VOLUME CII NUMBER TWO

THE NATIONAL GEOGRAPHIC MAGAZINE

AUGUST, 1952

U. S. Capitol, Citadel of Democracy
With 56 Illustrations
32 in Natural Colors
LONNELLE AIKMAN
WILLARD R. CULVER

High Adventure in the Himalayas
With Map and 33 Illustrations
23 in Natural Colors
THOMAS WEIR
DOUGLAS SCOTT

Back-yard Monsters in Color
With 34 Illustrations
27 in Natural Colors
PAUL A. ZAHL

Canada Counts Its Caribou
Map and 12 Illustrations

Water for the World's Growing Needs
With 18 Illustrations
HERBERT B. NICHOLS
and F. BARROWS COLTON

Sixty-four Pages of Illustrations in Color

PUBLISHED BY THE
NATIONAL GEOGRAPHIC SOCIETY
WASHINGTON, D. C.

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ORGANIZED FOR "THE INCREASE AND DIFFUSION OF GEOGRAPHIC KNOWLEDGE"

To carry out the purposes for which it was founded sixty-four years ago, the National Geographic Society publishes the National Geographic Magazine monthly. All receipts are invested in The Magazine itself or expended directly to promote geographic knowledge.

Articles and photographs are desired. For material The Magazine uses, generous remuneration is made.

In addition to the editorial and photographic surveys constantly being made, The Society has sponsored more than 100 scientific expeditions, some of which required years of field work to achieve their objectives.

The Society's notable expeditions have pushed back the historic horizons of the southwestern United States to a period nearly eight centuries before Columbus crossed the Atlantic. By dating the ruins of the vast communal dwellings in that region, The Society's researches solved secrets that had puzzled historians for three hundred years.

In Mexico The Society and the Smithsonian Institution, January 16, 1939, discovered the oldest work of man in the Americas for which we have a date. This slab of stone is engraved in Mayan characters with a date which means November 4, 291 B. C. (Spinden Correlation). It antedates by 200 years anything heretofore dated in America, and reveals a great center of early American culture, previously unknown.

On November 11, 1935, in a flight sponsored jointly by the National Geographic Society and the U. S. Army Air Corps, the world's largest balloon, *Explorer II*, ascended to the world altitude record of 72,395 feet. Capt. Albert W. Stevens and Capt. Orvil A. Anderson took aloft in the gondola nearly a ton of scientific instruments, and obtained results of extraordinary value.

A notable undertaking in the history of astronomy was launched in 1949 by The Society in cooperation with the Palomar Observatory of the California Institute of Technology. This project will require four years to photomap the vast reaches of space, and will provide the first sky atlas for observatories all over the world.

In 1948 The Society sent out seven expeditions to study the eclipse of the sun along a 5,320-mile arc from Burma to the Aleutians. The fruitful results helped link geodetic surveys of North America and Asia.

The Society granted $25,000, and in addition $75,000 was contributed by individual members, to help preserve for the American people the finest of the giant sequoia trees in the Giant Forest of Sequoia National Park of California.

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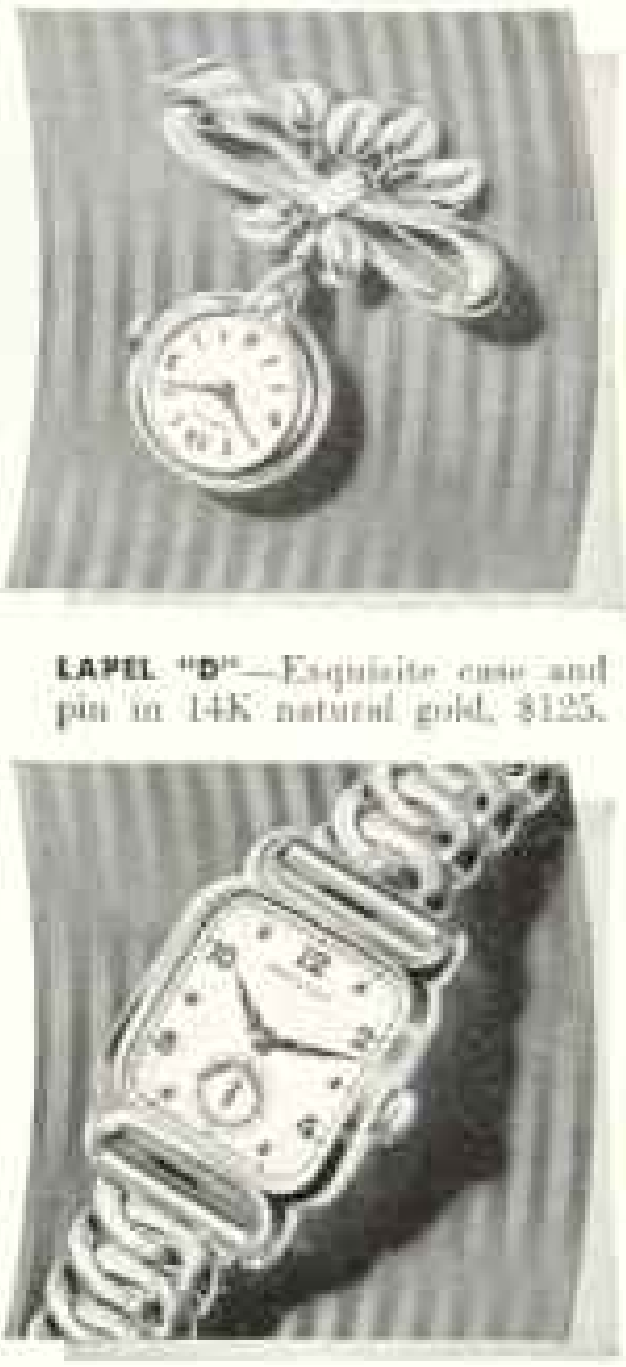

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TIPS ON TRAVEL

by BRADLEY WESTON
World Traveler, Author and Travel Columnist

WHERE LIFE HOLDS A THOUSAND CHARMS

IF you've been spending the summer minding the store while everyone else is off carousing around a foreign countryside, don't fret, for the cause ain't lost. There is still the Fall. While the local folk on this side of the sea are bundling up in rugs, the vacation season goes on swimmingly in Southern Europe.

When Autumn comes to Italy, it is both fashionable and pleasant to repair to the watering places —to Fiuggi, to Salso Maggiore, to Montecatini. One sips the waters, takes the cure, listens to the open-air concerts morning and evening, and returns home ready to face winter with a smile.

Chic Clientele at Ischia

Fiuggi's water filters through volcanic rock, arrives at the surface warmed to fifty degrees, tasteless and full of radioactivity. Up at Montecatini, just outside Florence, you sit under shade trees, listen to the band, sip the water and eat magnificent food.

Ischia, the island near Capri which was the fountain of youth of the old Romans, is popular again. Back in the old days it was a sure cure for the rheumatism a man could get running around a drafty forum in a thin toga. Today its waters are described as the most radioactive in Europe, and it attracts a chic clientele to match.

Carnival of Eating

All of fashionable France repairs to the Basque country in the Fall, when the season centers around the seaside resort of Biarritz. Folklore festivals featuring fiery Basque dances are staged at Biarritz and surrounding villages all through September. A mild form of bull fighting, at which the Spaniards would sneer, is held in the Basque towns in early Fall and also in the ancient Roman arena at Arles in Provence.

While all this activity is rampant in the south of France, up in Burgundy the Burgundians are having at their favorite sport—eating. France's list of Fall festivals is headed by Dijon's Gastronomic Fair, a two-and-a-half-week caloric binge.

Jai Alai between Courses

The Fall lingers long down in Spain, the pulse of life gradually turning from the resorts to Madrid, Barcelona, and Seville. In the capital, golf goes on at Puerta de Hierro Club's course, there are pigeon-shoots, soccer matches and, of course, *jai alai*. At Madrid's Recoletos, a smart dining spot, you watch *jai alai* between courses and dances. Theaters and movie houses don't open until 11 p.m., and the crowd doesn't filter into the night clubs until 1 a.m. Most clubs have a minimum charge of about fifty cents, American, and at one spot on the Plaza Santa Ana you can hire a troupe of Flamenco dancers and a private room until well past dawn for the likes of twenty dollars.

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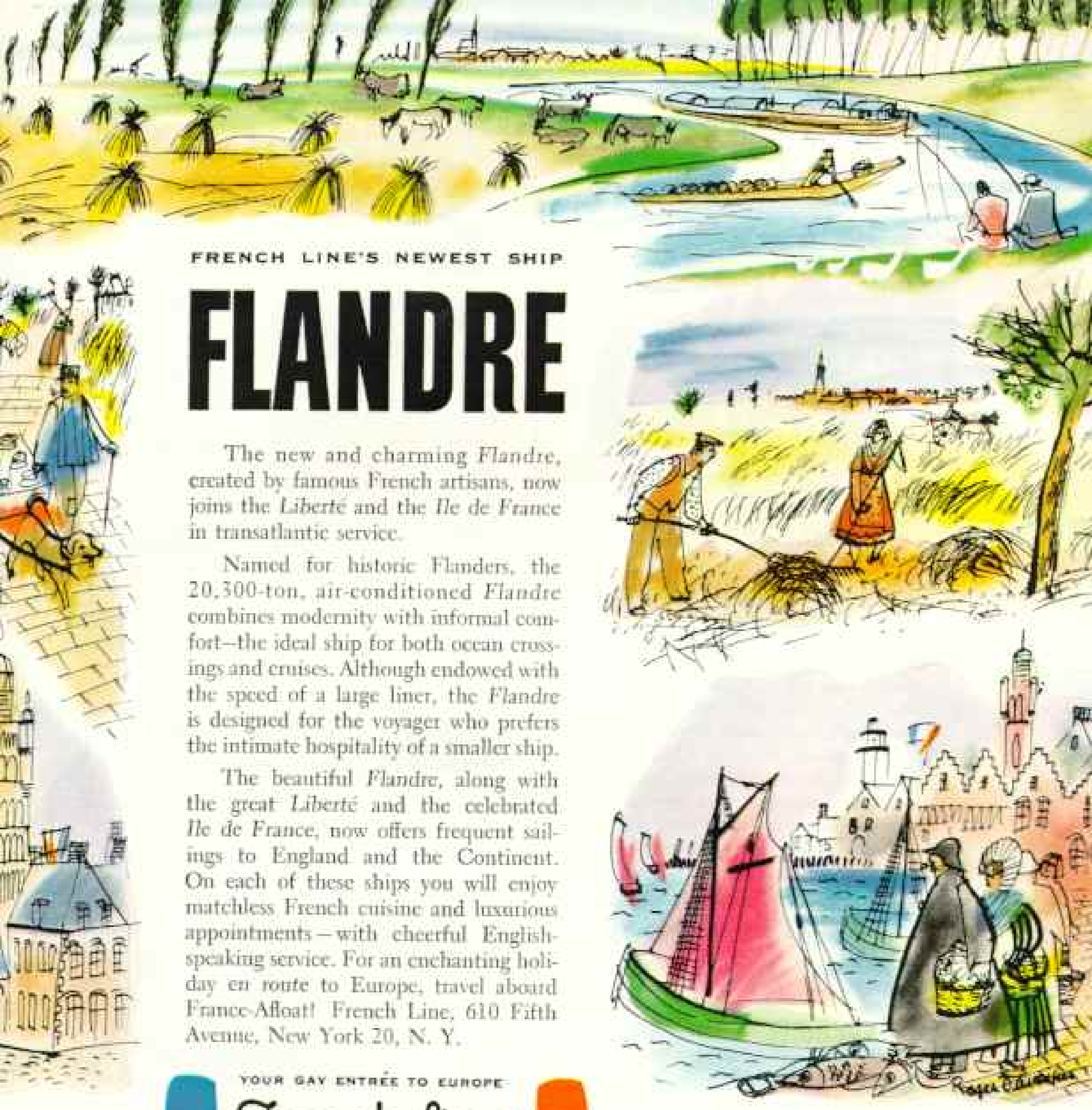

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And to you who have experienced the difficulties of distance and fringe-area reception—a promise of a revelation in improvement. Even in fringe areas, your Zenith can be tuned with one knob and the picture "locked" to eliminate further tuning.

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(Above) **New Zenith Television Console** *Model* K2260R, 21-inch (248 sq. in.). Graceful classic simplicity with genuine, lustrous mahogany veneers and selected hardwoods. $379.95*. See this and the many other Zenith models now on display at your dealer's.

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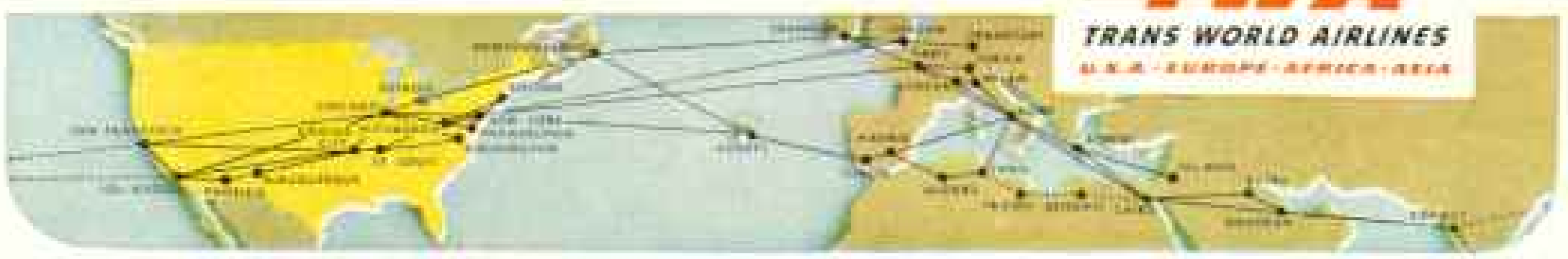

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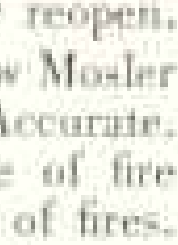

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A voice out of the past . . . Some messages never grow old—because the truths they express are enduring. One such message is reprinted here. It appeared 30 years ago this month as the first of the Metropolitan's health advertisements.

The Land of Unborn Babies

IN Maeterlinck's play—
"The Blue Bird," you see the exquisite Land —all misty blue—where countless babies are waiting their time to be born.

As each one's hour comes, Father Time swings wide the big gate. Out flies the stork with a tiny bundle addressed to Earth.

The baby cries lustily at leaving its nest of soft, fleecy clouds—not knowing what kind of an earthly "nest" it will be dropped into.

Every baby cannot be born into a luxurious home —cannot find awaiting it a dainty, hygienic nursery, rivalling in beauty the misty cloud-land.

But it is every child's rightful heritage to be born into a clean, healthful home where the Blue Bird of Happiness dwells.

As each child is so born—
the community, the nation, and the home are richer. For just as the safety of a building depends upon its foundation of rock or concrete so does the safety of the race depend upon its foundation—the baby.

And just as there is no use in repairing a building above, if its foundation is *weak*, there is no use in hoping to build a strong civilization except through healthy, happy babies.

Thousands of babies—
die needlessly every year. Thousands of rickety little feet falter along Life's Highway. Thousands of imperfect baby-eyes strain to get a clear vision of the wonders that surround them. Thousands of defective ears cannot hear even a mother's lullaby.

And thousands of physically unfit men and women occupy back seats in life, are counted failures—all because of the thousands and thousands of babies who have been denied the birthright of a sanitary and protective home.

So that wherever one looks—the need for better homes is apparent. And wherever one listens can be heard the call for such homes from the Land of Unborn Babies.

The call is being heard—

by the schools and colleges that are establishing classes in homemaking and motherhood; by public nurses and other noble women who are visiting the homes of those who need help and instruction; by the hospitals that are holding Baby Clinics.

By towns and cities that are holding Baby Weeks and health exhibits; by magazines and newspapers that are publishing articles on prenatal care.

By Congress that has passed the Mothers and Babies Act, under which health boards in every State will be called upon to give information to expectant mothers.

All this is merely a beginning—

The ground has hardly been broken for the Nation's only safe foundation —healthy babies—each of whom must have its rightful heritage—An Even Chance—a healthy body.

The call will not be *answered* until every mother, every father and every community helps to make better homes in which to welcome visitors from the Land of Unborn Babies.

Babies of 1952 have a far better chance of growing up to be sturdy and healthy than did boys and girls who were born in 1922, the year in which "The Land of Unborn Babies" appeared.

In fact, the great gains that have been made in protecting child health—through diet, immunizations, and knowledge of infant growth and development—represent one of medicine's greatest triumphs. Today, the infant mortality rate is, by all odds, the lowest in history.

Equally heartening has been the drop in maternal mortality rates. At present the chances of an expectant mother surviving childbirth are better than 999 out of 1000! In these figures there is truly a story of human and social progress.

Metropolitan Life Insurance Company

Unwind it, and there's a Pangolin!

Eluding the sharp claws or fangs of his enemies isn't too tough for the African pangolin, *Manis tricuspis*.

Surprised while he's out in the open, the pangolin simply winds his body into a ball, his snout between his forelegs. And his tough, overlapping scales—ruffed up like a pine cone—persuade his foe to pass him by.

Unfortunately, you can't curl up, as the pangolin does, when danger threatens. But you can provide yourself with a sure and reliable device to protect you from the worry and loss of money which danger may bring.

The name of that device is Accident Insurance—and what a load it can take off your mind!

You can even make sure you'll have an income when a disabling injury causes a long period of disability.

The man to see about your Accident Insurance is your Travelers agent or broker.

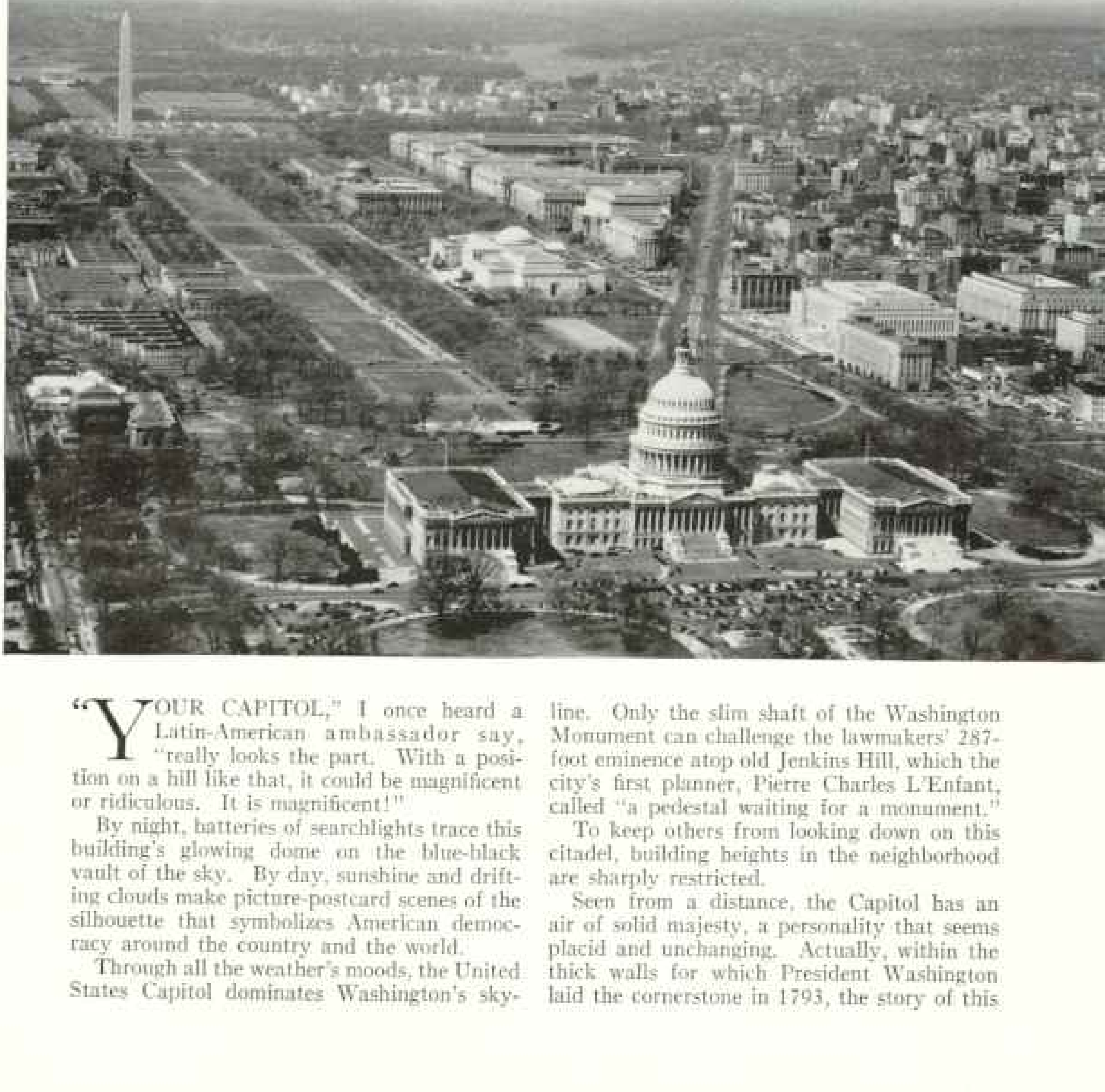
How the pangolin looks when he's not curled up

VOL. CII, NO. 2 WASHINGTON AUGUST, 1952

THE NATIONAL GEOGRAPHIC MAGAZINE

U. S. Capitol, Citadel of Democracy

BY LONNELLE AIKMAN



"YOUR CAPITOL," I once heard a Latin-American ambassador say, "really looks the part. With a position on a hill like that, it could be magnificent or ridiculous. It is magnificent!"

By night, batteries of searchlights trace this building's glowing dome on the blue-black vault of the sky. By day, sunshine and drifting clouds make picture-postcard scenes of the silhouette that symbolizes American democracy around the country and the world.

Through all the weather's moods, the United States Capitol dominates Washington's skyline. Only the slim shaft of the Washington Monument can challenge the lawmakers' 287-foot eminence atop old Jenkins Hill, which the city's first planner, Pierre Charles L'Enfant, called "a pedestal waiting for a monument."

To keep others from looking down on this citadel, building heights in the neighborhood are sharply restricted.

Seen from a distance, the Capitol has an air of solid majesty, a personality that seems placid and unchanging. Actually, within the thick walls for which President Washington laid the cornerstone in 1793, the story of this

National Geographic Photographers B. Anthony Stewart and John E. Fletcher

Busy as a Beehive, the Capitol Swarms with Senators, Representatives, and Sight-seers

On "the Hill," hub of the Washington street system, stands the 287-foot Capitol, where the Nation's laws are made. Its original design was submitted in the 1792 competition by William Thornton, an amateur architect trained as a physician. Many changes have been made, including these 36 steps to the portico.

building is one of ceaseless variety, conflict, and motion.

Surrounding the formal halls where Senate and House of Representatives debate and decide the Nation's laws are hundreds of smaller rooms—committee and office rooms; administrative, clerical, and utility quarters; exhibit halls swarming with visitors.

A City in Four Walls

"This is almost a city in itself," said the veteran Architect of the Capitol, David Lynn, whose numerous duties include the maintenance, structural care, and improvement of the home of Congress.

Wandering miles along the corridors, I could see what he meant. I caught glimpses of restaurants and kitchens, stationery, barber, and carpenter shops, ticket offices, disbursing and banking offices, post offices, and even dispensaries and the attending physician's office.

As a footloose correspondent, I was permitted to explore libraries and document rooms that serve the Members of Congress. I checked in at police headquarters to talk with officers who guard the Capitol and its 131-acre grounds. I saw reception rooms and private dining rooms where the President is entertained on visits with congressional dignitaries.

Beyond the steep galleries that look down on the sessions of Senate and House, I walked through rooms full of desks, typewriters, and telephones where reporters for daily press, periodicals, radio, and television turn out each day's grist of news (pages 180, 182).

Yet, for all the stir and bustle, a spirit of history broods over the Capitol. It fills the air in legislative chambers that once echoed to the oratory of America's political giants, the bitter arguments of the "great debates."

National Geographic Photographer Willard R. Culver

Juliana: "Mankind . . . Has to Trust Largely to Your Good Judgment for Its Deliverance"

The Queen of the Netherlands, speaking on cooperation between the North Atlantic Treaty powers, addressed Congress in joint meeting in the House Chamber on April 3, 1952. President of the Senate Barkley and Speaker of the House Rayburn sit behind her. Prince Bernhard (front row, lower left) listens to his Queen.

No other building in the country can summon so many illustrious ghosts: Jefferson, Adams, and Lincoln; Webster, Clay, and Calhoun. There were the Chief Justices John Marshall, Charles Evans Hughes, and William Howard Taft, the only man in American history to serve both as President and as Chief Justice.

Art Teaches History

The past lingers in the antique mirrors and marble fireplaces of modern offices. Statues and portraits of statesmen and soldiers look down soberly on every chamber and corridor.

For the Capitol is more than a legislative factory. It is one of the Nation's foremost showplaces. Its art galleries and columned halls, its decorations and memorials are fascinating not only in themselves but in their graphic presentation of the American story.

Would you like to see what the first Speaker of the House, Frederick Augustus Conrad Muhlenberg, looked like? You will find his portrait hanging, with those of others who have held the post, in the long Speakers Lobby outside the Hall of Representatives.

The round, serene face of this Pennsylvania clergyman, who served in the Continental Congress and the first four Congresses of the United States, belies the fiery period of revolution and post-revolution in which he lived.

Or you may want to look up the bronze or marble likeness of the distinguished son chosen to represent your State in Statuary Hall (page 148). Of the 40 States which so far have contributed statues in response to the congressional invitation of 1864, only one has selected a favorite daughter. She was Frances E. Willard of Illinois, ardent feminist leader and temperance crusader.

Mr. Barkley Honors Daniel Boone VII

Vice President Alben Barkley, who used to represent Kentucky in the Senate, makes a Kentucky colonel of young Boone. The boy, a descendant of the famous frontiersman, wears a coonskin cap and the Boy Scouts' merit badge sash. The Vice President's seal, which stands on the easel in Mr. Barkley's office, was created by a Presidential order in 1948.

Girl Scouts Pass the Cookies

Sam Rayburn, Speaker of the House, and Joseph W. Martin, Jr., House minority leader, sample the offerings before contributing to the Girl Scouts' camping fund. Left to right, the girls are Anne and Lera Thomas, daughters of the Texas Representative; Linda Kefauver, daughter of the Tennessee Senator; and Marta Miller, from Texas.

National Geographic Photographers B. Anthony Stewart and John E. Fletcher

147 National Geographic Photographers B. Anthony Stewart and John E. Fletcher

Ohio's Robert A. Taft Greets Visitors in the Senators' Reception Room

Constituents, lobbyists, and sometimes feathered Indians meet their Senators here. Constantino Brumidi, who decorated much of the Capitol in 25 industrious years, lacked time to fill the empty medallions (pages 164, 168).

National Geographic Photographers B. Anthony Stewart and John E. Fletcher

The Guide Whispers; Echo Carries Her Words Across Statuary Hall

Bronze and marble statues contributed by 40 States in honor of distinguished sons and one daughter give this room its name. Here the House met from 1807 to 1857, and here Representative John Quincy Adams, a former President, was mortally stricken with paralysis (pages 145, 182). Statues (l. to r.) show Delaware's Caesar Rodney, Ohio's William Allen, Arkansas's Uriah M. Rose, Mississippi's Jefferson Davis (bronze), Virginia's Robert E. Lee (bronze), and Rhode Island's Roger Williams. California's Junipero Serra (bronze) holds a cross, and Pennsylvania's Robert Fulton looks at a ship model.

Or perhaps you had forgotten the story of Edward Dickinson Baker, whose life-sized toga-draped figure stands in the high-domed Rotunda along with those of Washington, Jefferson, Lincoln, and others. Senator Baker of Oregon, Civil War hero and close friend of Lincoln, was killed as he led Union forces into action at Balls Bluff, Virginia.

According to contemporary news reporters, Lincoln wept when he learned of Baker's death. Congress later singled out the Oregonian for his place of honor in the Rotunda.

All three branches of the United States Government figure in the Capitol's history.

In one room or another of the old Senate wing the Supreme Court sat from 1801 until 1935. Most of our Presidents have taken the oath of office—some in rain or snow—outside the main east entrance.

Just before each Presidential inauguration, incoming Vice Presidents traditionally have been inducted into office in the Senate Chamber, where they also automatically assumed the role of President of the Senate. Since 1937, however (with the exception of the 1945 ceremonies at the White House), the Vice Presidential swearing-in has been part of the inaugural procedures on the Capitol's east-front platform.

How the Capitol Has Grown

Physically, the Capitol has grown up by bits and pieces, its construction alternately promoted and delayed by national pride and practical difficulties. The process began years before the Federal Government was moved, in 1800, to the wilderness capital by the Potomac.

National Geographic Photographer Willard R. Culver

An Artist Sitting on the Platform-supported Canvas Cleans a Rotunda Painting

Marie Kalnoky freshens "The Surrender of General Burgoyne," one of four documentary pictures made by John Trumbull especially for the Capitol (pages 154, 156, 157, and 177). Trumbull (1756-1843), who drew on his own Revolutionary experiences, had the additional advantage of painting his heroes in the flesh.

Curiously, the original design for this building—the only one submitted that met George Washington's specifications for "grandeur, simplicity, and convenience"—was the work of an amateur architect. Dr. William Thornton, who won $500 and a city lot for his entry in the Capitol competition of 1792, was a physician by training.

Brilliant and versatile, Dr. Thornton turned out his classically based design with as much ease, apparently, as he dashed off poetry, painted portraits, and experimented with steamboats and speech for the deaf.

Talented professionals—notably Benjamin H. Latrobe, Charles Bulfinch, and Thomas U. Walter—made their contributions as Capitol Architects. Despite disputes and setbacks, they tailored and merged the various elements and additions into the present structure.

But the record also gives credit for the overall success of the work to the guiding role of other amateurs in architecture—the successive Presidents of the United States.

Both Washington and Jefferson had a direct hand not only in making broad decisions affecting the building's design, but in such practical measures as importing hard-to-find skilled masons, carpenters, and sculptors.

So closely was Jefferson associated with plans for the Capitol that he has been erroneously credited with certain of its more original designs. It seemed logical, for example, to attribute Latrobe's charming and unusual cornstalk and tobacco decorations at the head of some of the interior columns to Monticello's master of the ingenious gadget (page 170).*

Oldest section of the Capitol is the rectangular north wing, now the connecting link between the central Rotunda and the big Senate extension (chart, pages 174-175).

* See "Mr. Jefferson's Charlottesville," by Anne Revis, National Geographic Magazine, May, 1950.

It was there, in a building of propped-up arches and temporary partitions, that Congress held its first joint session on November 22, 1800. It was addressed by President John Adams, who, with his wife Abigail, was having his own housekeeping troubles in the new White House at the other end of the forest- and meadow-framed trail ambitiously called Pennsylvania Avenue.

Congressmen Baked in an "Oven"

Some seven years more were to pass before the Capitol's twin south wing, including what is now Statuary Hall, was ready for the House of Representatives. Meanwhile, the Representatives met in the Senators' north building, with a three-year interlude in a queer oval-shaped structure temporarily erected on the south site and descriptively known as the "Oven."

Even before the move into the Oven, the original House Chamber in the north wing was the scene, in February, 1801, of the exciting climax to Washington's first major political struggle. The issue was the contested Presidential election between the two leading candidates, Jefferson and Aaron Burr, the latter already a sinister figure. Since the electoral vote was tied, it was up to the House, under the constitutional rules of the day, to make the decision that would give one man the Presidency, the other the Vice Presidency.

The eyes of a tense nation turned to the House as a six-day deadlock followed. During the final 30-hour struggle before Jefferson was announced the winner, one determined Member voted from a sickbed set up at the scene of action!

In these early building phases the two Capitol units were united only by a wooden walkway. At one time, public springs bubbled in the intervening open space; around them children played and neighboring housewives gathered to gossip and fill their buckets.

It was not until the reconstruction after the burning of the building in the War of 1812 that a connecting rotunda came into being. Completed in the mid-1820's, its low, copper-covered wooden dome was modest compared with the towering iron dome that eventually was to take its place.

But the country was growing fast—almost doubling its population every two decades—and the Federal Capitol on Jenkins Hill both reflected and influenced the changes and developments.

A dozen States joined the Union between 1820 and the outbreak of the Civil War. With each newcomer, more and more Members were added to Congress. Debates also grew hotter and more complex—the Missouri Compromise of 1820; Andrew Jackson's bank battles of the 1830's; the slave and free-State controversies of the 1850's.

Today, in the quiet, seldom used Old Senate Chamber, you find a small picture showing this room just as it was in 1850. Below it hangs a chart of each Senator's place.

"There's where Webster, Clay, and Calhoun sat," said my companion, Col. Carl Miller, of the Capitol's professional Guide Service. "Sam Houston, who'd been President of the Republic of Texas twice, was here then. So was Stephen Douglas, even before his debates with Lincoln. And Seward and Chase, who later served in Lincoln's Cabinet. And his Vice President, Hannibal Hamlin."

I followed his finger down the list. "And look! Jefferson Davis, too. With so much in the history books about Davis as President of the Confederacy, you forget he had an important Senate career before."

Barracks, Bakery, and Hospital

Through the years, neither crisis nor war halted the Capitol's growth. In 1850, despite the approaching civil conflict, Congress voted funds for two big extensions.

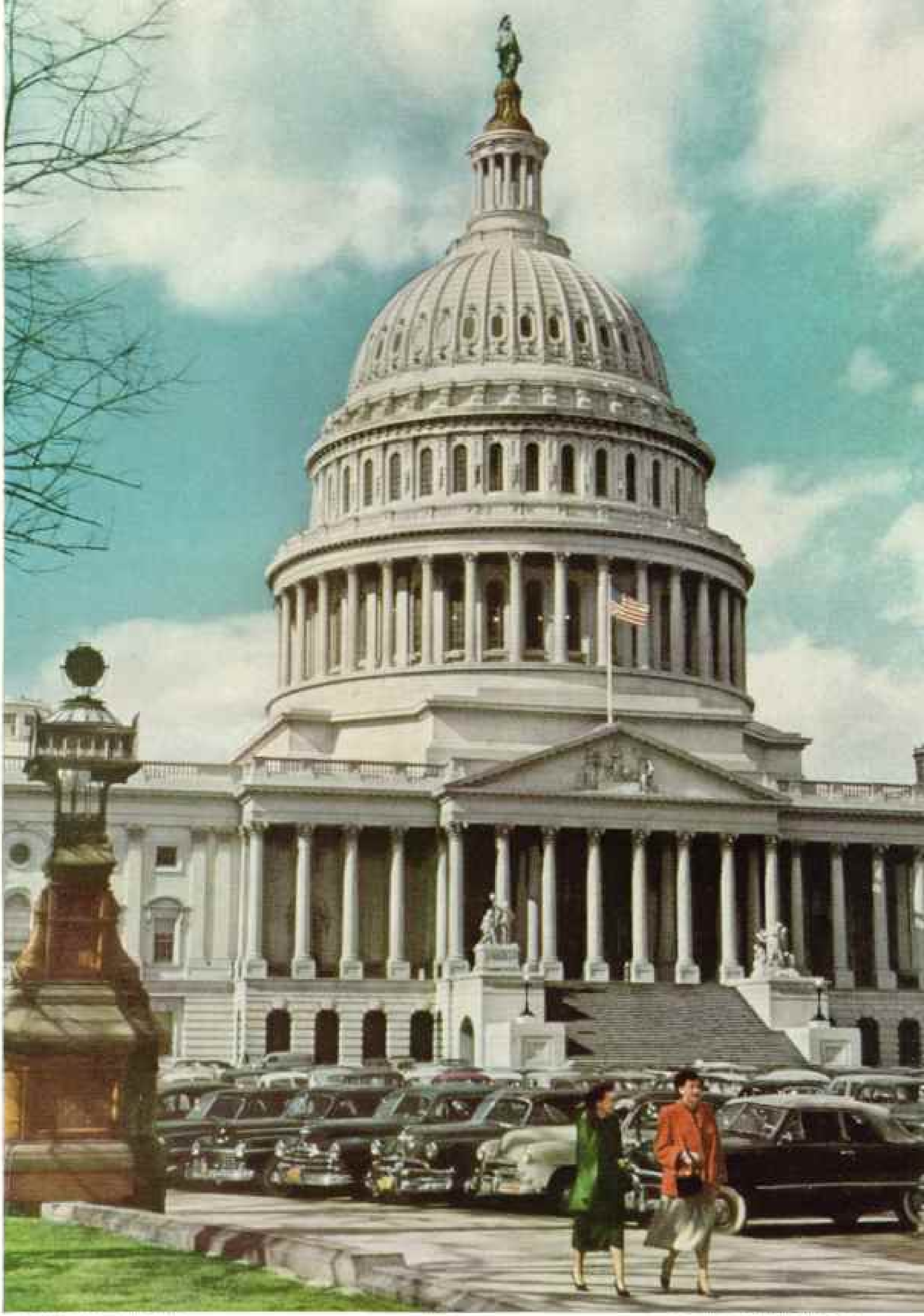
The first session of the House (237 Members) was held in the new south-wing addition in December, 1857. Nearly a year and a month later, the Senate moved over to the comparable north building, while the Supreme Court transferred its quarters from the ground floor into the vacated Senate Chamber.

During the fateful days of the Civil War, when Washington was a borderline town and sometimes a beleaguered one, the Capitol served as barracks, military bakery, and hospital.

Some of the Union's first volunteer troops were quartered in the Senate and House Chambers; there they amused themselves by holding mock legislative sessions. Others slept on the floor of the Rotunda, their new rifles stacked high under John Trumbull's historic paintings of the Revolution.

