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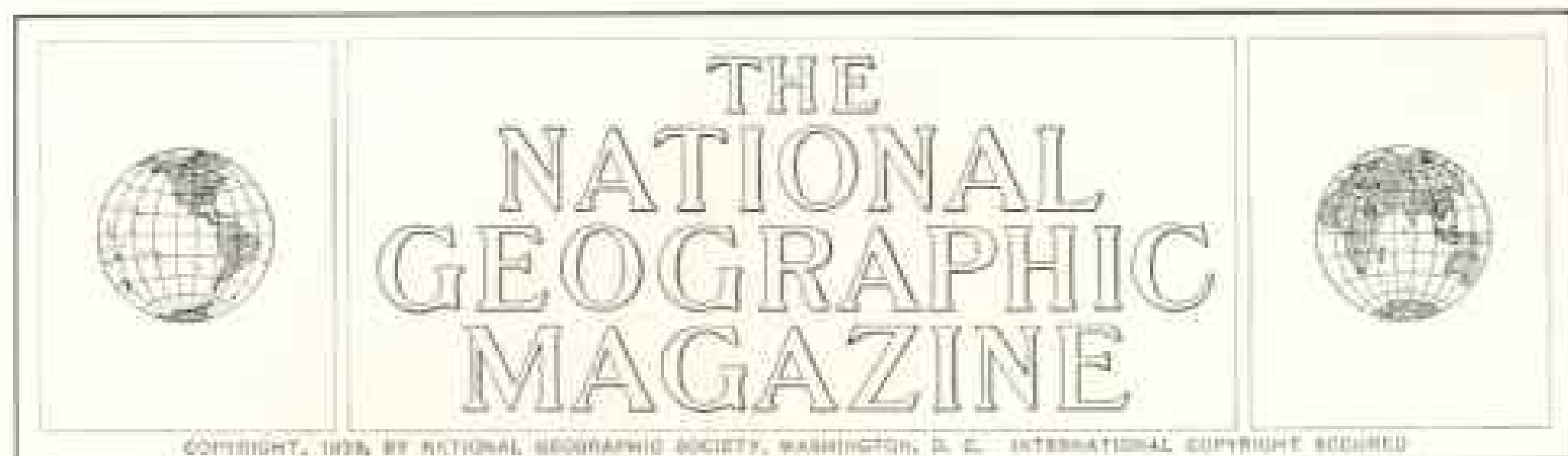
JAMES M. DARLEY

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NEWS OF THE UNIVERSE

Mars Swings Nearer the Earth, Sunspots Wane, and a Giant New Telescopic Eye Soon Will Peer Into Unexplored Depths of Space

BY F. BARROWS COLTON

VIOLENT, invisible outbursts of ultraviolet light on a near-by star, our Sun, are meddlers today in human affairs.

Hurling through 93,000,000 miles of space, they may capriciously interfere when an ambassador telephones across the Atlantic to the President at a time of world crisis. Or, in a mellow mood, they may allow the world to hear easily the blessing of a newly crowned Pope.

Not only can the distant Sun upset our vaunted short-wave radio broadcasts, and even mar television images. Far out in the cold and awesome space around us many other things are happening that affect our daily lives.

Through limitless depths of distance, scientists are reaching out to the twinkling stars and using them as laboratories to learn more about the insides of atoms and to verify experiments made on the Earth.

STEEL-MAKING SECRETS FROM THE SKY

The hard nickel-iron alloy of meteorites, fused in some cataclysm far off in space, helped teach metallurgists how to make the tough steel armor plate of modern battleships.

Astronomy is more than a sleep-destroying hobby that is keeping increasing thousands of amateurs up nights to gaze through homemade telescopes (page 4). It is a prac-

tical science, used daily by the workaday world.

Astronomy pilots air liners, cargo steamers, and war fleets. It wakes us on time, helps us catch trains, brings the semi-monthly payday around on schedule.

We realize so well today the importance of the Sun, for example, that there are many astronomers whose entire job is to keep close watch upon its blazing disk, photograph it almost continuously with still and movie cameras, and measure the tiny variations in its heat.

RED MARS SWINGS UNUSUALLY CLOSE

The sky will be full of dramatic and important events this year and in the near future. Mars, one of the two other planets on which some astronomers suggest that life of some sort may exist, will come closer to the Earth on July 27, 1939 (36,000,000 miles), than it has been for 15 years. This event will provide a long-awaited opportunity to study Mars with the latest instruments and methods (Color Plate IV).

Sunspots, associated somehow with happenings on the Sun which affect our lives, have passed the peak of the eleven-year cycle through which they increase and decrease in numbers, and are now growing fewer.

As a result, we know that short-wave radio reception will begin to improve, the



Photograph courtesy Pan American Airways

STARS HELP GUIDE THE HUGE "YANKEE CLIPPER"

The navigating officer of the transatlantic flying boat takes a sight at the stars to check the course. A special glass-enclosed turret is built into the ship's wing so that the Sun or stars can be observed. The officer is using a bubble sextant, in which a spirit level provides an artificial horizon.

troublesome "magnetic storms" will rage less often, and fewer northern lights will be seen.*

Hermes, the little asteroid that came so close to Earth in 1937, is expected to swing toward us again early in 1940, though at a safe distance, renewing interest in what would happen if such a body should collide with the Earth. On October 1, 1940, there will be another total eclipse of the Sun, visible in parts of South America and South Africa, providing one more rare chance to

*See "The Mystery of Auroras," NATIONAL GEOGRAPHIC MAGAZINE, May, 1939.

probe secrets of the mighty star around which we circle like moths around a flame.*

200-INCH EYE TO PENETRATE UNSEEN DEPTHS OF THE UNIVERSE

Most important of all, the giant new "eye" of the 200-inch telescope on Mount Palomar, California, is expected in 1940 or soon after to take its first look out into dark reaches of the Universe which up to now have been entirely unexplored. With a mirror more than 16 feet in diameter, this telescope is expected to penetrate so far out into space that it will photograph objects whose light, traveling 186,000 miles a second, takes a billion years to reach us (p. 3).

The 100-inch telescope at Mount Wilson Observatory, California, at present

the world's largest, already has almost reached the limit to which it can penetrate into space, though its usefulness will never be ended. With it astronomers already have partially explored a section of the Universe shaped like an enormous hollow sphere, about six sextillion miles across.

But measuring the giant Universe in miles is like measuring the United States in trillionths of an inch! It is more con-

*See "Nature's Most Dramatic Spectacle," by S. A. Mitchell, and "Eclipse Adventures on a Desert Isle," by J. F. Hellweg, in the NATIONAL GEOGRAPHIC MAGAZINE for September, 1937.

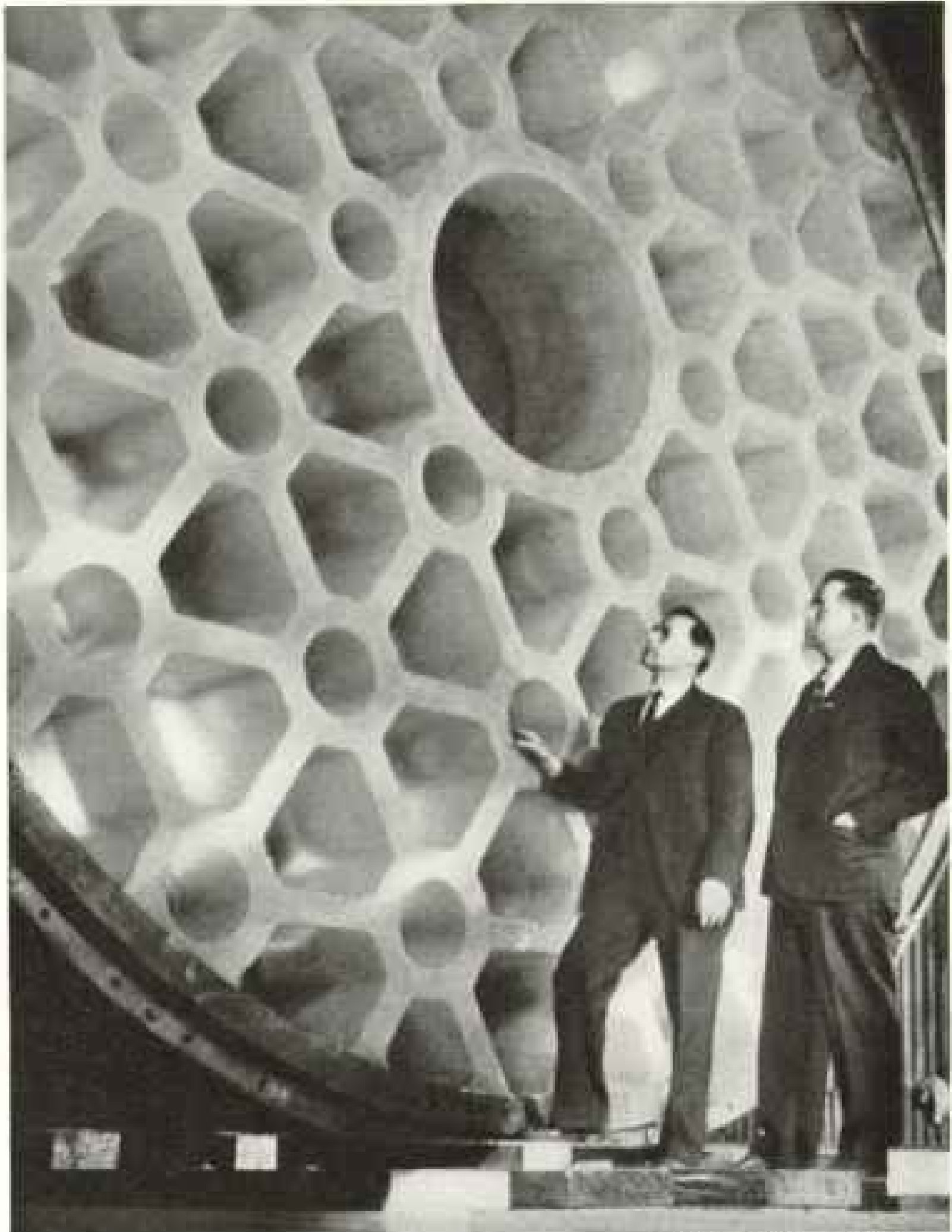
venient to use a larger unit, the "light year," which is six trillion miles, the distance light travels in a year at its speed of 186,000 miles per second. The range of the Mount Wilson telescope is half a billion light years, so we can say that the "known" region of the Universe is one billion light years in diameter.

When the 200-inch telescope is turned upon the sky, this range will be about doubled and it is expected that astronomy will begin to take vast new strides. We shall be able to photograph and study stars and galaxies of stars that now lie hidden beyond our farthest horizons. We may learn once and for all whether the Universe is actually expanding, as it seems to be. We may even discover whether the Universe is infinite or has boundaries beyond which not even space or time exists!

EARTH HITCHED TO A STAR

But before the new wonders begin to be revealed, now is a good time to look at the big show already going on, in that part of the Universe we already know. To call it "super-colossal" is a mammoth understatement!

Think of a huge hollow balloon, representing the region of space that has been



AP Photograph from Pictures

THIS EYE COULD SPOT A CANDLE FLAME 40,000 MILES AWAY

The 200-inch mirror for the telescope on Mount Palomar, California, is expected to gather so much light that it will be possible to photograph galaxies a billion light years distant. Recesses in the mirror's rear reduce its weight from 40 to 20 tons. The telescope, world's largest, will be operated by California Institute of Technology with the cooperation of Mount Wilson Observatory (p. 2).

explored up to now. Scattered inside it, like a giant swarm of bees, are 100 million enormous aggregations of stars, dust, and gas, called galaxies or nebulae, each one of tremendous size. Many of them are flat and round like a watch or coin, with arms spiraling out as from a Fourth-of-July pinwheel; some are globe-shaped; others oval.

These galaxies are turning like wheels, each one a rotating island of stars, dust, and gas, isolated in an immense ocean of nothingness far emptier than any earthly vacuum. Light from any average galaxy



Photograph by Joseph S. McCoy, Jr.

HOMEMADE TELESCOPES REVEAL THE HEAVENS TO AMATEUR ASTRONOMERS.

The 6-inch reflecting telescopes were made by these men who are members of the National Capital Amateur Astronomers Association of Washington, D. C. They ground the mirrors, and most of the tubes are of sheet metal. The image of a star, planet, or the Moon is reflected from a large mirror to a prism and thence to the eyepiece in the side where the observer sees it.

travels two million years before it reaches the nearest neighboring galaxy.

In the midst of one of these galaxies—one of the flatter, thinner ones—is a yellow star, smaller than the average, just one among 30,000 million other stars in the galaxy. It happens to be our Sun. Circling around it are comets, asteroids, clouds of dust, and nine planets. One of the smaller of these planets is the little Earth on which we ride (Color Plate I).

This tiny globe of rock and iron, only 8,000 miles thick, is a mere speck in one great galaxy of stars. Yet, so far as we now know, it is the only place in explored space where intelligent life exists.

VAST KNOWLEDGE FROM MERE RAYS OF LIGHT

But though man must stay forever tied to the career of a single unimportant star, his mind is not so restricted. From the tiny one-celled organisms that were the beginnings of life on Earth has developed an intelligence that can explore a billion times six trillion miles out into the Universe.

And the mind of man has done all this with but a single tool, the rays of light. Except for a few facts gleaned from meteorites, we have gained our whole vast knowledge of the Universe from light, and light alone (Color Plate VII).

Just what light is, no one can surely say. But we do know that when it is split up into its different colors, or wave lengths, each wave length vibrates a different number of times per second, like the different notes on the piano. And each of the 92 elements of which the Universe is made will, when in a gaseous state, radiate or absorb light of different colors or wave lengths, an identification as positive and individual as a fingerprint.

So, taking the light of a distant star, we can split it into its different wave lengths, and they tell us positively that there are in that star, for example, oxygen, helium, hydrogen, sodium, or other familiar things. Moreover, we can photograph the spectrum, or split-up light of a star, and the resulting picture shows a series of lines, arranged like the rungs of a ladder. From

the position, spacing, intensity, and thickness of these lines, an astronomer can tell you, in many cases, the distance of that star, its mass, or weight, its brightness, its temperature, size, speed of rotation, and atmospheric pressure.

The giant mirrors of telescopes catch light that started toward Earth from the distant galaxies before the human race existed. These ancient light rays tell us that the farthest reaches of the Universe contain no materials different from those in our own bodies and our planet. Who, then, can say that man on his little Earth is insignificant?

Seen from outside, the Earth would be a globe colored about the same blue as our sky, largely covered by clouds (Plate I).

Outlines of some continents might be distinguishable at times, large patches of green would appear as spring came on, fading with autumn, and large white areas would surround the poles in winter.

The Earth is built like a golf ball, with a core of nickel-iron, an outer layer of heavy rock, and a thin skin of lighter rock. Oceans cover three-fourths of its surface.

HYPOTHETICAL BIRTH OF THE EARTH

It is certain that the Earth, other planets, and the Sun are related, for all are made of the same materials. Probably big masses of gas somehow were ripped off the Sun and started circling around it. Gradually they cooled and formed into the planets, one of the smaller ones becoming the Earth. All this happened in the distant past, for we know that the Earth's crust has been solid for about two billion years.

Perhaps the planets had two parents, the "mother" the Sun, and the "father" another star, according to the theory of Drs. F. R. Moulton and T. C. Chamberlin. The "father" star, if such there was, circled in close to the Sun, and possibly there was even a sideswiping collision.

In either case, while the two were close together great tides were raised on both by their mutual attraction. Vast masses of hot gas extended out into the space between them. The "father" star did not tarry, and, as he pulled away, his gravitational attraction detached much hot gaseous matter from the Sun. Some of it followed him off into space. The rest began revolving around the Sun.

A few of the larger gaseous masses then perhaps became the planets, with smaller fragments evolving into the moons, comets,

asteroids, and meteors we see today. Or the planets may have been slowly built up by the joining of smaller fragments.

It may be, too, that the planets were born in a catastrophic breakup of the Sun, says Dr. Ross Gunn of the United States Naval Research Laboratory (Color Plate V). At some distant day when it was larger than now, the Sun may have gotten to spinning too fast to hold together. Some stars today apparently are on the verge of such a breakup.

First the spinning Sun developed huge bulges, according to this idea, making it lopsided. Then one of the bigger bulges broke clean away. At the same time, tides were raised on both the fragments, and masses of material were shot off from them.

As the Sun broke in two, the terrific heat of its interior was suddenly released, as when steam bursts from a hot potato cut in half. Both halves of the sundered Sun thus had hot faces from which rushed forth the light and energy which until then had been pent up inside.

As the recoil of ejected gases drives a rocket, the recoil of this outrushing energy drove apart the two halves of the Sun. The smaller one shot off into space to become a separate star. The other remained as the Sun we know today. The smaller fragments of ejected material began revolving around it and became the planets.

We know that stars sometimes do break up. Just recently a star known as Nova Pictoris split into three sections, and astronomers have been watching them fly apart at the rate of a million miles per hour.

If the Earth was created out of the Sun, by whatever means, we humans can truly say that we are the Sun's grandchildren, for we in turn are made of the Earth's materials. The atoms in a chorus girl's blond hair or in a beggar's ragged coat probably once danced in the flaming gases of our parent star.

THE MIRACLE OF LIFE APPEARS

In the deepest oil well drill hole man has scratched less than three miles into the Earth's outer skin of rock, but with the aid of earthquakes he has explored to its very center. It's an ill temblor that shakes nobody good! The vibrations of earthquakes that pass through the Earth's center show by their behavior that the central core must be a mass of nickel and iron, 4,000 miles thick.



© Robert H. Goddard

ROCKETS EVENTUALLY MAY EXPLORE HIGHER THAN STRATO-BALLOONS

A model designed by Prof. Robert H. Goddard of Clark University takes off from its 60-foot tower. He hopes to send instruments into the upper air by rocket to record temperature, pressure, and other data while returning by parachute.

About half a billion years ago the beginnings of life appeared on our ball of solidified gas. From where? Not long ago a scientist believed he had found living bacteria inside meteorites which had fallen upon the Earth. Were they living visitors from outer space? Did life come to Earth originally by similar means, from some other planet or distant star? Most astronomers doubt it. They are inclined to think that if there were bacteria in the meteorites they somehow got inside after the meteorites fell on Earth.

If life did not come from outside, it must have arisen spontaneously here, through some mysterious process of Nature.

Raining down from the Sun upon the outside of the Earth's air blanket is a never-ending shower of light, not only the visible light we see, but invisible ultraviolet rays. Some of them, if not screened out by a layer of ozone in the air, would destroy all earthly life.

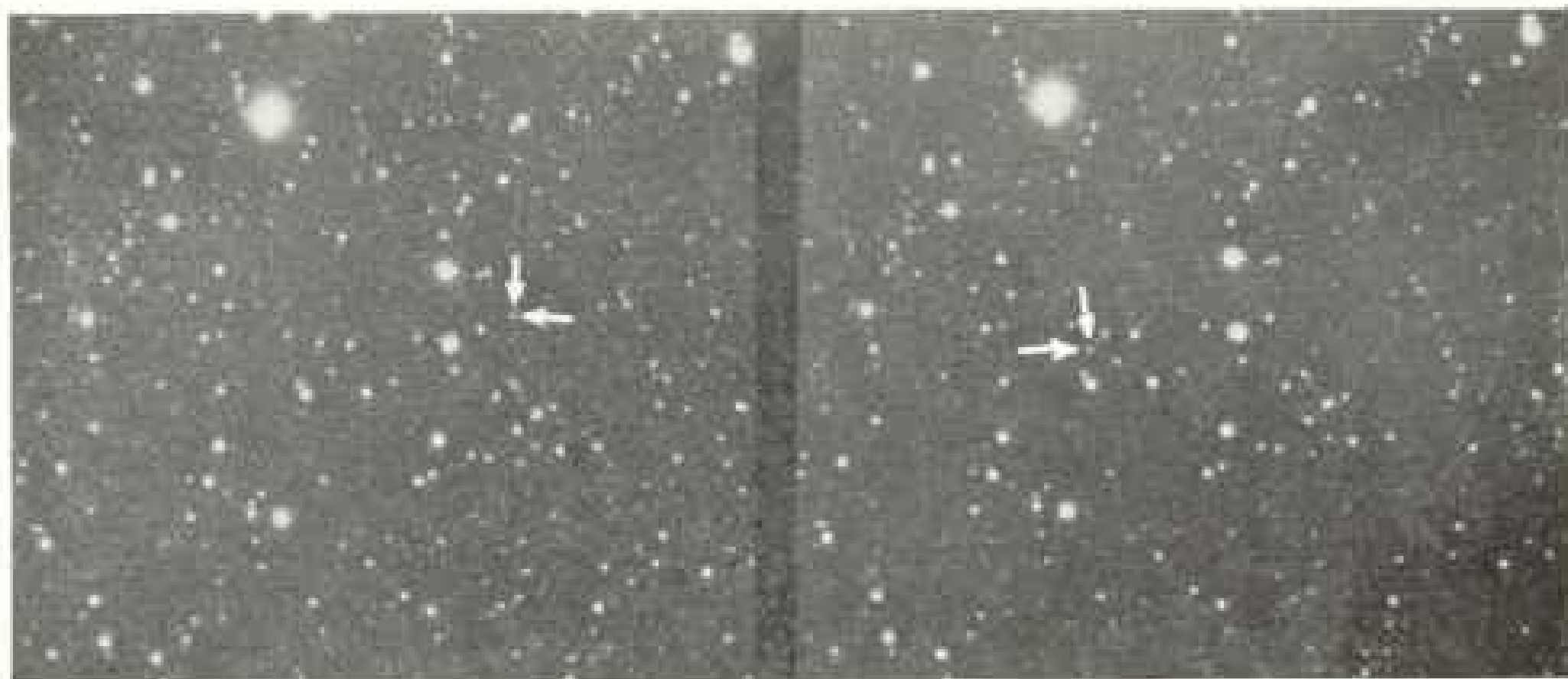
SOLAR OUTBURSTS BREAK RADIO "MIRROR"

Between 60 and 250 miles above Earth, other types of ultraviolet rays from the Sun are absorbed and there build up layers of electrified air, the "radio mirror," or ionosphere. It is a fine example of how our parent star affects the civilization of today. Though radio waves can go through a wall, they cannot (except ultra-short waves) penetrate these layers of electrified air. So, flashing up from the sending station, they are reflected back again to Earth, and thus travel in a series of huge bounces between Earth and sky, making possible long-distance radio communication.

But sudden outbursts of ultraviolet light and other radiations from the Sun sometimes upset this convenient arrangement. Their effect on the ionosphere is as disturbing as suddenly turning a garden hose on a man standing quietly under the gentle spray of a shower bath.

Under this sudden "hosing" the radio mirror often breaks. Programs and signals fade. The invisible shell of magnetic force that surrounds the Earth is upset and currents in the Earth are disturbed; news dispatches and telegraph messages traveling over wires are garbled. Some of these disturbances are called magnetic storms. They are most frequent when sunspots are most numerous (pages 10 and 11).

Huge red masses of hot hydrogen gas also often flare up from the Sun's surface. Sometimes when this happens there is a



Photographs from Lowell Observatory

HOW PLUTO WAS FOUND—A WHITE DOT MOVES AMONG THE STARS

The ninth and most distant planet was discovered by comparing these two photographs of the same section of the sky taken six nights apart, on January 23, 1930 (right) and January 29 (left). Arrows point to the dot that represents Pluto. The movement indicates that the object was relatively nearer the Earth, and therefore must be a planet. The other white dots are stars, and show no movement between pictures because they are so far away (page 16).

complete fade-out of short-wave radio on the daylight side of Earth at the very instant the flare is seen. Eruptions of ultraviolet light shoot out from the hydrogen flares and interfere with the radio mirror.

FATES THAT MAY AWAIT THE EARTH

Our air blanket holds also a hint of Earth's future fate. Probably our planet once had twice as much oxygen in its air as now. Half of it already has been gradually absorbed by iron and organic matter in the Earth's crust, and the process is continuing. But we have enough oxygen remaining to last at least a billion years.

Other fates may overtake us. We may pass through a thick cloud of dust in space, whose friction would slow the Earth's velocity in its orbit. Then we would be drawn nearer the Sun until the increased heat destroyed life. Or the Sun may explode, as other stars occasionally do, destroying life in a flash. Or another star may pass so close as to disrupt the Sun and solar system. But there's much more chance of being hit by an automobile!

If the cold of some future ice age should become unbearable, and the remnants of mankind should escape by rocket to the Moon, they at least would find a terrific contrast—during daylight there the temperature is hotter than boiling water!

Experimental rockets already exist, and some scientists feel that eventually we may send a rocket to the Moon, though not

carrying people. But no fuel known today can propel a rocket at nearly seven miles a second, the speed necessary to overcome the Earth's gravitational pull.

Without leaving the Earth, however, we have learned from delicate instruments that in "daytime" on the Moon the temperature is unbearably hot, whereas when darkness falls it drops to almost 200 degrees below zero Fahrenheit.

MOON'S MOUNTAINS RIVAL EVEREST

A topographic map of the side of the Moon that faces us is being made, showing heights of the weird mountain ranges, angles of slopes, and depths of the great craters. Moon mountain heights, some almost equalling Mount Everest, are measured by the lengths of their shadows.

Craters on the Moon range up to 140 miles across. Some probably were made by volcanic eruptions. Others may have been formed by large meteorites which hit at 100 times the speed of a rifle bullet, since there is no air to break their fall (page 31).

A fine powder of the nature of volcanic ash and pumice is the "make-up" on most of the Moon's face. Astronomers have learned this by noting how the vibrations of light waves are changed when they are reflected from various types of rocks.

As our Earth speeds along on its path around the Sun it follows a dusty and rocky road. We're constantly colliding with meteors and rocks that are flying through

space. Occasionally we even strike a mass of meteorites or a comet head on.

WHEN METEORITES HIT OUR PLANET

The last time this happened was in 1908. One day, in a remote part of Siberia, a huge, luminous mass roared down out of the sky. As it struck Earth, a blast of superheated air rushed out and for miles around the countryside was charred and seared as if by a giant blowtorch, while in every direction the forest trees were uprooted, with their trunks leaning away from the central area.

In the Arizona desert, too, several thousand years ago, the same thing happened, when a large mass of meteorites or a small comet fell and formed a crater 570 feet deep and nearly a mile across (Plate III and page 13).*

It almost happened again in 1937, on a vastly greater scale. The asteroid *Hermes*, about a mile in diameter, came within some 500,000 miles of the Earth, though its path was such that it could not have struck us. Should such a body fall on one of the world's great cities, it would dig a crater several miles wide where the city now stands, and the hot air blast would destroy all life and property for scores of miles around.

But most of the Earth's surface is still empty or sparsely populated. Should *Hermes* strike anywhere but in a thickly settled area, it would merely dig a crater, destroy vegetation, and cause an earthquake in the vicinity, if on land, or produce a great tidal wave if at sea.

Thousands of asteroids of all sizes are speeding around the Sun. The largest is 480 miles in diameter, as big as Texas, while others are no larger than small mountains. Most of them follow a path between the orbits of Mars and Jupiter, and are perhaps the remnants of another planet that broke up. Only a very few of the smallest have orbits such that they ever could collide with the Earth.

MESSENGERS FROM SPACE

But though we could seldom collide with an asteroid, we strike "rocks" fairly often. These are the meteorites, large enough not to be consumed by the heat generated by friction as they fall through our atmosphere.

* See "Mysterious Tomb of a Giant Meteorite," by William D. Boutwell, in the NATIONAL GEOGRAPHIC MAGAZINE, June, 1928.

They tell us two things: first, that all of the Universe apparently is made of the same materials as our own Earth, for no element not known to us ever has been found in a meteorite; and second, that strange processes of mineral-making take place out in the great beyond. The familiar elements contained in meteorites often are fused into new combinations not existing on Earth, by methods unknown to us.

These visitors also bring riches from the sky. A Colorado meteorite contains enough gold to make one good tooth filling. Others contain tiny but genuine diamonds. So sure are some astronomers that there is a fortune in platinum and iridium in the great mass of meteorites that made the Arizona crater that several once invested money in a project to dig them up!

Meteorites are of three kinds: iron, different from earthly iron; stone; and a mixture of the two. You can identify them by pockmarks, like thumbprints in a cake frosting, where softer materials have been melted out, and by a smooth, glossy surface resulting from heating. Also, they're heavy for their size (pages 29 and 32).

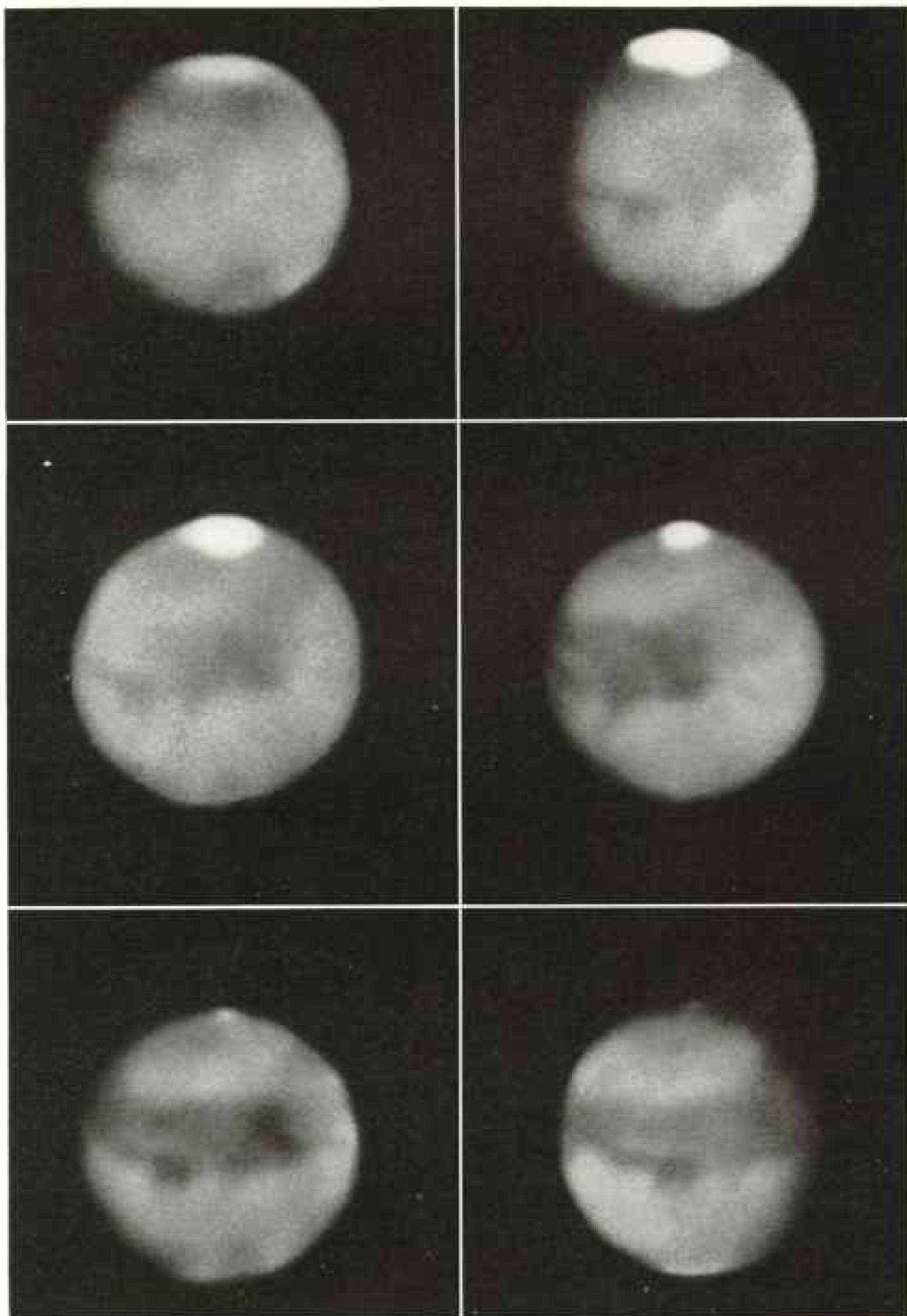
The ancient Phrygians worshiped a meteorite as "Cybele, mother of the gods." The sacred black stone in the southeast corner of the Kaaba, the holy place of Mecca, is believed to be one.

Smaller cousins of the meteorites are the countless tiny meteors. Every day the Earth collides with billions, most of them no bigger than a grain of sand.* As they speed into our atmosphere, its friction heats them and they burn to ash while they are still 40 miles or more above the Earth. All we see is a brief flash of light, a "shooting star."

Vast numbers of the meteors that the Earth "sweeps up" each day come from the real depths of space, from far out between the stars, beyond the solar system. But sometimes we plunge into a thicker cloud of meteors. Then for a few hours the night sky is filled with flashing lights. And that brings us to comets, for these thicker meteor swarms are the debris of comets that are dead or dying.

"From the Devil and the Comet, good Lord, deliver us," said an old prayer. In 1910, when it became known that the Earth would pass through the tail of

* See "Exploring the Ice Age in Antarctica," by Richard E. Byrd, in the NATIONAL GEOGRAPHIC MAGAZINE for October, 1935.



Photographs from Lowell Observatory

WHEN SPRING COMES ON MARS, THE POLAR CAP SHRINKS, GREEN AREAS GROW

Changes caused by advancing spring and summer are revealed strikingly in these telescopic photographs. Left to right, top to bottom, the pictures show how the white cap at the south pole (top of planet), probably snow, gradually dwindles. At the same time, dark, blue-green regions in the Martian tropics increase. Many astronomers believe this represents the growth of vegetation (Color Plate IV and page 14).



Photograph courtesy Carnegie Institution of Washington

SPOTS ON THE SUN MAY MEAN TROUBLE ON EARTH

Like gigantic tornadoes, sunspots are whirling vortices in the outer gaseous envelope of the Sun. They do not affect the Earth directly, but are "symptoms" of radiation outbursts from the Sun that interfere with short-wave radio and telegraph communication. Such disturbances are most frequent when sunspots are numerous (page 6). This group measures about ten times the diameter of the Earth.

Halley's comet, some inhabitants of Asia Minor filled barrels with water in which to submerge, hoping thus to escape destruction. But the barrels were never used, for when we went through the tail nothing happened at all. And no wonder. A comet's tail contains less material per cubic inch than the best vacuum we can produce.

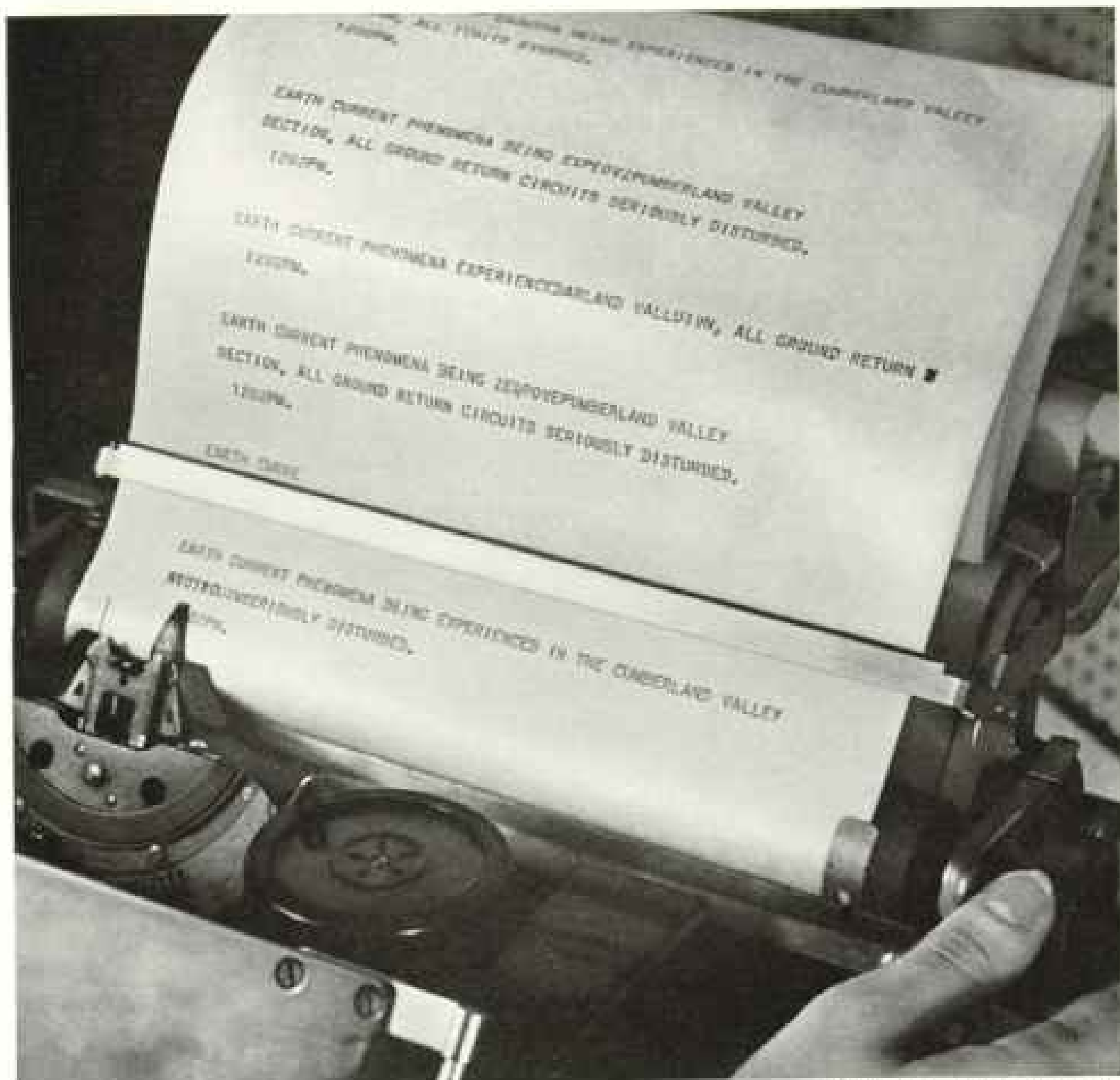
COLLISION WITH A COMET'S TAIL

Moreover, comets have no tails except when they come near the Sun (Plate VIII). The real comet consists of a nucleus of small pebbles, larger masses of rock or metal, dust and gas, surrounded by the "coma,"

a thin cloud of dust and gas. Seldom is the nucleus more than 500 miles thick, but the coma may be tens of thousands of miles in diameter.

Each comet speeds along an oval-shaped or elliptical orbit, one end of which circles the Sun, while the other end lies far out in space. Some comets follow comparatively short orbits, returning to swing around the Sun every few years, while others have such long paths that it takes them hundreds or thousands of years to complete one circuit.

As a comet approaches the Sun, the increasing heat makes the nucleus glow, and the gas around it expands. Then pressure



Photograph by Volkmar Weitzel

NO OPERATOR WILL LOSE HIS JOB BECAUSE THIS TELEGRAM WAS GARBLED—
THE SUN DID IT!

The scrambling of the letters is the result of a magnetic storm, caused by outbursts of ultra-violet light and other radiations from the Sun, which upset electric currents on the Earth (page 6). Repeated attempts were made to send the teletype message, "Earth current phenomena being experienced in the Cumberland Valley. All ground return circuits seriously disturbed."

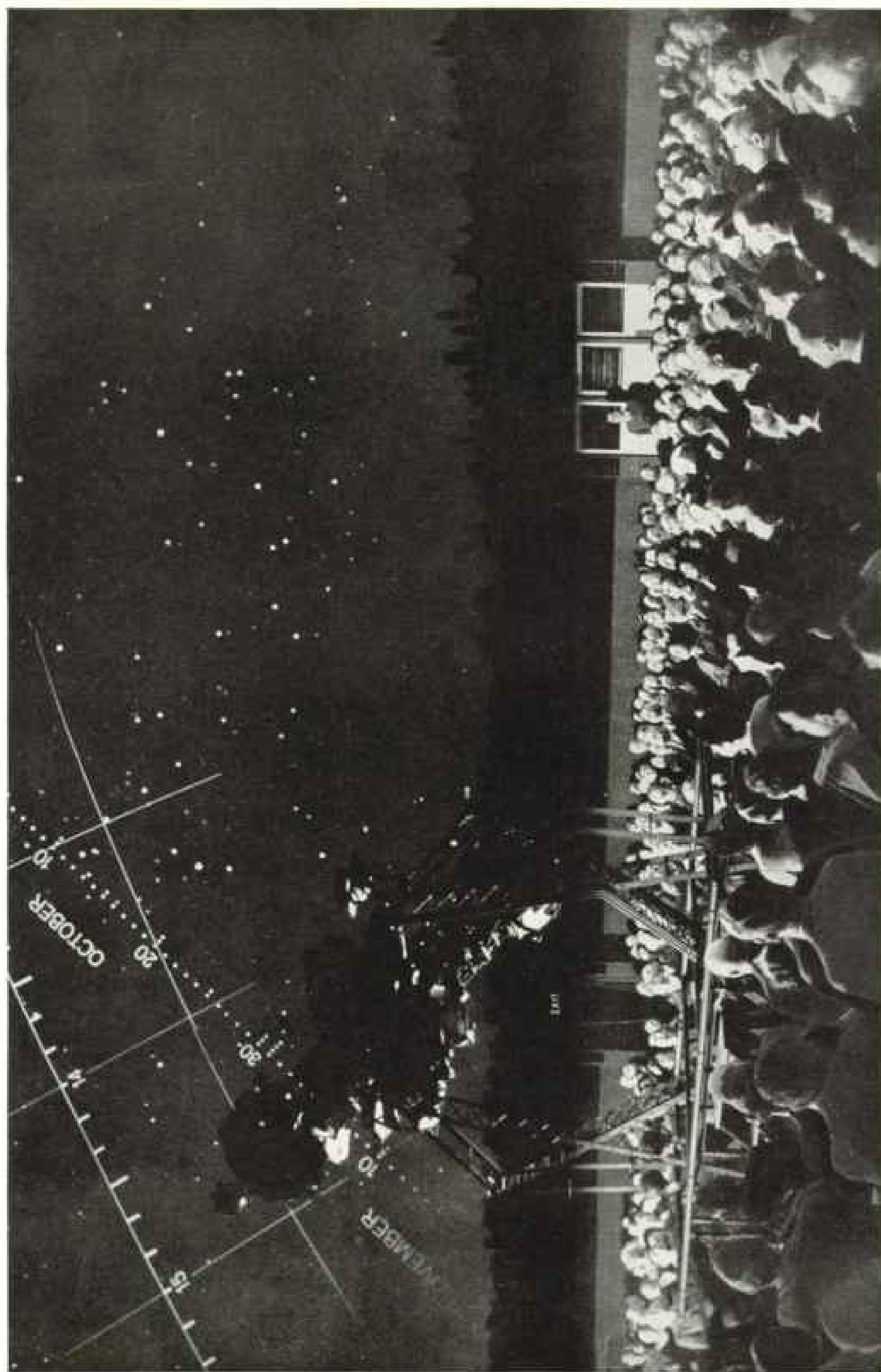
of the Sun's light (as real as any other kind of pressure) starts pushing gas and dust out behind the head. Thus the glowing tail is born, and it may grow to be 100 million miles long.

But the tail does not often stay behind. As the comet circles the Sun, the pressure of sunlight keeps the tail always pointing outward, so that finally, when the comet moves away again, the tail goes first.

Comets seem to be gradually wasting away. Each time they circle the Sun, some material "leaks" out to form the tail and is lost, though it keeps on trailing around the Sun behind the comet.

Astronomers actually witnessed the destruction of Biela's comet in 1846. As it neared the Sun, it broke into two parts which moved on together. Six years later, when it again came near the Sun, the two fragments were 1,500,000 miles apart. Since then, Biela's comet never has been seen again, but a vast swarm of meteors now circles through space in its old path.

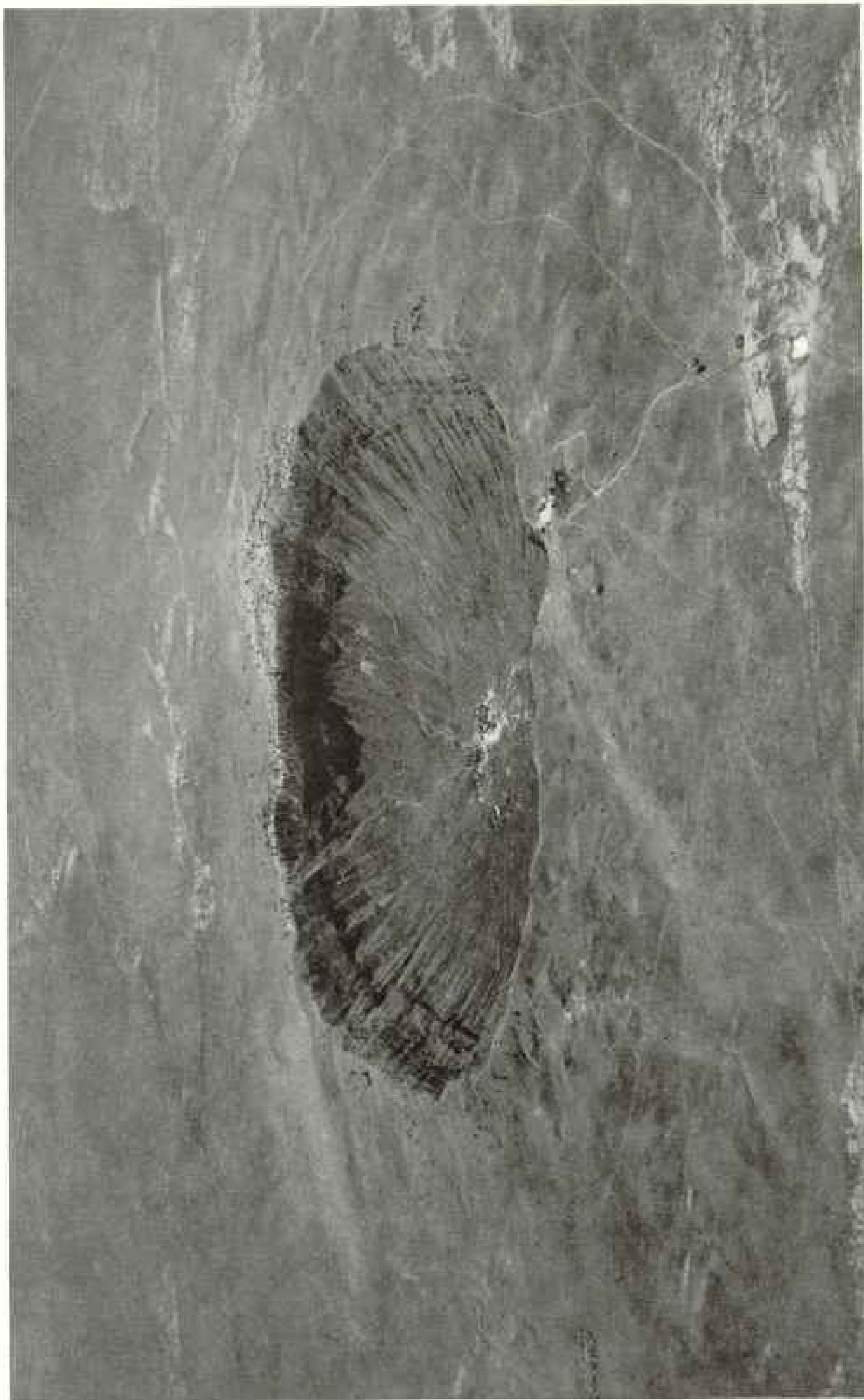
Other comets, too, have failed to return, while clouds of meteors now speed along their former paths at 30 or 40 miles a second. So we know that many meteor swarms are just the fragments of old, worn-out comets, like the dust and broken bricks



Photograph from Wide World

THE SKY OF THE TIME OF CHRIST CAN BE SHOWN TO PLANETARIUM AUDIENCES

Images of the stars, Sun, Moon, planets, and Milky Way are thrown on the interior of the dome-shaped ceiling by the complicated projection machine dimly visible at left. A scale of months and days is being projected on the "sky" at the Hayden Planetarium in New York City.



Photograph by Major Albert W. Stevens

A GIGANTIC COLLISION BETWEEN THE EARTH AND A COMET OR GROUP OF METEORITES DUG THIS MIGHTY DIMPLE IN ARIZONA

Known as Meteor Crater, the gaping hole in the desert twenty miles from Winslow is three miles in circumference, nearly a mile across, and 570 feet deep (Color Plate III and page 8). Its rim rises 150 feet above the surrounding plain. Probably several huge masses of material struck here at once, penetrated deep into the ground, and then exploded, forming the crater.

that remain when an old house collapses.

Many comets which still exist have swarms of meteors scattered out behind, like a cloud of dust behind a speeding car. The Aquarids, a meteor swarm which we meet in early May, move in nearly the same orbit as the famous Halley's comet, and probably represent its "cloud of dust." The Perseid meteors, seen about August 11, follow the path of Tuttle's comet; the Leonids, seen in mid-November, follow the orbit of Tempel's.

THE EARTH'S EIGHT NEIGHBOR WORLDS

But while the meteor showers fall, let's turn to more important things—those eight other worlds that circle with us on the solar system merry-go-round. The other planets—is there life on them? Will we ever visit them in space ships?

Near the Sun are four small planets, in this order outward—Mercury, Venus, Earth, Mars. Farther out are four giant ones—Jupiter, Saturn, Uranus, Neptune. Then far beyond them all, forlornly alone in the outer void, is tiny, mysterious Pluto.

Closest to the Sun moves yellowish Mercury, not much bigger than the Moon. It is two-thirds nearer the Sun than we, exposed to blistering heat, and keeps always the same face turned toward the Sun, so the heat accumulates enormously upon it.

If there are oceans and lakes on Mercury, they are of molten lead, bismuth, and sulphur, for the temperature is around 600 degrees Fahrenheit, hot enough to melt any of these metals. On the other side, where the Sun never shines, the cold must be equally severe. Mercury has no air, the terrific heat having long since boiled it away. Life upon it is impossible.

Like a harem beauty, Venus, the next in order, hides her face behind a perpetual veil of clouds. If she has inhabitants, they probably never have seen the stars nor the beauty of a clear, sunny day.

Venus is about Earth's size, but 26,000,000 miles closer to the Sun than we, and hence much warmer. She shows no signs of having water, so her clouds are probably different from ours, perhaps mostly dust. They contain a vast amount of carbon dioxide, far more than in earthly air.

This gas might have been produced by decomposition of vegetation that perhaps formerly existed on Venus, but it seems unlikely that many plants, if any, exist there now or they would have absorbed

the carbon dioxide. Plants also would need oxygen, which has not been detected on Venus. Her surface probably is a glorified dust bowl, with barren soil stripped by the wind.

FASCINATING MARS AND ITS "CANALS"

Next comes Earth, and then Mars, most fascinating of all the planets (Color Plate IV). Mars is a little rusty-red world, only about half the diameter of Earth, swinging through space 48,000,000 miles farther out from the Sun. Great deserts of reddish sand cover most of Mars. At both poles are white round caps of snow and ice, like those of Earth, which grow larger in the Martian winter and shrink in summer (page 9). Water is scarce, and the ice in the polar caps is probably only a foot or two thick.

Over much of Mars' surface are strange lines and markings. The first astronomer who saw them was an Italian and he called them "canali." The word can be translated either as "channels" or "canals."

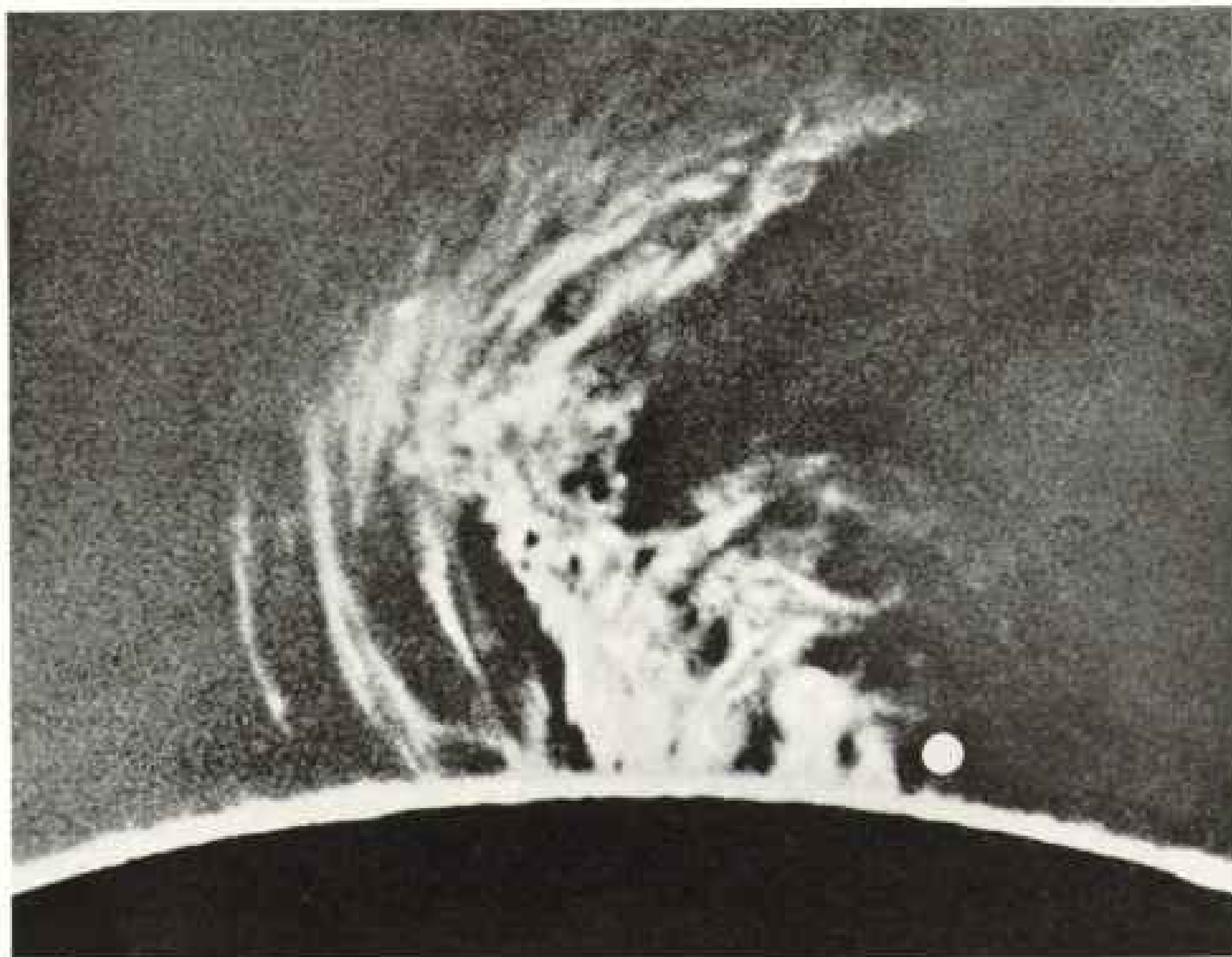
The lines look too straight and sharp to be natural streams. Some of them are 1,500 miles long and cross almost at right angles, which natural streams don't do. The late Dr. Percival Lowell believed the lines to be strips of vegetation along canals built by intelligent beings to bring water down from the melting ice caps to fertilize the deserts. He pictured Mars as a planet gradually drying up, while its surviving inhabitants struggled to keep alive by irrigating their fields from an ever-dwindling water supply.

