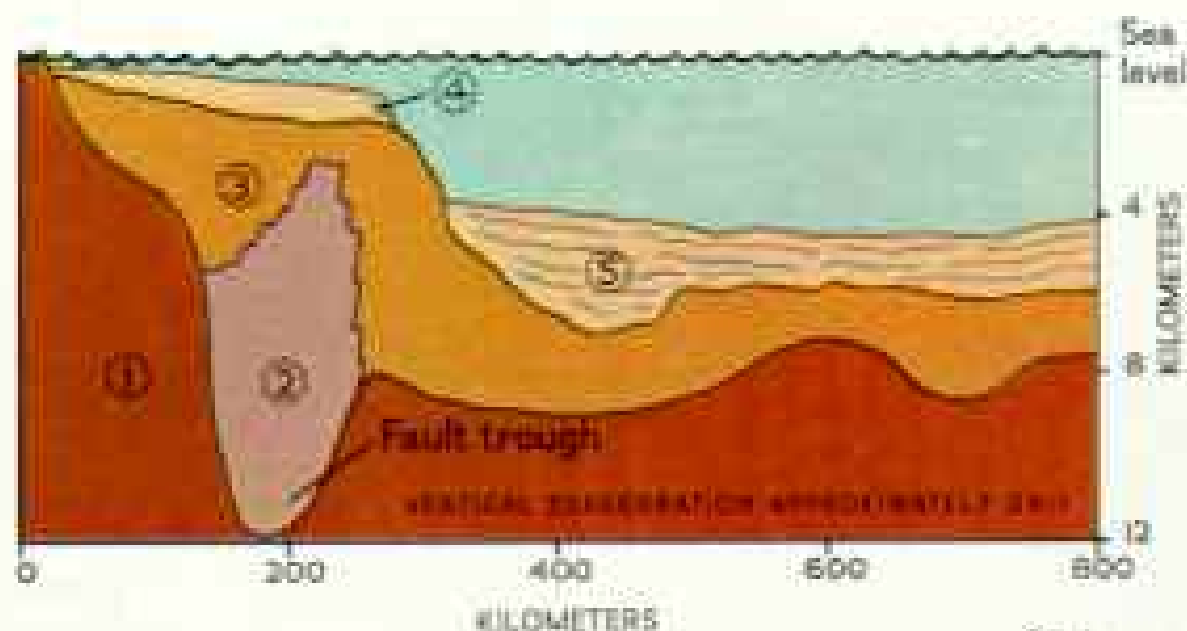
11,324 METERS ATLANTIC'S DEEPEST POINT

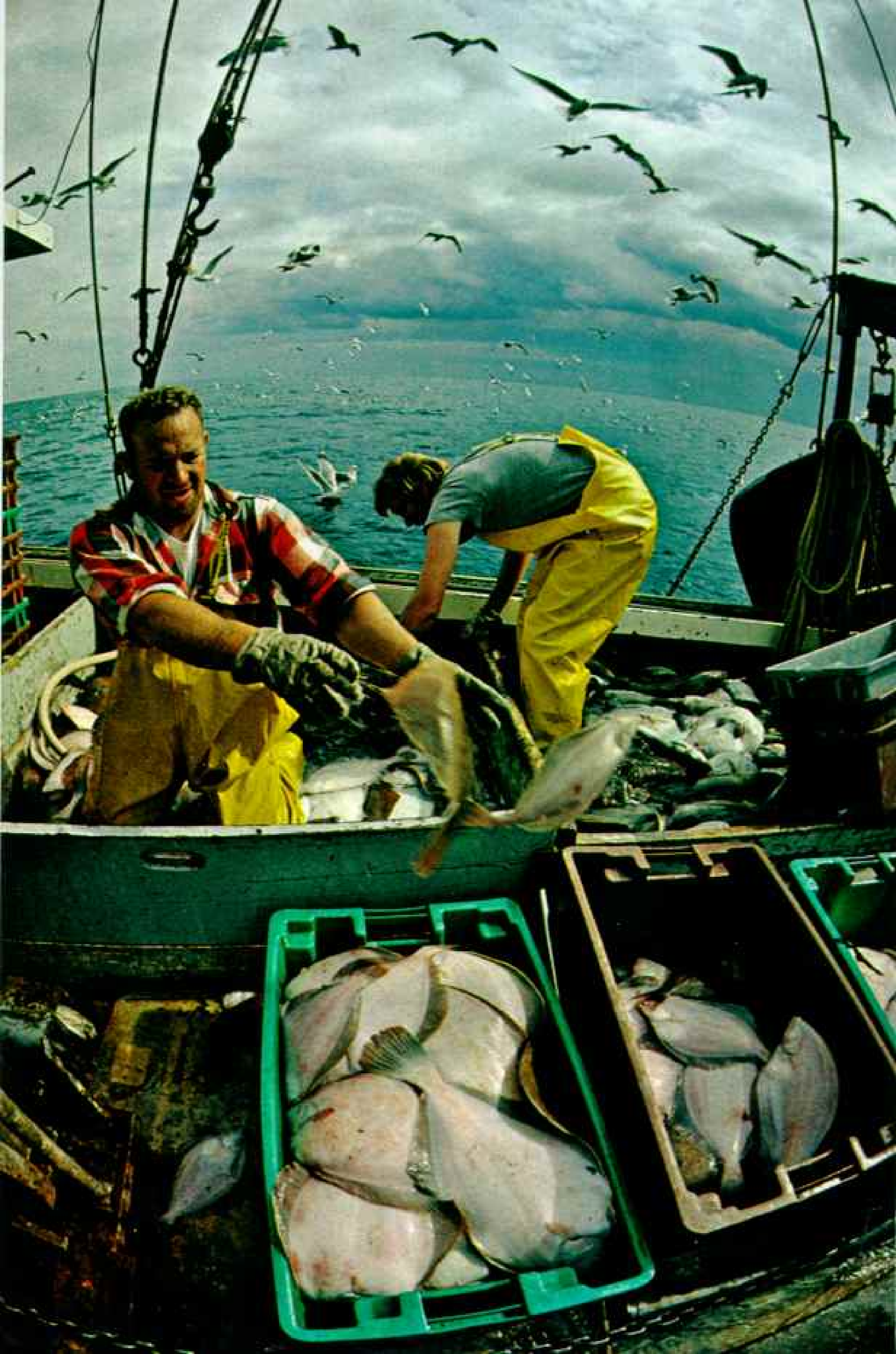
LIKE FRUITFUL UPLANDS beside a barren desert, the shelf's fertile shallows border the Atlantic's abyssal wastes. The waters above them nourish the multitudes of microscopic plants that form the base of the marine food chain, which finds a plentiful supply of the two elements vital to survival: food and light.

The shelf generally lies within 130 meters of the ocean's surface, an area shallow enough to admit the sun's life-giving rays. Currents welling up from the deep and outflow from rivers carry nutrients to this zone, which is further enriched by nutrients stirred from the shelf by waves and currents. Where this mixture nourishes the greatest concentrations of plankton, as on the Atlantic fishing grounds, there, too, gather the greatest numbers of fish and other creatures that feed on the broth.

Even as the shelf incubates life, its own richness is renewed in a cyclical balance by a fine rain of organic matter from the water above. A great deal stays on the bottom, to be buried later by sediments. If early layers are cut off from oxygen in the water before they decompose, then the first condition has been met for transformation into oil.

The great width of the Atlantic shelf results from events that began 180 million years ago. The primordial landmass that then united all dry land on earth cracked and divided along great rifts, and today's continents began to drift apart. When North America moved away from the area of seismic stress, the base rocks (1) (diagram, below) contained a trough that may have resulted from faulting, but it long ago filled with sediment (2). Later sediments accumulated undisturbed in a thick wedge (3) that spread far out to sea, eventually burying a coral reef that grew above the seaward edge of the trough. The youngest and uppermost sediments on the shelf (4) were planed down by waves and weathering when sea level dropped during periods of glaciation. Sediments of the same age, but deeper beneath the sea on the continental rise (5), were not exposed to this process and so form thicker deposits.







GARY WOLINSKY (ABOVE) AND WILLIAM H. CURTIS (FACING PAGE AND BELOW)

FLOUNDER FLIES as skipper Marshall Alexander (left, foreground) and mate Wayne Crowley sort fish from the Gulf of Maine aboard Alexander's 42-foot trawler *De-Dee-Mae*. Working close to their home port, they supply the fresh fish favored by American consumers. Flounder and other bottom dwellers scooped up in the *De-Dee-Mae* trawl (right) will be packed in ice at dockside and will bring top prices.

The market for fresh seafood enables traditionally independent New England fishermen to compete with highly organized foreign fishing fleets, but concern over declining numbers of such favorites as halibut and haddock prompted them to lobby for the 200-mile limit. Many applauded the seizure in April 1977 of the Russian trawler *Taras Shevchenko* (above) for taking illegal catches of squid and river herring. Fines of a quarter of a million dollars were paid before the vessel was released from Boston Harbor a month later.

Fishing in home waters



(Continued from page 507) on the horizon the inevitable conflict between energy needs and environment."

Dr. Leslie Mack, assistant director of the institute's Department of Exploration Affairs, says: "Oilmen are gamblers. The excitement of the game, of not being sure how much oil they are bidding for, is what they love. They don't know in advance what, if anything, is out there."

Retorts Louise Dunlap, director of the Environmental Policy Center in Washington, D. C.: "Yes, but what are they gambling with? Our property, everyone's, not just their own. We all have a stake in the energy future. We are reasonable people. We don't say: Don't drill at all. We do say: Let's do it slowly and carefully and with concern for the effects on countryside and people."

Environmentalists often want the Federal Government to do the exploring, to learn more about potential deposits, and also to consult with seaboard states whose economy and environment would be affected when and if oil comes ashore. But the oil industry has a virtual monopoly of sophisticated equipment and specialists.

The stakes for an energy-consuming world are so high—and the sums of money involved so astronomical—that pressures on the side of immediate and massive exploitation are enormous. An estimate of what industry will need in the next decade to explore and exploit the free world's onshore and offshore oil and gas deposits is 1.3 trillion dollars. In contrast, the total assets of the world's 100 leading banks come to only 1.9 trillion.

At present consumption rates, the world may well be pricing itself out of its future.

MAN WILL GO DOWN to the submerged continental edges to find fuel, but his first need is food. From the earliest days of its "discovery" the continent of North America meant fish, among other prizes, to Europeans.

Ninety percent of the food fishes of the world are taken on the continental shelves. The reason is elementary: light. We are all creatures of the sun, dependent on the rays of that primordial nuclear reactor. Traces of sunlight can penetrate to well over a thousand feet in clear seawater, but there is not enough light to support the abundant growth of

plants below three or four hundred feet.

The chain of life in the sea begins with phytoplankton, minute plants that swarm in the shallow waters of the continental shelf. In this lambent blue-green zone, bathed in the nutrient salts of the sea, the microscopic plants perform the daily miracle of photosynthesis. With the aid of their chlorophyll they convert the radiant energy of the distant sun into carbohydrates, combining carbon dioxide and water in a not-fully-understood process.

The phytoplankton are eaten by small animals, or zooplankton, which are ingested in turn by larger crustaceans and fish, which then feed man.

Man, and the other animals of earth, could thus literally be called heliophagous—sun eating—ingesting daily and burning as fuel energy that has flashed across the void of space since the beginning of the world.

Nearly three-quarters of earth, the liquid planet, is covered by water, so most of the sun's energy reaching the earth's surface is trapped by the sea. Seawater is a highly efficient heat sink, absorbing the sun's heat and slowly releasing it year round, which is why coastal regions enjoy a milder climate than that of the hinterlands.

Statesmen, who represent terrestrial animals, tend to forget the sea and think only of landmass. With growing concern for use and ownership of the sea, this attitude is changing. Whereas the oceans once were thought to separate continents and peoples, today they are seen as a universal link.

The establishing of the 200-mile fishery zone off the United States does not mean that foreign fishermen are forbidden to fish within that area. It does mean that Americans now have first access to harvestable stocks. What is left may be apportioned among foreign fishermen.

U. S. fishermen, who lobbied for a 200-mile zone for years, were surprised and disgruntled when they found that conservation quotas applied to them too. In the first few months under the new law, fishermen off the northeast coast of the United States quickly caught almost all their allotted 60,150 metric tons of groundfish, mostly cod. When they had to stop fishing while the fish still swarmed on Georges Bank, they complained.

"For years those damned foreigners took

our fish," they said, "and now that we've got a chance at 'em, we're told to stop fishing." But many of the high-liners, the captains who bring in the biggest catches, realize the rules are for everyone's good.

"In about five years we ought to see a big improvement," one told me. "If not, then we'll really holler."

At the National Marine Fisheries Service (NMFS) laboratory at Woods Hole, a fisheries biologist explained:

"All the marine fishes of the world are either demersal, bottom dwelling, like the cod, or pelagic, roaming upper layers of the sea, like the tuna. Both are linked to the shelves because the nutrient-rich shallow waters offer bountiful feeding.

"Our laboratory has figured maximum sustainable yields for the major commercial species, based on studies of the stocks, and all fishermen in U. S. waters must adhere to the quotas based on these figures."

WHEN EUROPEANS first came to these shores, groundfish such as cod and haddock were the most-sought-after species, and they were the ones Americans came to like. Although the southern Catholic countries of Europe have always prized dried cod, what northern Europe wants most is herring. Both thrive on the shelf.

In the late Middle Ages herring was the wealth and currency of northern Europe. On this silvery fish that swarmed in the Baltic the German Hanseatic League, a consortium of shippers and traders, had grown rich and powerful. Then, just before the discovery of the New World, the herring suddenly disappeared from the Baltic.

Only four years after Columbus's epic discovery, Henry VII of England granted a patent to "our well beloved John Gabote, citizen of Venice," to sail on a voyage of exploration. One of Cabot's prizes: fish.

In August of 1497 Cabot came home with tales of a place where fish were so thick he took his plenty simply by lowering weighted baskets. King Henry called it a "new founde lande." The Italian navigator had found the shallow waters of Newfoundland's Grand Banks, still a rich source of cod, haddock, and other bottom fish.

Skippers from England, Portugal, France, and Spain soon followed Cabot, catching

cod and salting and drying them on the New World's rocky shores. Thus, foreign fishermen have been sailing to North America's continental shelf since the early 16th century. Later, Canadians and Americans joined them in fishing these rich waters.

IN THE PAST 20 YEARS foreign trawlers turned in increasing numbers toward the shores of the United States. Until the 1960's American fishermen took some 90 percent of the catch in what are now U. S. waters of the Atlantic. By the early 1970's their share had dwindled to about 45 percent.

From every maritime nation of Europe, and even Asia, the fishermen came, because these are still among the richest fishing grounds in the world, and burgeoning nations clamored for protein. In the 1950's the herring catch fell off dramatically in the North Sea, repeating what had happened 500 years earlier in the Baltic. This started an exodus of European fishermen to North America, and since then herring here has diminished alarmingly.

Probably the most abundant fish in the world, the herring and related anchovies, menhaden, sardines, alewives, and shad pululate in their billions in the world ocean. The alewives, or river herring, and the shad are anadromous; that is, they live in the sea but ascend rivers to spawn, like salmon.

Scientists have yet to discover how such fish find their way back to their natural streams from the open sea, but they suspect that a sense of smell or taste guides them. Here again the fishermen's prey concentrates on the continental shelf, as the home-seeking fish gather in shoals to sniff out the waters of their birth.

Nature has given the United States a generous share of the largess of the sea. Says biologist William Royce, formerly of the National Marine Fisheries Service:

"Nearly 10 percent of the world's continental shelf lies off our shores. Within the 200-mile fishery conservation zone, which includes waters well beyond the shelf, we probably have 20 percent of the world's total fisheries resources. What these shores meant at the time of the European discovery is still true. But now that the 200-mile limit has been established, big foreign fleets no longer are reaping most of the silver harvest.

"The haddock, once our most important





In the history of oil spills, *Argo Merchant* will live in infamy. On December 15, 1976, the 640-foot tanker—aged, ill-kept, and off course—ran aground on Nantucket Shoals. Her cargo, 6.2 million gallons of fuel oil as thick as molasses and 1.5 million gallons of lighter oil, began to leak immediately (below). On December 21, in a raging sea, she broke in half (left). Offshore winds kept the mess from washing onto beaches, but hundreds of large oil pancakes slid across the surface of fish-rich Georges Bank, killing eggs and contaminating plankton; the effect on fish and shellfish could not be determined. The lighter fuel penetrated the depths and may have entered the food chain.



BOTH BY ZARY WOLINSKY

Atlantic fish, is an example of gross destruction. In the 1950's haddock yielded a total of about 100 million pounds a year. By the 1960's the damn-the-future style of fishing practiced by the Russians and, to some extent, by Canada and the U.S. caught up all the larger stock, and now the fishery returns one-tenth of the former catch."

When the 200-mile fishery conservation zone was proclaimed, the NMFS and United States Coast Guard were charged with policing it.

"Fortunately," says Adm. O.W. Siler, Coast Guard Commandant, "fish pay no attention to politicians. The 200-mile zone encloses an area of 2.2 million square miles, nearly two-thirds of U.S. land area. It would be almost impossible to police it adequately, but fish continue to congregate in the same places, making our task easier.

"Since March 1, 1977, foreign ships in our zone (pages 508-9) have dropped about 35 percent in number. They all seem to be making an honest effort to conform to the new law."

When American fishermen mutter darkly that foreign fishermen are taking their fish and call them collectively "the Russians," it is because the greatest number of fishing vessels off our East Coast are Russian. The Soviet Union fields more than 800 trawlers over 1,000 tons, the rest of the maritime world less than half that number. If you add smaller fishing vessels, the Soviets send to sea one-fifth of the world's fishing fleet.

ONE WINTER DAY I went on fisheries patrol with the Coast Guard cutter *Alert*, under Cdr. Michael O'Brien. On board was special agent Richard Whittaker of the National Marine Fisheries Service.

"Many of the skippers know me," he said. "Out here people are seamen first, fishermen second, and Russians, Americans, or whatever third. We find that everyone is about the same regardless of nationality, some good guys, some not so good."

Eighty miles off New Jersey, Captain O'Brien pointed his binoculars at a 300-foot-long trawler, one of a score on our port hand. I followed Dick Whittaker below and zipped myself into an orange wet suit of thick foam rubber.

Our boat swung out from the davits and dropped into the heaving seas. From the

cutter fluttered the signal flags, S, Q, and 3—"Heave to; I am going to board you." Green water came over our bow as we neared the trawler *Biryusinsky* of Murmansk. The Russian seamen dropped a 40-foot wooden-runged Jacob's ladder to the water, and Whittaker swung nimbly aboard. I followed on the next rise.

While the boarding party inspected the catch in the deep-freeze holds, I watched the fish-swollen trawl come aboard, sliding slowly up the slipway at the stern. It was January, and the Russian ships were fishing in 40 fathoms for *skumbriia*, mackerel.

"Twenty-two tons," said Dick later. "Not bad, though I have seen sixty tons come in after a haul of only twenty minutes. Sixty metric tons means 132,000 pounds of fish."

These big trawlers can process 45 tons of fish a day. Belowdecks, lines of men and women gutted and filleted the fish, then froze them in slabs of ice. One trawler even had a small cannery on board.

I remembered American fishermen telling me morosely: "You never see gulls following a Russian trawler." They use everything; even the offal is processed into fish meal for animal fodder and fertilizer.

From the Russian captain's cabin we could see a gray supply ship to starboard. Periodically these vessels come to the fishing grounds, unload fuel and food, and take aboard the frozen fish. The poor devils on the trawlers stay on station up to eight months.

When the first officer, Evgeny Krasissovsky, gray-eyed and with a wispy beard like Trotsky's, learned I was a journalist, he thumped me on the back and cried:

"*Kollega!* I, too, was journalist."

He opened a bottle of vodka, and we tossed off toasts to friendship.

At the end of the two-hour inspection of holds, gear, and logbook, Whittaker pointed to a Russian sentence in his phrase book: "I have found no violation." The serious captain smiled for the first time.

"I am glad to see you," he said.

There is the brotherhood of man and the brotherhood of fishermen, I reflected when, many toasts later, I felt my way carefully down the swaying ladder.

As our boat was hoisted in, the signal flags U, W, and First Pennant snapped overhead, sending the

(Continued on page 523)



Core sampling for clues to climate



UNLOCKING the planet's archives, long cores drilled by the U. S. Geological Survey on the shelf off Florida (above) reveal Ice Age records in the underlying rocks. When massive glaciation lowered the level of the sea, the limestone bottom was laid bare to weathering that testifies to such long-ago events.

Cores taken from coral heads in the Florida Keys show growth bands (left), similar to tree rings. These reflect the reef-building polyps' reactions to seasonal variations.

A ten-foot sample from the heart of a living coral head, alongside a broader X-ray photograph of the core (right), shows weather variations in the keys from 1620 to the mid-1970's. Colder-than-average winters appear as darker bands on the photograph. They prove that extensive reef deaths in 1969-70 were caused by severe cold—not, as had been suspected, by pollution.

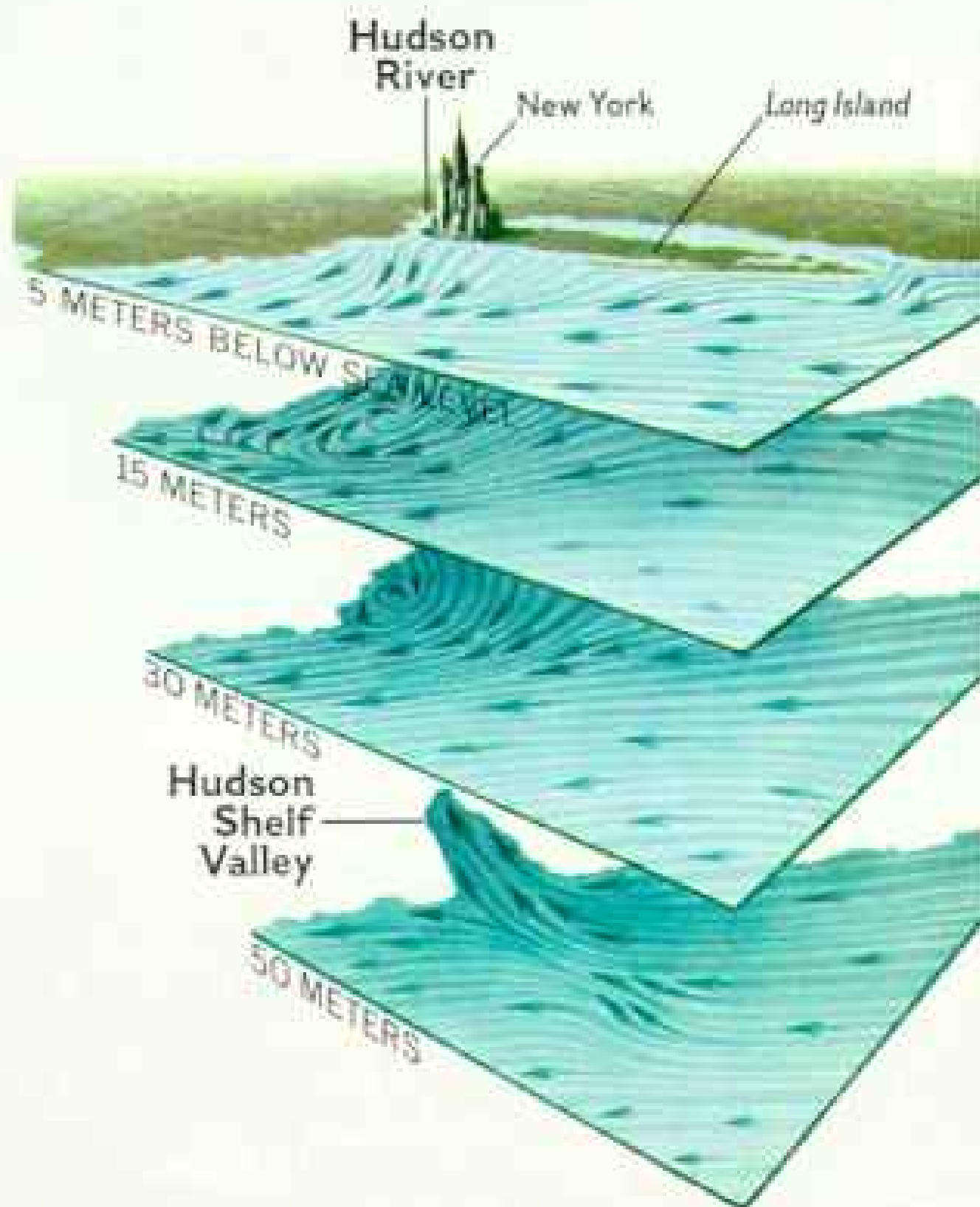


Sewer for a megalopolis: convenient but too costly?



UNDER THE WATCHFUL EYE of a Coast Guard helicopter, a New York City sewage ship pumps sludge into a designated site in the New York Bight (left). Partly as a result of massive dumping, the ecosystem of the bight, a 15,000-square-nautical-mile area covering the shelf from Long Island to New Jersey, has been strained to its limits. Each year it absorbs about 130 million cubic feet of sludge, 140 million cubic feet of dredge spoil, 30 million cubic feet of debris from construction sites, and 80 million cubic feet of waste acid from industrial plants. Such acid, pouring from a barge (right), leaves a fishhook-shaped trail; tiny white dots are floating targets dropped to track the acid's dispersal.

Scientists shake their heads at the dismaying variety of the pollution—from toxic metals to a plethora of chemicals, including fertilizers. No one knows the effects of currents in the Hudson Shelf Valley (below). Dumped material flows into the valley because of gravity, but swirling currents may carry harmful dissolved chemicals back toward shore. Aroused New Yorkers, together with other environmentalists nationwide, lobbied for the law enacted last November that will prohibit ocean dumping of sewage by ship in all United States waters after 1981.



NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION; DAVID DOUBILET (FACING PAGE)



(Continued from page 518) message in the gathering darkness: "Thank you for your cooperation. I wish you a pleasant voyage."

But the Russians would make no homeward voyage until spring. Back and forth they plodded in the freezing blue dusk, like dogs casting about for a scent.

OTHER NATIONS, too, have shown concern about foreign vessels fishing on their continental shelves. In October 1975, Iceland became one of the first nations to establish a 200-mile zone for fishery conservation.

In Reykjavik I met with Thordur Einarsson at the Ministry of Foreign Affairs.

"Iceland is fish," said Mr. Einarsson. "No fish, no Iceland. More than 80 percent of our exports are fish products. So, can we wait for the world to agree while foreign fishermen sweep up our livelihood? For generations our fishermen cropped the sea, fishing with hook and line or from small draggers. Now these enormous foreign vessels come in and do a vacuum-cleaner operation.

"Newspapers talked of the 'cod war.' We never thought in terms of war; we have always had the friendliest relations with British and German fishermen. But cod is our most important resource."

Matthias Bjarnason, Iceland's Minister of Fisheries, summed it up:

"We made a decision that could wait no longer. We hope the final verdict of the law of the sea conference will follow our pioneering and that the establishment of all maritime nations' economic zones can take place peacefully and gracefully, in friendship with other nations. Meanwhile, we must live."

Iceland won the "war," and today British and German trawlers fish outside Iceland's 200-mile belt.

Not all authorities agree on the fisheries and sea-zone questions. Capt. Jacques-Yves Cousteau, the diving pioneer and one of the chief spokesmen for the sea, takes the long-range view.

