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THE NATIONAL GEOGRAPHIC MAGAZINE

EXPLORING THE STRATOSPHERE

BY CAPTAIN ALBERT W. STEVENS

Scientific Observer of the National Geographic Society-U. S. Army Air Corps Stratosphere Expedition

TO LOOK back, we were indeed in a strange predicament.

We were imprisoned in a stout metal shell, hanging from a huge balloon, more than eleven miles above the earth. Yet we had at arm's length two hatches we had only to open to be free.

One of the hatches had a lever to facilitate prying it open. But no one made a move toward the lever. To have opened it would have meant almost instant unconsciousness from change of pressure. Our tissues would have expanded suddenly, somewhat as would those of certain fish drawn hurriedly to the surface from ocean depths, and the results would have been both distressing and disastrous.

A PLEASANT COMPARTMENT—11 MILES ALOFT!

Our lofty prison was a very livable place. We were perfectly familiar with every square inch of it, for we had been in and out of it dozens of times daily for many weeks. It was airtight; it resisted all the strains of the heavy load it carried; it was almost comfortable, certainly much more so than we had expected.

The inside walls were painted a glossy white, and on them shone bright rays of sunlight streaming through the glass ports above our heads. All around us were scientific instruments, and their subdued clatter, ever increasing as the balloon ascended, had been music to our ears.

With earphones on our helmets and microphones in front of us, we could talk, allowing a few minutes for necessary connections, to practically anyone in the United States. We were neither hungry nor thirsty, and the artificially prepared air we breathed was surprisingly good.

Suddenly and without warning there came a great rent in our balloon! A glance above us just a few minutes before and all had been well; soon we were dropping—bag, gondola, instruments, and men.

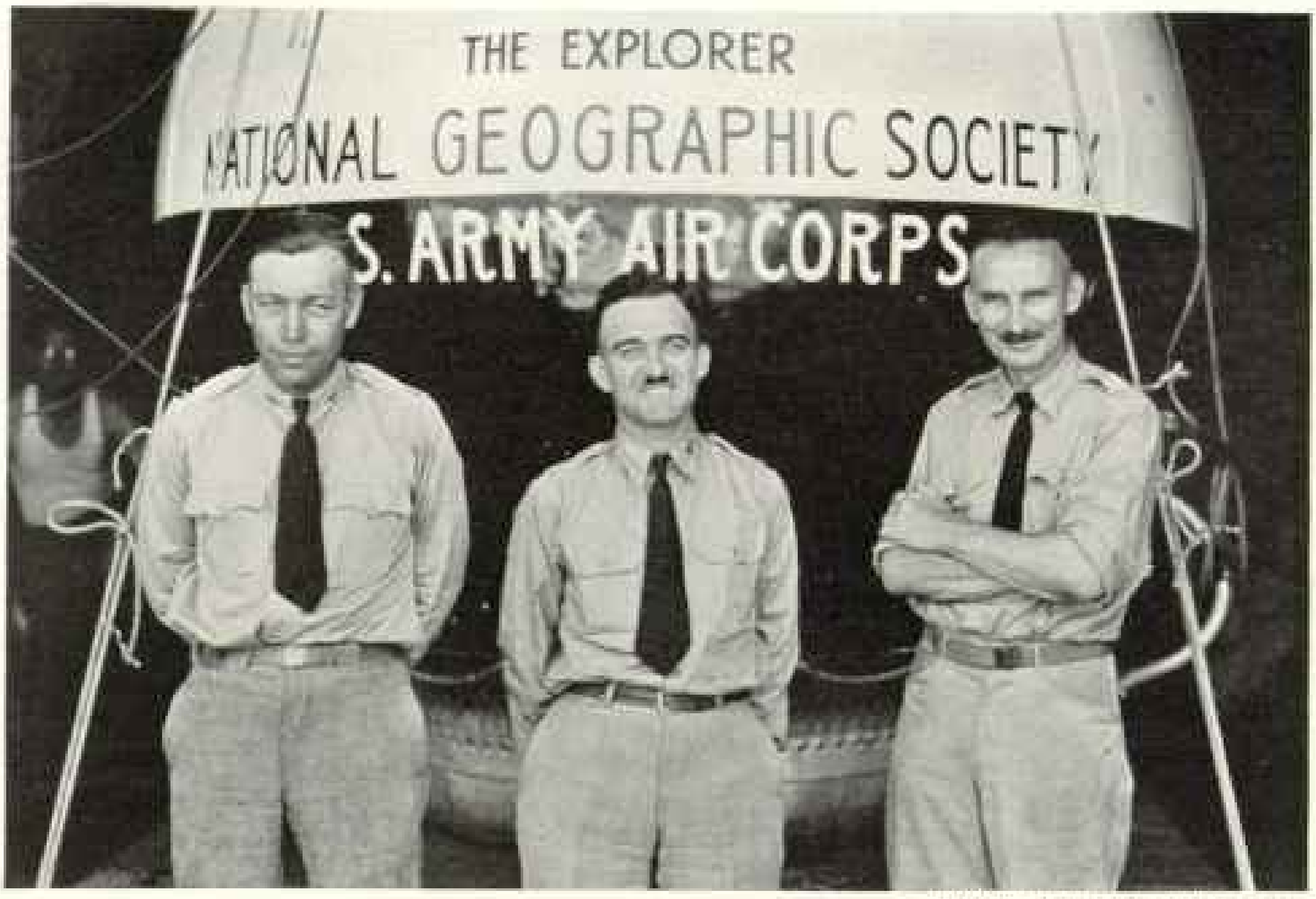
So long as things held together reasonably well, there was hope. But if too many breaks in the fabric developed the gondola would go hurtling through space, and we with it.

With a free fall of nearly 11½ miles, starting in air approaching the thinness of a vacuum, the downward speed would be so great that we could scarcely expect to push through the rush of air across the hatch openings, even should we be able to open hatches at precisely the right time.

Later it became necessary for one of us to dive through a hatch when our gondola was falling more than a mile a minute. But such a dive could not have been made had the rate of free fall been five miles a minute.

* * * * *

Let us start with our ascent on the National Geographic Society-U. S. Army Air Corps Stratosphere Expedition. The take-off was shortly after sunrise (5:45 mountain standard time), July 28, from the Black Hills of South Dakota. Here, for many weeks, at the Stratosphere Flight Camp near Rapid City, scientists, Army officers, veteran balloonists, troops, and many civilian workers had toiled day and night in



Photograph by Richard H. Stewart

THE CREW OF THE "EXPLORER"

Major William E. Kepner, pilot, stands between Capt. Albert W. Stevens, scientific observer (right), and Capt. Orvil A. Anderson (left). Behind them is the gondola, built by the Dow Chemical Co., in which they were sealed while in the stratosphere. The upper half is white in order to reflect away some of the heat of the sun's rays and so prevent an uncomfortably high temperature inside during the middle of the day. The lower half is black to absorb heat rays from the earth.

preparation for a flight by means of the largest free balloon ever constructed.

From the inception of the project, in the fall of 1933, with the guidance of the scientific committee appointed by President Grosvenor, no pains were spared to produce the best possible instruments and equipment for collecting scientific data in the stratosphere. The instruments were to be of full laboratory size to insure the greatest attainable accuracy. This meant that some would be both bulky and heavy.

THE LARGEST FREE BALLOON OF ALL TIME

To house these many large instruments, it became necessary to design a gondola larger than any that had previously been sent aloft.

Finally, it became apparent that to lift the gondola and its cargo of apparatus high into the stratosphere, a very large balloon would be required. Experts were consulted, skilled in such construction, and a contract was given to design and build a larger balloon than any previously constructed—a bag which, when fully inflated, would contain three million cubic feet of gas.

It required five months to fashion this gigantic bag, and into it went two and a third acres of rubber-impregnated cloth made from long-staple cotton. While it was being built, work was begun on the gondola, a globe of dowmetal, lighter than aluminum; and in a score of laboratories and workshops from New York to California specially designed instruments were being constructed.

Meanwhile a site for the base camp of the stratosphere flight had been chosen in western South Dakota. Three considerations determined this choice: the point was far enough west to permit the balloon to drift even 700 or 800 miles to the eastward and still come to earth in relatively level, unforested country; the record of the region was promising for good summer flying weather; and the site was sheltered from surface winds.

Early in June a camp was established in the deep, cliff-encircled natural "bowl" twelve miles southwest of Rapid City. It quickly became known as the "Stratocamp."

Photograph by Lieutenant James F. Phillips and Master Sergeant G. B. Gilbert

THE BALLOON MAKES A WAYSIDE STOP

So that certain instruments might be lowered, others set going, and the hatches closed, the flyers "leveled off" their huge craft at an altitude of 15,000 feet. The outside spectrograph is shown partly lowered. In the rigging above the gondola are a United States flag and the flag of the National Geographic Society. The outskirts of Rapid City, South Dakota, headquarters for many of the arrangements for the flight, appear in the distance to the right (see text, page 434).

Photograph by Edwin L. Wisherd

WORKERS WORE SHOES OF CLOTH WHILE PUTTING THE BALLOON TOGETHER

In every way the fabric was protected while the huge gas bag took shape. All windows in the factory room were sealed, and only filtered air was admitted. The discarded shoes of a worker are shown in the foreground. Not a stitch was taken in putting together the two and a third acres of rubberized cloth that was used. Every seam was cemented and then reinforced by tape on both sides. The seams of the finished balloon were even stronger than the adjoining fabric.

Captain Orvil A. Anderson was on the scene from the start. Under his capable direction the camp developed from an almost deserted basin into a bustling little village of more than a hundred inhabitants (see illustration, page 405).

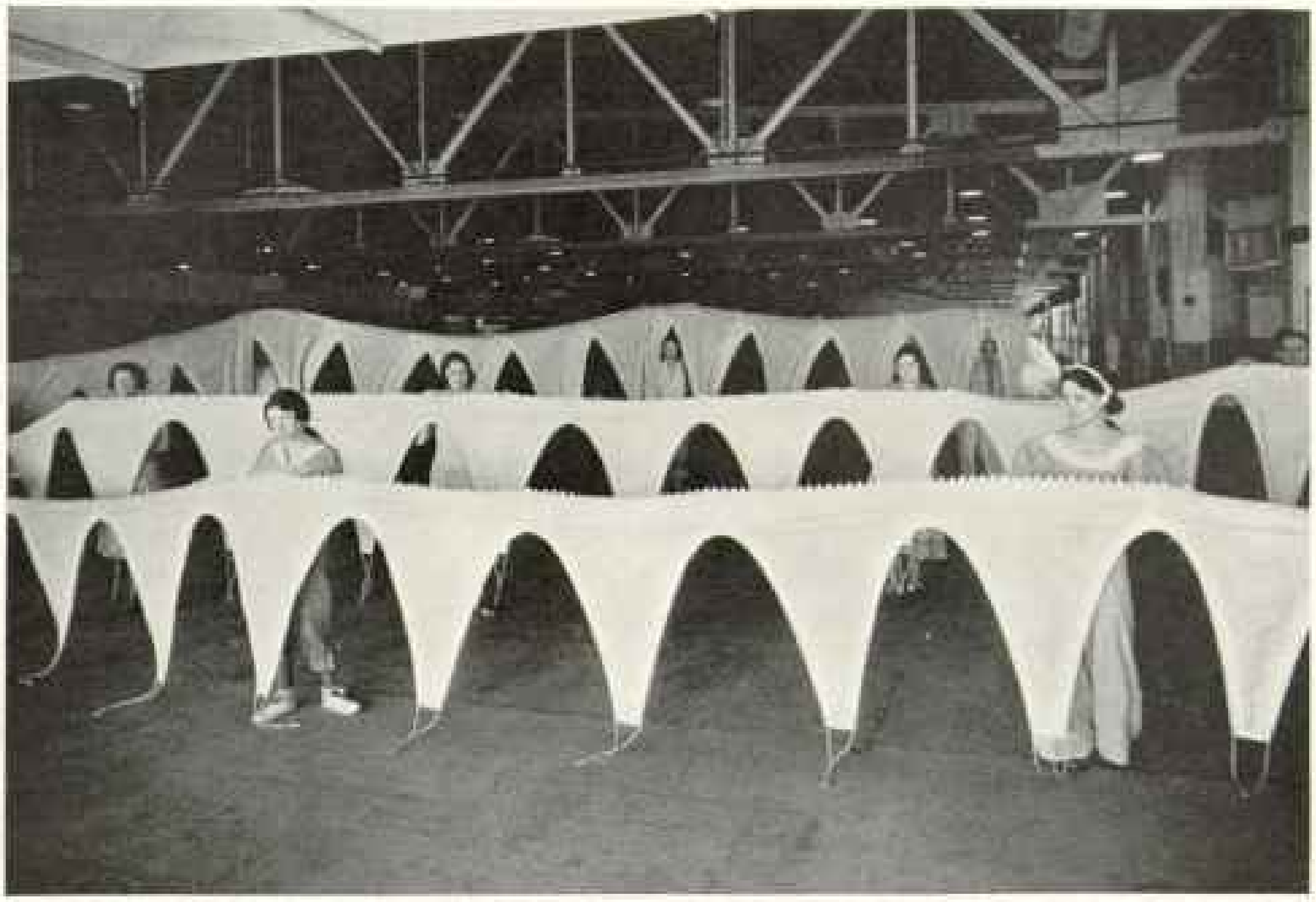
Within a few weeks it had its drainage system and sawdust-paved streets, a waterworks, two electric lighting systems, a sewage disposal plant, parking spaces, traffic officers, a hospital and ambulance. There was even a fire department with a full-size hose wagon, two professional fire fighters, a dozen fire extinguishers, and a volunteer corps to operate them, providing a safeguard against accident in handling quantities of explosive gas. No smoking was permitted in the neighborhood of the hydrogen cylinders.

Three telephone lines and two radio stations kept the Stratocamp in communication with the outside world; and there were two telegraph wires leading to teletype machines which constantly rapped out weather information from points as far away as Alaska, Cuba, and Iceland. The special weather station set up at the camp, through the coöperation of the U. S. Weather Bureau, the Signal Corps, and the Air Corps, ranked, in fullness of information furnished, with the half dozen most important weather stations in the United States (see illustration, page 418).

Two weeks after the camp was started I went out by plane from Washington, taking some special instruments. A few days later Major William E. Kepner flew into Rapid City, and our flight personnel was complete.

Freight-car loads and truck loads of the equipment necessary for a stratosphere flight had been converging on the Stratocamp for weeks. Three railroad cars filled with heavy steel cylinders containing compressed hydrogen arrived in Rapid City. Thanks to the generous coöperation of the National Guardsmen of South Dakota and their fleet of trucks, these tons of steel were soon neatly piled along one edge of the camp (see illustration, page 406).

The gondola rolled in by truck, after a journey of more than a thousand miles,



Photograph by Edwin L. Wisherd

THESE SCIENTIFICALLY DESIGNED SCALLOPS OF CLOTH SAFELY SUPPORTED A FOUR-AND-A-HALF-TON LOAD

From the loops at the ends of the 160 tabs of this "lower catenary band" extended the ropes which sustained the gondola with its cargo of men and instruments. This vital feature of the equipment showed no breakage or strain, but held fast to the fabric above and the ropes below even after the top portion of the balloon exploded. A small rope is hemmed into the curved edges of the scallops, which are in the form of the mathematical curve known as a catenary. This shape serves to distribute the downward pull evenly to the fabric above.

from Midland, Michigan, and was installed in the commodious gondola house, the entire front of which could be opened up. This became our workshop.

A few days later another truck brought in a huge box containing the balloon bag, which weighed two and a half tons, carefully packed in a waterproof container. The box was placed on blocks in the exact center of the level floor of the "bowl," protected from sun and rain by a canvas tent fly, there to remain until the day of the inflation.

INSTRUMENTS ARRIVE BY AIRPLANE

The largest truck of all to traverse the winding road down into the basin arrived the following week—the liquid-oxygen generator truck of the Army Air Corps. It supplied the essential liquid oxygen used to make breathable air inside the gondola during our stay in the stratosphere.

Several airplane loads of instruments were flown to Rapid City; and daily freight and express packages arrived, their contents varying from machine-shop tools to delicate vacuum tubes.

For many weeks the gondola house was the center of activities that started sometimes as early as 4 o'clock in the morning and often lasted until 9 at night. Our numerous instruments and pieces of equipment had to be assembled, tested, some of them altered, and all of them firmly fixed in the places assigned to them on the gondola shelves or hanging from the gondola roof.

The last of this preparatory work was completed on July 9. From that time on we could have flown any day, so far as the equipment was concerned. But it was essential that we make our flight during very special—and, unfortunately, rare—weather conditions covering the area for seven or eight hundred miles east.

Photography was to play an important part in our work during the proposed twelve hours aloft; and for satisfactory photog-

raphy we must have cloudless skies and good visibility. Only a broad area of high atmospheric pressure could assure such conditions, and we determined to wait for such a "high" if it took all summer!

None of us was willing to mark time lazily. We opened up the gondola house as usual every morning and busied ourselves in making tests and in figuring out minor, and sometimes major, improvements to the instruments.

Dr. Lyman J. Briggs and Dr. W. F. G. Swann collaborated during this waiting period in building a dehumidifying apparatus to "wring" surplus moisture from the air of the gondola. It was a complete success and greatly contributed to our comfort and efficiency while the gondola hatches were closed.

Major Kepner brought his long ballooning experience and meteorological knowledge to bear on our weather problem during the weeks following July 9. At 10 o'clock every morning and at the same hour every evening, the current weather maps were completed by the camp's weather staff, under the direction of Mr. V. E. Jakl, of the U. S. Weather Bureau (see illustrations, pages 413 and 418).

Major Kepner pored over these maps with the weather staff as soon as they were available, searching for favorable indications to the west and northwest, where "highs" might be developing days before they could reach the Stratocamp.

Everyone concerned with the expedition—the scientists, the entire camp personnel, and the newspaper correspondents covering the flight—realized that weather was the final and necessary ingredient in a stratosphere flight; so we watched the twice-daily ritual of map examination with the keenest interest. Day after day the news that came from the weather room was discouraging.

AT LAST THE WEATHER IS "RIGHT"!

At last, on July 27, the long-awaited high-pressure area had drifted in from the west and promised for the next day the conditions which we wanted both at the Stratocamp and to the east. When, at noon, Major Kepner announced officially that the weather was satisfactory for the flight and that the inflation would begin that evening, the camp was galvanized into activity.

Guests were barred from the floor of the "bowl"; only men with definite jobs to perform were permitted in the camp. The balloon box was opened and the huge, billowy mass of fabric was spread out on the circular sawdust-covered, canvas-protected bed that had been prepared for it (p. 405).

Bus load after bus load of soldiers arrived from Fort Meade. They were the men of the ground crew who were to hold the balloon in leash while the hydrogen poured into it.

At the gondola house, those of us concerned with the instruments were extremely busy. A definite schedule was worked out, minutes were allotted, and, one after the other, specialists climbed into the black and white ball to install batteries and to give their instruments a final tuning up.

INFLATING THE GIANT BAG

On all sides the preparations moved ahead like clockwork. At dusk the floodlights in the great ring that extended around the floor of the basin were turned on, and a little later the hydrogen gas was started through the canvas tubes into the vast maw of the balloon (see illustrations, pages 412 and 416).

Before 2 o'clock in the morning the inflation had been completed. Held to the earth only by slender ropes, the huge bag towered overhead, a beautiful sight as its top melted into the dim shadows above the direct rays of the floodlights. The weather was ideal. Hardly a movement could be detected among the acres of cloth.

Quickly the gondola, its instruments all in order, was wheeled under the dangling center ropes and the three-hour task of lashing it to the balloon was begun.

By shortly after 5 o'clock there remained only a few last-minute tasks to be performed—the careful placing of rope-ends for valve and rip cords; the lashing on of a small mail sack; the loading of warm flying clothes and parachutes.

Captain Anderson and I climbed into the gondola; Major Kepner to its rope-enclosed top, the better to direct the take-off.

The outer ropes were dropped; only the gondola and ten small hand ropes attached to it held the gigantic bag of gas to the earth (see page 419).

Major Kepner directed the final ground activity of the flight (see page 415) before the ascent—the weighing-off. Ropes were slackened to test the balloon's lift. Ballast was adjusted until the upward pull seemed just right.

Photograph by Acme

THE "EXPLORER" IS CHRISTENED WITH LIQUID AIR

Mrs. Berry, wife of the Governor of South Dakota, holds a double-walled metal flask of the liquid. Major Kepner stands at the left; Captain Stevens at the right.

Then came the order, "Cast off!"—and we were away for the stratosphere!

Below us the ground dropped rapidly away, and the *Explorer* swept over the rim of our camp, in a direction eastward toward Omaha. As we rose higher and higher we could look back on the deep bowl, and we saw that thousands of people had gathered during the night around the rim to watch the take-off (page 408).

But we were rising rapidly—too rapidly, in fact—and could pay no further attention to the ground. It was important to get the balloon under control and all of our equipment functioning properly.

Under the direction of Major Kepner and Captain Anderson, who were outside arranging things in the rigging, I worked the balloon hydrogen gas valve from inside the gondola. At first we valved cautiously, but it soon became evident that we were riding a different kind of balloon from any we had known before. It "took the bit in its teeth," and kept on soaring skyward faster than was desired for recording data. But we kept the valve open for longer and longer intervals, and finally the ascent became slower.

Major Kepner and Captain Anderson had been standing by to handle the external emergency gas valve which was operated by the usual rope. When it became apparent that the pneumatic valve was able to handle the required volume, Captain Anderson joined me inside and established equilibrium at 15,000 feet (see chart, page 431).

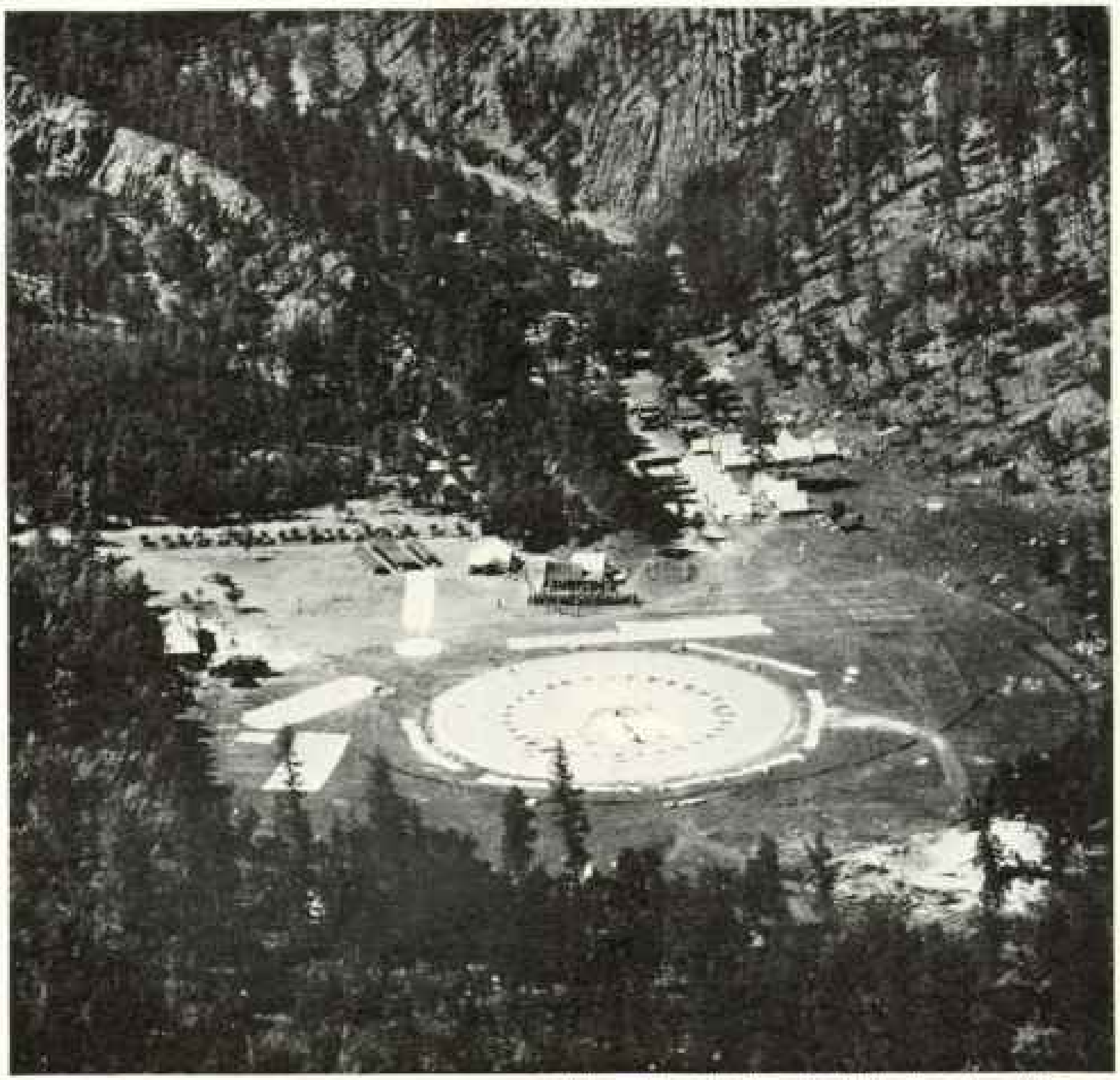
THESE MASTERS OF HORSES BECAME MASTERS OF BALLOONS

The ground crew of 120 dismounted troopers of the Fourth United States Cavalry from Fort Meade, South Dakota, had no previous experience with balloons, but quickly mastered the novel job. Their practice with the demonstration balloon of 35,000 cubic-foot capacity helped. Above the flight-camp administration cabin, where they are lined up, floats the National Geographic Society flag.

Photographs by Richard H. Stewart

IN PRIMITIVE GARB, THEY SEE ONE OF THE WONDERS OF SCIENCE

Sioux warriors and their squaws from a reservation on the plains of South Dakota journeyed to the Black Hills to see the gondola of the stratosphere balloon. The brave in the center is going through a few steps of a dance, while other visitors to the flight camp look on.



Photograph by Lieut. James F. Phillips, U. S. Army Air Corps

THE BALLOON'S SAWDUST RING RESEMBLES A GIANT'S GRIDDLECAKE

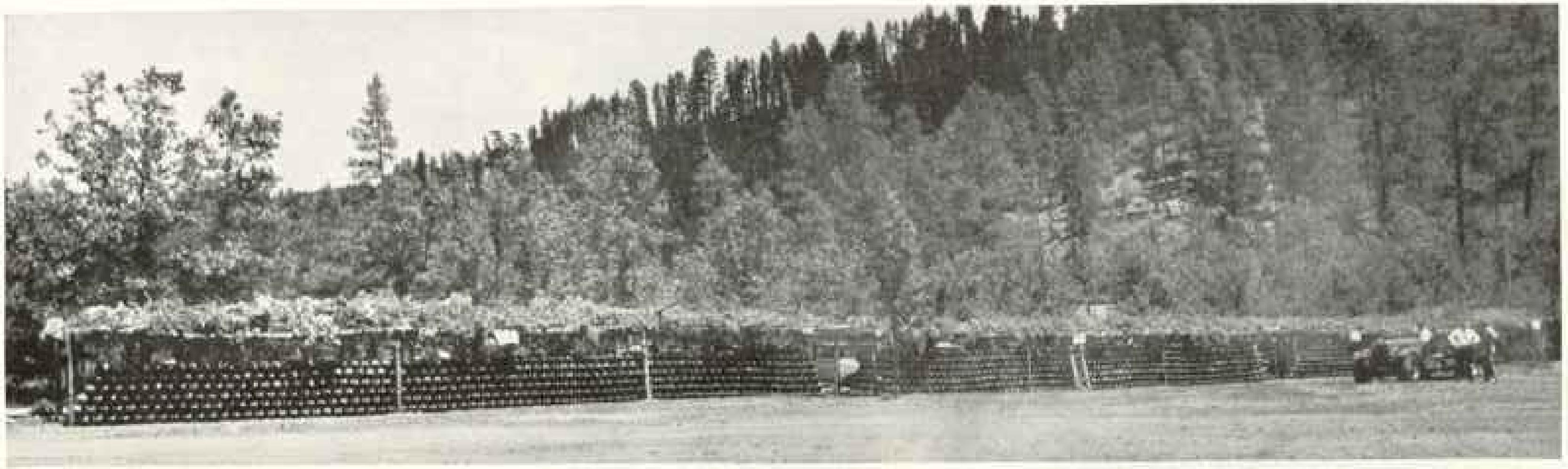
The sawdust is not a figure of speech: four inches of it were spread within a level circle, 200 feet in diameter, to cushion the huge bag when spread out for inflation. Around the edges of the circle are canvas ground cloths to cover the sawdust and keep the fabric dry and clean. The inner ring of dots was made by iron rods, with eyelet tops, sunk into the ground to serve as anchor points for ropes to hold the bag during inflation. In the right background are tents of officers and civilian scientists.

I crawled outside and from the slippery top of the gondola assisted Major Kepner in lowering the heavy spectrograph to the required 500 feet below the gondola. I wonder whether any of my readers have ever had the problem of lowering 125 pounds of swaying bulk a distance of 500 feet on a quarter-inch rope! It took us more than half an hour to finish the task, for we had to be extremely careful that the heavy and valuable instrument did not get away from us—or take us with it (p. 422).

When everything outside the gondola was shipshape, Major Kepner and I went inside and closed the airtight manholes. We were now sealed in. Before going any higher we tested the gondola for airtightness. This we did by starting the air vaporizing equipment (see text, page 432). The air pressure built up inside and held. We knew then it was safe to start upward toward the stratosphere.

RADIO CONTACT AT 15,000 FEET

While at the 15,000-foot level we made our first contact with the earth by radio. We carried on with ease conversations with General Westover and Dr. La Gorce, Vice



MOTIVE POWER FOR THE FLIGHT: HYDROGEN IN 1,500 STEEL CYLINDERS, EACH WEIGHING 131 POUNDS AND CONTAINING 190 CUBIC FEET

Photographs by Richard H. Stewart

LIKE PILES OF CORDWOOD, THE HYDROGEN CYLINDERS WERE HAULED TO CAMP BY 42 TRUCKS OF THE SOUTH DAKOTA NATIONAL GUARD

THE GONDOLA, FITTED WITH THESE INSTRUMENTS AND MECHANISMS, WAS A LABORATORY OF THE SKIES

Left-hand picture: 1, 2, 3, 4, 22—flasks for obtaining samples of stratosphere air; 41—observation porthole in top of gondola (through this window the tear in the balloon was discovered); 43—altimeter for outside pressure; 47—altimeter for inside pressure; 44, 6, 30—observation portholes (fitted with double pyrex glasses); 34—statoscope (tells whether balloon is rising or falling); 40—manhole assigned to Major Kepner; 48, 49, 50, 51—cosmic ray counters; 12—barometer box; 38—horizon spectrograph (sky spectrograph is behind 22); 39—most heavily shielded electroscope (shell contains 600 pounds of lead); 36, 37, 46—batteries; 45—photographic recording device for cosmic ray counters; 52—switchboard for cosmic ray counters; 31—special vertical observation porthole; 32—air lock for dumping ballast. (It will be noted that some numbers are duplicated for the same instruments in the three pictures.) *Center picture:* 7—balloon valve hose; 5—part of unshielded electroscope; 10—manhole assigned to Captain Stevens; 11—camera for recording barometer readings; 13—Eyemo Motion Picture Camera; 8, 9—Factographs (to take photographs of instrument dials at frequent intervals); 14—National Broadcasting Company's radio transmitter (the receiver is on shelf above, to right); 15, 16, 20—batteries; 18—dial showing pressure in bumper, outside; 19—dial showing pressure in gas cylinder; 17—one of three flasks containing a mixture of liquid oxygen and liquid air; 21—observation porthole. *Right-hand picture:* 13—tubes bringing outside air pressure to barometers; 14—valve to air-sample flask. When the gondola rose, sacks of tiny lead shot ballast were piled around the edge of the floor; the Fairchild camera for vertical pictures was in place in the center of the floor.

Photograph by Lieutenant James F. Phillips and Master Sergeant G. B. Gilbert.

THOUSANDS OF SPECTATORS SAW THE "EXPLORER" START SKYWARD

Hundreds of cars are clearly seen parked in a pasture to the right, and other hundreds on the highways. Several thousand more, many of them not easily discerned, are in the woods near the edge of the cliff that rose above the Stratocamp. The balloon (not shown) has just risen. The circular bed from which it took off, whitened by its canvas cover, is seen to the left. Cars brought sight-seers from hundreds of miles. Probably 30,000 people gathered within a radius of a few miles of the camp.

"ARE YOU THERE?" CAME THEIR CLEAR CALL FROM ALOFT

Major Kepner and Captain Stevens are testing the apparatus in the gondola which enabled them to broadcast from far above the clouds, and converse with officers of the National Geographic Society and the United States Army Air Corps in Washington. This mechanism, working perfectly, transmitted one of the most dramatic radio broadcasts ever made, as they told of their thrilling descent to the minute of their escape by parachutes (see page 405).

Photographs by Richard H. Stewart

THE GONDOLA RECEIVES ITS CARGO

An assistant is lifting to a manhole the Fairchild aërial camera which was mounted in a side porthole to photograph toward the horizon. With this camera it was expected that pictures could be made showing laterally the curvature of the earth. Its film roll was ruined when the gondola crashed. To the left, Gustave Fassin, of Rochester, is holding one of the two spectrographs carried inside the gondola.

President of the National Geographic Society, both in Washington, and also requested further weather information from the stratosphere camp.

Our extra-light transmitting and receiving sets, built especially for the flight by engineers of the National Broadcasting Company, functioned perfectly throughout the trip. We made immediate contact with radio stations whenever we found time from our many duties to speak into the microphone (see page 409).

There was something heartening, as we hung far up in the heavens, in being able to talk to those who were following our flight from the earth. Of course there were more practical considerations: our ability to receive weather and other important information in the gondola, and to report our changing positions to the earth. The faultless performance of our communications system—and, in fact, of all our mechanisms—was one of the gratifying features of the flight.

Although we were now in the warm rays of the sun, which should have expanded the gas and provided more lifting power, the *Explorer* was sluggish and seemed disinclined to move upward; in fact, it even settled a little. It became evident that, because we were dealing with an unusually large balloon, the responses were slow. Finally, Anderson discharged bag after bag of ballast through the air-locked hopper—nearly 400 pounds in all. Suddenly the balloon started to rise, and shortly the rate-of-climb meter indicated that we were ascending at 500 feet per minute.

During the next hour the balloon rose steadily to 40,000 feet, which was about what we had planned. On no previous stratosphere flight had a balloon ever been brought to pause on the ascent at points midway between the ground and the maximum altitude of a flight.

Yet, for more than an hour and a half, Captain Anderson, by careful and continuous valving, kept the balloon in practically perfect equilibrium. It neither rose nor fell.

We stayed at 40,000 feet, as scheduled, while the various instruments went through their cycles of operation. We started up the Geiger counter apparatus (see page 407) designed to record the directions of movement of cosmic rays. The magnetic relays of this instrument clicked when a cosmic ray passed through the apparatus in a certain narrow path.

While the clicks had been at the rate of one or two a minute at ground level, already the device was clicking away at a much faster rate. Later on, the relays sounded like many typewriters in a newspaper office, or like a flock of chickens pecking grain from a metal pan. Rays were actually coming in more than fifty times as fast as on the ground (see page 423).

We stopped valving gas and the *Explorer* again started to ascend. It was now nearly noon, mountain time, and for the next hour we moved steadily upward. At 1 o'clock we were approaching the 60,000-foot level, and Major Kepner prepared to bring the balloon again into equilibrium. Valving was begun, and the balloon started to slow down.

ALL IS WELL—THEN A RIP IN THE BAG

At the time, I was giving some instrument readings over the radio. Suddenly a clattering noise was heard on top of the gondola.

We looked upward through the three-inch upper port and saw that the noise had been caused by part of the appendix cord—a small rope—falling on the roof of the gondola.

What had caused the cord to drop? Looking still higher, we were startled to see a large rip in the balloon's lower surface. It was then a few minutes past 1. The gas had not expanded to fill out the balloon completely. Had the rip not occurred, the bottom of the bag should have become spherical at something over 65,000 feet. The hydrogen would have poured out of the 8-foot appendix (an open sleeve of fabric at the bottom of the balloon) and the *Explorer* automatically would have stopped rising. From that point on, as we discharged additional ballast, we could have risen to more than 75,000 feet.

To go higher after the rip appeared was inadvisable. The gas was practically down to the open rip. We valved. But superheat from the sun's rays was expanding the hydrogen so fast that the valve was just able to take care of the excess. It was twenty minutes before the bag started downward. In fact, it rose somewhat.

Imagine our feelings for a few minutes! It looked as though the valve hose had parted along with the torn fabric. Had this happened, we would have been helpless. But the valve did work! We operated that valve altogether no less than 150 times dur-

ing the flight. It never once failed us, though we could neither see it nor hear it working (see illustration, page 421).

Through the overhead glass porthole we watched the rent in the fabric gradually becoming larger and larger. The minutes passed slowly by; the magnets of the cosmic ray instruments clattered on; the buzzers hammered on the barometer box; the instrument cameras clicked in unison at regular intervals.