Few others agreed with him. But some astronomers think that the lines may be natural stream courses through the desert with vegetation along their banks. The Nile Valley, with strips of green bordering the river, would appear much the same from a distance.

COLOR PATCHES MAY BE VEGETATION

But the best evidence that at least some form of life exists on Mars is furnished by the great patches of greenish-blue color here and there in the desert. They grow larger and darker as spring and summer come on in the Martian hemispheres, then turn yellower and fade with autumn, which seems to indicate that they may be patches of vegetation.

And this vegetation, if such it be, is a highly developed, hardy kind, evolved



Photograph courtesy Carnegie Institution of Washington

GIANT OUTBURSTS OF GAS ON THE SUN WOULD DWARF OUR LITTLE EARTH

The gaseous flare photographed rising from the Sun is 140,000 miles high. A white disk shows how small the Earth would be in comparison. Such flare-ups, known as prominences, take place constantly on the Sun, and have risen as high as 950,000 miles. Still and motion pictures of such solar happenings are made at several observatories whenever weather permits.

through ages of evolution on Mars to adapt itself to conditions there.

On Mars we may see dramatized the future fate of Earth. Gradually our own oxygen is being absorbed by the Earth's crust. On Mars this process may have gone much farther. There is only 1/1,000th as much oxygen in the air of Mars as in ours. Most of it has combined with iron to give the planet its reddish iron-rust color.

Mars has no sign of animal or "human" life. Its air is highly rarefied. If man could adapt himself to living on the top of Mount Everest, he might be able eventually to learn to live on Mars. Since Mars's gravity is small, a 150-pound Earth man would weigh only 57 pounds on Mars and would need little strength to move about.

But he would need plenty of blankets. Even in midsummer at high noon, the temperature rises only to about 60° F. on Mars, while at night it turns suddenly cold and may drop to 40° below zero or more.

Would you like to breathe "air" composed of ammonia, which brings tears to your eyes, and methane, which is found in illuminating gas and in firedamp, the cause of coal-mine explosions? These gases are believed to exist on the four huge outer planets, rotating at terrific speeds as they circle slowly around the Sun.

PLANETS WITH SHELLS OF "ICE"

Too far from the Sun to receive much light or heat, life upon these weird worlds is impossible. Their central cores are of rock or metal, probably iron. Around the cores are great shells of ice, thousands of miles thick, but far different from the ice we know. Above the ice lie deep atmospheres of ammonia, methane, and hydrogen.

Jupiter, largest of the planets, 87,000 miles in diameter, weighs more than all the others combined. Just a year ago Dr. Seth B. Nicholson, with the 100-inch telescope at Mount Wilson, found two more moons

circling Jupiter besides the nine already known.

A cataclysmic crumbling of one or more moons probably produced the "rings" of Saturn, next beyond Jupiter outward from the Sun. The terrific gravitational pull of the parent planet, it is believed, caused the luckless moons to disintegrate. The three flat rings, only 10 miles thick, but 41,500 miles wide, are composed of millions of tiny moon-fragments circling together around the planet (Color Plate II). Nine other larger individual moons, still intact, move around Saturn farther out.

Uranus and Neptune are so far away that little is known about them, save that they are of much the same construction as Jupiter and Saturn.

HOW A NEW WORLD WAS FOUND

Early in this century astronomers noticed that Uranus had an unexplained "waver" in its orbit. Dr. Percival Lowell, founder of Lowell Observatory, Flagstaff, Arizona, suspected that the gravitational pull of an

undiscovered planet was the cause. In 1915 he announced his definite belief that such a planet existed, and predicted where it would be found.

To look for the planet, a certain region of the sky was divided into sections, and each section photographed twice, a few nights apart. When the two pictures of each section were compared, the stars in them would not have changed position, but a planet, being much nearer the Earth, would have moved noticeably (page 7).

Dr. Lowell began the search before his death in 1916. The hunt was resumed in 1929, with improved equipment. Clyde Tombaugh, a young assistant at Lowell, was taught to make and compare the photographs. On February 18, 1930, he found that a point of light in one of the sections of the sky had moved between pictures. The orbit and behavior of this body proved to be very close to what Dr. Lowell had predicted. It was the long-sought ninth planet, nearly four billion miles from the Sun.

"Solar System's Eternal Show"

The eight astronomical pictures accompanying this article were painted by Charles Bittinger, of Washington, D. C., a pioneer in the field of scientific painting.

In these paintings Mr. Bittinger has combined a fine sense of color values and artistic composition with a painstaking effort to achieve scientific accuracy. Small details of shadows and angles in the pictures, hardly noticeable to the layman, were worked out by the artist as carefully as the more obvious features. In this he received valuable assistance from members of the staffs of the United States Naval Observatory, Mount Wilson Observatory, Pasadena, California, Lowell Observatory, Flagstaff, Arizona, and the National Bureau of Standards.

In 1937 Mr. Bittinger was a member of the National Geographic Society-U. S. Navy Eclipse Expedition to Canton Island in the Pacific Ocean to observe the total eclipse of the Sun on June 8 of that year. He executed an impressive painting of the eclipse, which was reproduced in the NATIONAL GEOGRAPHIC MAGAZINE for June, 1938, and is now on exhibit at the New York World's Fair.

Originally Mr. Bittinger planned a career in physics, and devoted three years to study at the Massachusetts Institute of Technology. But an increasing interest in art led him to change his plans, and he spent four years at the École des Beaux Arts in Paris. Paintings by Charles Bittinger now hang in the National Arts Club of New York, the Art Museum of

St. Louis, the Boston Athenæum, and the Metropolitan Museum of New York. He is a member of the National Academy of Design, election to which is one of the highest honors in American art, and winner of many prizes and awards.

Mr. Bittinger has pioneered in "changeable paintings." Such a painting may appear as a portrait when illuminated by ordinary light, but changes to a landscape when light from a different part of the spectrum is thrown upon it. On the walls of a room at the Franklin Institute in Philadelphia are three murals done by him in fluorescent paints, visible only when ultraviolet light is thrown upon them. Under ordinary light the walls appear white.

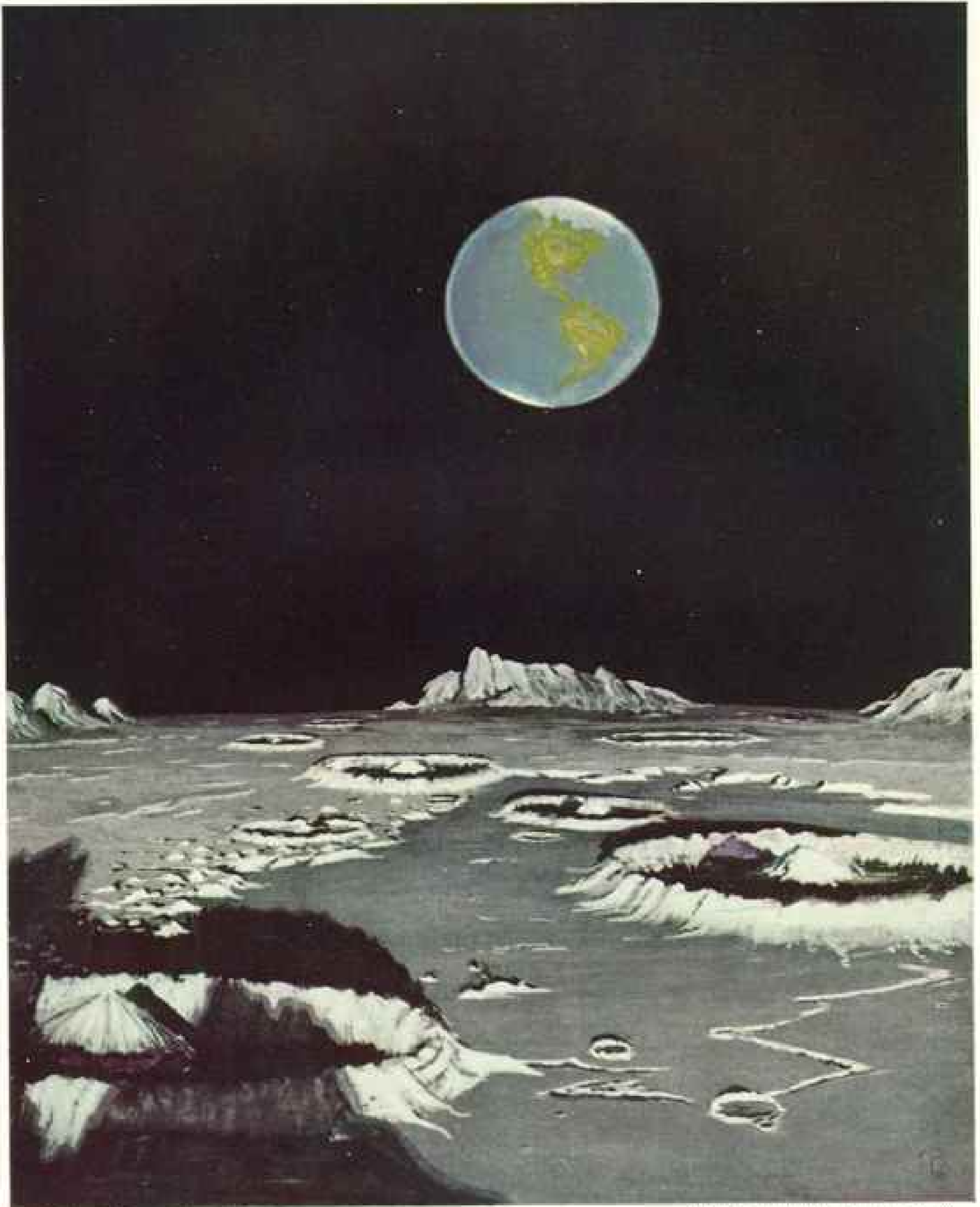
A beautiful painting of the spectrum of the Sun, by Mr. Bittinger, adorns the National Academy of Sciences building in Washington.

The solar spectrum in Webster's New International Dictionary of the English Language was painted by Mr. Bittinger.

"In planning and working out the paintings which accompany this article," said Mr. Bittinger, "I came to feel more than ever that astronomy is the greatest monument to human intelligence, which has explored out into unimaginable depths of space with nothing more tangible than the fragile waves of light.

"Astronomy gives us, as nothing else can, an appreciation of the power and wisdom of the unseen hand of the Creator which has produced and governs this stupendous Universe."

SOLAR SYSTEM'S ETERNAL SHOW

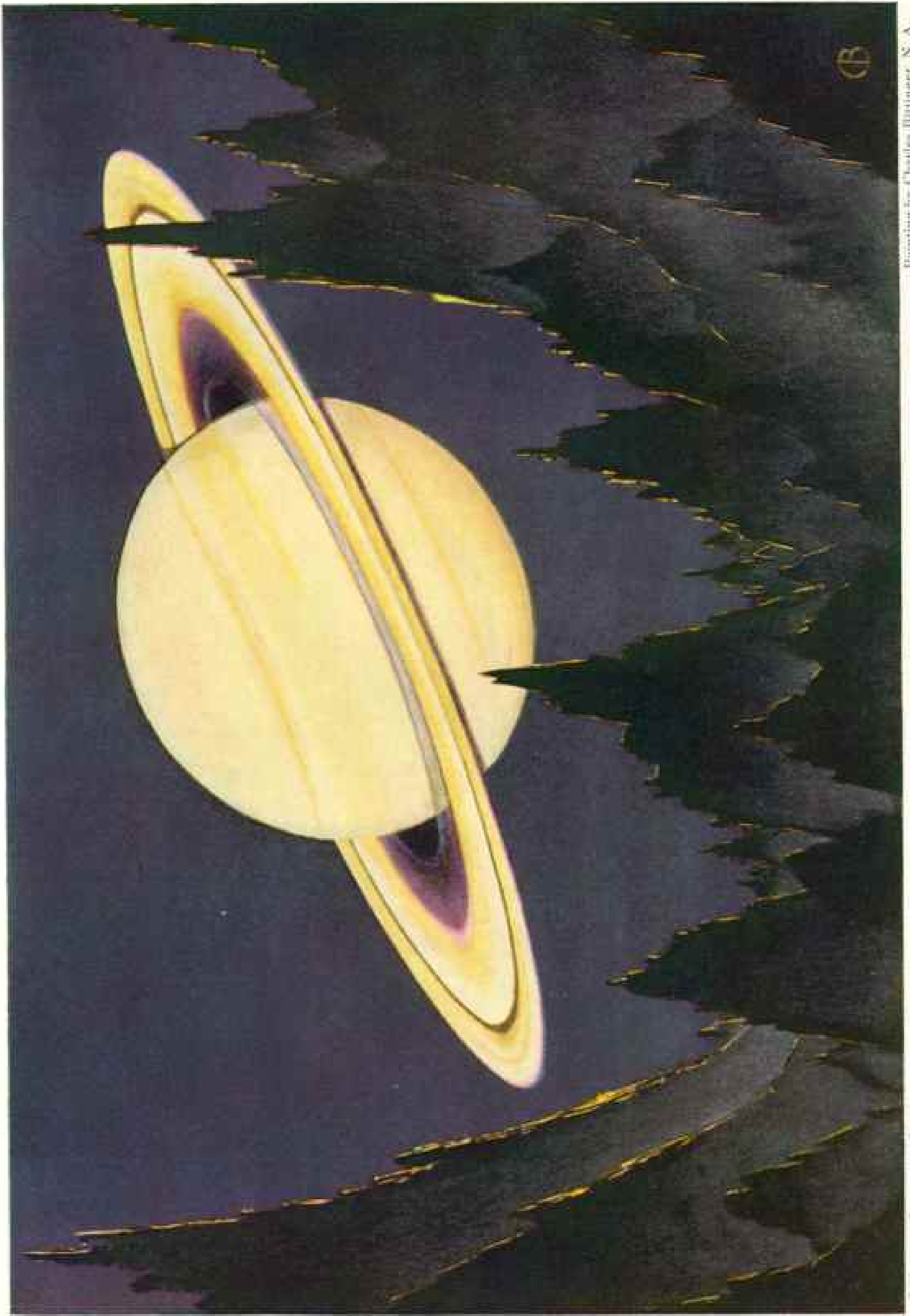


© National Geographic Society

Painting by Charles Bittinger, N. A.

A BLUE GLOBE HANGING IN SPACE—THE EARTH AS SEEN FROM THE MOON

Our planet is this color because it is enveloped by the same "blue sky"—really air—which we see from beneath. The atmosphere scatters blue light rays more than others. Continents would be faintly visible if the day on Earth were cloudless, as depicted here. The white patches are the polar ice caps. In the foreground is the Moon's surface, with its craters and mountains. From the Moon the sky appears black because there is no atmosphere to scatter sunlight and modify its actual appearance.

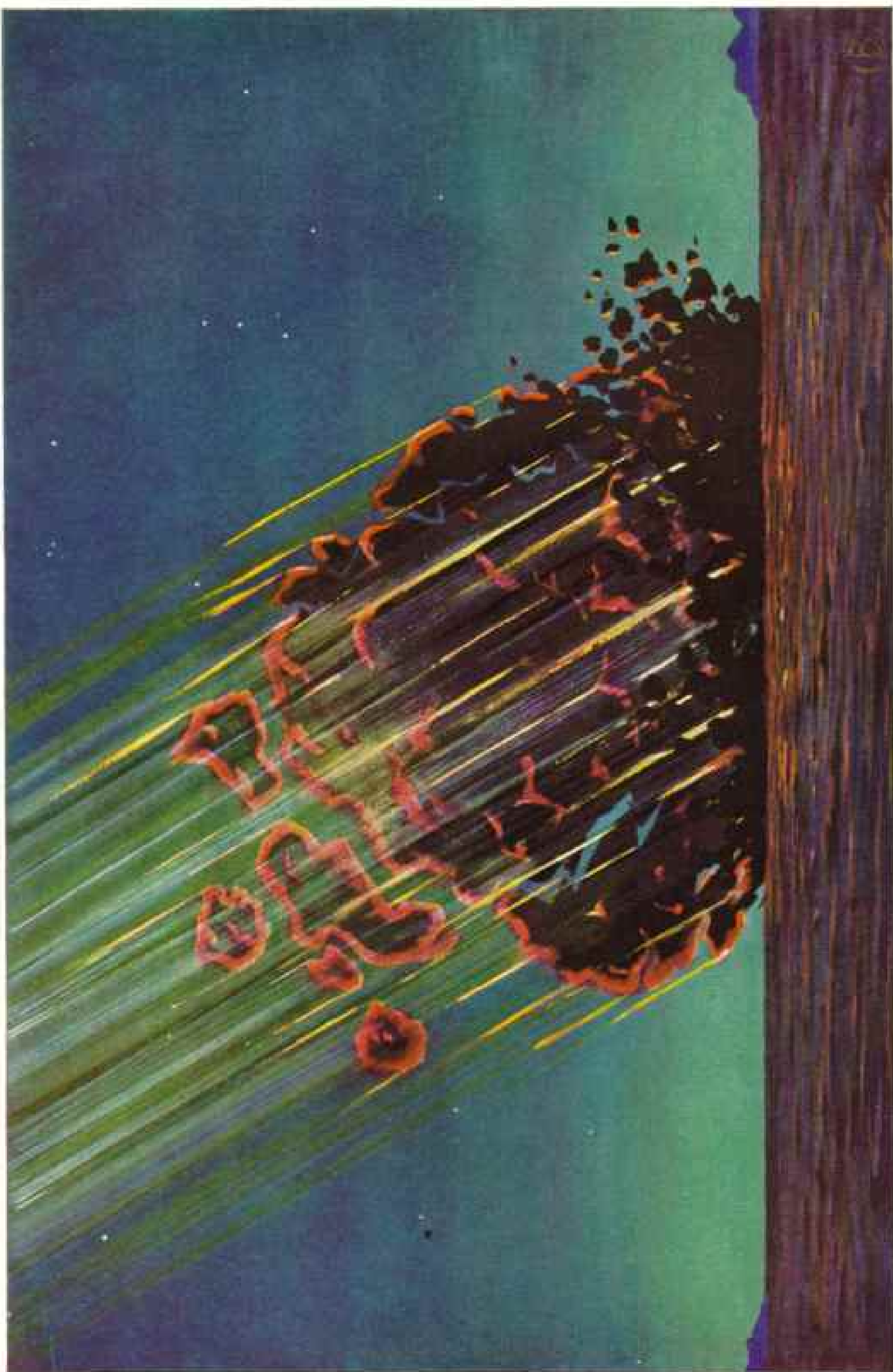


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SATURN, WITH ITS STRANGE REVOLVING RINGS, AS SEEN FROM AN ASTEROID 500,000 MILES AWAY

Painting by Charles Blüthner, S. A.



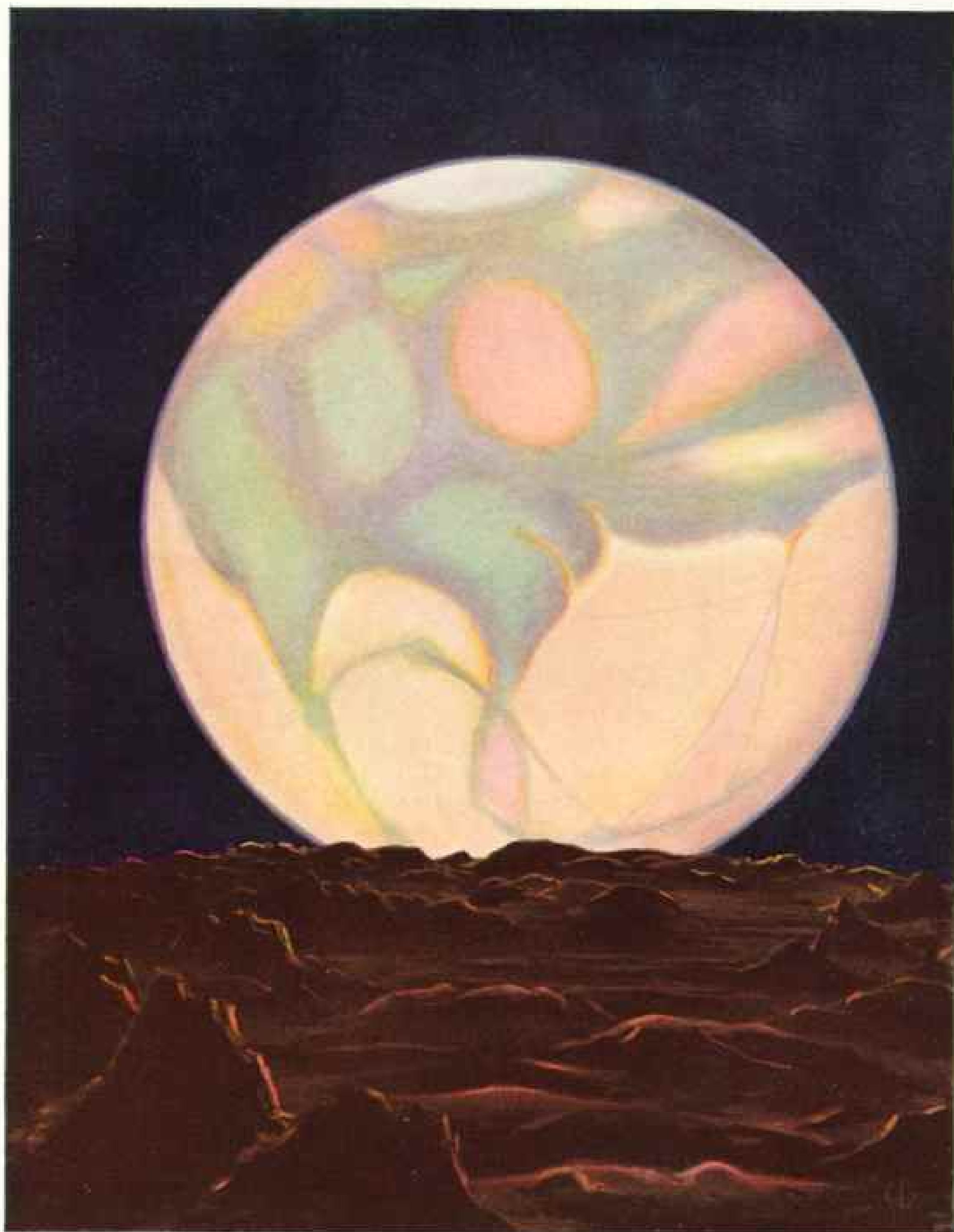


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Painting by Charles Bittinger, N. A.

ROARING IN FROM OUTER SPACE, A HUGE METEORITE OR SMALL COMET DUG ARIZONA'S GREAT METEOR CRATER

Red-hot on the outside from the friction of its passage through the atmosphere, the million-ton mass appeared somewhat like this as it struck the Earth at terrific speed. The constellation of Orion is shown at upper right.



© National Geographic Society

Painting by Charles Bittinger, N. A.

THE ONLY LIFE OUTSIDE THE EARTH MAY EXIST IN MARS' GREEN PATCHES

Many astronomers think they are some form of vegetation, for they appear and disappear with the changing Martian seasons. The planet is seen here from Phobos, the nearer of its two moons. Spring prevails on the upper half of the globe, so the white polar ice cap has shrunk considerably. At lower right are some of the famous "canals." Vast areas of Mars are deserts whose soil has turned rusty red, probably through absorption of oxygen from its atmosphere. Mars' diameter is about half that of the Earth. It is extremely doubtful that there are any "Martians" in existence.

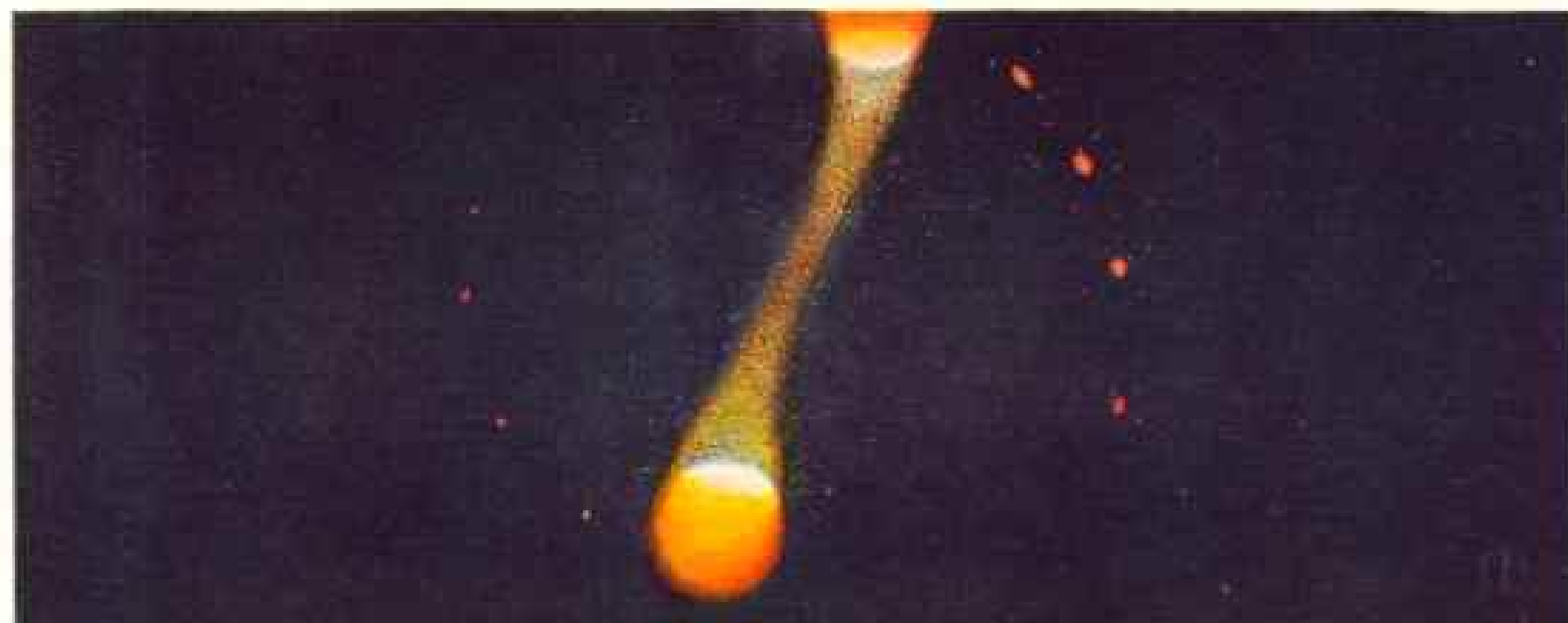
SOLAR SYSTEM'S ETERNAL SHOW



IN A BREAKUP OF THE SUN, THE EARTH AND PLANETS MAY HAVE BEEN BORN. In the distant past, according to one theory, the Sun was rotating so fast that it began to fly apart. Huge bulges developed on it, as shown here.



AS THE SUN BROKE INTO TWO STARS, SMALLER FRAGMENTS ALSO WERE EJECTED. These became the planets. Tidal forces slowed down the rotation of the two large masses, and some of their momentum was transferred to the newborn worlds.

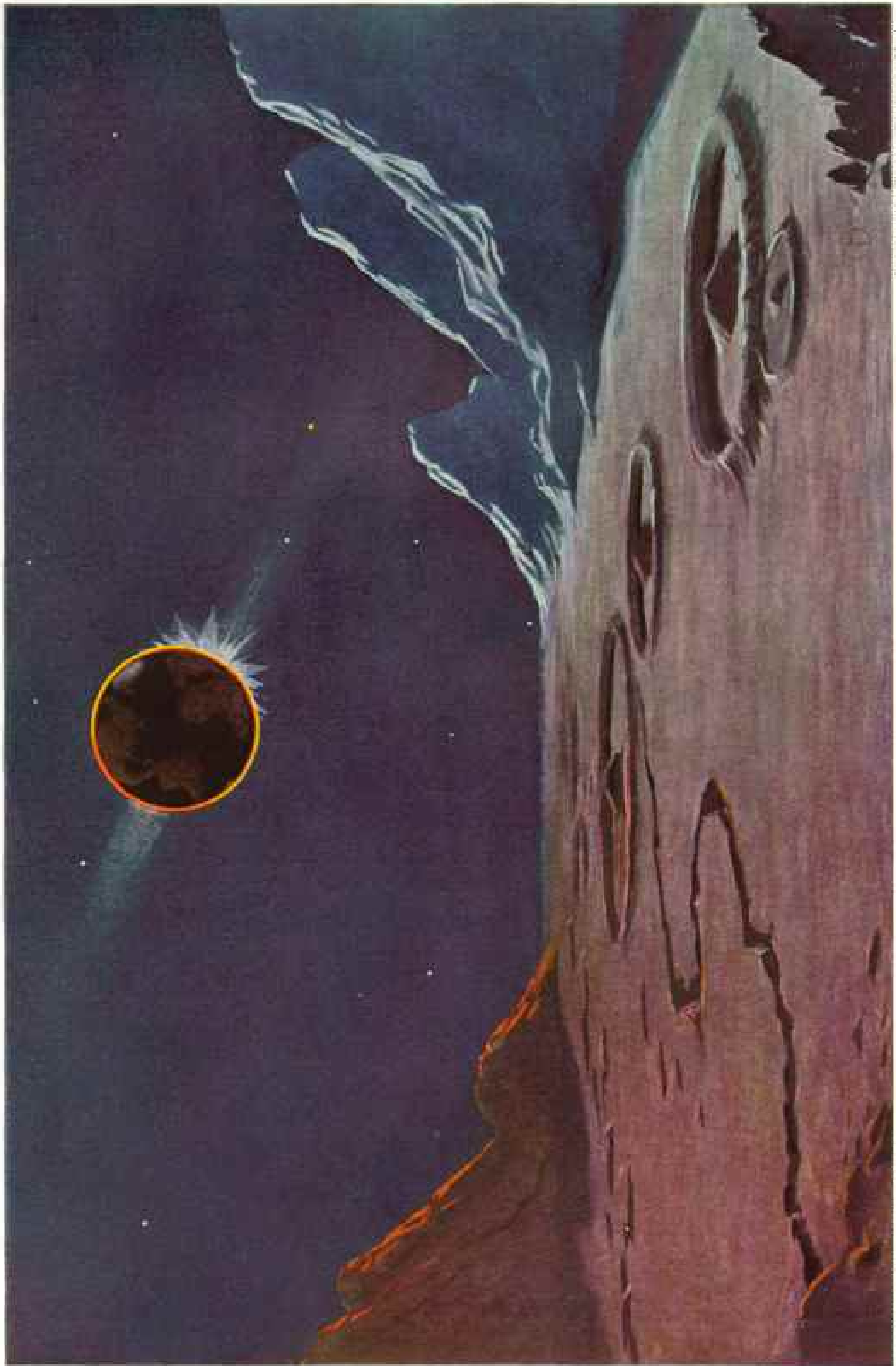


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Paintings by Charles Rittiger, N. A.

LEAVING THE SUN (BELOW), THE OTHER STAR SPED AWAY INTO SPACE

When the original Sun broke in half, terrific light burst from the hot faces that were exposed. The force of this light drove the two masses apart by recoil, like skyrockets.

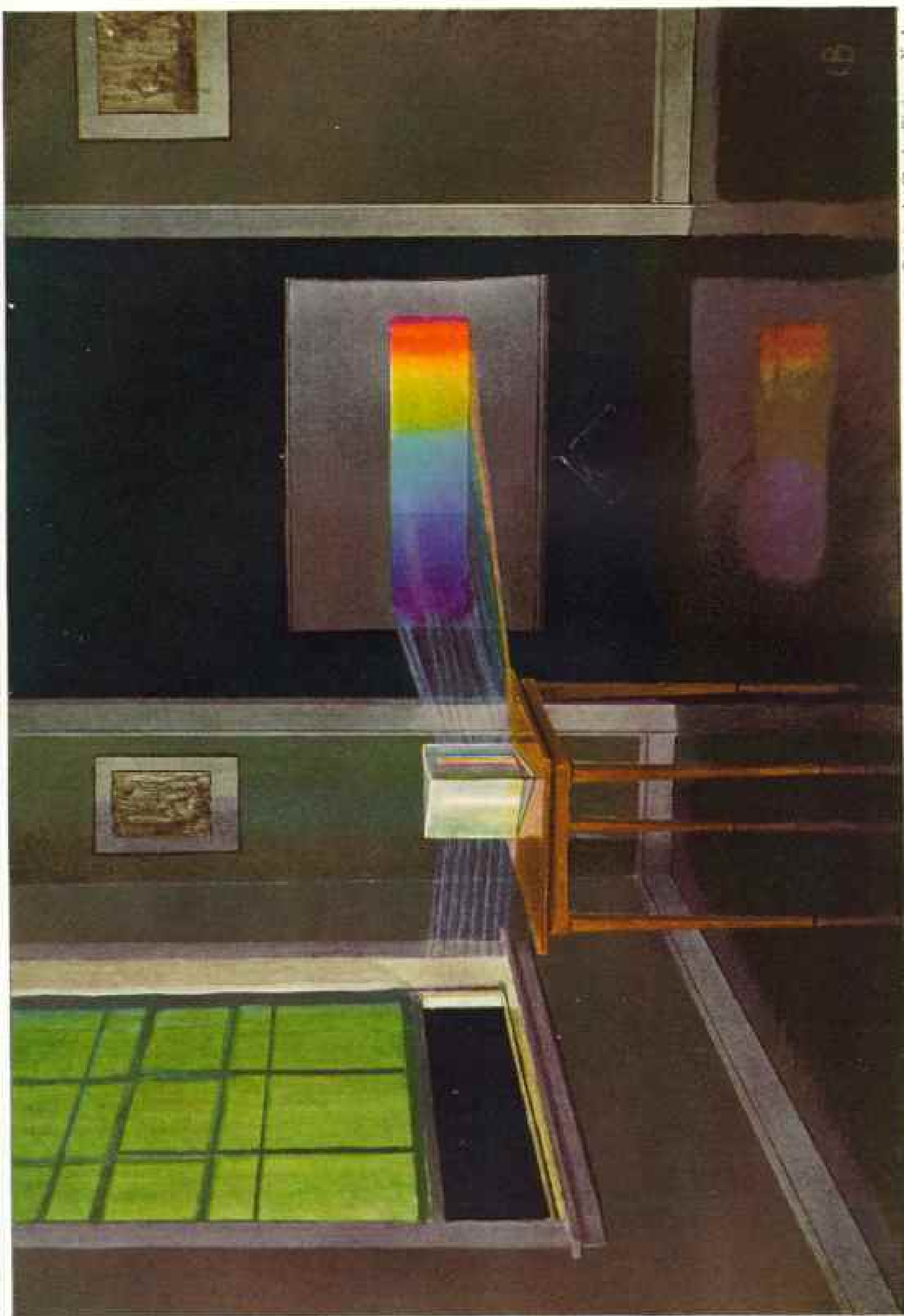


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Painting by Charles Dittinger, N. A.

AN ECLIPSE OF THE SUN BY THE EARTH, WHICH WE CAN NEVER SEE, WOULD BE VISIBLE TO A MAN ON THE MOON

Sunlight shining through the Earth's atmosphere from behind forms a red ring around our planet. Streamers of the Sun's corona show, at right, where the Sun is about to reappear. The luminous cloud is the "zodiacal light," believed to be reflected from small particles surrounding the Sun. Continents on the Earth and the north polar ice cap are faintly illuminated by moonlight. In the foreground is the Moon landscape (Plate I).



© National Geographic Society

Painting by Charles Dittinger, N. A.

LIGHT, HERE SHOWN SPLIT INTO ITS SPECTRUM OF COLORS, HAS TAUGHT US ALMOST ALL WE KNOW OF THE UNIVERSE

In this demonstration a reflected beam of sunlight, entering through a slot at the window, is broken up by the prism and thrown on the screen.



© National Geographic Society

Painting by Charles Bittinger, N. A.

WHEN NEARING THE SUN, A COMET GROWS A TEMPORARY TAIL.

This one is seen at dawn behind the Washington Monument, though actually millions of miles away. When one of these mysterious wanderers approaches the Sun, the pressure of solar radiation, as real as the pressure of a fire hose, pushes a tenuous cloud of matter out of the comet's head to form the tail. This appendage disappears when the comet returns to outer space, however. Orion's Belt is visible at the upper right, and the bright reddish star at upper left is the giant Betelgeuse.

Pluto probably is smaller than the Earth, without air, and chilled by a cold of 200 degrees below zero. No wonder it was named for the god of the lower world.

Do we ever get signals from other planets? No, say the astronomers, for there's probably no one to send them. Will we ever visit other planets, by "space ships"? Again the answer is no. Only on Mars and Venus is there any possibility that men could survive even if they landed safely.

Martians, setting out to attack Earth, assuming their space ships could move at meteor speeds, would have to travel for days through the 400-below-zero cold of space. Then, as they dashed into the Earth's atmosphere, they would have to endure sudden terrific heat for two or three seconds as their ships were heated to flaming incandescence by the friction of the air.

SUN'S HEAT WOULD TURN ROCKS TO VAPOR

To a man on Pluto the Sun would appear as an extremely brilliant star, and a star is what it is, the type known to astronomers as a "yellow dwarf." Our Earth is tied to the Sun by a gravitational pull as strong as 10,000,000 steel cables one mile thick. And we would not want to get away, for the Sun feeds us, warms us, keeps us alive.

After shining countless ages the Sun is still so hot that an ordinary 25-cent piece, heated to the temperature of the Sun's center, would shrivel up everything within thousands of miles. Even the outside of the Sun is heated to about 10,000 degrees Fahrenheit, a temperature at which the hardest rocks and metals not only melt but turn to vapor.

The Sun is slowly losing its heat, but will keep on shining about as it is now for billions of years more. It is a ball of super-heated gas, 864,000 miles thick. Even at the center, where the pressure is something like 5,000,000 tons to the square inch, it is still a gas, though the atoms in the gas are very tightly packed together.

Despite this great heat, the Sun is not burning. One of two things is probably happening to produce its enormous energy—either the complete destruction of atoms, or the creation of them, perhaps both. Within the Sun's interior, the terrific heat sends atoms and electrons rushing about at breakneck speed. Constantly they collide. Sometimes both are destroyed, releasing the energy that held them together.

Remember that heat is a form of energy. Destroying the atoms in a thimbleful of water would release as much power as burning several thousand tons of coal. Perhaps, also, atoms of hydrogen, the gas that exploded in the dirigible *Hindenburg*, are being turned into helium, the nonexplosive gas, in the Sun. If so, great energy would be left over from the process to add to the Sun's heat.

Enormous whirling vortices of gas, the sunspots, thousands of miles wide, issue from the Sun's hot interior. Nobody knows their origin.

HARNESSING THE SUN'S ENERGY

Does the Sun cause weather changes? Dr. Charles G. Abbot, secretary of the Smithsonian Institution, has measured slight daily variations in the Sun's heat over many years. He believes they are the main cause of weather and that it might be predicted two weeks in advance if we had more complete and accurate data about the Sun.

In the meantime, practical steps are being taken to make more and better use of the vast energy that the Sun is sending to us.

An engine powered by the Sun's heat concentrated by mirrors has been invented and will run a boiler. Homes in Florida and California have hot water heated by solar heaters.

Methods of making trees grow faster are being studied, in hopes of speeding up the conversion of solar energy into a form we humans can use. Ways to use Sun heat to run engines for mechanical power, to change solar radiation into electrical energy, to convert sunlight chemically into forms available for work, are being sought by other researchers. The Sun shines almost steadily in the deserts, so some time they may become the new centers of the world's industry, as we learn to utilize the Sun as a chief source of power.

MILKY WAY A MIGHTY WHEEL OF STARS

Meanwhile, the Sun moves along, with its planets, through the Milky Way Galaxy, the great system of stars in which we live. This galaxy is a huge, round, flat conglomeration of bright stars, dark stars, dust, and gas. It is shaped much like a solid cartwheel, with a large bulging hub at the center, and is rotating (pages 26 and 27). Probably it has two or more arms



Photograph courtesy Carnegie Institution of Washington

SEEN EDGE ON, THIS GALAXY IS FLAT WITH BULGING HUB

Like our own Milky Way, it probably rotates wheel-fashion around its shining hub of gas and stars (page 25). Its mottled appearance results from dark clouds of dust and gas mixed with millions of shining stars and luminous gas clouds. Seen flat side on, it probably would appear like the one opposite.

beginning to fly off from the outer rim, like a Fourth-of-July pinwheel.

Our Sun is about halfway out from the hub of the wheel toward the outer rim. Look up at night at the Milky Way and you will be looking out toward the outer rim of the wheel. The Milky Way appears as a band of light across the sky because you are looking up through the thickness of the wheel and seeing the concentrated light of all the vast numbers of stars between you and the "tire."

In summer, if you look toward the constellation Sagittarius, you will be looking

toward the hub of the Milky Way wheel. In that direction the Milky Way divides, split in two by a cloud of dark dust and gas which lies near the hub. Today, using infrared-sensitive plates, astronomers are penetrating this dark curtain and photographing stars that lie in and beyond the hub — 50,000 light years or more away.

Our great star-wheel is about 600,000,000,000,000,000 miles in diameter — light from a star on one edge would take 100,000 years to travel across to the other. The thickness of the wheel is some 10,000 light years. As the wheel turns, it carries the Sun along at nearly 200 miles a second, but so enormous is the wheel that it takes 200 million years to revolve. Our

Earth, since it was formed, has traveled with the Sun around the wheel at least 10 times.

The wheel is built somewhat like a huge, round ham sandwich—two outer layers of stars corresponding to the bread, enclosing a middle layer of dark dust and gas representing the ham. But the "bread" is very crumbly and the "ham" chopped very fine, for there are many stars mixed with the dark matter in the center, and much dark matter mixed with the stars in the two outer layers. Altogether, the substance or mass of the dark dust, dark stars, and gas



Photograph courtesy Carnegie Institution of Washington

FROM AFAR, OUR MILKY WAY PROBABLY WOULD LOOK LIKE THIS

Resembling a Fourth-of-July pinwheel, this distant galaxy is believed to contain millions of stars and clouds of dust and gas, rotating around the central hub (see opposite).

in the wheel is about the same as that of the stars that shine. Forming a sort of open-work sphere around the wheel are about 100 large globular clusters of stars.

SPOONFUL OF STAR STUFF MIGHT WEIGH
A TON

Amazing things go to make up this wheel-like Milky Way galaxy—stars that pulsate like gigantic hearts; double stars that spin around each other; stars shrunk together so tight that a spoonful of their material weighs as much as a truckload of ours.

So distant from us are the other stars in our galaxy that the total light we receive from all of them (except the Sun) is no more than we would get from a single candle 100 feet away. The nearest star, Proxima Centauri, is so far away that if you were traveling to it on an air liner at 100 miles an hour, and tipping the stewardess 50 cents a day, the trip would cost four billion dollars in tips alone.

Brightest star in the sky is Sirius. It has a strange "companion" revolving around it once every 50 years, and this companion is 2,000 times as heavy as gold.

Most stars range from 10,000,000 miles in diameter down to about 300,000, but there are some "super-giant" stars. One

of the largest known is Epsilon Aurigae, nearly 2,600,000,000 miles across, so huge that if the Sun were placed at its center all the planets except Uranus, Neptune, and Pluto would be revolving inside it.

Whence came the stars? They probably were formed from clouds of dust and gas out in space, though whence came the dust and gas few astronomers are prepared to say. The process may still be going on.

Throughout their long lifetimes stars follow the opposite course to man's—they shrink instead of grow. "Young" stars are the giants, huge and cool and red, blown up like vast balloons by the pressure of light from inside, and thin and rarefied. Then gravitation starts to overcome that pressure, and they begin to shrink. At the same time they grow hotter, for they must give out the same amount of radiation from a much smaller area. Gradually their color changes from red to blue. The hottest stars of all are blue.

"WHITE DWARFS" MYSTIFY ASTRONOMERS

Finally the shrinking star begins to grow cooler again and its color returns to red. Some day our Sun, now a yellow star, is expected to turn red as it keeps on cooling. At last the evolving star shrinks to a size

much smaller than our Sun and finally becomes a cold, dark, solid mass, continuing to circle on in the wheel of the Milky Way.

A mystery to astronomers are the stars known as "white dwarfs." They are no bigger than the Earth; they have shrunk together until a cubic inch of one may weigh several tons; yet instead of being cool they are fiercely hot—in fact, white hot.

The smallest star known is a white dwarf, not much bigger than the Moon, yet containing two and one-half times as much material as the Sun! Such tight packing is possible because the atoms in the star are broken up, just as you can pack more electric light bulbs in a box if you first smash them!

The white dwarfs are being intensively studied at Yerkes Observatory, Williams Bay, Wisconsin, and at the new McDonald Observatory, Mount Locke, Texas.

Twin, triplet, and even quadruplet stars are fairly common. About one in every three stars is double—really two stars revolving around each other, in periods ranging from a few hours to thousands of years.

By measuring the pull of double stars on each other, astronomers can determine their masses. From this we know that the average star contains something like two thousand million million million tons of matter: yet all of this is gas!

Like flashing electric signs, some stars, the variables, flare up in brightness, then die down again, some at regular intervals, others on no set schedule. One such star, Chi Cygni, increases 10,000-fold in brightness from its minimum to its maximum!

Certain variable stars, the Cepheids (named for the star Delta in the constellation Cepheus) are good yardsticks of distance in the Universe. They wax and wane in brightness at regular intervals of four to 40 days. The more slowly they pulsate, the brighter they are. A Cepheid that varies up and down once a day is 100 times as bright as the Sun, while one that pulsates through a period of 10 days is 1,000 times the Sun's brightness.

If you know how much light a star gives out, you can tell its distance. So, seeing a Cepheid star pulsating at a certain speed, either within our Milky Way or in some distant galaxy, astronomers at once know its brightness, and hence can tell how far away it is. In this way they measure the distance from our own galaxy to many other galaxies far out in space, in which

they can photograph Cepheid variables flashing like distant lighthouses.

Just a few years ago, however, a new spectacle flared up before the astonished gaze of astronomers. This has been called "the most colossal catastrophe of matter which man has been privileged to witness." Known to astronomers as a "super-nova," it is the gigantic explosion of a star.

Ordinary exploding stars have been known for some time. They were called "novae" (Latin for new) because at first they were thought to be new stars. Now, however, we know they are ordinary stars that suddenly increase greatly in brightness because of an explosion. About 30 stars explode every year in our Milky Way.

But a super-nova is 1,000 times as bright as an ordinary nova. In one month it may radiate away as much light or energy as the Sun gives out in 23,000,000 years! A mystery of super-novae is that their light, when analyzed, shows that they contain matter in a state never before known, something outside all earthly experience.

What makes a star explode? Probably the energy being generated inside it suddenly increases greatly. It needs an outlet, so the star blows up. Thick layers of gas are shot off into space at 600 miles a second, gradually thin out and drift away, but the star is not entirely destroyed.

We soon may see a star explode much nearer the Earth than usual, though not close enough to be dangerous. The central star of the five that make the W in the constellation Cassiopeia has been increasing and decreasing in brightness in a puzzling manner. It may be getting ready to explode. If it does, it probably will become a spectacle unparalleled in astronomical history, sending us for several weeks perhaps as much light as the full Moon!

ICY COLD OF INTERSTELLAR SPACE

The mighty energy that keeps the stars shining is the same as is operating in our own Sun—the upbuilding or destruction of atoms, or both. Scientists dream of some day releasing and harnessing vast stores of subatomic energy—driving the *Queen Mary* across the Atlantic with the energy pent up in the atoms of only a spoonful of coal. Out in the stars such energy is already at work. From these giant seething test tubes we may learn secrets some day that will revolutionize our lives.

Out between the stars in our Milky Way,



Photograph by Volkmar Wentzel

THE RING-SHAPED METEORITE IS UNIQUE—THE SMALL ONE PROBABLY STRUCK A COW

"The Ring" fell in Pima County, Arizona, perhaps 300 years ago. It was used as an anvil by a blacksmith in the 1850s. The central part may have been burned out as the iron roared through the air (page 8). The small stony meteorite held by the lad came to earth at Chicora, Pennsylvania, June 24, 1938. After it fell, a cow near by was found to have a downward tear in her hide. Both meteorites are in the U. S. National Museum, Washington, D. C.

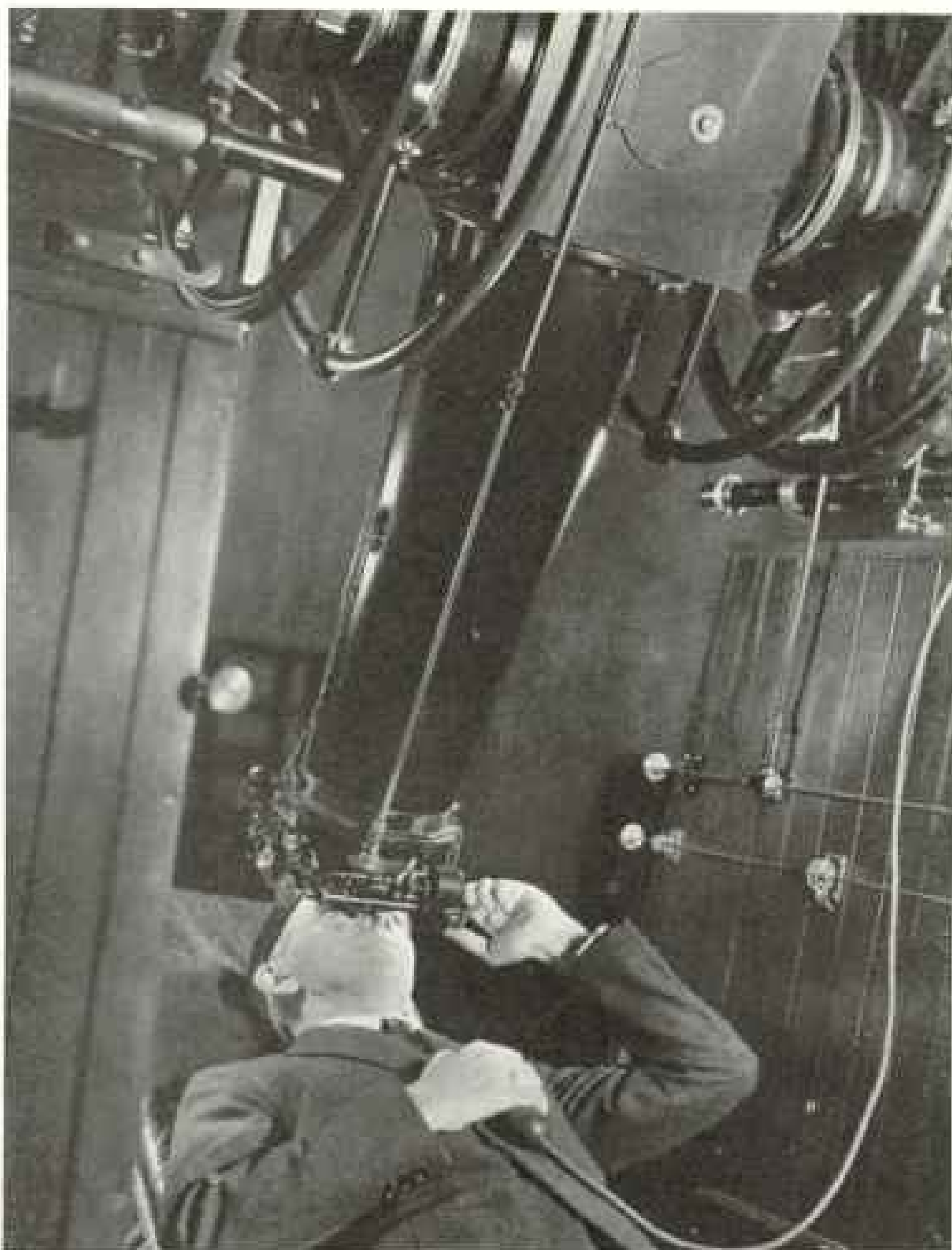
we are exploring successfully the enormous depths of space. There the temperature is only a little above the "coldest cold," absolute zero, about 459 degrees below zero Fahrenheit. It is not completely dark—there is more starlight than the Earth receives. Great clouds of dust and gas are scattered there, but so vast is the space in which they are spread that there is only about one atom to the cubic inch, a far greater vacuum than any known on Earth.