"Fishing is a wasteful way of harvesting the resources of the sea," Captain Cousteau told me. "Do we eat lions, tigers, and other predators brought down by hunters? No, we eat the flesh of their prey, grass eaters, raised by us. Ten thousand years ago man learned this on land.

"If we eat one pound of fish, we eat one



Innovative techniques help inventory the shelf and analyze man's damage to it. On Tanner Bank 115 miles off San Diego, a diver photographs pink hydrocoral (facing page). A closeup from the area reveals a crab, anemones, a snail, and other organisms (below). Scientists study the images to determine the size and makeup of such shelf "neighborhoods."

On yet another front, fresh information on pollutants in bottom sediment has emerged as a result of a new sampling device (above). Its designer, Andrew Soutar of the Scripps Institution of Oceanography, in La Jolla, California, studies a specimen in a surgically clean environment.



ALL BY SCIENCE APPLICATIONS, INC., TUP NICKLIN

thousand pounds of plant life, or more! It takes ten pounds of phytoplankton, the microscopic plants of the sea, to make one pound of zooplankton. Ten pounds of zooplankton make one pound of larval fish or crustaceans. And ten pounds of larvae make one pound of fish. Simple arithmetic: ten to the third power. But ruinous arithmetic for man.

"Viewed thus, all the furor about the 200-mile limit shrinks to its proper insignificance. The future lies in ocean farming, not fishing." Many marine scientists, however, consider Cousteau's ideas about large-scale ocean farming impractical.

But needy man is eyeing the food chain in the sea hungrily. Some nations, limited in taking protein on the American shelf, want to short-cut the chain and take the food fishes' food directly.

In the waters off Antarctica's shelf, for example, krill, small shrimplike crustaceans, seethe in vast numbers. Once great whales swam with distended jaws through the reddish clouds of life, ingesting tons of the tiny animals. Now that man the destroyer has taken his toll of the whales, he is feeding krill to pigs and poultry and even trying it himself.

Proponents estimate that the potential catch may reach 150 million metric tons a year, more than twice the present world catch of all fish.

Whether we fish or farm the sea, we must do it in clean water. Nature can cope with most organic wastes, but modern man adds much more lethal ones: industrial acids, deadly metals, insecticides.

The highly concentrated and industrialized agglomeration called the Atlantic Urban Region, between New Hampshire and Virginia, supports almost 10 percent of the nation's population. This is the world's largest urban cluster; at its center the New York City area's 18 million people each year inject into the once healthy body of the sea the staggering total of 14 million tons of waste (pages 520-21). In one generation alone enough material was deposited in the shallow waters of the New York Bight to raise the bottom by 35 feet in one six-square-mile area. Such dumping is alarming enough, but it causes even less offshore pollution than the constant runoff from contaminated rivers.

All of it points to the same problem: Where does one put waste? The glittering Ocean Sea,

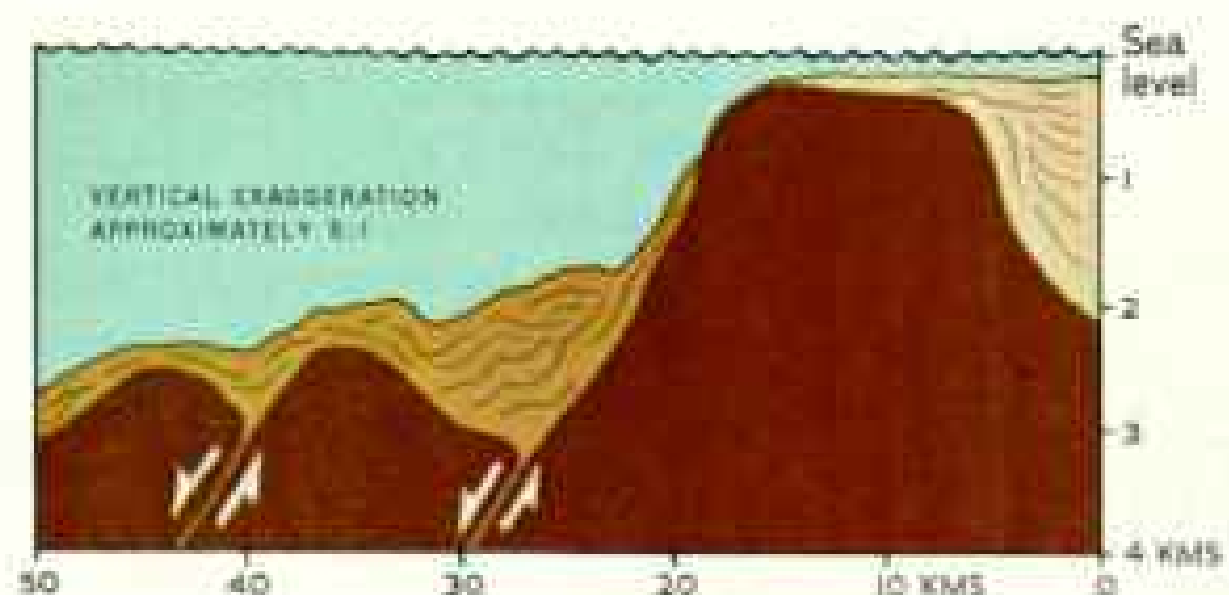
Oil stakes a claim to the western shelf

A TITANIC STRUGGLE between two massive tectonic plates, or segments, of the earth's crust limits North America's Pacific shelf to a ribbon far narrower than its Atlantic counterpart. The westward-moving continent meets the plate of the Pacific floor along a line of fractures generally paralleling the coast. Rocks thrust upward by the strain form under-sea ridges, or fault blocks (diagram, below), that act as dams against the shelf's seaward growth. Sediment falls into deep basins created by faulting until they are filled; thereafter it spills over the edges. Deposits on the Pacific side of the fault are carried away as on a conveyor belt. Actually the plate of the Pacific floor is slipping slowly northward toward the gaping Aleutian Trench.

Derricks dot the sea off southern California (1) (map, right), where the sediment-filled basins ooze with oil. There, too, nutrient-rich water of the California Current wells up from the deep, drawn by prevailing winds that also push surface waters away from the coast and westward across the Pacific.

Similar upwellings off the Aleutians (2) and in the Gulf of Alaska (3) nourish fishing grounds worked by fleets from Russia and Japan as well as Canada and the United States. The shallow Bering Sea (4) yields great numbers of fish, while king crabs and migrating salmon throng close to shore.

Alaska's broad shelf may hold a further wealth of oil. Wells in the Cook Inlet (5) have pumped for many years, but drilling farther offshore in the Gulf of Alaska has so far produced only dry holes. Most of the region remains unexplored; oilmen are eyeing potential fields in the Beaufort (6) and Bering Seas.



PRINTING (RIGHT) BY HEINRICH C. BERANN AND HEINE VIELAND
 COMPILED BY ROSS M. EMERSON, NATIONAL GEOGRAPHIC ART DIVISION





because it covers nearly three-quarters of our planet, swallows our dross without a sound and, until recently, without trace, but the system and the citizens are beginning to protest.

TOO LONG have we insulted the ocean; now man is learning to respect it, to see with his own eyes and touch with his own hand the treasures of the shelf.

The U. S. Navy's Capt. George Bond, the medical officer who revolutionized diving with his "saturation" technique that enables man to live and work for long periods on the seabed, had spoken to me of an old friend who had built with him the world's first undersea habitat.

"Edwin Link's system, a lockout submarine and decompression chamber," Dr. Bond had said, "is the first one capable of putting two divers down to the limits of the continental

shelf. It allows divers to work on the shelf anywhere in the world and then brings them up to complete decompression in comfort."

Some weeks after our conversation I was aboard a Harbor Branch Foundation research vessel, 40 miles off the Florida coast near Fort Pierce.

On the afterdeck stood a big transparent sphere clasped in a frame of aluminum struts and tubing, the *Johnson-Sea-Link I* research submarine. Pilot and observer sit in the five-and-a-half-foot acrylic sphere; behind it, two divers ride in a metal pressure chamber with a sea lock at their feet.

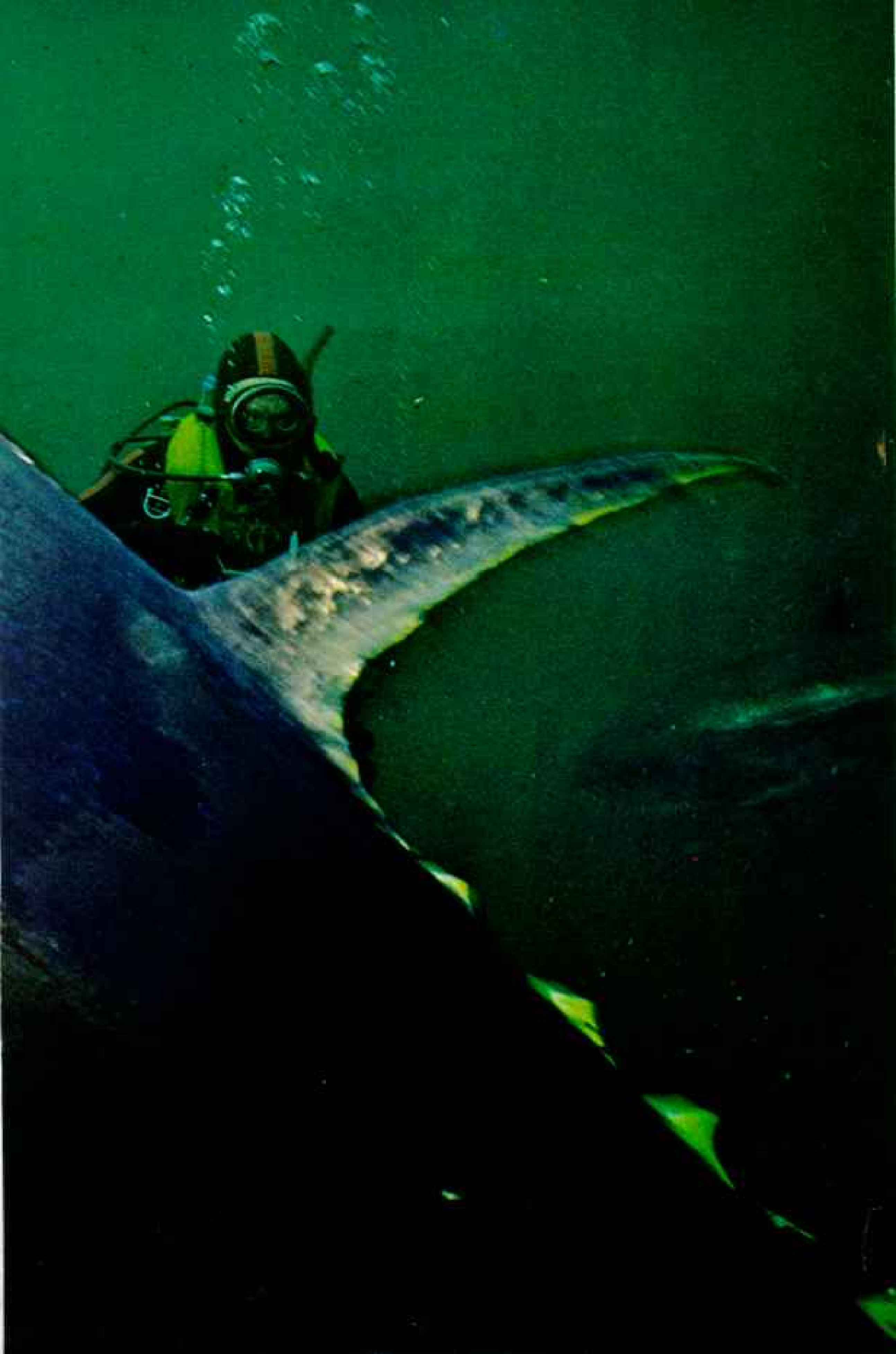
I follow the pilot through the manhole atop the crystalline sphere, and the hatch is dogged shut. Gently a hydraulic crane lowers us into a cobalt sea. Our electric motor-drives drone, slowly the frothing hemisphere of the sea rises, and suddenly we are still and bathed in



Pastures of plenty: Infrared film reveals a three-square-mile kelp bed (left). Swaths through the California field were cut by a ship harvesting the plants for algin, an emulsifier that, among many uses, helps beer keep its head and smooths out ice cream. Looking to the day when dried kelp may become a source of natural gas, divers in a kelp-farming experiment lower plants to a more nutrient-rich level (above).

Submarine stockyards: Half a ton of bluefin tuna flashes past a diver in a holding pen on the Nova Scotia coast (following pages). Janel Fisheries Ltd. fattens the tuna on mackerel, then sells the flesh to Japan. Used for sashimi, it can cost ten dollars a pound or more. High mercury content bars some bluefin and other fish from U. S. tables.





lambent green light. Only the skeins of silver bubbles wavering slowly upward tell us that we are sinking.

The light dims, and the sea deepens to blue green and then to rich indigo. I look at my companion; his face is blue, so are my hands. The dials glow like sapphires. We are drained of all color save the pure blue of subtropical seawater.

A small fish bumps into the invisible wall of the sinking sphere. Its look of surprise—yes, fish have expressions—is comical, but in a moment the fish has disappeared, falling upward toward the sunlit world we are leaving. With a gentle bump we come to

rest on the bottom in blue-black twilight.

In the diffused light from our lamps the bottom stretches before us, a gently undulating plain of silver-gray ooze, pocked with wormholes and feathered with tufts of soft coral. The depth gauge reads 600 feet.

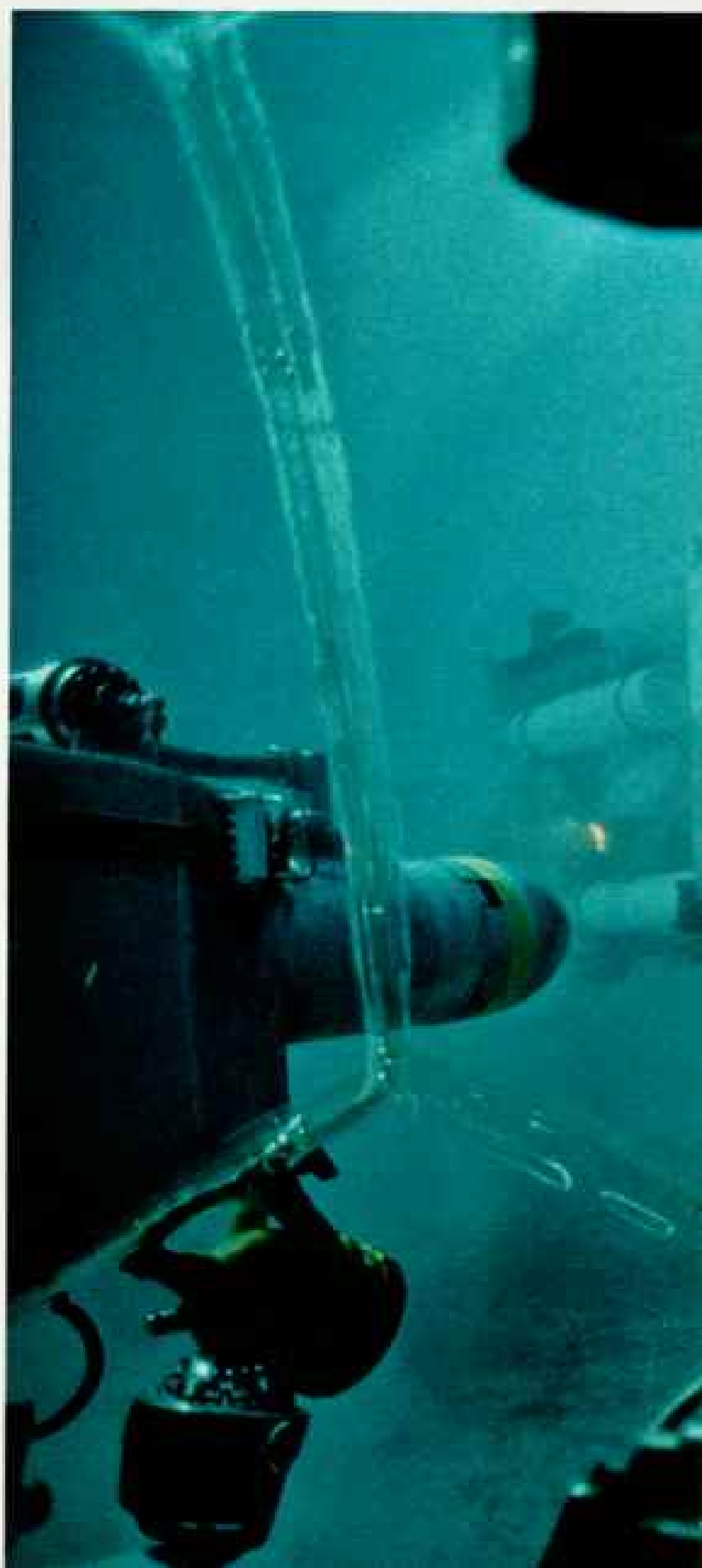
We wait in silence. A thin whine, and our sister vessel, *Johnson-Sea-Link II*, materializes from the gloom.

AS IN A DREAM we hear the muted roar of gas as the sister submarine's divers, invisible in their compartment aft, "blow down" their chamber to a pressure of 18 atmospheres, 266 pounds per square inch.



BOTH BY LUIS BARDEN

Descending into its element, the *Johnson-Sea-Link I* research submersible leaves the surface (above) for a rendezvous with a sister craft (right). Divers exit and reenter a compartment behind the sealed pilot sphere at the pressure of their diving depth. Decompression begins as the craft ascends. The vessel is then hoisted aboard a service ship and mated with a chamber where the divers can finish decompression in greater comfort and safety. This system greatly extends the range and duration of dives to the depths of man's new frontier.



Such is the crushing ambient pressure in 600 feet of seawater, the outer limits of the continental shelf. A squeak as the hatch drops open, and then the finned feet of a black-suited diver emerge. Slowly the diver drops backward, drawing the black serpents of his life and breathing lines after him, a submerged Laocoön. He swims slowly away from the submarine, which rests on its jointed frame like a skeletal spaceship.

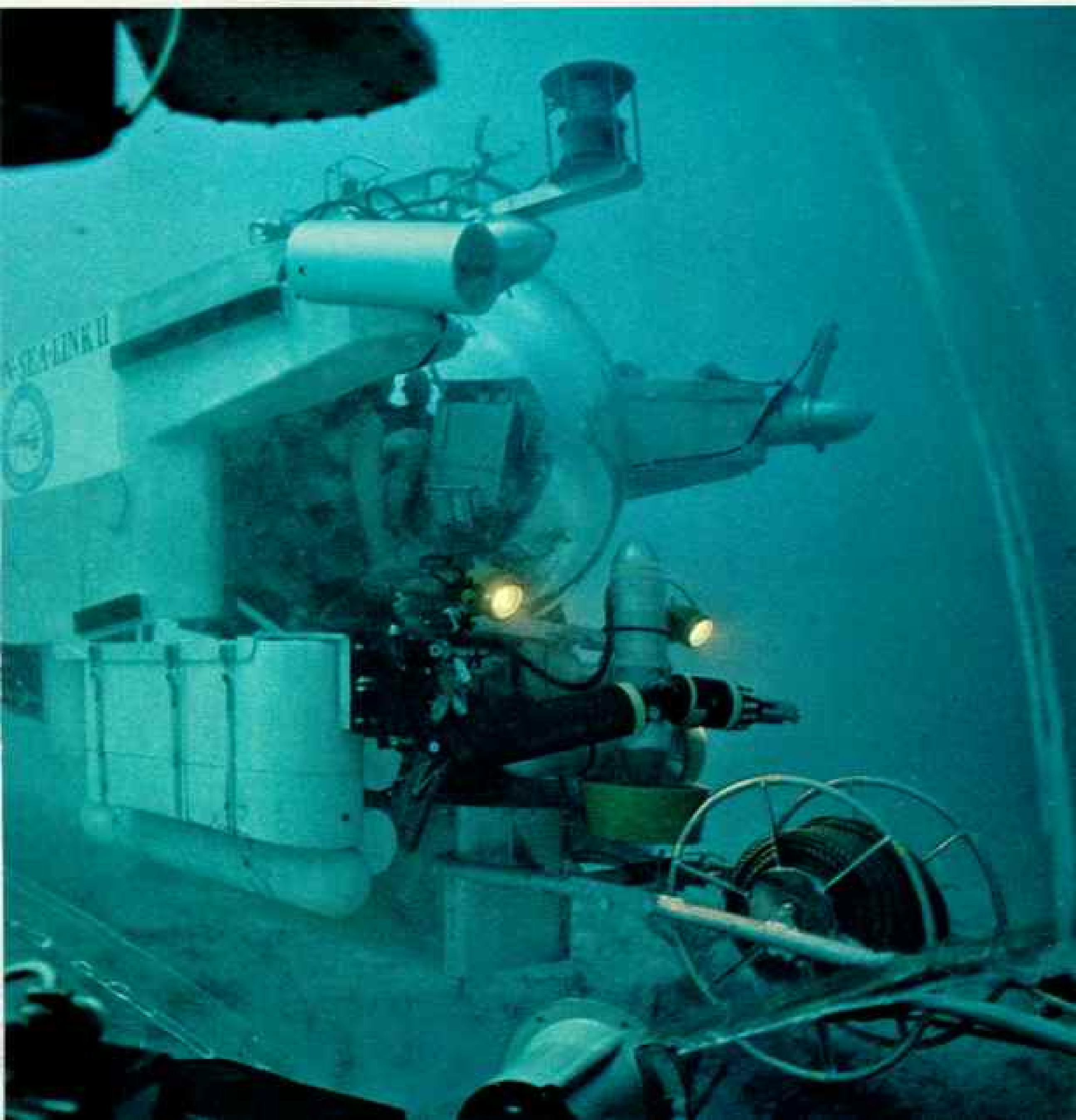
Like a traveler on the moon, the diver relies utterly upon his life-support system. Without it? On the moon he would explode like a soft grenade; here his lungs would be crushed. Man exists within an extremely

narrow segment of pressure and temperature.

The black figure beats slowly toward us, trailing his umbilical cords. Caught in our cone of saffron light, he pauses, transfixed like an insect in amber. Kneeling on the bottom, the diver caresses a brown plume of soft coral; then, with a decisive gesture, he plunges both arms deep into the ooze. Around the kneeling figure the bottom rises in a silver-gray roil.

Man has taken possession of the outermost edge of his continents, and ten million square miles of seabed will never be the same.

On the drowned plains of the continental shelf the year is 1492. □





Mother and monarch to millions, the queen of an East African colony of grass-eating termites dwarfs her throng of stone-blind offspring. Under her head crawls a larva that will grow to take its place among a highly stratified brood of workers, soldiers, and reproductives. Chemicals exuded by the queen help order life for the world's oldest social insects, which have endured more than a hundred million years.

DWELLERS
IN THE DARK

Termites

ARTICLE AND PHOTOGRAPHS BY
GLENN D. PRESTWICH, Ph.D.



TERMITES, *MACROTERMES SUBTANALIS*, IN ALL PHOTOGRAPHS EXCEPT WHERE NOTED

AT THE FINAL FLICKER of daylight on the East African plain, the termite mound burst into life. Workers swarmed out through curved slits they had excavated from within the perimeter of their fortress of sunbaked clay.

Soon the ground teemed with thousands of flightless, sterile worker and soldier termites clearing away insect foes, preparing for the emergence of the alates—their winged brothers and sisters, able to reproduce and carrying in their genes the destiny of the species.

The first of these flying termites poked through the exit slits, or flight holes, and

climbed onto grass stems to rev up their cumbersome wings, then took to the air in seemingly random, clumsy flight (page 536).

In ever increasing numbers, the alates emerged, tested their wings, and flew. Soon the air was thick with their bumbling hordes.

We could fancy we were viewing, in the beams from our vehicle headlights, an oddly upside-down winter scene. The glistening “snowflakes” fluttered upward, wafted by a gentle breeze, to spread in a gauzy veil of life over the plain around us.

The December short rains had come to Kenya. In the pungent odor of the moistened

earth we had smelled relief for the dying cattle and their Masai herdsman. We, too, welcomed the rains, for they heralded the nuptial flight of the African termites, those tireless architects of tropic soil.

Without delay my research companion, Dutch biologist Oebele Bruinsma, and I had eagerly boarded the "Termite Kombi," a modified Volkswagen bus, and set out on the 80-kilometer drive from our lab in Nairobi south to our field station here in Kajiado.

We arrived at sunset, with only minutes to prepare for the dramatic flight of the alates, the termite princes and princesses, a ritual of survival more than a hundred million years old. We located a likely spot—a group of a dozen scattered termite mounds nearly two

meters high—by following noisy, low-flying birds. From 6 p.m. onward they clustered in the trees, waiting for the emergence of the juiciest morsels of nature's provender—the high-protein, high-fat termite reproductives.

The frenzy of the nuptial flight was brief. Within minutes the alates came to rest on the damp soil. Two twists of their "shoulders" and they shed their now useless wings. The females instinctively raised their abdomens to expose scent glands, and males scurried in frantic pursuit of the primeval perfume that attracts them to their mates.

Predators—ants, beetles, birds, lizards, and other creatures—pounced and gorged. Of the several thousand reproductives from each mound, only a few couples would survive



the carnage. These lucky exceptions formed brief tandems, with the male following closely behind the female as she searched for a place to found her new family.

Having selected a site, the termite prince and princess laboriously dug a nest by moving single lumps of soil with their mandibles. After a night's toil they sealed themselves in a tiny chamber a few centimeters below the surface and readied themselves for their new lives as king and queen.

To photograph this spectacular nuptial flight, I had prostrated myself beside a mound amid the swarm of ground-clearing workers and soldiers. As I clicked off the first few pictures, through my shirt I felt hundreds of razor-sharp mandibles stabbing into my arms

and stomach. The soldier termites clung in a death grip to my pinched and bleeding skin; I tingled under thousands of tiny termite feet protesting my intrusion into their life-sustaining affairs.

Into a Vast, Hidden Realm

The semiarid grasslands of the Kajiado District in Kenya offer an ideal laboratory for research into the ecology and behavior of termite societies. The stately Masai herd their cattle and goats amid hundreds of the insects' brick-red fortresses, which protrude from the ground like the ruins of some ancient civilization. These, one learns, are only the iceberg tips of massive, life-filled tunnels.