Above our heads were five glass flasks, each more than a foot in diameter, that had been pumped free from air. We had intended opening these at 75,000 feet to obtain samples of the air of the stratosphere, but now we opened them at 60,000 feet. We heard a faint hiss as each valve was cracked; methodically we shut the valves again, thus sealing the samples.

Across the gondola stood Major Kepner, his hand on the special lever that would release the 80-foot parachute installed by its designer, Major E. L. Hoffman.

Kepner was ready to turn the lever should the balloon suddenly disintegrate. However, when the balloon burst at a much lower altitude, no one was within reach of the lever to release the parachute.

Photograph by Richard H. Stewart

DID YOU EVER SEE A COSMIC RAY'S PORTRAIT?

A study of this mysterious form of energy was a major scientific object of the flight. Here Brig. Gen. Oscar Westover, Assistant Chief of the United States Army Air Corps, is inspecting test photographic records shown him by Captain Stevens. General Westover, a member of the Advisory Committee for the flight and himself a veteran balloonist, flew by plane from Washington to the camp just before the ascent.

DESCRIBING THE DESCENT BY RADIO

Beside Major Kepner was Captain Anderson, with his hand on the control that led to the pneumatic balloon valve. Both officers looked in turn at the bag above, at the rate-of-climb meter (which had now become a rate-of-descent meter), and at the statoscopes, which also gave indication of the speed of descent.

At times we all talked briefly over the radio. But little other talking was done, for our ears were strained to get warning sounds from above us. Soft swishing noises came through the roof of the gondola from time to time. Each of these sounds meant a new rent, or an increase in length of a rip already there.

ABOVE ITS GLEAMING FOOTLIGHTS THE WORLD'S LARGEST BALLOON HOLDS THE STAGE

Throughout the night of July 27-28, more than 60,000 candlepower of electric light flooded the balloon and the ground on which nearly 200 men worked.

Photographs by Richard H. Stewart

THROUGH SNAKELIKE CANVAS TUBES, HYDROGEN SURGED INTO THE HUGE BAG

The photograph was taken on the night of the inflation. Capt. Orvil A. Anderson, in charge of the ground work and copilot during the flight, is shown directing the men who are opening the valves of the cylinders to feed gas into the cloth pipes. The tubes extended 300 feet across the floor of the valley to the opening into the side of the balloon. More than 210,000 cubic feet of hydrogen flowed through the cloth conduits during the six hours of inflation. Over the cylinders is a canopy of pine boughs to protect them from the heat of the sun. The sandbags hold the pipes in place.

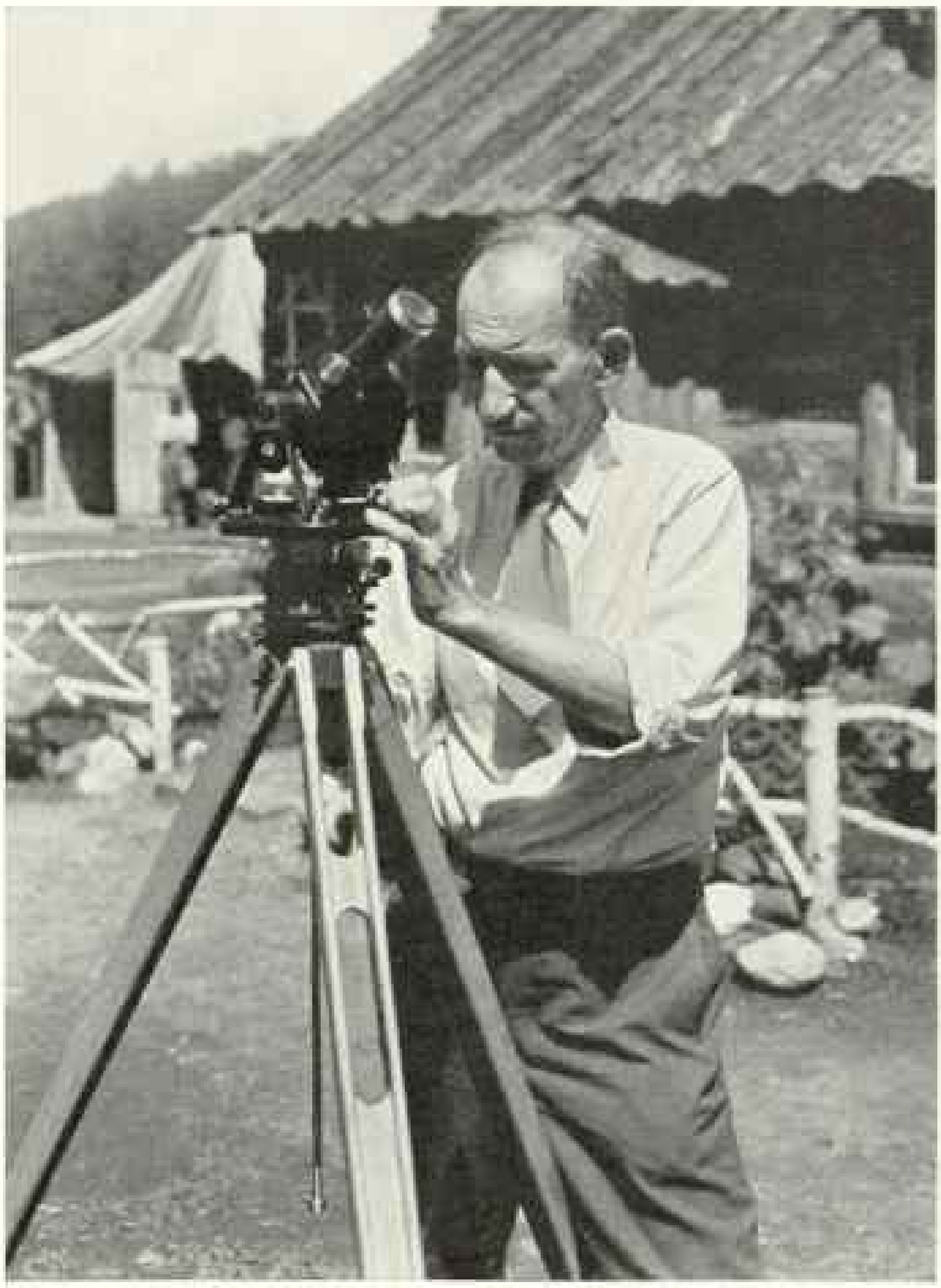
There was a temptation to shut off all the switches and quiet the instruments. The sharp drumming of the buzzer hammers on the barometer tubes was particularly irritating. But there was still a possibility of saving the records of the flight; so we let the mechanisms click on.

Below us was the brown, sun-baked earth, so far away that no roads, railroads, or houses could be made out. Our direction of drift was changing, but that was now a matter of little concern. The question now was not *where* we should get down, but *how!*

At the top of our flight an extraordinary phenomenon was visible through the upper porthole. As we looked through the ports that were 45 degrees from the vertical, the sky was the rich dark-blue color associated with high mountain views; but from the vertical port the sky was like black velvet on which ink has been spilled and dried—it was black with just the merest touch of dark blue. It looked as dark as the sky at the time of an eclipse of the sun when stars may be seen.* However, it did not occur to us at the time to look for stars; our interest was in the increasing rents in the great white bag overhead.

But we could not fail to note the astounding brilliance of the sunlight and the intensity of the reflected light from the balloon rigging. Some of the ropes, especially those nearest the gondola, were so bright that they had a fluorescent appearance and looked larger than they really were. It is possible that the extreme contrast between the brilliantly lighted balloon envelope and rigging and the sky made the sky look darker than it actually was.

At our high elevation, however, not much light may be expected from the air directly above, because the air of the stratosphere is so clear, so thin, and so free from moisture and dust that it does not scatter the sun's light to the extent that it is scattered nearer the ground.

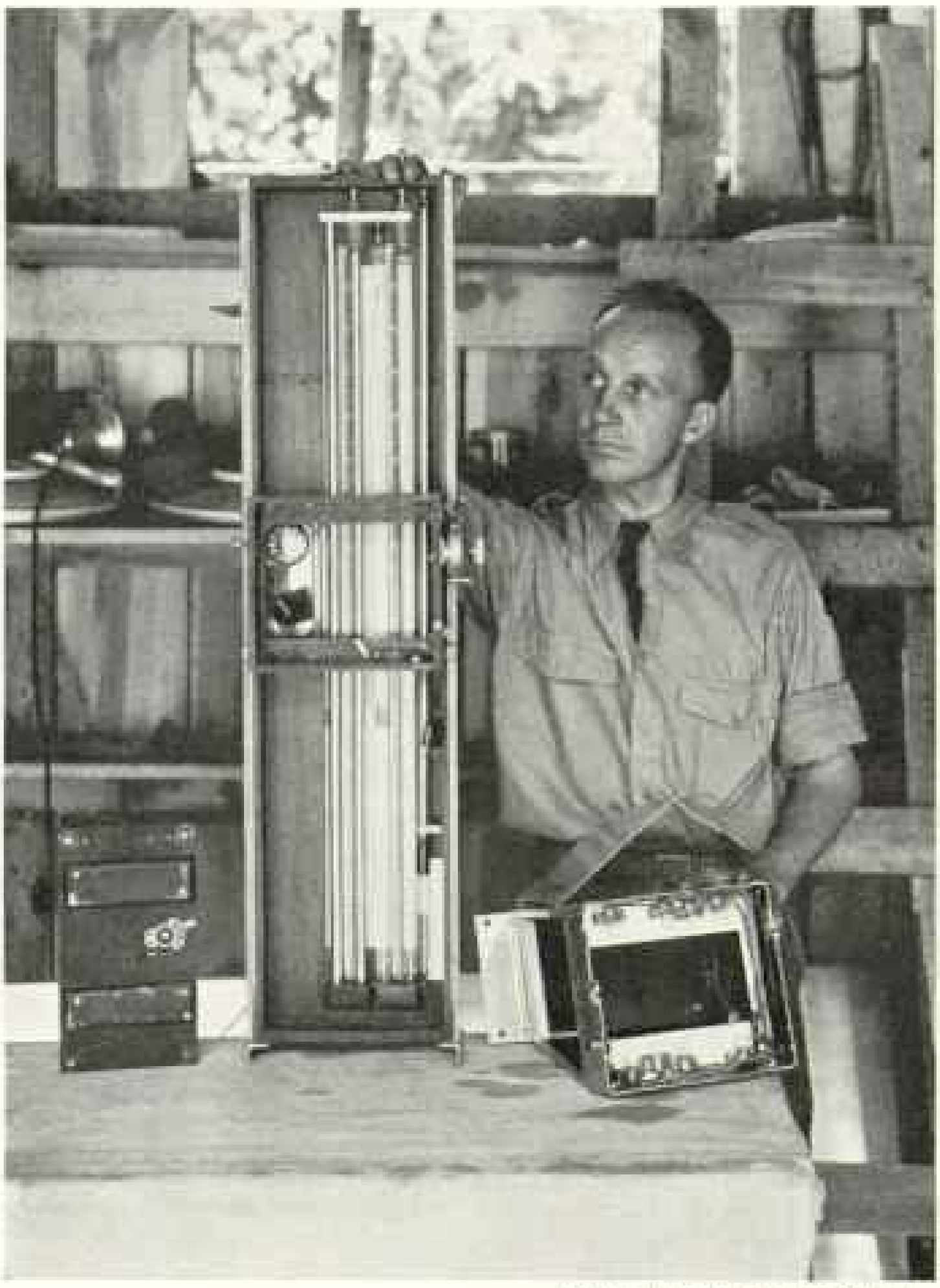


Photograph by Richard H. Stewart

LONG-RANGE SPYING ON THE TOYLIKE PILOT BALLOONS

Tiny balloons were sent up daily from the flight camp to help record the speed and direction of the wind at various altitudes. V. E. Jakl, United States Weather Bureau expert of Kansas City, in charge of the camp's weather station, is sighting a soaring balloon (see illustration, page 418). The small spheres, white, red, or black, depending on whether the sky is clear, leaden, or covered by white clouds, can be seen at surprising distances. On the day of inflation a white one was observed for 57 minutes, until it was more than 30 miles away and 7 miles high.

* See "Ballooning in the Stratosphere," by Auguste Piccard, National Geographic Magazine, March, 1933.



Photograph by Richard H. Stewart

TWO BAROMETERS READY FOR A SCIENTIFIC RELAY RACE

Because it was planned to rise through the relatively dense lower atmosphere and to enter a region in which the air is very thin, two barometers were provided. The three white vertical bars on the left (best distinguished at the bottom) are the two glass tubes of a U-shaped mercury column barometer, with a millimeter scale between them. To the right are the similar tubes and scale of a barometer in which the column is a liquid known as n-butyl pthalate. In thin air the mercury column falls very little, even with a considerable increase in altitude. In such regions the n-butyl pthalate column takes up the task and registers more sensitively. On the table to the right is the camera box for recording automatically the readings of the barometers. Beside the barometer box is Lieut. J. F. Phillips, who assisted Captain Stevens in technical work at the flight camp. Lieutenant Phillips, with Master Sergeant G. B. Gilbert, obtained the remarkable photographs of the balloon from the air reproduced with this article.

From our instruments we knew that outside it was almost 80 degrees below zero, Fahrenheit. We were in relatively warm air inside, about ten degrees above freezing, but it was getting steadily colder. Already ice had formed in our gondola in a narrow band about two feet below the top. At first there had been condensation of moisture on the walls. This froze and accumulated still more frost until now there was a layer almost an eighth of an inch thick in places.

Lower down on the walls it was not quite so cold; and, surprisingly, when we lifted the floor panels and felt the metal near the bottom of the gondola, it proved to be relatively warm. Had our flight continued for hours longer, as planned, the temperature inside the gondola would have dropped perhaps to 20 or 30 degrees below zero, Fahrenheit (page 430).

ALTHOUGH FALLING, ROUTINE GOES ON

We still had to go about our routine duties. One was to watch the supply of liquid air, to keep it evaporating at the required rate, and to let air out of the gondola now and then to keep the internal pressure of the sphere to less than nine pounds per square inch.

A little electric fan whirred away, sending its blast of air across the coils of the liquid oxygen apparatus and toward the screens of chemicals that were absorbing the carbon dioxide generated by our breathing (page 421).

Everything inside the gondola was working perfectly, so that it seemed strange to realize we were hurrying downward in the hope of escaping a very real danger.

Three quarters of an hour passed, and we were down to 40,000 feet. Our speed was increasing, and half an hour later we

were down to 20,000 feet. Major Kepner and Captain Anderson each forced open a hatch, and for the first time we felt we were free.

It was good to know that we were in a position to use our parachutes if necessary.

BOTTOM DROPS OUT OF THE BAG

We all climbed out on top and took a good look at the balloon. It was pretty badly torn. Many more tears and rips had appeared in it. The question was, How long would it hold together? As the enormous bag came downward through the air, large waves appeared in the lower fabric, sweeping across it and back again. With almost every wave the rents grew bigger and bigger.

Suddenly the entire bottom of the bag dropped out. We could look up into the whole bare inside of the balloon. Only the part above the lower catenary band now remained (see illustration, page 427). The bottomless bag was acting largely as a parachute. It was a pretty sight, quite round and tight and symmetrical.

But it was a bit too tight for safety!

We still had an enormous weight left in the gondola and it was urgent to lessen it. Kepner and Anderson cut loose the spectrograph and it floated down to earth on its individual parachute (see text, page 418).

I climbed back into the gondola and started discharging ballast. In accord with plans decided upon before the flight, all the liquid air that remained was first poured out. Then the two empty containers were fastened to a parachute and thrown overboard. These I followed with hundreds of pounds of lead ballast poured out through the hopper and in streams through the hatch, after opening each sack.

We could have disposed of the ballast much more rapidly if we had hurled it out in bulk, but at no time during the flight was anything thrown out in a way that might injure people on the ground.

Photograph by Richard H. Stewart

THE GONDOLA RECEIVES ITS LAST-MINUTE GROOMING

Major Kepner is on top of the ball. Captain Stevens appears at the open manhole. Captain Anderson, not shown, is also inside. In front of Major Kepner is the basket containing the spectrograph, which later was lowered to a distance of 500 feet beneath the gondola. In the long dark bundle hanging in the rigging at the left are nine parachutes for use in discarding batteries and other equipment. Below and farther to the left is a bag containing the 80-foot parachute provided to lower the gondola. In a roll below the manhole is the 580-foot drag rope for use in landing. On each side are shown arms supporting instruments. They were later lowered to horizontal positions.

Photograph by Richard H. Stewart

A BOUND GIANT TUGS AT ITS BONDS

With all of its gas inside, the balloon was pulling upward with a lift of nearly seven tons. Three of the tethering ropes extending to the upper catenary band, immediately in front of the camera, snapped one after another a few moments before this photograph was taken. Most of the ground crew rushed to the center of the balloon bed and grasped the big bag itself.

We had worn our parachute harnesses constantly during the flight, and when things began to look bad we had each put on the detachable portion, or parachute proper.

We were all set to leave, but we wanted to stay with the balloon as long as possible to avoid being distant from it when we landed.

At 10,000 feet we really should have left the balloon, but we did not wish to abandon the scientific apparatus. So we stayed on. At 6,000 feet we again talked the matter over and decided we had better leave. The last altimeter reading I gave was 5,000 feet above sea level.

Since this part of Nebraska was 2,000 feet above sea level, we were in reality only a little more than a half mile from the ground.

In the meantime Captain Anderson, atop the gondola, had been having difficulty with his parachute. The release handle had caught on something and the parachute

pack had come open. It was a situation that might have been disconcerting to a less cool head. There was only one thing to do—that was to gather the folds of silk under one arm preparatory to leaping.

While getting the fabric together, Anderson stepped down until both his feet were in the hatch from which I planned to leap. Andy is a big man, but never before had I noticed that his feet were large. Now, looking up at the opening partially blocked by his pedal extremities, I shouted:

"Hey, get your big feet out of the way! I want to jump."

Whether Anderson heard me or not does not matter. Things started to happen fast. The feet disappeared, and I knew he had leaped. As he jumped, the balloon exploded.

The pressure suddenly became too great all over, and the fabric burst at once in hundreds of places.

The gondola dropped like a stone.

Twice I tried to push myself through the hatch of the gondola, but wind pressure around the rapidly falling sphere forced me back. So I backed up and plunged headlong at the opening. I managed to hit it fairly, and went out in a horizontal position, face down, with arms and legs outspread like a frog. By that time we had fallen 1,500 feet and were descending so fast that the wind pressure held me practically even with the gondola. In other words, I was not falling away from it, but moving downward at the same rate of speed. I turned over a half revolution and, as I came right side up, pulled my rip cord. The parachute opened instantly.

FALLING FABRIC THREATENS PARACHUTE

The jerk was like that made when one jumps from an airplane at 80 miles an hour. The folds of white silk opened in a large circle—and then a portion of the balloon fabric above the gondola fell on top of my parachute.

For a second it looked as if the balloon would take my chute with it. The fabric covered it to the very center of the silk. And then luckily the parachute slid out from under and worked itself free.

How about Kepner and Anderson? I looked around and saw the other two parachutes in the air and knew they were safe. Directly below me, I heard the gondola hit with a tremendous thud, and saw a huge ring of dust shoot out (p. 429). Forty seconds later I hit—fortunately with a much lighter thud—and the parachute dragged me a few feet on my face through the black dirt of a Nebraska cornfield.

In a very few minutes, Major Kepner, Captain Anderson, and I had rolled up our parachutes and hastened to the spot where the gondola had struck; already a score of people were present, seemingly rising out of the very ground, and in a few minutes hundreds more were coming across the fields to the wreck.

AIRPLANE TRAILS BALLOON'S COURSE

Lieut. J. F. Phillips already had landed his airplane in the adjoining field. He and Sergeant G. B. Gilbert had followed us, making pictures, all the way from South Dakota, had seen practically every detail of our flight up to the altitude they could reach, 25,000 feet, and had actually photographed the final collapse of the balloon as they circled us (see illustration, page 428). We were in a cornfield not far from the town of Holdrege, Nebraska.

It then appeared that hundreds of local people had been trailing the balloon by automobile. Soon the place swarmed with spectators.

The crowd of sight-seers lent willing assistance in rolling up the main section of the balloon fabric into a pile. But, like people the world over, they became relentless souvenir hunters. Numerous small fragments of balloon had fallen like snowflakes all over the farm field, and probably nearly every member of the crowd had picked up a small strip of the rubberized fabric.

Major Kepner and I went to the farmhouse of Mr. Reuben Johnson, on whose field we had landed, to telephone and send some telegrams. For some time I had been conscious that it was nearly 100 degrees in the shade (with no shade), and that I still wore two suits of heavy woolen underwear and a light canvas flying suit; so in the farmhouse I asked permission to use a room to shed some clothing.

In a few minutes I was dressed only in the canvas suit, and I took the two suits of underwear outside and hung them over a fence. Then I went inside to get my messages off by telephone.

When I came out, I found that souvenir hunters had taken my underwear! I have not seen it since. Perhaps by this time it has been cut into small squares.

Photograph by Richard H. Stewart

THESE WEATHER EXPERTS WERE ARBITERS OF THE DATE OF THE FLIGHT

Into this little room in the headquarters cabin at the Stratocamp came by telegraph and radio weather reports fuller than those reaching most of the urban centers of the United States. Complete maps of the North American Continent were drawn morning and evening, so that a careful watch could be kept for approaching weather suitable for the flight. At the right is seated V. E. Jakl, of the U. S. Weather Bureau, in charge of the meteorological work; in the center is Sergeant W. F. Bernheisel, U. S. Signal Corps; at the left stands Private Horace Slutter, U. S. Army Air Corps.

Maybe, like pieces of balloon cloth that have been received by mail, some of it may be sent in with the request that it be autographed!

Things looked pretty black for scientific results when we walked up to the pile of balloon fabric that covered the fallen gondola, pulled it aside, and found that our beautiful black and white globe had been crushed like an eggshell. It had been almost flattened out, and gaping crevices ran in every direction across the irregularly curved top.

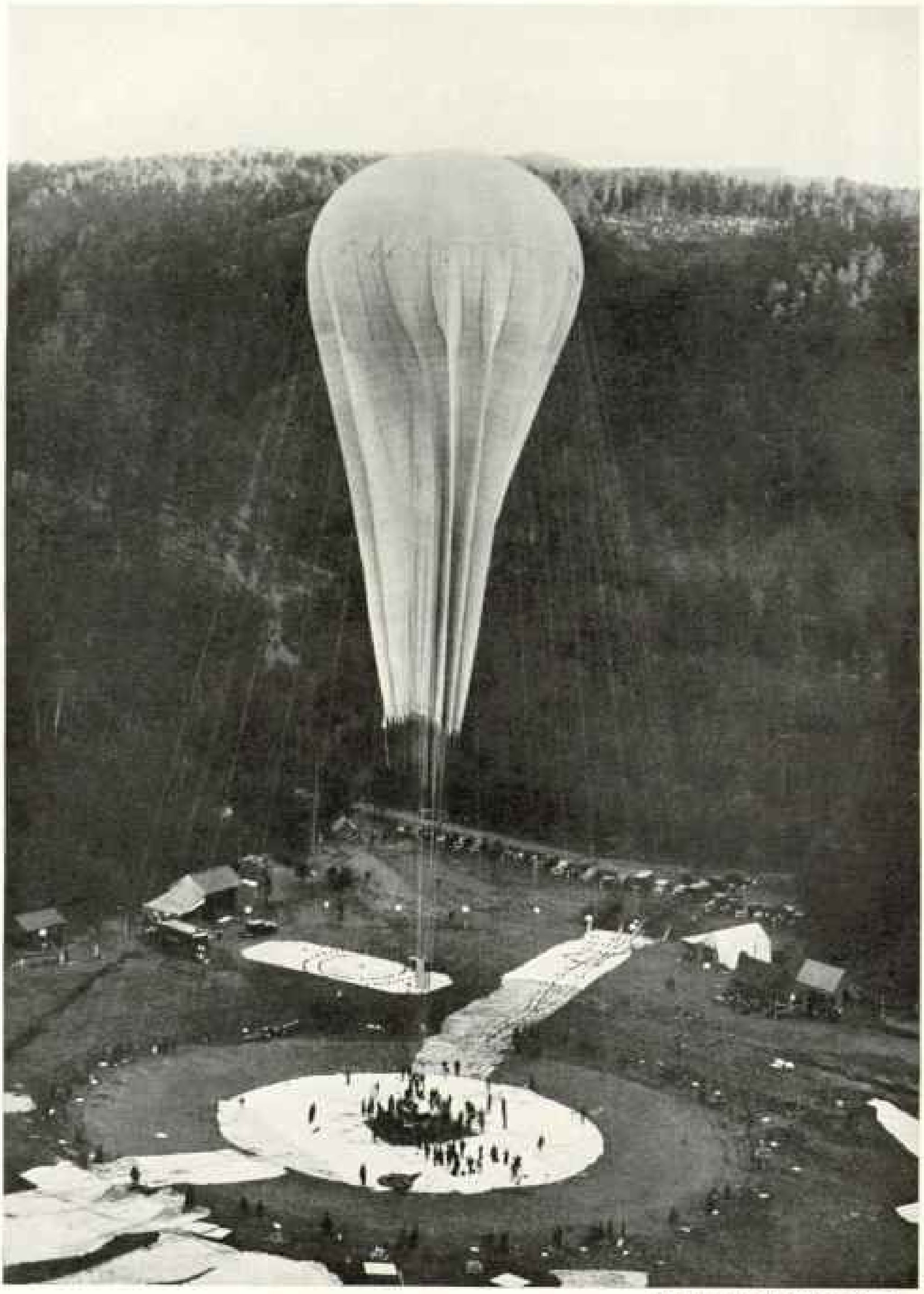
We borrowed an ax and cut through the few uncracked areas, removing sections of shell. Inside, the instruments of which we had been so proud were a heart-breaking mass of wreckage.

We realized, however, that since we had registered almost all of our records photographically, there still were chances that some of the recording negative could be salvaged. So we removed every roll of film we could find, and quickly wrapped it to prevent further damage by light. Happily, as the weeks have passed, preliminary reports from the several scientific laboratories have somewhat dissipated the dark picture we first built up in our minds.

The spectrograph, which Major Kepner and Captain Anderson cut loose before the balloon exploded, was set down by its parachute as gently as if it had been handed to a skilled workman. All of its complicated and delicate mechanisms were in perfect condition, and continued to operate on the ground. Its photographic record was complete and intact, and, in the opinion of Dr. Brian O'Brien, of the University of Rochester, who supervised the construction of the instrument, the film will disclose valuable scientific information.

This spectrograph was designed to make a study of a definite portion of the spectrum of direct light of the sun, to note differences in the spectrum that might appear as the instrument rose above the earth and received the sun's rays through atmosphere progressively less and less dense.

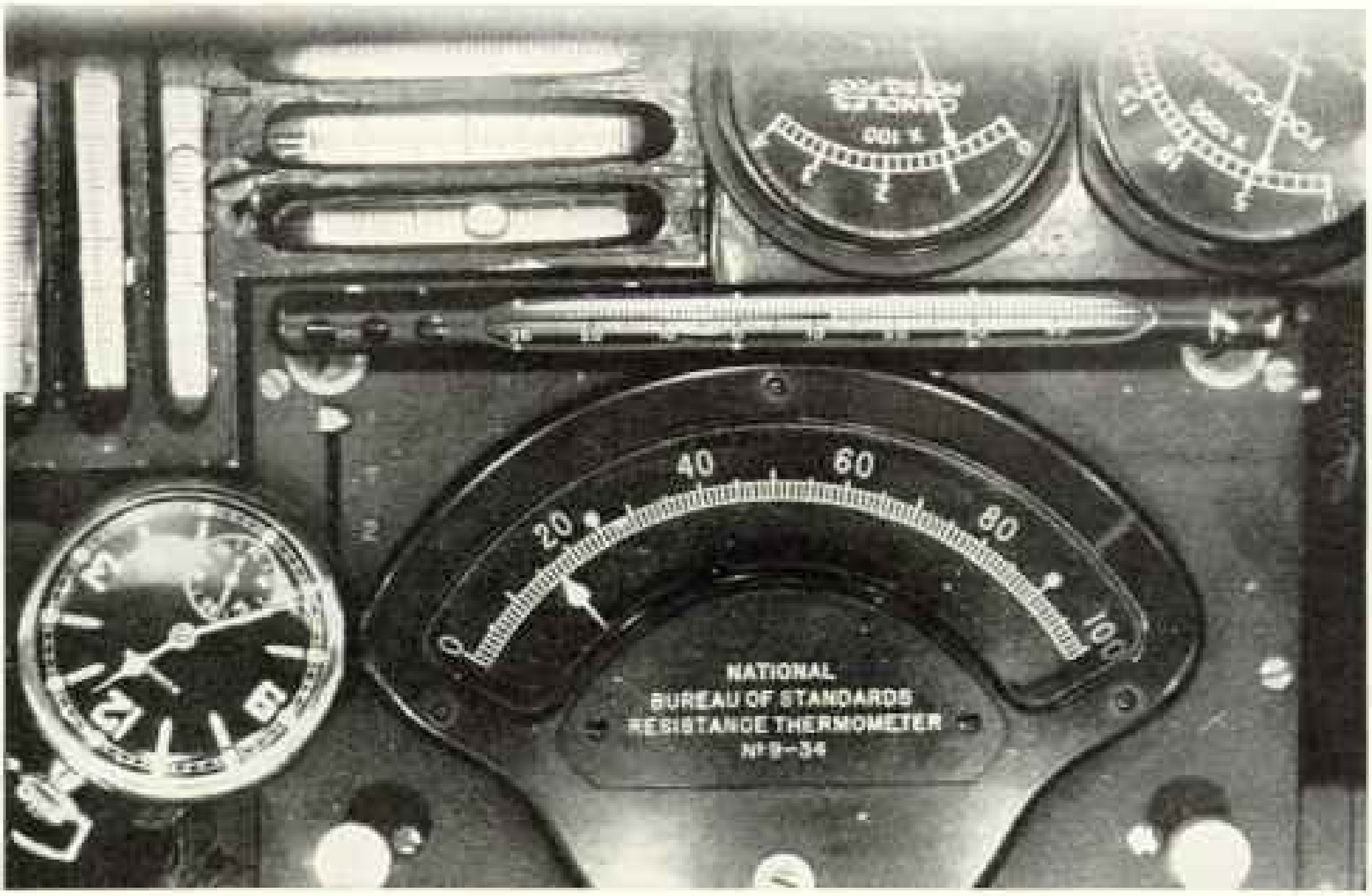
It was expected that the variations in



Photograph by Richard H. Stewart

POISED FOR ITS CLIMB INTO THE SKIES

At dawn on July 28 the gondola had been fastened to its supporting ropes and the *Explorer* was about ready to take off for the stratosphere. The faint lines extending diagonally downward from the upper catenary band are the double tethering ropes. A few minutes after this photograph was taken, these ropes were pulled through their eyelets and dropped, leaving the weight of the gondola and a few hand ropes attached to it holding the balloon to earth.



CAMERAS TIRELESSLY "READ" INSTRUMENT DIALS DURING THE FLIGHT

One of hundreds of records made by automatic cameras as the balloon rose into the stratosphere. This reading, made at 12:36, when the gondola is known from the barograph record (see chart, page 431) to have been at an altitude of 43,000 feet, shows the temperature of the outside air to have been 70.1 degrees below zero, Fahrenheit. (This is found from the scale reading, 17.) The photograph also shows a sun brightness of 4,500 foot candles (the instrument not pointing directly at the sun); a sky brightness of 80 candles per square foot; a temperature in the gondola of 12 degrees centigrade (53.8 degrees Fahrenheit); and a gondola tilt of 1.3 degrees in one direction and .4 degree in the other.

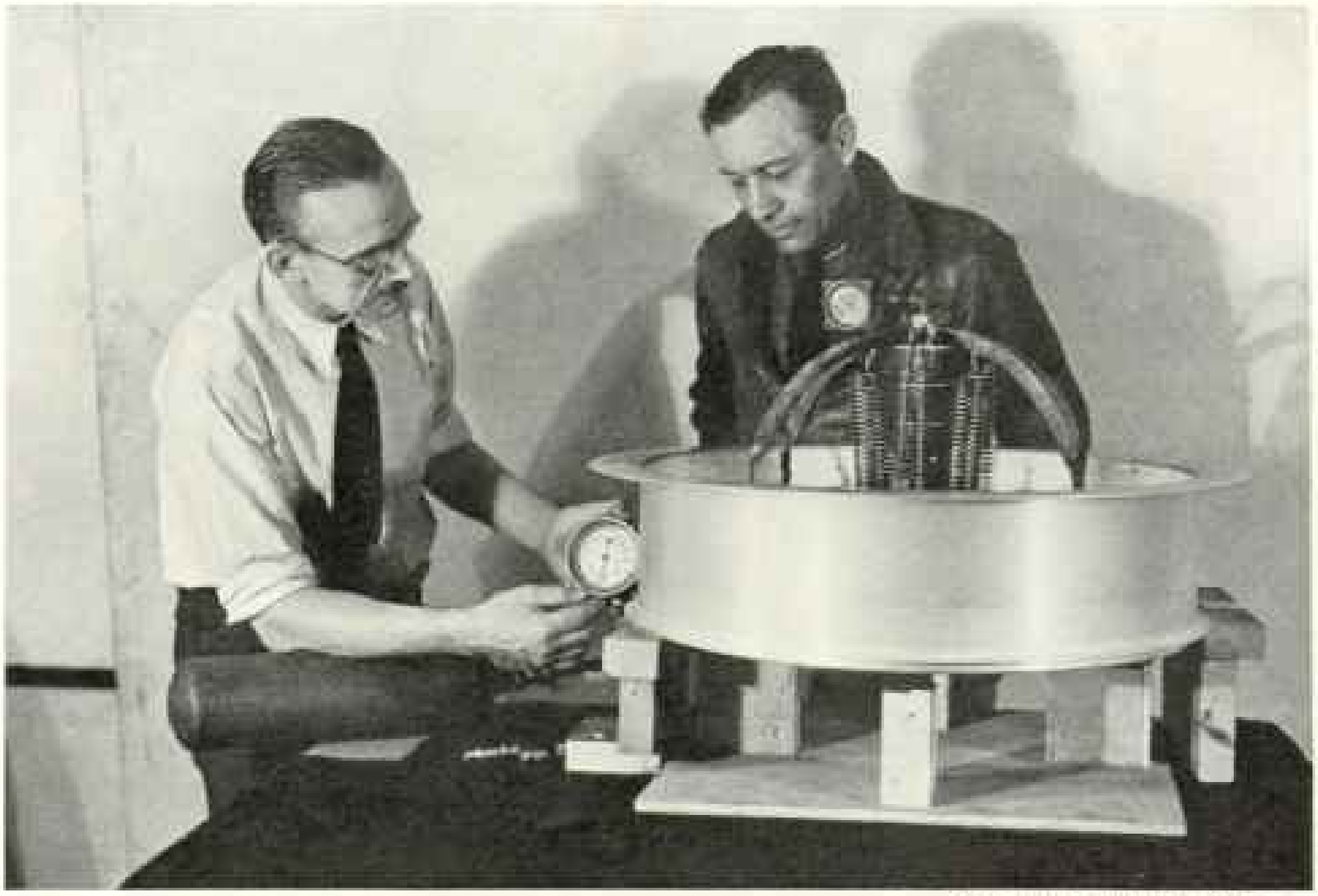
the spectrum would be effected chiefly by changes in the amount of ozone the sun's rays had to penetrate to reach the spectrograph, and that the record would thus give added knowledge of the ozone layer of the upper air. That layer, though invisible, screens out some of the active ultra-violet rays of sunlight as effectively as if it were a black bank of clouds, and so plays a vital part in making it possible for the earth to support life.

FILM RECORDS SALVAGED

Inside the gondola, two other spectrographs, furnished by the University of Rochester and the Bausch and Lomb Optical Company, were badly crushed by the fall. The films were salvaged, however, and when they were developed it was found that considerable portions of the record were legible. If sufficient data were saved, it is possible that the laboratory measurements originally planned can be made, and by study of the combined records of two of the spectrographs new information may be obtained regarding the distribution of ozone and the height of its center of concentration.

On the hanging spectrograph were strung small quartz tubes containing ten kinds of spores furnished by Dr. Fred Meier, of the Department of Agriculture. In spite of their rough treatment, including intense cold, thin air, and the blazing sunlight of the stratosphere, these spores suffered no harm, for they continued to grow as fast as ever when they were returned to a laboratory in Washington (see illustration, page 433).