In this dust, in space, astronomers now are recognizing familiar substances—sodium, which you find in table salt; calcium, used in making acetylene gas; titanium, used in paints and dyes; and faintly shining masses of hydrogen and oxygen.

Outside our giant "island" of the Milky Way stretches a far greater ocean of space, emptier even than the space between the stars. Scattered through this outer space are more "island" galaxies, like ours, or roughly similar. Sometimes they are called "nebulae," but this term is also used for gas clouds in our own galaxy. It is less confusing to call these outer islands "galaxies."

The space between the galaxies is as near to complete nothingness as can well be imagined. Probably it contains almost no matter at all.

You can see our nearest important neighbor galaxy without a telescope. Look at the constellation of Andromeda and you will see a hazy patch of light half as



Photograph by Willard K. Culver

HE TIMES THE MARCHING STARS WITH A SPIDER THREAD

In measuring the precise moment when a star crosses a meridian in the sky, an astronomer keeps the star's image divided exactly in half by a wisp of spider web stretched across his telescope eyepiece. This transit circle is used by the U. S. Naval Observatory to determine the positions of the stars, Sun, Moon, and planets. The observations form a basis for predicting future motions of these bodies for such purposes as forecasting eclipses.

big as the full Moon. Actually of course it is far beyond the stars in the constellation. You see it as you might see a distant mountain peak through a clump of near-by trees. It is a galaxy very much like ours, a flat "wheel" of stars and gas, known as the "Great Nebula in Andromeda."

About 700,000 years ago, when man perhaps was just evolving from an animal-like state, light from this galaxy started toward Earth. It is just arriving now. We see this "neighbor" galaxy as it looked

about 7,000 centuries in the past.

The Andromeda galaxy is only the nearest of millions of galaxies that seem to extend on indefinitely. The most distant ones appear as mere specks on astronomers' photographic plates; yet these specks are the images of great systems of stars.

About 100,000,000 galaxies are scattered in the space that we have explored around us. In them probably are many stars like our own Sun, perhaps with planets, even life, like ours.

The largest galaxies are 5 to 10 times the size of the smallest, though most of them are roughly the same size. A few are irregular clouds of stars and dust and gas, not rotating around any visible center. Others seem to be round balls of gas, with no stars

visible in them; still others are elliptical, more flattened and also of gas, with some visible stars. Many are flat, round, and wheel-shaped, full of stars like the Andromeda galaxy and our own Milky Way, rotating around a protruding hub, with spiral arms flying off from the outer rim.

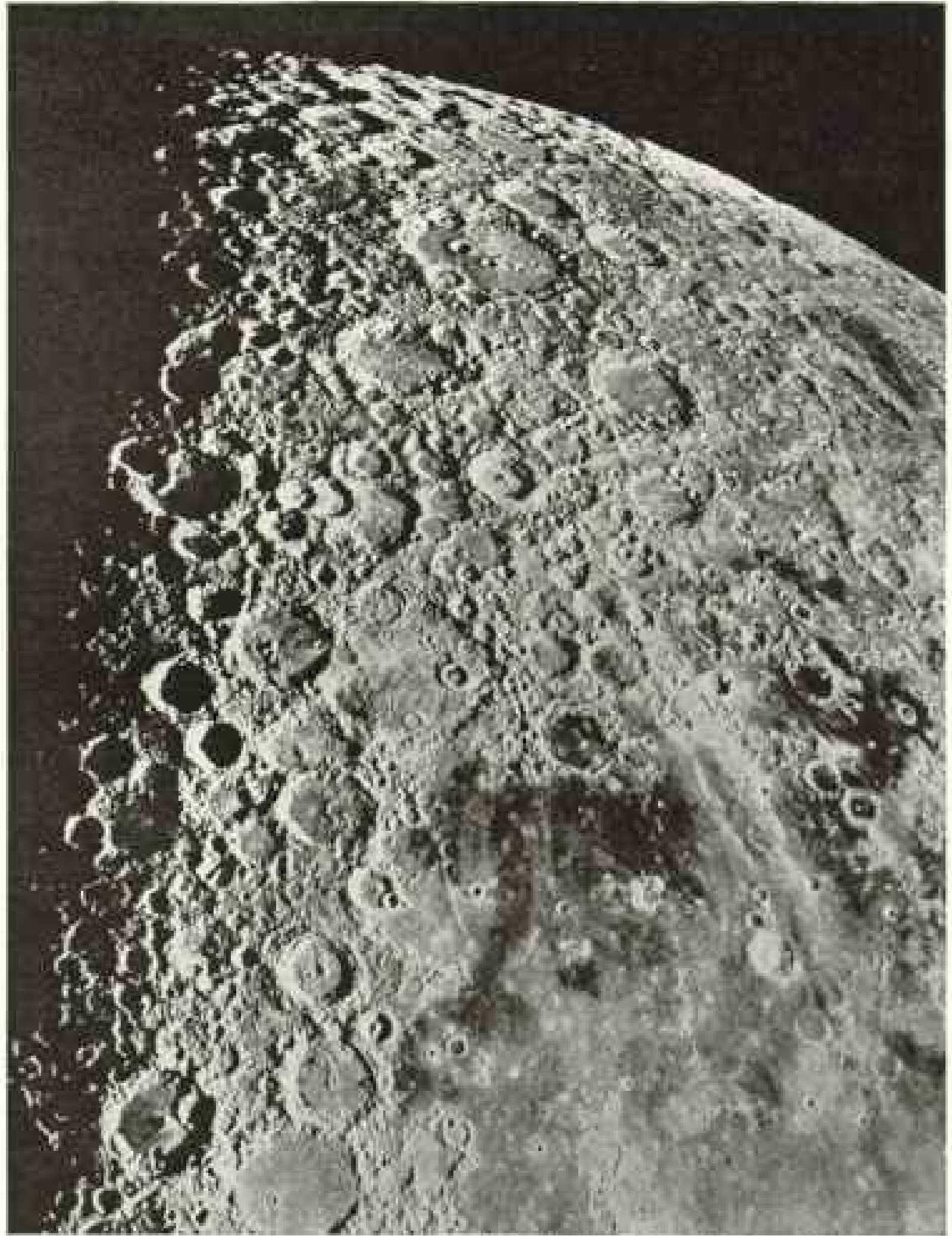
The most amazing thing that astronomers have discovered in recent years, however, is that this great Universe of galaxies seems to be expanding! All the galaxies apparently are flying apart, at terrific speed,

like the fragments of an exploding bomb. The most distant ones known are estimated to be racing off into space at the unimaginable speed of 50,000 miles per second! Our own galaxy is receding from the others also.

We cannot see the galaxies moving, but we have good reason to think they are. When a train speeds past you, blowing its whistle, the sound drops to a lower pitch as the train moves farther away. This is because the sound waves coming back to you are lengthened.

The same thing happens to light. When an object moves away from you, the light waves coming back from it to your eyes are lengthened, and so it looks slightly redder than it really is, for the red waves of light are the longest. This happens to light from the galaxies. Astronomers call this effect the "red shift," because in a photograph of the spectrum of a galaxy the ladderlike lines are shifted toward the red, or long wave length, end.

It's hard to believe the Universe is "exploding," but the only other explanation, says Dr. Edwin P. Hubble, is that the "red shift" is caused by some new law of Nature not yet discovered, perhaps as important as gravity itself.



Photograph courtesy Carnegie Institution of Washington

NO WINDS OR RAIN'S CARESS THE MOON'S DEAD FACE

Our satellite is so small it has not enough gravitational pull to retain any appreciable atmosphere, so it has no water, no clouds, no air (page 7). Without air, too, it would be impossible to hear sounds or detect odors on the Moon. Vast craters, high mountains, and plains cover its visible surface. This view shows a part of the Moon at last quarter. To astronomers it is a nuisance, for its light interferes with photography of distant heavenly bodies.

Where will it all end? Will the galaxies fly so far apart that we can no longer see them with telescopes, leaving the Milky Way "isolated" in space? Perhaps; or they may slow down and stop. Or the Universe may be alternately expanding and contracting, like an accordion!

These various possible—or impossible—kinds of Universes are worked out by mathematics. In the process strange ideas arise. Besides the familiar dimensions of length, breadth, and depth, we are told,



Photograph courtesy Field Museum of Natural History

LUCKILY, NO ONE WAS IN THE CAR WHEN THIS METEORITE STRUCK

The girl is holding a four-pound stone-from-the-sky which fell in Rend, Illinois, September 29, 1938, and now is on exhibition at the Field Museum of Natural History, Chicago. It smashed through the garage roof, shown above, penetrated the top of an automobile, and made a hole in the front seat cushion, to which Geology Curator Henry W. Nichols is pointing. The stone fell with a roar resembling that of a diving airplane.

there's a fourth dimension—time. We're not only somewhere, but some-when! And now Dr. Albert Einstein and some of his colleagues report they are investigating a fifth dimension.

How large is the Universe? Some astronomers think it may be infinite in size, with all the galaxies we see just tiny parts of a far larger supergalaxy, and so on forever.

If the Universe *is* expanding, however, it must have definite boundaries, astronomers say. Then what lies beyond? Nothing, not even space! But can space have boundaries? Yes, if space is curved, as Dr. Einstein says.

In curved space, you could look straight forward and see the back of your own head, if your eyes had sufficient power. This is because a ray of light, in curved space, would follow a curved path back to its starting point. So light reflected from the back of your head would travel on around curved space to your eyes, and you would see the back of your own head!

What of the future of the Universe? Since all the stars are radiating themselves away into space, some astronomers predict that eventually there will be no material substance left. It all will be turned into energy, they say, scattered afar. The Universe will have run down like an unwound clock. So far, we know of no way in which energy can be turned back into matter again; no way in which the Universe can be kept "wound up," though there may be such a process at work.

But of one thing we are sure. Through all the great Universe order prevails. The same natural laws that man has discovered in his laboratories govern every atom in the farthest, faintest galaxies.

"Man may be," says Dr. Harlow Shapley, of Harvard, "only the latest development of the whirling star mist, but the fact that he has intelligence enough to trace his own evolution stands unexplained, except by the presence in Nature of an intelligence far superior to his own."

AT HOME ON THE OCEANS

Whales and Sharks Make Exciting Neighbors for a Professor's Wife, Turned Able Seaman, On a Three-year Voyage Around the World

BY EDITH BAUER STROUT

With Illustrations from Photographs by R. S. Strout and the Author

TRAVELING over the oceans in small boats is getting to be a habit for young men, but people still think it strange that a woman should enjoy such a cruise, except as a passenger.

Igdrasil carries no passengers, however, and when she sailed from Jacksonville, Florida, in June, 1934, I was, numerically at least, half of the crew. My husband, the other half, is listed as captain, while I am usually listed as seaman.

Though I may not fulfill all the requirements of an A.B. to "hand, reef, and steer," I do stand regular wheel watch, night as well as day. Sometimes I am listed as cook, but I usually object when the immigration officers want to list me as stewardess.

9,000 MILES FOR A VIEW

It all came about very suddenly. Many jokes have been made about the wife who insisted on the seashore when her husband wished to spend his vacation in the mountains. In our case it was just the reverse, for I came from Colorado and my husband from the coast of Maine. Instead of arguing the matter, we planned a vacation in far-off New Zealand, where sea and mountains meet in magnificent fords hung with wind-blown waterfalls.

Since New Zealand's rugged southwest coast is practically uninhabited, we knew we must visit it in our own boat if we wished to see it thoroughly. So, to the astonishment of his associates, my husband resigned his assistant professorship at the Georgia School of Technology, Atlanta, and built a husky 37-foot craft suitable for ocean cruising (pages 34-36).

Though he had never built a boat before, the result was most satisfactory, for he is by no means the usual absent-minded professor. My small share in the construction was to putty some ten thousand nail holes!

Now, building a boat is much harder than sailing it; so, despite our lack of maritime experience, we started the long voyage from

Jacksonville to Jamaica without any keen concern for what the future held in store (map, pages 38-39). The summer squalls of the Bahamas soon taught us all we needed to know about handling canvas.

BIRDS AND FISH ENLIVEN THE LONG WATCHES

To me, a landlubber, everything was new and exciting: the scream of protest from the long-tailed boatswain-birds as they hovered over us; the swift flight of the storm petrels, or Mother Carey's chickens, that followed in our wake, just touching the water with their feet as they picked up food shaken out of the sargasso seaweed by our hull; the boobies' curiosity in our spreading canvas; or the chattering of the terns when they found a school of small fish.

Then there were always the jellyfish, which to me seem like the flowers of the sea, with their many shapes and colors. With so much interesting life near by, how could I get lonely or bored, as so many people seem to expect?

Even in my night watches, I would sometimes be surprised by a porpoise blowing close by. This was always startling until I recognized the sound, and then I would watch intently while the porpoise wove a shining ribbon of phosphorescence as it played around the boat.

ABOARD THE "TREE OF LIFE"

At Jamaica the name of our sloop, *Igdrasil*, proved a stumbling block. No one could spell it, pronounce it, or remember it! This came as a shock to us, for we had picked the name deliberately as one that was easy to spell and pronounce, and appropriate in meaning.

Igdrasil is the Tree of Life in Norse mythology, the roots running down into hell while the branches reach up to heaven. Life on a small boat is just like that, sometimes pleasant, sometimes not. Also, the end of the world comes when the tree *Ig-*



TRANSIT AND GAUGE CHART A STRAIGHT WATERLINE FOR "IGDRASIL"

Mr. Strout marks the hull accurately, guided by H. O. Bamann, engineer, who sights through the instrument. When the boat is launched the line will meet the water uniformly all around the hull. The author's part in building the little yacht was to putty some ten thousand nail holes.

drasil falls. If our *Igdrasil* goes on the rocks, it will probably be the end of our world, too.

Mountainous Jamaica seemed a perfect paradise to me. It was my first tropical island and my first port after that trying voyage of calms and squalls. I appreciated a rest and was glad to get some fresh fruit. But no one lingers long in Jamaica in late July, and we certainly were not out looking for hurricanes, so we soon up-anchored and sailed across the high trade wind seas of the Caribbean for Panama (see Atlantic Map Supplement).

It is very nice to make a strange port in the daylight, but small sailboats are unable to know the exact time of arrival and we always enter when we arrive. Frequently the best view of a city from seaward is during the night, and Cristóbal looked dressed for a carnival. There were colored lights of several hues, both fixed and flashing, occulting lights and revolving lights—a grand display. But this was no

festive mood, just the usual maze of navigational lights that help guide navigators through the Canal Zone.

I was a little frightened about the trip through the locks, but the water came in so gently that I did not notice when it started.

Everything in the Zone is built on such a uniformly huge scale that nothing appears big. Forty feet seems high when talking about it, but as our mast is that tall, and reached to the top of the walls, we did not have the feeling of being in a huge pit, as I had expected (page 37).

BLACK SQUALLS, A DOZEN A DAY

We saw the Canal Zone during the rainy season. Consequently we had no regrets when we left for sunnier days in the Galápagos Islands.

The Gulf of Panama, through which we now sailed, has a bad reputation for weather. Black arch squalls can have a fascination all their own, but when they come a dozen a day they are not wel-

come to a sailing vessel.

It was, of course, physically impossible for my husband to reef and set the big wet mainsail that many times a day, so we usually trusted to our ability to "luff them out." In such weather this is a dangerous procedure, but the boat was stoutly built and her gear was new and strong, so no damage resulted. Though there were many exciting moments under those great black arches, we suffered most from lack of sleep and the seemingly interminable rain which fell in torrents more than half of the time.

But all things end, and suddenly we emerged from the rain and mist to get our first view of the "Enchanted Isles," much higher on the horizon than they should have been, because of unusual refraction. Though they looked only five miles away, we sailed many times that distance before we reached them.

PRINTS OF HIGH-HEELED SHOES, EVEN IN THE "LONELY" GALÁPAGOS

Accounts of the Galápagos Islands had led us to believe they were desolate and barren. Barren they are, but, out of fifteen anchorages, at only one did we find no trace of previous human visitation.

At Marchena, or Bindloe, we found an Ecuadorian fishing boat catching a species



SEAMAN STROUT ALSO RATES THE TITLE OF COOK

She welcomed such a listing by immigration officials. Only when inspectors described her as "stewardess" of *Igtraxil* did she balk (p. 33). This galley, equipped with stove, sink, and table, is larger than usual for a 37-foot craft.

of rock cod. We saw several tracks of human footprints, one of them a pair of high-heeled shoes, leading to the salt pond in James Bay on San Salvador Island; at Sullivan Bay there were fresh footprints before us as we climbed the loose lava of Bartholomew Island. While we were here an American yacht and the Ecuadorians came in, making three boats in Sullivan Bay (page 40). It seemed really crowded.

The anchorage between Santa Cruz (Indefatigable) and Seymour Islands is seldom visited and we found the mockingbirds not only friendly but willing to learn new tunes. Even this anchorage we could not



FLOATING RAFTS OF WATER HYACINTHS CLOSE IN ON "IGDRASIL"

Ready for departure on her world cruise, the craft lies in the St. Johns River off Jacksonville, Florida, 20 miles from the Atlantic. The sluggish stream, three miles wide here, is choked with the orchidlike plants which cover it like a sheet of bright lavender.

have alone with the mantas and sharks, for the fishing boat soon followed us and anchored for a night.

Santa Fé (Barrington Island) is a favorite rendezvous for fishermen drying their fish, and there were many evidences of frequent visits.

We spent Christmas on Santa Cruz Island with the settlers at Academy Bay. Even that much-attempted climb to the top of Indefatigable had been accomplished before, though I believe I was the first woman to reach the crater's rim. From the right direction it is an easy trip.

At Post Office Bay on Santa María we found letters left by a sailing ship which had called just before us (page 44). There was also evidence of a thoughtless visitor who had used oil drums for rifle targets, rendering them useless for catching precious rainwater.

In Tagus Cove, Isabela Island, besides the names of previous visiting yachts painted on the rock walls, there were good footpaths to the rim of the salt pond and

cast-off clothing, some of it feminine, along the trails.

But at Elizabeth Bay in Penguin Cove we found no evidence of anyone having been there before. We were indeed alone to enjoy the scenery and the wild life. In the mangrove swamp the sea lions objected feebly to our encroachment as they slid off huge tree roots, while the marine iguanas hardly moved from their sunny spot at our approach (page 43). Even the big green turtles wouldn't swim off until we hit them with an oar.

WHALES TOO CLOSE FOR COMFORT

Unable to get drinking water, we were forced to leave these delightful islands when our supply was reduced to thirty gallons, for the next place of supply was the Marquesas Islands, 3,300 miles to the westward.*

With the steady winds in this section, the trip was apt to get tiresome. There were moments of excitement, however, as when

* All distances are given in statute miles.



LIKE AN OVERSIZED BARNACLE, "IGDRASIL" CLINGS TO A CANAL TUG.

U. S. S. *Favorite*, used by the Panama Canal Commission, dwarfs the small yacht as together they make the downward trip through one of the locks. On the upward journey the craft was controlled by lines from shore. Electric locomotives, called "mules" in honor of their stubborn predecessors on the towpaths, pull ships through the locks. One "mule" appears just above the top of *Igdrasil's* mast.



IN A HOME-BUILT SLOOP, A PROFESSOR AND HIS WIFE GIRDLE THE GLOBE

Aboard the *Igdrasil*, 37 feet overall, 14 feet beam, 5 feet draft, the author and her husband sailed from Jacksonville, Florida, in June, 1934, bound for the New Zealand Sounds. After passing through the Panama Canal, they visited the Galapagos Islands, and then pushed into the South Sea. After a pleasant cruise, enlivened by stops at remote islands, they gained their destination on the southwest coast of South Island. Then the travelers took the longest way home. They crossed the Indian Ocean, rounded the Cape of Good Hope, and scudded up the Atlantic before the trades. When they reached the United States they had been away for three years and had cruised 38,000 miles.

two finback whales came up astern. They would swim languidly along ten feet from the transom, looking us over carefully, then pass deliberately three feet to one side of the boat, smothering us with the vile odor and vapor of their blowing (page 45).

One whale touched the boat the first time they passed and did not like it; so with a mighty heave he sent the boat in one direction while he departed on the opposite course! The other one played tag with us for an hour, coming so close at times that we could easily have jumped on his back, so we got to know him quite well. He showed scars on his skin where former travelers had used him for a rifle target.

Not caring for the foul smell of his exhaust, we were glad when he decided to depart.

Neither did I enjoy having the wheel spun out of my hand when a large blackfish hit the rudder during one of my watches. While it is delightful to watch the graceful motions of the porpoises and blackfish as they leap in the air, turning about and landing with a loud splash on their backs, it is disconcerting to have so heavy a fish jumping so close (pages 46 and 48).

A porpoise once hit the rail of our boat and we could not help thinking of the damage one would do if it landed on deck!

Meanwhile, the wind was pushing us along at a steady clip and before our drink-

ing water was dangerously low we reached the Marquesas.

The native women were invariably excited when they learned there was a woman on board the *Igdrasil*, since small boats visiting the islands usually have only men aboard. On the larger yachts they had seen American women in purely decorative roles and generally wearing fancy pajamas. They had come to regard these as standard apparel in "Meniki," as they call our homeland, and so were very surprised when I came ashore in dresses.

Like all women, however, they were interested in the style of clothes and frequently I saw them indicating to one another how a collar or skirt was made.

THERE'S MANY A SWEET TOOTH IN THE MARQUESAS

All the natives like sweets. At Tahuata Island, wishing to repay some kindnesses the natives had shown us, I sent ashore some doughnuts. These created a great stir, but as usual were passed out to the children, and when I came ashore later there was a little boy asleep on the *paepae* (the stone platform on which the native house is built) with his small fingers through the hole of a doughnut!

As the natives are so fond of children, anything special in the way of food is given to them at once. At Hanaiapa on Hiva-Oa

Island I took some fudge ashore for one of the chiefs, but instead of eating it or keeping it for his own family, he passed it all out to the children.

It was the first time they had met chocolate, apparently, for they didn't know what

weaving with pandanus. I liked the design of the basket and asked her to show me how to weave one. Taupu spoke French and Marquesan, while I spoke only English, but the basket was soon started. All the women of the village knew the moment I finished it,



to do with it. After a sign that it was to be eaten, a child tentatively licked a piece; then, as realization came, a broad smile flashed across his face.

At Hana Nai Bay, on Ua-Huka, I made a frosted cake for the chief. As he lived at another bay two miles away, we had to wait for someone to take it over. The owner of the valley put the cake under lock and key and went into great detail to the messenger on how to carry this valuable gift to the chief. Baked food is very rare here, even bread being available only where there is a Chinese to bake it.

The Marquesans are extremely courteous and most appreciative of any courtesies shown them. At Taipū-Vai (Typee) on Nuku-Hiva we called on Haka Hau, the last of the Taipis. A very old man now, he was confined to his bed, but he retained the bearing of a gentleman, and his speech was pleasant in a language normally harsh, to my ear.

THE "COCONUT TELEGRAPH"

After a walk up the valley, on our return we found his wife waiting for us with drinking nuts and a large basket of papayas. This showed real thought in a gift, as the natives do not eat papayas. There are few growing in the valley, but, knowing that Americans like them, Haka Hau's wife had managed to collect them for us.

One day I saw Taupu, wife of a trader,

by that wonderful word-of-mouth relay system, the "coconut telegraph."

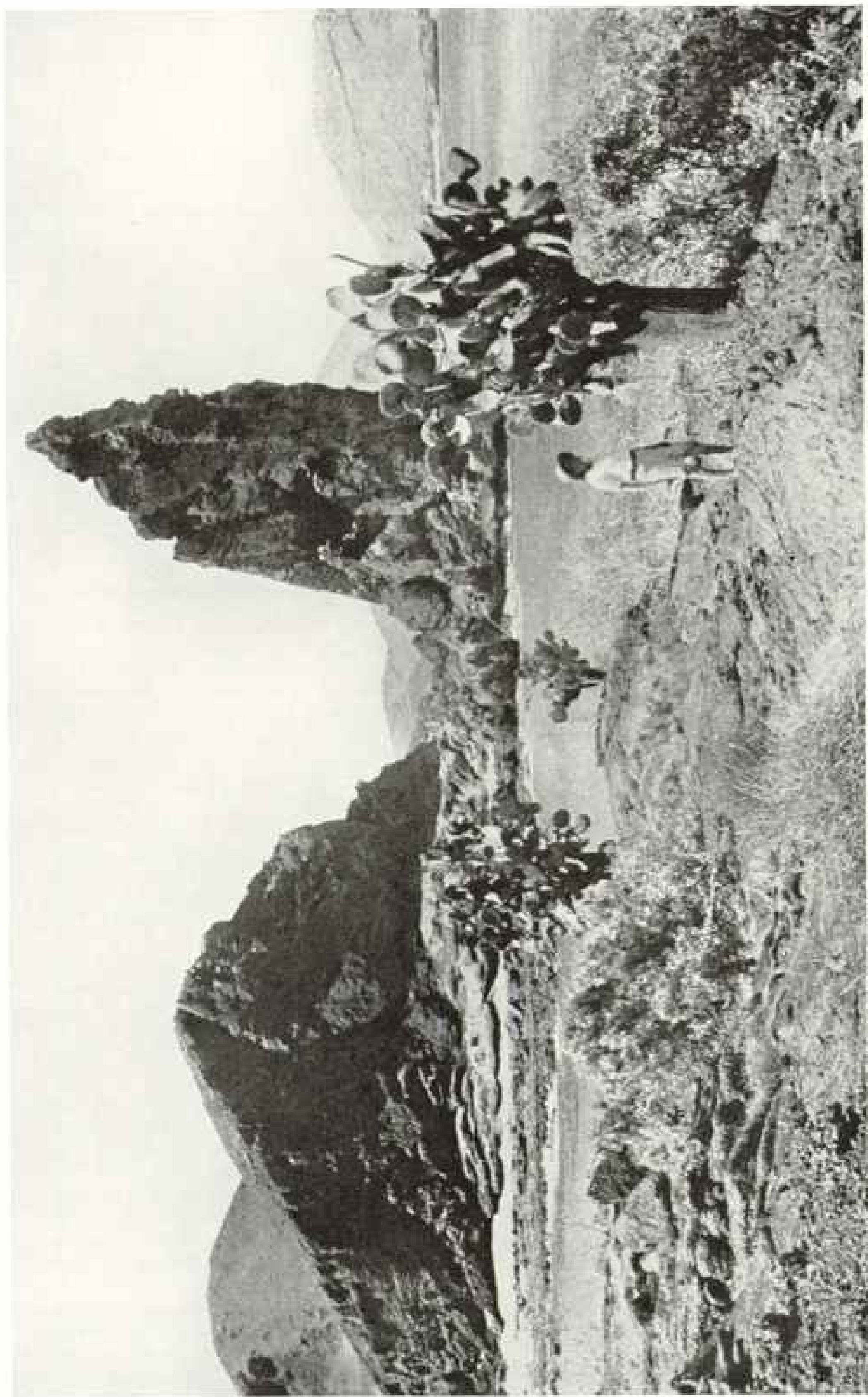
Taupu was so delighted that a white woman should be interested in her handiwork that she gave me a fine vakini palm hat which had taken her at least a week to weave (page 53).

We took long walks on all the islands, sometimes visiting a lofty waterfall at the head of a valley. Few people make the short trip up to the falls and the village where Herman Melville lived, not so much because of the heat as because of sand flies. But if one keeps on the move they don't bother too much.

Going inland, we were always taken to see *tiki*, the large stone gods which adorned the natives' old sacred places. These shrines were tabu for women, and even now few native women will go near them (page 49). Going to visit one at Tai Oa Bay, I fell from a loose rock and scraped the skin off my nose. A murmur arose among the native men: "Devil strong today."

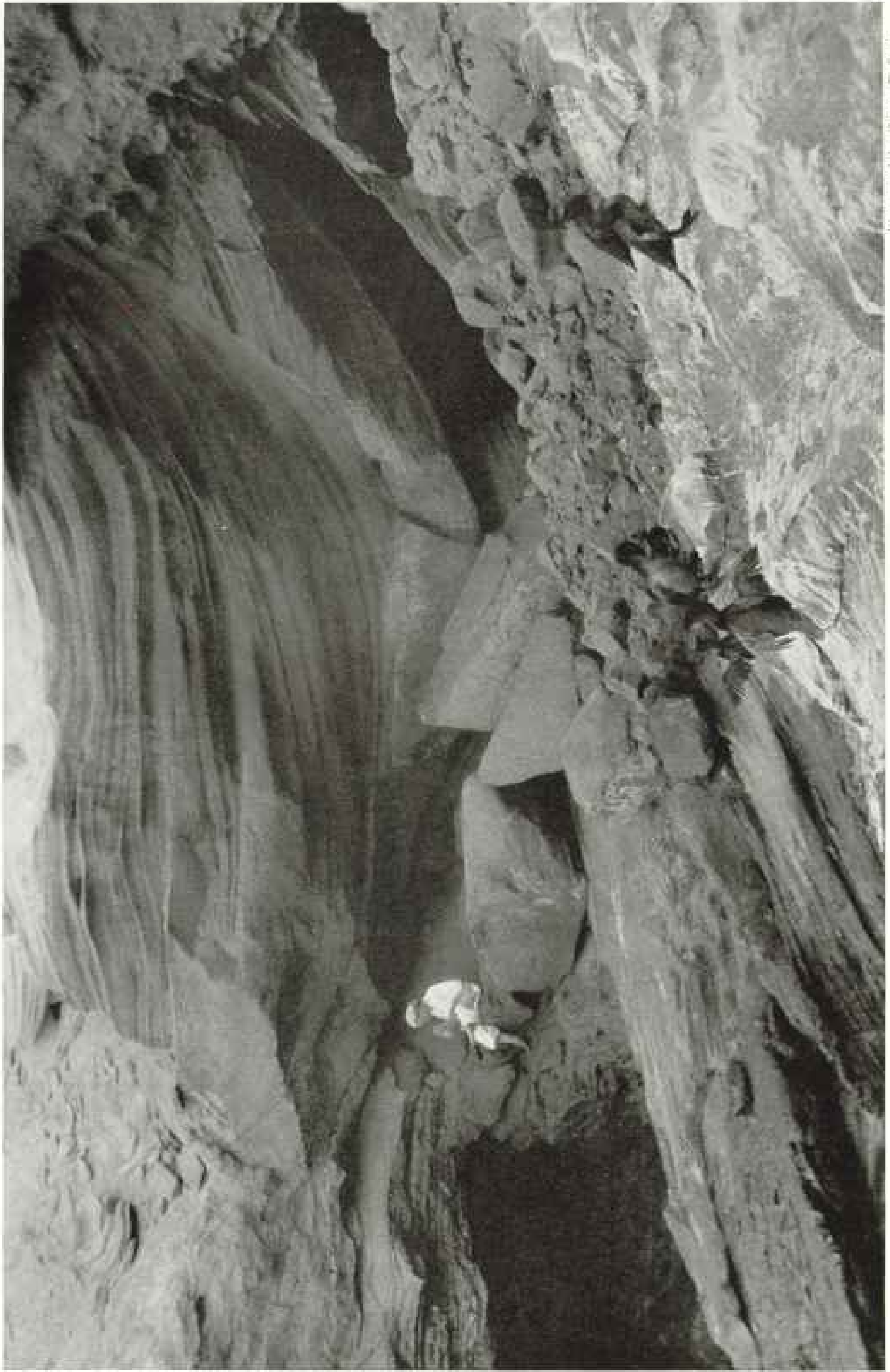
Most tropical fruits are plentiful in the Marquesas, and our diet was quite varied. Eggs, however, are difficult to obtain. The natives consider only the final result, a nice chicken to eat, and so let nature take its course.

At Haka Hetau, on Ua-Pu, the natives took a liking to our large forged salt water fishhooks, and offered a chicken or a dozen eggs for three fishhooks. We wanted eggs,



A RUINED CASTLE IN THE GALÁPAGOS ISLANDS—A LAVA PINNACLE WIND-ETCHED WITH SAND

Mrs. Strout inspects a tree cactus rising from volcanic soil near Sullivan Bay, on San Salvador (James) Island. Thousands of wild donkeys have trod a complicated network of trails across its surface. In the seventeenth century the island was the rendezvous of buccannars, who named it in honor of James I of England.



Photograph by George E. Smith

FLIGHTLESS CORMORANTS OF GALÁPAGOS ISLANDS SHOW NO FEAR OF HUMAN INTRUDERS

Since seafood is abundant and enemies few, the cormorants have little occasion to fly. Over the centuries they have become stunted until now they are virtually useless. Here in a cove on Isabela (Albemarle) Island, they permitted the visitor to approach within two or three feet before they waddled away.



IF WALLS COULD SPEAK, WOULD THESE DISCLOSE THE MYSTERY OF "THE BARONESS OF THE GALÁPAGOS?"

The author (right) chats with Mrs. Wittmer who, with her husband and two boys, settled on Santa María, or Charles Island, in 1931; they are now its sole residents. They were preceded by the German Dr. Friedrich Ritter and Frau Dore Koerwin, seekers of an idyllic tropical existence. Quiet of the island was disturbed later with the coming of the Baroness Eloise de Wagner Wehrhorn and two men companions. Constant scenes of turbulence came to a climax in March, 1934, when the Baroness and one of her friends suddenly vanished. Alfred Lorenz, the other companion, said they sailed away in a boat. They have not been seen since. Lorenz perished later of thirst and hunger on an island to the north. Dr. Ritter died and Frau Koerwin returned to Germany.

so all the children in the village started following the hens, waiting for them to lay. As soon as they had collected four eggs, they brought them out, still warm, to get their fishhook.

WHITE "CANNIBALS" INSPIRE FEAR

Instead of the admonition that "the policeman will get you," the Marquesans vary it for their children by telling them that "the white man will get you." At Haka Hetau we took the big camera ashore to make pictures of the pinnacles which grace this lovely island, and, while we were waiting for the clouds to lift, the older boys started teasing their younger brothers by telling them that we would cut them up, pack them in the camera case, and take them back to America. This started the children crying and off they ran.

I tried to quiet a little girl one day by giving her a doughnut. Curiosity overcame her fear for a while, but when I tried to explain

by signs that the doughnut was good to eat, the child thought I was going to eat *her*, and so became more frightened than before!

Throughout the islands we had heard through the coconut telegraph that the "man who knew the war business fine" wished us to stop and visit with him. The natives' description aroused our curiosity. Stopping at Hikeu Bay, we found living there an American ex-Navy enlisted man who welcomed fellow countrymen and appreciated news of home.

Sailing on, we reached Manihi in the Tuamotus, which I shall always remember for the politeness of its citizens. The natives had asked to come aboard to see the boat. While they were on board, my bread had risen and was ready for the oven, so I started the fire. Instantly everyone, even the children, left. To them the fire meant cooking and if they stayed I would have to offer them some of the food to be polite. To stay, they believed, would be begging.



TWO SUSPICIOUS SEA IGUANAS SCRAMBLE ASHORE AS THE AUTHOR APPROACHES.

Though alarmed as Mrs. Strout visits them on Isabela (Albemarle) Island, they will not retreat inland, for they always stay close to the water. Galápagos iguanas are the only lizards in the world that live in the sea. When they swim they keep their legs tight against their sides and propel themselves by snake-like wriggles of tails and bodies. Only their heads are visible above water. Charles Darwin described these strange creatures a century ago.

Though we remained only a few hours, we left with gifts of shell, coconuts, and chickens, while the natives enjoyed our large mangoes.

With the Tuamotus behind us we encountered the sudden change in weather characteristic of this region. The trades were fickle and sometimes a dozen small rain squalls would be in sight at once. This meant slow progress and hard work for my husband handling canvas. To make matters worse in the calms, a long heavy swell was rolling up from some disturbance in the far south.

We stopped at Tahiti only long enough to collect mail, then left for Mooréa and the beautiful Leeward group of the Society Islands. The largest of these, Raiatea, presented a rugged outline from the sea and the native thatch-roofed villages looked most attractive as we coasted along the edge of the reef. But close inspection detracted so much from the beauty of the houses that we soon left for Bora-Bora, a tiny island consisting entirely of one massive mountain encircled by a narrow and comparatively

level strip of land upon which the inhabitants live.

The southeast trade winds are supposed to blow between Bora-Bora and Samoa, but we had days of calm which for once we appreciated, since they gave us a chance to recover from serious colds contracted in Bora-Bora.

A BLOW IN THE DARK

After the calms came first a southwest and then a southeast gale. During one of these howling black nights, while intently watching the compass and trying to keep the rain from running down my neck, I received a sudden hard blow on my arm.

A shout from me brought "the captain" on deck to start investigations. The flashlight disclosed a large flying fish, dead of a broken vertebra! Laughable when it was all over, but I don't delight in hard blows from some unseen foe.

There is always a fascination about entering a strange port at night. We have put into many in the dark, but of them all Pago Pago Harbor will be remembered



LOOKING FOR WESTBOUND MAIL IN THE BARREL POST OFFICE

Craft calling irregularly in the Galápagos collect letters left in the crude "mail box." Usually few are found. On this occasion Mrs. Strout discovered two handfuls because a sailing ship had passed a few days before and the crew had deposited letters. *Igdraal* picked up the mail addressed to places on her course.

longest. I am not a lover of corrugated-iron roofs, but here they were objects of beauty, as their aluminum-painted surfaces reflected the moonlight, diamondlike, while the dark-green background took on a velvety appearance.

Generations of tribal customs have bred in the Samoans an attitude of community ownership, which, naturally enough, sometimes clashed with our viewpoint. They would swarm aboard the boat, never thinking to ask permission first, and stay indefinitely. When we went ashore, they would frequently borrow our dinghy to row out and look the boat over. This was in marked

contrast to the other Polynesian islands we had visited, where the natives made a detour around the boat when we were not aboard.

In American Samoa the native has been encouraged to retain his customs and arts, but contact with civilization makes some startling contrasts. We watched a wedding procession one day. The bride was dressed in a white satin gown with long sleeves and a long white tulle veil held up by two little flower girls, also in white satin. All the bridesmaids were dressed in white. The clothes would have looked appropriate in any American town, but not one of the girls wore shoes!

We were anchored off the *malae*, the market place of the

Station, and could watch at leisure as the natives arrived on steamer days to display their goods. They came in long boats pulling anything up to thirty oars, and always with some small child in the bow setting the stroke by drumming on an oil tin (page 52).

WATER'S FINE, BUT NOT THE SHARKS!

After we left Apia, the trade winds failed us again and for three days we drifted about in calms and light airs with Savaii in sight to the northwest.

During the blistering heat of these calms, the water alongside looked tempting for a



"OH, FOR A SAIL!" CRIES THE "MAROONED" SKIPPER

Mr. Strout could not resist playing Robinson Crusoe when he saw this sentinel palm overlooking the sea on a rocky islet off the southwestern side of Moala. This island is one of the small outposts of the Fiji Archipelago in the South Sea.



A WHALE WITH HALITOSIS COMES TOO CLOSE FOR COMFORT!

Playing tag with *Hydroail* for an hour, as the craft headed for the Marquesas, the monster came so close the author could have leaped on its back. When alongside it blew lustily, almost smothering Mr. and Mrs. Strout with vile vapor. The whale's companion touched the boat the first time it swam by. Becoming displeased, it pushed the yacht away with a mighty heave (page 38).



"WALKING ON ITS TAIL," A PORPOISE TURNS FLIP-FLOP IN THE AIR

These playful, bottlenosed fellows, some of them 12 feet long, swarmed about *Igdrasil* as she headed into the South Pacific. Often these mammals weigh up to 400 pounds. The foam at lower left is the wake of the yacht.



TAKING OFF ON A FULL STOMACH IS TOO MUCH FOR THIS ALBATROSS

After gorging itself, the bird tries vainly to fly away as the yacht pursues it in a stretch of the South Sea. Chumily the big fellow bounces over the water. Even with its great wing spread, it could not sail aloft until it had disgorged its dinner.

swim, but the sharks were too numerous. Other small-boat travelers have gone over the side for a daily swim and lived to tell about it, but we saw too many sharks, in the South Pacific at least, to tempt me to follow their example.

Sometimes at night a shimmering blob of phosphorescence fifty feet astern showed where a lone hunter followed us, patiently waiting. It always gave me an eerie feeling.

At other times half a dozen ten- or twelve-foot brutes would play around, just under the transom. Sometimes they would try to rub off parasites by scraping along the bilge of the boat, much to the detriment of the bottom paint. Then my husband would shoot them at a range of three feet with the .45-caliber service pistol. Though they often sank, trailing blood and mortally wounded, the others did not attack them.

These memories are too vivid for me to wish to swim offshore in the open ocean.

Finally the wind came and we bore away for Niuafoō, so-called "Tin Can Island," expecting to make it the next morning. But the wind freshened steadily and by midnight a slightly denser blob of shadow in the general darkness ahead told us that we were almost on top of the island. We had to change course to avoid it.

The landfall did not come as a surprise,



THE HELMSMAN TAKES IT EASY ON A GLASSY SEA

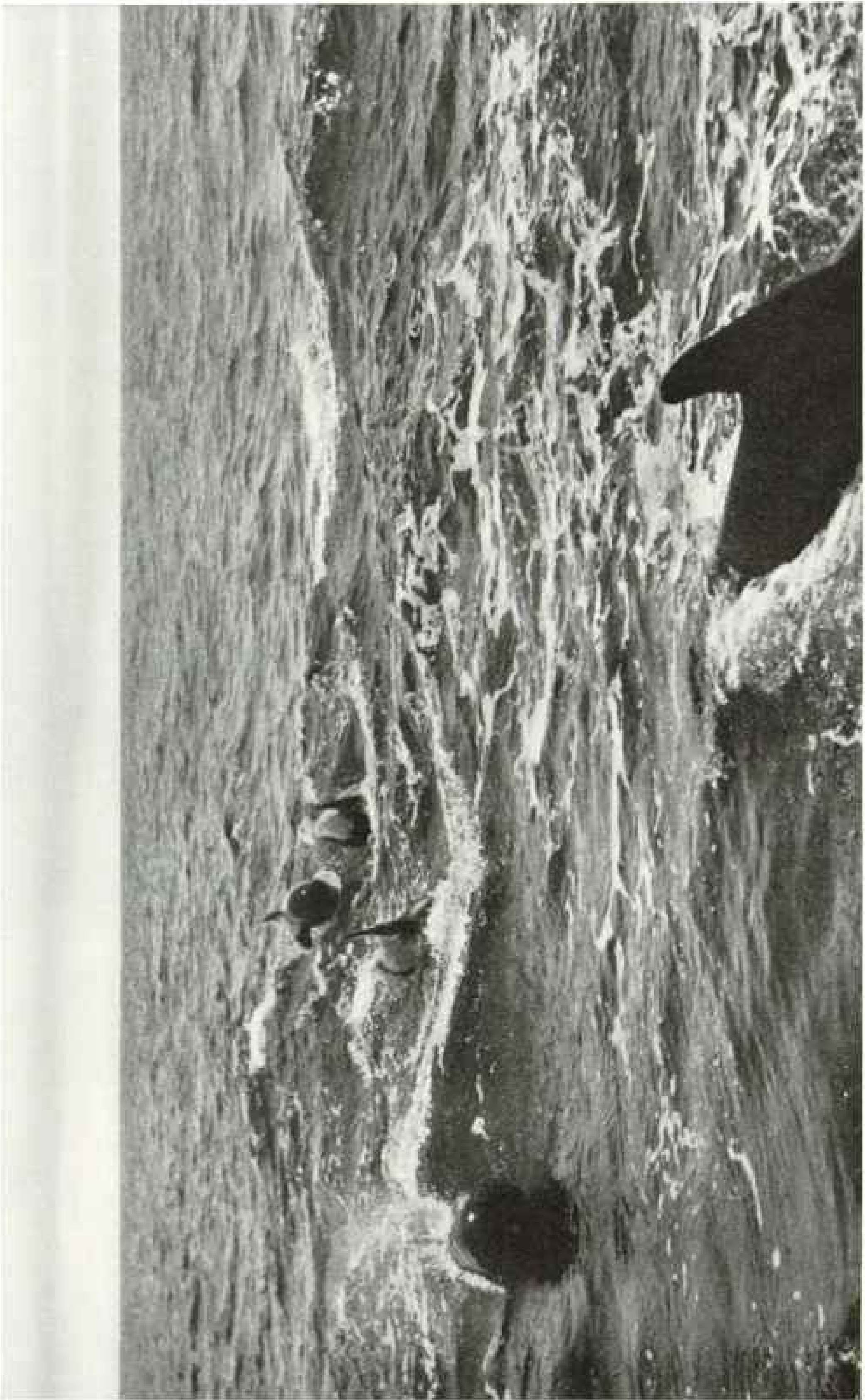
During light weather on the cruise to New Zealand, even the tortoises in their pen behind the wheel find sailing smooth. These pets were acquired in the Galápagos. To the right of the author a piece of canvas protects the diaphragm bilge pump, fortunately not needed on the voyage.

for we had been smelling the island for hours. It was smoke that we smelled, but whether from fires or from the volcano on the island we could not tell.*

In Fiji I again fell back on candy for trade goods with the children. I wanted some sea shells, and soon found that their quick eyes could find them better than mine. They brought me all I wanted.

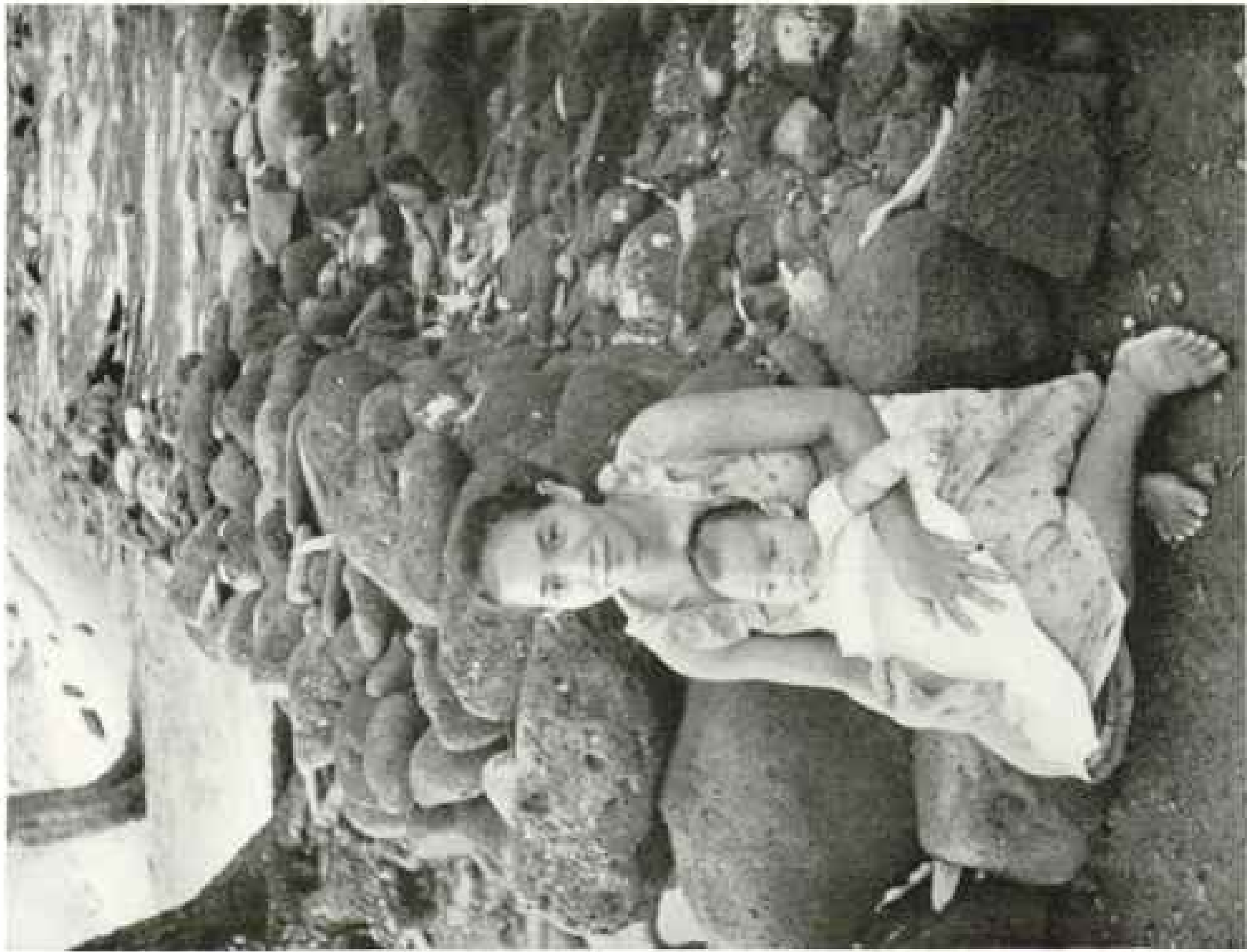
We had difficulty in obtaining food at any of the islands in the Fiji group until we hit upon the particular thing the natives

* See "Living on a Volcano," by Thomas A. Jaggar, NATIONAL GEOGRAPHIC MAGAZINE, July, 1935.



BIG BLACKFISH ROMP ABOUT "IGDRASIL" AS SHE CRUISES THROUGH SOUTHERN WATERS

One of the sportive mammals once hit the rudder with terrific force while the author was on watch in the South Pacific. The wheel spun around, knocking her hand away (page 38). Blackfish sometimes attain a length of 28 feet and weigh as much as one and a half tons.



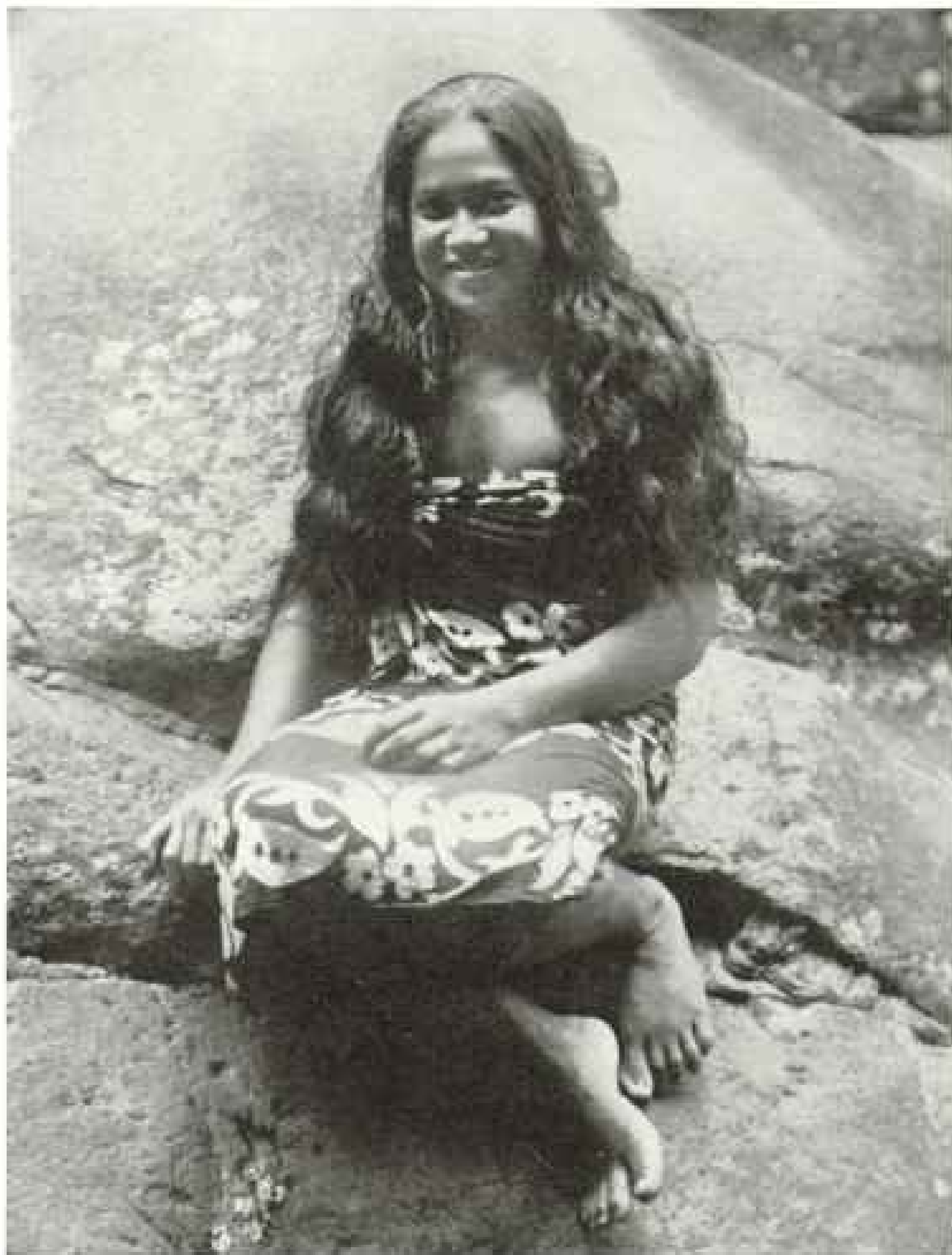
MARQUESANS ASKED FOR PICTURES OF THEIR CHILDREN

Photographs replaced the old-time beads and trinkets as a medium of barter. Parental affection was marked. When the author gave a Hanaiapa chief some fudge, he immediately passed it all out to grinning youngsters (page 38).