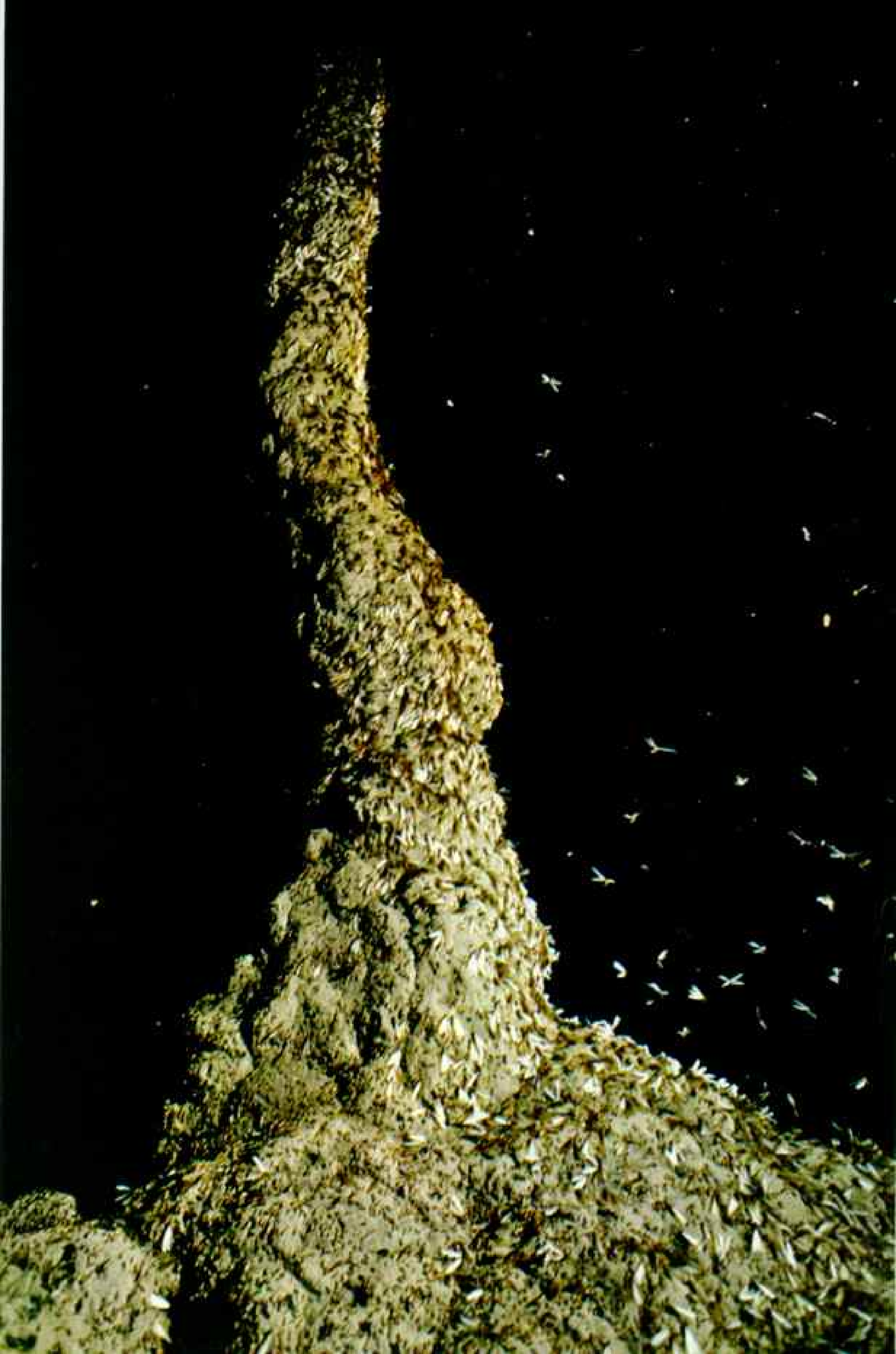
My colleague Oebele is a specialist in



RONALD HIRZ

Atop the Gothic skyscraper of a termite mound in Kenya, the author searches for signs of fresh building activity. At least twenty years old and composed of several tons of soil, the engineering marvel was constructed by tiny animals weighing less than a thousandth of an ounce each.

Their nursery invaded, workers in a mound opened by the author (left) escort larvae to safety, while others seal off a rupture with soil and regurgitated matter.





Born to fly and—for most—to die, a small caste of reproductive termites swarms in brief nuptial flight (left) following seasonal rains. Emerging from holes opened and guarded by their sterile nestmates (above), almost all these hopeful kings and queens, called alates, meet a tragic end. Hungry hordes of ants, birds, and other predators await their flight, cued by instinct to attend the banquet of protein-rich morsels. No return allowed, alates that fall near their mound are often cannibalized (middle). The few that escape promptly shed their wings and seek mates, frequently alates from other mounds. A successful pair (bottom) sets out to found a new colony in the rain-softened earth, with the male following the tantalizing scent of his bride. Once underground and mated, both will live off fat reserves until the first eggs hatch into workers who will feed them. Soldiers and alates will come later, as the colony grows.



ALAN ROSE (FRONT PAGE)



The chewers and chompers: Workers drag a blade of grass to their mound, where

termite behavior and a fellow scientist at the International Centre of Insect Physiology and Ecology in Nairobi. An organic chemist by training, I was studying how insects use chemicals for communication.

Together we sought to find out how building, food finding, defense, and other aspects of these termites' lives are controlled by the odors of nestmates and of their tomblike environment. Two other ICIPE ecologists, Jo Darlington of England and Michel Lepage

from France, staffed the ICIPE field station in Kajiado and offered us their hospitality and invaluable experience with local termites.

Termites are omnipresent in the tropics. They live in people's houses, in gardens, in fields, in trees, even atop telephone poles. They play an essential role in the ecology of the soil. Commonly called white ants, they are rarely white, and most certainly are not ants; they descend from cockroachlike creatures of the coal age some 250 million



they will partly digest it and through regurgitation feed it to the other castes.

years ago. A hundred and fifty million years later, when dinosaurs ruled the earth, the first termites formed their weakly knit societies and tasted their first bite of wood. It was from their wood-eating cockroach ancestors, presumably, that they derived the ability to assimilate cellulose; protozoa dwelling in their guts helped digest wood fiber.

The termite we studied at ICIPE was *Macrotermes subhyalinus*—or literally, “large, opaque woodworm.” These enterprising

insects eat grass. Aided by bacteria in their bodies and special fungi in their hives, they break down cellulose into life-giving sugars.

These mound-building *Macrotermes* (only one of some two thousand termite species that infest the world) are more highly evolved—and less destructive—than their pesky American cousins, which live in diffuse colonies in the soil. The familiar subterranean termites of the genus *Reticulitermes* are the most damaging of these earth-dwelling

species. They eat their way into millions of North American homes. Other termite genera of the United States devour dry and rotten wood of buildings, lumber, and utility poles in the South and Southwest.

Termites Take on Earthworms' Job

Humans generally regard termites only as obnoxious pests. Yet in the ecology of the tropics they are crucial. No earthworms live in the arid, clayey soil of Africa's savannas. Instead, termites assume the vital task of enriching the soil, recycling dead woody matter,

and fostering the growth of vegetation.

After losing their wings, the African flying termites are often collected and used for poultry feed. They are also sold—fried and salted—in African markets, packaged in plastic bags. I found this tropical snack quite palatable: It reminded me of fried pork rind, peanuts, and potato chips rolled into one.

Cutting into a termite mound is an awe-inspiring experience. We found the above-ground portion to be an elaborate defensive structure, its climate cleverly controlled by a neat balance of temperature, moisture, and



ENOURED TERMITE, *TRINERVITERMES SETONIAE*

HARVESTER TERMITE, *HOODOTERMES WOODSAMBICUS*

On guard against unseen foes, soldiers from a colony of snouted termites (above) defend the home front with a form of chemical warfare. Using uncanny blind aim, they immobilize archenemy ants by squirting a gluey liquid from syringelike nasal guns. Bred in numbers according to their colonies' needs, soldiers are living armament. In most species, like the harvester termite (right), they rely on razor-sharp mandibles and huge crash-helmet heads. But a similarly equipped *Macrotermes* (facing page) proved no match against a gang of marauding weaver ants.



gas. Deep below in Stygian darkness lies the hive, or nest area (following page). It comprises separate "apartments" for raising the young, growing food, and housing the vulnerable royal pair—the soul of the colony, and "the mysterious power which governs" all the mound's activities, as Eugène Marais characterized it in *The Soul of the White Ant*.

Food is grown in fungus gardens—beige-colored, labyrinthine, spongelike structures that the termites build from their own feces. These fungus gardens furnish the medium for culturing *Termitomyces* fungi, and we could

readily see the tiny round white nodules called conidia growing atop them (page 547). After consuming the conidia, termites then re-ingest the spongy fecal material, recovering additional nourishment from their original grass forage.

A termite colony is a totalitarian society under the sway of a single matriarch. A thick-walled queen cell houses the royal pair—the king and queen termites. Former winged alates, they have survived the nuptial flight and subsequent predation to found a new colony. (Continued on page 545)

TERMITES: *MACROTERRIS BELlicosus*; ANTS: *CECOPHYLLA LONGIRIS*



Hidden world of a dynamic termite city lies open to view in this cross section of a man-high mound (**below**). Riddled with tunnels that help stabilize temperature, gas balance, and humidity, the cone is both fortress and air conditioner for the hive below. There its inhabitants cultivate fungus gardens along the fringes and attend to their matriarch in her royal chamber, seen here above a root at the bottom of the photograph. Incredibly, this damaged mound can be repaired by its workers in 24 hours.





Queen of darkness and her throngs of Lilliputian subjects (below) endure dreaded light as a royal cell (left), dug from the bowels of another mound (far left), is opened. After some 15 years of prodigious fertility, this once sleek alate princess has been transformed into a 12-centimeter-long immobile mass of blood and ovaries a thousand times heavier than the workers who constantly feed her. Chemical secretions, picked up from her body by grooming workers, function in unknown ways to maintain group harmony.





The king looks much the same as in his youth, but the queen has grown grotesquely, assuming the size and appearance of a huge fat grub (left and below). She is virtually a reproduction factory, able to lay between 5,000 and 30,000 eggs daily. Over her twenty-year life span she may produce more than 200 million eggs!

The colony's total energies are directed toward keeping the queen producing. To this end, the mound's inhabitants adhere to a rigid caste system, in which each individual plays a discrete and indispensable role.

The termites rear their young in a nursery, a chamber walled with tissue-thin plates (pages 534-5). Thousands of tiny white larvae—pale miniatures of the adults they will become—crowd into tiny cubicles where they are fed by their older brothers, the minor workers. In this genus, all workers are male, all soldiers female.

Major workers take charge of food gathering and mound repair and maintenance. Minor workers, which are smaller, feed and groom the royal pair. Minor soldiers serve as

escorts for major workers wherever they go. Major soldiers are the palace guards, the last line of defense against invasion of the nest.

Yet even at the pinnacle of all this power, with all their needs attended to, the queen and king are prisoners for life in their dark, dank cell.

The Doctor Makes Night Calls

As we studied termite mounds, we frequently found ourselves surrounded by curious Masai boys and their omnipresent cattle and goats. When asked why I was digging in their grazing lands and filling plastic basins with *dudus* (insects), I replied, "*Mimi ni daktari wa dudus*—I'm a bug doctor." The Masai smiled in amusement at the crazy *Mzungu* (white man), no doubt wondering what a bug doctor actually did for a *living*.

A termite colony transacts much of its business at night. Then it is that the inhabitants repair any damage to their mound, dig tunnels, gather food, and have to ward off most predators.

So it usually was evening when I stepped



The other half in one of nature's strangest unions, a large termite king huddles close to his colossal mate (above). Termite queens are regularly fertilized by the same mate for life, unlike their bee and ant counterparts, whose partners die after one coupling. Another queen (left) receives food from a worker while others groom her.



As much a slave to duty as are her offspring, the termite queen enjoys the dubious destiny of nonstop procreation, laying as many as 30,000 eggs a day (left). Though she and the king may live some twenty years, the rank and file do well to survive six months—thus creating an unending demand for recruits. Workers stack the newly laid eggs (below) before other workers arrive to distribute them among nurseries that fill much of the nest. Larvae molt four or five times before maturing, their cast-off skins providing another food source for the waste-nothing colony. Underground gardeners, *Macrotermes* cultivate fungi (right) on combs of their own nutrient-rich excrement. Termites eat both the fungus and fecal comb to supplement their grass diet.

outside our hut, laden with photographic equipment, and walked into the moonlit grasslands studded with termite mounds. The *askari*, or night watchman, from our field station helped me with my load while lighting the way with his flashlight.

Special Features Warn of Danger

Sometimes my efforts were in vain. I would set up equipment to photograph termite workers nibbling at bits of grass, bone, dung, or even discarded paper, plastic, or cloth. Although sightless, the termites often detected my presence from the shock waves of my footsteps and the heat of the flashlight beam. With “ears” in their legs, “eyes” (light-sensitive organs) in their skin, and “noses” in their antennae, the busy workers and soldiers fled even as I planted my tripod.

“*Hapana taki too*,” commented the Masai watchman. “*Ameenda nyumbani*.” The termites “didn’t like the light, so they went home.” No use trying for pictures tonight. I could hear the muffled clickety-clack of the alarmed soldiers drumming their heads against passageway walls.

“*Labda kesho*,” I replied, packing my gear. “Maybe tomorrow night.”

The termites would be there. In that blackness beneath our feet they toiled tirelessly, one of the smaller segments of nature’s grand design, a society governed only by survival’s unwritten yet inviolate laws. □







With ruffles and flourishes, dancers of the Frantic Follies in Whitehorse recall the

CALL OF THE NORTH

YUKON FEVER

By **ROBERT BOOTH**
WITH NATIONAL GEOGRAPHIC STAFF

Photographs by **GEORGE F. MOBLEY**



days of the Klondike gold rush, when a frontier spirit was born that refuses to die.

IN MY MIND'S EYE I can see them. Men like ants, bent under their too-heavy loads, plodding in lockstep up the frozen slope. A human chain with a common link, a common dream.

For this is the Chilkoot Pass, a tiny notch in the coastal mountains that separate Canada from the Alaska panhandle. And for 30,000 men in the cruel winter of 1897-98, it was the first hurdle in a desperate race to the heart of the Yukon Territory, that vast land that is the northwest corner of Canada. The finish line, still 600 miles away, was a small

salmon stream the Indians called Thronduick, or Hammer Water, but that white men mistakenly pronounced Klondike. The prize lay beneath the creeks that fed this minor tributary of the Yukon River. The prize was gold.

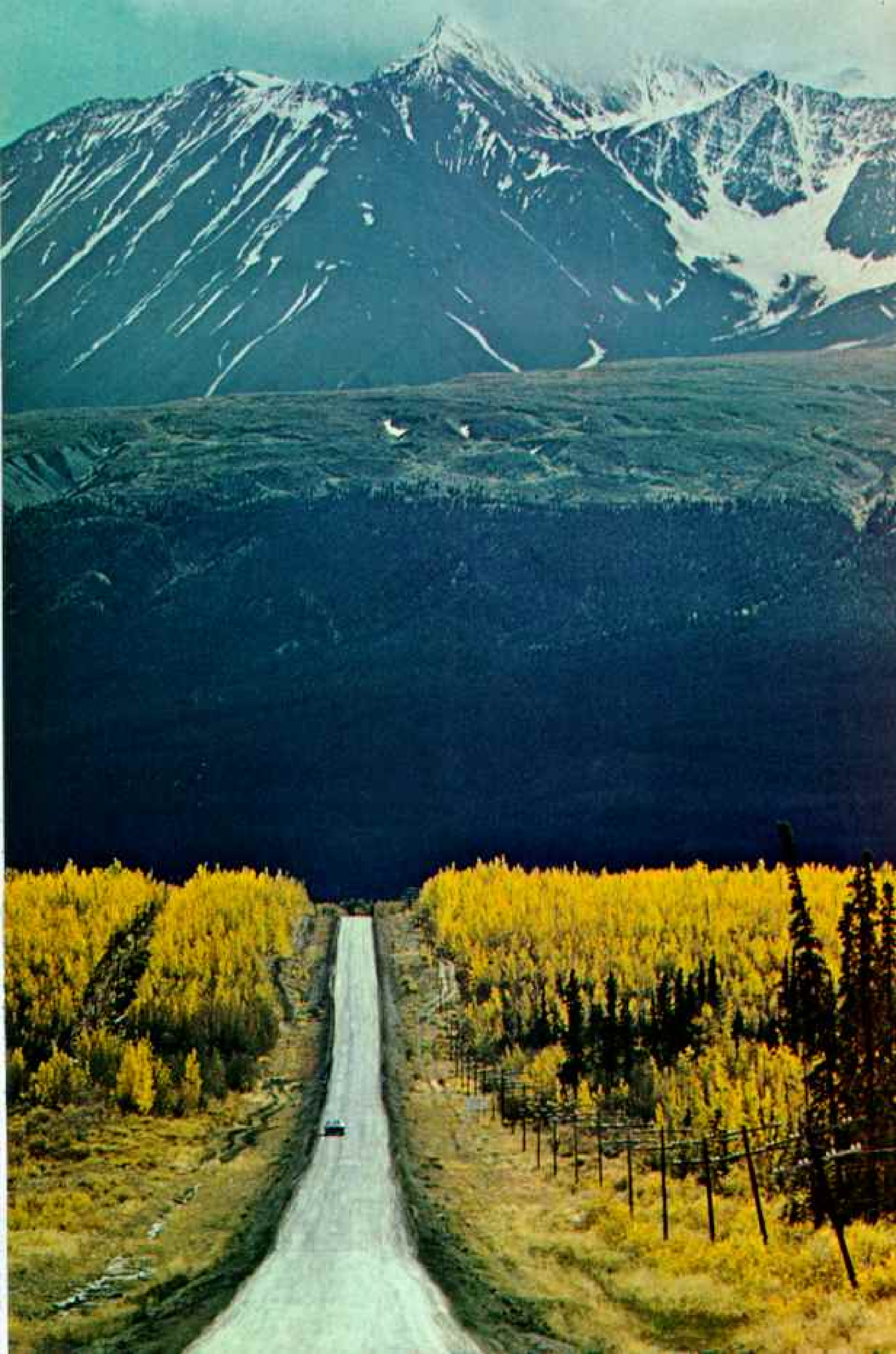
Now, at the foot of the pass on a warm July afternoon, I cinch the padded belt of my backpack tighter around my hips and glance over at my companion, Lowry Toombs, a good friend and Chilkoot veteran. He grins back: "If it were any steeper, we'd have to use ropes. Keep three-point contact and your weight forward. OK? Let's do it."



THIRD BOOM FOR WHITEHORSE

TRAFFIC JAMS pose few problems in Canada's Yukon Territory, where 23,000 people enjoy 207,076 square miles (536,326 square kilometers) of unspoiled wilderness. Established in 1898 during the gold rush, the Yukon still relies on mining: lead, zinc, silver, copper, and asbestos. But tourism is booming, with 300,000 visitors last year, and the economy will soon get a boost from a natural-gas pipeline that will parallel the Alaska Highway (right).





And so we climb, picking our way up the 1,250-foot tumble of jagged, man-size boulders that for two-thirds of the year is blanketed with snow. With frequent rest stops, and after a couple of heartbreaking false summits, we reach the top. A cairn marks the international boundary; ahead lies Canada. I am dog-tired, but more than a little pleased with myself.

We have hiked 16 tough miles from the abandoned port of Dyea, near Skagway, Alaska. It was there that the coastal steamers from San Francisco and Seattle disgorged their cargoes of gold seekers. And now we

have scaled the pass itself. I am filled with respect for those who, 80 years before, made the final climb not once, but twenty times or more; a wise Canadian law stipulated that each man must bring 1,150 pounds of food with him, enough for one year.

Women, Too, Braved Trail of '98

That respect would stay with me as I crisscrossed the Yukon, talking to many of the 23,000 proud people who live there today. People who, in a charming example of northern chauvinism, refer to the rest of the world



EXPERT SHINNIER, a porcupine (above) could offer a few pointers to a grease monkey of the sporting variety (right), who loses his slippery grip at the annual Discovery Days celebration in Dawson. Such revels provide release for Yukoners, who must endure long dark winters between precious summers of midnight light.

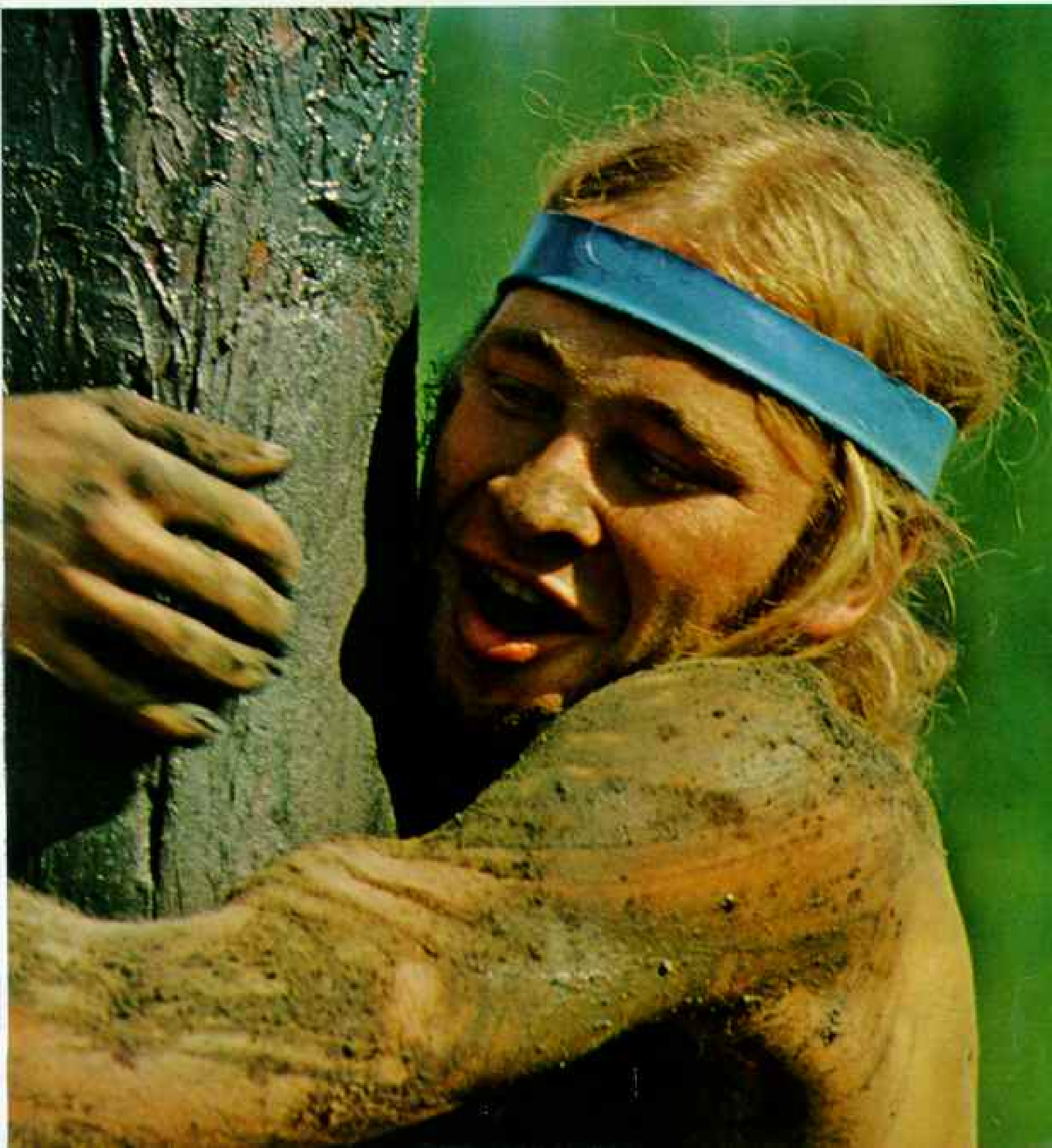


as "outside." (See "Close-Up: Canada"—British Columbia, Alberta, Yukon, a supplement to this issue.)

The rigors of the Trail of '98 did not end at the summit, and not all who walked it were men. Winding beside alpine lakes, past foaming cataracts, the rocky path noses down toward Lake Lindeman. One woman who made the trip described this section: "The trail led through a scrub pine forest where we tripped over bare roots of trees that curled over and around rocks and boulders like great devil-fishes. Rocks! Rocks! Rocks! Tearing boots

to pieces. Hands bleeding with scratches. I can bear it no longer." But bear it she did. The woman was Martha Louise Black, who left Chicago to go to the Klondike and manage a sawmill. She made it, and later was elected to the Canadian Parliament.

Lake Lindeman was the stopping point for many of the footsore stampeders. They would spend the rest of the winter building boats in anticipation of the spring thaw. From here they could sail down the series of lakes that make up the headwaters of the Yukon, to the river itself, *(Continued on page 558)*





"Steeped in eternal beauty, crystalline waters and woods," wrote Robert Service, the bard of the Yukon, of the land he loved. Here mist rises in luminous



tendrils from a stream 15 miles south of Stewart Crossing. The territory's many rivers are being studied as potential sources of hydroelectric power.

LIVING OFF THE LAND

CARIBOU STEW rivets the attention of three Loucheaux Indian boys: Carl, Kenny, and Doug. The youths have journeyed by dogsled to Old Crow Flats, 60 miles north of the isolated village of Old Crow, to trap muskrats with their father, Alfred Charlie (below). Sale of the pelts helps support the family. When muskrats are scarce, dogs, too, get caribou for supper (facing page, above). Though snowmobiles now outnumber dog teams, the iron brutes can't compete with the real things for dependability . . . or can they? Doug tries to teach two balky pups to pull. "I had to be lead dog," he explains. Yukon Indians, about 25 percent of the population, are negotiating a land-claims settlement with the federal government that they hope will preserve their way of life.





FRESH FACE of the Yukon, Shelly Craig is among a growing number of young people seeking adventure and opportunity in this rugged northland, where the median age is only 24.



(Continued from page 553) whose swift current would carry them to Dawson City and the goldfields.

As wood became scarce at Lindeman, others rushed on to the shores of Bennett Lake. When the ice broke in the lakes on May 29, 1898, more than 7,000 boats shoved off for the Klondike.

Bennett was our trail's end, too. There we would board the train for Whitehorse, capital of the Yukon Territory.

We camped that night midway between the two lakes and feasted on sourdough biscuits and honey. The stampedeers' preference for that flavorful yeast substitute spawned a tradition. To this day those who have seen the ice go out may claim the title of sourdough. I

was to come across another definition: "sour on the Yukon and not enough dough to get out." But it was offered with a smile.

The next morning we arrived at the depot in Bennett just in time to hear the approaching wail of the White Pass and Yukon. The narrow-gauge train chugs between Skagway and Whitehorse via the White Pass—longer than the Chilkoot but not as steep. Built as a direct result of the gold rush, the railway has been operating steadily, though not necessarily on time, since 1900. Today it is the centerpiece of an integrated road-rail-sea transportation system.

Finding two seats in the tourist-laden train, we rattled and lurched our way to the one intermediate stop along the route—the sleepy village of Carcross, population 240. The shy woodland caribou haven't crossed the river here since the railroad bridge was built. But the village retains much of its flavor. Many buildings are log constructed, and an old stern-wheeler speaks of past glories.

Several of the Yukon's most famous characters lie buried in the cemetery. Two, Skookum Jim and Tagish Charley, along with George Carmack, made history when they discovered gold on Rabbit Creek, renamed Bonanza, on August 16, 1896. By the following year, much of the world had heard about their find.

Yukoners Mourn Irreverent Bird

I first learned of another famous character buried here when I walked into the sunny, plant-draped café of the Caribou Hotel, and was met by the insolent stares of three bright-plumed parrots. And what, I asked the waitress, would these tropical birds be doing here in the subarctic?

"Why, they're Polly's replacements," she said. Later I learned the details.

Polly had been orphaned at 70, so the story goes, when her owner, a Captain Alexander, was lost at sea in 1919. She was a fixture at the hotel until her death in 1972. The old bird's funeral, attended by dozens of mourners, made news across Canada.

In her day Polly was known to have had a taste for strong spirits. And, though she reportedly learned to squawk "Onward, Christian Soldiers," religion never really took hold. To the end, whenever asked if she wanted a cracker, Polly would unfailingly screech: "Go to hell!"