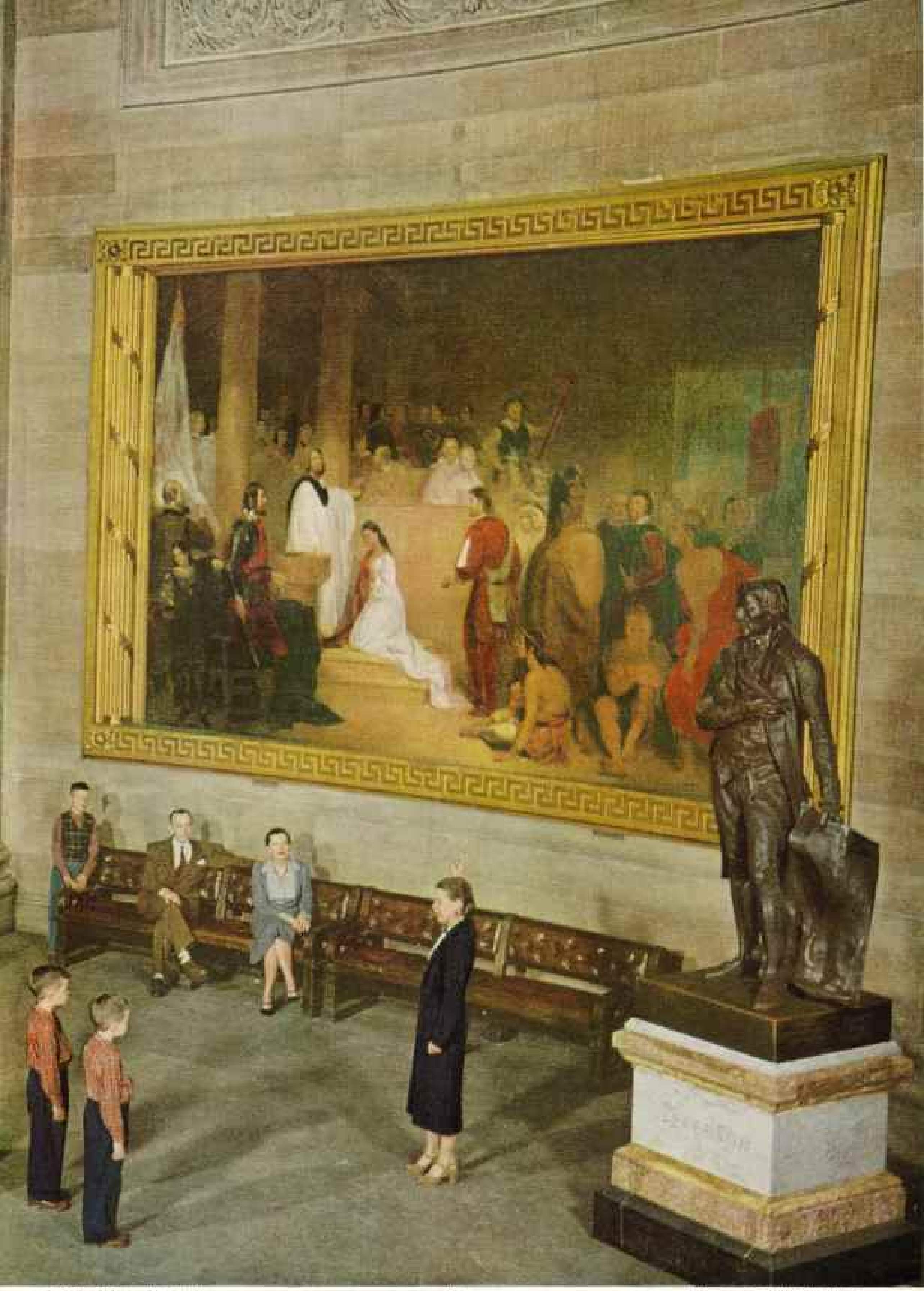
At one time long lines of dusty wagons rolled up to the basement entrances bearing valuable loads of flour evacuated from threatened Georgetown bakeries. Later, as the wounded poured back from the battlefields into the crowded, harried city, volunteer nurses and doctors found their patients in rows of hospital beds set up between the statues and busts.

Above all the activities, the clanking and pounding of workmen putting up the vast new cast-iron dome went on. For President Lincoln, who had known this building well as an Illinois Congressman from 1847 to '49, was determined to keep the construction going as a symbol of the strength and the future of the Union (page 168).



Kodachrome by Willard R. Culver

Beacon of Liberty and Treasury of Art: the United States Capitol



De Soto's Mississippi Discovery and Pocahontas's Baptism Impress Visitors to the Rotunda

W. H. Powell (left picture) and J. G. Chapman painted two of eight historic scenes that adorn the Capitol's hub.

Americans and French Accept the British Surrender at Yorktown, 1781. George Washington Sits on His Charger (Right)

Pleading indisposition, Lord Cornwallis sent a subordinate (on foot), who capitulated to Washington's deputy, General Lincoln. Opposite: Pilgrims pray aboard the *Speedwell* on departure from Holland, 1620. Both paintings, John Trumbull's (above) and Robert W. Weir's, hang in the Rotunda.

A Committee of Five Presents the Declaration of Independence to John Hancock in Philadelphia. Painted by Trumbull

John Adams, Roger Sherman, Robert Livingston, Thomas Jefferson, and Benjamin Franklin offer the document, which the Second Continental Congress adopted July 4, 1776. Hancock, the first signer, wrote his name in such bold script that "John Hancock" became a synonym for signature.

General Gates, an English-born American, Accepts General Burgoyne's Sword after the Battle of Saratoga. By Trumbull

Perry on Lake Erie: "We Have Met the Enemy, and They Are Ours"

This War of 1812 engagement, fought September 10, 1813, secured Lake Erie for the American cause. Oliver Hazard Perry, the 28-year-old American commander, built, equipped, and manned his victorious fleet.

Here Perry transfers the colors from his battered flagship, the *Lawrence*, to the *Niagara*.

For this painting, acquired in 1865 and placed in the east stairway of the Senate wing, artist William H. Powell received $25,000.

A vandal cut out a small section in the lower left of the painting and threw it down the stairway, from which it was retrieved. Restorers did such a neat job that the slash is not noticeable here.

↓ Howard Chandler Christy's painting, which hangs in the east stairway of the House wing, portrays the Constitutional Convention in Philadelphia, September 17, 1787.

George Washington, presiding, receives the delegates as they step up to sign the Constitution. James Madison, chief architect of the document, sits at right of Benjamin Franklin (with stick). Alexander Hamilton leans toward Franklin.

Constantino Brumidi, "Michelangelo of the Capitol," Adorned Its Walls with Vivid Murals and Ageless Frescoes: Valley Forge

Brumidi's "Battle of Lexington" Gives Drama and Color to the Senate Appropriations Committee Room

Photograph by Willard B. Culver

Lawmakers, Press, and Visitors Crowd the House Chamber for a Joint Meeting

Reporters fill three tiers of desks in the balcony. Cabinet members occupy temporary chairs encircling the rostrum. Senators use the front seats, Representatives the rear ones. Portraits show Washington and Lafayette.

Kodachrome by John E. Fletcher

Britain's Winston Churchill Addresses the U. S. Congress for the Third Time

On January 17, 1952, the Prime Minister said: "I have come here to ask not for gold but for steel." Vice President Barkley (left) and Sam Rayburn, Speaker of the House, sit behind him in the newly redecorated Chamber.

Cherubs Whirl above the Crystal Chandelier in the Senate Reception Room

Brumidi, the long-neglected master who created this rich ceiling, labored 25 years on his monumental decorative projects in the Capitol. As compensation, the Congress awarded him an average $10 a day, with allowances.

Benignant Peace and Scowling War Deck a Senate Room

A captain of the guard in his native Rome, liberty-loving Constantino Brumidi defied an order to fire on his fellow Italians during the 1848 revolutions. In penalty he spent 14 months in jail and, though he had the friendship of Pope Pius IX, he had to flee Italy for his life.

A century ago this September Brumidi emigrated to America; he devoted virtually the rest of his life to painting for freedom's cause. So proud was he of becoming an American that he signed one of his works "Citizen of the U. S."

In 1855 the painter began to decorate the Capitol, a project he carried out through the terms of six Presidents. More than any other artist, he was responsible for its dazzling decorations.

Brumidi died unhonored, "worried by the terrible future prospect of starvation," and so impoverished that Congress appropriated funeral funds. His obscure grave in a Washington cemetery remained unmarked until 1952.

Illustrations by Willard R. Culver

Geography and Physics Illuminate the Senate's District of Columbia Room

These madonnas balance others symbolizing History and the Telegraph (not shown). In the corners, Brumidi frescoed his pastel-hued Graces in the flat, but made them so lifelife and third-dimensional that they stand out like sculpture in the round. Certain native painters, resentful of his commissions, belittled him, but his works have never failed to astonish and charm the millions who visit the Capitol.

At 55 years, Brumidi married Lola German, a beauty of 18, who posed for several of his madonnas. Descendants said she was the model for Freedom in the dome's fresco (pages 186-187 and 188-189).

At last came the hoisting of the Capitol's crowning feature, the giant goddess, Statue of Freedom, designed by the prolific and imaginative Thomas Crawford.

This nearly 20-foot figure, with flowing draperies, eagle-feathered helmet, and sheathed sword, is a saga in itself. Completed in Crawford's Rome studios in 1857, the unwieldy plaster model was eight months in reaching the United States, after a passage beset by storms, leaks, and other all-but-fatal sailing problems.

Wartime conditions further delayed the casting in bronze, and it was not until late in 1862 that the statue was set up temporarily on the Capitol Grounds for the public to view.

Guns Greet a Goddess

The triumphant raising of "Armed Liberty" to her lofty spot above the dome was accompanied by a significant bit of power display. As the head piece slid into place at high noon, December 2, 1863, the American flag was unfurled, a 35-gun salute boomed out from the Grounds, and in turn an iron-throated answer was roared by cannon from 12 of the forts then encircling Washington.

The Capitol, as we now see it, was finished then. But huge office-space annexes were still to come, as congressional needs expanded. The House Office Buildings were completed in 1908 and 1933. The Senate Office Building was occupied in 1909, and four years later was linked to the Capitol by means of that treasured convenience the Senate subway, popularly known as the "Toonerville Trolley" (page 169).

Even yet, some say, the Capitol itself is incomplete. In the room below the Rotunda sight-seers crowd around a glass-enclosed model built in 1903-04 to illustrate proposals for an extension of the building's central east front (page 172).

The project was never carried out, though periodically the subject breaks into the headlines. Those who oppose the change say the Capitol should be left the way it is, as a historical monument. Others, including President Truman, argue strongly for the extension.

Architects wholeheartedly agree that the addition would correct the false impression of lack of dome support, add space to the building, and, moreover, provide an opportunity to replace the old sandstone center with marble to match the wings.

You can imagine what a tremendous job is involved in the basic care and upkeep of the Capitol when you consider such staggering statistics as these: 14 acres of floor space, 11 elevators, 435 rooms, and 679 windows.

Whenever the way has been cleared by congressional recess, battalions of extra cleaners, painters, carpenters, repairmen, and other skilled and unskilled workers join the "regulars." They swarm over the building on assignments that may range from painting the big dome (1,000 gallons every four years), to polishing each tiny pendant of mammoth crystal chandeliers (page 179).

In addition, the Capitol's art treasures call for special attention.

The Lady Who Irons Paintings

I came on a curious sight in the Rotunda one day. Trumbull's huge painting, "The Surrender of General Burgoyne," was out of place, its empty frame resting on the floor and attached to ropes suspended from a balcony high in the dome. The picture lay face down on a platform built to size, while a small blue-smocked woman went over its surface with an electric iron (page 149).

The ironer, I learned, was an artist from Vienna, working for a Washington art store which is under contract to freshen and repair three of the Rotunda's eight historic paintings. The warm iron was taking up excess wax so that a new protective backing could be applied to the canvas.

A small patch caught my eye. "Is that the spot," I asked, "where some vandal cut a hole in Daniel Morgan's boot?"

"No," came the answer. "That's where a workman's ladder slipped. But someone *did* slash a big piece out of the 'Battle of Lake Erie,' on the Senate east stairway. Look closely and you can see where it was mended" (page 158).

Now and then the problems of Capitol upkeep go far below the surface to basic and structural needs.

"Last year we finished the biggest job undertaken since they built the dome," Architect Lynn told me when I visited him in his high-vaulted groined-arch room. "That was the reconstruction of Senate and House Chambers and roofs."

Both legislative halls now have new, solid roofs in place of the dangerous and defective old ones with their dingy glass and iron skylights. Ceilings of stainless steel and plaster, with soft, indirect lighting, have replaced the unsightly crisscross supports put up in 1940 to protect the lawmakers from then perilously sagging surfaces.

The two Chambers have been redecorated in different colors—Senate red and gold, House blue—and given improved acoustics and air conditioning. Additional provision has been made for radio and television pickup. In the House, rows upon rows of comfortable leather chairs have been substituted for the old "torture seats" (pages 162-163).

Only a few relics remain, in fact, to link

168 From the collection of Frederick R. Meserve

The Great Dome Was But Air When the Crowd Gathered for Lincoln's First Inaugural

Soon the Civil War broke out, but the President kept work going on the Capitol as a symbol of the Union (page 150). Here on March 4, 1861, Thomas Crawford's marble figure of "America" rested on the ground. Later it was raised to a pediment on the Senate wing.

these rooms with the traditions of other years. Among them are the old brass cuspidors with a new polish, the Senate's snuffboxes, and bottles of blotting sand (from a pre-blotting-paper time) on the Senators' desks.

Of all the Capitol's refurbishings, however, one has special significance this year. The recent restoration of some of the many paintings created by Constantino Brumidi coincides with a revival of interest in this 19th-century Italian artist who fled to America to avoid political persecution (pages 160-161, 164-166, and 183-190).

September 18, 1952, will mark the 100th anniversary of Brumidi's sailing into New York Harbor. By coincidence, the month and day were the same as those on which the Capitol cornerstone had been laid in 1793.

But it was no accident, when Brumidi began his career of decorating this building a few years after his arrival, that he added to his signature the title, "Citizen of the U. S."

He Painted for Freedom

Brumidi had acquired U. S. citizenship as soon as possible. Characteristically, he described his future lifework in these words: "My one ambition and my daily prayer is that I may live long enough to make beautiful the Capitol of the one country on earth in which there is liberty."

His works in the Capitol far outnumber those of any other single artist. The Brumidi panoramas and portraits, medallions and murals stand out in splashes of vivid color on innumerable ceilings and walls.

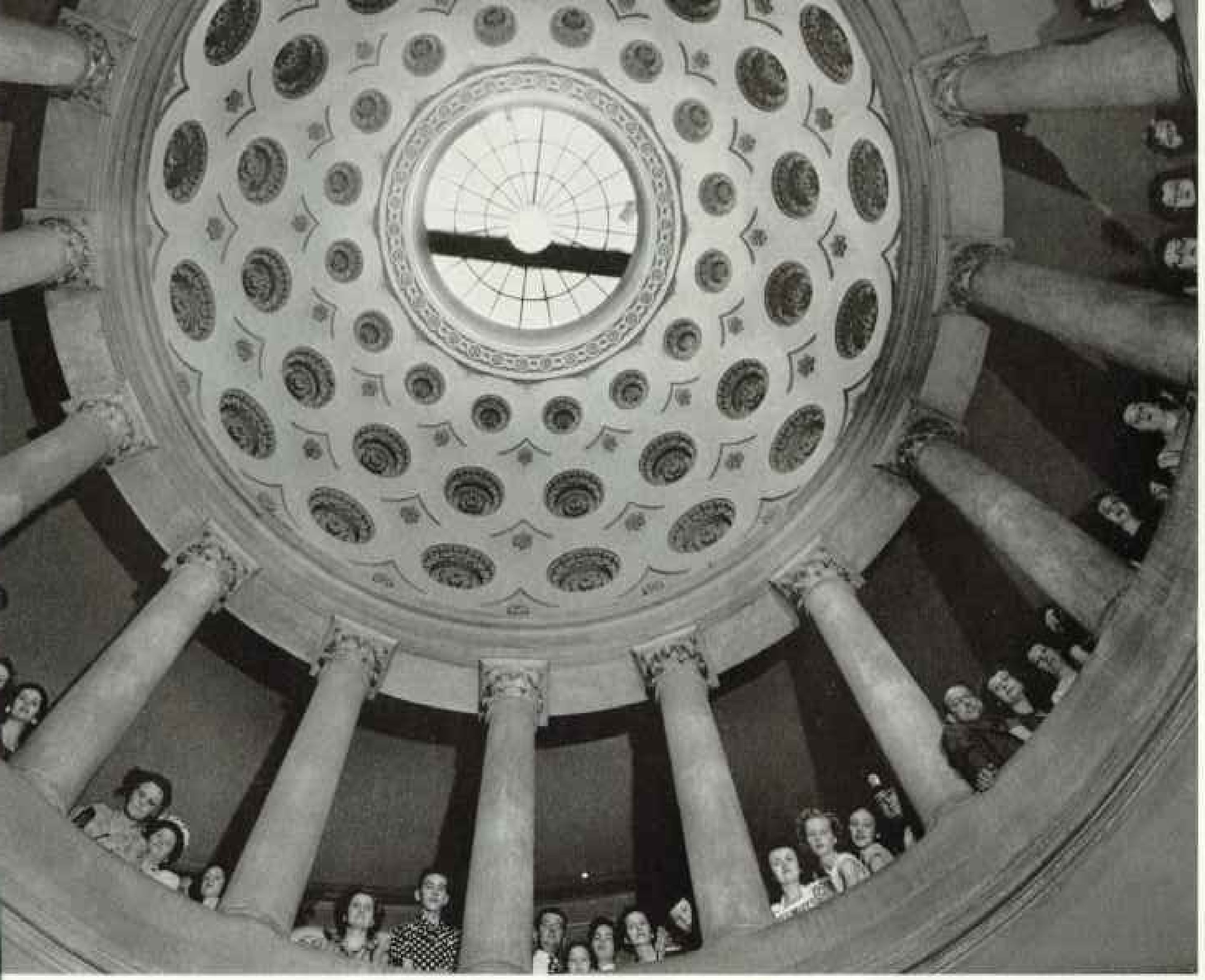
National Geographic Photographers B. Anthony Stewart and John E. Fletcher

Senators Weary of Tumult Escape to Their Private Lobby

Left to right: Senators Smith of New Jersey, Connally of Texas, Wiley of Wisconsin, and George of Georgia. Connally and George together have devoted 65 years to the Congress. The Rev. Frederick Brown Harris, Chaplain of the Senate, appears in background.

Anyone May Go for a Ride in the Senate Subway

This single-rail car, one of two operating between the Capitol and the Senate Office Building, makes the trip in 55 seconds. Representatives walk through another tunnel linked with both the Old and New House Office Buildings. On roll calls they have been known to run.



Visitors Form a Living Frieze in Small Rotunda

Ornamented heads of the columns that support this dome in the Senate wing are known as the tobacco capitals. Designed in 1816, they are an original American contribution to architecture. Leaves and flowers of the tobacco plant, which contributed so mightily to the wealth of the Colonies, are glorified by the columns.

Benjamin Latrobe, designer of the capitals, left England for the United States in 1796. He was appointed Architect of the Capitol by President Jefferson.

Latrobe also created the original and charming cornstalk detail that crowns the columns in the ground-floor vestibule of the old Senate, or north, wing. Some writers have erroneously credited the cornstalk motif to Jefferson.

"This Capital . . . obtained me more applause from the Members of Congress," Latrobe wrote to Jefferson in 1809, "than all the Works of Magnitude, of difficulty & of splendor that surround them. They christened it, the Corn Cob Capital,—whether for the sake of the allitteration I cannot tell, but certainly not very appropriately."

Actually, the pattern shows ears of Indian corn, husks partly opened to reveal the kernels (page 149).

National Geographic Photographers
B. Anthony Stewart and
John E. Fletcher

Cameras, Microphones, and Questions Bombard a Witness Before the Senate Crime-investigating Committee

Television of last year's crime hearings gave the Nation a thrilling show. Here Tennessee's Senator Kefauver, as committee chairman, sits among Maryland's O'Conor and Wisconsin's Wiley (right), New Hampshire's Tobey (head turned), and Wyoming's Hunt. William D. Amis (left), investigator, and George S. Robinson, associate counsel, also sit at the committee's table. James J. Carroll (dark glasses), a St. Louis odds layer, is the witness at this gambling inquiry.

Wide World

A Miniature Capitol Enclosed in Glass Attracts Visitors

This 12-foot-long plaster model was made in 1903-04 with the idea of demonstrating a proposed east-front extension (not shown).

No action has been taken on the project, though heated arguments still make headlines from time to time. Opponents contend the Capitol should stand unchanged—a historical monument. Advocates point out that Capitol Architect Thomas U. Walter, who designed the dome and large Senate and House extensions, intended to bring the central portion forward. Such a change would enlarge the interior and prevent the overhang of the dome's base some 15 feet beyond the east portico (page 167).

The model shows the Senate (right) and House wings before their 1949-51 reconstruction. Structural steel and concrete have replaced former iron roofs. Old glass and iron skylights are gone.

National Geographic Photographers
B. Anthony Stewart and
John E. Fletcher

The Public Sees This View No More; Stairs and Balconies in the Dome Are Shut

Once children skipped and ran, their elders toiled and panted up the steep spiral stairway to the top of the dome. However, the youngsters ran such risks and tossed so much trash from balconies that the ascent has been forbidden except to an occasional special party. Even then a police escort is required.

Some 365 steps link the Capitol's basement to its crowning Statue of Freedom. Winding and twisting, they rise between the dome's two iron shells, which allow space for expansion and contraction. Kilroys have carved their names and fond couples hearts and arrows on exposed surfaces everywhere.

With her police escort, the author stopped at the topmost balcony, from which this picture was taken. From that eyrie she could see the doll-size visitors on the Rotunda's floor nearly 180 feet below; overhead she could almost touch Brumidi's giant figures on the dome's canopy (pages 168, 186-187).

Here a dark encircling strip indicates the Rotunda frieze which the dying Brumidi left half-finished.

National Geographic Photographers D. Anthony Stewart and John E. Fletcher

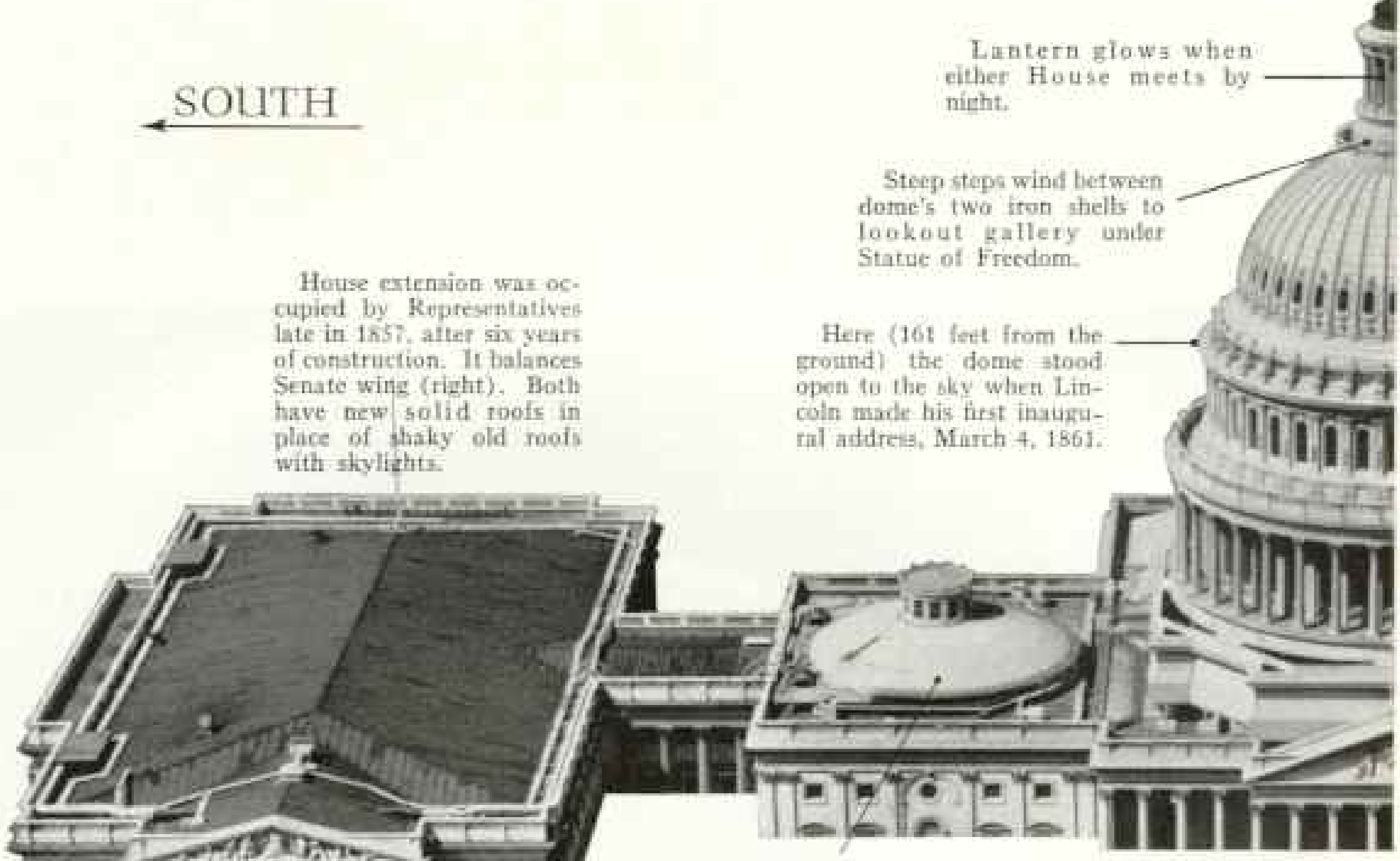
SOUTH

House extension was occupied by Representatives late in 1857, after six years of construction. It balances Senate wing (right). Both have new solid roofs in place of shaky old roofs with skylights.

Lantern glows when either House meets by night.

Steep steps wind between dome's two iron shells to lookout gallery under Statue of Freedom.

Here (161 feet from the ground) the dome stood open to the sky when Lincoln made his first inaugural address, March 4, 1861.



Speakers Lobby: Portraits of 42 Speakers, starting with F. A. C. Muhlenberg of the 1st Congress.

House west-wing stairway to galleries. Painting, "Westward the Course of Empire Takes Its Way"

In House's old south wing—second major section of Capitol—Representatives met 1807 to 1857. After a seven-year interlude of "cobwebs, apple cores, and hucksters' carts," meeting space became Statuary Hall, to honor distinguished State citizens.

Rotunda, decorated with statues and paintings, is 180 feet high. Here artist Constantino Brumidi was working on frieze 58 feet up when he slipped and almost fell. He died soon after (1880) from the shock.

House Reading Room

House Chamber

Statuary Hall

Rotunda

Speaker's office

Office of Clerk of the House, where John Quincy Adams died following paralytic stroke on House floor.

House Small Rotunda holds statues of George Clinton (New York), Stephen F. Austin (Texas), and J. P. G. Muhlenberg (Pennsylvania).

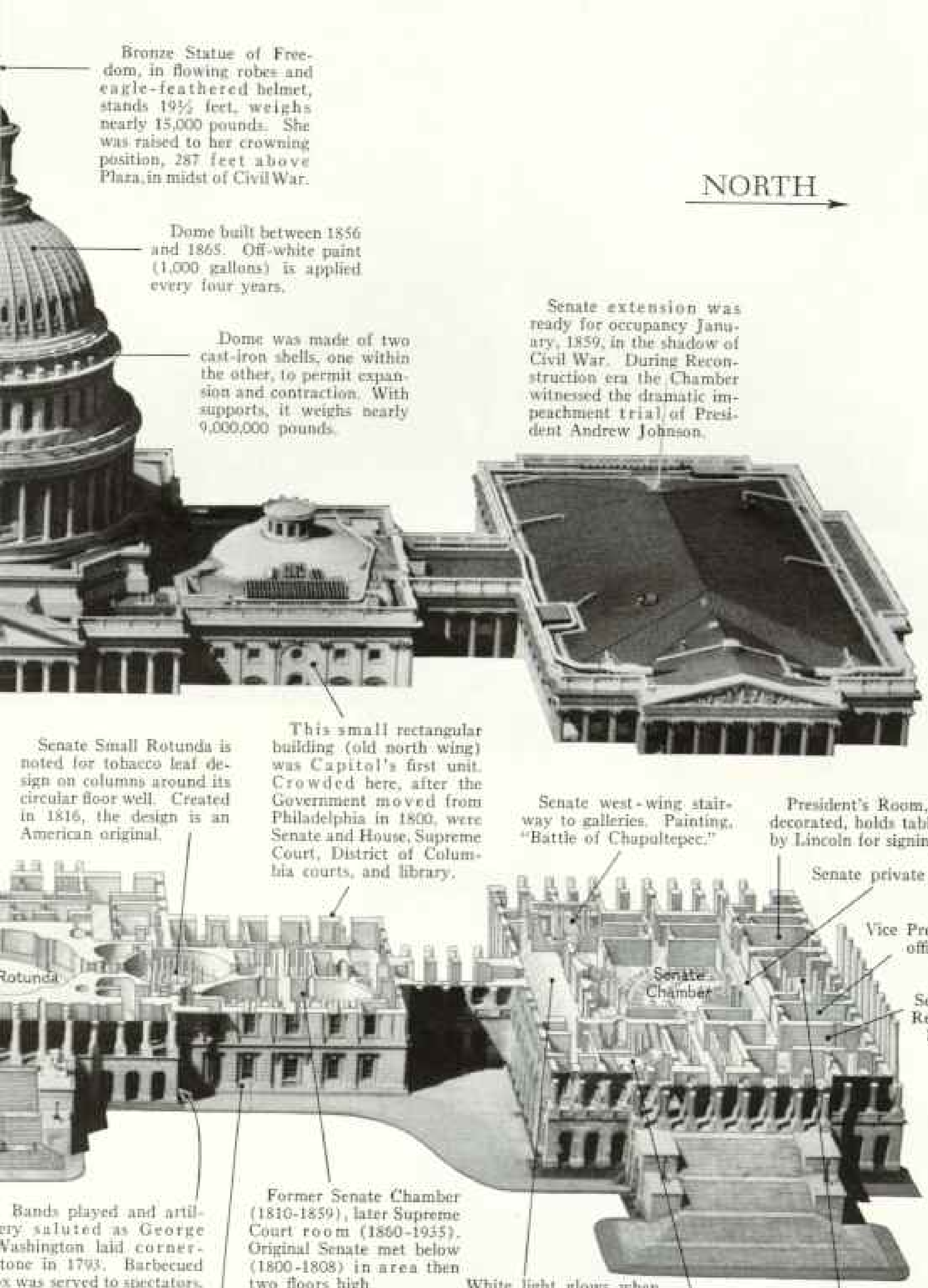
House east-wing stairway to visitors' and press galleries. Painting, "Signing of the Constitution."

Two red bulbs gleam when House is in session.

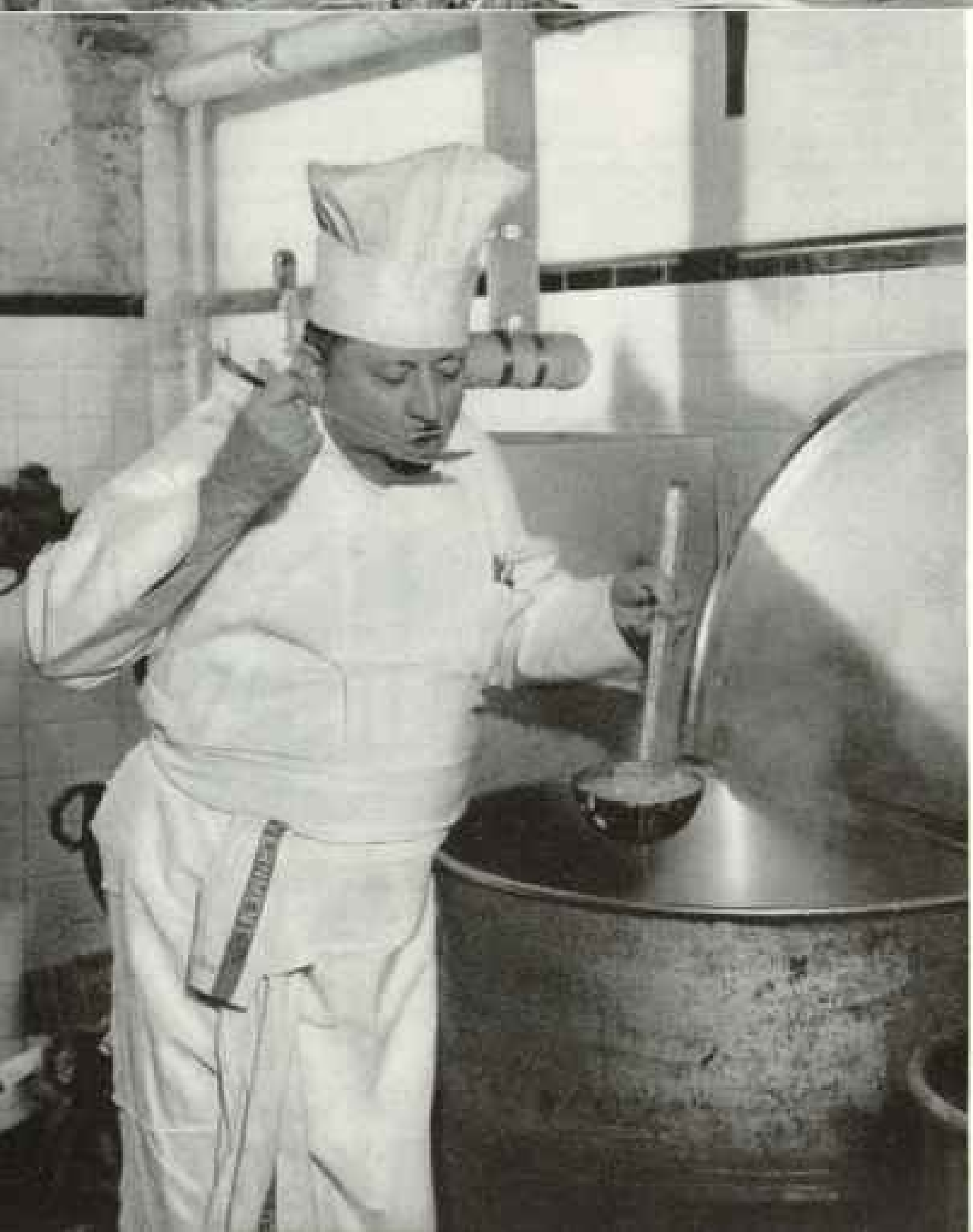
Twenty-one Presidents have taken oath of office outside the Capitol's main east entrance. First was Andrew Jackson, last Harry S. Truman. William Howard Taft took oath in Senate Chamber owing to blizzard.

Architectural drawing by F. Leonard Staglo
Photograph by B. Anthony Stewart

A Photodiagram, Raising Dome and Galleries, Reveals History-making Chambers



The Capitol Covers 3½ Acres. It Grew by Bits and Pieces from 1793 to 1865



Bean Soup: A Must on Senate Menus

With the aid of the powerful Senate Rules Committee, Minnesota's Senator Knute Nelson introduced the bean-soup item in 1907. The menu of the Senate dining room has carried it to this day. Once the printer left it off, but waiters served it as usual. These diners are (l. to r.) Senators Flanders (Vermont), Capehart (Indiana), Watkins (Utah), Thye (Minnesota), and (forehead) Carlson (Kansas).

← "Just right," says chef Joseph Boccabella as he sips from the 40-gallon bean pot filled every day to meet senatorial demand.

National Geographic Photographers
B. Anthony Stewart and John E. Fletcher

Senator Francis Case → Shows Lincoln Head to Constituents

Carved by Gutzon Borglum, the Rotunda's famous Lincoln later served the sculptor as a guide when he carved the giant bearded Lincoln on Mount Rushmore in Mr. Case's own South Dakota. Trumbull's "Surrender of Lord Cornwallis" appears in color on page 154.

National Geographic Photographer
Willard R. Culver

National Geographic Photographers B. Anthony Stewart and John E. Fletcher

Congressional Pages Must Learn Their Lessons Before They Run Errands

From 6:15 to 10:25 a.m. the boys study history, mathematics, government, and other college-preparatory subjects. The Capitol Page School, opened in 1927, was reorganized later as part of the District of Columbia school system. Congress, which employs the boys as messengers, pays the school's expenses (page 191).

So skillful was his technique that these flat paintings give almost unbelievable effects of bas-relief execution. In bronze, his delicate cupids dance with fruit and flower designs along the railings of four of the building's stairways.

Starting in 1855, Brumidi painted through the administrations of six Presidents. His most spectacular achievement, the creation of the heroic figures that enliven the canopy of the dome, was undertaken and completed during the Civil War.

Like much of his work, the dome panorama was accomplished through the medium of "true fresco," the technique used by Michelangelo in decorating the Sistine Chapel of the Vatican. Brumidi himself once had worked on Vatican restorations.

This art of true fresco is extremely exacting. It requires painting on freshly laid, still-wet plaster by means of colors mixed with water. If the plaster dries during the process, the work has to be removed and started again.

I stood, breathless, close to the top of the dome on the highest balcony of the Rotunda and marveled at the fortitude of the man. Nearly 180 feet below, tiny people milled about (page 173). Above, I could reach up and almost touch the giant characters of Brumidi's frescoed allegories.

It seemed incredible that one small man, perched on a dizzily suspended scaffold, could have covered those 4,664 square feet of curved surface with creatures of his imagination and carried out his designs through one of the most difficult of all art forms.

Recognition Long Delayed

Actually, Brumidi gave his life to the Rotunda paintings. He was working, years later, on the broad encircling frieze below the dome canopy when his chair slipped off the edge of the scaffold, 58 feet above the stone floor. He managed to grasp a precarious hold until rescue came; but the effort took the remaining strength of a man then well past 70, and he died a few months later.

In a Washington, D. C., cemetery, early last spring, I saw a kind of epilogue to the Brumidi story, a story which both personally and professionally was one of frustration and disappointment.

A sizable audience was gathered there for the unveiling of a bronze plaque recently

↑ Painters Brighten and Repair the Capitol's Decorated Halls

Several of the Capitol's arched corridors are splashed with hundreds of flowers, fruits, and birds painted by Brumidi, a 19th-century artist.

The detail immediately below shows a few of the many birds in the master's paintings.

Passing visitors have been heard to exclaim, "Oh, I recognize that bird!"

Above: Three artisans in a corridor beneath the Senate Chamber restore work damaged by leaking pipes.

