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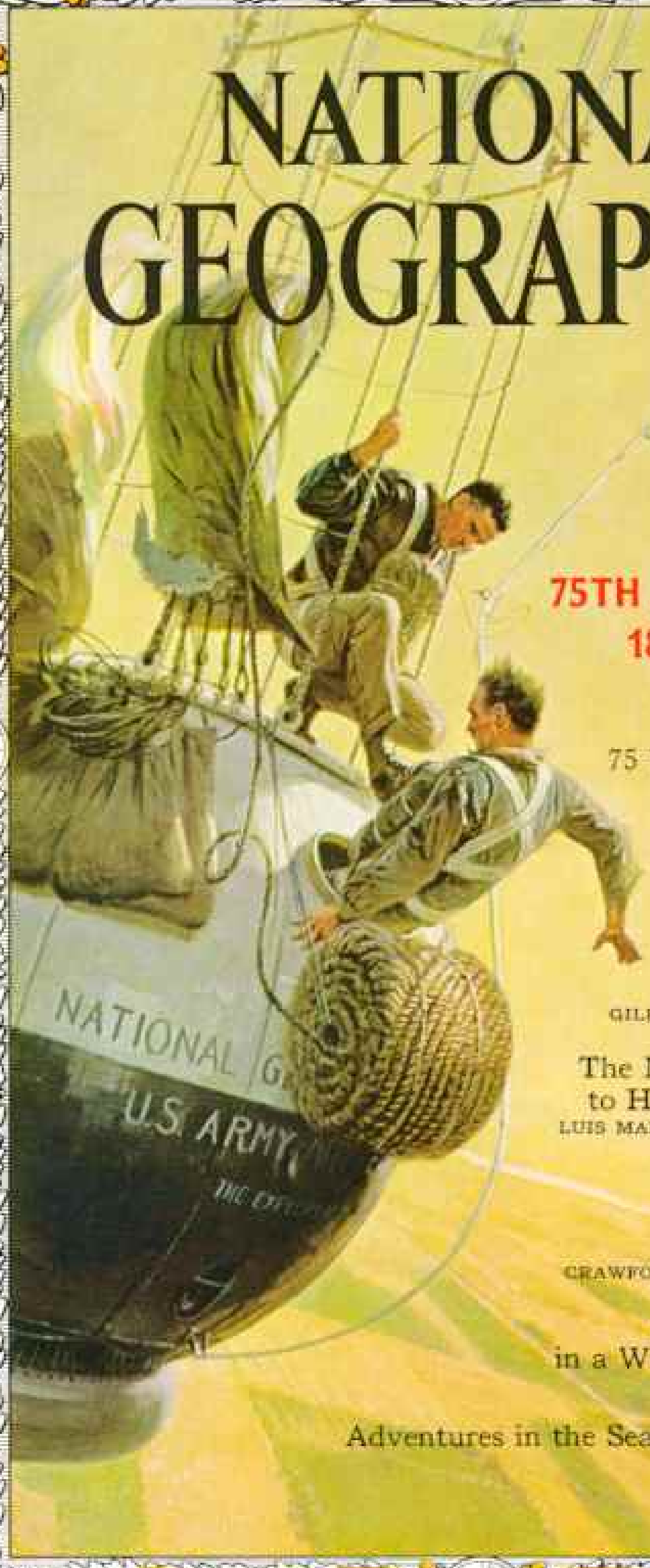

75TH ANNIVERSARY
1888 – 1963

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1963

NATIONAL GEOGRAPHIC

THE NATIONAL GEOGRAPHIC MAGAZINE VOL. 123, NO. 1

75 Years Exploring Earth, Sea, and Sky

NATIONAL GEOGRAPHIC SOCIETY OBSERVES ITS DIAMOND ANNIVERSARY

By MELVIN M. PAYNE, D.Sc.
Executive Vice President and Secretary

ON THE EVENING of January 13, 1888, a chill, dense fog smothered the streets of Washington, D. C. Carriages groped their way cautiously, setting courses by the dim, yellowish beacons of occasional gas lamps. It was a night to be home by the hearth.

Yet 33 distinguished men, most of them scientists, ventured abroad for a meeting at the Cosmos Club. Their purpose: to consider "the advisability of organizing a society for the increase and diffusion of geographical knowledge." They came in answer to a printed invitation, reproduced on this page from an original in the Society's archives.

As a result of that meeting, and two others at the Cosmos Club the same month, the National Geographic Society was founded (next page). Within a year, the Society gave birth to Volume I, Number 1 of the NATIONAL GEOGRAPHIC MAGAZINE. And within two and a half years, in 1890, the young organization sent out its first expedition of exploration and discovery.

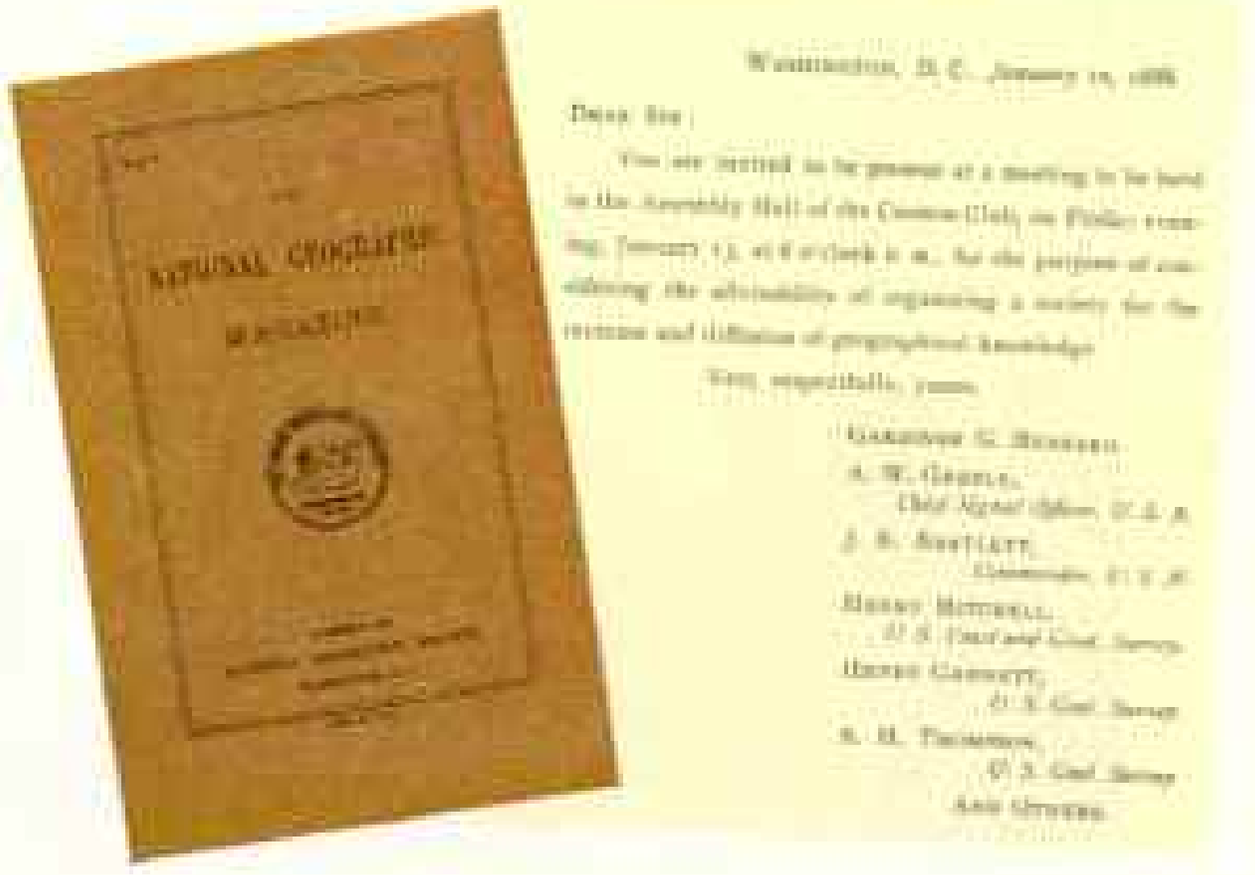
First Expedition Foreshadows Future

Under Society sponsorship, scientists from the United States Geological Survey scaled the icy heights of southeastern Alaska, discovering, among other features, North America's second highest peak—19,850-foot Mount Logan, exceeded only by Mount McKinley—and Hubbard Glacier, a massive river of ice named for the Society's first President, Gardiner Greene Hubbard.

Israel Cook Russell, an outstanding geologist and an original member of the Society, led the team (painting, pages 6-7). Blizzards, fog, high winds, whirling dust, avalanches—the little group fought them all and won. The party successfully mapped some 600 square miles, studied iceberg formation, and gathered geological data still in use today.

In several ways, this first expedition set a pattern for the Society's 200 explorations and researches that have followed over the years. It triumphed over the forces of nature. It added to man's knowledge of his world. And it established a tradition of close cooperation between the National Geographic Society and agencies of the United States Government.

This month the Society completes three-quarters of a century dedicated to the increase and diffusion of geographic knowl-



Washington, D. C., January 13, 1888

Dear Sir:

You are invited to be present at a meeting to be held in the Assembly Hall of the Cosmos Club, on Friday evening, January 13, at 8 o'clock p. m., for the purpose of considering the advisability of organizing a society for the increase and diffusion of geographical knowledge.

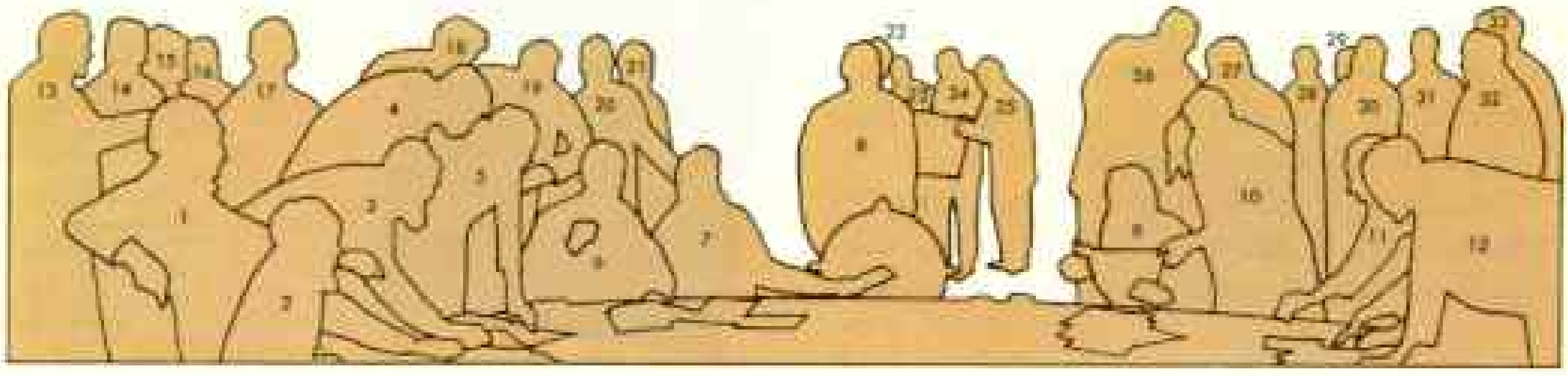
Very respectfully, yours,

GARDINER G. HUBBARD.
A. W. GREELY,
Chief Signal Officer, U. S. A.
J. S. BILLINGS,
Commander, U. S. A.
HENRY MITCHELL,
U. S. Coast and Geod. Survey.
HENRY GANNETT,
U. S. Geol. Survey.
W. H. DALL,
U. S. Geol. Survey.
And Others.

Meeting in Washington, D.C.— the 33 eminent men

RESPONDING to an invitation to organize "a society for the increase and diffusion of geographical knowledge," the men gathered at the Cosmos Club January 13, 1888. From this small beginning, the Society has extended its membership around the world.

Artist Stanley Meltzoff based his depiction of the meeting on individual photographs. Key below identifies: **1** Charles J. Bell, banker; **2** Israel C. Russell, geologist; **3** Commodore George W. Melville, U.S.N.; **4** Frank Baker, anatomist; **5** W. B. Powell, educator; **6** Brig.



PAINTING BY STANLEY MELTZOFF © NATIONAL GEOGRAPHIC SOCIETY

who founded the National Geographic Society

Gen. A. W. Greely, U. S. A., polar explorer; **7** Grove Karl Gilbert, geologist and a future President of the Society; **8** John Wesley Powell, naturalist and explorer of the Colorado River; **9** Gardiner Greene Hubbard, Boston lawyer and first President of the Society, who helped finance the telephone experiments of Alexander Graham Bell; **10** Henry Gannett, geographer and a future Society President; **11** William H. Dall, naturalist; **12** Edward E. Hayden, meteorologist; **13** Herbert G. Ogden, topographer; **14** Arthur P. Davis, civil engineer; **15** Gilbert Thompson, topographer; **16** Marcus Baker, cartographer; **17** George Kennan, author, lecturer, and explorer of Arctic Siberia; **18** James Howard Gore, educator; **19** O. H. Tittman, geodesist and a future President of the Society; **20** Henry W. Henshaw, naturalist; **21** George Brown Goode, naturalist and author; **22** Cleveland Abbe, meteorologist; **23** Comdr. John R. Bartlett, U.S.N.; **24** Henry Mitchell, engineer; **25** Robert Muldrow II, geologist; **26** Comdr. Winfield S. Schley, U.S.N.; **27** Capt. C. E. Dutton, U.S.A.; **28** W. D. Johnson, topographer; **29** James C. Welling, journalist and educator; **30** C. Hart Merriam, Chief, United States Biological Survey; **31** Capt. Rogers Birnie, Jr., U.S.A.; **32** A. H. Thompson, geographer; **33** Samuel S. Gannett, geographer.

THE AUTHOR (above, left) rides a foot-cramping canvas sack down into the Sacred Well of the Maya at Chichén Itzá, Mexico. It's all part of a year's work for Dr. Melvin M. Payne. He inspects the extraordinary air-lift dredging operations whereby the Society, together with Mexican archeologists and skin divers, has recovered precious relics and bones of human sacrifices thrown into the well of death by Maya priests.

At 51, Dr. Payne has served the Society for 30 years. He has spent more than 15 months under canvas with Geographic expeditions—stratosphere balloon flights, solar eclipse expeditions, and excavations of early Indian dwelling sites. As Secretary of the Committee for Research and Exploration for more than ten years, he has administered the Society's world-wide scientific research program; for this he was honored in 1962 by a doctorate in science from the South Dakota School of Mines and Technology. A year ago he became Executive Vice President and Secretary of the Society, responsible for all its membership, business, and legal affairs.

Sacred Maya well at Chichén Itzá yields gold-washed copper rings. Scientists believe a single donor tossed the rings as offerings to the gods. An air-lift recovered the treasure from the *cenote*.

Frothy geyser spouts from the outlet of a suction pump on the bottom of the cenote, 40 feet below. Like a vacuum cleaner, the barge-mounted air-lift sucks in water, silt, stones, and artifacts, and deposits the mixture on a screen. Divers in the depths direct the intake pipe by hand; compressed air powers the ingenious device. Canvas bucket at upper right lowers expedition members from the brink of the well.

Grotesque rubber effigy, submerged for 500 years, reappears from murky waters at the cenote.

EXTACHROMES (BELOW AND OPPOSITE) AND BOTH BY NATIONAL GEOGRAPHIC PHOTOGRAPHER KATE LITTLEMALES © N.G.S.

edge. Its historic ventures have probed the ends of the earth, the depths of the sea, and the enormously far reaches of the sky (pages 10-16).

Robert E. Peary reaches the North Pole. Richard E. Byrd lands at Little America. William Beebe dives in the bathysphere. *Explorer II* lifts men to the stratosphere.

These are memories from the past, for all time to come. They are memories for you, as members of the largest scientific and educational organization in the world. These are things *your* Society helped brave men do.

But what of the present? To my office overlooking 16th Street in Washington come messages such as these:

"Fossil manlike jawbone found . . . 12 to 14 million years old."

"Two gold rattles, one wooden idol, skulls of children. . . . Still diving."

"Rain and floods, roads closed, chimpanzees moving inland."

"Atlas of the planets going well. Mars pictures now complete."

These cryptic reports might seem as odd and diverse as the world is wide —and they are! For they came from Kenya, Mexico, Tanganyika, and Arizona to describe Society activities.

Geography in Action

"Of all the sciences," Joseph Conrad wrote in the NATIONAL GEOGRAPHIC of March, 1924, "geography finds its origin in action, and, what is more, in adventurous action."

This year the Society's 3,300,000 members are sponsoring adventurous action on a scale broader then ever.

As you read this, a team of 18 Americans supported by your Society prepares to climb Mount Everest (page 42). Elsewhere, during the past year, your Society's flag has flown in the wilds of Brazil and New Guinea, where anthropologists record the customs of primitive tribes; in Yellowstone National Park, where naturalists track grizzly bears by miniature radio transmitters attached to plastic collars; and in Jerusalem, where scholars trace crumbled remnants of walls built centuries before Christ. Undersea archeologists study relics lifted from ancient shipwrecks lying on the floor of the Mediterranean.

First National Geographic expedition nearly meets disaster on 18,008-foot Mount St. Elias, highest point on the boundary between Alaska and Canada. Mud and rubble, freed from the mountainside by torrential rain, thunder past the tent. As a rock carries away an anchor rope, Israel C.

PAINTING BY PAUL CALLE © N.G.S.

Russell and his companions prepare to retreat. Despite this close escape in 1890, the expedition successfully mapped the area around the peak.

Geologists in Australia search for meteorites and tektites that offer clues to the conditions that will confront spacemen.

These projects, and others under way or only recently concluded, comprise some of the most intriguing and significant researches your Society has ever undertaken. Consider, for example, each of those messages that crossed my desk:

"Fossil manlike jawbone found. . . ."

On a sunny hillside at Fort Ternan, Kenya, British anthropologists Dr. Louis S. B. Leakey and his wife Mary pursue a richly rewarding search for fossils from the dawn age of man. Dr. Leakey has already reported in your journal his important finds at Olduvai Gorge, Tanganyika, among them *Zinjanthropus*, East African man, who lived 1,750,000 years ago. Now, at this new site, fossil beds at least 14,000,000 years old are just beginning to give up their secrets (page 132).

Divers Find Precious Maya Relics

"Two gold rattles, one wooden idol. . . ."

From a dark, water-filled sinkhole, or *cenote*, at the ancient ruins of Chichén Itzá in Mexico, divers and an underwater vacuum cleaner were bringing up relics—and bones—of the ancient Maya (pages 4-5). Sponsored by the Society, Mexico's National Institute of Anthropology and History, and the Exploration and Water Sports Club of Mexico (CEDAM), the hunt has yielded a trove of new knowledge of the culture that flourished in Yucatán centuries before the white man came.

I well remember my own visits to this sinister pit, with its stagnant, scum-covered water, where human sacrifices to the rain gods once gasped out their lives. A temple then stood on the rim, and I could picture the priests and nobles in their vivid costumes, hear the chanting of worshipers, smell the pungent odor of burning incense, or copal, at this Mecca of the Maya.

"Chimpanzees moving inland. . . ."

This message comes from Miss Jane Goodall, a courageous blond Englishwoman with the deceptive appearance of a schoolgirl (next page). With Society support, this intrepid scientist has spent months in the wilds of Tanganyika, living among chimpanzees as their friend and even joining their hunts.

"Mars pictures now complete. . . ."

Planet-watching has been for 57 years the nightly pursuit of Dr. Earl C. Slipher of Lowell Observatory in Flagstaff, Arizona. With Society sponsorship, he is now compiling a unique *Photographic Study of the Brighter*

Scientist Feeds Bananas to a Hungry Chimp

Accepted by the great apes as a strange sort of monkey, Jane Goodall gathers data on chimpanzee life in the wild. On field trips in Tanganyika, she often sits motionless for hours observing her charges. She reports that chimps sometimes eat game as well as vegetation. Once she was struck by an angry male ape. Miss Goodall, whose work is sponsored by your Society, will report her findings in a future issue of the Magazine.

BY PAINTINGS BY WERT VAN LAWICK © N.G.S.

Unlidded eyes staring, a rainbow parrotfish sleeps in the night unaware of a diver's hands. W. A. Starck II investigates Florida reef life for the University of Miami Marine Laboratory; your Society supports the study.

Wired to beep, a grizzly lies immobilized while Frank Craighead (right) and Maurice Hornocker adjust a plastic collar fitted with a radio transmitter. Receivers like that near the bear's flank will catch the beep and report on the beast's range and movements.

Frank and his brother John, assisted by the Society, seek knowledge that may save the Nation's few remaining grizzlies.

PAINTINGS BY FRANK AND JOHN CRAIGHEAD (BELOW) AND BINGHAM SUMNER

Planets—Mars, Venus, Mercury, Saturn, and Jupiter. His atlas has been aptly dubbed "a road map for astronauts."

Gilbert Grosvenor at Helm 55 Years

Of the 201 expeditions and researches supported by the National Geographic Society in its first 75 years, 130 were undertaken during the 55 years in which the fortunes of the growing Society and its Magazine were guided by Dr. Gilbert H. Grosvenor.

If the world-wide National Geographic Society can be said to be the long shadow of any one man, that man is Dr. Grosvenor, today, at 87, the beloved Chairman of the Society's Board of Trustees. At the age of 23 he was given the reins of the Magazine by Alexander Graham Bell. By the time of his retirement as President and Editor in 1954, Dr. Grosvenor had built the Society from a tiny, struggling organization to a world power for knowledge, with 2,150,000 member-families in 173 countries.

In the words of the late Dr. John Oliver La Gorce, his associate for 49 years and his successor as President and Editor, Gilbert Grosvenor was "the architect and master builder" of the Society. During his years as chief executive, the Geographic flag was borne to both the highest and the lowest points that had yet been reached by man. It crossed both Poles, and explorers carried it deep into other unknown regions of the earth. Society expeditions and grants led to the founding of national parks and unearthed the oldest dated work of man yet found in the Americas.

Today the Society's activities go forward under the vigorous leadership of President and Editor Melville Bell Grosvenor. Some of the Nation's most distinguished scientists serve on the Committee for Research and Exploration. Its Chairman is Dr. Leonard Carmichael, Secretary of the Smithsonian Institution. A former Director of the National Bureau of Standards, Dr. Lyman J. Briggs, is Chairman Emeritus. Our program, past and present, owes much to these gifted men, who have an intimate understanding of basic research and its assorted problems.

Never Too Old for Adventure

An elderly lady called at our offices one day. First she expressed thanks to the Society for inviting her to become a member. Then, quite seriously, she added, "But I am afraid that at my age I shall not be able to go off on all those expeditions."

Though now 75, the Society itself will never be too old for adventure. There is no dearth of able young men and women to carry its blue, brown, and green flag.

"How much roaming space does a grizzly bear need?" "How many fish can a coral reef support?" "What kind of fishing rod is best to catch hummingbirds?"

Determining the roving area of grizzlies may help save this threatened species from extinction. Since 1959, Drs. Frank and John Craighead, of the Montana Cooperative Wildlife Research Unit, have been working in Yellowstone National Park to learn not only the animals' range but facts about their food, breeding, hibernation, cub mortality, and life span. Their studies even include taking blood samples from the bears—no easy task.

The Craigheads first immobilize their quarry with a harmless muscle relaxant; an anesthetic then puts the beasts to sleep while the scientists work (opposite). When the bears are released, disgruntled but unscathed, they wear bright ear tags and miniature Philco radio transmitters affixed to plastic collars.

On one occasion a big male shook off the drug prematurely, and for a few long seconds the Craigheads were the subjects of a potentially homicidal study by the grizzly!

Studying the ecology of a coral reef involves more than a mere census of the inhabitants. How much living room do they need? How many links exist in their food chain? What happens if the chain is broken?

Dr. Gilbert L. Voss, of the University of Miami Marine Laboratory, heads a team seeking answers in waters off the Florida Keys (opposite). Research ships and divers have

(Continued on page 18)

Gold-and-black spider in a Thailand forest dangles before Wilda S. Ross. Society grants enable Mrs. Ross and her entomologist husband, Edward, to collect specimens in Asia, Africa, and Australia.

Expeditions of

Louisiana
N.G.S.

the National Geographic Society

Design by W. N. Palmstrom
Painting by Carlos Lacamera
Research by D. A. Nicholson

Chronology of adventure and discovery

A KEY TO THE MAP OF NATIONAL GEOGRAPHIC EXPEDITIONS AND SCIENTIFIC RESEARCHES

Exploration of
- *Land*
- *Sea*
- *Sky*

1 **2** In 1890, with U. S. Geological Survey, mapped 600 square miles of Mt. St. Elias, Alaska, region and discovered Mount Logan, North America's second highest peak. Further explored region, 1891.

3 Aided Walter Wellman Polar Expedition, 1898-99, which mapped eastern Franz Josef Land and discovered new Arctic islands.

4 Some 250 Society members sailed from Washington to Norfolk, Va., for solar eclipse, May 28, 1900.

5 Investigated eruption of Mont Pelée, Martinique, and volcanic conditions in West Indies, 1902.

6 Directed scientific work of Ziegler North Polar Expedition, 1903-05.

7 Provided chief scientist as Walter Wellman attempted to reach North Pole by dirigible, 1906-07.

8 **Gave $1,000 to 1908-09 expedition of Robert E. Peary, first to reach North Pole, April 6, 1909.**

9 Observed geologic changes from earthquake at Messina, Sicily, 1909.

10 – **12** Studied growth and retreat of glaciers in southeast Alaska, 1909, '10, '11, resulting in classic Tarr-Martin report.

13 With U. S. Geological Survey, reconnoitered area of Mt. Katmai, Alaska, after its eruption in 1912.

14 – **15** **With Yale University supported excavation, in 1912, of lost mountaintop city of Machu Picchu in Peru discovered by Dr. Hiram Bingham and (1914, 1915) his further explorations in Inca land.**

17 – **19** Aided pioneer biological studies by Dr. W. E. Clyde Todd, Carnegie Museum, Pittsburgh, on Hudson Bay (1912, 1914) and in Labrador (1917).

20 – **24** **Discovered, named, and explored Valley of Ten Thousand Smokes, Mt. Katmai, Alaska, 1915-19; these expeditions, led by Dr. Robert F. Griggs, resulted in establishment of Katmai National Monument.**

25 Assisted biological work of Dr. Frank M. Chapman, American Museum of Natural History, in Urubamba Valley, Peru, 1916.

26 Flamingos photographed by Drs. John Oliver La Gorce and Louis Agassiz Fuertes, Bahamas, 1920.

27 – **34** **Expeditions led by Neil M. Judd of Smithsonian Institution in 1920-27 unearthed communal dwellings and precious relics at Pueblo Bonito, Chaco Canyon, N. M., a national monument.**

35 Shared study of elephant seals and other fauna of Baja California islands, 1922; two isles were later set aside as wildlife reservations.

36 – **42** **Tree-ring expeditions of 1923-29 under Prof. A. E. Douglass, University of Arizona, revealed age of Pueblo Bonito and other Southwest ruins by tree growth rings in beams of buildings. Historic horizons of Southwest pushed back to nearly eight centuries before Columbus.**

43 Neil M. Judd explored and photographed prehistoric ruins of little-known area of Utah between Colorado and San Juan Rivers, 1923.

44 Yünnan-Szechwan Expedition, 1923-24, led by Dr. Joseph F. Rock, explored river gorges and mountain fastnesses of China.

45 Central China Expedition, led by Frederick R. Wulsin, collected botanical and zoological specimens in Inner Mongolia, 1923-24.

46 Ruins of Cuicuilco, Mexico, preserved by lava flows, studied in 1924-25 by Dr. Byron Cummings.

47 **Willis T. Lee mapped and photographed huge Carlsbad Caverns, New Mexico, 1924, leading to preservation as national park.**

48 Alaskan coast explored in 1924, prior to proposed polar flight of U. S. Navy dirigible *Shenandoah*.

49 MacMillan Arctic Expedition, 1925, with United States Navy, made first extensive use of planes in Arctic exploration. Lt. Comdr. Richard E. Byrd gained first knowledge of polar flying conditions.

50 Helped Dr. C. G. Abbot of Smithsonian erect and operate solar radiation observatory on Mt. Brukkaros, South-West Africa, 1925-29.

51 Dr. Joseph F. Rock led exploration of Hsiangcheng tribal lands, southwest China, 1927-30.

52 **Encouraged and helped finance Byrd Antarctic Expedition, 1928-30, which achieved man's first flight over South Pole and mapped by aerial photography 160,000 square miles of Antarctica.**

53 Pavlov Volcano area of Alaska explored by Dr. T. A. Jaggar, Jr., 1928, in early amphibious vehicle.

54 Sponsored bird-life study in Venezuela, 1929-30, by Ernest G. Holt of Carnegie Museum, Pittsburgh.

55 Neil M. Judd excavated at Chavez Pass and three sites within Hopi reservation, Arizona, in 1929, seeking timber fragments to close gap in tree-ring chronology.

56 Ernest G. Holt, with Brazilian-Venezuelan Boundary Survey party, collected jungle creatures of tropical South America, 1929-31.

57 Dr. Robert F. Griggs, in 1930, studied revegetation of lands desolated by Katmai eruption of 1912.

58 First aerial photosurvey of Latin American air routes made by Capt. A. W. Stevens on Washington-Buenos Aires-Chile flight, 1930.

59 **Granted funds and services of Dr. Maynard Owen Williams to Citroën-Haardt Trans-Asiatic Expedition, 1931-32, which blazed 7,370-mile motor trail across Asia, first overland exploration from Mediterranean to Yellow Sea since Marco Polo.**

60 Scientific investigation in Death Valley, California, under Dr. Frederick V. Coville, 1931.

61 With U. S. Army, 1932, photographed eclipse of sun and observed cosmic rays from airplane five miles above Maine. Made other observations elsewhere in eastern U. S.

62 In 1933-35, strongly supported second Byrd Antarctic Expedition, which vastly enlarged knowledge of topography of Ross Sea quadrant.

63 **National Geographic-U. S. Army Air Corps stratosphere balloon *Explorer I* in 1934 carried Maj. W. E. Kepner, Capt. Albert W. Stevens, and Capt. Orvil A. Anderson to 60,613 feet. Flight from Rapid City, South Dakota, obtained valuable scientific data and highest altitude photographs of earth.**

64 Dr. William Beebe and Otis Barton in steel bathysphere dived to record depth of 3,028 feet off Bermuda, 1934, observing sea life never before seen.

65 Rev. Bernard R. Hubbard, S. J., in 1934 explored and mapped Alaska Peninsula and Aleutian Islands.

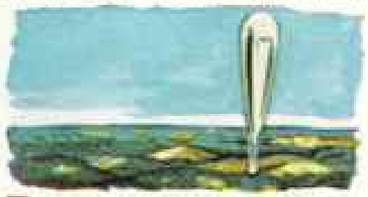
66 Contributed to Antarctic aerial expedition of Dr. Lincoln Ellsworth, 1934.

67 Amos Burg studied islands, channels, and Indians near Cape Horn and Strait of Magellan, 1934.

68 Supported U. S. Dept. of Agriculture spore survey, 1935, in flight over West Indies and parts of South and Central America.

69 With U. S. Geological Survey, made boat-borne geologic reconnaissance through Salmon River Canyon of Idaho, 1935.

70 **In second stratosphere flight, 1935, National Geographic-U. S. Army Air Corps balloon *Explorer II* attained manned-flight record altitude of 72,395 feet, ascending from Rapid City, South Dakota.**



71 Bradford Washburn, in 1935, explored and mapped mountains and glaciers in Yukon Terr., Canada.

72 Observed solar eclipse of June 19, 1936, from base at Kustanai, U.S.S.R., with Georgetown Univ.

73 Joined National Bureau of Standards at Ak Bulak, U.S.S.R., to obtain color photographs of sun's corona during 1936 eclipse.

74 **Unearthed prehistoric Eskimo armor, weapons, and implements on Bering Sea coast of Alaska, 1936, in dig directed by Henry B. Collins, Jr., of Smithsonian.**

75 Cooperated with Pan American Airways in photographic flights by Bradford Washburn over Mt. McKinley and adjacent peaks in 1936.

76 Supported Smithsonian expedition led by Dr. William M. Mann in 1937 to collect Netherlands Indies mammals, birds, reptiles, and fishes for National Zoological Park.

77 G. Weidman Groff of Lingnan University, Canton, collected plants in Kwangsi, China, 1937.

78 **With U. S. Navy, observed eclipse of the sun at Canton Island in mid-Pacific, June 8, 1937.**

79 Capt. C. W. R. Knight, in 1937, studied and photographed birds and other wildlife in South Africa.

80 Discovered vast icefield and glaciers, 1938, in Chugach and St. Elias ranges of Alaska in Bradford Washburn air survey with Harvard.

81 – **88** **Expeditions to southern Mexico by Dr. Matthew W. Stirling of Smithsonian Institution in 1938-46 uncovered 1,000-year-old La Venta civilization and treasure trove of carved jade, colossal stone heads, and a stele bearing date equivalent to November 4, 291 B.C. (Spinden correlation), New World's oldest dated work of man.**

89 Supported original aurora researches, 1938-62, by Dr. Carl W. Gartlein, based at Cornell Univ.

90 Made photographs and spectrogram, with National Bureau of Standards, of solar eclipse of October 1, 1940, at Patos, Brazil.

91 Joined Woods Hole Oceanographic Institution in photographing ocean bottom 200 miles southeast of Cape Cod, 1940.

92 Supported South Dakota School of Mines and Technology, in 1940, excavating 175 fossil bones, including giant rhinoceros and skull of 8-foot-long pig, in Badlands, S. D.

93 Launched air-sampling balloons into stratosphere from Bismarck, North Dakota, in program with National Bureau of Standards, 1940-41.

94 – **95** **Society grants helped Dr. Arthur A. Allen of Cornell to record voices of North American birds and photograph them in color, 1944-49. Highlight discovery: nest and eggs of bristle-thighed curlew, in Alaska, 1948.**

100 – **103** With Army Air Forces and Bartol Research Foundation, in 1946-48, made first systematic record of cosmic ray intensity at selected altitudes over 70-degree range of latitude; 1949 and 1950, instrumented balloons, flown from Churchill, Manitoba, broadened knowledge of cosmic rays; 1952-53, high-altitude research continued in India.

104 Reconnoitered Pacific shores of Oaxaca and Chiapas, Mexico, with Smithsonian, 1947, finding evidence of preceramic culture.

105 Dr. Lyman J. Briggs led studies of solar eclipse of May 20, 1947, at Bocaiúva, Brazil, with U. S. Army Air Forces cooperation.

106 **107** **Strongly backed Woods Hole Oceanographic Institution and Columbia University in survey, led by Dr. Maurice Ewing, of submerged range, the Mid-Atlantic Ridge, 1947 and 1948.**

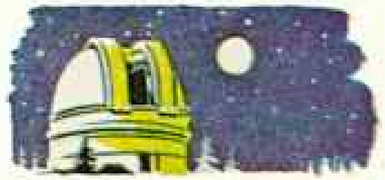
108 Charles P. Mountford led Australian Government-Smithsonian-Geographic study of ethnology, art, and legends of aborigines of Arnhem Land, Australia, 1948.

109 – **112** Panama expeditions of Dr. Matthew W. Stirling of Smithsonian Institution, in 1948, '49, '51, '53, established links between ancient cultures of Middle America and northwestern South America.

113 In cooperation with the U. S. Government, observed annular eclipse of sun of May 8-9, 1948, from Burma, Thailand, Japan, China, Korea, and Aleutian Islands.

114 Dr. S. Dillon Ripley made Yale-N.G.S.-Smithsonian zoological survey of Nepal, collecting rare spiny babbler, 1948-49.

115 **Collaborated with Palomar Observatory, 1949-56 and 1958, in photographing 879 separate star fields to provide a sky atlas of 1,758 plates revealing objects to distance of a billion light-years.**



116 Dr. Paul A. Zahl observed and photographed in color the rare scarlet ibis in Venezuela, 1949.

111 Supported University of Miami Marine Laboratory pelagic fish life history program, 1950-60, identifying larval and infant forms of food and game fish of the Gulf Stream.

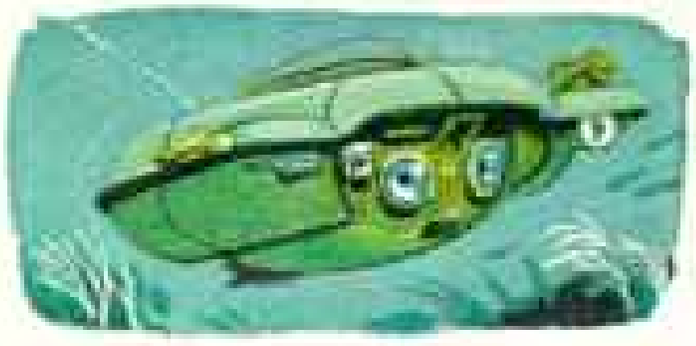
112 With Smithsonian, 1951, surveyed from air and ground giant gravel pictographs in southeast California, attributing them to Yuman-speaking Indians of 1540-1850.

113 **Dr. V. Ben Meen of Royal Ontario Museum established, in 1951, meteoritic origin of 2-mile-wide Chubb Crater, northern Quebec.**

114 Joined three British research institutions in study of geology and glaciology of Norway's West Spitsbergen Island, 1952.

115 Verified "Einstein shift" by comparison of photographs made at Khartoum, Sudan, of star field surrounding sun during solar eclipse of February 25, 1952, and others made six months later from same site. Dr. George A. Van Biesbroeck of Yerkes Observatory led work.

116 Dr. and Mrs. Carnes Weeks studied birds, mammals, and plant life in French Equatorial Africa and French Cameroons, 1952, with National Geographic and American Museum of Natural History support.



117–133 **Since 1952, the Society has cosponsored sea researches of Capt. Jacques-Yves Cousteau with French Government and scientific organizations: 1952, from flagship *Calypso* studied undersea life of Mediterranean; 1953-58, from 2,200-year-old Greek ship, found offshore near Marseille, retrieved cargo of wine jars and dinnerware; 1954, using Edgerton deep-sea flash cameras (see 134), photosurveyed Mediterranean bottom and studied marine life associated with "deep scattering layer"; 1955, cruised to Persian Gulf and Madagascar probing for oil and filming life of coral shelves; 1956, photographed 25,000-foot depths of Romanche Trench in Atlantic; 1957-58, studied biology and geology of Mediterranean and shared IGY oceanographic program in eastern Atlantic; 1959-61, used two-man "diving saucer" in Mediterranean, Caribbean, and Atlantic researches; 1960-61, built large inflatable boat, *Amphitrite*; 1961, surveyed continental shelf of Atlantic coast of South America; 1962, tested, in Mediterranean, undersea manned observatory.**

134 Supported Dr. Harold E. Edgerton, M.I.T., since 1950, in developing deep-sea cameras and other instruments for oceanographic research, and testing them in close cooperation with Captain Cousteau.

135 Built 3,000-pound Aquascope from which Gilbert C. Klingel observed marine life on Chesapeake Bay floor, 1953-54.

136 **Expedition directed by E. Thomas Gilliard of American Museum of Natural History studied bird life and Stone Age natives of New Guinea, 1953-54.**

137 **Recorded life of archaic Tiwi culture on Melville and Bathurst Islands, north Australia, on 1954 expedition headed by Charles P. Mountford and cosponsored by Yale and University of Pennsylvania.**

138 Dr. George A. Van Biesbroeck set up a station in Colorado to observe zodiacal light of rising eclipsed sun, June 30, 1954.

139 In 1954, U. S. Air Force flew Royal Ontario Museum-National Geographic party to Merewether Crater in Labrador in effort to prove its meteoritic origin.

140 **With Smithsonian and National Museum of Canada, discovered 3,000 stone, bone, and ivory implements of ancient vanished Dorset Eskimo culture. Dr. Henry B. Collins led expedition to Southampton Island, 1954.**

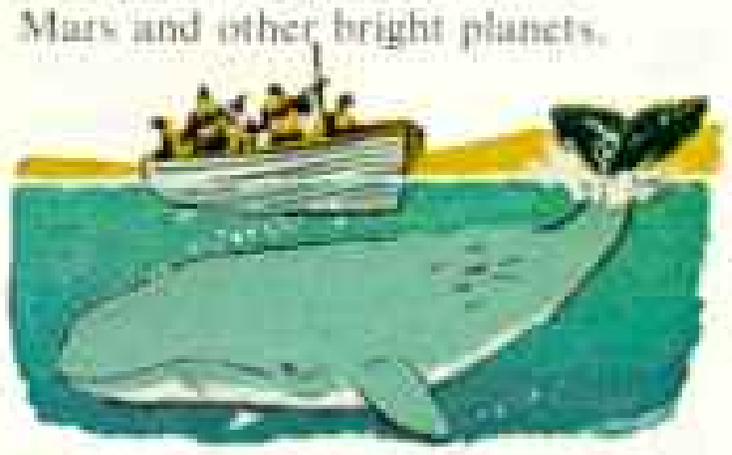
141 143 Mars studied from Bloemfontein, S. Africa, during close oppositions of 1954, '56, by Dr. E. C. Slipher of Lowell Observatory.

142 In 1955, Dr. Philip Drucker of Smithsonian, in expedition with University of California and National Geographic, established that La Venta, Mexico, was religious capital of 1,500-year-old Olmec culture.

144 Dr. T. Nicholas Panay studied fresh and salt sea streams at Cephalonia, Greece, 1955-56.

145 146 National Bureau of Standards scientists in 1956, making spectrum analyses from Mauna Loa, Hawaii, of sunlight reflected from Mars, detected no oxygen or water vapor. In 1957, made spectrograms of Jupiter's atmosphere.

147 Presented a "planet pavilion" to Georgetown University, in 1956, for spectroscopic observations of Mars and other bright planets.



148 Backed Dr. Paul Dudley White in attempt to make electrocardiogram of a 30-ton gray whale off Baja California, Mexico, 1956-57.

149–151 **From bones, tools, and weapons, established human occupancy of Russell Cave, Alabama, from 7000 B.C. to A.D. 1650. Excavations in 1956-58 by Carl F. Miller of Smithsonian Institution led to Society gift of cave to U. S. and establishment of Russell Cave National Monument.**

152 Placed 3-ton monitor on merchant ships to record cosmic-ray fluctuations in unreported regions. Dr. Martin A. Pomerantz of Bartol Research Foundation directed 1956-58 work with Swedish, Canadian, and U. S. cooperation.