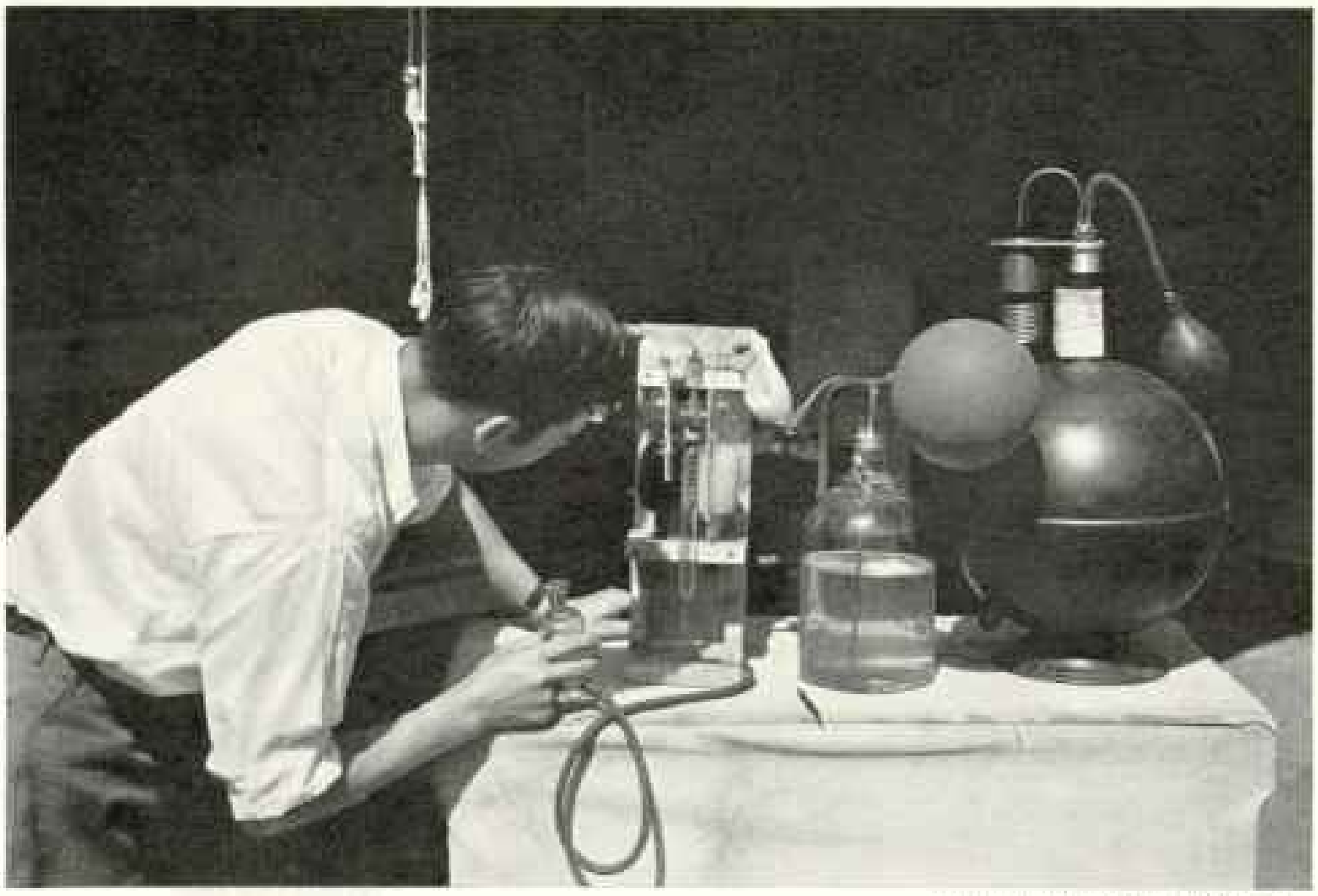
Three special electroscopes, furnished by the California Institute of Technology, were carried on shelves within the gondola. One was unshielded, one had a shielding layer of four inches of fine lead shot around it, and the third was surrounded by a six-inch layer of lead shot. All three instruments were badly crushed and their film rolls were exposed in varying degrees. Two



Photograph by Edwin L. Wisherd

THIS VALVE, A NEW INVENTION, LITERALLY WAS A LIFESAVER

Because the valve at the top of the mammoth balloon was 300 feet from the gondola, and a rope between the two points might easily become entangled, Captain Stevens (left) devised a compression valve to release hydrogen gas. The device performed perfectly no less than 150 times during the flight, through nearly 400 feet of hose (page 410). Captain Anderson watches the test.



Photograph by Richard H. Stewart

TESTING THE GONDOLA'S AIR SUPPLY

The apparatus shown, consisting of tubes and flasks of chemicals, was used to check the amounts of carbon dioxide and oxygen in the air of the globe when three men were sealed in it and when the device for removing the carbon dioxide was in operation (see text, page 432).

Photograph by Lieutenant Phillips and Master Sergeant Gilbert

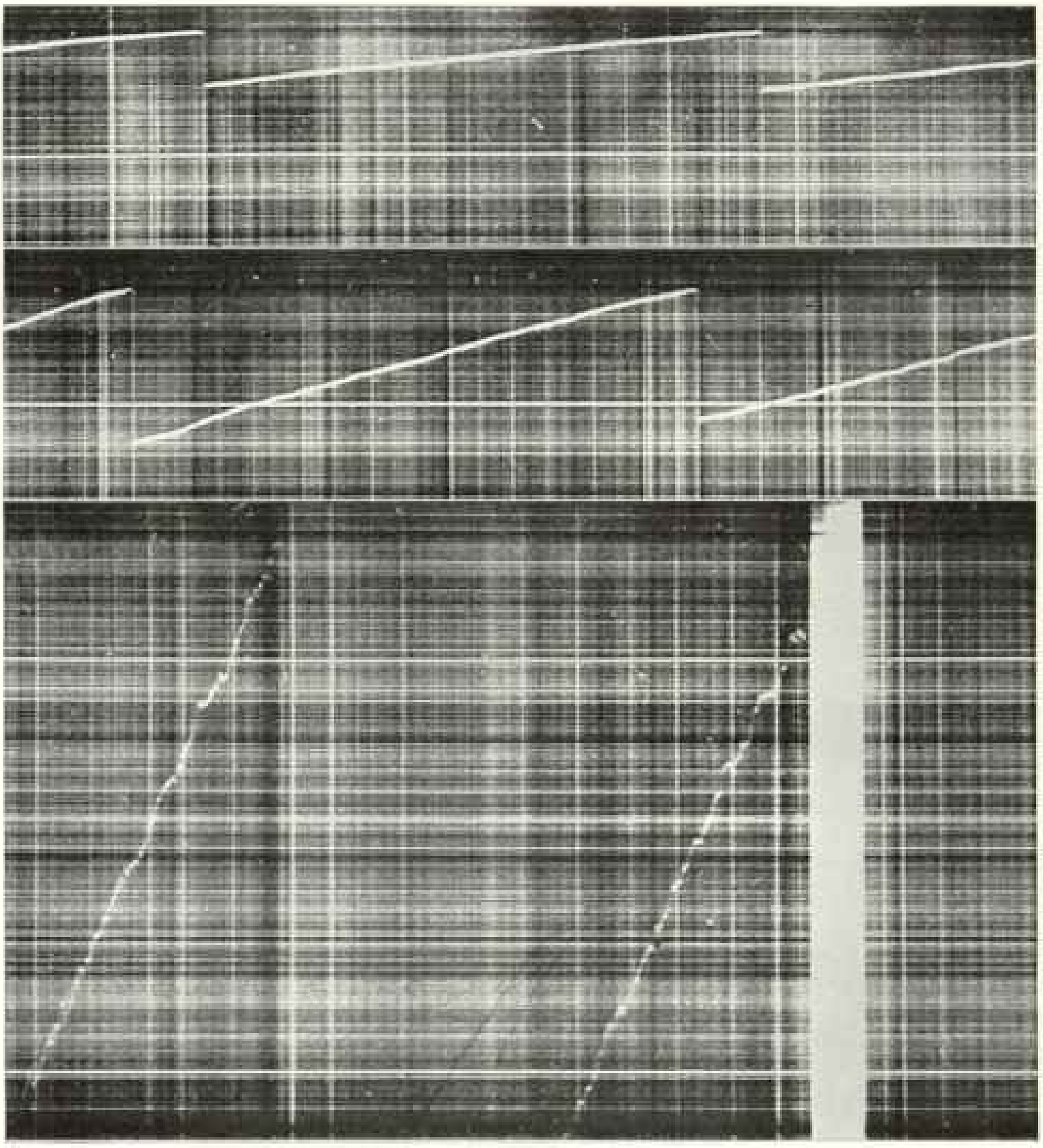
THE "EXPLORER" COMPETES FOR SKY SPACE WITH ANOTHER SPHERE

The moon, only a little past full, had shone down on the Stratocamp through the night, and still hung well up in the west when the balloon rose. In this photograph the bag is at an elevation of 15,000 feet and has expanded slightly. Major Kepner and Captain Stevens have just started to lower the heavy spectrograph (see text, page 405, and illustration, page 399).

of the rolls were utterly ruined. The third was fogged at one end, but the rest of it showed an excellent, clear record (see illustrations, page 423).

Only a balloon the size of the *Explorer* could take up apparatus as large as these instruments. The electroscope, for example, surrounded by six inches of lead, weighed nearly six hundred pounds. Such thickness is necessary to obtain certain data on the penetration of cosmic rays. No matter how small an electroscope can be made, a sphere of lead six inches in radius around it is still more than any sounding balloon can carry.

For cosmic ray investigation it is highly desirable that a balloon be leveled off for certain periods at different altitudes during the flight. This seems possible only with a man-controlled balloon. While it is more costly to use a large balloon, certainly more information can be gathered in a single flight than is possible with many small balloons. If the cost per pound of scientific apparatus carried be considered, then



HOW COSMIC RAYS WRITE THEIR AUTOGRAPHS

These enlargements of photographic records from one of the three electroscopes furnished by Dr. Robert A. Millikan, of the California Institute of Technology, show the increasing intensity of cosmic rays encountered as the balloon rose. The space (right to left) from the beginning of one white line to the beginning of the next represents five minutes. The increasing slope of the lines indicates the greater intensity of the rays penetrating the instrument. The upper tracing was made at ground level before the flight, the middle record at about 40,000 feet above sea level, and the bottom record near 60,000 feet (see text, page 430).

the flight of a large balloon is not unduly expensive.

THE STUDY OF COSMIC RAYS

Our elaborate Geiger counter apparatus was built by Dr. W. F. G. Swann and Dr. G. L. Locher, of the Bartol Research Foundation of the Franklin Institute (see text, page 410). This apparatus was the equivalent of an assembly of electrical telescopes so mounted that cosmic rays could be counted coming from the vertical, from the horizontal, and from two angles between. To use this apparatus and the electroscopes of Dr. Robert A. Millikan and Dr. Victor Neher, the balloon was brought into equilibrium at 40,000 feet and allowed to drift at that altitude for more than an hour. It

Photograph by Lieutenant Phillips and Master Sergeant Gilbert

ON ITS WAY!

The airplane from which this photograph was taken has reached its ceiling at 25,000 feet. The balloon is at 30,000 feet and is ascending 600 feet per minute. The bag is approximately one-quarter full. (At an altitude of 60,613 feet the hydrogen had expanded only down to the lower suspension band. Full inflation would have come at about 65,000 feet.) Below is the sun-lighted surface of South Dakota and, just above, is the haze-laden horizon. The balloon is strongly lighted, but the stratosphere air beyond it—clear, thin, and free from moisture and dust—does not affect a photographic negative as does air near the ground. The photograph shows that, photographically, the scattered light gets weaker and weaker toward the zenith. At 60,613 feet the sky was black to the eye as well as to the camera, when looking almost straight upward. At 45 degrees upward the sky was a dark blue in color.

was planned to do the same thing at 60,000 feet and at 75,000 feet.

While in equilibrium the gondola was turned constantly so that the counters could be pointed successively to all positions of the compass.

To accomplish this, we had mounted, on a 14-foot arm, a fan for revolving the balloon. When we first closed the motor switch at 40,000 feet we were pleased to note how quickly this fan started the balloon into rotation. Actually we had to stop the fan from time to time to prevent too rapid turning.

Dr. Swann's apparatus suffered most in the wreck of the gondola. The housings collapsed, the delicate radio tubes and counter tubes were crushed, and the photographic records were exposed to daylight.

Later, these records were carefully developed by the Eastman Kodak Research Laboratories and it was found that more than half of the readings made at the 40,000-foot level were legible. When considered in connection with other data available from the Bureau of Standards instruments, the recovered records may increase our knowledge of the direction of cosmic rays.

The two sealed barographs, hung outside the gondola, were to determine officially the altitude reached. Packed in balsa wood boxes and held in place by a thick insulation of sponge rubber, they suffered scarcely any damage (see illustration, page 432, and chart, page 431).

The curve plotted from the tracings made on the smoked cylinders of the barographs gives an accurate record of the altitude at every minute during the 9 hours and 57 minutes of the flight. It shows that we reached an altitude where the barograph readings corresponded to a pressure of 51 millimeters of mercury. The normal pressure at sea level is 760 millimeters.

According to the calculations of the U. S. Bureau of Standards, 51 millimeters of mercury, at the temperature prevailing, indicates an altitude of 60,613 feet above sea level. This was only a trifle more than two of our balloon lengths short of the official world record of 61,237 feet, held by Commander T. G. W. Settle and Major Chester Fordney.

By 624 feet, then, we missed equaling the highest balloon ascent made in the Western Hemisphere! Had the rip not occurred, it is probable that the balloon would have risen at least an additional 15,000 feet.

Photograph by Lieutenant Phillips and Master Sergeant Gilbert

AT THE THRESHOLD OF THE STRATOSPHERE

The *Explorer* was seven miles above the earth when this photograph was made from an airplane over northern Nebraska.

Photograph by Lieutenant Phillips and Master Sergeant Gilbert

RISING ABOVE SOUTH DAKOTA'S SCENIC BAD LANDS

Beneath the balloon are fertile fields, but at both edges of the narrow strip of farms the eroded ground has been cut away as if by a malicious giant with a huge chisel.

A STRATOSPHERE VOYAGER NEARS ITS END

The *Explorer,* at an elevation of 8,000 feet over Nebraska, is falling at a speed of approximately 700 feet a minute. The torn fabric from the bottom of the bag hangs down until it touches the gondola, a hundred feet below. The Platte River is shown in the middle distance.

Photographs by Lieutenant Phillips and Master Sergeant Gilbert

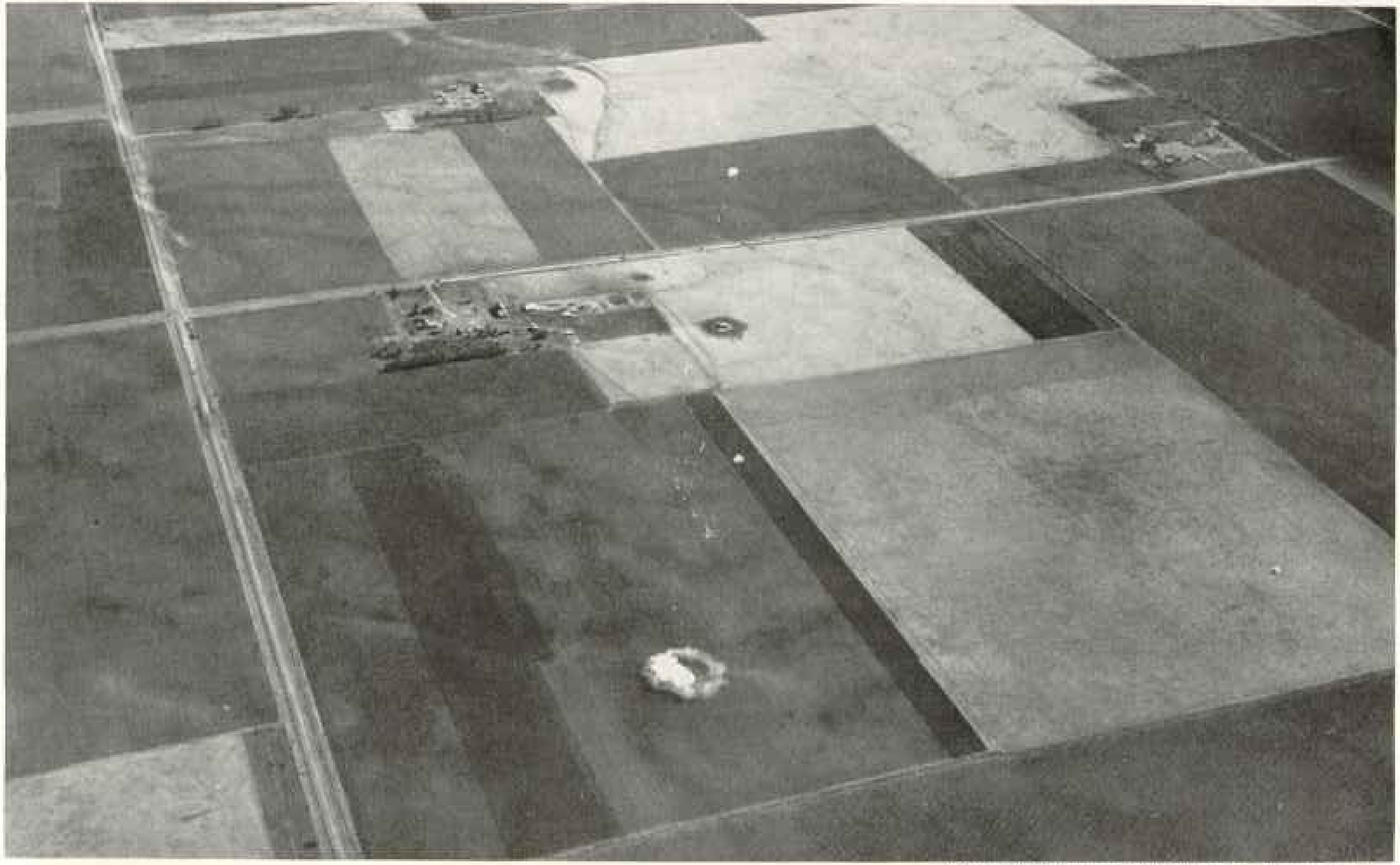
THEN THE BOTTOM DROPPED OUT!

The balloon, now at 7,000 feet, is little more than a gigantic parachute. The fabric of the bottom has torn loose almost completely around the bag. It is held only by a narrow strip on the right, and by the ropes that support the gondola.

Photograph by Lieutenant Phillips and Master Sergeant Gilbert

HURTLING GONDOLA, FRAYED REMNANTS OF THE BAG, AND TWO PARACHUTES

Immediately after the explosion of the balloon, the gondola is falling with unrestrained speed. Only an open sleeve of cloth is left of the huge bag that rose into the stratosphere. One parachute is visible just above the remains of the balloon. Another appears near the top of the picture. Between them are numerous fragments of fabric blown out when the bag exploded. The gondola is about 800 feet above ground.



Photograph by Lieutenant Phillips and Master Sergeant Gilbert

FLIGHT'S END—AND A CLOUD OF DUST!

Here in the drought-parched cornfield of a Nebraska farm, near Holdrege, the gondola crashed to earth. The photograph was made from the accompanying U. S. Army airplane at the moment of impact (see text, page 417). The ring of dust caused when the globe struck is just rising. The balloon had burst less than a minute before, and fragments blown out by the explosion can be seen floating downward. The parachutes of two of the balloonists are still in the air above and slightly to the right of the fallen gondola. In the adjoining field to the right is the spectrograph, which was cut loose with its parachute and came down without damage. The smashed gondola is covered by the sleeve of balloon fabric which remained attached after the explosion.

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A NEBRASKA CORNFIELD BECOMES A WORLD NEWS CENTER

Telegraph, radio, and printing press made Reuben Johnson's farm, near Holdrege, Nebraska, on which the *Explorer* came to earth, known to millions of people. Within five minutes after the crash, hundreds of sight-seers were crowding around the wreckage. Captain Stevens, in canvas flying suit, is directing the salvage of the crushed instruments. Lieutenant Phillips, who landed his plane in an adjoining field immediately following the crash, helps with the work. The crushed metal ball and the tangle of ropes that supported it appear at the right. A large section of the balloon fabric lies in the left foreground.

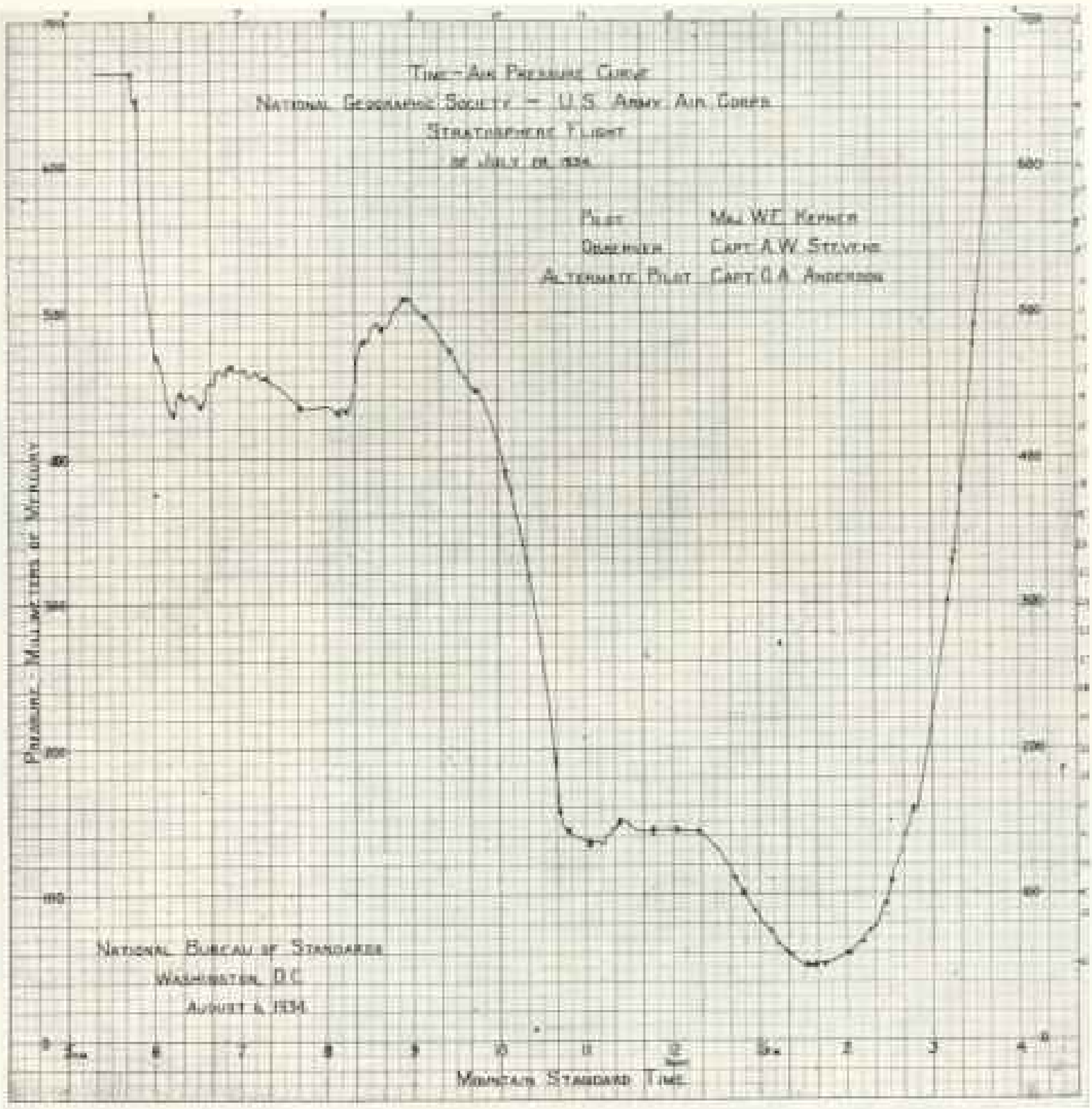
The perfect barograph record of our flight was, indirectly, a valuable bit of salvage. It permitted us to solve some practical puzzles and deduce still more scientific data.

TEMPERATURE DATA ARE OBTAINED

On one of the salvaged photographic records part of the pressure information was missing, but the time and the temperature of the outside air were shown clearly. The time record was common to the separate records of pressure and temperature, so we were able to construct a table and a curve showing how the temperature changed with the changes in altitude. The same photographs which gave us the outside temperature readings also provided a record throughout the flight of changes in sun and sky brightness and of temperature inside the gondola.

Temperature falls rather rapidly as one leaves the earth's surface, and at 20,000 or 25,000 feet it is sure to be below zero, Fahrenheit, even in summer time. As one ascends still higher the temperature drops even faster, until it gets down to about 75 degrees below zero, Fahrenheit. After that the air gets gradually warmer. This turning point, or inversion of temperature, occurs about 50,000 feet above the earth's surface.

Our records showed this turning point, and, above it, the increase in temperature that was to be expected. However, our instruments showed that the temperature dropped at a faster rate between 20,000 feet and 35,000 feet than the average of other observers. Our original plans were to plot the temperature readings from the resistance thermometer and those from the mercury barometer against altitudes calculated from measurements of aërial photographs made of the earth's surface directly beneath us.



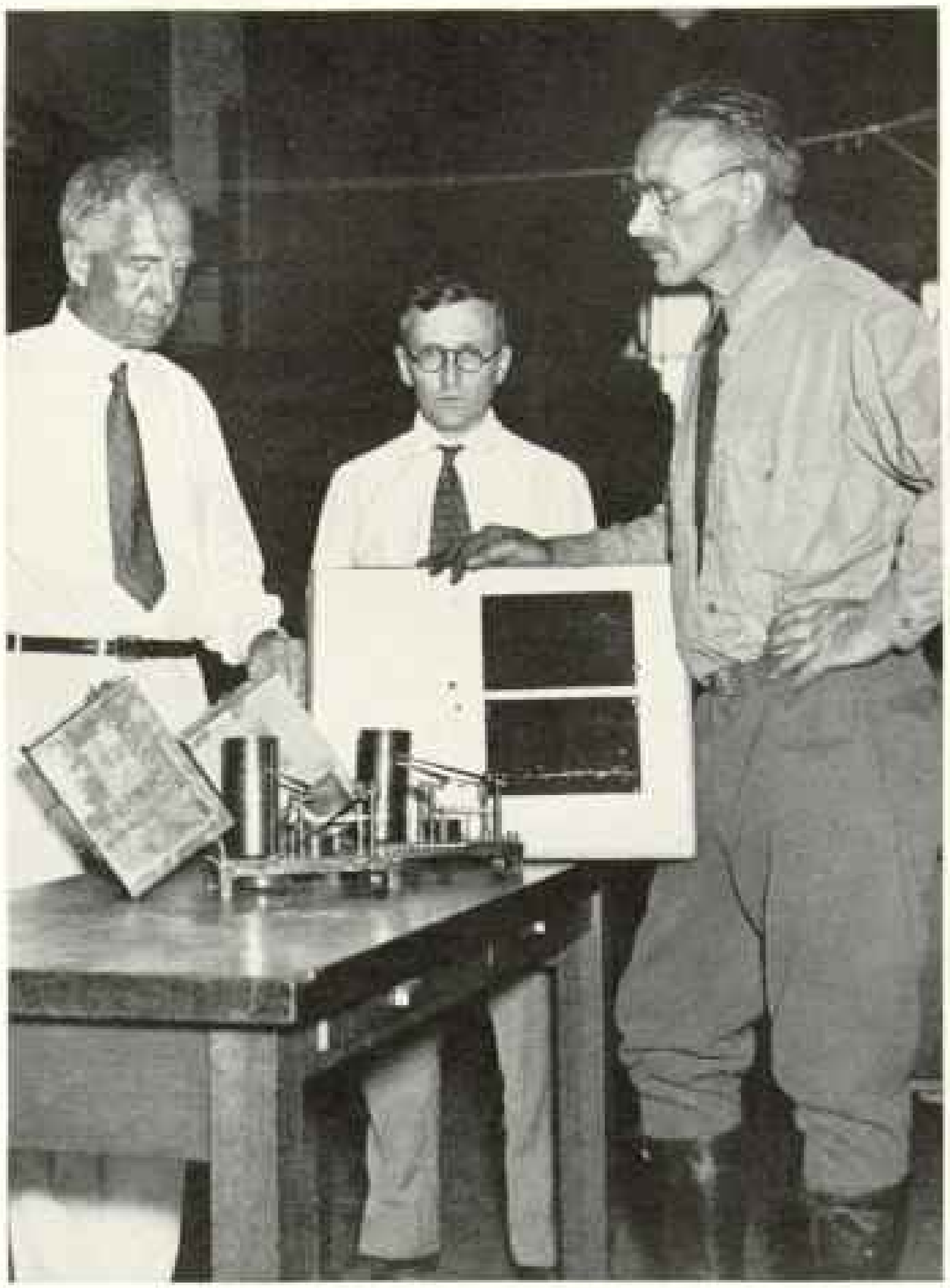
THE BALLOON'S OWN STORY OF ITS FLIGHT

The black curve has been plotted on paper to reproduce the lines automatically traced on the smoked drums of the two official barographs, carried on the flight, as changing altitude affected the instruments' needles. The figures on the margin, from left to right, denote hours, mountain standard time. The figures from bottom to top denote atmospheric pressure in millimeters of mercury. Lighter figures in the right margin show approximately corresponding altitudes in thousands of feet. For quick reading this diagram is best understood by turning it upside down. The upward curves of the line will then denote the rise of the balloon, the downward curves its descent. It will be noted that the barograph was set working at 5:19 a. m.; that the balloon rose at 5:45; leveled off at about 15,000 feet at 6:15; reached 40,000 feet at 10:50; started down from 60,613 feet at 1:40; and crashed at 3:42.

Pointing through the bottom of the gondola was a Fairchild aërial camera to provide the photographs for our calculations. Its negatives were intended also to show the position and altitude of the balloon at all times, its rate of ascent or descent, the direction of drift, and the velocity of air currents.

Unfortunately, the aërial camera magazines were broken wide open by the fall and the negatives on red-sensitive film were a total loss. However, the idea of ascertaining accurate altitude in this way is sound, for it is not difficult to measure points on the negatives, measure corresponding points on maps, and from this information compute true altitude.

Once we determined the altitude optically, we could compare it with the height of the mercury column in the barometer,



METAL FINGERS THAT WROTE THE AUTOMATIC ALTITUDE LOG

Beside the two uncovered barographs are Dr. Lyman J. Briggs, Director of the U. S. Bureau of Standards and chairman of the Advisory Board for the flight; Dr. W. G. Brombacher, specialist on altitude instruments; and Captain Stevens. The smoked drum sheets are held by Captain Stevens. The barographs were packed in a balsa wood box and were insulated by sponge rubber. The box was carried outside the gondola and suffered little damage. The records were intact.

as recorded on one of our three Factograph instrument cameras.

Evidence is available from similar apparatus used in airplanes, and from triangulations on Piccard's balloon with theodolites, to indicate that altitudes computed from existing pressure-altitude tables are too low for great heights. Increased accuracy in records of altitude, pressure, and temperature would make possible more accurate calculation of the distribution of the mass of our atmosphere.

When the rip in the bag occurred, the *Explorer* continued to ascend slowly for nearly twenty minutes longer. During that time it was possible to fill all the air-sample flasks and to take nearly twenty exposures with an aërial camera mounted to point eight degrees below the horizon line.

Our experience on previous high-altitude flights in photographing Mount Aconcagua (Argentina), Mount Rainier, and Mount Shasta across distances of 300 to 331 miles indicates that these negatives should have shown the curvature of the earth's surface. Such negatives are made on red-sensitive and infrared-sensitive film through a red filter. While the yellow-sensitive film of the small instrument cameras exposed to daylight was protected by a few turns of the film itself, the red-sensitive film of the aërial cameras continued to fog for some distance through the roll; therefore, when this film was exposed to daylight by the crash, it could not be saved.

Although many of the photographic records were lost, and although the balloon did not attain its maximum theoretical altitude, we feel that the ascent has definitely added information that will assist in solving problems of ballooning and in the acquisition of needed scientific data.

One important problem was the matter of a satisfactory air supply.

We had inspected our gondola time and again for possible air leaks and had tested it several times under pressure. We carried a large reserve of liquid oxygen and liquid air sufficient to renew the air of the gondola completely four times. Even when used

generously, this was more than enough to keep us supplied with good air from dawn till dark (see page 421).

Our liquid-air apparatus consisted of three vacuum-insulated containers of the kind used in high-altitude airplane flights of the Army. On airplane flights such containers are filled with liquid oxygen. For use in an enclosed gondola it is not safe to use pure oxygen because there is a possibility that the oxygen content of the gondola might approach 100 per cent, in which case an electric spark might start a fire which could not possibly be extinguished.

Consequently, we made a somewhat radical departure by partly filling each of the flasks with liquid air and adding enough liquid oxygen to make a mixture of 45 per cent oxygen and nearly 55 per cent nitrogen. This liquid mixture, when evaporated through the coils of our apparatus, gave us an atmosphere of not more than 45 per cent oxygen. The gondola leakage was practically nil, and consequently we had to release pressure from time to time to prevent the gondola internal pressure from rising too high. The air inside approximated that on the summit of a mountain 13,000 feet high, except that it was richer in oxygen.

Photograph from U. S. Department of Agriculture

TINY SPORES DEFY THE RIGORS OF THE STRATOSPHERE

Knowles A. Ryerson, Chief of the Bureau of Plant Industry of the U. S. Department of Agriculture, and Dr. Fred C. Meier, senior agriculturist, show Captain Stevens (seated) a thriving culture of barberry spores that the balloon carried into the stratosphere. These spores, with representatives of nine other types, were exposed to the sunlight, cold, and reduced pressure of the upper atmosphere. All came back to earth alive.

MANY CONTRIBUTED TO SUCCESS OF THE FLIGHT

On the side of the gondola away from the fan, which circulated our air, were steel screens holding chemicals for the absorption of carbon dioxide. The entire set-up was so effective that when the manholes were reopened after many hours no decided change was detectable as we emerged into the outside air.

Our balloon, gondola, and most of the apparatus were made at prices close to the cost of manufacture, and this cost, less than $60,000, although largely borne by the National Geographic Society, was also shared by individuals, corporations, and laboratories interested in the advancement of scientific knowledge. The huge bag, the gondola and the instruments were insured from damage while in flight by Lloyd's, of London.

Photograph by Newton V. Blakeslee

HAPPY LANDING!

The three balloonists return to the home of the National Geographic Society with the parachutes which brought them safely to earth: Captain Anderson, Major Kepner, Captain Stevens.

Perhaps never was a flight conducted so economically, considering its size and scope, nor one in which so many people gave so readily of their funds and time. The Army approved the flight and lent freely of its men, both from the Air Corps and from the cavalry unit at Fort Meade, and considered that the time spent was valuable training for Army personnel. An opportunity also was afforded for practical service tests, in the field, of certain equipment, such as the Army's liquid-oxygen truck.

South Dakota found that thousands of visitors to Yellowstone National Park and other points were attracted to the State by the preparations for the stratosphere flight.

The Chamber of Commerce of Rapid City had generously helped preparations in making our camp ready, even to the point of providing railings to protect the thousands of spectators who day and night looked on from the cliffs that encircled the "bowl."

The generous hospitality of these western people and their co-operation added to the willingness with which the visiting scientists attacked the many problems of installation. Never was there a camp in which so many people, engaged in widely varying lines of activity, worked together more harmoniously.

Our most cheering thought of the recent ascent is that we feel we have successfully solved the problems of living and working efficiently in the stratosphere. It is gratifying to be able to state that not a single piece of scientific equipment attached to the gondola failed us during the flight; every instrument worked exactly as planned. As for the balloon, we think another can be built that will go to its calculated maximum elevation without mishap.

HAITIAN VIGNETTES

By John Houston Craige

Captain, U. S. Marine Corps

TWO young men lolled over the gunwale of a tiny tramp steamer, avidly drinking in the beauty of the scene of tropical loveliness that lay before them.

One was massive, blond, powerful, with huge white teeth and a glass eye three shades darker than the blue of its natural mate. He was ordinarily called "Blink"—a revolutionist, smuggler, gun runner, Louisiana French-Irish. One of those indomitable Americans with a Napoleon complex and an itching foot, he drilled dusky armies and made a name to conjure with on the Spanish Main until his sudden demise in the troubles attendant upon a Guatemalan revolution.

The other young man was tall and lean, with thick shoulders, pale-gray eyes, and a thatch of sandy hair—myself.

The syncopated beat of drums came faintly across the quiet waters of the bay. Blink beat time absently on the ship's rail with his knuckles.

"It draws you, this country," he said. "The Indians called it Haiti, 'The Mountainous.' The French named it Domingue—on their maps. Informally they referred to all their beautiful Creole dominion here in the lap of the Caribbean as 'Le Pays des Revenants.' You might translate that as 'The Country of the Ghosts,' or 'The Country You Are Bound to Come Back To.' I have a notion the French felt that it was a little bit of both.

GHOSTS OF EXPLORER, PRIEST, AND PIRATE

"Ghosts? What a host must walk the jungles and hills over there at night! Columbus, Cortez, Pizarro, Francis Drake, L'Ollonois, Las Casas, Captain Kidd, Toussaint L'Ouverture, Dessalines, Christophe; explorer, conqueror, colonist; buccaneer, priest, pirate, picaroon; saint, slaver, spawn of the devil. What a country!

"This was the capital of a vast French-African empire before Paris dreamed of Algiers. Haiti, Louisiana, Guadeloupe, Martinique. Half a continent and a dozen islands. French aristocrats, African slaves. A sweet, luxurious realm worth the ransom of a dozen kings. The domain of Circe, fascinating, mysterious. Anyone who tried the life here and had to go away spent the rest of his days seeking to get back, even if only to lay his bones in the shadow of one of those big purple hills.