Washington Evening Star

↓ Something's Always Breaking Down; Repairmen Keep Busy

The Capitol, a building of 435 rooms, 11 elevators, and 6,000 light sockets, requires the services of scores of carpenters, electricians, engineers, plumbers, window washers, charwomen, and others (page 167).

Clock repairers are in frequent demand. Locksmiths answer many emergency calls to fix a jammed door or to open one left locked when a retiring Congressman forgets to turn in his key. This cabinetmaker carves new parts for a Senator's chair.

National Geographic Photographers B. Anthony Stewart and John E. Fletcher

Reporters Enjoy a Lull Between News Breaks on Capitol Hill

More than a thousand news gatherers carry credentials for the Capitol beat, but only about 200 are on duty regularly. Newspaper, magazine, radio, and television people have separate workrooms in both House and Senate sides. William J. Donaldson, Jr., (far right) supervises the House press gallery (page 182).

voted by Congress to honor the artist's grave. Numerous Washington officials, including the Speaker of the House of Representatives and the Chaplains of Senate and House, were on hand.

But all eyes were turned to another figure on the speakers' platform—a tiny, gray-haired woman in a sun-bright scarf, whose unremitting efforts for a decade and a half had borne fruit in this moment.

Myrtle Cheney Murdock, wife of Arizona Congressman John R. Murdock, had been enthralled by the Brumidi paintings since her first visit to the Capitol in 1937. She was shocked to learn that the artist had been severely criticized during his lifetime.

"A plain coat or two of whitewash is better . . . than the tawdry and exuberant ornamentation with which many of the rooms and passages are being crowded," stated a congressional committee report of 1859 in response to an appeal for exclusively "American art" in the Capitol.

To gain recognition for the work of her hero, Mrs. Murdock set herself the task of searching out the obscure facts of his life, of finding his long-lost grave.

Eventually her detective work led her to Brumidi's unmarked resting spot in Washington's Glenwood Cemetery. One day in 1946 she was painting the neglected iron fence around it when a pretty girl came up and asked what she was doing there.

The girl turned out to be a great-grandniece of Brumidi's beautiful and much younger wife, Lola Germon, who, although long estranged from her husband, had claimed his body and seen to its burial.

With family records provided through this meeting, plus further research, Mrs. Murdock recently produced an illustrated book: *Constantino Brumidi, Michelangelo of the United States Capitol.* To what extent feminine persuasion brought about the belated congressional honor at the grave in Glenwood Cemetery is the lady's secret. During the ceremony

Speaker Sam Rayburn gave her full credit for the Nation's final acknowledgment of its debt to this "Citizen of the U. S."

But there is still one bit of unfinished Brumidi business at the Capitol. Today's visitors to the Rotunda often look up curiously at an uncompleted portion of the encircling frieze.

Soon after Brumidi's death, Congress engaged a second fresco artist, Filippo Costaggini, to carry out the half-accomplished work, using Brumidi's original designs. This the artist did, but in the execution he squeezed his predecessor's panels and figures so that room was left for additional scenes of his own.

Congress rejected the suggested additions. Years later, still a third artist filled in part of the space, but the work was judged unsatisfactory. It is soon to be replaced by three scenes, for which Congress voted $20,000 in 1951. The subjects will be the "Civil War," "Spanish-American War," and the "Birth of Aviation in the United States."

Millions Tour Their Capitol

About a quarter of a million visitors every year take the official paid tour conducted by the Capitol Guide Service. Other unrecorded scores of thousands come in to wander around for themselves, to see their Congressmen, or to consult the building personnel on business of one sort or another.

"Our rush season is during the spring holidays," said Harry Nash, dean of the guide corps, who in 57 years of service has probably greeted more people than anybody else in Washington. "But we never have what you might call really blank spots in this business."

At all times of day I met the visitors tramping the long corridors alone or in groups—serious-looking middle-aged couples, sweethearts holding hands, and many children.

"Look, Daddy," I heard a little girl call out to her father as they inspected the Rotunda paintings. "The man has six toes!"

Sure enough, a seated Indian in John Chapman's "Baptism of Pocahontas" has an extra toe. Whether the artist was careless or purposely painted one of Nature's slips is hard to say.

The Capitol's professional guide system, designed to give visitors an explanation of the building's chief features, is now 76 years old. It was born out of the near-chaos which resulted when hordes of sight-seers moved on to Washington from the Philadelphia Centennial in the summer of 1876.

Soon floods of traffic were inundating the Capitol, and pickpockets and confidence men were taking advantage of the situation.

To meet the twin problems, Congress appointed five guides to organize and oversee the crowds while describing the Capitol's wonders. The service proved popular and slowly but steadily has grown through the years.

At present there are 24 guides, including 11 women. They are appointed equally by the House and Senate. Their pay comes from fees collected from sight-seers themselves—25 cents a head, with a 15-cent rate for school organizations. The price hasn't gone up yet.

Several marriages have developed from romances between the guides and tour patrons.

I heard of a former Congressman who stayed on as a guide for 12 years. One of the girls inherited an appointment held by her mother. And only recently death took from the ranks the veteran son of courtly and conscientious "Old Cap'n" Benjamin Cady, an original member of the service.

Sculptor of Pioneer Suffragists Now 105

By law all official parties start in the Rotunda, go "to the Senate wing; lower floor through the crypt; to the House gallery, and back to the Rotunda."

In practice, however, the trips are as varied as the personality of the guides. Each has his own technique and favorite stops.

An attention catcher in the crypt under the Rotunda is the group statue of three pioneer suffragists, Susan B. Anthony, Lucretia Mott, and Elizabeth Cady Stanton. This work has been labeled, by the irreverent, "Ladies in a Bathtub," because it takes the form of three busts rising from a solid block of marble. It was carved by Adelaide Johnson, still living in Washington and planning to celebrate her 106th birthday in September.

"We find most visitors want to see their Congressmen in action," said one of the guides. "So we identify Members when we can, and explain that absence doesn't mean the lawmakers are not on the job. Most congressional work is done, of course, in committee rooms and individual offices" (page 171).

Some of the questions asked by visitors show a woeful lack of accurate information on the Capitol.

"Does the President live here?" is a familiar one. Another went this way: "We've seen the House and Senate Chambers. Now where does Congress meet?"

The Floor: Visitors Keep Out

On the House side two red bulbs outside the legislative hall are lighted when the Members are in session. The Senate uses a white light for the purpose, with an adjoining red one which can be turned on as a warning of closed executive session.

Actually, officials tell you, it has been years since the doors to the galleries of either Chamber were closed to those wishing to observe.

"Floor" privileges, however, are jealously guarded. During sessions, only specifically designated outsiders—depending on Senate or House rules—are admitted. These include the President, Vice President, Supreme Court Justices, Cabinet officers, former Members of Congress, Members-elect—and those special persons who have by name "received the thanks of Congress."

The galleries that look down on congressional deliberations are divided into sections. Some are open to the public (when provided with easily obtainable passes); others are reserved for congressional families, diplomats, or accredited members of news services.

The story of the press and the Capitol is one of long-term struggle—with a happy ending. For this building now rates as a major and accessible news source for Washington and the world (page 180).

From the beginning, the public was generally permitted to watch the proceedings. Favored guests, including ladies, once even sat on sofas and chairs put up on the floor.

Pies, Peanuts, and the Press

A few privileged newsmen, starting in 1801 with Jefferson's friend and protégé, Samuel Harrison Smith of the *National Intelligencer*, were given reporting facilities either on the floor or in the gallery.

One of the early correspondents of the *Intelligencer* was still further privileged. He shared the snuffbox of the presiding President of the Senate!

It was not until the 1840's, however, that the right of the press as a whole to cover Congress at work was recognized. Official action then came only after passionate debate and after firebrand James Gordon Bennett had published scathing attacks in his *New York Herald* against Senate restrictions on coverage.

Eventually, a committee elected by the newspapermen themselves was given jurisdiction, under congressionally prescribed rules, over the admittance of bona-fide reporters to the press galleries. This is now the accepted system.

But, meantime, accommodations were often uncertain and sometimes sharply limited. Back in 1880, Washington's *Evening Star* published an editorial complaining that new rules were holding the press "to the corridors, which for the most part are occupied with telegraph instruments, peanut stands, tramps, pie women, and lobbyists."

Today, well over a thousand men and women, representatives of newspapers and magazines, radio and television, are accredited to cover "the Hill," as the Capitol is called in popular parlance. They may sit in House and Senate galleries and use the extensive working facilities provided in near-by offices.

Only about 200 of this news army are regularly on hand. When historic events are in the making, however, attendance jumps, and space must be carefully allocated. Such occasions in recent times have included three talks to joint meetings of Congress by British Prime Minister Winston Churchill (pages 162-163); the 1951 home-coming "old soldiers never die" speech of General of the Army Douglas MacArthur; and the address of Queen Juliana of the Netherlands in April of this year (page 145).

Many a tense and dramatic scene has been enacted before the galleries in both old and new halls of Congress.

Ex-President John Quincy Adams was suddenly stricken with paralysis in 1848 as he sat in the former House Chamber, now Statuary Hall. He died close by on a couch still preserved as a memorial in the room now used by the Clerk of the House.

In the old Senate wing, one of the most bizarre situations ever witnessed in the Capitol occurred during the impeachment trial, in 1805, of Supreme Court Justice Samuel Chase. In a most theatrical setting the Justice was acquitted.

Aaron Burr, the presiding officer, had provided accommodations for crowds of spectators and had had the benches draped in scarlet in imitation of the scenes in Westminster Hall during England's sensational impeachment trial of Warren Hastings a decade before.

Stranger still, Vice President Burr, in solemn state above the proceedings, was himself under indictment for murder at the time, as a result of the duel in which he had killed Alexander Hamilton.

Other high dramas played in the Chambers of Congress include the Senate's impeachment trial of President Andrew Johnson in the bitter post-Civil War days; and the April, 1917, address of Woodrow Wilson, made at the joint session in the House on the eve of the war declaration. That was the speech in which the President introduced his famous phrase about making the world "safe for democracy."

But not all the excitement in Congress takes place on the floor.

In the public gallery above the Senators one day in 1950, a veiled apparition in flowing

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 Attachment to Willard R. Culver

President's Room Captures → Every Visitor's Attention

A glittering chandelier hangs above a mahogany table on which many Presidents have signed bills, beginning with Lincoln. Minton tile from England forms the floor's superb mosaic. Brumidi's Americus Vespucius looks down from the ceiling (pages 184-185). All-seeing Religion (in circular border) seems to follow visitors with her eyes.


PRESIDENT'S ROOM

Work Restoring the Vatican's Art Treasures Helped Give Brumidi the Classic Touch

Jewel-bright frescoed medallions at the top of these two pages embellish the ceiling of the President's Room. Legislation holds the sword of justice; Liberty draws the ax from the fasces symbolizing power.

Brumidi executed the paintings in true fresco. By this method the artist paints moist plaster with pigment mixed with water.

When the mortar hardens, colors grow lighter and more brilliant. Air's chemical action on the lime produces a durable finish approaching that of marble.

Michelangelo used this technique in decorating the Vatican's Sistine Chapel.

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Illustrations by Willard B. Culver

✦ Vespucius, Columbus, Franklin, and Elder Brewster Represent Forces That Shaped America

Exploration, Discovery, History, and Religion are symbolized by the four men at the bottom of these pages. To characterize his subjects, Brumidi immersed himself in stories of his adopted land.

Said the artist: "My one ambition and my daily prayer is that I may live long enough to make beautiful the Capitol of the one country on earth in which there is liberty."

The four portraits are frescoed at corners of the President's Room (page 183). Picture moldings, which stand out like marble or wood, actually have no depth, the artist having painted them flat with oil on dry plaster. Medallions at the corners show State seals.

Brumidi Completed His Masterpiece, the Dome's Fresco, in 11 Months

Often lying on his back on a scaffold, the artist spread the spectacular "Apotheosis of Washington" across 4,664 square feet of the concave dome. He scaled his heroic figures, some of them 15 feet tall, to appear life-size to viewers on the Rotunda floor 180 feet below. Colors on the rim he made more brilliant.

Brumidi was 60 years old when he finished the canopy in 1865. Fourteen years later, while working on the circular frieze below the dome, he slipped. Catching a desperate hold on a scaffold ladder, he dangled 58 feet in the air for 15 minutes. Rescue finally arrived, but the shock was too great; the artist died a few months later.

In the fresco, George Washington sits between Liberty (left) and Victory. Completing the inner circle, 13 female figures stand for the original States. Six allegorical groups on the rim show, in counterclockwise order:

Arts and Sciences. Helmeted Minerva (left), goddess of wisdom, addresses Benjamin Franklin, S. F. B. Morse, and Robert Fulton.

War. Freedom, with upraised sword, strikes down Tyranny and Kingly Power.

Agriculture. Ceres, goddess of harvests, holds the horn of plenty and rides a reaper. Young America wears the liberty cap, the *bonnet rouge* of France.

Mechanics. Vulcan, god of metalworking, rests on a cannon.

Commerce. Mercury, protector of travelers and merchants, offers a bag of gold to Robert Morris, financier of the Revolution.

Marine. Bearded Neptune emerges from the deep. Aphrodite, rising from the waves, holds the Atlantic cable.

The next two pages show the six groups in greater detail.

Ektachrome by Willard R. Culver

gray garments suddenly rose to her feet and began wailing like a banshee. Newspapers called her "the Phantom."

"The Phantom was no stranger to us," said Capt. Olin Cavness, of the 170-man Capitol Police force. "During debate over a military bill in 1941, before we got into the war, she chained herself to a bannister in the House gallery and started screaming.

"Under questioning, she said she was a member of the 'Keepers of the Sacred Flame' and felt a compulsion to warn the world of its impending doom. She was committed on both occasions to a local hospital for mental observation, and later discharged."

On the whole, though, Capitol disturbances are rare. Police problems generally concern losses or petty thefts among the crowds or damage to works of art by souvenir snatchers.

Picketing of all kinds is prohibited by law within this building and its Grounds—one of the few public places in the country where this is so. Even wearing party campaign buttons here is banned.

Cogs in the Law Machine

Few of those who watch the formal proceedings of Congress are aware of the complex administrative and clerical activities that go on behind the scenes to keep the machinery of legislation in smooth running order.

Both Senate and House have their own separate working staffs, subject generally to the control of the political party in power. Officers of the House are elected or re-elected every two years, at the beginning of the new Congress. Officers of the Senate serve during "the pleasure of that body," because of the continuing nature of the Senate, which always retains two-thirds of its membership.

In a building where lawmakers' careers may be cut short after two years, many of these trained and valuable functionaries have held their posts for two, three, and more decades.

The congressional hierarchy is headed by the two presiding officers, the President of the Senate and the Speaker of the House. Two key administrative jobs are the Secretary of the Senate and the Clerk of the House. But there are also Parliamentarians, Sergeants at Arms, Doorkeepers, Postmasters, and dozens of other officials and subofficials whose knowledge of detail and tradition is essential in the carrying out of the Congressmen's numerous and often ritually prescribed duties.

70 Alert Blue-suited Pages

The congressional pages are, in a sense, Washington's youngest officials. These boys, from 14 to 18 years old, are selected by their Congressmen, with patronage committee approval. They run errands, distribute documents, and otherwise make themselves useful.

This session there are 21 Senate and 49 House pages; and it is a cheering sight to see one of them, in his standard blue suit, white shirt, and black tie, when you are lost in the mazes of Capitol corridors.

"Are you going to write about Congress or about us?" asked one of the boys when he heard I was gathering material for a NATIONAL GEOGRAPHIC article. "Hope you have lots of pictures," chimed in another.

The pages are paid $285.23 a month and are precociously versed in politics and cloakroom gossip. But they are by no means excused from the formal educational chores of other boys of their age.

In a congressionally sponsored school started in 1927, they study history, languages, mathematics, and similar college-preparatory subjects (page 178). Together with eight Supreme Court pages, they start classes at the formidable hour of 6:15 a. m., stay with the academic world until 10:25, then move on to the day's business where history is in the making.

One book which is not in the Capitol Page School curriculum, but which the boys as well as Members of Congress study and use constantly, is the annual *Congressional Directory*. Published from the Capitol building and produced for and by Congress, this book furnishes important personnel information concerning all Government activities in Washington. It is known to have been issued as early as 1809.

This year the *Congressional Directory* contains 737 pages and has had a printing of more than 55,000 copies. Members receive a specified number free of charge, but other thousands of purchasers, through the Superintendent of Documents, make this volume one of Washington's perennial best sellers.

It is not hard to understand why, in the light of the *Directory's* contents. Its pages include charts to the physical labyrinth of the Capitol building as well as a who's who guide to official Washington.

A still bigger publishing activity is the well-known *Congressional Record*. There is nothing quite like it in the world.

This daily report on all legislative meetings

 Ektachromes by Willard R. Culver

‹ 97 Years Have Not Dimmed Brumidi's First Works in the Capitol

One of the first to introduce true fresco to America, the artist in 1855 completed Winter (above) and Autumn, two of the Four Seasons in the House Appropriations Committee Room, which in Brumidi's time belonged to the Agriculture Committee. Shadows skillfully introduced in "frames" and "moldings" make them appear as sculptured plaster, though all the work is painted.

of House and Senate has 531 "associate editors"—435 Representatives and 96 Senators.

High-speed stenographic reporters take down everything said during sessions. Until lately, some of the old-timers kept a tiny ink bottle strapped to a finger against sudden shortage.

But the *Record's* copy is not delivered to the Government Printing Office until it has been rushed to each Member quoted, for approval and "revision of remarks."

The lawmakers may also put into the appendix of each issue of the *Record* masses of printed matter of all sorts, from poetry to yards of statistics.

In addition, since 1947 a Congressional Daily Digest has been carried in the *Record*, providing quickly accessible capsules of information on congressional proceedings, committee work, and related data.

During the last session of Congress, more than 8 million copies of the *Record* were distributed. In all, they contained nearly a billion pages of closely printed material!

Home of "the Hermit"

Among all the words that have poured from the Capitol you look in vain for mention of its most mysterious and shadowy character—"the Hermit."

Until his death a few years ago, this man lived in an out-of-the-way workshop in the subbasement. He was fed from near-by kitchens and slept on a discarded door until sympathizers contributed a cot.

If Congress knew of the Hermit's existence, it gave no official sign; but many people I saw around the Capitol remembered him well.

"He was like something out of Disney," one of them told me. "But he must have seen better days. He was well informed and very fond of music. He particularly enjoyed the Marine Band concerts we have here in the summer in the Capitol Plaza."

When I learned about the Hermit, I thought I had heard everything. But there was still one more quest, a quest that led down winding dungeonlike stairs, through quiet passages, to a locked door.

"The tomb is directly under the center of the Rotunda," said my official escort as he opened the door and ushered me along a narrow hall to an iron-grilled barrier at the other end. "Of course it's a tomb in name only."

At this spot, I learned, Congress once had planned to raise a marble monument to George Washington and to transfer the General's remains here from Mount Vernon. The original project called for a circular opening in the floor of the Rotunda, from which visitors could look down on the memorial below.

The plan failed to materialize. For one thing, Washington had asked in his will that he be buried at Mount Vernon. Though Martha Washington rather reluctantly agreed to the move, with the provision that her body also rest in the Capitol beside that of her husband, eventually the Washington heirs decided against it.

Rotunda Scene of Mourning

Through the iron gateway I saw a glass-enclosed catafalque, or bier, draped in black cloth. This badge of mourning is not for the man who rests at Mount Vernon but for all those chosen to lie in state in the Rotunda.

The catafalque has been used there 12 times, beginning with the grief-laden hours when endless lines of silent people moved past the body of Abraham Lincoln. Others who have lain there in state under the dome were Thaddeus Stevens, Charles Sumner, Garfield, John A. Logan, McKinley, the disinterred remains of L'Enfant, Admiral Dewey, the Unknown Soldier, Harding, Taft, and General Pershing.

"I saw the last five of these ceremonies," said chief guide Nash. "Most impressive to me was the time when the Unknown Soldier was here in 1921. A boatload of flowers came over with him from France. They were banked high along the walls and brought down in the form of a cross. Their sweet, heavy scent was almost overpowering."

At such times, when the Capitol overflows with humanity, it seems more than ever to belong to the people. But whether the citizen is in Washington, D. C., or in Washington State, his presence is always felt in this building. Its business, after all, is everybody's business.

Here, with few interruptions, all the Nation's laws have been enacted from 1800 to the present.

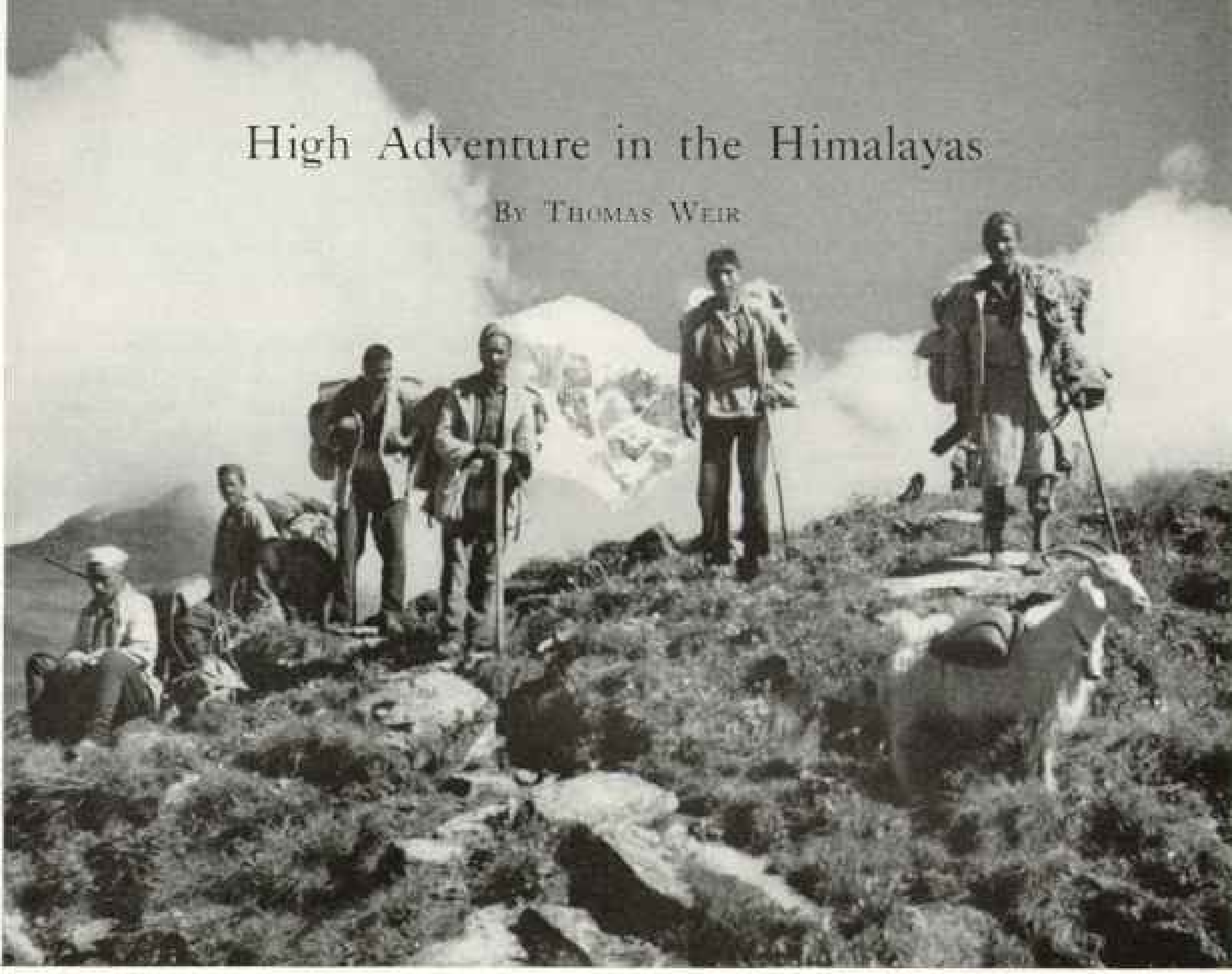
These statutes, which have guided the country's growth and rising power through ever-changing conditions, have reached the impressive total of nearly 70,000. Each session brings more to affect the life of citizens everywhere, today and tomorrow.

In my wanderings I encountered in the old Senate wing a strange time-and-event juxtaposition. Congress's Joint Committee on Atomic Energy has its headquarters in the very room where Prof. S. F. B. Morse in 1844 ticked off his famous message, "What hath God wrought!" for the formal opening of Washington's first telegraph line.

"What our committees of the future will be concerned with is anybody's guess," one old-time Capitol employee remarked. "All I'm sure of is that they will have to deal with the same old human nature—and the sound of the human voice."

High Adventure in the Himalayas

By Thomas Weir



OFTEN since his return to Scotland, my friend Douglas Scott had spoken to me about the Himalayas. Wistfully he had told me of the delights of climbing in the highest range on earth.

As he talked, his words painted pictures: of paths that climbed ridge after ridge of foothills, dipped into deep gorges, and wound through vast woods of pine, rhododendron, and bamboo with amazing varieties of birds; of camps at 12,000 feet on grassy hollows ablaze with alpine flowers; of the glisten of ice walls plunging to jungle ridges thousands of feet below.

Many of these peaks, he had said, were unclimbed, unexplored.

Now he wanted to do more than talk; he had come with a plan. His eager finger traced a line on a map, and I caught the magic of strange names, names with the ring of adventure—the Rishi Gorge, Nanda Devi, Dunagiri, the Girthi.

Cost? We need have no expensive organization. Mobility and lightness were the things. We could live cheaply off the country.

We would explore the area of the Tibet-Nepal border, where it forms a great angle with India in the districts of Garhwal and Almora (map, page 197). This was described as the most beautiful region of the whole 1,500-mile chain. Opportunities for the mountain explorer ranged from unknown gorges to giant clusters of unscaled peaks 20,000 feet high and more.

Further, the inhabitants, Bhotia tribesmen, were reported to be scrupulously honest semi-nomads, a people of great charm. They would sell us native food, and they and the Nepalese Dotials would help transport our gear.

Gave Up Security, Chose Mountains

Now, if ever, was the time to go. We had known each other for the 20 years we had been climbing, and we were both under 40. It meant giving up the security of good jobs, but we chose mountains; we took the step.

Luck was on our side. Tom MacKinnon and Bill Murray, the two men we would have chosen from any company, were willing to join us. MacKinnon is a pharmacist; Murray an author.

Our party had a combined experience of more than 80 years of British and Alpine mountaineering. More important, we were well known to each other as members of the Scottish Mountaineering Club, and that means

a lot when men must live together for long periods of isolation.

By mutual consent we appointed Bill Murray organizer. We had barely two months to prepare. Each of us was given tasks.

Scott made detailed climbing plans. On the basis of them, I worked out food and transport needs.

Staking the success of the expedition on local supplies, I decided to take a mere 440 pounds of food for five months. The main items were dried eggs, dried milk, pemmican, sugar, cheese, jam, chocolate, sweets, biscuits, dried soups, butter, and, of course, tea.

Tom MacKinnon was responsible for medical supplies—an obvious bit of casting.

Murray combed his friends and associates of the Alpine and Himalayan Clubs, without whose help and good counsel we could not have moved. He coordinated our efforts, showing a remarkable flair for administration.

Not knowing a word of the language was considered a minor difficulty; we could learn it as we went along. We Scots have an old saying that with a good Scottish tongue in your head you can go anywhere.

Heights a Heaven after Plains

The man who said it is more pleasant to travel than to arrive has certainly not crossed, in the dust and glare of midsummer, the 1,200 miles between Bombay and the first surge of the central Himalayas. It was a joyous moment when the green foothills reared above the haze—real green, like a memory of Loch Lomond's woods in a desert. In the wilting heat of May, India's hottest month, the parched plains cried for moisture.

We were glad to forsake the railway for a bus that zigzagged upward, climbing steeply through jungle to terraced fields. Wherever water could be brought, potatoes and rice showed a rich green.

Mounting steeply, we came upon lilacs and exotic flowering shrubs. From green banks by the roadside, wild flowers sprouted in profusion. Now and again we had to wait for sacred gray langur monkeys to cross the road.

After the plains it was delightful to feel the hot wind grow gradually cooler. At Ranikhet, 6,000 feet up, storm clouds were discharging the first rain we had seen since leaving Glasgow.

Morning saw me out on the lawn in my pajamas. Beads of rain sparkled on flower and tree.

Ahead, crest after crest of jungle foothills caught low slanting sunrays of gold. Incredibly far above them, like silver writing in the sky, soared peaks so unearthly that at first I could not believe I saw them. Those wondrous shapes were Nanda Ghunti, 20,700 feet; Trisul, 23,360; Nanda Devi, 25,643; Nanda Kot, 22,510, and a peak recognizable as our first objective, Bethartoli Himal, 20,840.

Was it possible that we might tread these silver tops, the very throne of the gods? I could not believe it, but cried aloud for the mere joy of seeing.

Dotials Eager to Serve as Porters

When we sought porters—called coolies here—21 Dotials from Nepal were lined up before us by their headman, Kuar Singh. Superficially, they were a criminal-looking band, with their ropes and ragged homespuns (page 193), but we liked them instantly, and it was rather pathetic when the rejected refused at first to leave the line. But our needs were modest and four of them had to be left behind.

Our porters carried 80-pound loads, including 20 pounds of their own supplies and gear, for three rupees (about 63 cents) a day—four for mountain work. They furnished their own food, mostly flour from which they made chapatties, or thin pancakes. Loads were borne by headbands over the brow (page 200). We carried 20-pound loads in rucksacks.

For the next 10 days we were on the march, going over high ridges on fantastic paths, dropping down to rivers, crossing huge bluffs, and plumbing a wild ravine. From the snows of 12,140-foot Kuari Pass, we descended 6,000 feet to Tapoban (page 230).

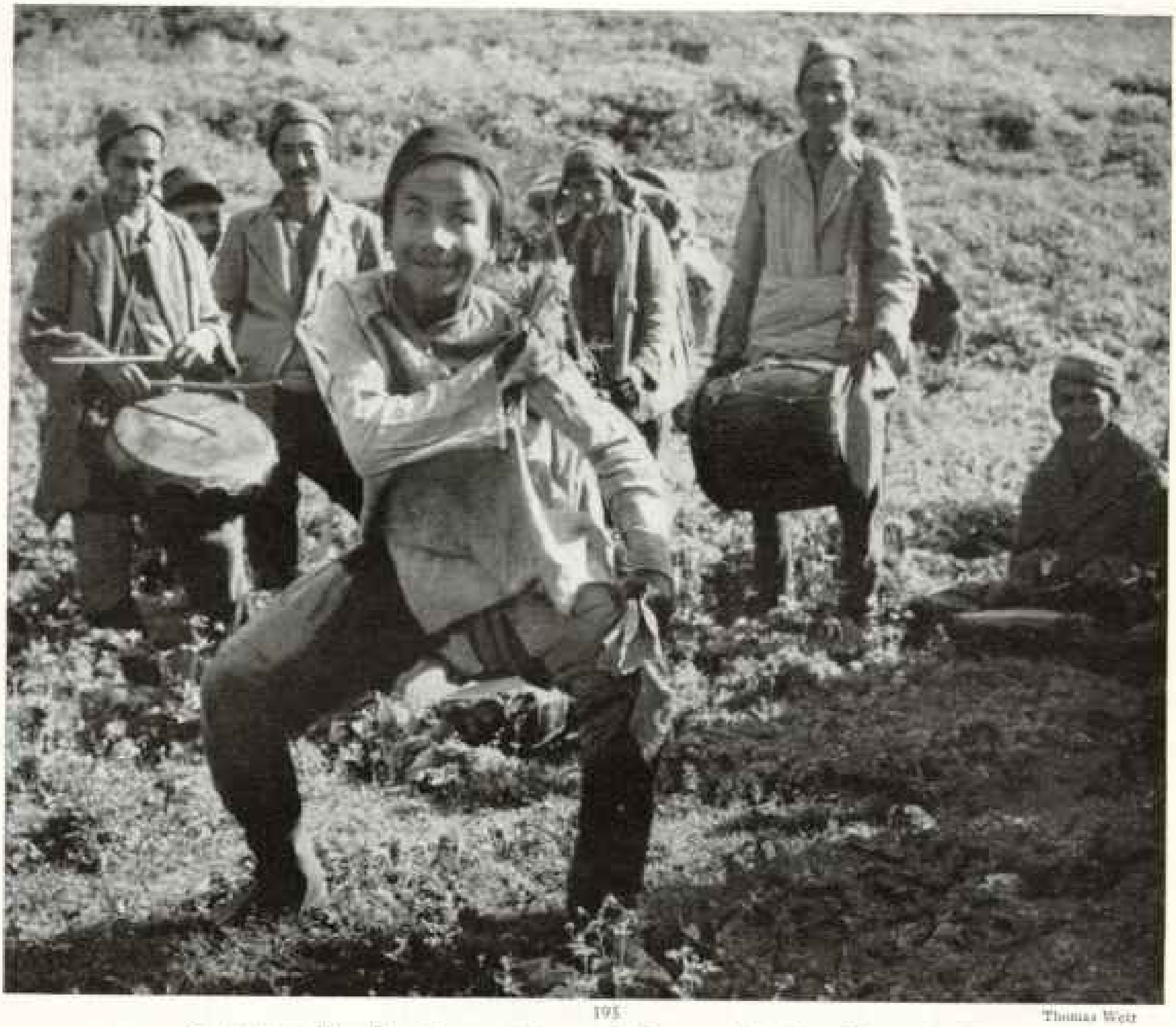
At many of our camps MacKinnon had to open his dispensary as natives heard the news that white men were around. One almost blind old fellow expected his sight to be restored, and declared it to be so after swallowing a few tablets. Later he returned with his goat to have iodine applied to a wound in its hairy throat.

Wherever we went the natives were friendly. Puffing enormous hubble-bubble pipes, or spinning raw wool onto bobbins as they walked, they followed us for miles. They wore homespun trousers tight on the legs, with a blanket fastened over their shoulders in the manner of a Scottish plaid.

Already our porters had shown themselves to be men of sterling character. They were natural climbers and willing workers. Scots and Dotials understood each other, though we could not speak a common language. All hands were enjoying themselves.

Bethartoli Beckons

From Tapoban we headed for almost four-mile-high Bethartoli Himal, our first objective, by way of the Rishi Gorge. The country we were entering now was incomparably wilder than anything we had seen—a fierce tangle of rock spires split into two tremendous gorges,



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Scratching His Shoulder, a Dancer Imitates a Monkey Bitten by Fleas

Accompanied by three fellow Scots, the author explored Indian peaks adjoining Nepal and Tibet (map, page 197). Between climbs the mountaineers visited highland villages. This youngster performed a comic folk dance to drum music at Raiam. He carried flowers and leaves to emphasize arm movements.

the Dhauli and Rishi, by the Lata Peak (page 230). This mountain we had to cross.

To reach the ridge of the Lata Peak we threaded jungle, then crossed rock. We camped on the ridge at 12,000 feet, getting water from the snow beds around us and reveling in our situation. Up here, little alpine plants starred the ground with pink and yellow, and everywhere we looked were amazing peaks, ice-plastered needles of rock, Matterhorn shapes, and spiky tops.

Murray reconnoitered tomorrow's route, getting back in darkness with the report that the going was difficult. It was! It took us five hours to climb 2,000 feet.

We were now above the lower Rishi, a sheer-walled box canyon built on a colossal scale.

What would happen to a man who fell was demonstrated when one of the porters dropped his load into the Rishi. We were too relieved that it was the baggage, and not the man, to be anything except thankful. But, although we did not know it then, that loss of baggage cost us our chance of climbing Bethartoli Himal. A week's supply of food had gone at one stroke.

Nanda Devi an Icy Goddess

The strain was telling on the porters. One was violently sick, and all had headaches in the rarefied air of 14,000 feet. We were tiring too, but the colossal scale of everything made it worth the effort as on we went.

Ahead, above the rock walls of the Rishi, rose Nanda Devi. All other mountains we had ever seen were insignificant beside the "Blessed Goddess." Draped in the pale green of ice, this queen of mountains held her shining head almost five miles high in a halo of cloud.

Incredible that such a peak could be climbed! Looking at the tremendous robe

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Wary Explorers Skirt a Glacier Crevasse near Their Doorstep on Panch Chuli

Unscalable ice barred the Scots from reaching Panch Chuli's 22,650-foot crest (pages 199, 232). Camped on the glacier, they endured extremes of heat and cold. Their tent stands at 19,000 feet. A safety rope links the men.

of the south ridge, we took off our caps to H. W. Tilman and the 1936 Anglo-American expedition for their fine performance in climbing it. To my mind, the feat still ranks as the greatest of all mountaineering achievements.

By the time we reached the gray flood of the Rishi, 12 porters had been paid off, but the remaining six worked furiously to throw a log bridge across (pages 218-19).

Size 6 Fits Everybody

After the crossing came more hard climbing, but at last we stood at the foot of Bethartoli, our mountain. Nearly 9,000 feet above us, high above a welter of hanging ice, loomed the peak we hoped to climb. From here we could see no safe route to the top. The danger of avalanche was all too apparent.