153 Supported ethnological expedition, with Smithsonian, to Otavalo, Cañari, Canelo, and Colorado Indians of Ecuador, 1957. Leader Matthew W. Stirling also excavated significant early clay figurines.

154 Contributed to 1957 studies of tropical butterflies in Trinidad by Dr. William Beebe and Jocelyn Crane of N. Y. Zoological Society.

155 Unearthed pyramids at Cuicuilco, Mexico, of ceremonial center that carbon dating proved to be contemporaneous—2,000 to 2,500 years ago—with center at La Venta. Dr. Robert F. Heizer, U. of California, led excavations in 1957.

156 With Western Speleological Institute and Nevada State Museum, excavated ancient dwelling caves at Lake Lahontan, Nevada, 1957.

157 **Collections and photographs of insects and small creatures of central and south Africa made by Dr. Edward S. Ross of Calif. Academy of Sciences, 1957-58.**

158 Dr. Paul A. Zahl found and pictured 6-inch-long beetles and giant ants as part of insect study along Amazon River, Brazil, in 1957.

159 Excavated early-man sites on Santa Rosa Island, Calif., occupied as much as 30,000 years ago, with

Western Speleological Institute and Santa Barbara Museum, 1957.

156 **At Dzibilchaltun, Mexico, Dr. E. Wyllys Andrews of Tulane Univ. heads continuing expedition studying, since 1957, what may be largest and longest-inhabited city of ancient America, occupied perhaps as early as 2,000 B.C.**

161 With American Museum of Natural History, studied descendants of imported greater birds of paradise at Little Tobago Island, 1958.

162 **Unveiled life environment of ancient cliff-dwelling Pueblo Indians at Wetherill Mesa in Mesa Verde Nat'l. Park, Colorado. Dr. Douglas Osborne of Nat'l. Park Service continues study begun in 1958.**

163 Supported E. Thomas Gilliard of American Museum of Natural History in zoological exploration of New Britain, 1958-59.

164 **165** Sent J. Lear Grimmer of National Zoo, in 1959 and 1960, to study the houtzin, little-known bird of British Guiana rivers.

166 **Explored drowned city of Port Royal, Jamaica, submerged by earthquake of 1692. Inventor Edwin A. Link led N.G.S.-Smithsonian expedition, 1959.**

167 With the National Science Foundation, in 1959, helped Jocelyn Crane of N. Y. Zoological Society continue world study of fiddler crabs.

168 Since 1959, cosponsored grizzly bear research of wildlife biologists Frank and John Craighead in Yellowstone National Park. Program with Montana Cooperative Wildlife Research Unit uses radio-transmitter "collars" on bears to track their wanderings.

169 **170** With Univ. of Wyoming and Smithsonian, studied and carbon-dated early Indian artifacts at Agate Basin, Wyo., 1959 and '61.

171 Ceremonial chambers in Bolankanche Cave, Mexico, yielded to Dr. E. Wyllys Andrews of Tulane University, in 1959, sculptured urns, incense burners, and other artifacts from A.D. 1100.

172 – **175** **Supported, since 1959, work of Dr. and Mrs. Louis S. B. Leakey, who had discovered *Zinjanthropus*, tool-maker of 1,750,000 years ago, at Olduvai Gorge, Tanganyika. Continuing expeditions have found parts of even older manlike creature, and at Fort Ternan, Kenya, remains of a primate of 14,000,000 years ago.**

176 Backed glaciological and meteorological researches of Barry C. Bishop, with Sir Edmund Hillary's 1960-61 Himalayan expedition.

177 **178** **Helped recover skeleton of 5-ton mammoth found near Rawlins, Wyoming, in 1960-61, with tools and weapons of men who trapped it 11,000 years ago.**

179 Maya Well of Sacrifice at Chichén Itzá, Mexico, explored by free diving and "air-lift" dredge, 1960-61, in collaboration with Mexican Government and others.

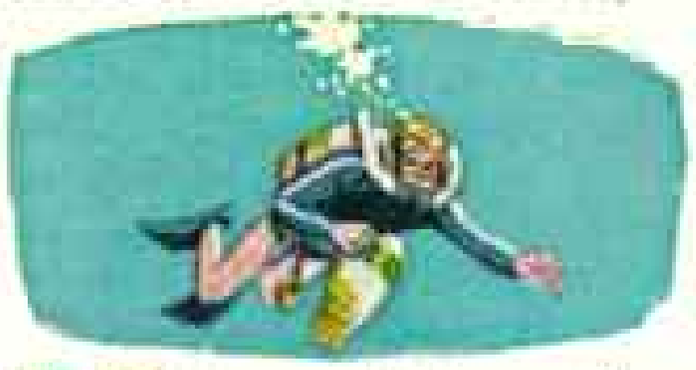
180 **In 1961 cosponsored Dr. Maynard M. Miller of Michigan State University remeasuring southeast Alaska glaciers surveyed in 1909-11 by Tarr and Martin.**

181 Photographer-naturalist Frederick Kent Truslow studied rare California condor in 1961.

182 Dr. Edward S. Ross of Calif. Academy of Sciences collected insects in Pakistan, India, Southeast Asia, and Australia in 1961-62.

183 **With University of Miami Marine Laboratory, studying life cycle of coexisting coral reef animals and plants near Key Largo, Fla., in program begun in 1961.**

184 Recorded, in 1961, dancing courtship and daily life of golden cock-of-the-rock in jungles of British Guiana. E. Thomas Gilliard made research cosponsored with American Museum of Natural History.



185 **186** **Supported George Bass, Univ. of Pennsylvania Museum, in sea-bottom study, 1961-62, of Byzantine ship wrecked 1,300 years ago at Yassi Ada, Turkey.**

187 In re-evaluation of Sandia Cave, New Mexico, 1961-62, by Dr. George A. Agogino of Univ. of Wyoming, carbon-14 dating confirmed human occupancy in Glacial Age.

188 Joined in survey by S. Frederick Starr of Persian Royal Road and other ancient trade routes in Anatolia, Turkey, 1961.

189 Assisted British scientist Jane Goodall in study of wild chimpanzees in Gombe Stream Reserve, Lake Tanganyika, Africa, 1961-62.

190 **Enabled Dr. Harald Schultz of São Paulo State Museum to make ethnological expedition, in 1962, to feather-ornamented Canoeiro Indians in Brazilian jungles.**

191 Roger Tory Peterson received support, in 1962, for experiments with artificial nesting sites in effort to counter depletion of osprey in the Connecticut River area.

192 Salvaged marble components of "knocked-down" Byzantine altar in Greek ship sunk off Syracuse, Sicily, in 6th century A.D. Edwin A. Link made 1962 recovery.

193 **In special aluminum cylinder, Edwin A. Link and teammates, in "Man-in-Sea" project, 1962, spent periods up to 26 hours long at depths to 200 feet in Mediterranean off Villefranche, France.**

194 Helped British archeologist Dr. Kathleen M. Kenyon excavate, in 1962, for earliest walls and relics in old quarter of Jerusalem.

195 Found important early Indian remains—hearths, tools, ornaments, grinding stones, spear points—at Hell Gap, Wyoming, with Peabody Museum of Harvard, 1962.

196 **Recorded Neolithic culture of Dani tribe of Baliem Valley, West New Guinea, with Peabody Museum, 1962.**

197 Aided observations of rare and exquisite hummingbirds, captive and wild, in State of Espirito Santo, Brazil, by native-born naturalist Dr. Augusto Ruschi, 1962.

198 **Backed, in 1962, publication by Lowell Observatory of photographic survey of brighter planets, to be edited by Dr. E. C. Slipher.**

199 With American Research Center in Egypt, will excavate, in 1963, ancient fortress and cemetery of Gebel Adda to be inundated by Aswan High Dam, Egypt.

200 Supported American Museum of Natural History for the collection and study, in 1963, of meteorites and tektites in Australia.

201 **Sponsored glaciological and solar radiation programs of American Mount Everest Expedition which, in 1963, will assault peaks of Everest, Lhotse, and Nuptse.**

JOSEPH F. ROCK

Reluctant Mule Crosses China's Raging Yalung River on a Sagging Cable

A Society-sponsored expedition led by plant explorer Joseph F. Rock constructed the perilous span in 1929, the same year it located 24,900-foot Minya Konka, loftiest peak in China. One man climbs the rope hand over hand. Others pull the mule to shore.

Tattered flag accompanied Adm. Robert E. Peary, discoverer of the North Pole, in 11 seasons of Arctic exploration. Mrs. Peary made the taffeta banner in 1898 for him to wear around his body. He cached cuttings from it at major objectives. Four pieces already were missing by June 28, 1906, when he planted the flag above at Cape Thomas Hubbard —now called Cape Stallworthy—in Canada. He left another scrap there and deposited a final slash at the Pole on April 6, 1909. Today Peary's patched Stars and Stripes is enshrined in the Society's Explorers Hall. For being the first to reach the Pole, Peary received the Society's Special Gold Medal.

(Continued from page 9)

surveyed a selected area, analyzed its waters, and collected specimens of reef population. They have even built an artificial reef of quarried coral to study the rate and character of its colonization by plants and animals.

And that hummingbird fishing rod? You will find the answer in Luis Marden's article beginning on page 80.

Peary Conquers the Northern Frontier

The spirit of scientific inquiry behind such projects is a direct legacy from those 33 men who founded the Society, and from the great explorers of the Geographic's earliest years.

As this century opened, the North Pole stood as the ultimate geographic challenge. It awaited conquest by a dauntless U. S. Navy commander who had been gaining a reputation for polar exploration.

Robert E. Peary had written for the NATIONAL GEOGRAPHIC in its very first year—Vol. I, No. 4—an account of his trip across Nicaragua to trace the route of a proposed canal. When he began his relentless drives into the frozen north, the Society encouraged and supported him. Peary lost eight frozen toes on one journey. On another he broke his leg. But he would not surrender his dream.

PAINTING BY HERBERT LEITICH © NATIONAL GEOGRAPHIC SOCIETY

First to Fly Over the South Pole, Byrd's Plane Fights for Altitude

As the trimotor *Floyd Bennett* labors to surmount a glacier in the hostile Queen Maud Range, U. S. Navy Comdr. Richard E. Byrd (right) orders Ashley McKinley to jettison a 150-pound bag of food. Another bag followed, lightening the plane enough to continue its 1,600-mile round-trip flight between Little America and the Pole on November 29, 1929. Harold June shouts advice. Bernt Balchen peers back from the pilot's seat.

Admiral Byrd credited the Society with playing an important part in the success of his early expeditions.

He had the Society's financial backing when, in 1909, he made his final dash. "Stars and Stripes nailed to the Pole," the jubilant explorer radioed to the world.

The Far North was the early proving ground of another famous explorer long identified with the Society, Richard E. Byrd. As a young naval officer, he led an aerial group attached to the 1925 expedition of Lt. Comdr. (now Rear Adm., Ret.) Donald B. MacMillan, cosponsored by the Society and the Navy.

Daily the expedition maintained contact with the outside world by the new marvel of short-wave radio, and people around the

Lost City of the Incas, Machu Picchu Hides Amid Misty Peaks of Southern Peru

Conquistadors failed to find the citadel, and the Indians abandoned it to the jungle when their empire crumbled. For three centuries the Andean

KODACHROME BY EDWARD H. NATIONAL GEOGRAPHIC STAFF © N.G.S.

fortress lay forgotten until its discovery by Hiram Bingham, who led three National Geographic Society-Yale University expeditions to the site in 1912, '14, '15. Time fails to dim the splendor of the penthouse city. Temple with sundial surmounts the stairstep pyramid. Terraces supported gardens.

globe followed these reports avidly. Byrd and his aviators flew more than 6,000 miles and observed 30,000 square miles of territory. Expedition scientists collected flowers, birds, and mammals never before scientifically studied; NATIONAL GEOGRAPHIC photographers brought back the first natural-color photographs of Arctic life and scenes.

Soon after, Byrd wrote prophetically, "Aviation will conquer the Arctic—and the Antarctic, too." When he became the first man to fly over both North and South Poles (1926 and 1929 respectively), he gave generous credit to the ingenious sun compass invented by Albert H. Bumstead, first Chief of the Society's Cartographic Division.

"The sun compass," Byrd said, "made it possible for us to fly with confidence to the North and South Poles and to find our way back to our bases."

The Society contributed substantially in funds and research assistance to the first two of Admiral Byrd's five expeditions into the Antarctic Continent. These explorations mapped hundreds of thousands of square miles never before seen by man. Byrd named Grosvenor Range, La Gorce Mountains, and Mount Bumstead for Society officials.

Until his death in 1957, the "Admiral of the Ends of the Earth" was a Trustee of the Society. My colleagues and I will always treasure a remark he made at one of our Board meetings. "Other than the flag of my country," said Admiral Byrd, "I know of no greater privilege than to carry the emblem of the National Geographic Society."

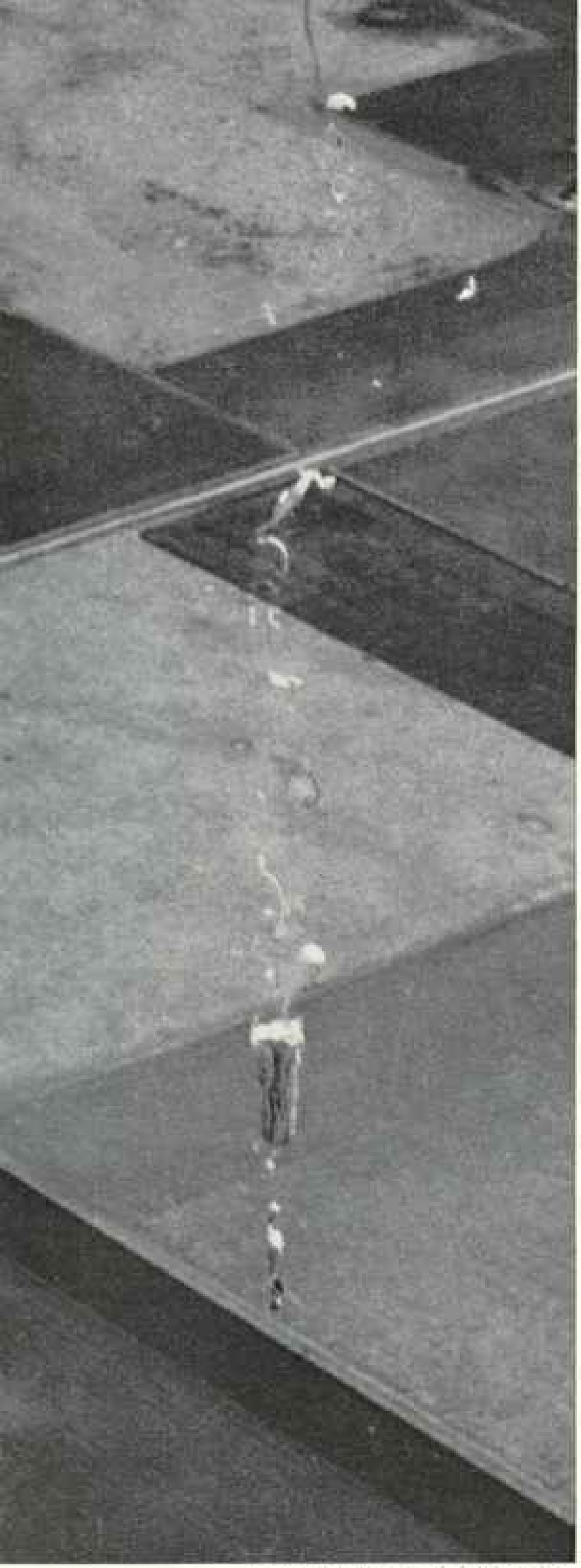
Balloonists Reach the Stratosphere

Since its inception, the Society has scanned the sky and recorded the epic of its conquest —from Alexander Graham Bell's man-carrying tetrahedral kites to the X-15 rocket plane and astronauts who dare space itself.

My own first two assignments for the Society made me an eyewitness to aviation history—the epochal flights of the stratosphere balloons, *Explorer I* and *Explorer II*.

Both went aloft from the Cape Canaveral of that era, the Stratobowl—a cliff-encircled depression in the Black Hills of South Dakota near Rapid City. There your Society and the U. S. Army Air Corps, cosponsors of the flights, built a tent city to house the myriad technicians, scientists, and specially trained troops required for the assaults on the fringe of space. Setting up, supplying, and maintaining that little city became my chief and constant concern.

Death of a balloon: A tear in *Explorer I*'s gas bag ended a National Geographic-Army Air Corps attempt to probe the stratosphere in 1934. The rip widened until, at 7,000 feet, the gaping balloon suggested a parachute (above). Minutes later the bag



LT. JAMES P. PHILLIPS AND M/SGT. G. R. KILBURY

exploded. Gondola and fabric hurtled earthward past the parachutes of two balloonists (center). Puff of dust in a Nebraska cornfield marked the end of the flight (right). Instrument capsule landed nearby; much of the data gained aloft was saved.

Dr. Thomas W. McKnew, now Vice Chairman of our Board of Trustees, was Project Officer for the Society. I served as his assistant, in close partnership with Army personnel.

Shortly after sunrise on July 28, 1934, *Explorer I* rose from the floodlighted bowl carrying three passengers, Maj. William E. Kepner, Capt. Albert W. Stevens, and Capt. Orvil A. Anderson, in its magnesium-alloy gondola. All went well until the huge gas bag ripped as it rose past the 60,000-foot level.

Down it came, the long fall becoming faster and faster. When uncomfortably near the ground, the hydrogen-filled bag exploded, as all three men leaped for their lives by parachute. Luckily no one was injured.

Nearly sixteen months passed before a second attempt could be made. Various delays plagued us in that period, and the weather often turned bitterly cold as the autumn of '35 waned. Snow fell, a prelude to the heavier storms of late fall and winter. Everyone grew increasingly anxious.

Everyone, I should say, but Stevens and Anderson. They would make the second attempt as a two-man team, and both remained remarkably calm. Stevens, the leader, who had originally conceived the flights, kept in trim by climbing like a frisky goat on the nearby cliffs, frightening all of us. He, however, always seemed totally without fear, and I recall he once fell sound asleep during a discussion of the hazards of the flight.

Second Flight Sets a World Record

Finally, on Armistice Day, November 11, 1935, *Explorer II* whisked Stevens and Anderson from the bowl. Grouped around radios, millions of Americans heard their conversation as they drifted upward to 72,395 feet, a record for man's farthest aloft that endured for 21 years. After 8 hours and 13 minutes above the earth, the men came safely to rest near White Lake, South Dakota, 225 miles from the launching site.

Explorer II carried 64 scientific instruments totaling one ton. They revealed reams of startling new data on the thin upper atmosphere. In addition, Stevens and Anderson demonstrated that man could live and work in an environment almost as hostile as the dark reaches of space. Scientific reports of the flight became the broad foundation for much of this Nation's subsequent research on the vertical frontier.

General of the Army H. H. ("Hap") Arnold, U. S. Army Air Forces, was to write Dr. Gilbert Grosvenor ten years later: "We owe much to that flight. The contributions by your Society, the scientists you interested in the pioneering effort, and the cooperation you gave the Army Air Forces bore fruit in World War II far in advance of what was imagined to be the results at the time."

Your Society's interest in the lonely reaches of the sky began long before the *Explorer* flights. Officers at the time of our founding included a "Vice President for the Air," who

made annual reports on meteorological phenomena. Our fourth expedition, to Norfolk, Virginia, in 1900, studied a solar eclipse.

Earth's mother star, the sun, without which life could not exist, has been investigated by many expeditions. In 1936, two teams of scientists journeyed to Asiatic Russia to observe a blackout of the sun's face. The following year, in cooperation with the U. S. Navy, the Society sent scientists to Canton Island in

Stuck in the Hatch! Balloonists Struggle to Escape a Doomed Gondola

When *Explorer I*'s bag disintegrated (pages 22-23), the gondola dropped like a stone. Capt. Albert W. Stevens tried to climb out, but wind pressure held him half in, half out. Maj. William E. Kepner shoved him clear with his foot, then jumped. Their chutes popped open a few hundred feet above ground. Capt. Orvil A. Anderson parachuted first (upper right).

mid-Pacific to view the longest solar eclipse in 1,200 years.

In 1947 the U. S. Army Air Forces flew a 76-man eclipse team and 75 tons of equipment to a specially built airstrip at Bocaiùva, Brazil, 400 miles north of Rio de Janeiro. Nearby, a tent city rose under the Society's flag. As Project Officer, I shuttled to and from the site in a wild variety of aircraft. Once I flew in aboard an old Brazilian cargo plane that literally had sagged under the weight of an electric generator.

"There's nothing to be concerned about," a helpful crewman reassured me. "The plane is condemned anyhow."

As eclipse day, May 20, approached, I worried about the persistently cloudy sky. Father Francis Heyden, S.J., of Georgetown College Observatory, was a member of our party. I suggested to him that he had the accredited channels of communication to do something about the weather.

Father Heyden said he would see what he could do, and I'm sure he did. The skies cleared just long enough that morning to get excellent photographs and observations!

Sky Atlas Charts the Universe

In 1956 the Society and the California Institute of Technology completed their monumental Sky Atlas, one of the most significant achievements in the history of astronomy. Prepared at Palomar Observatory, it mapped a volume of space

Dry run in the gondola of *Explorer II* enables Stevens (left) and Anderson to give their instruments a preflight check.

NATIONAL GEOGRAPHIC PHOTOGRAPHER KILBURN G. STEWART © N.G.S.

Historic flight *of Explorer II* began at dawn on November 11, 1935. Rising from the Stratobowl near Rapid City, South Dakota, the helium-filled bag climbed to 72,395 feet above sea level, for 21 years the highest altitude reached by any manned craft. The National Geographic Society and the United States Army Air Corps sponsored the venture.

at least 25 times as large as ever before charted. Its 1,758 photographic plates disclosed new comets and asteroids, thousands of unknown galactic "island universes," and billions of heavenly bodies as far as six sextillion (six followed by 21 zeros) miles away.

The Sky Survey, made with Palomar's 48-inch "Big Schmidt" telescopic camera, took seven long years, instead of the four originally planned. It gave rise to certainly the most distant namesake of the Society—a baby planet, an asteroid that was named Geographos in recognition of our part in making possible this magnificent survey of space.

Research in the upper atmosphere and the challenging void beyond has written one of the proudest chapters in the Society's research history. Long before space studies became

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

JOHN H. GLENN, JR. - Navy Astronaut
Lt. Colonel, U.S.M.C.

2 August 1962

Dear Dr. Grosvenor.

The flag United with me in Space
ordered the Aeronautics flag
during Spacecraft "Friendship 7"
on February 20, 1962.

I am most pleased to
present it to you in recognition
of the pioneering contributions to
space research made by the
Geographic's early stratosphere
flights — in 1934 and 1935.

I want you to also have
the American flag - my personal
standard I carried on the flight -
as a tribute to the
Geographic many years of

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

JOHN H. GLENN, JR. - Navy Astronaut
Lt. Colonel, U.S.M.C.

Friendship 7

service rendered
with me to explore the
unknown.

My best personal regards
to Gilbert and other members
of the Society.

Sincerely,

John H. Glenn, Jr.

NATIONAL
GEOGRAPHIC
SOCIETY

popular, your Society believed in their great potential and helped pioneer the field.

Similarly, the Society engaged in man-beneath-the-sea research decades before the invention of self-contained underwater breathing apparatus made such work commonplace. In 1934, while probing the stratosphere, the Society also supported two undersea pioneers, William Beebe and Otis Barton, who were lowered in their bathysphere to a record 3,028 feet off Bermuda (page 31). Dictating from his round steel ball to his secretary far above, Beebe described "a world as strange as Mars," while Barton photographed weird and glittering creatures that floated and swam by their windows in the sea.

Other oceanographic projects have also contributed greatly to man's knowledge of the undersea frontier. In 1947-48, the Society joined Woods Hole Oceanographic Institution and Columbia University to support an investigation of the submerged Mid-Atlantic Ridge, an undersea mountain range that runs for 10,000 miles from Iceland almost to Antarctica. Led by Prof. Maurice Ewing of Columbia, the expedition sailed thousands of miles, charted underwater peaks and valleys, took samples of rock and mud from the bottom, collected marine organisms, and photographed creatures of the black depths.

Drifting Pastures of the Sea

Two years later, in cooperation with the Marine Laboratory of the University of Miami, the Society undertook a 10-year research program on the spawning grounds, migrating habits, and relationships between various species of pelagic, or seagoing, fish. The study began with organisms called plankton, the drifting pastures of microscopic food on which all marine animal life depends.

Your Society took another great plunge beneath the seas in 1952, when it began aiding the explorations of Capt. Jacques-Yves Cousteau of France, aboard his oceanographic research vessel *Calypso* (following page).

More than any other individual, Captain Cousteau has been responsible for the impetus given marine research by free-diving techniques. Many NATIONAL GEOGRAPHIC articles have described our varied programs with the co-inventor of the Aqua-Lung. In addition to support of his field work, the Society has contributed to development of his unique equipment: the diving saucer, a two-man undersea craft; "troikas," sea-bottom sleds that carry cameras and stroboscopic lighting equipment developed, under a Society grant, by Prof. Harold E. Edgerton of the Massachusetts Institute of Technology; and *Amphitrite*, a 65-foot inflatable nylon boat, carrier and tender for the diving saucer.

Society Studies Undersea Survival

Educator John Dewey once remarked, "Every great advance in science has issued from a new audacity of imagination." This past year the National Geographic Society made additional grants to aid pioneering survival experiments in the hostile high-pressure depths of the seas.

One was begun last fall by the American inventor and explorer Edwin A. Link. Lowered from the Link ship *Sea Diver*, a daring Belgian named Robert Stenuit spent a record 26 hours in a unique "undersea elevator," 200 feet down in the Mediterranean off Villefranche, on the French Riviera. Although 58 years old, Link himself had previously spent eight hours submerged.

The 11-foot-long tank, designed by Link as the first stage of a "Man-in-Sea" system, was filled with a special mixture of helium and oxygen under pressure matching that of the sea outside. Thus Stenuit, breathing normally, could talk on a telephone to the surface, eat, and even sleep. He could open his hatch and, wearing normal free-diver's gear, leave on excursions into the depths.

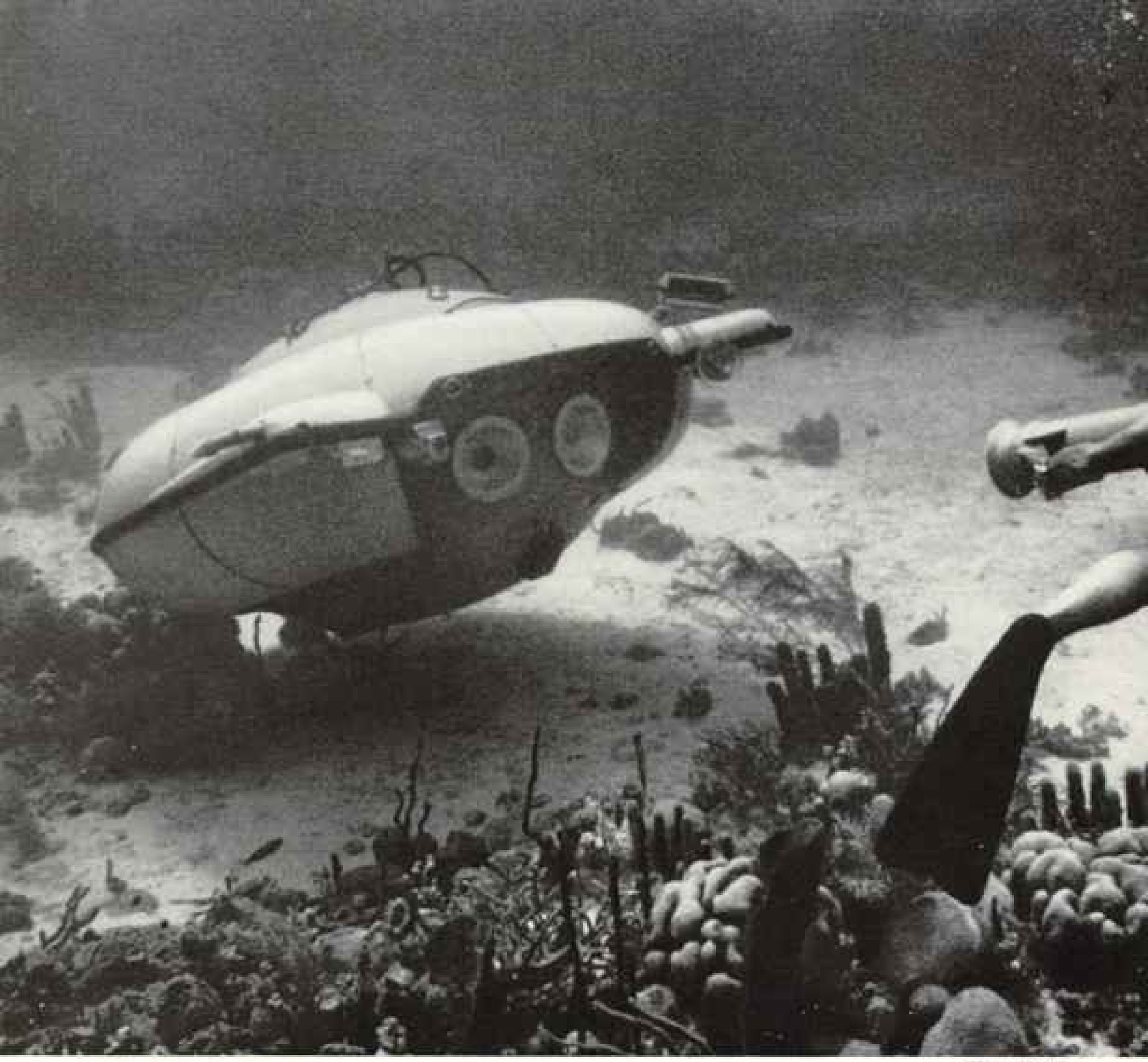
Hauled back to the surface quickly, rather than stage by stage, Stenuit—still in his tank—could spend the normal long decompression period on the deck of the ship. While an air conditioner kept him cool, he smiled through a porthole at his wife.

In September, also in the Mediterranean, two divers of Captain Cousteau's team—Albert Falco and Claude Wessly—descended

U. S. and National Geographic Flags Circled Earth With Glenn in *Friendship 7*

America's first orbital spaceman, Lt. Col. John H. Glenn, Jr., U.S.M.C., presented the flags to President and Editor Melville Bell Grosvenor in recognition of the Society's support of early balloon flights into the stratosphere. For his epic flight, Astronaut Glenn received the coveted Hubbard Medal, the Society's highest honor for exploration.

PHOTOGRAPH BY ROBERT S. OAKES, NATIONAL GEOGRAPHIC STAFF © N. G. S. FLAGS ABOUT ½ ACTUAL SIZE



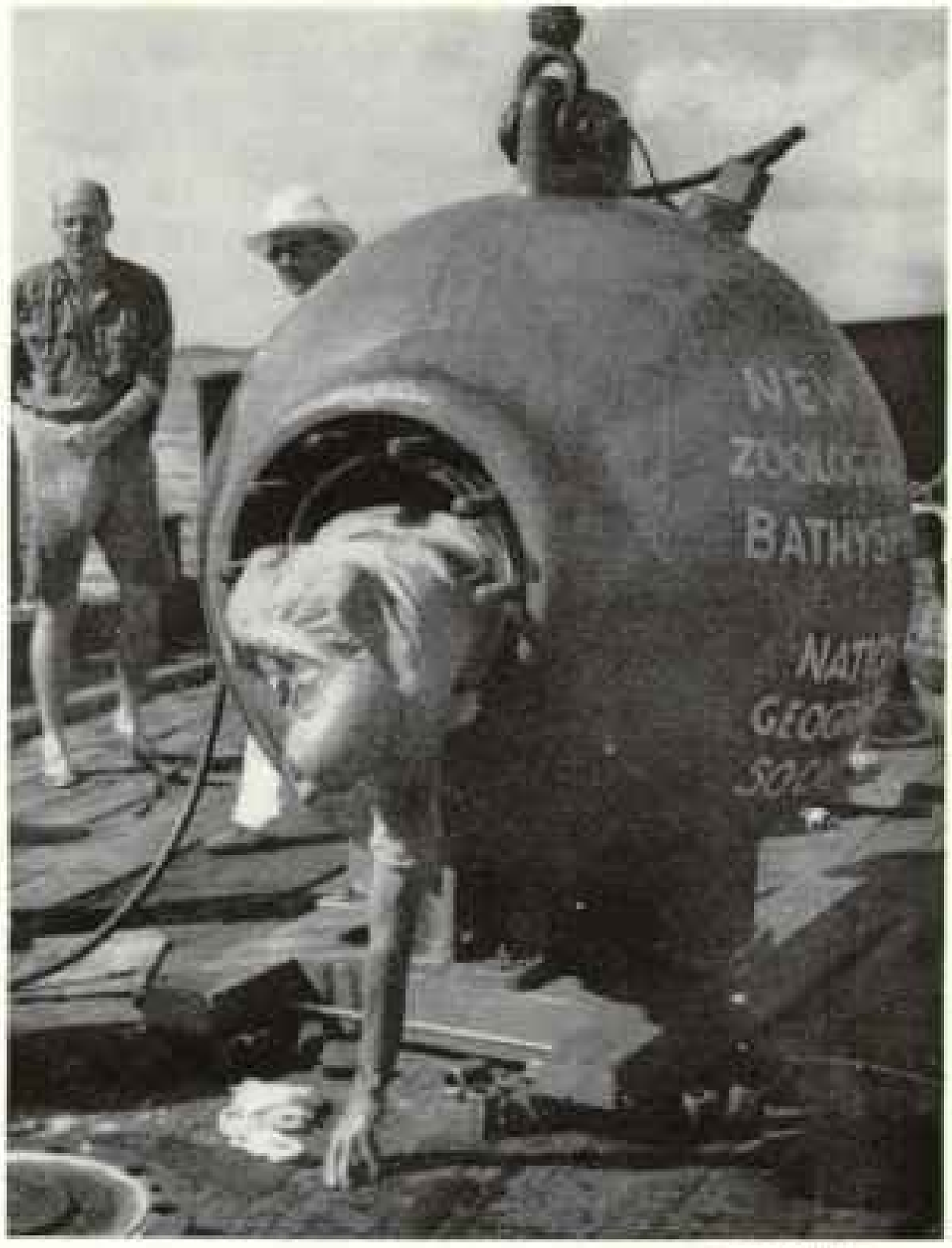
PAINTING BY PETER

ILLUSTRATION BY THOMAS J. ABERCROMBIE, NATIONAL GEOGRAPHIC STAFF © N.G.S.

Man meets monster above the sea floor. Aiming his camera like a bazooka, Capt. Jacques-Yves Cousteau films *Denise*, the diving saucer, in the depths of the Caribbean. Able to go deeper and stay down longer than a free diver, the jet-propelled baby submarine aids man's underwater probes. Pilot and observer peer through twin portholes.

Undersea explorer Cousteau leads the National Geographic-*Calypso* expeditions for oceanographic research. In 1961 the Society awarded him its Gold Medal for his pioneering efforts in the silent world.

Mother ship for Captain Cousteau's fish men, *Calypso* suspends the diving saucer from her stern.



DAVID SHUMAN

Headfirst, Dr. William Beebe emerges from the bathysphere, a diving chamber that in 1934 carried him and Otis Barton (left) to a record 3,028-foot depth in the sea off Bermuda. Your Society sponsored the dive.

Ancient amphorae lie in Mediterranean mud off Marseille, France. A National Geographic-*Calypso* diver salvages wine jars from a Greek ship that sank 2,200 years ago.

some 33 feet to a similar but larger cylindrical chamber, where they stayed seven days.

Their temporary home contained two rooms, one a living space, the other a workshop. From it the frogmen swam out each morning, building concrete fish houses and planting plastic kelp to lure sea creatures.

Their shelter was linked with the surface by air pipe, power line, telephone, and television. It had running water, heat, and light. A doctor visited the men each day. When one diver developed a toothache, a dentist swam down with a drill.

Both experiments, designed to test man's reactions to prolonged periods under great pressure, foretell a day when technicians may make extended undersea searches for oil or other minerals, or workmen may stay down for days or weeks at underwater farming or construction projects.

Divers Excavate Byzantine Ship

Most archeologists comb the dust for their finds, but George Bass, of the University of Pennsylvania Museum, seeks his on the floor of the eastern Mediterranean off the coast of Turkey. There he and his colleagues, sent by the museum and your Society, last summer excavated the ruins of a Byzantine ship. A find of gold coins, showing the head of Heraclius, 7th-century Byzantine emperor, enabled them to date the shipwreck. From an inscribed metal bar they even learned the name of the skipper, George the Elder, who went down with his vessel.

Mr. Bass and his crew adapt precise land-dig and surveying methods to undersea conditions. They set up underwater drafting frames, grids, and plane tables to prepare accurate charts of the wreck, use frosted plastic to sketch locations, and attach plastic tags to their finds.

"When the excavation is completed," says Mr. Bass, "we want a plan that would enable a shipwright to build a Byzantine vessel—plank by plank and nail by nail."

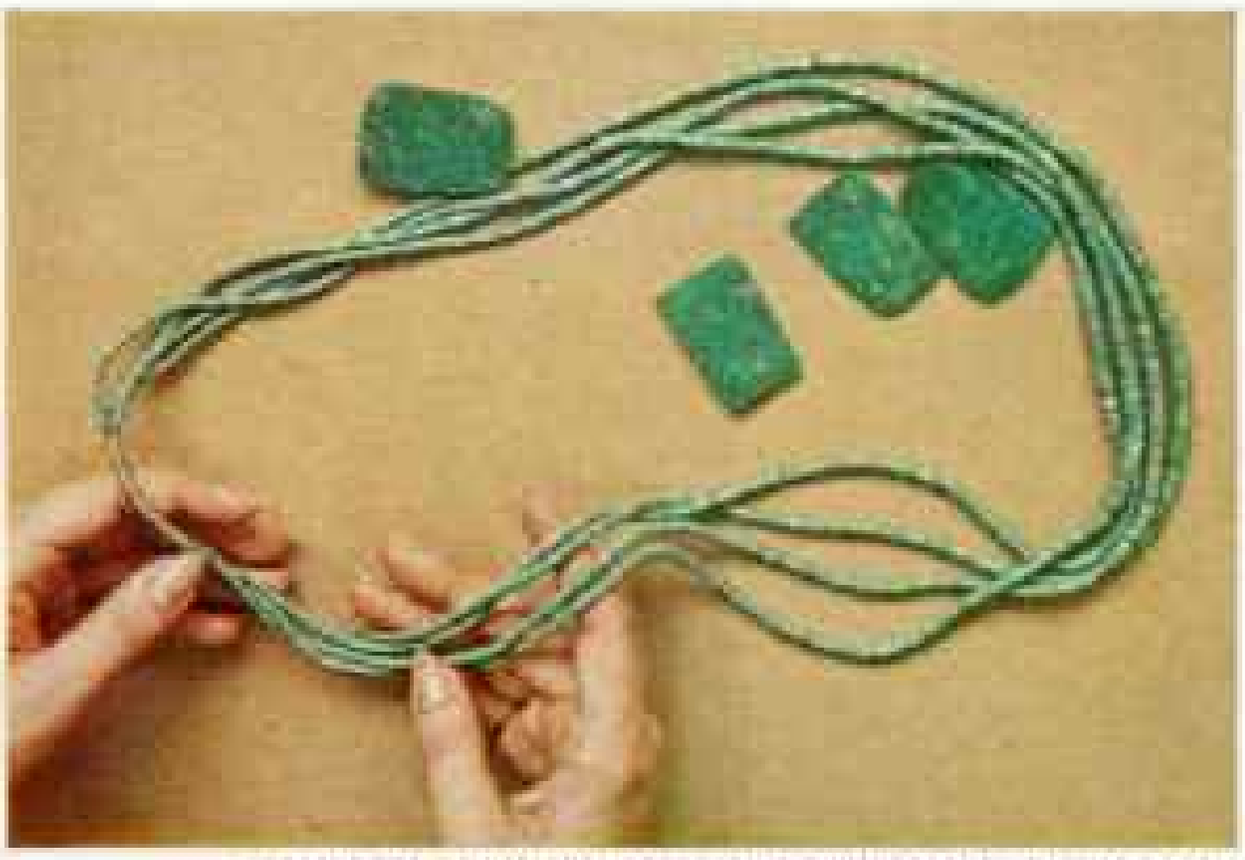
Not far away, on land, another team dug into the dusty past of the Old City of Jerusalem. Dr. Kathleen Kenyon, a British archeologist, is undertaking a seven-year research program supported by various organizations, including your Society.

The first two years, just completed, produced reliable evidence on the location and extent of the city's early settlement, ancient walls, and sacred sites. There are indications that Jerusalem was much larger during the early Jewish kingdom than had been believed, that walls supposedly dating from the time of David and Solomon were actually built in

Brass watch fixed the time of an earthquake that tipped Port Royal, Jamaica, into the sea in 1692. A National Geographic-Smithsonian team mapped the sunken city.

Drowned bottle found at Port Royal yields 267-year-old wine to a hypodermic needle.

Aqua-Lunger plots position of cargo of a Byzantine ship that sank off Turkey 1,300 years ago. The Society and the University of Pennsylvania Museum support the work.



PHOTOGRAPH BY NATIONAL GEOGRAPHIC PHOTOGRAPHER THOMAS NEBBIA

Turquoise treasure attests the skill of a pre-Columbian craftsman. Unearthed in Pueblo Bonito, New Mexico, the necklace contains 2,500 hand-shaped beads.

Ruins of Pueblo Bonito cover three acres on the floor of Chaco Canyon. Eight hundred rooms cling together like the cells of a honeycomb. Eight National Geographic Society expeditions in the 1920's unearthed the thousand-year-old Indian city.

PHOTOGRAPHED BY BRUCE HOWELLS © N. G. S.

Grooved bone from Russell Cave, Alabama, enabled early man to whet bone awls.

Sifting the sands of time, diggers in Russell Cave probe 9,000 years into Alabama's prehistory. Excavated by a National Geographic Society-Smithsonian Institution expedition, the site portrays the evolution of the Indian from his pre-Stone Age ancestors. The cave, given to the Nation by the Society, became a national monument in 1961.

Layer on layer of bones, weapons, and tools lie where the occupants left them. Stakes tell the diggers where to work. Gasoline lanterns cut the gloom.