From Carcross it is a short hop to Whitehorse, whose 15,000 people make up two-thirds of the territory's population. At first glance the Yukon capital seems a somewhat drab collection of low, post-World War II buildings that have been uprooted from Anytown, North America, and dropped into this wilderness. Closer inspection reveals some surprises. Like the international jetport on a bluff overlooking the city, or the excellent restaurants, such as the Golden Garter, serving up some of the finest French fare I've ever tasted. Or the half-dozen banks, a large museum, and a first-rate library.

Whitehorse has seen two great booms. The first was at its birth in the gold rush, when the stampeders stopped here to dry their socks after the run through treacherous Whitehorse Rapids. The second was in 1942, when the U.S. Army, fearing a Japanese invasion of Alaska, built the Alaska Highway through the southern Yukon. Today the city is on the verge of a third boom.

Gas Pipeline Stirs Controversy

Last September, after months of negotiation between Canada and the United States, a plan was approved to pipe natural gas from Prudhoe Bay, Alaska, to markets in the lower forty-eight states. The line will cross the Yukon, paralleling the Alaska Highway.

Many in the territory feel that the project's long-term benefits—tax revenues totaling perhaps a billion dollars by the year 2000—outweigh all arguments. Others disagree.

Martyn Williams is an elementary school teacher and avid outdoorsman who, among other things, teaches his students how to survive in the bush. He is also president of the Yukon Conservation Society. And he is worried: "It's the construction phase that worries us most, in terms of environmental degradation and social impact. But also we feel that the pipeline will be just the start of a new life-style for the Yukon. Once a big project is started, as in Alaska, there's pressure on to keep the boom going, to keep things rolling. We believe the Yukon must have low growth if its wilderness values are to be preserved."

Commissioner of the Territory Art Pearson admits: "The pipeline is never going to satisfy those who want the Yukon to remain precisely the way it is today. It will change the Yukon. But I feel we can manage the project,

GRIZZLED VISAGE of "O. D." Brown in a Whitehorse café seems the image of an old sourdough. Yukoners take pride in their gold-rush roots that snared Robert Service's race of men "that can't stay still."*



avoiding the massive impact of in-migration and consequent inflation, so that it will change it for the good."

Before agreement on the Alaska Highway line was reached, one proposal would have routed the pipe across the northern Yukon interior to connect with gas deposits in the Northwest Territories. That suggestion was tabled because of the effect it would have had on Old Crow. The village of 200 Loucheaux Indians sits beside the Porcupine River, some 70 miles above the Arctic Circle. Its one transportation link is a well-maintained airstrip. Of the 12 native communities in the Yukon,

*This line and others by Service are from *Collected Poems of Robert Service*, published by Dodd, Mead & Company, New York.

Old Crow, because of its isolation, has remained the least influenced by white culture.

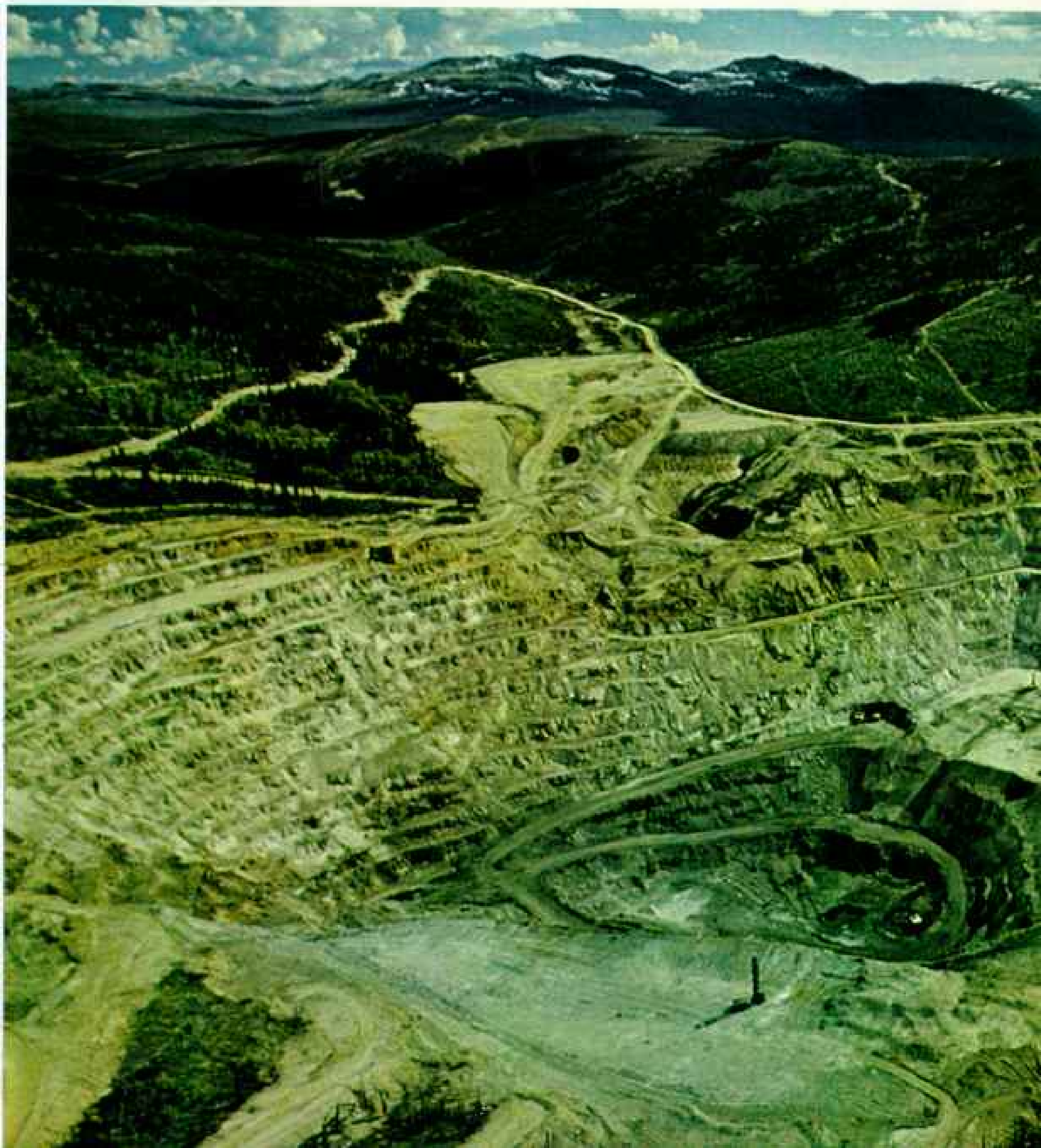
It was snowing the day photographer George Mobley and I arrived in late April. Yielding to snowmobiles as they buzzed by us, we walked through town to our room above the co-op store, past the clattering power plant, the government-run school and nursing station, the police barracks—necessary implements of civilization, perhaps. Sometimes, though, the government gets

carried away, like the time it delivered twenty freezers in the dead of winter.

Nearly all Old Crow Indians receive some government support, but many still return to the bush for part of the year, to hunt and trap as they have always done.

Each spring, before the snows are gone, Alfred Charlie hitches up his dogs and heads for Old Crow Flats, 60 miles to the north, to trap muskrats on the frozen lakes (pages 556-7). The pelts he will sell; the meat will feed his

Giant amphitheater, the Cyprus Anvil Mine near Faro produces lead and zinc



dogs and himself. He is a sinewy 53 years old, tireless, and quick to smile. This year he was taking three of his sons with him: Carl, 17, Kenny, 15, and Doug, 13. We were granted permission to go along. With a rented snowmobile towing a toboggan piled high with gear, we were ready.

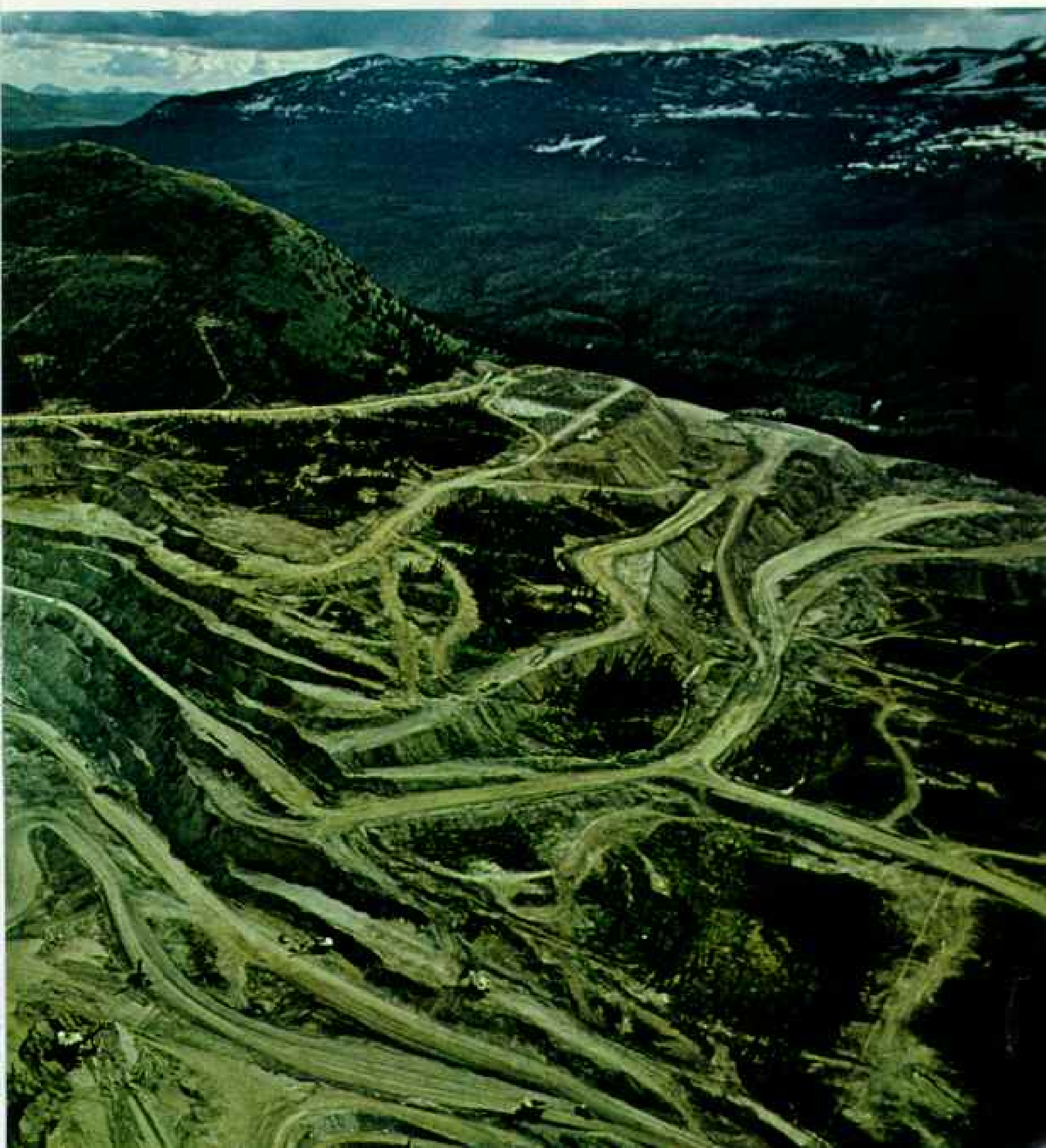
Crow Flats may indeed be flat, but getting there is anything but. Three mountain ridges must be crossed. We were soon cursing our recalcitrant steed, which had a nose for the

deepest drifts. It seemed after a time that we were pulling it more than it was pulling us.

We stopped at the halfway point for the night, though it never got dark. Doug tethered the dogs and gave each a ration of dried caribou meat. As Alfred was lighting the small wood stove and I was trying to decide whether I was too cold to be tired or too tired to be hungry, I noticed Carl pull something from his pack. He pushed a button, and in that Arctic stillness came the most incongruous

for export. The operation accounts for 40 percent of the Yukon's economy.

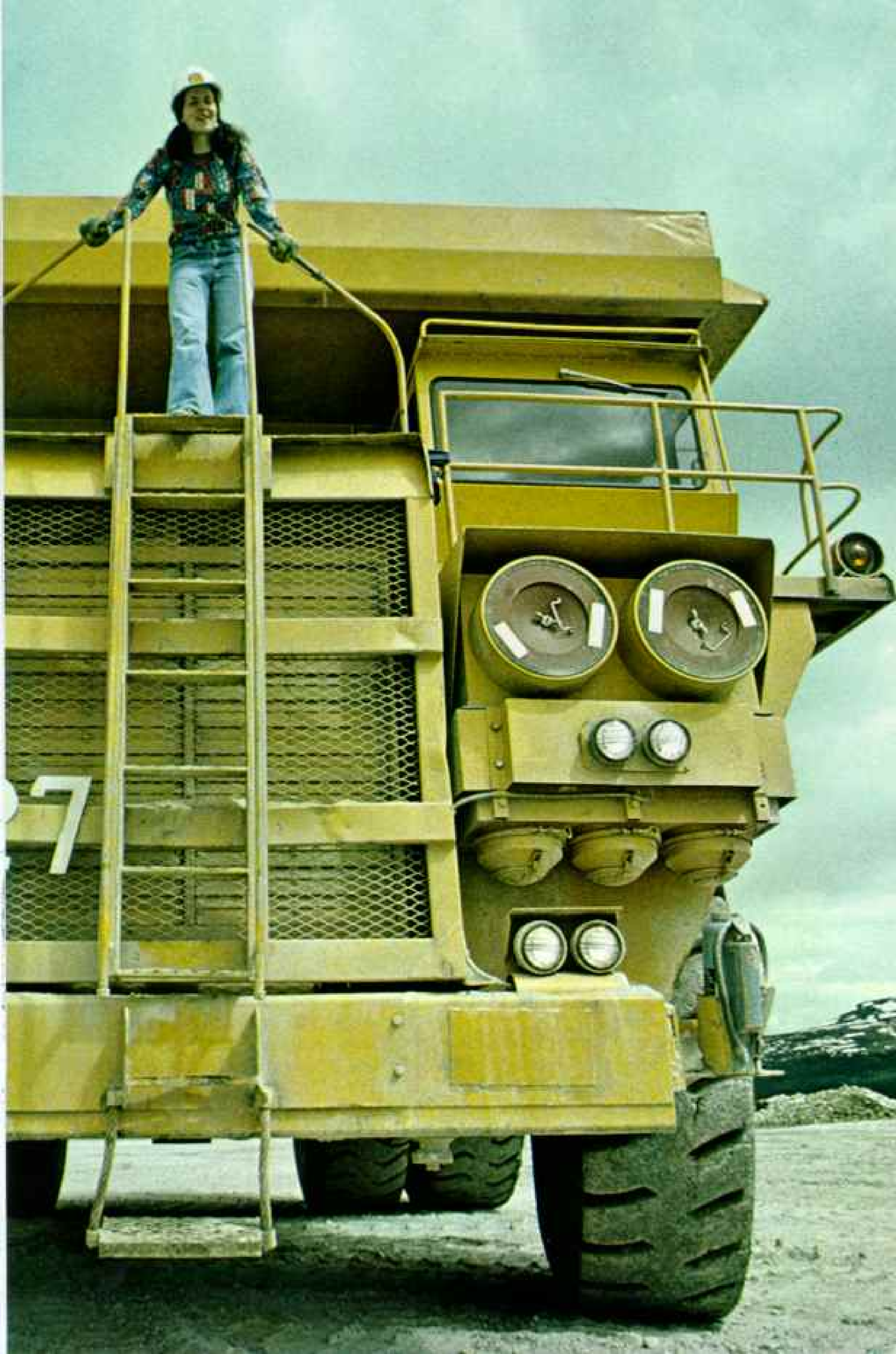
561

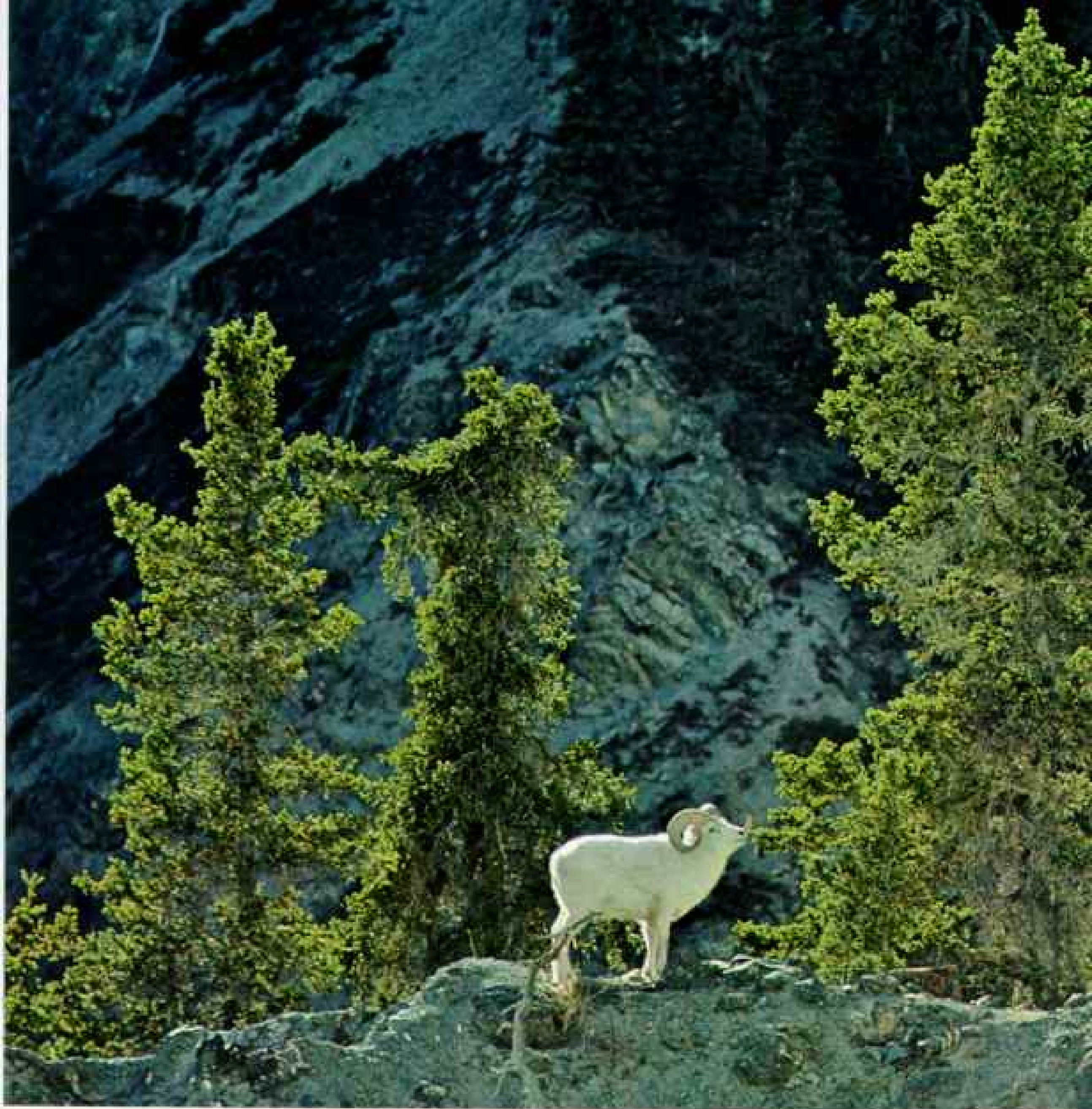


I DON'T have to change the tires," says Wendy Kostiuk, 22, atop the 120-ton ore hauler (right) that she operates for the Anvil Mine. Wendy was the first woman hired to wheel the big trucks. "If anyone had told me three years ago that I'd be driving a truck like this, I'd have told him he was nuts.

"I guess the closest call I've had was the winter before last, when another truck started sliding toward mine. He didn't miss me by much!" Wendy's fascination with machines extends into leisure time, when she exercises her motorcycle, and her pet Doberman pinscher (below), near the mining town of Faro.







sound I could imagine—the Beach Boys, tinnily harmonizing: “Honolulu, Waikiki—Do you want to come along with me?” I still smile when I think about it.

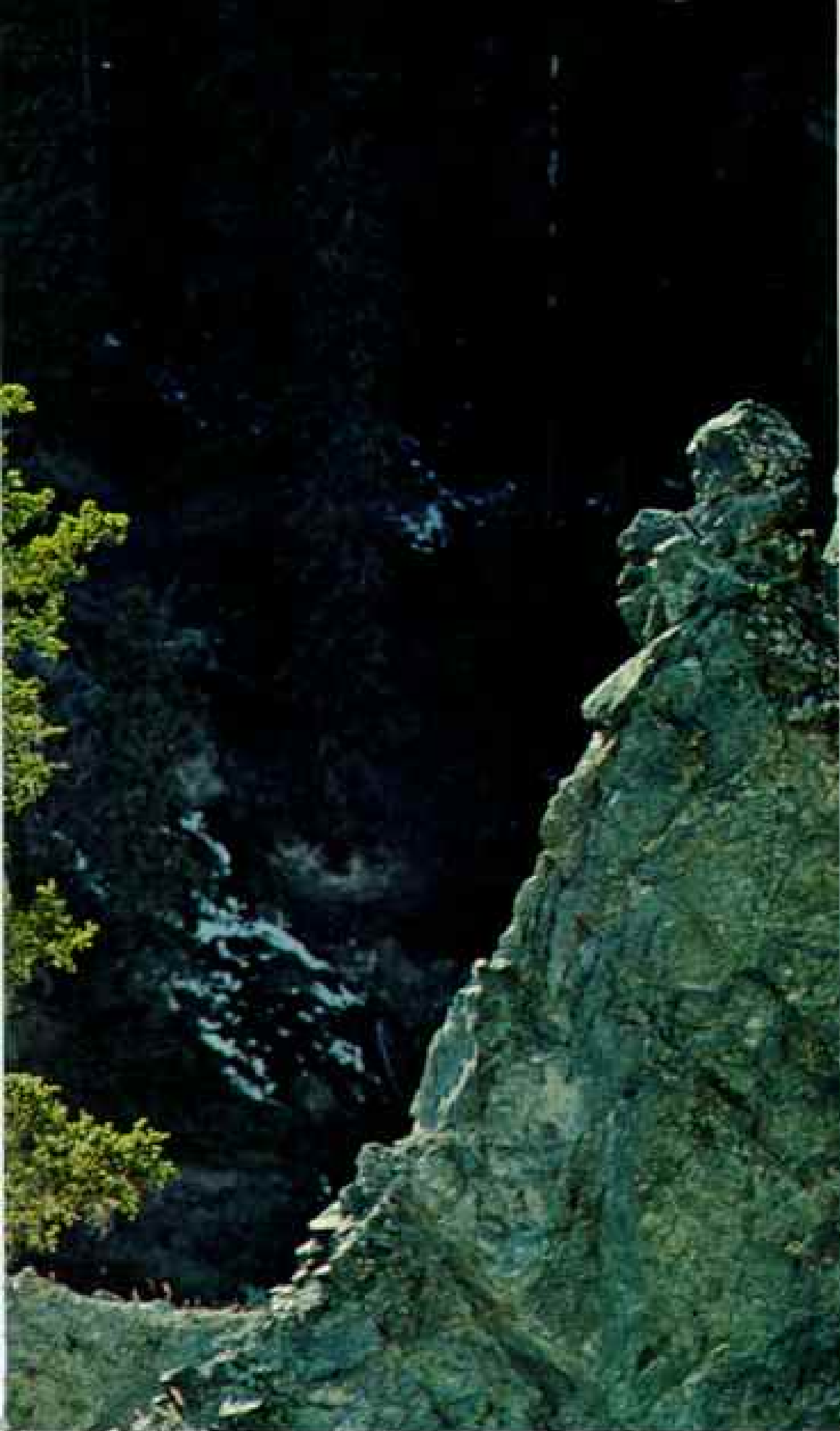
The next day the trail improved, and before long we were in the flats, zipping across the lakes and struggling up and over intervening portages. We reached the campsite and pitched Alfred’s 10-by-12-foot tent over a floor of spruce boughs. Inside there was room for us all to stretch out, with one corner reserved for the stove.

After a supper of caribou stew and bannock

—delicious panfried bread—I asked Alfred why his sons were not in school. He replied in his soft voice: “Right now these boys in school here in Crow Flat. Learn how to live; pitch tent, set trap. Learn all the old ways. Otherwise,” he laughed, “pretty soon they be just like you!”

Muskrat: An Acquired Taste?

During the next few days we accompanied Alfred as he searched for telltale mounds in the snow that signal “rat houses.” He was discouraged. “This is worst spring I ever saw.



KING OF THE MOUNTAIN: A nimble Dall ram picks his way along a ridge in Kluane National Park (left). Nearby, a wild crocus heralds spring (below). Other residents include wolf, moose, and bear. Dominating the southwest corner of the territory, the park encompasses some 8,500 square miles of glacier-ribboned peaks.



Too warm. Too much snow. Rat houses all flooded."

Finally, after many empty traps, we bagged four plump muskrats. They were quickly skinned and cleaned, their pelts left to dry in the sun. That evening we had our long-awaited muskrat dinner. And if you've never bitten into a steaming muskrat haunch, cooked over a wood stove with just a pinch of salt, you haven't missed a thing!

We bade farewell to Alfred and the boys, who would remain in the flats until June, and returned to Old Crow, traveling at night when

the crust would better support our weight.

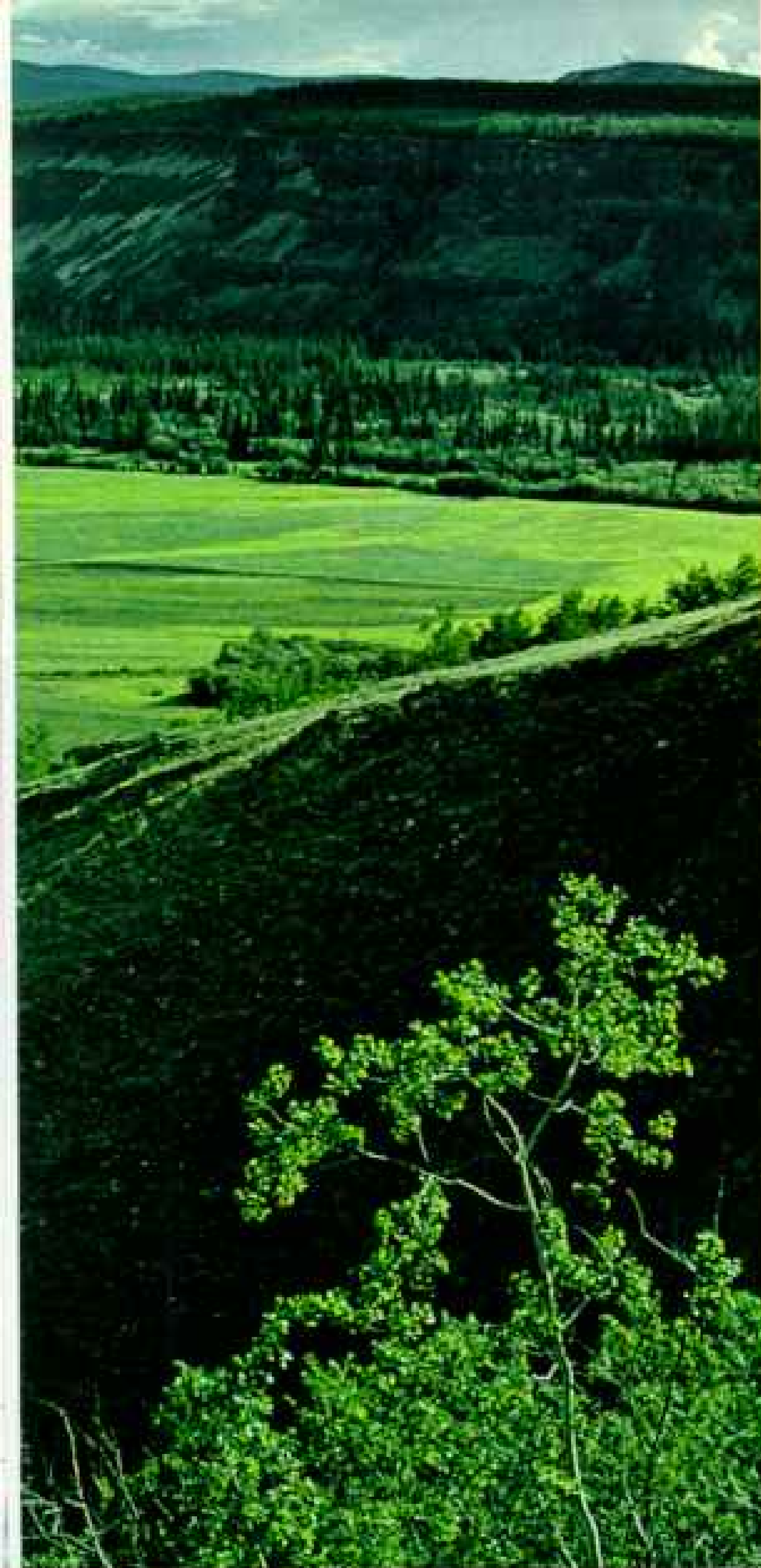
On the flight back to Whitehorse I met Grafton Njootli. Now 30, he was the first Old Crow Indian to finish high school and to attend college, at the University of Alaska. He talked about his hopes for the village: "We want progress, yes. But not at the expense of our culture. People may go to the flats by bush plane, but they will still go. And someday I'd like to see running water and bathtubs. You know, *luxuries*." That day may not be far off.