"What made the fascination? Was it the people or the country? Was it French or African, or a mixture of the two? Or was it purely West Indian, something distinct from either? I don't know, but whatever it was, it hasn't lost any of its strength. No man who sets his foot on the shores of this country can ever forget it. You may love it or you may hate it, but somehow you can never get it out of your mind, and the first thing you know you're heading back for more of it. You'll see."

My friend was something of a poet, yet there was cold fact in what he said. At least I found it so. That was a score of years ago; but, one way or another, Haiti has seldom been completely out of my life from that day to this.

PORT-AU-PRINCE, CITY OF CONTRASTS

Around the land-locked bay steep hills towered, horseshoewise, north, east, and south, mounting to incredible heights in the clear tropical sky. It was early morning, but already the ship's iron deck was almost unbearably hot to the touch. Ashore, mist and shadow still shrouded valley and mountain side, while the first rays of the sun just commenced to gild the roofs and pinnacles of the buildings of the town along the bayside.

The city had an air of beauty and ugliness, naïveté and mystery, magnificence and squalor. It attracted and repelled. The breeze brought to our nostrils languorous tropical perfumes mingled with stenches. There was a sinister suggestion of menace in the hushed streets. Revolution and war brooded over the place. Occasionally we could hear outcries and the sounds of gunshots. The syncopated thump of innumerable tom-toms floated out to us over the water, blended with the high-pitched buzzing near at hand of bloodthirsty malarial mosquitoes that hung in clouds about our ship as we rocked at anchor.

The lower town lay along a curving, painted bay, like a huge gorgeous fish stranded on a green and white coral shoal, a long, brilliant-hued fish, from ardent

Photograph by Clifton Adams

PORT-AU-PRINCE'S ONE AND ONLY WHARF IS PRIVATELY OWNED

Into this West Indies harbor come many private yachts in winter. American seaplanes make stops on their Caribbean route. Cargo boats bring general merchandise, petroleum, cement, steel, drugs, flour, and lumber. Then they load coffee, cacao, wax, cotton, goatskins, raw sugar, and sisal.

equatorial waters. Close under the Bel Air hills its head nestled, the rising walls of the Cathedral upthrust, like parched gills hopelessly gasping for breath. Ridges of brilliant mango and breadfruit trees marked the green line of its back, following ancient watercourses down past the Champ de Mars toward the Outer Cemetery in leafy masses of glittering emerald and malachite against brown dust and parched jungle.

At the bend of the spine gleamed a scarlet dorsal fin of giant flamboyant trees, big as northern oaks, each clothed from root to crest in a solid mass of crimson bloom. Myriads of iron roofs, some red, some green, some brightly galvanized, reflected the sun like brilliant scales.

South, where the road curved towards Bizoton, a triangle of brightly colored villas added a tail, one fluke nestling in a clump of nodding coconut palms, the other brightly outlined against a rolling eminence.

The year was 1912 and the city was Port-au-Prince. Before that time it had never boasted a Marine garrison, a sanitary inspector, a paved street, or a Chamber of Commerce. A filthy, beautiful, glamorous, appalling city, capital of a unique and fascinating country.

BEFORE THE AMERICAN OCCUPATION

"Better not go ashore," said the captain of our ship. A revolution, it appeared, was in progress. But Blink had business connected with a certain arms shipment and I wanted to stretch my legs.

Revolutions were not a novelty to either of us, and an extra one more or less was rather an attraction. So in due time we found ourselves in a cranky native coracle propelled by a couple of grinning black boys in G strings gliding over the coral-paved waters of the bay through floating refuse of a most unromantic nature.

An all-pervading stench of decayed vegetation and lack of sanitation gripped our nostrils. Our craft nosed silently into the shore. Blink jabbered noisily to the black boys. They grinned and responded at length. Blink said that the Haitian patois was close enough to Louisiana Creole to be intelligible to him.

"End of the run," said he. "The boys say we land here. This is Fort Cuca. Means

Photograph by Clifton Adams

HAITI'S NATIONAL PALACE FACES THE CHAMP DE MARS AT PORT-AU-PRINCE

Where this "White House" now stands, the author, on his first visit, saw only ruins (see text, page 439). The Republic's government is administered by a President and two Chambers whose members hold office according to a constitution dating from 1889. The country has been independent since 1804.

Fort Manure. This is all built land. I wouldn't be too curious as to what it is built of. The third Government before the last one put a fort near here to help defend the bay. They were proud of the fort and christened it with ceremony. I don't know if its name would make much of a hit anywhere else, but it seems to be quite all right here. Naïve, these Haitians, what?"

Gingerly we scrambled up the narrow path from the water's edge and picked our way for a couple of hundred yards, until the trail widened out into a street and commercial Port-au-Prince spread before us.

A CRAZY-QUILT OF CONTRAST

Like everything else about the town, this was a crazy-quilt of contrast. Perhaps half of the buildings were of stone and masonry, with walls from 18 inches to three feet thick and heavy iron doors and windows. The other half were of flimsiest wooden construction, mostly unpainted and bleached to a phosphorescent gray by the sun, many of them cocked at the craziest imaginable angles. Here and there along the streets were gaps showing the charred remnants of structures destroyed by fires, ancient and recent.

None of the streets had sidewalks, and as far as we could see not a square yard of paving existed. Close under the fronts of the houses, each street had deep-washed ditches in place of gutters, filled with sewage of all description, while progress in the street itself was rendered hazardous by broken bottles, rocks, deep ruts, and sump holes filled with mud and rubbish.

Along footpaths that twisted a tortuous way around the obstructions of the streets, a throng of women glided. Barefooted and clad in blue denim dresses, they plodded along. A few bore burdens on their heads or guided diminutive donkeys almost buried beneath enormous loads, but for the most part they were empty-handed and manifestly apprehensive.

Not an able-bodied male was to be seen and the iron shutters of places of business were closed. This, said Blink, was because of the impending revolution. Plundering might break out at any moment. Men were

LOCOMOTIVES WHISTLE AND RING BELLS DOWN MAIN STREET OF PORT-AU-PRINCE

This narrow-gauge train, puffing down the Rue Grand, is loaded with sugar cane. The cane is hauled from the fields, through the city streets, and out to the mill.

Photographs by Clifton Adams

"ALWAYS ROOM FOR ONE MORE" ON ANY BUS IN HAITI

With American occupation came leagues of new, good roads, so now automobiles carry men and goods between the capital and many outlying towns and villages. This vehicle is near the Custom-house, Port-au-Prince.

Drawn by A. H. Bumstead

600 MILES SOUTHEAST OF FLORIDA LIES HAITI

Its 2,550,000 French-speaking Negroes rule the western third of the tropic island of Hispaniola, off the coast of which Columbus' flagship, the *Santa Maria*, ran aground and was abandoned in 1492. At Môle St. Nicolas the Great Admiral landed. Within 20 years was begun the importation of slaves, the seeds of the Negro nation of to-day. Cap Haitien, on the north coast, was the capital in the days when Haiti was a French colony, but now the seat of government is Port-au-Prince, near a region of rich, irrigated sugar lands.

likely to be shot on sight, or, escaping this, were certain to be impressed into one or another of the contending armies.

There were men who were not able-bodied, however, and women also. Beggars sat at every street corner and a throng followed at our heels. Blind men and men with patched eyes, men and women with withered limbs and limbs that were swollen to enormous size by tropical elephantiasis, monsters of all sorts with deformities surpassing the imagination and the pathology of more temperate climes. All of them of an indescribable inky jet.

TOM-TOMS LEAD TO THE CHAMP DE MARS

Over all the sun beat down, silent, merciless, interminable. To the visitor its rays seemed to have a solid quality, a tangible substance, a weight. They burdened the shoulders, cramped the heels, deadened the brain.

As we made our way inland, the streets trended gradually upward and the ominous thump of the tom-toms came louder to our ears. Suddenly we came out on an open space several acres in extent. It was evidently a park, but dismally neglected and overrun with the swarming vegetation of the Tropics.

"Champ de Mars," said Blink. Waving to the right, where lay a great charred hole in the ground with masonry and beams blackened by smoke protruding from it, he continued, "Haitian White House, used to be the National Palace.

"Well, I'm leaving you here. Have a good time, but better get back to the ship before dark."

Blink cut off to the right with the assuredness of one who knows where he is going. I continued to follow the road inland.

Presently the street climbed sharply to a deep, mysterious canyon. On either hand rose banks of earth and rock and above them walls of masonry.

Here and there gateways and entrances afforded vistas of parklike grounds filled with a well-ordered profusion of tropical trees and shrubs, while far back from the road discreet glimpses could sometimes be obtained of spacious villas and porticoed residences.

THE ESTATES OF THE WEALTHY

Masses of tropical verdure overhung the walls on either hand and the air was heavy with the scent of frangipani and bougainvillea. Here, evidently, was a quarter occupied by the estates of the wealthy. Fascinated by the charm of the scene, I toiled on, catching glimpses, through occasional windings in the trail ahead, of a noble mountain crowned with green luxuriance.

Photograph by Clifton Adams

"DO YOU BELIEVE THAT COLUMBUS REALLY LOST THIS ANCHOR?"

Visitors to the National Palace, or Haitian White House at Port-au-Prince (see page 437), are shown this rusty relic which, tradition says, was lost when the *Santa Maria*, flagship of Columbus, was wrecked on a reef in the bay at Cap Haitien, Christmas Eve, 1492. Once it was taken to Paris and pawned, then recovered after much difficulty.

Suddenly a wild and raucous clamor burst from the trail ahead. The ever-present throb of drums swelled into a stuttering roar. Shots rang out. Flames stabbed from the green-bordered trail. Smoke hung in the still air and reports rattled and reverberated. A motley column surged into view. It wasn't in military order, or, in fact, in any order. Disorder was its most salient feature.

It was composed in almost equal parts of Negroes on foot and Negroes on horseback. Hardly any of the Negroes had shoes. Some of them had trousers and smocks of blue overall denim. Some had very few clothes indeed. A few had red pantaloons and blue coats with the round gold-laced caps reminiscent of the French Army. Perhaps half of them had guns of one sort or another. Nearly all had machetes, the long cane knife of the country.

IN THE MIDST OF A REVOLUTION

Foot and horse, clothed and unclothed, surged along together. From time to time the spirit would move one of the warriors with a gun and he would fire a shot or perhaps half a dozen shots in rapid succession. Then he would shoulder his piece or sling it across his back and go on as if nothing had happened.

Another would burst into a cacophony of shouts and cries. Instantly the whole host would take it up. Then the volume would dwindle and subside until time for a fresh outburst. The roar of the drums and the shriek of conch-shell horns were deafening.

I looked for the enemy, but there didn't seem to be any. Everybody was in the best of humor and all acted as if they were having the time of their lives. Eventually I decided it must be one of Haiti's famous revolutions.

As a rule, the natives did not harm foreigners on these occasions, I had heard. But I wasn't sure that all members of this army knew the rules, and so I didn't want to take chances on being the victim to make a Haitian holiday. A hundred yards back I noticed a break in the wall on the right of the road where a modest villa stood. Thinking this might offer an opportunity to

NATIVE GIRLS IN SHORTS ARE STILL AN UNCOMMON SIGHT IN HAITI

Posed by members of an athletic club, this picture represents the most modern group at Port-au-Prince. One might travel over the island for years and not meet another discus thrower.

Photographs by Clifton Adams

AWNINGS AND PALMS ARE THE "WALLS" OF THIS HAITIAN LIVING ROOM

Because of the mild climate, few glass windows are used; even screens are rare, although most people who can afford to do so sleep under mosquito nets. Many of the better homes are floored with imported French tiles; furniture and other household equipment come from France. Illustrated magazines and newspapers of France are preferred by Haitians, whose language is French.

Photograph by Clifton Adams

STRIPPED OF POWER, THE TYRANT CHRISTOPHE FELL HERE IN A PARALYTIC FIT

Downhearted, deserted by most of his former followers, the Black King was stricken in this chapel at Limonade while at Mass on August 15, 1820. His head hit the floor just under the plaque which, translated, reads, "Here fell King Christophe."

get out of the path of the advancing multitude, I made my way in that direction.

Scrambling across a 6-foot ditch, I climbed into the garden of the villa and stood behind a thick clump of shrub, close against the portico of the house. Draped from a veranda were a couple of British flags, which cheered me measurably.

REFUGE IN A BRITISH HOME

I had a feeling of being minutely scrutinized. Presently a bolt grated and a long French window swung open. A carefully groomed colored gentleman dressed in a faultless morning coat made his appearance.

"Better come in, sir," he said. "We foreigners are ordinarily safe in time of disturbance, but one cannot always be certain."

By this time the head of the column, shouting and blazing away, had come abreast of us; so I did not stand on order or ceremony, but accepted his hospitality with much thanks and stepped hastily into the house.

"You are quite safe here, sir," said my host. "The British flag is a firm shield and a sure defense. Allow me," he said gracefully. "I am Ludovicus Tilghman, barrister-at-law, late of London." I told him my name and we shook hands warmly, my admiration for the British Empire rising a couple of notches.

Inside was the typical interior of a British home of the upper middle class. It might have been Chelsea. Copies of the *Times* and the *Daily Mail* were on the table. I learned that my host was a Barbadian who had spent some years in the mother country.

"This sort of thing is no doubt new to you," he said. "You may perhaps enjoy a view of it. We shall see it better if you will permit me to conduct you above." In a spacious living room on the upper floor blinds were tilted discreetly to permit a view and chairs were brought.

"This," said my host, "is the fifth time this has happened in my short residence here. It is a great nuisance. Revolution, and all that sort of thing. Paralyzes business. These people have absolutely no conception of law and order. No Magna Carta, no Bill of Rights. Suffrage a ghastly sham. Trial by jury a joke. Presidents arrive one day and are exiled or assassinated the next.

Photograph by Clifton Adams

"WHAT LUCK?" THE WOMEN SHOUT, AS THE FISHING FLEET COMES IN

Even a vagabond rooster, hunting a fish head, comes down to meet the boats. True to form in Haiti's easy-going life, offshore winds blow the boats out to the fishing grounds every morning, then shift, blowing them home at night (see Color Plate VII).

Only one ruler of this country ever finished his term and got out alive and in peace. The rest were murdered, died mysteriously, took their own lives, or were driven into exile.

"What a country for this civilized 20th century! Upsetting to the whole Anglo-Saxon scheme of life. What they need is a liberal application of the Pax Britannica, don't you think? But I beg your pardon; I presume you are from the United States."

I hastily assured my host that, although I was indeed a Yankee, a little peace, British or otherwise, would do no harm.

I asked about the mob that was defiling outside.

"These gentry are *cacos*," he said. "Mercenary soldiers, bandits, that sort of thing. Some politician gives them a few shillings and promises them loot. They come down from the mountains. A president is driven out and another comes in. They kill a few dozen, a few hundred, or perhaps a few thousand, and loot what they can. Then they go back to their mountains and wait for the next revolution."

When the end of the ragged army passed we returned below. My host proffered coffee. Thunder rumbled in the distance. I arose to go.

"Better not go yet," said my host. "The storm is due in twenty minutes."

"What storm?" I inquired.

"You shall see," said he.

THE DRAMA OF A HAITIAN STORM

On the veranda the air was thick, still, and oppressive. Far above the head of the valley up which our road ran, inky clouds shrouded the mountain side. Where we stood the sun shone brightly and the trees hung motionless, but an electric tenseness gripped the atmosphere. On the steep sides of the mountain black masses of clouds whirled with frightful velocity, enormous streamers of mist separating themselves from the parent body and driving this way and that like gray curtains.

Athwart the rays of the sun, torrents of rain descended on hilltop and valley thousands of feet above.

As we stood, the first huge drop of the storm fell in the dust at our feet with a plop, leaving a wet spot as big as a silver dollar.

At the bottom of the 7-foot chasm that served the road in place of a gutter a foot of water hissed and boiled where dry rocks had been 15 minutes earlier. A thin stream trickling from above twisted and writhed through the dust in the road.

Rain drops pattered thicker and faster. The light of the sun grew pale and sickly. At length, with a blinding flash and earth-shaking reverberations, the storm burst upon us. An icy wind rushed down the mountain side. Lithe, elastic palms whipped almost to the earth, while massive mangoes and oaks labored and groaned. The sky opened and water crashed down in torrents. Lightning flashed above a cannonade of thunder. Balls of fire streaked down from the heavens and ran along the ground, dazzling the sight and bursting at last in unbearable effulgence.

In spite of their depth and capacity, the gutters at each side of the road soon filled to the brim. Before long the road itself was covered with a foot of water. Soon it was three feet. Tree trunks and carcasses of pigs and goats swept by. A horse and man came swirling along.

Then, with a final orgy of lightning and a roar that seemed to split the skies, the storm departed as quickly as it had come.

My host drew out his watch. "Five o'clock," he said. "Just on time. Ought to be 5:15 to-morrow. You have still an hour of daylight to regain your ship."

Down the steep road and past the ruined palace of the Champ de Mars I made my way, overtaking Blink, also hastening seaward.

A LINE OF SHACKLED LOSERS

The revolution, like the storm, had passed over the town. Bands of native warriors wandered in the streets. Everywhere shutters were closed tightly and the flags of foreign nations fluttered from nearly every balcony. It did not seem that there could be so many aliens in the city. As we made our way to the water front, we passed a line of half-naked Negroes tied neck to neck with straw ropes and guarded by a dozen barefoot soldiers.

"Losers," said Blink, carelessly. "They belong to the President's army. Or maybe they are the enemies of somebody on the winning side. They take them right down there a piece and shoot them. Then they push them into the swamp."

Despite the fate in store for them, the captives did not seem depressed. They chattered and begged cigarettes from us. Occasionally the guards would fall to beating one of the captives with their gun butts or clubs.

Back aboard the ship we found that two new passengers had come aboard—a small, heavily bearded Frenchman and his charming Parisian wife. He was the editor of a French paper and was writing a book on Haiti. He was brimming with enthusiasm and spoke English fluently. He told of terraced gardens he had visited, magnificent villas, books, music, beauty and gayety, spotless napery, gleaming glass and silver—all the refinements and delights of civilization.

WHY HAITIANS ARE DIFFERENT

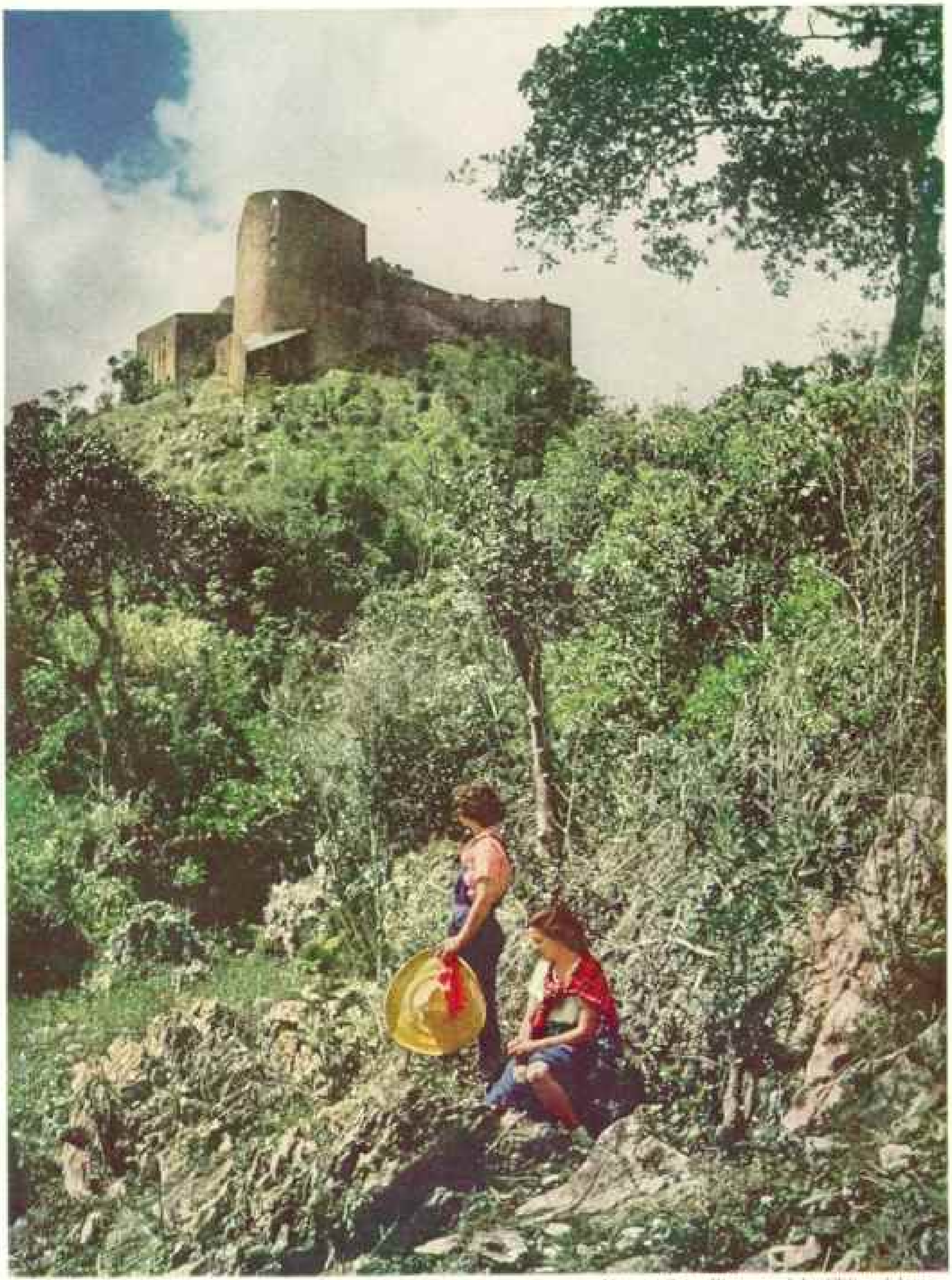
This didn't sound like the Haiti I had just seen. I asked him about it. He chuckled a bit, then looked thoughtful. Yes, he said, he knew about the things I had seen. They were all part of the picture.

"To understand this country," he said, "you must begin by comprehending two things: first, the origin of its people; second, its isolation. Consider, *mon ami*. We French brought here thousands of black slaves, savages from the Congo. They cross-bred with colonial whites—some able whites, aristocrats, the best blood of France. The mulatto caste grew up. Ah, there's a fascinating study for you!

"Old Papa Mendel taught the world's biologists that when you mix two races you are likely to pull the most amazing individuals out of the hat. Mix the daughter of a Dahomey chief with a French marquis and you may get a man with the skin of a Cetywayo and the brain of a Talleyrand. You may get a woman with a black skin and a white soul or one with a white skin and black mentality. What possibilities for variety, drama, suffering!

"For the hundred years of Haiti's independence this mixing has been going on in isolation from the rest of the world. A caste of intelligent, highly educated mulattoes grew up, and beneath them a caste of primitive, black, transplanted Africans. Each caste reacted on the other, and in the passage of time members of each caste grew to be different from any other people in the world—Haitians.

"The mulattoes were French in language and education, but they absorbed from the blacks much of their African mysticism and



 Natural Color Photograph by Clifton Adams

CHRISTOPHE'S CITADEL DEFIED THE FRENCH—WHO NEVER CAME

His Black Majesty needlessly crowned the 2,886-foot Bonnet-à-l'Evêque with the impregnable fortress La Ferrière. Today the century-old ruin, like a huge stone battleship stranded on a mountain, lures travelers to a hard three-hour climb up the steep trail.

THIS GAUDY KITE MOANS AND GROANS AS IT DIVES IN AËRIAL JOUSTS

Haitian boys build into their home-made toys of colored paper vibrating vanes that make queer noises. Sometimes they tie pieces of broken glass to the tails and try to maneuver the kites so as to cut the tails and strings of those of other boys.

 Natural Color Photographs by Clifton Adams

LITTLE BROTHER WORKS A PRIMITIVE CANE CRUSHER

Natives of the fertile district southwest of Port-au-Prince use a mill of one-boy power and one-stalk capacity. The juice is not boiled into molasses or sugar, but sweetens the family coffee. In the crude mortar behind the standing girl, corn and cassava are pounded into rough meal.

OLD GLORY FLIES BESIDE THE FLAG OF HAITI AT THE RACES

Spring meetings, open only to horses raised on the island, were supervised by officers of the United States Marine Corps at Bowen Field, the military airport of Port-au-Prince. Citizens of both Republics mingle in the friendly crowd of devotees of the sport.

 Natural Color Photographs by Clifton Adams

MASKED STRUTTERS REHEARSE FOR MARDI GRAS

Haiti celebrates the beginning of Lent with ceremonies half Latin, half African. In Port-au-Prince exquisitely gowned beauties vie for the crown as Queen of Beauty, but rural joymakers, clad in brilliant costumes and grotesque straw headdresses, dance to the beat of work drums.

Natural Color Photograph by Clifton Adams

COAST PACKETS SUN THEIR WINGS AT WHARF CABOTAGE, PORT-AU-PRINCE

Haiti is a rugged country, and before the American days there were few roads. Scores of roughhewn wooden craft with white, red, or purple sails cruised along the coasts. Now highways have come, and high-speed trucks compete with the ships.

 Courtesy of Bruce S. Ingram

THE BLACK NAPOLEON, HENRY CHRISTOPHE, ONCE KING OF HAITI

Born a slave about 1765, he became a leader in the Haitian slave uprising. Made president in 1807, and crowned king five years later, he shot himself—tradition says with a golden bullet—in 1820. Painted by Richard Evans, from life, and exhibited at the Royal Academy in 1818.

Natural Color Photograph by Clifton Adams

SOULOUQUE'S GOLDEN CROWN IS SELDOM EXHIBITED

The gem-incrusted relic is usually kept sealed in a vault of the Banque Nationale d'Haiti in Port-au-Prince. A Government official guards the masterpiece of a French jeweler, which, in old prints of the coronation in the forties, is shown on the head of the second "Emperor," Faustin the First.

EARLY SHOPPERS RUSH TO HAITI'S "IRON MARKET"

The structure covers about half a city block. It was designed and built in the early nineties by President Florvil Hippolyte, who never tired of admiring the Moorish towers connecting its two parts.

 Natural Color Photographs by Clifton Adams

BARGAIN HUNTERS SHOP IN SIDEWALK FIVE-AND-TENS

Merchandise of all descriptions is stacked on the pavement in front of stores in Port-au-Prince's poorer districts. Most of the buyers are country women who bring the produce of their small farms to the city for sale. Sometimes they have as much as 50 cents gold for an orgy of spending, but usually a dime or a quarter is their limit.

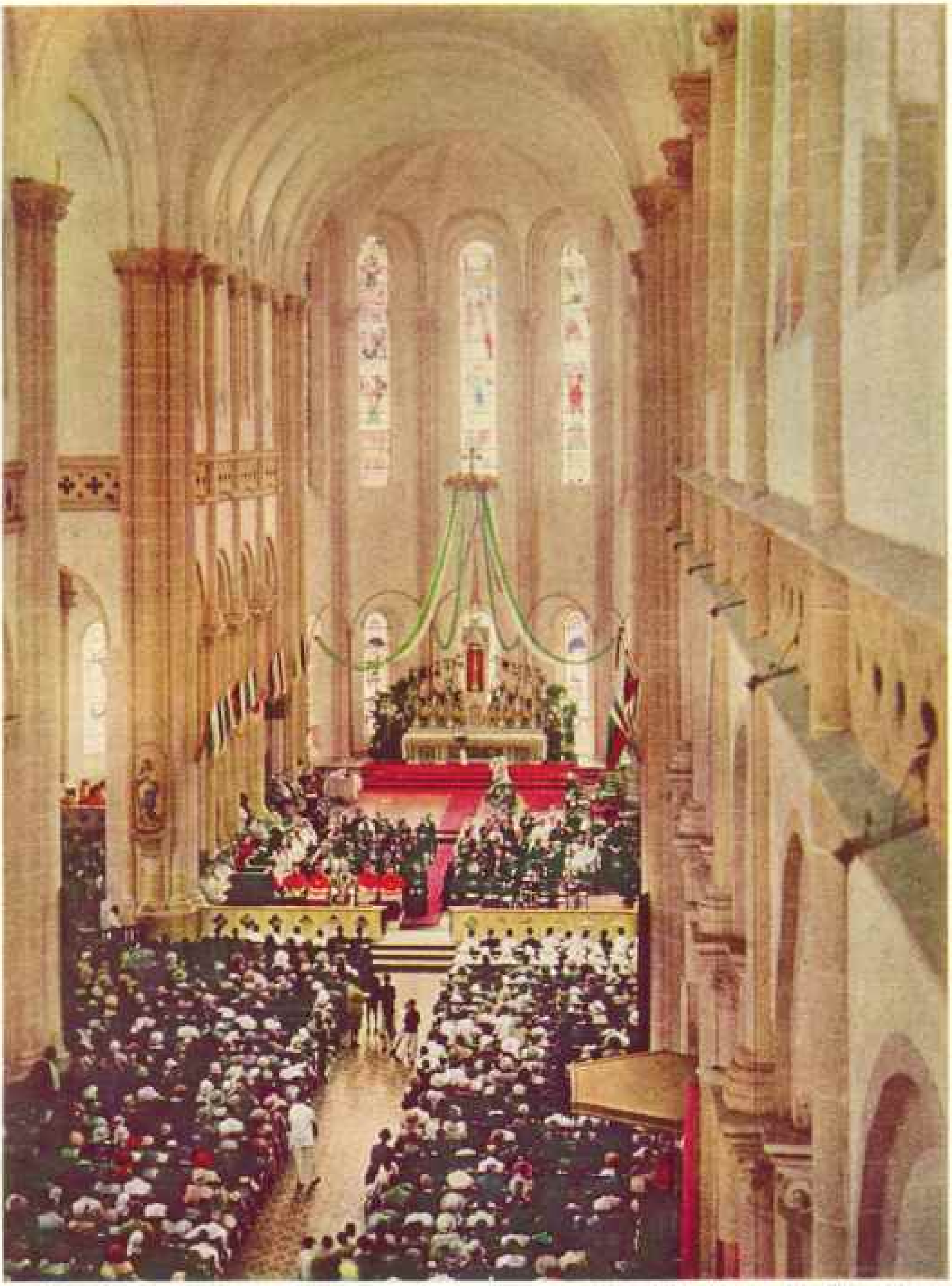
THE PANORAMA OF PORT-AU-PRINCE BAY RIVALS THAT OF NAPLES

Viewed from the hills where live the city's wealthy and cultured classes, Haiti's capital presents an aspect of breath-taking loveliness. The Presidential Palace may be discerned on the left.

© National Geographic Society Natural Color Photographs by Clifton Adams

EXOTIC COLOR TOUCHES EVEN THE FOOD FISH

Tempting to the eye is the fishwife's offering of red snapper and other delicious varieties, glowing with brilliant reds, blues, yellows, and greens. The wind blows the fleet out to sea in the morning, and, changing, wafts it back with the catch. When the breeze does not turn, native anglers toot horns and beat pans.



 Natural Color Photograph by Clifton Adams

A BRILLIANT SERVICE HONORS THE ARCHBISHOP OF HAITI

In the rosy twilight of the new Cathedral in Port-au-Prince, President Sténio Vincent, his Cabinet, the diplomatic bodies, and many notables of the capital attend High Mass, celebrating the fiftieth anniversary of the ministry of a revered ecclesiastic.

superstition. The blacks held to their mother religion, the voodoo, and many of their African social customs, but they absorbed in turn a few French words and a veneer of Christianity.

"In the main, the mulattoes held the wealth of the country and all the powers of the government, modified by the propensity of the blacks for periodical revolution and plundering. Neither caste felt any responsibility for maintaining order, sanitation, facilitating business, or paying debts, private or public. The country was chronically bankrupt. Commercial obligations were not worth the paper on which they were written. Epidemics of disease found a hotbed. While the intellectuals produced poems and lived epics, the perpetual tales of uprisings irritated the civilized capitals of the world.

"That is why all this must go. This is an age of standardization, sanitation, uniformity. The world is growing smaller. Haiti's isolation cannot last. The great nations of the world will not permit any small country to maintain what they regard as a nuisance at their gates, however exotic and fascinating its spiritual life may be. In twenty years this country will be cleaned up, civilized. As a poet I deplore it, but as a realist I know that it is inevitable."

Next morning our ship steamed out of Port-au-Prince harbor and soon the towering purple mountains remained only as vague cloud masses on the horizon. With me, however, it was not to be a case of "out of sight, out of mind." As we plowed northward through cobalt tropical waters, the sights and experiences of my day ashore seemed to grow clearer rather than to fade, and to assume a rational sequence until the whole spread out before me like a vast picture, a cunningly wrought vignette etched into the tablets of my memory.

HAITI RETAINS THE FRENCH LANGUAGE

Haiti occupies the western third of the island of Hispaniola, second in size of the Greater Antilles, which lies between Cuba and Puerto Rico. Haiti is the only Latin-American republic in which French is the official language. Its neighbor, the Dominican Republic, which occupies the eastern two-thirds of Hispaniola, thinks and speaks in Spanish.

The Haitian Republic is about 10,204 square miles in area, not quite as large as the State of Maryland. It is made up principally of three ranges of towering mountains, interspersed with fertile alluvial plains, mostly small, and plateaus and valleys (see map, page 439).

The island of Haiti, or Santo Domingo, was the second largest discovered by Columbus on his first voyage. His name for it, Hispaniola, has recently been revived as a distinctive name for the entire island.

In Haiti proper, from 1805 to 1915, 26 men held executive power. These included two emperors, one king, and 23 presidents. One committed suicide, four were killed outright, five died in office, and fifteen were driven into exile by revolutions. Only one retired voluntarily at the end of his constitutional term. He must have been an eccentric, even for Haiti.

U. S. MARINES CLEAN UP THE CAPITAL

One morning at the breakfast table I read headlines that United States forces had occupied Haiti. A president had been killed in Port-au-Prince streets. Debt payments had been defaulted. The French Legation had been violated. Foreign protests rose in chorus.

I remembered my French friend's words. He had been a true prophet. Fewer than 20 years had passed, but the cleaning-up process had begun. The world was emphatic in declaring that Haiti must change her ancient ways. In July, 1915, Uncle Sam undertook the disagreeable and expensive task of seizing her by the slack of her ragged skirts and dragging her into the modernity of the 20th century.

One day I got orders to pack my kit for Haiti. Nearly ten years had elapsed since my first visit to Port-au-Prince, and I knew that many changes must have taken place since Uncle Sam stepped in.

The transport steamed in to Port-au-Prince harbor. Same purple bay; same amethyst hills; same rolling thump of drums. But something was missing from the picture. Where was the stench of yesteryear? Gone, apparently. In its place, only the clean odor of roasting coffee.

The same host of black boys surrounded the ship to dive for coppers, but their boats were different. In the old days these craft were made of logs crudely fastened together, or of huge single tree trunks, hollowed out. Now they were made of packing cases, mostly those which had held gasoline cans. Some of the craft had "Standard Oil" in bright letters on prows or sides. Where

Photograph by Clifton Adams

MARDI GRAS CARNIVAL HONORS ONE OF ITS QUEENS

As in New Orleans and elsewhere, the annual festival in Port-au-Prince is the year's most colorful spectacle. Then merchants vie with each other in the construction and display of ornamental floats; citizens of all ranks, high and low, and many in costume, share in merrymaking.

formerly nakedness had been the rule, now most of the lads wore a garment of some sort. One had a pair of swimming trunks of which he was visibly proud.

Ashore, the harbor front was a mass of concrete buttressed with pilings. Fort Caca and its malodorous mud were gone. Inland and upward ran wide, well-kept streets, each paved with concrete. Sump holes and pools of stagnant water had disappeared. At the sidewalk edges now ran gutters with frequent sewer inlets. Overhead hung electric lights, while gangs of street cleaners plied their brooms with vigor. The beggars with the hideous deformities had disappeared, many of them, I was told, cured by U. S. Navy doctors and sent back to work.

Crowning wonder of all, dozens of automobiles chugged hither and yon. At the time of my first visit there had been none. Inland, where I had seen the charred ruins of the old palace, now rose the white magnificence of a new structure, said by many to be the finest public building in the West Indies (see page 437).

My duties took me to Cap Haitien, about 185 miles north of Port-au-Prince (page 474). I journeyed thither by automobile in eight hours over an excellent gravel road. In the old days there had been only a narrow trail. He who made the trip had to go on horseback and spend at least a week on the way. The road was thronged with country people, men and women, going about their business unconcernedly.

I was struck by the increase in the quantity and quality of the clothing worn. In the old days garments were sketchy enough and nakedness not uncommon in the back districts. Now the men were clothed from neck to knee, and even the poorest of the women had some sort of skirt. Flour and cement sacks, discarded by the Marines, seemed to constitute the latest thing in fashions. At least half the pedestrians seemed to have "Portland Cement" or "Pillsbury's Best" stenciled across some prominent portion of their anatomy. Later, prosperity rose still further and these ex-flour and cement sacks were discarded for more conventional garments of blue denim.

LIKE A PILGRIM TRAIN, MARKETWOMEN ON DONKEYS FILE UNDER THE ARCH

Donated by a native in honor of former President Hippolyte, this structure was a Haitian conception of the Arc de Triomphe in Paris. It stands near the "central" (sugar mill) of the Haitian-American Sugar Company. The sign warns of a 15-mile-an-hour speed limit.