KODACHROME BY RALPH GRAY, NATIONAL GEOGRAPHIC STAFF © N.G.S.

the 2d century B.C., and that the accepted site of the Church of the Holy Sepulchre is authentic.

A number of our 1963 activities represent continuing projects. At Mesa Verde National Park in Colorado, for example, scientists continue five years of archeological detective work into the mysterious past of Pueblo Indian cliff dwellers who flourished amid the arid hills for centuries, then vanished.

Cosponsored by the Society and the National Park Service, the work at Mesa Verde seeks to preserve the crumbling ruins of cliffside communities at Wetherill Mesa, an area within the park. One ghost settlement, Long House, has been cleared (page 37). Others, such as Step House, Badger House, Mug House, and Two-Raven House, eventually will become sightseeing attractions. Meanwhile burial pits, pottery, tools, basketry, and ornaments emerge from the debris.

On visits to Wetherill Mesa, I have clambered laboriously down steep canyon walls to reach apartments of these vanished cliff dwellers. I can testify that they must have been a sure-footed people, untroubled by vertigo. Some of their dwellings are accessible only by small footholds chiseled into the cliff.

A systematic, almost foot-by-foot investigation of the area is under way so that we may know more about these cliff people. Last August, in Step House, excavators unearthed a naturally mummified Indian baby wrapped in rabbit skins and a feather blanket. A curious stone pit, probable site of secret religious ceremonies, also came to light.

Science Reconstructs a Culture

Altogether, 32 interrelated studies—from soil analysis to collecting plants and insects—converge at Wetherill Mesa. From the findings, investigators hope to learn how the cliff dwellers lived, the crops they grew, the game they hunted, the rites they practiced, and—above all—what happened to them.

Did they abandon their homes because of a devastating drought? Or did powerful enemies drive them away? Present evidence lends support to both theories.

"When the returns are in," says Dr. Douglas Osborne, supervising archeologist, "I believe the Wetherill Mesa project will stand as one of the most fruitful 'in-depth' operations of its kind ever undertaken. It asks not only the

Stone Canopy Protects a Cliffside Ghost Town

Abandoned 700 years ago, Long House sheltered Indians who farmed Wetherill Mesa until drought or enemies forced them to leave. Built in a huge rock alcove providing a haven against marauders, the fortresslike dwelling could be reached only by steep paths. Algae colonies streak the overhang.

Wetherill Mesa, part of Mesa Verde National Park in Colorado, takes its name from a ranch family who discovered the ruins. To learn about the vanished Indians, the Society and the National Park Service began excavating the site in 1958. Dr. Douglas Osborne, who supervises the work, reports progress to Conrad L. Wirth (right), Park Service Director and a Trustee of the Society.

Mesa dweller's skull (left) and ancient pottery emerge from the dust of centuries.

questions of what, where, and when, but the infinitely more difficult ones of how and why."

The work at Mesa Verde is closely akin to an earlier project, the Society's classic excavation of Pueblo Bonito in Chaco Canyon National Monument, New Mexico. It, too, was the home of pre-Columbian Pueblo Indians, and a task force led by Neil M. Judd of the Smithsonian Institution saved the pueblo during the 1920's (preceding page).

At the same time the Society sent other expeditions to Pueblo Bonito under Dr. Andrew Ellicott Douglass, who dated the ruins by his technique of reading annual growth rings in trees used as beams by the original builders. Dr. Douglass charted the rings of trees whose felling time was known, matched them to overlapping patterns of older trees, and developed a tree-ring calendar that could be applied to the oldest beam unearthed at Pueblo Bonito. It was cut in the year 919.

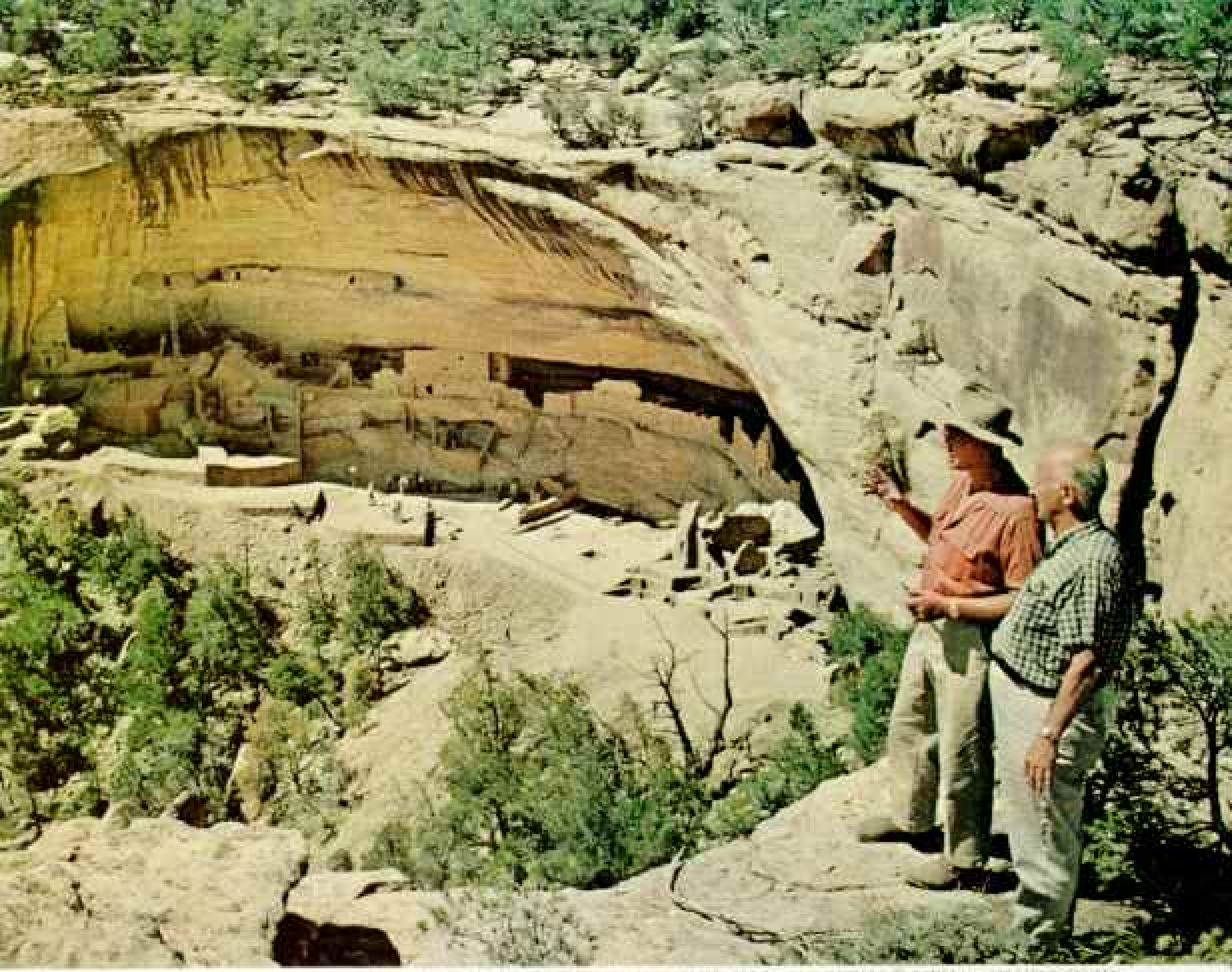
In 1961 your Society presented to the National Park Service one of the oldest known homes of primitive man in the southeastern United States—Russell Cave near Bridgeport, Alabama. The cave, purchased by the Society, had been excavated over a three-year period in cooperation with the Smithsonian Institution. Probing the cavern's floor to a depth of 32 feet, diggers brought up tools, weapons, utensils, and bones from successive layers of family living (page 34). The record goes back from the last and topmost layer of occupancy, about A.D. 1650, to more than 7000 B.C.

Russell Cave has been designated a national monument by President Kennedy. In 1963 a new visitors' center, dramatizing the cave's past, is scheduled for completion.

Explorer Finds Lost Inca Citadel

Our first archeological expedition, in 1912, uncovered the most spectacular find in the history of South American exploration: Machu Picchu, lost city of the Incas, built centuries ago on a Peruvian mountaintop.

A young Yale professor, Hiram Bingham—later a U.S. Senator—led the excavators. After three years of digging, conducted with Yale University support, the Inca citadel emerged in rows of stone buildings, all



linked by thousands of stone stairs climbing dizzily up the precipitous slopes (pages 20-21).

The longest and most extensive of our many archeological programs was a series of interrelated studies in Mexico, Panama, and Ecuador from 1938 to 1957. During those years 15 expeditions, sponsored jointly by the Society and the Smithsonian, went out. Thirteen were led by Dr. Matthew W. Stirling, then Director of the Smithsonian's Bureau of American Ethnology, and two by Dr. Philip Drucker, also of the Smithsonian.

These expeditions sought knowledge of vanished Indian cultures. The finds ranged from colossal basalt heads weighing 20 tons (next page) to delicately carved jade figures smaller than a fingernail. A stone stele unearthed near Veracruz, Mexico, proved to be the oldest dated work of man found in the Western Hemisphere. It bore an inscription in Maya dot-dash symbols equivalent to November 4, 291 B.C. (Spinden correlation).

To wrest such information from jungle wilderness or mountain heights requires stamina and courage. On many expeditions physical discomfort becomes a way of life, and mishaps sometimes occur.

Richard H. Stewart, Assistant Chief of our Photographic Laboratory, nearly drowned when raging river waters overturned a dugout canoe in Central America. Members of a 1948 expedition to Australia's Stone Age Arnhem Land, among them Howell Walker of our Foreign Editorial Staff, were shipwrecked on that bleak coast, and for a time were believed lost.

We tell our representatives there is nothing they can bring back so precious as their lives. To date we have been fortunate enough not to lose a man on an expedition. Careful planning and good equipment lessen the risk.

On one expedition, the planning even included how to avoid being shot. Bandits infested China in the 1920's when botanist Joseph F. Rock led several plant-collecting expeditions into the interior (page 17). So Dr. Rock hired his own small private army, and they fought off many attacks. On one occasion he spent the night in the burial chamber of an old temple, sitting among coffins

with his precious plants and two .45-caliber pistols beside him, while brigands prowled around the walls of a village his "army" had occupied.

Dr. Rock brought home valuable zoological and botanical specimens, including a blight-resistant chestnut tree. He also explored, mapped, and photographed regions new to Western cartographers.

Botanist Discovers Awesome Inferno

Part of the fascination of research is that it often produces totally unexpected results. For example, one would not expect a botanical expedition to discover a physical wonder of the world. But it happened.

In 1915 the Society sent a small party to Alaska under botanist Robert F. Griggs. Three years earlier Mount Katmai had literally blown its top, and Dr. Griggs wanted to study the explosion's effects on vegetation.

Having recorded some interesting phenomena, Griggs's team returned in 1916. While making a routine field trip along the Katmai Pass trail, Dr. Griggs saw a puff of smoke rise from behind a hill. He climbed the hill and looked down into a seething miles-long inferno. Plumes of steam, thousands of them, rose high in the air from the boiling, hissing caldrons of fumaroles.

"It was as though all the steam engines in the world, assembled together, had popped their safety valves at once," Dr. Griggs wrote later in the Magazine.

He named his discovery the Valley of Ten Thousand Smokes. The Society sent four more expeditions to the Mount Katmai region, and articles in your journal on the valley's weird sights so stirred public interest that President Wilson in 1918 preserved the area as Katmai National Monument.

Katmai is one of seven areas that the Society has helped the Government to establish or enlarge as either national parks or monuments.

Willis T. Lee explored the dark and labyrinthine passages of Carlsbad Caverns, New Mexico, for the Society and the U. S. Geological Survey during the early 1920's. NATIONAL GEOGRAPHIC descriptions and photographs of its underground wonders led to Carlsbad becoming a national park in 1930.

Individual members of the Society contributed $100,000 to save the big trees of California's Sequoia National Park.

El Rey—so named because he was the king of 11 huge heads found in southern Mexico—gets his colossal face patched. A National Geographic Society-Smithsonian Institution expedition found the 30-ton basalt image in 1946. Created by long-dead Indians, the flat-nosed idol wears a cap suggesting a football helmet.

Temple of the Seven Dolls rises from the rubble of Dzibilchaltun, long-lost Maya city in Yucatán. George E. Stuart, member of a 1958 National Geographic-Tulane University expedition, surveys pre-Columbian ruins that cover 20 square miles.

Seven clay dolls gave the temple its name. All showed some monstrous deformity, suggesting that they may have been priestly devices for curing diseases.

Up from the depths of Cenote Xlacah come drowned Maya treasures. For 3,000 years dwellers in Dzibilchaltun tossed clay pots and ornaments into the pool. Searching by touch, Aqua-Lungers probed as far down as 144 feet. Expedition leader E. Wyllys Andrews works at left. Lyman J. Briggs, Chairman Emeritus of the Society's Committee for Research and Exploration, stands beside him.

Later the Society made a lump-sum grant to help create Shenandoah National Park in Virginia.

Year by year, as earth's untouched places shrink, explorers must move faster if they would see and record examples of primitive life before they vanish forever.

Race Against Modern Times

In the remote, unpacified highlands of West New Guinea, Karl Heider hurries to finish a still- and motion-picture ethnographic survey of the Stone Age Dani people before a government program brings this tribe into the 20th century. Your Society and the Peabody Museum of Harvard University support Mr. Heider's important photographic documentary.

In Brazil Dr. Harald Schultz, of the São Paulo State Museum, faces a similar problem. Civilization is moving rapidly up the Sangue River toward another remote and primitive tribe, the Canoeiro. Dr. Schultz's camera captures their eternally dark huts and ancient tools, bright feather garments, and the huge wooden disks that stretch their earlobes. His tape recorder preserves their strange music, songs, and language.

But time is running out. When the long-feared Canoeiro went off the warpath recently, rubber tappers, diamond prospectors, cattle breeders—and even criminals fleeing justice—began to move into the area.

You could stock a sizable Noah's Ark with the birds, animals, and insects that Society explorers have observed—and sometimes discovered—in their native haunts.

"We have found the curlew's nest," said a terse telegram received at our headquarters on June 18, 1948. It came from Dr. Arthur A. Allen, Professor of Ornithology at Cornell University, who had traced the nesting place of the bristle-thighed curlew to a lonely field in southwest Alaska.

Though known to ornithologists for 163 years, this member of the sandpiper family was the last of all North American birds to yield the secret of its fledgling young.

Dr. S. Dillon Ripley of Yale University's Peabody Museum scored another spectacular find the same year in Nepal when he bagged the first specimen of a spiny babbler seen alive by a foreigner in 105 years.

For years reports from our natural history expeditions have provided some of my most

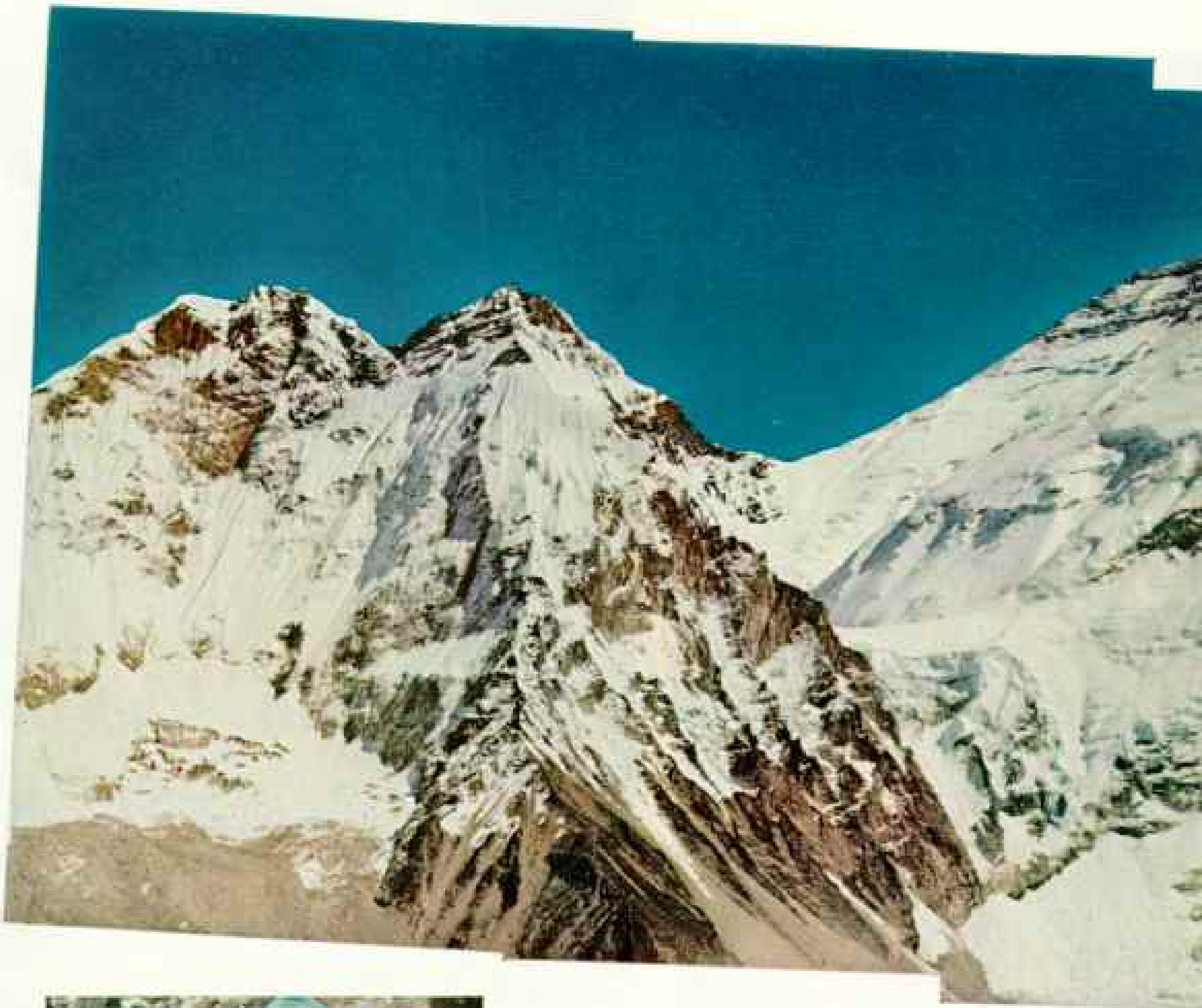
EQUACHROMES BY E. THOMAS GILLIARD © N.G.S.

Soaring plumes of King of Saxony bird of paradise display serrated blue flags to attract a mate in a New Guinea forest.

Porters Fording a New Britain River Snatch Up Drinks in Cupped Hands

Approaching an unknown "land of fire," the fearful men refused to continue. Notwithstanding, E. Thomas Gilliard's 1958 zoological expedition carried on to become the first to penetrate the heights of southern New Britain. There he discovered five birds new to science.

Focusing a long lens, ornithologist Gilliard sights a distant bird. He has led three campaigns into New Guinea and New Britain for the Society and the American Museum of Natural History.



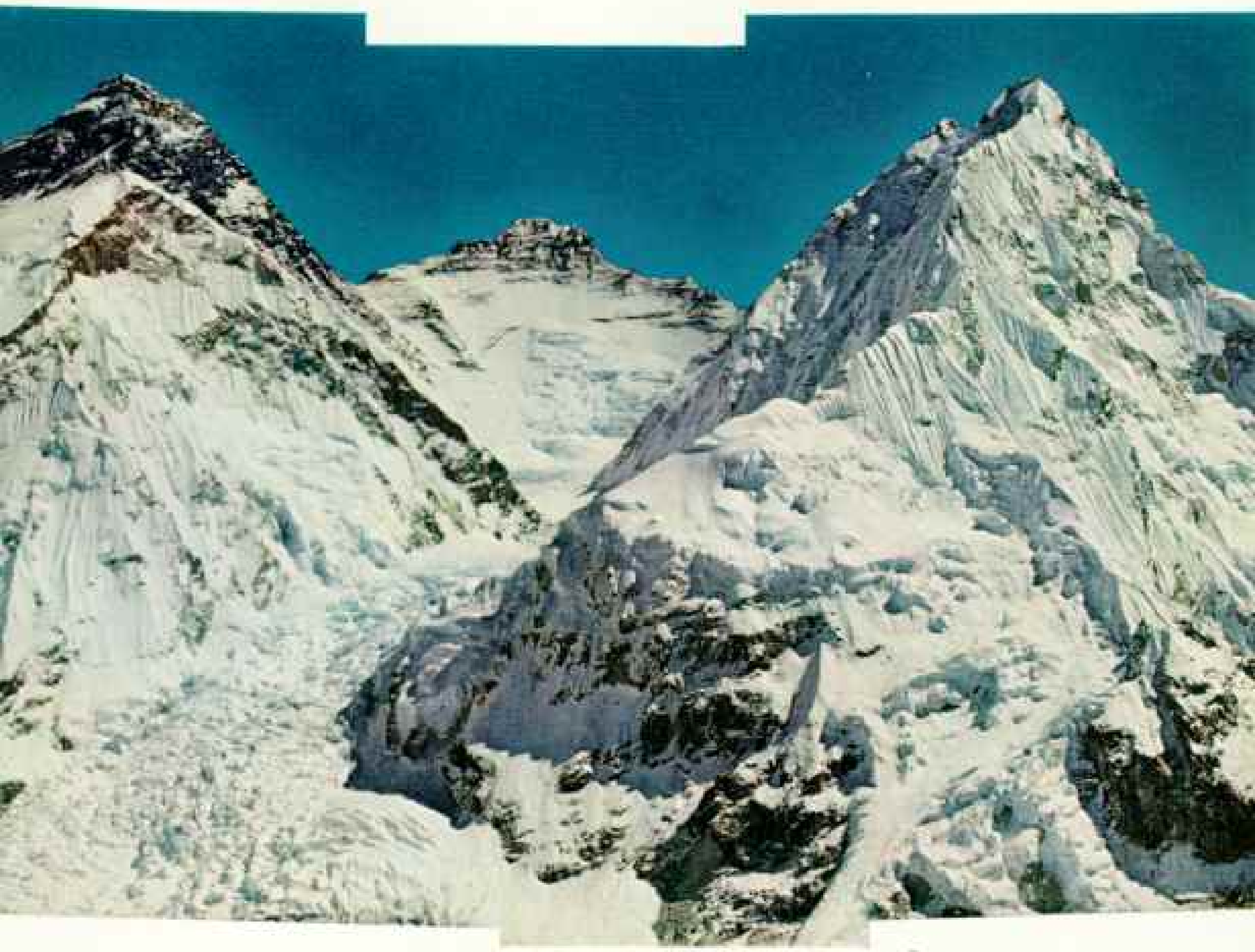
Forbidding Himalayan peaks close craggy ranks against intruders. In the center soars Everest, at 29,028 feet the world's loftiest mountain. Lhotse (27,923) and Nuptse

Oxygen mask disguises an expedition member training on Mount Rainier, Washington, to meet rarefied Himalayan air. Rubber bladder fills with oxygen.

interesting reading—tales of vanishing birds of paradise in New Guinea (preceding page), a totally new species of honey creeper in the Amazon Valley, the strange courtship practices of British Guiana's cock-of-the-rock.

My mail discloses strange facts about pink flamingos in the Bahamas, the rare and beautiful scarlet ibis of Venezuela, a new species of thicket warbler in New Britain, the monkey-eating crowned hawk eagle of South Africa. Among the most curious is the raucous, pheasant-sized hoatzin, a bird that climbs better than it flies. Indigenous to lonely upriver shores in British Guiana, it has claws on its wings, and long, curling eyelashes.

Studies of butterflies flitting through the rain forests of Trinidad, of the world's biggest ants and giant beetles crawling about the jungles of northern Brazil—these and many other projects have given the world new knowledge of the way insects live, mate, and outwit or battle their enemies.



EXPEDITIONS BY EXPEDITION LEADER NORMAN A. NEHRENFURTH © NATIONAL GEOGRAPHIC SOCIETY

(25,726) flank it to the right. All three await the 1963 assault of the American Mount Everest Expedition, whose studies in glaciology, geology, and solar radiation will be undertaken by your Society. Khumbutse (21,785 feet) and Changtse (24,780) loom at left. Six overlapping pictures compose this stark panorama.

Just as the Society's first expedition in 1890 challenged a formidable mountain foe, so too, in our Diamond Anniversary year, dedicated men face another.

Assault on Everest for Science

One of the Society's latest grants supports an American expedition now preparing to ascend Mount Everest. The purpose is not simply an assault on Everest's peak and those of neighboring Lhotse and Nuptse; instead, some basic questions will be asked of the inscrutable white-crowned giants (above). For example, what effect does this highest land mass have upon the world's weather?

Specialists, including NATIONAL GEOGRAPHIC Foreign Editorial Staff member Barry C. Bishop and geologist Maynard M. Miller of Michigan State University, will study the mountains' rocks and ice, solar radiation, atmosphere, and other phenomena.

In spite of oxygen equipment, the climbers' muscles, nerves, and mental processes deteriorate gradually in the thin, bitter air. Physiologists will study this deterioration, and psychologists will observe changes in individual and group behavior stemming from a prolonged state of stress.

As it has been for the past 75 years, the goal will be new geographic knowledge. New knowledge—the most frustrating, rewarding, and enviable of pursuits! THE END

Accounts of expeditions and research projects mentioned in this article, as well as others listed on pages 13-16, may be located through the Cumulative Index to the National Geographic Magazine: Vol. I, 1899-1946; Vol. II, 1947-1956 (with supplements to date).


12
11

Copenhagen

WEDDED TO THE SEA

By STUART E. JONES

Photographs by GILBERT M. GROSVENOR

Both National Geographic Staff

DANES GROW TIRED of hearing their exuberant capital referred to as "Copenhagen, Paris of the North." They retort: "Paris, the Copenhagen of the South."

The two cities have much in common. Both approach life with zest and gaiety. Never take anything too seriously, least of all yourself.

One fine day I strolled with Mogens Rasmussen, a young Danish writer, beside the Peblinge Sø, or Pupils Lake, near the heart of Copenhagen. "Paris of the North, eh?" said Mr. Rasmussen. "Well, *there's* something you won't see in Paris."

He pointed to a fleet of tiny sailboats (left). Each manned by a youngster, they made a brave sight as

Junior sailors, running with a fair wind, race prams across Pupils Lake bordering central Copenhagen (map, page 531). Built on islands, the Danish capital has a maze of waterways thronged by ships and boats.

they skimmed against a background of handsome apartment houses.

The mid-city sailing program, my friend explained, was sponsored by the newspaper *Politiken*, with other business firms cooperating. The aim: to indoctrinate boys, even before they reach their teens, in the feel of sea and wind.

"These boys may not know it," Mr. Rasmussen said, "but they're training to become useful citizens. Later, you may find them on the bridges and in the engine rooms of Danish ships. Maritime commerce we take very seriously, for without it we could not live."

Copenhagen is wedded to the sea. This was emphasized again when I talked a few days later with Arnold Peter Møller (below). Eighty-six-year-old "A. P." may be the world's only multimillionaire who sails a boat to and from work every day, fair weather or foul.

I found A. P. in his office overlooking Kongens Nytorv, the bustling King's New Square. From this command post he directs an empire —shipyards, refineries, petrochemical plants, a sugar plantation in Kenya, and the Maersk Line's 80-odd freighters and tankers on round-the-world service.

We chatted a while; then my host looked at his watch and at an instrument on his desk whose twin dials told him the wind direction and velocity.

"Four o'clock," he said, rising to his six-foot-three-inch height. "The wind is from the south; 15 knots. A fair wind. Shall we go?"

Scorning an elevator, he darted down two flights of stairs. A chauffeur handed us into a venerable gray Citroën.

Sign of Prosperity: Jammed Traffic

As we moved off, A. P. glared at surging masses of automobiles, trucks, buses, motor scooters, and bicycles. Tooting and hooting, these symbols of prosperity funneled through the streets. Customs duties and other taxes double the list price of an automobile. Yet, among the 1,263,000 residents of the capital and suburbs, one in every eight owns a car.

As for Copenhagen's bicycles, nobody knows precisely how many there are, perhaps 300,000. At rush hours, bikes and riders erupt with a cheery jingling of bells into H. C. Andersen's Boulevard and other busy streets.

"There," said A. P., gesturing toward a clogged intersection, "is why I sail to and from work."

It was an in-and-out day—bright sun one minute, pelting rain the next—typical of the fleeting Scandinavian summer. At Langelinie, the lush green park that fronts on Copenhagen's harbor, a man in yellow oilskins met us with a dinghy at the quayside. He rowed us through a heavy downpour to Mr. Møller's 60-foot auxiliary cutter, *Karama III*.

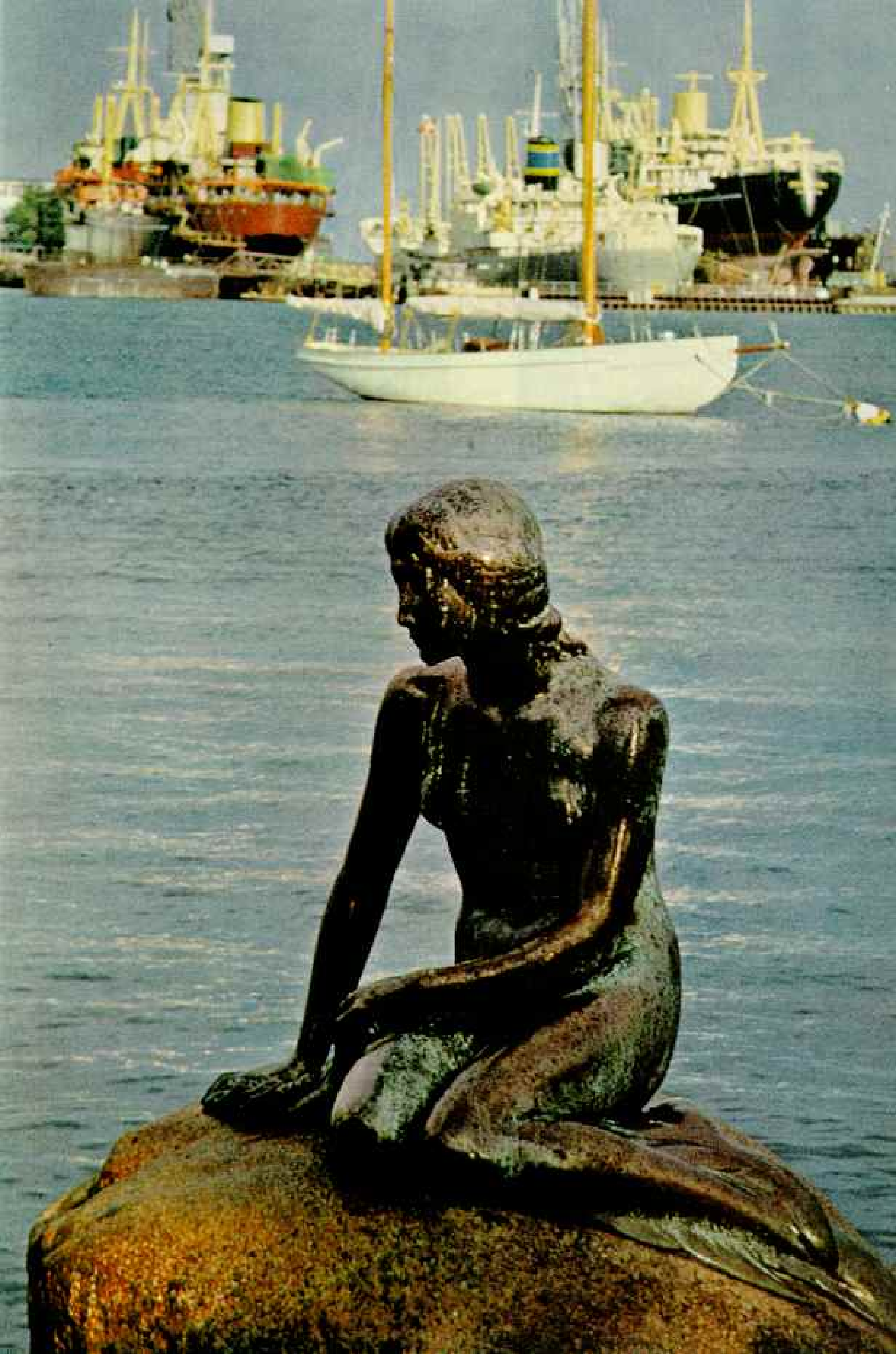
(Continued on page 53)

Sailing to work, 86-year-old shipowner A. P. Møller epitomizes the average Dane's lifelong love affair with the sea.

Perched on a Rock, The Little Mermaid Drinks in the Sea With Pensive Eyes

Denmark's most photographed girl, the heroine of Hans Christian Andersen's fairy tale about an aquatic beauty who fell in love with a prince, watches over Copenhagen harbor. Sculptor Edvard Eriksen executed the graceful bronze figure. Sitting in the sun, she looks as though she had just slipped out of the waves. Shipbuilding yards of Burmeister & Wain, Denmark's largest industrial plant, loom across the harbor.

PHOTOGRAPHS BY GILBERT M. GROSVENOR, NATIONAL GEOGRAPHIC STAFF © N.G.S.



Distinguished physicist Niels Bohr earned a 1922 Nobel Prize for his atomic studies.

Pastor Palle Bartholin, in ceremonial clerical garb, attends a royal reception.

Beauty in a bower. Dark eyes and dark hair say that not all Danes are fair and blond.

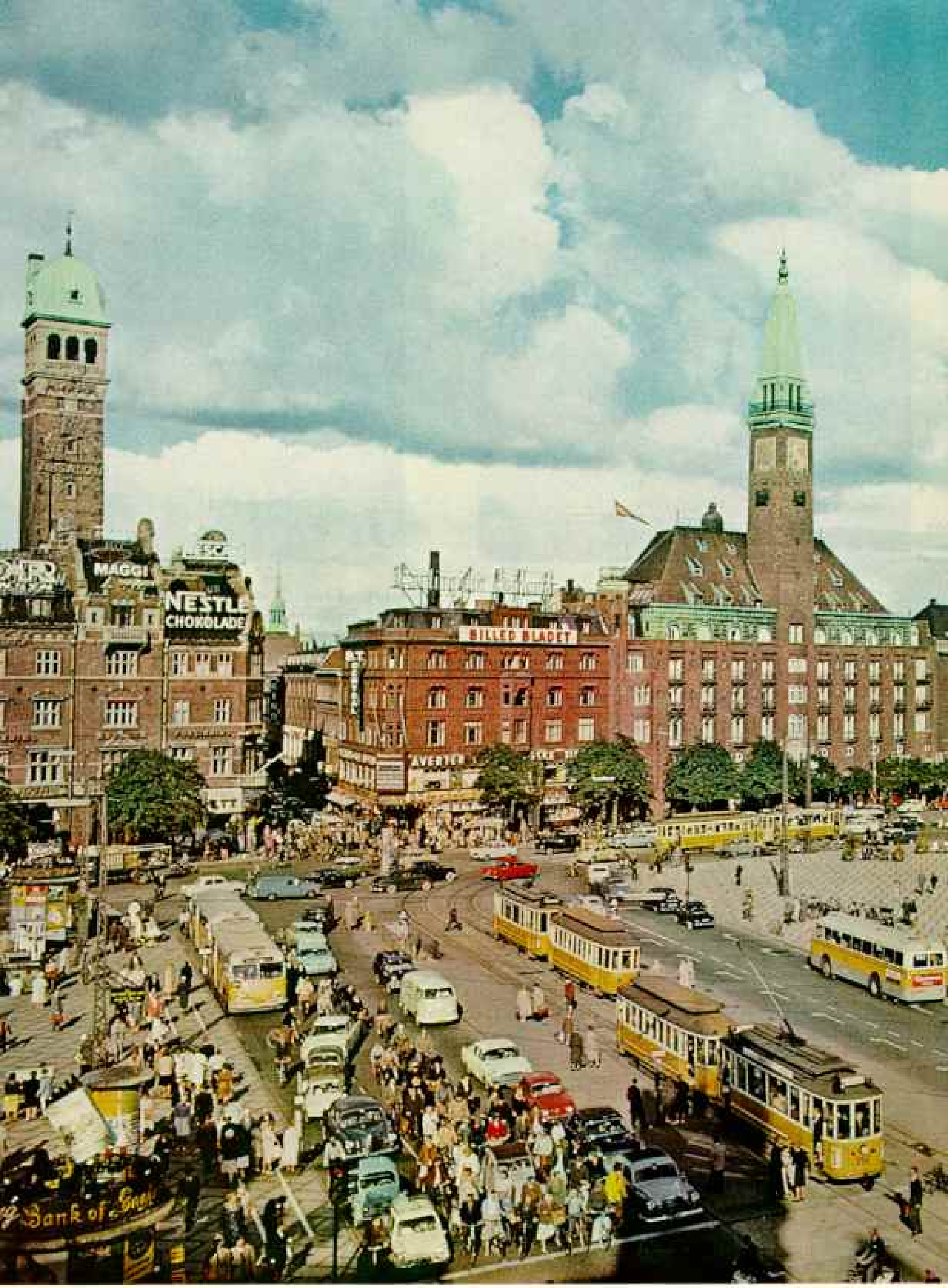
Knight's Cross of the Order of the Dannebrog adorns the tunic of Col. Tage Hansen.

Plumed cocked hat tops the finery of Holten Eggert, Denmark's Ambassador to Moscow.

Glow of health sets off the lustrous Danish mink draping a Copenhagen girl.

Decorated Dane arriving at King's reception wears Commander's Cross on a neck ribbon.

Matron puffing a *cerut*, or small cigar, is a commonplace sight in Copenhagen.



Lofty Towers Fence Town Hall Square, Commercial Center of Copenhagen

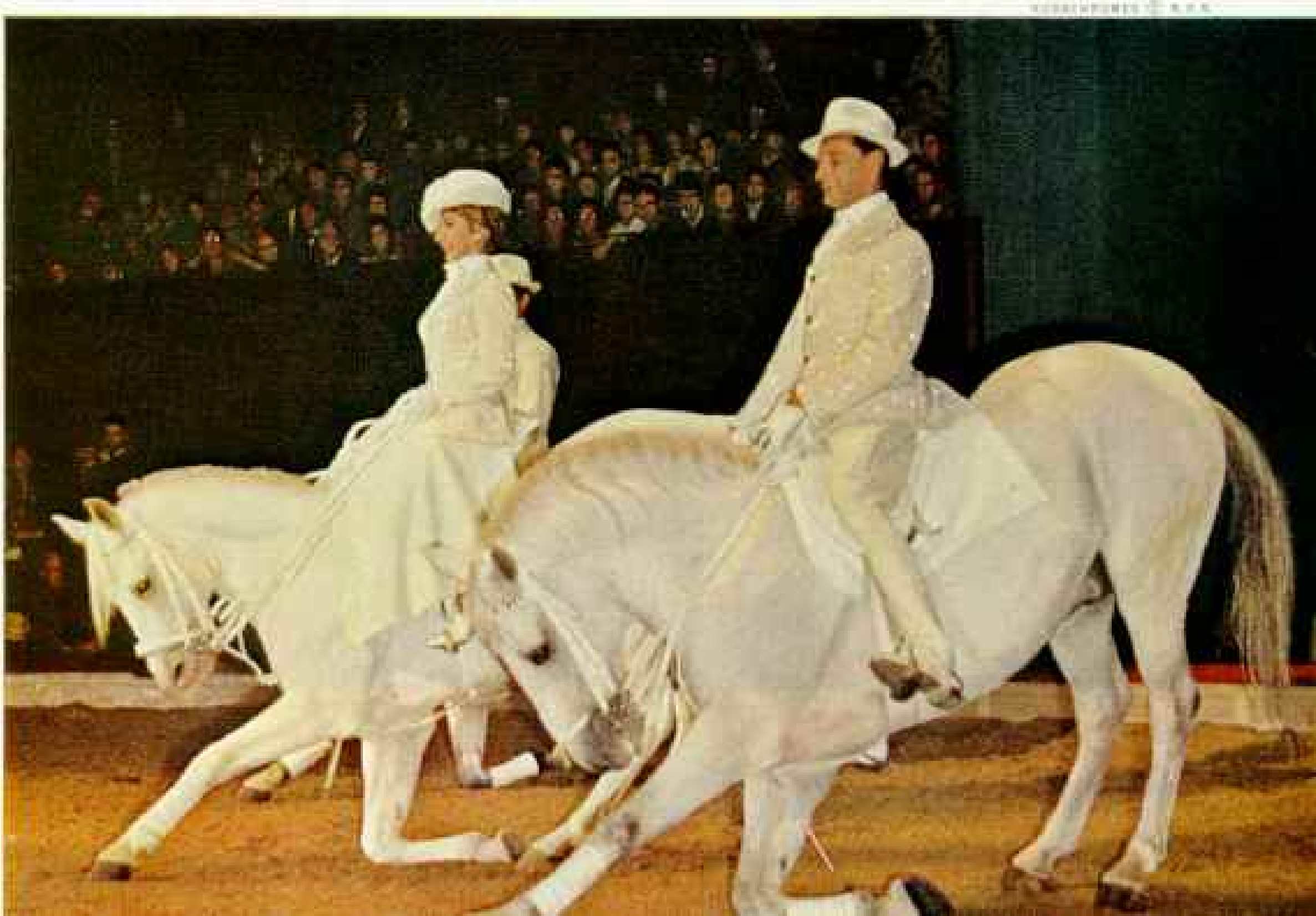
The city's coat of arms crowns the roof of Copenhagen's massive Town Hall at right. Bronze statues

of old-time watchmen stand beside it. Some six hundred rooms include offices of the mayor and city council. Cars and bicycles, tandem trolleys and buses jam the streets from dawn till midnight.

Lucky, Trained Giraffe, Extends Tongue for Circus Star's Reward

Copenhagen's Circus Schumann bills itself as the oldest in the world—114 years. Owned and operated by the fifth generation of the Schumann family, it features acrobats, clowns, performing tigers, and sleek show horses (below). Nightly performances and three matinees a week draw full houses in a permanent building near Tivoli, Copenhagen's famed amusement center.

Elegant horses with elegant riders bow gracefully at show's end. Circus princess Pauline Schumann leads this trio.



In the cabin we donned foul-weather gear. The owner took the tiller in streaming rain, while two paid hands hoisted mainsail and jib. The cutter moved swiftly; our heading was almost due north, toward the Møller home overlooking Øresund, The Sound, a few miles from downtown Copenhagen.