Under the leadership of the Council for Yukon Indians (CYI), Indian people, about



DOWN ON THE FARM

SPRING TONIC draws a neigh vote (left) at the Pelly River Ranch (above). During the short growing season, Hugh and Dick Bradley, with Dick's wife, Marjorie, and their son, Glen (right), raise grain for sixty head of cattle, along with potatoes and a vegetable garden. Says Hugh, "We harvest enough for ourselves, and a little more besides."



one-fourth of the total population, are negotiating a land-claims settlement with the federal government. "Our mandate is to get the best possible deal for our people," Ken Kane, communications director for CYI, told me. "Number one, we're asking for land. Land is the cornerstone of our life. And we're asking for money for the damage that has already been done."

Federal negotiator Wally Gryba believes the claim is justified: "Our position is that for the 'silent conquest,' for the incursion of the European on the Indian way of life and on the Indian land, there is compensation due." But some non-natives express misgivings.

Dan Lang, 29, one of 12 members of the Yukon Legislative Assembly, wonders about the justness of land claims: "I don't understand how anyone, because he possibly walked across a piece of land, or his ancestors did, can think that he has a claim to it. The land is your economy, and your economy should be there to support everyone."

Ken Kane responds: "This is big country up here. We're willing to share it, but we want to make sure that the people who were here first have a stake in the future."

Indian Land Claims Could Include Park

The issue is complex, and its effects reach across the Yukon. In 1972, for instance, the Canadian Government established Kluane National Park in the southwest corner of the territory. It is 8,500 square miles huge (22,100 square kilometers) and has some of the largest glaciers in the world outside the polar ice caps, along with the highest mountains in Canada, including Mount Logan, rising nearly 20,000 feet (page 577). The front ranges support perhaps the best representation of large mammals in North America.

The park administration is currently wrestling with the problem of visitor access. Should roads be built into this ecologically sensitive area? Should the park exist only for those who are able to hike the 30-mile round trip to see a glacier?

Along with those questions, park superintendent Jim Masyk has another concern. "The land-claims question could constitute a very serious obstacle in planning the park," he explained. "There is a chance, a very good chance in fact, that the boundary of the park will change—that part, indeed perhaps all, of



the park will be claimed. However, I believe the possibility of anyone's claiming the ice fields as a traditional hunting area to be extremely remote."

Even more far-reaching are the possible effects that land claims could have on mining—backbone of the Yukon economy. "We're just hoping that everybody involved is wise enough not to kill the number-one industry," Dutch Van Tassell told me in his Whitehorse office. Dutch is the chief of exploration for United Keno Hill Mines, which has been taking silver out of its mines at Elsa for thirty

years. "If the Indians are clever," he continued, "they will ask for reasonable royalties from the mining industry rather than tie up land so that there's no access."

Huge Mine Bolsters Economy

In recent years several large ore bodies have been discovered, and experts believe the territory's surface has barely been scratched.

At present there are four major mining operations: the Keno mines, Cassiar Asbestos at Clinton Creek, Whitehorse Copper just outside the capital, and the Goliath of them



all, Cyprus Anvil's lead-zinc mine at Faro (pages 560-61). Last year it grossed a hundred million dollars—roughly 40 percent of the territory's total income.

The town of Faro grew up with the mine in the late sixties. Now, boasting a population of just over 1,500, it is the second largest community in the Yukon. Thirteen miles out of town lies the open-pit mine.

I drove my rental car as far as the gatehouse and was met there by the assistant mine superintendent, George Everett, who offered to show me around. Donning the

proffered hard hat, I climbed into his pickup. "You may as well see it from the top," he said, as we bounced our way to the rim of the pit.

Seven hundred feet below, toy shovels were busy filling toy dump trucks. My sudden realization of the scale of the project must have shown on my face, because George chuckled and said, "We call it the gopher hole." I would not want to meet the gopher.

After a tour of the mill, where, in noisy succession, the ore is crushed, ground, separated, and finally concentrated for shipment to Europe and Japan, I asked George if I could



YUKON EDITOR DOES IT ALL

MAN OF MANY TALENTS, Paul Koring, 23-year-old editor of the *Yukon News*, helps out in all phases of the operation: advising reporter Suzanne Mason (far left, upper), photographing a city meeting, conducting a telephone interview, laying out pages, and loading the finished product (below). With circulation at about 8,850, the Whitehorse paper plans to switch from weekly to daily publication this spring. "It's a small paper in what is still a small city," says Paul, "but it also serves an area the size of France."



take a look at those 120-ton "toy" trucks. He introduced me to one of his veteran drivers. Wendy Kostiuk, 22, smiled hello.

She has been driving for two years, and she is expert (pages 562-3). "It was hard at first, being the only female driver. It was a challenge. I knew I could do it, but I had to prove it." We were creeping down the winding haul road toward the core of the pit. Her feet danced on the pedals. "I've trained six guys now, but I'm a little worried about them. They figure if I can do it, so can they. And it takes a while to get the feel of it, eh?"

She jockeyed the truck up close to one of the giant electric shovels. "I want to learn to run one of those," she said, as the truck shuddered under the impact of 15 cubic yards of rock, "so that if I ever leave, I can get a job anywhere. But I sure love this country. I think there must be a call of the North."

Later, as I was getting ready to leave, Wendy said, "I'll probably be hearing from some of those wise guys about your riding around with me." Then she grinned. "But that's OK. I can handle them." Bet on it.

One Rule for Driving Yukon Roads

From Faro I headed southeast toward Watson Lake, 265 miles away, on the Robert Campbell Highway. The road is named for the Hudson's Bay Company explorer who, in the 1840's, became the first European to probe deep into the Yukon interior.

As with other roads in the territory, the Campbell Highway is unpaved. And, except for a few radicals, Yukoners like the roads that way. In winter, which is much of the time, what's under the snow is irrelevant. In summer they can be very dusty or very muddy, but are generally well maintained and a pleasure to drive. The one rule of the road is quickly learned and never forgotten: When meeting a vehicle larger than your own, yield. In the Yukon, might makes right-of-way.

South of Ross River, a predominantly Indian community of 200, the road meanders across a forested plateau studded with trout-filled lakes and laced by countless streams. Flashes of fireweed, the hardy territorial flower, line the shoulders. There are no facilities and few travelers on this stretch, and I had the road virtually to myself. My only companions were little ground squirrels, seemingly bent on suicide, that waited

until the last moment to dash across my path.

The road ends at the junction of the Alaska Highway in Watson Lake, population 1,100, easternmost and third largest settlement in the territory. Other than for one or two modest sawmills, the town exists for the care and feeding of highway travelers.

When I pulled up to my hotel, there was a fistfight in progress in the parking lot. No one seemed particularly concerned as a drunk man pummeled a drunker man.

Alcohol abuse is not unique to the North, but it is a major headache. "Liquor-related crime is the biggest problem we have in the Yukon," Cpl. Dennis Levy of the Royal Canadian Mounted Police told me. "We have the most liberal liquor laws in Canada. You can drink in any public place. You can even drink while you drive, so long as you're not impaired. The penalty for impaired driving could be a fine of as much as \$2,000. A second offense will land you in jail."

The RCMP has been in the Yukon since the territory's beginnings. It was the Mounties who kept the Klondike gold rush practically violence free. But the famed overland patrols by dogsled are gone. "These days we can drive to every town except Old Crow," said Levy. "And we don't go into the bush in winter anymore unless there's a serious problem. Even then our Twin Otter aircraft gets us where we need to go." There are still those who remember the way it used to be.

Memories From the Good Old Days

In Watson Lake lives one of the Yukon's great natural resources. His name is "Chappie" Chapman and he is 76 years old, but his back is straight and his eyes are clear. At 17 Chappie enlisted in what was then the Royal North West Mounted Police. A year later he opened the RNWMP detachment at Ross River. Warning that "half the lies I tell aren't true," he shared his memories with me.

"Yes, I spent a couple of winters out on patrol from Ross River and Whitehorse. Back then, the Indians would only come to town long enough to get supplies, and maybe for Christmas, and then go back to their traplines. Nowadays, most of them see what they can trap in the beer parlors.

"After I left the force in 1924, I got a job with the old Northern Commercial Company and ended up in Dawson City. Stayed there

twenty years and raised a family. Dawson during the Depression actually boomed, because the price of gold stayed high. Quarters were the smallest coins accepted in the stores.

"In those days travel between Dawson and Whitehorse was like a holiday, in the summer that is. The service on those riverboats was tremendous, just like an ocean liner."

Gold-rush Route Still Navigable

The wedding-cake stern-wheelers haven't plied the Yukon since the mid-1950's, when a road connecting the two cities was completed. But it is still possible to follow the stampede's route to Dawson, and to do it in style, through the services of Yukon Rafting, Ltd. The Dawson-based outfit uses safe, comfortable, 16-foot inflatable Zodiacs, equipped with outboard motors and boatmen to pilot them. Also provided are food, tents, sleeping bags, and anything else required for the trip downriver.

I arranged to rendezvous with Greg Caple, 29, a partner in the enterprise, at the village of Carmacks, a hundred miles north of Whitehorse. From there we would depart on a six-day, 250-mile journey to Dawson.

Greg strode into the Carmacks Hotel swatting the dust of a five-hour drive from his clothes. "I can't wait to get on the river," he said, as he raised a small cloud. Greg is tall, with sharp features and a ruddy complexion. His billed cap and ever present neckerchief complete this portrait of a river rat. With him was Barbara Gale, 24, who would be our first mate and assistant chef.

We loaded our gear into the boat and pushed off late in the afternoon of a perfect August day. The sun made the green water sparkle as it swirled around us. Using the motor sparingly, we were content to let the river set the pace.

Aptly named Great River by the Indians, the Yukon drains an area of 330,000 square miles (858,000 square kilometers), making it the fifth largest in North America. It arches north to the Arctic Circle in Alaska, then sweeps southwest to the Bering Sea, a distance of nearly 2,000 miles (3,200 kilometers).*

We camped that night on a small island about 12 miles down from Carmacks and suffered through a dinner of grilled salmon steaks, buttered boiled potatoes and carrots, crisp green salad, and fresh raspberries for dessert.

After a suitable recovery period, we turned in, and let the river sing us to sleep.

In the morning we geared up for the toughest white water on the trip, Five Finger Rapids. This is one of a score of sites that have been studied as potential sources of hydroelectric power. The tappable energy could amount to 50 billion kilowatt-hours a year—about what the State of Georgia with five million residents produced in 1976.

I recalled a conversation with Jim Smith, former commissioner of the territory and now chairman of the Northern Canada Power Commission. "Our ability to survive," he told me, "is going to be based on our ability to supply our own energy needs. Otherwise, we will forever be dancing to someone else's tune. There is enough choice of water sites so that we can develop those that will have minimal effect on the environment."

For now, at least, there is no dam at Five Finger Rapids. Rock knuckles, like giant stepping-stones, divide the river, and many a stampede's raft was shivered upon them. But the stampede didn't have Zodiacs. We chose the roughest chute and made it through with ease, shipping very little water.

Cattle Ranching in the Subarctic

Below the rapids the river swung in lazy curves between low cliffs pocked with swallows' nests. A few birch trees, like nuggets in a gold pan, were turning yellow on the hillsides, and flocks of geese were honking south. We stopped at several places to explore falling-down cabins that recalled the days when the river was the only highway.

At the confluence of the Pelly River a dozen structures stand at the deserted outpost of Fort Selkirk, established by Robert Campbell in 1848 and rebuilt during the gold rush. We pitched our tent there and then headed up the Pelly several miles to visit one of the few working farms in the territory (pages 566-7).

The Pelly River Ranch is run by the Bradley brothers—Hugh, 46, and Dick, 48, along with Dick's wife, Marjorie, and Glen, their 12-year-old son. The Bradleys have about 300 acres in grain, which feeds their 60 head of cattle. Each year they sell off some of the beef at Pelly Crossing, 30 miles upstream.

We arrived and were immediately invited

*See "Rafting Down the Yukon," by Keith Tryck, NATIONAL GEOGRAPHIC, December 1975.



"GOLD! GOLD IN THE KLONDIKE!"

At news of the strike 100,000 men headed north, dreaming of nuggets by the double handful (above). The stampede's destination was Dawson City (facing page), where the dark waters of the Klondike River meet the silt-laden Yukon. After the 1898 rush, huge gold dredges ripped up the Klondike's creek beds again, leaving long caterpillar-like tailings. Today, with gold bringing \$150 an ounce, the area is once more being staked. At his claim on Hunker Creek a miner (above, right) checks for "colors," while spray from a monitor, or water cannon, which melts and dislodges the frozen ground, splashes down behind



him. A monitor at the Miben Mine (below) eats into the White Channel—an ancient, gold-bearing riverbed.

To preserve the Trail of '98, the U. S. National Park Service and Parks Canada have cooperated in an international historical park. From Seattle, where many stampede's embarked, the park hopscotches to Skagway, Alaska, then over the mountain passes and down the Yukon River to Dawson.





IN FULL REGALIA, a member of the Royal Canadian Mounted Police leads a parade in Dawson City. Mounties have kept the peace in the territory since gold-rush days. Once a boomtown of 30,000, Dawson today has a permanent population of less than 900, and tourist dollars have all but replaced gold dust.

to stay for supper. I tried my hand at milking Little Red, the dairy cow, and later helped churn butter. Over a homegrown meal Hugh talked about farming in the Yukon.

"We came up here in 1954 when we were just starry-eyed kids. Now we're just as broke as when we started, and no wiser either," he said with a twinkle. "We're not in the business of getting the highest possible yield, of figuring so many dollars will produce so much grain. We don't use chemical fertilizers, just manure. We do things the way we do because we like doing them that way.

"There's plenty of room for people to farm up here. But it'd be pretty tough getting started today with prices what they are and land so hard to get."

The Canadian Government owns virtually all the land in the Yukon. I had spoken with the regional manager of land resources, Hiram Beaubier. "A moratorium has been placed on land for agricultural use," he told me, "because we don't know what lands are suitable, and there's been a history of mistakes. We are studying the problem." There are also restrictions on recreational and residential land use, I learned, but not on requests for commercial land. "We simply review those on a case-by-case basis," Beaubier said.

Grizzly Doesn't Overstay Welcome

We left the Pelly farm bearing a parting gift of half a dozen fresh eggs. As we rejoined the Yukon, we saw a bear, a young grizzly, swimming across the river. It landed uncomfortably close to our campsite, but merely shook itself off and lumbered into the forest.

The following night we camped up a quiet slough, and I found myself slapping a few mosquitoes. It is useless to kill a mosquito in the Yukon, I had been told, because a million relatives come to the funeral. But it was late in the season, and their legions had dwindled.

We awoke next morning to a cold drizzle.



It didn't seem to bother a cow moose feeding on willows perhaps fifty yards away. She ignored us and calmly finished her breakfast before disappearing into the trees. As we headed downriver, the sun popped out and played peekaboo the rest of the day. There's a saying in the Yukon: If you don't like the weather, wait five minutes or move five miles.

Our destination was Stewart Island, a one-time riverboat stop about seventy miles from Dawson. It is a strip of land a mile long, but in some places barely a hundred yards wide,



and shrinking. The river is eating it. "We had to move the house back once," Rudy Burian told me over coffee in his comfortable kitchen. Rudy, a small, wiry man with a thatch of graying hair, has lived on the island for four decades and raised a family. He runs a 30-mile trapline in winter and hauls freight in summer. For the benefit of river travelers, he rents cabins and operates a small store.

"I started out as a woodcutter, and I guess I still like having lots of wood around," said Rudy, gesturing to the *two hundred* cords

of split wood stacked high behind the house.

"The country's changed a lot since I've been here," he mused. "All this government, you know. Course it doesn't bother me too much here. I don't pay much attention. They might try to move me out one of these days, but I don't think so. I wouldn't go, anyhow. This is still a free country, you know!" I couldn't help thinking that the Yukon would be safe as long as Rudy Burian was around. We spent that night on Stewart Island and pushed off for Dawson after breakfast.

Before you see the town, you see the scar—the wound that a prehistoric landslide left on the mountain just behind the townsite. It marks the Klondike like an X marks a treasure map.

In all, some three hundred million dollars' worth of gold has been taken from the region. About a third of that was mined during the rush; then companies moved in using huge dredges, whose mazes of tailings still line the creeks.

The great irony of the gold rush is that all but a very few of those who climbed over the Chilkoot Pass and raced to Dawson came away empty-handed. By the time they got there, prospectors who had been in the North for years had already staked every inch of gold-bearing ground.

Brief Reign of the Klondike Kings

We beached our boat on the riverbank just below Front Street, where storefront space at one time sold for \$5,000 a foot. It is hard to imagine that Dawson (page 573), with its present population of less than 900, once burgeoned with 30,000 people—the largest city west of Winnipeg and north of San Francisco—and that a pint of champagne once cost two ounces of gold.

The "Paris of the North," it was called. Down its boardwalk-lined streets strolled the Klondike kings. Men like "Swiftwater" Bill Gates, who bought up every egg in town to impress his paramour, and Charley Anderson, the "Lucky Swede," who was conned into buying a "worthless" claim for \$800 that later yielded a cool million. But their glory was short-lived. Most died broke, and Dawson itself soon emptied when word came of the strike at Nome.

Dawson has seen too many fires for many of its original buildings to be still standing, but a few go back to the turn of the century, and at least one has been completely rebuilt.

AT THE TOP OF CANADA, climbers slog above the clouds, towing gear along the east ridge of 19,520-foot Mount Logan, the nation's loftiest. Superlatives seem well placed in the Yukon. Born of the last great gold rush, set amid unsurpassed splendor, it is a special land. And Yukoners know it.

FRANK W. BEUMANN





Today the Palace Grand Theatre packs in crowds of tourists to see the Gaslight Follies, counterpart of the Frantic Follies in Whitehorse. The vaudeville shows draw heavily from the ballads of Robert Service, beloved bard of the Yukon.

"The Follies are one of our major attractions," director of tourism Karl Crosby told me. "In the Yukon we have wilderness, and we have history. The Follies put people into the boots of miners who may have seen the same type of show during the gold rush."

Tourism is the territory's second largest industry. Some 300,000 visitors came to the Yukon last year and left thirty million dollars behind. A portion of that money found its way into the croupiers' boxes at Dawson's Diamond Tooth Gertie's—the only legal gambling casino in Canada. Named for one of the "ladies" of the gold rush, the hall is run by the nonprofit Klondike Visitors Association. I made a modest contribution.

Wolves Adjust to a Scent of Man

Not everyone in Dawson depends on tourist dollars. "I started out in the grocery business," Fred Caley told me, over the well-worn counter of his store. "That's been my gold mine. Now tourism's the big thing, of course. But it's the miners and local people who have kept me in business."

The conversation was interrupted by a small customer who asked the price of a large candy bar. "What do you have there, a nickel? Well, that'll do," said Fred, stifling a smile.

"There are a lot more people coming through town these days," he continued. "There was a time, you know, when a wolf wouldn't cross a man scent. Now he will. He has to.

"I tried my hand at mining when I first came up fifty years ago. Didn't make any money. Didn't lose any either. It's mostly younger fellas mining now." With gold at \$150 an ounce, many of the old claims around Dawson have been restaked.

I drove out the Hunker Creek road to the Miben Mine, owned by Mike Stutter and

Benny Warnsby. I watched with Benny as powerful water cannons, pumping 3,000 gallons a minute, bit into an ancient riverbed above the creek and washed the earth toward a long, narrow sluice box that reached down the hill. Mike, atop a bulldozer, was pushing the mud into the mouth of the box. On its way down, any gold, with a specific gravity 19 times that of water, would sink, and lodge in riffles that lined the bottom. Though the methods have changed, the principle has remained the same.

"There's not much to it, really," said Benny. "It's just a matter of getting the dirt into the box."

"And leaving the gold behind!" said Mike, as he walked over to us.

It was Benny's turn on the dozer, and I joined Mike for soup and a sandwich in his trailer. Mike is tall and deeply tanned, looking younger than his 48 years. He spoke of his feeling for the land. "It gets under your skin," he said. "There's a lot of room up here. I guess that's what I like about it. There's enough room for a man to be himself."

As if on impulse, he reached under the couch, pulled out a small coffee can, and casually handed it to me. The can must have weighed five pounds. "That's some of the coarser stuff," he said. It was more gold than I had ever seen, or ever dreamed. It seemed to glow with a dull luster all its own. Reading my mind, Mike said: "You know, it's funny, most people seem to find magic in the gold. But I mostly like looking for it. Once I've got it, I lose interest. I guess I'm like the guy in that Robert Service poem." I knew the verse he meant:

*There's gold, and it's haunting and haunting;
It's luring me on as of old;
Yet it isn't the gold that I'm wanting
So much as just finding the gold.
It's the great, big, broad land 'way up yonder,
It's the forests where silence has lease;
It's the beauty that thrills me with wonder,
It's the stillness that fills me with peace.*

□

SIX-MONTH INDEX AVAILABLE

As one of the benefits of membership in the National Geographic Society, an index for each six-month volume will be sent free to members, upon request.

The index to Volume 152 (July-December 1977) is now ready.

NATIONAL GEOGRAPHIC SOCIETY

WASHINGTON, D. C.

Organized "for the increase and diffusion of geographic knowledge"

GILBERT HOVEY GROSVENOR

*Editor, 1899-1934; President, 1920-1934
Chairman of the Board, 1934-1966*



THE NATIONAL GEOGRAPHIC SOCIETY is chartered in Washington, D. C., in accordance with the laws of the United States, as a nonprofit scientific and educational organization. Since 1890 the Society has supported 1,314 explorations and research projects, adding immeasurably to man's knowledge of earth, sea, and sky. It diffuses this knowledge through its monthly journal, NATIONAL GEOGRAPHIC; its books, globes, atlases, filmstrips, and educational films; National Geographic WORLD, a magazine for children age 8 and older; information services; technical reports; exhibits in Explorers Hall; and television.

ROBERT E. DOYLE, President
GILBERT M. GROSVENOR, Vice President
OWEN R. ANDERSON, Vice President and Secretary
HILLEARY F. HOSKINSON, Vice President and Treasurer
WILLIAM T. BELL, FRANK S. DELK,
LEONARD J. GRANT, RAYMOND T. McELLIOTT, JR.,
C. VERNON SANDERS, EDWIN W. SNIDER
Associate Secretaries

BOARD OF TRUSTEES

MELVIN M. PAYNE, Chairman of the Board
LLOYD H. ELLIOTT, Vice Chairman,
President, George Washington University
MELVILLE BELL GROSVENOR, Chairman Emeritus
THOMAS W. MCKNEW, Advisory Chairman

FRANK BORMAN, Chairman of the Board and President, Eastern Airlines
J. CARTER BROWN, Director, National Gallery of Art
WARREN E. BURGER, Chief Justice of the United States
ROBERT E. DOYLE, President, National Geographic Society
GEORGE M. ELSEY, President, American National Red Cross
GILBERT M. GROSVENOR, Editor, National Geographic
ARTHUR B. HANSON, General Counsel, National Geographic Society
CARYL P. HASKINS, Former President, Carnegie Institution of Washington
JEROME H. HOLLAND, Former U. S. Ambassador to Sweden
CARLISLE H. HUMELSINE, President, The Colonial Williamsburg Foundation
MRS. LYNDON B. JOHNSON
CURTIS E. LEMAY, Former Chief of Staff, U. S. Air Force

WM. McCHESNEY MARTIN, JR., Former Chairman, Board of Governors, Federal Reserve System
LAURANCE S. ROCKEFELLER, President, Rockefeller Brothers Fund
ROBERT C. SEAMANS, JR., Henry R. Luce Professor of Environment and Public Policy, Massachusetts Institute of Technology
FREDERICK G. VOSBURGH, Former Editor, National Geographic
JAMES H. WAKELIN, JR., Former Assistant Secretary of Commerce for Science and Technology
JAMES E. WEBB, Former Administrator, National Aeronautics and Space Administration
CONRAD L. WIRTH, Former Director, National Park Service
Trustees Emeritus
CRAWFORD H. GREENEWALT
JUAN T. TRIPPE
ALEXANDER WETMORE
LOUIS B. WRIGHT

COMMITTEE FOR RESEARCH AND EXPLORATION

MELVIN M. PAYNE, Chairman
EDWIN W. SNIDER, Secretary
ALEXANDER WETMORE, Chairman Emeritus

BARRY C. BISHOP, National Geographic Staff; ROBERT E. DOYLE, GILBERT M. GROSVENOR, MELVILLE BELL GROSVENOR, CARYL P. HASKINS, STERLING B. HENDRICKS, Scientist Emeritus, U. S. Department of Agriculture; THOMAS W. MCKNEW, BETTY J. MEGGERS, Research Associate-Anthropology, Smithsonian Institution; T. DALE STEWART, Physical Anthropologist Emeritus, Smithsonian Institution; GEORGE E. STUART, FREDERICK G. VOSBURGH, JAMES H. WAKELIN, JR., GEORGE E. WATSON, Curator of Birds, Smithsonian Institution; FRANK C. WHITMORE, JR., Research Geologist, U. S. Geological Survey; CONRAD L. WIRTH, LOUIS B. WRIGHT, and PAUL A. ZAHL, Former Senior Scientist, National Geographic Staff

ASSISTANT SECRETARIES OF THE SOCIETY: Joseph B. Hogan, James P. Kelly, Adrian L. Loflin, Jr., Lewis P. Lowe, Ward S. Phelps, Clara Pride

ASSISTANT TREASURER: Alfred J. Hayre. **Assistants to the President:** Earl Collins, Jr., Richard E. Pearson. **Administrative:** D. Evelyn Carnahan, Janet C. Soper

SECRETARY'S STAFF: Accounting: Martha Allen Haggitt, Dorothy L. Dameron, Jay H. Givens, Laura L. Leight, William G. McGhee, George E. Newstedt, David H. Peters, James M. Swartz. Administration: Ruth E. Clark, Frederick C. Gale, Robert V. Koenig, Zbigniew Jan Lutyk, Joyce S. Sanford, Karen F. Shrewsbury, Frank M. Twigger. Computer: James G. Schmelzer. Educational Services: Jerome F. Dwecker, Carl W. Harmon, Jr. **Employer Benefits:** Howard R. Hudson, Mary L. Whitmore. **Explorers Hall:** Peter Porpora. **Membership Services:** Margaret L. Bassford, Robert C. Dove, Erma T. Goetzinger, William T. McDonnell, Jimmie D. Pride-more, Charles P. Thomas, Paul B. Tylor, Dorothy M. Wagner, Marguerite M. Wise, Peter F. Woods. **Personnel:** Thomas L. Hartman, M. D., Robert E. Howell, Glenn G. Pepperman, Shirley N. Wilson. **Printing:** Joe M. Barlett, Frank S. Oliverio, Wilhelm R. Sasse, Hans H. Wegner. **Promotion:** Charles T. Kneeland, Robert J. Warfel, Robert L. Feige, Joseph S. Fowler, Thomas M. Kent, F. William Rath, Towne Windsor. **Purchasing:** Robert G. Corey, Thomas L. Fletcher, Sheila H. Immel

ADVERTISING: Director: James L. Till, 1251 Avenue of the Americas, New York 10020. **Regional managers—Eastern:** George W. Kellner, New York. **Midwestern:** Robert R. Henn, Chicago. **San Francisco:** Cecil H. London. **Los Angeles:** Richard H. Lehman. **Detroit:** George E. Moffat. **Canada:** Robert W. Horan, New York. **International:** John F. Grant, New York. **Travel:** Gerald A. Van Splinter, New York. **European Director:** Michel A. Boutin, 90 Ave. des Champs-Élysées 75008, Paris. **Business Manager:** Peter W. Michaels. **Asst. to Director:** Blanche Coffey

COPYRIGHT © 1978 National Geographic Society, 17th and M Sts., N.W., Washington, D. C. 20036. Second-class postage paid at Washington, D. C., and additional mailing offices. Cover design and title protected by U. S. and foreign trademark registrations. \$10 a year, \$1.25 a copy. **POSTMASTER:** Send change of address form 3579 to address above.