MRS. STROUT LINGERS IN MELVILLE'S VALE OF "TYTEE"

An old stone god conjures memories of the author of *Moby Dick*, who dwelt in this paradise on Nuku-Hiva. The American writer described in *Typee* his life in the jungle Eden with cannibal captives and the lovely Fayaway.



POOR SHRIMPS CAN'T RESIST HER!

Netting fresh-water shrimps is a specialty of this Marquesan beauty. When asked to pose, she hurriedly let her hair down.

wanted most. At Ngau they wanted their photographs, and brought us all the food we needed. We could always get food with pictures, but because of the limited water supply carried and the amount needed for developing and printing, we preferred other means of barter.

NATIVES PRIZE THE "GEOGRAPHIC"

At Moala the natives all wanted to learn English and magazines were highly prized, worth more than money, particularly the NATIONAL GEOGRAPHIC because of its illustrations in color.

At Matuku we tried for a week to purchase bananas, but without avail until

I showed some women a velvet jacket. It appeared to be the first velvet they had ever seen. When word was circulated that we had women's clothes for trade, more than 800 pounds of fruit and vegetables were loaded on board before 8 o'clock the next morning!

Here in Fiji the natives varied the usual question and, instead of asking if we were married, they asked if I were Mr. Strout's sister. This puzzled us until we discovered that the Fijian girls of my size were much below marriageable age. Just as child marriages in India shock us, I suspect we shocked the Fijians!

In October we left for New Zealand, with "Mothé" (sleep), the Fijian good-by, coming again and again from the tree-covered hills.

One of New Zealand's frequent barometric depressions greeted us as we approached the Dominion* and for some hours we lay hove-to under the close-reefed mainsail. It blew so hard it seemed likely that the sail, now getting old, might blow out and a sea anchor was made ready to meet that possible contingency. But the many weary hours spent with palm (the sailor's "thimble") and needle in Fiji paid good dividends here, for nothing let go.

*See "New Zealand 'Down Under,'" by W. Robert Moore, NATIONAL GEOGRAPHIC MAGAZINE, February, 1936.

The weather was still thick when we made a landfall on Cape Brett, but soon, between the rain squalls, we could make out sheep farms which, from a distance at sea, looked like well-kept lawns of country estates.

We were now within seven hundred miles, air line, of the objective of our whole cruise, the west coast Sounds, which we had sailed more than a third of the way around the world to see.

Located on the southwest coast of the South Island of New Zealand, the Sounds, or fiords, were carved out of the Southern Alps partly by previous glaciers. Narrow, winding ribbons of water between very steep and high mountains, they vary from a half to two miles wide and sometimes extend inland for twenty miles.

A hundred and sixty-odd years ago Captain Cook, finding in Dusky Sound what he considered good harbors and a thick stand of trees "suitable for masts," prophesied that it would become the site of a large and thriving city. But the boisterous weather and exceedingly rocky and mountainous country all around have defied attempts at settlement, and one finds the Sounds today almost as peaceful and uninhabited as when first discovered. As the excursion steamers stop only for a few hours at Milford Sound, it is necessary to go in your own vessel if you wish to see the other twelve Sounds thoroughly.

IN THE "ROARING FORTIES"

Being so near our goal, we begrudged the time necessarily spent in Auckland making a new suit of sails and changing the rig of the boat from sloop to ketch. The ketch rig, however, made the boat easier to handle in the more boisterous weather of the "roaring forties" (page 60).

As the season advanced and our impatience increased, we decided to go the shortest but roughest route and headed north out of Auckland to round North Cape and sail directly down the Tasman Sea to the Sounds (map, pages 38-39).

We stopped at the Bay of Islands, for this bay of smooth waterways is too tempting for any yachtsman to pass. We left it by moonlight which silvered the scene as we glided silently along this bold coast.

After a short stop at Whangaroa, with its fantastic rock formations, we had a look into the arm where, 130 years ago, the British ship *Boyd* was burned.

Sailing on toward North Cape, we wondered whether we should meet with the same bad luck that befell Captain Cook when he was rounding this rocky point. Head winds, calms, and currents delayed him for ten days.

A FULL-RIGGED GHOST OF THE PAST

As we neared North Cape, our attention was attracted to what I at first thought was a large off-lying rock. Actually we soon made it out as a ship under full sail (page 62). We passed her off Parengarenga Harbour at sunset and she proved to be the ship *Joseph Conrad*.*

All of her crew were lined up on the fore-castle to look us over. Apparently a small vessel flying the American flag was as strange to them off these sand dunes as they were to us. My dream of passing a full-rigged ship at sea was at last realized.

Cape Maria Van Diemen, the northwestern point of New Zealand, had the appearance of having been just newly finished by the Creator, and though some might call it barren, to us it was beautiful. Here, however, we felt the full surge of the long southwest swell of the Tasman, as we were out of the lee of New Zealand.

We shaped our course for Milford Sound, running the length of the Tasman with the usual summer weather while the barometer fluctuated from high to low in quick succession. After a hard southeast gale, which, being an offshore wind, blows the clouds to sea, we got our first glimpse of the Southern Alps, sighting Mount Aspiring and Pembroke Peak, the landfall for Milford Sound.

WATERFALLS THAT BLOW AWAY

It was night when we finally made the entrance to Milford Sound, and cautiously felt our way into Anita Bay. As in most of the anchorages in the Sounds, the bottom slopes so steeply that an anchor will not hold with offshore winds. Since any possible anchorage depth is very near the shore, a hook is dropped, then a line from the stern is made fast to a rock or large tree (page 64). By the time our anchor touched bottom we seemed directly under the trees and within jumping distance of the rocks.

In the morning fog came rolling rapidly in from the sea and soon a nasty squall shut off everything from view. Naturally

* See "North About," by Alan J. Villiers, in the NATIONAL GEOGRAPHIC MAGAZINE, February, 1937.



DRUMMING ON A CAN, A SMALL BOY IN THE BOW SETS THE STROKE

Samoaan longboats are copied after the trim craft which carried landing parties from British ships to the islands, nearly a century ago.



MAN'S PLACE IS IN THE KITCHEN IN THE MARQUESAS

Husbands do most of the cooking. The islander at right pounds roasted breadfruit spread on the board before him with a stone pestle. He dips his left hand into a bucket for water to moisten the mixture. His helper is peeling an additional supply. Breadfruit is eaten as a pasty mass. At least thirty-two varieties of this staff of life grow on the islands.

we wanted fine weather for seeing the mountains, but the spectacle of rugged peaks coming out of the clouds was well worth viewing. Besides, the high hillsides suddenly blossomed out with waterfalls all over. The mountainsides are so steep that during rains many high ribbons of water fall directly into the sea. Some of the high ones never meet the sea, for the strong wind blows the water away into mist before it reaches the foot.

The Sounds are as famous for their bad weather as they are for their beauty, and we had both a southeast and a northwest gale during the short time we were in Milford.

But in any of the Sounds a gale, besides causing extra work in putting out more lines ashore to moor the boat securely, is a beautiful sight. The wind sweeps over some high mountain, hits the high walls of another on the far side of the sound, and swirls down into the cove, lifting the surface of the water in great white sheets and throwing it around the landscape.

Waterfalls are blown from their regular drop, causing the hillsides to sparkle as the sun shines on the spray. If rain accompanies the gale, it is a game to see who can find the most new waterfalls.

Weather conditions along this coast were such that it was best for us to leave the



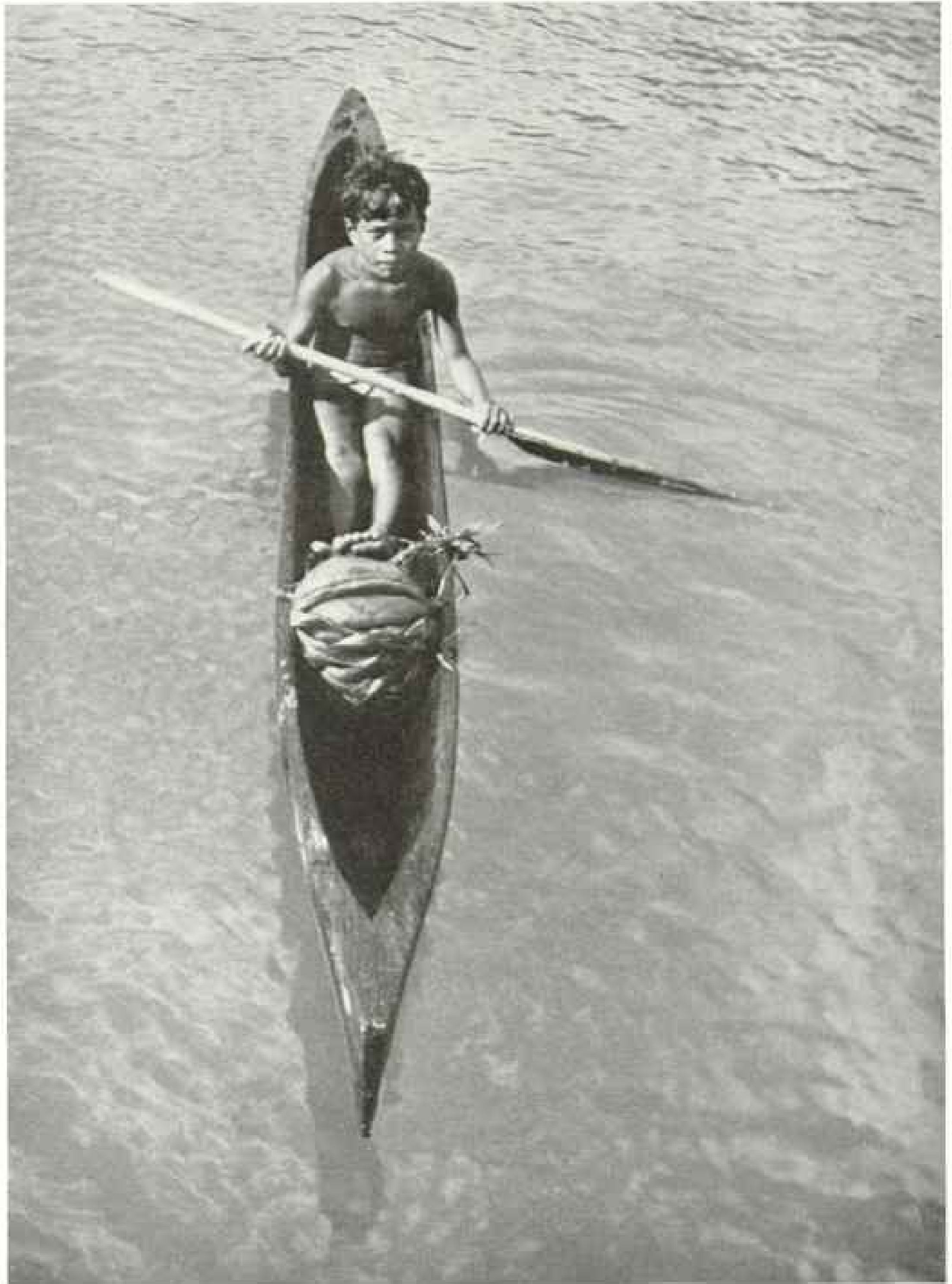
TAUPU MUST WEAVE FOR A WEEK TO MAKE A FINE HAT

The author, impressed by the skill of this Marquesan woman, asked to learn the art. So pleased was the weaver that she gave Mrs. Strout her masterpiece as a present (page 39). Islanders seldom sit cross-legged, preferring to stretch out comfortably on the floor.

Sounds during the night, and arrive off the entrance to the next one in the early morning. Offhand, it would seem wrong to go down such a beautiful coast at night, but the mountains show up clearly in the moonlight, which lays a new and different emphasis upon each glacier, ridge, and valley.

At Charles Sound we noticed that the trees at the entrance all grew inward toward the land, testifying to the force and constancy of the wind along this coast.

We were thankful for the fine weather as we anchored in Daggs Sound, remembering that in 1851 Commander G. H. Richards, of the British naval survey vessel *Acheron*,



"NEED ANY PAPAYAS TODAY?"

Serious mien changed to broad smile when the lad disposed of his basket of tropical fruit to the yacht. He received a biscuit tin and some candy in payment and paddled rapidly back to the village. He tramped down the main street, drumming on the tin, while his envious playfellows trooped after him. Ancestors of this Bora-Bora Island boy traded in this manner with Captain Cook.

had recorded here "a remarkable scene."

"Our anchorage," he wrote, "was at the head of the northern arm, 200 yards from shore, in 12 fathoms; the change of the moon brought a northwest gale, with heavy rain, and in the course of a few hours no less than 14 magnificent cascades were pouring down the steep sides of the mountains (upwards of 3,000 feet high), by which we were surrounded, bringing with them trees of considerable size and all other obstructions met with in their passage.

"The effect was as if a heavy surf was breaking round the vessel; the mist, floating as low as our mastheads, occasionally obscured everything but the summits of the mountains and the foam below, and produced altogether a scene as grand as it is possible to conceive, which lasted without abating in any degree for two days, when the water alongside, which had been as salt as the ocean, was for a considerable depth below the surface perfectly fresh."

MAP IS DOTTED WITH GRAPHIC NAMES

One look at the names on the chart and you know Captain Cook passed this way. There are Dusky Sound, Anchor Island, Facile Harbour, Duck Cove, Luncheon Cove, Supper Cove, Nine Fathom Passage, Cascade Cove, Wet Jacket Arm, Beach Harbour, Breaksea Island, Broke-adrift Passage, Cast-off Point, Towing Head, and so on indefinitely.

All over New Zealand, but particularly around the southern Sounds, the names are descriptive of the character of the mountains or sea, or of incidents of their exploration. It takes little imagination to reconstruct the path of the early navigators and what they found, even without their journals as a guide. And what delight just to read the names on the map, even if one cannot visit the places!

We passed Breaksea Island on such a calm day that it did not deserve its name, then proceeded up Breaksea Sound. Only the wake of our small craft, and the occasional flight of wild ducks or black swans, broke the surface of the still waters. Next day we went through the passage that connects Breaksea and Dusky Sounds. By using our small auxiliary motor we made in five hours a trip which took Captain Cook in the *Resolution* eight days under sail and tow.

At Pickersgill Harbour in Dusky Sound we saw many fish, nice fat blue cod, swimming lazily among the kelp, though we

didn't want a couple of boats full, as had some of the early explorers.

SAND FLIES WORSE THAN "FIFTY ANIMAL"

As for the sand flies, the description given by a member of Vancouver's expedition is still accurate:

A sand fly annoy'd us more than perhaps fifty animal wou'd: for no sooner did we set our feet on shore than we were covered with these flies, and their sting is as painful as that of a Musquitto, and made us scratch as if we had got the itch; indeed, one of my legs became so much swell'd by this means that I was forced to apply a poultice to it, and was lame for two or three days.

Knowing about them in advance, we suffered no casualties, though we were glad to be on the water instead of camping.

Since the weather was getting worse, we took the *Igdraail* into a very small nook on the west side of Crayfish Island. The anchorages in these Sounds are so few that one gets into some rather astonishing places. Here we had rock walls on either side only ten feet away and but little more astern, while the opening faced into the main cove. Once we were securely tied in this snug little hole, the gale whistled overhead unheeded.

Leaving Dusky Sound, we soon picked up the blink of Puysegur Light on the low-lying clouds. All night we were able to see either the blink or the light itself and keep our bearings on it. It is the only light on this coast. What a consoling and cheerful sight it was to me as I realized that here at last were some people!

Balleny Reef was breaking heavily as we took the narrow passage between it and Gulches Head, off which there are many rocks. All along this coast the major points have off-lying pinnacles and spires on which the sea breaks heavily. To a person on shore it looks beautiful, but to a mariner it looks like a graveyard done in brown. Strangely, there have been comparatively few wrecks on this coast, perhaps because everyone who can keeps severely away.

We decided to drop in on the lonely keepers, and as no day watch is kept at the light, we were not seen as we entered Preservation Inlet. At the radio operator's residence we whistled CQ, the call to all stations.

"Come in," said a voice, and we entered.

The operator had thought it was one of his two fellow lighthouse keepers and was amazed to see two strangers walk in. For



FIJI ISLANDERS NOW GO TO CHURCH WHEN THE TRIBAL DRUMS SOUND

The resonant thump produced by beating the stick on the hollowed trunk carries far. Once it called the warriors to pagan rites, but today most of the inhabitants are Christians. Such drums are commonplace on most of the 250 islands in this South Sea group.

three months he had not seen a soul from the outside world.

At leisurely pace we made our way up the sound until it terminated abruptly at the foot of a waterfall. In this perfectly protected spot we listened to the ringing notes of the bellbird and the scolding of the fantail.

WEASELS TAKE TOLL OF BIRDS

Rowing into the bordering swamps, we could watch the young ducks swimming near by, see the pigeons flying overhead, and, if lucky, sight a weka, for this region is one of the last stands of the many native New Zealand birds. The flightless ones, particularly, are disappearing before the onslaughts of the weasel, imported to curb rodents.

In such a peaceful, quiet setting, who would believe that only twenty miles away, at the entrance to the sound, a hard gale was blowing? Only the swiftly moving clouds gave any indication of wind.

We were in the Sounds in late March, when it is cold in these latitudes, and the snow was creeping down on the hillsides. When we had frost on the sails twice and

the snow was at times within a thousand feet of the water, we left our snug anchorage so far inland for a very wet and cold run through Foveaux Strait.

Of course we had seen albatrosses all along New Zealand, but around Stewart Island there were several species following the boat at all times. Like the South Sea islanders, who can't understand a boat that isn't trading, these albatrosses couldn't understand a boat that didn't dispense fish scraps. Even the species called the shy albatross would come close, expecting to be fed.

We spent a day at Oban, Stewart Island, and would have liked to linger in Paterson Inlet, but a spell of good weather at this time of the year was too tempting to a sailor, so we crossed the usually rough Foveaux Strait to Bluff. The town here is really Campbelltown, but sailors have always referred to the port as "The Bluff" because of its prominent landmark, so that now even letters bear that postmark.

The Bluff has a reputation for wind, and it demonstrated its claim to this before we left, blowing so hard that a 9,000-ton steamer at the same pier with us let go both



FIJI TOY BOATS PUT OUT TO SEA, NEVER TO RETURN

Hibiscus branches are the hulls, coconut fronds the sails. The frail craft, traveling with the wind, forge across the lagoon and away. Dark eyes watch intently until the canoes disappear.

anchors to bring up with, in case all her dock lines parted!

The coast from Bluff to Dunedin seemed as desolate and uninhabited as the west coast, for not once did we see any sign of human habitation other than two light-houses. Winter was howling up from the southward, and as this was supposed to be a pleasure cruise, we were hurrying north. So we made short stops in Dunedin, Lyttelton, and Wellington, but such was the hospitality of these cities that we made many friends in each.

"LET'S GO ON AROUND THE WORLD"

This was the turning point of the voyage. For nearly two years the New Zealand Sounds had been before us as the objective of the cruise. Now they were behind and we had to come home. Which way should it be, back across the Pacific or around the Cape of Good Hope and up the Atlantic?

Though many thousands of miles longer, the latter route is probably the easier and pleasanter, so we continued on around the world.

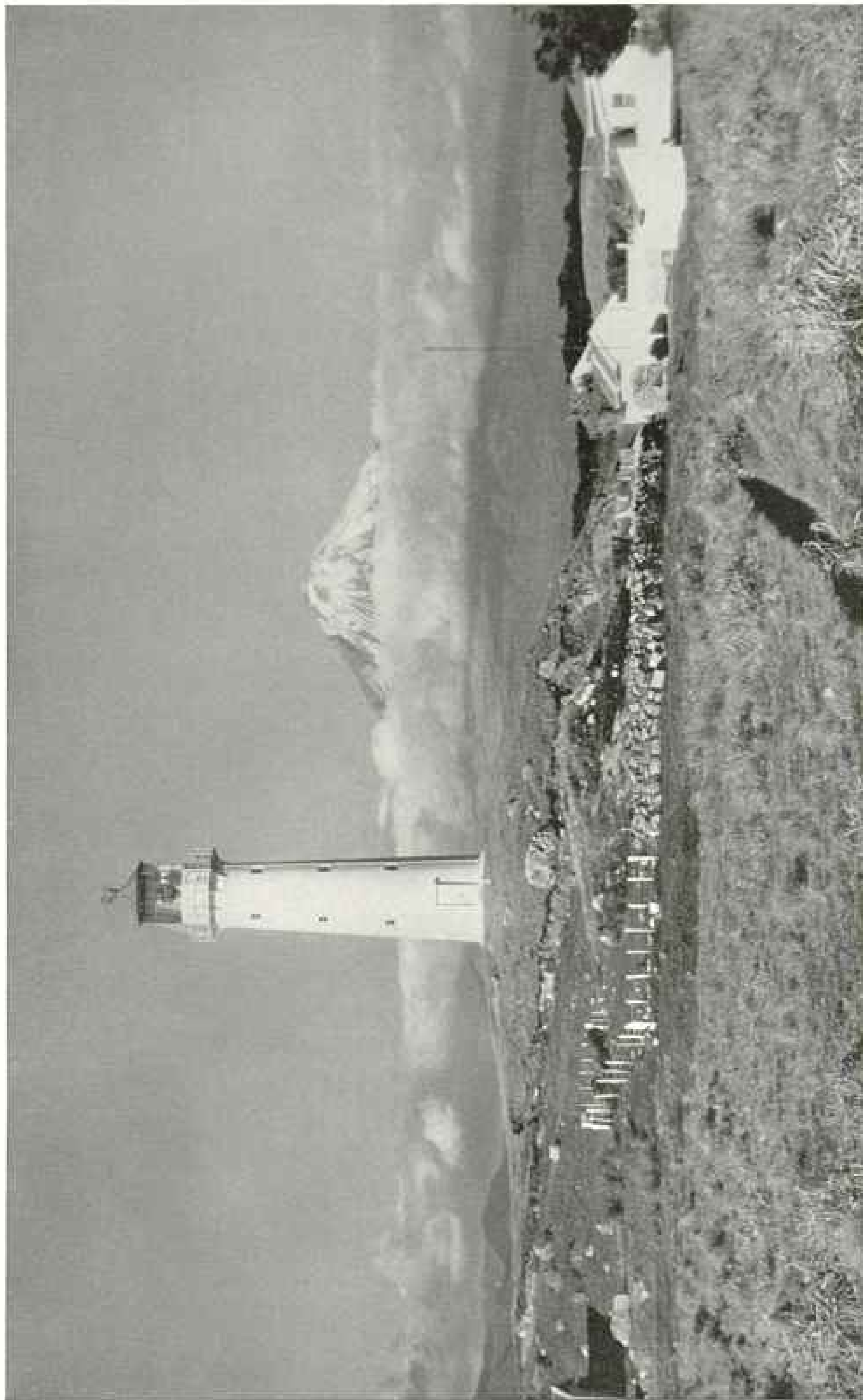
My husband was somewhat reluctant to do this, for ever since the keel of the ship had been laid, newspaper reporters had

annoyed him by writing of us as "round the world voyagers." To his logical mind circumnavigation ceased to be a legitimate objective for a cruise when Magellan proved it could be done. After that it was merely a trivial incident, which might occur with anyone in the course of more interesting activities.

Wellington got a first-class storm while we were there, making a sixty-year-record barometric low, but we hardly felt it, tucked away in the most protected spot the harbormaster could find for us. In the calm following this storm we passed through Cook Strait and started across the Tasman Sea for Brisbane.

The Tasman Sea lived up to its evil reputation by developing a cyclone west of Norfolk when we were heading for that island. We changed course to avoid it, but even so *Igdrasil* took quite a beating.

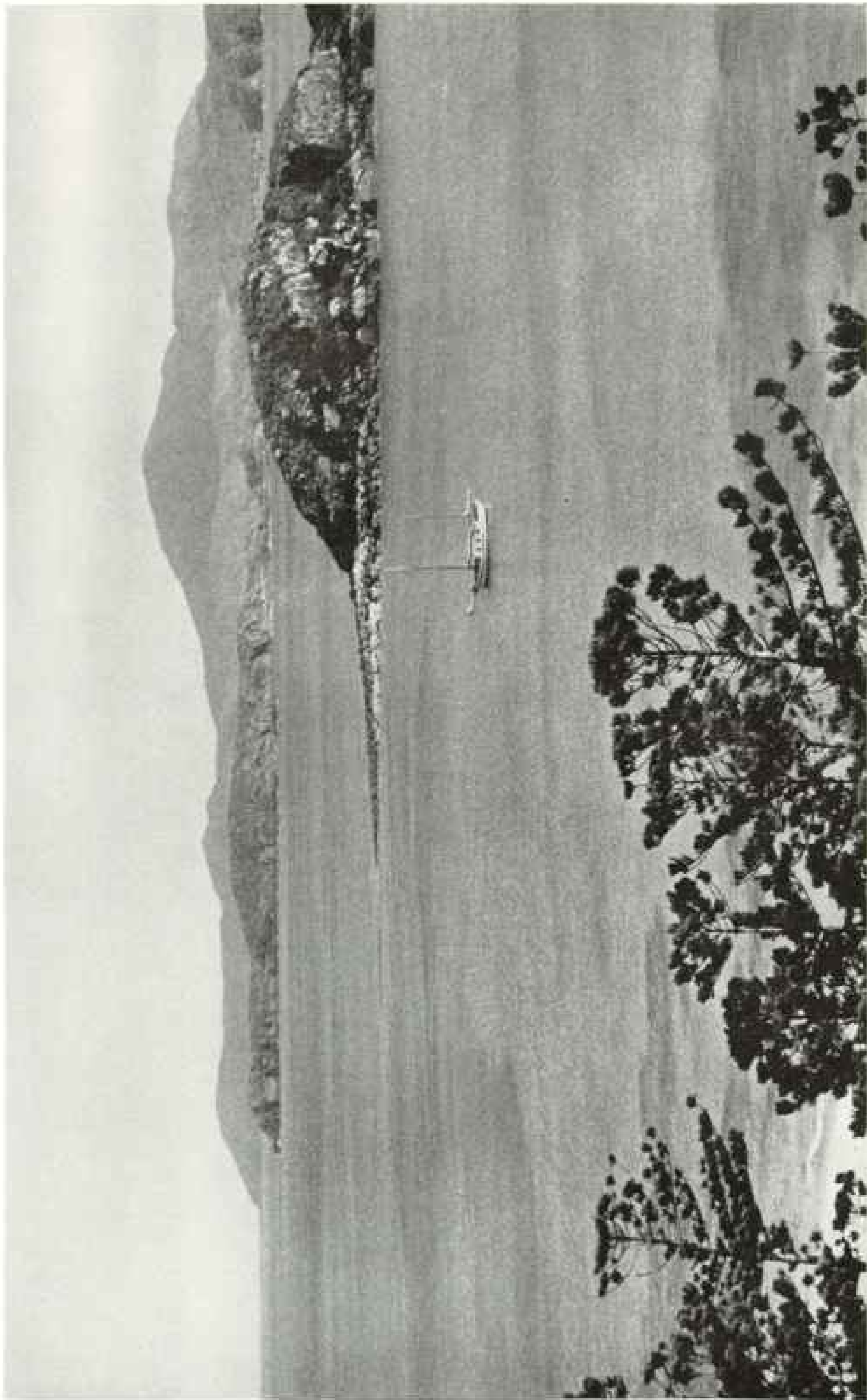
My usual wheel watch is three hours, though I have, in light weather, stayed at that post for as long as eight hours. Running in this storm, however, the steering was so hard as to be utterly beyond my strength. This put a greater load on my husband, who fought that bucking wheel continuously for thirteen hours on one



Photograph courtesy New Zealand Government

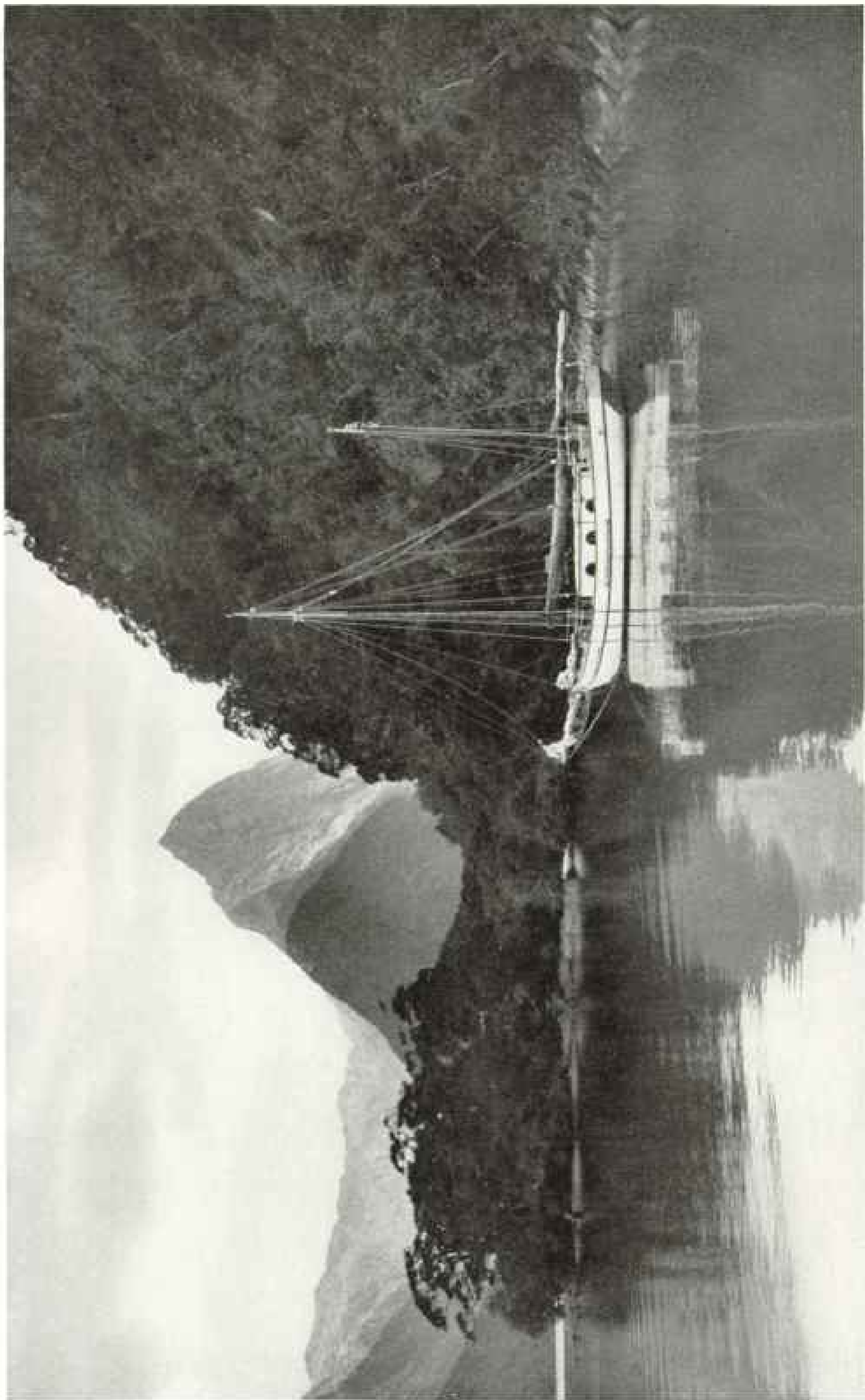
EVEN MAJESTIC MOUNT EDMOND DIMMED IN GRANDEUR AS "IGORASIL," BECALMED, LAY WITHIN SIGHT FOR FIVE DAYS

Close to the western shore of North Island, New Zealand, the slumbering volcano towers 8,260 feet above the sea. Three other peaks rise farther inland. The lighthouse stands near one end of Cook Strait, which divides New Zealand into North and South Islands.



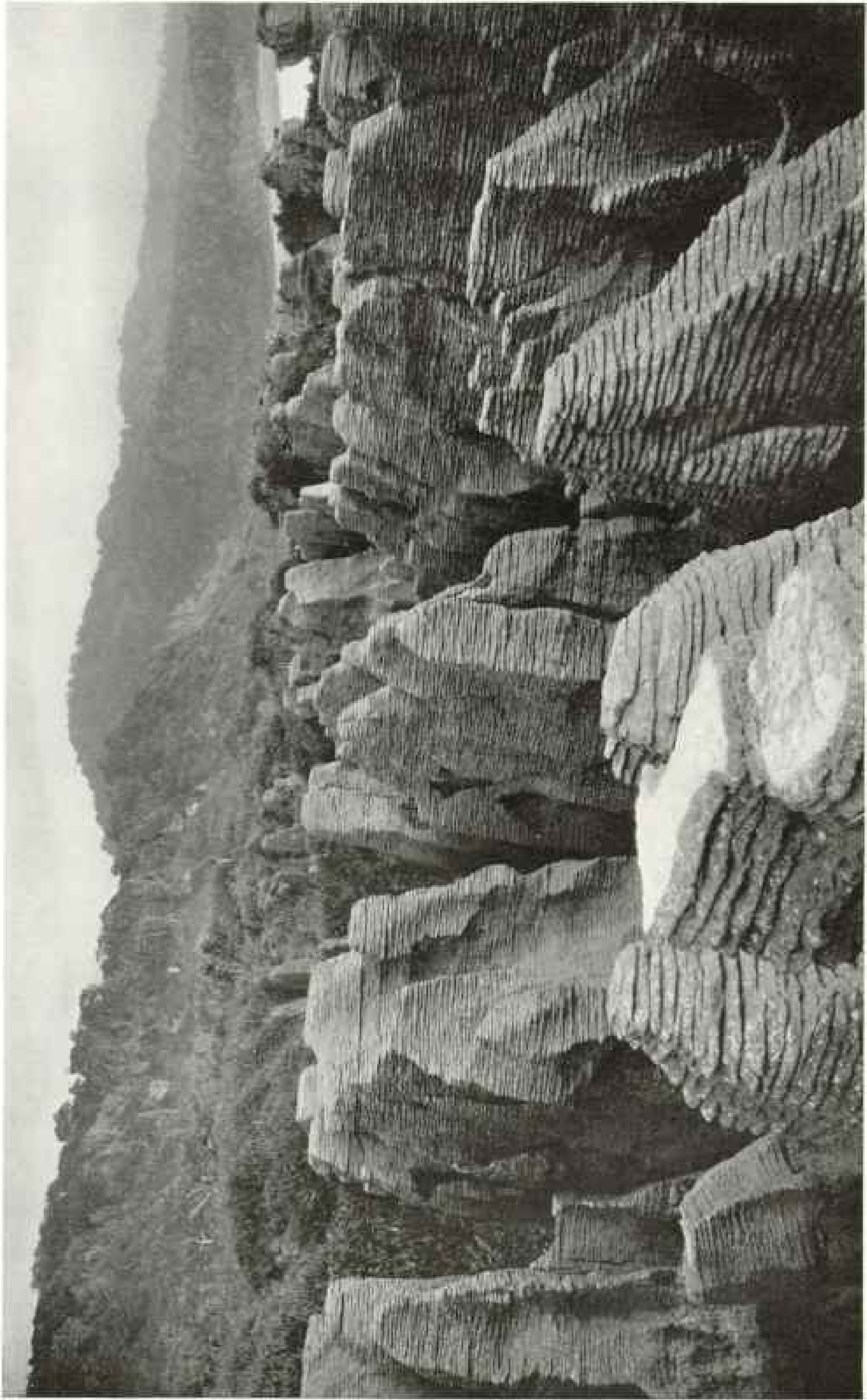
"ICHLABEL" FINDS A HEAVEN AMONG ROCKY CUMBERLAND ISLANDS, WITHIN THE GREAT BARRIER REEF

After a rough passage from New Zealand, the Strouts welcomed this pleasant anchorage off the east coast of Australia. Branches of Moreton Bay pine trees, or booby plants, wave a friendly greeting in the foreground. From this quiet bay the globe girdlers pushed northward, hugging the shoreline on the inner route to Darwin (page 67).



WITH SHEER-RISING MITRE PEAK AS A BACKDROP, "IGDRASIL" LIES AT ANCHOR IN FRESHWATER BASIN.

Such tranquillity at the head of Milford Sound seldom lasts long, for heavy gales are frequent. The boat now is rigged as a ketch. The change, made during a stop at Auckland, permitted easier handling of the craft in the stormy weather that prevails along this part of the New Zealand coast (page 51).



Photograph courtesy New Zealand Government

GIANT PILLS OF STONE PANCAKES ARE STACKED HIGH ALONG THE NEW ZEALAND COAST

Curious rock formations and caves stud the shore near Punakaiki, South Island. Near by, the sea rushes with great force into a famous blowhole between rocky barriers, sending up waterspouts that sometimes shoot spray 150 feet into the air.



UNDER FULL SAIL, "JOSEPH CONRAD" DRIFTS BY AGAINST THE SUNSET

Nearing North Cape, New Zealand, *Idrasil* passed Alan Villiers' famous square-rigger on its voyage "North About." Sailors line up on the forecastle to watch the small yacht, just as interesting to them as their own full-rigged ship is to the Strouts (page 51). *Joseph Conrad*, built in 1882 in Copenhagen, no longer carries cargoes across the seas. Her last owner, Huntington Hartford, gave the vessel to the United States Maritime Commission to be used as a training ship for the merchant marine. Her home berth is a Staten Island Coast Guard pier in New York Bay.

occasion before heaving to for a rest.

Two knockdowns resulted from this hard driving under close-reefed main and fore-staysail. They scared me thoroughly, but did no damage to the ship.

Looking back on the experience now, I am not sure which bothered us the more, the storm or the ten-day calm that followed it!

We spent some time in the spreading city of Brisbane before heading north for warmer weather and the famous route inside the Great Barrier Reef (page 59). Though most strangers enter this route through the spacious Curtis or Capricorn Channels, we chose the winding strait inside of Great Sandy, or Frazer Island. The scenery is very similar to the salt-water

creeks of Georgia where we built the boat.

Against the advice of the Brisbane yachtsmen, we sailed night and day at all times within the Barrier. This added interest to the trip and was perfectly safe, as the route is very well lighted. We stopped at a number of islands along the way, liking Thomas, with its snug anchorage and smooth beaches, best. Indeed, the beaches of these islands are their chief attraction, for the vegetation is mostly hoop pines and turkeybush.

The islands along this Queensland coast are almost entirely devoid of coconuts, that palm not being indigenous here. But visitors usually associate coconuts with the Tropics, so the vacation resorts always have some planted near by. This makes an

excellent label, for it advertises, even to the casual visitor like ourselves, which ones are resort islands.

At Thursday Island pearling is the major industry and the fleet of luggers employed in this service are splendid sailing vessels. They are manned mostly by aborigines, while the divers are indentured Japanese.

Though able boats, they are not too well kept and they look their best in the evening light. Then on each boat the rice and fish are cooked on deck over an open fire that throws its light on the glistening faces of the waiting blacks. If the boat has been at anchor long, the fish may have been caught on a trolling line carried out astern by the current. Trolling at anchor is not a joke at Thursday Island's harbor, with its strong currents.

We arrived at Darwin at the best time of the year, during the dry season, when the large areas of semi-swamp country have dried out, leaving only small ponds, or "billabongs." These are densely populated with wild ducks and geese, brolgas, or native companion birds, pelicans, egrets, plovers, and many others.

ANTHILLS RUN NORTH AND SOUTH

In northern Australia one frequently runs across giant anthills, but the most interesting to us were those near Darwin. Gray instead of the usual red, they are built like a flattened wedge, the narrow edge running north and south. This has earned them the name of "magnetic" ant hills. When seen broadside, they so closely resemble granite tombstones that one large field of them is called "Cemetery Park" (pages 64 and 65).

We left Darwin and Australia during the month of change from dry to wet seasons: so when we saw five waterspouts around us at one time we thought the rainy season was winning. But it was merely the trade wind trying to assert itself. Wind was what we wanted, and soon we were making good time toward Christmas Island.

With the boat moored securely to the phosphate company's buoys in Flying Fish Cove on this British island 15 days later, we were free to spend many hours ashore. Except for a visit to the phosphate quarry, our activities were mostly social, for there is but one short road and Christmas Island terrain resists exploration on foot (page 68).

About thirteen miles long and rising nearly 1,200 feet, the island is composed

of uplifted limestone, extremely rough on the surface, and densely covered with trees and underbrush. Hiking, anywhere off the railroad, means constant work with the machete, so it is seldom attempted. The trails cut in the original exploration for phosphate are now mostly grown over.

EXPLORING CHRISTMAS ISLAND BY RAIL

There is nothing monotonous about the trip over the railroad system of Christmas Island. Though only eleven miles long, it includes a long, cable-operated incline and so many picturesque curves that Shay articulated locomotives haul the trains of phosphate, even on the level. It was interesting to find American-made rails and rolling stock so far from home.

The locomotives are all fired with wood cut on the island, but woe to the coolie who, fresh from China, cuts a tree of stinkwood by mistake! The Christmas Island stinkwood really merits its name.

In the cable car we rose above the trees on the incline and could look down on the boobies nesting in the treetops. Changing to a rail motorcar at the head of the incline, we sped along the high plateau. Often we emerged from the forest into camp clearings, passing smiling Chinese coolies who interrupted their Sunday juggling feats and tests of strength to watch the car go by. Then we were back in the forest again, constantly flushing birds feeding on the right of way. We passed a joss house, catching snatches of weird music as we sped along.

At the end of the line lay the phosphate quarries, the sole reason why Christmas Island is inhabited. Located on the higher points of the island, the phosphate beds vary from a few feet to forty or fifty feet deep, usually covered with a thin overburden of soil. Power shovels strip the surface, but the phosphate is loaded entirely by coolie labor, since some selection is required and it is necessary to work down between the limestone pinnacles.

Wondering how anyone had discovered this underlying bed of phosphate, we delved into the island's history. It seems that samples of its rocks were submitted for examination to Sir John Murray, who had been a member of the famous *Challenger* expedition of 1872-76. He found specimens of nearly pure phosphate of lime.

This valuable discovery led to the annexation of the island by Great Britain in 1888, and later to the formation of



LIKE ISOLATED CLIFFS, GIANT ANTHILLS RISE ABRUPTLY ON A FIELD
NEAR DARWIN

Built by "white ants" of northern Australia, the mounds are more than ten feet high and exceed six feet in width. They rise in the shape of a flattened wedge (opposite page). These architects really are not ants at all, but termites related to cockroaches.



LINES ASHORE KEEP STRONG WINDS FROM BLOWING "IGDRASIL" INTO DEEP WATER

So steeply does the bottom drop off in Charles Sound, New Zealand, that an anchor will not hold against offshore winds. Only by fastening ropes to trees and rocks could the Stroutz obtain a quiet overnight anchorage (page 31).

the Christmas Island Phosphate Company. A daughter of Sir John is the wife of the present manager and was on the island when we arrived.

PHOSPHATE
KEEPS HOUSE-
KEEPERS BUSY

Phosphate is king here, not only for the men but for the women also. The men work with it all day, and so do the women—trying to keep it out of the food and off of the furniture.

Soon even the *Igdrasil* was getting a covering of white powder, inside as well as out, so I didn't mind much when my husband came home one day with large white patches on his clothes. He had crossed a damp spot under the phosphate bins, without realizing how treacherous the innocent-looking white powder can be when wet.

"Now you are one of us," remarked the Englishman who was showing him around. "We all do that sooner or later, and we don't feel as though we belonged to the group until we have taken at least one tumble."

Fortunately it has no odor and is easy to wash off.

Over Christmas Island's one motor road, six miles to the water pumping stations, we drove in an open car. Having no language in common with the Malay-speaking chauffeur, we controlled him by the much-



MAGNETIC ANTHILLS POINT NORTH AND SOUTH.

These homes of "white ants" of northern Australia are called "magnetic" because the narrow sides of the wedgelike structures always face north and south in perfect alignment. Photographed with the camera facing directly north, the hills appear conical and their extreme width is concealed (pages 63 and 64).

advertised "push-to-stop" system of motor control. A push from behind and the car stopped for pictures; when we were aboard again it went on. As there were no intersections, no instructions were necessary!

Near the pumping station we were fortunate to see one of the large crabs, for this was the off season and there were few around. But during the rainy season these crabs are so voracious that they will attack a man sleeping in the bush. Indeed, they constitute the greatest danger should a person get lost on the island.



TOO BIG A CATCH TO SUIT THE COOK!

The author pulled this kingfish aboard as *Igdrasil* made her way up the east coast of Australia, within the Great Barrier Reef. This husky mackerel is a relative of the species taken in great quantity off the Florida coast.

The crabs are notorious for their ability to climb trees and get the coconuts. Formerly they were found in large numbers on Cocos, or Keeling Islands, but now only an occasional one is found there, while Christmas Island has a great many (page 67).

In the early days fledgling man-o'-war birds often figured on the menu of the first inhabitants, but now one seeks their nests, or those of the boobies and boatswain-birds, out of curiosity only. The Christmas Island pigeons are less fortunate, for they are still esteemed in pies and the Chinese often trap them, though the Englishmen find them too

tame for sport shooting.

The Chinese coolies make good cooks. They master the art by watching their mistresses and doing likewise.

Visitors are rare at Christmas Island, for no passenger steamers stop there. Freighters, mostly Japanese, call for phosphate, and the company's steamer *Islander* makes regular visits to Singapore; but any other craft is practically unknown.

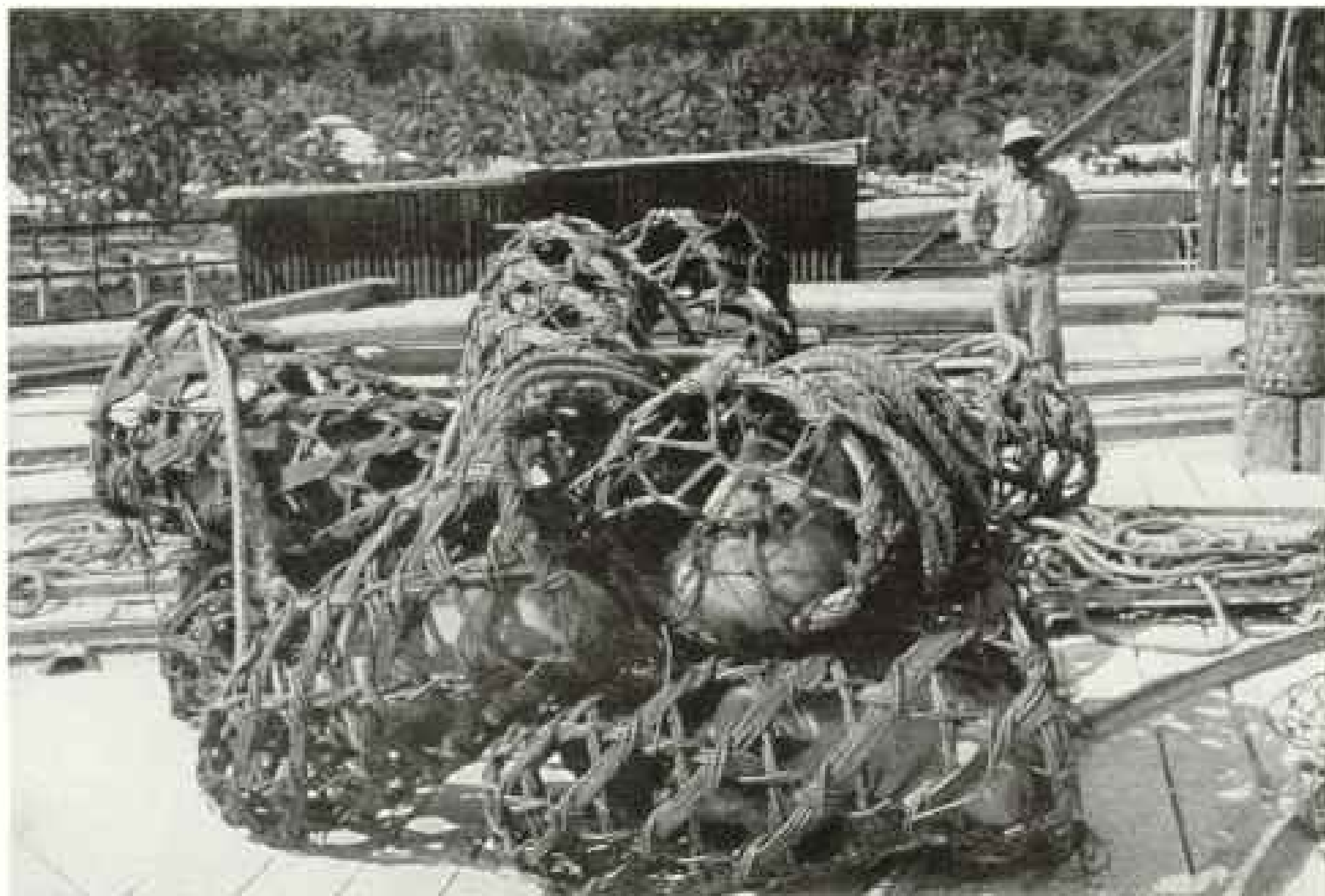
ISLANDS AS FAMILY HEIRLOOMS

We stayed at Christmas Island a week and I enjoyed every hour of it; but the company employees stay three years at a time, and I am sure the six white women on the island envied me my freedom to

sail away and not return.

After a pleasant sail of just under four days we arrived at Cocos, where the Malays reported us as "boat all same Captain Pidgeon," referring to the lone circumnavigator who made his second visit here about a year before we arrived.* Of course they did not mean that the boats were alike, but simply that another of those rare but welcome white-winged visitors was approaching the island. Soon two cable company boats and the launch of Gov-

* See "Around the World in the *Islander*," by Captain Harry Pidgeon, in the NATIONAL GEOGRAPHIC MAGAZINE, February, 1928.



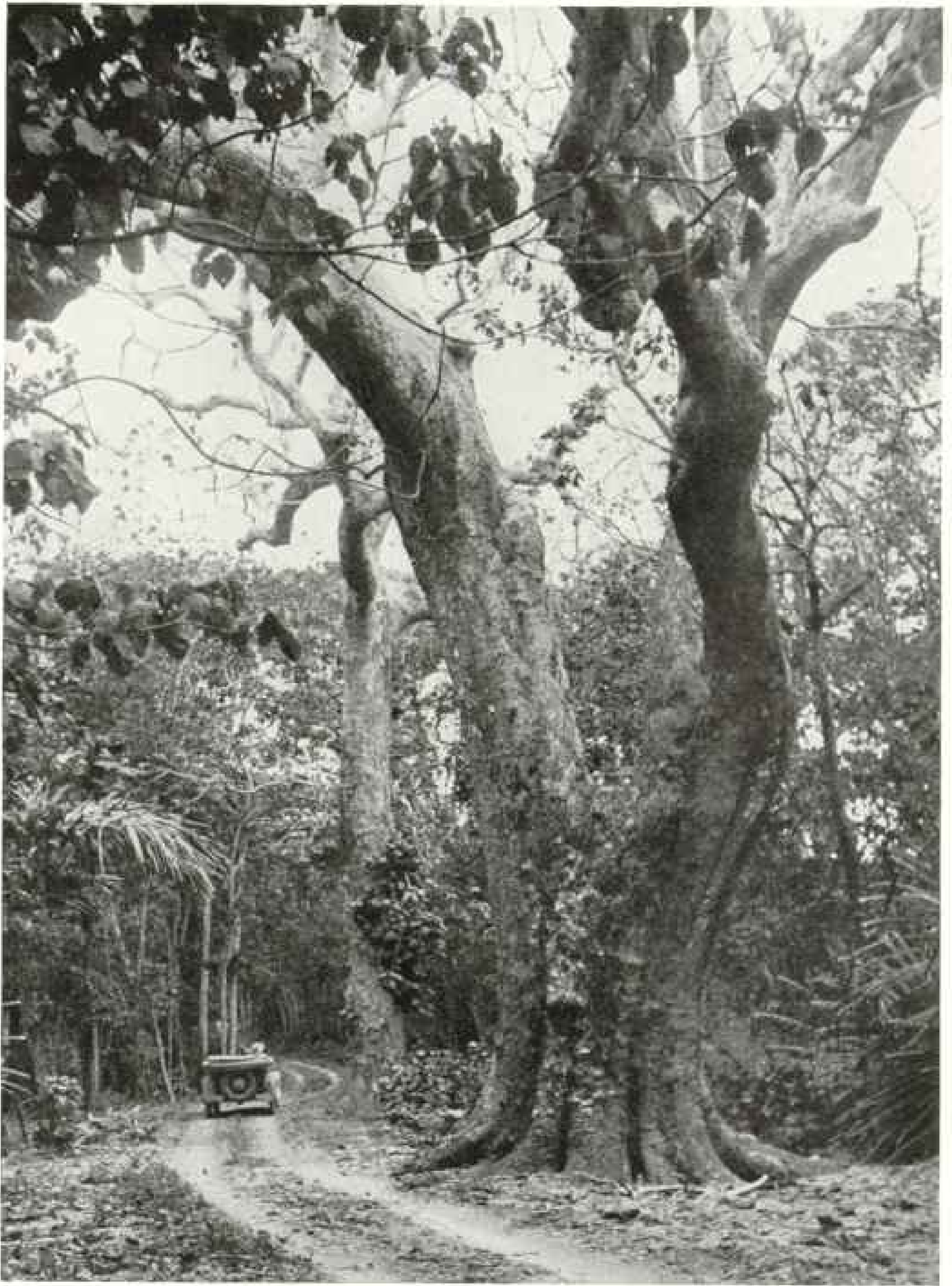
PIGS ARRIVE ON CHRISTMAS ISLAND IN INDIVIDUAL PACKAGES

This shipment, from Singapore, is for the Chinese workers employed by the phosphate company which operates on the island, south of Java. English supervisors import their porkers from the Cocos Islands to the southwest, where the animals are more carefully raised. Cargoes of dirt are sent back to barren Cocos as part payment, and used in vegetable gardens (page 71).