Commuter Fights Salty Traffic Jam

There was traffic here, too. Long, low launches were filled with raincoated tourists eager to see Copenhagen's famous bronze trademark, The Little Mermaid, perched on an offshore rock (page 47). White yachtlike ferries plied the 18-mile run between Copenhagen and Malmö in Sweden. Other ships, their prows knifing toward the open sea, were bound to ports throughout the world.

We altered course to avoid an outbound freighter, deep-laden with supplies for Denmark's huge overseas county of Greenland. For maximum visibility in the foggy northern wastes, the ship was painted bright red.

We glided past the *Empire State IV*. This training ship of the Maritime College of the State University of New York was paying a call so that her cadets could see Copenhagen's shrines and monuments.

"Just now," said A. P., observing a colorful swirl of activity near *Empire State's* gangway, "it looks as though the shrines and monuments have come to see the cadets."

The shrines and monuments rode bicycles and wore transparent slickers over gay summer dresses. Most were blond.

Soon we cleared the harbor proper and headed out into Øresund, with the low-lying Swedish coast a pale-blue line on the eastern horizon. A. P. began to talk about the salt-water crossroads and trading center that, 800 years ago, gave the Danish capital its name—København, or "Merchants' Harbor." From a tiny fishing village, Copenhagen has climbed to its present rank as first port in Scandinavia and eighth in Europe.

"I've heard people say," he began, "that if the warrior-bishop Absalon hadn't founded Copenhagen back in the 12th century, the place would have been invented by Hans Christian Andersen or Walt Disney. Perhaps so. There is much fun and games, but this is essentially a hard-working city."

The harbor is the soul of Copenhagen, and I took a good look at it. There are 25 miles of quays, enough to berth 350 ships at once, and virtually no tide to complicate arrivals and departures. Five million square feet of warehouse floor space hold goods in transit.

There are 13 grain elevators, which can handle from 80 to 200 tons per hour. About 200 cranes, of sizes to lift anything from a case of canned hams to a diesel locomotive, jut above the quays. A separate Free Port lets shippers escape customs duties and store goods for 30 days without charge.

A. P. pointed across the harbor to the towering gantry cranes of Burmeister & Wain, Copenhagen's largest industry. The company's diesel engines drive ships on all the seas, and its yards turn out passenger liners, ferries, freighters, and tankers.

Now we neared our destination, a small,

MAP BY JOHN F. WOOD © NATIONAL GEOGRAPHIC SOCIETY

circular yacht basin in suburban Skovshoved. We glided between the arms of a breakwater, and A. P. maneuvered *Karama III* stern first into a berth between two other yachts.

Then Copenhagen's saltiest commuter changed back into his gray suit and Homburg, stepped ashore, climbed into the gray Citroën which had come to meet him, and was driven off to his home.

Later, I crossed the harbor to the old quarter of Christianshavn and visited some plants of Burmeister & Wain's sprawling complex. In the engine shop, workmen swarmed over a many-cylindered diesel power plant larger than a four-story house.

In a B. & W. drydock two block-long steel boxes were taking shape. These were ship "midbodies," to be towed across the Atlantic to Baltimore and fitted between the fore and aft sections of tankers that had been cut apart.

Denmark's sailor-king, Frederik IX, combines the regal and common touch. Here he gives a reception with Swedish-born Queen Ingrid and Princess Margrethe, oldest of their three daughters and heir presumptive to the throne.

The result would be ships with much larger cargo capacity. Because of lower wage scales, the cost of building the midbodies in Copenhagen and towing them thousands of miles would be less than if they had been constructed in the United States.

Back in mid-town Copenhagen, I joined my wife and explored Strøget—literally "The Stretch," but best known as "the place where people stroll"—a series of winding shopping streets (page 58).

Danish Craftsmen Welcome Visitors

Along Strøget's narrow sidewalks swarmed throngs eagerly inspecting—and buying—silverware by Georg Jensen, porcelain by Royal Copenhagen or Bing & Grøndahl, modern-design teak furniture and accessories by such masters as Finn Juhl and Jens Quistgaard, glass by Holmegaard, and sumptuous furs by Birger Christensen.

Most firms welcome visitors to their workshops. At the Royal Copenhagen Porcelain Manufactory we saw highly skilled artisans transform fine white china clay and other raw materials into lustrous tableware and figurines. Girl artists, each in a little cubicle, each listening to music piped through earphones, painted designs on the pieces as they came from the kilns.

In Georg Jensen's shop there were gas flames, the clink of tiny hammers on metal, and graying craftsmen using strange tools to shape silver bars and sheets into pitchers, vases, cutlery, and the like. Boy and girl apprentices applied the final showroom polish with chamois and power buffers.

In furniture factories we watched master cabinetmakers shape miracles in teak, the rich wood that Copenhagen imports from the forests of Thailand and Burma. Some years ago, to combat unemployment in their ranks, a group of these cabinetmakers merged their techniques with the designs of adventurous young architects. Lustrous teak was a fitting medium for the bold new creations that evolved. By 1958, Danish furniture had gained international fame.

Besides being hard, oily, and water-repellent, teak also contains chalk deposits that play hob with edged tools such as saws, chisels, and planes. To compensate for tool damage, cabinetmakers who work with teak receive extra wages.

The products of their skill are displayed—along with other Danish craftsmanship—at Den Permanente, the Permanent Exhibition of Danish Arts and Crafts, under the

KODACHROME BY GILBERT M. GROSVENOR © N.G.S.

Models in mink and seal try to coax a word or a glance from a royal guard in bearskin outside Amalienborg, the royal residence. Danish mink farmers last year supplied the world with 1,350,000 skins.

patronage of Queen Ingrid. A jury of leading artists and architects passes on all articles before they go on sale (next two pages).

Tivoli: Copenhagen's Fun Fair

"Copenhagen," a French wit once wrote, "is a country of the Far North with a capital named Tivoli."

Back in the 1830's a wandering Copenhagener returned to his home city to edit a newspaper. Soon, with King Christian VIII's cooperation, he was staging fireworks displays on the grounds of Rosenborg Castle. Then

(Continued on page 63)

Danish Designs From Den Permanente Brighten Households Across the World

Opened in 1931 as a humble souvenir shop, Den Permanente today stands as Copenhagen's most famous mart. Every article, from the simplest pottery ash tray to the finest piece of cabinetmaking,

must be certified as Danish in origin and form and be approved by a cultural committee before going on display. This sample exhibit shows one wall half-covered by a contemporary painting. Modern sculpture sits atop a teakwood chest of drawers. Cone-shaped lamps hang above a table laid with Royal Copenhagen porcelain and Georg Jensen silver pitcher and centerpiece.


STRANDGADEN
INN
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Strøget: "So Crooked Wind Cannot Blow Down It," Danes Say With Affection

Actually not a single street, but several short ones, Strøget winds a scant mile from Town Hall Square to King's New Square. Its name means "The Stretch." Small shops, specialty houses, and department stores line narrow sidewalks that are thronged daily with bargain-hunting wives and souvenir-seeking travelers.

Beloved Dane, Hans Christian Andersen (1805-1875), turned the simple folk tale into literary art. Immortalized in bronze beside Town Hall, the great spinner of fairy tales gazes across the boulevard named for him.

Squadrons of pigeons flutter about boys with corn in Town Hall Square (pages 50-51). Birds roost in an ornate cote atop the hall. Fruit and ice-cream vendors find business slow on a rainy day.

TIVOLI

TIVOLI'S FEATURES NUMBERED.
OTHER FEATURES LETTERED

1. *Main entrance*
2. *Light orchestra pavilion*
3. *Nimb, restaurant*
4. *Bubble fountain*
5. *Pantomime Theater*
6. *Fun House*
7. *Open-air stage*
8. *Roller coaster*
9. *Galley ship ride*
10. *Ferris wheel*
11. *Tour train ride*
12. *Divan I, restaurant*
13. *Flower garden*
14. *Tivoli Theater*
15. *Belle Terrasse, restaurant*
16. *Concert Hall*

17. *Divan II, restaurant*
18. *Children's playground*
19. *Ferry Inn, restaurant*
20. *Brass band pavilion*
21. *Vintage car ride*
22. *Chinese Tower, restaurant*
23. *Boat rides*

A. *Federation of Danish Industries*
B. *Palladium Theater*
C. *La Rotisserie Frascati, restaurant*
D. *Town Hall Square*
E. *Town Hall*

(Continued from page 55)

Georg Carstensen decided that Copenhagen deserved an amusement park to surpass any in Europe.

Christian VIII granted a royal license after hearing Carstensen's argument that such a park would keep Danes' minds off the political unrest troubling the Continent.

Carstensen opened his park in 1843. He called it Tivoli and Vauxhall, after a pleasure garden near Rome and one in London. Later "Vauxhall" was dropped, and the park became Tivoli.

Leading Artists Perform at Tivoli

On the site of ancient ramparts, Carstensen erected buildings that reflected his travels and exuberant imagination—slender, elegant buildings evoking images of China, Turkey, the Indies. There were balloon ascensions, fireworks displays, and "grand illuminations." To Tivoli's concert halls and theater stages came, as they still do, the world's leading artists.

Today, within its 20 walled mid-city acres, Tivoli offers theater, symphonic music and light opera, ballet, cabarets, dance halls for both twisters and sedate fox-trotters, a chil-

Big treat for small fry. Tivoli, a 20-acre amusement park in the center of Copenhagen, has delighted young and old for more than a century.

These towheaded sisters, on finishing their cotton candy, may attend the Pantomime Theater or climb aboard one of the many rides. Perhaps they will enter the House of Forbidden Games, where children may scribble on walls, ring bells, clamber into keyholes, and do other things prohibited at home.

Moorish Palace in Tivoli Blossoms With Light

Multicolored bulbs outline Nimb, one of the park's 23 restaurants, whose terrace overlooks a lake studded with lighted glass columns.

Ride in a vintage car, a scaled-down copy of a Model T Ford, charms two Tivoli guests. Cable in slot guides the vehicle.

dren's playground, boat rides, Ferris wheel, roller coaster, Fun House, and flower-decked bowers for just sitting (painting, pages 60-61).

In Tivoli's 119 years, some 150 million persons have passed through its gates; on one memorable day 112,802 people crowded into the colorful park. Most have been convinced that no other fun fair equals this. British statesman Herbert Morrison had such a good time there that he coined a verb for it: "to tivolate."

Royalty Joins People at Tivoli

Copenhageners like to tivolate so much that, in April, they queue up by thousands to buy season tickets. Those getting low-numbered cards feel specially honored.

Having heard that the royal family were regular patrons of Tivoli, I asked Managing Director Henning Søager if the first five season tickets went to King Frederik IX, Queen Ingrid, and the Princesses Margrethe, Benedikte, and Anne-Marie.

"No," said Mr. Søager, "the King asks no favors. He sends a man over from Amalienborg, and the messenger stands in line like everybody else."

On a Sunday night my wife and I were finishing dinner at Belle Terrasse, one of Tivoli's 23 restaurants, when we noticed a mild flurry at the entrance. The headwaiter wore an air of alert expectancy, and soon a tall, broad-shouldered man and a slim, handsome woman appeared with Mr. Søager.

The King and his Swedish-born Queen had come to Belle Terrasse for a late supper. The younger princesses, Benedikte and Anne-Marie, had gone off to stand in line for a Ferris wheel ride. As the King and Queen walked to their table, several diners looked up and smiled, but nobody stood or otherwise acknowledged that royalty was present.

"That's the way the King and Queen want it," Mr. Søager told us later.

Beneath the tinsel of Tivoli lies a real world of gate receipts, expenditures, and balance sheets. A board of directors guides the park's

(Continued on page 71)

Cartful of Kids Heads for Day Nursery

To safeguard the well-being of children, Danish families receive tax relief, cash, and rent deductions. The municipality helps care for youngsters from broken homes, and maintains recreation centers for after-school hours of children of working parents. Street sign prohibits parking in this block.

Flower-bright balconies of the Vestersøhus overlook lakes near downtown Copenhagen. High-rise apartment houses have been built in all sections of the city since World War II. The city owns and operates several buildings for the aged.


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ROBICHAUMEX © NATIONAL GEOGRAPHIC SOCIETY

Close work at the weather mark. Sportsmen compete in the annual regatta of the Royal Danish Yacht Club. To keep dinghies balanced on the turn, skippers lean far out to windward. Some wear as many as seven wool sweaters—presoaked—to provide extra weight for the maneuver. Boats race on Öresund, a 15-mile-wide strait that separates Denmark and Sweden.

Race Week Contestants Tent Beside Their Boats

Flags of France, West Germany, the Netherlands, Belgium, United Kingdom, and Denmark will fly above the fleet. Most sailors arrive at the yacht club by car, with boats in tow.

"Since it rained most of the week, I doubt these campers ever were dry," says photographer Grosvenor. "Each day they came off the water soaking wet and hung out their clothes on the tent poles."


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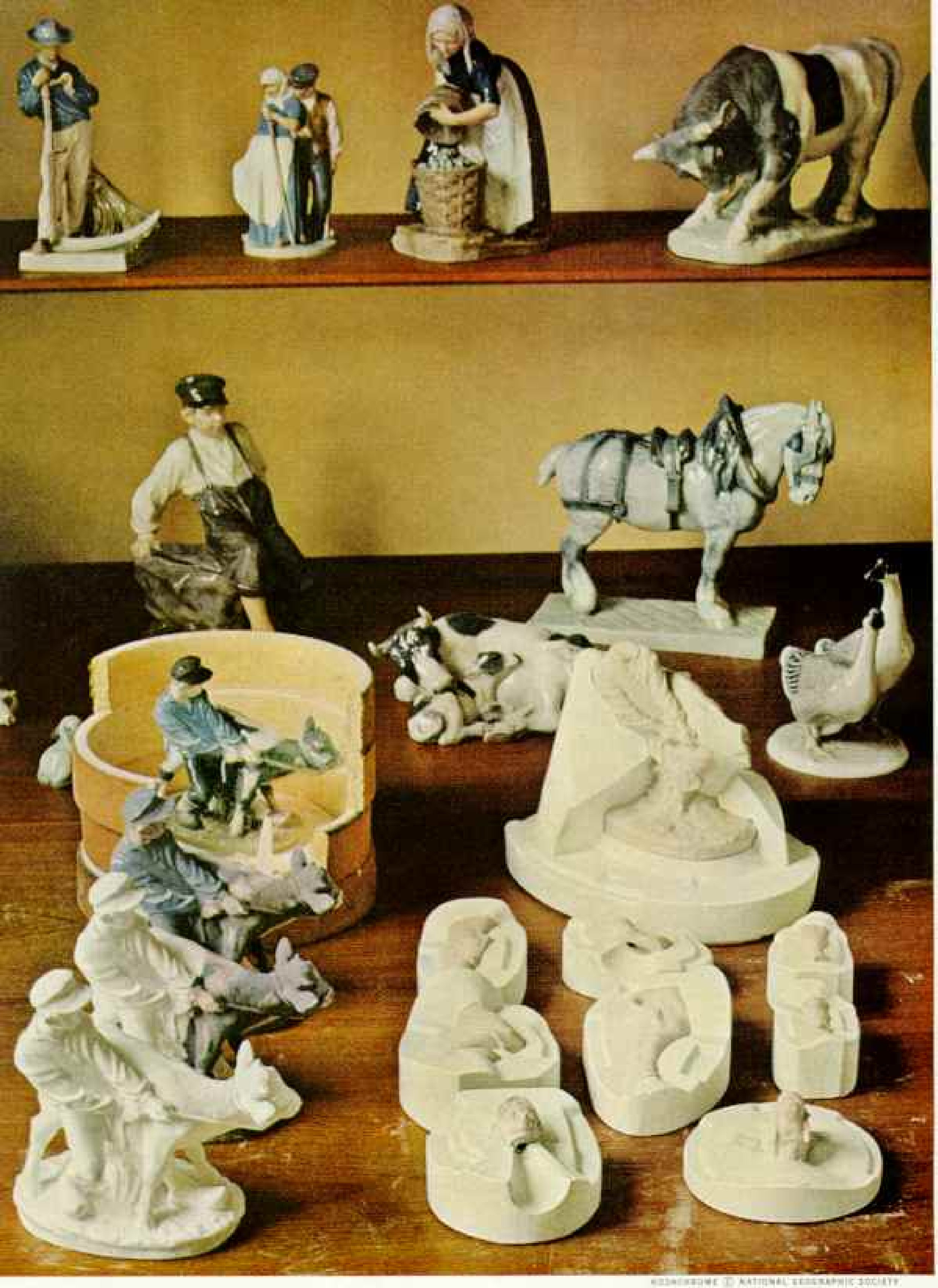
63
210

Knippelsbro Drawspan Admits a Ship at the Spot Where Copenhagen Was Born

Here in the Middle Ages a ferry served a fishing village that has become Scandinavia's largest port. The green-roofed Stock Exchange rises just beyond the bridge. Probably the world's first secu-

rities market, the fanciful building was started in 1619 by Christian IV. Entwined tails of four dragons form its rococo tower. Directly behind looms Christiansborg, former site of the royal residence but now home of Denmark's Parliament. Round Tower, finished in 1642 as an observatory, rises beyond the belfry of Saint Nicholas's on right. Apartment houses spike the horizon.



Ceramic figurines fresh from the kiln line shelves of the Royal Copenhagen Porcelain Manufactory. Plaster molds at lower right cradle pieces that, when fused, make up the boy-with-calf sculpture at left; four aligned models illustrate stages in its firing. The color-finished product stands within a flowerpotlike fire shield.

affairs with hardheaded thoroughness, and shareholders receive regular dividends.

Just outside the walls of Tivoli, I encountered one of the most bizarre enterprises in Copenhagen—that of Bech Kjeldsen. I met Mr. Kjeldsen one day on the outdoor terrace of La Rotisserie Frascati backing on Tivoli, but overlooking busy Rådhuspladsen, or Town Hall Square (pages 50-51). He asked permission to share my table, introduced himself, and invited me to have some Danish beer.

Looking over the dinner menu, I noted that it included *escargots à la Bourguignonne*.

"I didn't know Danes ate snails," I remarked to Mr. Kjeldsen.

"Oh, yes," he replied. "The better restaurants serve them."

"Imported from France, I suppose."

"No," he said. "They are raised right here in Denmark. In fact, a good many Danish snails are exported to France.

"It just happens," he said, "that you are talking to the leading breeder of the edible snail, *Helix pomatia*, in all Denmark. I am also in toads. *Bufo vulgaris*."

"Don't tell me Danes eat toads."

"No," said Mr. Kjeldsen. "I sell them to hospitals and laboratories. They use them in making pregnancy tests."

Then he asked if I would like to visit his snail farm. "You might enjoy seeing the little chaps running around," he said. "Early morning is the best time. That is when they are most active—before the dew has dried."

The next morning Mr. Kjeldsen and I drove to a farm just outside the city. We left the car beside a barn, and he led me across a soggy turnip patch to the edge of a small wood.

"Here they are," he said. "Here are about five hundred thousand snails."

Snails Undulate in High Gear

Snails were scattered profusely in the grass. Others clung to trees and shrubs. At first they seemed motionless, but prolonged study revealed many to be undulating along as fast as two and a half inches per minute—Mach 1 for a snail.

In a good year, Mr. Kjeldsen said, he sells about 22,000 pounds of snails to restaurants and canneries in Denmark, France, and other European countries.

Sturdy trenchermen all, Copenhageners pay scant heed to such dainty fare as snails. They prefer their own distinctive cuisine, one that might alarm calorie counters or cholesterol watchers. In restaurants, butter comes to the table in great golden slabs, and there is no stinting on the rich sauces that go with superb Danish pork, ham, beef, and seafood. Lashings of whipped cream usually accompany desserts. Danish pastry, which Copenhageners unaccountably call "Vienna bread," is a favorite snack.

Rising from a three-hour luncheon with a group of businessmen, I asked one, "How do you manage to get any work done?"

He laughed. "You are our guest. This is a special occasion. Usually we take a package of *smørrebrød* to the office and have a quick lunch in the company canteen."

Here he referred to the famous open sandwich, the standby of Danish diet. It consists of a single slice of bread

KODACHROME BY GILBERT M. GROSVENOR, NATIONAL GEOGRAPHIC STAFF © N.G.S.

Lion and snake battle in clay. Royal Copenhagen sculptor Knud Kyhn grows so absorbed in his creation he neglects the sandwich in his hand. The 82-year-old artist's faithful studies of nature grace museums in Europe and the United States.

Tame Deer Roam Meadow and Forest Where Royal Hunters Chased the Stag

Only strollers, cyclists, and horse-drawn carriages may enter Dyrehave, Deer Park, a favorite retreat of Copenhageners. Eremitagen, completed in 1736, still serves as a place of rest and refreshment for royal hunting parties. White deer came from Germany.

piled high with meats, smoked fish, and other edibles in imaginative combinations. With smørrebrød builders, it is a point of honor that the bread be totally concealed.

A housewife, sending her man off to work and then getting his evening report on a fellow worker's superior lunch, strives to get even, or possibly forge ahead, with the next day's smørrebrød. Copenhageners call this keeping up with the Jensens.

Professional open-sandwich makers go by the name *smørrebrødsjomfruer*, which translates as "open-sandwich virgins." Smørrebrødsjomfruer have their own union, and in years past these specialists had to be unmarried young women.

The rule of spinsterhood no longer applies, as I learned when I watched jovial matrons creating masterpieces in the kitchen of Oskar Davidsen, the smørrebrød king. While I watched, one of the ladies made me a "Hans Christian Andersen's Favorite," listed as number 48 among the 178 creations on Oskar Davidsen's four-foot menu. It contained bacon, tomato, liver paste with truffles, meat jelly, and horse-radish. It was delicious.

Ballerinas Practice Before Mirrors

Word came one day that Denmark's proudest cultural achievement, the Royal Danish Ballet, was starting rehearsals for the new season. We were invited to watch.

In the Royal Theater we found a mirror-lined rehearsal hall filled with girls in leotards. They were tall and slim, short and round, all in poses that were pure Degas. Their teacher, Vera Volkova, formerly of the Leningrad Kirov Ballet, signaled to a pianist, who struck up a waltz tune, and the girls began limbering-up exercises.

During a break, we asked the prima ballerina, Margrethe Schanne, how dancers managed to attain such superb physical condition. We recalled one performance requiring her to hoist a hefty male partner into her arms and gracefully carry him into the wings. Miss Schanne stands about five feet four inches tall and weighs about 100 pounds.

"Mainly," Miss Schanne answered, "it's practice, practice, and practice."

But remembering the body-building Danish diet, we suspected that the real answer might lie in Miss Schanne's next remark.

"Next to dancing," she said, "I like cooking and eating best. Let me give you my recipe for Danish liver paste. You take a pound of fat and an onion, run it through a fine grinder, add a pound of ground liver. . . ."

Friendship blooms between girl and guinea pig at Children's Zoo beside Frederiksberg Garden.

Fat black rabbit basks in the firm but tender embrace of a visitor to the Children's Zoo. Youngsters are encouraged to play with tame animals.

No one stays in Copenhagen long without hearing and seeing on all sides the name Carlsberg. With an outpouring of millions of dollars, it influences the cultural, educational, and scientific life of Denmark, as do Rockefeller and Ford in the United States.

Yet Carlsberg is not the name of a man or a family; this label for a brand of beer honors brewery founder Jacob Christian Jacobsen's son Carl. The younger Jacobsen's most celebrated gift to his city was the statue of The Little Mermaid. As local legend has it, Jacobsen commissioned Edvard Eriksen's bronze of a Hans Christian Andersen heroine as a tribute to a dancer with the Royal Danish Ballet.

Carlsberg's chief competitor, the Tuborg Breweries, also uses part of its profits to promote the general welfare.

Gauguin Links Copenhagen and Tahiti

In the Ny Carlsberg Glyptotek, one of the city's finest museums, I found a poignant link between a far-northerly metropolis and the lush South Pacific.

Paul Gauguin married a Dane and lived in Copenhagen after abandoning his career as a Paris stockbroker in favor of Impressionist painting. Later, Gauguin left his large family in Copenhagen and began the unhappy wandering that took him to Tahiti. Fame did not come until years after his death in 1903.*

Among many other French Impressionist works, the Glyptotek's collections include a whole roomful of Gauguins acquired by the Carlsberg Foundation. Gauguin's beautiful "The Seamstress," painted early in his career, is a feature of the exhibit. Five of his haunting Tahitian canvases are also displayed.

In a summer's visit I found Copenhagen a city that wears a perpetual smile. Despite its hardheaded, no-nonsense respect for business matters, the carnival spirit always lies close to the surface. Where else would a stroller suddenly come face to face with a live giraffe?

Lucky, a towering, doe-eyed female, spends most of her time chewing hay and studying the queer two-legged creatures who pass her pen outside the Circus Schumann, a beloved landmark for more than 100 years (page 52).

I went to the circus to see the "world's only trained giraffe" perform. Lucky opened the show by reaching far out into the audience to snatch and eat a lady spectator's hat.

The lady had been "planted," of course, and her hat was made of such giraffe food as carrots and greens. After galumphing around the ring while the band played "The Beautiful Blue Danube," Lucky exited to cheers.

Returning to serious matters, I journeyed to the University of Copenhagen's Institute for Theoretical Physics. There, in the sparsely furnished office of the director, I found Denmark's grand old man of science, Professor Niels Bohr (page 48), engrossed in a vast perplexity of numbers, letters, and mathematical symbols that his middle-aged son Aage was chalking on a blackboard.

The elder Bohr, puffing a pipe, watched silently. Suddenly he stepped forward, tapped a figure 2 with his pipestem, and looked questioningly at his son, also a brilliant physicist. Aage Bohr wrinkled his brow and quickly ran back over his calculations. Then he erased the 2 and replaced it with a 1.

The blackboard equations, the younger Bohr told me, added up to a formula that had to do with superconductivity in metal.

"Few but my father and me could possibly understand this formula," he said apologetically, "so I won't try to explain it to you."

Bohr Pioneered Nuclear Research

Niels Henrik David Bohr, when he was studying under Lord Rutherford at the University of Manchester, published treatises that won him the title "founder of modern atomic theory." In 1939, working at the Institute for Advanced Study in Princeton, N. J., he and a colleague, J. A. Wheeler, electrified the scientific world. They declared that the uranium isotope U-235, rather than the more abundant U-238, was responsible for atomic fission and the resulting release of energy.

The theory proved correct, and the Bohr-Wheeler discovery stands as a historic milestone in nuclear research.

Professor Bohr, who died last November 18 at 77, wore his Nobel Prize and other laurels lightly. Even in his 70's he bicycled daily to the Institute from Jacobsen House, the "mansion of honor" provided by the Carlsberg Foundation for Denmark's most distinguished figure in the arts or sciences.

Fellow Copenhageners, though aware of

*See "Tahiti, Finest Island in the World," by Luis Marden, NATIONAL GEOGRAPHIC, July, 1962.

Grundtvig's Church, Named for a Pastor-poet, Wears an Organ-pipe Façade

Artisans toiled 19 years, using five million bricks, to build this memorial to Bishop N. F. S. Grundtvig, who founded Denmark's adult educational system a century ago.

Young lovers reflect the romantic spell the city casts on residents and visitors alike.

Professor Bohr's international renown, revere him more for his warmth of character and his endearing absent-mindedness. They never tire of recounting his many World War II adventures, which included hairsbreadth escapes to Sweden and then to England just ahead of the Nazis who wanted very much to capture him.

I asked Professor Bohr about an incident said to have occurred while he was in the United States in 1945 with the atomic Manhattan Project. Security officers renamed him "Dr. Nicholas Baker" and instructed him carefully in concealing his true identity.

One day in New York a lady hailed him on the street. "Why, Niels Bohr!" she exclaimed. "I didn't know you were in this country!"

For once the professor remembered his cover name. "I'm sorry, madame," he said, "but Baker is my name—Dr. Nicholas Baker."

"But you are Niels Bohr!" insisted the lady. "I knew you in Copenhagen."

"My name is Nicholas Baker," said Professor Bohr, tipping his hat and passing on. Then he turned and called out cordially, "And how have you been, Mrs. Hansen?"

The story was true, Professor Bohr told me, except in minor details.

"It happened in an elevator," he said, "and the lady's name was Olsen, not Hansen."

Danish Heroes Fought Nazis

More wartime lore came to light during a walk I took with a journalist friend, Børge Outze, a hero of the Danish Resistance movement. I paused to study a marble tablet on an office building. The inscription listed the names of eight Danes and explained that they had died here, "For Denmark's Freedom," on March 21, 1945.

"This is Shell House," said Mr. Outze. His words seemed fraught with dire meaning, as if he had said, "This is Pearl Harbor," or "This is Dunkirk."

"It's a new building, put up since the end of World War II," he added. "The old one was destroyed by the RAF—at the request of the Resistance."

The old six-story Shell House, Mr. Outze explained, had been used as Gestapo headquarters. Its top floor, an attic, served as a prison for Danes awaiting questioning about suspected Resistance activities. On other floors were Gestapo offices and files. These files contained records that might lead to the arrest of other Danes.

"We felt that Shell House was a danger to our whole Resistance movement," Mr. Outze said. "So we persuaded the RAF to bomb it. Eighteen Mosquitoes hit it from low level, skipping bombs across the sidewalk into the lower floors so as to spare the attic."

Within minutes, Mr. Outze went on, Shell House was a flaming wreck.

"The raid wiped out the Gestapo's records and killed a lot of Nazis," he said. "Of the 35

Legend in Bronze: a Goddess Transforms Her Four Sons Into Oxen

Gefion Fountain at the entrance to Langelinie promenade tells the myth of the goddess Gefion. "I will give you as much land as you can plow around in a day," the Swedish King Gylfe promised her. Thereupon she converted her sons into a powerful team and plowed out of Sweden the whole of Zealand, Copenhagen's main island.

Spouting goose with boy rider sprays passing ducks in King's Garden, a park laid out by King Christian IV in the French style.

Fearless red squirrel climbs into a park-goer's palm for a handout of corn. Tame animals abound in the city's many parks.

prisoners locked in the attic, 27 escaped."

Sadly, however, the same raid destroyed a school, and some 80 children lost their lives. Today a monument on the site recalls the tragedy.

I remembered having seen in Burmeister & Wain's museum a jagged bomb fragment. It represented more than six tons of explosives dropped by British airmen upon B. & W. plants when they were held by the Germans during the 1940-1945 occupation. Throughout the occupation, while the company unwillingly produced equipment for the invaders, workmen in a secret shop turned out arms for the Resistance.

King Wore Star of David

When the Nazis required Copenhagen's Jews to display Star of David brassards, King Christian X appeared in public wearing one of the armbands, and so did thousands of his non-Jewish subjects.

I spoke admiringly of his countrymen's courage under an oppressor's jackboot, and Børge Outze replied: "Well, it's something a future aggressor might well remember."

The day before we left Copenhagen, my wife and I took a last stroll. Manhattan-type skyscrapers now loom on the

Red-hot rivets fasten a tanker's deck plates in the Burmeister & Wain yards.

Ferries and Tug-guided Freighter Pass in Copenhagen's Inner Harbor

What Denmark lacks in raw materials—and in this regard she ranks among the world's poorest nations—she makes up in foreign commerce. Her importance as a trader has grown out of all proportion to her size.

Some of the larger vessels moored here regularly circle the globe. Others run between Copenhagen and other European ports. Trim ferryboats link the capital with Malmö, Sweden—a 90-minute sail. In this telephoto view, made from the tower of Our Saviour's Church, the steeple of the English Church rises directly above the wooded grounds of Kastellet, the Citadel. Oil refineries beyond the trees ring the Free Port.

Copenhagen skyline, but the flavor of the 16th and 17th centuries remains.

We found it particularly along the canal at Nyhavn. This canal was built in 1671 as a passage between the harbor and a main market square, and it is still lined with old gabled houses that formerly were the homes of merchants. Today many of these buildings are occupied by ship chandlers, export and import firms, dealers in charts and maps, and makers of navigating instruments.

Much of the street bordering the canal remains a resort for sailors, as it has been for centuries, with a string of neon-lighted tattoo parlors, pinball pavilions, and bars that ring with revelry around the clock.

I couldn't, however, keep my wife's attention focused on this local color. What she wanted was a final trip to Den Permanente.

We went there—"just to look" at the treasures. On earlier visits we had resolutely bought only modest gifts for friends at home.

This time something happened to our will power. When we came out, we owned a magnificent teak coffee table.

"Oh, well," said my wife, thumbing through a shrunken store of kroner, "we don't *have* to stop in Paris on the way home." THE END

The Man Who Talks to Hummingbirds

From a little Brazilian town
the fame of naturalist Augusto Ruschi
has spread around the world

By LUIS MARDEN
Senior Editorial Staff

Illustrations by National Geographic photographer JAMES BLAIR

BRAZIL, A VAST SEGMENT of geography more like a continent than a country, is a place where overexuberant nature has surpassed the wildest bounds of credibility. More and stranger creatures swim, slither, crawl, stalk, leap, climb, flap, flit, and buzz in its green forests than in any other country on earth.

It is a place to delight the heart of a Texan—or an Alaskan. Here live the world's largest snake (the anaconda, up to 35 feet long), the biggest rodent (the capybara, a kind of guinea pig the size of a police dog), the largest spider (as big as a man's hand), the largest ant and beetle, a fresh-water fish 12 feet long, a toad the size and shape of an apple pie, a moth with a one-foot wingspread, uncounted species of birds, and more different insects (20,000 moths and butterflies alone) than in any other region of like size on the globe.*

Yet of all this impressive bestiary the most attractive members are not the biggest; on the contrary, they are among the smallest feathered creatures in existence: the hummingbirds. In her dark green hair Brazil wears more than 80 species of these glittering creatures, birds that rival in their brilliance the many-colored gems nature has scattered prodigally throughout this favored country.

In a small town in the mountains of Brazil's State of Espirito Santo lives a man who knows more about the ways of hummingbirds than anyone else in the world. He is Augusto Ruschi, a native Brazilian and a great naturalist, who possesses an impressive affinity for these miniature birds. His rapport with them is so close that I believe he can understand what they say in chirps and trills, and I am convinced that, in a sense, he can talk to them.

*See "Brazil, Oba!" in NATIONAL GEOGRAPHIC, September, 1962, for staff writer Peter T. White's account of South America's booming but troubled giant; also "Giant Insects of the Amazon," by Paul A. Zahl, NATIONAL GEOGRAPHIC, May, 1959.

Dr. Ruschi studies hummingbirds feeding from a bottle of sugar water within a tent. Fingernail polish stains the spout red, the favorite color of the birds known to Brazilians as "flower kissers." Cloth netting prevents newly captured birds from injuring themselves.

To learn about the man who talks to hummingbirds, I went to Brazil, home of vast numbers of the *beija-flores*—"flower kissers"—as they are poetically called in Brazilian Portuguese. Dr. Ruschi, an unassuming hazel-eyed man in his mid-forties, met me at the airport in Vitória, a port 265 miles northeast of Rio. In his station wagon we drove 45 miles into the mountains to his home at Santa Teresa (map, page 85). As we drove, Ruschi told me of his early love of nature.

"As a child I used to flee from my house to stay in the woods all day. I would follow a bird from tree to tree, to study how I could trap it alive. I spent hours on end in my father's garden, which was full of orchids he had collected in the forest.

Orchid Plays Host to Tiny Spider

"It was orchids that led me to hummingbirds. One strong-scented species, *Stanhopea graveolens*, with clusters of spotted yellow-and-white flowers, fascinated me. Father had collected it in 1891.

"One day I went into the forest to look for another specimen. I smelled the strong, cloying odor of one from a distance of half a mile. When I found it in dense bush, I concealed myself and watched the plant for hours. I actually heard one blossom open with a distinct *puff!*

"Finally a hummingbird flashed before me—a streak of vivid color. He flew straight to the orchid, and thrust his needle bill into the labellum, the tongue of the blossom. I saw him start back sharply, then resume his search. After hours of observation, I learned what had happened.

"A small spider, also colored yellow and white, lurked inside the hypochilium, the lip. He was well camouflaged, but the hummingbird knew he was there.

"As the *Stanhopea* had matured, its sweet scent had turned to a stench like that of carrion. Flies, drawn by the odor, came to the flower, and the spider seized them. In turn, the hummingbird ate the spider. When the bird probed deep into the flower, his head brushed the gynandrium, or column, which discharged pollen onto his poll. That's what made the little fellow dart back in momentary fright.

"I observed this on the 15th of December, 1934—I well remember the date because it marked the beginning of my interest in hummingbirds. I collected that first bird and sent it to an ornithologist in São Paulo; he identified it as *Glaucis hirsuta*. When he

Santa Teresa follows the twisting Timbui River. European settlers, including Dr. Ruschi's ancestors, colonized the valley in 1875. His home and museum lie behind the wall at the base of the terraced hill. Virgin timber clothes the mountaintops; farms cover the slopes.

Hanging in air, a silhouetted hummingbird approaches a feeder at Dr. Ruschi's biological station. The hummer not only hovers, he can also fly backward—the only bird able to do so.

Showing no fear, hummingbirds buzz about the Ruschi veranda. Tiny wings beating around the feeders make so much noise they often stop conversation.

wrote: 'Unfortunately very little is known about the life history of these birds,' I determined to study hummingbirds."

We were driving fast, high above the bed of a mountain torrent that dashed over rocky outcroppings. Ruschi flicked his thumb at the high slope on our left. "See that?" I had caught only a flash of magenta. "*Cleistes macrantha*, a ground orchid."

As I came to know Ruschi better, I found that he shared the gift of all great naturalists: nearly total observation.

"Of the 15,000-odd known species of orchids, we have 3,000 here in Brazil," Ruschi continued, "and this little State of Espirito Santo has 800 of them, with many more, I am certain, still to be discovered. In my orchid period I used to stay in the forest for 15 days at a time, collecting orchids and bromeliads. I would come back to town with great bundles of plants on my back. The townspeople made fun of me; they called me *o verdureiro* —'the vegetable vendor.'

"As for hummingbirds, though Espirito Santo is one of our smallest states, we have 34 of the 80-odd species found in Brazil."

As we neared Santa Teresa, I smelled the resinous scent of fresh-cut timber. Streamside sawmills operated by waterwheels whined as they bit into great logs of hardwood. The slopes that rose on both sides of us had been mostly cleared, but dark green rectangles of virgin timber still stood on the higher ridges. Espirito Santo's forests furnish 500 kinds of woods, of which about twenty are exported from the state.

Santa Teresa, at 2,200 feet above the sea, is a town of about 2,000 people who live in red-tiled, earthen-walled houses lining streets paved with rectangular stone block. We stopped at a small cafe to drink some of the superlative coffee of the district. Everyone who entered hailed my companion as "Gutti," the diminutive of Augusto.

School children on a nature walk visit the Mello Leitão Museum of Biology, named by Dr. Ruschi for his teacher. The naturalist points out birds, orchids, and (overhead) a flowering cassia tree.

The Santa Teresans are proud of their local son today. Gone is Gutti the vegetable vendor. Since he acquired international fame for his important work in ornithology and botany, they introduce him to out-of-towners as "Dr. Augusto Ruschi, scientist, the man of the hummingbirds."

His fame has spread far. In 1956 the Emperor of Japan, a scientist himself, read of the doctor's work and asked the Brazilian Ambassador in Tokyo to obtain copies of Ruschi's publications. Ruschi personally sent the Emperor the technical papers and a gift of a rosewood case in which he had beautifully mounted 22 Brazilian hummingbirds in natural poses.

In 1957 he delivered 24 live birds to Dr. José Maria Garção Caldeira in Estoril, Portugal, to learn if they could adapt to life in European parks. So far, the birds have lived in a large enclosure, as Dr. Caldeira has studied their ability to acclimatize and to derive sustenance from local plants.

Tyroleans Flocked to a New Land

As we sipped our coffee in the Santa Teresa cafe, I remarked that most of the townspeople seemed to have gray or blue eyes and light hair.

"Nearly all their grandfathers came from the Austrian or Italian Tyrol," said Ruschi. "Germans, Swiss, and Poles helped give our people their blond look, but they're mostly northern Italian in origin, like myself."

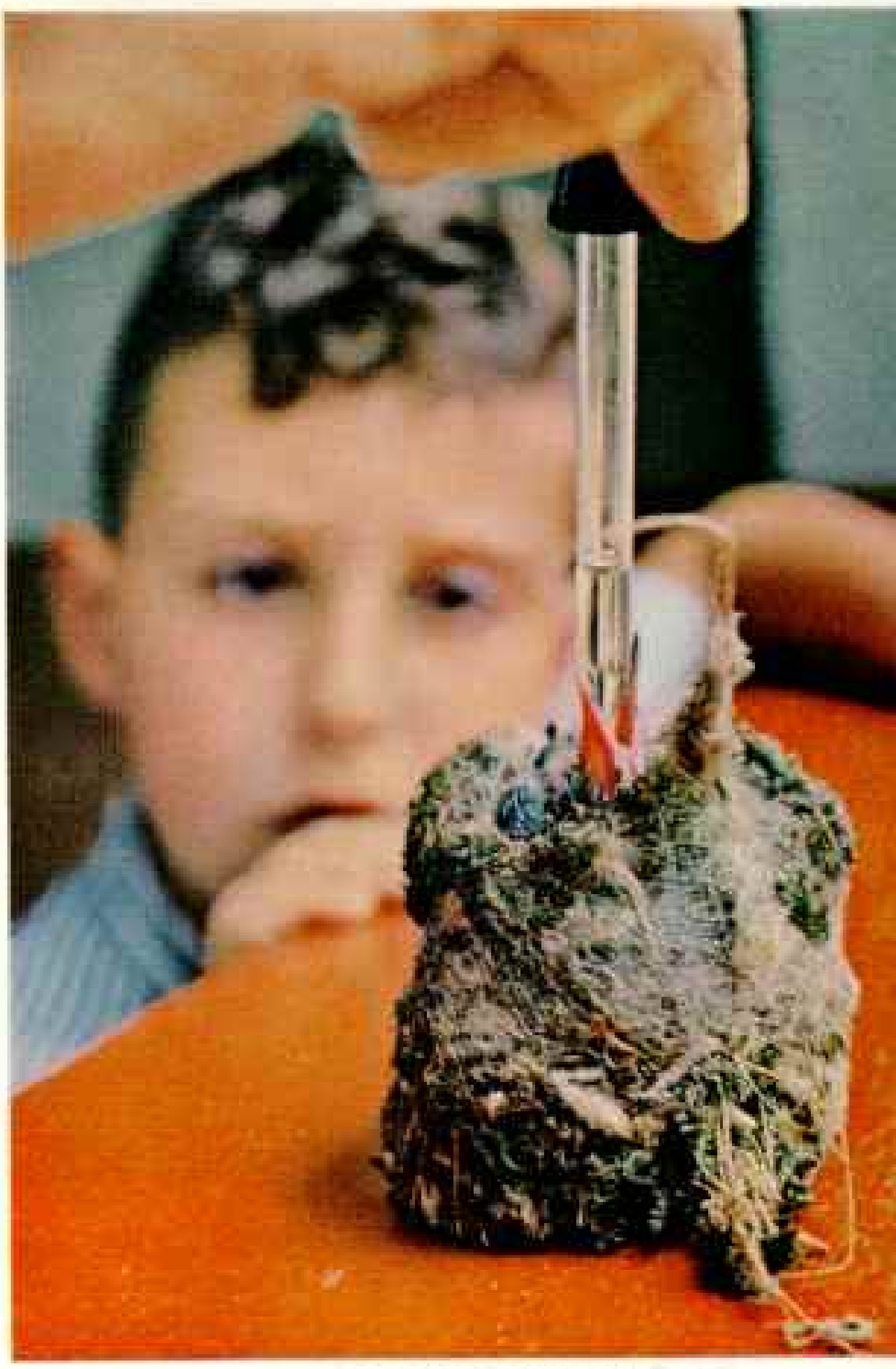
Santa Teresa was founded in 1875 by immigrants who came in response to the offer of Emperor Dom Pedro II to give 50 acres to anyone who would settle and work the land. On the 26th of June, 1875, the immigrants drew lots for the land. Antonio Roatti, an Austrian, drew the land on which Dr. Ruschi's museum stands today.