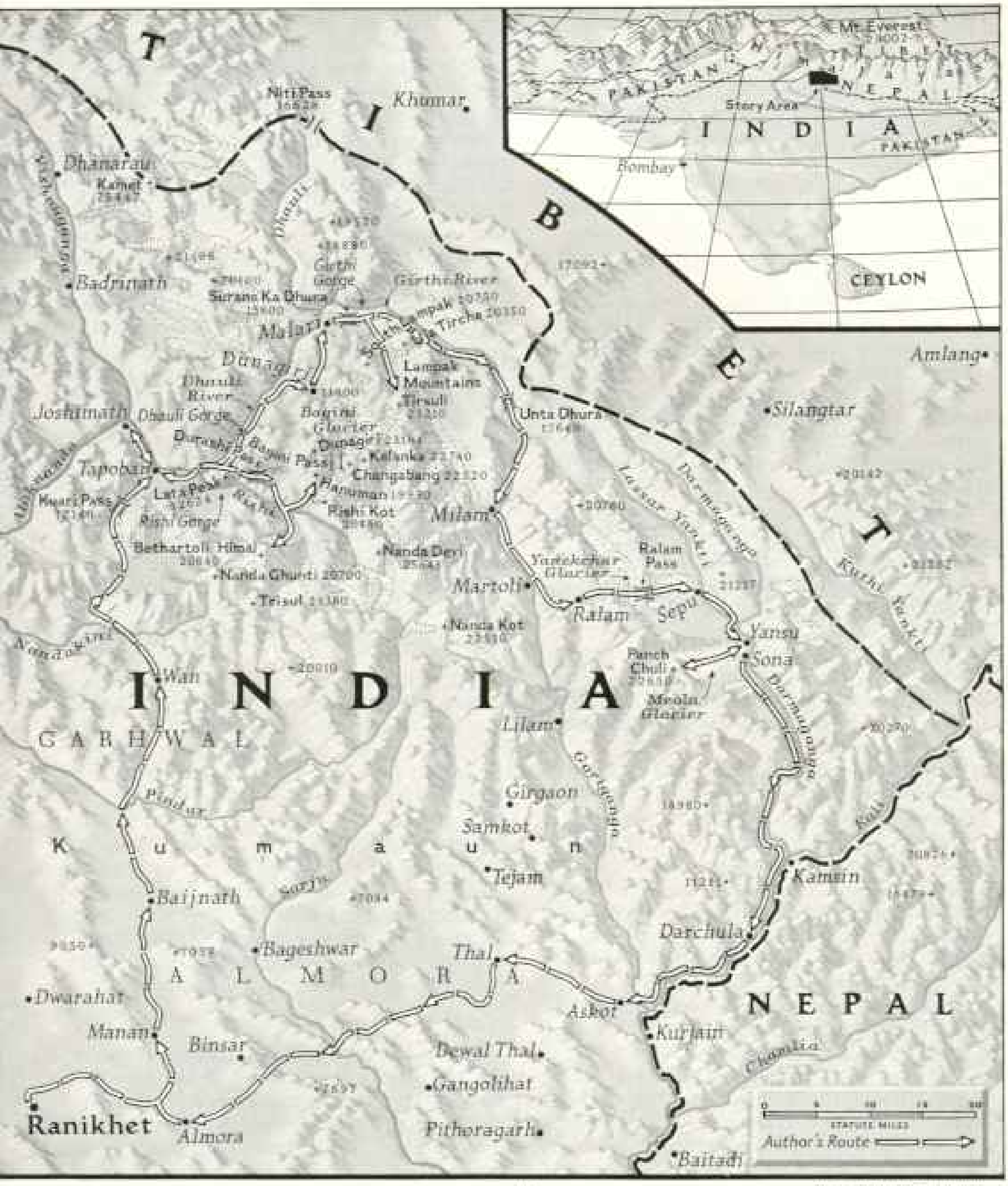
In planning the expedition, we had bargained for three porters coming high with us, and accordingly we had purchased boots, sleeping bags, and high-altitude clothing for them. Now was the time to present them, and the porters were as delighted as children at Christmastime.

All but the sleeping bags had been bought at Glasgow Barrows, a kind of "Hawkers Bazaar" in Gallowgate, where you can buy, at cutthroat prices, anything from a wooden leg to a pair of long drawers. The boot size was a pure gamble, but acting on advice we had chosen size 6. We prayed that they would fit.

Beaming all over, Zungia, Goria, and Matbir tried them on. They fitted.

Food was our main worry. That man-load of flour lost meant that our climbing time would have to be cut by six days, leaving only five for reconnaissance and getting to the top.

Ascending to 14,000 feet next morning, we



197 Drawn by Iris K. Altman

Earth's Mightiest Peaks: the Himalayas. Their Name Means "Abode of Snow"

saw that attack from the north ridge must take the line of a protective rock rib, for otherwise we were liable to attack from an artillery of huge poised blocks and tottering pinnacles of ice. We decided to pin our faith to this rib in the hope that it offered a route to the summit. That same day we brought porters and tents to 14,500 feet.

The reward of being up there came at evening, when the clouds that had lain on the high tops all day suddenly spilled off. The red sun, breaking through, lighted a ring of monstrous peaks that shot like needles to more than 20,000 feet, peaks with challenging names like Changabang (22,520 feet), Kalanka (22,740), Rishi Kot (20,460), and various others unnamed (pages 202-3).

There was snow on the ground when we rose at 5 a.m. and started up the ridge. Loose and stony at first, it crossed a snow gully, then steepened to rock, demanding use of hands as well as feet. In 2,000 feet the

ridge narrowed to an arête, or sharp edge, of snow, corniced on one side, with a little gendarme, or rock tower, blocking the way.

The coolies had climbed magnificently, though troubled by altitude. At about 17,800 feet we decided it was unfair to ask men unused to Alpinism to go farther. With many salaams they departed for the lower camp.

Chasm Defends Bethartoli's Crown

Bad weather was closing in, so MacKinnon and I cut platforms for the tents in the snow of the narrow ridge, while Murray and Scott reconnoitered.

Back they came with bad news. Ahead yawned a 100-foot gulf impossible to climb down. We could have fixed the rope and slid down, but we could never have returned the same way.

To get over this nasty shock we crawled into the tents, got the stove going, and melted snow for pemmican soup and tea with biscuits.

Eating brought on breathlessness, and even to turn in our sleeping bags made us gasp like newly landed fish. Plainly we were not yet accustomed to the heights; a dull, persistent headache proved it. And, although we were reasonably warm in our eider-down bags, our breath froze on the tents, falling in the form of powdery snow.

Bitter as the cold was our sense of frustration—blocked by an impassable gulf when only 3,000 feet from our goal.

But our spirits rose with the morning sun. To be here in this glistening world was the ultimate reward. Far below lay the forest, steep-walled, enclosing the Rishi. Up here the rock, snow, and ice were alive, the tip of Nanda Devi shooting like an arrow above the tiny tents on the crest of the ridge.

Because of loss of that week's supply of flour, there was insufficient time for another attempt. Thus Bethartoli beat us.

But our failure had taught us a few things about Himalayan climbing, camping at high altitudes, and our reactions in the rarefied air. It had given us a new appreciation of scale, without which no one can climb successfully in the Himalayas, for what appears from below to be a tiny nick in a ridge can turn out to be a virtual chasm, precisely the kind of thing that stopped us on Bethartoli.

The lessons were to be rubbed in. Rising above the Rishi, the 19,930-foot peak of Hanuman, the "Monkey God," had taken our fancy.

All went well until we were less than 1,000 feet from its summit. Then, to our intense disappointment, we were stopped at 19,000 feet by another cut-off similar to the one on Bethartoli but deeper.

In fast-falling snow and thick mist we had an anxious time descending. It took so long that we finished in a race with the gathering darkness. We steered by compass, little expecting on such a night to find the tents.

Suddenly in the gloom we smelled wood smoke, and with twitching nostrils followed it to camp. By carrying up juniper wood and keeping a fire going the porters had saved us from a night out.

Listening to the blatter of snow and wind as we lay snug in our sleeping bags, we not only blessed our Dotial friends but gave thanks for the precaution of taking a compass bearing back to camp in the morning when it was clear enough to see its direction from the peak.

Next day we headed back to our base at Tapoban. It was a journey done on short rations of rice eked out with wild rhubarb, curtailed allotments of chapattles, and a modicum of butter, cheese, and pemmican. We had native beans, but these proved so damaging to our internal economy that not even the porters would eat them.

Winding down to Tapoban, we were sorry to be descending to 6,000 feet among the fly-ridden haunts of man, but glad to be nearing a food dump.

June had come, and in two weeks we had jumped from winter to spring. Snow gullies that had troubled us on the ascent were shrunken beyond recognition, and hosts of new flowers were ahloom—forget-me-nots, wild garlic, sweet peas, and whole hillsides of yellow broom.

Over the gorge soared a Himalayan golden eagle, much like the bird we see on Scottish hills. The voice of the cuckoo had come to the Rishi; flocks of snow pigeons twisted over the crags on silver wings; and Himalayan bullfinches occupied the upper tree line. Tree pipits were performing their flights of love.

On a Dizzy Trade Route to Tibet

The next phase of the expedition, timed to take place before the arrival of the monsoon in early July, was reconnaissance of the Lampak Mountains from the south. Our way lay up the Dhauli Gorge, one of the great trade routes of the central Himalayas and a track to Tibet (map, page 197). Where the Rishi had been grand, this was austere, for few trees grace its steel-gray walls of rock (page 208).

The track wound along these walls, high above the rushing Dhauli River. In some places it hung suspended in space, supported on big iron stanchions driven into the rocks. No doubt they had been put there by the British when they administered this area, for it was their responsibility to keep the passes open.

Traffic was heavy on this highway. Nomads were lugging their household effects; some carried hens in baskets. Curiously clad

Kodachrome by Douglas Scott

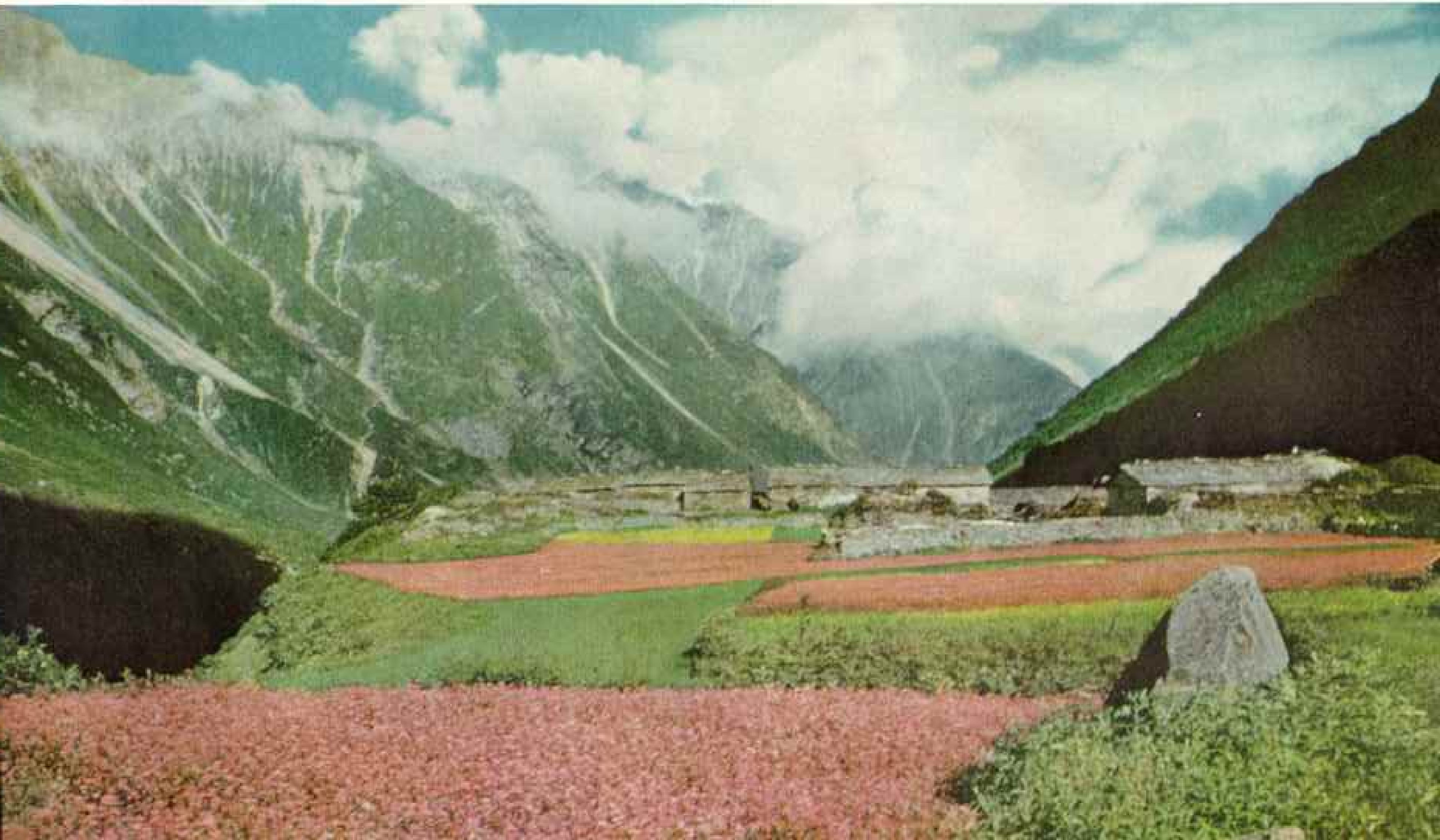
Meola Glacier Tumbles down the Panch Chuli Range in a Welter of Riven Ice

Isolated from their fellows, shepherds live in these stone huts 12,000 feet up in the Himalayas. Fireplace fixtures and a few rugs are their only furniture. Green pastures support cattle and goats.

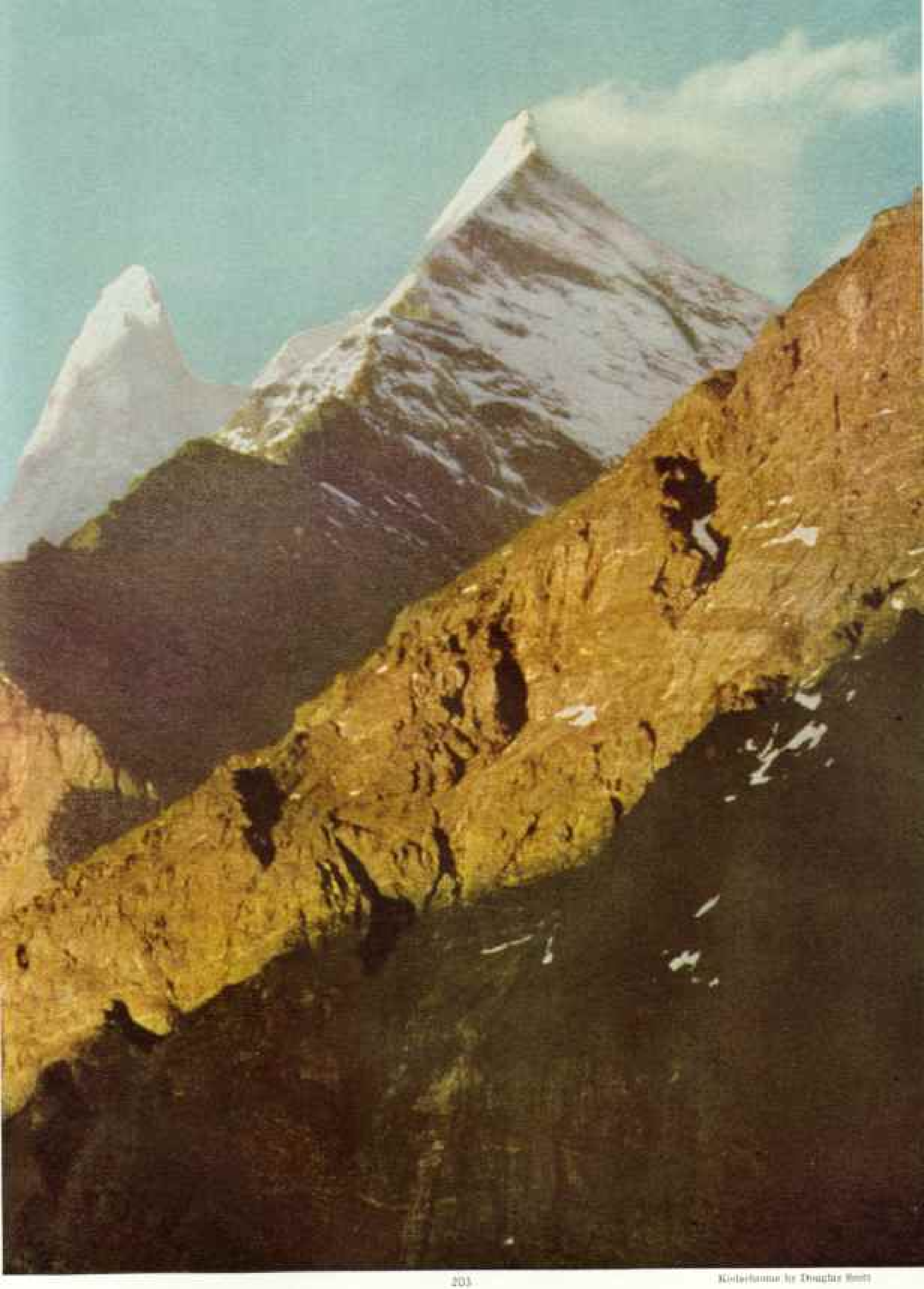
Porters En Route to the Top of the World Trudge Through Baijnath Village in the Hills of Kumaun. Packs Weigh 80 Pounds

A carpet of flowering grain amaranth borders millet fields at Sepu, a village in the upper Darmaganga Valley. Indian farmers cultivate grain in terraces. They grind it into a flour called *pappar*. Mixed with water, kneaded, and baked, pappar becomes chapatty, an unleavened pancake.

Kodachrome by Douglas Scott



Sunset's Fading Gleam Emblazons the Crags above a Shadowy Chasm: Bagini Pass



Spumy Clouds Drift Like Snow; Changabang's Milky Granite Suggests a Shark's Tooth

← Porters Steady the Author Crossing a Sliny Ledge above a 300-foot Drop

Dotial porters from Nepal showed amazing strength and endurance. Packing 80-pound loads, they negotiated rough terrain with the sure-footedness of mountain goats. Cheerfully they pushed onward despite occasional headaches and nausea caused by exertion at high altitudes.

This steep cliff lines the flanks of Panch Chuli, a 22,650-foot peak which defeated the Scottish explorers. Grass and seeping water make the footing treacherous. A strap looped over the forehead holds the porter's bulging pack.

↓ Dancers Court Gods of Fertility

Drought had parched the fields outside Malari village in northern India's Dhauli Valley. Now Bhotia tribesmen call upon their gods to hasten the summer monsoon. Dancers scatter handfuls of dust and grain, symbolizing earth's fertility. They circle a stone altar (hidden) on which incense burns. Drummers sound a rhythmic beat.

A Rhododendron Tree, Growing Wild at 12,000 Feet, Spreads Red Blossoms Against a Background of Eternal White

Entering Dunagiri, an Indian village near Tibet, the Scottish mountaineers found a school session under way in a courtyard. Solemn Bhotia youngsters sat in a circle listening to an elderly schoolmaster. As part of the lesson, teacher demonstrated uses of the author's watch, compass, and other pocket items. A photographer's light meter, however, baffled him; he had never seen one.

Right: Young Bhotias study the Devanagari alphabet, chalked on blackboards. Their nose rings are a common dress accessory. Homespun garments ward off the cold of an 11,800-foot altitude.

Left: Seeking firewood, these children visit the site of Dunagiri's new school. They carry chips discarded by the carpenter.

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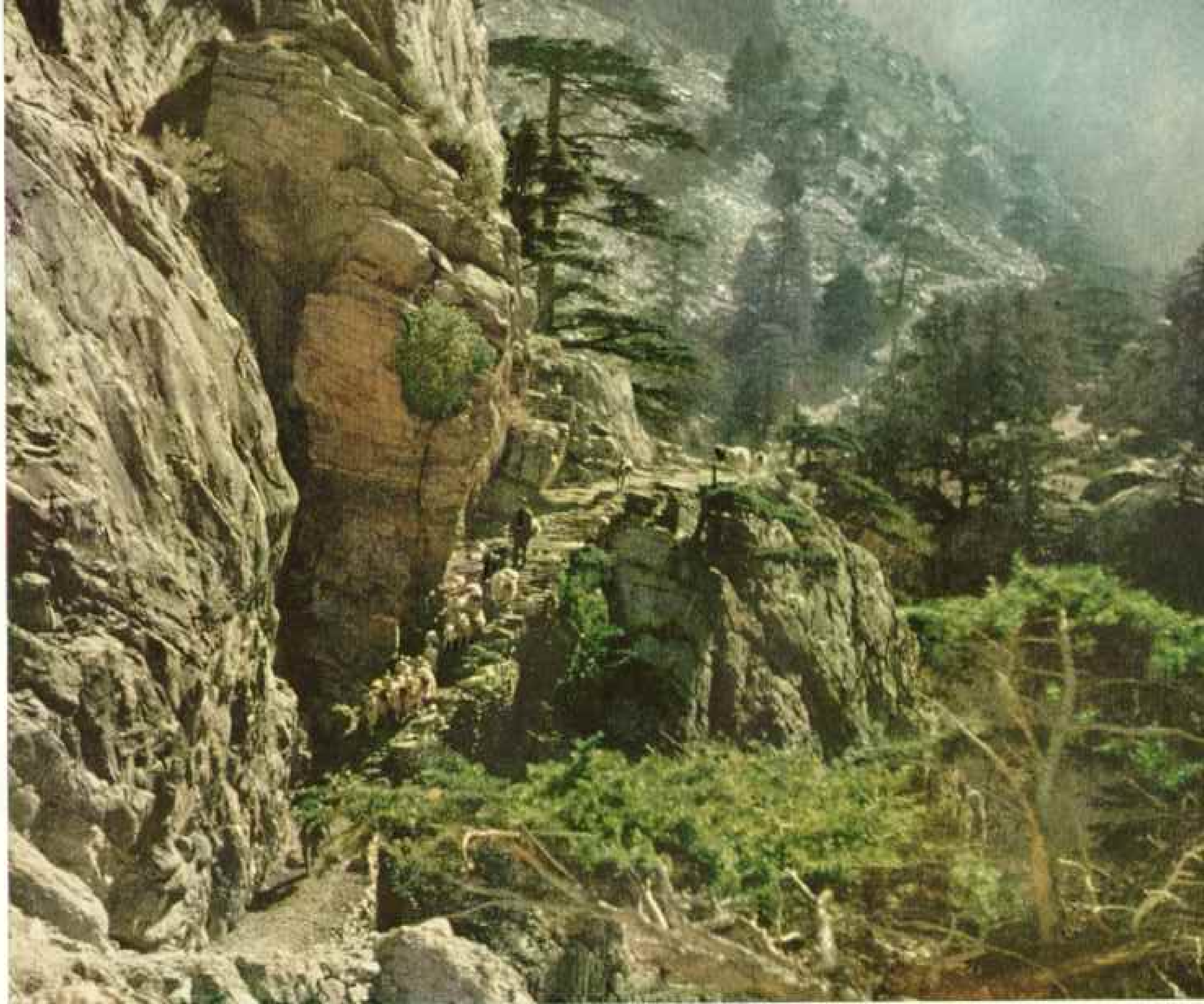
Kodachromes by Douglas Scott



Tibetan Traders Drive Their Goats down a Cliffside Trail in Dhauli Gorge

India's Dhauli Gorge winds through the central Himalayas. In 35 miles it gains 10,000 feet in elevation. Steel-gray walls plunging thousands of feet hem a cataract of foaming glacier water. The chasm's rugged depths form a much-traveled trade route to Tibet. In places the trail, hacked from the cliffs, seems to hang in space.

The author and his party followed the gorge north to reach the Lampak peaks. Along the narrow ledges they passed many Tibetans carrying goods for barter.

Each of these goats carries a pack load of salt and borax which will be exchanged for grain and rice. Pines and dwarf junipers grow among the stones.

Each Shaggy Goat Carries 24 Pounds of Provisions in Balanced Saddlebags. This Was the Scots' Pack Train

These sturdy animals, raised for transport only, are aristocrats compared to the small, scraggly goats slaughtered for food. A cow loaded with bedding brings up the rear. Cultivated fields belong to the men of Malari, 3,000 feet below (page 205).

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Kodachromes by Douglas Scott

A Glistening Ice Curtain Three Miles Long Hangs from the Crest of Tirsuli

Kodachrome by Douglas Scott

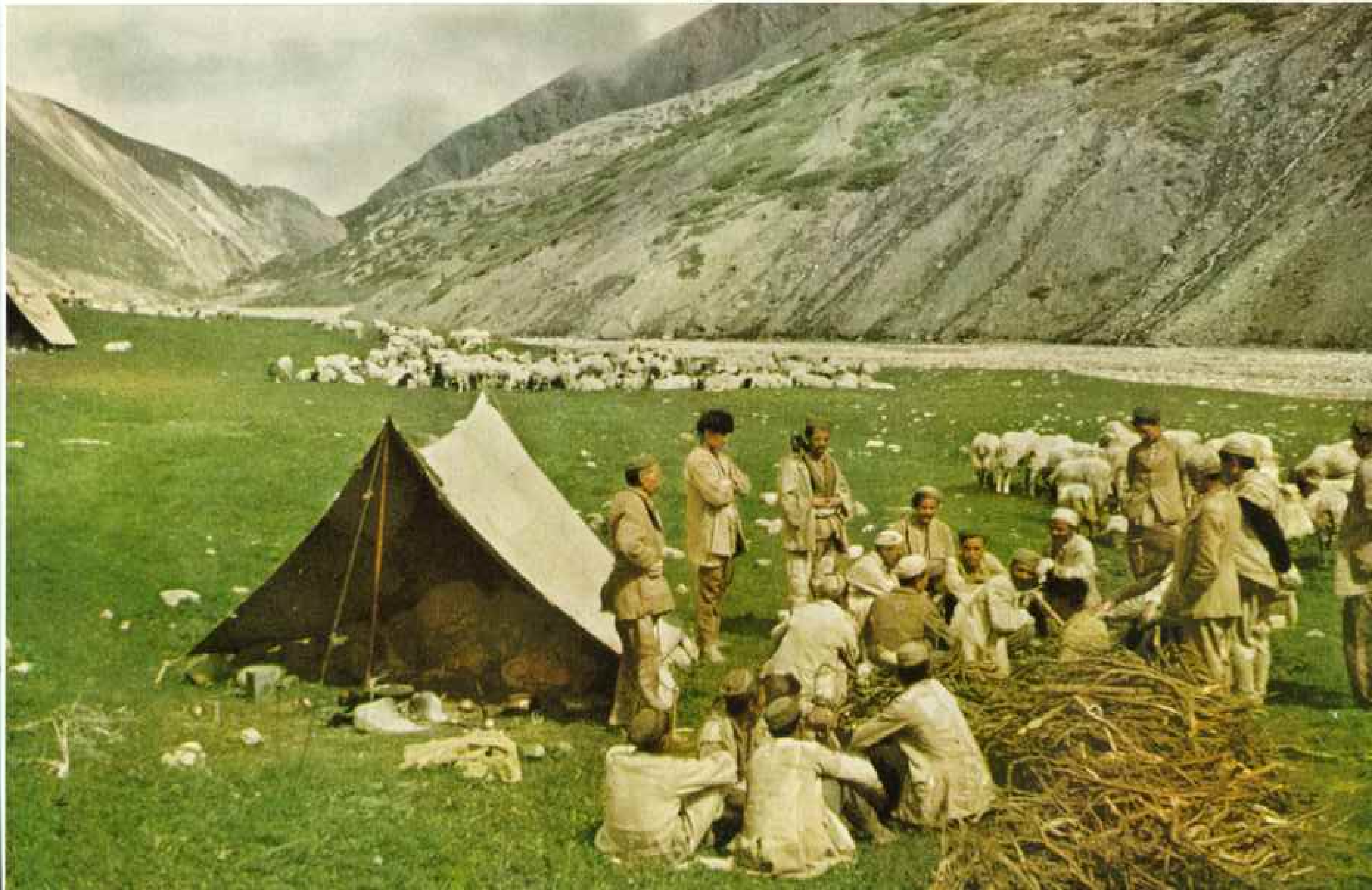
Tents Stand in a 15,000-foot Meadow; Alpine Flowers Star the Ground

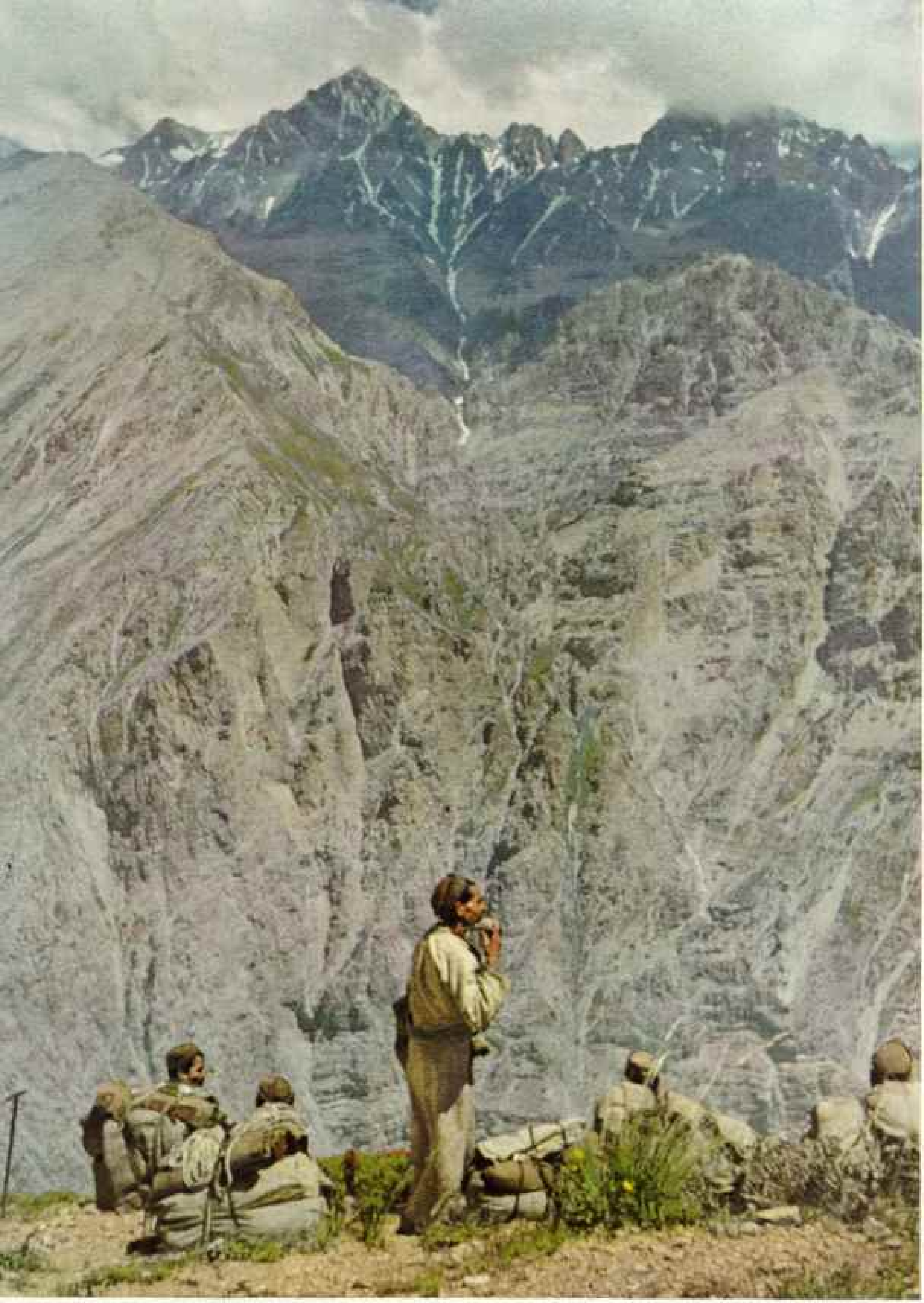
Kodachrome by Tom Weir

↑ **Monsoon Clouds Swirl Around Mountain Flanks above India's Darmaganga Valley. Porters (Left) Survey a Caldron of Mist**

↓ Tibet lies a day's march away from this camp of Bhotia tribesmen in the Indian highlands. Each summer the nomadic Bhotias cross the border to trade. Winter finds them far to the south selling their Tibetan goods. Here men from the author's party negotiate for the purchase of a blackfaced sheep.

Kodachrome by Douglas Scott





Kodachrome by Douglas Scott

India Looks Toward Tibet's 19,000-foot Peaks Across Mile-deep Girthi Gorge

Tibetans, wearing ex-army bush hats, colored woolen boots, and frock coats, herded sheep and goats, each animal fitted with small saddlebags containing salt or borax.

The sheep would be sheared here in India. Then back the patient Tibetans would go, bearing their barter—Indian rice or wheat, or manufactured goods.

These Tibetans are solemn men, but give them a smile and their faces nearly split in half with welcoming joy.

Climbing up a side ravine to reconnoiter a route to the Lampak Mountains, we came to a most beautiful village situated on an alp. Its stonework and finely carved wooden balconies were the best we had seen. But to our surprise the place was entirely deserted.

We found out why when we climbed 3,000 feet higher to Dunagiri, a village of Bhotias, perched at 11,800 feet above a glen of wild roses, walnut trees, and sweet-smelling shrubs.

Bhotias Migrate Like Birds

Bhotias, like the birds of the Himalayas, have different life zones, occupied according to the season. Many tribes have three villages, the highest being close to the Tibetan border, for Bhotia means "Man of Tibet."

These people are traders. From their high summer homes they journey far into Tibet, carrying grain and rice, or other goods, to barter for salt, borax, or trinkets. Like Tibetans they use sheep and goats as pack animals.

When the two-months' trading season is over, these birds of passage journey down to autumn quarters. Forgathering in the lower valleys, they hold their traditional fairs.

Winter's approach sees them in their lowest homes, whence many journey to the plains to buy goods for next year's trade.

Such a life breeds self-reliance and a great knowledge of mountains and men.

The people of Dunagiri greeted us with smiles of pleasure. Many were red cheeked and almost fair skinned.

When we asked if we could obtain food, bowls of *ata* (native flour) promptly appeared. Then potatoes! They were a Scottish variety known as Arran Banners, but of a quality I have never seen in Arran or elsewhere. It appeared that they had been introduced into the hills by the former British administration to better the lives of the people.

At this altitude the potatoes took twice the normal time to cook, but they tasted even better than they looked. Replete, we toured the town.

In a little square the village school children squatted, slates on knees, while an ancient autocrat put them through their lessons (pages 207 and 234). After greeting us and drawing the class to attention, he pointed to my pockets. He wanted to see what was in them—for educational purposes.

The old teacher proceeded to give the class a lecture on my belongings, each item being greeted with cries of joy. He took evident pride in showing his familiarity with such things as watch and compass, but was completely stumped by my exposure meter.

Wherever we went in India, we saw new schools being built. One was going up here. The villagers were well dressed. For best, the men wear homespuns consisting of tight trousers with matching jacket of semi-European cut. The dress of Bhotia women, however, is rather baggy and unbecoming. Ornaments range from silver girdles, anklets, nose rings, and earrings to chains of bear claws (pages 217 and 228).

At Dunagiri, ailing residents were brought to us for treatment. The worst case was a little girl whose lower leg and foot were black with gangrene and swollen with pus. MacKinnon at first despaired of her life, but his penicillin had the child well on the way to recovery when we left.

Later we were shocked to discover that many of the people in this area have venereal disease, and that tuberculosis is rife among them.

Unfortunately, too, they are much addicted to a form of rice spirit that is very near to raw alcohol. Locally, it is called chang (the same word used for the milder Tibetan beer), and it seems to result in a lowering of physical and moral standards.

Despite this, however, we found the Bhotias the toughest of travelers and the happiest of men when we had the good fortune to get them to work for us.

From Dunagiri we made two climbs that gave us our first success in pioneering new ascents. The first was a rock-and-snow peak of 17,830 feet; the second a 16,690-foot rock climb to a knife edge of granite.

A brief view from the latter through boiling cloud layers showed that the Lampak Mountains could not be climbed from Dunagiri. Uncompromising ice walls offered no hope of ascent from this side.

Dance Honors Gods of Fertility

Leaving Dunagiri, we headed for the north side of the range to have a look from there. With us were five huge pack animals called jhibus—crosses between yak and cow—and our faithful six Dotials.

Our fears of an early monsoon were strengthened when we came down to Malari village in the upper Dhauli. To hasten the rains and end a drought, the gods of fertility were being honored by six Bhotia men and

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Bhotia Tribesmen Clip Fleece from Shaggy Tibetan Sheep

A Tibetan herder (left) brought this flock to Milam, where he bartered the wool for grain. Shorn, his sheep will return to Tibet with saddlebags loaded (page 208). Bhotia buyers will sell the fleece in lowland India.

one woman, wearing long scarves of green, orange, pink, and crimson. To a thudding drum rhythm they danced around a stone altar on which a charcoal fire burned a green-juniper incense (page 205).

The whole village watched the dancers, whose faces wore daubs of red pigment and an ecstatic look. They wove a clockwise pattern around the altar, going through the motions of scattering grain, or picking up handfuls of earth which they let trickle through their fingers. Sometimes they touched their foreheads with grain or earth, rubbed their brows with charcoal from the altar, or tossed water down their throats. All the time the jerky figure of the dance went on.

Only the woman danced a solo. With her mane of black hair swinging wildly about her shoulders, she threw herself about like one possessed, her face transformed by emotion.

Malari is a vertical village in an equally vertical world; its houses perch like mountain boulders, one above another.

That Malari fights a battle with gravity was shown by the many ruins disfiguring its narrow streets. Landslides had eaten dangerously into the southern edge of the village; many houses appeared overdue to fall into the stream several hundred feet below.

For a three-weeks' reconnaissance of the unexplored Lampak peaks, we left Malari three days later with quite the queerest of

baggage trains—13 Bhotias, 6 Dotials, 1 cow, and 18 goats (page 209).

Climbing to 15,600 feet across the snow and rock of the Surans Ka Dhura pass, we contoured through hillsides massed with wild flowers—multicolored primulas, yellow ranunculus, saxifrages, stonecrops, and hosts of other brilliant plants.

But what filled our minds as we dropped to a glacier and camped below a huge waterfall was the sight of a peak called Uja Tirche, 20,350 feet. Clouds hid its summit, but its sides fell sheer for thousands of feet in rock bands and ice bulges.

Even as we looked the clouds lifted, disclosing twin sickles of ice and a fringe of cliffs sweeping downward to rock splinters; we knew they must be gigantic pinnacles to show from here.

Accepting the mountain's silent challenge, we sorted out three days' food supply for an attempt next day.

By morning every cloud had been swept from the sky, and Himalayan rubythroats and whistling thrushes were singing their hearts out.