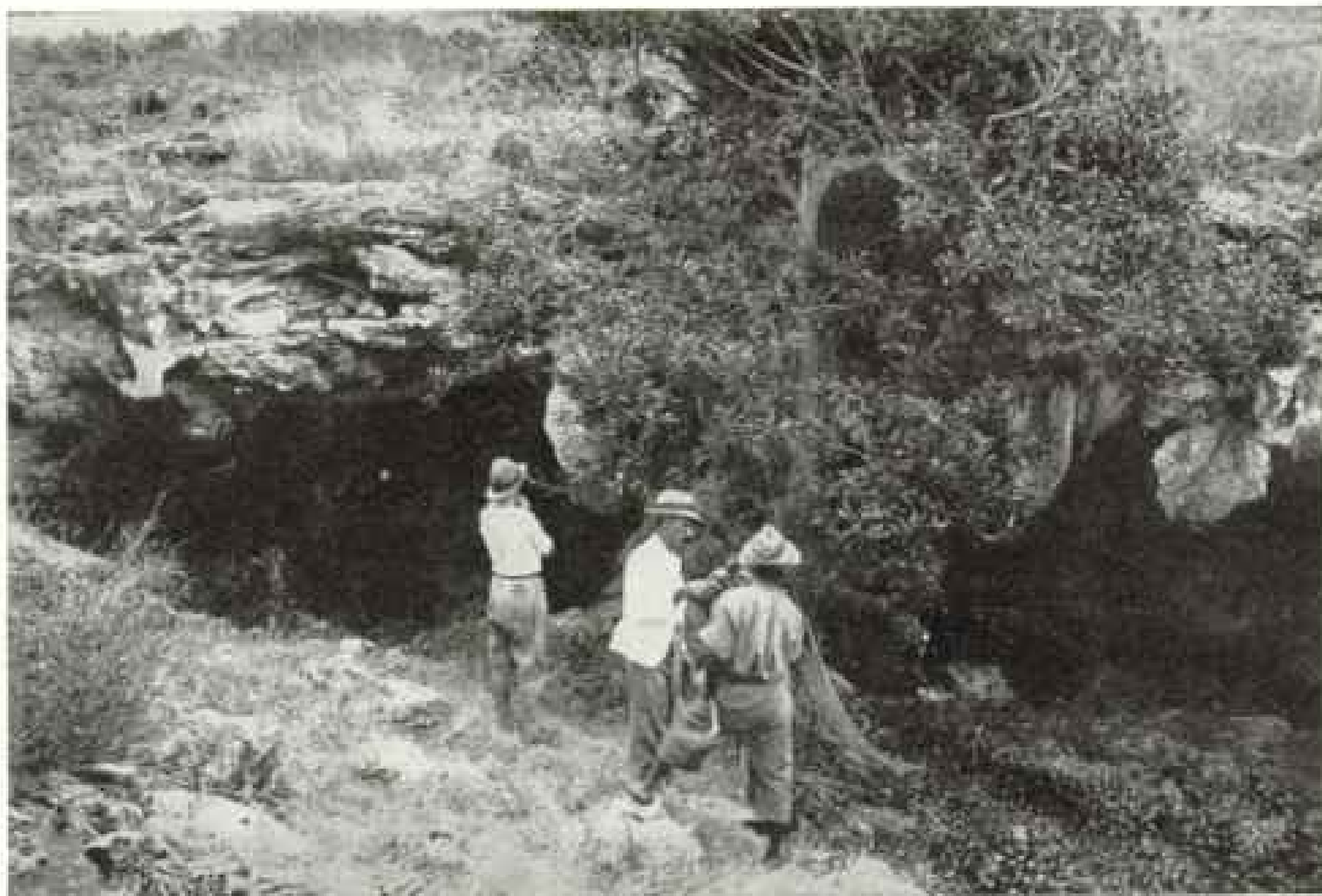
THIS LAND CRAB EVEN CLIMBS TREES TO GET COCONUTS

So powerful are the pincers of the red "robber" that they can nip through wire netting as easily as pliers. The big fellows dwell on Christmas Island, in the Indian Ocean. Islanders tell of campers, sleeping out in the bush, who have been attacked by the voracious creatures (pages 65-66).



UNDER THE SPREADING BAOBAB TREES WINDS THE CHRISTMAS ISLAND ROAD

Only one highway penetrates the tiny island, a dependency of Singapore. High in the huge trees, sometimes 30 feet in diameter, grows monkey bread, a gourdlike fruit with a pleasant acid pulp, which may be eaten or crushed into a beverage. Bark and leaves of the baobab trees have medicinal value and the bark also is made into cloth and ropes. The Malay driver of the automobile spoke no English, so the signal for him to stop when the author wished to make pictures was a punch in the back (page 65).



CAVERNS STUD A PLAIN OF CORAL LIMESTONE ON RODRIGUEZ ISLAND

Men with torches guided the author on a tour through the caves (page 79). Fringed by a reef of coral, this small speck on the Indian Ocean is a station on the British cable route between South Africa and Australia.

ernor J. S. Clunies-Ross came alongside to greet us.

Although these low islands were discovered in 1609 by Captain William Keeling, a Briton in the service of the East India Company, it was not until 1827 that J. Clunies-Ross came here with a handful of sailors and took possession of the islands, later laying out extensive copra plantations and bringing over a number of Malays to work them. Since then this group of islands has belonged to the Ross family (p. 70).

Only two are regularly inhabited. Governor Ross and his eleven hundred Malays live on Home, or New Selima Island, on the northeastern side of the lagoon, while Direction Island, to the north of Home Island, is leased to the Eastern Extension Telegraph Company.

AN ISLE FOR MEN ONLY

Cable stations are often in strange places, but this one is particularly isolated. Direction Island is so small that one can walk around it in fifteen minutes; its greatest altitude is five feet, and it is covered with coconuts. Though it is entirely of coral formation, one frequently finds on the shore

lumps of pumice that floated here from Krakatau, 700 miles distant, after its tremendous eruption in 1883.

Bearing in mind Direction Island's physical limitations, the cable company wisely insists that the employees stationed here shall leave their wives at home. Since there are no women on the island, the company's usual rules regarding them do not apply, and I found myself being invited to both senior and junior messes.

But the first night I was puzzled. Invited ashore for dinner, we first went to our host's room where the rest of the mess were assembled for drinks. After several hours of conversation dinner was served. So I learned that there it was the custom to have the evening's entertainment, whether cards, billiards, or just talk, come before the meal, dinner being the closing event of the day.

Relieved of all feminine influence, the entire staff grow beards. With Vandykes, Burnsides, and Galways all around me, it was hard for me to believe that most of the men were younger than I! (Page 70.)

The English, more than any other people, appreciate that the first thing a trav-



GOVERNOR ROSS WELCOMES MRS. STROUT TO THE COCOS ISLANDS

For more than a century his family has owned and superintended the group, now a part of the Straits Settlements. He has built a model town on New Selima, known by all the residents as Home Island, where well-constructed houses and shops line the streets. To each newly married couple the governor presents a modest home. The principal crop from this tiny settlement in the Indian Ocean is coconuts (page 69).



VANDYKES, BURNSIDES, AND GALWAYS FLOURISH WHERE NO LADIES LIVE!

Employees of the cable station are not permitted to bring their families with them when they are posted at Direction Island in the Cocos. During the World War a landing party from the German raider *Emden* cut two of the three cables here, but the ship was run aground and destroyed on a near-by reef by the Australian cruiser *Sydney*.



ACROSS THE COCOS ISLANDS LAGOON, "IGBRASIL" GLIDES CLOSE TO
PALM-FRINGED SHORES.

More than twenty islets group themselves like a necklace about this shallow basin in the Indian Ocean south of Sumatra. The yacht sailed in through an opening in the north side of the enclosing reef. These coral dots were discovered in 1609 by Captain William Keeling and often are called the Keeling Islands.

eler requires is a bath, and all the half dozen or more bathrooms on the station were at our disposal. And what baths! A small waterproof room was fitted with a drain in the floor and a Shanghai jar, a round earthen tub holding perhaps thirty gallons of water. A small dipper floating in the latter constituted the only movable equipment.

The idea of pouring water over oneself with such a dipper may send a shiver through anyone in the Temperate Zone, but shivers are at a premium in the Tropics and under such conditions a dipper shower bath may be most delightful.

No money is allowed at the cable station. In fact the only money in the whole group of islands is the bone coinage issued by Governor Ross for use among his people.

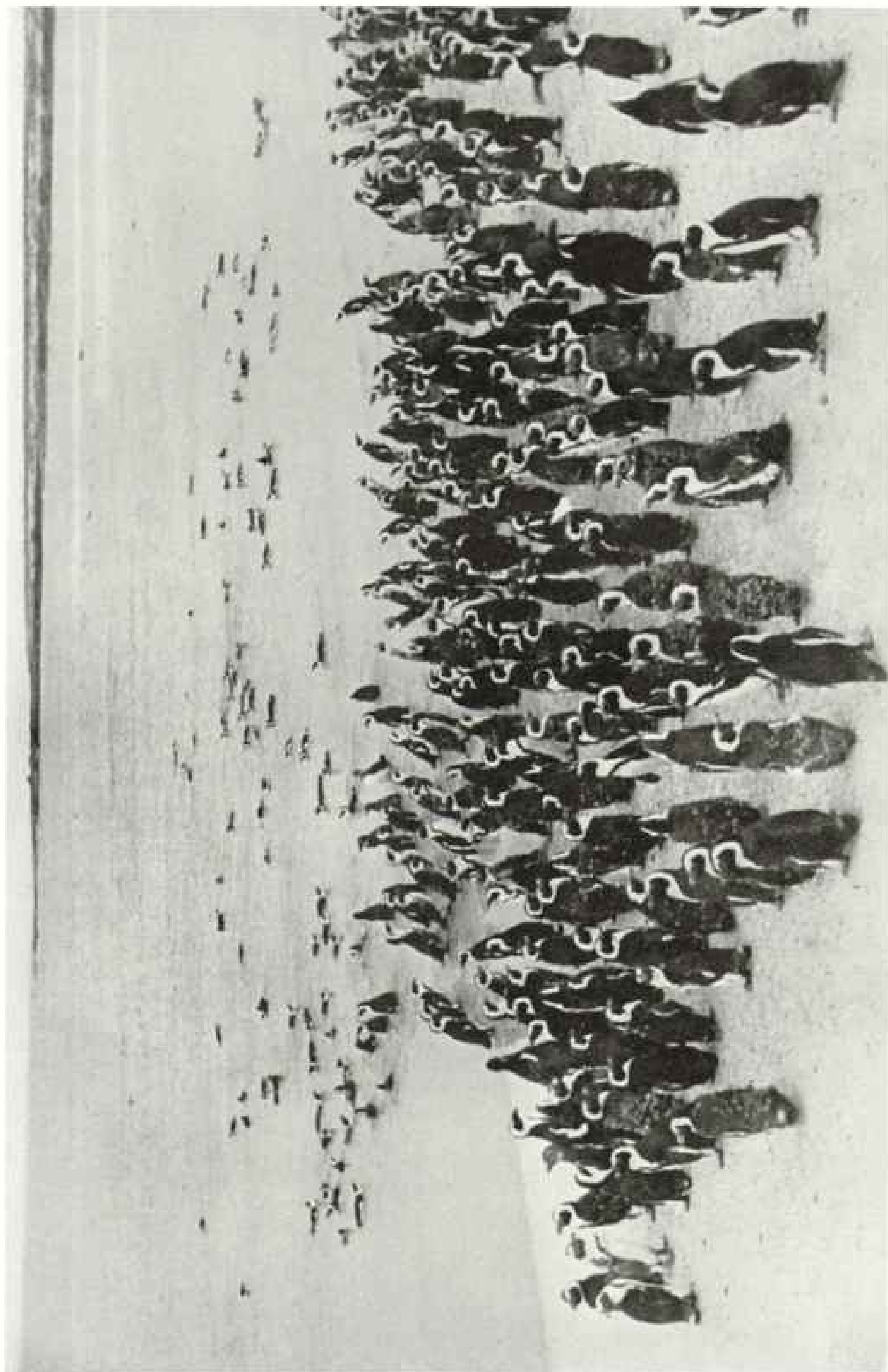
Supplies and personal necessities for the cable station men are purchased on account in Singapore and brought down on

the *Islander*, the vessel owned by the Christmas Island Phosphate Company and chartered by the cable company four times a year.

One of the unusual items in the supply ship's cargo is earth to maintain the small garden at Direction Island, which is under the tender care of the doctor. Some of this earth comes from Singapore and the rest from Christmas Island, the latter in return for pigs raised on Direction Island, for the English at Christmas Island will not eat the Chinese pigs brought in for their coolies (page 67).

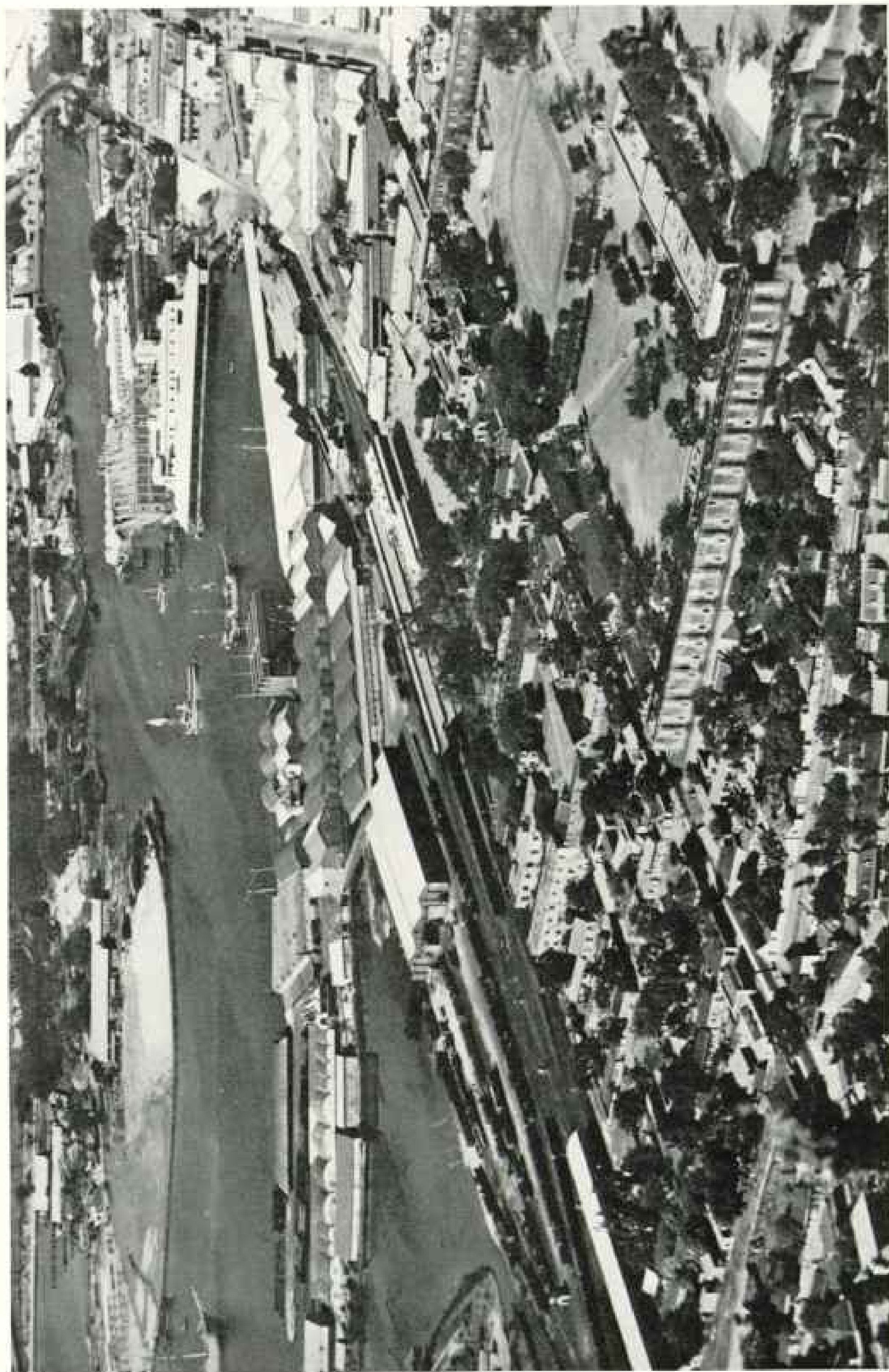
An occasional novelty in supplies comes when the skipper of one of the Australia-India passenger boats fills a cask with fresh vegetables or other luxuries and throws it overboard for the cable men to pick up.

Home Island, being slightly higher than the others, and having an adequate supply of water from wells, was chosen by the



JACKASS PENGUINS ON DASSEN ISLAND LAY THEIR EGGS FOR THE GOVERNMENT

Collectors for the state monopoly sell for food thousands of eggs, gathered every year on this barren stretch near Capetown, South Africa. Unwary visitors are apt to receive vicious pecks on the ankles from the little "men" (page 81).



Photograph by F. L. Patterson

LIFE ON MAURITIUS, WHERE SUGAR IS KING, CENTERS IN COSMOPOLITAN PORT LOUIS

On this lonely island in the Indian Ocean live 55 members of the National Geographic Society. Into the deep harbor come big ships to load sugar cargoes bound chiefly for Asia and Africa. Although the colony has been British for more than a century, Mauritians speak French (page 60).



A STONE ARGOSY HONORS A GALLANT EXPLORER

Capetown erected the monument to Captain Robert Falcon Scott who sailed from there for the Antarctic aboard the *Terra Nova*. With three companions he reached the South Pole on January 18, 1912, after an exhausting journey, only to find that Amundsen had been there before them. Heart-broken, they began the long trek back and perished on the way. A searching party found their bodies, and Scott's remarkable diary.

Rosses for their settlement. Far from being simply the headquarters of a coconut plantation, it is a model town, with neatly laid out streets, well-constructed houses, many shops, and boat sheds.

NEWLYWEDS ARE GIVEN A HOUSE

The uniformity of housing is traceable to the present Governor Ross's practice of presenting a home to each newly married couple, while the high quality of workmanship in all fields results from a rigorous system of apprenticeship.

There is an excellent Diesel engine-driven sawmill, but the boys who are to become carpenters start their training with whipsaws and continue with them until they can saw straight boards of uniform thickness. Those who are to become blacksmiths finally graduate from bellows boys to making nails, Cocos being one of the few places that still uses the hand-forged variety, even in small sizes. Machinists, boatbuilders, sailmakers—in all the mechanic arts these smiling little Malays were learning their trade with a thoroughness seldom seen anywhere.

Governor Ross owns these islands and all governmental authority centers in him, but his administrative success depends upon his remarkable ability to do anything that must be done in the island better than the people who are doing it. He is a jack-of-all-trades and master of them all.

NO IMMIGRATION ALLOWED

Though Cocos is attached to the British Empire, it is strictly a one-man government. The laws and penalties are sometimes peculiar.

No outsiders are admitted to residence, and any who leave the island may not return, on the theory that tales of grandeur in other countries would tend to breed discontent. This elimination of outside influences makes for social unity and the ban on immigration seems very desirable in a land which, like Cocos, has limited resources and a birth rate higher than desired.

When we were there, one of the men was contemplating leaving on the next boat. As he was an old man, with little chance of financial success in the outside world, we asked him why he wanted to leave. His only reason was that since his wife had died he was living with his daughter, and she would not sew the buttons on his shirt!

There is little crime, as we know it, at Cocos, the commonest infraction of the rules being unofficial marriage before the 16-year age limit is reached, this limit having been set in an effort to hold down



HOMEWARD BOUND!—AT THE CAPE OF GOOD HOPE

On the tenth day out from Durban, the voyagers passed the famous light and felt they were almost home because they were back in the Atlantic Ocean! Alternating gales and calms beset the yacht as it rounded the South African cape (page 80).

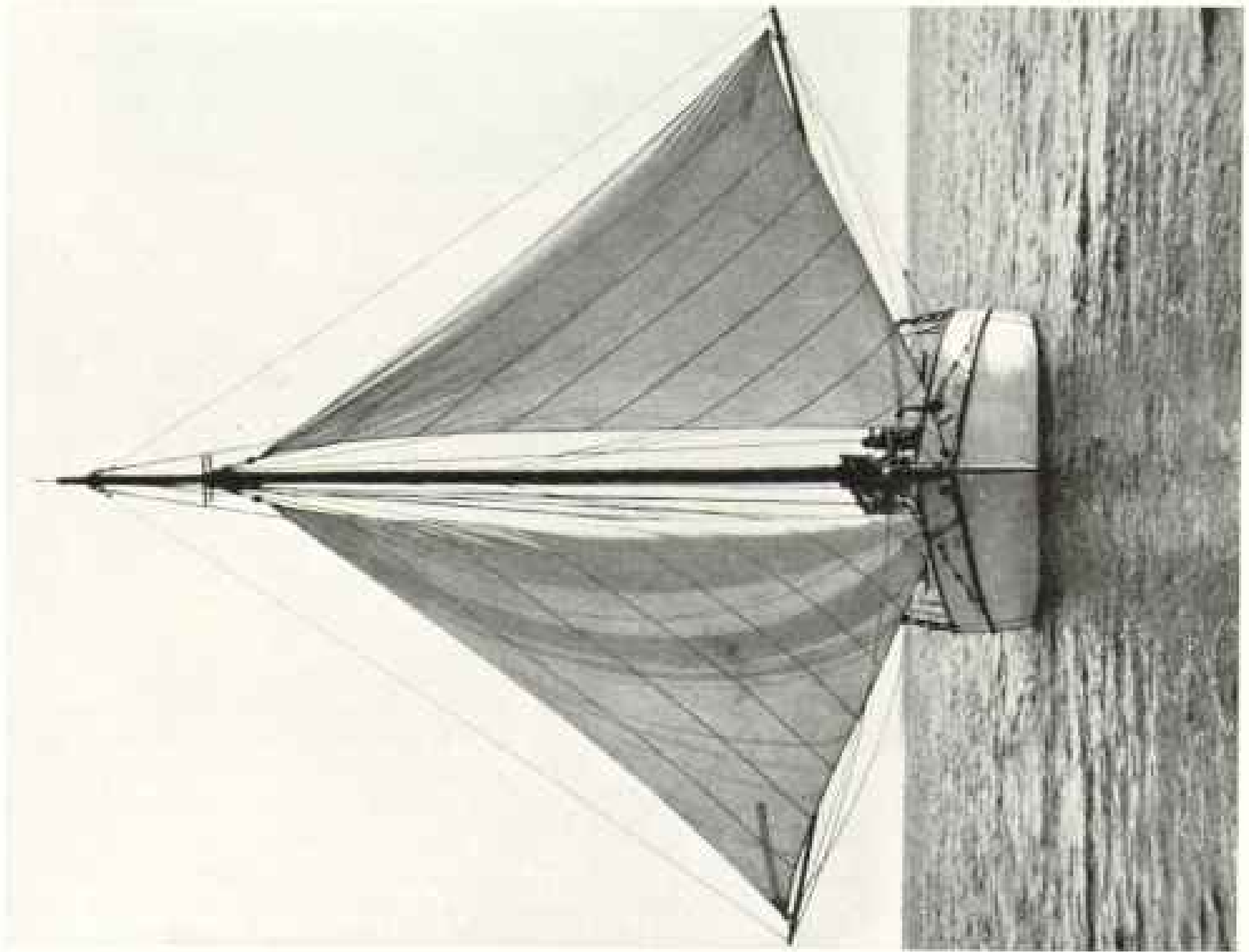
the birth rate. The punishment is a certain number of lashes for each party.

But at Cocos a person may assume another's punishment, so in this case the boy takes both his own and the girl's chastisement. Thus he gets a really sound thrashing, after which the marriage is recognized without regard to age!

Some of the island's natural resources have been depleted, principally the land crabs and the birds, for in spite of Governor Ross's order that none of the sea birds should be killed, the Malays can think only of a good meal to be had now, and kill the men-o'-war and the terns whenever possible. So the birds have taken refuge on North Keeling, 16 miles to the northward,

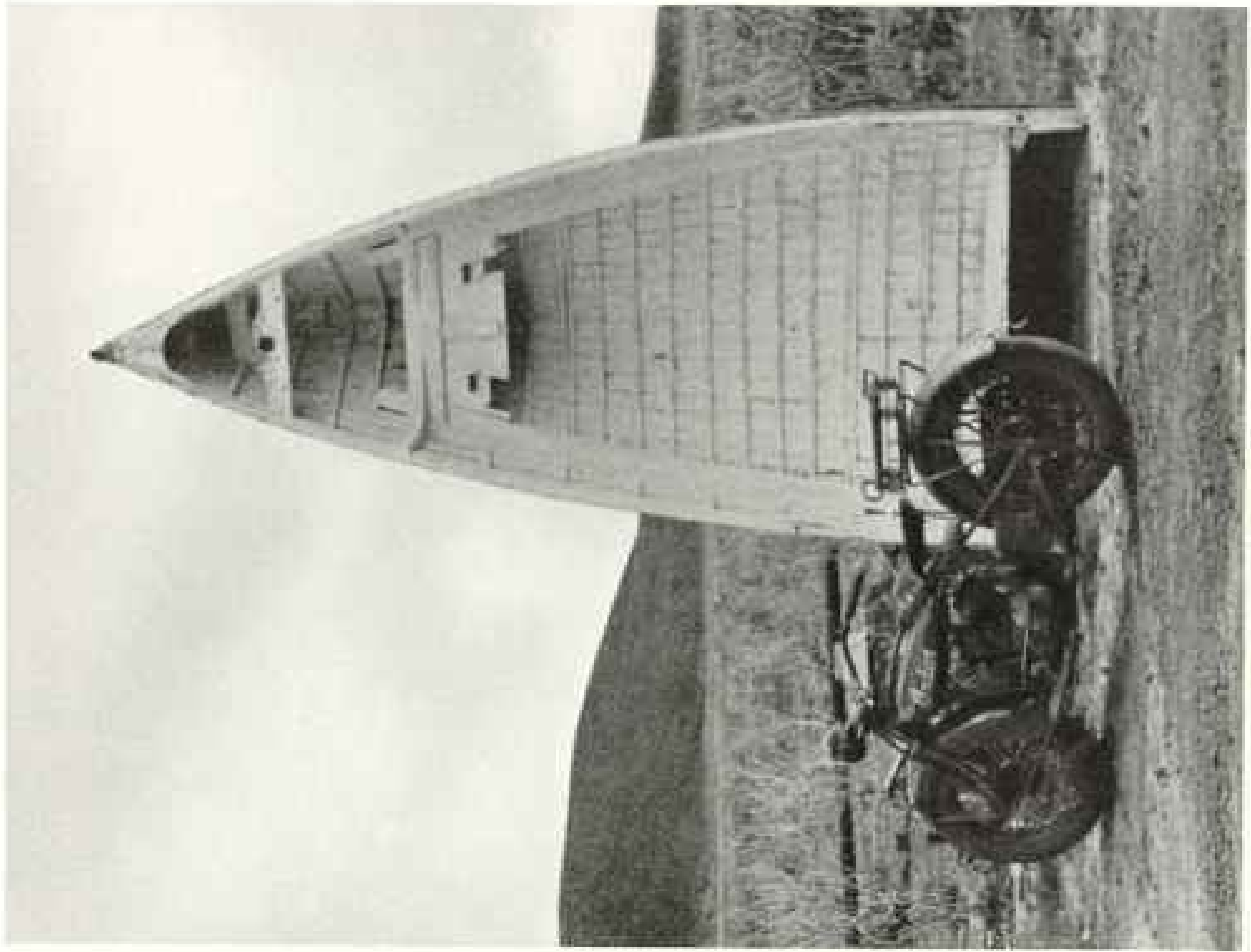
That orphan of the group, incidentally, is the resting place of the famous German raider, the *Emden*, which during the World War landed a party at Direction Island for the purpose of destroying the cables. The *Emden* was surprised by H.M.A.S. *Sydney* and finally was run aground on the reefs of North Keeling.

The landing party from the *Emden* put the radio and cables temporarily out of commission, but graciously spared the refrigerator with its precious food contents. They watched the naval engagement from the roofs of the cable station, and seeing the way it would end, took one of the cable station boats to Home Island. There they commandeered one of Governor Ross's



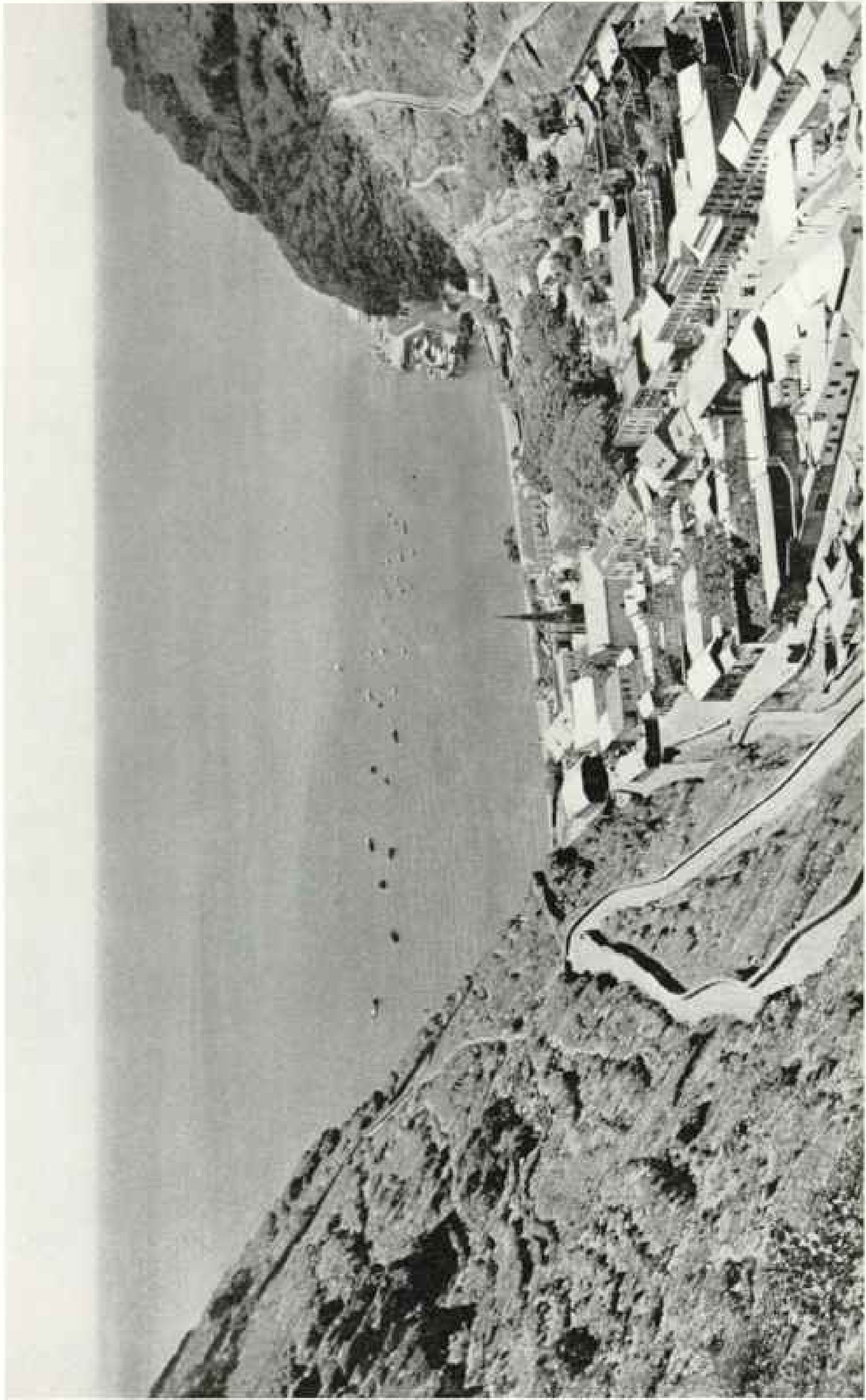
WING AND WING, "IGDRASIL" ROLLS "DOWNHILL."

Under double-spinnaker rig, the yacht made the long run up the South Atlantic, more than 3,000 miles, dead before the southeast breeze. For centuries skippers have welcomed the trade winds. Mariners named them in the days when the word "trade" meant "course" or "trail."



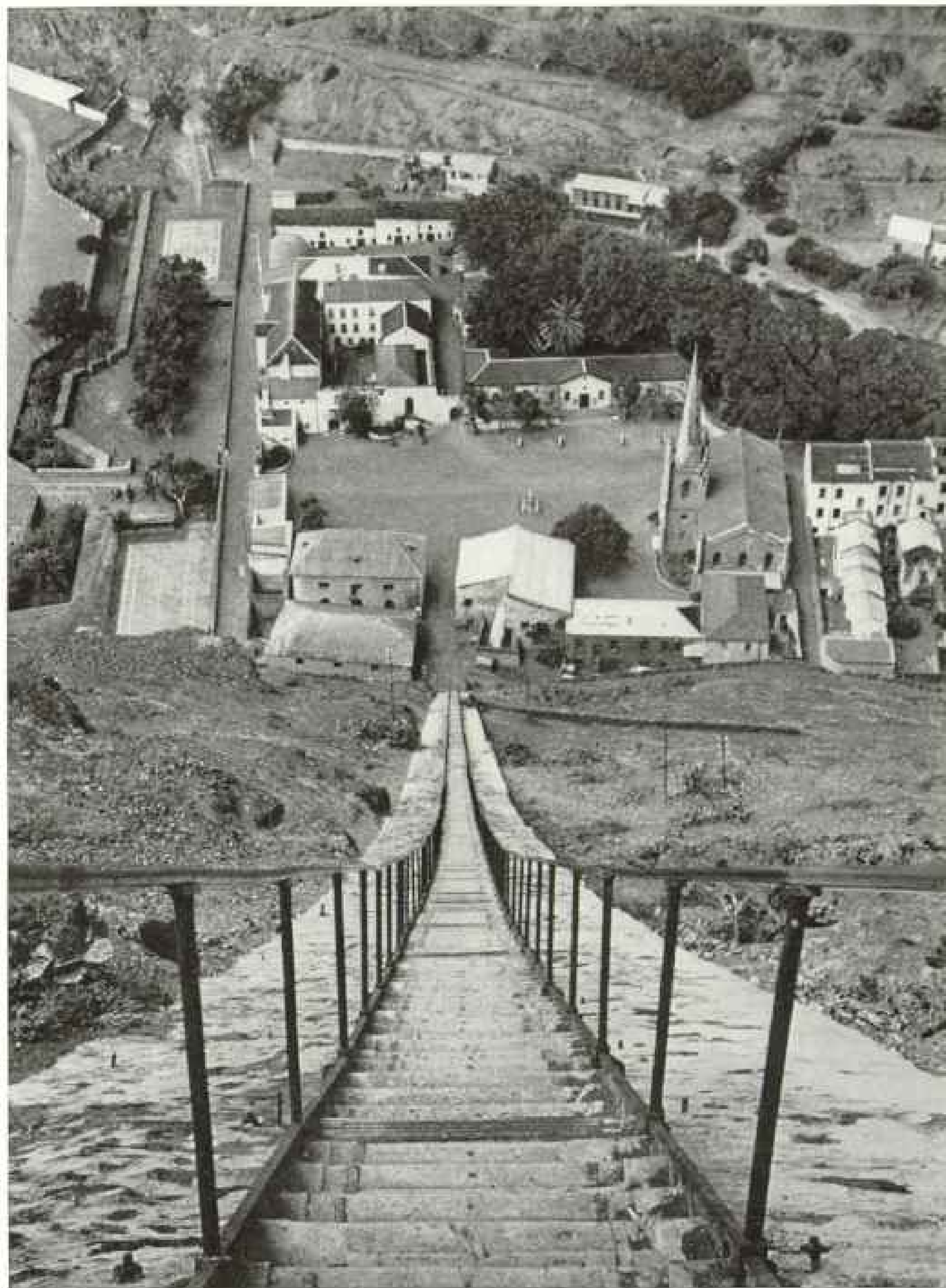
CLIMBERS HALT AT SHADY "ONE-BOAT" ON GREEN MOUNTAIN

Farther along, on the steep, hot, dry road to the top of Ascension Island, in the South Atlantic, travelers find a second resting place, "Two Boats." At the summit they reach a huge elliptical crater, 2,870 feet above the sea. Here cable company employees maintain a farm (pages 82-83, 85).



ON THE LEEWARD SIDE OF SAINT HELENA, JAMESTOWN BECKONS SAILORS TO SAFE ANCHORAGE.

The town nestles in a valley between high cliffs, sheltered from the trades which blow against the other side of the island. Saint Helena, where Napoleon died, has since been the place of exile for other political prisoners, including several Zulu chieftains and an ex-Sultan of Zanzibar. During the Boer War several thousand prisoners captured by the British were confined here (pages 78, 55).



ST. HELENA RESIDENTS IN A HURRY SLIDE DOWN THE BANISTERS

Putting a pole across the handrails, they make the quick descent from the top of Ladder Hill to Jamestown in the valley. They touch the steps just enough with their feet to keep their progress under control. The garrison for this small island in the South Atlantic is quartered at the top of the hill. An automobile road also leads up to the barracks. The old moat appears at the left.

sailboats and put to sea, reaching the Netherlands Indies. Ultimately, by other means, they arrived at Constantinople after an epic journey.

The Australian Government tried to salvage the *Eden*, but finally abandoned the attempt because of continually high seas. Afterward, Governor Ross and his able surfmen removed everything of value, but in the long delay the ship had broken on the reef and he still regrets those big propellers that sank into deep water before he had permission to salvage them. For many years, however, the brass gleaned from the ship's fittings supplied his brass foundry.

RATS CLIMB TREES AND DESCEND IN COCONUT "ELEVATORS"

One sea captain, visiting these islands a hundred years ago, remarked that "here crabs eat coconuts, fish eat coral, dogs catch fish, men ride on turtles, and shells are dangerous mantraps."

"It must yet be said," he added, "that the greater part of the sea fowl roost on branches, and that many rats make their nests at the top of high palm trees."

I found no crabs, for they are almost extinct here now, though at one time they were so plentiful that the natives extracted oil from them. I saw, however, the extensive turtle ponds where Governor Ross keeps sea turtles, both large and small, not for the sport of riding, but for food.

The rats have been mostly eradicated, so I couldn't see them burrow into a coconut and then chew off the stem, thus getting a free ride down to earth. We were told that this habit resulted from the fact that while the rats could climb up the sloping trunks they were unable to walk back down. The greatest difficulty with this kind of elevator is that it works only one way.

It is also destructive to the island's economic system, as the only revenue is derived from copra. In an effort to raise more of the island's food supply, Governor Ross has imported various kinds of trees, but the natives' principal food, rice, still has to be imported.

With many examples of fine Malay craftsmanship aboard, *Igdrasil* left Cocos and its happy people and started the long crossing of the Indian Ocean. For the first time in our travels the trade winds blew strongly enough to be interesting for days on end, so we made the 2,300 miles to Rodriguez in sixteen and a half days.

Like so many islands, Rodriguez, now British, was discovered by the Portuguese in the early 17th century. Later the Dutch occupied it for a short time, but it was not permanently settled until 1760 by the French.

"ROCK FARMS" ON RODRIGUEZ

Originally used as a ship-provisioning depot where wild game and wood were available, Rodriguez surprised us by its barren appearance. The reason is not far to seek. A population of 250 in 1847 increased to almost 10,000 in 1936, so naturally most of the available firewood has been burned and the ground cleared for cultivation.

Instead of following the New England practice of making stone walls and a rock pile in the middle of the field, the Rodrigans move only the small rocks, making little piles upon all the larger ones. Thus, from a distance a hillside looks like a "rock farm" instead of a sweet-potato patch.

Excellent paths traverse the island in all directions, and one meets people along them at all times of the day. But no information can be obtained from them, for they know no English, and their patois has departed so much from its original French base that questions in that language are equally fruitless.

Even my husband's sign talk was unavailing, so the magistrate obligingly detailed Mayeuse, his boatman, who spoke a little English, to show us the island. Mayeuse considered it not only his duty but a privilege to accompany us.

There are large limestone caverns at the southwestern end of the island, but they are a long way from Port Mathurin. As I had broken a rib only the week before when tossed against the quarter-bitt by a sudden sea, I thought it would be too much of a walk; so the magistrate provided a boat and, with Mayeuse in charge, we made half the trip by water.

At the caverns two natives lighted us through the underground labyrinth with torches, but Mayeuse, the leader of the expedition, was a waterman and nothing could induce him to go into holes where the light of day had never reached! (Page 69.)

Walking back to the boat, we passed the school, which the French teaching sisters hurriedly dismissed as we approached. Anticipating an invitation, we walked slowly, but Mayeuse, after stopping to talk, fol-

lowed along. Half an hour later he explained that the sisters had wanted me to stop for tea, but since they spoke no English and I no French he had refused without consulting me! It never occurred to him that one could drink tea in any language.

Whenever we rowed ashore the natives would line up on the beach and watch us pull the dinghy up the sand; yet not once did they offer to help. Whenever we came back, there were two deep arcs well marked in the sand on either side, showing where some child had been practicing rowing, safely tied to a *filao* tree.

The English staff of the cable company and the officials of the island did everything possible to make our stay pleasant. One night when we dined ashore, M. Martin insisted that a guest of his should not have to row home, so he kept a crew of three men in his 34-foot shallow-draft sailing lighter until we were ready to go aboard. Then we sailed out over the reefs in the moonlight, touching gently several times. This was returning in state, for our tender was nearly as long as our floating home and it carried a bigger crew.

Should we mention that we liked any particular kind of food, if it were available on the island it would immediately be sent out to us. Even the two Netherland steamers that came into port during our stay were eager to help and sent over a box of delicacies. So we left here supplied with a wealth of food, as well as many memories of these gracious and hospitable people.

ANOTHER FRENCH-SPEAKING ENGLISH ISLAND

The nearest neighbor to Rodriguez is Mauritius, an island as beautiful as it is historic. Like Rodriguez, Mauritius was discovered by the Portuguese and was settled by the Dutch, who, finding it unprofitable and their escaped slaves troublesome, abandoned the island in 1710 (page 73).

Afterward it was settled by the French, and when the British took possession in 1810, they permitted the inhabitants, as usual, to retain their own language; so to-day the Mauritian speaks French. The patois-speaking laborers, descendants of the French and the African slaves, have been greatly outnumbered now by East Indians brought here for work in the sugarcane fields. The population is very dense, about 550 people to the square mile.

The mountains rise abruptly from the plateaus and, with their very jagged outlines and cane-covered valleys, give many splendid vistas as one drives over the island's excellent highways. The mountains add both beauty and distinction to the town of Port Louis, although, surrounding it in amphitheater style, they cut off the usually cool trade wind and make the town hot and stifling.

WORST STORM OF THE VOYAGE

The passage from Mauritius to Africa was in the variables, with the wind boxing the compass about once every three days. Between Madagascar and Africa we met our worst blow of the whole voyage, strong, but of short duration.

Unlike the usual black arch squalls of the Tropics, which we knew so well, this advanced as a solid wall of black, blotting out everything right down to the water as it came. For two hours the resistance of the masts and shrieking rigging was enough to heel the ship far over, while the rain fell at a rate to equal a western cloudburst. Though uncomfortable, the rain was welcome, for it kept the sea from building up.

After the squall came another calm.

Such a tedious voyage gave me time to review all my old impressions of "Darkest Africa," but instead of sighting lions along the coast of Zululand we found that the most conspicuous object was a golf course! It was hard to realize that the smooth fields of sugar cane were indeed the famous Zululand.

As we saw nothing of the natural scenery when entering Durban at night before a northeast gale, friends ashore quickly made up for that by driving us around. Durban is rapidly becoming a city of apartment houses, and many of the buildings of the fashionable residence district are of modernistic design.

We had the usual summer weather for rounding South Africa, some gales but more calms. On the tenth day out we passed close to the Cape of Good Hope, where we were reported by the signal station (page 75). Most signalmen ignore small craft entirely.

Capetown is beautiful at night, as well as during the day, with the lights of the city clustered, as if for protection, at the foot of Table Mountain and Lion's Head. We found a good anchorage in New Basin, farther out than the other yachts. This was an advantage in that frequently I could



NAPOLEON PINED FOR JUST SUCH A "LIFT" FROM ST. HELENA

When the Little Corporal was in exile on St. Helena, his guards watched him day and night to prevent an escape. They were successful, for Napoleon died here in 1821 without repeating his famous flight from Elba. Mr. Strout, left, helps an islander row out to *Igdraui* in a longboat. The boatman brought the 30-foot craft back to shore by himself!

watch the jackass penguins swimming near the boat in groups of two or three.

Of course I wanted to see the large colony of these birds on Dassen Island, but the Government discourages private boats visiting the place and requires a permit to land. So we found it more convenient to go on the Government tug when it took supplies to the staff on the island (page 72).

PENGUINS PECK INVADERS' LEGS

Many people regard the penguin as a rare bird, to be protected at all times, but in this case the cause of the governmental solicitude is primarily the protection of a source of revenue, for it sells many thousands of penguin eggs every year.

As the tug approached the anchorage one misty February morning, low, barren Dassen Island appeared as one of the most uninteresting islands I had ever seen. But once ashore, the desolate surroundings were forgotten, for all interest centers in the penguins.

One or more families nestle under every bush, while the burrows made by others riddle the hard-crusting earth in all directions. The unwary visitor soon discovers this by breaking through the roof of one of them, and he is lucky indeed if he escapes a vicious peck on the ankle. A

sudden retreat is apt to be disastrous, for there are always other penguins just behind you waiting their chance.

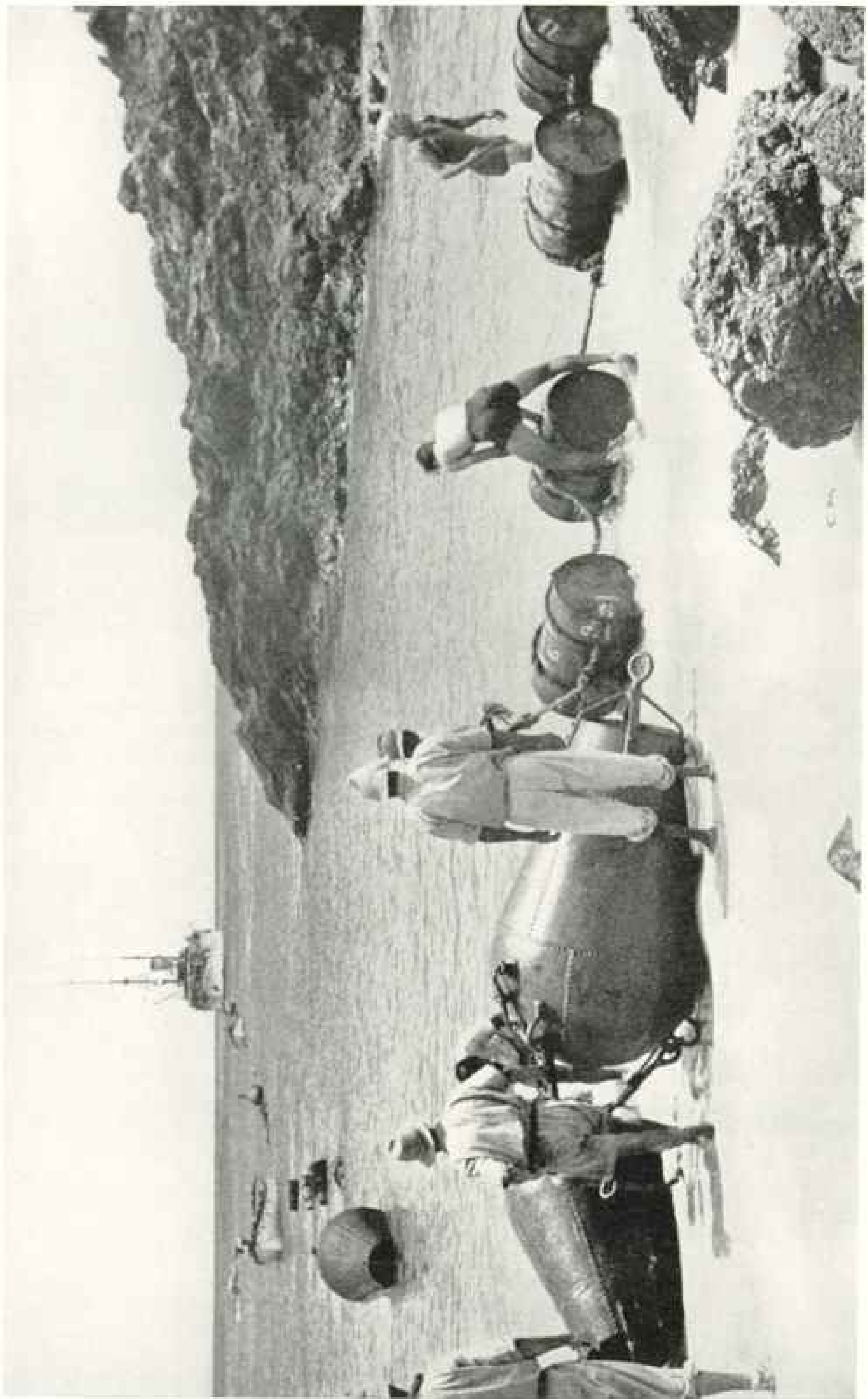
The southeasters of Table Bay are interesting to watch—when on shore. First the cloud spreads over Table Mountain like a tablecloth, gradually coming over the edges. The wind rushes down the sides of the mountain to the ocean, where it meets the seas rolling in on the beach. Being an offshore wind, it blows the tops of the waves in the direction opposite to their natural curl, sending up a white spray, reminiscent, to me at least, of the smoke of a prairie fire.

It is hard to convince people elsewhere that these southeasters blow 75 to 100 miles an hour in the squalls without causing the residents the least concern. Apparently one can get used to anything.

A SHOWER OF SQUIDS

We wanted a southeast wind for leaving, so we did not tarry into fall but sailed for Saint Helena in late February, 1937.

South of that island one sunny day we had a rather startling visitation of unwelcome guests from the sea. I was at the wheel and my husband below when suddenly, without the slightest warning, a veritable cloud of squids, about three inches



A REPLACEMENT LINK IN A EUROPE-AFRICA CABLE COMES ASHORE AT ASCENSION ISLAND

The end was floated in from the ship by the large buoys and boats. Although the British navy once attempted to colonize this bit of land in the South Atlantic Ocean 800 miles northwest of St. Helena, only cable company employes now dwell there. Sea turtles visit the coast by the thousands between January and May to lay their eggs. Many are caught and kept in large ponds (pages 76, 83, 85).



MYRIADS OF SOOTY TERNS, OR WIDEAWAKES, WHEEL OVER ASCENSION ISLAND IN MATING SEASON.

Wideawake Plain is the name of the ciriler-covered valley on this volcanic isle where the birds lay their eggs each year. They always rest facing southeast, headed directly into the trade winds (page 85).



"IGDRASIL'S" SIGNAL FLAGS INTRIGUE A TRIO OF BROWN BOOBIES

The craft was escorted by the tireless flyers while approaching Navassa Island, between Haiti and Jamaica. The birds occasionally closed in and pecked at the banners flying from the mast. The United States owns the island, a tiny speck on the Caribbean Sea, and maintains a lighthouse there.



A PUNCHEON OF BARBADOS MOLASSES TAKES A RIDE ON A "SPIDER"

long, swept out of the water on our quarter and landed all over the boat.*

A couple went down my neck; some fell through the scuttle into the cabin; scores of the slimy things plastered the sails and deck. As they dried they stuck as if glued, and they left their mark with the black ink a squid squirts into the water when pursued by enemies. Cleaning up was half a day's job.

Undoubtedly the squids had been pursued by some predatory fish, and their momentum carried them through the air fifteen or twenty feet. On other occasions a few squids had come aboard, but we had never experienced anything like this. There were probably two or three hundred. There must be an unusual number of them in this part of the South Atlantic, since other small boats have had similar experiences in the same vicinity.

So much has been said about Napoleon in connection with Saint Helena that most people have forgotten its previous long and notable history and fail to realize that its steep cliffs and rugged scenery need no history to be impressive (pages 77, 78, 81).

Old batteries, some built by the British East India Company, appear in almost every view, from the beaches to High Knoll on the crest of the mountains, but the military importance of the station has dwindled until twelve marines constituted the entire garrison when we were there.