MELVIN M. PAYNE, Chairman of the Board

ROBERT E. DOYLE, President of the Society

MELVILLE BELL GROSVENOR, Editor Emeritus

NATIONAL GEOGRAPHIC MAGAZINE

GILBERT M. GROSVENOR, Editor

W. E. GARRETT

JOSEPH JUDGE

Associate Editor, Illustrations Associate Editor, Text

SENIOR ASSISTANT EDITORS

James Cerruti, *Five-Yearly Articles*; Robert E. Gibka, *Photography*; William Graves, *Expeditions*; Edward J. Linehan, *Manuscripts*; Samuel W. Matthews, *Production*; O. Louis Mazzatenta, *Layout*; Howard E. Poole, *Art*; Carolyn Bennett Patterson, *Legends*; Thomas R. Smith, *Illustrations*; Kenneth F. Weaver, *Science*; Ann K. Wendt, *Research*; Herbert S. Wilburn, Jr., *Control Center*

TEXT

ASSISTANT EDITORS: Rowe Findley, Allan C. Fisher, Jr., Robert P. Jordan, Bart McDowell, Elizabeth A. Moore, Marie Severy

SENIOR WRITERS: Thomas J. Abercrombie, David S. Boyer, William S. Ellis, Howard LaFay, John J. Putman, Volkmar Wentant, Peter T. White

SENIOR EDITORIAL STAFF: Harvey Arden, Kent Britz, Thomas Y. Carby, Mike Edwards, Boyd Gibbons, Rick Gore, Noel Grove, Alice J. Hall, Bryan Hodgson, Ethel A. Starbird, Gordon Young

EDITORIAL STAFF: Robert Booth, John L. Eliot, David Jeffery, Michael E. Long, John L. McInosh, George E. Stuart, Fritz J. Vesilind

RESEARCH: Frances H. Parker (Associate Chief); Carolyn H. Anderson, Susan L. Anderson, Judith Brown, Susan P. Byrnes, Susan Day Fuller, Ann B. Henry, Jan Holderness, Patricia B. Kellogg, Levenia Loder, Jean B. McCoeville, Carol M. McNamara, Jeanne E. Peters, Lesley B. Rogers, Frances W. Shaffer. **Geographic Information:** Betta Joan Goss. **Style:** Michaeline A. Sweeney. **Legends:** Abigail A. Tipton

ILLUSTRATIONS

PHOTOGRAPHERS: Dean Conger, Joseph J. Scherschel (Assistant Directors); James L. Amos, James P. Blair, Victor E. Borwell, Jr., Jodi Cobb, Bruce Dale, Gordon W. Gahan, David Alan Harvey, Otis Imboden, Emory Kristof, Bianca Lavies, Bates Littlehales, Robert W. Madden, George F. Mobley, Robert S. Oakes, Steve Raymer, Robert F. Sloan (Natural Sciences); James L. Stanfield. **Administration:** John E. Fletcher, Guy W. Starling

ILLUSTRATIONS EDITORS: W. Allan Royce (Assistant Chief); David L. Arnold, Taylor Gregg, Declan Haun, H. Edward Kim (Layout); Charlene Murphy, Robert S. Patton, Andrew Poggenpohl, Ellie S. Rogers, Jon Schneberger, Mary Griswold Smith (Research Projects). **Picture Editor:** Bruce A. McElfresh

ART: William N. Palmstrom (Chief); Walter O. Crowe, John D. Gars, Jr. (Assistant Chiefs). **Artists:** Luca Biganzoli, William H. Bond, John W. Lecher, Robert C. Magn, Ned M. Seidler. **Cartographic Artists:** Jaime Quintero, Snezhina Stefanoff. **Map Editor:** John T. Bostis. **Research:** Virginia L. Baza, Harold A. Hanson, Dorothy A. Nicholson. **Production:** Isaac Ortiz (Supervisor); Iskandar Baday, Elie Sabban, Alfred L. Zebarth, Leo B. Zebarth

DESIGN: Charles C. Uhl, Robert E. Putman, Betty A. Clayman

ENGRAVING AND PRINTING: Dee J. Andella (Chief); William W. Smith (Assistant Chief); John T. Dunn, John R. Metcalfe, James R. Whitney

CARTOGRAPHY

Richard K. Rogers (Assistant Chief); Margery K. Barkdoll, Charles F. Case, Ted Dechtera, Richard J. Darley, John F. Dorr, Russel G. Fritz, Charles W. Gotthardt, Jr., Thomas L. Gray, Catherine M. Hart, Donald A. Jaeger, Harry D. Kaufman, Mary Anne McAleer, Charles L. Miller, Robert W. Northrop, John P. Shope, Charles L. Stern, Douglas A. Strobel, Tibor G. Toth, Thomas A. Wall, Thomas A. Walsh, Charles M. Wilson III

EDITORIAL SERVICES

ADMINISTRATION: Joyce W. McKean (Asst. to the Editor); Elaine B. Chisman, Lillian Davidson, Virginia H. Finnegan, Mary F. Klemm, Lucille L. McIntirey, Winifred M. Myers, Shirley Neff, Barbara A. Shattuck, M. Jean Vile. **Correspondence:** Catelyn F. Crowell, Eileen W. Bowering, Clifford R. DuBois. **Indexes:** Jolene M. Bostis

PHOTOGRAPHIC LABORATORIES AND TYPESETTING: Carl M. Shrader (Chief); Milton A. Ford (Associate Chief); Lawrence F. Ludwig (Assistant Chief); Herbert Allemus, Jr., David H. Chisman, Edwood M. Kohler, Jr., Geoffrey T. McConnell, William S. Perrini, Claude E. Perrone, Joan S. Simms (Assistant)

LIBRARIES: Publications: Virginia Carter Hills (Librarian); Patricia Murphy Smith, Carolyn Locke, Louise A. Robinson, Marta Strada. **Photographic:** L. Fern Dame, Carolyn J. Harrison. **Records:** Lorie Northrop, Mary Anne McMillen. **Films:** Betty G. Kincher

RELATED EDUCATIONAL SERVICES OF THE SOCIETY

SENIOR ASSISTANT EDITORS

Julius B. Billard, *Book Service*
Robert L. Brenden, *Special Publications and School Services*

BOOK SERVICE: Thomas B. Allen, Seymour L. Fishbein (Associate Chief); Ross Bennett, Constance Brown, Mary H. Dickinson, Robert C. Firestone, Mary Swain Hoover, Charles O. Hyman, Anne Dirkes Kobor, J. Edward Lannette, Carol B. Lutyk, David P. Robinson, Shirley Scott, Margaret Sedeen, Verla Lee Smith

SPECIAL PUBLICATIONS AND SCHOOL SERVICES: Donald J. Crump (Associate Chief); Philip B. Slocott (Assistant Chief); William L. Allen, Jody Bolt, Toni Eugene, Ronald Fisher, William E. Gray, Sallie M. Greenwood, Mary Ann Harrell, Suzanne J. Jacobson, Geraldine Linder, Ted Loflin, Louise V. Magravian, Tom Melham, Robert Messer, Jennifer C. Urquhart, Ursula Perrin Yostler, George V. White, Merrill Windsor. **National Geographic WORLD:** Ralph Gray (Editor); Charles H. Sloan (Associate Editor); Ellen Joan Hunt, Margaret McKelvey, Pat Robbins, Eleanor Shamahan, Veronica Smith. **Books for Young Explorers:** Cynthia Ramsay. **Filmstrips:** Jimmie Abercrombie, James B. Caffrey, Margery G. Dunn, Jacqueline Geschickler, Jane R. McCauley, H. Robert Morrison, George Peterson, Judith E. Rinard, Joan Ann Straker

NEWS SERVICE: Paul Simpson (Chief); Donald J. Frederick, William J. O'Neill, Robert C. Radcliffe. **TELEVISION AND EDUCATIONAL FILMS:** Dennis H. Katz (Chief); Margerie M. Mooney (Research); Patricia F. Northrop (Promotion); Sidney Platt (Educational Projects); Georgina N. Lampathakis, Carl E. Zerbe. **LECTURES:** Joanne M. Hess (Chief); Robert G. Fleegal, Mary W. McKinney. **GERALD L. WILEY RECORDINGS:** John M. Lavery (Chief). **AUDIOVISUAL:** Jon H. Larimore



Life is for living and Visa is there.

In 118 countries around the world,
at 2.3 million shops, hotels, restaurants and airlines,
and with cash advance service at 60,000 banking offices,
Visa is the most widely recognized card in the world.

We're keeping up with you.



Discover that great Cutlass feeling: retreat into solid luxury in Olds Cutlass Supreme Brougham.

Solid elegance.

Here's the luxury inside and out that you've come to expect from Cutlass Supreme Brougham. A clean, handsome look. A classic shape. Inside, a spacious new velour interior, with loose-cushion look seats



and more head and legroom than last year's coupe.

Solid comfort.

That great Cutlass feeling begins even before you turn the key. Just shut the door and discover the feeling of solid comfort. Then take a test drive. And note how Brougham's new suspension helps smooth out jolts and bumps.

Solid economy.

As miles roll by, you'll really appreciate Brougham's fuel-efficiency. No other midsize gets better V8 EPA gas mileage ratings! EPA estimates are 27 highway, 19 city, 22 combined, with available 260 V8 and automatic transmission. Your mileage will vary with how and where you drive, your car's condition and equipment. (EPA estimates lower in California.) Note: The Cutlass Supreme Brougham is equipped with GM-built engines produced by various divisions. See your dealer for details.

A solid feeling.

Come discover solid luxury and that great Cutlass Supreme Brougham feeling in a test drive at your Olds dealer.

**There's a lot of
News in Olds today.**



Oldsmobile

Cutlass Supreme Brougham '78.

Can we build one for you?

GM



Pursuing the prolific termite

PREDESTINED TO SERVE, sightless termites in an East African mound groom the enormous body of the queen, their mother. Distant cousins of the cockroach, these soft-bodied, preyed-upon insects have survived more than 100 million years, making them among the world's oldest social creatures. Organic chemist Dr. Glenn D. Prestwich (right) of the State University of New York at Stony Brook used photographic and writing skills to bring to this issue a fascinating account of rarely seen termite behavior (pages 532-47). Nominate friends or relatives for membership today, so that they too can glimpse some of nature's covert realms.



GLENN D. PRESTWICH (TOP) AND DEBBIE BRIDGEMAN

18-MONTH NATIONAL GEOGRAPHIC SOCIETY MEMBERSHIP

JULY 1978 THROUGH DECEMBER 1979

EIGHTEEN-MONTH DUES in the United States and throughout the world are \$12.75 U.S. funds or equivalent, which is 1½ times the annual fee. To compensate for additional postage and handling for mailing the magazine outside the U.S.A. and its outlying areas, please remit: for Canada \$16.53 Canadian or \$15.70 U.S.; for the British Isles, Australia, and New Zealand \$19.20; for all other countries \$18.55 by U.S. bank draft or international money order. Upon expiration of the 18-month term, memberships are renewable annually on a calendar-year basis. Eighteen-month membership starts with the July 1978 issue. Eighty percent of dues is designated for subscription to the magazine.

LIFE MEMBERSHIP is available to persons 10 years of age or older. The fee for U.S. (including its outlying areas) is \$200 U.S. funds or equivalent; for Canada, \$210 Canadian funds (\$200 U.S. acceptable); for all other countries, \$250 by U.S. bank draft or international money order.

Mail to: The Secretary
National Geographic Society
Post Office Box 2895
Washington, D.C. 20013

CHECK
ONE

I WISH TO JOIN the NATIONAL GEOGRAPHIC SOCIETY and enclose my dues \$ _____

(FILL IN NAME AT LEFT)

(GIFT MEMBERSHIP) I nominate and enclose \$ _____ for dues of the person named at left.

Send gift card signed: _____

I NOMINATE for Society membership the person named at left. (Use separate sheet for additional nominations.)

NEW MEMBER _____
PRINT NAME OF AN INDIVIDUAL ONLY (MR, MRS, MISS, MS)

MY NAME _____
PLEASE PRINT (MR, MRS, MISS, MS)

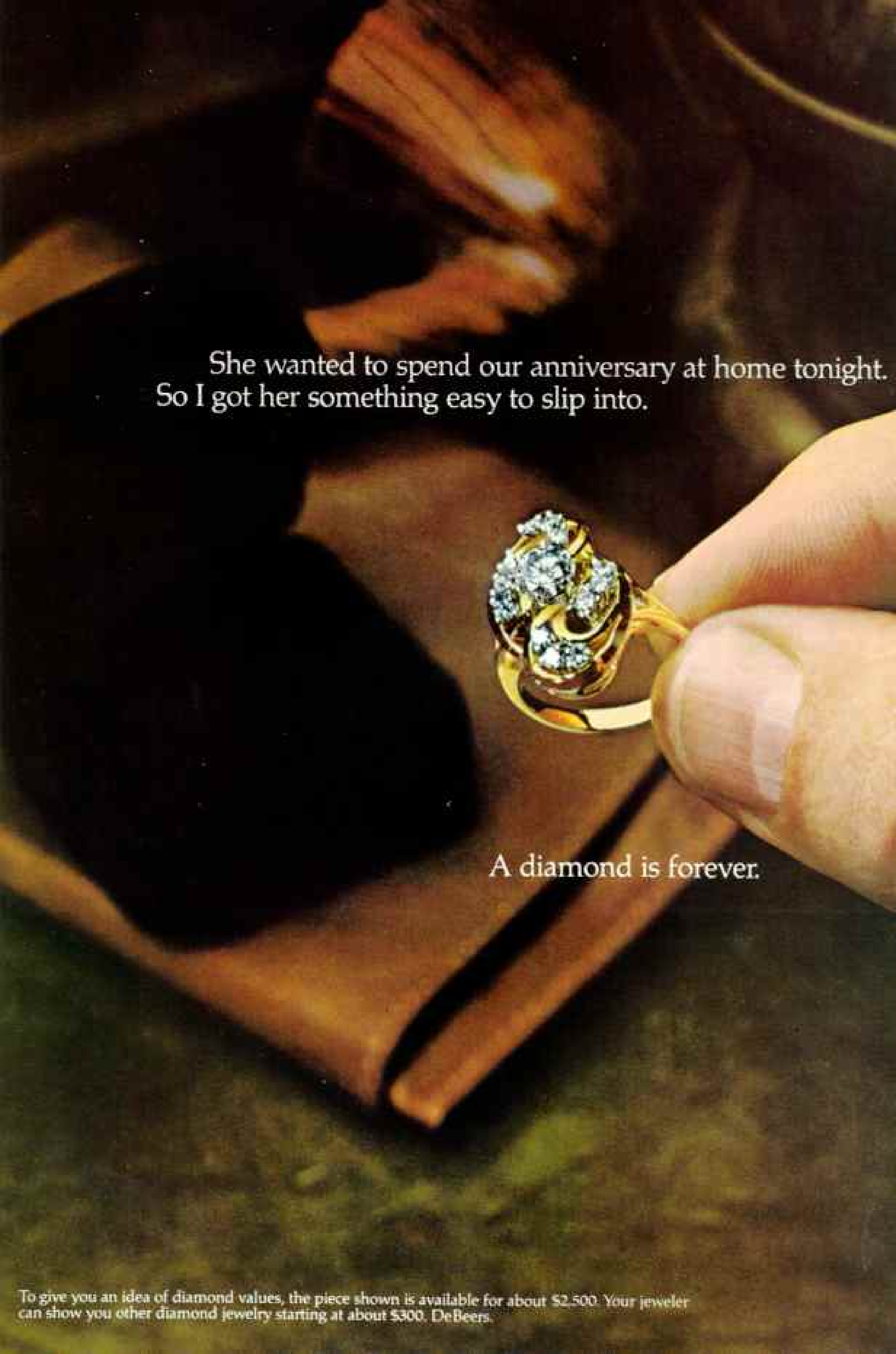
STREET _____

STREET _____

CITY, STATE, ZIP CODE _____

CITY, STATE, ZIP CODE _____

09479

A close-up photograph of a hand holding a diamond ring. The ring features a large central diamond surrounded by smaller diamonds in a halo setting, all set in a yellow gold band. The background is a blurred image of a woman's legs in a black dress, suggesting a romantic or intimate setting.

She wanted to spend our anniversary at home tonight.
So I got her something easy to slip into.

A diamond is forever.

To give you an idea of diamond values, the piece shown is available for about \$2,500. Your jeweler can show you other diamond jewelry starting at about \$300. DeBeers.



World's Largest Lodging Chain

Why? Best Western has over 2000 attractive, well-furnished and dependably clean motels, hotels and resorts conveniently located in more than 1300 cities.

Each one looks refreshingly different, yet all offer the same personal and efficient service. Every Best Western is regularly inspected to assure that it meets Best Western's high standards of cleanliness, quality, comfort and value.

Wherever you travel, get your money's worth at Best Western. And stop at any Best Western for a free copy of our 1978 Road Atlas & Travel Guide.

(800) 528-1234

Call toll-free for reservations
... see your travel agent or
consult the yellow pages.
In Arizona (800) 352-1222
Phoenix 279-7600



United States, Canada, Mexico, Caribbean, Guatemala, Great Britain,
New Zealand, Australia, Southern Africa.



Special peppers are aged in oak barrels until the passing of years mellows them to the savory aroma and flavor of TABASCO® sauce.

©1978. TABASCO is a registered trademark of McIlhenny Company, Avery Island, Louisiana 70513

COME SEE THE REAL ITALY



Where even hospitality is an art.

Famous cities, beaches, mountains, lakes, folklore — Italy has it all.

You'll find incredible art treasures, of course. And history at every turn. But today's Italy offers so much more to satisfy even the most demanding visitor.

There are art festivals. Opera and folk music. Fashions, handicrafts and sports for every season. Large cities and untouched medieval towns. Spas and tourist villages. Modern hotels and quaint inns. All set in spectacular scenery among mountains and lakes and beaches, and offering you a delightful variety of climates from the Alps to Sicily.

Making your visit more memorable are Italy's superb wines and foods. An ultra-modern system of superhighways, and an extensive network of railroads, air, land and sea transportation will make your sight-seeing easier. You can even buy a museum card for a nominal charge which entitles you to visit some 800 national museums, art galleries and archaeological sites.

Most memorable of all though, is the warm welcome you get from Italy's friendly people — people who have made hospitality an art. Why wait? Visit Italy, the inexhaustible treasure.



ITALIAN GOVERNMENT TRAVEL OFFICE

630 Fifth Avenue, New York, N.Y. 10020 (212) 245-4822

500 N. Michigan Ave., Chicago, Ill. 60611 (312) 644-0900

360 Post St., San Francisco, Calif. 94108 (415) 392-6206



**NAME THE FIRST PRESIDENT
TO WEAR A BEARD, AND YOU'LL NAME AMERICA'S
TENTH-LARGEST LIFE INSURANCE COMPANY.**

Lincoln. It's a name you remember. And we're Lincoln National Life. We have nearly 4,000 agents who do more than just sell insurance. They work with you to prepare a personalized plan that meets your goals for the future. At a price you can afford right now.

That's why we've grown to be the tenth-largest life insurance company in America. With over 70 years of experience and more than \$40 billion of life insurance currently in force.

Lincoln National Life. For millions of Americans who buy life insurance, we're a name that's easy to remember.



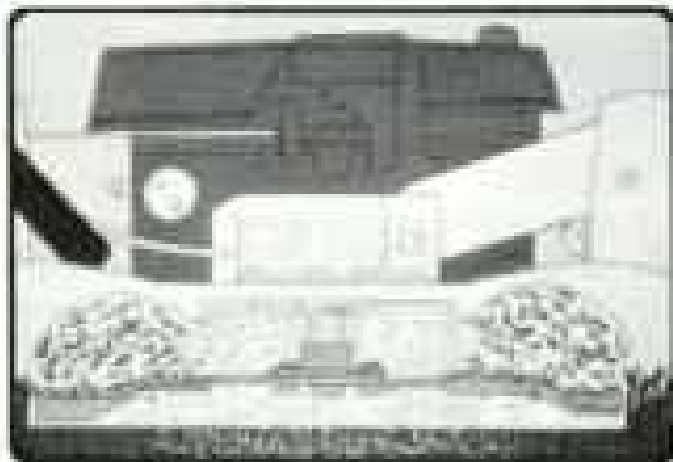
WE'RE EASY TO REMEMBER.

Bolens[®]



Discover the mower that discovered mulching.

The Bolens Mulching Mower™ not only cuts your grass it also cuts and re-cuts the clippings into tiny mulch particles that are fed back to your lawn. No raking, bagging or clean-up. And no confusion about the quickest, cleanest way to mow: the one and only Bolens Mulching Mower™



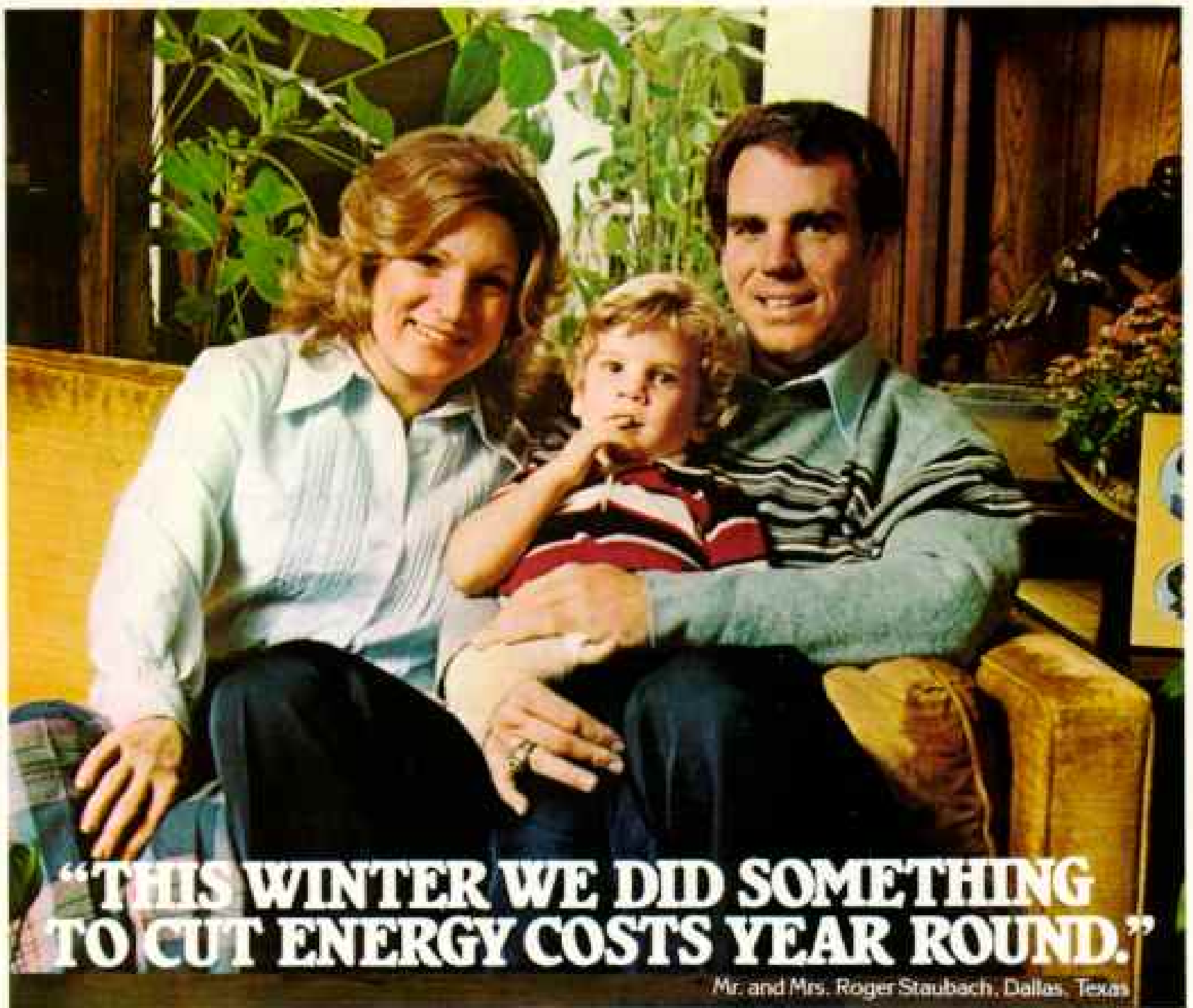
Visit your Bolens dealer now. He's got the largest selling mulcher. The only one that's proven itself rugged and reliable. For his name, check the Yellow

Pages or call **800-447-4700** toll-free anytime (in Illinois, call **800-322-4400**), FMC Corporation, Port Washington, WI 53074.

You're a good yard ahead with Bolens.

FMC

Bolens Mulching Mower is a Trademark of FMC Corporation. © 1978 by FMC Corporation.



“THIS WINTER WE DID SOMETHING TO CUT ENERGY COSTS YEAR ROUND.”