Photograph by Clifton Adams

SUBSTANTIAL HOMES LIKE THIS ARE RARE IN HAITI

Most of the dense population dwells in the shady interior, sheltered in primitive huts of grass or palm leaves. This home, built by an upper-class Haitian, stands in the best residential district of Port-au-Prince.

The older huts were all situated on prominent, exposed hills, but new ones, I noticed, were near wells or on the banks of streams. The reason, I was told, was that the chief requirement of a hut in the old days had been safety for its male occupants. The dwellings had to be so located that their inmates could keep a sharp lookout in all directions to spot the approach of a caco band and make a quick escape to avoid being recruited as members of its force. Now there were no cacos, so the new huts could be placed with an eye to convenience.

But the significant thing, that remains graven on my mind after the passage of years, is the visit I made to the stronghold of one of Haiti's famous rulers.

CHRISTOPHE'S CITADEL DOMINATES CAP HAITIEN

Historic Cap Haitien is situated on a shallow bay on the north coast of Haiti. On a coral reef just offshore, historians believe, Columbus' flagship, the *Santa Maria*, was wrecked. In the days of the French, the Cap, then called Cap Français, was the capital of the colony (see map, page 439).

As I went about the old town, I was conscious of a strange hump on the skyline to the southeast, many miles distant.

"Oh, that?" said my host. "Christophe's Citadel—the most imposing structure of man in the American Tropics. Why don't you go up to-morrow?"

It lacked two hours of dawn when a servant called me. I had just time for a plunge in my host's basin, the small swimming pool with which every Haitian house of the better class is equipped, and a sketchy breakfast when an automobile entered the courtyard and it was time to be off. Through the narrow streets of the sleeping town I rolled with my companion, young Lake, a lieutenant of the Gendarmerie, the native constabulary officered by U. S. Marines. He seemed to be a perfect encyclopedia on Christophe, and, as he talked, a new image built itself up in my mind of the Negro ruler who had held sway here a century ago.

His was a success story. From a barefoot slave boy he rose to be a ruler of power and magnificence. A despotic and cruel ruler, perhaps, but one who was honest, proud, and courageous. He made his country respected and feared for the first time in its history by the great powers of Europe, the *blancs* (whites). That is why black Haitian lads to-day regard Christophe's memory much as American schoolboys regard that of George Washington (see Color Plate V).

THE "SUCCESS STORY" OF HAITI'S BLACK KING

"Henry Christophe," said Lake, "born probably between 1760 and 1765, came to Cap Haitien from the British island of St. Christopher (the old name for St. Kitts). He ran away on a French ship and was sold as a slave boy in Haiti. He became a French officer's servant and sailed north to take part in the siege of Savannah in our own Revolution. He was a proud, high-spirited lad, intelligent, and quick to learn.

"When the French fleet returned, Christophe was sold to the owner of a tavern, the Hotel Couronne. You can still see the ruins of the place and the big *mapou* tree where the French gentlemen tied their horses. He was a good servant—polite, efficient, obliging. While he waited on guests, he learned what he could from each. In his successful days he often told how he had picked up scraps of helpful information or had acquired useful traits by imitating this or that patron.

"But within him, as he grew to manhood, he began to feel that he was a superior man. He compared himself to the customers at his master's inn, and almost always the balance seemed to be to his advantage. Although he hid his feelings skillfully, he began to hate the system that condemned Christophe, the able, to remain all his life the hopeless servant of any incompetent master who had the price of his purchase.

"He acquired two great motivating ambitions that remained with him throughout his life. First, he wanted to prove that he, Christophe, was the equal or superior of any man in the world. Next, that black men were inherently equal or superior to their white brethren.

"When the troubles attending the French Revolution broke out in the colony, he became a private in the French Colonial Army. Soon his abilities made him an officer; in a few years a general. Then, when the blacks under Toussaint L'Ouverture rebelled against the French, he commanded the forces of the insurrection in all the northern communes of the colony. After the defeat of the French, he became the second president of the Republic, and eventu-

Photograph by Clifton Adams

CONCH SHELLS AND CHAIRS, CORAL AND DRIED FISH, FOR SALE!

Native bumboats with odd cargoes swarm about when liners reach Port-au-Prince. Passengers toss down coins, for which natives quickly dive should the coin fall into the sea, and purchases are hauled up on a string.

ally mounted the throne as self-crowned king of the North American monarchy."

THROUGH THE MARKET AND ON TO THE CITADEL

As Lake held forth, we rolled past the market place, where drowsy market people were beginning to bestir themselves.

Out across a shaky iron bridge we drove into what had once been the French Royal Highway of the Plaine du Nord, the Haut du Cap, of colonial days. In the French time this had been an avenue wide enough for four carriages to pass abreast. On each side it had been flanked with palatial villas. We could see the crumbling gateposts of many of them, and, back in the shadows, the ruins of *habitations* that once had been.

Here the road was deserted no longer, but as far as the glare of the headlights could penetrate it was thronged with market women and their donkeys, streaming into town with their goods for the morning market. Bare of foot, turbaned, with their long blue gowns fluttering behind them, they swung along, backs rigid, haunches rolling, some chattering and gesticulating, but for the most part silent, weary from their long night on the trail.

Our car nosed east and began to pull uphill. Cocks crowed vociferously, and the scent of dawn was in the air. As we ground along mile after mile, the plain which we traversed constantly mounted higher. From ravines and valleys echoed the thump of drums, never silent in the Haitian mountains, and sprinkled here and there over their almost perpendicular sides shone the red flames of tiny fires.

Gradually earth and air brightened until the sun showed a segment of its red disk over the crest of the jagged mountains on the Dominican border. The nose of our car pointed straight at the Citadel.

Now it was distant and indistinct no longer. Right over our heads it seemed to tower, like a great medieval fortress set on an almost perpendicular mountain peak rising to a tremendous height (see Color Plate I and illustration, page 478). Lake

Photograph by Henry W. Moore

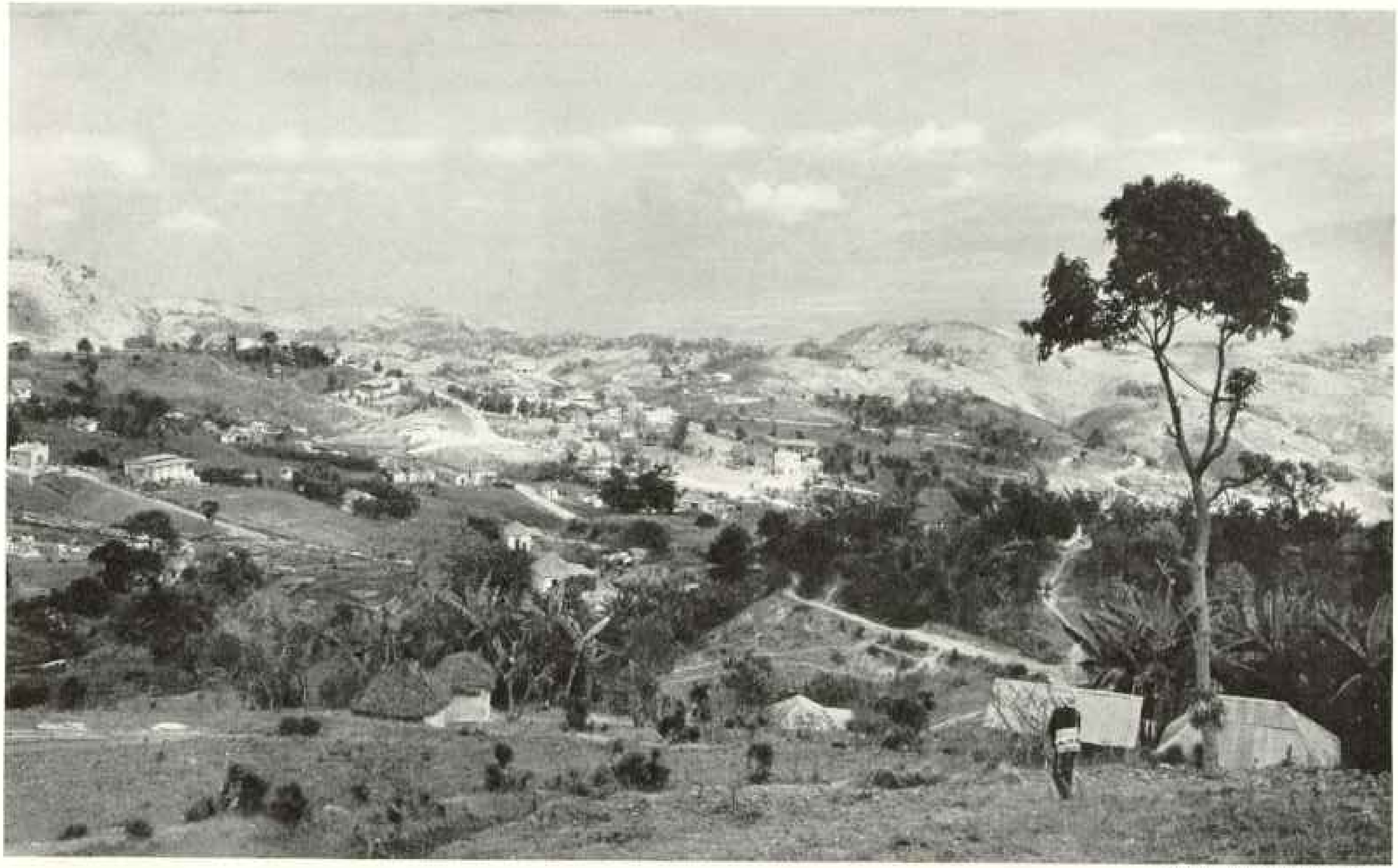
COASTAL TRADING CRAFT MUST COMPETE NOW WITH TRUCKS THAT USE NEW ROADS ALONG THE BEACHES

Anchored on the Port-au-Prince water front at a spot known as the Wharf Cabotage (see Plate IV), these small sailing craft are typical of the fleet that formerly carried all goods and passengers about the island before motor trucks absorbed so much of this trade. On each is a tiny altar and an image of the native water god, Papa Agoué. Sailors blow horns to raise a wind, and sometimes beat Papa Agoué when winds are too strong.

BELOW THE BASTIONS OF AN OLD COLONIAL FORT SPREADS A FINE PANORAMA OF PORT-AU-PRINCE AND ITS ROADSTEAD

Photographs by Clifton Adams

AMERICAN CAPITAL AND ENERGY CREATED THIS 22,000-ACRE SISAL PLANTATION (SEE PAGE 473)



Photograph by Clifton Adams

THE RESORT COLONY OF KENSKOFF LIES IN THE COOLER HILLS ABOVE PORT-AU-PRINCE

Made more easily accessible by good roads built since the American occupation, this hill colony is much sought now both by foreigners and well-to-do native families. Set about 4,600 feet above the city, it enjoys cool breezes and affords a rare view of Port-au-Prince and the sea.

Photograph by Clifton Adams

"HOLD STILL! IT PULLS A LITTLE—BROKEN GLASS ALWAYS DOES!"

When one wants a shave in rural Haiti, all he has to do is break an old bottle, hand a scrap of glass to a bystander and say, "If you please!" Friends usually shave each other. The barber here, using a piece of glass, is not one by trade. In a regular shop in the country areas, a shave costs about one cent.

Photograph by Elizabeth R. Hibbs

WOMEN MAY WALK 50 MILES OR MORE TO MARKET

They enjoy the social wrangle of barter in the market place, where they trade their breadfruit, cassava flour, avocados, and mangoes for a few candles, matches, some salt, calico, or a bit of soap. Walking at night when it is cooler, women may spend several days on a trip, stopping at different markets along the way.

Photograph by Clifton Adams

TRAINING YOUTH IN THIS CENTRAL SCHOOL OF AGRICULTURE, HAITI SEEKS TO AID THE VAST RURAL POPULATION

Connected with the modern institution at Damiens is an experimental station. Boys study animal husbandry, soils, and farm crops adapted to the island. Efforts are made, under American instruction, to improve the culture of cane, cotton, sisal, coffee, fruit, and other crops. Field agents of the United States Department of Agriculture have introduced many vegetables and increased quality and production.

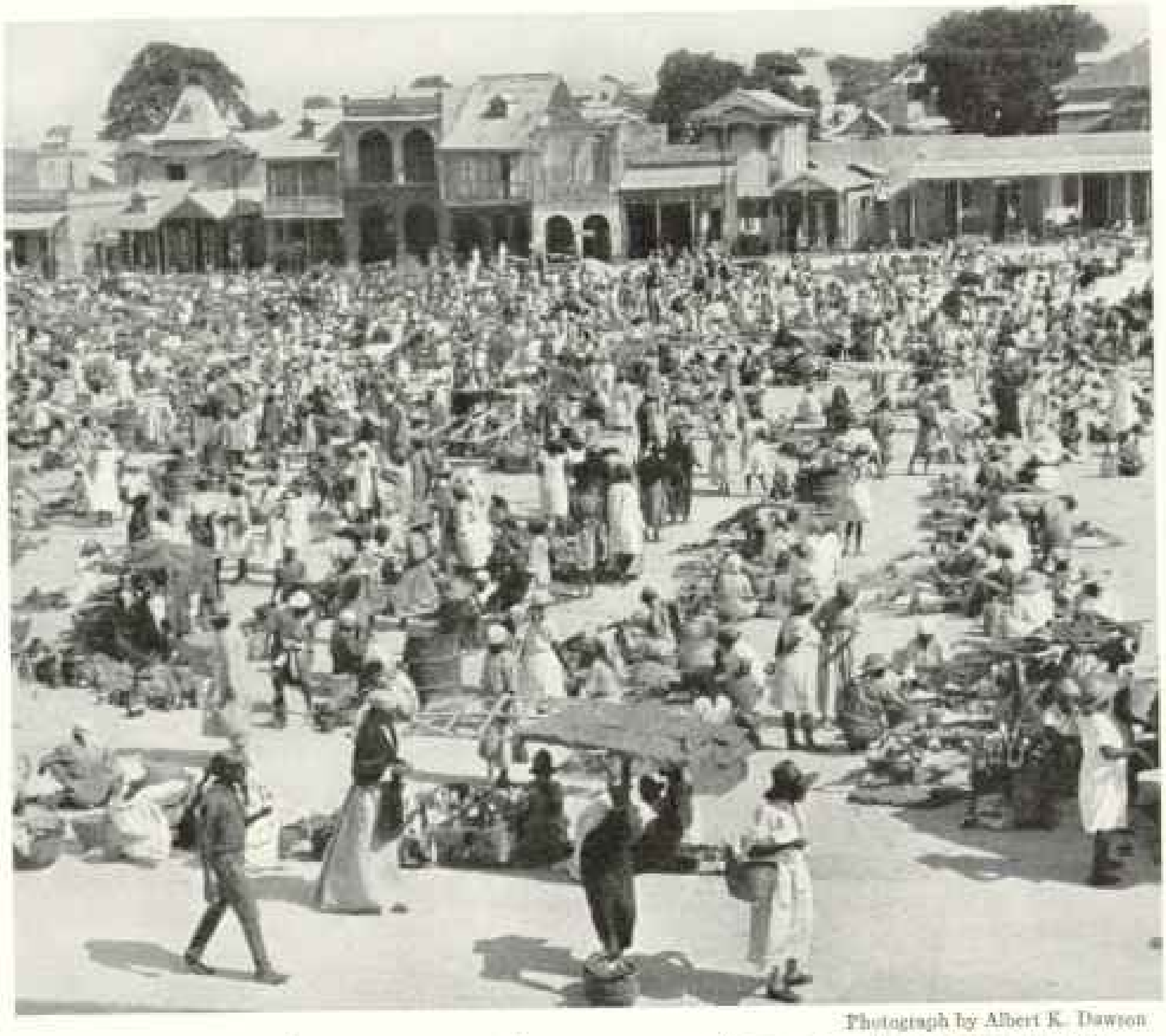
informed me that the peak was known as the Bonnet-à-l'Evêque, the Bishop's Bonnet, and that its altitude was nearly 3,000 feet. The Citadel covered the whole mountain top; there was no room for anything else.*

The enormous size of the structure sank deeply into my imagination. It was roughly square and measured something like 500 feet to a side. Someone once estimated that it contained nearly half a million tons of building material, every pound of which had to be carried up the precipitous side of the mountain more than 2,000 feet above the plain. Ten thousand men were continuously employed.

Lake explained that Christophe built the Citadel as a result of the same driving motives that accounted for a majority of his kingly actions—fear and emulation of the white European powers. He and his little kingdom were free. He resolved that they should remain so, and to that end he decided to build an impregnable fortress to shelter himself and his army should an invader ever attempt to conquer his realm.

He strained every resource of his kingdom and worked his subjects without mercy. The king was a man of huge size and gigantic physical strength, skilled as a mason. Often, tradition says, he would take trowel

* See "A Little-Known Marvel of the Western Hemisphere (Christophe's Citadel)," by Maj. G. H. Osterhout, Jr., in the NATIONAL GEOGRAPHIC MAGAZINE for December, 1920.



Photograph by Albert K. Dawson

THE OLD MARCHÉ EN HAUT, OR "HIGH MARKET," OF PORT-AU-PRINCE IS NOW ABANDONED

Such open squares form market places in all Haitian towns and cities. Wares for sale and barter are laid in little piles, sometimes on straw mats, more often in baskets or on the bare ground. The two most prominent market squares in Port-au-Prince now are the Low Market and Iron Market (see Plate VI), which do business daily. Some wooden houses in the background are built on masonry foundations, remains of French colonial architecture.

and mortar and perform more work in a few hours than the best of his subjects could do in a full day. Always the king drove his workmen. Twenty thousand, it is said, died of hardship and exhaustion, but the king sent his overseers for fresh drafts of peasants and the work continued without pause.

SANS SOUCI, WHERE CHRISTOPHE HELD HIS COURT

Our car crossed a tiny stream and ran through the streets of a squalid native town, Milot. Here had been Sans Souci, the palace where King Henry held his court and where his queen and royal family had their residence. Lake announced that we had finished our journey by automobile and would make the rest of the trip on horseback.

We mounted and trotted off to have a look at Sans Souci before beginning the climb to the Citadel itself. The ruins of the palace and its grounds occupy a pleasant valley about ten acres in extent at the foot of the Bishop's Bonnet. As in the case of the Citadel, the palace was built in emulation of similar structures in Europe of which the king had heard. Christophe, it seemed, had many palaces, all fine.

One day it came to his ears that in Prussia was a much finer palace than any of his, and that it was known as Sans Souci. He resolved to build one of the same name

Photograph by Clifton Adams

CARGOES OF HAITIAN CALABASHES LOOK LIKE TOY BALLOONS

These big gourds, of cannonball size, are borne to market from the hills near Bizoton. The skinny horse walks along the track of the railroad that connects Port-au-Prince with Léogane.

that should be bigger and finer (see illustration, page 477).

He employed women and old men who could not stand the tremendous exertion of carrying building material up to the Citadel. Of these, corvées of 5,000 at a time were used. The building was begun in 1811 and finished the following year.

All of the little valley in which the palace was situated was paved with marble tiles and squares brought from France as ballast in the king's coffee ships. Shrubbery imported from the tropical countries of the world lined its walks and gardens. Cool mountain streams were directed through marble pools and channels.

THE DUKE OF MARMELADE

There were suites within the palace for the ministers of state, for the officers of the palace guard, for the members of the royal family, and for the nobles of the kingdom. A nobility was another of the institutions which the king had created to place his realm on a footing of equality with those of European sovereigns. Among the nobility were the unforgettable Count of Limonade and Duke of Marmelade.

Costly works of art and French mirrors lined the walls of the corridors of the palace, and the Throne Room shone with a magnificence of gold and silver bullion that fairly dazzled all beholders. Appended to the palace was a magnificent royal chapel, a state theater, and barracks for the royal guards; not far away was the arsenal which the king had created for manufacturing and storing powder and shell.

Nearly all of this had vanished in our time. In accounting for the rapid disappearance, local tradition says that the upper stories of the palace and other buildings were of costly wood, and were burned when Sans Souci was sacked after the king's death (see illustration, page 442).

We remounted our horses for the long climb up to the Citadel itself. The trail followed a well-defined zigzag up the side of the precipitous mountain. Once this zigzag had served as the bed of a paved and graded road on which two carriages of state could pass abreast. Vegetation, mountain storms, and a hundred years of neglect had done their work, however. Of the magnificent road, little trace remained except the contour of the grade that had once served as its

Photograph by Clifton Adams

HAITI HAS ITS "HORSEBACK FARMER" WATCHING FIELD HANDS AT WORK

Cotton grows high and is not cut back; much grows wild. This field, being picked, belongs to the experimental farm of Haiti's agricultural school, near Port-au-Prince (see page 462).

bed. Only here and there, where a recent storm had cut deeply into the soft earth, could be seen the huge flagstones and paving blocks of the old Royal Road.

Up a path just wide enough for their feet, our horses toiled and labored. Mile after mile it mounted precipitously into the air. Larger and larger loomed the Citadel.

At last, rounding a final turn, we came under its frowning walls, and after a scramble up a steep slope passed inside through a narrow gateway.

THE CITADEL HOUSED 10,000 TROOPS

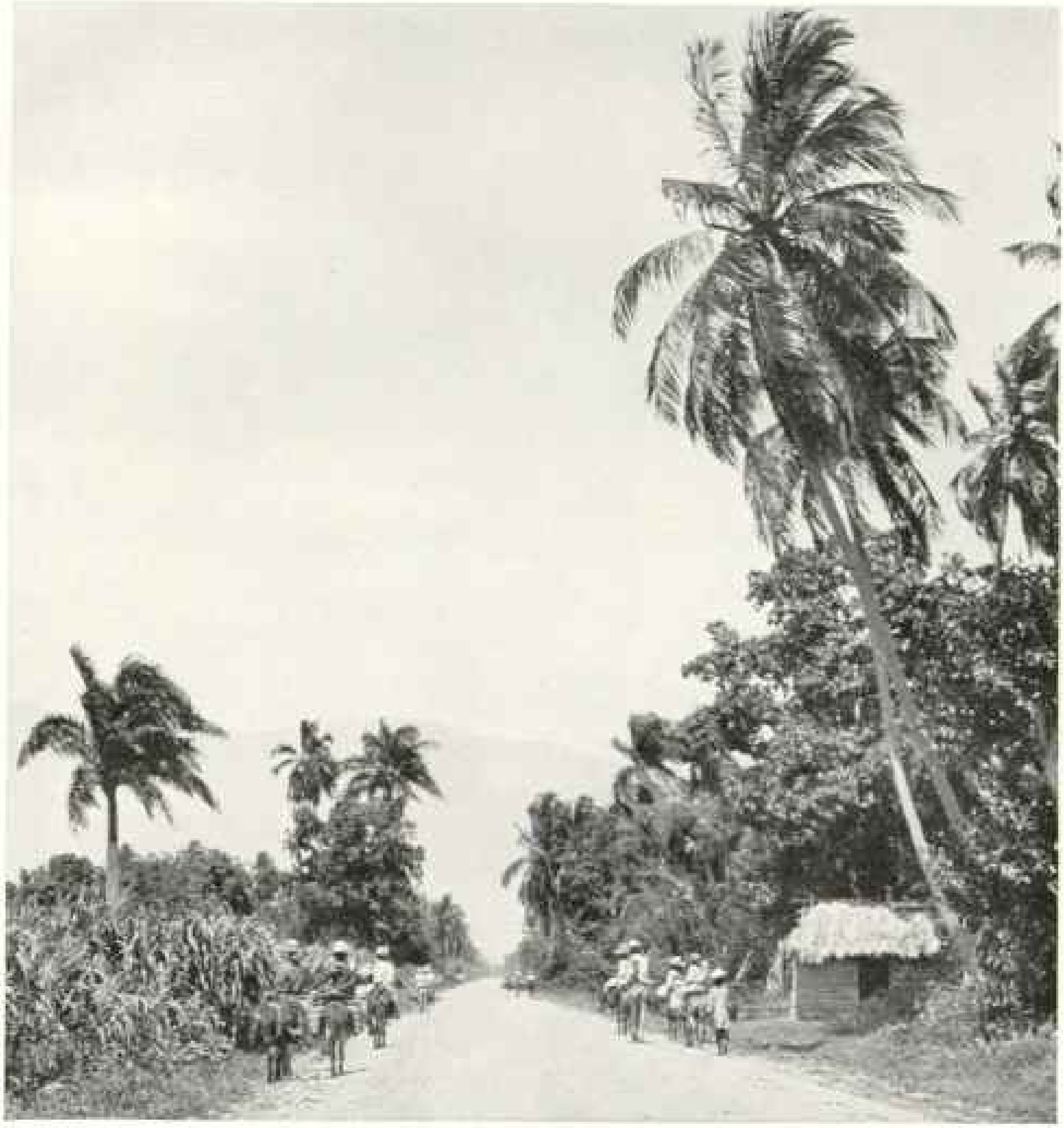
Inside the rectangular courtyard, or Place d'Armes, the Citadel seemed more huge than ever. Lake told me that it was begun in 1804 and was still not complete at the king's death, in 1820. The work was carried forward under the supervision of three captive French engineers, one of whom, La Ferrière, gave it the name by which it is often called, "La Citadelle La Ferrière."

Inside the Citadel were an arsenal, storehouses for supplies, and barracks that could accommodate 10,000 troops, as well as a small palace. There were stationed the best trained soldiery of the kingdom. The sides of the hill on which the fortress was built were smoothed away so that they could be commanded in all directions by artillery fire. Batteries of the heaviest cannon of Christophe's day were installed in casemates commanding all approaches. They are still in position to-day (see page 485).

It seems difficult to believe that these huge guns could be dragged to the summit of the Bishop's Bonnet by manpower alone. A typical story of King Henry explains how this was accomplished. Christophe had assigned a hundred men the task of transporting one of these monster cannon up the zigzag roadway in a working day. At noon, while inspecting the work, he noted that they had made little progress.

A delegation waited on the king. "Sire," said their spokesman, "the task you have given us is beyond our strength. We cannot possibly move this heavy cannon the distance you have required of us."

"That is too bad," replied the king. "I am very sorry. What I have to do grieves me immensely, but the king's word is sacred. I have said that you must take this gun to the top of the mountain and I am sure you can do so. If you do not think so, I must



Photograph by Ernest G. Holt

HAITI'S BUSIEST ROAD RUNS FROM PORT-AU-PRINCE TO CAP HAITIEN

First built by the French in colonial times, largely for military use, this 185-mile stretch was improved and modernized after the American occupation. In generations past, millions of blacks have walked its length, which echoes now to the rumble of crowded motorbusses. In all, Haiti enjoys about 1,200 miles of improved highways. The hut at the right is typical of the countryside.

find some way to stimulate you. I think I can find a way."

Saying this, the king ordered his executioners to select 50 of the 100 men and put them to death. The remaining 50 took the cannon to the top of the mountain and placed it in position well ahead of the scheduled time.

SOLDIERS ORDERED TO MARCH OFF CLIFF

On the cleared slopes of the hill the king ordered to be planted yams, bananas, plantains, and other food-producing plants in large quantities, enough to feed the men of his garrison. All of the roofs of the building and its appendages were made watertight and fed a system of cisterns. Providing the usual amount of rain fell, the garrison of the Citadel would never be short of water.

The wall of the castle flanking the space used as a drill ground is a continuation of a sheer cliff. Here the vertical drop is more than 200 feet. Legend says that Christophe,

having heard of the iron discipline of the Prussian soldiers of Frederick the Great, resolved to drill regiments of Haitian soldiers that would outdo those famous grenadiers. When he had trained a regiment to his liking, he would form it facing this 200-foot drop and give the command "Forward March!" If they were properly disciplined, according to the king's idea, the soldiers would march off into space, file after file, until they received the command to halt from the royal lips.

Should any soldiers fail to march off the cliff at his command, Christophe had ways of making them wish they had done so.

HIS MAJESTY'S MOUNTAIN REVELS

Lake led me to the south wall and pointed out some scarcely discernible heaps of crumbling stones several miles distant—the remains of two other palaces, Ramier and Bellevue, respectively. They were small palaces used by the king in his lighter moments. In them were assembled the best wines and liquors, the best cooks at his command, and the most beautiful women of his kingdom. Here he went frequently for extended revels, taking with him the favorite noblemen of the court and occasionally some foreign visitor.

So much has been written and related of the savage, sensational side of Christophe's character that the world is in danger of losing sight of another aspect. He was arbitrary, harsh, and ruthless, of course; but for all that, he was inspired by an ideal, that of building the feeble, ignorant people into a powerful, enlightened state. To attain this end he was willing to make any sacrifice himself or impose any hardship, however savage, upon his people.

Into this task he threw himself with ferocious energy, and the list of his accomplishments reads like a fairy tale. His country must be well armed, powerful. He built the Citadel and other impregnable fortresses. He trained an army which was pronounced the most powerful in the Western Hemisphere. His country must be rich.

He decreed that every one of his subjects must work so many hours a day. He regulated by law just what each must do, and what must be produced. No man must work too long or produce goods likely to leave a surplus on the marts of the kingdom. His was an early parallel of the present-day American idea of planned production.

He instituted a currency that was an example of stability for its day. The unit, a round silver piece about the size of an American dollar, was called the "gourde."

From the earliest days all the countries of the Caribbean, including Haiti, used the Spanish dollar, or *peso*. About the middle of the 16th century the Spanish ran short of silver and so debased their dollars that they were mostly lead, and hence practically valueless. Then vast quantities of silver came from Mexico and Peru, and the Dons reformed their currency. To distinguish the good new dollars from the worthless old ones, the Spanish mints marked each of them with the words "peso—gordo." Gordo is an adjective and means solid, substantial.

In Haiti the natives knew that the new dollars were good dollars, but they did not know what the words stamped on them meant. The Spanish words sounded harsh to their ears; so, in referring to the coins, they frenchified peso—gordo into "piastre-gourde." Later they dropped the piastre from the hyphenated combination, and when the first silver Haitian coins were minted they were inscribed simply as "gourdes," which they have remained ever since.

CHRISTOPHE'S GOLDEN BULLET

Last place of all to which my guide conducted me was a ramshackle lime and plaster structure in the center of the main courtyard of the Citadel. It looked much like a dog-house, but the roof had fallen in and the sides were cracked.

"Christophe's tomb," said Lake.

In 1820, after 14 years of despotic power, Fate overtook King Henry at divine services. Stricken with paralysis, his giant body was cold and dead from the waist down. Revolution broke out. Day by day the paralysis crept upward and the rebels gained ground. At last, realizing the game was up, the crippled monarch caused himself to be attired in his robes of state and placed on his royal throne. There he said farewell to his family and loyal friends.

Then, as the sun was setting, he blew out his brains with a golden bullet he had long carried, believing that it alone had power to cause his death (see page 442).

As we inspected the tomb, a group of peasants approached. "Pilgrims," said Lake.

"If half the stories of how Christophe dealt with his subjects are true," I replied,

Photograph by Clifton Adams

NEAR CROIX DES BOUQUETS A PEASANT BUILT THIS HOUSE OF MUD WALLS AND THATCHED ROOF

In Haiti there is practically no middle class, and this native dwelling is superior to the average countryman's home. Around even the most humble home, however, flowers are often planted.

"I should think they would hate his memory and want to forget him."

"You'd be wrong," my guide replied. "In the north, here, he is regarded as the greatest Haitian who ever lived. He made himself feared and respected by the European powers. He made it possible while he lived for the Haitians to be proud of their country and race. For that they are willing to forgive a great deal."

ASSIGNED TO THE HAITIAN GENDARMERIE

Once again Fate turned up the cards that sent me to Haiti in 1925, this time as an officer in the Gendarmerie d'Haiti, the native constabulary, trained and commanded by U. S. Marines. This was a force of romance. It was made up of black troopers under white officers and was a sort of police unit rather than a real army. I was to hold a commission under the Haitian flag for three years as a member of this force.

I was assigned to command a district on the central plain, with headquarters at the village of Hinche, about 80 miles from Port-au-Prince, in almost the geographic center of Haiti. The district of which it was the capital was about the size of that portion of New Jersey south of Atlantic City, and had a population estimated at a quarter of a million Negroes so black that the darkest resident of Harlem's black belt would be suspected there of being a white man.

Some of the primitive beings there, I was told, had heads shaped like peanuts and shuffled on the sides of their feet in lieu of walking. To police this area I was to have a company of about 200 black troopers, officered by four lieutenants.

Long before dawn I cranked up my small car and set out for Hinche to take over my first command.

In the car beside me was Destiné, my new "Number One Boy" and my first venture in black ivory. Destiné was a wonderful type of tropical servant, the sort who make the White Man's Burden bearable down near the Equator. He was short, slim, jet-black, with a nose like a squashed tomato and lips so thick they gave him the appearance of having a bill like a duck. He did not look quick-witted or intelligent, but appearances in Destiné's case were deceptive. His father had been a Jamaican and he

Photograph by Clifton Adams

SUCH WOODEN HOUSES, FACED WITH FANCY WOODWORK, ARE COMMON IN PORT-AU-PRINCE

Fruit trees grow about the house and a fence guards against stray pigs, chickens, and unwelcome guests; otherwise, country visitors would calmly enter and take a nap under the trees.

could stretch a broad A and drop an H as well as any cockney living, besides reading and writing English and speaking all known varieties of Haitian dialects.

My good angel must have sent Destiné to annex me. He appeared one morning and announced, "I have come, sah, to be your butler, sah." Every *blanc* had a butler, Destiné informed me. I hadn't realized this, but it seemed reasonable, and as Destiné considered the matter settled, I took him on at the princely wage of six dollars a month and found.

CLIMBING STEEP MOUNTAIN GRADES

Our motor hummed along steadily between fields of rustling cane. For 15 miles the road followed easy curves almost at water level toward the mighty central massif of mountain ranges that divides Haiti from the Dominican Republic border to the sea. Then the ascent commenced. In the next mile we must have climbed several hundred feet (see map, page 439).

Now the peaks of the central range, jagged and precipitous, towered almost over our heads, some of them reaching more than 5,000 feet into the air. The wall in front seemed impenetrable. Just as it appeared that we were about to crash into the vertical cliff, a crevice revealed itself and the road oozed to the left down a canyon hitherto invisible, which led out onto the side of the mighty mountain known to the Haitians as Morne à Cabrit, or Goat Mountain.

Up the south face of this mass of rock that rears its head more than 3,500 feet above the plain, the road zigzagged its tortuous way. Two thousand, three thousand feet, we crawled and wriggled back and forth along the precipitous face of the mountain on the road carved like a shelf into the face of the cliff. Everywhere the rock dropped almost perpendicularly from the outside edge of the road hundreds, sometimes thousands, of feet.

At our feet lay the southern plain of Haiti, the Cul de Sac, one of the country's agricultural treasure houses. Thirty miles away across the shimmering flat lay Port-au-Prince, a city of doll houses. Far and near lay habitations, canefields, towns, and villages.

For the last time our car crawled up an almost perpendicular grade to reach the top of the pass, 4,000 feet above the sea.

Then we dropped down over a road that had much the contour of an old-fashioned roller coaster through a maze of valleys and peaks, coming out eventually a dozen miles beyond the high point on the central plateau of Haiti near the old frontier town of Mirebalais.

This central plain, or *savane*, stretches more than 50 miles from north to south and varies from 10 to 30 miles across. In the rainy season it is covered with tall Congo grass, which turns to tinder in the arid months and is swept by searing prairie fires.

By the wells and watercourses the natives lived in wretched clusters of huts, their existence one of poverty and misery. In the winter they were likely to be rained out and in the summer it was more than probable that their poor huts would be destroyed by fire. In the old days they avenged themselves on society by providing savage warriors for the bands of cacos which ravaged the land for so many years, but since the arrival of the American Marines even this consolation has been denied them.

TRAPPED BY A RIVER FLOOD

When our car came down out of the mountains at Mirebalais, Destiné and I thought that the remainder of our journey would prove uneventful. We were wrong. In Haiti the unexpected always happens. A gendarme officer at Mirebalais told us that there was a bad river on our trail, the Peligre. It was one of a total of 42 rivers and streams which we must cross, all of them by fords. It was the rainy season and the rain was due at about 1 o'clock.

We arrived at the river well before 1 o'clock; got nearly across; then our car stuck. Destiné was all upset. The flood was almost due. The sun was shining brightly, and it was difficult for me to believe that a flood was in prospect.

"You don't know these rivers, sah," said Destiné. It was the rain that fell in the mountains, he continued, that produced the floods.

Meantime a couple dozen Haitian peasants had waded into the river and stood around our car: the towing crew, it developed—another custom of the country. These men lived on the banks of the stream near the ford and waited for cars to get stuck. Then they would make big wages pulling the stranded automobiles to the bank and safety. Sometimes each made as much as ten cents gold a week.

The head "boy" of the towing crew was a dignified old citizen with woolly white side whiskers. He bargained with Destiné in a series of sneezes, coughs, and grunts. Bargaining finished, our towing crew hitched a couple of lengths of stout grass rope to the front springs of our car, the boss boy commanded "Allez vite!" and in a jiffy we were high up on the far bank of the stream.

Just in time, too! As I was mopping some of the water off my motor there came a sound like the rumbling of an earthquake. Suddenly, half a mile up the canyon of the stream, a wall of water 10 feet from base to crest burst into view, sweeping down the valley with express-train speed, bearing trees, animals, wreckage of all description in its resistless course. My watch said 1:15. The flood wasn't quite on time, luckily for us. We reached Hinche just before sunset.