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A Dunagiri Girl Wears a Nose Ring Bigger than a Bracelet

Bhotia women vie with one another in unusual decorations carried in the left nostril (page 207). Bear claws dangle from the silver breastband of this girl in homespun. In her village the Scots' penicillin proved a boon (page 215).

Unfortunately, our six Dotials were feeling the altitude. One was sick and the others were going very slowly. It is a tribute to the men that they carried to 17,400 feet, to pitch our tents some 600 feet under the pinnacles. Three then returned to base; the other three stayed with us.

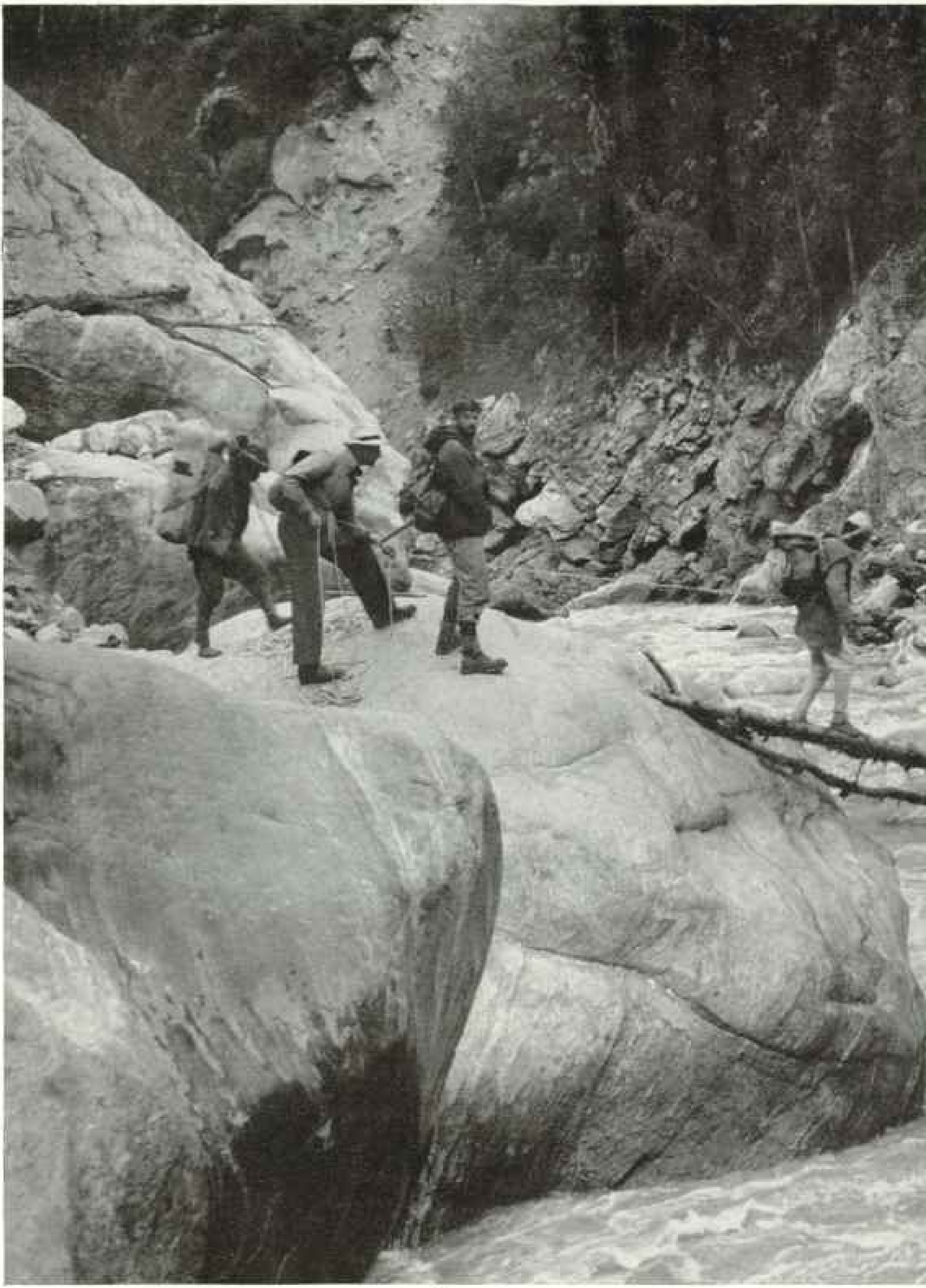
Wild Mountain Sheep Share Heights

Tom MacKinnon had made a quick reconnaissance of the pinnacles and reported them as amazing shapes of crumbly rock. He had "cairned" a route to a giant sphinx head; beyond that he had judged it unwise to go without a rope.

We were not alone. To our surprise, flocks of bharal—wild mountain sheep—appeared at heights equivalent to our own.

From our camp the scenic contrast was startling. On the Indian side, from northwest to southeast, immense snow peaks spiked the sky, rising from green valleys to glaciers and surging upward to ice walls. North and east, across the Girthi Gorge, lay a land of soft autumnal beauty—rolling hills, their dun uniformity flecked with patches of snow.

They might have been the hills of the Scottish border, but no Scottish sky ever had such an electric-blue intensity. We were beholding the Tibetan plateau, stretching through a wilderness of space.



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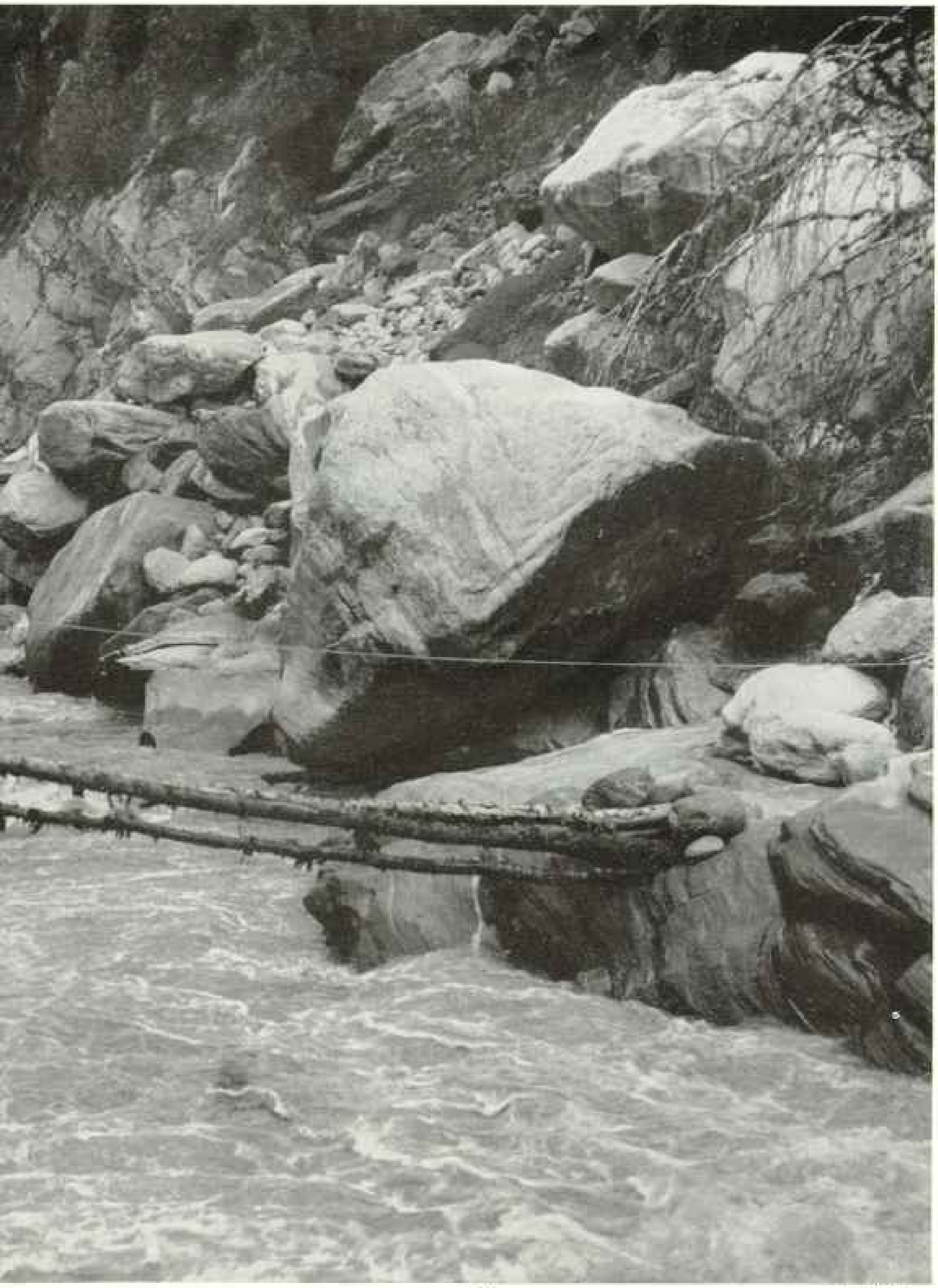
With Full Pack, a Porter Inches Across the Rishi on a Slender, Quaking Log

Several logs were swept away before the party succeeded in bridging the swift waters. Bill Murray (holding rope) and bearded Douglas Scott await their turn to cross.



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A Rope Handrail Aids Balance; Glacier Waters Swell the Mountain Stream

To reach this crossing, the Scots and their porters traversed dangerous landslides in the cliffs overhanging Rishi Gorge. A torrential rainstorm swept the river as the last man stepped from the bridge.

110 Thomas Weir

Zungia Models His Handiwork, a Wool Sweater

This Dotial porter fashioned the yarn with a hand spindle while carrying his pack. Using homemade needles, he knitted by campfire light and completed three sweaters. Though elderly, Zungia proved to be the ablest porter.

When night had come to the valleys, high peaks still burned with sun glow.

Breakfast in a high camp is not a jolly affair. Getting out of a sleeping bag is not so bad as the business that precedes it—forcing biscuits and lukewarm tea down one's throat, the latter from a flask filled the night before. Boots and other preparations seem a confounded nuisance at such times, and it is a brave man who will say anything controversial.

At 5:30 a.m., with this behind us, we set off with two ropes. Tom MacKinnon and I shared one, Bill Murray and Douglas Scott the other. Clouds enveloped us.

Crossing a Wall of Ice

Above 18,000 feet the route quickly narrowed to a knife edge calling for care. Soon we saw that we must traverse an ice wall and cross an overhanging cornice.

At such times it is reassuring to have a good anchorage on the mountain, such as a well-driven ice ax with a turn of rope around it. A slip by the leader can then be checked by the second man. In this case a few inches of ax head in the ice had to suffice. It looked woefully insufficient with a drop below of thousands of feet.

But MacKinnon led confidently. Cutting hand and footholds, he moved across the wall, stopping midway to ask me if I was quite happy. He told me he was fairly enjoying himself.

Forty feet outward, Tom swung himself over the cornice on the far side, out of sight. Five minutes passed and then I heard his cheery cry to come on.

At 19,000 feet we required two breaths to every step. But we crossed a second ice wall, worse than the first, and plodded onward, driving each foot carefully into the narrow ridge.

Suddenly a fragile blade of snow loomed ahead—the 20,350-foot summit of Uja Tirche! It was snowing as we crowded onto its narrow top, to look down ice walls disappearing into gloom.

In such a situation one does not feel a conqueror; quite the reverse. The climb had taken eight and a half hours, and we were going to need all available time for the descent. Besides, it was too cold to linger.

Anchored Rope Saves All Four

On the way down our safety-first tactics proved their worth, for an ice step broke under MacKinnon's weight, shooting him down 40 feet before he was pulled up by the rope. Without firm anchorage, in rock this time, we all probably would have been pulled off.

Almost unnoticed at first, a minor miracle was taking place. The mists that had enveloped us all day were submerging to the valleys,

unfolding a sight that made us forget the bitter cold.

In waves of movement peaks were breaking through. Kamet rose high over Badrinath in a 25,000-foot wedge of silhouette, immense against fire-tinted clouds.

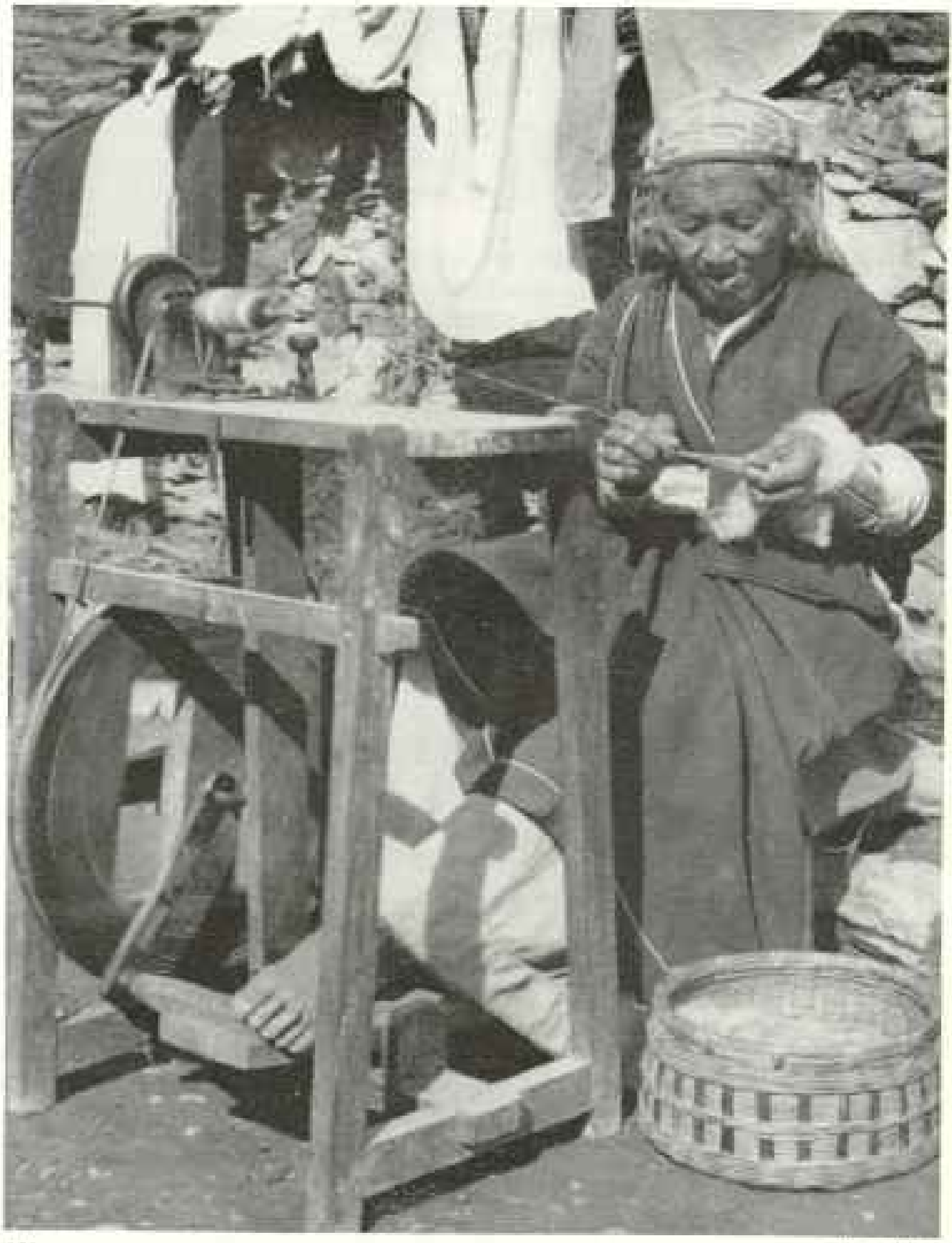
Even as we looked, the warmth was withdrawn from the sky; the rolling cloud-sea paled to shadow. The immensity of depth, of incredible space, is something I am never likely to forget. It was a feeling of being not on the earth, but on another planet.

The Providence that looks after fools and mountaineers had not only submerged the clouds, but had given us a clear sky. From it now shone a three-quarter moon to light our campward steps. We reached the tent just 18 hours from the time we left it. Curiously, no one was hungry, though we had eaten little all day. Altitude has strange effects.

Next morning the sun shone warmly on the tents. It was delightful, but not for MacKinnon. He was snow blind, and the tent had to be darkened to give him relief for his eyes.

In the clouds of yesterday, Tom had been much troubled by his dark goggles steaming up, and from time to time he had removed them. He was now paying the penalty. Castor-oil drops cured him in 24 hours.

Meantime we prepared for another attack. From what we had seen of a peak we called South Lampak (20,750 feet), there seemed a fair hope of climbing it. We lost no time in descending to the base camp and moving up 2,000 feet to pitch our tents.



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A Barefoot Grandmother Spins Wool at Milam

She pulls the raw wool into a rough strand, carefully paying it out to the whirling bobbin. Gnarled toes power a treadle turning the bobbin and winding the yarn. Most Indian hill people spin by hand (opposite page).

Wall Creepers Seem Huge Butterflies

Around our camp at 15,000 feet, pink and yellow flowers were so thickly massed that we couldn't avoid tramping on them. All about us were many birds—rosefinches, plain-backed mountain thrushes, pipits singing their songs in spiral dives, and a lovely thrushlike bird of cobalt blue and black, afterward identified as an unclassified species of grandala. Alpine choughs circled the ridges.

Most beautiful of all was a wall creeper, fluttering its gray and crimson wings like some huge butterfly as it climbed a vertical cliff in search of insects.

With three porters we climbed hard and established a camp at more than 18,000 feet on the edge of an airy snow cornice with long drops on either side. The summit was less than 3,000 feet above. Ahead was an 800-foot rock buttress, steep but not capable of stopping us, we thought.

Came the hour of rising for the attempt—3:30 a.m.—and we had to withdraw to our sleeping bags. Wet snow pattered against the tents, and visibility was nil.

There was nothing we could do but lie up and watch puddles form on the tent floor. I read the Gospel of John while avalanches roared off the peaks, falling down each side of us.

Pinned down, we could do no more than wait, enduring the coffinlike discomforts that small tents impose. The second night passed like an age.

Now it grew colder; ice encased the guy ropes. The mountain was in no mood for climbing. We shouldered the packs, roped up, and descended 5,000 feet.

Five days had been spent on this attempt, but there was time for another try. Once again we camped on the snow cornice under the 800-foot cliff, and once again foul weather developed overnight. But this time we came to grips with the crags in an attempt to force the peak.

To our disgust the rock was mere shale, so rotten that it came away in handfuls. There was no choice but to cut steps back to camp and pack up.

Into the Girthi's Scenic Savagery

Now we came to what promised to be the most exciting phase of the expedition, the traverse of the Girthi Gorge.

Our route lay across the flank of Uja Tirche, through flowers that filled the air with their fragrance. Now we would be tramping through a haze of vivid blue rock geraniums or bright red potentillas. Then we would be brought to a halt by saxifrages clustering among the rocks, or dewdrops sparkling in the tiny blue eyes of pincushion mosses.

On this fresh morning, the Himalayas of imagination had come to life. From the crest of the Girthi pass we took our last look at the peaks that had been our companions for the past three weeks. They cleft the air like knife blades. Could it be that we had camped up there among those ice flutings so delicately poised on the blue-black sky?

When we took the plunge into the Girthi, it was like heading into another world. This was a vegetationless world, a world of naked rock that rose sheer on the north side 7,000 feet from the river (page 214). On our side the wall of Uja Tirche sent down a great buttress to make the most impressive ravine we had seen, a Grand Canyon of the Colorado on a more vertical scale.

Yet, for all the arid prospect, there were flowers at our feet as we rounded the next bluff, flowers that found foothold in stones. There was even a thistle like our Scottish one, and roses that grew in a bower over our heads.

In this incredibly wild country, we were amazed to find an attempt being made to establish a settlement. It consisted of two thatched houses, built, we were told, by Malari Bhotias with the pioneering spirit. They had even built two little shrines, about the size and shape of dog kennels.

The menfolk were away from home, but there were two attractive women who smiled with bad effect on our men.

On this Girthi crossing, we had expected difficulty with glacier streams, but none held us up unduly. The main trouble with Himalayan rivers is that the boulders on the bed are moving with the rush of water. The correct technique is to charge through. To try to balance across is to be swept away.

At the Border of Tibet

By the fourth day we were through the gorges, and in mist and rain we climbed into the snow and stones of the Unta Dhura pass at 17,640 feet. We had reached the border where northeast lies Tibet and southeast lies India.

In this desolate place we heard, of a sudden, the jangle of bells and the wild cries of drovers. Streaming out of the mist came dim forms of yaks and sheep driven by Tibetans who stopped in their tracks to stare at us. They wore robes of blue and scarlet, and all carried knives or swords as protection against bandits. For the next few hours caravan after caravan passed over this bleak height.

(At the time of our visit, the Communists had not yet taken over Tibet.)

Our men had done well on the climb. They did even better on the descent. Next day we strolled into Milam, the first village in India. Its millet fields and neat squares of houses gave it the appearance of a Promised Land—and that is what it must seem to Tibetans after the hostility of the high passes.

At once we were greeted cordially and conducted through courtyards piled with saddlebags, where Tibetans lounged and Bhotia women wove carpets or ground flour. Local people were eager to introduce us to another European, Leonard Moules of the Worldwide Evangelization Crusade. He had hoped to carry Bibles to Tibet, but permission had just been refused him.

Len had been doctoring the natives for the past six weeks, sometimes dealing with as many as 100 cases a day. Right now he was about to remove a cataract from an eye.

Drums Announce a Farewell Party

Milam was the turning point of the expedition. MacKinnon's time was up, and sorrowfully we said goodbye as he left with one porter for the long trek to Ranikhet.

For us, money was running short. The last phase of the expedition, reconnaissance of Panch Chuli, 22,650 feet, would need to be

Kodachromes by Douglas Scott

↑ After a Jungle Trek, All Hands Relax in a Camper's Fly-free Paradise

Insect pests plagued the Scots and their bearers at low altitudes. This campsite atop a 12,000-foot ridge offered relief from heat and flies. Firewood was handy; a snowbank (lower right) provided water. Porters, weary of climbing, dropped their loads.

↓ Amateur Cooks Brew "Hoosh," Using Snow, Dried Soup, and Pemmican

Climbing South Lampak peak, the explorers pitched their tent on an 18,000-foot cornice. Snow squalls developed; avalanches thundered past. Huddled together, the men read the Gospel of John. Tom MacKinnon (left) and the author prepared the meal.

Kodachrome by Tom Weir

↑ **Porters March below a Grassy Canopy in Darmaganga Valley**

Quitting the peaks, the Scots and their party returned to lowland India via the Darmaganga Valley (page 212). Their journey took them through thick woods and deep ravines. At times the trail spiraled dizzily up and down canyon walls. Flagstones served as steps.

These men walk on timbers supported by iron braces. Lush vegetation carpets the 7,000-foot slopes.

← **Buffalo Soak in Mud under a Waterfall**

On its lower reaches the Darmaganga Valley is hot and humid. Natives of the region wear little clothing. Unlike the hill-dwelling Bhotias, they live by agriculture rather than trade. These water buffalo plow the small fields and cart the farmers' burdens.

Kodachrome by Douglas Scott

Drummers Beat a Ceremonial Rhythm as Yansu Village Fetes the Explorers

Kodachrome by Tom Weir

Murray (Left) and Scott Occupy Seats of Honor in the Town Square

A Bhotia Woman Doing Her Chores Wears All Her Beads

Yansu villagers strap these grain-filled saddlebags to the backs of goats and sheep (page 209). Herders, driving the animals across high mountain passes, trade the grain for Tibetan wool, rugs, salt, borax, or gold.

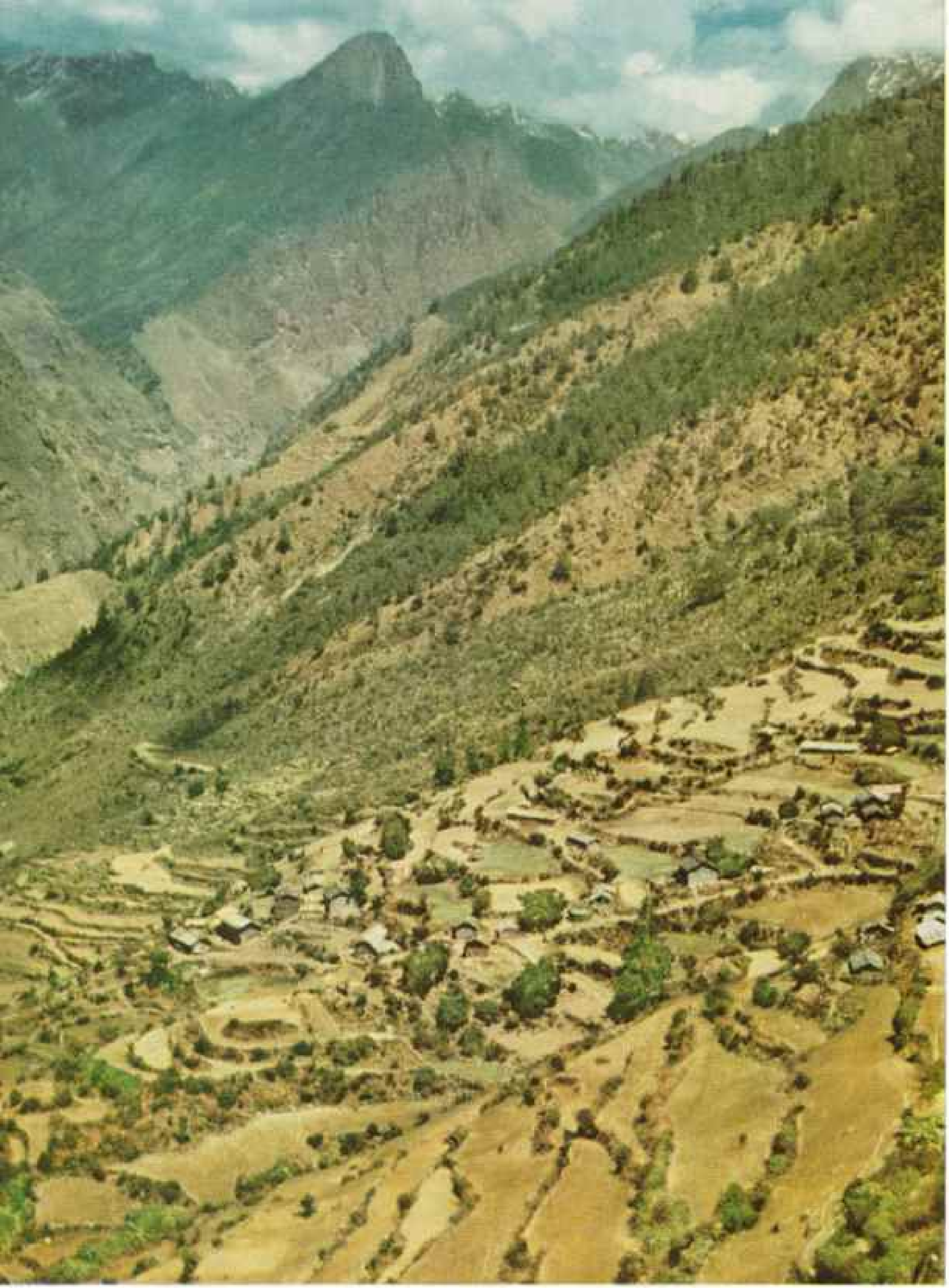
This stone-lined hole in the ground serves as a granary. At harvesttime tribesmen pour millet into the pit and seal the entrance with rock and earth. The grain, though unsacked, does not spoil.

Beads and baubles hang from the woman's neck, nose, and ears. Rings and bracelets weight fingers and arms. Hair across the forehead is combed into scores of neat little plaits.

Dancers Sway to a Fiddler's Tune

At Milam the Scots found a farewell party under way for the region's medical missionary. Villagers thronged the square to watch a floor show by dancers and musicians. These women, wandering entertainers, swayed ecstatically and sang a monotonous chant. "Violin" and bow produced fearful discords.

Kodachrome by Douglas Scott



 230 Kodachrome by Tim Wirt

Hedges Separate Terraced Wheatfields Climbing the Slopes at Tapoban

Lata Peak (background) guards wild Rishi Gorge. The author knows of no one who has managed a passage of the lower gorge, a box canyon with sheer walls thousands of feet high.

done in the monsoon. It was now mid-July. We could not afford to wait for the clear skies of September.

Moules, too, was leaving, and a farewell party had been arranged in his honor; the sound of drums announced it. Standing on roof tops and crowding the narrow streets, the whole population turned out.

In the center of it all were the musicians and two rather attractive singers. The band consisted of an instrument like a piano accordion and a sort of rectangular violin. They struck up as we arrived (page 229).

With swaying bodies and sensuous movements of the hands, the girls managed to get the maximum of sexual excitement into their simple song. Their concession to the dance was in little shuffling steps delivered with a tap of the shoe.

Sword Dance Gets Dangerous

Then the sword dancers took a hand. "Dancers" is a misnomer. The swords were merely brandished and whirled about, though one man tiptoed in neat steps. The other swordsman made fierce and comic faces.

Sometimes the music stopped, and the comedian would deliver a pantomime, sending the crowd into roars of laughter at his funny faces. Almost literally sidesplitting was the climax; in his antics he sent his sword whirling through the crowd, cutting open a couple of heads.

The appearance of Moules with his laden jhibus was the signal for the procession to move forward. A garland of flowers was hung round his neck; the girl dancers swayed around him, and musicians and drummers played more furiously as they advanced through the village to mount the col which marked the beginning of his journey. Villagers, old and young, streamed behind.

The finale was a tremendous tattoo from the drums, rising to a crescendo and ending with the crack of gunfire. In the dramatic silence that followed, Moules took his departure for the bleak northward passes.

Our own departure came soon after. With Bhotias from this wealthy village helping to carry our kit, we started for Panch Chuli, our last great mountain objective. The approach we had chosen was the Ralam Pass, really a succession of three passes crossing the main Himalayan range at 18,470 feet.

It was good to walk 10 miles down a glen similar to many in the Scottish Highlands on a misty day—swift running water, with glimpses of craggy ridges as the clouds boiled.

The path was turfy and fairly flat, curling into fields of flowering millet where Himalayan greenfinches and goldfinches sported. Red-billed choughs replaced the alpine choughs of Milam; rufous turtle doves inhabited the trees, and wagtails flirted by the streams.

A climb of 5,000 feet took us over the first pass, then down to Ralam village, 3,000 feet below. Its inhabitants seemed to suffer from sore heads, sore tummies, sore eyes, and a host of other complaints. We dispensed medicine to the needy, but the malingerers were quickly identified and sent packing with a halibut liver oil capsule.

Our visit was such an occasion in this remote place that when it came time to leave at 7 a.m. a procession was formed in our honor. Heading it were the boys of the village.

In farewell the kiddies plucked handfuls of flowers and danced with a bouquet in each hand. Finally each gave a solo in the center of a ring. One imitated a monkey scratching for fleas; another made funny faces; still others flung themselves about, whirling fiercely in true Highland-fling style (page 195).

The second pass was harder than the first, over a glacier and up a rock saddle to drop to the Yanckchar Glacier. We camped on flat stones near a couple of snow beds.

At more than 15,000 feet in this Arctic wilderness, it was a surprise to see a fox, fawn colored and with an enormous brush of lighter color.

Moonlight flooding the tent awakened me. In the incredible silence, the peaks stood clear of cloud, silvery above vast shadows. I find it impossible to put into words the mood of these mighty peaks, all of them unclimbed.

Porters Pull Wool Over Their Eyes

The men were in great form next day, competing with each other in cutting steps across a slippery icefall. We merely followed, marveling how sure-footed they were in such an assortment of footgear—sandals made from rubber tires, sneakers, unnailed leather shoes.

On the upper glacier we were worried for their eyes, for we could issue only a few pairs of goggles. They produced wool, teased it out, and pulled it over their eyes.

On the other side of the pass, our men sat on their loads and sledged down, whooping at the rush of speed.

At one point, boulders hurtled down toward our last three porters, but they ran hard and escaped with nothing more than a fright.

Soon now we were descending steeply to a more verdant land of rosebushes and stunted birches, of blue-fronted redstarts, rufous hedge sparrows, rubythroats, and rosefinches.

The valley floor of the Lassar Yankti seemed impossibly far down, but at length we were beside it. In a couple of miles we saw ahead the village of Sepu, a cluster of houses perched above neat terraces of pink and yellow grain amaranth (page 201).

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A Porter Buys Wheat Flour at Tapoban for the Journey Through Rishi Gorge

Native foods, purchased in highland villages, were the mainstay of the Scots' diet. Traveling light, they carried limited amounts of tinned foods.

Here several women came to us to show stomachs pitted with small, clean scars. Thinking it was some kind of skin disease, Murray painted each scar with Castillani's paint, a deep purple medicine which the ladies admired.

Hot Coals for a Stomach-ache

Not until long after did he learn the true origin of the scars. When a Bhotia woman has a severe stomach-ache or dysentery, she lies down, places a live coal on her stomach, and a friend blows it red hot!

From Yansu we had hoped to reconnoiter Panch Chuli (page 199), but the rainy and overcast weather veiled its face. At last we decided to start climbing in the hope that high up the clouds would clear.

Our first view of the mountain next day was breath-taking. The whole range rose 12,000 feet above our camp. Four summits soared over a welter of rock faces, crevassed ridges, and fierce ice bulges. Waterfalls a thousand feet high leaped over crags. We had never seen such uncompromising peaks or such colossal icefalls.

Reconnaissance showed that there were two possible approaches to the main peak (22,650 feet), the north and the south col. We chose the north. It was pure gamble, as neither was visible.

By the time we reached 19,000 feet on the mountain, our two porters had had enough. Climbing so high with 60-pound packs had taken every ounce of their will power and reflected great credit upon our doughty Dotials.

Giving them a rope and a warning to stick to the steps we had cut that morning, we said our salaams and shouldered the kit. But the potential dangers of avalanche and crevasse in the mists of this difficult mountain were too great for us to continue. We camped between two crevasses (page 196).

Then came a most marvelous sight, though one that brought us disappointment. Panch Chuli threw off its cloud.

At the head of the glacier before us was the col on which we had hoped to camp. It rose above rock, sheer for nearly 1,000 feet. Grooved ice at its foot indicated avalanche danger. Also, the ridge rising from it to the summit gleamed translucent in the sunshine—ice, 2,000 feet of it, in which every step would need to be cut by ice ax. Clearly, this was not the route to the top of Panch Chuli.

Despite the sting of defeat, we did not regret coming up. We were in a shining basin ringed by mountains whose walls fell like folds of pleated silk. Below, the clouds were boiling up in masses of cumulus, huge towers of it, that wound around the ridges of Tibet and Nepal. Tonight we did not belong to the earth.

Next day we climbed, through a maze of crevasses, far enough to assure ourselves that we were not being merely chickenhearted. Stones falling continuously showed our judgment had been sound.

Freak conditions of snow flurries and enervating heat alternated until sunset. At times we found it so hot on the glacier that we filled the crowns of our hats with snow and were forced into the tent for shelter from the fierce sun. Yet three hours later, when the sun had set, my feet were cold in three pairs of socks.

That attempt disposed of the north col approach. An examination of the south col showed that if Panch Chuli can be climbed it will be done from there.

Back at our valley base village of Yansu, we prepared for the 150-mile trek out to civilization. But first we were invited to a celebration in our honor.

At 8 the next morning we were ushered into a house and seated on a carpeted dais. A wall of Bhotia faces pushed nearer and nearer to us as more and more newcomers squeezed in from behind. Not knowing the language, we could do no more than smile and murmur "*thik*" (right), politely.

Toasts and Brown-paper Cigarettes

It was a relief when brown-paper cigarettes were handed round. None of us smokes, and you need to be a smoker to smoke a brown-paper cigarette. Also, you require a strong pair of lungs to promote combustion.

We puffed and coughed and were glad when a basin of gray liquid arrived. Our hosts filled three little silver cups and handed them to us. Saying "cheers" to the multitude, we drank. It was supposed to be milk, but it didn't taste like it. The cup was promptly seized and refilled.

Then chang made its appearance. It tasted like vinegar and burned with inspiring fire.

Under its influence I was invited to play an instrument like a piano accordion with a little bellows attached. My attempted rendering of "I Can Wash a Sailor's Shirt" was foiled by broken keys. Only two notes appeared to be working. Playing those two, one of the Bhotias intoned a monotonous chant like a snake charmer's.

From outside came drummers lined up to accompany us down to the village square. There we were seated on carpets while the drummers began a long tattoo (pages 226-7).

It was so long that I decided it was time we gave them something in return. The crowd stood around expectantly while I collected the drums in a semicircle. Wielding a couple of big sticks, I beat out rhythms fast and furious, but my art appeared to be lost on them. They looked baffled rather than amused. Nevertheless, had there been a spare drum I would have joined the band that marched us back to camp.

Down to a Hothouse Atmosphere

Next day we were off, down a wooded glen that cut deeper and deeper, becoming a ravine on a tremendous scale (page 224).

After the bleakness of the other two Tibetan trade routes we had seen, this one was a revelation. Tropical vegetation, langur monkeys, banana palms, sunbirds, and hothouse atmosphere showed how fast we were losing altitude.

It was exciting one day to round a corner and look on a green wall, scored by rock gullies, rising to a sea of forest that disappeared in the gray of monsoon clouds. We were on the western border of Nepal, looking into that forbidden country.*

It was a wild path, crossing under waterfalls, climbing like a staircase in places, at other times spanning drops on wooden planks: a narrow gangway contouring a complication of rivers and foothills.

Five days down the Darmaganga we were able to buy mangoes, ripe bananas, and sticks of tall Indian corn for roasting. At Darchula we had to wait for the torrential rain to subside and let us resume our journey.