ASCENSION HAS GOLF "BROWNS," NOT GREENS

At dawn one morning, seven days after we left Saint Helena, an island appeared ahead. We rubbed our eyes. Was it really Ascension, or were we miraculously again among the Galápagos Islands? It was Ascension all right, but if some giant had plopped it down among the Galápagos, some 5,000 miles to the westward, it would have been right at home. It is more modern, to be sure, for automobiles now go up the 2,500 feet to the farm on Green Mountain as well as to Wideawake Plain.

To this "plain," really a cinder-covered valley, the sooty terns, called "wide-awakes," come each year to lay their eggs among the volcanic ashes. All of the birds rest facing southeast, headed directly into the wind (page 83).

*See "Marauders of the Sea," by Roy Waldo Minor, NATIONAL GEOGRAPHIC MAGAZINE, August, 1955.

On this barren island, originally listed and administered as H.M.S. *Ascension*, the British Navy spent much money and labor, laying out paths, cutting tunnels to connect fields on the steep sides of Green Mountain, planting and maintaining the farm on the mountain, and building concrete water-catchment areas. The island's naval importance having waned, it was turned over to the Eastern Telegraph Company, which now maintains the island as well as the cables (page 82).

The only inhabitants are the staff of the cable company, some twenty-odd men and their families, and about a hundred and fifty workmen and servants who have come from Saint Helena.

Here, of course, one must make one's own amusements. We were puzzled at first by large brown circles scattered over the lava back of the village. These turned out to be golf "browns," for here there is no grass to make any "greens."

MOVIE-GOERS BRING THEIR OWN CHAIRS

Though very isolated, the island has talkies once a week. The major expense of showing the films is borne by the cable company's staff, a small charge being made to the Saint Helenans. A one-eyed Saint Helenan servant registered emphatic objection, contending that he should pay only half price, on the ground that he could see only half as much!

One week we were able to put on an extra show by lecturing about our trip and displaying our colored slides. Chairs were furnished us at the movies, but it is the custom for each person to supply his own chair. Then he has only himself to blame if he has an uncomfortable seat!

A good deal of the food must, of course, be imported, but at the farm on Green Mountain a limited quantity of fresh vegetables is raised. About four hundred sheep are kept here as a reserve supply lest any of the boats be unable to land provisions. A few cows supply milk and butter, but their food must be brought all the way from South Africa.

The Ascension Island housewife buys her fish by the month, paying a fixed monthly rate which entitles her to all she wants, any or every day. Although sea turtles are available, and sometimes a reserve is kept alive in the turtle ponds, they are seldom eaten, as beef and mutton are much preferred.



"IGDRASIL" SPEAKS HER SECOND SAIL NEAR THE CLOSE OF HER VOYAGE

Until they neared the shores of Dominica, on the last leg of their 38,000-mile cruise, the Strouts had encountered only one sailing vessel, *Joseph Conrad* (page 62). Here among the Leeward Islands they meet *J. W. Glor*, a four-master out of Jacksonville, Florida.

Though Ascension, as well as several other islands we had visited, is subjected to occasional heavy rollers, we thought we had missed seeing them. But on the morning we had set for our departure they started coming. We slipped the chain to the mooring buoy and moved farther from shore. The staff of the Eastern Telegraph Company had been so kind to us that we would not leave without saying good-by, and waited two days before we were able to land, even in the company's ably manned whaleboat.

The long run to Barbados was broken by sighting and coasting along the Brazilian island of Fernando de Noronha with its huge undercut rock spire balancing above everything. As one doesn't visit a penal colony except by request, we didn't stop.

NEARING HOME, AFTER THREE YEARS

Back in the West Indies again! To be sure, many miles to the east of our outward route, but to us it was next door to home. Throughout all of these islands an American yacht is not a strange sight, but the harbor officials always had a surprise when, thinking we had come direct from the States, they asked how long we had been

out. As they expected weeks or months, the answer of three years was naturally startling.

Crossing our outward path, we experienced again the squally summer weather of the Bahamas, but, boosted along by the Gulf Stream, we were soon out of the Tropics and well on our way to New York, our destination.

SAFELY AROUND THE WORLD, AND THEN—

As we crept up Ambrose Channel at night in a dense fog, the events of the previous three years passed in mental review: three years of strange rocky shores, coral reefs, and sandy wastes; yet three years without adventure. For these natural obstacles are friendly things; they stand still and let you dodge them, and not once had they caused us the slightest damage.

Just then the blast of a steamer's whistle sounded astern, and after much agonized tooting back and forth the bow wave burst through the fog and her steel stem sliced by a few yards to one side. It was a fitting climax to our 38,000-mile voyage in which the major risks had been the dangers of civilization.

LORDS OF THE ROCKIES

Photographing Big Game Animals in Their Primeval Surroundings, from Arizona to Canada, Brings Adventure to Two Wilderness Wanderers

BY WENDELL AND LUCIE CHAPMAN

With Illustrations from Photographs by the Authors

PERCHED fifteen feet above ground in the limbs of an evergreen, I gazed down into the bloodshot eyes of an angry cow moose. Under one arm were my still camera and tripod, but how they happened to ascend the tree with me I shall never know.

My wife and I, packs on our backs, had been trudging through the wilderness near Bridger Lake in the Wyoming Rockies.* We were on the lookout for big game. Instead of guns we carried cameras, since we were making for the National Geographic Society a series of natural-color photographs of North American animals in their primitive surroundings.

Squashing over spongy ground, parting bushes with our hands, we had burst into an opening. There, not fifty feet away against a wall of willows, stood a moose with twins, all three craning their necks to browse the tender top shoots.

Lucie scrambled to safety on a rock ledge as I worked closer, trying to get poses of mother and young together. Finally I moved so near the 800-pound animal that her head completely filled the ground glass of my camera. She cocked her ears toward me. Enthusiastic over the grand close-up, I concentrated on focusing.

ON COMES THE MOOSE!

Suddenly the image on the ground glass blurred. I looked up. Here came the moose, ears back, muzzle outstretched! What happened then I do not recall clearly. I went up that tree in a hurry.

* In the Bridger Lake area, Hon. George Shiras, 3d, pioneer wild life photographer and naturalist, discovered and photographed moose on expeditions in 1909 and 1910. (See *Hunting Wild Life with Camera and Flashlight*, by George Shiras, 3d, published by the National Geographic Society, \$5.) At that time naturalists generally regarded the big animals as extremely rare in the Rockies below the Canadian border. Investigations showed them to be a subspecies of the well-known Eastern moose and they were named, in his honor, *Alces americana shirasi* (page 102).

In the meantime, Lucie had been photographing a squirrel with the motion-picture camera and had missed the action. When she looked down from the ledge, to see me and the moose glaring at one another, she was visibly disappointed.

"Try it again," she called. "We don't often have a chance to get a picture like that. What grand action—a moose chasing you up a tree!"

I failed to share her enthusiasm, but summoned my courage. When the moose withdrew about 25 feet, I eased nervously to the ground. The result was an anticlimax. The cow, no longer angry, completely ignored me. I took pictures of mother and calves from all angles (page 102). Peace reigned in the willows—but not for long.

Ten minutes later I was up that tree again. Lucie had handed the movie camera down from the ledge and I was busy shooting away when through a dark doorway in the forest emerged the head and shoulders of another moose, a bull this time. Freshly peeled were his antlers and polished for fighting.

Without warning, the bull moose charged on sight. I leaped for the tree and scrambled up, camera tripod bumping against the bark. The bull rushed beneath me, snorting and rattling his antlers in the dipping branches. Once more I sat safely clinging to the perch, hugging the camera.

AGAIN LUCIE LAMENTS

Within fifteen minutes the bull lost interest in me and followed the cow and twins into the forest. Lucie wailed. This time she had seen the action, but I had had both cameras. Down to earth once more I came. Ruefully we suspended moose photography for the day.

We found ourselves following this strange avocation much as a river follows its channel; something irresistible was drawing us on. During the eleven years I was in active

business we spent our summer vacations seeking unfrequented byways in the wildernesses of the West. While we camped from Arizona to the Canadian Rockies, we studied the animals about us, and discovered that we had a knack for gaining their confidence.

Returning home from early trips, we told friends of our experiences—of a mountain goat before us on a sheer wall, running at amazing speed in apparent defiance of gravity; of bighorn sheep lambs butting one another off a huge boulder; of a black bear and a bull elk cavorting about a forest, playfully bluffing one another.

"Why don't you take a camera so you can get pictures of some of these unusual things?" our friends suggested. Some even said frankly, "Why don't you bring back a few pictures so we can believe you?"

DEVELOPING IN A BEAR DEN

So we decided to take cameras. That was seven years ago. When the NATIONAL GEOGRAPHIC MAGAZINE published an article with some of the photographs we made on our first summer's camera tour, we felt rewarded for our trouble.*

Once we used a bear den for a darkroom, heated pans of sand in the campfire to keep developing solutions warm, and washed negatives in a mountain stream.

At one camp deer poked their heads into the tent each morning for graham crackers. At another, a pine squirrel, wheezing from a grass barb in her nose, was always on hand at mealtime, springing to the table, getting into everything and making a welcome nuisance of herself. At a third, a pine marten slipped into the tent during the night to carry away our eggs; and a bull moose with unusually large antlers and wattle, or throat pendant, was a neighbor.

Moose we found not only in the Bridger Lake country but also in the Gallatin Range, which lifts its pyramid crests into southernmost Montana skies. There, five years before, we had had excellent luck with moose, so we pulled the trailer up the main highway along the Gallatin River.

In a valley below the junction of the Beaverhead National Forest and the Gallatin Range, we turned off on a bumpy dirt road. Shadows were creeping down

the valley when we drew up to a familiar log cabin squatting among the hills. As we stopped, a wiry, weather-beaten man burst out of the doorway to call off two barking dogs.

A TRAILER FOR A TEPEE

In rolling cowboy gait he came over, extending his calloused hand.

"Hello, there!" he exclaimed. "We've been wondering what had become of you." Looking at the heavy trailer, he added, "Is that your tepee now?"

"Part of the time," Lucie said.

"Back it under that tree, then," the settler suggested.

His wife came running from the cabin, drying her hands on her flour-sack apron.

"You're just in time for dinner," she announced. "I was saying to Jack it was a pity to have so much to eat tonight and no one to help us enjoy it. He's just butchered a sheep and the vegetables's been extra good this year."

Western food and friendliness were at their best. After dinner Lucie helped clear the table while the host and I went out to dig supplies from trailer and car and to see that packsaddles were in order. We had to get an early start next morning, for Jack was to take out a hunting party a few days later.

INTO THE WILDERNESS BEFORE DAWN

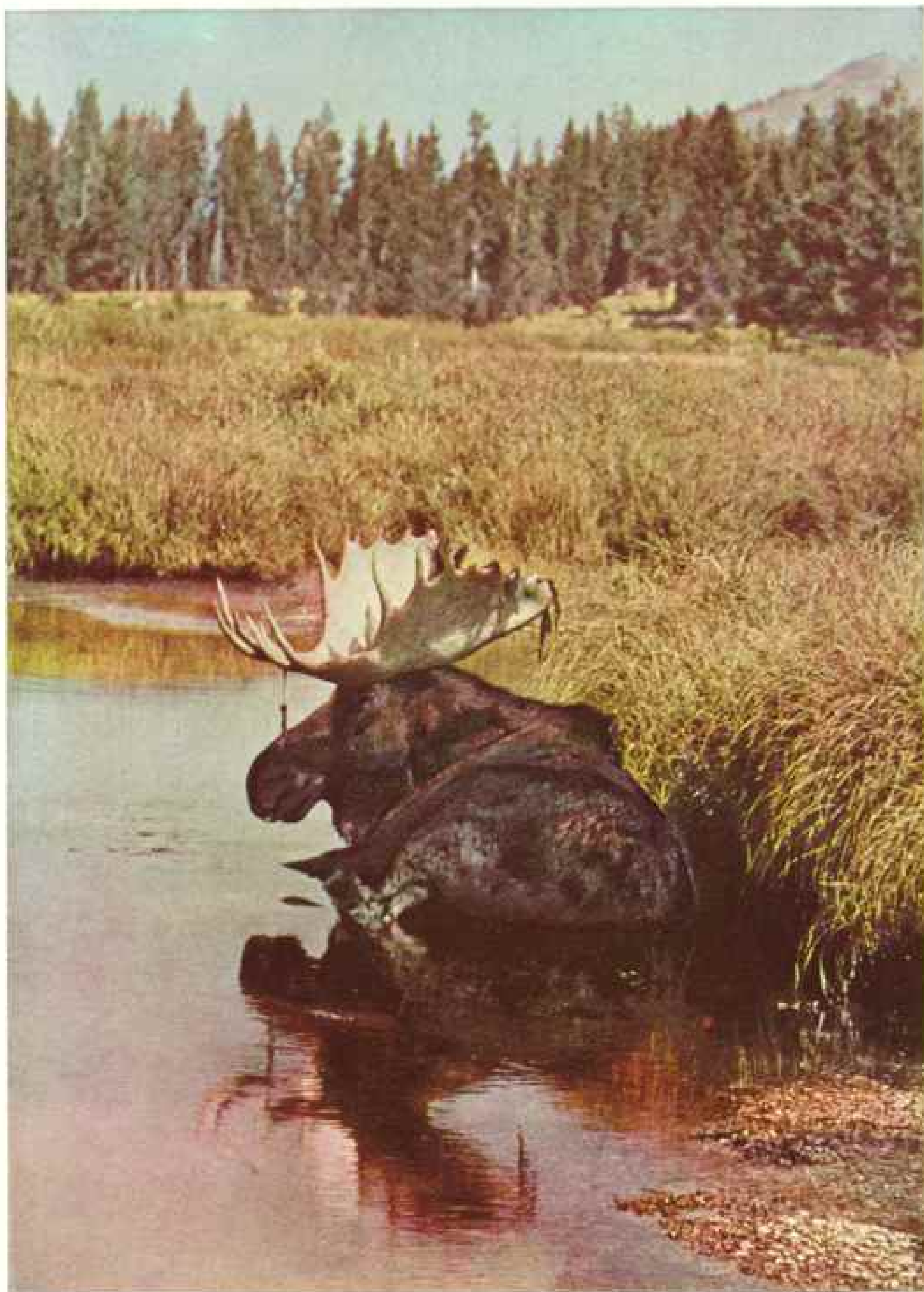
Long before sunlight penetrated into the deep valley we rounded up the horses, loaded them with bulging packs of bedding, food, cameras, and other camp conveniences, and were off. The animals picked their way between shrubby cinquefoil, now almost bare of yellow blossoms, to an open stretch dotted here and there with scarlet paintbrushes and late-blooming buttercups.

Above the click of hoof on stone rose the burble of a fast-running creek as our trail turned to follow along the bank. Soon we plunged into the cool of an evergreen forest where going seemed easier, thick needles of lodgepole pine silencing the beat of feet. Smells of pine and spruce mingled in a familiar fragrance.

Mid-afternoon found us winding along an elk trail through thick timber where we breathed deeply of the cool piny air. Near the edge of the forest the horses tugged the reins from our hands to drink at a rivulet trickling from a clump of lady ferns that concealed a spring.

* See "With Wild Animals in the Rockies," by Lucie and Wendell Chapman, in the NATIONAL GEOGRAPHIC MAGAZINE for August, 1935.

STALKING BIG GAME WITH COLOR CAMERA



© National Geographic Society

Kodachrome by Wendell Chapman

HIS CONFIDENCE WON, A MONARCH OF THE FOREST NAPS IN A COOLING STREAM

Mr. and Mrs. Chapman camped several days in the retreat of this wary old bull moose, in the Gallatin Range of Montana. Gradually he became accustomed to the human visitors and totally ignored their close approach. His wide, pointed antlers are losing their velvet. This soft skin envelops the headpiece during its rapid growth each spring.



© National Geographic Society

POKER FACE GIVES NO CUE TO INTENTIONS WHEN HE DECIDES TO CHARGE

The bull moose's huck-neck hair rises when he becomes angry, but then it's too late—he's on his way! Twice Mr. Chapman took to the nearest tree when he was charged while making pictures. This powerful fighter emerging from the waters of Mountain Creek in Montana has been rubbing his antlers against saplings. Shreds of velvet will cling to the prongs.

Kodachrome by Wendell Chapman



© National Geographic Society

Contributed by Wendell Chirpman

FEMINE CURIOSITY GOT THE BETTER OF THIS COW MOOSE—SHE BEGAN TO TRAIL THE AUTHOR

She turned the tables after he had followed her for an hour. The animal showed no hostility, even though her call (Plate V) was near by. From her neck hangs the moose "bell," a pouch of hairy skin.



FROM THE BIG SENSITIVE EARS SHE GOT HER NAME—MULE DEER. Cutover timberland, with a second growth, is a favorite feeding place for this graceful animal. When alarmed, she bounds high and wide over the tangled forest, rarely tripping or stumbling.



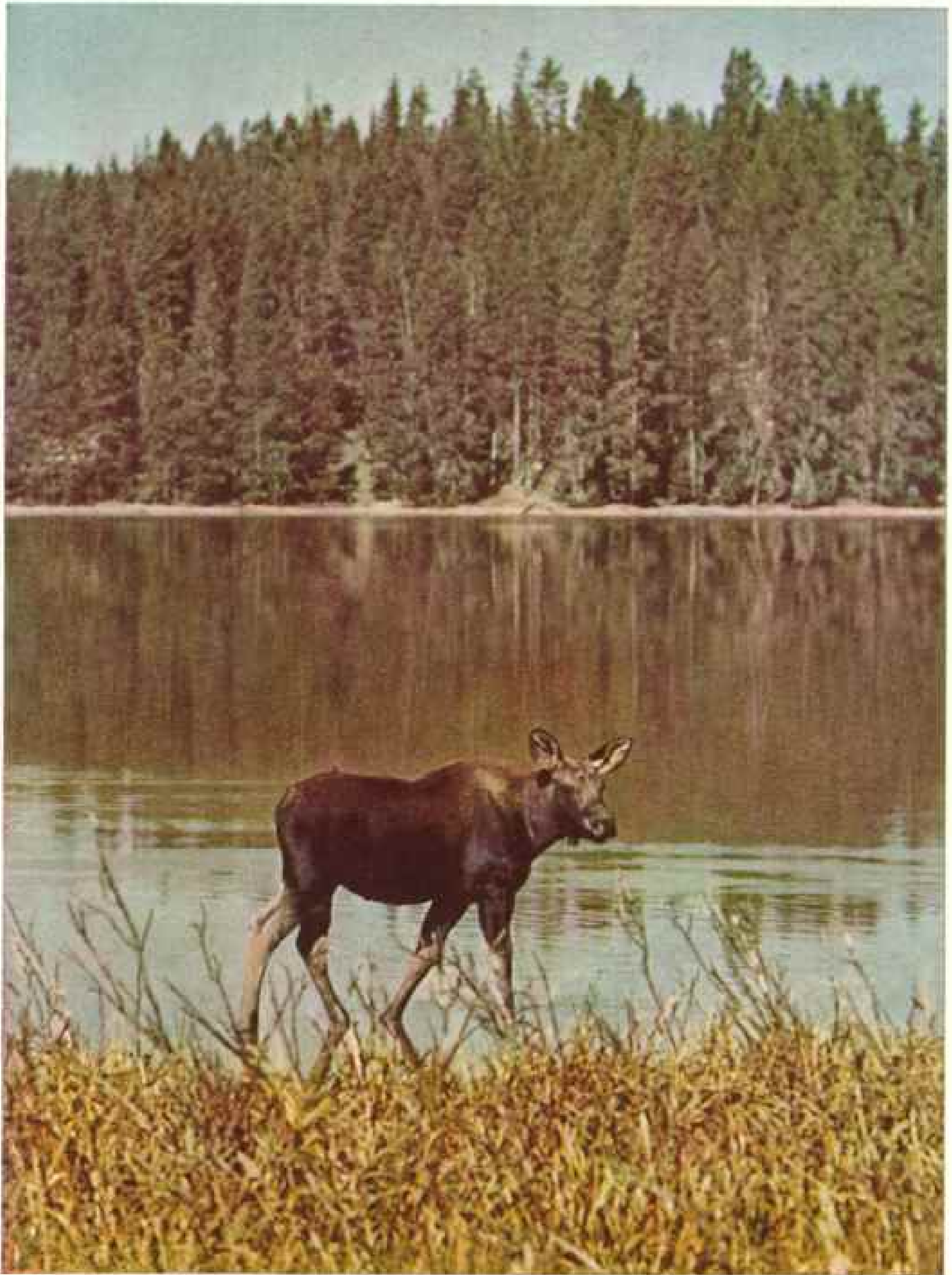
© National Geographic Society

Kodachromes by Wendell Chapman

BASHFUL BLOND AND BRAVE BRUNETTE PEEP OUT AT THE WORLD

The "cinnamon" cub is a full brother of the coal-black youngster. The two color phases often occur in the same litter. In the six months since their birth in the Montana Rockies, each has grown from the size of a grapefruit to a furry bundle weighing about 70 pounds.

STALKING BIG GAME WITH COLOR CAMERA

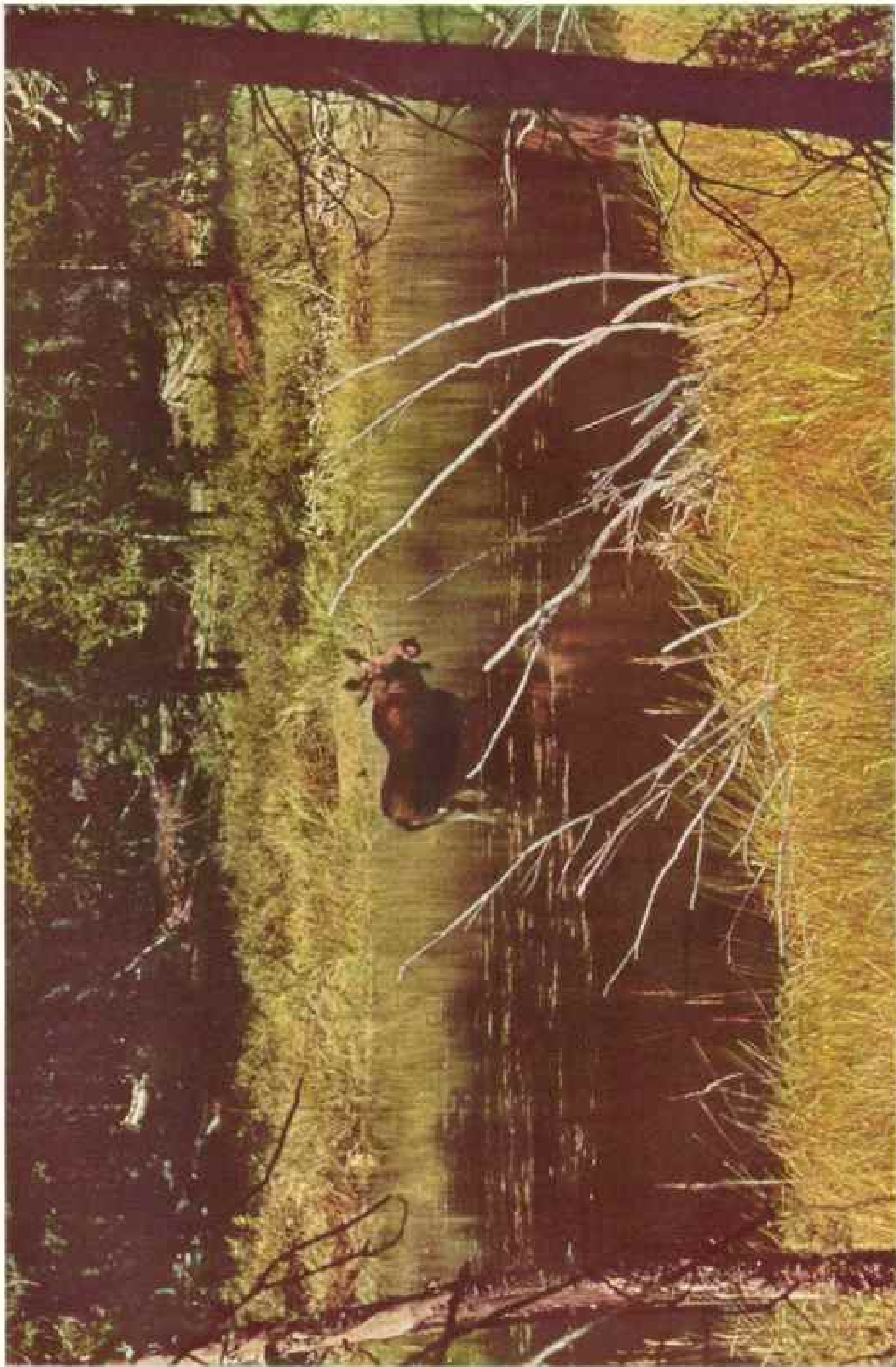


© National Geographic Society

Kodachrome by Wendell Chipman

IN LONG WHITE STOCKINGS A BABY MOOSE GOES WADING

His mother (Plate III) calls to him in low guttural grunts from her feeding place in deeper water. He responds obediently with shrill little squawks. A slight noise, such as the breaking of a twig, although not startling enough to rouse the parent to action, will set up a loud and lengthy chatter between parent and calf. When the youngster grows up, he will be taller than an ordinary horse.



© National Geographic Society

SECLUDED POOL AND WOODLAND, HAVEN FOR A YOUNG BULL MOOSE, CREATE A SYLVAN PHANTASY

In this former home of beavers, the animal liches on succulent water plants, most relished item on the summer menu. New velvet-clad antlers are tender. He manipulates his spreading palms so deftly in thick growth that they seldom touch a low-hanging branch

Kodachrome by Wendell Chapman



© National Geographic Society

AS DO TREES AND GRASS, THE AMERICAN ELK COW MODIFIES HER COLOR WITH THE SEASONS.

Yellowish-gray haunches become a deep orange brown in early winter. By spring her whole coat fades to a light buff and often becomes ragged from ticks and general wear and tear. This cow showed no fear as Mr. Chapman approached her in the Montana back country, but her companion, a magnificent bull, fled into the forest. Indians called the American elk "wapiti," which has remained the official name.

Kaolachrome by Wendell Chapman



© National Geographic Society

Kodachrome by Wendell Chapman

AN ORPHANED MULE DEER TAKES ITS MILK STRAIGHT FROM A KETCHUP BOTTLE

Found abandoned in Arizona foothills, the lonesome little fellow was turned over to its devoted young foster mother, who raised it with care. Mule deer often are incorrectly called "blacktails." The short tail is white, except for a small tuft of black at the tip.

By this same spring we had camped before. Grass and flowers almost covered the blackened rocks of our old campfire, but they did not erase the memory of those days with our friends of the wilds.

Below the camp site lay a meadow containing the unnamed lake where we hoped to find moose. Since last we had seen it the upper end had been filled in with silt and sedges. The small oval of water lay contracting annually within the meadow, whose grassy banks were squeezing it from all sides. A forest marched an advance guard of young trees down to take over both. Already the lake seemed to have given up, for the diminished surface was a solid reflection of encroaching grass and trees.

MOOSE AND ELK RETREAT

From the edge of the timber where we stood, we saw black furrows crisscrossing and skirting the meadow. But we sighted none of the moose and elk that had made them. The clatter of hoofs and the shouting of the guide to the hot, snorting horses had frightened away the wild life, which would not return until he had left with the pack train. Rarely having had luck with wild creatures when other people were present, we were willing to have our friendly guide return home promptly.

The only "assistant" we have ever had was a black bear cub that became intrigued by the insectlike buzzes and clicks of the cameras (page 103). Necessary as guides are, we employ them only to pack us in to base camps, where they leave us to follow the animals in our own way.

From the top of the packs we unloaded the two four-foot parcels containing our folding canvas boat. Next we tossed to the soft grass the rolls of bedding, air mattresses, tent, and folding table. Out of the saddle boxes we lifted more carefully the photographic supplies and food, which we turned over to Lucie. She unpacked kettles while I gathered dry pine sticks for a fire.

Scarcely needing to look, Lucie reached here and there in the boxes, pulling out a package of macaroni, a roll of dried soup, powdered milk and salt, and had them in kettles ready to boil. She mixed up a pan of biscuits which I baked in the reflector oven before the open fire. Crackers, macaroni and cheese, gooseberry jam made from wild berries gathered in our last camp, and tea completed the lunch.

We do not use any stimulant except weak tea with a tablespoonful of honey per cup. After a 20- to 30-mile hike, a pint of this "pick-me-up" revives us completely in 15 to 20 minutes with no let-down afterward. The fact that we do not smoke has proved fortunate, for we have been admitted to areas closed to the public because of fire hazard. We never carry guns.

SELECTING A CAMP SITE

We chose a site beside the silver branches of a sturdy alpine fir, whose candlelike cones stood up as if to light our camp. Here we pitched the tent behind a hedge of alders and willow clumps bordering the rivulet.

On this location the rising sun dried out dew and gave warmth; yet the forest wall afforded protection from wind and furnished shade during the heat of the day. The camp was concealed from the lake and meadow on which we expected to see moose and elk by peeping through a lattice of willows.

With all our precautions for concealment, suddenly the chatter of a pine squirrel ripped the silence of the cool valley as she announced our presence, at the same time berating us for intruding upon her homestead.

At her first volley Lucie dug into our bags for shelled almonds, pecans, raisins, and crackers, which we put on rocks and fallen trees. Canada jays, called "camp robbers," swooped from nowhere to feast on the offerings, but before our sleeping bags were unrolled and the boat set up the pine squirrel discovered the bribe and complained no more (page 99).

FOUR TROUT IN 15 MINUTES

Before the sun left the silent valley we unpacked fishing rods, fitted the wooden keel and metal ribs into the canvas boat, and pushed out through slapping wavelets into the lake.

At one end we found deep water where within 15 minutes four large trout exploded the surface and made the lines sing before giving up. We had all the fish we could eat for dinner and breakfast.

Carrying the boat up the slope, we turned it upside down near the tent, so no evidence of our presence would be visible from the lake. Also, the craft afforded a shelter for our provisions.



A PINE MARTEN BRINGS HOME THE BACON

Lured by the tantalizing odor, this graceful American sable scampered down the tree to snatch the slice (pages 99 and 114). Sharp claws rattling on the bark, he darted back into the high branches. He can leap four-foot gaps in the treetops with the agility of a squirrel.

During the evening we peeped through the hedge of willows, expecting to see moose and elk in the lake and meadow, but the splashing oars and the tang of campfire smoke kept them away. After dinner we carefully packed our food, and, when all was still and dark, crawled into our sleeping bags.

In the night a stick snapped just outside the tent. I jumped up and played the flashlight about. Two bright spots burned back. Crash, thump, thump—into the forest fled some large animal.

In previous years we had been frightened by a similar commotion in the dark, think-

ing it was a bear, but now our ears told us that it was a mule deer. From the sounds we could visualize the peculiar gait of the animal. We heard it, all four feet together, bouncing in and out of small openings among tangled, cutover timber where another kind of deer, a dog, or a wolf can hardly penetrate. Whenever an animal goes bounding away as if on a pogo stick, we know it is a mule deer.

SALT AND GRAHAM CRACKERS
LURE A MULE
DEER

"Put out salt and graham crackers," Lucie suggested, "on that old stump where we can see it from the tent in the morning."

The bait set out, soon we dropped again into sound sleep,

to awaken only at dawn when boisterous gabbling of mallard hens in the lake roused us. Thumping of hoofs beside camp snapped us upright in bed. Thrusting our heads out the tent, we saw our night visitor, a mule deer doe, chasing another from the salt (Color Plate IV). They bounded away in stiff-legged leaps three or four feet high, easily clearing currant bushes and tangled timber.

In the chill air we dressed rapidly and started a warming fire. Lucie then went for the fish, which we had placed under the upturned boat.

"Didn't you put two fish in here?" she

asked, picking up the pan, which held but one.

"Why, the larger one is gone!" I said. "Maybe we heard a bear after all."

"No! A bear wouldn't have taken a single fish, and he'd surely have overturned the boat."

We did not have to wait long to solve the puzzle. Lucie was serving bowls of oatmeal with dates when the rattling of claws on bark on a limb overhead brought us up with a start.

"There's the little scamp!" Lucie cried.

A PINE MARTEN ASKS FOR MORE

A graceful pine marten, or American sable, clung with ebony claws, cocked his kittenlike face at us, and wiggled a sensitive nose toward the remaining trout now frying in the skillet. Lucie cut a piece of bacon rind and fastened it on the tree trunk to lure him while I adjusted camera on tripod (page 98).

By early afternoon the pine squirrel became confident and kept us busy digging into bags and boxes for dry oatmeal, nuts, and crackers. Whenever her chatter was of fright, wild neighbors heeded her warning; but when it was from anger, they paid no attention to her noise.

Hardly had the squirrel ended one of her tirades at the jays for robbing her tree-top store of crackers than we heard a twig snap not twenty feet away in a clump of evergreens behind us. Cautiously we



RAISINS BRIBE A FOREST CHATTERBOX

So tame did this pine squirrel become that she gave the campers little peace unless she was pampered. Mrs. Chapman quieted the noisy intruder to the Rockies camp with gifts of shelled almonds, pecans, and other dainties (page 97).

turned. From a hole among the branches of a lodgepole pine protruded a long, dark head with alert ears. Sunlight glistened on the homely face of a cow moose.

We were not afraid of this cow, despite my experience with the other one. Wild animals do not go about looking for trouble.

Our moving about for close-ups interested her, but she did not eye us intently as if hostilely inclined. Instead, she casually watched a few minutes, then grunted. From somewhere behind her came a high-pitched answer. The head disappeared.

A minute later the cow emerged down the slope, on the way to the lake, a stilt-legged calf capering after (Color Plates



SWIRLING WATERS SWAMP A WOODLAND CAMP

The authors awakened one night to find their tent in the center of a Canadian Rockies "river" 150 feet wide and one foot deep. Four inches of rainfall in 24 hours produced rushing streams where none had existed before. By the time cameras and film were rescued, other equipment was eddying round and round in the tent.

III and V). Leisurely they browsed to the lake, turning to look at us every few minutes.

Out in the water the mother ducked her head to feed on the succulent underwater plants. Each time she came up for air she grunted to the calf, which answered from the grassy shore.

When we approached to within a few yards of the young one, the dialogue between it and the mother grew into an excited chatter. But the cow, remaining in the water, seemed to realize that we were friendly and soon paid little attention to us. Her visit to our camp was the beginning of an unusual comradeship between us. During the days that followed, we trailed the pair almost as unnoticed by them as if we had been other moose.

TRAILED BY A COW MOOSE

One morning as the cow slowly moved among the willows, browsing, we followed only a few feet behind her. After an hour she swung around, intently focusing eyes and ears in our direction. We feared that this interest in us might be a danger sig-

nal, and so Lucie withdrew with the motion-picture camera while I sat upon a log with my still camera.

The moose grazed so close I could have reached out and stroked her coarse hair. I rose and edged away. She turned and, for an hour, followed a few feet behind me, looking up often, seeming to enjoy my companionship.

Nor was she the only friendly moose we found while encamped at the lake. By sunrise one morning we started over a ridge for a pond, below a V-shaped patch of aspens on a distant mountain slope. Even though we had marked the location, it was so long since we had visited the little lake hidden in the forest that we spent most of the morning trying to find it.

The "laughing" of a loon at last directed us through the forest to the pond. At the timber's edge we stopped to photograph deep-blue fringed gentians, darker monkshood, and rosy mimulus growing along the damp bank of the spring-fed trickle.

As we slogged from the spring into the marshy sedges, Lucie stumbled upon a



LIKE A SHOT OUT OF A GUN, BRUIN LEAPS FOR LIBERTY

Because he has been bothersome to visitors in Yellowstone National Park, rangers have carted him about fifty miles away for punishment. He loathes the truck ride and loses no time in making an exit when the end gate is raised.



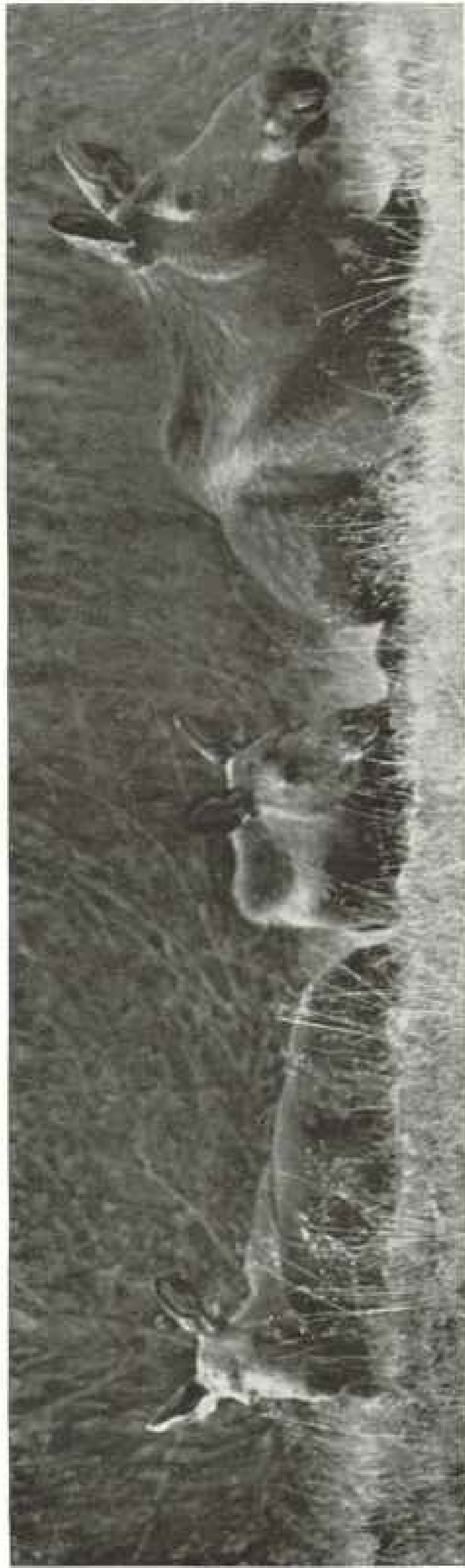
BY A SHORT CUT HE SPEEDS BACK TO THE CAMP GROUNDS, WHERE FOOD MAY BE HAD FOR THE BEGGING

The black bear knows that succulent gifts from campers await him at the end of the trail. An old bear with cubs once outwitted the Chapmans in Yellowstone and got more than her share of supplies from their tent (page 113).



HOW CLOSE MAY HE GO? MR. CHAPMAN TURNS A MINIATURE COLOR CAMERA ON A SHIRAS BULL MOOSE, 60 FEET AWAY

This subspecies (*Alces americana shirasi*) is named for George Shiras, 3d, the veteran naturalist and author of *Pounting Wild Life with Camera and Flashlight*. He found moose in the Bridger Lake District of Wyoming some thirty years ago when they were believed to be nearly extinct in the Rockies.



THE COW MOOSE HAD JUST CHASED THE AUTHOR UP A TREE, BUT NOW SHE IGNORES HIM AND PEACEFULLY JOINS HER TWINS. When he tried to induce her to repeat the attack so that his wife could get photographs, the animal refused to budge (page 87). Taken near Bridger Lake, Wyoming.



"ARE YOU READY, MOTHER?"

The only assistant cameraman the Chapmans ever had was this black bear cub in the Gallatin Range, Montana (p. 97). Teddy's firm grasp on the tripod of the motion-picture camera gives an unusual close-up of his left forepaw. Only one of the short claws is visible. His five toes are equally well developed.



EARLY RISERS—BUT THEY BREAKFAST AT 10:35!

Strenuous morning field work preceded the meal. The two-room trailer, equipped with water tank, range, fan, and other conveniences, is the authors' base camp in the Rockies. Warm baths in the built-in tub are luxuries after several days on the trail. The gate-leg table seats eight persons (page 113).

bleached antler which had been shed several years before.

Picking it up, she exclaimed, "Why, it looks just like the 13-point antlers of that big fellow we saw five years ago in this same valley—the big black bull who had the prize wattle, remember?"

"Then he must winter here, too," I replied, knowing that moose in the Rockies shed their antlers about January.

"I wonder where he is now?"

"There are plenty of willows and evergreens in this valley for him to eat. If he stays here winter as well as summer, maybe he's not far away now."

"Looks as if porcupines have been gnawing the points," Lucie said, looking at the antlers. "Or maybe it was a coyote."

Scarcely had we started on than a huge, dark moose sprang up in front of us, turned his head, eyed us, then trotted off.

"That's the very bull," Lucie said.

"I'd know that wattle anywhere," I agreed, watching the long flap of hide and hair swaying under his throat as he walked.

"But his antlers——"

They looked more like large deer antlers than the huge shovel affairs with points and prongs which he carried when first we saw him. His sleek body sagged only slightly with age, but during our five years' absence he had passed his prime. With waning strength, each successive summer he had grown smaller and smaller sets of antlers until this year's growth was almost devoid of palms. He was now in his decline, and his antlers were hardly heavier than when he was a four-year-old.

MOOSE TO RIGHT, MOOSE TO LEFT

It was difficult to steady the tripod legs firmly on the marshy ground where he began grazing, so I hurried through the forest to get in position for a better picture.

Suddenly I heard a crash. Up from a willow clump shot antlers and body of an enormous bull. He glowered down upon me, rags of bloody velvet hanging from his massive antlers. I froze in his presence. Up popped two young bulls. Then Lucie scared up a fifth. We were in a moose "ambush." In all, seven arose about the pond (Color Plates I, II and VI).

We followed the largest bull. He drew away. Disturbed by our approach, and restless from the itching of the drying antlers, he threshed willows and saplings, rubbing more skin from his weapons. We

approached as close as we dared—about 60 feet when he was standing and 25 when he was lying down.

On the way back to camp we entered a small clearing in the evergreens where we surprised, grazing on yellow grass, an elk cow and a bull with six-pronged antlers. Slender legs, luxuriant mane, and proudly held head gave the bull a regal presence as, alert and intent upon us, he stood for a moment beside the cow (page 117).

ELK COW POSES; BULL RUNS AWAY

His majestic bearing vanished as he saw us and bolted. Nimble winding through the trees, head weaving from side to side to avoid hitting his cumbersome antlers, he seemed almost to float up the mountain.

Two hundred yards away the elk circled behind a clump of firs and stopped. He eyed us through a hole in the branches, exposing only part of his face. Every few seconds he coughed an explosive warning bark to the cow, which stood quietly watching (Color Plate VII).

Almost a duplicate of the bull in size and color, she lacked his headdress and majesty. She watched us while, in full view, we adjusted cameras on tripods and moved about for better angles and light. Elk are nervous, wary creatures, which migrate with the seasons. During the late fall they are killed by the thousands. Therefore it was a surprise to find this cow so unafraid.

Next morning we broke camp and packed the horses before the sunshine had dried the dew from the tent. Harty appetites, the result of hiking 150 miles in 10 days, had left little food to pack. Once started down the trail, we made good time, for we were as eager to return to our base, the trailer, as the horses were to reach home and oats.

Long before shadows fell we were back at the ranch. We asked the packer and his wife to have dinner with us in our two-room home on wheels.

In the trailer Lucie exchanged high boots and breeches for light, clean clothes from two cedar-lined, full-length wardrobes while I pumped water from the tank and heated it on the gasoline range. Warm baths in the built-in tub were luxury after the cold ones in the lake. The convenience of the shaving cabinet was appreciated after I had used a tiny mirror hung on a tree in camp.

STALKING BIG GAME WITH COLOR CAMERA



ALERT AND WARY IS THIS PRONGHORN, ATTRACTED BY AN INTRUDER

Often while his fellows rest or graze, a watchman ascends a knoll where he has an unobstructed view in all directions. When he senses danger, he gives a snorting bark and the whole group of curious antelopes gallops up the hill for a look. If trouble seems near, away they bound.

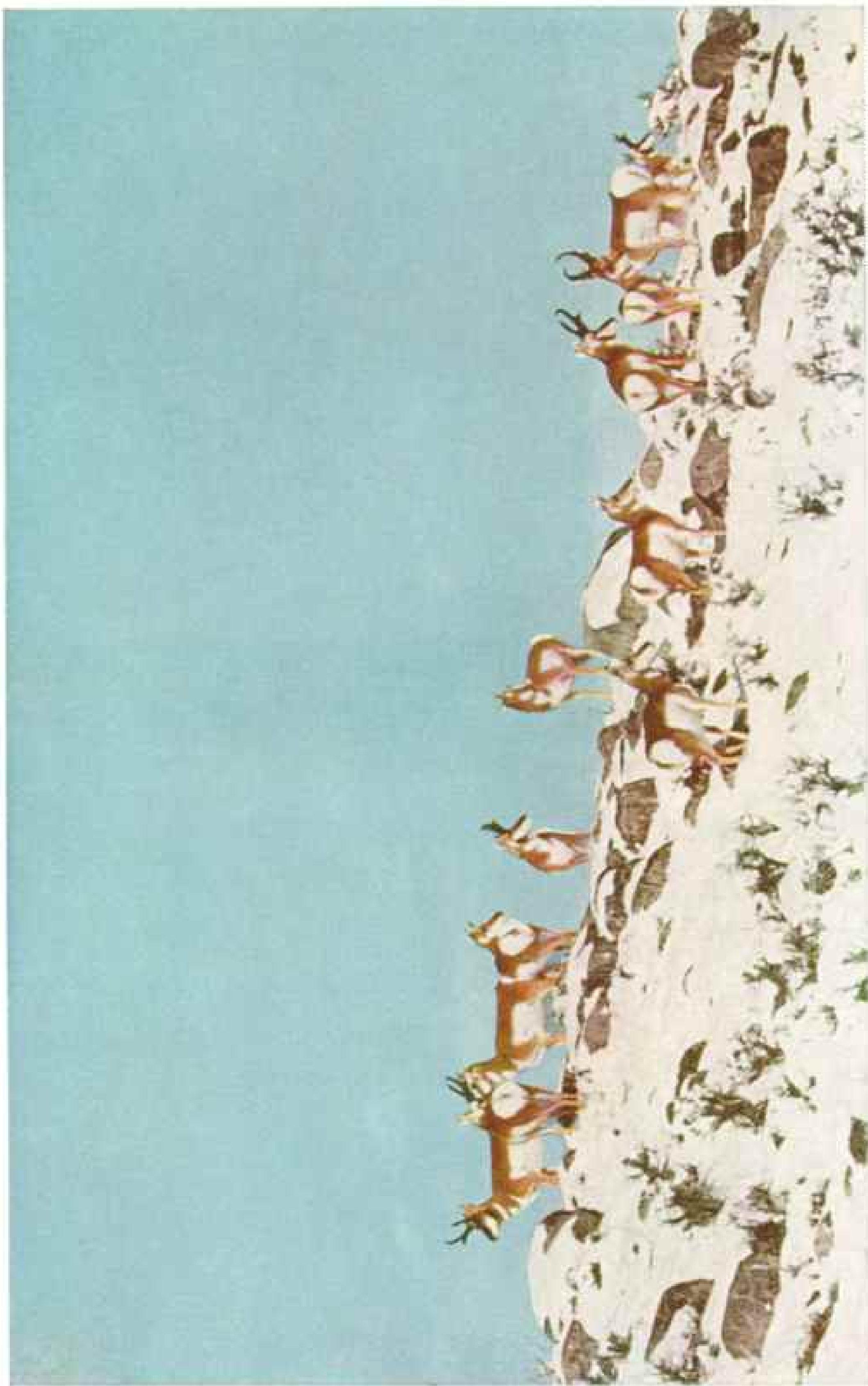


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Kodachromes by Wendell Chapman

MOTIONLESS, A PRONGHORN SUSPICIOUSLY WATCHES A RIVAL BUCK

The tawny creature paid no attention to the author and was too lazy to pose, until another antelope appeared. Now the animal stands rigidly at attention, heedless of the blades of grass in his mouth.

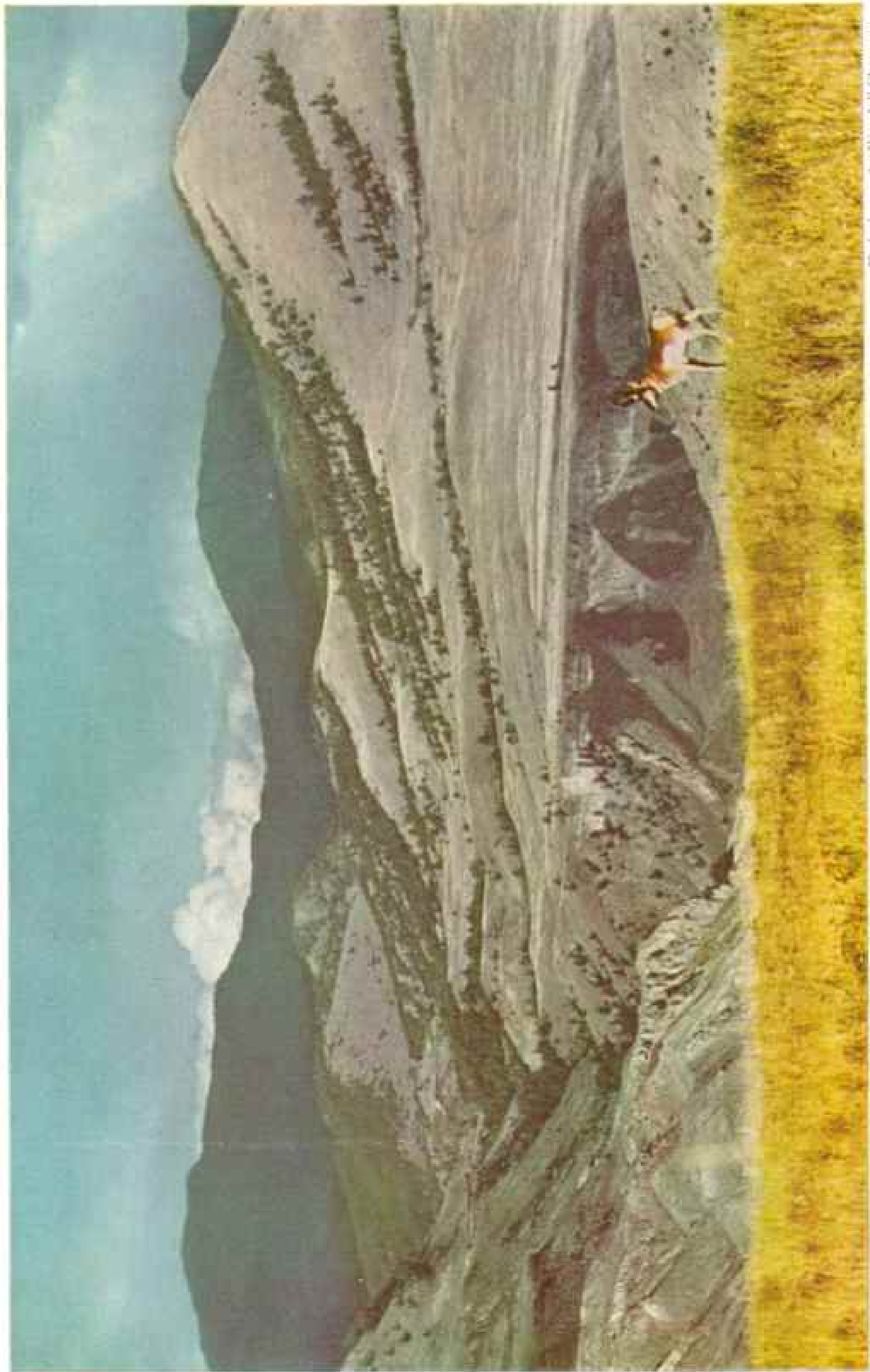


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STATUES IN SHELLOLETTE AGAINST A WINTER SKY, PRONGHORNS WATCH TENSELY AS A GOVGETH MOVES ON A DISTANT HILL.

Keelachrome by Wendell Chipman

When snows retard their speed, the animals are more wary than ever. They eat sagebrush in winter, because grass is so deeply covered that they cannot paw it out. Sometimes, in severe weather, they come down from the rough Devil's Slide country, north of Yellowstone, to lower farming lands, seeking forage. The pronghorns are a distinct family. Their hollow horns are shed each year and new ones develop over the remaining busy year.



© National Geographic Society

Kodachrome by Wendell Chapman

"WHAT YOU SEE CAN'T HURT YOU" IS THE PHILOSOPHY OF THE PRONGHORN.

Telescopic vision enables this buck to see much farther than a man. From his vantage point on the edge of a canyon in the Montana Rockies, he detects a moving object. In vain the author swept distant slopes with binoculars, trying to find what attracted the antelope's attention.