At the hour of the Angelus on that day, a woman placed a small image of Saint Theresa in the hollow of a great tree, saying, "This place shall be called Santa Teresa."

Roatti married the namer of the new town, and one of their daughters later wed a José Ruschi. One of the sixteen children of this marriage was Augusto Ruschi.

Under the shoulder of a forest-clad hill at the edge of town stands the Professor Mello Leitão Museum of Biology. We passed into the grounds through the cool shade of an avenue of great eucalyptus trees and royal palms planted by Ruschi's father.

Actually the museum is a biological station. Half a dozen pavilions scattered about the



Medicine dropper feeds nectar to a baby hummer as André Ruschi watches. Spider web, lichen, moss, and fiber form the nest.

Giant Brazil has some 80 known species of hummingbirds. Little Espírito Santo, Dr. Ruschi's home state, counts at least 34.

Scarlet flowers, the hummingbirds' favorite, brighten a screened aviary. First to breed hummers in captivity, Dr. Ruschi has encouraged 61 species to reproduce.

Birds of a variety new to science record the frequency of their wingbeats. Microphone within the net tent catches the vibrations. Later a tape plays them back on a machine that reproduces the beats in the form of a graph. Dr. Ruschi films the experiment.

CRAWFORD H. GREENEWALT

Ruschi Family and Friends Gather to Dedicate a New Guesthouse

Crawford H. Greenewalt (left), who has photographed hummingbirds at the Santa Teresa estate (pages 100-113), stands with Charles Rule, a representative of Du Pont do Brasil S.A., Mrs. Ruschi, her husband, the Ruschi sons, and a playmate.

grounds house collections of birds, reptiles, insects, and woods. On the banks of a small stream, flowering trees and thickets of green-and-gold bamboo shelter more than 5,000 orchids and bromeliads, which were Ruschi's first love as a naturalist.

"I named this place for my old teacher, Professor Cândido de Mello Leitão," said the doctor. "He was an eminent zoologist of the National Museum of Brazil and one of the world's authorities on spiders. When a friend called the professor's attention to my early experiments, he said, 'This boy has a vocation; let us send him to school.'

"I went to Rio de Janeiro to the National Museum to start my studies. That was the first museum I had ever entered, and I stood it for one month. Then I said, 'I cannot study within four walls; I want to go back to my forests.' I have always thought that systematic contact with nature is essential to the study of the natural sciences.

"Seeing my determination, the museum directors voted to make a field station of my home in Santa Teresa. My mentor died in 1948, and in 1949 I founded the museum and named it for him."

From the moment we entered the grounds, hummingbirds flashed by or hovered a few feet away, looking us over fearlessly, as if aware of their sanctuary.

Huge Cages Hold Flashing Life

In the grounds stand *viveiros*, big flying enclosures in which live as many as 400 hummingbirds (opposite). The biggest cage measures 160 feet in length by 50 wide and 20 high. Among the flowering trees and shrubs that fill it, the little birds seem to be at complete liberty, as they probe scarlet flowers with needle bills or sip sugar water from small bottles hung in the branches. Here they live, fight, court, and—a triumph first achieved by Ruschi—nest and rear their families.

"When I started to study hummingbirds intensively, I heard that some had been kept alive for a short time at the Copenhagen zoo, but no one had ever succeeded in getting hummingbirds to breed in captivity. It took several years, but now we have them rearing

Flowering cluster hangs from a bromeliad, *Vriesea simplex*, an air plant that clings to trees but draws no sustenance from them.

Dime shows the size of a dwarf orchid, *Oncidium pusillum*, in the crotch of a tree.

BIRDS BY LUIS MARDEN © N.G.S.

Rosy orchid, *Laelia pumila*, juts from a tree near the naturalist's home in Santa Teresa. Even as a boy, Dr. Ruschi studied orchids. Some 3,000 species grow in Brazil.

young as freely as they do in the wild. So far, we have bred 61 species here," Ruschi said.

When we entered the biggest cage, we were in a small forest of green and gold, bright with sunlight and red blossoms, and loud with the swooping hum and buzz of the flower kissers. They hung inches from our faces, suspended in a blurred disk of vibrating wings. As they turned their heads from side to side, inspecting us carefully, flashes of pure spectral color glowed and winked, hot fire red, bright sapphire blue, lambent green, deep wine purple.

The brilliant colors of hummingbird crests and gorgets excite wonder in all who see them. For years learned men argued about the cause of these flashes of pure color. On page 105, Mr. Crawford H. Greenewalt, a noted student and photographer of hummingbirds, whose striking pictures follow this article, explains how they are formed.*

Bird Nests Under Artificial Moon

As Dr. Ruschi and I walked round the station, he named the species of orchids that clung to trees or stood in black pots of *xaxim*, the fibrous trunk of the tree fern. Then he continued to talk of hummingbirds.

"Going back to 1934: I knew then that I must spend my life studying the hummingbirds, and when I found a nest of *Chlorostilbon aureo-ventris pucherani*—the name is nearly as long as the bird—I set up an observation post. As soon as I saw the female

*A Trustee of the National Geographic Society, Mr. Greenewalt has studied hummingbirds for ten years.

KODACHROME BY ROBERT S. SAKES

Jewel of the forest, a morpho butterfly *(Morpho menelaeus)* spreads a field of blue satin bordered with russet. From wingtip to wingtip, this specimen spans 4⅞ inches.

KODACHROME (ABOVE) AND KODACHROME BY LOIS WARDEN

Butterfly lure, blue silk at the end of a fishing line, attracts a morpho. Mistaking the cloth for one of its kind, the insect circles to battle a rival or woo a female.

Casting for butterflies, Dr. Ruschi takes no captives but studies their behavior. Morpho at upper left pursues the bit of blue silk brandished by the naturalist.

lay the first egg, I remained glued to my post day and night, except for four hours of sleep that I would snatch when I saw the mother bird bedded down for the night.

"When she settled down to brood, I wanted to see exactly what she did, but I knew that a light would frighten her away. I decided to make an artificial moon.

"I covered the lens of a flashlight with opaque black paper in which I had cut out a crescent. Over the cutout I placed orange-red paper—you know, moon color—then I fixed the flashlight to a tripod and aimed the beam on the nest from 15 feet away. In front of the flashlight I hung a big leaf, attached to a line.

"Just before dark, when the bird was off the nest feeding, I turned on the flashlight. When she came back and settled down for the night, I drew on the line, pulling the leaf slowly down from in front of the light. What did the bird see? An orange moon rising; that was something she was used to, and she sat tranquilly on, sleepily blinking her eyes in the 'moonlight.' "

Here Ruschi suddenly *became* the bird, blinking his eyes, lifting his elbows like wings, and settling in the nest with little side-to-side movements.

"It took her 14 days to hatch the eggs, and all the while—except from midnight to four in the morning—I was there. In all I watched that nest for 35 days. When the young hatched and the mother flew away to get food for them, I quickly removed the little things,

weighed them, and put them carefully back.

"I even robbed them of their food in the interests of science; sometimes, after feeding, when the mother left on another trip, I would thrust a glass dropper down their throats, to draw out the contents of their stomachs for weighing and analysis.

"I found that, at first, protein dominates the diet—insects—and, later, carbohydrates—flower nectar. After that, it was easy to keep hummingbirds in captivity. I knew what kind of food they needed, in what proportion, and how often. In 1936, I got four species to reproduce in captivity; I believe that was the first time it was ever done."

Buzz of Wings Makes Talking Difficult

Dr. Ruschi lives with his wife and two small sons in his grandfather's house, a cool, thick-walled old building. At dusk we would sit on the veranda and talk, but frequently we had to raise our voices, literally, because of the loud thrumming of hundreds of wings. Throughout the year, 32 species of hummingbirds come to glass feeders on the porch in such numbers that the air seems to vibrate. As they swooped and passed inches from my face, it was as if we were being subjected to dive-bombing and "buzzing" by a swarm of miniature, multihued aircraft (page 83).

"They are not so numerous now," said Dr. Ruschi, "because we have a white eucalyptus, *Eucalyptus robusta*, in flower, and the birds prefer the natural blossoms to my sugar water, even though it matches the nectar exactly—20 percent sugar in water. We use as much as 45 pounds of sugar a day in the feeders spread over the grounds."

As it grew darker, I watched the hummingbirds hawking invisible insects, dipping and stabbing through the soft evening air like swallows or swifts.

"Hummingbirds need a good amount of protein," said the doctor. "If you feed them sugar water alone, they will die. However, insects are no problem. All I have to do is to place some overripe fruit in the cages, and swarms of fruit flies, *Drosophila*, appear out of nowhere."

The clip-clop of horses' hoofs echoes the past in the streets of Santa Teresa. Countryfolk come in from the neighboring hills on horseback, and on Sundays a hitching rack at the edge of town may have two dozen horses tied to it while their owners are at Mass. The riders sit their small mounts with legs thrust stiffly out, and hands held knuckles up at the breastbone like cowboys in a Remington painting. The five-gaited horses, with tails tied in a graceful knot, click along in a fast single-foot, carrying their riders as smoothly as if mounted on rails. The plump, red-faced farmwife, in an ordinary print dress but riding astride, usually follows her husband on her own horse.

During the meatless days of Lent, Brazilians cook dishes of palmito, the edible palm *Euterpe edulis*, together with shrimp and fish. I saw truckloads of the pale white stalks daily leaving Santa Teresa for the coast. I wondered where so many came from, because every time a stalk of palmito comes to town, a palm tree must die.

Santa Teresa lies clasped in the narrow

Bold bird rushes in to scold its enemy, the sun owl (*Glaucidium brasilianum brasilianum*), a decoy used by Dr. Ruschi to lure hummers within reach of his "fishing" rod (page 92). Chained to his perch, the owl faces his tormentor. On the same job seven years, he looks bored.

COURTESIES OF LUIS BARRON (ABOVE) AND JAMES BLAIR © NATIONAL GEOGRAPHIC SOCIETY

Parabolic aluminum reflector amplifies bird calls for a tape recorder. Dr. Ruschi lures his subject within microphone range with a game call. This whistle was made by an Espirito Santo family which has specialized in fashioning them for half a century.

valley of the Timbuí River, which loops to the north around the town before flowing eastward to the sea (page 83). The doctor and I climbed the main street to the edge of town. I noted that coffee bushes on a steep hillside grew in full sunlight and not in the shade of bigger trees, as in Central America.

On the circumambient hills, magnificent stands of trees lift their green crowns high above the gray-green bush. One species, *jacarandá*, produces, I think, the most beautiful cabinet wood in the world: rosewood. Four kinds grow in Brazil; one is nearly black, with purple lights; the others are striped like a tiger on a rich tawny to dark red ground.

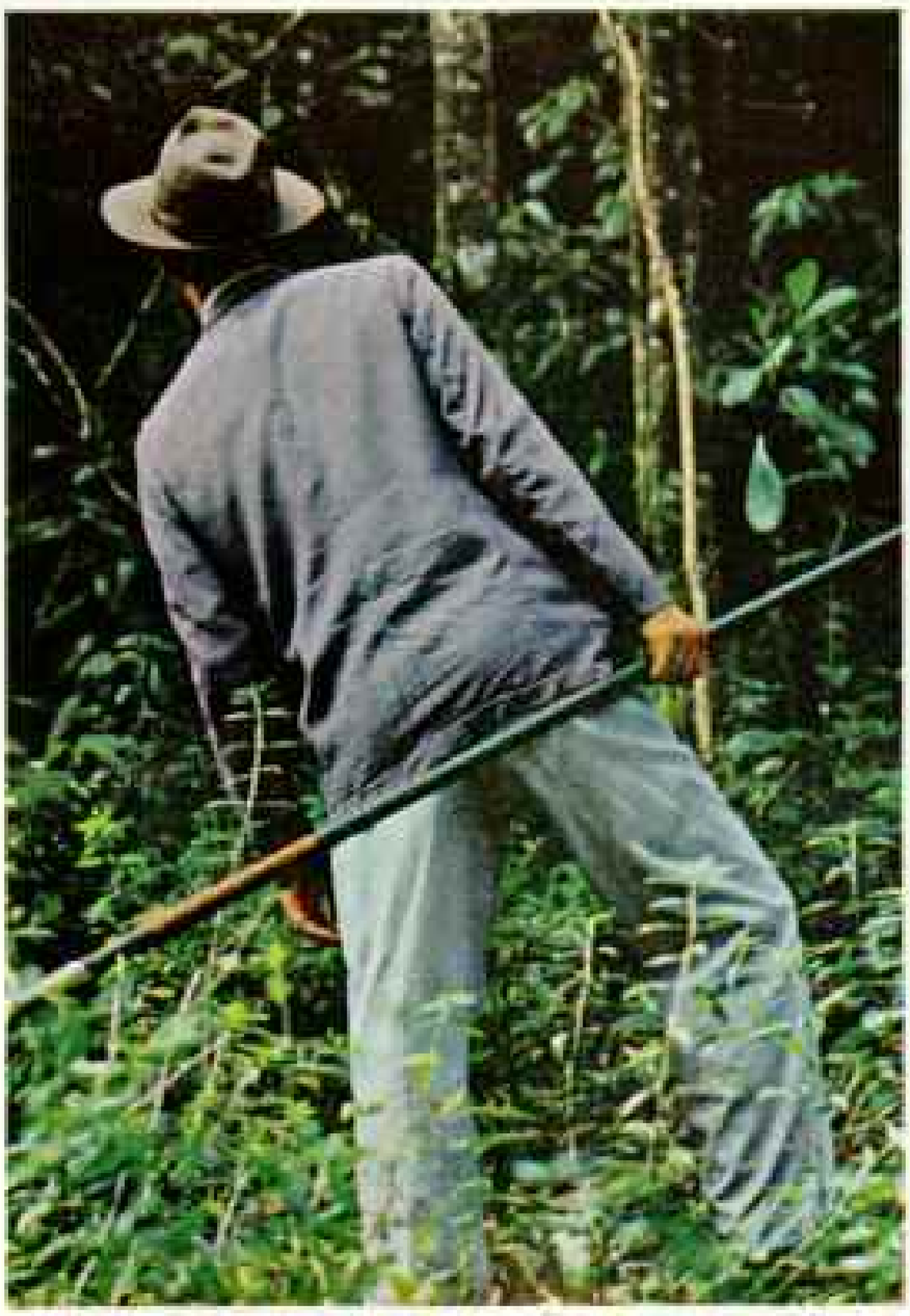
Ruschi pointed to a hillside where the

forest had been stripped and brush burned so that the red soil showed like a raw wound.

"I've spent my life trying to convince my countrymen that we should set aside forest preserves before it is too late. I remember my first encounter with wanton destruction of all this natural beauty. It was in 1933. There was a wood where I used to go to study orchids and birds. An orchid, *Houlletia brocklehurstiana*, covered the forest floor with a dark yellow carpet. I have never seen anything like it since; there were thousands of flowers, and the fragrance was such that you seemed to be in a closed room that had just been sprayed with perfume.

"One day I heard that the owner was going to cut down the forest. I hurried to see him and asked why. 'To grow *aipim*,' he said. That is the 'tame' or nonpoisonous variety of *mandioca*, which produces *farinha*, the coarse flour used in so many Brazilian dishes. I asked him how much he expected to get for his crop of aipim; he said he should

Ruschi goes fishing for hummingbirds. At lower left he surveys the forest for prospects. At left and below he slowly probes with a hookless 30-foot aluminum rod.



be able to grow about 1,500 cruzeiros' worth.

"I said, 'I'll give you that much, if you promise not to cut down the wood.' That was a lot of money thirty years ago, and the man thought I was mad. I didn't blame him; I was a student with a part-time job at a government seed farm, and what I offered him was three months' pay. The man accepted, but one year later he cut down everything anyway and set fire to the undergrowth. Will you believe me when I tell you that when I saw the smoking waste I sat down and cried, like a little boy whose pet bird has just died?"

Tree Wears 35 Species of Orchids

Ruschi stared moodily at the bare hillside and shrugged as if to throw off an unpleasant burden. Then he brightened and said, "But things are more encouraging now. By prodding officials, lecturing to citizens, and buying up land, I got the government to set aside preserves. Two of them, totaling about 2,000 acres, are near here; one belongs to my museum, and the other is an adjunct of our National Museum."

To reach one, we drove in a Brazilian-made jeep up into the hills, over a rudimentary road high above a stream bed, through increasingly heavy woods. The road ended beneath tall clumps of green-streaked golden bamboo, and we dismounted to follow a trail along the river. The sand bottom shone like warm gold through the pale water. On the far bank, the land, covered with a dense forest of hardwood and palm, rose steeply.

We walked beneath trees with musical Indian names: *paraju, macanaiba, tapinhoan, jiquitiba.* An incredibly rich mantle of air plants clung to the trunks and branches—orchids and bromeliads of fifty species, some as small as a thimble, a few as big as a man. On one tree alone, the doctor pointed out and named 35 different species of orchids.

In the sea-colored twilight of the forest, *Cattleya* and *Laelia* orchids burned like mauve flames. Round the purple blossoms

Captured bird, *Aphantochroa cirrochloris,* calmly dangles from a rod smeared with thickened linseed oil. Having eyes only for the decoy owl (page 91), the hummingbird perched in the bush at left and failed to observe Dr. Ruschi's pole silently and gently touching its gluey glass-fiber tip to its feathers. Strangely, the bird did not struggle.

danced fat bumblebees clad entirely in rich black velour, save for a touch of powder yellow near the head.

When I said I had never seen a bumblebee of that coloring, Ruschi said professorially, "Yes, zoogeographically speaking, we have many species which are *sui generis*."

The doctor pointed across the stream to a high eucalyptus covered with white blossoms. A literal swarm of hummingbirds wove in and out of the crown of flowers. "There are at least a hundred birds in that tree; some are perching and are harder to see. There are fourteen species in that one flock."

I looked impressed, but Ruschi said, with a smile, "I have a formidable eyesight, admired by the Indians, but I cannot make out the individual species from here. I know the number because I have observed that tree through glasses many times. I planted the eucalyptuses in 1940 to attract hummingbirds; now they are 60 feet high."

Water's Roar Masks Approach of Danger

As we walked downstream, the river flowed over an increasingly rocky bed, and in the distance I could hear the subdued rush of falling water. I remarked that there were fewer birds.

"Animal life is always sparser near a waterfall," said Ruschi. "The small creatures, birds and fur bearers alike, don't like to stay near a place where the roar of a cataract may mask the sound of danger. They prefer quieter haunts."

I remembered that I had seen few animals near waterfalls I had visited, but the reason had never struck me. Ruschi taught me the difference between looking and seeing.

Although birds grew scarcer as we approached the waterfall, butterflies flitted in increasing numbers over the brown waters. Here at last I saw that most beautiful of all butterflies—the genus *Morpho*. The lovely creatures came flapping upstream, flying high above the stream bed. Up there, the sun glinted on their wings with a coppery light; but when they dipped close to the water, the electric blue of the upper side of the wings flashed like a high-tension spark (page 89).

The morpho's flight was peculiar: a slow, hesitant beat, with wings a fraction longer in the down position, so that they seemed to be flying upside down in an inverted V.

I had seen souvenir trays in Rio in which lay hundreds of morpho wings, and I wondered aloud how so many were captured.

"They drink themselves into captivity," said Ruschi. "You take some overripe bananas and leave them on the ground. Hours later you find a cluster of morphos strewn there. They have feasted on the fermented bananas and gone off into a drunken sleep."

When at rest, the morpho shows only the underside of his wings, a dull moth brown, but when the wings open, the heavenly blue color blazes out, as though one of Brazil's celebrated aquamarines had taken wing.

Just beyond the butterfly pool, the river slid over a lip of rock and disappeared. We clambered down to the flat stone bed and walked to the edge. The stream flowed in a smooth agate curtain over the rounded

Wings stuck, *Chlorostilbon aureo-ventris*

pucherani rides the fishing rod. Telescoping sections slide the bird into Ruschi's hands

rock, rebounded from a ledge ten feet below, and cascaded in steepening steps into a narrow valley that dropped swiftly between forest-clad hills.

Hazily in the distance, humped bosses of granite rose like the backs of mastodons in a dim Pleistocene landscape; somewhere beyond them the Timbui River wound at last to the barely discernible blue line of the sea.

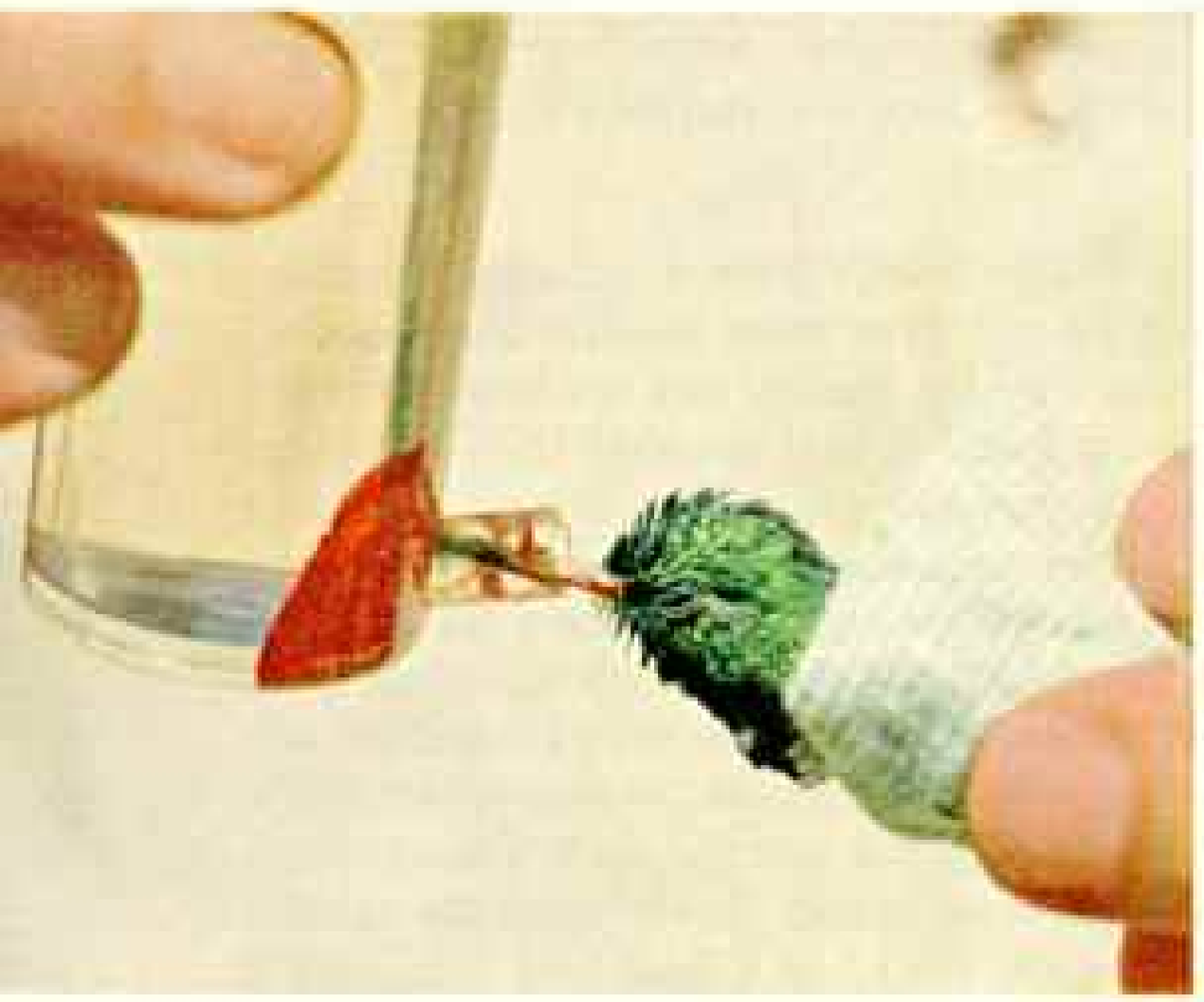
I thought of the young naturalist Charles Darwin who wrote, on first beholding the green continent, "Delight itself, however, is a weak term to express the feelings of a naturalist who, for the first time, has wandered by himself in a Brazilian forest. . . . such a day as this brings with it a deeper pleasure than he can ever hope to experience again."

One day Dr. Ruschi took me hummingbird fishing. I call it that because the implement Ruschi uses to capture the little fellows alive is a telescopic aluminum fishing rod.

"I have them made at a fishing-tackle place in Paris," Ruschi said. "Every time I go over, I order one made longer; once I asked for one 30 feet long. The Frenchman was taken aback and asked why I wanted such a long rod. I said, 'It is for a fish that lives in the middle of a wide river.' If I had told him that I wanted to catch hummingbirds, he would never have taken me seriously again."

Lighter fluid on cotton removes gummy birdlime from *Iphantochroa cirrochloris*. . .

Held by the beak, *Thalurania glaucopis* fans air with wings, evaporating the fluid. . .



Straitjacketed in a shirt, *Chlorostilbon aureo-ventris pucherani* sips sugar water.

Ruschi also carried a live owl on a stand. "The *caburé do sol*, the sun owl, lures the hummingbirds within reach. He is the birds' natural enemy, because he hunts by day. So whenever they catch him in the open they flock around and scold."

Beside a road cut like a red slash in the side of a hill, Ruschi thrust a sapling into the ground and hung the caburé's platform from it (page 90). The doctor attached a whiplike glass-fiber tip to his rod and smeared it with a sticky birdlime made of thickened linseed oil.

Pursing his lips, he called in a series of soft, liquid whistles. Within seconds a small bird dropped out of the sky, perched in a bush 10 feet in front of the owl, and began to berate the predator with crying chirps. The little owl blinked his yellow eyes at us and looked bored. He had been doing this for seven years.

Suddenly, like small dark dots in a pe-

Thirty-two bright-eyed captives in cloth coats, Dr. Ruschi's invention, ride an air-

numbra of blurred wings, three hummingbirds hung just beyond the caburé. Ruschi kept whistling plaintively, and without taking his eyes off the birds, he began swiftly to extend the rod to its full length of 30 feet.

In a series of buzzing rushes, the flower kissers danced angrily round the owl, who kept his body motionless, but swiveled his head to keep his eyes on the darting birds. Two of them alighted on a twig three feet from the owl's head, keeping up a metallic scolding *chip, chip, chip, chip.*

Angler Gently Bags His Quarry

Holding the rod vertical, Ruschi took three gliding steps forward, like a fencer, and slowly lowered the sticky tip until it came within six inches of a bird at rest. With infinite slowness the nearly invisible rod tip moved closer.

Ruschi, leaning forward in utter concentration, reminded me of an angler who has made a long cast with a dry fly and now raptly watches it float over a fish's lie. I did not see the rod tip touch, but suddenly the little bird was attached to it, and Ruschi telescoped the sections hand over hand.

The little green-and-gold creature was held spread-eagled, with both wings in the grip of the tacky oil (page 95). Gently the doctor detached the hummingbird. He held it against one knee while he wiped off the sticky stuff with a pad soaked in lighter fluid. Then he held the bird by its bill, while the little creature whirred like a miniature egg beater. In two seconds the volatile fluid had evaporated, leaving the bird dry and clean, without a single misplaced feather (opposite).

Grasping the bird round the body, Ruschi slipped its head through a slit in a bit of cloth. Making sure the wings were flat against the bird's sides, he drew back the cloth and tied it loosely with a piece of string. Next, he inserted the pointed bill into the spout of a flask of sugar water. The bird drank avidly.

line bag divided into compartments. Bottles of sugar water in the end slots will support them on a long journey. The naturalist has carried as many as 500 birds at a time in this fashion.

The calmness of the bird, which had not once struggled, surprised me.

"They are very intelligent," Ruschi said. But I am convinced that it was another instance of the understanding between hummingbirds and the good doctor.

Ruschi unzipped a canvas airline bag that he had divided into compartments and placed the hummingbird in one of the slots, where it lay quietly, turning its head to watch us with its bright black eyes.

Hummingbirds were now diving and darting in fury at the caburé who, with the blasé air of an old pro, paid scant attention. Within an hour, the doctor captured a dozen. They lay in the compartments, stacked three deep like cigars, tranquilly turning their brilliant heads of mauve, green, and bright blue.

Quest Starts in British Museum

During his life as a naturalist, Ruschi has discovered more than a score of new plants and animals. None of these finds was so exciting as the discovery of a supposedly extinct hummingbird.

In 1957, the doctor was in London, examining the British Museum's collection of hummingbird skins in the company of the distinguished French ornithologist Dr. Jacques Berlioz, of the National Museum of Natural History in Paris. The Englishmen showed Dr. Ruschi their precious hoard of 14 skins of a hummingbird the noted ornithologist John Gould had called the hooded vizor bearer *(Augastes lumachellus)*. For nearly half a century, they believed, no skins of these birds had come to any of the great collections. Even their origin was uncertain. The British Museum skins bore only the label "Brazil."

"The British authorities generously offered me two skins. I thanked them warmly but said—and I don't know what prompted me—that I hoped to have a *live* specimen at my museum before long," said Ruschi.

"Dr. Berlioz lifted his eyebrows and said, 'Don't you think that the bird is extinct?'

"I replied that Brazil is a big country, and that relatively little really thorough collecting had been done in large parts of it. I knew I spoke brashly, because in the definitive French work on zoology Dr. Berlioz himself had mentioned *lumachellus* as a species of 'uncertain status.'

"Two years later I was in the American Museum of Natural History in New York. Imagine my excitement when I saw, on the label attached to a *lumachellus* skin, the legend '1928. Brazil. Morro do Chapéu.' Here was the first definite locality.

"On my return home, I got out large-scale maps. I found there were *three* Morros do Chapéu (Hills of the Hat), two in the State of Bahia and one in Minas Gerais. One of the Bahia sites was a town, as well as a hill; so I decided to try that one first.

"I flew to Bahia and then rode a bus for 20 hours to the town of Morro do Chapéu (map, page 85). I had chartered an airplane in Bahia. If I found the birds, I would radio the pilot, and he would fly in to get them out alive as quickly as possible. Otherwise, I would return to the coast in the usual slow manner.

"The Hill of the Hat stands at the northern limit of a mountain range, the Serra do Sincorá. The hill, which *is* shaped like a hat, rises to 4,000 feet out of the *sertão*, or dry country. For eight days I beat the bush; I collected a few birds of known species but at last gave up; I radioed the pilot not to come, and stayed on to photograph the geology of the region.

"Extinct" Bird Returns to the World

"I came to a waterfall called Cachoeira do Ferro Doido, that spilled into a great hole in solid rock, 650 feet deep and three-quarters of a mile across. It was the dry season, the waterfall had dwindled to a thread, and I stood in amazement before the great hollow that this filament of water had worn into the rose-colored rock. The rock was a diamond-bearing conglomerate known to geologists as Sincorá Formation. For more than a century, this region has yielded diamonds.

"As I was putting away my camera, a hummingbird shot across the trail. I saw it out of the corner of my eye and said to my guide, 'That bird is not known to me.' Five minutes later I saw, hovering before a yellow flower, a living *Augastes lumachellus*.

"How did I feel? *Grande emoção!*—my hair stood on end from satisfaction. I got on the radio and told the pilot to give me 48 hours, then come for me. In those two days I took a dozen live specimens of both sexes."

Dr. Ruschi created a stir in scientific circles with his rediscovery of the hooded vizor bearer. Since that time he has discovered two varieties of hummingbird entirely new to science, one of which, *Colibri delphinae greenewalti* (right), Ruschi has named for

"Extinct" hummingbird, *Augastes lumachellus*, the hooded vizor bearer, entertains André and Augusto Ruschi, sons of the man who rediscovered the lost species.

Green throat and blue side feathers mark *Colibri delphinae greenewalti*, a subspecies discovered by Dr. Ruschi and named for his friend Crawford H. Greenewalt, distinguished author of the article that follows.

Mr. Greenewalt, with whom he has collaborated since 1956 (see article beginning on next page).

Dr. Ruschi says, "Brazil is too big for anyone to say that all the flora and fauna of a given area have been described. I am certain that we shall continue to find new species for a long time to come."

"Augusto Ruschi, Naturalist"

As I write this in the guesthouse of the Mello Leitão Museum of Biology in Santa Teresa, a sudden movement catches my eye. Beyond the plate-glass window, a green hummingbird hangs suspended six inches from my face and stares at me impudently, as if to ask, "What do you know of me?"

Thanks to the patient observations of many men over many years, and modern techniques such as high-speed photography and electron microscopy, we already know a great deal. But just as surely we shall continue to learn even more through the brilliantly intuitive studies of the man who signs himself simply, "Augusto Ruschi, naturalist."

THE END

Sporting a disorderly crew cut, a male *Lophornis magnifica* appears to cast a disdainful eye on the nuptial display at right. When extended, his neck feathers form a handsome white fan tipped with iridescent green.

ALL THREE BIRDS TWICE LIFE SIZE

Bright-feathered suitor, *Lophornis chalybea* spreads a gaudy collar and

Photographing Hummingbirds in Brazil

By CRAWFORD H. GREENEWALT

Photographs by the author

IT IS REMARKABLE how large a part chance can play in forwarding or frustrating our ambitions. As I reflect on it, I see that Lady Luck was certainly operating on behalf of my hummingbird project.

The day I went to New York to suggest to the American Museum of Natural History that I attempt an illustrated book on hummingbirds (a suggestion which the museum accepted with enthusiasm), it just happened that Jean Delacour, then Director of the Los Angeles County Museum, was in New York; it just happened he was spending that afternoon at the museum; and it just happened I was taken to meet him.

"If you want to photograph hummingbirds," Delacour said, "you should get in touch with my friend Béraut in Rio." I did so immediately. It turned out that Dr. Etienne Béraut, a charming Frenchman, was a hummingbird "buff" and had an aviary with twenty or more species in his 12th-floor Rio de Janeiro apartment. After much cordial correspondence, a date was made and I prepared to set out for Rio.

Unhappily, about a week before my departure he wrote that his birds had become infected with a fungus disease and that all had died. Dr. Béraut's letter, in French, said his birds had *champignons*. Until I had fortified my indifferent French by a look at the dictionary and discovered the word also meant fungus disease, I wondered how on

swings from side to side before a female *Lophornis magnifica*. As he hovers, he makes a rattling noise by opening and shutting his tail like a fan. Normally, the two species do not cross-mate.

earth champignons, which I knew only as edible mushrooms, could be lethal to hummingbirds. Nonetheless, he said, come along. So my wife and I arrived on the appointed day, complete with photographic gear, not knowing what to expect, if indeed anything.

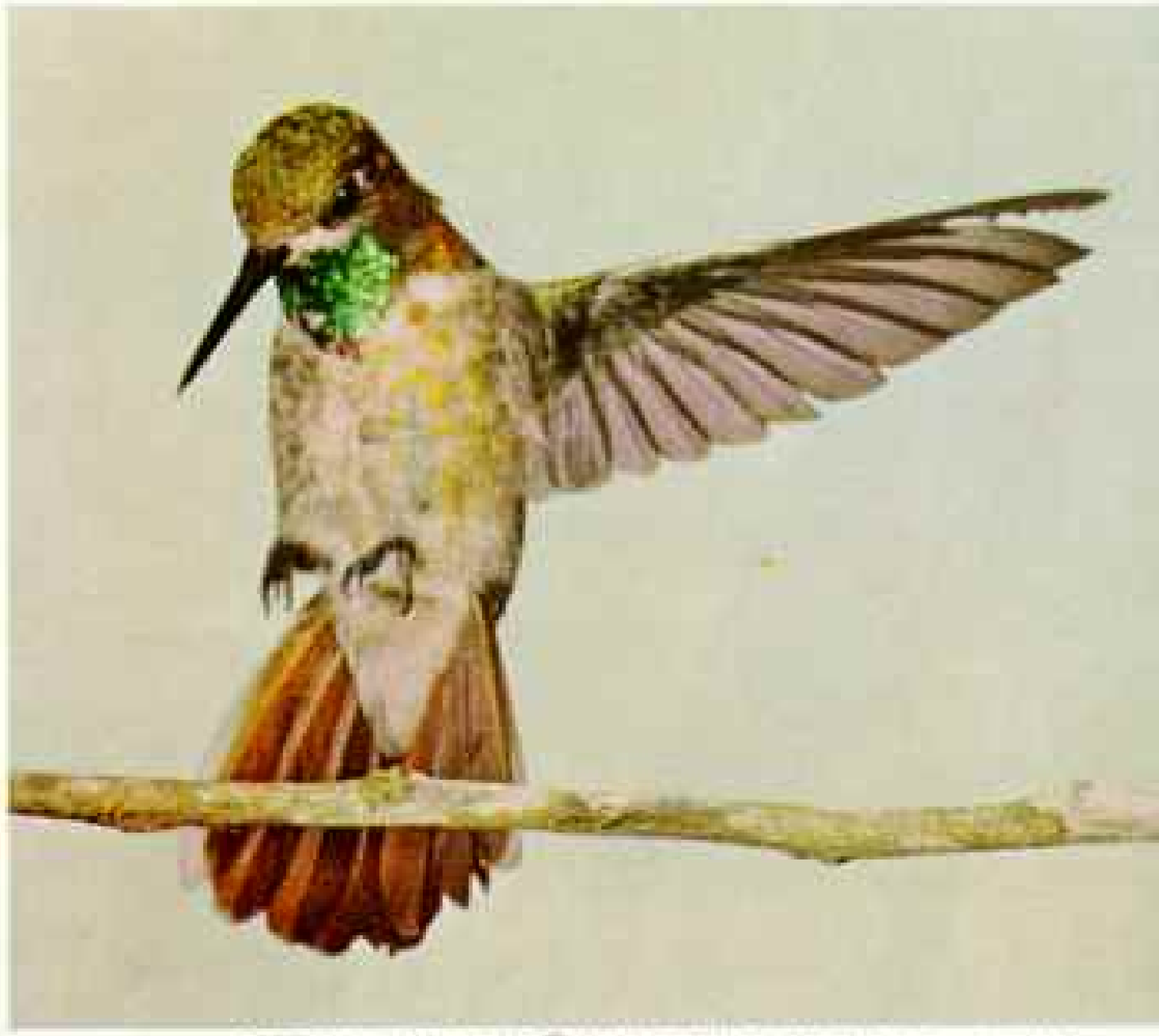
Hummingbird "Mine" in Santa Teresa

Dr. Béraut was prepared. He had constructed an outdoor aviary at the summer cottage of Mr. and Mrs. René Cassinelli, in Petrópolis, well-stocked with hastily captured hummingbirds. There we photographed our first Brazilian *beija-flores* (flower kissers). Dr. Béraut next took us to a friend in Santa Teresa where, he said, we would find many more species. The friend turned out to be Dr. Augusto Ruschi. Lady Luck had smiled, and at the end of the trail I found a hummingbird gold mine.

Mr. Marden has written a delightful account of Augusto Ruschi and his museum. To it I can only add that without Dr. Ruschi's assistance, extended so enthusiastically in many countries for the past several years, I doubt that my book on hummingbirds could have become a reality.*

Dr. Ruschi even brought me two live hummingbirds to be photographed when he visited us last June. Under his tender care, the two had made the 5,000-mile jet journey from Rio to Delaware without incident and were promptly installed in my absent son's bedroom. A few weeks later, having been duly photographed, they were given to the National Zoological Park in Washington, D. C.,

**Hummingbirds*, published for the American Museum of Natural History by Doubleday & Company, Inc., New York, 1960, $25.00. See also "The Hummingbirds," by Crawford H. Greenewalt, with photographs by the author, NATIONAL GEOGRAPHIC, November, 1960.



CRAWFORD H. GREENEWALT © 1968 AMERICAN MUSEUM OF NATURAL HISTORY

Braking for a landing, a female *Augastes lumachellus*, the "lost" species (page 99), thrusts her feet forward to a twig.

Preflight calisthenics of a male *lumachellus* include stretches to loosen feathers. With each stretch, the magenta tail spreads wide.

TWICE TIMES LIFE-SIZE

Feathers fluffed, the same *lumachellus* sleeps soundly on his perch.

BOTH BIRDS LIFE-SIZE

as the nucleus of a future hummingbird exhibit.

As to the series of hummingbird photographs shown here, I should perhaps apologize for using scientific names to identify the birds, but no common names exist. Even if they did, they would be in Portuguese and so not very helpful to English-speaking readers.

I am particularly happy with the pictures on these pages of *Augastes lumachellus*, the species which had been presumed extinct until Dr. Ruschi found living individuals. The pictures of the male bird sleeping and stretching are, I believe, photographic "firsts" for any hummingbird. I tried hard for the stretching picture (left) because this seemed the best way to photograph the spectacular iridescent tail.

TWICE LIFE-SIZE

Missing wing feather of *Clytolaema rubricauda*, probably lost in a fight with another male, attests the pugnacity of hummers. Light glints from iridescent patches on crown and gorget. The elegant species is a frequent visitor to the Ruschi home in Brazil.