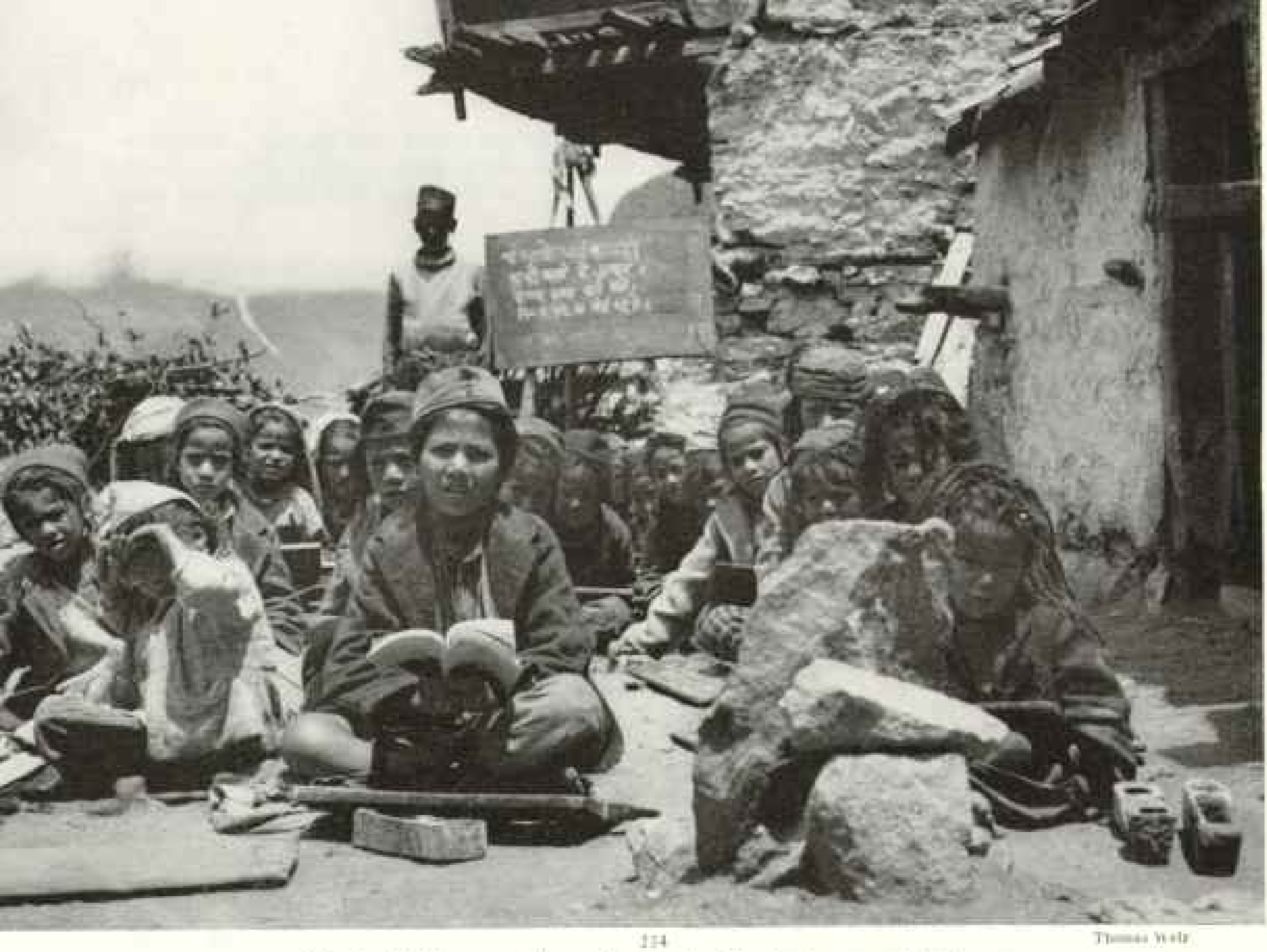
We were lucky to beat this rain by one day, for the track we had descended was now made impassable by landslides and rushing torrents. We had found these streams barely fordable the day before. The consequence of a slip in the thigh-deep water would have been to go over falls and perhaps to land in the roaring glacier river below. None of us had ever seen such a terrifying rush of water.

As we neared Almora the route led over a succession of jungle ridges, none of them above 6,500 feet and some considerably lower. Butterflies swarmed on the paths—large swallow-tailed varieties as big as a warbler. Smaller varieties went about in whirlwinds, dancing madly and settling like closely scattered petals. The humid air was strong with honey scents.

Birds were everywhere—kingfishers, bulbuls, red-billed blue magpies, shrikes, flycatchers, spotted forktails, black-headed sibia, crested hawk eagles, pigmy owlets, drongos, and an amazing variety of pigeons. It was a naturalist's paradise. Once I interrupted a bear hunt, but to the disgust of the hunters I had no gun. With clubs, spears, and dogs, they beat the undergrowth.

Holy men en route from Tibet to India

* See, in the NATIONAL GEOGRAPHIC MAGAZINE: "Peerless Nepal—A Naturalist's Paradise," by S. Dillon Ripley, January, 1950.



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Bhotia Children at Dunagiri Study Their Lessons Outdoors

These youngsters attended classes while awaiting completion of a new school. Their intelligence impressed the visitors. One boy who had never seen a map before pointed out local landmarks on the author's chart. The schoolmaster stands by the blackboard (pages 207 and 215).

were colorful figures on this path. We talked with them, drinking tea together.

To these men the body is nothing, the present is nothing, war is nothing, if the ultimate truth that each man has a greater self is realized. Ambition, lust, greed, comfort, ego—these are only a few of the things that stand between man and his Creator.

The inner joy is their goal, oneness with God, not necessarily a Hindu God but a Universal God. They have no doubt about reincarnation. One life is too short to attain the Ultimate, according to them.

One evening, after heavy rain, Panch Chuli came out of the clouds. It was the first time we had seen it since leaving our base camp. Now it appeared as a point of snow utterly removed from the earth, dwarfing the foothills and soaring over the blurred shapes of immense forest ridges.

A fortnight ago we had been camped under its crest, enduring heat, glare, rarefied air, and loss of appetite, which together had been well-nigh insufferable.

The Poison of the Heights

The natives call these effects the "poison of the heights." We had tasted the poison, and been glad to get away, to live again at lower levels and exult in the feeling of physical energy in daily marches through beautiful country.

Yet one view was sufficient to flood the mind with longing to go back, the discomforts forgotten, the revelation of the heights remembered.

Notice of change of address for your National Geographic Magazine *should be received in the offices of the National Geographic Society by the first of the month to affect the following month's issue. For instance, if you desire the address changed for your October number, The Society should be notified of your new address not later than September 1. Be sure to include your postal-zone number.*

Back-yard Monsters in Color

Even in a Great City, the Insect Kingdom Reveals Its Shimmering Hues to a Hunter Armed with Patience and Kodachrome

By Paul A. Zahl

NEW YORK City may seem a strange place for starting a natural-history project. But it was amid Manhattan's walls that I discovered the fascination of an unusual form of hunting—hunting insects with a color camera.

The project stemmed directly, but accidentally, from bird photography. In a downtown Manhattan pet emporium I was taking color pictures of tropical birds when all at once an immense brown cockroach appeared on the perch.

As Broadway would put it, he stole the scene. On impulse I trained my lights and lens on the insect instead of the bird.

The picture proved successful enough to open my eyes—and my shutter—to a colorful kingdom that is all about us, even in such a city as New York.

Insect Colors Rival the Birds'

Hidden under leaf and bough, beneath the ground, and in the nooks and crannies of man's own habitations, lies this unseen, living world of color, to most of us unknown and often unsuspected. The splendor of the miniature, almost secret, teeming world of the insects is largely concealed from human eyes, even though it exists in intimate contact with the world of men.

A fleeting glimpse of a fluttering butterfly's gay wings, the brightly spotted carapace of some beetle scurrying to a hide-out, or perhaps a green grub chewing voraciously upon the leaves of a cherished shrub or tree, is all that most people ever see of insect colors.

The occasional "bug" that crosses our path, the hungry housefly, the singing mosquito, the honeybee sipping at a clover blossom, even the hordes of grasshoppers or army worms that may devastate field or garden, give hardly a hint of the glamour of the insect world.

Yet actually no living creatures, except perhaps the birds, rival the infinite variety and delicate loveliness of the insects' rainbow hues.

Capturing insect color with the camera is no easy task. To obtain the 27 color photographs reproduced on pages 239-246 and 251-258, I exposed about 3,000 Kodachromes. Of these, 100 were used in making the final selection. Many were made no farther from home than my own back yard.

One warm afternoon last summer I was at work in my research laboratory, a block from the great new United Nations center in New York, when my wife phoned. Our four-year-old daughter had come in from the garden with her hands and arms full of bristly, red-headed caterpillars. They were all for me!

Little Eda had listened to our dinner-table conversation and knew of my new interest in insect collecting. Now she was trying to help.

When I reached home, I found that the caterpillars were larvae of the tussock moth. They were about an inch and a half long, each with four tussocks of white fibers bristling up off the back and with tiny bundles of hairs standing out elsewhere. Good color subjects, they had red-enameled heads and two scarlet spots on the back (page 245).

Insisting that I go with her to the source of her find, Eda led me out into the garden which hangs over New York's East River Drive. There on the cherished apple tree were hundreds more of the caterpillars.

By now I was less inclined to rhapsodize over the gaudy good looks of these guests than to grieve at what they were doing to the garden trees. Not only were the leaves of the apple tree being gnawed to lace, but so were those of the maple.

In ensuing days I noticed how the greenery in other little gardens and mews of Manhattan's East Side was aswarm with caterpillars of the same sort. The iron railings in near-by river-front parks were busy caterpillar avenues. The summer of 1951 had brought to New York City an especially severe infestation of the destructive tussock moth, a member of the family that includes the notorious gypsy and brown-tail moths.

With my young daughter, I watched and studied the voracious eaters in action.

Miracle of Caterpillar-into-moth

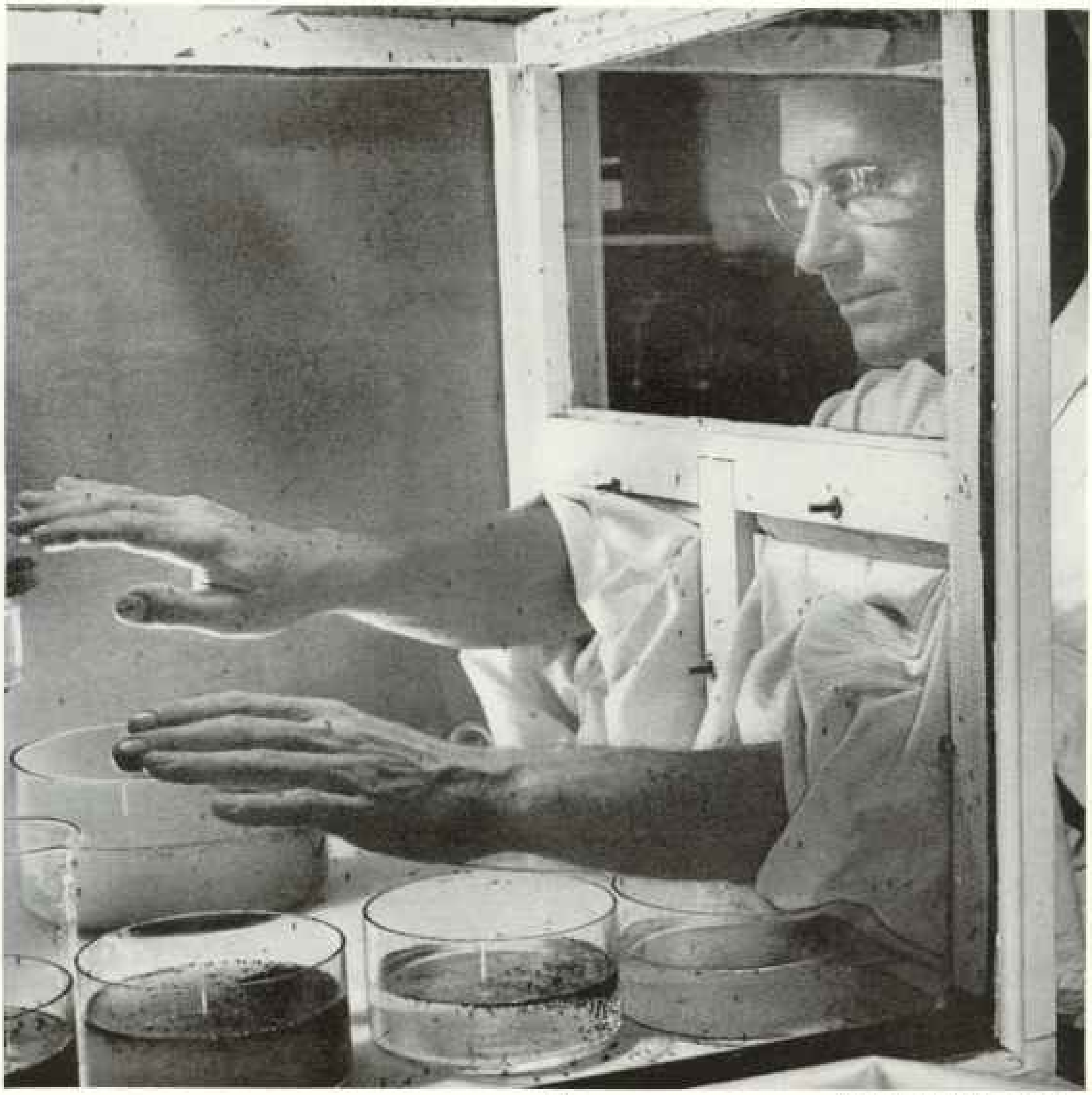
Each caterpillar, after it had grown fat on our trees, became sluggish and finally settled in a branch crotch to weave a cocoon from silk mixed with its own pincushion bristles.

Then, deep within the cocoon, one of Nature's great miracles would quietly take place. The tissues of the sleeping caterpillar would break down and reform into new ones wholly different.

Finally, toward the end of summer, a small, drab moth would emerge from each chrysalis. Only the male can fly; the female moth is practically wingless and must remain crawling about on the branch where she was born, waiting for a mate to fly to her.

Guinea-pig Houseflies Die for Science to Test the Effectiveness of Insecticides

A single fly may carry a million bacteria, and it may develop resistance to certain poisons. This bell jar contains about 100 flies. The observer introduces different sprays in varying concentrations and counts the casualties.



237 Bubley, Standard Oil Co. of N. J.

Mosquitoes Refuse to Lay Eggs Unless Fed on Blood; the Scientist Obliges

Multiple bites are the price F. C. Nelson pays for raising pests to aid Esso Standard Oil laboratory's experiments with insecticides near Elizabeth, New Jersey. Glass dishes contain larvae and pupae.

The almost microscopic eggs are covered with a bit of froth. They lie dormant through the winter and hatch a new generation of caterpillars in spring just as fresh leaves are sprouting to provide the youngsters with plentiful food.

The hungry tussock and other specimens from no farther afield than our Manhattan garden provided a good nucleus for my gallery of insect Kodachromes. Then I started looking about for more.

At first it seemed a bit foolish for a city dweller to select insects as a photographic subject. The task was going to take at least all summer, and for a while I considered moving to some nice rural spot in the South.

Then I learned that entomologists had found and described more than 15,000 species, representing almost every known family of insects, in the State of New York alone. Why go far away, with so copious a supply within easy reach?

To supplement my back-yard source, I ventured across the Hudson River, over into the garden counties of New Jersey. Here, thanks to modern science, I was disappointed; insect collecting was about as fruitful as it would have been in Times Square. The carefully sprayed cornfields, cabbage patches, and flower gardens of New Jersey may be the farmer's and gardener's delight, but they are the bug collector's despair.

238 U. S. Army

When Bees Swarm in a Jet Fighter, Even the Marines Take Cover

If hive or nest becomes overcrowded, the queen and older bees move out to make room for the younger generation. They swarm in a compact, buzzing formation which sometimes pauses at a convenient resting place while scouts search for a new home. This sergeant, wearing an improvised mask, sweeps the visitors out of the fuselage of a Panther in Puerto Rico.

At this point my brother came to the rescue. Not far from New York, also in New Jersey, he had 40 acres of woods and meadows that had once been a farm but for years had lain fallow and unsprayed. The place was alive with insects, he said. Why not go there and collect?

I was grateful for the suggestion, but I warned my brother not to expect me to act as an exterminator. I wasn't interested in killing insects or mounting dead specimens on pins. I wanted to photograph them alive in their natural surroundings.

It was mid-August when my assistant, Andy Nowak, and I arrived at the farm. We set up camp in a small shack in the woods and turned an old barn into an operations base.

We could tell immediately that we had come to the right place. Everywhere butterflies flitted, bumblebees buzzed, grasshoppers jumped, ladybirds crawled, and mantises prayed. It was insect Elysium.

A Mouse Makes Good Beetle Bait

There are many techniques for collecting insects. The simplest is merely to walk through a field and sweep an ordinary butterfly net from side to side across the top of the waving vegetation. The theory is that many a bug is borne unseen on the underside of leaves and grass blades. When disturbed, they fly or let go and fall groundward—and so into the net swishing by.

The trouble is that this way one is apt to catch anything and everything. If a delicate lacewing (page 251) and a grasshopper (page

Kodachrome by Paul A. Zahl (enlarged 10 times)

Beware That Look of Wide-eyed Innocence! Greedy Grasshoppers Have Ravaged the Earth

Swarms have devastated Bible lands, Africa, and the American West. This specimen is a **Short-horned Grasshopper,** so named for its short feelers. Multiple eyes look forward and sideward. Claws help in climbing.

← **Bulbous "Nose" Between Biting Jaws Is Really the Long-horned Grasshopper's Upper Lip**

Antennae which equal or exceed the body length identify the **Long-horned Grasshopper** (enlarged 10 times). The long-horned family includes the Mormon cricket, which in 1848 threatened to destroy crops in Utah until flocks of gulls devoured large numbers. Author and daughter (above) examine an insect caught in a field of coreopsis. To quiet his grasshoppers for their photographs, Dr. Zahl chilled them in an ice bucket.

↓ **Short-horned Grasshoppers** posed on pokeweed berries display powerful hind-leg hopping muscles. If a man could leap as far in proportion to size, a 6-footer could broad-jump 300 feet.

A Paper Wasp Feasts on a Thistle's Nectar. Hooked Antennae Identify a Male

Early spring's wasps found buzzing in attics are queens of the **Paper Wasp.** Hibernating through winter, they hatch young to form new colonies. Nests are made of dead wood chewed into a pulp.

Kodachromes by Paul A. Zahl (enlarged 4 times)

A Furry Bumblebee's Long Tongue Probes Deep for the Nectar in a Thistle

Like its smaller relative, the honeybee, the **Bumblebee** gathers summer's sweetness. Unlike its relative, it does not die after stinging but uses its weapon repeatedly. Antennae project stiffly from the head.

Velvety black and yellow bumblebee fur has a deep pile. Carrying pollen grains caught on the hairs from male to female flowers, the bee helps propagate many farm crops. This bee is the only insect which pollinates some types of red clover. Others have tongues too short to reach the nectar, and so are not attracted to deep flowers where they would pick up pollen.

Leggy, Nightmarish Praying Mantises Are Man's Allies in the Insect Wars

Belying their prayerful attitude, the front legs of the **Praying Mantis** are armed with sharp spines; the legs fold like the blades of a jackknife to hold prey, which includes many harmful insects. Long antennae are thought to serve as smell and hearing aids. Bulging compound eyes have several hundred tiny facets, each receiving light from a small fraction of the field of vision. Adult mantises may be kept on perches in screened jars and fed on live insects or bits of raw meat, but they die at winter's approach.

Above: This mantis ignored impending disaster. Seconds later the cat ate her.

◂ The author grouped three females in a "gossip session" around red fruits of the dogwood.

Leaf-eating Pests Wear Gala Furs or Convict Stripes

→ The **Tussock Moth** gets its name from the four tufts of short, erect white hairs on the back of its caterpillar. Bundles of long black fibers project from either side of the larva's head. Here the left bundle appears short because it points vertically upward. A third cluster ornaments the tail.

In its larval stage the moth chews tree leaves to skeletons, but insect enemies help control it. The adult moth ranges the eastern United States and Canada west to Colorado and British Columbia.

← These caterpillars, collected in the Bahamas, quickly devoured the amaryllis leaves that the author gathered for their feed. The larvae evolve into pink and black moths, *Xanthopastis timais*, found generally in the region of Florida and the Gulf coast and from the West Indies south to Brazil.

Kodachromes by Paul A. Zahl

♣ Carpenter Ant Carves Its Nest in Wood

With powerful jaws the **Carpenter Ant** hollows out galleries in logs, stumps, poles, or old buildings. Unlike termites, it does not eat the wood, but it often damages porches and window sills. Carpenters are the largest of the North American ants. This specimen, ¾ inch long, was chilled to keep it quiet for the photograph.

♣ Exposed! A Member of the Underground

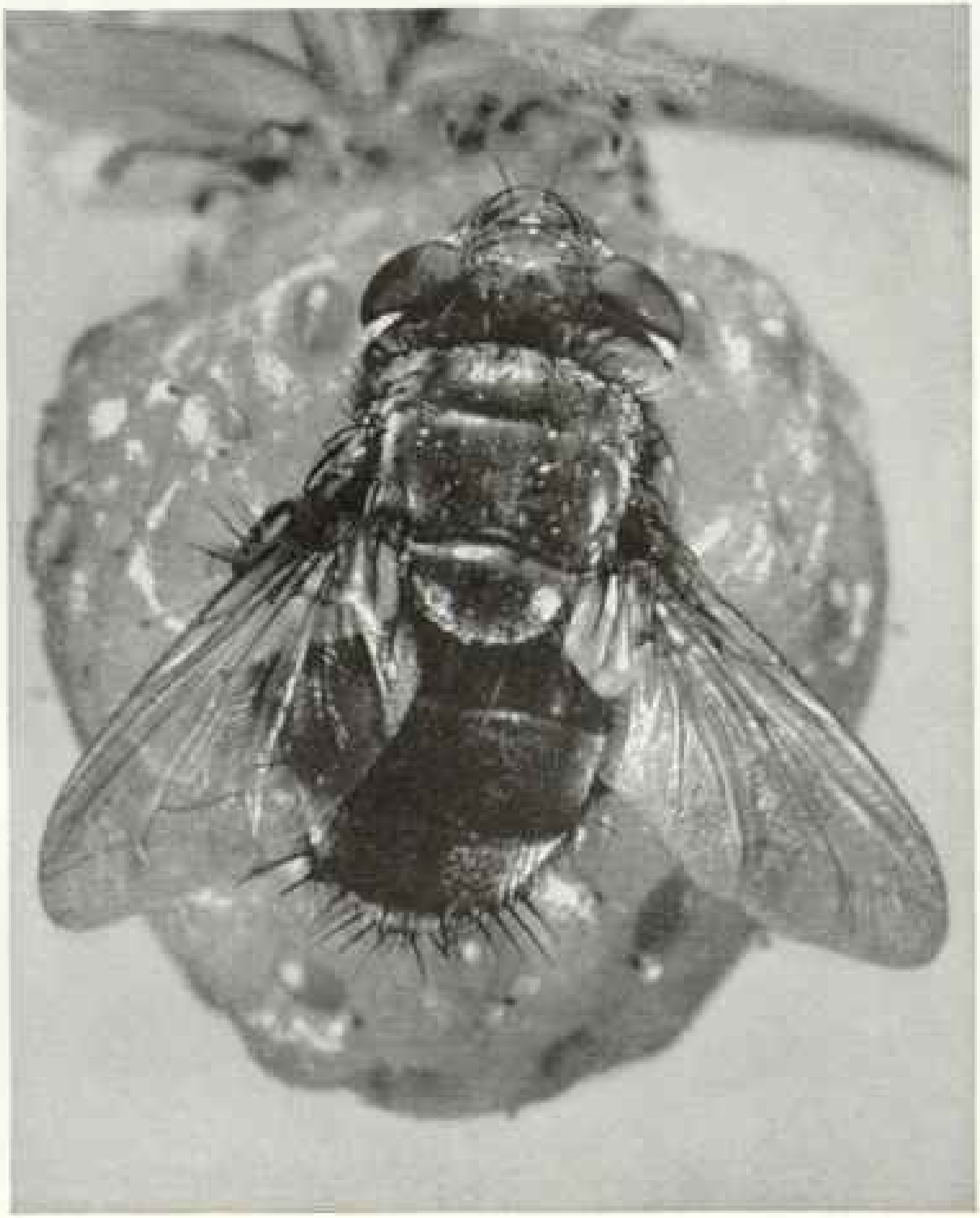
A widely destructive pest, this white grub, an immature **Scarab Beetle,** lives in the soil, where it attacks roots of grains, vegetables, flowers, and grasses. "Portholes" are breathing pores. The "eye" near the dark head is an internal organ visible through the translucent body. Normally the larva lies coiled

239) find themselves at close quarters in the net, the struggling grasshopper is likely to kick its companion to bits before they can be removed or separated.

Even so, the method did produce astonishing results. A few minutes of net sweeping often yielded us several praying mantises, dozens of grasshoppers and ladybirds, and scores of assorted stinkbugs, caterpillars, and aphids.

Another obvious method is to spot your butterfly and chase it as it flits from flower to flower. This has one main drawback: it makes you look like the proverbially silly butterfly chaser. It should be done only in the absence of potentially jeering friends.

Still another common technique involves shaking the branch of a tree or shrub and holding an open net or cloth underneath to catch whatever falls. It is recommended that the shaker wear a hat.



247 Paul A. Zahl

A Parasitic Fly: Its Larvae Kill Caterpillars

Some species have been imported to fight the European corn borer, Japanese beetle, gypsy and brown-tail moths. This adult sips wild strawberry juice. Two hairlike appendages on the head are thought to be smell and hearing aids.

Insects may be lured by various odors, and night flyers can often be attracted by lights. Others, however, are repelled by light, and this provides the basis for still more collecting devices.

To try the odor technique, we brought along from New York four dead mice carefully wrapped in wax paper. These were to be trap bait for scavenger, or burying, beetles, a tribe of exquisitely colored creatures that few people ever see, although they are found the world over.

These dwellers of the twilight either live underground or hide from sight so securely that special lures must be used to bring them out. They lay their eggs on decaying animal matter, and one way to capture them is to plant a piece of putrefying meat or the carcass of some small animal almost anywhere on the ground.

Within a few hours, especially after dark, the beetles are drawn by the smell. They first go to work excavating beneath the carcass, to bury it; then they lay eggs on the disintegrating protein. They are very lively, and, if you approach the bait with a light, they are likely to scuttle out of sight before the capture can be accomplished.

In anticipation of this, we designed cans like old-fashioned flytraps with inverted screen cones. The bait was placed inside the can; the beetles would enter the small opening at the apex of the screen cone, and, when once in the can, would be unable to get out.

We baited several such traps with dead mice, placed them at various locations in the woods, and covered them half over with leaves and humus.

The method worked beautifully. Next morning, at the bottom of each can were a half-dozen or more black beetles, each about an inch long and with elytra (hard, shell-like wings common to all beetles) gaudily cross-striped with gleaming orange-yellow blotches (page 256).

When I showed these specimens to my brother, who came to visit us that day, he took

National Geographic Photographer Willard R. Culver

Uncle Sam's "Insect Iron Curtain" Stops Pests at the Borders

In an average year U. S. quarantine stations intercept some 150,000 lots of plants and plant products, many of which carry insects or diseases. Some are admitted after fumigation. This Department of Agriculture inspector uses magnifying lenses to look for undesirable aliens in imported dahlia tubers.

one look and exclaimed: "There ain't no such animal." During all the years he had roamed and dug on his 40 acres, not a single scavenger beetle had he seen.

This, incidentally, emphasizes one of the pleasures of insect collecting and photographing. Even an amateur, if he is persistent enough, can find species that are not only astonishing to casual observers but unknown to entomologists.

There are probably more species of insects on this planet than of all other animals combined. About 800,000 species have been described; yet these are presumed to be only a fraction of those yet to be found and given a Latin name.

Among beetles alone, some 250,000 have been catalogued in the museums; yet any entomologist can tell you that there are hundreds of thousands more, mainly in the Tropics, unknown to science.

The next night Andy and I performed an experiment. We had brought along a number of pure chemicals, including indole and scatole, whose odors resemble those of decaying meat or putrefying protein material. We baited several of our traps with these and hid them in the woods, together with a single trap baited again with a dead mouse.

Next morning we found beetles in the mouse-baited trap, but none in those redolent with chemical allure.

Our primary aim was to catch bugs, not to engage in olfactory experimentation, so with this failure we abandoned further use of the chemicals.

Of course it is true that entomologists have made many studies of the insect-attracting power of pure aromatic chemicals and have proved that various insects can be so attracted. Indeed, some widely used bug traps are based on this principle. But, with our limited knowledge of the chemicals, we decided to continue using dead mice to lure such beetles; molasses and honey to attract the insects with a sweet tooth.

To convert the old barn into a photographic studio, we pushed aside piles of dusty straw

Flying Locusts Cloud the Sky above a South African Cane Field

The photograph clearly shows wings in raised and lowered positions, indicating that insects in flight move their wings in much the same manner as birds. Sugar-cane leaves already are notched by hungry jaws. These crop destroyers are a species of the short-horned grasshopper (page 239).

and odds and ends left over from busier farming days. Now and then a rat skittered across the loose plank floor; swallows nested high on the beams above. We were going back to Nature in a big way.

High-speed Lights Freeze Motion

Some pictures we could make with ordinary flash bulbs, but to freeze the motion of many of our subjects we used high-speed lights providing a brilliant flash of very short duration —a ten-thousandth or a fifteen-thousandth of a second. These lights are the type used in making the remarkable photographs of birds, bats, and flying squirrels published during recent years in this Magazine.*

For the speed lights, we had to rig a 40-foot extension cord from the nearest outlet on the barn's south wall, since the central condenser for the three lights had to be charged from the regular power line after each flash. The reflectors were beamed down to the area of photographic interest.

Finally, there was a powerful incandescent lamp controlled by a foot treadle near the camera. The beam from this light was turned on the subject only for brief moments at the time of focusing.

When we had all this equipment installed and operating, the old barn began to look like a young electronics laboratory. The tripod was set up, the camera and close-up lens adjusted, the synchroflash mechanism connected, and we were ready.

At home I had worked out some techniques that looked good on paper. In actual practice, however, they needed constant revision.

For example, I had built a number of transparent boxes out of thin Lucite, with sides held together with Scotch tape. Some were no bigger than a penny matchbox (for small insects); some were as large as a shoe box

* See, in the National Geographic Magazine: "A New Light Dawns on Bird Photography," by Arthur A. Allen, June, 1948; "Hummingbirds in Action," by Harold E. Edgerton, August, 1947; "'Flying' Squirrels, Nature's Gliders," by Ernest P. Walker, May, 1947; and "Mystery Mammals of the Twilight," by Donald R. Griffin, July, 1946.

(for monsters). The idea was to place an appropriate background of grass, leaves, or flowers in the box; then to add the live insects and close the lid.

The lights were spotted on the transparent box, so that whenever an interesting pose seemed to be attained by the more or less free-ranging insects, I could press the camera's button and so freeze real-life action.

Our first subjects were some soldier beetles. They were moving over and around the foliage in one of the medium-sized Lucite boxes, and I was about to proceed with the picture taking. Then I saw a layer of moisture creeping over the clear front of the box, blurring the scene. Foliage and beetles were "sweating," and the moisture was condensing on the Lucite.

I tried lifting the lid a bit; then reducing the amount of foliage; then decreasing the number of enclosed specimens. None of these expedients worked, so finally I did what I should have done in the first place: constructed the two side walls of the box out of wire screening to allow full ventilation. With this accomplished, we attained the result shown on page 257.

Iced Bees and Hot Lights

Bumblebees and wasps presented problems of a different sort. We weren't worried much about being stung (though that happened, too), but the creatures were so active in confinement that almost immediately the Lucite front would be dirtied by their crawlings and maneuverings.

The Nature photographer never likes to employ artificial restraints, but in this case it was necessary. We would either place the specimens, bottled, in an ice bucket for a time, or give them a whiff or two of ether.

Neither procedure killed or even stunned; it merely decelerated. While in this state, the insects slowly crawled up and over the posed flower or leaf cluster, and when they were in what we fancied was the right position, we snapped the shutter.

We found the ice-bucket method somewhat better than the ether, but it was not without its drawbacks. Warming an insect, of course, quickly negates the effect of a previous chilling. Needless to say, often while the intense focusing beam was on, our photographic subjects would spring to life and out of the area of focus. Then we had to begin all over again.

All the insects shown in the color series are alive except the Cecropia and Polyphemus moths on pages 254 and 255. The colors of these moths and the details of their scales and hair structure are so striking that I felt justified in using mounted specimens for these pictures, since no living ones were available.

Ladybirds, angelically harmless, were none the less exasperating. I would get a number of them sitting nicely on a flower and myself ready to take the picture, when, all of a sudden, and seemingly in unison, they would up and try to "fly away home" always, of course, a split second before the shutter snapped.

Grasshoppers, too, were unreliable, and in making the take-off leap they would invariably wreck the tiny stage setting I had prepared for them.

Most friendly and cooperative, and needing no box or artificial restrainers, were the praying mantises (page 244). I would place two or three of them on a branch, and for a matter of minutes they would pose, preen, and be quite indifferent to the camera shenanigans.

In all, I found insect photography to be about on a par, as regards difficulty, with bird photography, with which I have had considerably more experience.*

On one of our visits to the farm, we encountered a spell of rain, so we packed up the equipment and I took it home, together with as many live insects as we could catch that day and maneuver into cans, jars, test tubes, and even buckets.

When I arrived at my New York apartment thus burdened, my wife, for some reason, welcomed me only halfheartedly. But little Eda, showing true scientific spirit, was enthusiastic.

Her enthusiasm grew when I opened a package that had arrived in the mail that day from Florida, marked "Rush! Perishable!" It had been sent by Dr. David Fairchild, distinguished botanist and a Trustee of the National Geographic Society, who knew of my insect project. He himself, long ago, had discovered the fascination of insect photography and presented the memorable results in this Magazine.†

When the lid was removed, we found, nestled among greenery which Dr. Fairchild had placed in the box for moisture and food, a giant caterpillar with a face that looked like a lion's (page 258).

Sphinx with a Built-in Taillight

Even more remarkable, near the creature's hindquarters was a little structure that kept wiggling and flashing like the light on a fire-chief's car. The thing was actually a mirror-like membrane, about the size of a pinhead, which was oscillating and reflecting the room lights. Presently the flickering stopped, but

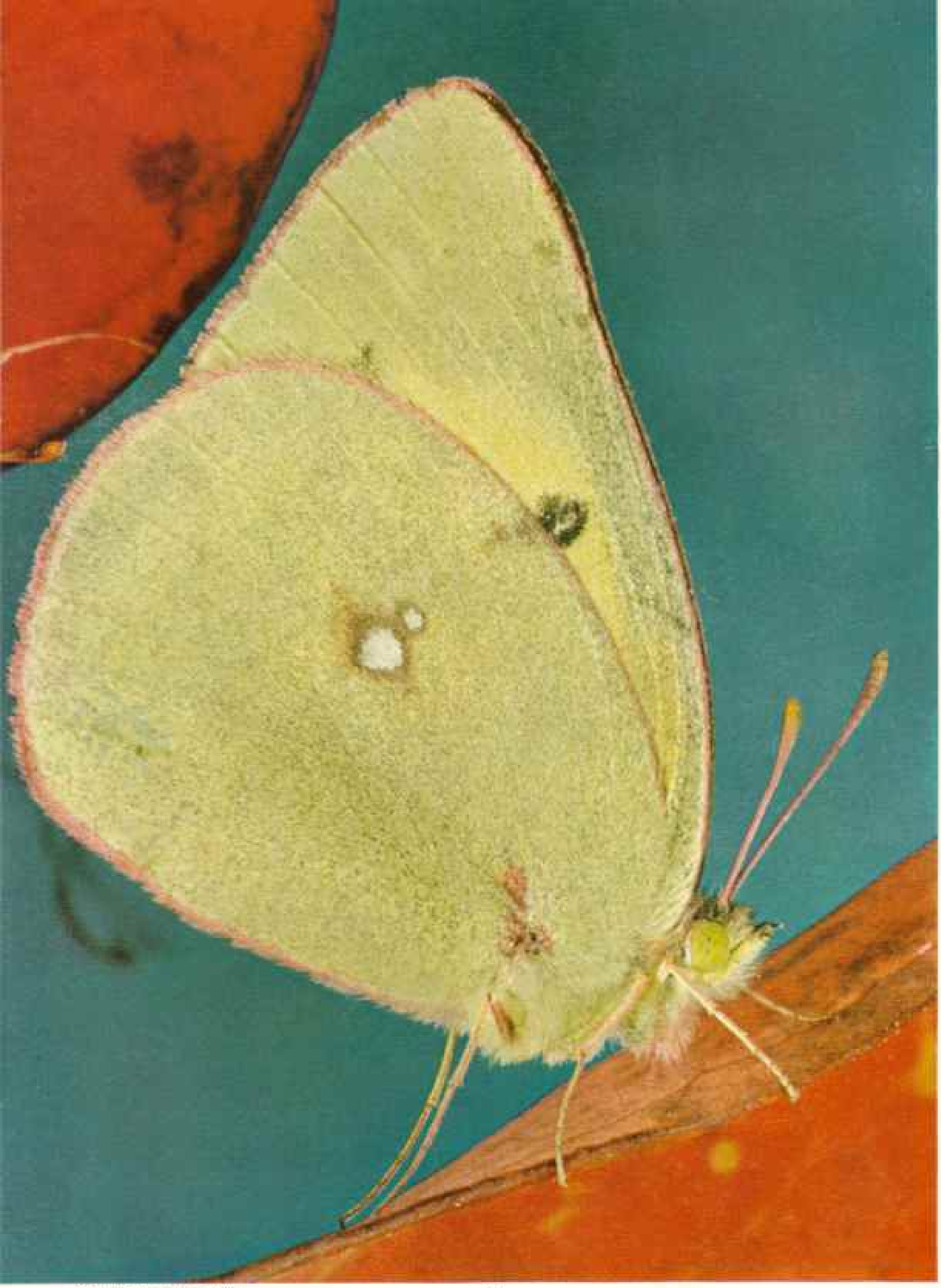
* See, in the National Geographic Magazine: "Flamingos' Last Stand on Andros Island," May, 1951; "Search for the Scarlet Ibis in Venezuela," May, 1950, and "The Pink Birds of Texas," November, 1949, all by Paul A. Zahl.

† See "Monsters of Our Back Yards," by David Fairchild, National Geographic Magazine, May, 1913.