Mr. and Mrs. Roger Staubach, Dallas, Texas

“In recent years, we’ve done a lot of little things to try to save energy. Always with the same result. Our fuel bills have gone up anyway. So this winter we did a big thing. We put in a Year-round One heat pump air conditioner from Carrier.

“Already the Year-round One has cut our heating bills. This summer it should save us even more energy on cooling.

“Currently, we’re building a new, larger home for our family. We’ll heat it and cool it entirely with Carrier heat pumps. Given the energy situation, we think it’s the only way to go.

“And given Carrier’s expertise in air conditioners and heat pumps, we think Carrier is the only way to go.

“Cut your fuel bills, too. See your Carrier Certified Heat Pump dealer.”



**WE CAN'T CONTROL THE WEATHER.
BUT WE CAN HELP YOU CONTROL ITS COST.**



FTC NOTICE

As a result of an investigation by the Federal Trade Commission into certain allegedly inaccurate past advertisements for STP's oil additive, STP Corporation has agreed to a \$700,000 settlement.

With regard to that settlement, STP is making the following statement:

It is the policy of STP to support its advertising with objective information and test data. In 1974 and 1975 an independent laboratory ran tests of the company's oil additive which led to claims of reduced oil consumption. However, these tests cannot be relied on to support the oil consumption reduction claim made by STP.

The FTC has taken the position that, in making that claim, the company violated the terms of a consent order. When STP learned that the test data did not support the claim, it stopped advertising containing that claim. New tests have been undertaken to determine the extent to which the oil additive affects oil consumption. Agreement to this settlement does not constitute an admission by STP that the law has been violated. Rather, STP has agreed to resolve the dispute with the FTC to avoid protracted and prohibitively expensive litigation.

February 13, 1978



"The quiet. The flowers.
The views of the ocean.
Somehow, golf in Bermuda
has an added dimension
you won't find back home."

Mike and Mary Lee Hurley
talk about their third visit to Bermuda.



"There's no waiting
on the tees. You can
take your time on the
greens. It's like having a
golf course of your own."

"We can play a nice relaxed
eighteen in the morning and
still be back on the beach by noon."

Bermuda

Unspoiled. Unhurried. Uncommon.

See your travel agent or write Bermuda, Dept. 115, 630 Fifth Avenue, N.Y., N.Y. 10070
Suite 1422, 401 N. Michigan Ave., Chicago, Ill. 60611 or Suite 1010, 44 School St., Boston, Mass. 02108.

Bermuda has nine challenging courses,
both public and private, within 21 square miles.
Ask your hotel or guest house manager about
an introduction to the private ones.



How to build, remodel and insulate with Andersen windows. **FREE**



Three illustrated brochures show you how to make the most of beautiful, energy-saving Andersen windows and gliding doors. Order yours today.

Mail to:
Andersen Corporation
Box 12,
Bayport, MN 005-048

Please send me the following literature:

- How to get Good Windows
- Remodeling
- Energy Facts

Name _____
 Address _____
 City _____ Zip _____
 State _____



© 1984 Andersen Corp., Bayport, MN 1974.

The
National Audubon
Society
takes pride in
announcing
its first
bird sculpture

This year the National Audubon Society will issue the first porcelain bird sculpture in its history. This important work of art will be created exclusively for individual collectors, by private commission only, and only by direct application to the Society.

An announcement illustrating and describing the bird sculpture will be sent upon specific request. Write directly to the National Audubon Society, 950 Third Avenue, Dept. 1, New York, N.Y. 10022. Or phone toll-free: 800-523-7580 Ext. 100. In Pennsylvania call 1-800-662-5180 Ext. 100.

National Audubon Society

Some of our parks go back thousands of years.

Here, a day in the park can be the free-wheeling excitement of Six Flags Over Georgia. Or a canoe ride through the mysterious Okefenokee Swamp—one of our beautiful wildlife refuges.

Whatever your idea of a good time is, you can find it in Georgia. Every mile leads to natural and man-made wonders. The only problem is deciding which to see first.

To help you get started, we've written a colorful vacation guide. Write for your free copy today. And when you reach Georgia, stop at one of our Visitor Centers for directions and information. We'll help you plan a trip you'll always remember.

Georgia Department of Industry & Trade
Tourist Division
P.O. Box 1776, Dept. NG-83
Atlanta, Georgia 30301
Please send me your free vacation guide to Georgia.

Name _____

Address _____

City, State, Zip _____

Georgia



THE ORIGINAL.

Native Newfoundland artist Gerald Squires works out of this lighthouse home on the Atlantic cliffs. In his studio there, he conceives hauntingly original soulscapes of the human spirit and the sea.



Come join us this summer. It's easy to get here. For a place that's so different, we're unbelievably close — with a refreshing sea voyage if you drive. And so much to see.

You can visit fishing outports. Stroll the oldest street in North America. Discover where Vikings landed. All in fascinating Newfoundland, the original part of Atlantic Canada.



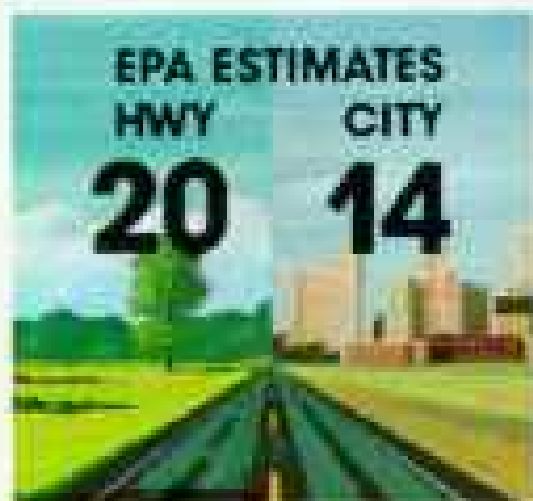
NEWFOUNDLAND

Another world next door.

Write for: The Original Vacation Kit,
Dept. of Tourism, Gov't. of Newfoundland and Labrador,
P.O. Box 2016, St. John's, Newfoundland,
Canada A1C 5R8.

The New Chevrolet.

More of the things you want in a wagon.



More mileage.* Compared to 1976 full-size Chevrolet wagons, EPA estimates with the standard 305 V8 and auto. trans. Power train not available in California.



Convenient door-gate. Opens out like a door for people. Drops down like a gate for cargo. Counter-balanced. Easy to operate.



Roomy cargo compartment. Takes loads up to 4 feet wide through a rear opening that's wider at beltline, higher overall than the 1976 model it replaced.



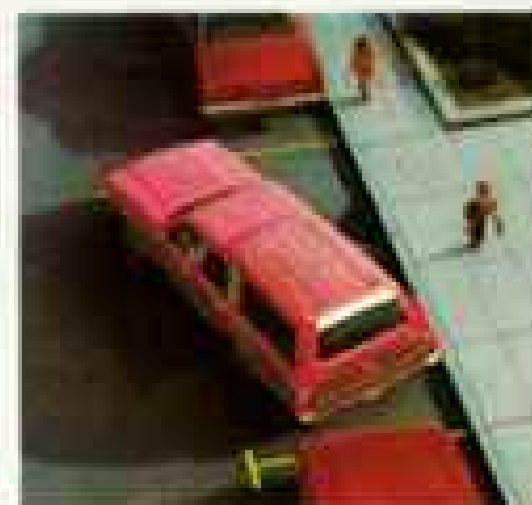
Push-button seat conversion. A lever releases the folding third seat back. A button high on the side panel lets the second seat fold forward.



Lockable storage under the floor. 8.0 cubic feet on 2-seat model. Less on 3-seat model (shown).



Lockable storage in the side. Over 2 cubic feet. Handy storage trays hold things that usually clutter seats and floor.



More manageable in city traffic than the model it replaced. Something to appreciate as you slip into tight parking spaces.



Seats 8 with available third seat. Built to take big families with plenty of room for heads, hats, legs, and feet.



*Your mileage will vary depending on how and where you drive, your car's condition and available equipment. (Chevrolet is equipped with GM-built engines produced by various divisions. See your dealer for details.)

Introduced a little more than a year ago, The New Chevrolet quickly became, and remains, the best selling full-size wagon in America †

You can see some of the reasons for its success on this page.



The other reasons will become obvious the first time you test drive The New Chevrolet Wagon.

And the best place to do that is at your local Chevrolet dealer's Wagon Stop, your complete shopping center for wagons.

†Based on latest R. L. Polk registrations.



SEE WHAT'S NEW TODAY AT YOUR CHEVROLET WAGON STOP.

**Witness the
shaping of
North America.**

**See the
emergence of
the life and
land we
know today.**

Trace 4.6 billion years of natural history, exploring our continent from the glacier-gouged Canadian Shield to the remote Mexican highlands, from the Ice Age moraine that is Cape Cod across the prairies and mountains and deserts to the Pacific Ocean. Follow the evolution of major forms of life within this still-moving, still unfinished landmass.

Join more than 400,000 readers of this landmark new National Geographic volume simply by clipping and mailing the coupon. Pay for *Our Continent* only if you decide to keep it.

398 pages, 9 1/4" x 11 1/8"

360 illustrations, including 248 full-color photographs, 88 paintings, drawings, 24 maps
14 outstanding authors, today's leading scientists

Bonus feature: "The Wheel of Time"

Hardcover • Only \$11.95



NATIONAL GEOGRAPHIC SOCIETY
Washington, D. C. 20036

YES, please send me a copy of *Our Continent*. Bill me just \$11.95, plus postage and handling, when delivered. If not satisfied I may return the book without payment.

California and Maryland residents please add applicable sales or use tax.

NAME _____ (please print)

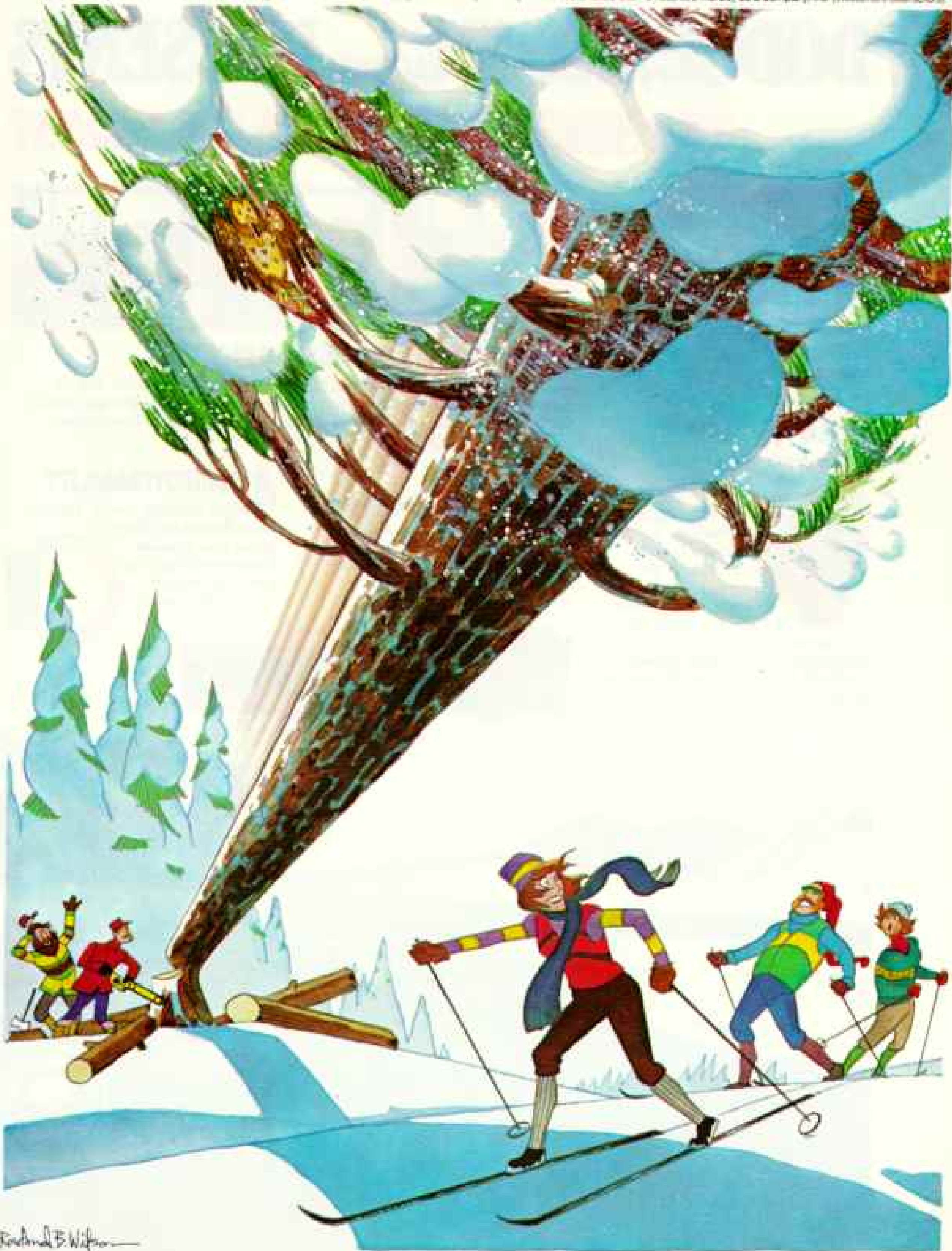
ADDRESS _____

CITY, STATE, ZIP _____

00110

60





Richard B. Wilson

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

We offer a smashing selection of financial services, including disability income insurance.

DODGE, NO. 1 ^{IN VANS} AND WAGONS, PRESENTS

THE NEWEST, MOST VERSATILE, MOST

THINK OF IT AS AN UP-SIZE STATION WAGON FROM AMERICA'S NO. 1 SELLER OF VANS-WAGONS.

We've been the industry leader in domestic wagon* sales for many years running. Here's to the years ahead.

1. ALL-NEW SEATS.

The bucket seats are more comfortable, more colorful. And now you can order them in fun-to-touch fabrics. Mounted on curved tracks, the new seats allow a higher position for the shorter driver and more headroom for the taller driver. And you can order bench seating for up to 15 people.



2. EXCLUSIVE TRAVEL SEATING PACKAGE.

This new factory-installed option on B200 and B300 Royal Sportsman lets you easily convert from two three-passenger bench seats to a dinette set to a double bed. It makes your Sportsman into a home away from home.

3. ALL-NEW INSTRUMENT PANEL.

Sedan-type luxury combined with practical convenience. The combined starter and ignition switch is now on the locking steering column.



4. MANEUVERABILITY.

Our turning circle, tighter than Ford's or Chevy's, gives you greater maneuverability to get your wagon where you want it.



SPORTSMAN WAGON FOR 1978.

MANEUVERABLE WAGON YOU CAN BUY.

5. LOTS MORE VISIBILITY.

We've put more glass area in the side windows behind the front doors. And rear quarter windows in the Maxiwagon wrap right around the corners to make backing up a snap.



6. MORE ROOM, MORE QUIET.

We've made the engine cover smaller to make the people compartment bigger and increase the footroom. We've put in more sound insulation on Custom and Royal models and made suspension improvements to make the ride quieter.

7. MORE ROOMINESS.

Maxiwagon has eight inches more loadspace length this year. Room for more cargo and more fun.

8. NEW ANTI-THEFT MEASURES.

The steering column now locks when you shut off the ignition. And the door vent windows have new latches that click shut for extra security.

9. 23MPG HWY 17MPG CITY MILEAGE.

EPA estimates for Dodge Sportsman B100 wagon, with standard 225-cubic-inch six-cylinder engine and manual transmission. Pretty good for a wagon that does this much work. Your mileage may vary according to vehicle condition,

equipment, and how it is driven. California mileage is lower.

10. NEW OPTIONS.

Trailer-towing packages for up to 7000 pounds gross trailer weight. Six different kinds of radios including two units with 40-channel CB, Sky Lite sun roofs, air conditioning, and more.



Put our new features together with Dodge dependability and value, and you'll see why we intend to keep on selling more vans and wagons than anyone. Buy or lease one or a fleet... at your Dodge Dealer's.



NO. 1 IN VANS AND WAGONS*

* Passenger van-type vehicles known in the industry as wagons.





Energy for a st



What Exxon's Bill Simms finds by reading the sands of time may someday light your home.

To Exxon geologist Bill Simms, Utah's remote canyon country reads like a book: layer upon layer of sandstone laid down by ancient rivers, then carved into stately monuments by the mighty Colorado River. Looking at a canyon wall, Bill can read the "sands of time" and interpret conditions that may have caused uranium to be deposited millions of years ago.

Although Exxon is already producing uranium ore at our mine near Douglas, Wyoming, Bill and other Exxon geologists are searching for more uranium because our nation needs even more electrical energy. The expansion needs of the electric utilities will substantially increase demand for uranium to fuel nuclear power plants.

Knowing how it was deposited is only one facet of the knowledge Bill needs to find uranium today. Small amounts exist in many kinds of rock, but finding deposits large enough to justify mining is a challenge. Exxon geologists use many sources of geological data. One day they'll be in a helicopter scanning the country with sensitive instruments. The next, they'll be drilling exploratory holes to check radiation levels hundreds of feet below the surface and to bring up samples of the ancient "sands of time" for analysis.

Uranium exploration takes solid geological knowledge, plus money, time and plenty of optimism. Exxon has brought all these to the search for uranium. Being an oil company has helped us with the technical and managerial expertise needed to become a supplier of the uranium fuel that's helping electric utilities provide light, heat and power for hundreds of thousands of American homes.



EXXON



rong America



BMW WILL NEVER BUILD A CONVENTIONAL LUXURY SEDAN BECAUSE NO ONE AT BMW COULD BEAR TO DRIVE ONE.

INTRODUCING THE BMW 733i

In the sedate and somewhat stuffy world of the very expensive luxury sedan the BMW 733i is indeed rare.

While most of the world's auto-makers are apparently quite content to produce solidly engineered, elegantly appointed, carefully crafted carriages for the gentry, we at the Bavarian Motor Works are not so easily satisfied.

Racing engineers by nature and by profession, it has long been our contention that, while the pursuit of luxury is no vice, extraordinary performance is the only thing that makes an expensive car worth the money.

So, while the BMW 733i provides all the creature comforts one could sanely require of an automobile—supple leather, full-power accessories, etc.—it provides a driving experience so unusual, so exhilarating it will spoil you for any other car.

A GAIN IN SIZE WITH NO SACRIFICE IN PERFORMANCE

The genius of the BMW 733i lies not in the fact that it is—by European standards—large and luxurious.

The technical feat involved here is that the engineers at BMW have managed to incorporate the aforementioned qualities into a car that retains the performance characteristics of a BMW.

Under the hood of the 733i is the same basic engine that powers the BMW race cars. A 3.3-liter, electronically fuel-injected masterpiece of engineering that the editors of Road & Track magazine unequivocally call, "...the most refined in-line six in the world."

Its four speed manual transmission (automatic is available) slips precisely into each gear. Its acceleration comes up smoothly, with the turbine-like whine peculiar to BMW.

Its suspension system—independent on all four wheels, with a new and patented "double-pivot" front geometry—is astonishingly quick and clean through the corners. And, rather than reduce or distort driver "road feel"—as do the steering systems found in many of today's passive luxury sedans—the suspension system of the BMW 733i is designed to provide the driver, through the steering wheel, with instant, precise information at all times, under all conditions.

THE INTEGRATION OF MAN AND MACHINE

While the interior of the conventional luxury sedan is deliberately planned to isolate the driver from the world outside, the road beneath and the mechanical functionings of the car,

the interior of the BMW 733i is biomechanically engineered to literally include the driver as one of the functioning parts of the car.

The driver's seat is adjustable for both seat angle and height.

All instruments and controls are strategically positioned to help avoid even a split-second loss of concentration.

Pedal direction and pedal pressure have been carefully balanced to reduce fatigue and facilitate effortless gear changing.

So successfully is this integration of man and machine accomplished that, when you drive the BMW 733i for the first time, you will experience an almost total oneness with the car.

As the editors of Motor Trend magazine once observed, "The reaction to a BMW is always the same: The first time driver takes the wheel and after a few minutes no other automobile will ever be the same again."

If the thought of owning such a car intrigues you, call us anytime, toll-free, at 800-243-6000 (Conn. 1-800-882-6500) and we'll arrange a thorough test drive for you at your nearest BMW dealer.

THE ULTIMATE DRIVING MACHINE.
Bavarian Motor Works, Munich, Germany.



Made by Nature. Bottled by Mazola.



ASK YOUR DOCTOR...
about a total dietary program
that includes MAZOLA CORN OIL.

Mazola

PURE

CORN OIL

32 FL. OZ. (1 QT.)

Corn grows no cholesterol.
So Mazola has no
cholesterol.
Mazola: the only leading
brand made from
pure corn oil.

Best Foods

a Division of CPC International Inc.
International Plaza, Englewood Cliffs, N.J. 07632

CPC
International

BLIZZARD WIZARD.



New Plymouth Horizon. The worse the weather gets the more you'll appreciate it.

Horizon gives you outstanding traction in snow and slush, because it's the first American car of its size with front-wheel drive.

Inside, Horizon seats four big people. And has plenty of room for luggage.

Horizon also goes a long way on a gallon of gas. With manual transmission it has

38 / 25
MPG HWY / MPG CITY
\$3706*
AS SHOWN

been EPA estimated at 38mpg on the highway, 25 in the city. Of course your

mileage may vary, according to your driving habits, the condition of your car and its optional equipment. California mileage is lower.

What's all this add up to? \$3706*. That's the base price on the new Plymouth Horizon. And that low price includes AM radio, whitewall radial tires, rack and pinion steering, front disc brakes, inside hood release—many features that are not standard on other cars of its type.

For new comfort and confidence, make tracks to your Chrysler-Plymouth dealer, where you can buy or lease Plymouth Horizon.

*Base sticker price excluding taxes and destination charges.



A PRODUCT OF
CHRYSLER
CORPORATION

RELAX.

PLYMOUTH HORIZON CAN HANDLE IT.

If you don't want to quit smoking or drinking, shouldn't you at least replace the vitamins you may be losing?

A lot of people smoke. Many drink alcohol, too. Despite the health hazards, they may enjoy smoking and drinking so much, they don't plan to stop. If that's your case, consider what may be happening to the vitamins in your body.

Smoking may rob your body of Vitamin C.

Recent scientific evidence has proved that blood plasma levels of Vitamin C in smokers may be up to 30% less than in non-smokers. If you smoke 20 or more cigarettes a day, the Vitamin C reduction can climb to 40%.

Drinking may rob you of vitamins, too.

Many people ranging from alcoholics to those who may be classified as heavy, regular or even so-called "social drinkers" can have poor diets because alcohol preempts normal food intake. The result may be lowered protein, mineral and vitamin levels. Also, chronic drinking can reduce the storage capacity of vitamins in the liver, particularly folic acid. When alcohol damage to the liver occurs, the liver has difficulty performing its normal function of absorbing vitamins from food, particularly vitamin B₁₂ and folic acid.

When the liver doesn't work properly, repair of damaged tissues becomes difficult for the body and your B-complex vitamin storage starts to get depleted.

You may come up short on vitamins.

It's very possible to compound a vitamin loss by continually depleting your body's "warehouse" of vitamins. After a while, loss of your body's extra supply can turn into a vitamin shortage. Once your levels are depleted, noticeable symptoms can result.

You may lose your appetite and then body weight. You could experience adverse psychological symptoms. Irritableness, sleeplessness or constant drowsiness can occur.

What are some of the important functions of vitamins?

Vitamins are essential for life and good health. Their primary function is to produce chemical reactions within the body that, in turn, convert food into energy and build body tissues.

Of course, specific vitamins are responsible for performing different tasks in the body. For example, folic acid plays a key role in the development of red blood cells. It also helps your intestinal tract maintain itself. Studies have shown this is the most commonly deficient vitamin in heavy drinkers.

Vitamins B₁, B₂, B₆, and niacin help your body in many ways. They maintain the heart and nervous system. They help build new body tissues and help keep skin, teeth and gums healthy among others.

Vitamin C is essential for healthy gums and bones, strong body cells and blood vessels, faster wound healing and the prevention of scurvy.

Other reasons to need vitamins.

As you can see, vitamins are not only important — they're essential. What's more, if you eat poorly, take birth control pills, or happen to be sick, you may not be getting all the vitamins you should.

Since vitamins are essential for good health, know how to get them.

There are a variety of ways to make sure you get enough vitamins. First, eat a balanced diet. Today, many foods are vitamin enriched or fortified, so look at the nutritional labels of the foods you buy. Just to be sure, you can take vitamin supplements daily.