The female *Augastes lumachellus* is unusual in having an iridescent gorget, not so extensive or spectacular as that of her mate, but bright enough to rival that of many males of other species (page 103). Most female hummingbirds are relatively dull and apparently rely on their charm rather than on their adornment to attract the opposite sex.

The iridescence shown in these pictures is a phenomenon that has aroused the interest of physicists and biologists for many years. More than two hundred and fifty years ago Sir Isaac Newton suggested in his *Treatise on Opticks* that iridescent colors in birds were similar to the colors formed by light rays acting on thin films, whose optical properties he had discovered. He wrote:

"The finely coloured Feathers of some birds, and particularly those of Peacocks Tails, do in the very same part of the Feather appear of several Colours in several positions of the Eye, after the very same manner that thin Plates were found to do . . . and therefore arise from the thinness of the transparent parts of the Feathers; that is, from the slenderness of the very fine Hairs, or *Capillamenta*, which grow out of the sides of the grosser lateral branches or fibres of those Feathers."

After much controversy, it was established about fifty years ago that Newton was right. The brilliant colors in hummingbirds are what we now call "interference colors." (The colors in a soap bubble or in a drop of oil on a wet pavement are common examples of interference colors.)

Forked tail cocked, *Popelairia langsdorffi* appears to squat in mid-air as he hovers above a feeder. Iridescent red band sets off the gorget of glittering metallic green.

Electron Microscope Pierces Mystery

Our work with the electron microscope and the spectrophotometer has shown for the first time the precise nature of the structure in hummingbird feathers that is responsible for these brilliant colors. The colored portions of the feather are a mosaic of tiny elliptical platelets visible only under the most powerful optical microscope. Under the much higher magnifications possible with the electron microscope, one sees that each platelet is somewhat like a pancake liberally filled with air bubbles. It is this structure that produces the almost pure spectral hues one sees in the flash of a hummingbird gorget.

Another photograph which especially pleases me is the nuptial flight of *Lophornis chalybea* (page 101). This is the first time such a performance has been recorded on film. The union, if consummated, would have been a mismarriage, since the female is *Lophornis magnifica*, indistinguishable to my eye, and apparently to the male hummingbird's, from his own *Lophornis chalybea*. We have shown the proper male, *Lophornis magnifica*, looking on with disapproval (page 100).

The picture of *Phaethornis eurynome* (page 112) was selected to show the forked tongue, which is very long when fully extended, much longer than the bill. The tongue is tubular, and nectar can be sucked out of a flower or artificial feeder without the bill itself touching the liquid.

The male *Calliphlox amethystina* (page 110) has the highest wingbeat rate I have recorded,

Spectacular tail compensates for lack of iridescence on *Melanotrochilus fuscus*, aptly nicknamed "top hat and tails." Here it executes a fast getaway from a feeder. As in other hummers, its wing muscles account for more than a fourth of the entire weight.

Golden lamp of the hummingbirds. No other member of the family wears a larger area of iridescence in proportion to the body than does *Chrysolampis mosquitus*. The shining feathers almost caused his extinction at the turn of the century, when Brazil exported thousands of skins to ornament ladies' hats.

about 80 beats per second. The lowest rate, about 10 per second, belongs to *Patagona gigas*, the largest of the hummingbirds.

The flight montage (pages 108-9) warrants some additional explanation. Hummingbirds are the only birds that can hover indefinitely and that can fly backward and sideways as well as forward. The analogy with a conventional helicopter is very close. When a helicopter rises vertically or hovers, its rotor is parallel to the ground; so is the plane in which the hummingbird beats its wings.

When a helicopter goes into reverse, its rotor tilts to the rear, and when it flies forward, its rotor tilts forward. The hummingbird wing plane behaves in exactly the same way. The hummingbird, however, is about twice as efficient as the helicopter in fuel consumption per unit of weight.

Hummingbird Wings Do Double Duty

Hummingbirds derive power on both the upbeat and downbeat of their wings. Other birds get flying power only on the downbeat. Whether the hummingbird is hovering, backing up, or flying forward at top speed, each wingbeat does double duty. It is this that gives the hummingbird maneuverability unmatched by any other bird.

One final oddity calls for mention. For any dimensionally similar group of animals—cats or dogs or horses or even humans—the weight will be proportional to the cube of a linear dimension, say the length of an arm or leg. When Alice, for example, drained the bottle labeled "DRINK ME," she diminished in size. If she had shrunk to one twenty-seventh of her original weight, her arm would have shortened to a third of its original length. (Three is the cube root of 27.)

Hummingbirds are apparently an exception to this almost universal law. Their wings vary not as the cube root (the one-third power) but as the two-thirds power of their weight. Their weight ranges over rather narrow limits, from about 2 grams for the smallest to 20 grams for the largest. If, however, this odd relationship extended to other birds, or if hummingbirds covered a much larger size range, we would have aerodynamic monstrosities. A swan on the hummingbird model, for example, would have a wing span of 65 feet; a gnat, at the other extreme, would have wings so small as to be visible only under a powerful microscope.

I'll take the hummingbirds as they are—beautiful creatures, fearless, pugnacious, aerial acrobats. As Audubon said, they are indeed glittering fragments of the rainbow.

* * *

Perched on a platform above the public square in Santa Teresa, Brazil, the author prepares to make motion pictures of a bird feeding her young.

Mr. Greenewalt's book, *Hummingbirds*, published by Doubleday & Company, Inc., for the American Museum of Natural History, has been hailed as a classic. He serves E. I. du Pont de Nemours & Company as Chairman of the Board and the National Geographic Society as a Trustee.

Ruby-throat, alarmed,

At upper left the bird tranquilly sips nectar from a flamevine blossom. Startled by the click of the high-speed camera, she spreads her tail and gives a strong forward thrust. As she puts her wings in reverse, pulling the beak out of the bloom, she rotates her body until in positions 6 and 7 she is flying virtually on her back. Then she performs a half-roll to turn

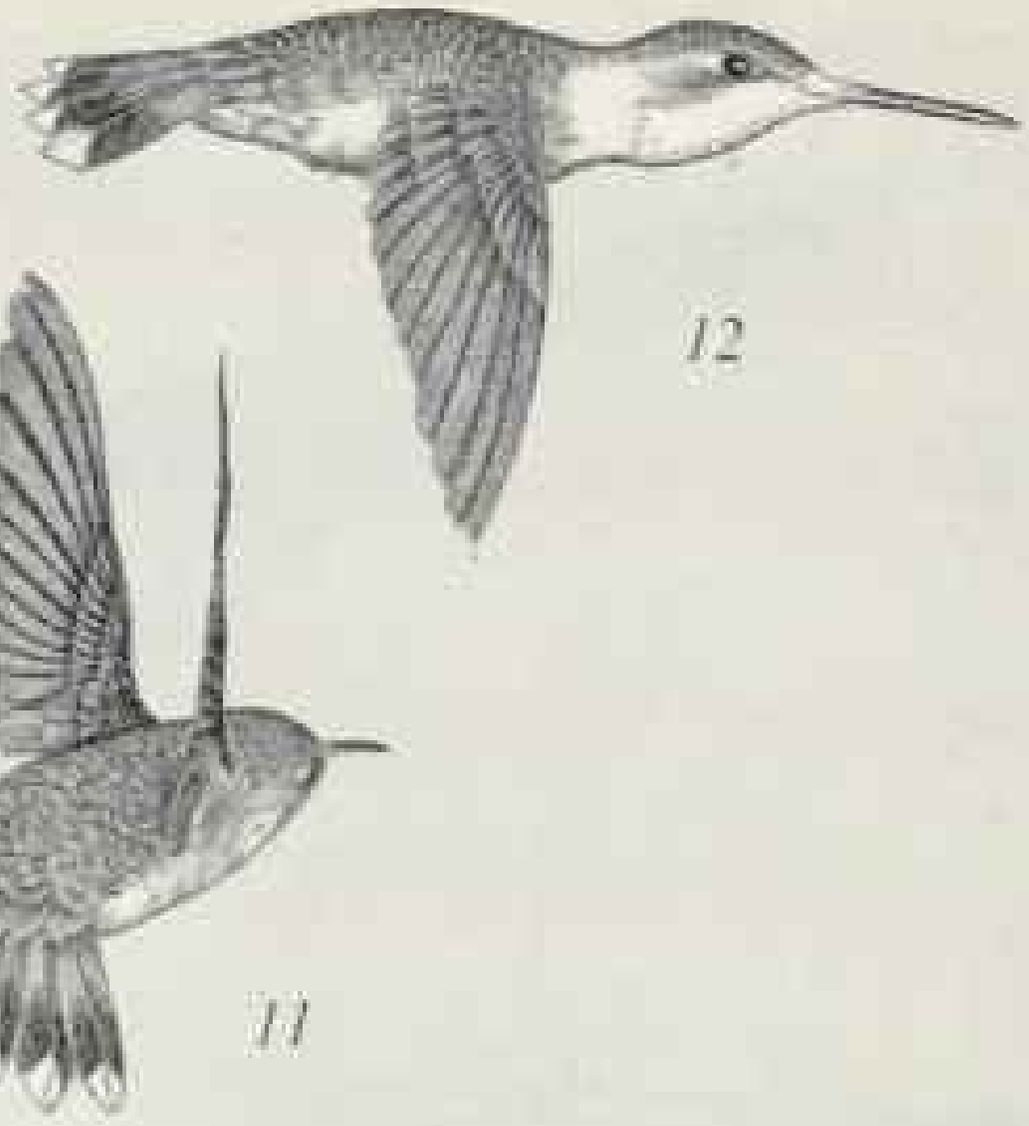
Hovering

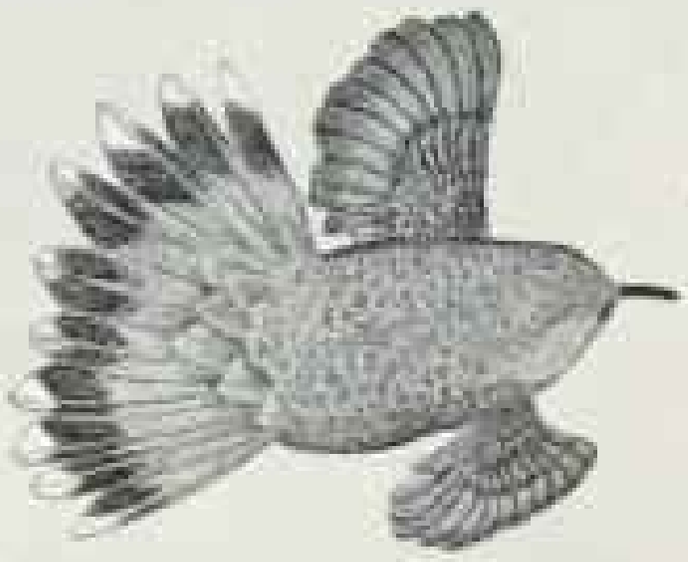
Pivoting like semaphore flags, wings move forward and backward about 50 times a second. On the backstroke, they twist at shoulder nearly 180° so that top becomes bottom and generates lift. Like helicopters, hummers can rise vertically and hover. Weight for weight, they use about half as much energy.

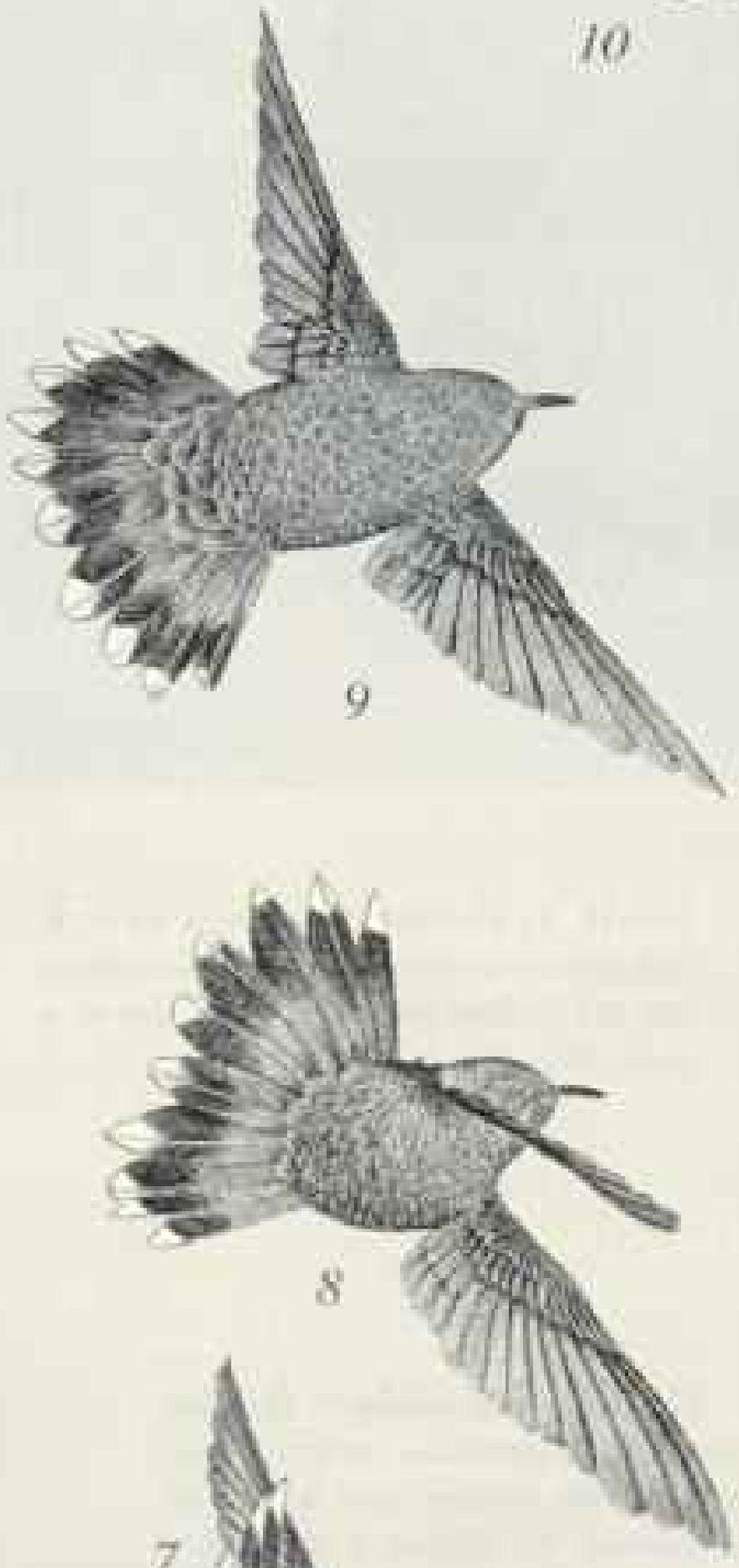
quits the premises

right side up, and darts away. In 11 and 12, her wings are in position for full speed ahead. The entire sequence takes place in about two-tenths of a second.

These drawings by Dale Astle, from high-speed motion pictures taken by the author, are slightly less than life-size. The ruby-throat is the most common hummingbird found in the United States.







Backward flight

Plane of the wings tilts backward, as does a helicopter rotor, producing lift and rearward thrust. Speed of backward flight is much less than the darting forward speed. Like an automobile, a bird is designed for efficient forward movement; its reverse gear is intended for low speed and occasional use.

½ LARGER THAN LIFE-SIZE

TRUE LIFE-SIZE

Small, scalelike feathers of rich and luminous emerald green lengthen into a pendant point on the chest of a male *Augastes scutatus*.

Tom Thumb of a midget family, *Calliphlox amethystina* weighs one-fifteenth of an ounce and beats its wings about 80 times a second—fastest of any hummer tested by Mr. Greenewalt. To measure wing vibrations, the author records the sound of a bird's flight on tape running at 15 inches a second, then plays it back at quarter-speed on an instrument that transcribes the sound on graph paper.

CRAWFORD H. GREENEWALT © 1942 AMERICAN MUSEUM OF NATURAL HISTORY

¾ LARGER THAN LIFE SIZE

Now You See It; Now You Don't! A Hummingbird Turns Magician

Flashing iridescence of hummingbirds depends on the angle at which light strikes mosaics of tiny elliptical platelets on the feathers, visible only under the most powerful microscopes. Deviation of a few degrees from the correct angle causes colors to wink out as if a switch had been thrown.

Photographs must achieve exactly the proper angle to record the resplendent brilliance, for if the positions of subject, light, and observer change even a trifle, the bird looks drab and dark.

This male *Thalurania furcata eriphile* proves an excellent model: dull above, brilliant below, as he shifts position.

To lesser degrees, the turkey, pigeon, starling, and crow show iridescence.

½ LARGER THAN LIFE-SIZE

Fork-tongued Hummer Licks His Bill After a Feeding

Split halves of the tongue of *Phaethornis eurynome* fit together into a drinking straw when the bird sips nectar from flower or feeder.

Per unit of weight, the hummer expends the highest energy output of any warm-blooded animal and therefore must refuel frequently to keep up its energy supply. Dr. Ruschi uses up to 45 pounds of sugar a day to feed winged visitors at his Brazilian aviary (pages 80-99).

Because hummingbirds of this genus seem shy and frequent densely wooded areas, they are known as "hermits." Neither male nor female displays iridescence. A forked tail is not uncommon among hummingbirds.

Taking his own picture, *Stephanoxis lalandi* backs away from a feeder. In his retreat, tail feathers interrupt a beam of light shining on a photocell, triggering shutter and flash.

½ LARGER THAN LIFE-SIZE

© 1965 AMERICAN MUSEUM OF NATURAL HISTORY

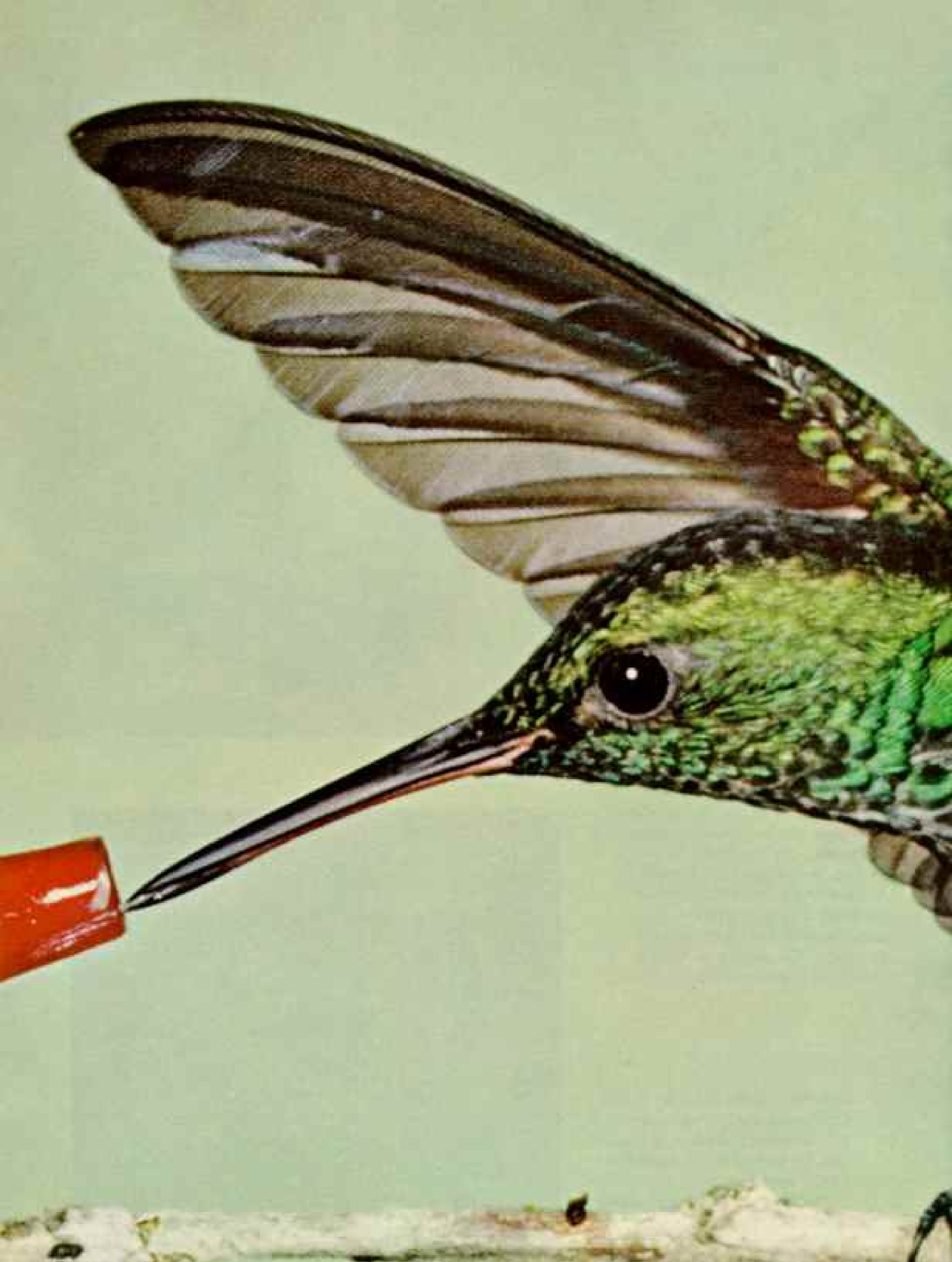
¾ LARGER THAN LIFE SIZE

Aerial acrobat with the grace of a ballet dancer, *Colibri serrirostris* homes in on the perch. Members of this genus possess iridescent ear coverts. When excited, they extend the feathers at right angles from the sides of the head. The bird, a placid creature, never grew angry enough to enable the author to photograph the coverts, until . . .

Serenity gives way to ire as Dr. Ruschi gently grasps *serrirostris* between thumb and finger, and its gleaming ear fans stand partly open.

Probably no family of related creatures varies so widely in physical equipment as do the hummingbirds. Bills range in length from a short protuberance to an extraordinary five-inch beak. Some curve slightly downward; one or two are upward. And one genus has a sickle bill.

¾ THEIR LIFE SIZE



Foraging tongue, almost transparent, draws sugar water from a feeder. Mr. Greenewalt's high-speed photography disproves an earlier theory that the bill itself had to touch the liquid. In this portrait of **Chlorestes notatus**—*4¼ times life-size—light from the electronic flash gleams from feather barbs.*

BERNINA

Across the Alps in a Wicker Basket

By PHIL WALKER

"LISTEN," I ASKED. "Do you hear that sound?"

There *was* a sound, so lovely yet so distant that it seemed almost a dream. It was the rush of waters flowing from Alpine glaciers, tumbling over precipices, falling through gorges thousands of feet below us.

Otherwise all was still, there in the incredibly clear sky. Three of us—two Swiss and one American—dangled in an improbable wicker basket beneath the free balloon *Bernina*, as she drifted like a silver teardrop through the Swiss Alps toward Italy.

Beside us rose the snow-clad Jungfrau, 13,642 feet high, one of the famous mountains of the world (page 122). To the southwest, the Matterhorn's bent peak pierced the sky. Just to the east lay the Greater Aletsch Glacier, whose enormous tongue licks 14 miles down the Jungfrau massif.

We floated serenely, as if sightseers from another planet. Movement of the gondola was scarcely noticeable, a slow and irregular swaying. The balloon constantly revolved, and each of us in his own corner of the car

Carrying a crew of three, *Bernina* drifts serenely above Lotschen Valley in the Swiss Alps. The photograph was made from a small plane. Swiss flag hangs limply from the balloon's rigging.

TOURIST OFFICE OF MÜRREN

Mürren, Switzerland, 1910: Spectators await launching of *Sirius*, one of the first balloons to cross the main Alpine massif.

could witness an unending 360-degree panorama of Switzerland.

"Wunderbar! . . . magnifique!" exclaimed Capt. Fred Dolder. Like so many Swiss who know German and French, and often Italian and English, our pilot mixed his languages. At 64 Fred Dolder, one of Europe's foremost balloonists, was making his 177th flight—his fourth in the Swiss Alps—with all the enthusiasm of a boy at a picnic.

Bespectacled, with a white goatee and a head of short-cropped white hair covered by a knitted stocking cap, he sat on a sandbag in one corner of the basket, holding his chart, log, and pencil. The other two of us stood: Erwin A. Sautter, the man who had organized our flight; and myself, a lecturer from San Francisco who had come to Switzerland to make a color motion picture. I had been invited along, unexpectedly, to make a movie record of the trip.

For both Erwin and me, this was a first balloon flight. We stood entranced, gazing at the silent summits.

Village Sponsors Transalpine Leap

Less than an hour before, we had soared away from the village of Mürren, more than a mile above sea level in the Bernese Alps (right). Now we were 8,000 feet higher, drifting past the very top of the Jungfrau on a southbound wind that was answering our hopes and those of the villagers who had sent us off.

Fifty-one years and one day earlier, on August 12, 1910, the Swiss balloonist Eduard Schweizer, who became known to the world as "Captain Spelterini," flew in a balloon from Mürren south across the Jungfrau and Matterhorn ranges to land in Italy, near the city of Turin.

Mürren, 1961: On the 51st anniversary of *Sirius*'s flight, *Bernina* inflates at the same site. Ballooning in Europe started nearly two centuries ago. In 1783, France's Montgolfier brothers used straw-burning braziers to generate hot air that lifted pioneer balloons above Paris. Manned flights, some using hydrogen as does *Bernina*, began the same year.

PHOTOGRAPH BY FLORENCE WALSH © NATIONAL GEOGRAPHIC SOCIETY

By sponsoring another flight half a century later across the Alps into Italy, Mürren hoped to commemorate Spelterini's feat. Erwin, as Mürren's tourist-office director, was responsible for the try. Fewer than 20 balloon flights had ever been made all the way across the main body of the Alps (map, page 126).

After the weather of the preceding week, we had expected anything but this rare day. On our target date, it rained pitchforks. But at midnight, with winds howling and rain still pounding, Dolder alerted *Bernina*'s crew for an ascension in the morning. Weather reports were good: The storm would blow out.

Dawn came with crisp, electric air and a magnificent sky. By seven o'clock the balloon, a rumpled mass resembling a beached jellyfish, lay spread out on one of the few level spots in the village. The ground crew was arranging the net that would cover the balloon and support the gondola. Hermann Johannes Scheer, himself a balloonist, supervised rigging the huge rubberized cotton bag to receive its fill of hydrogen from 96 metal cylinders ranked nearby.

All Mürren turns out to see the flight begin

Bulging *Bernina* hauls its human cargo skyward. The hydrogen lifting the great cloth bag, filled to three-fourths of ground-level capacity, expands as the balloon rises.

Like ants on a picnic cloth, well-wishers throng a playing field near the Palace Hotel to see the balloonists off. Empty gas cylinders resemble a stack of cordwood. Fearing that sparks might ignite escaping hydrogen, the crew carried no electrical instruments.

All aboard! Bearded Fred Dolder, Swiss aeronaut and captain of *Bernina*, briefs the author as Erwin A. Sautter of Mürren, who organized the flight, scrambles into the gondola. Only Dolder, veteran of 176 ascents, had ballooned before. Prepared for a possible emergency landing high in the chilly Alps, his companions dress for cold weather. Bags of sand hanging from the basket serve as ballast.

EXTACHROME (ABOVE) BY E. A. VAUT

Mürren sits on a high shelf, 2,600 feet above the narrow Lauterbrunnen Valley. Its only access is by cable railway; there are no automobiles, or even motor bicycles, at Mürren. The 96 bottles of gas had come to the valley town of Lauterbrunnen by train, up the cable railway, thence along the shelf by an old-fashioned electric car that visiting Americans call the "Toonerville Trolley."

Though the morning was chilly, Fred Dolder blithely wore only a faded blue yachtsman's outfit and thin canvas shoes. Erwin and I, fearing we might land on some inhospitable glacier, dressed in thick alpine jackets and ski boots. For added measure I put on a second set of trousers; to the 450 villagers of Mürren, seemingly all of whom were out to watch, I became "the American from San Francisco with two pairs of pants."

About 7:30, hydrogen began hissing into *Bernina*. Hydrogen is the lightest known element, a colorless gas and, in pure form, odorless, although now and then I caught a suggestion of cooking gas. Hydrogen, too, is highly flammable, and no one near the balloon could smoke.

Inflated Balloon Poised for Flight

Helium, the next lightest gas, would have been preferred, for it will neither burn nor explode when mixed with air, as will hydrogen. But the United States, chief source of free-world helium, rigidly controls its export.

Twenty-five bags of sand, each weighing

PAINTINGS BY PAUL WELLER © NATIONAL GEOGRAPHIC SOCIETY

34 pounds, now went into the gondola or were hung on the sides of the basket. Sand ballast is as important to a balloon as gasoline to an automobile. Without it, the inflated giant would rise to its maximum altitude, then descend steadily again to earth. But by releasing sand and gas in small amounts, the pilot can control the balloon's motion upward and downward. He can hold it within favorable currents of air.

By 10:40 *Bernina* had received her full quota of gas. She was still only three-fourths inflated, but as she rose to altitudes of lower air pressure, and as the sun warmed her hydrogen, she would swell into a sphere. Even now, pear-shaped, she tugged at the wooden hoop above the basket.

Icy prongs of the Alps challenge the crew

Spectacular panorama of the Bernese Alps greets Erwin Sautter (above) at 7,000 feet. To clear these peaks, most formidable hurdle on the seven-hour ride into Italy, he and his companions soared to some 14,000 feet. From the left, the spires of Eiger, Monch, Jungfrau, Rottalhorn, and Gletscherhorn all tower more than 13,000 feet.

The gondola was ready, a wicker car 3 feet by 4 feet across with sides 3½ feet high. It looked like an outsized laundry hamper. Into it we scrambled awkwardly.

Lines were cast off for a test rise. "Too much sand," Dolder said. "Out it goes."

One by one we removed bags from the basket, until only 11 remained. Then, amid a great cheer from the crowd, *Bernina* lifted. We were away (page 120).

As we rose swiftly and silently, we soared off in a northerly direction. The spectators gave a great groan.

In summer, winds high above the Bernese Alps normally blow east or west. But to cross into Italy, as Spelterini did, we needed a wind headed south. A small test balloon released that morning at Mürren had shown a high-altitude wind from the north.

Sure enough, past 10,000 feet—just as we were beginning to anticipate an evening landing in Basel or Brussels—we changed direction. The sparkling day and hot sun gave *Bernina* the lift she needed to cross the Jungfrau massif, and soon we were sailing south in warm air at nearly 14,000 feet.

Raft of the Wind Drifts in Silence

A balloon sails with the wind, or rather *in* the wind. She is like a raft drifting on a current of the sea. There is nothing for the wind to rub against, and thus no sound.

She will rise until her expanding hydrogen begins to escape from the narrow neck, or appendix, of the balloon, which remains open as a safety valve. She will sink when gas is valved off (a control rope from the gondola leads up through the appendix and the inside of the balloon to a valve at the top), or in late afternoon as the air cools.

Sunlight falls on one side of the balloon. The hydrogen is heated unevenly, thus inducing rotation. *Bernina* turned very slowly, requiring a few minutes per revolution.

The air at this elevation was so thin that each exertion meant extra breathing. But there was little to do, except occasionally transfer a sack of sand into an open ballast pouch that hung outboard. From there, the captain at intervals sprinkled a scoopful of sand over the side.

Erwin pointed out landmarks. "The peaks of all the famous Alps are familiar to the Swiss," he said. "We call them horns, such as the Aletschhorn, that we just passed, or the Gletscherhorn, or the Matterhorn."

A moment later he said, almost to himself, "By heaven, it is quiet!"

Silent as a swallow, breeze-borne *Bernina*

PAINTING BY LORENZ FRIED, © NATIONAL GEOGRAPHIC SOCIETY

glides above craggy Alpine peaks. Low, distant clouds obscure the Rhône River

Heaven seemed the right word. It may have been the altitude, or the warmth of the sun, or the absolute silence, but I felt a wonderful sense of ease, of complacency and peace. It was as if we were far out at sea, cut off from the cares of everyday life.

Yet, strangely, my feeling was not that we had escaped from reality, but that we had come to it. This was what life should be, what it was meant to be. Here *was* reality.

This must be why, to men like Fred Dolder, the importance of ballooning is not the end—the getting somewhere, farther or higher—but rather the means, the flight itself. This feeling of freedom, of utter peacefulness: Here was the essence of this very old sport, and why free balloonists seem a people apart.

I came back from my thoughts suddenly. "Ach! Watch out!" said a voice. Dolder, who was still seated on a sandbag, extracted his foot from beneath my boot. For the fifth time, I had trodden on the pilot's sneakers.

"Now I know how that rooster felt," he said with a laugh. I must have looked blank.

Jettisoned scoop of sand checks the balloon's descent as she begins to sink. Valving of gas and dropping of ballast control *Bernina*'s altitude, keeping her in a favorable windstream.

Transalpine adventure spanned 100 miles. Winds at take-off pointed the balloon toward Belgium; loftier currents carried her into Italy.

Sight of Visp, beside the Rhône,

"In 1783," he explained, "when the brothers Montgolfier sent up their second hot-air balloon, for the French court at Versailles, it carried a sheep, a cock, and a duck—the very first aeronauts. They came down safely, except that the sheep had stepped on the rooster and hurt his wing."

I was properly abashed, and Dolder grinned. He went on talking about that famous year, 1783, when men, too, first flew. One of them, the French physicist Jacques Charles, went aloft in a balloon amazingly like *Bernina*.

Charles used hydrogen for the first time. His balloon was made of cloth covered with elastic gum. A net over it supported a wicker basket. It had a valve at the top, an appendix, sandbags for ballast, and a barometer for reading altitudes. His ascent, watched by a throng of some 400,000 people, proved conclusively man's conquest of the air. He and a companion stayed aloft for two hours.

"Here we are, almost 200 years later," Dolder said, "flying in exactly the same way as Monsieur Charles."

signals success. Here the sky-piercing Swiss Alps give way to safer terrain

Becalmed Near Besnate, Italy, the Crew Sees a Plane Pass Below

Sun struck *Bernina* on one side, and unevenly heated gas imparted a slow spin. Because the bag rode noiselessly in the wind, the passengers

seldom experienced a sense of motion. Wind alone dictated its velocity and its direction. *Bernina* cruised at an average 15 miles an hour. On a three-hour flight a year earlier, pilot Fred Dolder swept from Zürich, Switzerland, almost to Czechoslovakia at more than 70 miles an hour.

Visitors From the Sky Enliven a Red Rally in Italy

Author Walker (in basket) and his friends landed without mishap in the midst of a Communist picnic outside Besnate. Onlookers seized the balloon's trailing rope and helped bring their uninvited guests to earth.

Canvas sling, draped overside, held the heavy trail rope while the ship was aloft.

Jigging across the crumpled bag, pilot Dolder expels the remaining pockets of gas. A bystander straightens the appendix to permit easy escape of hydrogen. Balloon, of rubberized cotton, weighs 600 pounds when collapsed and measures more than 40 feet in diameter when fully inflated. The shirtsleeve weather at Besnate pleased the lightly dressed skipper but plagued his heavily clad comrades.

FROM TECHNITOTO GIORNALE

He glanced down, then at his chart. "Ah," he said exuberantly, "there are the towns of Brig and Visp. Soon we will be out of Switzerland."

Sipping champagne on a successful balloon flight is an old custom. Ruedi Meyer, of Mürren's Jungfrau Hotel, had supervised a picnic lunch for us, and he had not forgotten the bottle of sparkling wine. Fred twisted the wire away, and the cork shot over the side.

"I wonder where that went?" Erwin asked.

"It will fall among the wildflowers of the Simplon and become a cork tree," joked the captain. We were over the Simplon Pass; to the east, under solid rock, ran the famed Simplon rail tunnel. We ate slowly, as the peaks of the Italian border drifted past.

Our course was turning slowly from south to southeast, away from the Matterhorn. In our carefree, lighthearted mood, we drifted on until we were over Lake Maggiore, well inside Italy (map, page 126).

Soon we began losing altitude rapidly. The balloon's condition was still excellent, but Dolder decided not to attempt to fly over the city of Milan, farther to the southeast. We were down to five and a half bags of sand, and he did not want to risk becoming involved with the city's rooftops, electrical wires, and heavy traffic.

Bernina Lands Amid *Comunisti*

After a period of utter calm, a light breeze carried us toward the little town of Besnate, 25 miles from Milan. Forest, swamp, and electric wires flanked the field we finally chose for a landing. As the captain issued rapid-fire orders, we became dimly aware that a festival of some kind was taking place in the woods below. We could see crepe-paper trimmings and other decorations on the trees.

We made a hairsbreadth descent past the high-tension wires. A crowd suddenly appeared, and a dozen men grabbed our trail rope, which hung more than 100 feet below the basket. Dolder gave a mighty yank on a red cord leading upward from the hoop above us. This opened a ripping panel extending halfway down *Bernina*'s side. Our hydrogen escaped upward all at once. It was then that danger of fire was greatest, and we shouted *"Non fumare!"* again and again.

Only when *Bernina* had collapsed into a tangle of netting and cloth, and we were safely down, did we learn who our welcomers were. We had descended, like a monster out of the heavens, upon a Sunday picnic of the regional membership of the Communist party!

As we dropped into the arms of the waiting *Comunisti*, it was 5:45 p.m. The winds had carried us close to 100 miles and we had been seven hours aloft.

The picnickers helped us roll *Bernina* into a big ball, pressing out the remaining gas. The net was detached and stored inside the basket.

Soon we had a crowd of two or three hundred spectators. A television cameraman and news reporters from Milan had rushed to the scene; soldiers and police appeared. Our flight had been followed and reported by radio all day.

Deflated Balloon Puzzles Customs Men

The little post office of Besnate opened that very Sunday evening to postmark the letters and hundreds of special balloon-mail cards we carried. A truck was lent to us to haul *Bernina* back to Switzerland. But the flying club of the nearby town of Vergiate insisted we stay until the next day as their guests.

When, finally, we pulled up to the border point of Ponte Tresa, customs men gaped. On the back of the truck, two men lay stretched out on what appeared to be a dead whale. In the cab with the driver sat an older man with white hair and a white goatee, wearing a stocking cap.

"And what is *that?*" asked the first official.

"A balloon," replied Fred Dolder, as he headed for the customs office.

"A what?" There was utter disbelief in the official's question.

"A balloon. *Un pallone, una montgolfiera,*" explained Erwin from the back of the truck.

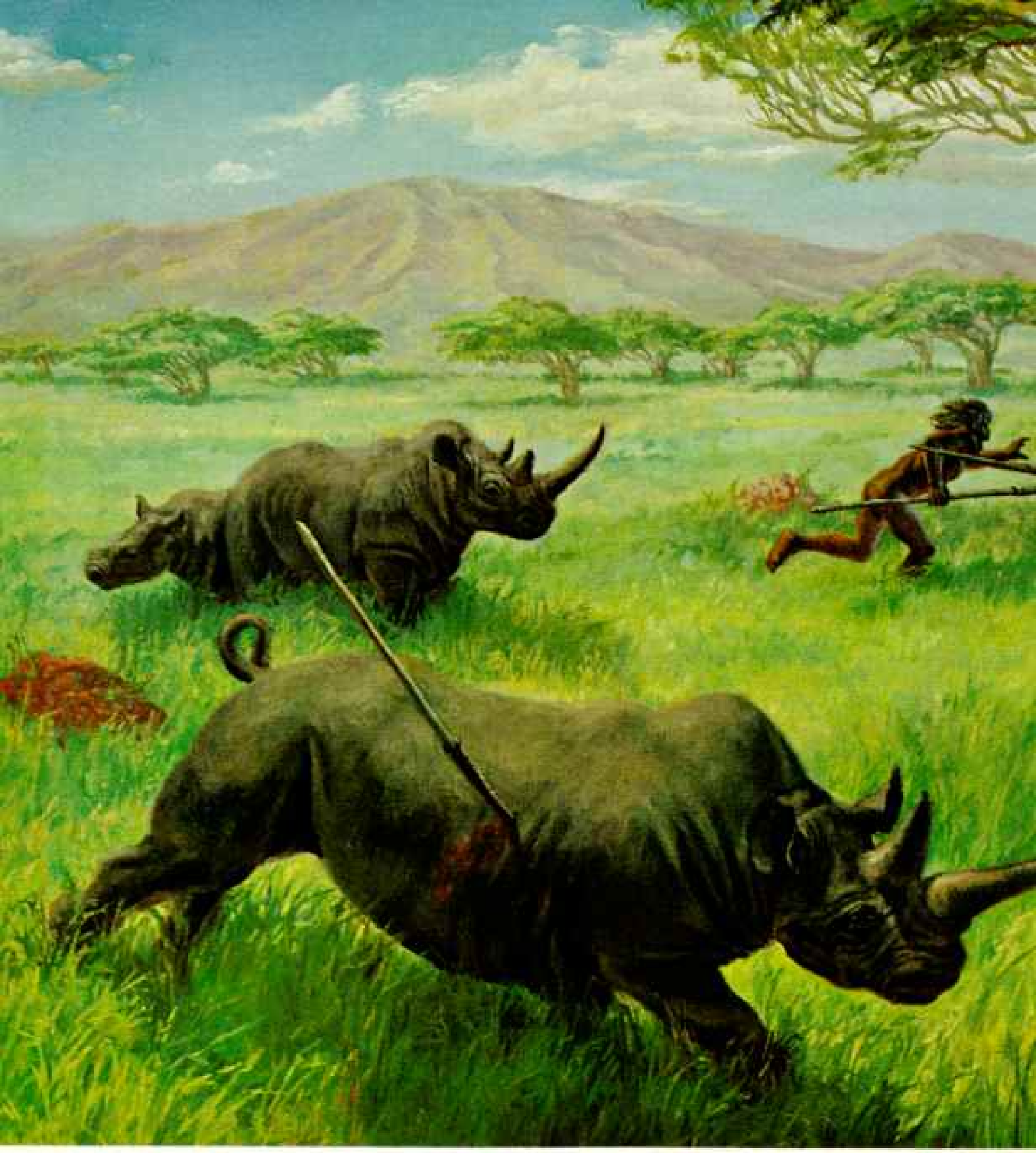
Swiftly the word spread that we were the balloonists who had crossed the Alps to Italy. By the time Fred returned, another curious crowd had gathered.

"We'd better get rid of this monster soon," I said, "or we'll never get home."

"*Arrivederci!*" said Fred, as the driver put the truck into gear.

"Arrivederci!" the crowd shouted, and with a great noise we crossed into Switzerland.