Kodachrome by Paul A. Zahl (enlarged 4 times)

Lacewing Unfolds the Wings of a Fairy but Spreads an Unpleasant Odor

This insect's larvae are called aphis lions because they eat harmful plant aphids. To photograph the **Lacewing,** the author focused his camera on the petal, then waited for the creature to crawl into range.



Sulphur Butterfly Appears to Be All Wings and No Body

Clubbed antennae distinguish butterflies from moths, which have featherlike feelers. The **Sulphur Butterfly** folds wings together upward; moths, like birds, rest theirs against the body.

Kodachromes by Paul A. Zahl (enlarged 1 and 2 times)

Queen Butterfly Defends Her Fragile Beauty with Bad Taste

Unpleasant secretions, probably derived from rank plants consumed by the larva, cause insect eaters to avoid the **Queen Butterfly.** This specimen, flapping to gain balance, lights on a hibiscus plant in the Bahamas.

Giant Moths Have Furry Bodies and 6-inch Wingspread

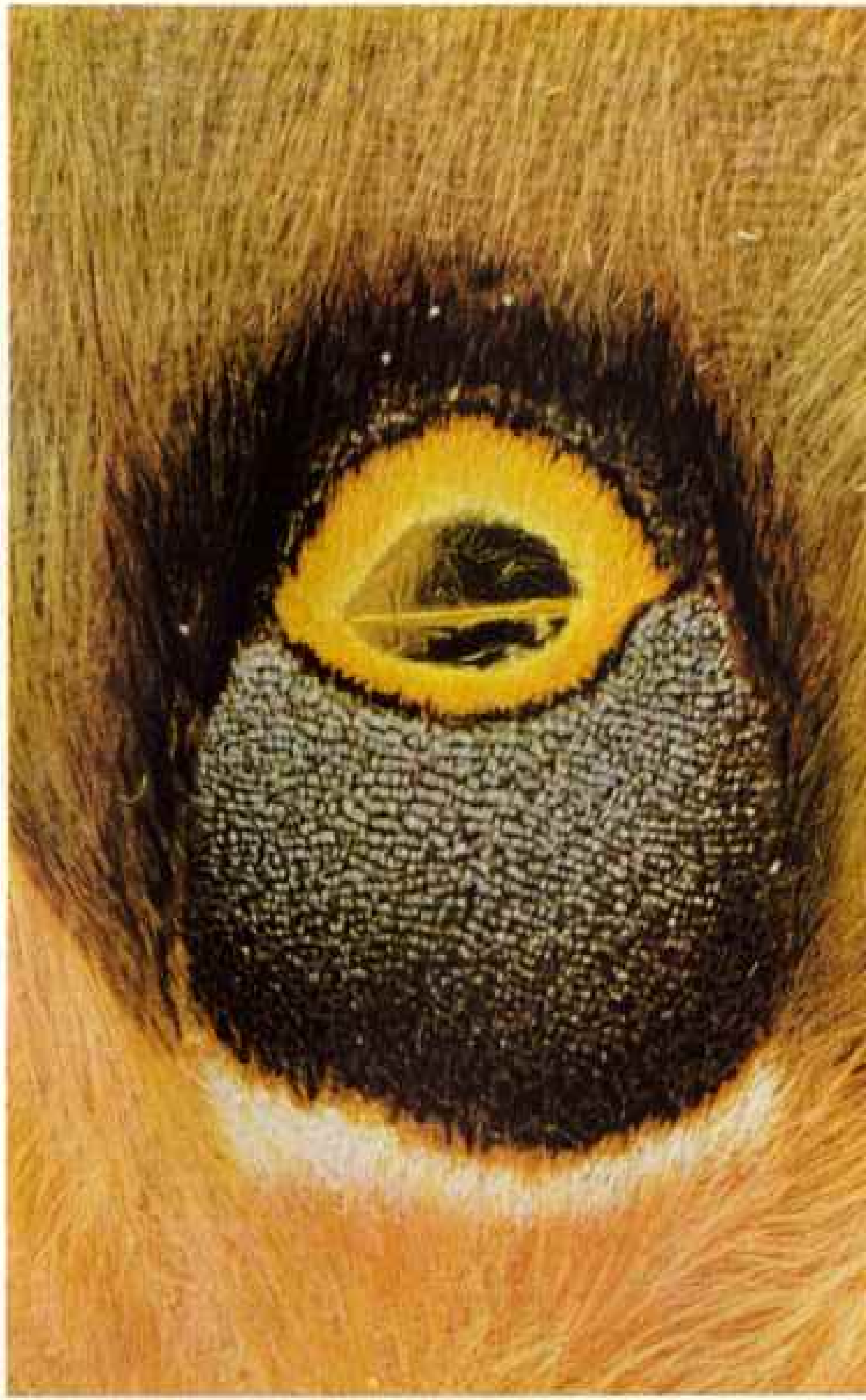
These moths, found in most of the United States, are sometimes called giant silkworms, but the silk spun by their larvae is too matted and tangled to be reeled for commercial use. Their pestiferous young feed on maple, apple, elm, wild cherry, and many other trees. Cocoons are so tough and leathery that birds must break through with beaks to reach the grubs. Female moths apparently have a strong odor to attract males. In experiments, the odor of caged females lured marked males three miles away.

Opposite page: **Cecropia** (left), is one of the largest American moths. **Polyphemus** (right) is named for the one-eyed giant of Greek mythology because of the eyelike spots on its wings. These specimens, mounted on a begonia plant, show the wings in a position rarely assumed in Nature.

←Thick, velvety hairs cover Cecropia's body, turning to scales on the wings. Antennae resemble ferns.

→The area surrounded by bright yellow in Polyphemus's wing spot is transparent; the remainder consists of tiny scales.

Kodachromes by Paul A. Zahl (enlarged 2½ and 7 times)



Beetles Do Good and Evil. Japanese Invaders at Lower Right Are Plant-eating Pests; Ladybirds and Scavengers, Beneficial

Ladybirds (above, left and right) used to be raised for sale to attack crop pests. An Australian species saved California's orange groves from the cottony-cushion scale. The "stranger" marked with a U (on a Shasta daisy) is a leaf-eating chrysomelid beetle. **Scavenger Beetles** (lower left) bury dead mice and birds by excavating soil beneath them; then they lay eggs so that the larvae may feed on the carcasses. Because they flee from light, these specimens were kept in darkness until the camera was ready. Larvae of the green and bronze **Japanese Beetles,** hidden in soil around roots of nursery stock, entered the United States undetected in 1916.

← **Soldier Beetles Wage War on Many Harmful Insects**

Winged adults resemble fireflies but produce no light. They dine on such pests as aphids and mealy bugs and, for a dessert, visit a goldenrod or alderberry and sip its nectar. The **Soldier Beetle's** useful larvae devour the eggs and young of other insects.

→ **A Blister Beetle Can Raise Blisters**

Cantharidin, contained in the oil carried by this insect, has been used for centuries in various love potions, though it is dangerous to swallow. Crushed against human skin, the substance causes a severe irritation. Many birds, however, eat the beetles seemingly without ill effect.

The beetle's larvae, burrowing through the soil, feed on grasshopper eggs. They have been known to grasp the hairs of bees, ride to the nests, and eat eggs and larvae.

The **Blister Beetle** is often called the "old-fashioned potato bug" because it fed on that plant until the Colorado potato beetle drove it off. Now it attacks garden vegetables, flowers, and cotton.

Kodachromes by Paul A. Zahl
(enlarged 4 times)

A Black Widow's Bite Is Seldom Fatal, but the Pain Is Agonizing

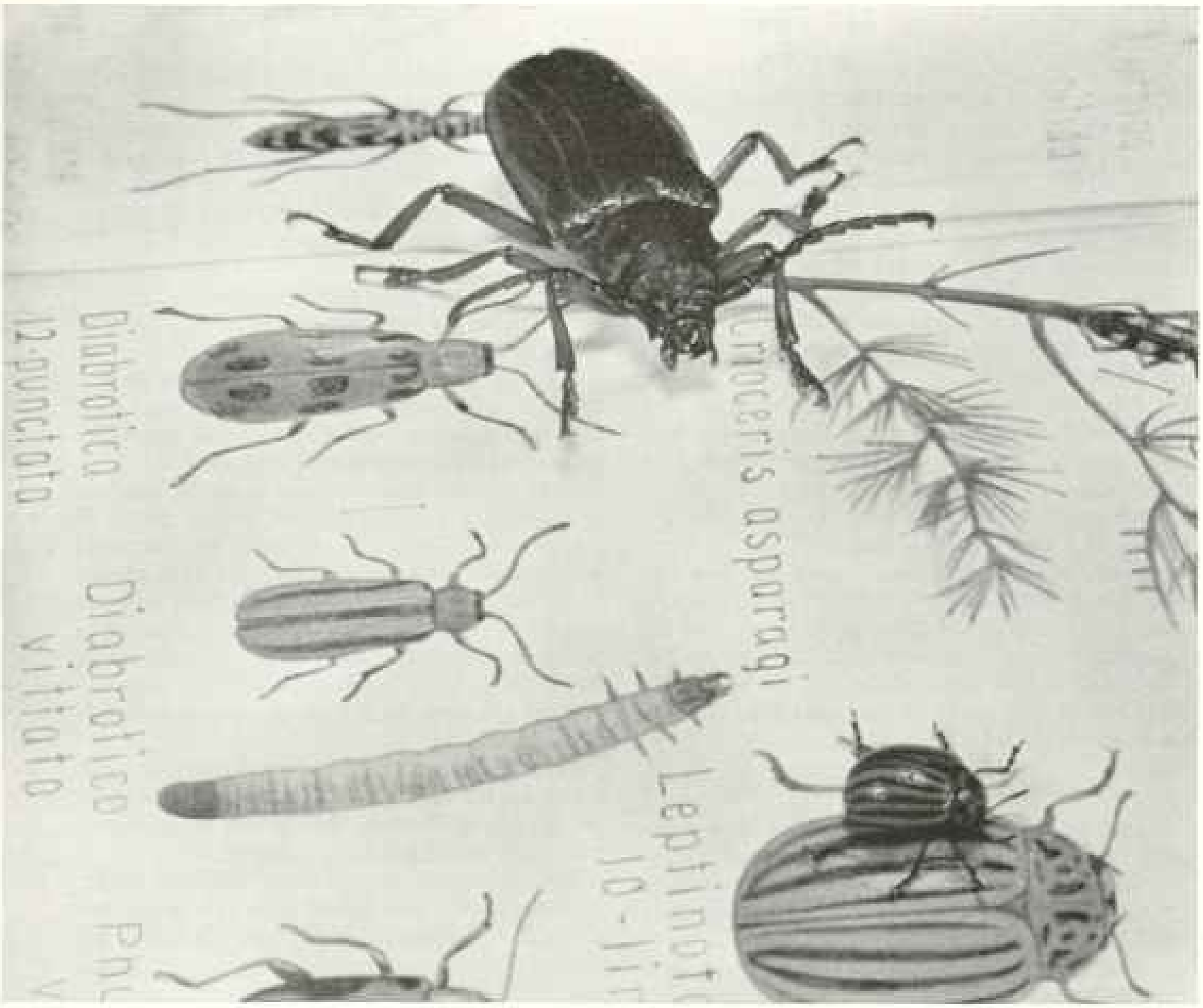
Though she is North America's most venomous spider, **Black Widow** kills only about five percent of her known victims. Severe abdominal pains caused by the spider's venom are sometimes mistaken for symptoms of appendicitis.

A bright-red, hourglass-shaped spot under the abdomen identifies the black widow. Otherwise, most adult females are black; but this Florida species has a spotted back and reddish legs. The web was spun in a glass box.

Fake Eyes Scare Foes of the Sphinx Moth Grub

When disturbed, the caterpillar raises the fore part of its body, somewhat like the Sphinx of Egypt. **Sphinx Moth** adults hovering over flowers are often mistaken for hummingbirds because their wings vibrate so fast as to be invisible. This specimen was found in Florida by Dr. David Fairchild, the plant explorer. Its "eyes" are actually dots of pigment.

Kodachromes by Paul A. Zahl (enlarged 4 times)



Two Live Beetles Look at Beetle Pictures. One Crawls Across His Enlarged Portrait

Larvae of the broad-necked root borer (upper) injure poplar, oak, and chestnut trees. The Colorado potato beetle (lower) did not begin to eat potatoes until the plant was introduced into the southern Rockies, his home. They sit on a page from the *Field Book of Insects*, by Frank E. Lutz, G. P. Putnam's Sons.

each time my fingers came close, it would begin again.

The covering letter from Dr. Fairchild explained that workmen had found this caterpillar in his tropical gardens at Coconut Grove, Florida. It was a larva of the sphinx moth (*Sphecodina abbotii*), and the glittering tail ornament, more or less typical of members of this species, is intended to frighten enemies.

One scientist has described seeing an oriole, about to devour one of these grubs, dart away with a scream when the creature lifted its snakelike tail with the tubercle shining like an eye.

Self-protection, the endless job of staying alive in a world full of hungry birds and animals, accounts for much of the brilliance and intricate design my color camera captured. In many cases, design and hue match the twig, leaf, or plant on which the insect lives; for, in general, the longest-lived bug is the one that is hardest to see.

But even this rule has exceptions. The insect that is unpleasant to taste, or poisonous, or has a sting, may advertise itself in brilliant colors to warn potential enemies away. The bitter but beautiful queen butterfly is a good example (page 253).

More palatable bugs, in turn, may imitate their sour or stinging cousins to scare away predators. There are flies that look like bees, and moths that look like wasps.

Nature Uses Varied "Paints"

Nature paints her insect colors in a variety of ways. Many of the lovely hues of some butterflies and moths are produced by the diffraction, or breaking up, of light by multitudes of microscopic ridges on the tiny scales covering the wings.

The gold color of the Cassida beetle comes from an extremely thin film of fluid under the skin, which also diffracts light.

The green of some caterpillars is created by chlorophyll of the plants they eat, deposited in the digestive tract and blood.

With my grub that looked like a lion, plus the rest of my captives, I had enough models to keep my camera busy until dawn.

Not all the insect pictures were made under the studio conditions of a barn or a city apartment. There was a big solitary thistle bush out in one of my brother's meadows which, during the warmth of midday, was always alive with bumblebees, honeybees, and wasps. And there was one particular blossom that seemed never to be without a nectar-hungry visitor.

I set my tripod up close and brought that blossom into camera focus. Here breeze was my enemy, for the thistle kept swaying to and fro, in and out of the frame. Finally I stuck a lath into the ground alongside the stem and tied the two together.

Now, with the blossom more or less immobile, I waited. First a gorgeous yellow and black bumblebee alighted and went into its feeding routine, completely indifferent to the lens only a foot away (page 243). When the bee left, a wasp arrived and also behaved like a trained model (page 242).

Lights Make Caterpillars Dash

One would ordinarily think that slow-moving caterpillars would be among the simplest of insects to photograph; yet they, including the tussock in the city, were among my most difficult subjects.

The principles of physiology were against me here, for whenever I turned my focusing light upon a group of caterpillars crawling over a set of posed leaves, the animals would act like creatures in a speeded-up movie. Metabolically excited by the light's heat, they would scurry madly in all directions and be out of focus or out of the frame before the camera was half adjusted. Only by prefocusing on the background, adding the caterpillars, and then shooting blind, was I able to get their pictures.

The scavenger beetles were just as uncooperative. In the subdued illumination of the barn they would crawl around on whatever background I had provided. But the instant my focusing lamp went on, they would speedily hide behind anything that would shield them from the light. Here again the prefocusing technique was employed, not always with auspicious results.

During cool nights on the farm, Andy and I would retire to the little house in the woods, build a big fire in the fireplace, light a kerosene lantern, and read up on the insects we had collected and photographed during the day. I had taken entomology courses in college, including Prof. W. M. Wheeler's famous "bug" course at Harvard; yet some of the most elementary facts about insects now took on meanings that had escaped me years earlier in the classroom.

I learned anew that without these creatures at work pollinating, boring, scavenging, and supplying a food source for other animals, the balance of Nature would be seriously altered and the whole world greatly changed for the worse.

Probably less than one percent of all insects are harmful to our crops or health; most of those remaining are beneficial in some way or another to the combined well-being of plants, animals, and man. Entomologists take this fact into account before advocating too-widespread use of powerful new insecticides.

In one of our books was an amusing account of insects as a component of human diet. If I had said to Andy: "Let's have grasshoppers for breakfast tomorrow," he would have known I was joking. Yet Hottentots consider a locust plague as manna from heaven. Australian bushmen still eat various types of raw insect larvae or pupae. American Indians enjoyed roasted crickets, as well as the queens of leaf-cutting ants.

An ear of corn full of borers, Aztecs thought, tasted better than a clean one. Likewise there are people of Oceania who prefer their breadfruit well sprinkled with maggots.

But civilized man, who relishes crabs, oysters, snails, and frogs' legs, scorns insects as food. Perhaps some day our chefs will rediscover them.

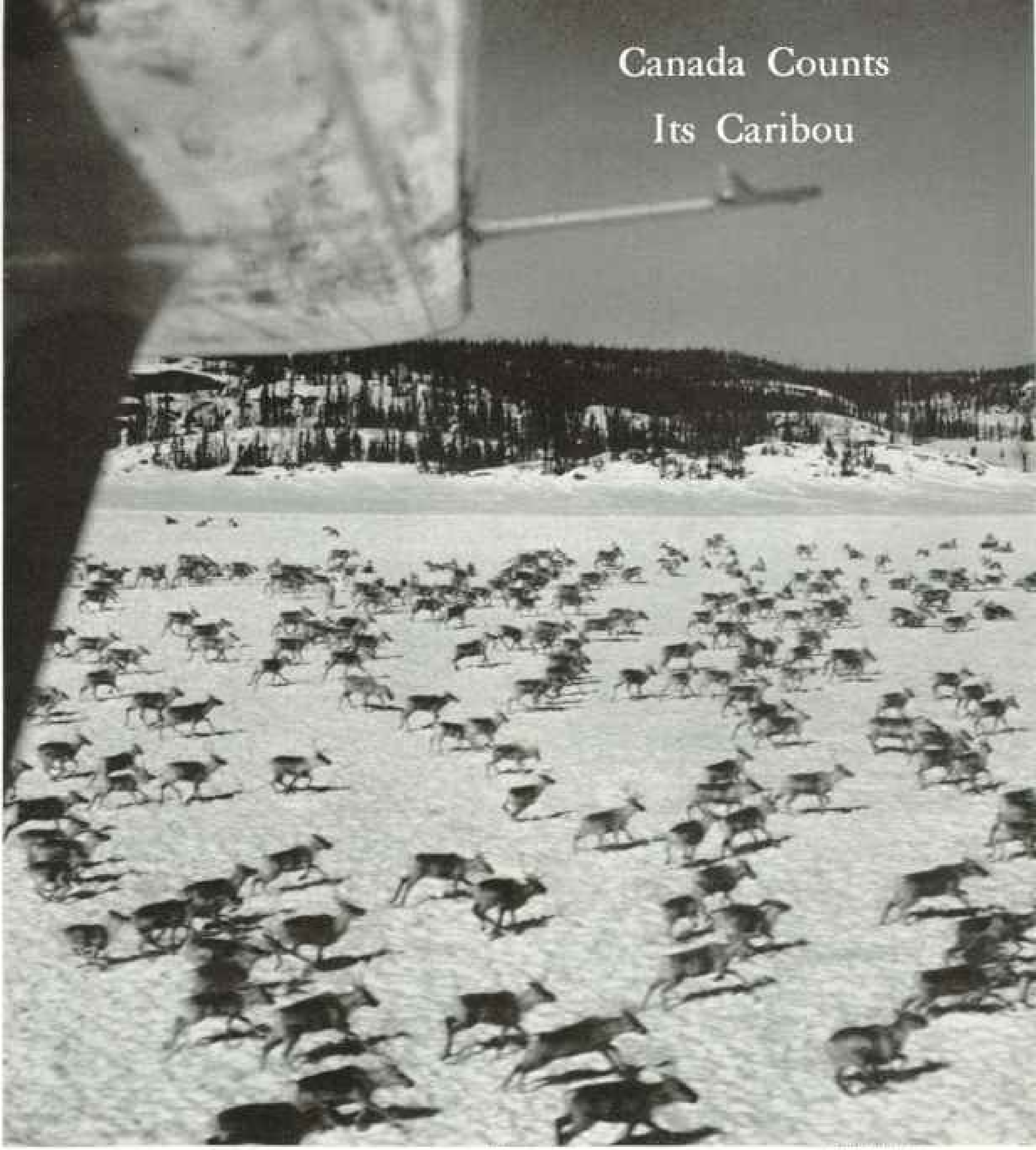
Autumn Lowers the Insect Curtain

Andy Nowak and I had started our New Jersey insect studies early in September, spending several days to a week at a time on the farm. We made our last visit late in October. Now the leaves had begun to take on their autumn colors, and the insects were noticeably fewer.

Some of them would migrate to escape the rigors of a northern winter, but the great majority, having served Nature's plan, were doomed to an early death. Among the former were the monarch butterflies, whose annual migration south represents one of entomology's great puzzles. As though by common directive, they are all off for warmer climes at almost precisely the same time, roosting in the trees en route in enormous numbers.

As winter took over the countryside, the leaves fell, the ground hardened, and our woods and fields looked barren and dead. But in fact, they were not. For hidden under fallen leaf and bare bough, in nuts which the squirrels had cached, in humus, galls, seeds, almost everywhere, lying quiet and unseen, were insect eggs, larvae, or pupae waiting to be awakened six months later by the magical touch of spring.

Canada Counts Its Caribou



A. W. F. Banfield

A Caribou Herd May Take Days to Pass a Given Point. Airmen Tally This Stampeding Pack

EACH April and May, along the edges of the Arctic tree line, the caribou mass for their great migration toward the lichen-rich tundra. Small bands emerge from the scrub, join others, mill about on the frozen lakes, and head north. A trickle at first, then a stream, then a flood of dun-gray bodies, the deer pound over the ice in throngs measured by the square mile.

At narrow defiles and oft-used crossings, Eskimos and Indians lie in wait with rifles, as their fathers once did with bows. From lookouts on the ridges rolls the cry, "The deer are coming!"

Downwind floats the clicking of the caribou's heel bones, the grunt of the loping herd, and a rank, distinctive odor. Suddenly the horde bursts into sight, and steel-jacketed bullets thud into the leaping flesh. Pressed on by those behind, the caribou surge helplessly toward the guns. To the rear of the firing line stand women and children ravenous for the season's first fresh meat. Quickly they heat kettles to boil the North's choice delicacy: caribou tongues. Later they cure the hides for clothing, dry and cache the meat, and remove the sinews for sewing.

To determine how many caribou still roam, the Canadian Wildlife Service recently took a census, largely from the air. The figures showed a decline from 1,750,000 in 1900 to 670,000 today (page 267).

Domestic Reindeer Hold Aloft a Thicket of Velveted Antlers

Wanton slaughter by whalers along the Arctic coast, introduction of the repeating rifle, meat requirements of dog teams, and bush fires' destruction of ground forage have combined to diminish the caribou's range and numbers.

As famine insurance, the Canadian Government has imported reindeer from Siberia via Alaska and herdsmen from Lapland to teach nomadic Eskimos the art of managing domesticated deer. European reindeer, almost identical with American caribou, can be corralled like cattle and confined to limited ranges.

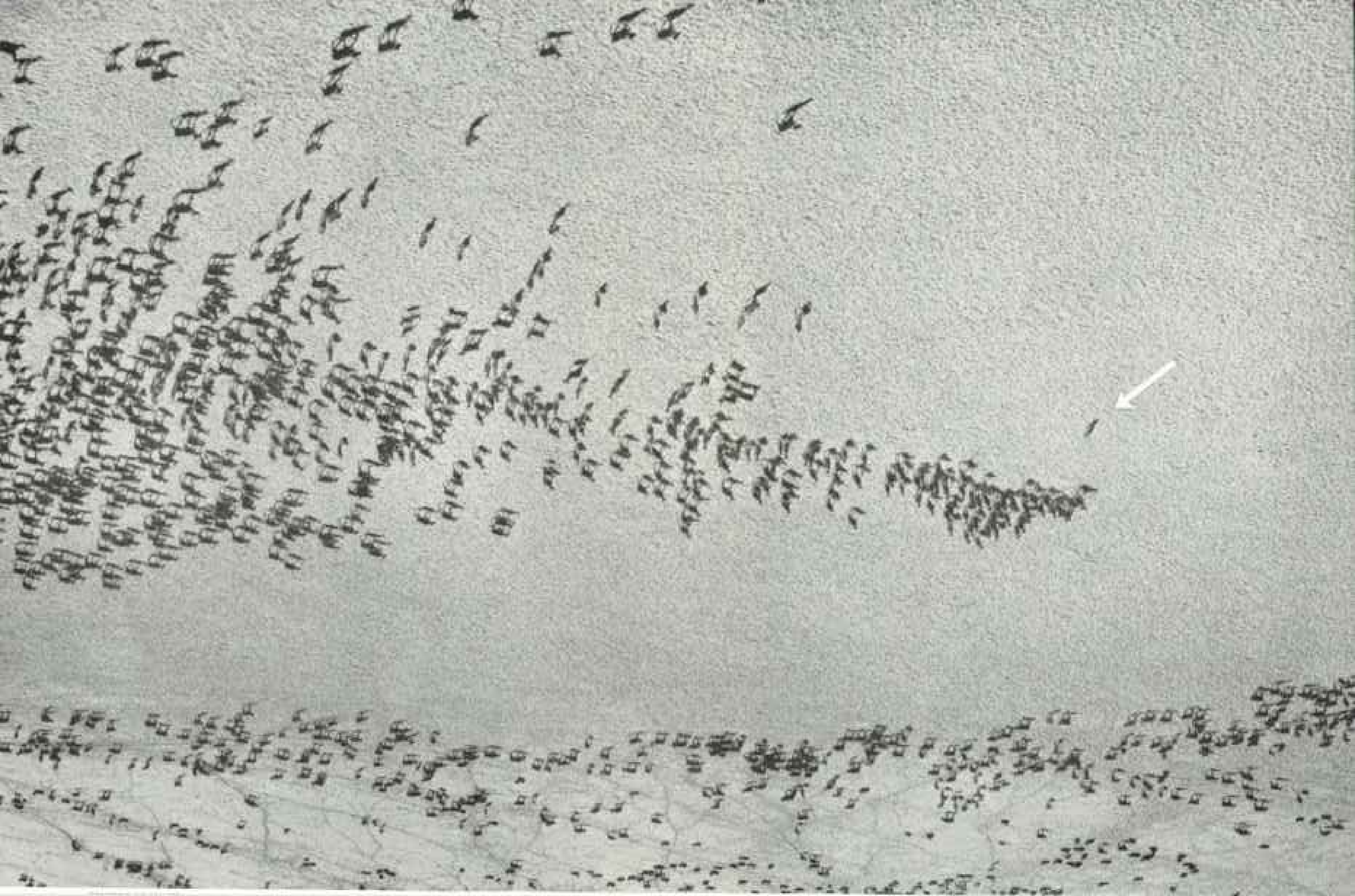
Reindeer roundup time on Richards Island, near the mouth of the Mackenzie River, takes place during the last week of July. The Government's main herd (top and left) numbers about 5,000; two herds managed by Eskimos bring Canada's reindeer total to some 7,500. Tundra and timbered range could support several million, but conversion of hunters to herdsmen takes time.

About one reindeer in a hundred is an albino like the one at top, left. Eskimos often run a quick check on their herds by counting the albinos. Antlers are worn by both bucks and does.

Eskimo boys here help a tallyman take inventory on their mobile larder.

Canadian National Film Board

↓ A Lone Wolf (Arrow) Harries a Herd of Caribou



Saturday Night Is Gossip Time on the Northern Air Waves

A Royal Canadian Mounted Police constable mans the microphone at Stony Rapids. Plane pilots and the Hudson Bay Company's manager listen for news of friends. Mammalogist A. W. F. Banfield (seated, arms folded) heads the caribou census (page 261).

Indians, Eskimos, and Whites Kill 100,000 Caribou a Year

Wolves, disease, weather, and accidents bring total mortality to about 168,000, or 27,000 in excess of the estimated calf crop. Unless careless shooting and wasteful caching of meat can be curtailed, caribou may vanish within the lifetime of these Saskatchewan hunters.

A. W. F. Banfield

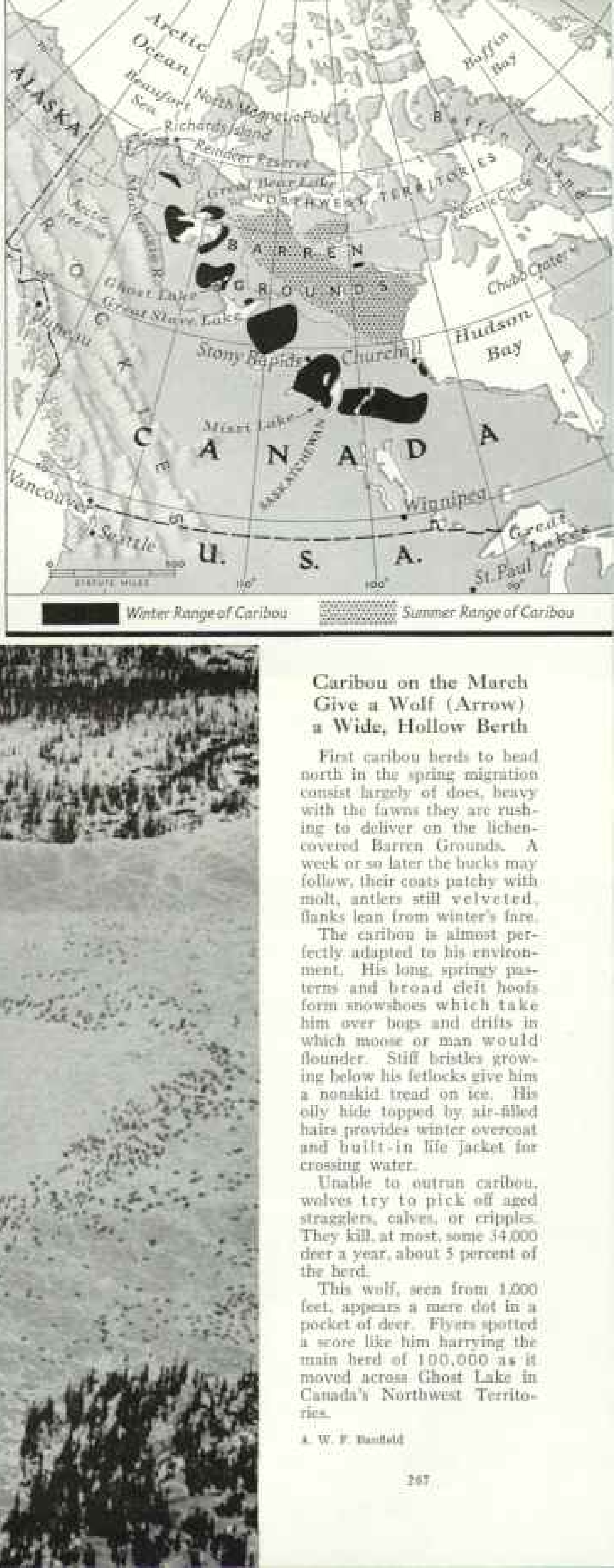
Lurking on the Heels of the Herd, the Wolf Looks for Strays

Following the spring migration, caribou get a brief respite from raids as wolves den up to bring forth their young. Not till late summer do family packs start trailing the caribou again. Grizzlies and eagles occasionally attack calves; wolverines merely scavenge.

Caribou Post-Mortem on Missi Lake: The Killer Was Man

Government experts checking the health of caribou herds found that the only practical method was to shoot and examine sample animals. Here mammalogist Banfield takes notes above the deer he killed; at 30 degrees below zero, the report sheet shakes in his mittened hand.

Saskatchewan Visual Education



Caribou on the March Give a Wolf (Arrow) a Wide, Hollow Berth

First caribou herds to head north in the spring migration consist largely of does, heavy with the fawns they are rushing to deliver on the lichen-covered Barren Grounds. A week or so later the bucks may follow, their coats patchy with molt, antlers still velveted, flanks lean from winter's fare.

The caribou is almost perfectly adapted to his environment. His long, springy pasterns and broad cleft hoofs form snowshoes which take him over bogs and drifts in which moose or man would flounder. Stiff bristles growing below his fetlocks give him a nonskid tread on ice. His oily hide topped by air-filled hairs provides winter overcoat and built-in life jacket for crossing water.

Unable to outrun caribou, wolves try to pick off aged stragglers, calves, or cripples. They kill, at most, some 34,000 deer a year, about 5 percent of the herd.

This wolf, seen from 1,000 feet, appears a mere dot in a pocket of deer. Flyers spotted a score like him harrying the main herd of 100,000 as it moved across Ghost Lake in Canada's Northwest Territories.

A. W. F. Banfield

Canadian National Film Board

Deer-dogging Takes Two Men, One to Hold, One to Clip

Eskimos earmark reindeer on Richards Island, then turn them loose to graze a 6,600-square-mile reserve. Summer range lies along the coast of the Beaufort Sea, winter range along the east channel of the Mackenzie River. A youngster (right) plays Arctic cowboy.

An Eskimo Herdsman Gets Pointers on the Way to "Shoot" a Deer

Able to forage along the trail, the moss-eating reindeer could replace the Husky as the Eskimos' motive power. Government experts concentrate now, however, on building up healthy stock. Inoculations can cut disease, double a herd in three years.

Water for the World's Growing Needs

Ever Seeking More, Man Makes Better Use of Earth's Liquid Assets, Fights River Pollution, Even Desalts the Sea

By Herbert B. Nichols and F. Barrows Colton

WHEN drought hangs hot over the land, when fields parch and wells run dry, men in many parts of the world, in their seasons, look to the sky and pray for water—*maya*, *shui*, *pani* in Arabic, Chinese, Hindustani.

Yet within the same year runaway rivers like the Mississippi and Yangtze spread muck, death, and destruction over hundreds of square miles.

How to make best use of the rain that falls is one of man's oldest and greatest problems, for without the bounty of the clouds life on earth would not last long. Our very bodies are about two-thirds to seven-tenths water. A man can live some 30 days without food, but no more than a week without water.

Americans Use 1,100 Gallons a Day

New York City authorities watch daily rainfall reports with new interest since their wryly remembered water shortage of 1949-50. Actually, they suffered only minor inconvenience—fewer baths and shaves, no washing cars and sprinkling lawns, using paper cups at fountains instead of drinking from spouts, and washing all the day's dishes at once.

But these small annoyances drove home a telling fact: even in a great modern city you can't take water for granted.

Nowadays we hear much about dropping water tables, artificial rain making, the urgent need of finding a way to make the ocean drinkable. Yet actually, for the earth as a whole, we have as much water as we ever had. Though rainfall varies from year to year, there is no sign of any permanent decrease.

Rainfall in the United States has averaged 30 inches a year ever since 1870 when Government agencies started keeping records. Every year, as rain, snow, or hail, 10 million gallons fall for every man, woman, and child in the country—surely enough to go around. Then why these water shortages?

One difficulty is that the water is not evenly distributed. In many local areas the demand is exceeding the present supply. Sites for our industrial and population centers were not often chosen with an eye to long-range water needs.

But another important part of the answer is the fact that world population is growing—now placed at about 2,400,000,000—and that many millions are using more water than ever.

The average American uses far more water than his grandfather. Bathtubs, sinks, and running water are considered essentials rather than luxuries. Electric washing machines, automatic dishwashers, garbage-disposal units, all require more than the old-fashioned equipment they replace. In Washington, D. C., air-conditioning plants are estimated to account for 15 to 20 percent of the water now used.

Though our average citizen drinks less than half a gallon of liquid a day, he uses about 1,100 gallons of water daily for all domestic, agricultural, and industrial purposes, not counting hydro power. In just the last ten years use of water in the United States has jumped from 150 billion gallons a day to more than 170 billion.

In Texas the population nearly tripled in the 50-year period ending in 1940, but use of water increased 71 times on an average for all purposes. For industries and municipalities the increase was 30 times: for irrigation, about 55 times; for water power, about 85 times.

Vast Quantities Needed by Industry

Few people realize that today water is the largest single raw material used by American factories. We could not make cars or television sets without plenty of water.

For example, it takes 65,000 gallons, or 270 tons, of water to produce one ton of highly finished steel. Chiefly for cooling and quenching and granulating slag, American iron and steel mills use nearly five times as much water in an average day as all of New York City.

To make a ton of the high-grade paper used in this Magazine takes 70,000 gallons, to wash away impurities and assist the refining process.

Other industries use vast amounts for cooling, removing impurities, preparing solutions, and diluting and removing wastes, besides using water as an ingredient of finished products.

Many industries, including steel plants, oil refineries, and chemical factories, circulate used water through cooling towers and re-use the same water as often as ten times.

In the last 100 years, population of the United States has increased more than 600 percent—which means six times as many users for the same amount of water.

Most of this great growth of population has been in the large cities. Half of the people of the United States now live on less than two percent of its land area.

This puts a heavy strain on local water supplies, and many cities have to reach farther and farther out to find enough water to fill their needs. New York City, for example, is tapping the Delaware.*

Some cities have grown faster than their water systems could be expanded. Population also has mushroomed in some arid areas where water supplies are limited. In California two-thirds of the available water is in the northern half of the State, two-thirds of the population in the southern half.

Drips That Drain Reservoirs

Even where water is scarce, much is wasted. During New York's water shortage, engineers estimated that 200 million gallons a day were being lost from leaky faucets and pipes alone.

Ground water is wasted in large parts of the West by phreatophytes, plants that often send thirsty roots far down into the subsoil. Most of them are of low value—mesquite, salt cedar, cottonwood, willow; a useful one is alfalfa. The water they draw from the ground is eventually dissipated into the air.

The U. S. Geological Survey estimates that phreatophytes in Nevada waste five times as much ground water as is consumed for useful purposes. In 17 western States approximately 15 million acres of such plants are believed to consume enough water every year to cover 20 to 25 million acres one foot deep.

Floods, in which vast amounts of water run off without sinking into the ground or being held by reservoirs, represent a resource whose only present contribution is to keep stream channels scoured out—a purpose that could be achieved by smaller, less wasteful flows.