My district stretched about 50 miles north and south from Hinche and perhaps 30 miles east and west. There were four good-sized villages besides Hinche itself, but the greater part of its teeming population lived in thatched huts hidden by the high grass, wherever they could find a stream or a spring to afford a water supply.

Enforcing the law was somewhat complicated. The laws were French. They were well enough known in the seacoast towns, but few of the natives of the back districts had ever heard of any law less primitive than that of the club and the knife. Education for them was a minus quantity. In all my district the men and women who could read and write might be counted on the fingers of my two hands.

A LESSON IN POVERTY

The natives' lack of material wealth was almost beyond the comprehension of the inhabitant of a modern, civilized community. To them an empty tin can was a rare treasure and an empty flour sack a rich find. Before I had been long in the district, I had a lesson in their poverty.

One morning in the dry season the fire alarm sounded. A grass-thatched hut in the village blazed and crackled while its owner and his family crouched near by in apathetic grief. Soon the hut was totally consumed.

Next morning among the reports on my desk was one which read: "Fire discovered

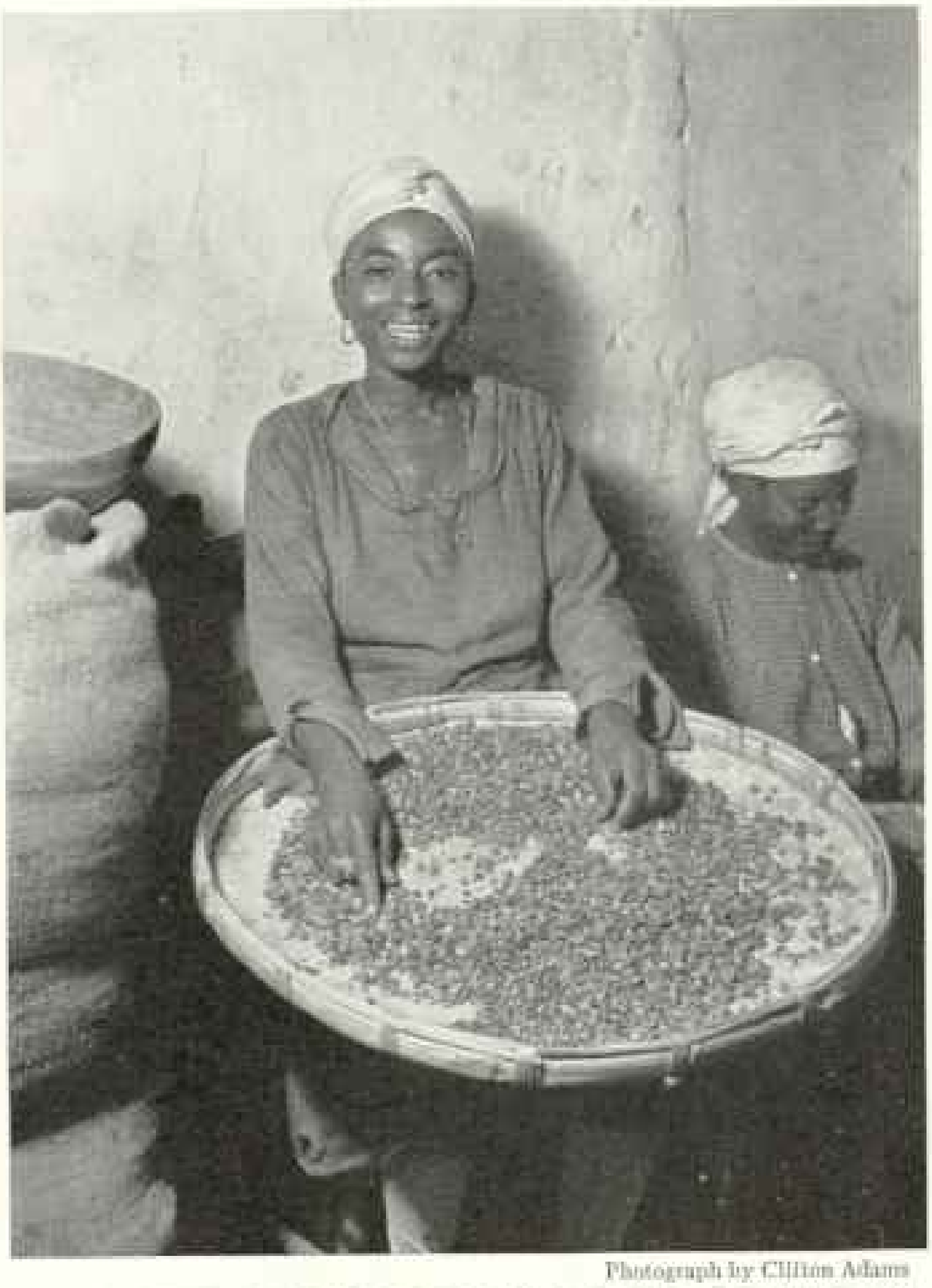
10 a. m. yesterday. House of Jean Bonhomme totally destroyed. Loss, $1.25." At first I thought the clerk had misplaced his decimal point, but the report proved correct.

Here is how the figure was arrived at: The cost of the hut was all labor cost, building material being obtainable free from the nearest mud bank or brush thicket. It took about six days' labor to build the house, labor in the Hinche district being priced at 15 cents a day. This brought the total to 90 cents. The remaining 35 cents was made up of furniture, household goods, and personal property.

Sorry for the family's loss, I had the peasant call and presented him with all my loose change, amounting to about $1.50 American. He was overcome by the munificence of the gift and salaamed to the dust. Later, I heard that he bought himself quite a country estate with his new wealth.

One day a local wizard put a *wanga* on me. Wanga is an African word and means a voodoo spell. There are good and bad wangas and wangas to produce all imaginable results. Every white man and every native have wangas put on them from time to time. Natives take them seriously, but whites pay little attention to them. But there are cases on record of misfortunes following in strange series on the trails of those on whom a deadly wanga has been placed.

My wanga was a horse spell. It consisted of a plait of braided horsehair woven in curious fashion around a bit of leather cut from my stirrup strap. Strangely enough, shortly after I noticed the wanga, a horse ran away and my saddle turned over.



Photograph by Clifton Adams

GREEN COFFEE BERRIES ARE SPREAD ON FLAT PANNIERS AND DEFTLY SORTED BY SINGING NATIVES

Trained women and girls work in groups; some sit under sheds, some out in the open, and all do piecework. Often they sing what they call "meringues," which are extemporaneously intoned by a leader. When a stranger stops to watch them work, they immediately begin to sing about him, usually enjoying a laugh at his expense.

The voodoo was one of the outstanding facts in life in the Hinche district. The drums were never silent.

Despite its bizarre aspects, my life in Hinche comprised many pleasant features. When I met the natives on the trail, the men would touch their hats and the women would bow. Then they would say: "Bonjour, Papa Blanc." I always took pains to salute gravely in return and say: "Bonjour, mon fils," or "Bonjour, ma fille," as the case might be.

Photograph by Elizabeth R. Hibbs

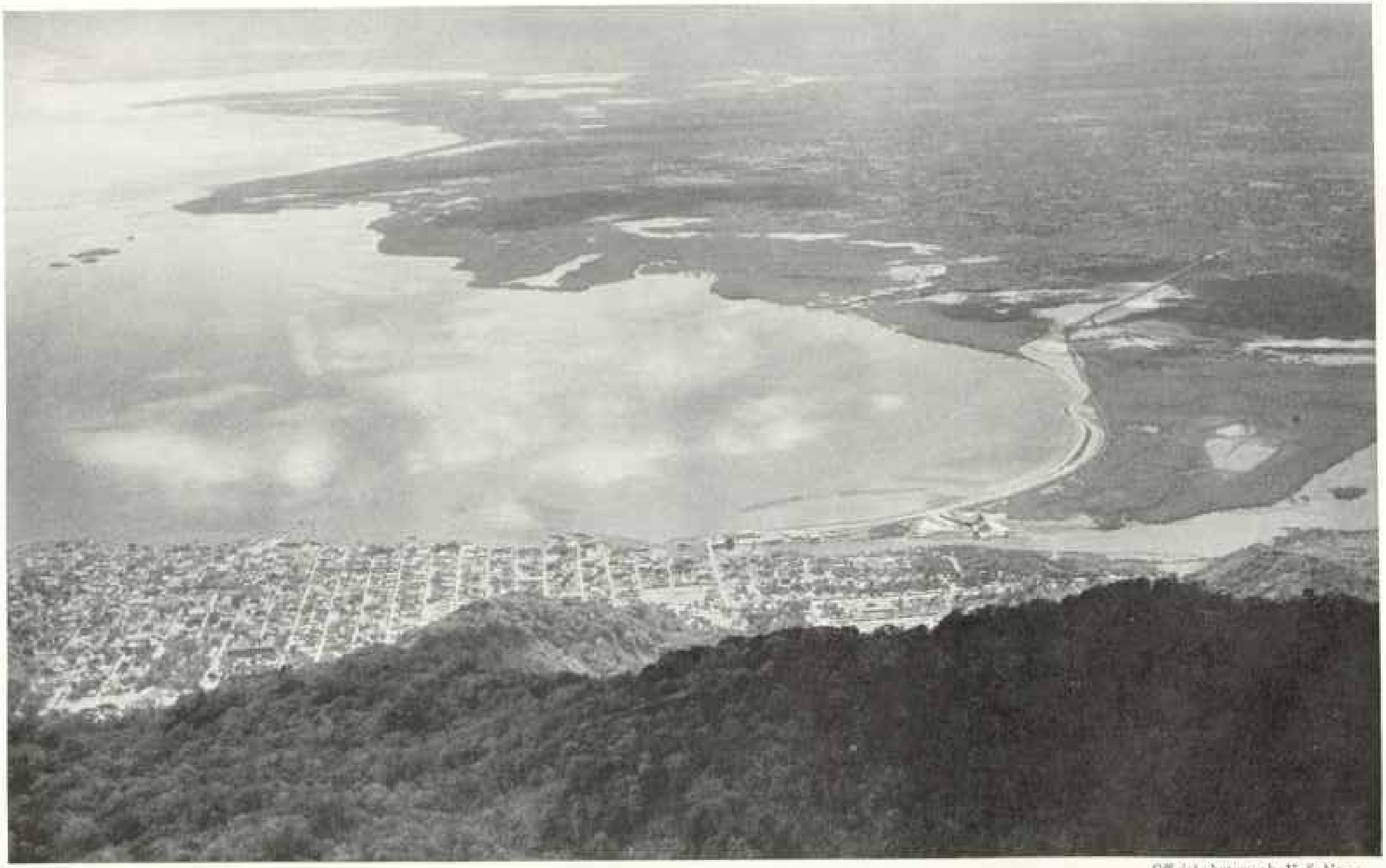
LIFE IS JUST A MERRY-GO-ROUND FOR THE BOY ON THE CIRCLING POLE

Whip in one hand, cigarette or banana in the other, he shouts at the plodding ponies, while a primitive mill squeezes the juicy cane. In the background, juice boils to molasses, is skimmed, and boiled again for making brown sugar and rum. Refined sugar can be made only in the larger mills.

Photograph by Clifton Adams

WHO HAS A STRING? OR A ROPE? HOW ENDLESS IS MAN'S QUEST FOR SIMPLE THINGS!

Miles of stout, clean agave fiber, known to the trade as sisal, stripped and hung to dry before shipment from Haiti for manufacture into commercial cordage. In Yucatán, henequin, of the agave family, supplies much of the sisal that is made into twine and used to bind the United States wheat crop (see page 459).



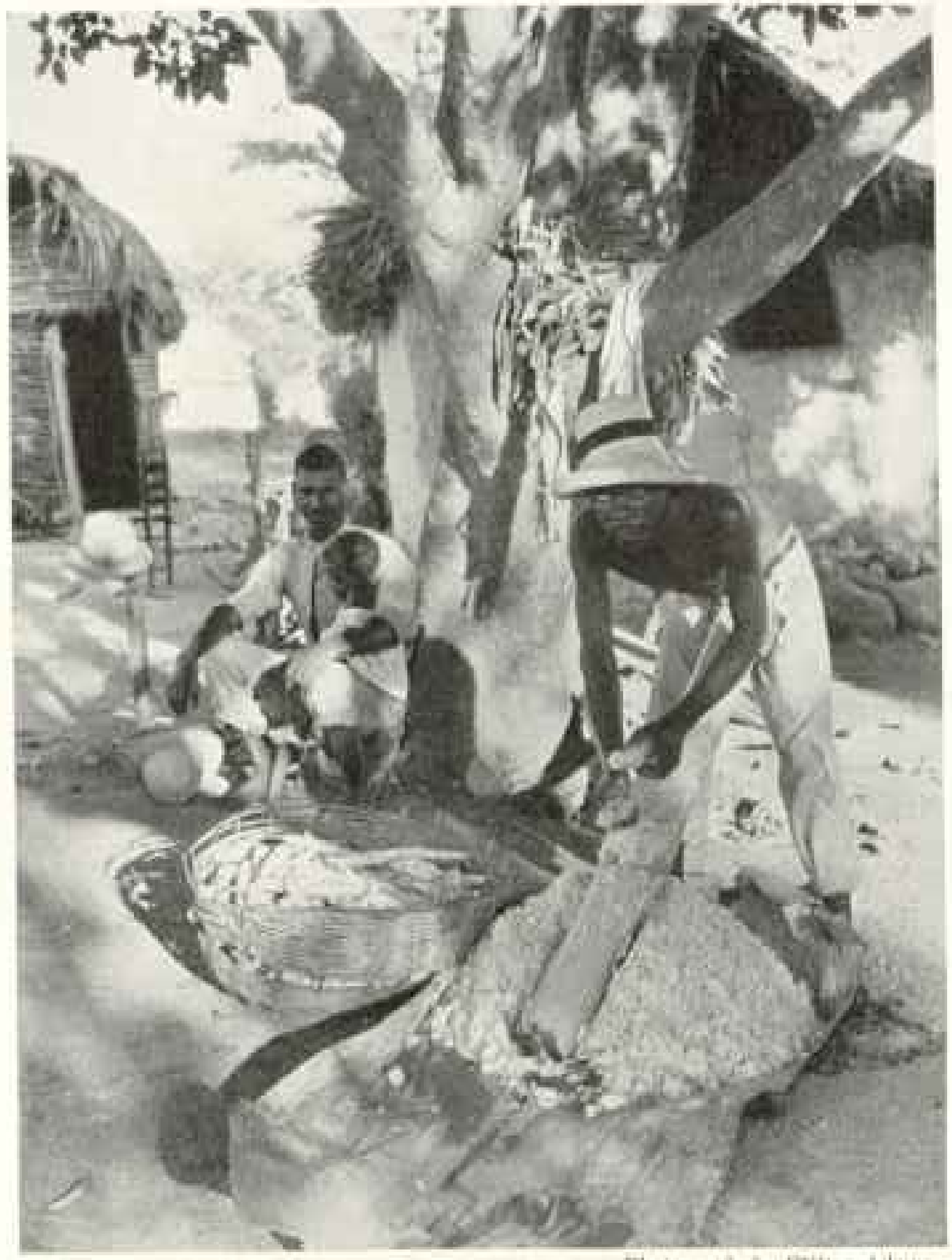
Official photograph, U. S. Navy

LOOKING UP THE COAST OVER CAP HAITIEN, CAPITAL OF THE ISLAND WHEN IT WAS A FRENCH COLONY

Until the French Revolution, Cap Haitien was accounted one of the most prosperous ports in the Western Hemisphere. Here General Leclerc landed with his army, to find yellow fever the chief enemy. To-day, with some 14,000 inhabitants, the city, sanitary and healthful, still trades in sugar, logwood, sisal, and pineapples (see text, page 454).

WHERE CASH IS SCARCE AND LABOR SO CHEAP, WHY BUY RICE MILLS?

Just lift the blunt stick and let it fall into the mortar hewn from a log. That hulls the rice. Winnow it then by shaking the pannier in the breeze, which blows all chaff away. Then pour the clean grain into the old oil can, and threshing is over—a process as old as rice growing.



Photographs by Clifton Adams

NATURE FURNISHES MUCH WILD FOOD, BUT THE HAITIAN MUST WORK TO PROCESS SOME OF IT

This man is grating manioc root to make cassava flour. In the basket are manioc roots, shaped like long, slim sweet potatoes. Besides being used in making bread, the cassava flour is also converted into starch and serves for laundering white clothes.

Then there were my prisoner "house boys," from the local penitentiary. They cleaned up the public grounds and property around my house; also they loved to squat in my back yard and converse, in between begging scraps from Destiné's kitchen. Nobody guarded them; there was no need. Prisoners in Hinche didn't want to run away from jail; they wanted to stay where they were well off. I formed the habit of sitting for a while each day, after lunch, under a big tree to listen to them. They held great councils, mostly, I imagine, for my benefit. Destiné used to stand behind my chair and give me a free translation of what went on.

JAIL POPULAR WITH THE NATIVES

The head "boy" of the group was a white-haired patriarch named Ali. In the pre-American days he was a caco chief. I earned his undying gratitude by keeping him from being put out of jail. Prior to the arrival of the Americans there had been no jail, and when the first penitentiary was opened there was considerable local prejudice against sojourning there.

Later this changed. It was found that the whites didn't do anything terrible to the prisoners. In fact, they did nothing at all except give them three square meals a day and a clean, comfortable straw mat on which to sleep under a rainproof roof. The natives thought all whites were crazy. This was regarded as convincing proof. Soon the peasants became convinced that life in jail was much more comfortable and desirable than freedom, and eventually the penitentiary acquired a waiting list.

The trouble with Ali was that his sentence had expired. He didn't understand this. The gap between his comprehension and my ability to explain was so wide that I never succeeded in making it clear to him. He only knew that in the beginning he hadn't wanted to go to jail, but the gendarmes had brought him there by force.

Now that he was really beginning to like the place, they wanted to throw him out. I fixed the matter up by getting his sentence extended as a special favor.

One day word came to me that the period of my tour of duty at Hinche had expired, and I was summoned to Port-au-Prince for service in the metropolis.

The capital had undergone many changes since my first visit. More than a dozen years had elapsed, and the American Marines had been in control for ten of them. There had been no revolutions, no riots, no fires of any consequence. U. S. Navy doctors had effected startling changes in the health of the city. Epidemic diseases had been stamped out. A germ-free water supply had been provided. It was said that even malaria, the ever-present scourge of the Tropics, had been banished from the city limits.

American Navy engineers had remodeled the city. Public parks had been cleaned up and beautified. An elaborate program of public works had studded the streets of the official section of the town with gleaming white public buildings. Swamps had been drained and filled in, sewage disposed of in a sanitary manner.

Taking advantage of the new security to provide residences for the officers of the Occupation and those of the Marine Brigade, local capitalists had engineered a building boom. The fashionable residence sections of Bois Verna and Turgeau, on the hills above the lower town, had multiplied in extent.

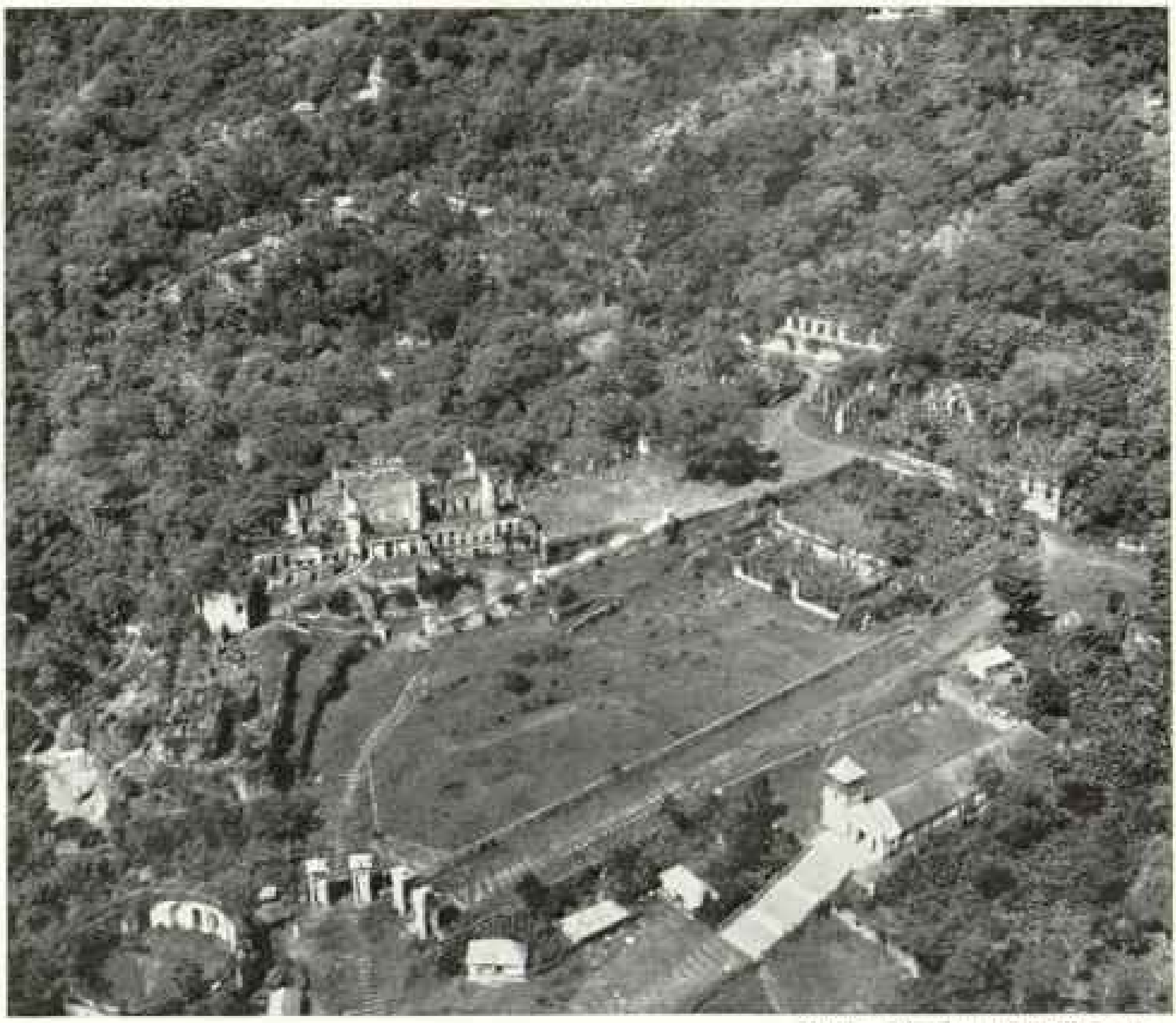
It was computed that the Occupation brought more than a million American dollars to be spent in Haiti each year, and a large portion of it found its way into the pockets of landlords and tradesmen of the capital city. The city showed the effect of this stream of alien gold. It was a tropical Spotless Town.

In due time I arrived in Port-au-Prince and found a home, a lovely villa outside the business section of the city, in the hills to the south. It had been the seat of a French colonial family and was still known to the natives by their name, as the Habitation Martissant.

The house was a two-story wooden structure, raised on the foundations of the old colonial mansion. Its wide-spreading veranda overlooked the bay of Port-au-Prince from an altitude of some 600 feet, while its rear backed up against towering mountains which rose steeply almost from the garden wall.

In the daytime brisk sea breezes fanned its front, and at night cold air from the mountains rushed through its chambers and bedrooms, making a blanket necessary even in the hottest season.

From my front doorstep an avenue of gorgeous royal palms ran down a steep grade to the Bizoton Road, a quarter of a mile below. Oranges bloomed in the garden, mangoes came and went with the summer season, avocados flourished in profusion.



Photograph by Capt. Albert W. Stevens

LOFTY RUINS OF SANS SOUCI PALACE ATTEST THE VAULTING AMBITION OF AUDACIOUS CHRISTOPHE

Fantastic in his dreams of empire, the monarch amazed the world when at the zenith of his power he erected this architectural marvel high up in Haiti's mountain wilderness. Here he held his glittering court and other royal ceremonies in the large palace (left center). Circular ruins in the lower left corner are remains of the king's private theater. In the center area, "where once the garden smiled, still many a garden flower grows wild" (see text, page 463).

The hibiscus, poinsettia, and bougainvillea spread their luxuriance. A Haitian friend and I once counted more than 70 different varieties of tropical fruits, shrubs, and flowers. The Martissant family had been noted for their love of plants, and these were what remained of the paradise they had created here before the slave revolution.

It was pleasant to sit on the veranda in the afternoon, when the setting sun hung round and red over blue Gonâve Island, in the distance, and the city, like a map, lay unrolled at one's feet (see page 459).

A HAITIAN INAUGURAL, NEW STYLE

The town began at the edge of the sparkling waters of the bay. From above, it appeared somewhat the shape of a thick crescent moon with the concave side toward the sea. About the middle of the crescent the wharf jutted out like a thick cigar from the mouth of a man in the moon.

My first job in Port-au-Prince was to command the Caserne Dartiguenave, the barracks where was quartered the military garrison of the city. I had under my command about 300 gendarmes, organized into three companies. There was also a force of U. S. Marines stationed in the city, but it was not the policy to employ these in police work, and in my time their aid was never necessary.

An election was approaching. In the old days each election had been accompanied by a reign of terror. In my time no trouble was expected, but every provision was made

Photograph by Capt. Albert W. Stevens

HIGH ON THE RANGE (IN THE UPPER CENTER BACKGROUND) STANDS THE HISTORIC CITADEL OF CHRISTOPHE

With its thick walls, gun chambers, parapets, and dungeons, this giant isolated fortress is one of the most remarkable ruins in the Western World. It was built by the ex-slave waiter, Christophe, a Negro who was crowned king and diplomatically recognized by Europe. The vast structure is deserted now (see text, page 456, and Plates I and V).

Photograph by Clifton Adams

TOOTING AND THUMPING ON CRUDE INSTRUMENTS OF JUNGLE ORIGIN

Only native "music"—no tunes as we know them—is played on these bamboo horns. Drums of "voodoo" type are held between the knees and played by being beaten and rubbed with the hands. Before the girl on the right a male dancer will presently appear, holding a coin in his mouth. Unless he can give a satisfactory imitation of her dance, she takes the coin.

Photograph by Clifton Adams

SALT SCRAPED UP IN PILES WHERE SEA WATER HAS BEEN EVAPORATED

These ponds, at the mouth of the Artibonite River, and those near Fort Liberté and elsewhere, supply common salt to the people. Burros and boats carry it away in sacks and baskets.

to render disturbance impossible. Training schedules were prepared, all leave was canceled, and officers worked day and night to bring their commands to the highest possible state of proficiency. The election came and went with virtually no disorder.

About a month after the voting came the inauguration ceremonies. The world was treated to the spectacle of a Haitian president taking his seat in peace, at the legally appointed time, as the result of an election conducted in accordance with the laws of his country. This was in May, 1926. The like had happened only once before in history, in 1922, when Mr. Louis Borno succeeded Mr. Sudre Dartiguenave, first president under the American Occupation.

TAKING THE ARMY TO CHURCH

Both the incoming and the outgoing president were present on that occasion and both were alive and reasonably happy. Now Mr. Borno was succeeding himself legally and in peace, after a full and peaceful constitutional term.

My part in the ceremonies was not exciting, but interesting. I took the Army to church for the service held in honor of the occasion. This was a survival of an old custom. In former days Haitian presidents always took the army to church. When the ruler was at his devotions was a favorite time for adversaries to start a revolution. So it became the custom to keep the Army handy. Any president who failed to do so was likely to find that he was no longer president when he emerged from the doors of the sacred edifice.

Our battalion formed at the barracks and, headed by its flags and the palace band, marched to the Cathedral. This huge white structure, one of the most imposing buildings in the West Indies, faces toward the bay, and across its front is a wide concrete driveway from which half a dozen steps lead to a stately portico before the main entrance. A short distance away stands the famous Iron Market (see Color Plate VI) and around it is the heart of old Port-au-Prince.

We lined up our battalion of khaki-clad gendarmes facing the Cathedral. In their center were the National Colors with their color guard, and to the right the band, ready to render musical honors to the President and to visiting dignitaries.

Photograph by Clifton Adams

BAKING CASSAVA CAKES ON A PIECE OF SHEET IRON AT PÉTIONVILLE

First a manioc root is grated and all poison washed and squeezed out. Then the fine white flour is made into pancakes. Cassava forms a staple item in Haiti's diet.

Ornate equipages drove up. Dignitaries descended from them and made their way up the steps of the Cathedral. Other throngs of spectators arrived on foot. Droves of school children came, their stiffly starched white robes contrasting with their excited dusky faces. A troop of Haitian Boy Scouts arrived in khaki shorts.

The Cathedral began to fill up and the throngs, awaiting the arrival of the President, began to press against the ropes that separated the driveway from the spaces marked off for the public. At last came a rattle and a clatter of hoofs and a dozen aides-de-camp cantered up on horseback, escorting the presidential automobile.

Troopers took the horses and the aides climbed the steps to attend their chief. The car halted and the President descended. With measured tread he mounted the stone steps, faced about, and removed his hat. At the signal, the colors of my gendarme battalion, now directly in front of him, were raised in salute and the battalion presented arms. The band struck up the presidential march, followed immediately by the Haitian national anthem, "The Dessalinien."

As the last bar of the music died away came the deep boom of the first gun of a national salute. It was a striking ceremony.

As I stood rigidly, with my gleaming saber held at attention, I could not help thinking of other days. Now my dependable, American-trained battalion stood stolidly in immaculate lines, admired by well-dressed, prosperous-looking citizens, while the Chief of State safely went about his devotions.

Had anyone suggested to the participants that the soldiers might soon assassinate the President or begin to massacre the spectators, he would have been thought insane. It was different in the old days.

At the Fête Dieu, for example, May 28, 1891, when President Hippolyte was in church, a revolution broke out. Troops mutinied, and there was a bloody battle. But the President got the upper hand, and for hours led his regiments through the streets, shooting all he chanced to meet. A little park near the Palace was stacked with corpses piled like cordwood. I wondered if savage old Hippolyte could see us and note the changes time had wrought.

Then we took our troops home for lunch. Other festivities were scheduled for the afternoon.

GAYETY AT THE PALACE

The Presidential Palace stirred with animation, for this was a great day on its calendar. Its white bulk, silhouetted against the heaven-climbing mountains, made a lovely picture. Like most things in Port-au-Prince, the Palace is a copy of something French, the Petit Palais of the Champs Elysées being its model. It is one of the most impressive buildings in the West Indies, yet one is never able to repress a start at its Franco-Greek façade cast against palm-sprinkled hills, on which drums beat in perpetual staccato (see page 437).

Gay streamers of bunting decorated the front of the building. On a balcony the President and his Cabinet, with their ladies, were assembled. Other balconies and windows were crowded with guests.

A battalion of gendarmes, with their American officers, led by their band and colors, passed in formal review to do honor to the Chief of State and the Haitian flag, which flew at its masthead over his head.

On the Palace steps were gathered the officers of the President's Guard and his aides-de-camp in white uniforms. In former years these had been generals, some of the 1,200 of that rank in the country's army. Now, under sober American auspices, they were lieutenants, with a captain or two.

When the review was finished, the reception commenced.

In a spacious salon at the head of a marble staircase, President Borno stood to receive his guests. Sweeping windows opening on ample balconies dotted the walls of the chamber, admitting every vagrant breath of tropic air. Tapestries and hangings lent dignity and grace, and along the walls on every hand tables groaned with sandwiches, cakes, sweetmeats, and beverages for the refreshment of the hungry, thirsty, or convivial.

In a corner the champagne of France bubbled and sparkled. At an imitation American bar a white-coated and white-aproned servitor compounded cocktails. Another table was devoted to the rums of the country, famous since the days of the French colony. Here were no ordinary rums, but the celebrated beverages of Aux Cayes, Jérémie, and Anse-à-Veau. One, served in thimblelike glasses, was the famed Presidential Rum, said to be over 100 years old.

Slowly the guests arrived, filling the spacious chamber. Here were blond Americans in spotless white uniforms with gleaming gold buttons and ornaments. Here were phlegmatic Englishmen, excitable Frenchmen, traders of every nationality. Here were Haitian statesmen and diplomats of every shade and coloring, in frock coats, many of them with ribbons of the orders of many courts of Europe gleaming on their shirt fronts.

BEAUTIES OF EVERY TYPE AND COLOR

There were beautiful women, blond and golden, copper and ebony mingled together, clothed in the latest creations of Worth and Paquin, with masterpieces of jewelry from the shops of the Rue de la Paix gleaming on their persons. Here fair foreign women from the snows of the North mingled with the lively *filles de couleur* of the Indies, famed for beauty from time out of mind. Here griffe (black, with a small amount of white blood), quarteronne (quadroon), and métisse mingled with mulâtresse and marabout. Forms tall, erect, graceful; hands and feet long and shapely; faces about which a sculptor might dream.

A stately man in his middle fifties, Mr. Borno stood in the receiving line to welcome his guests. About middle height, with the face of a student, aquiline nose, and gray-brown eyes, he looked every inch a potentate, and might easily have been mistaken for an Italian or a native of the south of France. A celebrated international lawyer and an able statesman, Mr. Borno was an admirer of Mussolini and endeavored to adapt the Duce's doctrines, so far as was possible, to the needs of the Haitian State. This had advantages and defects. However that may be, he labored earnestly for the advancement of his country.

THE HAITIAN "NIGHT STICK"

As time went on, I was made Chief of Police of Port-au-Prince. Under my command were more than 200 gendarmes, selected for their intelligence and good records. Their duty was to maintain patrol systems and supervision within the city, much in the manner of police forces the world over. My policemen, being regularly enlisted gendarmes, had rifles and bayonets, but they did not carry them, except occasionally on parade. For police duty they

IN HAITI HE LAUGHS LAST WHOSE FIGHTING COCK WINS THE MONEY

Photographs by Clifton Adams

"I BET TEN GOURDES MY RED ONE WHIPS YOUR BLACK ONE!"

No metal spurs are used here. Native rooster-fighting fans file the cock's spurs sharp. Fowls that fall in battle are taken home and cooked. This Sunday morning cockpit scene was near the town of Thor.

went equipped with revolvers and *cocomacaques*.

The cocomacaque was a peculiarly Haitian institution. I met it when inspecting my first squad of policemen. The corporal carried what looked like an exaggerated walking stick. I examined it with respect. It seemed a fearful bludgeon, perhaps three feet long by two inches in diameter. Polished with oil until it took on the shine and color of ripe bananas, it was a beautiful thing. The wood seemed as hard as iron and was encircled by a succession of concentric rings, with a thick knot at the business end.

These clubs served the purpose of night sticks in American communities. I learned that the word meant "monkey coconut tree," and that the sticks were made from a species of dwarf coconut palm bearing coconuts the size of almonds.

The cocomacaque occupies a classic position in Haitian annals. Following the uprising of the slaves and the attainment of independence, it became unlawful to beat any Haitian with a whip or club, these being reminiscent of slavery.

But the new chiefs of the Haitian State felt it necessary to have something with which to inflict corporal punishment on their subjects; so Dessalines, the first emperor-president, discovered the cocomacaque. This, he decided, would inflict the maximum physical punishment with the minimum of indignity to the spirit of the new freemen.

THE AMERICAN OCCUPATION OF HAITI

As Chief of Police of Haiti's capital, I acquired functions in a number of fields of civil government and came much in contact with the remarkable organization which the United States had created under the designation of the American Occupation. The United States was endeavoring to do in Haiti something entirely new in the annals of the world. Other nations had annexed colonies, but here was a powerful nation occupying the territory of a small country by military force for the sole purpose of bringing to the weaker nation civilization and order, blessings which, in reality, Haiti would have been entirely content to get along without.

No precedents existed and the United States had evolved an organization by a series of steps as necessity arose. In the beginning there were errors; misunderstandings abounded on both sides. American authority was hopelessly divided among a number of coequal officials.

Matters came to a head after the so-called Caco Rebellion of 1919-20. A reorganization was imperative. Experts, including Dr. Carl Kelsey, of the University of Pennsylvania, visited Haiti. Brig. Gen. George Richards, Paymaster of the Marine Corps, at the instance of the United States State Department, made a study of the situation. A commission from the United States Senate conducted hearings in Port-au-Prince. As a result of recommendations, the machinery of the American Occupation was redesigned, with a High Commissioner, appointed by the President of the United States, as its supreme head. From his decision there was no appeal.

The first American High Commissioner was John H. Russell, then Brigadier General, now Commandant, of the Marine Corps. In addition to his military position he had the rank of Envoy Extraordinary and Minister Plenipotentiary. With this new organization under a unified control, a new phase of the march of Haiti toward modernity and civilization began. It is impossible to give to General Russell too much credit for his share in the work that followed. Under his administration, for the first time Haiti was given the benefit of intelligent, long-time planning in the development of her national affairs, and a government which could formulate progressive policies and execute them with untiring efficiency and rigorous probity.

Under General Russell were American treaty officials having to do with different departments of the public administration—Finance, Public Order, Public Works, Public Health, and the like. They remade the Haitian State from its foundations upward.