At Lugano, our balloon went aboard a train for Zürich. Then the three of us, rucksacks in hand, headed for Mürren. It took another day, and eight changes of conveyance, until by truck, bus, train, cable railway, and trolley, we returned to the tiny Alpine village from which we had flown. THE END



Giant rhinos drive off a band of Stone Age hunters some 200,000 years ago. Horn-tipped spear

Adventures in the Search for Man

By LOUIS S. B. LEAKEY

Photographs by HUGO VAN LAWICK

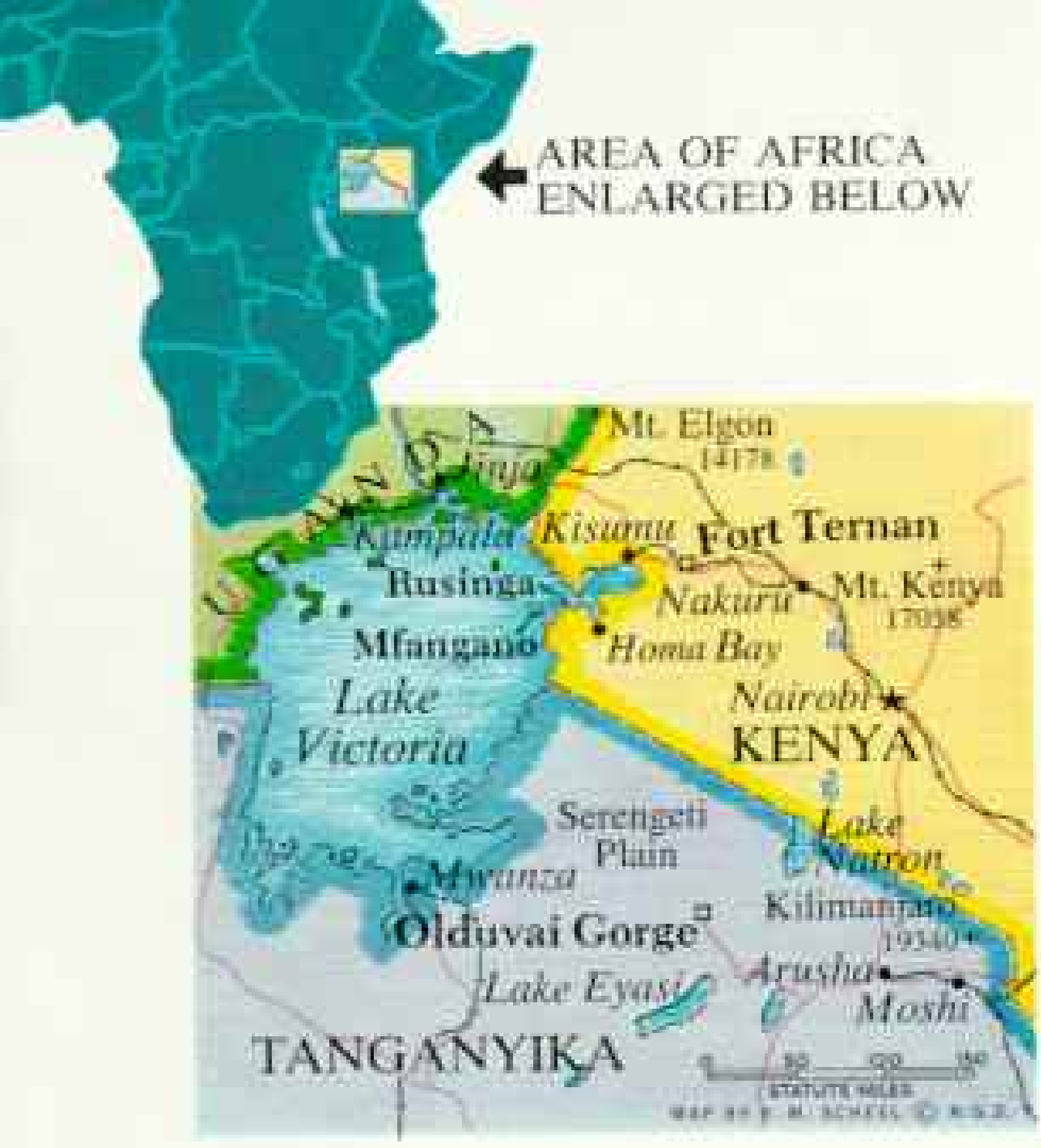
meant for lesser game pierces one brute's hide but fails to slow its charge across the African plain

MY AFRICAN ASSISTANT, Heslon Mukiri, is not an excitable man, but when I drove into camp one day not long ago, I found his composure had left him. I have rarely seen him look so pleased in the 36 years we have worked together.

He began to talk almost before I could switch off the Land-Rover engine. "I have something important to show you," he said.

I had just arrived at Fort Ternan, Kenya, one of the many fossil sites my wife Mary and I have been exploring in our more than 30 years' search for early man in Africa.

I had been absent from Fort Ternan for a few days and had left Heslon in charge of the excavation. Now I had returned with my good friend Professor George Gaylord Simpson, the world-famous paleontologist from Harvard University, to show him the progress of our latest work.



Olduvai Gorge yielded the fossil skull of *Zinjanthropus*, who takes man's story back 1,750,000 years. Rusinga Island gave up the skull of apelike *Proconsul africanus*, 25 million years old. Fort Ternan produced 14-million-year-old *Kenyapithecus*, whose newly discovered jaw fragments help to fill the gap between the two skulls.

Even a single tooth can give important information to a specialist. Canine teeth of apes and their extinct relatives show characteristic projecting crowns and long roots. 25-million-year-old *Proconsul nyanzae* (left); modern chimpanzee (center); and *Sivapithecus*, which has the smallest known canine of the large fossil apes. *Kenyapithecus* (opposite), like man, has a shorter canine with relatively small roots.

"What is it? Let's have a look," I said.

But Heslon is not to be rushed. Carefully he laid out the boxes containing all the interesting fossils the staff had uncovered in my absence, and we went through them in proper order. At last, however, Heslon's hands paused at one box, and I knew we had come to the prize.

Eagerly I lifted the lid and examined the specimen inside. Then I shouted, "George, George, come see what we've got!"

New Find Offers Clues to the Past

Dr. Simpson came over, and we gazed at the discovery together. There in my hand lay the first fragment of what we call today *Kenyapithecus wickeri*, an entirely new fossil member of the scientific group that includes both man and apes.

The striking fact about that fossilized bone is that it dates back 14 million years.

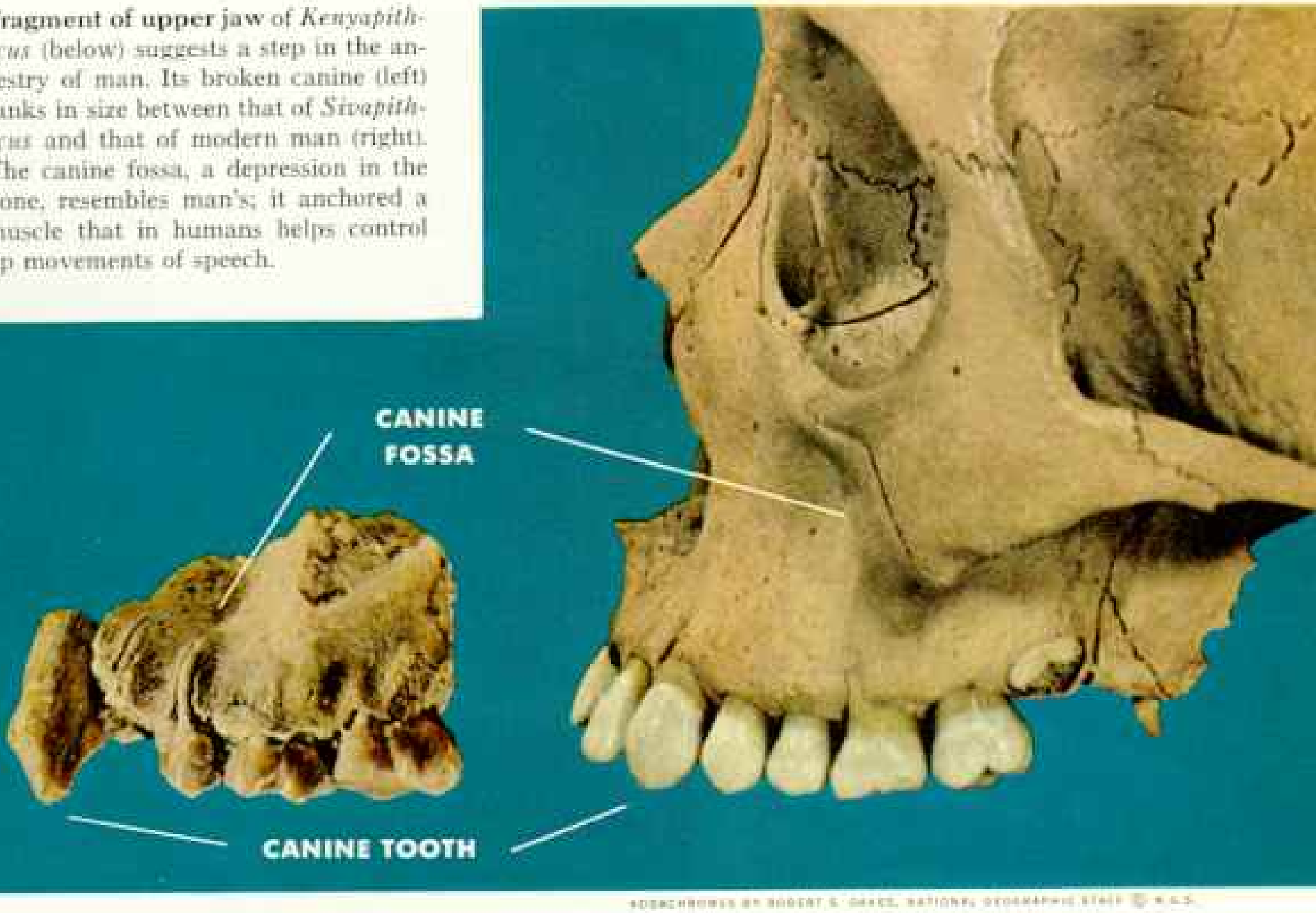
You may wonder how we can be so certain that *Kenyapithecus* is 14 million years old. Drs. Garniss Curtis and Jack Evernden, at the University of California at Berkeley, have put samples from the overlying deposits at Fort Ternan through their potassium-argon dating process (which Dr. Curtis described in the October, 1961, NATIONAL GEOGRAPHIC). Curtis and Evernden tell us that *Kenyapithecus* and the other fossils associated with it at Fort Ternan date from the beginning of the Pliocene, about 14 million years ago. The Pliocene lies between the Pleistocene and the Miocene Epochs in the time scale. The estimate is conservative; further tests may reveal *Kenyapithecus* to be even older.

Now there is nothing extraordinary in itself about a 14-million-year-old fossil. At some of our sites Mary and I have found thousands of fossil remains of animals that are two and nearly three times that age. Indeed, you can see photographs of some of them in this article.

What made my heart beat faster was that the fragment in my hand, a piece of upper jaw, filled an enormous gap in the panorama of man's development, a gap science has long tried to fill without success.

Every student of anthropology is familiar with the term Hominoidea. To put it simply, the Hominoidea are the group of mammals that include not only living man and the apes but a variety of extinct apelike creatures. The famous American circus gorilla Gargantua was a member of the Hominoidea. So, ac-

Fragment of upper jaw of *Kenyapithecus* (below) suggests a step in the ancestry of man. Its broken canine (left) ranks in size between that of *Sivapithecus* and that of modern man (right). The canine fossa, a depression in the bone, resembles man's; it anchored a muscle that in humans helps control lip movements of speech.



cording to science, are you and I. And so was *Kenyapithecus wickeri*.

To understand the significance of this fossil discovery, we must go back into the dim past, for the Hominoidea are fantastically old. In the history of this group, there existed not only various ancestral types of modern apes but also types that led toward man.

Several recent Hominoidea discoveries include *Zinjanthropus*, whose story I have already told; the pre-*Zinjanthropus* child which I have also described; and the long-sought Chellean man, the bolas-wielder of Tanganyika's Olduvai Gorge.*

All these creatures represented stages in man's development, but they are relatively late Hominoidea. The oldest fossil remains we have found at Olduvai date from a little more than two million years ago back to the Lower Pleistocene, the epoch that began, very roughly, three million years ago.

But what about the countless millions of years *before* the Pleistocene? What sort of creatures were our Hominoidea then, and how did they develop? To answer these questions is to shed new light on man as he is today. *Kenyapithecus*, I am sure, will provide an important chapter in the fascinating story of man's development. In a sense it will be the sequel to a striking find made by Mary almost 15 years ago.

Mary's extraordinary discovery occurred in 1948 on the island of Rusinga in Lake Victoria, which lies at the juncture of Tanganyika, Kenya, and Uganda (map, opposite). Rusinga had long been one of our major excavations. Mary and I had uncovered more than a hundred fossil sites there before World War II slowed our work.

Island Fossil Beds Yield a Prize

We knew we had only scratched the surface, and so after the war we went back to Rusinga for a more intensive search.

The Rusinga deposits were laid down in the Miocene Epoch, which began about 40 million years ago. Thus the Rusinga beds —which belong to the early part of the Miocene—are very much older than those at Fort Ternan or Olduvai.

In 1948 Mary and I were back at Rusinga for a few weeks, working at a site we call

*Dr. Leakey has told of earlier finds in previous NATIONAL GEOGRAPHIC articles: "Exploring 1,750,000 Years Into Man's Past," October, 1961; "Finding the World's Earliest Man," September, 1960.

Hand axes thousands of years apart show slight differences to the trained eye of Dr. Leakey (right), who holds a sharp-edged tool of some 300,000 years ago. Dr. Leonard Carmichael, Secretary of the Smithsonian Institution and Chairman of the Society's Committee for Research and Exploration, which sponsors Dr. Leakey's work, examines an earlier ax.

Bush rims the farm of Fred D. P. Wicker (left), for whom Dr. Leakey named *Kenyapithecus wickeri*. Mr. Wicker chats with Richard E. Leakey, one of the author's sons, at Fort Ternan.

R. 106. For some reason both of us had been drawn again and again to this particular site. I had found an interesting fossil crocodile skull about 50 yards from the cliff at 106, and I was working on that while Mary again explored the cliff face itself.

Mary was scanning the slope when suddenly she saw a tooth projecting from it, just a speck of gray fossilized enamel. She looked once more and then shouted for me to come.

Together we slowly cleared a little of the rock face with dental picks, the ideal tools for such delicate work. As the rock came away, we discovered that behind the tooth lay another tooth, and something more behind that. Perhaps, we thought with growing excitement, there might even be an entire jaw and skull.

It was painstaking work, but after several days we had all the pieces out and began putting our fossil jigsaw puzzle together. At last we could see what we had. Mary had discovered a nearly complete skull of *Proconsul africanus*, an early Miocene creature which many scientists believe represents the common stock leading to both man and the apes.

ILLUSTRATIONS BY HUGO VAN LAWICK (ABOVE) AND DAVID L. BOYER, NATIONAL GEOGRAPHIC STAFF © N.G.S.

It was the first time anyone had found so nearly complete a specimen of an early fossil apelike creature (page 142). A new door in the study of man's past had opened.

Fossil Skull Gets a Bodyguard

Mary's discovery was of such great scientific importance that we decided she should fly with it at once to England to show it to our fellow scientists in London, Oxford, and Cambridge, and especially to my colleague, Professor Sir Wilfrid Le Gros Clark of the Department of Anatomy at Oxford.

I put Mary on the plane at Nairobi in Kenya, bound for London with the fragile skull wrapped in a padded box on her lap. The captain and crew of the airplane had been instructed about their precious cargo and all precautions were taken to guard it. Mary told me later that the crew in fact seemed far more anxious about the parcel than about the passenger who carried it.

In London the press reporters, photographers, and newsreel cameramen were waiting for Mary.

"They wanted pictures of me bringing the

skull from the plane," she told me later. "I had to go up and down that ladder with *Proconsul* several times before they were satisfied.

"Then I took our parcel to a room set aside in the airport for the press conference. Everyone crowded around to question me, and I displayed the skull on the table. Two plain-clothes detectives assigned to guard it never let it out of their sight."

At the University of Oxford, Professor Clark agreed with us that the skull represented *Proconsul africanus*, and he was greatly impressed. Mary's discovery gave science the first opportunity to see what *Proconsul* had really looked like. Without the precious skull we could say very little about this important stage of primate development, for previously we had only jaws and teeth to go on. Here at last was the evidence we needed to place *Proconsul* in relation to man and the apes.

Proconsul Illuminates Human Beginnings

What did the skull tell us? It revealed that in a number of characteristics, such as a markedly rounded forehead, *Proconsul* was more like man than like the apes; yet in other characteristics, such as long, pointed canine teeth, it more closely resembled the apes. From the total evidence that the skull and other specimens provided, most anthropologists conclude that *Proconsul* represents neither ape nor man, but something that shares characteristics with both.

We believe, therefore, that at some stage just about the time of *Proconsul*, the stock that ultimately led to man broke away from *Proconsul* himself or from something much like him, and gradually led to you and me. Just when this happened we cannot say.

We shall never be able to point to a specific time and a particular creature and say: "Here man began." The whole subject of human development is far too complex for that. But each new discovery sheds fresh light on man's obscure beginnings. Such a discovery was *Proconsul africanus*. And such a discovery is our new *Kenyapithecus wickeri*.

I said that *Kenyapithecus wickeri* filled a major gap in our knowledge of man's development, and we can now see where that gap existed. It is the long period between *Proconsul*, with its related stock, of some 25 to 40 million years ago, and the Olduvai creatures represented by *Zinjanthropus* and the pre-Zinj child, who lived a little less than two million years ago.

Until the discovery of *Kenyapithecus*, we had literally no information from Africa about any stage of man in that vast stretch of time. There were only a few fossils elsewhere in the world from that period, and those all led in the direction of apes, not of man. Now at last we have *Kenyapithecus*, which lived some 14 million years ago, and we are beginning to explore our gap.

Kenyapithecus was not—emphatically not—a man. Our *Zinjanthropus* and pre-Zinj child may qualify for that description because their remains are found among stone tools. At Fort Ternan, where *Kenyapithecus* was discovered, there are no tools of any kind. But, though the Fort Ternan fossil fragments are few, they do tell us that here is a creature leading straight in man's direction.

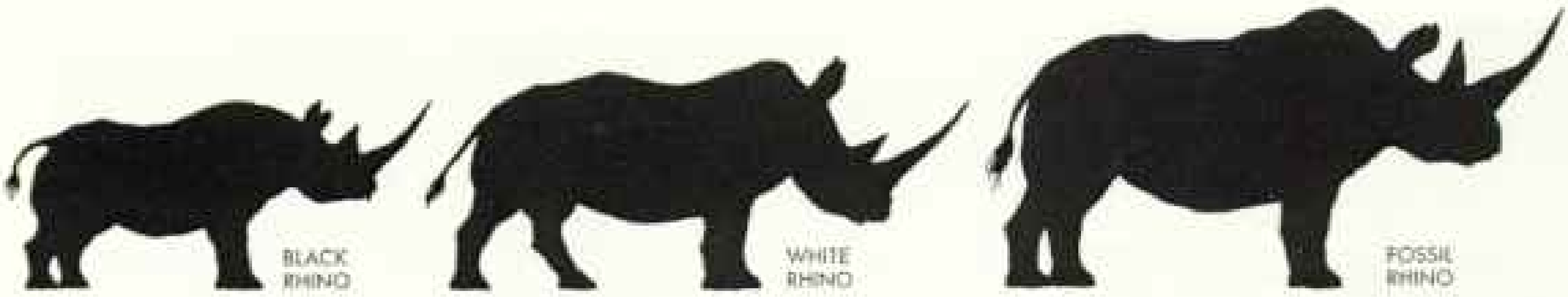
How do we know? Turn to the photograph on page 135, and you will see a fragment of upper jaw that we found. Precious little evidence to work with, one may say. But an anatomist would disagree.

Rhinoceros Skull Joins Olduvai's Giants

Extinct animals—baboons, kudus, ostriches, pigs, and sheep—ran to giantism at Olduvai. So did this 200,000-year-old rhinoceros, which the Leakeys show to Dr. John Waechter of the University of London. Skull of a modern black rhino (left) bulks only half as large. The front of the fossil's jaw and the seat of a horn are missing.

Strings of modern antelope vertebrae hang from the roof of the work shed. Special cardboard cartons hold fossils that are as jealously guarded as jewels.

Silhouettes compare sizes of present-day black and white rhinos with the extinct monster.



To begin with, the upper jaw of *Kenyapithecus* has what scientists call a canine fossa. The canine fossa is that depression in the upper jaw of a human just below the eye-socket. It is an essential characteristic of man as we know him today, and it is never found in this same form among fossil or living apes and monkeys.

The canine fossa in man serves as an anchor for a muscle which controls the movement of the upper lip, especially the corners.

The lips of the apes—the chimpanzees, gorillas, orangutans, and gibbons—are unlike human lips. To be sure, they can be manipulated, but quite differently from ours, and they are not capable of speech.

In man, the muscles that have their roots in or near the canine fossa make it possible for him to use his lips in many ways, and some of these ways are linked with speech, as distinct from mere sound. The fact that *Kenyapithecus* has a similar form of canine fossa does not necessarily mean that he could speak, but it *does* mean that the structure of his face, the anchorage of his lip muscles, and his control of the lips gave him that potential.

Silvery catch cascades from a fisherman's basket. He and his fellows descend from mainland tribesmen who sought refuge from tyrannical kings by moving to islands in Lake Victoria. Searching such remote spots, Dr. Leakey and his associates have unearthed parts of nearly 400 fossil apes on Mfangano and nearby Rusinga.

Conical baskets scoop fish from the closed coil of the papyrus float at upper right.

Papyrus stalks floating on Lake Victoria form a remarkable fishing boom that has no net, hooks,

or traps. Only the float's underwater shadow confines the quarry as the lone raftsman draws one end into a tight coil (opposite, lower). Youths in the canoe fish with conventional reed rod and line.

Kenyapithecus has another characteristic of man—a very small canine tooth, the one we call the eyetooth. In monkeys and apes the canine tooth is generally large and often powerful. In man the same tooth is only a little longer than any other. *Kenyapithecus*, therefore, is much closer to man in the character of his canine teeth than he is to the apes.

What other characteristics does our new fossil discovery have in common with man? We cannot yet say, for we need much more material. By the time you read this we shall have gone back to Fort Ternan to look for additional fossils of *Kenyapithecus* and his contemporaries. Once we have them, we may begin to paint a more detailed picture of this creature, just as we have done with *Proconsul*, *Zinjanthropus*, and Chellean man.

Before we leave *Kenyapithecus wickeri* I should explain its scientific name. *Kenya*, of course, indicates where the fossils were found, and *pithecus* is one of the endings frequently used in describing the higher primates of prehistoric times. The last part of the name, *wickeri*, honors my friend Fred Wicker, an orange grower at Fort Ternan, who found the first fossils where *Kenyapithecus* was later discovered. Mary and I were happy to name our new creature in honor of Fred and his discovery of the site.

Fort Ternan Rivals Olduvai in Riches

The discovery of *Kenyapithecus* establishes Fort Ternan as one of the most important sites of its epoch in the world, and Fort Ternan has proved rich in fossils of many other creatures of that remote time. It is, however, no longer the wildlife haven it was in prehistoric times, for man has taken over.

GEOGRAPHIC readers may think of our archeological sites in terms of Olduvai Gorge—flat, exposed plains country sliced by canyons that are either choked with dust or drowned by floods. Olduvai lies at the edge

of the Serengeti Plain, a vast and lonely area roamed by huge numbers of big game and by tribes of herdsmen and hunters.

In comparison to Olduvai and the Serengeti, Fort Ternan is almost resort country. It lies in the lowlands east of Lake Victoria, an area well watered by rains and mantled with grass and brush.

It is ideal farming country, and such men as Fred Wicker were quick to see the possibilities for grain crops, coffee plantations, and citrus groves. Farming and wild game, however, rarely go well together, and most of the larger animals have already disappeared from Fort Ternan.

The smaller animals have hung on—two types of antelope, for example, the duiker and the oribi. In fact, one of the four duikers which we now have as family pets came from Fred Wicker's farm.

In addition to the small animals, Fort Ternan has delightful bird life and not-so-delightful snakes. To my son Jonathan the prevalence of snakes is a decided attraction, for he is a herpetologist. He has established a snake farm not far from Fort Ternan.

The only resemblance between Fort Ternan and Olduvai Gorge, then, is in richness of fossil remains. In the two months we worked at Fort Ternan in 1961, we found no less than 1,200 fossils—creatures that are, for the most part, new to science.

Tiny Giraffe Once Roamed Fort Ternan

For example, we found the major part of a tiny prehistoric giraffe about the size of a calf. Fossil giraffes of about this epoch have been found in Europe and Asia, in such places as Samos, Greece, and in India. But the Fort Ternan giraffe is unlike any of these. One kind of fossil European and Asian giraffe was the ancestor of a now extinct group of antlered giraffes whose remains we have found at Olduvai; these were short-legged, thickset creatures with antlers somewhat like those of the American moose.

The Fort Ternan giraffe, on the other hand, closely resembles the modern giraffe in its proportions and anatomy, and it may represent a direct ancestor of the modern species.

At Fort Ternan, also, we have discovered a new type of mastodon. In the Miocene deposits at Rusinga Island—the site where Mary discovered *Proconsul*—we earlier found a miniature fossil mastodon which lived some 25 million years ago. In America, much larger mastodons survived until very recently, perhaps only a few thousand years ago.

The Fort Ternan find stands midway in

Smooth brow of *Proconsul africanus* foreshadows man, Dr. Leakey believes. Canine teeth are smaller than those of most apes, but larger than man's. Scientific name derives from Consul, a tame chimpanzee once nicknamed the "almost human ape."

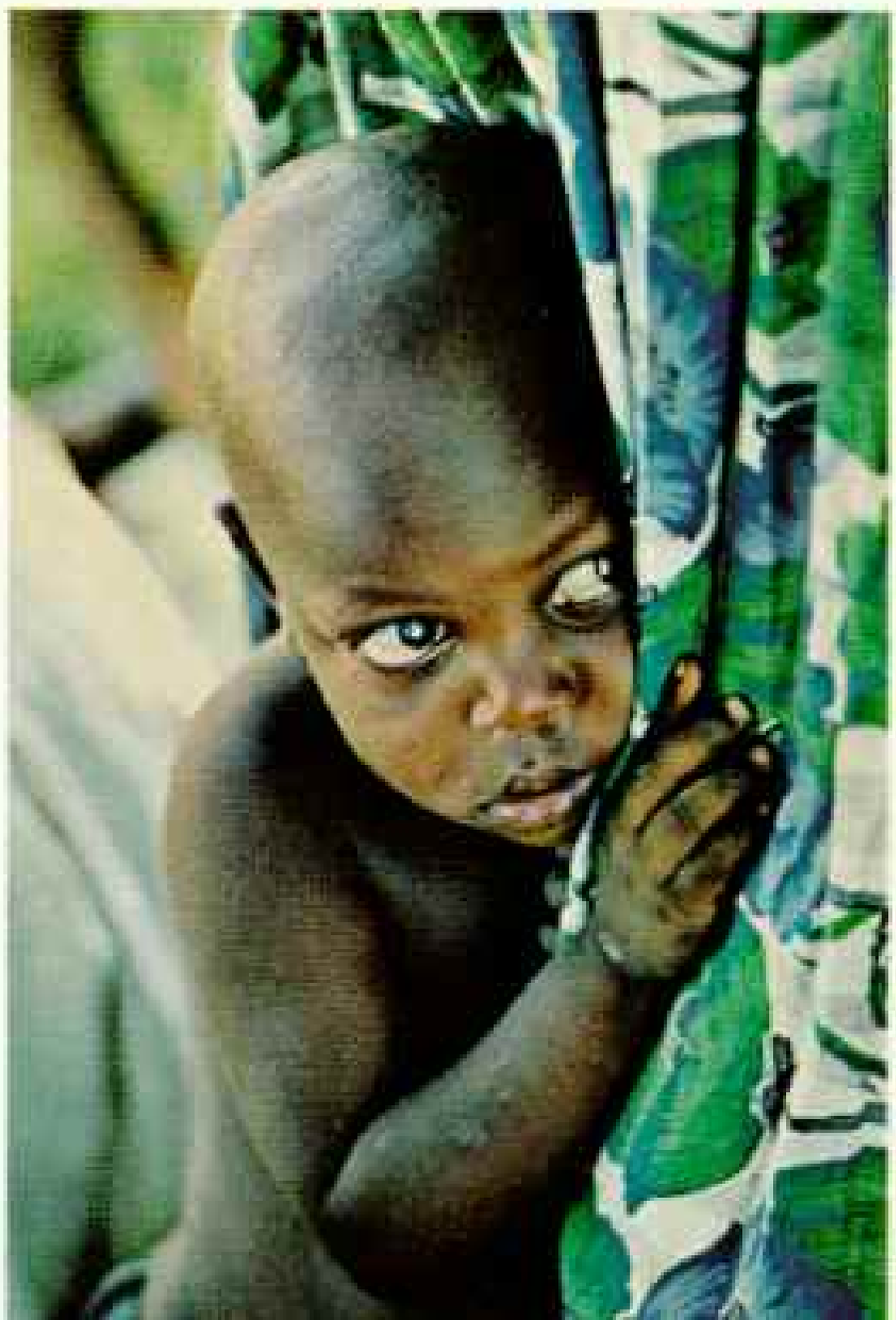
As if about to squirm, fossils of beetle pupa and caterpillar display every wrinkle of bodies that died 25 million years ago. Most fossils preserve only bones and teeth, but here stone has replaced soft tissue.

size and development between these two. With study, the new species may tell us much more about the mastodon's past.*

If Fort Ternan promises to be one of the most important fossil sites Mary and I have explored, Rusinga Island is surely one of the most mysterious. The riddle of Rusinga lies in some of the fossils we find there—a type that scientists cannot yet explain. These finds are beautifully preserved insects, fruits, and flowers.

Such fossils may not seem strange until one considers just what a fossil is and how it is formed. When Mary or I pick up a fossil—the leg bone of an antelope, or the

*For an account of a recent prehistoric find in America, see "Ice Age Man vs. Mammoth in Wyoming," by Cynthia Irwin, Henry Irwin, and George Agogino, NATIONAL GEOGRAPHIC, June, 1962.



REDACHROMES BY HUGO VAN LAWICK AND DAVID S. BOYER (LOWER) © N.G.S.

Mfangano boy chews his cattle whip beside Lake Victoria. His parents farm and fish.

Housewife smokes a clay pipe while balancing a waterpot on a cushion of reeds.

Shy, wide-eyed child, alarmed by the photographer, finds safety behind mother's skirt.

Olduvai Gorge, Peephole Into Prehistory, Exposes the Campsites of Earliest Man

Thorn trees stud arid slopes that entomb in layers of volcanic ash and lake-deposited clay the tools of archaic man and the bones of his prey. Oldest

campsite dated so far by the potassium-argon method stretches 2,300,000 years into the past. Leakey camp and diggings lie two miles to the right. The Serengeti Plain stretches along the top. Dry wash litters the canyon's floor; muddy torrents deluge it in the wake of heavy rains. 145

tusk of a hippopotamus—what we are holding in our hands is not the actual bone or tusk of that animal. The bone structure and the proteins and gelatin within it have long since been replaced—very faithfully, to the last detail—by minerals such as silica, lime, and manganese.

This process of replacement is immensely slow, and that is why most fossils represent bones or teeth. Only such relatively hard parts of the body normally retain their form and shape long enough for the minerals to do their work. Softer parts of the body, such as tissue and muscle, putrefy too rapidly.

The Pebble That Once Crawled

In a few cases you may get a fossilized impression, but only a flattened one, like the flowers or plants you press between the pages of a book. Until the Lake Victoria islands of Rusinga and Mfangano produced their fantastic specimens, no one had ever seen fossil insects in their original shape and form—except those trapped in amber.

I recall the day, now some years back, when we found the first of these riddles in stone. Mary and I had been working since early morning on Mfangano Island's cliff faces, collecting the familiar type of fossil bones and teeth. It was hard work, and about eleven o'clock we stopped for a cigarette. While smoking, I began to toy idly with the stones that lay around me.

I must have picked up a dozen stones when, without seeing it, I sensed that one had a peculiar feel—it seemed to be a stone beetle. I looked at it closely and nearly fell over backward. It *was* a stone beetle—something I thought could not exist.

I must have shouted, for Mary was instantly beside me. We looked down at the bit of beautifully shaped stone and Mary spoke for both of us:

"I'm sorry, but it's just not possible."

Today we know that a fossilized beetle *is* possible, for from Rusinga and Mfangano

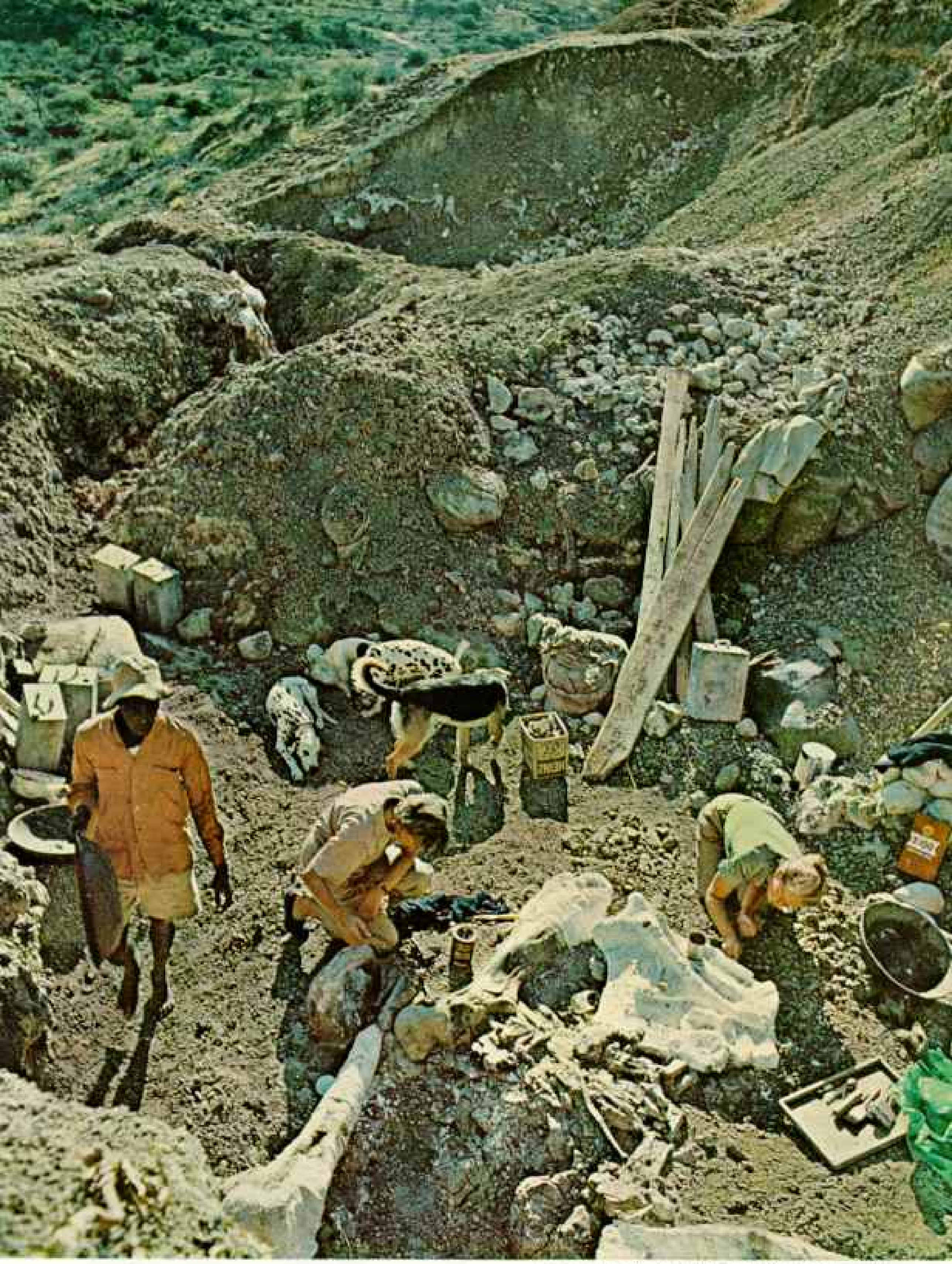
Islands we collect many of these wonders of nature, not only beetles but caterpillars, flies, ants, a slug, a worm, and the like (page 142). We have even added the fossilized breast of a bird to our collection, and one day Mary made the amazing find of the fossilized head of a large lizard. Its very eyeballs were preserved, the tongue was still sticking out of the mouth, and the creature's tiny scales were perfectly reproduced.

These are things to make a paleontologist rub his eyes in wonder, but even more fantastic are the fossilized flower buds, berries, nuts, and fruits we have found. I wanted to see whether we were dealing with mere casts or with completely fossilized material; so I had some of the specimens cut into cross sections. It took a diamond cutter to get through them, but the insides of the fruits were as astonishing as the outsides. In some cases we

World's oldest known structure, possibly a windbreak, fascinates Mary S. Griswold, a member of the Society's staff. Some stones of the circle have stood atop one another at Olduvai for more than two million years.

Scene of violence revisited. On this ancient campsite, exposed in 1960 by workmen slicing through layers of clay and volcanic ash, a child's skull bone told the dark tale of a crushing blow. Dr. Leakey, kneeling, points out the stratum that yielded 1,750,000-year-old *Zinjanthropus*. The child proved to be even older than Zinj, since it lay in a deeper stratum. Dr. Thomas W. McKnew (stooping), Vice Chairman of the Society's Board of Trustees, Dr. Carmichael, and Jonathan Leakey examine the evidence.

Discoverer of *Kenyapithecus* cleans a fossil in the field. Heslon Mukiri, Dr. Leakey's senior African assistant, quickly recognized the importance of his find.



HUGO VAN LAWICK © NATIONAL GEOGRAPHIC SOCIETY

Elephant Hunters Capture Their Quarry: Fossil Bones From an Olduvai Pit

Mrs. Leakey (center) and Margaret D. Cropper, a student at the University of Edinburgh, excavate million-year-old mineralized bones and jacket them with plaster to protect them. Dogs stand guard against poisonous snakes and marauding rhinos and lions.

found preserved in stone the whole inner structures and the seeds, just as you find them today when you cut into a fresh apple or pear.

How did these incredible fossils occur? And what conditions in the dim Miocene Epoch produced such freaks of nature? We simply do not know, but several scientific laboratories are at work on the mystery. Since that first discovery, similar fossils have been found in the western United States, and it may be that scientists there will be able to unravel the enigma. Meanwhile, Mary and I visit Rusinga and Mfangano every chance we have, for we still hope for other major discoveries there.

Early Rusinga Voyage Nearly the Last

Today, thanks to the generosity of a London businessman, Charles Boise, we can reach Rusinga or Mfangano Island safely and quickly in our own cabin cruiser, *Miocene Lady*, which we keep at Kisumu on Lake Victoria's eastern shore. But a trip to Rusinga was not always so easy, and one of the first voyages I made nearly ended my career.

In those days the canoes and dhows of the Lake Victoria tribesmen were the only transport between the mainland and the island. The graceful, streamlined Lake Victoria canoes are strangely constructed. Their planking is sewed together onto the keel and the basic frame. In the first stage the cut planks are fitted side by side, and matching sets of holes are burned through with red-hot awls. Then long strands of bark are stitched through the two sets of holes, and the planks are drawn flush together. Finally the holes and seams are caulked with fiber from the banana plant and the whole job made reasonably watertight.

I say "reasonably" because the seal is never perfect, and the canoe must be bailed from time to time. On the trip I speak of, I hired a substantial-looking canoe with 10 paddlers to take me the 20 miles from Homa Bay on the shore of Lake Victoria to Rusinga Island.

At first the weather was fine and we made excellent speed. Then, when we were still six miles from Rusinga and in deep water, a sudden violent squall caught us by surprise. Within seconds we were in trouble.

The stitching between the planks began to give, and the water poured in. Soon eight of the 10 paddlers and I were bailing for our lives, while the other two men tried to keep the canoe pointed upwind to prevent capsizing. We used cups, saucers, even my cloth hat to bail with—but as the waves hammered the hull, more stitches parted, and soon the water

Monkeyshines enliven the camp at Olduvai. Simon, a pet monkey, drapes himself across Mrs. Leakey's shoulders, teases a tolerant Dalmatian, and rides another. The Leakeys keep six other dogs, a baby gnu, a squirrel, horses, cats, four duiker antelopes, and a turkey rescued from a holiday dinner.

was coming in faster than we could bail.

I began to think about our chances. In those days the waters of Lake Victoria were infested with vicious crocodiles, and even if we managed to stay afloat when the canoe went down, our prospects would be dim. My crew obviously had the same depressing thoughts, for suddenly, while still bailing frantically, they began to make verbal wills among themselves.

"If I drown and you don't," one man said to his companion, "tell my wife to give two cows to so-and-so to pay off our debt. And tell her there is money in our secret hiding place and she must use it."

Another said to his friend, "Tell my family to give all my goods and crops to my wife's brother, so that he can look after her."

It was hardly reassuring, and I felt for my part that it was a waste of time—none of us was likely to survive. But then, just as suddenly as the storm had struck it passed, and we were left foundering but alive. Somehow we managed to work the canoe, now completely awash, to Rusinga and bring it ashore. Needless to say, I never made the journey by canoe again.

Treasures Still Pour From Olduvai

We come at last to the year's work at Olduvai Gorge, the magnificent fossil site that has yielded so many treasures to science (pages 144-45). Thanks to the National Geographic Society's generous research grants, we have been able to continue work in the gorge for a large part of the year, using again the greatly increased staff and facilities the grants have made possible.

Much happened at the gorge last year, one of the most welcome events being a visit from Dr. Leonard Carmichael, Secretary of the Smithsonian Institution in Washington, D. C., and Chairman of the National Geographic Society's Committee for Research and Exploration. He was accompanied by Dr. Thomas W. McKnew, Vice Chairman of the Society's Board of Trustees (page 146). We were most fortunate in having Mrs. Carmichael and Mrs. McKnew as well, and our visitors spent several days inspecting the work at Olduvai and Fort Ternan.

From the deposits at the gorge, we have taken out thousands of fossils this past year, a good many of them small ones. Unfortunately, we have not found any more remains of *Zinjanthropus*, though we did find more fragments of the pre-Zinj child, including a piece of the temporal bone, which forms a portion of the skull.