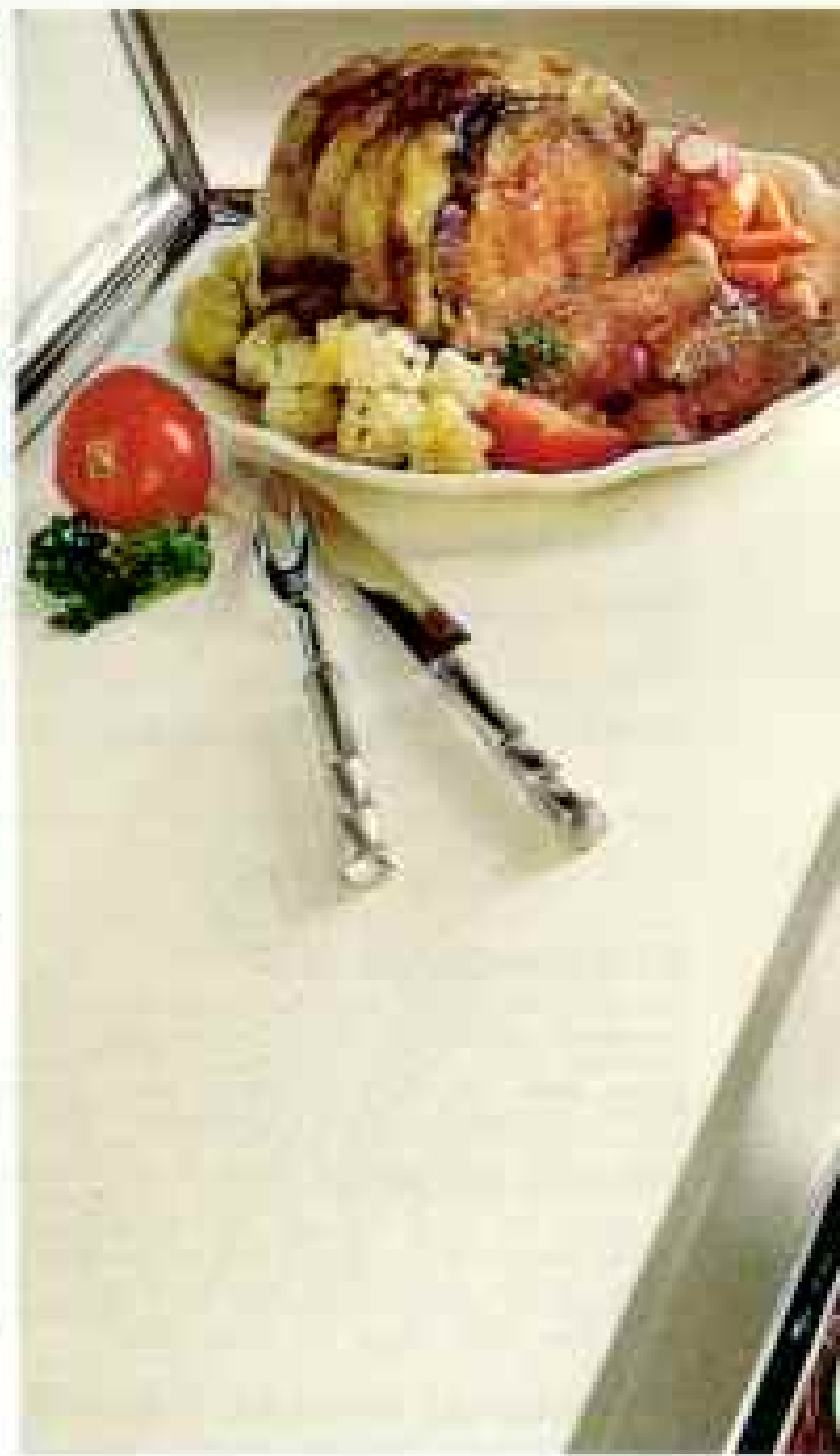
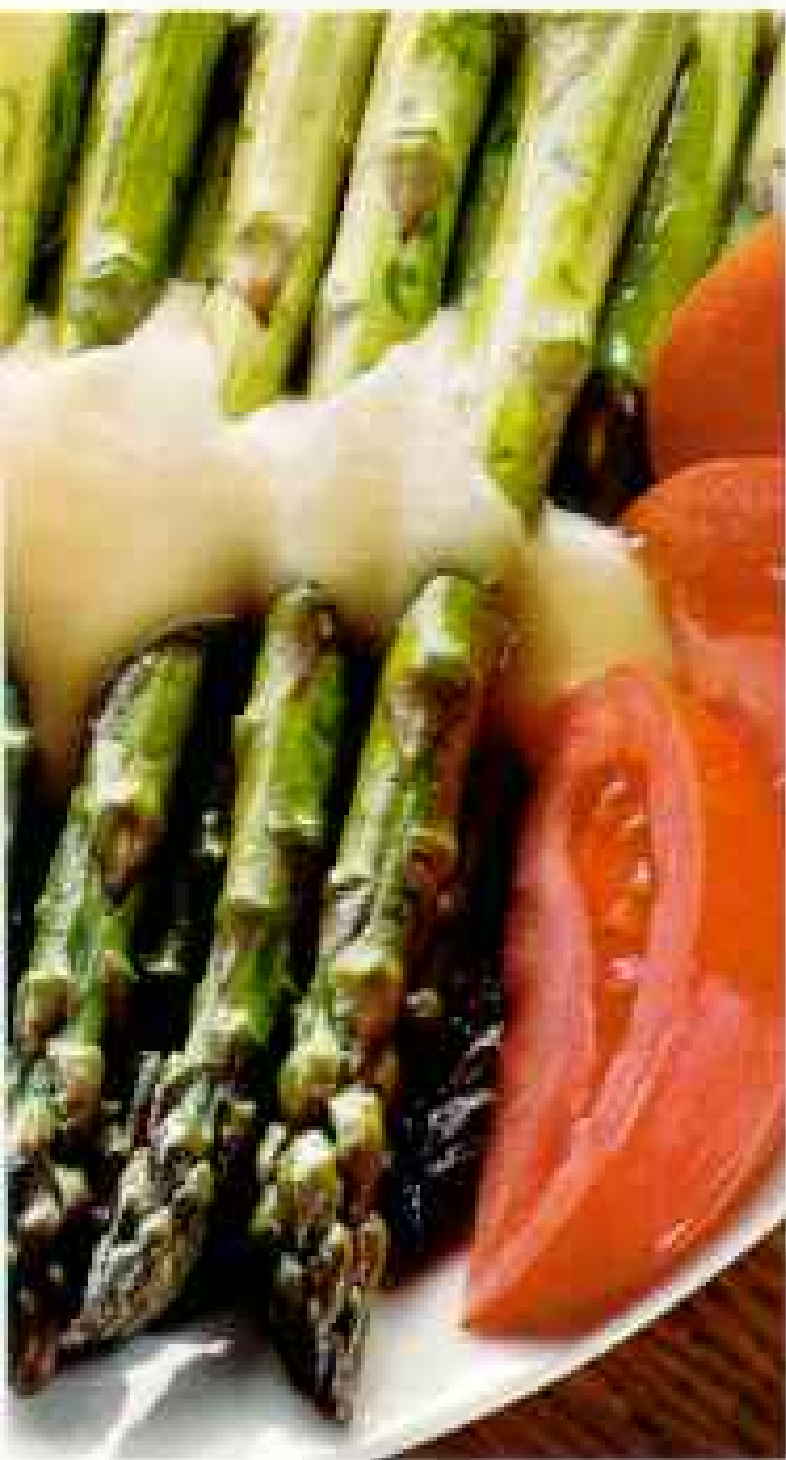
There are a number of different formulations including multiple vitamins and B-complex with C, as well as supplements of individual vitamins.

Vitamin Information Service, Hoffmann-La Roche Inc., Nutley, New Jersey 07110.



Your health is our concern.

The Ultimate Cooking Center: Microwave. Self-cleaning. Smoothtop.



Now with Vari-Cook® oven control for even greater cooking versatility.

The Litton Micromatic® double-oven microwave range, now with Vari-Cook oven control, makes it easier to bring out the best in microwave cooked foods. Simply change cooking speeds as you change foods. High, reheat, roast, simmer, warm, defrost or any speed in between. Set different speeds for different foods to bring out old-fashioned slow-cooked goodness, but at time and energy-saving microwave speeds.

Cooks four ways.

The ultimate cooking center gives you all the best ways to cook. Cook with microwave speed in the upper oven. Bake or broil in the lower conventional oven. Stir up something saucy on the smoothtop. Or prepare one dish or a complete meal using both ovens for a combination of conventional browning and microwave speed.



Self-cleaning ease.

Save clean-up time, too. Litton Micromatics have a self-cleaning oven system that removes even the toughest baked-on stains. And a one-piece smoothtop that keeps spills from dripping away.

Completely convenient.

Everything about the Micromatic double-oven range is designed for your convenience. Vari-Cook oven control. Micro-Timer® digital control. Automatic oven timer. Special 8-inch "quick-heat" cooktop element. One-piece smoothtop. Safe push-to-turn infinite heat controls. Black glass see-thru oven doors. And closed-door smokeless broiling.

You'd expect it from Litton.

Because at Litton, innovation means better microwave cooking

throughout our full line of energy-saving countertop ovens, combination and double-oven microwave ranges. Your Litton dealer can demonstrate how to save time and energy with all of them. For his name and address, call us now, toll free (800) 328-7777.

LITTON
Microwave Cooking

1422 Edmund Lane No. Minneapolis, Minnesota 55404

Litton... changing the way America Cooks.

Home Study

CALVERT SCHOOL INDIVIDUAL SUBJECT COURSES

Calvert offers separate subject courses for 8th grade math, history, English (incl. grammar, vocabulary development, writing), science, reading (skill work, literature). Excellent for make-up, brush-up or enrichment. Choose one subject or all. Home is the classroom. All texts, teacher's manual included. Start any time. Also complete courses for Kindergarten-8th grade. Used by over 300,000 students. Non-profit. Admits students of any race, color, national or ethnic origin.

Calvert

Established 1897



School

301-243-0030

Box BCN4-0 Tisbury Road, Baltimore, MD. 21210

Parents Name _____

Address _____

City _____ State _____ Zip _____

Child's Age _____ Grade _____

Camps

ALGONQUIN READING CAMP No. Boys

All abilities. Speed, developmental comprehension, remedial, perceptual & motor training for L.D. Certified staff. Indiv. instruction & progress. 160 acres, lake. All camp activities. ACA, James N. Doran, Algonquin, Rte 3, Rhineland, Wis. 54501

BRUSH RANCH Girls & Boys separate camps. On Peace River or Santa Fe. Boys: Rifle, shoot, ride, swim, fish, tennis, backpack, art. Girls: Riding, fencing, swimming, tennis, dance, art, music, drama, nature, backpacking. Phone: (503) 757-8772, Newcomb G. Rice, Box 2450, Santa Fe, N.M. 87501

Wisc. 7-17

FARRAGUT NAVAL CAMPS

FOR boys 9-14. Boating, fishing trips, 50-foot fleet incl. 25 sailboats. All sports, 2 gyms, athletic fields. Pool. Approved summer school. Opens July 1. Catalog: Farragut Naval Camps, Box LC, Toms River, N. J. 08753. (201) 349-1121

MAINE WILDERNESS

CANOE Basin—Inland waterways, canoe or base camp trips. Expert guides, 2, 3 or 4 wks. Deer Isle Sailing Center—Coastal islands, 2 or 4 wks. Boys 10-18. Separate trips for girls. Capt. & Mrs. C. A. Selin, 223 Neptune Dr., Groton, CT 06340.

NATURE TREK

SUWANNEE River Canoe trips and other Southern wilderness adventures. Backpacking and canoeing in small groups. We furnish food, equipment and professional guides. Coed. Route 1, Box 1224 Dept. N, Palatka, Florida 32977.

CAMP PITT IN Virginia on Barrage campus. Boys 11-15 develop skills in swimming, riding, golf, tennis, marksmanship, wrestling, football, basketball, baseball. Trips, camping. Pool. Two 2-wk. sessions at \$275 each: June 18-June 30; July 2-July 14. Write Camp Pitt, Box NG, Chatham, VA 24531. 804/432-2481.

Since 1929
Ages 9-15

PRIVATE coed summer camp. Excellent privs. In land & water sports. Tutoring avail. Choice of terms from mid-June to mid-Aug. On the Greenbrier River in the Allegheny Mtns. P.O. Box 288NB, Lewisburg, WV 24901. (304) 943-1309. Member ACA.

TELLICO MTN. CAMP Boys and Girls 5-15

SUMMER adventure in Smoky Mtns. Horseback riding everyday. Tennis, canoe trips, swimming, crafts, reading. Math, 3 wks. \$855, 4 wks. \$450, 2 wks. \$248. Catalog Write Sanford Gray, Dir. Box N, Sweetwater, Tennessee 37874

TRADITION IN SAIL Co-ed 13-18

BOATAN Bay Islands, Caribbean. Sailing: Sloop, ketch, Scuba, Masts/Spikes, Seamanship instruction, crafts, Marine biology lab, tide pools, Spanish Galleon, diving, Mayan ruins, Red Cross classes. Tradition in Sail, Box 8098, San Diego, Ca 92106.

TED WILLIAMS BASEBALL CAMP

BASEBALL—Pro staff, daily games, batting cages, training areas, excellent facilities. Umpire School—Drills, tests, umpiring games. Tennis Programs—Teaching Pros, lessons. B. J. Cassidy, Dept. NG, Lakeville, Mass. 02348

Coed Schools

THE BOLLES SCHOOL OF Florida Grades 7-12

FULLY Accred. 100% college prep. Coed Day. Boys Board. Advanced placement courses. College boards. Developmental reading. Study skills. Guidance. All varsity & intramural sports. Dir. of Adm., 7404 San Jose Blvd., Jacksonville, Florida 32217



Boys-Girls Ages 9-18 SUMMER ADVENTURES

ON LAKE MAXINKUCKEE

Write: Box 458 Culver
Indiana 46511 or call 219/642-3311

DELPHI III-standard, K-12 boarding school on 1300 acres in coastal Oregon. Individ. curbs, permits enrollment anytime. Summer & 9 or 12 mth. prgrams. L. Ron Hubbards study method; proven success in basics, humanities & sciences. Personal supervision. Dean, Delphin School, Sheridan, OR 97278/(503) 843-3321.

FLINT SCHOOL aboard Te Vega and te Quest



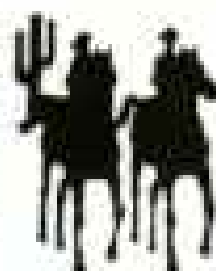
Drawer N, P. O. Box 5808, Sarasota, Florida 33579

CoEd 10-18. Aboard 150' Te Vega and 177' teQuest (sailing and anchoring together in foreign ports) your student will journey into educational serenity with the 4R's method providing students of ability with motivational incentive to academic excellence. Grades 6-12.

FLORIDA CENTRAL EDUCATIONAL ACADEMY College Prep. 43 acre campus 20 mi. N. of Orlando near Disney World. Grades 6-12. Fully scored. Development of effective study habits. Air-cond. dorms. Pool. Athletics. Racially non-discriminatory admissions. Catalog: Dean, Box 38, Sarrenta, Fla. 32776

HOWEY ACADEMY FULLY accredited co-ed college prep. Grades 7-12. Near Orlando, Florida. Individual instruction, horseback riding, supervised study, private beach, all sports. All air conditioned. Summer session. For catalog write: Department 482, Howey-in-the-Hills, Florida 32737

JUDSON-ARIZONA BOARDING COLLEGE PREP COED



Accredited Prep and General courses. Grades 1-12. Small classes. Developmental Reading, Remedial Math, English as a 2nd language. Weekend travel. All Sports. Soccer, Riding, Rifle, Healthful, informal Western life. Established

1928. Brochure. Henry N. Wick, Director, Judson School, Box 1589, Scottsdale, AZ 85252. 602-948-7731. TELEX: 669440

MASSANUTTEN ACADEMY

ACCREDITED Coed School for acceptable students of any race, color, national or ethnic origin. Gr. 9-12. Boys Jr. Div. Gr. 6-8. Special help classes. Sports: Swimming, Riding, JUDO, Hand scholarships. Write: John N. Palmer, Adm., Woodstock, Va. 22664

TMI Coeducational. Grades 5-12. College Prep. Fully accredited, small classes. Excellent faculty. Friendly atmosphere stimulates self-motivation, maximum academic potential. 10th year Catalog: Sanford Gray, Pres., TMI Academy, Box 147, Sweetwater, Tennessee 37874. Phone: 615-337-6032.

VILLA SCHOOL-ARIZONA

RANCH, Co-Ed ages 13-18; Fully accredited; Prep. and Remedial; Specializing in the Underachiever. Healthful desert climate. Art, Wallpapers, Sailing, Horses, Pool. Catalog: Director, P.O. Box 1313, Casa Grande, Ariz. 85222. Tel. 602-466-7957

Learn about yourself by living with others. Dynamic, creative & supportive community. 750 coed. gr. 9-12. College prep & gen. Art, music, Western outdoor recreation. Box A, Wasatch Academy, Mt. Pleasant, Utah 84647

WASATCH

Wayland

One of America's great prep schools for more than 100 years, emphasizes academic excellence & worthwhile values. Accelerated programs, award-winning science facilities. Athletics include the Midwest tennis center. Coed. Grades 6-12. Non-discriminatory.

Write: D. Lynn Redmond, WAYLAND, Box 35 Beaver Dam, Wis. 53916 Tel: 414-895-3373

Boys' Schools

ARMY & NAVY ACADEMY

FULLY accredited Military School on the Pacific Ocean, 80 miles south of Los Angeles. Strong academic emphasis, grades 7-12. Honor MI, ROTC. Ask about Summer Camp Program. Box N, Carlsbad, CA: 92008.

A faculty advisor for each student at

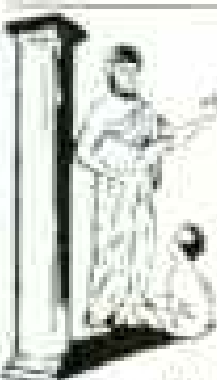
Augusta Military Academy

Augusta believes that individual attention develops the student's potential for academic self-reliance and leadership. Grades 6-12 and PG. Lower School Grades 4-7. Write: Col. H. Harnelwick

Non-Discriminatory Admissions

P.O. Box 100-N Fort Detrick, Virginia 24417

Non Military Summer School



Brandon Hall

EXCLUSIVELY INDIVIDUAL CLASSES FOR THE UNDERACHIEVER

Preparation for all schools, colleges. Structured, challengingly flexible prog. & acceleration for the academically talented. More 1-on-1 individual attention to students with language disabilities. Test-retest enrollment. Racially non-discriminatory admissions.

1701 Brandon Hall Drive, Grades 6-12, Atlanta, Georgia 30338 404/394-8278

CAMDEN MILITARY ACADEMY

A FULLY accredited college preparatory school, grades 7-12. In Carolina's winter resort section, Jr. Honor ROTC. Low rate. Students admitted of any race, color, national or ethnic origin. Write: Col. L. P. Bisher, Box N, Camden, S.C. 29028

CARSON LONG MILITARY SCHOOL

ACCREDITED. Emphasizes the whole boy—physically, mentally, spiritually. How to learn, how to labor, how to live. Prepares for college life. Grades 6-12. 142nd yr. of character building. Overall charges \$2000. Box 580, New Bloomfield, Pa. 17068

CASTLE HEIGHTS MILITARY ACADEMY

FULLY accredited ROTC. All sports, Champion drill, rifle teams. Coed gr. 6-12. Jr. Sch. 4-8. Sum. Sch. Extra study help. Driver ed. Non-discriminatory 10th yr. (Alumni send addresses) Box 478N, Lebanon, Tenn. 37087

FISHBURNE MILITARY SCHOOL

GR. 7-12 & P. G. SMALL school. Broad prgm. Full participation for each boy. How-to-study. Honors courses. Reading Dept. Sports. Jr. ROTC. Clubs. Band. Summer School. Est. 1879. In the Shenandoah Valley. Adm.: Box 988-N, Waynesboro, VA 22990

FARRAGUT NAVAL ACADEMIES

A complete academic program: Oceanography, Naval Science, extracurricular activities, sports. Grades 5-12. Separate lower school. Small classes. Honor Naval School. Fully Accredited. Band. Rifery. Sailing. NJROTC. College guidance program. 2 waterfront locations. Write for catalog. Admits students of any race, color, national or ethnic origin.

NORTH: Box L, Toms River, NJ 08753-201 • 348-1121
SOUTH: Box L, St. Petersburg, FL 33710-813 • 341-1891

Florida Air Academy

Preparing the Leaders of the 21st Century • Accredited • College Preparatory and General Courses •

Grades 1-12 & PG
 Indicate grade desired

Florida Air Academy

8601 W. Sunrise Blvd.
 Ft. Lauderdale 3, Fla. 33313
 Summer School Starts June 26.



FORK UNION MILITARY ACADEMY

Our ONE SUBJECT PLAN for grades 7-12 increases lower roll. Fully accredited. Training toward successful manhood and good character. Separate Junior School gr. 9-11. 1000 students. 18 modern bldgs. 2 pools. 2 gyms. Bands. gym. cl. 1000. 1000. 8000 yr. Non-discriminatory. Non-M.F.I. Summer School gr. 7-12. Ph. 804-843-3338 or write admissions. Box 288, Fork Union, Virginia 22969.

HARGRAVE MILITARY ACADEMY FULLY ACCREDITED

Comprehensive Reading & How-to-Study programs. Emphasis on stability & self-discipline. Golf, Aviation, Riding, Faculty & Intra-mural sports. Gr. 9-12 & PG. Racially non-discriminatory admissions. H.M.A., Box 401, Chatham, Va. 24531 804-432-2481

HOWE MILITARY SCHOOL

2R & Sr. Schs. Gr. 5-12. Thorough acad. training. Accred. College Prep. Developmental Reading. ROTC. Sports. Jrs. own dorm. Est. 1884. Sem. Camp. 2 mi. from Tompkins, Calif. Col. R. R. Kelly, Supt. 948 Academy Pl., Howe, Ind. 46746



LaSalle Excellence

Since 1863 LaSalle Military Academy's reputation for overall excellence has attracted boys 14 to 18 from all parts of the world who come to study under the guidance of dedicated Christian Brothers and laymen. LaSalle's tranquil 160-acre setting provides an ideal learning school atmosphere where boys develop intellectually, spiritually and on the athletic field. For more details call or write: LaSalle Military Academy, 14000 Lake Island, NY 11750. Phone: (516) 381-8801.

LaSalle MILITARY ACADEMY

Directed by Christian Brothers since 1863

MILLER SCHOOL COLLEGE PREP and Career Education. Auto shop, wood shop, electrical shop, photo lab, radio room, drafting room. 5:1 student-teacher ratio. Our 100th yr. CAP/USAF. Gr. 5-12. Catalog: Miller School, Box N, Charlottesville, Virginia 22901. Or call (804) 823-4885

MISSOURI MILITARY ACADEMY

& Separate Jr. Schs. 80th Yr. Gr. 4-12. Major college prepar. New Helms. Famous band & drill team. ROTC. All sports. Fine arts. Driver Ed. Golf. Riding. Non-Discrim. Write: Col. Charles Stripling III, 948 Main, Mexico, Mo. 65202

NORTHWESTERN MILITARY ACADEMY

PERSONAL attention key to individ. college prep curriculum. Gr. 7-12. Excellent faculty promotes achievement. All sports. Recreational activities incl. sailing, tennis, skiing. Box N-88, 500 S. Lake Shore, Lake Geneva, WI 53147

THE OXFORD ACADEMY

One Student/One Master concept. Boys 12-20 of average or superior intelligence with academic deficiencies, or foreign students preparing for American Universities. Enter anytime. The Oxford Academy, NG Westbrook, CT 06488

RIVERSIDE MILITARY ACADEMY

Tradition of excellence. Accredited. College Prep & General. Grades 7-12 & PG. Honor ROTC. Year-round outdoor sports. Ga. Sum. Sch. Racially non-discriminatory admissions. Write Supt., Riverside, Box R304, Gainesville, Ga. 30601.



Winter in Southwest Florida
 Fall & Spring in N. Georgia Mtns.

St. John's Military Academy

Est. 1884. Grd. 7-12. Accred. College prep. Structured society stressing character, leadership & initiative. All sports. Fine Arts dept. Honor ROTC. Driver Ed. Non-Discrim. Write Box NG 48, Delafield, WI 53018 (414/646-3311)

ST. JOHN'S MILITARY SCHOOL GR. 7-12 SINCE 1887

ACCREDITED. Friendly individual attention. College prep. ROTC. All sports. Driver Ed. Art. Music. Good food. Airline throughout year. Episcopal. Non-discrim. Write Col. R. G. Dorken, P.O. Box 838-NG, St. John's, Salina, Kan. 67401

WENTWORTH Military Academy Gr. 7-12 & Jr. College

ACCREDITED. 9th Yr. Sr. ROTC. Million dollar field has Golf, Tennis, FAA Flying. Top marching band/drill team. Camera Club. Hum. Schol. lounge. horse camp. Non-discrim. Col. Sellers, 948 Wash., Lexington, MO 64067 (816/298-2221)

The educational institutions listed in the Directory will be pleased to send additional literature to any National Geographic families expressing an interest in receiving further information. By mentioning The Geographic, your inquiries will be assured the best possible attention.

Change of Address?

Please print your new address below:

NAME _____

ADDRESS _____

CITY, STATE, ZIP CODE _____

And attach the address label from your National Geographic Magazine wrapper below, so your records can be updated. Six weeks advance notice should be given.

Paste Label Here

Clip this entire form and mail to:
NATIONAL GEOGRAPHIC SOCIETY
 WASHINGTON, D. C. 20036

FOR YOUR SPORT AND FAMILY FUN

You GO CAREFREE anytime with COMPACT Folbot. Only streams, lakes, marsh, bay & open sea. SLIDE smoother, faster & NOISELESS with paddles, oars, or sails and rde. softly w. 1 to 10 HP. motors. Many styles & sizes from 1 to 6 seats. FOLDING or rigid PORTABLE come in PREFAB KIT or SPECIAL FACTORY BUILT

TRAVEL CRAFT

FOLBOT

Fabulous Portable
NOW \$119

from
 PREFAB KIT
 or
 Factory BUILT

\$199
 DACRON
 Sail
 Rig
\$185

**BIG
 NEW
 Folding**
 from **\$341**
 factory finished

FREE

**ACTION CATALOG
 STARTLING
 FACTS & FIGURES**
 Mail coupon or address

to: FOLBOT CORP. G 478
 Charleston, S. C. 29405

Name _____

Address _____

City _____ State _____



Our engine sits sideways

When people sit in a Honda Civic® 1200® or Civic CVCC® for the first time, they are often surprised at the amount of room inside.

They discover that despite their brief overall length our Civics have plenty of room for four adults. Plus luggage space behind the rear seat.

How do we do it? To help solve the mystery, we took the roof and hood off a Honda Civic CVCC Hatchback.

As you can now see, one reason for the Civic's roominess is the way the engine sits. Because it sits sideways, instead of lengthwise, the engine doesn't interfere with



HONDA CIVIC CVCC 4-SPEED HATCHBACK.

so you don't have to.

front-seat legroom. Instead, it is neatly tucked away up front, out of everybody's way.

Of course, the engine in our Civic CVCC 4-speed Hatchback is sitting pretty when it comes to fuel economy. This model got 42 mpg for highway driving, 36 mpg city, according to EPA estimates. The actual mileage you get will vary depending on the type of driving you do, your driving habits, your car's condition and optional equipment. Mileage estimates are lower for California and high altitude cars.


Getting back to roominess. We gave the Civic additional space by giving it front-wheel drive. This means there is no drive shaft to the rear wheels, so the hump running through the passenger compartment is reduced.

So now when you sit in a Honda Civic, please don't be surprised that you're not cramped for space. And that you're not sitting sideways. After all, it was a simple matter to make our engine sit that way instead.



HONDA

We make it simple.



**“That dam
messed up the
valley’s wildlife.”**

Few water projects are built without conflict. Idaho’s Dworshak Dam was no exception. One side cited a billion watt electric potential and urgently needed flood protection. Others objected to environmental disruption. Who was right? The decision was difficult.

The dam brought change. Fifty-three miles of river and valley disappeared. It blocked steelhead trout in their upstream run to age-old spawning grounds. It flooded winter grazing lands of one of our few elk herds. Deep reservoir waters brought marinas, campers, tourists. Unaccustomed life style replaced the quiet woods.

But the dam has prevented flood damage to homes and businesses. Power brought new jobs, better schools, roads, recreation, tourist dollars and increased tax revenues. Dworshak’s total economic contribution, an estimated \$50 million a year.

Dworshak shows we can have both wilderness resources and water power. A \$20 million fish hatchery was created to supplant the steelhead run and stock the reservoir with rainbow trout and kokanee. The elk herd lost a grazeland. But, a new preserve was established to replace it. Reservoir waters opened up recreation in formerly inaccessible land.

Without question America should respect its untamed lands. Some wilderness should remain wilderness. But we need power, too. All kinds. Hydroelectric power doesn’t pollute air or water, it’s reliable, controllable, leaves no waste products. An ideal power source, but there aren’t many sites left. We should develop as many of these power resources as prudent, striving always to balance drawbacks with compensating benefits.

Caterpillar machines work on land conservation and water management projects benefiting all Americans. We believe in developing natural resources for the common need.

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



CATERPILLAR

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

**“That dam
can generate
power to light
30,000 homes.”**

**For outstanding
engineering achievement in television,
General Electric has won an Emmy.**



**The National Academy of Television Arts and Sciences has honored General Electric
for 'The First Application of the Vertical Interval Reference (VIR)
Signal System to Television Receivers.'**

The VIR signal was designed by a TV industry committee to correct distortions in the TV color signal as it passed from network sources, through communications systems, to homes. The development of VIR was a big step in color broadcasting.

The next challenge was to design a TV set that could use it. General Electric developed the VIR Broadcast Controlled Color System. And won an Emmy for being the first to use VIR in TV sets.

GE VIR color sets have computer-like circuitry

which uses the broadcaster's VIR signal to automatically adjust color and tint, sixty times a second, on many programs.

You owe it to yourself to see GE VIR color TV in action before you buy a new set. See a demonstration today.



Cabinet: Walnut finish on high-impact plastic.

THIS IS GE PERFORMANCE TELEVISION

GENERAL  ELECTRIC