The Department of Finance in particular accomplished results far and away beyond what had been expected or hoped. Plunging into the obscure mazes of pre-American finances, the Yankee accountants ascertained for the first time in history just how much the Haitian Government owed, both to foreign creditors and to her own citizens.

Much of the Haitian debt was held in France. When the franc was at nearly its lowest ebb, the debt was refinanced with a loan from the United States, thus at a

Photograph by Clifton Adams

IDLE FOR A HUNDRED YEARS, THESE BIG GUNS TELL AN ELOQUENT STORY

They were dragged through steaming jungles and up steep, back-breaking slopes to Christophe's pretentious citadel. The toil of thousands who labored on the fort recalls that of other sweating hordes who were ruthlessly driven to build Egypt's Pyramids. On the chamber walls and on the cannons are inscriptions of French, Spanish, and English origin (see page 465 and Plate I).

stroke cutting nearly four-fifths from the indebtedness of the Nation. Modern revenue laws were designed. From being chronically bankrupt, the Haitian treasury showed a large surplus each year, despite heavy appropriations for public works.

Even to-day, after five years of depression, the Haitian Government is able to run on current income and has a credit balance in its treasury.

THE DAWN OF A NEW ERA

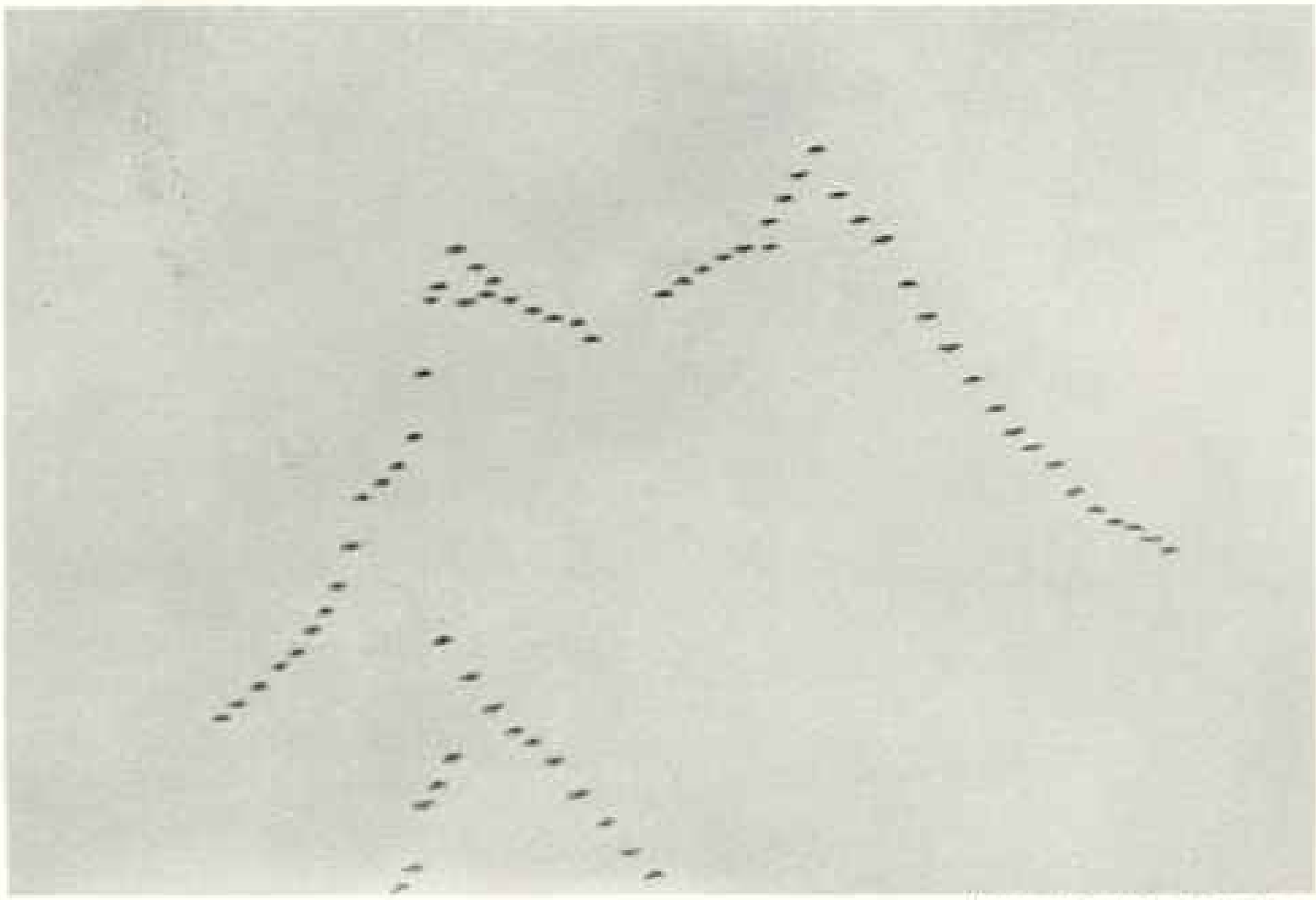
United States forces were to be withdrawn in October, 1934, and the administration of the Haitian Republic returned to native hands. Actually, the withdrawal has already taken place, many weeks in advance of the time set.

American forces first landed in Port-au-Prince in July, 1915. At the time of the withdrawal they had occupied the country for a trifle more than 19 years.

During that period their accomplishments in behalf of civilization and progress were little short of marvelous. They found the land in the Stone Age. They left it remarkably well abreast of the middle twentieth century.

The opinions or assertions contained in this article are the private ones of the writer and are not to be construed as official or reflecting the views of the Navy Department or the naval service at large.

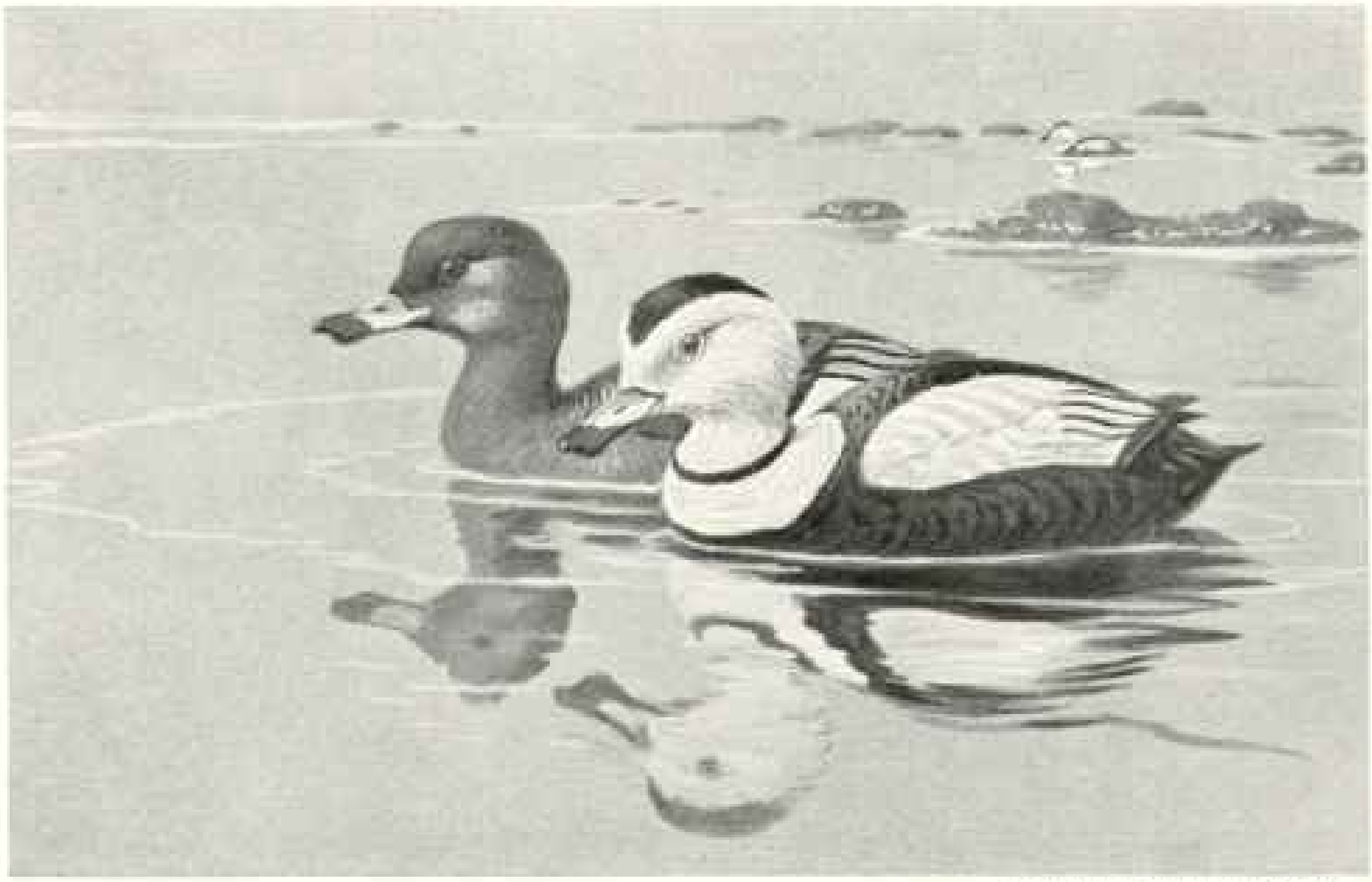
Notice of change of address of your NATIONAL GEOGRAPHIC MAGAZINE *should be received in the offices of the National Geographic Society by the first of the month to affect the following month's issue. For instance, if you desire the address changed for your December number, The Society should be notified of your new address not later than November first.*



Photograph by George Shiras, 3d

"DARK FLYING RUNE AGAINST THE WESTERN GLOW—"

By a strange, instinctive dead reckoning which has no need of map or compass, old ganders lead the long converging lines of the migrating "honkers," or Canada geese, here speeding over Michigan (see Color Plate II).



Drawing by Maj. Allan Brooks

WHY DID THEY VANISH FROM THE EARTH?

Mystery surrounds the extinction of the Labrador duck; the last one on record was killed near Long Island, New York, nearly 60 years ago (see text, page 491). To-day a few of the mild-looking little fellows may be seen—but stuffed and in museums.

FAR-FLYING WILD FOWL AND THEIR FOES*

By Major Allan Brooks

With Paintings from Life by the Author

"Dark flying rune against the western glow—
It tells the sweep and loneliness of things."

SO WROTE Pai Ta-shun (an American and not a Chinese) in the finest of all poems on wild fowl, and many others have drawn inspiration from the striking formations that especially characterize the movements of swans, geese, and ducks.

That flying wedge or undulating line etched against the sunset sky or the orderly, swift-moving formation high overhead! Here is the symbol that inspires the imagination of even the casual observer, as it has the poets who have written of flying wild fowl through the ages.

Behind this aura of glamour and mystery lies the fascinating life story of the majestic wild swans, the wily geese, the hardy and adaptable ducks, and the fish-loving mergansers, which, all together, form the suborder Anseres. They are a fairly compact and homogeneous group of birds, their only relatives of undoubted connection being the screamers of South America, large, goose-like, wading birds with unwebbed toes.

Geese and ducks are found all over the world wherever water exists, except on the oceans far from land.

Common to the order are a long neck, sometimes very long; short legs, webbed toes, and a bill covered with sensitive skin and provided inside with comblike structures known as *lamellae,* modified in the mergansers to sharp "teeth" for holding slippery fish.

The eggs are without markings, and the young, hatched covered with down, are able to find their own food very soon after they emerge from the egg.

The graceful, snow-white swans, sometimes five feet in length, make up the first of seven subfamilies into which are divided the North American members of the suborder. The other six are the geese, tree ducks, surface-feeding ducks, diving ducks, stiff-tailed ducks, and mergansers.

Much that has been written about swans has been influenced by their æsthetic appeal. This is apt to distort the facts to their advantage, and it is just as well, because no other birds can provide the thrill that a flock of wild swans gives the nature lover.

First in order and in size, they have a form too universally known to require description (see Plate I). The two North American species are so similar that they can be differentiated with certainty only by the character of their internal structure and by their very distinct voices.

SWANS ARE MODELS OF BEAUTY AND FIDELITY

Swans are perfect models of conjugal conduct. They mate for life and the sexes share the domestic responsibilities.

The downy young when first hatched are not the "ugly ducklings" of popular belief, but lovely little creatures, clothed in silky, golden down and without the exaggerated neck and huge paddlelike feet of their parents. Very soon, however, these characteristics begin to appear and ungainliness replaces their natal loveliness until the grace and beauty of maturity appear.

Fortunately, there is small if any possibility of the extermination of the whistling swan, and with careful conservation it may even be possible to perpetuate the trumpeter.

The goose family is well represented in North America, especially in the West, where in some localities six species may be seen on the same ground.

Their extraordinary migrations and the mystery of their breeding grounds intensify the interest that both sportsmen and naturalists take in these fine birds. Even yet, there are a few whose summer homes are unknown, while the systematic status of some of the races and their relation to each other have still to be worked out. Much study in the field, especially at their nesting grounds, is required to establish these facts.

Geese, like swans, pair for life, and the young birds remain in the company of their parents for nearly a year after they are hatched.

* This is the ninth article, illustrated by paintings by Maj. Allan Brooks, in the important GEOGRAPHIC series describing the bird families of the United States and Canada. A tenth article, with paintings in color by Major Brooks, will appear in an early number.

"DUCK HEAVEN" ON AN ARKANSAS ESTATE

Many thousands of ducks gather annually under the care and protection of George S. Wilcox on his property in the White River bottoms of Arkansas County, near Stuttgart. They are mostly mallards, with a sprinkling of pintails and green-winged teal (see Color Plates V and VII and illustration, page 491). The region is one of the foremost concentration areas for mallards in the world.

Endowed with keen intelligence and extreme wariness, they can be depended on to maintain a fair degree of abundance as long as adequate wintering grounds are afforded them. But, above all, they, like swans, require freedom from molestation when they are at rest, so that a large measure of solitude and wide spaces are the chief requirements for their perpetuation.

Both families have a lower rate of reproduction than ducks, as they require several years to attain maturity and the number of eggs laid is much smaller than with most species of ducks.

Whether by day or night, geese do a lot of calling while in flight; when migrating high overhead the clamor of their voices falling from the sky draws attention to the flock in arrowhead formation, cleaving the upper air (see illustration, page 486). Species can be identified by their different voices. When feeding they are silent, only gabbling a little to each other in low tones. The first appearance of danger will bring a warning challenge from the sentinel and every head is erected while the danger is scrutinized (see Color Plate II).

Both geese and swans are noted for their longevity, the latter being among the Methuselahs of the bird world.

There is actual record of a mute swan that lived 70 years, while rather uncertain report has attributed even a greater age to the birds.

Somewhat intermediate between ducks and geese are the tree ducks (see Plate XVI). They have only two representatives north of the Mexico-United States boundary, and neither of these penetrates much to the north of this line. Their name is misleading in our own territory, as here we seldom see them perching in trees and their nests are on the ground.

The great group of ducks is divided into two main sections, the surface-feeding and diving ducks. While these names actually

afford a general basis of distinction, it does not follow that surface-feeders never dive for their food, nor that diving ducks never feed on the surface.

To separate the groups, look at the foot. In the diving ducks, the hind toe has a lobe, so that it resembles a little paddle. In the surface-feeding group it is not particularly specialized (see illustration, p. 490).

If sportsmen wish to identify the ducks they shoot in all plumages, it is essential that they recognize the distinction between the two groups.

THE "HIND-TOE" FORMULA

By the "hind-toe" formula, stiff-tailed ducks fall under the category of diving ducks, but in many features of structure, plumage, and life characters they are further removed from true ducks than are the mergansers. The sometimes pugnacious and somewhat ludicrous-appearing ruddy duck is the sole representative of the stiff-tailed ducks in the United States and Canada, although a South American species, the masked duck, has been twice recorded in the Eastern States as a straggler.

Mergansers, the last of the duck group, are ducks with a narrow, specialized bill, edged with saw teeth, which enable them to catch and devour good-sized fish. Their feet, though proportionately smaller, resemble those of the diving ducks in having a paddle-shaped hind toe.

Ducks, for the most part, are very different from swans and geese in their family habits. While they pair much like other birds and are not as a rule polygamous or polyandrous, the male in most species is not a constant husband, and abandons the female and all family cares as soon as incubation of the eggs is well under way. Stiff-tailed ducks are notable exceptions to this rule, and in some true ducks, like the eiders, the male is not altogether indifferent to his family obligations.

Few ducks have striking voices. They are entirely different in the sexes, that of the male being often more musical than the female's, which varies from a quack to a croak in most of the species. Only one or two species may be called loquacious, the most notable being the old-squaw, which derives this name and many others from the syllabication of the musical call of the males, whose morning concert is one of the cheeriest sounds of the seashore.

The sexual difference in the voices has its origin in the very different patterns in the formation of the trachea. In some species this organ has a curious and elaborate sound box formed by an abrupt enlargement above the bronchial tubes in the male. There is a large variation of this character in different species.

The plumage of ducks is notable in the peculiar formation of some of their characteristic markings; many of these are repeated in several species, often in widely different genera. The white mark in front of the eye of the blue-winged teal is repeated in the harlequin and both species of golden-eyes (see Plates VIII and XI).

The transverse bands of black and white on the sides of the breast may be seen in the wood duck, green-winged teal, hooded merganser, and male harlequin (see Plates VII, XI, XV, and XVI). Indeed, the harlequin may be said to possess all the bizarre markings peculiar to the duck tribe on his own small body, including the white spot between the thighs and the base of the tail, which is found in one form or another in so many species.

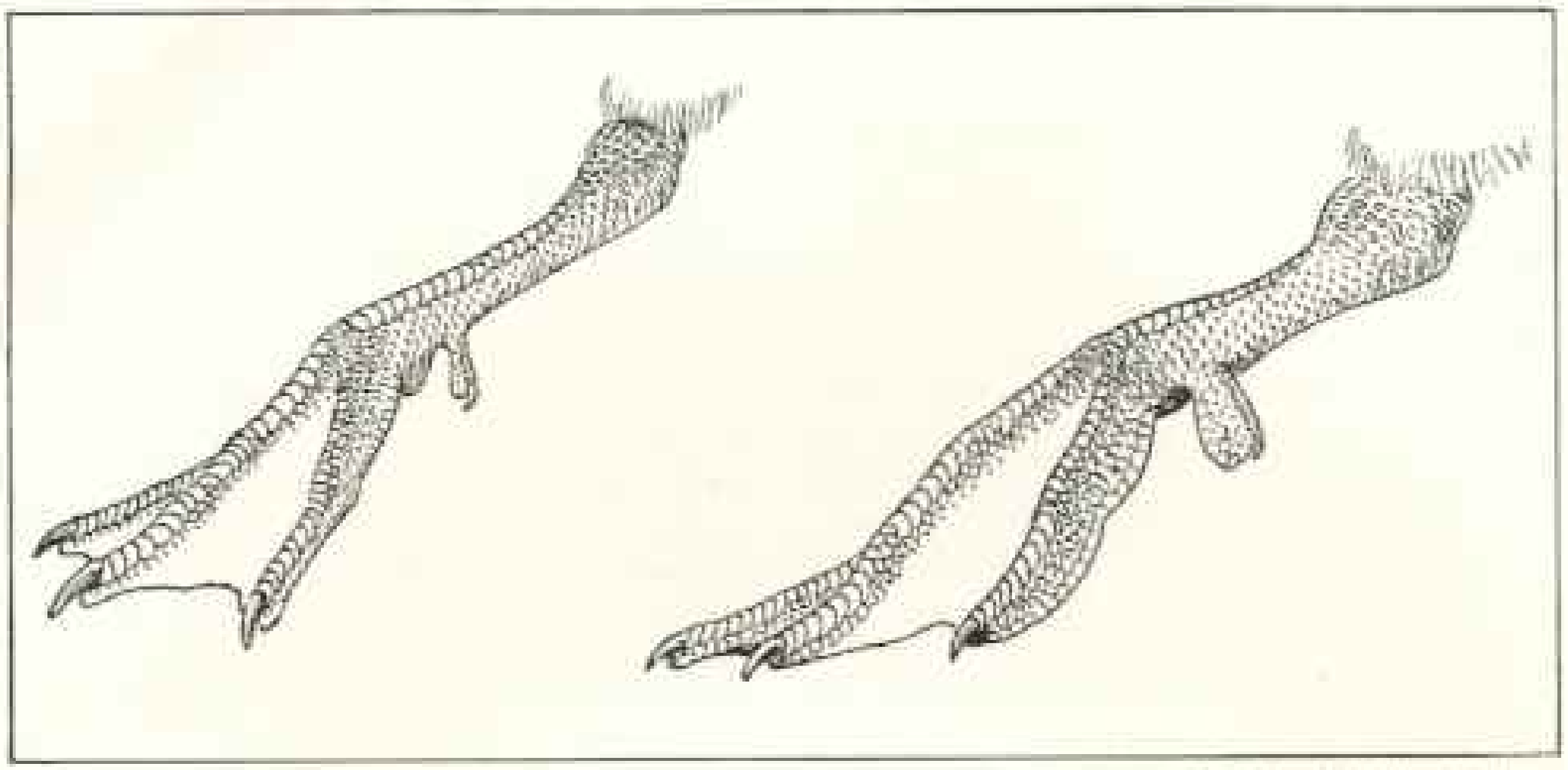
A feature of these adornments is that the white feathers composing them are specialized, usually of a texture different from the surrounding plumage.

THE DUCK'S "BEAUTY SPOT"

The speculum, or beauty spot, formed by the iridescent color of the secondary feathers of the wing, is a conspicuous feature of most surface-feeding ducks, although absent from nearly all the diving ducks, except the eiders and the male harlequin, and here again the harlequin shows up!

Towards midsummer the bright plumage of the drakes is gradually shed and replaced for two months or longer by a more somber feathering resembling that of the females. This phenomenon, known as the "eclipse," in the fullest expression is peculiar to the ducks, and is generally regarded as being a measure of protection while the bird is shedding his flight feathers. While thus rendered flightless, the accompanying dull-colored plumage will enable him to hide from his enemies more easily as he skulks in the rushes.

But this theory falls down when it is realized that only in the ducks of the Northern Hemisphere does this eclipse occur. In



Sketch by Maj. Allan Brooks

BY THEIR FEET YOU MAY KNOW THEM

The badge of membership in the group of diving ducks is the lobe, like a little paddle, on the hind toe, as shown in the drawing of a redhead's foot at the right. The unlobed hind toe on the mallard's foot at the left distinguishes the surface-feeding ducks. With the aid of the "paddle," some of the diving ducks reach considerable depths and have been caught in fishermen's nets from 80 to 100 feet below the surface.

the Southern, even when climatic conditions are similar to those in the far north, no eclipse occurs in any species. The extreme example of this is the cinnamon teal, whose range is divided into a northern and southern "colony," one in North and one in South America.

In the northern, a regular eclipse occurs when the male assumes a dress somewhat similar to the female's for several months. In the southern colony, extending south to Patagonia, no change takes place, and the male has only one molt in the year instead of two.

Strangest of all, ducks from the Southern Hemisphere when brought in captivity to our northern zoos do, in some species, after the lapse of a few years, commence to evolve an eclipse similar to that of their northern brethren.

This I have witnessed myself in the case of the Australian red-breasted teal kept in the zoölogical gardens in London.

In some northern ducks there is little or no eclipse. It is absent in all the scoters and only slightly in evidence in the canvas-back, while in the case of the old-squaw the eclipse takes place in May prior to the northward migration, and this summer plumage is almost as handsome as the winter dress (see Color Plate XII).

The ruddy duck (see Color Plate X) is distinguished from all our other ducks by possessing an ordinary sequence of spring and winter plumages similar to the plovers and sandpipers and so many small birds.

As the subfamily to which the ruddy belongs, that of the stiff-tailed ducks, is regarded as a "primitive" type, it is possible that the eclipse is evolved from a similar condition. In other words, the eclipse may be only a modification of the ordinary fall or winter dress.

A strange phenomenon of the eclipse is the thoroughness of the imitation of the female aspect in most species. Gadwalls and shovellers not only acquire a female plumage but their black bills change to the olive and orange color of the females, while the male of the American merganser, a crestless bird in full plumage, not only acquires the duller colors of the female but also the long crest of reddish feathers (see Color Plate XV).

The character of the eclipse has been dealt with at some length. Comparatively few people are aware of its existence, even though the drakes of our barnyard go through it each year; also, the consequences of its action have a direct bearing. The wood duck is protected over nearly the whole of America, and the striking plumage of the male is fairly well known; yet in the open duck-shooting season, starting in September in many Provinces of Canada, no trace of the well-known plumage of the male

exists, all males resembling the dull-colored female (see Color Plate XVI).

A great divergence in the arrival of maturity exists in the duck tribe. Swans are not fully mature before their fourth year; most geese probably nest in their third year, while ducks of most species usually pair and nest in the spring following their hatching, or before they are a year old. This has a direct influence on the rate of reproduction in each species and should be taken into consideration.

All the surface-feeding ducks nest before they are one year old, although this may not be universal in the case of some species such as the pintail and the widgeon.

A similar condition exists in most diving ducks, but notable exceptions are goldeneyes, bufflebeads, harlequins, and old-squaws, in which the males do not acquire full plumage until they are nearly two years old. In the eiders and scoters the adult stage is still further delayed.

Mention should be made of the extinct Labrador duck, *Camptorhynchus labradorius*, the last verified record of which was a bird taken in 1875 (see page 486).

The passing of this species is a mystery which cannot be accounted for; even from the earliest days for which we have any record of the bird, it was a scarce species in the limited area of its range on the North Atlantic coast.

Frequenting the shoal water of the shallow bays, it could not have been in much demand for food and few were brought in to the markets. There is no record of its nesting, nor even, with any certainty, of its summer home. Although it was a diving duck, the peculiar shape of its bill suggests that it sifted its food in shallow water.

PROBLEMS OF CONSERVATION

Of all the questions relating to wild fowl, the problem of their perpetuation is the most important. Every one naturally takes an interest in their conservation and wishes to see an increase in their numbers. But unfortunately there are two divergent schools at work, one that wishes to protect wild fowl from the viewpoint that they provide sport, and the opposite group that insists they be protected vigorously and all shooting be abolished. Between the two extremes lie all shades of compromise.

For the good of the wild fowl of North America, it is essential that these different views be reconciled, and a concerted course

© George S. Wilcox

WATCHING OVER HIS WILD-DUCK GUESTS

From the platform in the top of this bitter pecan tree, nearly 100 feet from the ground, George S. Wilcox, shown here on his way up, studies the flight habits of ducks flocking to his sanctuary near Stuttgart, Arkansas (see page 488).

of action that has the support of all parties is unquestionably the goal for which we must strive.

There can be no question that the total abolishment of their pursuit for sport can never be achieved. Equally certain is it that the old days of huge bags and reckless killing are gone forever. Taken as a whole, modern sportsmen are exceedingly tolerant and are obviously eager to support any sound schemes for protection.

While the dire prophecies of the total extermination of the ducks and geese of North America are obviously the product of a distorted outlook, yet action is required to cope with many of the dangers to which they are now subjected.

The basic requirement is a realization of the immense difference in conditions in the West as compared to the East. What must strike the most casual observer familiar with eastern conditions is the fact that in the West almost every puddle of water has ducks on it, and the drier the region the more certain it is that small ponds will be inhabited. Conversely, the westerner on a visit to almost any region in the East is struck by the large areas of untenanted duck marshes and lakes.

Probably the basis of this is the fact that the whole of the West is a nesting region for ducks and, to a less extent, geese.

Draw a line from the mouth of the Mississippi River due north to the Coronation Gulf on the Arctic coast. Nine tenths of the ducks of North America breed to the west of this line, although many of them may winter entirely to the east of it. This fact should be the basis for all protective work.

THE ENEMIES OF DUCKS AND GEESE

While duck shooting is one of the causes for our failing duck supply, it must not be considered to constitute the major cause for remedial action. Duck shooters must realize that the restrictions for smaller bag limits and in the firearms allowed must be made permanent, but it is equally important that the conservationist who wishes to curtail their sport must recognize the value in certain cases of some of the practices he may most strenuously oppose.

The chief enemies of our ducks and geese may be classified under the following heads:

Shooting; predators and natural enemies; parasitic diseases; failure of water supply; duck disease (botulism); destruction by crude oil, chemicals, lead poisoning; destruction on their nesting grounds by climatic conditions.

Of these, shooting in all its forms and abuses has been exhaustively dealt with, and this has a tendency to minimize the danger incurred from the other factors.

Predators and natural enemies include a number of foes not usually considered as such, and the damage is mainly confined to the nesting season. The enormous increase of the crow in the West is a danger that cannot be overestimated, and this increase is a comparatively recent condition, as is the tremendous increase of range of the coyote during the present century. The last constitutes the most serious menace to some of our largest and finest species, such as the trumpeter swan and whooping crane.

DEPREDATIONS OF THE "CRAZY LOON"

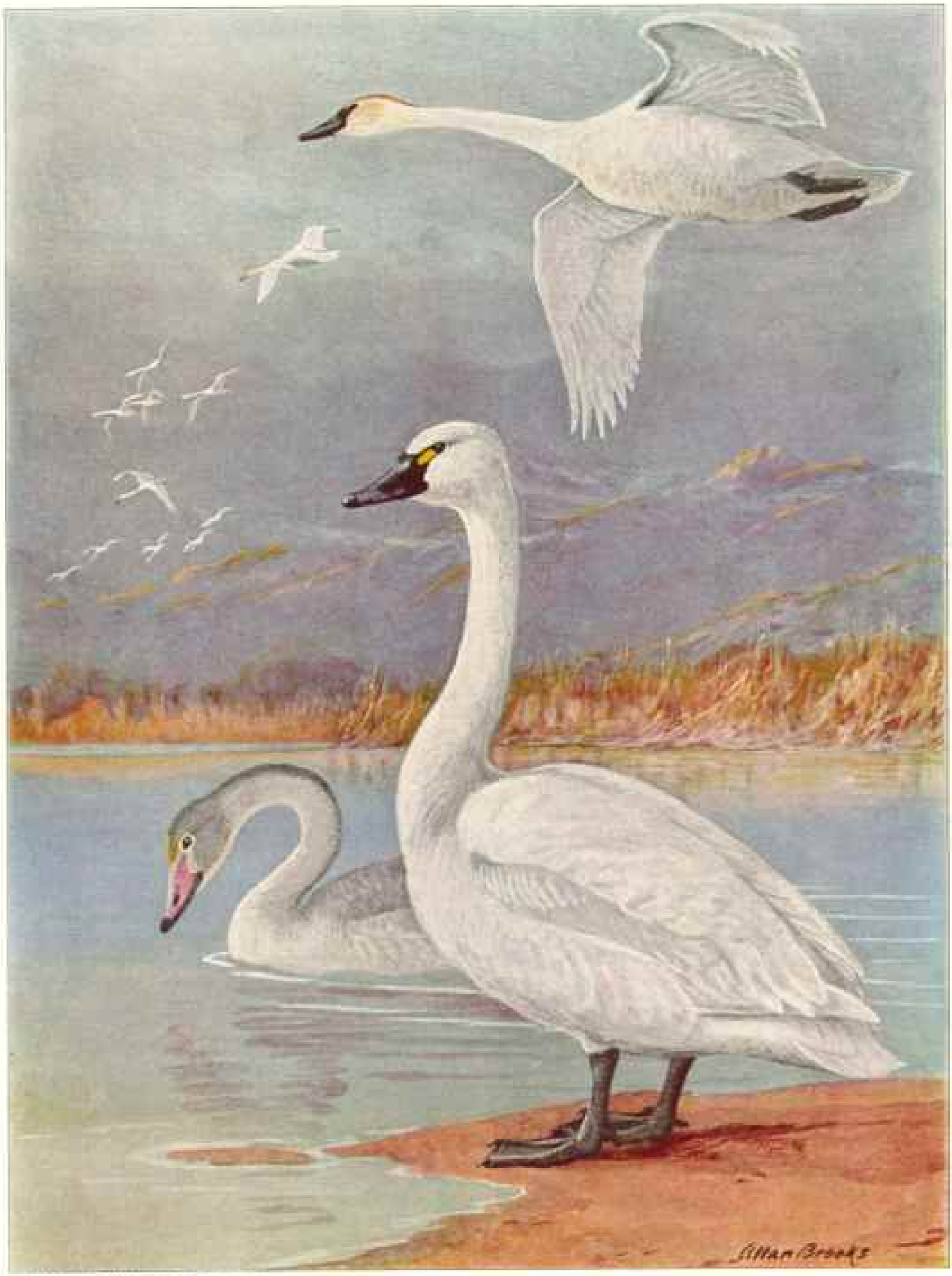
The provisions of the Migratory Bird Treaty Act may have to be altered in the matter of the protection of such birds as loons and large grebes.

Few people realize the enormous number of loons in the West and their destructiveness during the nesting season. It is as rare to see any fair-sized pond in western Canada without a pair of loons as it is to see a lake in the East with loons on it. Add to this the incredible numbers of the smaller species, especially the Pacific loon along the coast from Mexico to Alaska, and realize that every one of the thousands of loons that you see streaming by hour after hour for days in succession is responsible for the killing of the broods of at least two pairs of ducks, and you can form some idea of the duck destruction that goes on each year unchallenged.

That pair of loons on some lake of our summer vacations that give us such a thrill with their weird cries! How few of their admirers realize that they are, while at their nesting grounds, absolutely intolerant of all intrusion upon their domain by other waterfowl.

Coots also can be very destructive to downy ducks. A swift peck on the soft little pate is all that is required, and their killing propensities are not confined to small ducklings; half-grown birds may be destroyed.

Crows, magpies, hawks, horned owls, muskrats, coyotes, pike, turtles, and other creatures not usually regarded as duck



A VANISHING AMERICAN IS THE GREAT WHITE TRUMPETER SWAN

Over lonely lake and mountain in northern British Columbia ring the low-keyed, far-carrying calls of this majestic five-foot bird (in flight), one of the continent's largest waterfowl. A few pairs survive also in Yellowstone National Park. Not man, but the marauding coyote on the nesting grounds threatens to send the trumpeter the way of the great auk and the passenger pigeon. Slightly smaller, but far more numerous, are the whistling swans (full-grown in foreground, young in water). From Arctic to Gulf they fly. Long wedges often cleave the upper air high above the earth.

destroyers all take their toll during the nesting season.

How large is this toll? Well, in the region where I have lived for the greater part of the last thirty-eight years, the dry interior of British Columbia, I have attempted each year to keep an estimate of the ducks that reached the flying stage.

HIGH INFANT MORTALITY AMONG DUCKS

This is not a very notable breeding region in point of numbers of ducks, but probably unique in the number of species. Twenty-one species may be found nesting within a radius of 10 miles, while there is hardly a pond of any size but has its pair of ducks. I would estimate the loss in this area from natural predators to be fully 90 per cent, or only ten ducks reared out of 100 eggs laid! I have yet to see any nesting region that would not show a loss of at least 60 per cent.

Consider this waste and it is apparent that stopping the depredations must be one of our major efforts.

Second only to the destruction during the nesting season is the loss from the so-called "duck disease," which is not confined to ducks, but destroys every species of water bird as well as many land birds that drink the contaminated water.

By the researches of a few individuals we now know that this disease is not caused by alkali, as first investigations seemed to show, but is a food poisoning caused by the toxin from bacterial growth in decaying organic matter. The destruction of waterfowl from this cause in some years in the State of California will far outnumber the total killed by all gunners, and the area affected is spreading. It has reached the prairies of Canada in recent years.

The main cause of the plague is the congestion of large numbers of birds undisturbed on certain areas of shallow water. It is not generally recognized that the disease disappears shortly after the opening of the shooting season and asserts itself some three weeks after the commencement of the following closed season.

Any arrangement that may provide inviolate sanctuaries where waterfowl may congest on areas of shallow water will probably insure a death trap that may destroy the birds in millions.

The destruction caused by crude oil is fortunately mainly confined to seacoast areas, and its victims are mostly marine ducks and other sea birds. There seems to be a slight mitigation of this terrible evil in recent years, and by proper preventive measures it can be controlled.

In identification of waterfowl in the field, facility can come only with experience.

Diagrams showing color patterns, at rest or in flight, are of little use unless differences in contour are recorded accurately.

The old wild fowler squints at a flock of birds much too far away to show any color, and instantly identifies them by their contour, wing action, or some character imperceptible to the tyro.

In the air it is usually the under surface that is presented. Mallards are identified by the flash of white below their swiftly moving wings, not by the purple speculum of their upper surface.

In the figures that accompany this article, this character has been specialized as well as the general contour of a duck in full flight, and serious attention has been given to the character and contour of the duck in the water and to the angle at which it carries its head.

Whistling Swan

(Cygnus columbianus)

Whenever I think of swans, one experience stands out. I am standing by the shore of a lake in northern Alberta on a still, dark night in late October, with the black dome overhead spangled with stars and a keen touch of frost in the air. Suddenly comes the clear call of a whistling swan (see Plate I), another, and another, closer and closer, until right overhead there is, I know, a long wedge of birds cleaving their way southward. The thin, whispering whistles of the young form a background for the staccato shouts of the old birds.

Now they have passed, but already from the north I can hear the approach of another flock, and when this in turn has gone, another is heralded by the same magnificent chorus.