If *Zinjanthropus* has eluded us, evidence of other, still earlier tool-makers has come to light. In a level below that of *Zinjanthropus*, we have found a new living floor—that is, an area where man or manlike creatures made their home for some time.

The new site is the deepest we have explored at Olduvai, and the series of potassium-argon dating tests established its age at more than 2,300,000 years. This is fantastically old for early tool-making man, and while we have not yet found his fossil remains, we have taken several hundred beautifully shaped stone implements from the site, as well as the shattered animal bones that the tool-makers cracked open for the marrow.

These new stone tools are much smaller than those made by either *Zinjanthropus* or the pre-Zinj child, suggesting that this earlier creature had very small hands and, quite likely, was small in stature as well.

Higher up, though still in Bed I, the lowest fossil bed in the gorge, we have unearthed another living floor with a great quantity of stone tools.

These fill a yawning gap in the time sequence at Olduvai; they show a transitional stage of tool development between the hunters of Bed I times and the more advanced Chellean man, the bolas-wielder whose discovery I described in an earlier GEOGRAPHIC article. With these stone tools we have found only one bit of fossil evidence so far, a fragment of finger bone. This year we shall search hard for more fragments—perhaps bits of skull or jaw—that could tell us what this new tool-maker looked like.

New Giant Appears at Old Site

As GEOGRAPHIC readers know, Olduvai Gorge has become famous for its giants—the giant pigs, the giant sheep, and the giant ostriches whose remains we have unearthed there over the years.

The giants continue to appear, and this past year we have added an enormous fossil rhinoceros to the list. High up in the gorge, in Bed IV, we unearthed the massive jaw and part of a skull of this creature. These fragments indicate an animal nearly twice as large as the East African black rhinoceros we know today (page 139).

The giant rhino is almost a youngster by

Olduvai standards; he seems to have lived some 200,000 years ago, at a time when man was surely a skilled enough hunter to bring him down (pages 132-33).

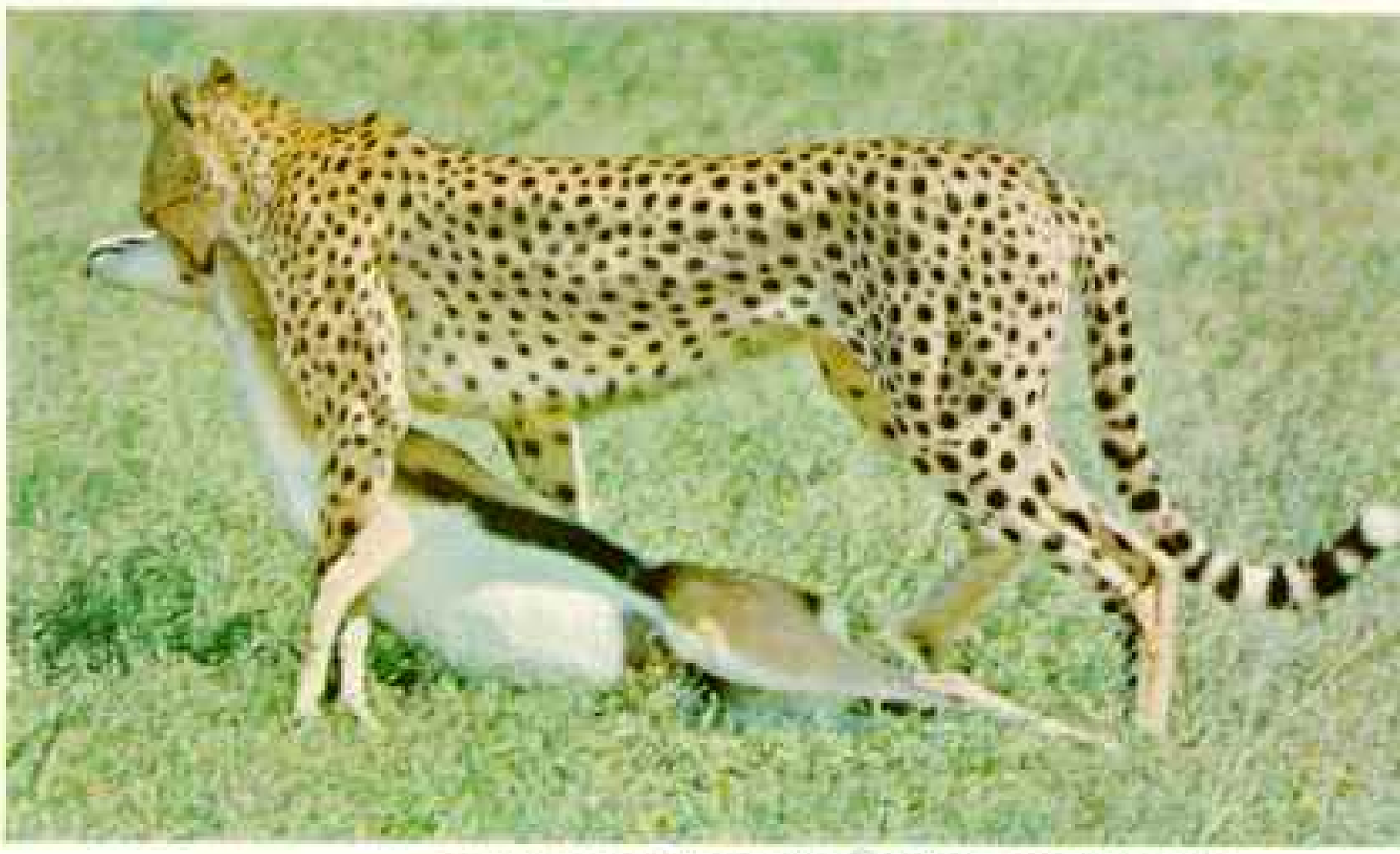
Another likely quarry of man was an immense baboon whose fossil skeleton we took from the gorge this year. This baboon was the discovery of Margaret Cropper, a young archeological trainee who worked for several months with us at Olduvai.

Margaret was working at the bottom of a cliff when she spied some fragments of bone sticking out of a cliff face overhead. Cutting footholds with her excavating pick, she reached the fragments and brought them

Mother cheetah, a cat with small head and slim, doglike body, lives with her woolly cubs near Olduvai. At top she scans the horizon for signs of prey.

Proud huntress returns to her brood after running down a fleet Thomson's gazelle. A cheetah's top speed, clocked at 70 miles an hour, exceeds that of any other mammal.

As she feasts, a court of vultures gathers to wait patiently for scraps.



KODACHROME © NATIONAL GEOGRAPHIC SOCIETY

Night at Olduvai finds restorers still hard at work. Technician Michael Tippett patches the lower jaw of the giant rhino. Miss Cropper and Mrs. Leakey piece out the skull from fragments scattered on the table. Skull of a modern lion hangs from a post.

to camp. Later we recovered almost the entire skeleton. It proved to be that of a new type of baboon.

Margaret's fossil baboon, which as yet has no scientific name, is larger than *Simopithecus jonathani*, which my son Jonathan discovered several years ago, and which at the time seemed the ultimate in size. It has a brain nearly as large as that of the smaller members of the so-called "near-men" of South Africa.

Unknown Hands Built Strange Structures

We have had many other surprises at the gorge the past year. One puzzling discovery by Jonathan was an area of about 10 feet by 8 strewn with the fossil remains of a kind of antelope new to us.

In that small but curious patch we unearthed 12 individual antelope skeletons, clear proof that the animals died together and were fossilized together. Such an occurrence is rare in paleontological work, and so far we have no idea how it happened.

One other mystery—a quite provocative one—appeared at Olduvai last year, and to me it is the most intriguing of all. There is a great deal more to be learned about it.

Again in the very lowest level of the gorge, well below the sites of *Zinjanthropus* and the pre-Zinj child, we have unearthed what can only be described as "structures," wide circles made of sizable stones, with some of the stones actually resting on top of others (page 147).

We know that no such stones existed on the site naturally when it was lakeshore more than 2,000,000 years ago. Where did they come from? How did they get there? What forces arranged them in those unmistakable circles, and why? Could they be the remains of primitive dwellings or windbreaks?

Somewhere in Olduvai, the answers to such questions await us. THE END

Notice of change of address of your NATIONAL GEOGRAPHIC *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 March number, the Society should be notified of your new address not later than February first. Please give BOTH your OLD and NEW addresses, including postal-zone number.*

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COVER: Balloonists struggle to clear the falling gondola of National Geographic-Army Air Corps *Explorer I* on its ill-fated flight, July 28, 1934 (pages 24-25).

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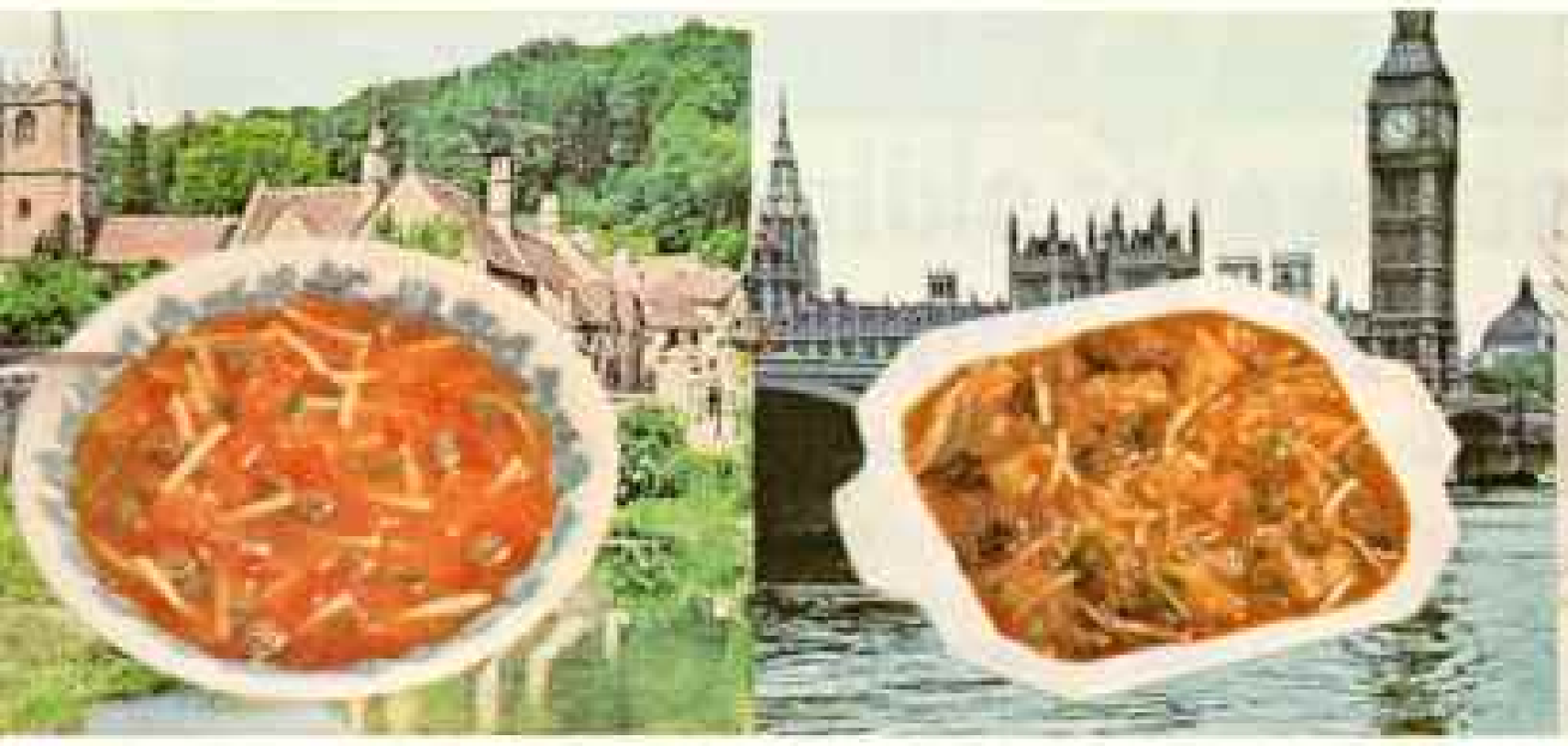

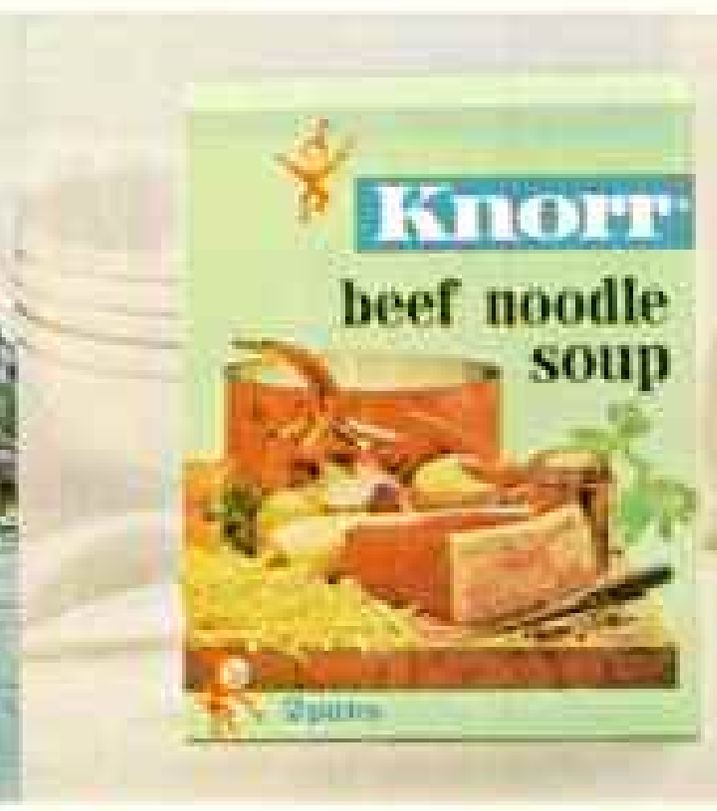

2nd stop: Squire Soup

- 1 foil pak Knorr Beef Noodle Soup Mix
- 1 tomato, peeled and finely chopped
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Boil water in saucepan. Stir in soup mix. Add tomato. (No salt or other seasoning needed.) Bring to boil again. Reduce heat, partially cover and boil gently 5 minutes. 4 servings. Enjoy it at lunch with grilled cheese sandwiches and fresh fruits. Delicious for supper with cheese rarebit and crisp green salad.

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- 1 foil pak Knorr Beef Noodle Soup Mix
- 1 lb. boneless chuck, cut into 1-inch cubes
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- 1 medium onion, chopped
- 2 cups water
- 3 Tbsp. oil

Coat chuck with flour. Heat oil in large skillet. Add beef. Brown on all sides. Add onion; cook 5 minutes. Stir in water and soup mix. (No salt or other seasoning needed.) Bring to boil. Cover, reduce heat and simmer 30 mins. Add potatoes. Simmer until tender, about 30 minutes. Serves 4.

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PAST AND FUTURE meet at the American Museum of Natural History in New York City. For NATIONAL GEOGRAPHIC photographer Robert F. Sisson the time is 150 million years ago, as he films *Brontosaurus*'s massive skull.

But in the museum's Hayden Planetarium, the time is 12,000 years hence, as the heavens of that distant period are created with the Southern Cross visible from New York.

As a reader of next month's GEOGRAPHIC, you will journey to these far-off times and to many in between. Your guide will be Dr. James A. Oliver, the museum's Director, guardian of priceless treasures great and small, from *Brontosaurus* to the pre-Columbian warrior of clay, found in a tomb in Mexico, and the masklike ornament of gold worn by an Ashanti chief in 19th-century Africa.

In other February articles, you will learn how Burma has used her first 15 years of independence, trail a pack of moose-hungry timber wolves on Isle Royale in Lake Superior, and see science solve more of the mysteries of lonely Antarctica.

You may share these and other Geographic journeys with your friends by using the form below to nominate them for membership.

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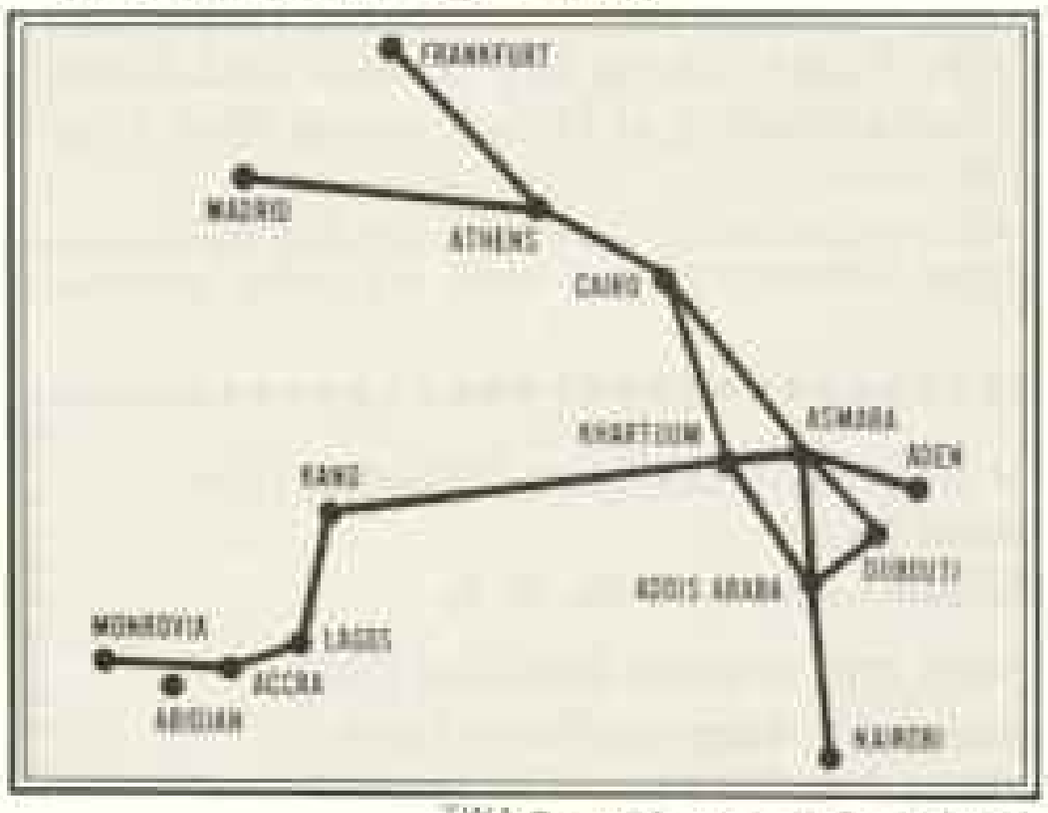

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Dept. NG-2, Chamber of Commerce Bldg., Daytona Beach, Fla. The Daytona Beach Resort Area (Ormond Beach, Holly Hill, Daytona Beach Shores, S. Daytona, Port Orange).

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In spring, valleys are heavy with the perfume of millions of orange blossoms

We could fill this whole magazine with pictures of a Southern California vacation. There's so much we *haven't* shown you. Like Pacific beaches. Acres of poinsettias. Desert oases. Sea cliffs and sea caves. Hollywood's TV studios. A subtropical city. It's all here–and *only* here. Plan now to come soon to **Southern California**

Winter shopping scene

See hand, foot, leg prints of stars

Jungle movies are often shot here

This yard is geraniums

See movie stars at the track

Sailing goes on all year at the Pacific

FREE OFFICIAL VACATION GUIDE. Covers scores of sights, 11 side trips, 50 special events. Mail coupon today!

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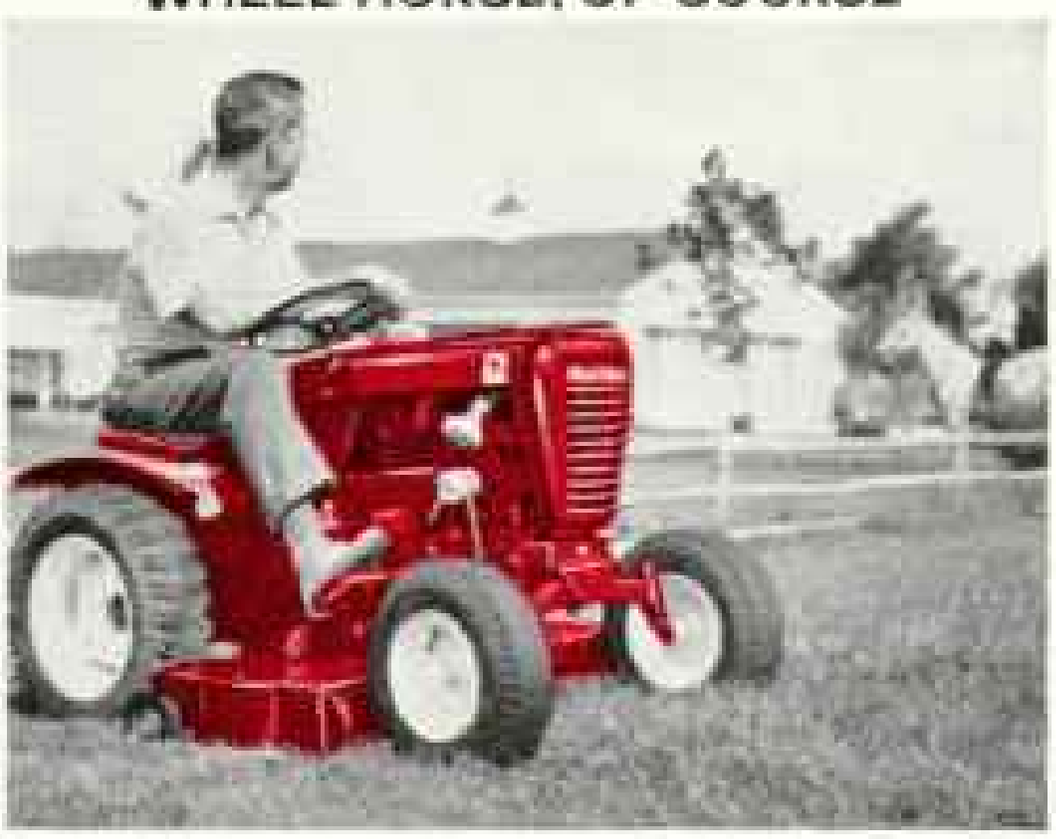
All-Year Club of Southern California. This advertisement sponsored by the Los Angeles County Board of Supervisors for citizens of Glendale, Hollywood, Long Beach, Los Angeles, Pasadena, Inglewood, Pomona, Santa Monica, Torrance and 181 other communities.

Get a Horse!

WHEEL HORSE, OF COURSE



SUPERB IN SUN AND SNOW. What else will mow lawn, clear snow, till soil and/or sweep leaves with the ability and aggressiveness of a Wheel Horse 4-season suburban tractor? Answer: No other single riding unit! Example: Using the attached full-floating rotary mower, you clip swaths a yardstick wide—and never miss a blade.

Wheel Horse will go year 'round to prove its power is geared for smooth flowing speeds on snow or slope. Result: Every job comes easy, and goes fast. Example: With this 42" snow-dozer blade, your driveway can be cleared before breakfast—with nary a shovel strain to show for it.

Use self-starting Wheel Horse tractor power with any of 22 easy-to-attach lawn and garden tools—available singly or in sets. Result: You get more done and have more fun.

(1) Ask your Wheel Horse dealer for a test-ride.
(2) Write us direct for full-color literature.

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Wheel Horse Products, Inc.
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EVERLITE—beautiful precision-fabricated aluminum greenhouses. Models for any location. Complete line of accessories. Send for complete folder N-13.
Orchids? New book by A. D. Hawkes—"ORCHIDS—Their Botany and Culture"—$6.95 postpaid.

Aluminum Greenhouses Inc.
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FREE to National Geographic readers:

Why Fort Lauderdale is the place to go in Florida

Here is a little booklet that gives you the big reasons why knowing people choose Fort Lauderdale as the place to go in Florida.

Its 16 pages sparkle with natural-color views. Its factual text tells why this city is called "Venice of America"; why Fort Lauderdale's beach is the finest on lower east coast. Read about golf, fishing, all the suntime sports, the sights to see, and places to stay. It's almost as exciting as a personal visit. To get your free copy, simply mail the coupon today.

Information Department G-7
City of Fort Lauderdale
P.O. Box 1181, Fort Lauderdale, Florida

Gentlemen: I'd like to be convinced Fort Lauderdale is the place to go in Florida. Please send the free brochure to:

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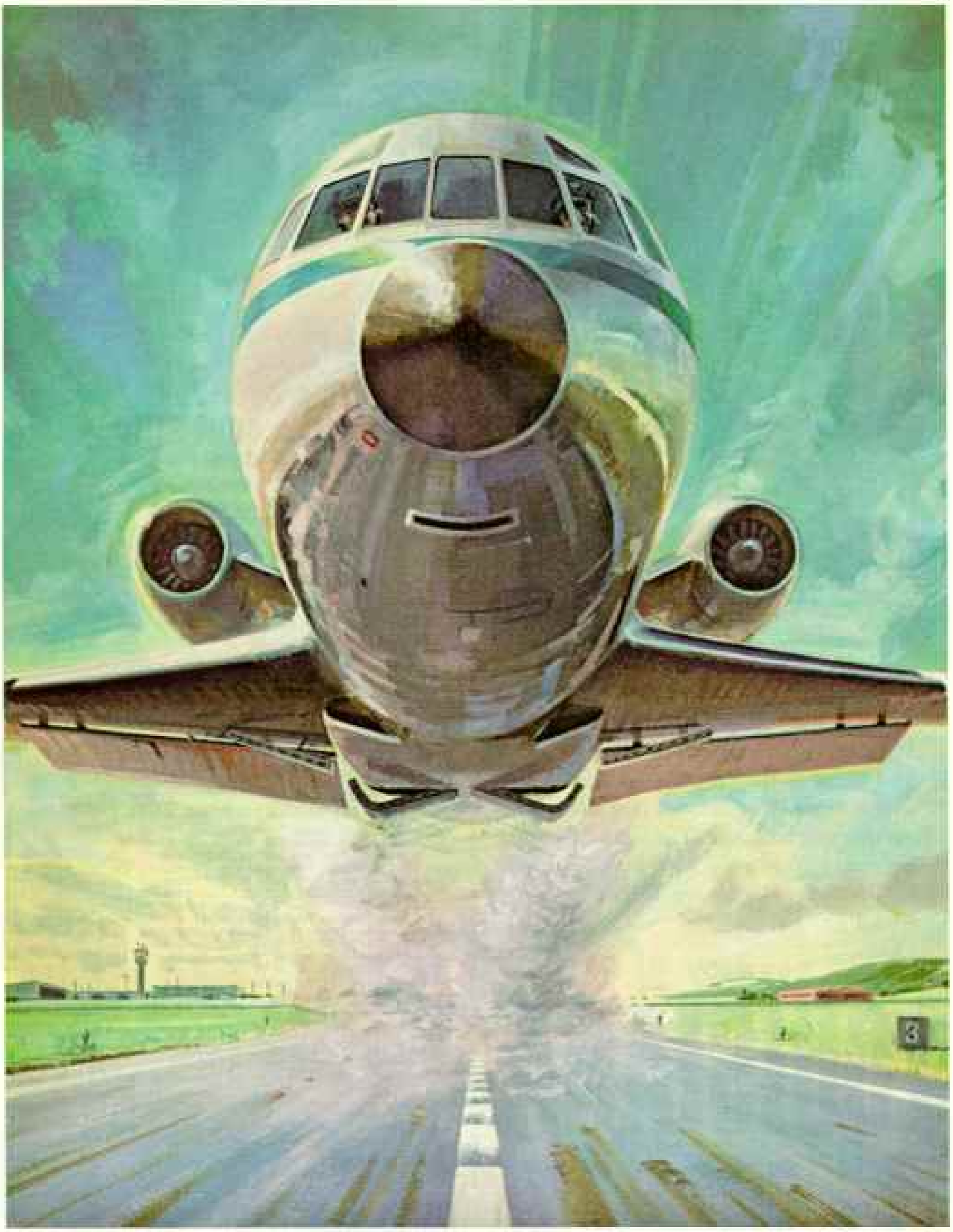

Jet power for shorter hauls will bring the jet age to hundreds more cities around the world. To power profitable short/medium-range jetliners, Pratt & Whitney Aircraft has developed economical new engines such as the turbofan JT8D. Pratt & Whitney Aircraft provides design and manufacturing leadership in power for many applications, in and out of this world.

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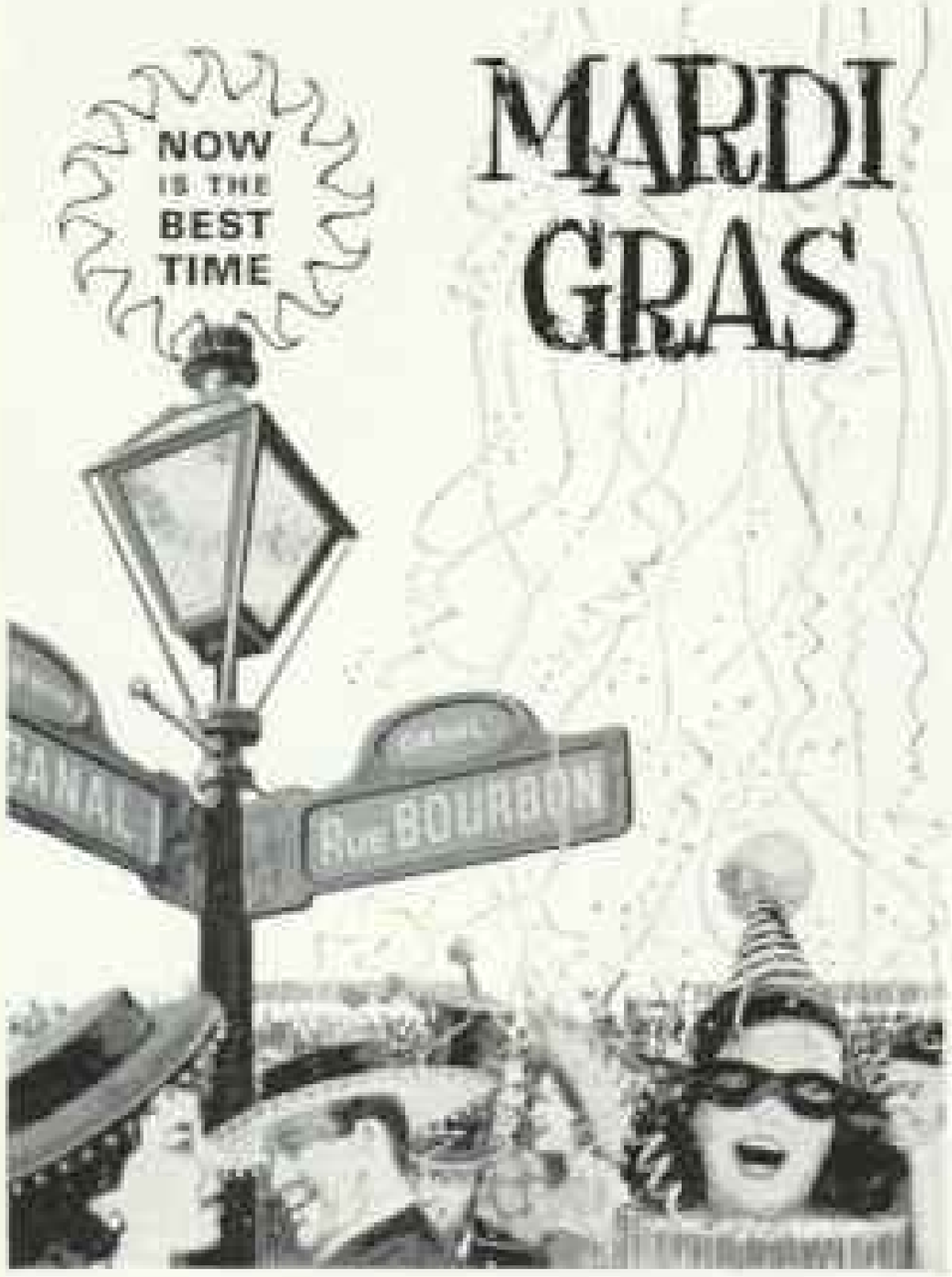

. . . to pack up and head south for the carnival season in New Orleans. It's getting underway now, and before you know it the spectacular climax—Mardi Gras, the greatest free show on earth—will be here. (The date falls on February 26 in 1963.) Be with us then in the "city that care forgot" when we all . . .

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The Louisiana Tourist Bureau is a division of the LOUISIANA DEPARTMENT OF COMMERCE AND INDUSTRY

MIRANDA 'DR' fl.9

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News from Allied Chemical:

Faster, low-cost way to "de-ice" highways

A new technique, using calcium chloride from Allied Chemical, is keeping today's highways "bare pavement" safe all winter. When temperatures drop below 25°, highway maintenance engineers reduce ice on roads by using calcium chloride from Allied. Mixed with rock salt, calcium chloride "triggers" the salt into action and keeps it melting well below its usual range. If temperatures sink to 10° or lower, the engineers use calcium chloride *straight*. This keeps highways safe for motorists and open for business traffic. At home, it takes the work out of clearing walks, steps, driveways. Here is problem-solving with *visible* results. Allied also helps solve the less common, more "hidden" problems. Whatever your line of business, we welcome your inquiry. Allied Chemical Corp., 61 Broadway, N.Y. 6, N.Y.

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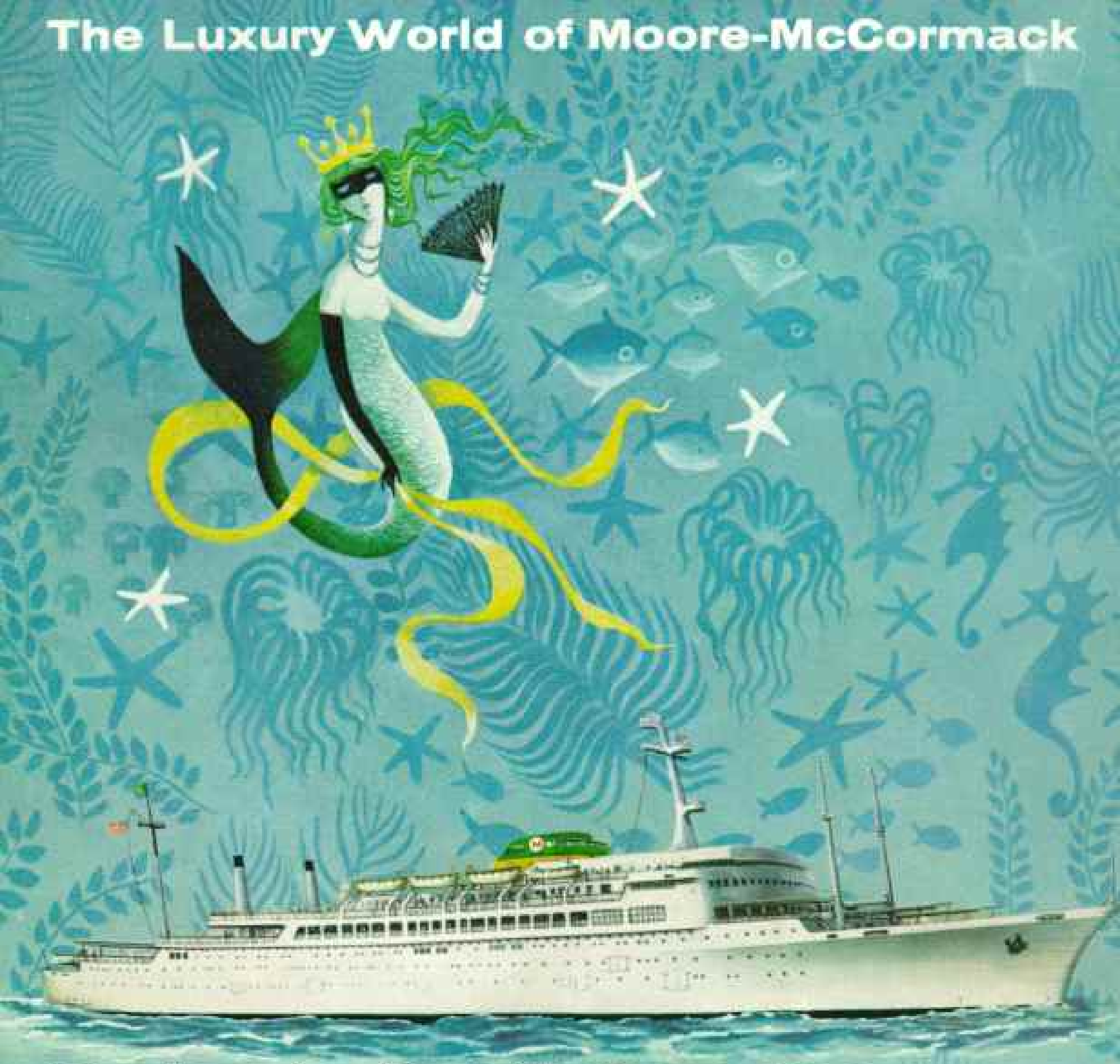
The Luxury World of Moore-McCormack



Cruise to South America

There is something special about a month's South America Cruise aboard America's newest luxury liners—ss Argentina and ss Brasil. These resorts afloat are the ultimate in shipboard relaxation and sophistication. Their superb comfort, their gracious decor are an invitation to enjoy life aboard and excitement ashore.

In Brazil, Uruguay, Argentina, and the Caribbean there is always a special welcome for these sleek, white liners. They are symbols of Moore-McCormack's half century of Good Neighbor relations with Latin America.

Your travel agent can help you select from a wide choice of sailings, including the always fabulous Carnaval-in-Rio Cruise leaving New York Feb. 1st. Other early sailings Jan. 10th, March 15th.

FIFTY YEARS OF IMAGINATIVE WORLD TRAVEL 1913-1963

MOORE-McCORMACK LINES

2 BROADWAY, NEW YORK 4, NEW YORK

New Kodak electric camera simplifies movies as never before

Kodak
TRADEMARK

Battery drive!
No crank!
No winding!

New film cassette
for quick loading!

Lens sets itself!
Just aim and shoot!

It looks like a de luxe camera—and *is*, handsomely so! But the KODAK Electric 8 Automatic Camera is more than this. It's a whole new simplified system of movie-making. A battery-driven motor does the work. Insert film as easily as changing a phonograph record. The KODAK DUEX 8 Cassette eliminates conventional threading, provides instant drop-in loading. The electric eye automatically sets the lens. Less than $100. (Batteries and KODAK Pistol Grip are extra.)

EASTMAN KODAK COMPANY, Rochester 4, N. Y.

New KODAK Automatic 8 Projector threads, projects, and rewinds the film for you—all automatically. Eliminates manual operations. Even turns room light off and on! Forward, reverse, and "still" projection. Runs quiet as a whisper. See it at your Kodak dealer's. Less than $110.

Prices subject to change without notice.

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—as you'll find when you fly to Europe in Scandinavian Style

When it comes to dispensing charming service to the air traveler, SAS has an almost unfair advantage. It can call upon the talents of friendly Denmark—and of Norway and Sweden, as well! Warm-hearted hospitality and natural courtesy are part of the tradition of all three. So when an SAS stewardess treats her passengers as you would your own guests, it's not just because it's in the rule book. That's the way Scandinavians are at home. (Incidentally, this is one of the reasons Scandinavia is such a delightful place to visit.) Choose SAS to Europe, and see how refreshing it is to fly in Scandinavian Style.

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SAS flies non-stop to Copenhagen from New York every day; also frequent service transpolar from California. In Europe, SAS serves more cities than any other transatlantic airline. Mail coupon for full details of reduced excursion, family and group fares, and of inclusive SAS vacations. Or, better still, see your SAS travel agent.

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638 Fifth Avenue, New York 20, N.Y.

Please send me folders on ☐ 17-day excursions to Europe (good through Mar. 31), ☐ family fares, ☐ group fares, ☐ inclusive SAS vacations.

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80 MAIDEN LANE, NEW YORK 38, NEW YORK —— HOME OFFICES —— 10 PARK PLACE, NEWARK 1, NEW JERSEY

A board chairman talks about tomorrow's executives . . .

The Bell System has always sought men who could keep telephone service constantly improving. Men with exceptional engineering talent, men with equally outstanding managerial potential. Such men are widely sought on college campuses across the United States. And with the future of communications unfolding so rapidly, the search has intensified.

But still there is the old question to be answered, "What kind of man handles a business challenge best?" A midwestern college audience recently heard these comments in a talk by A.T.&T. Board Chairman, Frederick R. Kappel:

". . . We took the records of 17,000 college men in the business who could fairly be compared with each other, and, examining their records, sought the answer to the question: 'To what extent does success in college predict success in the Bell System?' . . .

". . . The results . . .

". . . The single most reliable predictive indicator of a college graduate's success in the Bell System is his rank in his graduating class.

"A far greater proportion of high-ranking than low-ranking students have qualified for the large responsibilities. . . . While a relationship does exist between college quality and salary, rank in class is more significant . . .

". . . What about extracurricular achievement? . . . Men who were campus leaders reached our top salary third in slightly greater proportion than those who were not. But it is only real campus *achievement* that seems to have any significance. Mere participation in extracurricular goings-on does not . . .

". . . What we have here, as I said before, are some hints—rather strong hints—about where to spend the most time looking for the men we do want, the men with intelligence *plus* those other attributes that give you the feel, the sense, the reasonable confidence that they will make things move and move well. . . . They want to excel and they are determined to work at it . . .

". . . Business should aspire to greatness, and search diligently for men who will make and keep it great . . ."

FREDERICK R. KAPPEL, *Chairman of the Board*
American Telephone and Telegraph Company

BELL TELEPHONE SYSTEM

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New 37' Constellation: sleeps 6; twin V8 engines; Command Bridge optional extra (also on 30' and 34' models.) Smart new 17' Ski Boat delivers exciting V8 speeds.

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There's a whole new world afloat. Where everyone has one main objective: *fun*. Where people are friendly. And where it's so easy to relax and forget about the nagging little problems ashore. There's one best way to get to this world . . . hop aboard a Chris-Craft. The 1963 Chris-Craft fleet is equipped for more fun and pleasure than ever. There are new sizes . . . with more beam, more headroom, roomier cabin layouts . . . and with many features for better performance, less maintenance, and more comfort aboard. Visit your local Chris-Craft dealer soon to see the new models, or write for free literature to Chris-Craft Corporation, Pompano Beach, Florida; Subsidiary Chris-Craft Industries.

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