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FLEETEST QUADRUPED IN NORTH AMERICA IS THE PRONGHORN, CLOCKED AT 60 MILES AN HOUR

Kodachrome by Wendell Chapman

The cheetah, or hunting leopard of Asia and Africa, can exceed that record, but only for short spurts. So confident is the antelope of its superior speed that it invariably cuts across in front of pursuers, apparently to be tantalizing. One crossed the path of Mr. Chapman's automobile while the car was traveling 45 miles an hour. When a pronghorn is alarmed, the long white hairs of its rump patch rise on end to form two large chrysumbumlike moieties,



© National Geographic Society

Illustration by Wendell Chapman

ONCE A ROAMER OF THE OPEN PLAINS, THE PRONGHORN HAS BEEN FORCED BY MAN INTO ASPEN GROVES IN THE HIGHLANDS

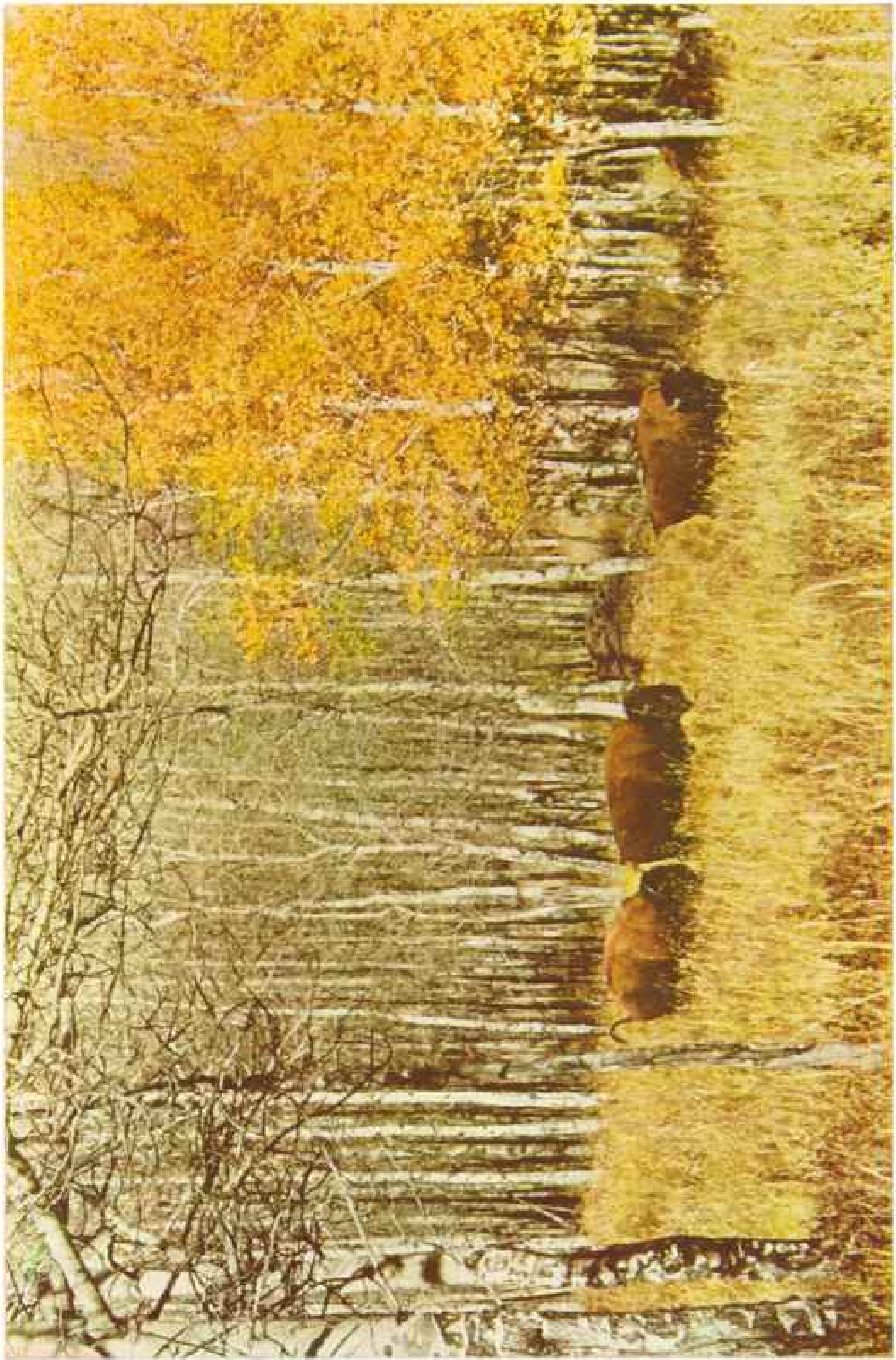


Kodachrome by Wendell Chagnon

DEEP IN THE BACK COUNTRY OF YELLOWSTONE TOWELL, REMNANTS OF AMERICA'S GREAT BISON HERDS

When white men first came to America, buffalo roamed the Plains in countless millions. After the Civil War, as the railroads pushed westward, reckless slaughter of the bison began. By September, 1883, only one large herd of about 10,000 head was left. Sitting Bull, accompanied by white hunters, found them in a North Dakota canyon and exterminated them in less than two months.

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Kodachrome by Wendell Chapman

BISON CLARES AND A RISING TALL WARNS THE AUTHOR, 40 FEET AWAY, TO COME NO CLOSER

Unlike white hunters, Indians killed only enough buffaloes to supply themselves with meat and hides. When destruction was at its height, the ancestors of this small herd drifted into Yellowstone. Now they are thriving under protection.



HUGE HEART AND LUNGS GIVE THE BISON REMARKABLE ENDURANCE.

The author has seen a shaggy giant run nearly 40 miles in one day, tiring out three sets of horses. Usually lethargic, the buffalo exerts himself only when pursued.



© National Geographic Society

Kodachromes by Wendell Chapman

THEY PREFER THEIR MEAT COOKED, THANK YOU!

When Mr. Chapman gave roast beef to these pet badgers on a Nevada ranch, they ate it greedily, turning away from their regular diet of pocket gophers. Later they buried the gophers for a "rainy day."

Refreshed and clean, we were soon at work. Noise from the typing of my notes filled the front room while Lucie's rattling of pans and the soft whir of an electric fan made the kitchenette hum. Through the sliding doors, the rhythmic sounds of a spoon clanking inside a mixing bowl told of a cake in the making and aromas revealed that it would be devil's food with chocolate-pecan frosting.

An hour later a knock at the door announced Jack and his wife, who stood with fresh beets and carrots from the garden, a loaf of homemade bread hot from the oven, and a pitcher of milk.

Lucie called, "Dinner is ready."

DINNER FOR FOUR IN THE TRAILER

We seated ourselves at the gate-leg table in the front room where a delicious dinner was served on colorful china. We were not crowded, for we have served as many as eight. After dinner, our guests were intrigued by the electric lights, bookcases, typewriter stand, numerous drawers, storage cabinets, closets for brooms, linen, and sewing. They could not understand how there could be so many built-in conveniences and at the same time so much room in a trailer 20 feet long by 7 wide.

Next morning, with cupboards and icebox full of fresh vegetables, eggs, milk, and butter purchased at the ranch, we started for the highways of Yellowstone Park.

Ordinarily the best wild-life haunts are not along the roads, but some of the national parks prove an exception, particularly the Yellowstone.

Near the hotels and camps more black bears gather than we ever see in the wilderness. Free to come and go as they please, these bears enjoy the normal activities of wild bears, which they are. They spend days in the woods gathering fruits and berries, cropping grass and herbs, digging roots and ground squirrels, and tearing apart logs for grubs and mice.

AN OLD MOTHER BEAR OUTWITS US

But the camp and highway bears have also learned to match wits with man. In foraging for food they use to the utmost their native shrewdness, and we find them exasperatingly and embarrassingly clever.

While we were cooking breakfast on the campfire one morning, an old bear with cubs appeared on the slope above us. They sat peering through the trees,

sniffing at the frying bacon. Unlike most bears which hang around camps, this family ambled off into the timber.

Because the morning was frosty we ate inside the tent, closing the flap against the cold. We left our food stores just outside under the fly, thinking that the bears were gone.

All was silent outside until we arose to clear the table. At our stirring, pans clattered and feet thumped the ground. We dashed out and saw the old bear romping toward the cubs, a pail of flour dangling from her mouth. I ran after her. Upon reaching the cubs she punctured the can with her teeth, then dropped it, and all three scuttled up the mountain. At the spot where the cubs had sat, there lay the wrapper of our new slab of bacon, the honey bucket licked clean, and a messy rag—all that was left of our oatmeal.

The old bear had outwitted us. Having been stoned out of many a camp, she was too smart to come into ours when we could see her. From concealment she had watched and, the moment we closed the tent, she had stealthily slipped in again and again to select choice packages for herself and cubs. On her last trip, having been interrupted by our coming out of the tent, she had grabbed the first package within reach. Upon discovering it was only flour, she dropped it.

Having come to understand the nature of black bears, we feel absolutely safe in their territory. Ordinarily a stone or stick of wood will send them flying. Sometimes we see and photograph bears in wild country (Color Plate IV), where we have no fear of them, for in the wilderness black bears are one of the least dangerous of all big game.

GRIZZLY BEARS REFUSE TO BE BLUFFED

Grizzlies are entirely different. Photographing them is uncertain and hazardous. They are nocturnal in their habits and larger and more fierce than the blacks. They appear only rarely and unexpectedly. Usually they shun people, but if surprised at close quarters they are likely to charge.

Last summer I was standing alone on a mountainside above timber line in the Rockies, color camera on tripod focused on a flock of bighorn sheep 150 feet away. Behind me the silence was broken by a clatter of rocks. I wheeled. Two grizzlies, not 50 feet off, hair bristling, mouths



BABY MARTEN DAIN'TILY SIPs HONEY FROM A SPOON

A rare visitor to the Gallatin Range camp was this young American sable, or pine marten, not old enough to be as suspicious and wary as his parents. When they hunt mice, squirrels, or other prey, they often stand on their hind legs to peer about. Their rich brown coats threaten their existence, for hunters pursue them in winter for their pelts (page 98).

open, galloped down upon me—not a tree or cliff near, no possible escape.

Facing the charging animals, I shouted, swinging the lens toward them. At thirty feet they halted. One reared, head and shoulders silhouetted against the sky. The other stood facing me. In the background curved a magnificently rugged mountain range—a setting that comes once in a lifetime.

Instantly I decided to snap two pictures, then check for focus and take more. I had barely snapped the camera when the rampant bear dropped to all fours.

Both milled behind boulders and disappeared into a ravine. I rushed after them. In full sight the grizzlies ambled over a rock slide below me. I got two miserable pictures. Down a ledge I scrambled, following the pair until they disappeared into timber where I dared not follow.

GRIZZLIES PAY US A CALL

Later one October evening we decided to try for flashlight shots of grizzlies near the main loop road in Yellowstone Park. We planned to spend the night in our trailer, in a valley near the Canyon feeding grounds. With the tourist season over, park employees had recently discontinued the daily serving of table scraps to the bears.

At our camp site I poured half a sack of oats on the ground twenty-five feet from our car and trailer. Then I fastened a flash reflector on a stake beside the bait, and ran the opposite end of the cord with battery and switch through an open window to the camera. With more oats and other food on the floor inside the door, and a supply of flash bulbs and film ready beside the camera, we retired.

Scarcely had we turned out the light and pulled up the covers when we heard a familiar breathy "woof"—a bear vigorously exhaling a blast of air. Delighted



SNOWBOUND IN THE ROCKIES—BUT SNUG AND WARM IN A TRAILER HAVEN

Held fast by blocked roads, the authors caught up with accumulated work. Darkening the kitchenette, they developed negatives and then hung them up in the living room to dry from the heat of gasoline stove and lanterns (page 120).

at the sound, I got out of bed and tiptoed to the camera at the other end of the trailer.

In the starlight loomed an enormous grizzly. Deliberately he swung his ponderous head toward the trailer, then moved on to the pile of oats, where he stopped to munch. I touched off the photo flash. The flare showed a bear slumped over—a shapeless hulk, head hidden by grass.

Immediately I turned on the searchlight. The old bear had not moved. That was not according to rule. Always before, grizzlies had fled at the glare of the flash. Now, caught in the steady beam of light, the big fellow looked up and continued eating unannoyed.

Crossing the trailer floor, I turned the searchlight out the back window. There stood another grizzly. From a third window more grizzly eyes reflected the beam: a wide pair here, a narrow pair there; a wide pair with a narrow pair on either side beyond—a mother and cubs. Eyes burned back from every side as I flashed the light. Another huge form loomed between car and hitched trailer, and ambled over to join the feeding grizzly.

The circle of eyes drew closer, bodies of bears gradually growing visible under searchlight illumination. Frosty air popped from their nostrils. All about in the dark we heard snorting exhalations. When the pile of oats was gone, the pair of feeding giants sat up and waved their noses inquisitively toward us.

Lucie whispered, "The food!"

TRAILER STORES NEXT ON GRIZZLY MENU!

Chills raced along our spines; our trailer was redolent of food! Bacon, fresh meat, fruit, sugar, honey, everything bears like. And between us and the grizzlies only frail trailer walls!

In a feverish desire to get rid of the bears, we forgot all about pictures. It dawned on me that grizzlies have sensitive ears and are panic-stricken by din. Beneath the sink I dived and snapped out a dishpan and basin. Out of the window I banged them, frantically. The bears merely pricked up their ears at the clatter and began moving in upon us.

In a cold sweat I set those pans on the floor without a clink. Banging was the grizzlies' dinner call! In clanking gar-

bage cans Park employees had brought food to them all summer long. The bears kept moving in, ears cocked and noses waving expectantly.

Desperately I grabbed the lantern and lighted it. I jumped about the trailer, rocked it, waved the light, shouted. I set the lantern at one window, threw out flash battery and switch from the other open one and closed it. A few paces away half a dozen bears sat down, ever waving their noses toward us. The others, disliking the light, withdrew until only their eyes shone in the darkness as they watched.

"Let's get out of here," Lucie urged.

"That's just what I'm trying to do," I replied. We had been in tight places before with wild animals, but this was the first time I ever found Lucie concerned.

DOWN A GRIZZLY-LINED PATH TO SAFETY

Grabbing a lantern, I rushed for the door, swung it open, leaped to the ground. I snatched up a piece of firewood and hurled it toward the nearest grizzly, but was mighty careful not to hit him.

With all my bustle and bluff the grizzly did not run. He just eyed me. Tensely I watched for signs of bristling. After a terribly long time—it must have been four seconds—he turned aside, his hair yet smooth.

Gripping the lantern in one hand, I snatched up the ax with the other, vigorously whammed the ground, and shouted. The old fellow withdrew a few paces, but so deliberately! Others began edging away slowly.

Clad only in pajamas and slippers, lantern and key in one hand, ax clutched in the other, I mustered up courage to dash from trailer to car. Luckily they were still hitched together and ready to go. Over frosty grass I raced.

Through habit I had locked the car door—out there in that no-man's-land! Quickly I forced the key into the lock. Through a blockade of bags and boxes piled to the roof, I dived, excavated the pedals, started the car. Off we lurched in low over the bumpy road.

A mile away I stopped and went into the trailer. Lucie, flashlight in hand, was prospecting the floor, picking up cushions, pans, and packages of food which had come crashing from everywhere and lay in a swirl of rice on the linoleum.

"That's about the roughest ride I ever had," she said. "But I'm glad we got out of there."

BISON'S TAIL IS A DANGER FLAG

After the grizzly experiences, we were ready for less exciting quarry and soon were following bison, or American buffalo. Although this animal appears clumsy and immobile at rest, he can handle his weight with remarkable agility. The bulk of his huge frame centers over pedestal-like front legs. On these he pivots in the manner of a skilled boxer. Once he charges a man afoot, there is little chance of evading this unbluffable ton of fury.

Notwithstanding the buffalo's treacherous nature and enormous strength, we consider him one of the safest of the big game animals. One little "giveaway" to his mood is his ridiculously small tail, which he hoists when perturbed. The greater the agitation, the higher goes the tail.

After snow fell on Mirror Plateau, which is 8,000 to 9,000 feet above sea level, we drove out to the Lamar Valley to ask a veteran ranger, Joe Douglas, if the herds had come down from their summer range.

"By the time the aspens turn color," he said, "you'll find some buffalo up there on top of Specimen Ridge or in the Horseshoe."

"Can we get near them?" Lucie asked.

"You'd better keep downwind and out of sight. They generally run."

"And if they don't?" I asked.

"Then you do," Douglas chuckled.

"Too bad you don't have the same chances to see buffaloes that the old-timers did," he added. "You didn't have to come clear to Yellowstone to see 'em then. The ones here just sort of drifted into the back country about sixty years ago to get away from the hunters."

BUFFALO HERDS BLOCKED TRAINS

"When I was a boy I heard many an old pioneer talk about the buffaloes all over the Plains this side of the Mississippi. There were millions of 'em. When the transcontinental railroads were being built, a train would be held up for hours as a herd crossed the tracks, for the bison were so thick an engine couldn't plow through without derailing. The passengers would take pot shots at them out of the coach windows, and let the dead ones pile up for amusement."



IN STIRRING NOTES AN AMERICAN ELK BUGLES HIS LOVE CALL

Beauty and duration of tone reveal the strength and maturity of this wapiti bull (page 104 and Plate VII). The musical cry, piercing the autumn air, also is a challenge to rivals. Closely related to the European stag, the wapiti, with its superb, wide-branched antlers, once ranged most of the United States. Today it is confined principally to the western mountains.

"When a herd decided to cross a river, it would hold up a steamboat for the better part of a day. Hunters, bringing in bison meat for the railroad crews, and pelts to send back East, would kill several thousand apiece in a season. Sportsmen used to come all the way from Europe just to shoot buffaloes. The early Indians never killed 'em that way. They just killed enough to get meat and hides for themselves."

"When did the wholesale slaughter finally come to an end?" I asked.

"Well," replied the ranger, "Sitting Bull with his tribe and some white hunters killed off the last big wild herd—about 10,000 of 'em—over in North Dakota in '83. In less than two months they killed 'em all."

Day after day, with heavy packs, we

tramped the mountains to the edge of the snow-covered country. Fresh signs were plentiful, but it was nearly a week before we found the animals. Then one morning just over the crest of a ridge we came face to face with seven large bulls. Into the air went their tails. They bolted before we could get cameras out of knapsacks.

Veering to keep upwind, we followed their tracks over rolling yellow slopes, through patches of evergreen timber, and within an hour caught up with them beside an aspen grove, brilliant in the early sunlight. This time they saw us at a distance. Again up went their tails, but they did not run. Quietly we waited until the danger signal was lowered before advancing. Eventually we worked to within a few yards (Plates XIV, XV, and XVI).



CLOSING IN ON YOUNG BIGHORN RAMS WITH THE COLOR CAMERA HIGH IN THE MONTANA ROCKIES (PLATES XVII TO XXIV)

As we stood watching the buffalo, four pronghorns, or American antelope, calmly walked past. Formerly both buffalo and pronghorn roamed the Great Plains west of the Mississippi in numbers greater than the human population there today.

ANTELOPE ARE FLEET, BUT CURIOUS

Once in danger of being exterminated, antelope are now numerous on many open ranges in the West. The fleetest quadrupeds native to this continent, and possessed of telescopic vision, they would be difficult to approach were it not for their extreme curiosity. Typical was the herd which we lured to within a few yards of us with a hat hung on a bush, a trick formerly used by hunters who nearly wiped out these graceful creatures.

We endeavored to win their confidence by coming out in the open and talking to them, as we do with beavers, otters, goats, and trumpeter swans.

Below Electric Peak in southern Montana, where rolling grassy hills break away from evergreen and rock-clad mountains, an antelope buck showed unusual confidence as I trailed him and talked softly. By the end of the third day he ignored me,

although I approached almost within touching distance. His indifference presented a problem, for he merely grazed peacefully, groomed his coat unconcernedly, or lay down sleepily.

I tried attracting his attention by coughing, but after turning his head to look at me, he paid no further heed. Even when I shouted, whistled, jumped about, and became boisterous, he simply strolled away a few paces and continued what he was doing.

For several days I trailed the buck, hopeful that he would become alert. The poses I did get are the result of his spying at different times a coyote, a rival buck, and something many miles away which I could not locate even through eight-power binoculars (Plates IX, XI, XII, and XIII).

BATTLING BIGHORNS CRASH HEAD ON

During the time we were following antelope, the first snow fell in the valleys, warning us that we must hurry to higher mountain ranges if we were to photograph bighorn sheep before winter set in. These statuesque creatures, which we stalked from Colorado to Canada, are more difficult to photograph than moose or buffalo.



A VETERAN NATURALIST TESTS MRS. CHAPMAN'S OUTDOOR COOKING

Vernon Bailey (right), retired Field Chief of the U. S. Biological Survey, and an expert woodsman, joins the authors in the Mogollon Mountains of New Mexico.

Not only are they few in number, but wary and agile in rough country.

Early on a crisp morning in the southern Montana mountains we scrambled up a rocky ravine to a slope where we had seen sheep through binoculars. Glaciated boulders nestling in crumbling banks rolled treacherously from under our feet and went bounding down as we clambered to the top.

Suddenly we were halted by an explosive whack. What could it be? Cautiously we crawled up behind a juniper bush and looked through its fragrant branches. On a sloping meadow 50 feet beyond, several old bighorn rams stood stiffly, heads back, eyes glassily gazing into the distance. Our noisy ascent had not alarmed them, for they were accustomed to hearing rocks falling from the crags. Half a dozen rams stood in a circle.

A pair of 300-pound rivals squared off twenty feet apart. Chins tucked under, horns lowered, through the air they hurtled, hitting in a head-on crash with all feet off the ground. The cliffs echoed. Down the pair dropped, balancing on their knees and slowly swaying their heads.

Half a minute they remained dazed, then staggered to their feet and resumed the fight. Again and again they crashed. Chips splintered from their horns. Fluted surfaces of the hitting arcs were hammered smooth (Color Plate XXIV).

BATTERING RAMS TEAM UP ON THE LOSERS

After a dozen crashes one ram weakened. He could hardly stagger to his feet. When he squared off for another battering, a strange thing happened. From the spectator rams a fresh one cut in to jolt the groggy battler. He took the count. Barely able to hobble, he dragged himself off a few paces where, sick and dazed, he lay down.

With him out of the fight, winner and recruit went at it until one of them weakened. Then another fresh ram cut in. More recruits continued the dueling.

Although the rams teamed up on the loser, they did not touch him when he gave up and turned away. This spirit of fair play was maintained only during the pre-mating battles. Once a ewe was at stake, each ram did his utmost to put rivals out of the running by fair means or foul.

We saw a fine ram dying from internal injuries received when he was butted over a cliff. Another, bumped off a ledge into the top of a juniper, was fatally impaled on a snag. A third died of concussion, a post-mortem showing that his skull had been split open between the horns.

Falling rocks and treacherous footing make bighorn sheep dangerous to follow. I was trailing a flock along a ledge, still camera in one hand, motion-picture camera on tripod in the other, when slowly my hobnails began to slip down the frosty rock. Not a crack, bush, or nubbin could I grab.

Quickly I dropped face downward, hoping trousers and coat would set up friction enough to check me. But down I slipped, slowly, irresistibly. A sheer precipice fell away below me. Closer and closer I was drawn to the brink.

Cautiously I let go of the still camera, grasped movie tripod in both hands, jabbed its legs into the frosty ledge. They held! I inched my way back to safe footing.

I would not have attempted to cross such treacherous rocks had not the flock of rams, ewes, and lambs stepped daintily across that very ledge a few minutes before.

Some of the ewes, lambs, and younger rams we approached by talking and by bleating like lambs. In taking natural-color pictures we found that such tactics worked with them (Color Plates XVII to XXIV), but every morning when we appeared on the range the mature rams went over the mountain and, if we tried to trail them, kept on over the next and the next.

A LAMB OUTWITS A COYOTE

The sentinel on duty, always a ewe, spied us before we saw the flock and watched while we puffed and perspired up the cliffs. So long as we did not talk or whistle while approaching under cover, the boulders which leaped and rattled from beneath our feet did not alarm the sheep. They seemed to rely largely on sight to apprehend enemies.

One cloudy day, as we watched a flock

grazing on a rocky slope, a big mountain coyote slipped up under cover of a ridge. Barely a hundred feet away, he charged. The sentinel stamped her foot. At the signal, the entire flock dashed for the nearest crags, half a mile away.

Neck ruffled, the coyote stretched out for the hindmost lamb, jaws opened expectantly. But the lamb wheeled, sprang up the slope, and circled the pursuer.

Round and round in ever-widening circles they raced, cloven hoofs holding firmly on the rocky slope, padded paws slipping and skidding on rolling pebbles. Gradually the pursuer fell behind. With a final spurt the lamb dashed away to rejoin the disappearing flock. The panting coyote stopped, looked about, and gave up.

HOME TO THE SNUG TRAILER

Winter came suddenly to the bighorn range. Sun had shone feebly in the morning, but by afternoon snow beat cold in our faces, laid damp hands on our thinly clad bodies, and soaked our shoes. As we trekked along in the dusk it was comforting to stumble upon the tent, now hovering white beside the car in the glen. Inside, the gasoline lantern and stove soon sent their warm glow over us as we filled the tea kettle. By the time we dug out dry socks and clothes from the dunnage bags the water was boiling.

Not until the storm cleared did we dig ourselves out of the drifts and break camp. Over whitened trails we slipped and slid down the mountains to the trailer (p. 115).

"At home," taking advantage of the bad weather, we spent several days developing negatives in the darkened kitchenette. We hung them in the living room where heat from gasoline lanterns and stove dried them quickly.

Brilliant sunshine followed with days of ideal light. Before the storm the sheep migrated to their lower winter range and there we found them. When the passes over the mountains of Wyoming and Idaho were opened, we put chains on the car, hitched on the snow-decked trailer, and crept back to civilization on icy roads.

INDEX FOR JANUARY-JUNE, 1939, VOLUME READY

Index for Volume LXXV (January-June, 1939) of the NATIONAL GEOGRAPHIC MAGAZINE will be mailed upon request to members who bind their copies as works of reference.

STALKING BIG GAME WITH COLOR CAMERA

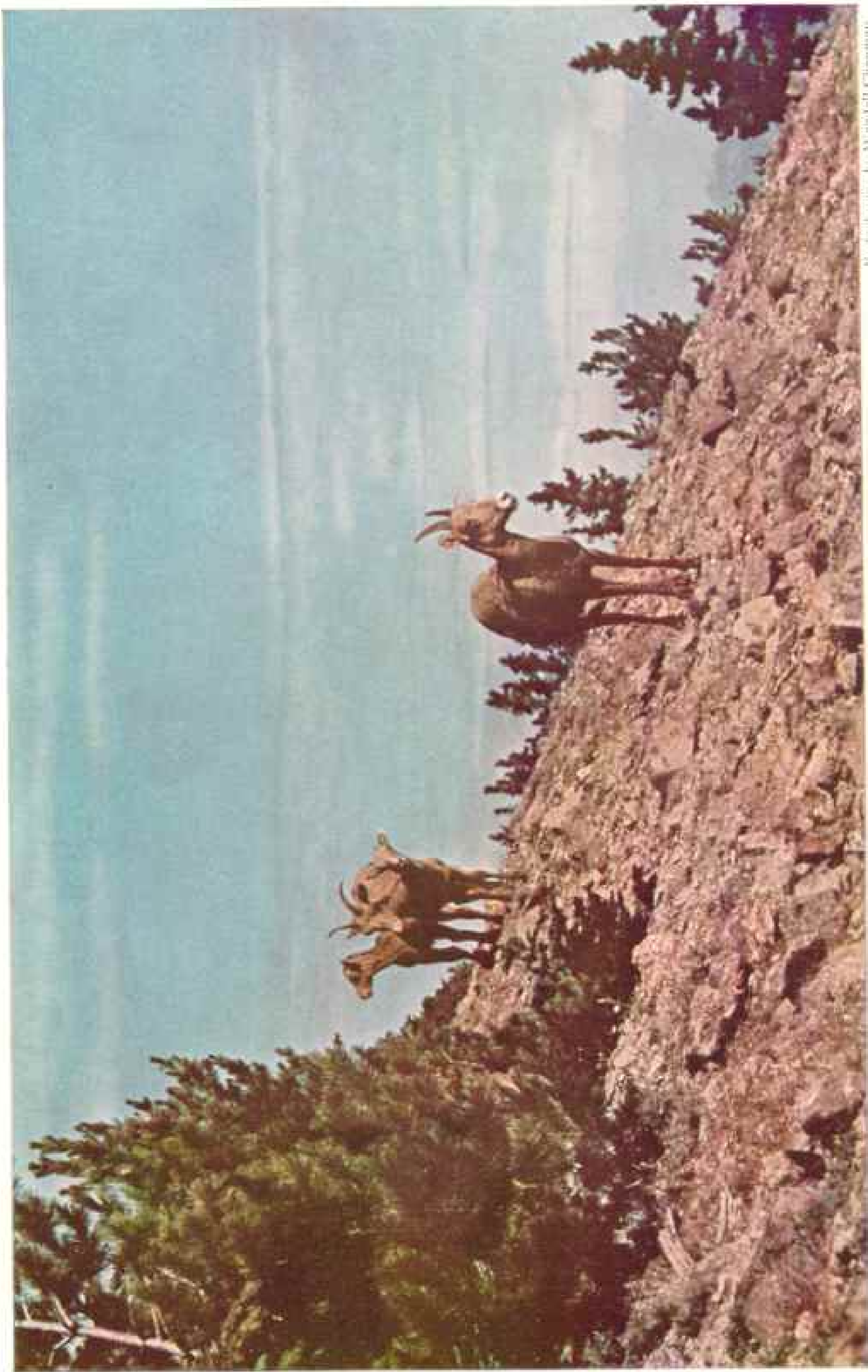


© National Geographic Society

Kodachrome by Wendell Chapman

MOTHER KEEPS HER EYES ON A FAR-OFF WOLF AS BABY NAPS IN THE SNOW

Heavy drifts in winter force Rocky Mountain bighorn sheep from their lofty crags down to lower levels. Here they are constantly threatened by coyotes, wolves, and mountain lions. Because of their excellent vision, sheep can detect an enemy from three to five miles away. The distant prowler has not alarmed the mother enough to make her arouse the youngster.

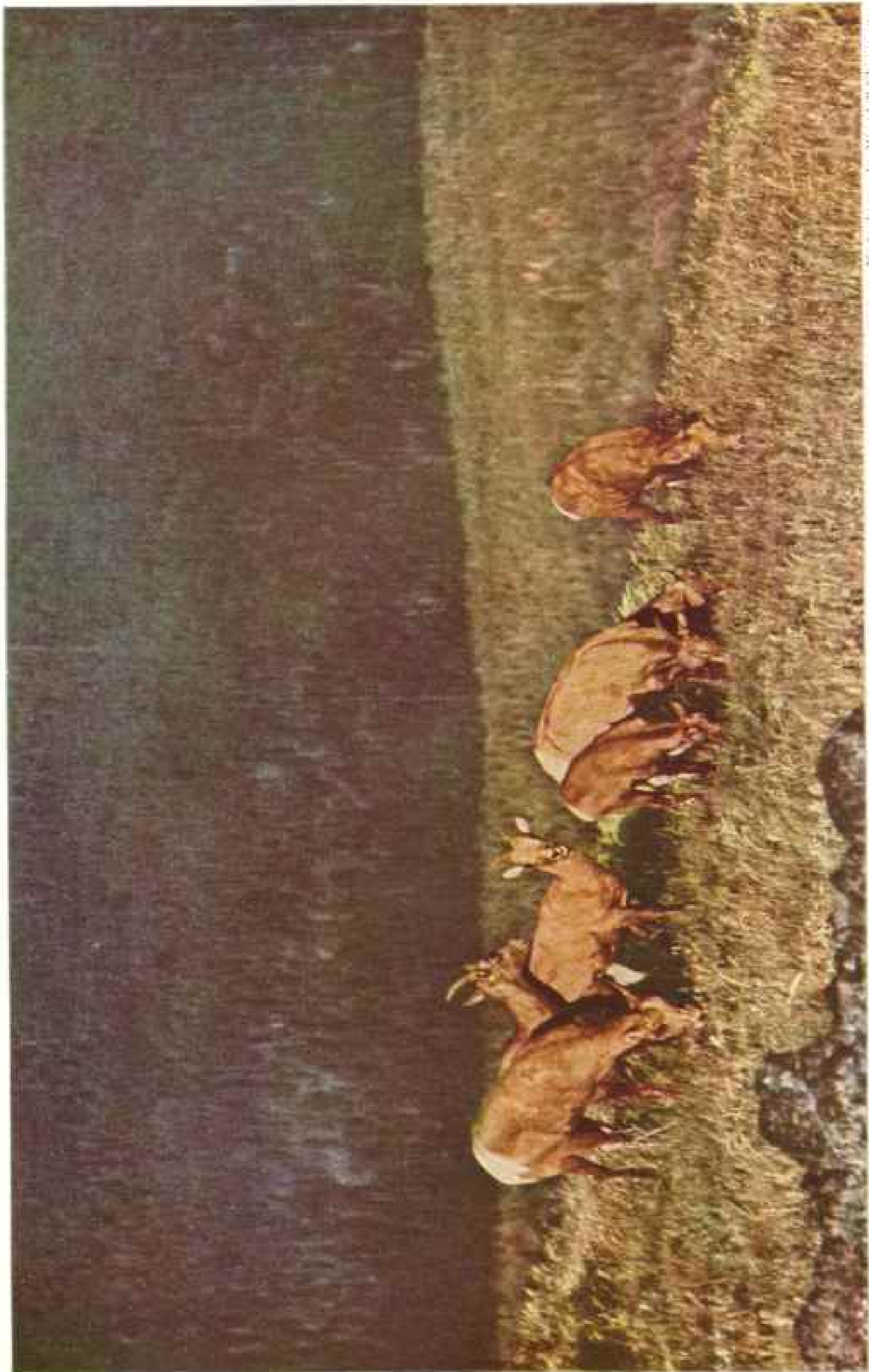


Kodachrome by Wendell Chiriphuo

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ON SUCH RUGGED SLOPES, SURR-FOOTED ROCKY MOUNTAIN SHEEP CAN OUTMANEUVER WOLVES AND COYOTES

Big horns dash up seemingly impossible cliffs, where a misstep would mean death. Although these ewes and lambs, on summer range at the timber line have strayed away from the crags, they can escape by running in circles. Their hoofs gouge into the sliding

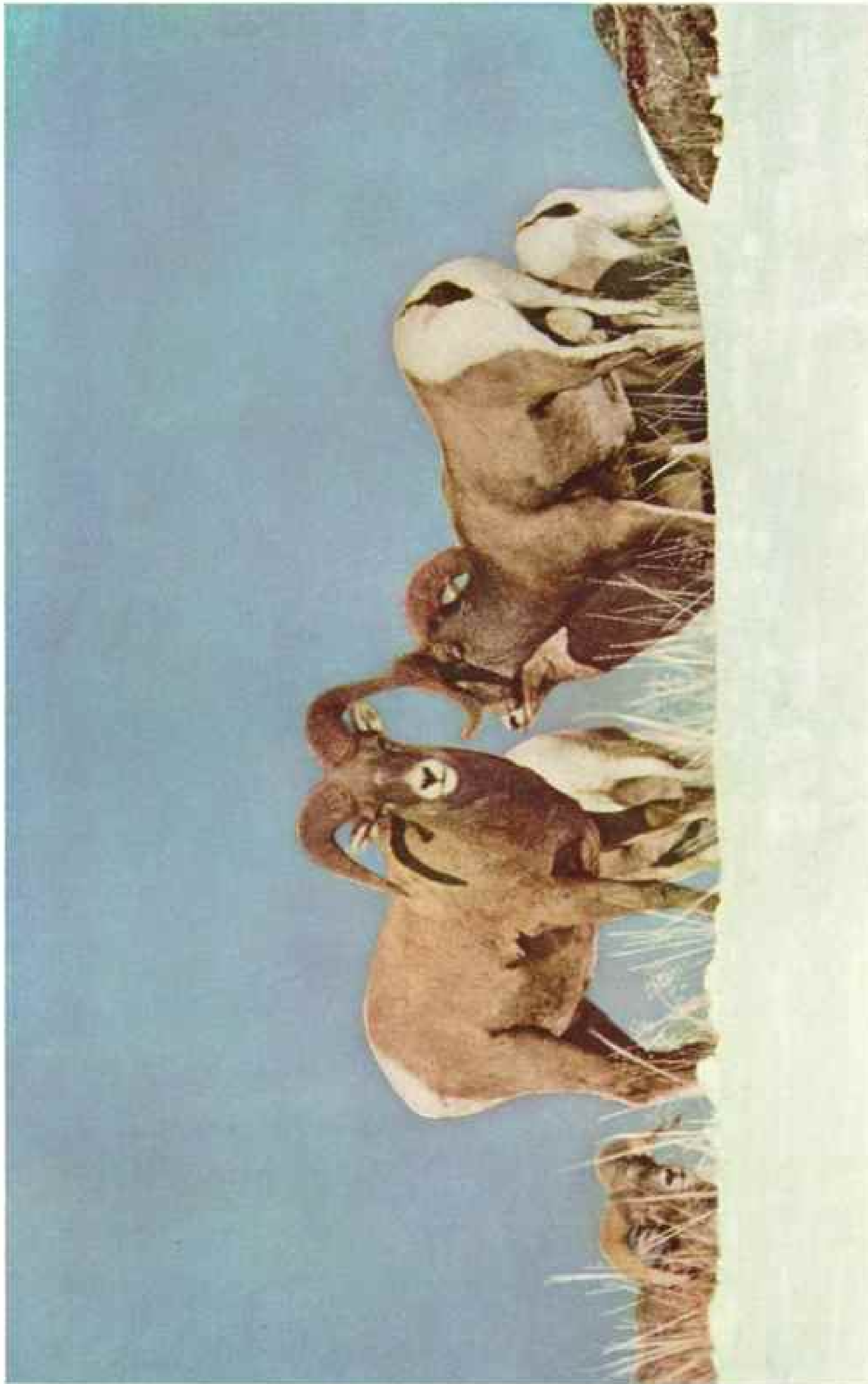


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Kodachrome by Wendell Chapman

ON THEIR SUMMER RANGE IN THE MONTANA ROCKIES, BIGHORN EWES AND LAMBS ACCEPT THE AUTHOR AS A FRIEND

Always a sentinel watches for enemies. After Mr. Chapman had been in their vicinity for several days, the flock became accustomed to him, much as they would to such harmless neighbors as elk, goats, and smaller animals. Bighorn sheep eat nearly any plant that grows within their domain. In winter they paw through the snow to uncover grass and brush (Plate XXII).



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TOO YOUNG TO FIGHT, TOO OLD TO STAY WITH THE "WOMENFOLKS," ADOLESCENT RAMS FORM THEIR OWN GANGS

Kodachrome by Wendell Chapman

Mature rams leave ewes and lambs to shift for themselves except in the mating season. The big fellows graze far from the flock in a select club, to which these two- and three-year-olds are not strong enough to gain admittance. White rumps and hind legs of big-horns resemble skintight pantaloons and are conspicuous at a short distance. When a few hundred yards away, the "panties" are a perfect camouflage on snow-covered, bush-dotted slopes of crags.

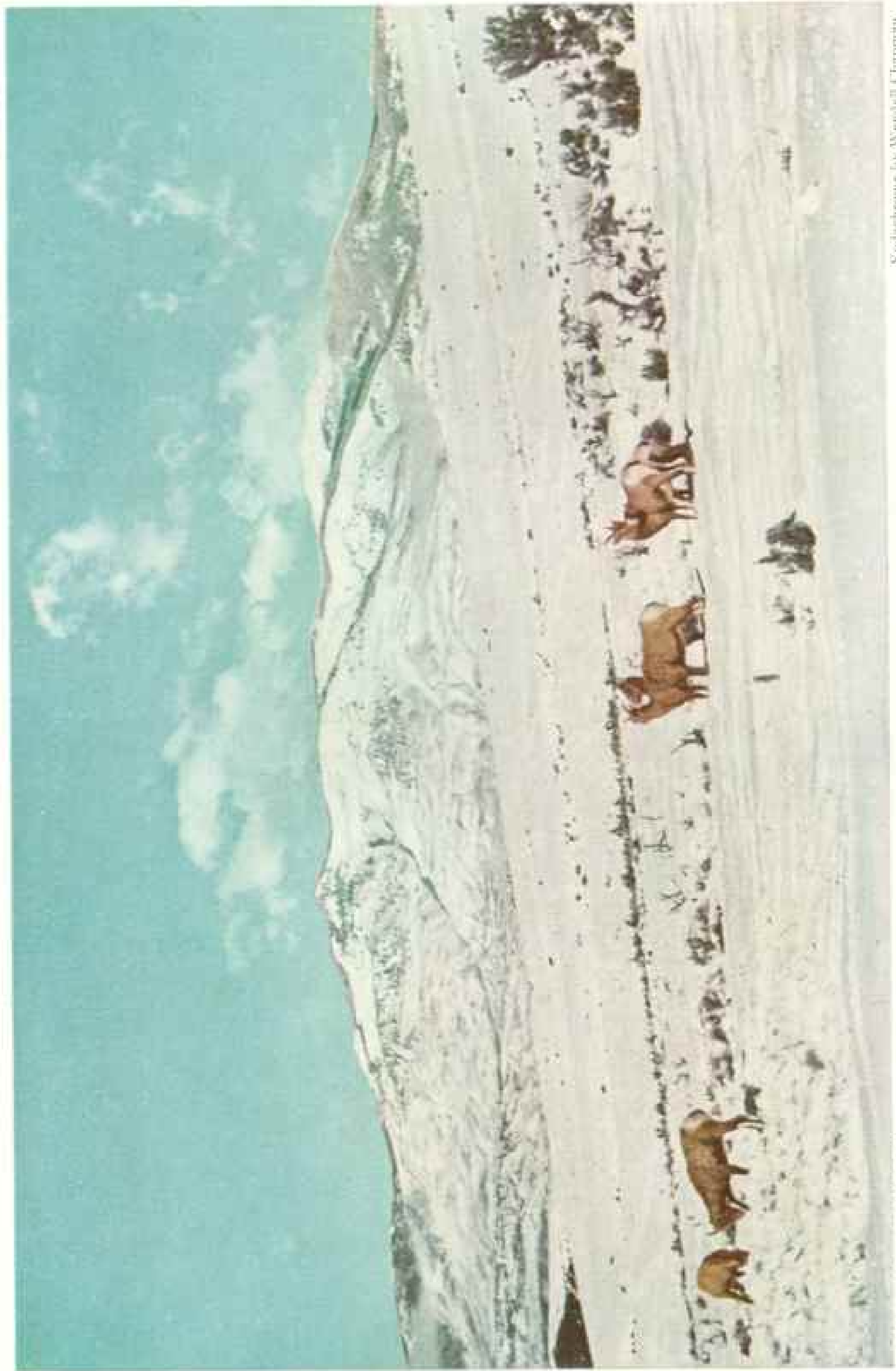


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PUZZY "EAR MUFFS," SUPPLIED BY MOTHER NATURE, PROTECT BABY HIGHLORN FROM FROSTBITE WHEN COLD WINDS BLOW

Kodachrome by Woodell Chapman

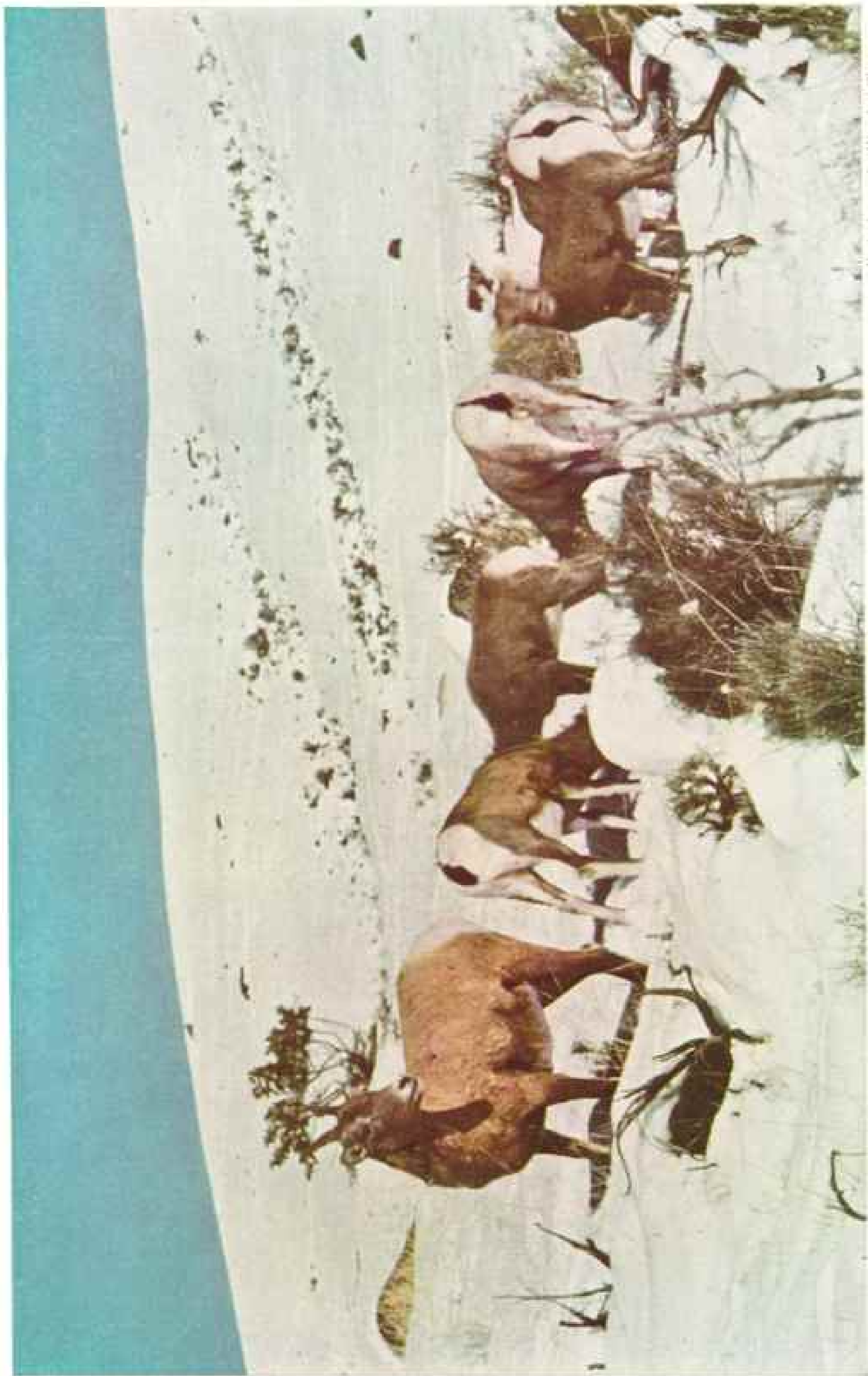
Awaking from his nap (Plate XVII), the lamb became perturbed when he could not see his mother. He ignored the camera and photographer, but was fearful because he was alone, out in the open, half a mile from the cliffs. He began to bleat in a low, pleading manner, but was soon reassured. The ewe had merely wandered into a near-by swale. The six-months old lamb is almost as tall as his mother.



© National Geographic Society

PROTECTED AT LAST, THESE REMNANTS OF ONCE MIGHTY FLOCKS OF BIGHORNS DWELL IN REMOTE BACK COUNTRY Mountain sheep were so plentiful from New Mexico to Canada that many Indian tribes lived on their flesh. Ruthless slaughter and long winters spent in sparse feeding areas brought the flocks to the verge of extinction.

Reproduction by Wendell Chapman



© National Geographic Society

Koelachroma by Mendell Chapman

ALTHOUGH THE AUTHOR SHOUTED AND DANCED, THIS FRIENDLY FLOCK KEPT ON GRAZING IN THE SNOW

Only a lamb (right) paid any attention to Mr. Chapman's antics, which were intended to persuade the bighorns to pose alertly before the camera. Even the sentinel ewe (left) refused to become perturbed; she gazed off into the distance instead. Had the author rushed at the flock or threatened to harm them, the sheep would have fled, but that would have ended the patiently built friendship, and picturemaking as well.



CRINKLED HORNS OF A TWO-YEAR-OLD ARE NO MATCH FOR A BATTERING RAM

After the first year's rapid growth, the horns increase in length an inch or two each year. Mature rams engage in terrific butting duels. Taking positions about 20 feet apart, they rush each other furiously, meeting with violent and resounding impact.



© National Geographic Society

Kodachromes by Wendell Chapman

THE BIGHORN'S WINTER COAT THICKLY INSULATES HIS BODY

Although mountain sheep may lie in the snow for hours, pressed-down flakes do not melt. The matted hair effectively prevents escape of body heat.

MY FOUR ANTARCTIC EXPEDITIONS

Explorations of 1933-39 Have Stricken Vast Areas from the Realm of the Unknown

By LINCOLN ELLSWORTH

AFTER embarking on four Antarctic expeditions, I have no hesitancy in putting down the last one, from which I have just returned, as the longest and hardest I have ever been on.

While I was cooped up in a tiny cabin just big enough to hold a bunk, a washstand, and a three-tier bookshelf, with no opportunity for any exercise, not even a bath, my good ship the *Wyatt Earp* wallowed and rocked in the trough of one of the wickedest oceans in the world—the Indian.

Sixty-five days passed after we left Capetown before we sighted the great ice barrier of the Antarctic Continent. Of this total of 65 days, 45 were spent in getting through the heavy pack ice. For 13 days at one time the propeller never turned, while we awaited a favorable wind to loosen the pack which held us prisoners.

It must have been an exceptional ice year, for during these 45 days we passed through pack ice extending a distance of 813 miles north and south, and much of it was heavy two-year-old ice.

Such a voyage with its delays wears nerves down considerably, especially when one realizes that an Antarctic summer is but two months long, and that time for flying is only a small fraction of the summer.

By the time we got through the pack, we were three weeks too late to attempt the flight I cherished—2,000 miles across the continent to the Bay of Whales—but we did explore from the air, and claim for the United States, an area almost the size of Nebraska.

ANTARCTICA IS TWO-THIRDS AS BIG AS NORTH AMERICA

Four expeditions, all told, at a total cost of \$400,000—such was the debt incurred. But what about the profit?

Now, the sole purpose of all four expeditions was the exploration of the interior of this great southern continent (map, page 132).

"The highest object that human beings can set before themselves is not the pursuit of any such chimera as the annihila-

tion of the unknown," said Huxley. "It is simply the unwearied endeavor to remove its boundaries a little farther from our little sphere of action."

A continent two-thirds the size of North America—was it mountainous, was it lowland, or was it high plateau?

Was it a single land-mass, or did a sea-level channel connect the deeply indenting Ross Sea on one side with the Weddell Sea on the other?

These were the problems that I wanted, if possible, to shed some light on.

BROKEN PLANE ENDED FIRST ATTEMPT

The object of my first expedition in 1933 was to fly across Antarctica from the Ross Sea to the Weddell Sea and return to my base ship in the Bay of Whales, a total distance of 2,900 miles.

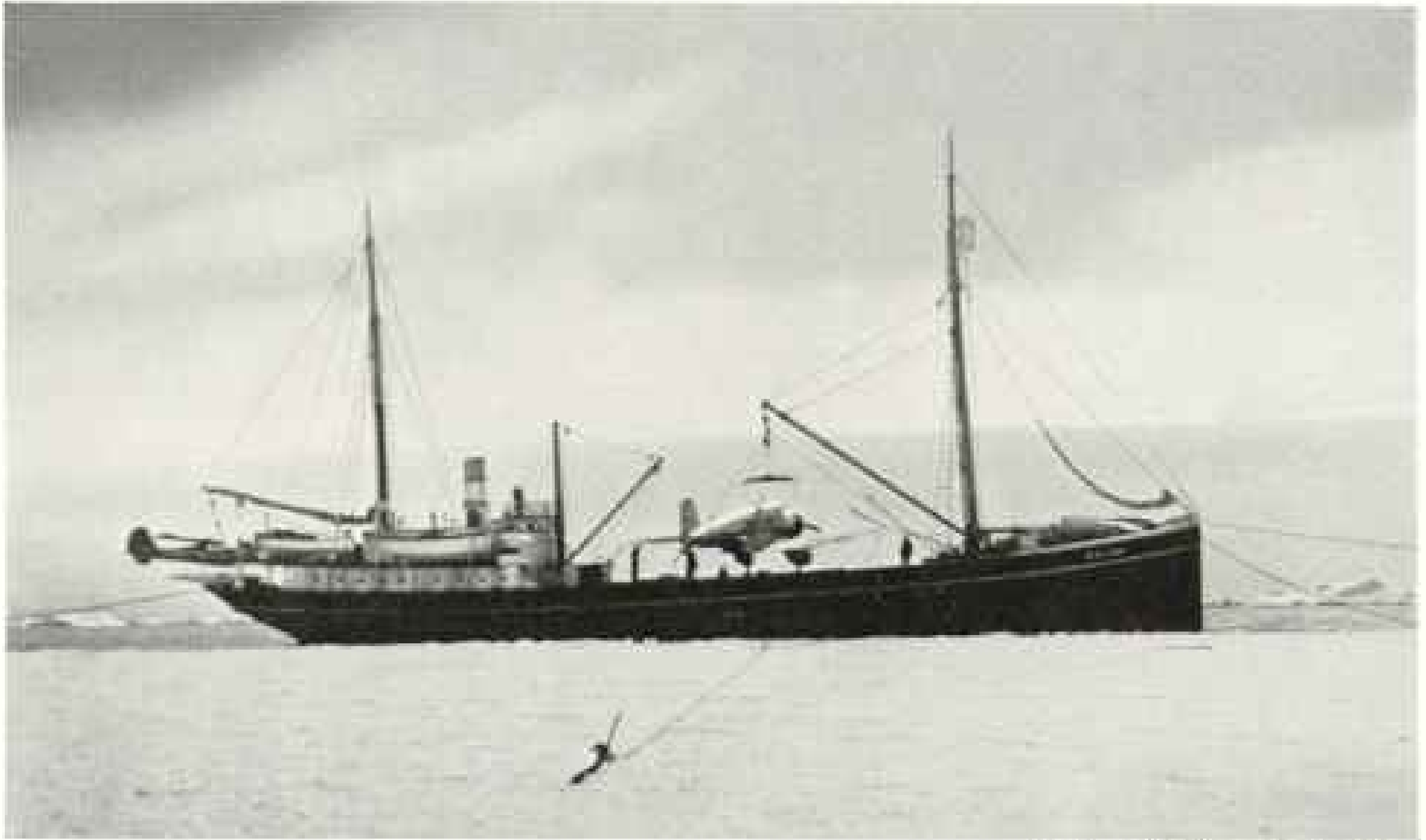
After a voyage of 2,500 miles from New Zealand, we had no more than assembled the plane on the frozen bay before the ice broke up and the plane was so badly damaged we had to return it to America for repairs.