Nothing Lives Without Water

Until it gets scarce, man gives little thought to the water he uses. Yet in many ways it is a strange liquid, unlike anything else on earth.

What is water? Everybody knows the famous chemical formula, H_2O, which means that one molecule of water contains two atoms of hydrogen (H) and one of oxygen (O). If you studied chemistry in high school, you probably manufactured water by burning hydrogen in the presence of oxygen to make them combine.

Water covers nearly three-fourths of the earth's surface, and most of it is too salty to drink. But the oceans provide the gigantic reservoir from which water constantly evaporates to fall back upon the earth. Without water our planet would be a dead and desert world like the moon.

The human body needs more than a quart a day to replenish normal losses. Every day, an average adult loses about a pint and a half of water by "insensible perspiration" through the skin and in exhaled air, in addition to that given off by the kidneys. Tests made by the U. S. Army show that a man working hard in the desert under average heat conditions loses water at the rate of nearly two quarts an hour.

Of the water that composes about 66 to 70 percent of a normal human body, most is lodged in the billions of tiny cells that make up living tissue. Thirst becomes critical when the body has lost too much water without taking in a balancing amount.

Proportion of liquid to solid varies in different parts of the body. Saliva is almost 99.5 percent water, but tooth enamel has only 2 percent. Bones are about 22 percent water, muscles 75, and blood serum 92.

We take in water not only when we drink fluids but when we eat. Some physicians believe that many people in the United States do not consume enough water to maintain the best possible health.

Some plants and animals, like the cactus or the camel, have special mechanisms by which they can store water whenever it is available or get along on a minimum when it is not.

Our Water as Old as Earth

Water is ageless and almost indestructible. It is one of the few things in Nature that can be used over and over again. We are drinking and using the same water now that existed when the earth was born.

This water is just as good today as it was three billion years ago. Though it may be polluted by wastes poured into streams, or made undrinkable by ocean salt, it becomes clean and fresh again as soon as it evaporates into the atmosphere.

Even rain water, however, is not completely pure chemically. It picks up many things, including traces of ammonium salts and gases from the air, and, when it falls near towns, a little sulphuric acid given off by burning coal. Absolutely pure water is unknown in Nature; even in the laboratory it is difficult indeed to get all foreign chemicals out of a water sample.

Minor impurities affect the quality of water. Rain water is "soft"; that is, it contains little or no calcium and magnesium. "Hard" water contains more of these salts and ranges from moderately hard to very hard, depending on the amounts present.

When used in washing, hard waters require much more soap than softer waters because part of the soap is consumed by these salts. The resulting "curd" is largely responsible for the well-known ring around the bathtub.

Water can be softened by boiling, by treat-

* See "Today on the Delaware, Penn's Glorious River," by Albert W. Atwood, National Geographic Magazine, July, 1952.

211 Charles Payne, N. Y. Daily News

A Cloud-seeding Plane above the Catskills Hunts Rain for New York Reservoirs

Under special conditions, silver iodide smoke or dry ice particles may trigger reluctant clouds into producing. Western ranchers underwrite rain-making projects, and New York City tried cloud seeding during its water shortage of 1949-50. Scientists still disagree about the effectiveness of such attempts (page 279).

ment with chemicals that precipitate out the salts, or by sand filtering.

Through millions of years earth's water supply has followed a regular cycle—evaporating countless times from the oceans, rising aloft to condense and form clouds in the sky, falling again as rain, then quickly running back to the oceans or seeping slowly downward into the earth. In some cases it may remain in the ground thousands of years before reaching surface water bodies or evaporating. In others, it by-passes the cycle either by falling as rain directly into the sea or by evaporating far inland before it ever reaches the oceans.

Evaporation from the oceans has been estimated at 80,000 cubic miles of water a year—more than 88 million billion gallons. Other tons of water return to the air by transpiration—as vapor given off from the leaves of plants after the water has been absorbed from the ground by the roots and used in the growing process.

Where Our Water Originated

Many scientists hold that when the earth was new it had a great deal more water in its atmosphere than now, and that this fell as rain to fill the oceans; additional water was locked up in the rocks of the interior.

Others believe that all the earth's water came from within, by way of hot springs.

Wherever it came from, we still have it all. Of this huge supply of water, however, only a fraction is available for man's use in lakes, rivers, and natural underground reservoirs. More than 95 percent of our planet's water is in the oceans, and much of the rest is frozen in the great icecaps of Greenland and Antarctica, virtually all of it useless to man unless he can find a cheaper way to desalt the sea or melt the glaciers.

"Little Drops of Water . . ."

Tiny raindrops, multiplied by the billion, can do tremendous damage to unprotected soil. Their bullet-like impact loosens earth, which running water washes away. Ground cover's importance as an erosion control is illustrated below: soil capped by rocks or sticks stands in pedestals; elsewhere rain has taken a two-inch bite.

Much is also locked up in the world's extensive regions of permafrost, in Alaska, northern Canada, and Asia, where the ground is permanently frozen in some places to depths of as much as 1,300 feet.*

There is always some moisture in the air everywhere, even over deserts. Air containing no moisture at all would be irritating to breathe; it would dry up the membranes of the nose, throat, and lungs.

Clouds form when moisture in the air condenses into tiny droplets of water or ice crystals. The droplets form around "hygroscopic," or water-attracting, particles of dust, smoke, salt from the sea, or gas particles always present in the air.

At first the droplets or ice crystals are tiny, scarcely a hundredth of a millimeter in diameter. When the larger droplets or crystals are about two-tenths of a millimeter in diameter, gravity generally pulls upon them with enough force to make them start to fall.

Raindrops and snowflakes often grow as they fall, by joining with others; by the time they reach the earth they may be 8,000,000 times the size of the original vapor droplets. They cannot grow larger than this, because in falling they tend to lose their teardrop shape, "saucering" out and splitting up.

The rainiest place in the world is Mount Waialeale, Kauai Island, Territory of Hawaii. Here in a 28-year period official records show an annual average of 489 inches of rain (page 280). Rivals for the honor are Cherrapunji, Assam, in the eastern Himalayas, and Buena Vista, Colombia.

In contrast, the place with the minimum recorded rainfall is the city of Iquique, in northern Chile, which has averaged .04 inch of rain a year during the last 40 years; some years no rain fell there at all.

* See "Our Hometown Planet, Earth," by F. Barrows Colton, National Geographic Magazine, January, 1952.

Living Plants Prevent Erosion →

Vegetation breaks the force of rains, prevents splash erosion, and retards runoff. Root structures bind the soil and keep it from washing. Only a thin crust of topsoil (an average 7 inches) stands between Americans and starvation. An inch of this soil takes three to ten centuries to build; it can wash away in a single storm.

John Gutmann, Pix

Southern China's Bamboo "Ferris Wheels" Raise Water to Thirsty Rice Fields

Drought and famine always at his heels, the Chinese farmer fights to conserve moisture. He and his wife and sons may spend long hours pedaling treadmills to lift water a few inches from canal to irrigation ditch. Brush dams repaired by these Yunnanese boatmen channel river current so that it turns the wheels. Bamboo scoops catch water and spill it into troughs 60 feet high.

Africa's Sahara, synonymous with desert, forms part of the largest arid region in the world, a vast, nearly rainless belt that extends across Africa and continues through Saudi Arabia, Iran, Turkistan, and Mongolia almost to the Pacific shores of Asia (p. 281).

Irrigation Turns Deserts Green

Nearly a third of the earth's land surface receives 10 inches of precipitation or less annually. For another third the usual amount is only 10 to 20 inches. In places that get less than 10 inches, and on much of the area receiving up to 20 inches, irrigation is required for raising crops.

For maximum yield, even areas having 40 inches or more annually may need the magic touch of water sluiced through ditches if there are long dry periods during the growing season or if the climate is hot.

In the United States east of the 100th meridian, which divides the Nation almost exactly in half, there is generally enough rainfall.* Precipitation increases from 20 inches a year on the Great Plains to 50 or 60 on the Gulf coast.

West of the meridian, comparatively speaking, is where America's water troubles begin. Except in the rain-rich Pacific Northwest, much of the West is arid unless irrigated. Large parts of Utah and southern California could support only a sparse population if it were not for irrigation. Nearly 25 million acres are irrigated in the 17 western States.

Why do places like Washington's Olympic Peninsula get so much rain, while our Great Plains get comparatively little?

Washington, Oregon, and northern California are visited by prevailing westerly winds heavy with moisture from the Pacific Ocean. When these wet winds reach the mountains,

* See map, "The United States of America," a supplement to the June, 1951, National Geographic Magazine.

they are forced upward to cooler levels. Here condensation takes place and the moisture falls as rain or snow.

The heaviest recorded precipitation in continental United States is at Wynoochee Oxbow, Washington, averaging more than 150 inches a year. But only a fraction of this water is carried over the Cascade Range; hence areas east of it go dry.

Winds Converge to Make Rain

Rain and snow falling in the Great Plains and to the east form by the lifting of moist air masses, often from the Gulf of Mexico, in the winter storms that move over the area, and in thunderstorms.

In southern California, Arizona, and New Mexico, the northeast trade winds are low in moisture. Over the rest of the world, too, rainfall is unevenly distributed. Europe is fairly well watered except parts of Spain. Most of Russia and Siberia have light precipitation.

On the other hand, some provinces of India, much of Burma, and Melanesia have more than 80 inches of rain each year. Africa and Australia have large sections with meager rainfall and vast interior deserts.

In South America, rainfall is highest in northwestern Brazil, in strips along the northern coasts, and in southern Chile. A dry belt extends north from Mexico into the southwestern United States.

273 General Electric Company

You Can Brew a Snowstorm in a Home Freezer

Breath gently blown into the box creates a cloud of supercooled water droplets. Contact with dry ice turns the drops to ice crystals, and they fall as snow. In the General Electric Laboratory, Dr. Irving Langmuir (left), a leading authority on artificial weather, and Dr. Bernard Vonnegut watch this experiment by their associate, Dr. Vincent J. Schaefer (page 282).

Drawing on Underground Deposits

The largest reservoirs of water in the United States lie underground. Water percolates downward through the soil and into the pores and crevices of subsurface rock, finally reaching depths where the rock is too tightly packed by the pressure above for any water to seep farther down. These subterranean rocks hold more water than all the surface lakes and ponds, geologists estimate. This ground water is what feeds wells and springs.

We don't know just how much ground water we have, for only a small part of the United States has been explored adequately to determine the amount buried under the surface. Yet geologists have a general idea of conditions in most of the country.

We do know that in some areas we are actually "mining" ground water, taking it out of the earth far faster than Nature is replacing it. Increased pumping from wells in some places is steadily removing water that has taken untold thousands of years to accumulate.

In many regions where water once flowed freely from artesian wells, it now has to be pumped. The U. S. Geological Survey reports that the ground-water level has dropped to depths of more than 400 feet in some California counties.

Under various parts of the earth, this "water table" varies in depth; it is generally nearer

276 C. J. Nichols, International News

A Bronze Fish Catches Missouri River Flood Water at Omaha, Nebraska

Using a sediment sampler, the engineer measures mud suspended in the river. Fins hold the 100-pound instrument steady in the current while water collects in a container. Analyzing sediment, an expert may tell where erosion control is needed or predict when silt will choke a reservoir. Each year sediment does some $200,000,000 damage in the United States (page 283).

the surface in valleys than under hills. As a rule, ground water in usable amounts and of good quality extends downward only a few hundred feet. But in some places, where the geology is favorable, such as on the Gulf coast and certain areas in the Great Plains, water wells have been drilled to depths of more than 3,000 feet.

Ground water is what actually keeps most of our streams flowing during dry periods. Without continual seepage into rivers, there would be no water in them except during and a short time after a rain, or when snow melts.

Empty Wells Mean Empty Factories

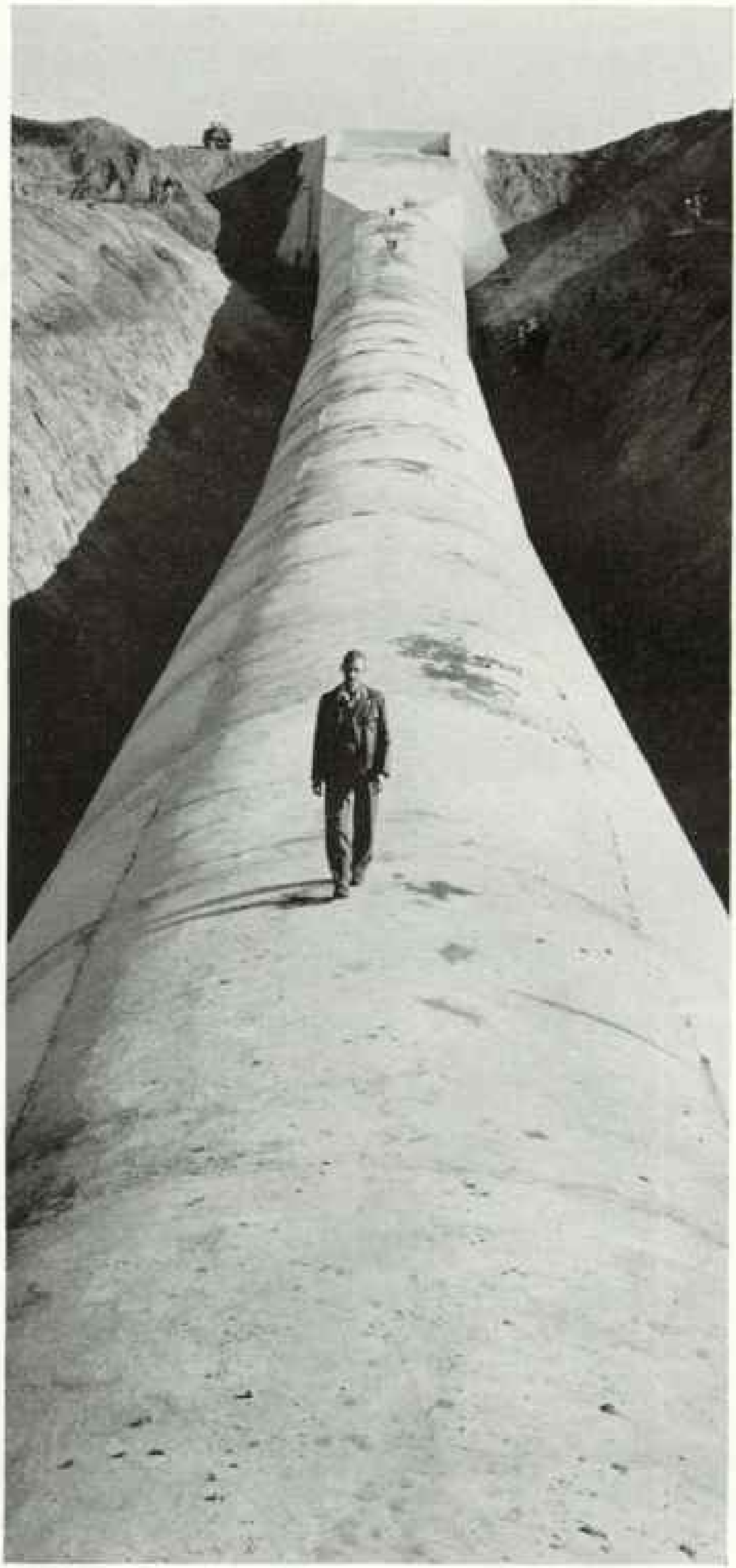
Sixty-six percent of American cities, mostly the smaller ones, depend entirely on water from wells. Eighteen billion gallons of ground water a day are used for irrigation in dry regions: industries take nearly 5½ billion gallons, in addition to great volumes of surface water; municipalities consume about 3½ billion gallons, and farmers use nearly three billion gallons for purposes other than irrigation.

In many instances during World Wars I and II, defense installations found ground-water supplies inadequate and had to develop more expensive sources. In a number of cases Army camps were forced to relocate or shift some activities to areas where ground-water supplies were more plentiful.

In Louisville, Kentucky, the city water from the near-by Ohio River is too warm for some factory purposes in summer; so many wells have been drilled to tap cold ground water. During World War II a survey disclosed that ground water was being pumped out faster than Nature could replace it, and that some of the wells would be dry in two years. Use of ground water was cut down, methods of cooling city water were instituted, and city water was pumped into some wells in winter

Turbid River Water in a Few Months Dumped This Muddy Mess into a St. Louis Basin

On being purified, river water drops much of its mud in settling basins. Chemicals coagulate remaining sediment into jellylike masses. These are filtered by sand or crushed anthracite (page 283). Chlorine kills the bacteria. Thus in 24 hours a filter plant can turn murky, polluted water into the sparkling liquid we take for granted (inset). Before cities adopted filtering, mud might settle an eighth inch deep in a glass of tap water.



U. S. Department of the Interior

Two Million Gallons Rush Through This Pipe Each Minute

As high as a two-story house, the conduit funnels Sacramento River water under Mountainhouse Creek. It is one link in man's longest water-diversion system, the Federal Government's 500-mile reclamation project in Central Valley, California. Water from Shasta Dam in the north flows by canal, river, and pipe to garden lands in the south (page 283).

to replenish the ground water, then pumped out in summer for factory use.

A later survey revealed several times as much ground water available from wells northeast and southwest of the city where factories could have located.

Guarding Sources of Ground Water

At some points along the coasts, fresh ground water has been so depleted that sea water has seeped in, making wells useless for drinking or irrigation. Miami, Florida, solved this problem by damming some of the canals that were admitting salt water and by drilling new wells farther inland.

On Long Island, when salt water began seeping into the ground under Brooklyn, regulations were issued requiring that when a motion-picture theater, restaurant, or other establishment sinks a well to obtain water for air-conditioning purposes, it must drill another in which to return the used water to the ground.

Consumption of ground water is controlled by law in a few States, including New Jersey, Maryland, Indiana, and Wisconsin. Certain other States regulate its use to some extent, and some western States have done this for many years.

Springs, where ground water reaches the surface, supply pure and adequate water for thousands of American farms. The U. S. Geological Survey has listed 60 springs each of which has a flow large enough to supply a city of 500,000 or more with all its water needs; and there are at least six others which could supply cities of 2,000,000. But all these springs are far from the present sites of large cities.

Big springs develop in regions of cavernous limestone or porous lava where ground water from extensive areas drains into subterranean

channels. Most of our large springs are in northern Florida, the Missouri Ozarks, central Texas, the Snake River Plain of Idaho, western Oregon, northern California, and central Montana.

Hot springs are formed by ground water that has come in contact with hot subterranean rocks. Geysers erupting periodically, like Old Faithful in Yellowstone National Park, spring from ground water collecting in underground chambers until it grows so hot that steam pressure sends a jet high into the air.

Ground water is preferred for many purposes, because it is generally pure and free from sediment and comes out at a uniform temperature, an important factor in industrial use. Water from underground is used for drinking by about half the people in the United States.

Taking too much water out of the ground may cause more than just a water scarcity. Mexico City is built on top of a subterranean reservoir; as wells draw out more and more water, the entire city is slowly sinking.*

There are similar spots in the United States where the land has sunk as much as eight feet.

Does "Seeding" Make Rain?

Many a farmer and rancher, his fields and pastures parched for lack of rain, has watched with angry frustration as fleecy white clouds drifted overhead but no rain fell.

Today most experts agree that it is possible, under the right conditions, to help Nature make rain. Some scientists assert they have made clouds give up rain or snow by "seeding" them either with dry-ice particles scattered from airplanes or with silver iodide smoke generated

* See "Mexico's Booming Capital," by Mason Sutherland, National Geographic Magazine, December, 1951.

379 The Oriental Institute

Armageddon of Biblical Fame Drew Water from This Spring

Women living near the Old Testament's famous battleground climbed 120 feet up and down the winding stairway at extreme right to get their daily ration. Here men working for the Oriental Institute form a basket brigade to excavate the ruin. This ancient engineering work proved to be the largest of its kind in Palestine.

Hawaiian Island of Kauai Claims Earth's Wettest Spot

Fog shrouds the summit of Mount Waialeale near these cliffs, one of Hawaii's scenic wonders. Waialeale's rainfall has averaged 489 inches a year.

In one recent year, Hawaii's ancient rain god poured 624 inches—a foot of water each week—on the mountain. The U. S. Weather Bureau has records of no other place so constantly wet (page 273).

Strangely, only some 20 inches a year fall on Waimea, a coastal town just 15 miles away. Such abnormal contrasts are common in the Hawaiian Islands. As moisture-laden winds rise over mountains, they are cooled and milked of their burden before reaching the lee side.

In some years Cherrapunji, Assam, rivals Kauai. One 9-month period had 1,041.78 inches of rain; July, 1861, alone saw a 366-inch fall.

On July 18, 1942, a phenomenal downpour drenched Smethport, Pennsylvania, with an unofficial 30.8 inches in 4½ hours. Many a western U. S. town does not enjoy that much in a year.

Wide World

Shifting Sand Dunes Swallow an Oasis

Many parts of the Sahara are lifeless for lack of water. Vegetation appears only in scattered places where springs break through the sand. Winds sometimes cover these garden spots with dunes. Half-buried walls and palms tell the fate of this Algerian oasis.

U. S. Army

Korea: A GI Measures the Chlorine in a Purifier

This improved filter protects American troops abroad from dysentery and other water-borne diseases (opposite and page 286). Two hours after trucks drive up to a stream the purifier can turn out 35 gallons of water a minute.

on the ground and carried aloft by air currents.

Pioneers in this field were Drs. Irving Langmuir, Vincent J. Schaefer, and Bernard Vonnegut, of the General Electric Company (page 275). They are credited with having started the first artificial snowstorm in this country by air-dropping dry ice on clouds over Mount Greylock, Massachusetts, in 1946.

Dry ice, the rain makers say, cools cloud water droplets enough so that they form ice crystals that turn into rain. Silver iodide particles provide tiny nuclei around which water droplets in a cloud are believed to condense into raindrops or snowflakes.

Other scientists, including U. S. Weather Bureau experts, believe that in many cases where rain has fallen from seeded clouds, it would have fallen soon anyway, by natural processes, from those same clouds. They feel that much more research needs to be done before artificial rain making can be performed on a large enough scale or under sufficient control to make it really useful.

In arid parts of the West, water-hungry ranchers and others are already paying millions of dollars for cloud seeding. Some customers have been disappointed, but others are satisfied that seeding has boosted their rain—and their crops.

Rain making is loaded with legal problems. Who owns the clouds? If farmers seed clouds and produce rain, near-by baseball teams and resorts may lose customers.

During its drought, New York City hired a meteorologist from Harvard University to try to increase rainfall and replenish its nearly empty reservoirs. Much rain fell, but the scientist modestly claimed credit for only part of it (p. 271).

Last year New York was faced with some $2,000,000 in lawsuits from other communities and individual citizens, alleging the rain making had damaged their interests. In its defense the city claimed that the program had failed.

Most large American cities still find that their surest sources of water are surface streams or lakes, even though they often must build aqueducts many miles long to reach them. One of ancient Rome's longest aqueducts, 58.4 miles, was the Marcia, built in 145 B. C.; others ranged from 55 miles downward. In contrast, the city of Los Angeles reached out 233 miles 39 years ago to tap the Owens River for water from the high Sierra Nevada. But soon the population of the city and its metropolitan area had skyrocketed to such size that more water had to be brought from Parker Dam on the Colorado River through 242 miles of aqueduct, including 92 miles of tunnels.

The old Roman aqueducts depended entirely on downhill flow of water, but in the Los Angeles aqueduct water is raised 1,617 feet by five pumping stations.

An even longer aqueduct, 430 miles, was built in 1903 to bring water to the Coolgardie and Kalgoorlie gold-mining fields in Western Australia.

New York City has already outgrown the water supply it receives through aqueducts reaching 100 miles into the Catskills and is developing new sources in the same area.

Boston constructed the largest lake in Massachusetts for its modern water supply, which comes to the city from 65 miles away and passes through a tunnel 12 feet in diameter.

San Francisco draws upon the Hetch Hetchy reservoir, 160 miles away, carrying water west-

ward through the Coast Ranges by means of 82 miles of tunnel.

One of the great water-supply feats of all time is the U. S. Bureau of Reclamation's Central Valley Project of California. This transfers water from one river to the bed of another and eventually makes water available through exchange over an area 500 miles long to benefit sections where it is badly needed in the southern part of the State (page 278).*

Communities bordering the Great Lakes, such as Chicago, Cleveland, and Duluth, need only reach out far enough from shore to draw in lake water from beyond the range of city pollution, though that is farther today than formerly.

Conserving Our Liquid Assets

Today the United States is trying to control more carefully the water it has, so that as little as possible will be wasted and there will be enough for all. Recognizing this need, the President's Water Resources Policy Commission has made a Nation-wide survey, with recommendations for getting all possible use out of every raindrop from the time it falls on forest, farm, or city street until it evaporates or returns to the sea.

Strong emphasis, the Commission said, should be placed on multiple-purpose water projects with unified programs to control floods, store water for drinking and irrigation, and generate hydroelectric power. When we try to manage water, we should do it for a whole river basin, including in a single plan flood control, water supplies, power, navigation, irrigation, drainage, recreation, soil conservation, and pollution control.

More than ever before, this country is making progress toward doing away with water pollution, caused both by sewage and by factory wastes. Fish are coming back and people again can safely bathe in many streams that once were little better than open sewers.

Much remains to be done. Water from many streams and lakes is still unfit for human use unless carefully filtered and chlorinated.

Cleansing Streams Pays Dividends

Polluted water kills not only fish but also the aquatic plants that provide food for waterfowl. Pollution once reduced the annual value of the salmon catch in the Willamette River, Oregon, from $5 million to $1 million, but new sewage-treatment plants will remedy the situation.

In 1900, for every 100,000 Americans, 30 to 40 persons died of typhoid fever, a disease spread by polluted water. Today typhoid is a rarity in this country, partly because practically all large cities now have sewer systems, partly because drinking water almost everywhere is treated to make it safe.

Originally most sewer systems emptied waste products directly into streams, harbors, or lakes, making the water unsanitary for drinking or bathing. Oyster-harvesting grounds in Hampton Roads, Virginia, were closed in 1926 because of pollution from surrounding cities. Today, since the building of four sewage-treatment plants, the water is so much cleaner that 2,240 acres of the condemned area have been reopened.

Many factory wastes, also formerly dumped into streams, now are turned into useful products and sold at a profit. A chemical company found that its waste had a high vitamin content. Processed into vitamins, it is now the firm's leading product.

A steel company built a treatment plant to recover ore from blast-furnace flue dust once discharged into a near-by river. It made a profit of $581,000 in the first year of operation. Another steel mill's "pickle liquor," a sulphuric acid by-product, once poured into a handy stream, now is given to a local firm that uses it to make iron sponge for gas purifiers.

Chemicals "Wash" Drinking Water

Water that could cause sickness if drunk in the raw state often can be made safe with the aid of chemicals and filters. Treatment is done on an assembly-line basis by many cities and towns by filtering the water through sand and gravel, and by aeration. Copper sulphate, alum, chlorine, and sulphur dioxide are added as required to kill bacteria and remove taste and odor (page 277).

Not a single death from cholera and typhoid, both water-borne diseases, has been recorded among American armed forces in the Korean war, partly because all were inoculated against them, but also because troops are trained to consume only purified water and avoid eating native raw vegetables and fruits (opposite and page 286).

In World War II American troops were issued Halazone tablets containing chlorine, which purified water when dissolved in it. They helped to hold down the rate of sickness from water-borne diseases.

Today these tablets are being replaced by a new type containing iodine, which is more effective against some forms of dysentery. They also give water a less unpleasant taste, which sometimes made soldiers reluctant to use the chlorine tablets.

How to keep our rivers from being muddied and clogged by sediment washed down from upstream slopes and farmlands is another

*See "More Water for California's Great Central Valley," by Frederick Simpich, NATIONAL GEOGRAPHIC MAGAZINE, November, 1946.

Black Blizzard: Dust Bowl Scourge of the 1930's

Terror struck Springfield, Colorado, in May, 1937. For half an hour the town was as dark as night. Streets were deserted as residents fled to cover, but no home was tight enough to keep out the grit.

Prolonged drought, improper plowing, and disturbance of marginal lands led to the Great Plains dusters. Enormous clouds of dirt tossed like tumbleweeds.

In 1934 winds picked up dirt from Montana to New Mexico, lifted it into upper air currents, and two days later dumped it on eastern cities and ships 300 miles at sea. Dust at 4 in the afternoon compelled Washington, D. C., motorists to turn on headlights.

By the end of the '30's the rains came, creating a mud bowl. Plains farmers learned new methods of tying down the land and holding rain. They returned thousands of acres to grass, and the Dust Bowl seemed ended.

Then war brought skyrocketing wheat prices. Shoestring farmers rushed to rip up sod.

Owing to dryness, soil has blown in parts of the Southwest since 1947. Experts say prolonged drought might bring back dusters worse than ever.

Irrigation's magic transforms desert to greenery. Scene is the New Mexico bank of the Rio Grande north of El Paso, Texas.

Fred O. Cain, Soil Conservation Service

problem now being tackled on a Nation-wide scale. Some streams, as the saying goes, still are "too thick to drink, too thin to plow" (pages 276, 277).

When great dams are built to store water for flood control, irrigation, and power, sediment too often flows in with the water and gradually fills the reservoirs. Behind Hoover Dam, in Lake Mead, from which southern California draws much of its water, sediment is accumulating at an estimated 100,000 acre-feet a year. If this sedimentation continues at the present rate, authorities say, the lake may disappear in some 430 years, with only "run of the river" water available for power and water supply unless silting is reduced.

Silt Filling Many Reservoirs

Many smaller reservoirs have already been silted out of use and abandoned. Studies by the U. S. Soil Conservation Service indicate that at least a fifth of the 3,000 municipal and industrial water-storage reservoirs now in use in the United States will have to be replaced or supplemented because of silting in the next 50 years.

Much of this silt is washed from land used for crops or grazing, where the soil is not sufficiently protected against erosion. But erosion is being attacked on a large part of the Nation's farm and pasture land, where terracing, contour planting, crop rotation, and better management of grazing and timber are practiced under guidance of the U. S. Soil Conservation Service, Forest Service, and the Department of the Interior. More farmers and ranchers are adopting these practices every year.

If sea water could be made fresh cheaply, all the water worries of our great coastal cities would be over. Already we know how to do it, but so far the cost is too high to make it practicable on a large scale.

Science Desalts the Sea

Untreated sea water is unfit to drink because it contains a higher percentage of salt than the human body can handle. Actually, water is drawn from the tissues, and the body becomes dehydrated. Therefore, drinking sea water soon adds to thirst instead of relieving it.

A lifesaver for thousands of sailors and airmen cast away in boats or life rafts in World War II was a chemical unit for making sea water drinkable in small quantities. Salt water is scooped into a plastic bag, and a small chemical briquette is dropped into it, which in a few minutes removes the salts. Drinkable water made this way costs about $10 a quart.

One practical way to turn salt water into fresh is to distill or evaporate it, the same process Nature uses when water is drawn from the sea up into the clouds.

Stills developed just before World War II provided temporary drinking water from the sea for more than a million troops in the South Pacific and North Africa until local supplies could be developed.

Brackish water from wells in Saudi Arabia is distilled to make it potable and safe for oil workers. Many ships distill sea water for drinking.

Some new stills work on the principle of vapor compression. Steam is compressed mechanically, a process which raises its temperature and also causes it to condense into water at a higher temperature. Heat given off as the steam condenses is used to evaporate more water in the still.

Once started, this process is continuous, and the only power needed is for running the steam compressor.

Three stills that can produce 50,000 gallons each per day from the sea are in use on Johnston Island, in the Pacific, where other sources of water are slim.

Frozen Reservoir—the North Pole

Freezing is another way to make sea water drinkable. Polar explorers well know that sea ice melts down into fresh water. When water freezes, the molecules get together in a solid crystalline arrangement. But the molecules of impurities have no tendency to adhere to the growing ice crystals, and become concentrated in the remaining sea water.

Scientists have recently developed a small-scale model of another device for desalting sea water. In their machine, briny or brackish water is passed over special plastic membranes and the impurities removed by application of small amounts of electric power. Water emerges from the machine in two streams—about two-thirds in one stream as fresh water, the other third containing the salts and minerals.

Inventors of the device estimate that, where electric power is cheap, salt water could be purified at a comparatively low cost; moderately brackish water, available in quantity in parts of the West, could be treated even more cheaply.

A noted chemist has predicted that before the end of this century some source of inexpensive energy, perhaps power created by harnessing the sun's heat, will become available so that fresh water can be produced from the sea at reasonable cost.

By such research, both here and abroad, man is making a long-range attack on his age-old problems of water, that liquid asset without which none of us could survive more than a week.

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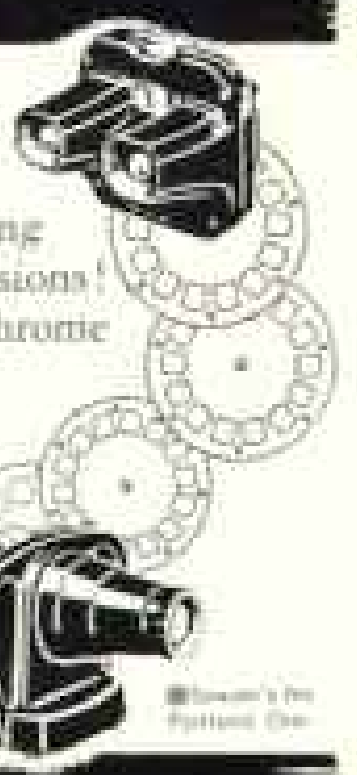

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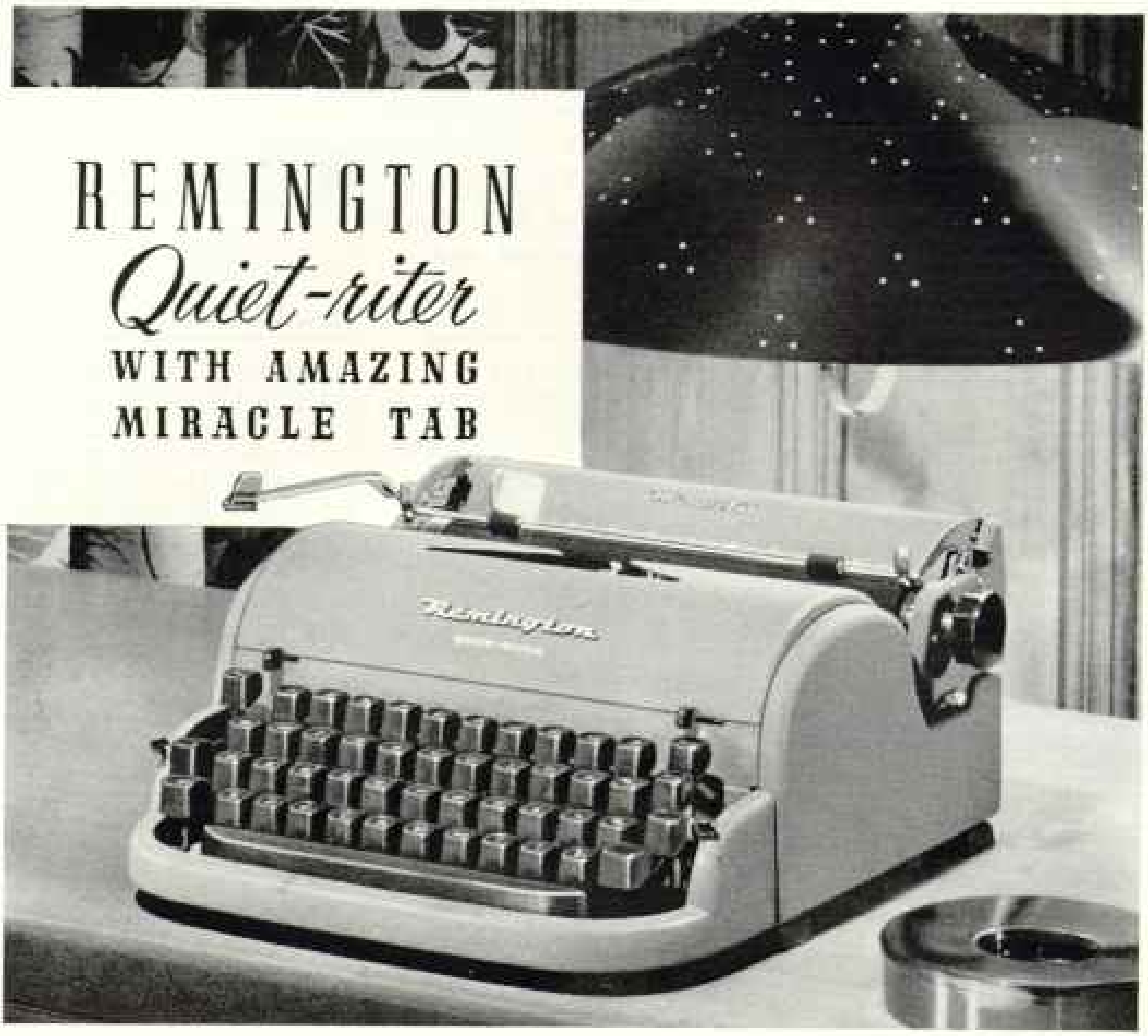

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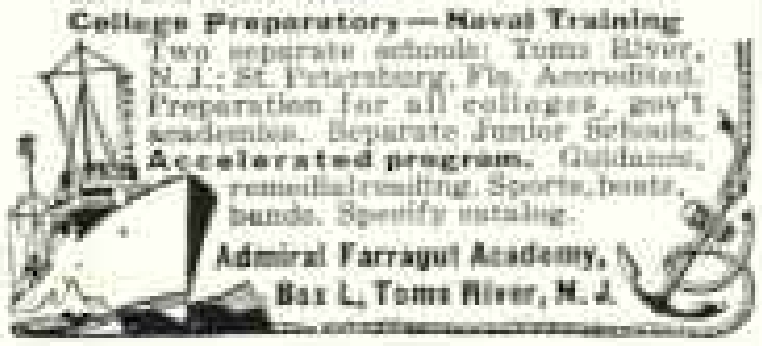

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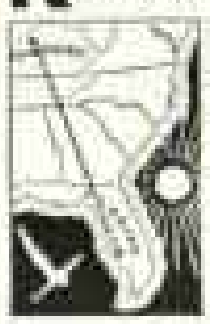

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