Meanwhile it was decided to winter the base ship, *Wyatt Earp*, in New Zealand pending a decision for the following year. I finally decided to make a one-way flight from the opposite direction; that is, from the Weddell Sea to the Ross Sea, and to camp at the Bay of Whales until the *Wyatt Earp* could come around and pick us up about a month later.* So the following spring we made the long journey across the South Pacific to Snow Hill Island, one of the three ice-free islands in the Weddell Sea.

But again we were frustrated and never had a chance to get started, for during the three months we waited we had no suitable weather in which to make a trans-Antarctic flight—only an unbroken period of snow squalls and winds.

We had to realize that flying weather in

* See "My Flight Across Antarctica," by Lincoln Ellsworth, in the NATIONAL GEOGRAPHIC MAGAZINE for July, 1936; "Exploring the Ice Age in Antarctica," by Rear Admiral Richard Evelyn Byrd, October, 1935; and "Conquest of Antarctica by Air," by Admiral Byrd, August, 1930.



Photograph by Lincoln Ellsworth

THE "WYATT EARP," VETERAN OF FOUR ANTARCTIC VOYAGES, MOORS TO THE
SNOW-COVERED FLYING FIELD

Both airplanes can be seen on board, the small scouting plane over the ship's stern, and the large plane, in which the overland flight was made, amidship. The ice field was snow-covered "bay ice," its edge still frozen fast to the continental ice barrier.

the Antarctic may occur only one day a month, and this fact, together with the difficulty of finding a take-off field, piles up the odds heavily against an explorer who wishes to make use of airplanes in these inhospitable regions.

SIGNIFICANT FOSSILS FOUND ON SECOND
EXPEDITION

But we did put in our time to advantage, for we found, upon the ice-free islands where we lay, an abundance of fossils, including petrified logs of trees belonging to the Sequoia family. I brought back to the United States for study 50 pounds of such fossils. They show that in Cretaceous times, when all this life and vegetation flourished—one hundred million years ago—Antarctica had a climate about like that of California today.

Think of America today, with its fertile valleys, giant forests, and accessible wealth in oil and minerals beneath the soil. Then picture it thirty thousand years ago; for it was then in the throes of an ice age, just as Antarctica is today, and with an ice cap hundreds of feet thick covering much of North America. Is there any reason to believe that Antarctica, a continent two-

thirds the size of North America, does not contain similar wealth?

Only 400 miles from the South Pole, on the west side of the huge Beardmore Glacier, Shackleton found, along the exposed walls of sandstone and shale, coal seams which extend for 100 miles and which in some places are forty feet thick. Fossil impressions of fern leaves were recovered there later, together with the petrified stem of a prehistoric plant which measured eighteen inches in diameter.

Of course, it was only much-weathered lignite that Shackleton found, but it was coal nevertheless. And perhaps this presence of coal may indicate that petroleum, too, underlies the ice and snow of the Pacific side of Antarctica.

Once, in southern California, I picked up a small piece of quartz intersected with a narrow vein of gold. Back at the hotel where I was staying, everyone exclaimed, "What is it worth?"

"You miss the point," I replied. "The interest lies in the fact that there *is* gold somewhere along this coast."

After the second expedition I wintered my ship in South America, for it seemed likely that the Weddell Sea side that year



Photograph by Lincoln Ellsworth.

MAKING READY FOR THE OVERLAND FLIGHT TO THE SOUTH

Having arrived late because of heavy pack ice, the crew rushes preparations in a race against the thawing weather of summer.

would be the best side from which to attempt the crossing, and I was determined to make it.

Nineteen thirty-five was my lucky year, for en route again to Snow Hill Island we saw another isle, Dundee Island, 100 miles farther north; and I doubt if a better take-off field could be found in Antarctica.

We were only a week getting ready before my pilot, Herbert Hollick-Kenyon, and I took off, in perfect weather. We started upon what we thought was to be a 16-hour flight; but, with our stops, it really took us just 22 days to make the 2,300 miles that separate Dundee Island from the Bay of Whales.

VAST TERRITORY CLAIMED FOR U. S.

Flying for a thousand miles over majestic mountain peaks rising 12,000 feet above sea level and never before seen by human eye, we were looking down upon the backbone of the Antarctic Continent and the onetime continuation of the Andes of South America, now broken by a gap of 500 miles of sea south of Cape Horn. Across this is the nearest approach to Antarctica, and a more turbulent stretch of ocean it would be difficult to find.

The 350,000 square miles of territory

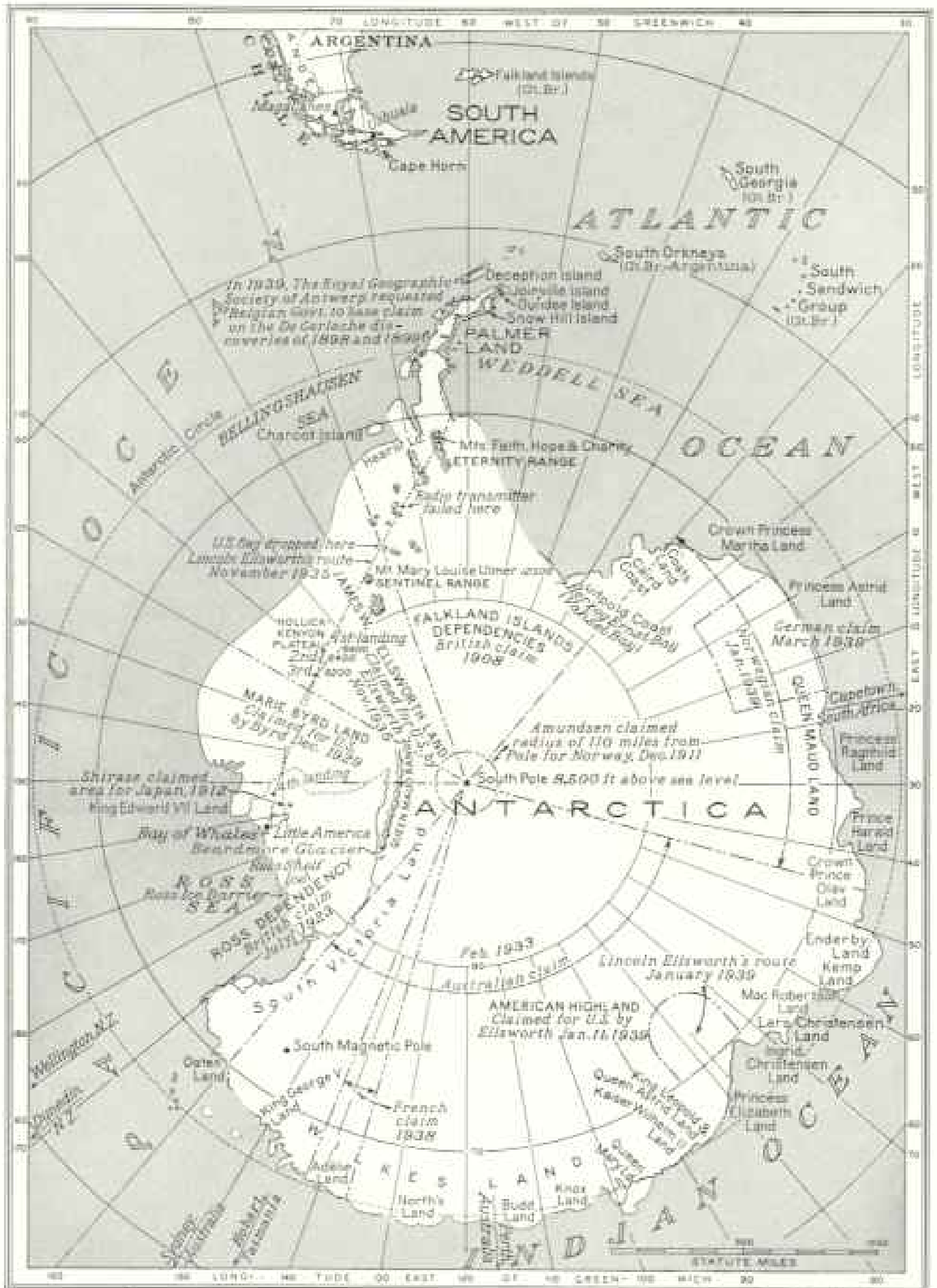
we flew over, comprising the area included between the meridians of 80 and 120 degrees west longitude, I claimed for my country, the United States of America.

We came down 16 miles short of our goal, but, strange to say, had to walk about a hundred miles to find Little America.

It was a happy and contented month that Kenyon and I spent alone there. The tension of 22 days was over. We had done our job. The blizzard camp of nine days with our goal still 600 miles away, the one-hundred-mile man-haul after our fuel had given out, were memories of the past as we settled down to a daily routine in our tiny shack fifteen feet under the snow, there to await the arrival of the ship—whenever that might be.

Ours had been the realization that we two were the only human beings upon a continent two-thirds the size of North America. Perhaps that thought brought us closer together. Anyway, we were glad of the four walls that shut out the fog-bound waste of endless white over which we had so long been traveling.

It was a glorious surprise when a parachute with provisions was dropped upon us during the night of January 15. It was from Lieutenant L. C. Hill, commander of the British Royal Antarctic Research Society



Drawn by Albert H. Bumstead

ELLSWORTH LOOKED DOWN ON A SECTION OF ANTARCTICA NEVER BEFORE SEEN

American Highland, flown over by Ellsworth and claimed by him for the United States, is on the Indian Ocean side of Antarctica in a region previously unexplored. After finding a snow-covered flying field at the rim of the continent, longitude 79 east, he made his flight south, on January 11, to a point about 240 miles inland and return. The map also shows Ellsworth's flight of November, 1933, from Dundee Island to the Bay of Whales, and a new claim by Germany as a result of an aerial survey conducted in 1939 from the catapult ship *Schwabenland*.



© The "Sydney Morning Herald"

THREE OUTSTANDING ANTARCTIC EXPLORERS "TALK SHOP" IN SYDNEY, AUSTRALIA

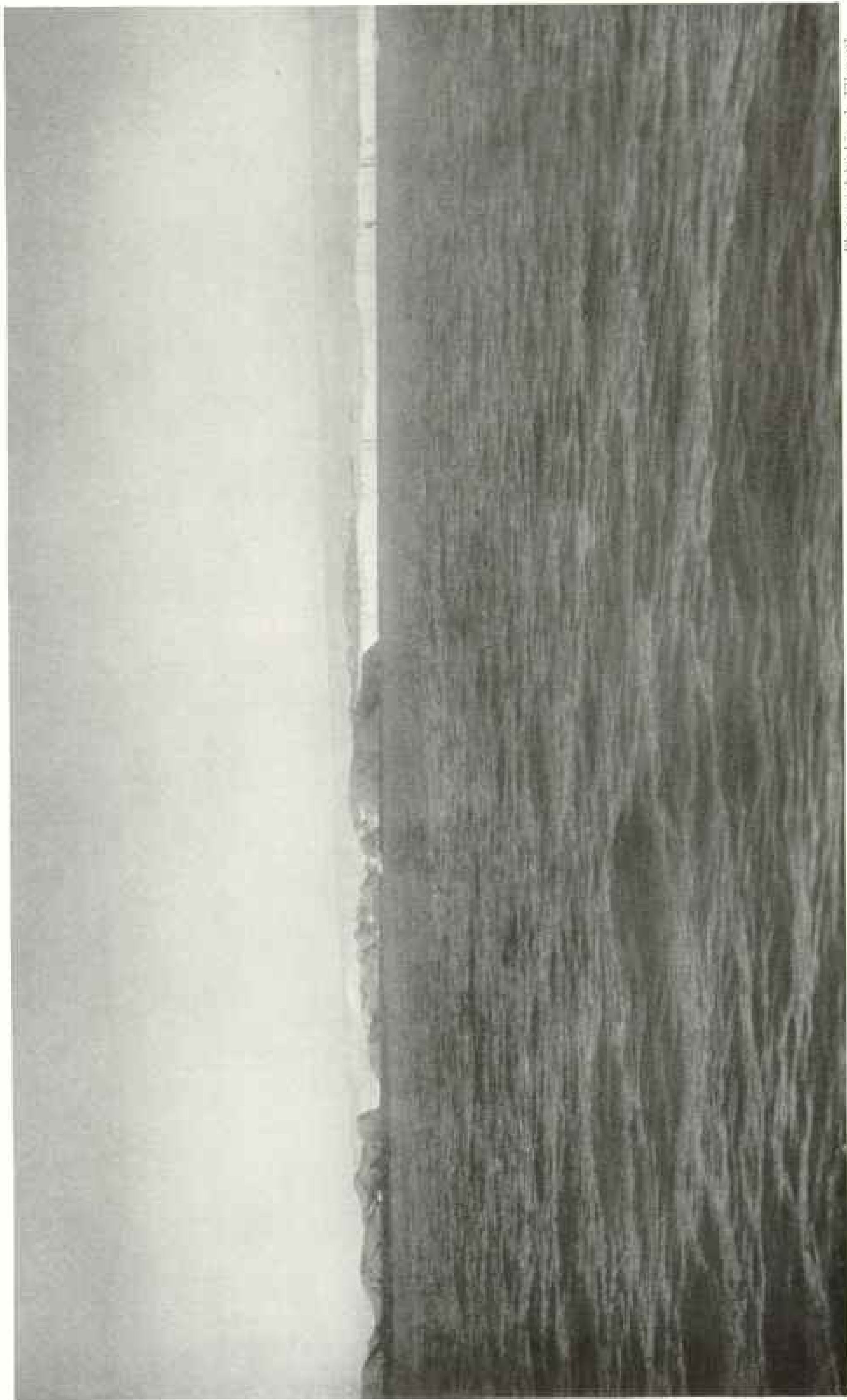
Sir Douglas Mawson (left) has led two expeditions to the Antarctic Continent along the Indian Ocean side. Sir Hubert Wilkins (right), who accompanied Lincoln Ellsworth (center) on his two latest voyages, made remarkable aerial surveys over Palmer Land in 1928, 1929, and 1930.



Photograph from Lincoln Ellsworth

OLD ROCKS, RICH IN MINERALS, MAKE UP THE INDIAN OCEAN SIDE OF ANTARCTICA

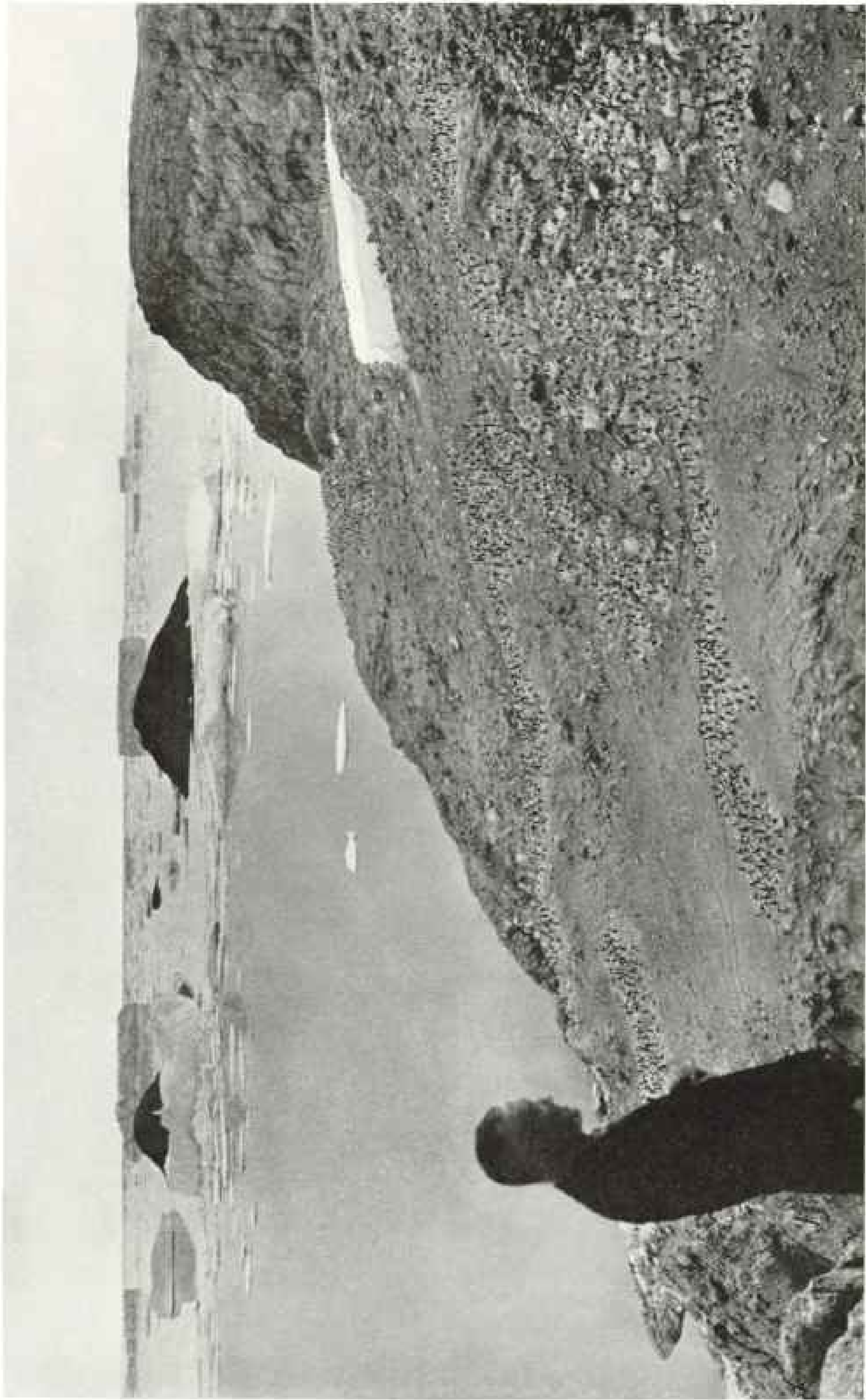
Probably pre-Cambrian in origin, the granites, gneisses, and schists found here are among the oldest rocks on earth. Much younger are the sedimentary formations Ellsworth noted on Snow Hill Island in Palmer Land. He brought back from Princess Elizabeth Land 50 pounds of samples containing iron, copper, and nickel (pages 137 and 138).



Photograph by Lincoln Ellsworth

LAND HO! THE BARRIER AND PRINCESS ELIZABETH LAND LOOM UP AT LAST

After fighting its way through pack ice for 65 days, the *Wyatt Earp* emerged into open water and soon sighted the southern continent dead ahead. Rocky land is emerging from the white covering in the center and at the left, the ice-free islands that have been smoothed by glacial action (page 137). The sudden rise of the ice sheet from its clifflike edge, called the barrier, to an estimated 1,500 feet is in striking contrast to the Pacific coast of Antarctica where the Ross Shelf Ice rises gradually for a distance of several hundred miles from its face.



Photograph from Lincoln Ellsworth

ELLSWORTH VIEWS A MASS MEETING OF ADÉLIE PENGUINS OF PRINCESS ELIZABETH LAND

Many of the islands were crowded with thousands of the "little old gentlemen with starched shirts and swallow-tailed coats." The birds' wings, useless for flight, have developed into swimming flippers. The nests on shore are piles of loose stones. Only two rookeries of the larger emperor penguins were found.



Photograph from Lincoln Ellsworth.

THEY EXPLORED A VAST AREA NEVER BEFORE SEEN BY HUMAN EYE

J. H. Lymburner, pilot, and Lincoln Ellsworth, beside their ski-equipped plane on the bay ice of Princess Elizabeth Land just before the take-off.

ship, *Discovery II*, and we shall be forever grateful to the Australian Commonwealth for its thoughtful aid in our behalf.

PROVED POSSIBILITY OF LANDING AND
TAKING OFF IN THE ANTARCTIC

Doubtless the greatest contribution derived from the flight was the fact that we landed five times during the crossing because of weather and took off again without difficulty. This points to the possibilities, in the future, of exploring the interior of this great continent by means of the airplane. Landings can be made and bases established from which to carry on detailed geological and other investigations of the surrounding territory.

After two years, in 1938, I again felt a longing to return south, this time to the Indian Ocean side of the Antarctic.

The long journey of 65 days from Cape-town, and the consequent change in our plans, I have already mentioned (page 129). In fact, we were lucky to be able to make any flight at all, for mid-January is midsummer in the Antarctic and time was growing short.

During our voyage along the coast look-

ing for a place from which to take off, J. H. Lymburner, from the small scout plane, spotted what was, perhaps, the only ice available.

The land-fast bay ice was soft and was breaking away from the shore. We faced the danger of the plane breaking through when landing it from the ship, where it was assembled, onto the ice. We wondered, even while taking off, whether it would hold. As the plane gathered momentum the danger lessened, until finally we were in the air. Rising to 1,500 feet, we cleared the barrier and headed due south.

TOOK PIPE—BUT NO TOBACCO

We carried in the plane emergency rations for five weeks, allowing 34 ounces per day per man. It's amusing—afterwards—to recall the incident of the tobacco. All of it to be included in the emergency list I had in my cabin before the plane was loaded. I very carefully pocketed my pipe before starting, and to my surprise, when I returned, there, still in my cabin, was the tobacco!

Once clear of the barrier, I was prepared



Photograph by Lincoln Ellsworth

SMOOTH-SURFACED ISLANDS INDICATE THAT THE ANTARCTIC ICE SHEET HAS RECEDED.

Off the coast of Princess Elizabeth Land lie glaciated islands of exposed rock, scarred by ice that has receded. The region was named in honor of the heir presumptive to the British throne by Sir Douglas Mawson, who explored it in 1931.

to see a rugged topography with great mountain ranges to the south. But I was surprised and impressed by the vast wind-rifled desert of unblemished white that greeted my eyes. South, east, and west it stretched to the cloudless, blue horizon.

AREA NAMED "AMERICAN HIGHLAND"

We were cruising 135 miles an hour at an altitude of 11,500 feet. The temperature was minus three degrees Fahrenheit, but we were not cold. From our altimeter we estimated the surface below to be 7,500 feet above sea level. Apparently the surface rose steadily to the south, where, we assumed, it would attain the elevation of the great Polar Plateau, 8,500 feet above sea level, upon which lies the South Pole.

The total area claimed by us is 288 miles north and south by 300 miles east and west, with a rounded southern end, a total of 77,000 square miles (map, page 132). I named it "American Highland."

At latitude 72 south I dropped a copper tube, 8½ inches deep by 2½ inches in diameter, from the opened door of the plane; it struck the wing and bounced off

onto the surface below. In the tube was a document worded as follows:

TO WHOM IT MAY CONCERN

HAVING FLOWN ON A DIRECT COURSE FROM LATITUDE 68.10 SOUTH LONGITUDE 79 EAST TO LATITUDE 72 SOUTH LONGITUDE 79 EAST I DROP THIS RECORD TOGETHER WITH THE FLAG OF THE UNITED STATES OF AMERICA AND CLAIM FOR MY COUNTRY, SO FAR AS THIS ACT ALLOWS, THE AREA SOUTH OF LATITUDE 70 AND TO A DISTANCE OF 150 MILES EAST AND 150 MILES WEST OF MY LINE OF FLIGHT AND TO A DISTANCE OF 150 MILES SOUTH OF LATITUDE 72 LONGITUDE 79 EAST WHICH I CLAIM TO HAVE EXPLORED.

DATE 11 JAN. 1939

(signed) LINCOLN ELLSWORTH.

I hated to turn back. I looked again upon the scene around me and thought how fiercely the gales must sometimes blow here, for at our elevation the ripples with a noticeable east and west trend must have been at least two feet from bottom to crest.

But now it was all so peaceful in the



© "The Mercury," Hobart, Australia.

PORT AT LAST! "WYATT EARP" ENDS 86,000 MILES OF VOYAGING

Ellsworth's veteran ship arrives at Hobart, Tasmania, upon completion of her fourth journey into the Antarctic. She has been acquired since by the Australian Navy.

mellowing glow of a low westering sun—serene in its solitude, though no human eye sees nor human tongue speaks its beauty—and I thrilled to think that we two were the first mortals actually to see the interior of this side of Antarctica.

The great ice sheet is slowly receding. The score or more of ice-free islands lying off the barrier where we were, all heavily littered with glacial boulders, is but one evidence. We visited seven of them and found all heavily mineralized (page 133).

The rock, mostly, is a pink granite intermixed with gneiss and quartzite. It contains dikes of decomposed quartz studded with garnet, is heavily copper-stained, and carries wide bands of metalliferous ore of a purplish hue, the color of chilled steel. I found iron ore in quantity and also samples which undoubtedly contained nickel. I collected and brought back 50 pounds of specimens of these mineral-bearing rocks.

The contrast between the geology of the opposite sides of Antarctica is quite marked. While the Indian Ocean side from Enderby Land to Princess Elizabeth Land appears to be mostly pre-Cambrian—

gneiss, granite, schist—the formations that I saw on the Pacific side are mostly of sedimentary origin.

Then, too, there is a marked difference in the topographical features of the two sides. There is much mountainous land on the Pacific side. From what I saw on the Indian Ocean side, however, the whole area appeared to be a featureless, unbroken white waste rising gradually from the barrier. At Princess Elizabeth Land it is 1,500 feet high and rises gradually toward the south. It is interesting to note that a party of Germans, on the Atlantic side, some 1,500 miles west of the region visited by me, apparently found the same vast ice fields rising toward the South Pole (p. 132).

And so, good fortune has permitted me the opportunity of a part in the unveiling of a continent for the last time in human history. My little 400-ton ship, *Wyatt Earp*, has voyaged more than three times around the world, covering 86,000 miles in quest of two flights.

Has it been worth while in the effort and money expended? My answer is unreservedly "Yes."

THE WORLD THAT RIMS THE NARROWING ATLANTIC

Latest Ten-color Map Supplement Shows Four Continents and New Transatlantic Air Routes Which Make This Ocean Only One Day Wide

BY JAMES M. DARLEY

National Geographic Society Research Cartographer

AN extraordinary map which shows the Atlantic Ocean as a huge lake rimmed by the shores of four continents is presented to the 1,100,000 members of the National Geographic Society as a special supplement to the July number of their Magazine.*

Red lines of regularly scheduled air routes now span both North and South Atlantic and emphasize how greatly this ocean has shrunk as measured in the time it takes to cross it: a single day as compared to Columbus's 70 days.

American Clippers of the latest type—109-foot flying boats far bigger than the *Niña* or *Pinta*—can cross the Atlantic with passengers and mail in about one day by the northern route, via Botwood, Newfoundland, and Foynes, Ireland, or only a little longer by the southern route, via the Azores and Lisbon (page 141). British seaplanes soon will link Montreal with London.

The transoceanic air base at Foynes, on the River Shannon, with its powerful Rynanna Wireless Station equipped to give the flying boats bearings across the ocean, is just seventy miles northeast of Valentia Island, first landmark of Lindbergh on his epochal flight. What a contrast Rynanna makes with Lindbergh's circling over the fishing boat to ask, "Which way is Ireland?"

ALL OF SOUTH AMERICA SHOWN

From Dakar and Bathurst on the bulge of Africa, mail-carrying French and German planes make regular hops to the Brazilian coast in 14 hours. It is another flight of about 14 hours from Natal, Brazil, to Rio de Janeiro and 11½ hours more to Buenos Aires.

* Members wishing additional copies of the map, "The Atlantic Ocean," may obtain them by writing the National Geographic Society, Washington, D. C. Prices, in United States and Possessions, 50¢ on paper (unfolded); 75¢ mounted on linen. Outside of U. S. and Possessions, 75¢ on paper; \$1 on linen. Postage prepaid.

This unusual map, loaded with information, brings out the true relationship between the Old World and the New.

Here on a single sheet of paper appear virtually all of Europe, with recent boundary changes; the United States west to the Rocky Mountains; the western shore of Africa; and the entire South American Continent. The area covered extends from the Arctic to the icy waters beyond Cape Horn.

The map spotlights South America, with its growing republics and busy cities, its rich trade resources and raw materials, its vast areas of undeveloped territory.

The earth's most often crossed ocean is shown in its entirety, with its winds, currents, deeps, limits of ice, and the broad expanse of the Sargasso Sea.

Red "NB" symbols indicate naval bases, and an inset ten times the scale of the main map portrays the Panama Canal, crossroad of commerce and cornerstone of continental defense. This vital waterway shortens the distance between United States Atlantic and Pacific coasts by 8,000 miles.

NEW MAP OF ANCIENT LINEAGE

Strangely, this ultramodern map is drawn on a projection devised more than 2,000 years ago. Unfold your map of the Atlantic and place your finger along the Equator to longitude 40° west. This is the point around which was constructed the framework of curving lines, each a segment of a true circle, that carries your latest National Geographic map. Used by Hipparchus, a Greek, who lived from about 160 to 125 B.C., this stereographic projection has been employed ever since, because of its ability to portray in their true shapes even those features in the remote corners of the map.

What with its Atlantic Clipper route, its new European boundaries, its new ports and railways only recently constructed, it can be truly said that this skeleton is here

draped with the most modern map its old bones have ever supported.

Carefully prepared in the cartographic studios of the National Geographic Society, the new map is drawn on a scale of 1:20,000,000, which means that 1 inch represents 20 million inches, or 316 miles, of the earth's surface. It recalls the map of the Pacific published as a supplement to *THE GEOGRAPHIC* for December, 1936. But it is a dissimilar twin, for while the Pacific is dotted with myriad islands, the Atlantic boasts but few that are genuinely oceanic.

Blue lines across the ocean are used to show strategic distances between the oceanic islands and the continents.

Ship routes have not been forgotten, for a table in the lower left-hand corner gives the shortest navigable distances between principal ports within the map area.

Deep-sea exploration, aided by sonic depth sounding, has gone on apace, and in 1939 the Hudson Canyon, a submarine extension of the river valley, was mapped in detail by the United States Coast and Geodetic Survey, 7,374 feet below sea level and only 100 miles from New York City.

With these submarine contour maps, a ship equipped with echo-sounding apparatus can determine its position even in pea-soup fog. As on land, the pattern of ridges and valleys is different throughout and each feature serves as an undersea landmark.

Ocean-floor topography is shown on the map by brown depth contours in meters.

THE ATLANTIC'S NEW "DEEPEST DEEP"

A + marks the Atlantic's new "deepest deep," the Milwaukee Depth, located in the Puerto Rico Trough at latitude 19° 36' north, longitude 68° 20' west. Here on February 14, 1939, while taking part in the Atlantic maneuvers, the U. S. S. *Milwaukee* made a sounding of 28,680 feet. The official announcement was made April 19, the day the Atlantic map was being sent to press. The near-by Dolphin Depth, formerly deepest, was promptly removed and the Milwaukee Depth was charted for the first time.

Corresponding roughly with the 100-fathom, or 200-meter, depth line of the map is the edge of the Continental Shelf. This shelf varies in width in different localities, extending out to sea for more than 250 miles southeast of Newfoundland and creating one of the world's most famous fishing grounds, the Grand Banks.

On the map Austria, Bohemia, Moravia,

and Memel have been engulfed by Germany's green, while Slovakia sports a new spring color, symbol of her autonomy. Hungary has grown in size and now has a common border with Poland. Albania wears Italy's yellow.

While boundary changes in Central Europe have captured the headlines and the imagination, the Western Hemisphere has been quietly putting its house in order. A settlement of the Bolivia-Paraguay boundary dispute was recently announced and that new South American frontier appears on the Atlantic map along with the new European ones.

Notes in red show historic highlights of the sea. They begin with Hanno, Carthaginian navigator (500 B. C.) who sailed down the African coast to Cape Palmas, bringing back tales of burning heat and rivers of fire, and they continue on through twenty-five centuries to record the expedition of Dr. William Beebe with whom the National Geographic Society co-operated in exploring undersea life off Bermuda. A world record descent of 3,028 feet was made, August 15, 1934, and previously unknown submarine creatures were observed and recorded in color for readers of *THE GEOGRAPHIC*.*

LEGENDARY LAND FROM WHICH THE ATLANTIC TAKES ITS NAME

Four hundred years before the Christian era, Plato in the *Timæus* wrote of the legendary island of Atlantis, supposed to have existed nine thousand years before his time beyond the Pillars of Hercules, as the promontories at the Strait of Gibraltar were then called.

It was believed to be larger than Asia and Africa combined and to have been swallowed up "in a single day and one fatal night" with great earthquakes and fearful inundations.

Another legendary island is that of St. Brendan, an Irish priest of the sixth century, who built the monastery at Clonfert and voyaged across the Atlantic in search of the "Promised Land of the Saints." With "the mighty intolerable ocean on every side," he spent a night on the back of a sea monster, passed a barren isle where Judas enjoyed each year a vacation from purgatory, and was then directed to his promised land by a hoary-headed hermit. This variously lo-

* See "A Half Mile Down," by William Beebe, in the *NATIONAL GEOGRAPHIC MAGAZINE* for December, 1934.



Photograph by Peter Killian

"YANKEE CLIPPER" WAS BUILT TO TAKE THE ATLANTIC IN A ONE-DAY STRIDE

Much longer than either the *Niña* or the *Pinta* of Columbus's day, the 109-foot double-decked, winged hotel, with a wing span of 152 feet, accommodates 74 passengers on short hops and will carry a maximum of about 35 on transatlantic flights. The 41½-ton flying boat, powered by four 1,500-horsepower motors, was christened by Mrs. Franklin D. Roosevelt in Washington on March 3. On May 20-21 the *Yankee Clipper* inaugurated regular air transport service between the United States and Europe, crossing the Atlantic via the Azores in just over 26½ hours.

cated island appeared on maps up to the eighteenth century.

But even in our century, islands have been charted and later removed from the maps. Thompson Island, formerly charted in 54° south and 4° east, has been searched for unsuccessfully by numerous survey vessels and is now considered not to exist.

Was an island ever there? Why was it charted? Herman Melville in *Moby Dick* gives a whaler's version, when he describes the floating carcass of a whale: "Espied by some timid man of war or blundering discovery-vessel from afar . . . the white mass floating in the sun, and the white spray heaving high against it: straightway the whale's unharmed corpse, with trembling fingers, is set down in the log—shoals, rocks, and breakers hereabout: beware!"

SARGASSO SEA OF VAST EXTENT

Southeast of Bermuda is the Sargasso Sea, that legendary and fictional "Port of Missing Ships." It takes its name from a Portuguese word meaning seaweed. It is a

sea without land features to demarcate it, being bounded only by ocean currents—by the Gulf Stream on the west and north, the Southeast Drift Current on the east, and the North Equatorial Current on the south.

Despite its lack of visible boundaries, it is definitely delimited by its peculiarities. Floating gulfweed, without roots and believed to be an adjustment of plant life to the environment of the open sea, is commonly found here in patches as large as a baseball diamond or infield, and areas up to an acre have been seen.

This weed area was met with and navigated by Columbus, who recorded it in the log of his first voyage. He had been warned by a Portuguese sailor that one of the chief difficulties to be encountered was the grasses, so there must have been some knowledge of its existence prior to 1492.

Despite these early legends and later novels, there is no proof that the weed ever seriously impeded the progress of a ship.

As defined on the Atlantic map, the Sargasso Sea covers two million square miles, or about two-thirds the area of the United

States. Its waters are deep blue in color and unusually transparent. In these two characteristics it even outranks the Gulf Stream. A 6½-foot disk, when lowered beneath its surface, was still visible at 217 feet.

Eels which inhabit not only the rivers of Europe and America but small brooks and ponds on both sides of the Atlantic converge on the Sargasso Sea each year to breed and then die.

BROWN ARROWS SHOW PREVAILING WINDS

Winds, once the most important factor in navigation, supplying the motive power for oceanic voyages, are shown on the map by brown arrows. Although supplanted by steam and motor, they are again of immense importance, for they are the very breath of the related sciences of aviation and meteorology.

Most constant of all winds are the trades, which blow for days and even weeks with no more than a slight variation in velocity or direction. The South Atlantic, along with the South Indian Ocean, is especially favored, for here the trade winds reach their greatest development. In still another way is the South Atlantic fortunate, for it is never invaded by tropical cyclonic storms. These storms originate only in the doldrums, north of the Equator, where the air is always hot and sultry and squalls are commonplace.

Other regions of light and variable winds are the horse latitudes, or calms of Cancer and Capricorn, where, in contrast to the doldrums, the air is clear and fresh.

MIGHTY RIVERS IN THE OCEAN

The prevailing westerly winds of the Temperate Zones blow in the Southern Hemisphere with a constancy second only to that of the trade winds. They have given the name "roaring forties" to the latitudes where they most regularly exhibit their turbulent temperament.

Ocean currents are shown on the map by blue arrows and of these the Gulf Stream is the most important. Like the other currents, it owes its origin principally to the winds. Breezes, through friction, set in motion the surface waters of the sea, and these in turn impart their motion to the next lower water layer, and so on until an ocean current is set up.

On the direction and force of the prevailing winds depend the strength and permanence of the currents. The Gulf Stream's velocity changes with the seasons

along with the intensity of the trade winds, to which it is indebted for its origin.

Of a deep indigo-blue color so that its juncture with other waters is plainly evident, the Gulf Stream in its swift flow to the north cools so little that it is vastly warmer than the waters through which it passes. Tempering the climate of the north as it does, it is often called the "heating apparatus" of western Europe.

The Labrador Current flowing southward from Davis Strait passes along the Labrador and Newfoundland coasts and then skirts the eastern shoulder of the Grand Banks, bringing with it the ice found in this region during certain months.

It was here in latitude 41°46' north, longitude 50°14' west, that one of the greatest of all sea tragedies occurred, when the *Titanic*, largest ship then afloat, sank on her maiden voyage after striking an iceberg, April 14, 1912. This disaster led to the establishment of the International Ice Patrol. Conducted by the United States Coast Guard, its expenses are paid by 14 nations according to their shipping tonnage.

ICEBERGS FROM GREENLAND AND ANTARCTICA

Most of the North Atlantic bergs are launched by the glaciers of Greenland's west coast. In the south of Greenland a small but prolific glacier gives birth to the bluish-hued bergs so difficult to see at night.

But these Arctic icebergs are completely eclipsed by the much larger Antarctic ones with their longer life span. The northern bergs are seldom older than two years, while the southern bergs sometimes reach an age of ten years.

Shown by white shading in the blue tint, the "northern and southern limits of ice" exhibit some queer kinks. Most peculiar of these is the tongue of ice, south of Martin Vas and west of Tristan da Cunha, which is driven north from the Antarctic by the cold Cape Horn Current.

Such a map shows vividly how far to the east South America lies as compared to North America, and this is emphasized by the time zones, depicted by white lines: The time difference between London and Rio de Janeiro is only three hours, compared to five hours between London and New York. The west coast of South America is about as far east as Jacksonville, Florida.

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

Articles and photographs are desired. For material which The Magazine can use, generous remuneration is made.

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

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

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

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

The National Geographic Society-U. S. Navy Expedition camped on desert Canton Island in mid-Pacific and successfully photographed and observed the solar eclipse of 1937. The Society has taken part in many projects to increase knowledge of the sun.

The Society cooperated with Dr. William Beebe in deep-sea explorations off Bermuda, during which a world record depth of 3,028 feet was attained.

The Society granted \$25,000, and in addition \$75,000 was given by individual members, to the Government when the congressional appropriation for the purpose was insufficient, and the finest of the giant sequoia trees in the Giant Forest of Sequoia National Park of California were thereby saved for the American people.

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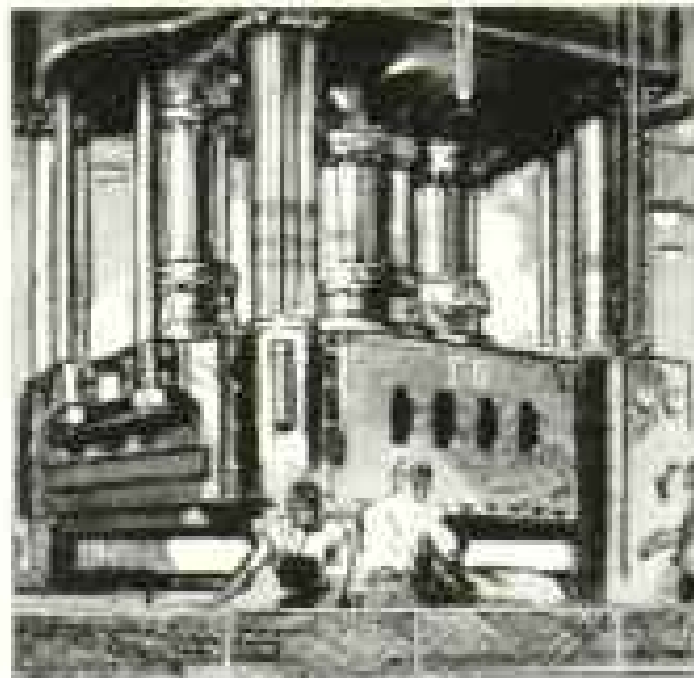


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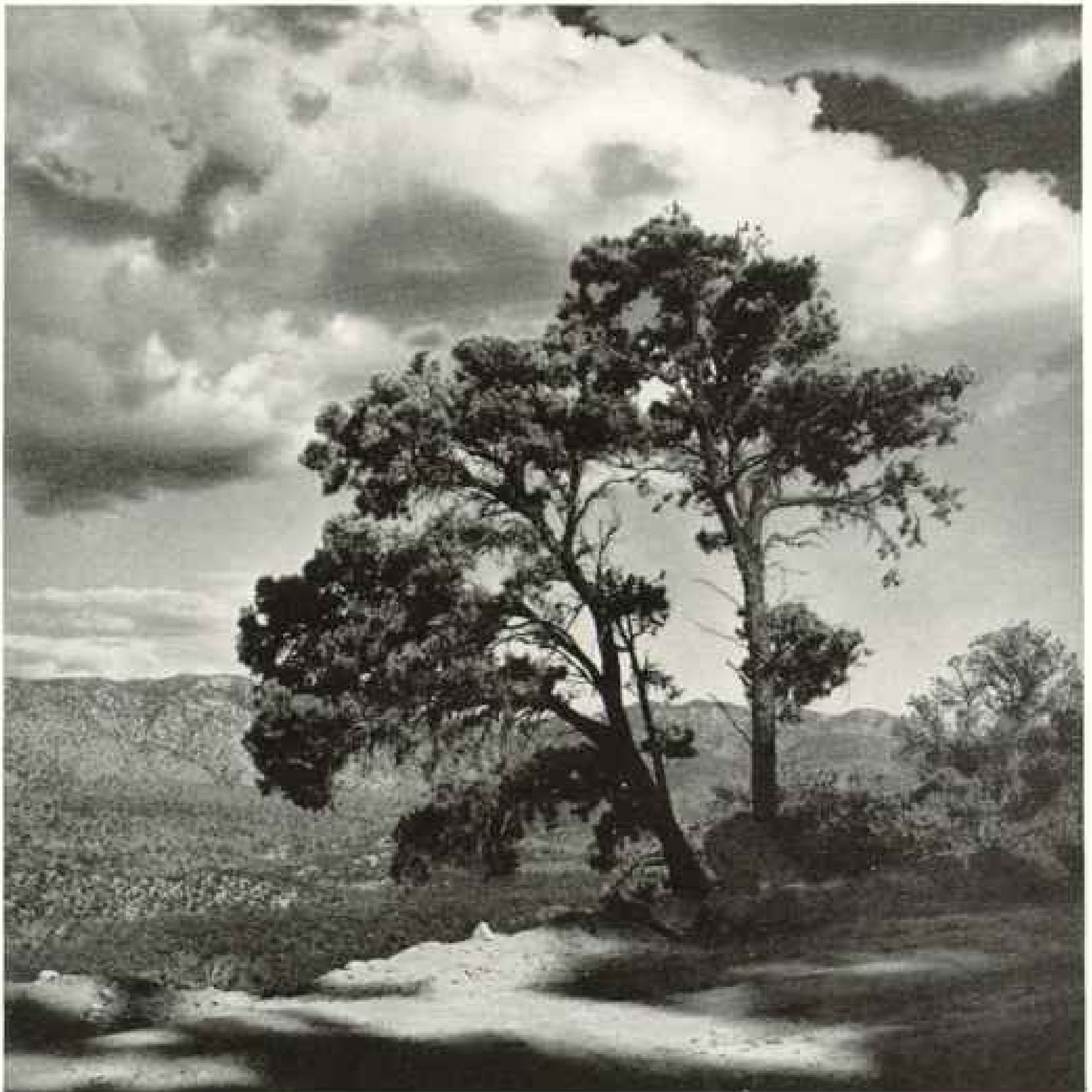
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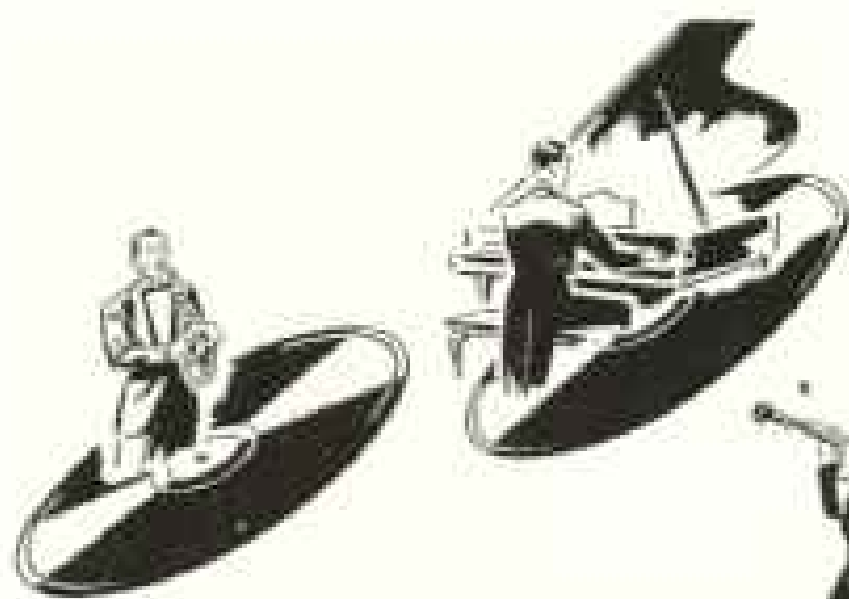
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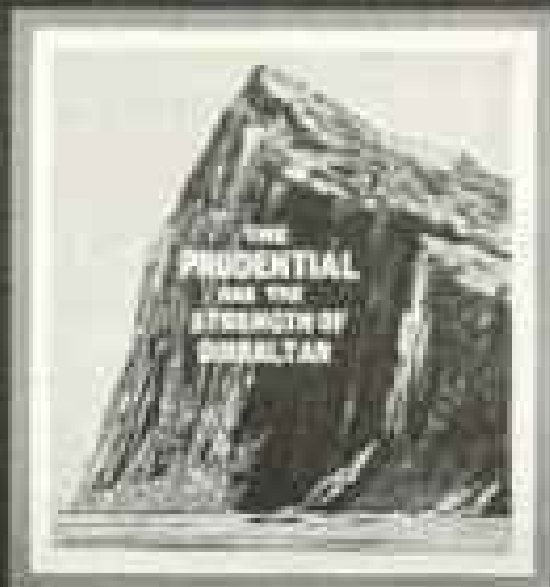
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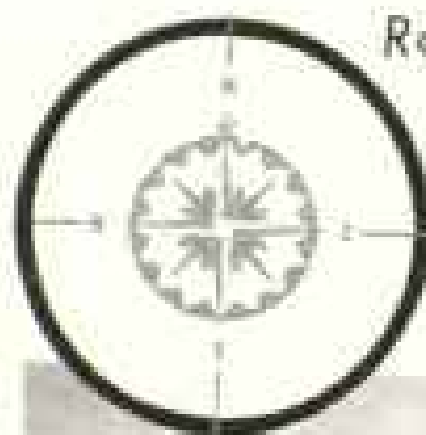
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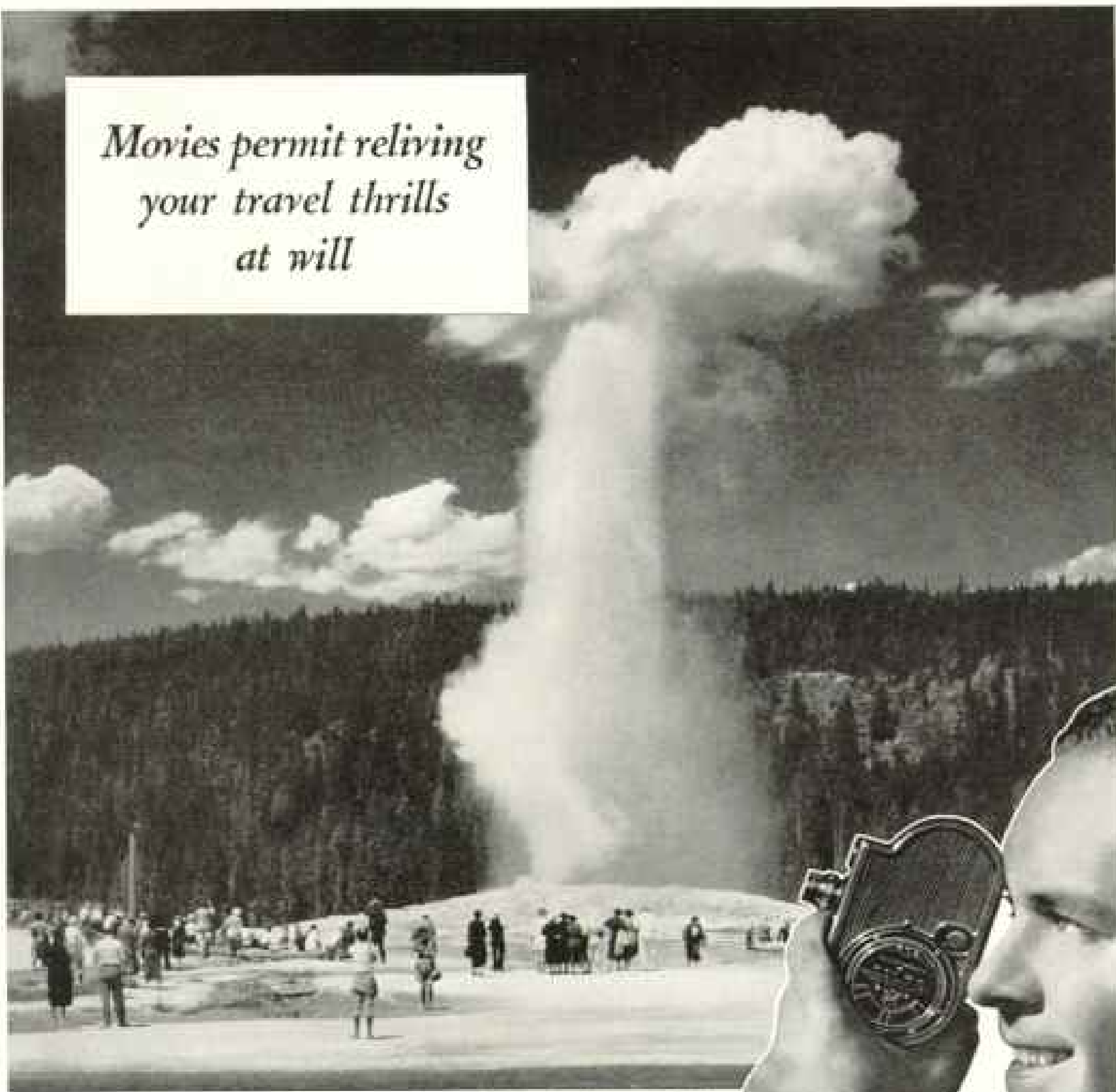


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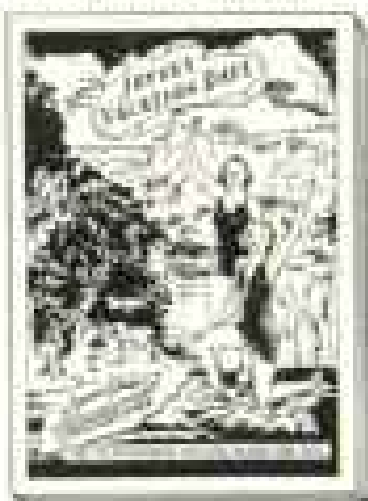
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the steering mechanism tested?	_____
the wheel alignment checked?	_____
the headlights focused?	_____
the taillights checked?	_____
the exhaust system checked for leaks?	_____
the battery tested?	_____
the oil checked; car greased?	_____
the tires and tire pressure checked?	_____
the ignition and fuel systems inspected?	_____

THREE HELPFUL BOOKLETS

The Metropolitan booklet "First Aid" tells how to apply artificial respiration, and how to treat Ivy poisoning, stings, sunstroke, snake bites, etc. Two other booklets—"Swimming and Life Saving" and "Calling All Drivers"—will help you plan a trouble-free vacation. Send a post card for all three . . . or mail the coupon.

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How *SENECIO HAWORTHII* meets its problem



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