Flock succeeds flock. Sometimes the cries seem so near that I strain my eyes upward, expecting to see the stars blotted out, but they must be very high, as not even a whisper of the magnificent pinions is to be heard.

Half the swans of the Arctic are on the way, and I am right in their track. I realize that all the thousands of swans that I have

seen feeding and at rest in the past two weeks are only a fraction of the host that is traveling overhead.

We never need to worry about the whistling swans; even if the present protection were removed, they would be well able to take care of themselves.

The spread of the coyote to the Arctic coast will mean a considerable destruction of their young, but they will always be able to find nesting sites and conditions that will enable them to combat this menace.

Breeding almost entirely north of the Arctic Circle, these swans winter well to the south. Chesapeake Bay and Currituck Sound on the Atlantic and the Sacramento Valley in California are especially favored winter resorts.

Trumpeter Swan

(Cygnus buccinator)

This, one of the largest living native birds of North America, presents a problem for its perpetuation that requires all the intelligence and effort that conservationists can concentrate on it (see Plate I).

The trumpeter is only slightly larger than the whistling swan and the main distinction is the voice. That of the trumpeter has a hornlike quality, very low in key—it might almost be called a groan at times—but possesses an extraordinary resonance. When a flock is passing overhead, the calls do not seem to be particularly loud, but long after, from miles away, the low groaning trumpet comes back, clear and insistent. I do not think the clear whistling shout of the whistling swan will carry half the distance.

I greatly doubt the stories of the former abundance of the trumpeter. Many of these, as well as some of the records of its recent capture, are based on the old diagnosis for distinguishing the two species.

Formerly all adult swans that did not show a yellow mark on the bill were called trumpeters. Now we know that many adult whistlers have an all-black bill, and all other distinctions are more or less unreliable, except the different characters of the windpipe and sternum.

Young birds of the trumpeter also have a lot of yellow on the feet. This is never present in young whistlers.

But the notable distinction and the only infallible one in life identification is the voice, and unfortunately swans have a habit of silence when on the water.

The ranges of the two species are very different. Simply put, the whistler summers as far north as he can and winters far south, while the trumpeter breeds as far south as he can find the necessary solitude and winters precariously as far north as he can find open fresh water.

Formerly the trumpeter nested far to the south of its present breeding range wherever the necessary degree of solitude was available, but the traditions of the Indians do not tell of anything but widely scattered pairs, never of the abundance of the whistler, even in the winter months.

Outside of a few pairs in Yellowstone National Park, the main stronghold of the trumpeter is in northern British Columbia. Possibly 500 birds are scattered through that rugged region in the summer. Concentrations of over 200 birds have been counted recently where unfrozen water was available in the interior, and we know that at other points smaller numbers were present.

Contrary to general belief, they are not molested by man except in rare instances, and even in early days few were shot, although the young birds are excellent eating.

The great danger lies in their enemies on the nesting grounds. Eagles and ravens were probably their chief menace at one time, but now the increased range of the coyote, which has invaded their most inviolate sanctuaries, spells nothing but complete disaster unless some remedial action can miraculously save them.

The old estimates of the great weight of a trumpeter swan are probably all exaggeration. Thirty pounds is probably a fair maximum for a large bird.

Canada Goose

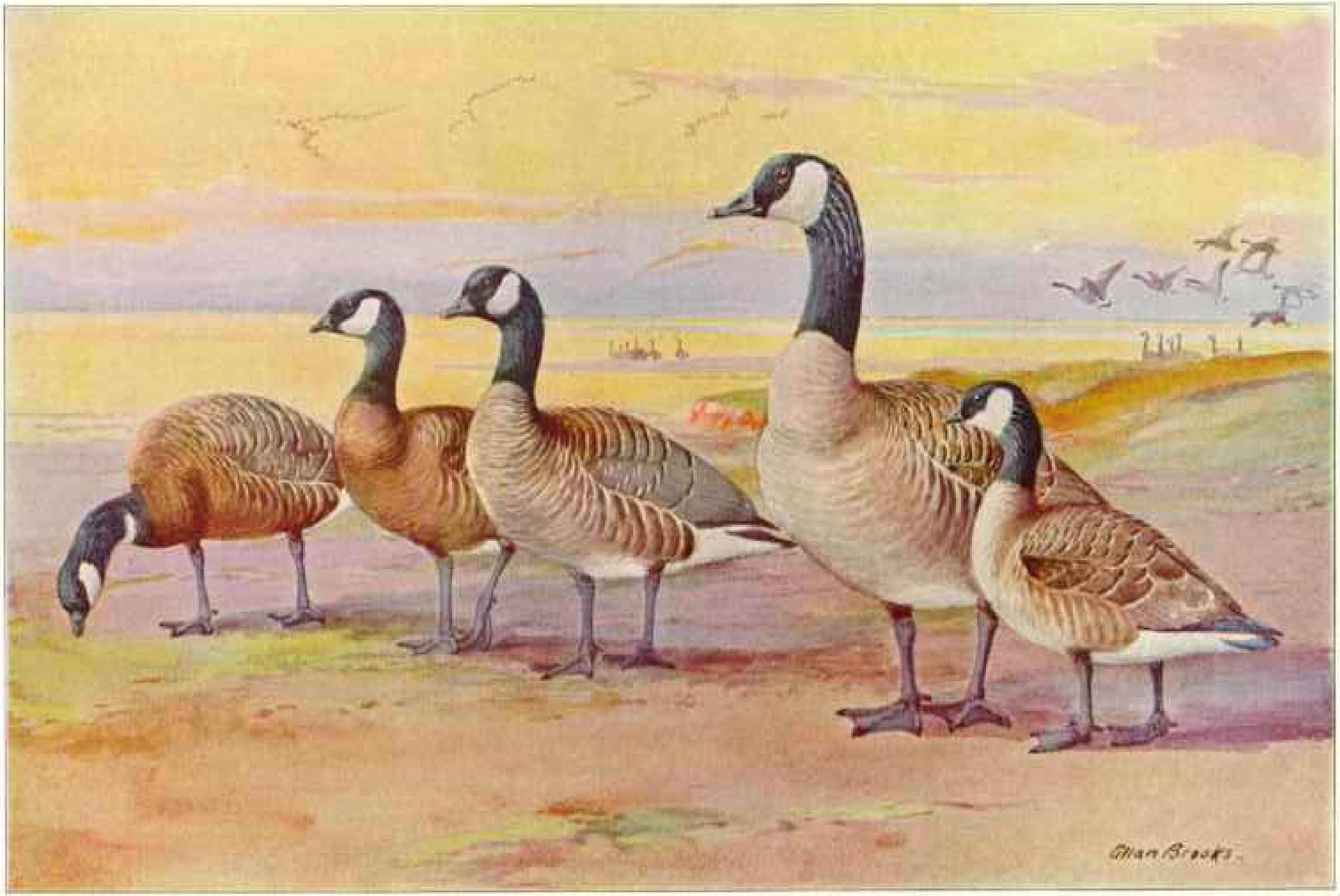
(Branta canadensis canadensis)

"Honker" in the West, "gray goose" in the North, and "outarde" in Quebec are only a few of the names by which this, the largest of our geese, is known (Plate II).

Breeding from the Yukon across the continent to Labrador and south to Quebec and the northern tier of the Prairie States east of the Rocky Mountains, it extends its breeding range south in the mountains to northern California and Utah.

It may winter as far south as Florida and Mexico, but also as far north as the interior of British Columbia.

Everywhere a very wary bird, except sometimes on its breeding grounds, the honker is well able to take care of itself under the existing laws for its protection.



WILD GEESE LOOK AROUND FOR DANGER BETWEEN BITES AND EVEN POST REGULAR SENTINELS

Biggest is the handsome Canada goose, second from the right, whose honking, V-shaped columns etch the sky in spring and fall. Vest-pocket editions abundant in the West are the two cackling geese at the left and the lesser Canada goose in the center. The still smaller Richardson's goose (extreme right) comes from the eastern Arctic.

BRANT, SMALLEST OF WILD GEESE, RIDE THE WATER GRACEFULLY LIKE RACING YACHTS

A full-grown, white-bellied brant, common along the Atlantic coast, swims with one of its young at the right, while others wheel overhead. A black brant, more abundant in the Pacific, wades ashore. In the Middle Ages men believed geese were hatched from barnacles; hence the name bestowed on the barnacle goose poised on one foot, a straggler from the Old World. The emperor goose at the left lives mainly in the region around the Yukon's mouth.

It is notable among our geese for the variety of its nesting sites. In certain regions it may be found nesting in high cliffs and even trees, although the ordinary sites, such as muskrat houses and islands, may be available.

I have several times seen it nesting in the high-tree nests of the osprey, laying its eggs before the return of the ospreys from their winter homes.

When these hawks return, there is a battle royal. It usually ends in a victory for the ospreys, which lay their own eggs alongside those of the geese and proceed to incubate. What happens if the young geese are hatched out first? Unfortunately, no observer has made any record of this. Possibly it has never occurred, but the mixed sets of eggs may be seen in several museums.

I have never talked with old goose shooters without stories of 20-pound geese coming up, but 14 pounds is my own maximum record.

On the northwest coast from Vancouver Island north to Prince William Sound, in Alaska, a dark race of the Canada goose is resident. This, the white-cheeked goose, *Branta canadensis occidentalis*, has been taken in winter as far south as northern California, but it is always confined to the coastal strip and islands.

It is only very slightly smaller than the typical Canada goose, being merely a dark race induced by the heavy rainfall.

Lesser Canada Goose

(Branta canadensis leucopareia)

This goose occupies an enormous range in western North America. Nesting only north of the range of the Canada goose or along the Arctic rim of the continent north of the tree line, it passes far south in the fall, even well into Mexico (see Plate II).

It is a medium-sized goose weighing from four to eight pounds, and ranging from very dark birds to very light, the latter grading into the typical Canada goose, some individuals being hard to place. The dark, short-necked birds with small bills probably come from the western portion of the breeding range, and are known to the Sacramento Valley gunners as "big brant."

Throughout the interior valley of California, it is the most abundant goose, wintering in numbers that seem almost incredible to sportsmen from any other region.

Here it associates with the other geese of the same approximate size, white-front, snow, and cackling geese. A "V," or line of geese, may be seen with all four of these geese mixed up, yet each conforming to the regular formation.

Richardson's Goose

(Branta canadensis hutchinsi)

This diminutive goose, originally described by Sir John Richardson over a hundred years ago, has been overlooked by more recent ornithologists and only recently has been reëstablished. It is the form designated by the vernacular name of "Hutchins's goose" in the last edition of the American Ornithologists' Union check list. In my opinion it should properly be called Richardson's goose (see Plate II).

It is only slightly larger than a mallard, and a full-sized bird will weigh but four pounds.

Except for its proportionately smaller bill, it is almost an exact replica of the big Canada goose, but less than half the size.

It breeds on the Melville Peninsula and some of the Arctic islands to the eastward, and apparently occupies the same ground as its larger relative, the lesser Canada goose. This does not conform to its present rank as a subspecies. Its migration route is imperfectly known, but it has been taken when migrating at the Gulf of St. Lawrence and west regularly to Manitoba and the Mississippi Valley, wintering in northeastern Mexico.

Cackling Goose

(Branta canadensis minima)

The "*canadensis*" in the scientific name should be left out, as in my opinion this is a full species, nesting along the coast of northwestern Alaska with its larger relative, the lesser Canada goose (Plate II).

Its winter quarters are the Sacramento and San Joaquin Valleys of California, and it has never been taken away from the Pacific coastal strip.

A small goose, only slightly larger than Richardson's goose, it weighs from three to five pounds when in good condition. It is darker in color than the other members of the Canada goose group. Its note is shriller than that of the lesser Canada goose and in its winter quarters, where it is known as "little brant," it is recognized by its loquacity and its short-necked, long-winged appearance, as well as by its erratic flight.

In spite of its limited range it is an abundant species, though less so some years than others. This is probably due to inclement weather during the nesting season, the penalty incurred by all birds that nest in the Arctic.

White-Bellied Brant

(Branta bernicla hrota)

True brant (or brent in the British Isles) are sea geese and their occurrence away from salt water can only be by accident.

Breeding only in the northern part of the Arctic regions, mainly on the northernmost islands, brant extend on their migrations down both coasts as far as Florida and Baja California. On the Pacific side the American, or white-bellied, brant is scarce, being outnumbered by the black brant. Both birds are small, short-necked, long-winged geese, but slightly larger than a mallard and the habits of the two are identical (see Plate III).

The recent disappearance of the eelgrass, *Zostera,* on the Atlantic coasts may spell disaster to the brant, as this is their staple diet and their choice of a wintering ground is governed by the supply of this succulent food. Feeding on it they become extraordinarily fat and one of the most delicious of all waterfowl.

But their natural wariness and the nature of the coast they frequent make their successful pursuit one requiring special knowledge, skill, and equipment, and so comparatively few are shot.

In some winters the brant, like the cackling goose, is notably scarce. Observation will show that the usual family parties of five or six young birds with their parents are absent, and that the flocks are composed of adult birds mainly or entirely. This is the result of a bad nesting season when a continued stretch of rigorous weather in the Arctic has destroyed their nests or possibly even the newly hatched young.

No other ducks or geese can compare with brant in sheer beauty of movement. On the water they sit as lightly as gulls, the tail upraised and the neat little head poised on the graceful neck. Seeking their food, they pick daintily at the water and pivot swiftly to do so. On the wing they are at their best. Sweeping low over the water or mounting high, they can drive into the teeth of a gale that sends other fowl scurrying for shelter, and the chorus of their clanging cries is the music that harmonizes with the crash of the incoming waves.

Black Brant

(Branta nigricans)

The black brant breeds on the Arctic coasts of eastern Siberia and of western America, migrating in winter down both coasts of the Pacific as far south as Baja California and Japan (see Plate III).

Except for its darker coloration and the uninterrupted white collar in front, it is a replica of the Atlantic species. Since the white on the tail and flanks is the same, the bird looks almost as white on the water as its eastern confreres. Its voice, habits and food are identical, and so far it is not menaced by any failure in the supply of eelgrass, although this staple food is certainly not as abundant and luxuriant on the coast of British Columbia as it was 25 years ago.

Nowadays the brant of this region have exhausted the eelgrass supply by the end of January and are forced to a diet of seaweed. They then rapidly lose not only their fine condition but also the delicate flavor of their flesh.

Their method of stowing away the long ribbons of eelgrass is peculiar. It is neatly folded in zigzag fashion as it is swallowed, and an enormous quantity can be packed away by a hungry bird.

Barnacle Goose

(Branta leucopsis)

The barnacle may be called a glorified brant, but in habits it is more nearly akin to other geese, as it comes ashore and grazes on the short grass of coastal pastures instead of seeking its food afloat (Plate III).

It nests sparingly in northeastern Greenland and more commonly on the larger Arctic islands and coasts of the Old World, occurring only as a straggler on the Atlantic coastline of America.

The barnacle owes its name to the ancient Norse belief that these geese were produced from the marine shellfish of that name.

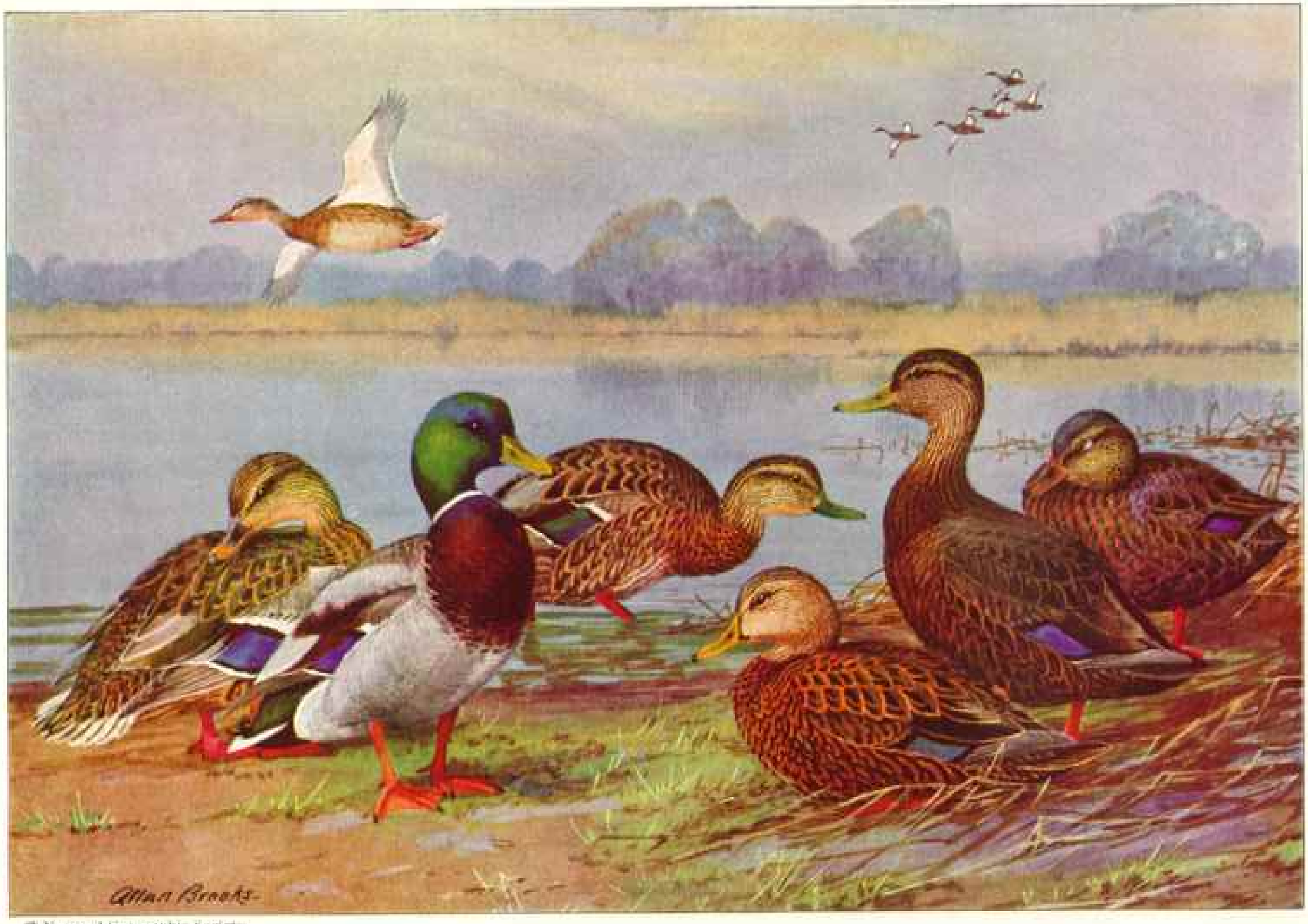
Emperor Goose

(Philacte canagica)

The emperor goose has a very restricted range—the region of Bering Sea and the Arctic coasts of Alaska and Siberia for a short distance east and west. Stragglers are frequently found on the western coast of America as far south as California and even on the Hawaiian Islands (see Plate III).

HUNTERS PRIZE THE WHITE-FRONTED GEESE, DROPPING DOWN FROM A CLOUDY SKY

The old bird, descending with one of its offspring, wears a speckled vest and utters a laughing cry. They are closely related to domestic geese. Left to right stand Ross's goose, a little westerner; the blue goose, which winters in Gulf coast marshes; and the West's lesser snow geese (young and adult), perhaps the continent's most abundant goose.



THE GREEN-HEADED, HANDSOME MALLARD IS AT HOME IN MARSHY WILDS

From this glossy-feathered, quacking citizen of the world and his drably dressed womenfolk (left and "single" flying) many varieties of domestic ducks have sprung. Wilder and harder to domesticate are the East's black ducks (extreme right pair, and flying). The Florida duck (third from right) is a bit lighter colored. The New Mexican duck (center, male) of limited range has only recently been discovered.

It is essentially a marine goose, feeding for the most part on shellfish exposed at low tide, but resorts to the estuaries of rivers to nest on the swampy tundra of their shores. On account of its diet, the flesh is rank and strong-flavored, but this makes no difference to the Eskimo and other natives, who kill these geese in large numbers and freeze the carcasses for winter food. Their numbers are greatly reduced at the present day, according to the records of their abundance made fifty years ago by Dr. E. W. Nelson and L. M. Turner.

White-Fronted Goose

(Anser albifrons albifrons)

Also known as "gray goose," "speckle-belly," and in the Mississippi Valley as "brant," this goose has the widest distribution of any goose, breeding in most of the Arctic and subarctic belt of both the Old and New Worlds (see Plate IV).

Its southward movement starts very early, taking it to southern British Columbia by the first week in September, long before the arrival of other Arctic-breeding geese. The main wintering grounds are to the west of the mouth of the Mississippi and the interior valley of California. Large numbers also winter in northern Mexico. In the Old World the white-front reaches its southern limit in northern India.

At all times and throughout their range, they are excellent table birds.

In the springtime in northern latitudes the laughing cry of this goose proclaims that the "gray waveys are in," and the blue sky is dappled with the lines and V's of the north-bound migrants.

Even after their long flight from their winter quarters, they are in excellent condition, weighing as much as seven pounds.

At certain points in the Sacramento Valley in California, a large edition of the white-front occurs in the winter months. This is the tule goose, *Anser albifrons gambeli*, which owes its discovery and systematic recognition solely to the market hunters of that region.

Their accounts of a white-front almost as large as a "honker," with a darker coloration, distinct voice, and rather different habits from the well-known species, were at first discredited, but when substantiated by specimens the form had to be recognized.

The tule goose when full-grown is not much inferior in size to a Canada goose and weighs as much as nine pounds, with proportionately larger bill and feet than the ordinary white-front.

The mystery of its summer home is as yet unsolved, but the capture of a migrating individual in central British Columbia in the fall of 1933 may afford some clue. Old World naturalists have identified the white-front nesting in Greenland as being the tule goose, this error being due to the fact that they have not seen authentic specimens of the tule goose for comparison.

Lesser Snow Goose

(Chen hyperborea hyperborea)

Snow geese are seldom known by that name by the men who hunt them. "Wavey" is the universal name in the Hudson Bay region and on the Canadian prairies, while in the Western and Southwestern States they are called "white brant" (see Plate IV).

This numerous species nests from Point Barrow, Alaska, east to Baffin Island along the rim of the Arctic coast and adjacent islands. There must also be some nesting ground on the Siberian coast, as large numbers cross Bering Strait in summer to the Asiatic side.

There are three important wintering grounds: the coast of Texas, the northern interior of Mexico, and the Sacramento and San Joaquin Valleys in California. Not that it is confined to these regions; large numbers can be found all winter at the mouth of the Fraser River in British Columbia and possibly even farther north.

Several migration routes have been mapped out for the enormous hordes of these geese, but it must not be assumed that their movements are confined to these routes; they probably represent only the most traveled highways.

Once in the Rocky Mountains of southern British Columbia I saw a large flock of snow geese coming right over the summits from the Alberta side. This was not an isolated instance, there being many similar occurrences in my own experience.

The lesser snow goose probably represents the most abundant goose in North America and the poorest of all gastronomically, the scarce emperor goose excluded.

"They are not bad, made up as sausages," an old hunter of vast experience once said of them, and under special feed conditions they may be excellent; but, as a rule, their flesh is dark and coarse as compared to that of other geese.

Six or seven pounds would be the weight of young and old birds respectively, in good condition.

Enormous numbers of snow geese are killed each year for food, especially in the region of Hudson Bay, where they are preserved for winter consumption, and the very existence of some of the tribes of the region is dependent on this supply.

In California dire predictions of their coming extermination have been made for many years past. While unquestionably their numbers in that State are much reduced from those of early days, it must be remembered that present-day conditions have a tendency to attract geese in enormous flocks to certain areas, and so cause a seeming scarcity in others. The tremendous wastage of rice in parts of the Sacramento Valley must feed thousands of geese that formerly were attracted to the wheat fields and grasslands nearer San Francisco Bay.

My own experience in this region goes back only to 1911, when I saw thousands of geese between Sacramento and the Bay.

In recent years this area has little attraction, but never have I seen a greater concentration of snow geese than I saw in the rice fields near Willows in February, 1933.

Completely restricted in its range to the Atlantic coast is the greater snow goose, *Chen hyperborea atlantica*. This is merely a large, heavy-billed edition of the smaller bird. Its numbers may be said to be confined to one huge flock of many thousand birds which appears at Cap Tourmente, on the St. Lawrence northeast of Quebec city, each year, in October, remaining there until weather conditions compel their withdrawal to more temperate regions along the coasts of Virginia and North Carolina.

The summer homes of this great horde are a mystery, as only isolated pairs have been encountered from the east coast of Greenland to Ellesmere Island.

Blue Goose

(Chen caerulescens)

The status of the blue goose is almost exactly parallel to that of the greater snow goose. Only in recent years have the nesting grounds of their vast hordes been found on Baffin Island. Their southward migration takes them southwest to the Valley of the Mississippi, and they winter in a small area west of its mouth (see Plate IV).

Some systematists regard the blue goose as a color phase of the lesser snow goose on account of the extraordinary variability of its plumage, which is often dappled with varying amounts of white; also, blue geese in captivity have produced young indistinguishable from lesser snow geese. As geese hybridize readily, this last can be explained by such a condition, and in view of the restriction of its nesting and wintering grounds, unless further investigations prove the contrary, it had better be regarded as a full species.

Ross's Goose

(Chen rossi)

The breeding grounds of this tiny goose still remain a mystery. The "warty-nosed wavey," as it is known in the fur countries, arrives at Lake Athabaska from the north in the first week in September, the earliest of the geese. From this general region the route is a peculiar one, as the flocks all pass through the mountains west of Great Falls, Montana, and fly southward to the west of the Rocky Mountains and other ranges of the interior. They winter entirely in the Sacramento and San Joaquin Valleys of California, a most restricted habitat when the vast extent of their migration is considered (see Plate IV).

In California they are known to gunners by the name of "China geese" and now enjoy absolute protection under the game laws.

Although these geese are no larger than mallards, the chief characteristic I have noticed is their pugnacity when in captivity.

Before the ban on live decoys, large flocks of geese of the several species were kept by goose shooters, and it was amusing to see these tiny fellows shoulder the larger species away in defense of their food. I have frequently seen a bellicose little gander keep several large geese away from his feeding family, rushing at them with opened wings and lowered neck.

Mallard

(Anas platyrhynchos platyrhynchos)

Best known of all ducks and the origin of of nearly all our domestic breeds, the mallard is found over the greater portion of the world's surface except South America, Australasia, and parts of Africa (Plate V).

It breeds from the middle row of States south to southern California and north to the Arctic Circle; also over the greater part of northern Asia and Europe. In southern

WITH ITS "POLICE WHISTLE" THE BALDPATE OFTEN GIVES THE ALARM

Stealing food brought up by better divers is another trait of the baldpate, or American widgeon, mainly found in the West (foreground, male, female; upper left flying). The European widgeon, in water, frequently visits the New World's eastern shore. Above, a swift-winged mother gadwall is about to land just ahead of her spouse and a daughter (upper right).

MANY A SPORTSMAN FIRES IN VAIN AT THE "GREYHOUNDS OF WATERFOWL."

A brace of the swanlike, stream-lined pintails racing downwind makes but a fleeting target (female and male at right and flying). The bantam resting on one leg, with his mate about to alight, is a green-winged teal, smallest of North American ducks and remarkably quick at leaping into the air. The European teal, swimming, nests in the Aleutian Islands.

Greenland a slightly differentiated race is resident.

One fine June day I came suddenly on a mallard with her day-old brood in a recently flooded pool of crystal-clear water. At the warning quack of the mother, every little duck dived, and as the surface became still I could see the youngsters dotted over the short turf that formed the bottom of the pool. They were not stretched out, but were sitting on the bottom with heads up, their wide-open, beady eyes regarding me through the limpid water.

After watching them for what seemed to me two minutes, I waded in and touched each little form in turn. Instantly they rose buoyantly to the surface and pattered away to join the anxious mother, making no further effort at concealment. Now, by what magic were they able to remain under two feet of water without effort of any sort?

Black Duck

(Anas rubripes)

This splendid duck, which replaces or outnumbers the mallard over a considerable portion of eastern Canada and the Northeastern States, is confined to eastern North America. It has been divided into two geographical races, the northern, true *rubripes*, and the southern, *tristis*. It is fortunate that duck shooters maintain that they are able to distinguish the two; naturalists as a rule cannot. The northern subspecies is called the red-legged black duck. But personally I have yet to see a black duck, even the young birds of the southern form, that did not have red legs (see Plate V).

In spite of the somberness of its plumage, the black duck is a magnificent game duck, the peer of the mallard in everything but color, and excelling the mallard in intelligence and wariness.

Probably it is also larger, as black ducks of four pounds and even a trifle more are on record.

Florida Duck

(Anas fulvigula fulvigula)

This might be called a light-colored black duck, and like that species there is little difference in the sexes. It is confined to the marshes of the Florida peninsula, where it is known to the residents as "native mallard," in distinction from the true mallard, which leaves the region in summer (see Plate V).

The mottled duck (*Anas fulvigula maculosa*) is a slightly darker race of the Florida duck, with a more spotted head. It has a wider range along the coasts of Louisiana and Texas and south into Mexico.

New Mexican Duck

(Anas diazi novimexicana)

This is a fairly recent discovery among the ducks of the United States, and has been described as a link between the mallard and the mottled ducks (see Plate V).

It can be described as a dark-colored female mallard, both sexes being similar.

Unlike the ducks of the black and Florida group, the speculum of the wing is bordered on both sides by white, as in the mallard.

Many individuals show decided mallard characters, suggesting interbreeding, but at several points in New Mexico, where I found it not uncommon during the spring and summer months, I never saw the two species associating together.

Its range in the United States is confined to southwestern Texas, across New Mexico to southern Arizona. Most of the birds pass south into Mexico before the opening of the shooting season in October.

Gadwall

(Chaulelasmus streperus)

The gadwall has probably the widest range of any species of duck, being absent only from South America and Australasia. It is curiously irregular in its distribution, being entirely absent from some localities and abundant in others (see Plate VI).

Owing to its subdued coloration, it is often overlooked where it is scarce, or is confused with other species. It can be told by its yellow feet, this and the wood duck being the only medium or large-sized surface-feeding ducks with this character.

On the wing gadwalls look much like mallards, showing the same white underwing, but in adult birds the under surface of the body shows white like a baldpate.

Their nesting range is rather southerly, few going farther north than the southern portion of the Canadian Provinces. This brings them under the domination of the predatory crow, so that at times a very small proportion of their eggs produce flying birds.

Once I saw a gadwall which had lost her first nest select a strange site for her second effort. The eggs were laid in an old crow's nest in a small tree, where they shared the same fate as the preceding ones.

Baldpate

(Mareca americana)

The baldpate, or American widgeon, breeds from northern California to the Arctic, but mainly in the West. On its winter migration it has been taken as far south as Panama (see Plate VI).

This is one of the commonest of California ducks, and it is hard to realize that the sun-baked birds of the San Joaquin or Imperial Valleys are the same species that you find wintering under severe conditions over a thousand miles farther north.

There is something distinctive about baldpates—their graceful action on the water, sitting lightly with tails held high, pivoting about as they peck daintily from the surface; their way of trotting about like pigeons on the turf, where they graze like little geese; or the splendid evolutions of their flight, when the birds are so closely bunched that there does not seem to be room for the long, pointed wings to function.

Yet they wheel and turn in massed formation like sandpipers. Above all rings the sweeping challenge of the male's musical whistle. On the other hand, the female's note is one of the harshest of all duck sounds—a loud, rasping, rattling croak.

European Widgeon

(Mareca penelope)

The Old World widgeon is easily distinguished from the baldpate, when the adult males are compared, the red head and gray body of the former being very distinctive (see Plate VI).

Young birds and females are more alike, those of the European species being redder and with the axillars, the long, pointed feathers beneath the wing at its base, strongly freckled with gray and not white, or only slightly marked, as in the American species. The European widgeon is turning up more and more frequently, especially on the Atlantic coast, where at some points it is more common than the baldpate.

It breeds in Greenland, Iceland, and Scotland east to Kamchatka Peninsula, wintering south to southern Asia and northern Africa.

American Pintail

(Dafila acuta tzitzihoa)

The pintail, or "sprig," as it is known in California, is a far more common duck in western than in eastern North America. In the West it may be found nesting from Nebraska and California to the Arctic. In winter it migrates as far south as the West Indies and Central America (see Plate VII).

The return of spring on the northern prairies is heralded by the musical whistle of the pintail as soon as the first sign of open water appears. The long flying lines of these graceful ducks, the snowy necks and breasts of the drakes clear-cut against the blue sky—what a thrill this brings after the long months of the white silence of winter!

On the wing the pintail looks like a large duck—as large as a mallard; this fact is due to the long neck and wings. Actually it will weigh but little more than a baldpate or gadwall in good condition, about two and a half pounds.

Green-Winged Teal

(Nettion carolinense)

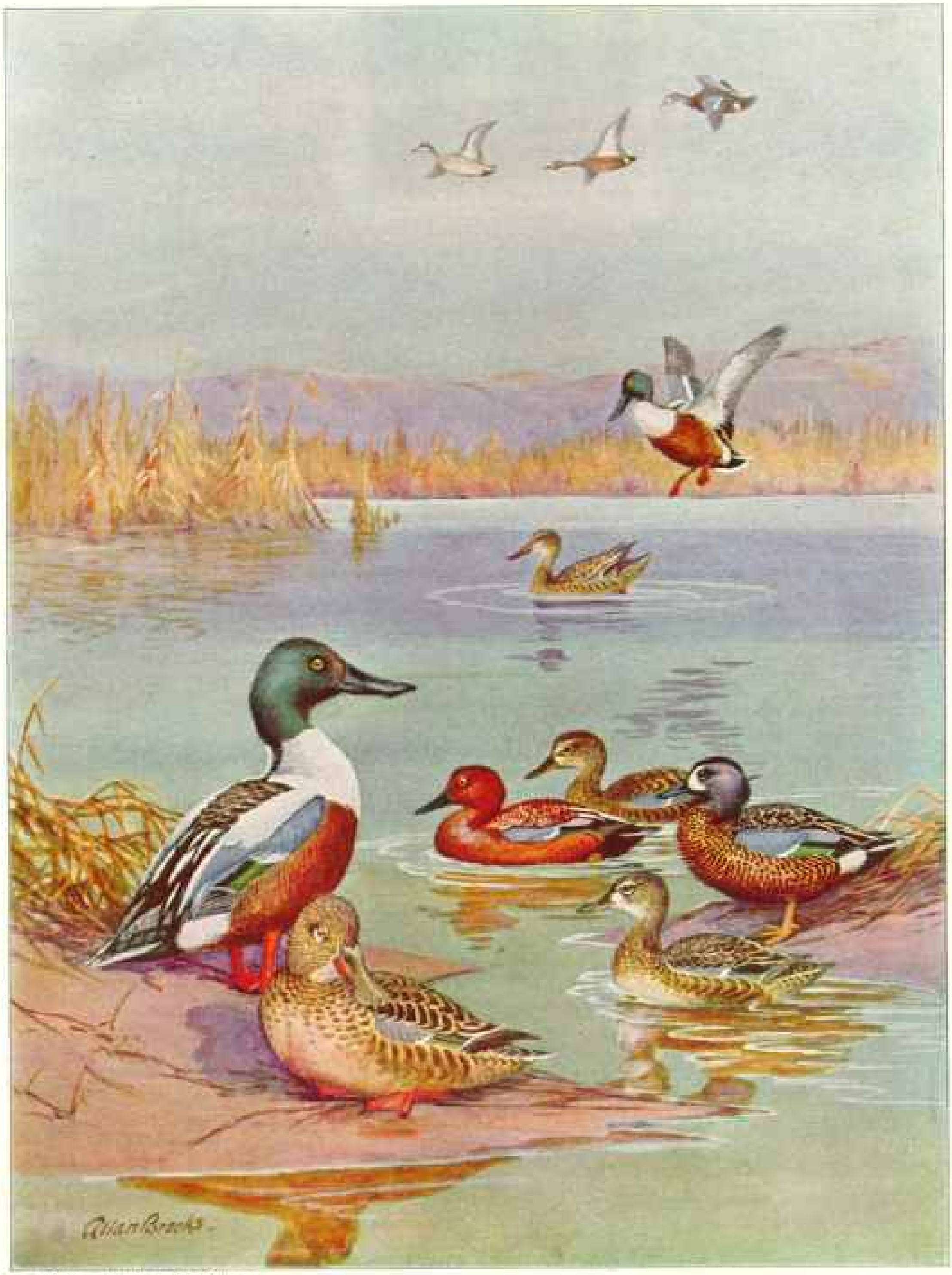
This, the smallest of our ducks, may be found in summer from about the limit of trees in the Arctic south to New Mexico and California at higher elevations. On the coast of British Columbia it may be found throughout the winter, but in the interior the rigor of the winter usually sends it south before January. The southern limit of its winter migration is in southern Mexico and the West Indies (see Color Plate VII).

Green-wings are usually rated as the last word in gastronomic delicacies, but this is not the case where they have access to the salmon-filled rivers of the Northwest. It is an extraordinary sight to see these lovely little birds in such surroundings. They scuttle over the rocks and gravel, shoveling up the masses of maggots in the rotting fish or working the shallow riffles for salmon eggs.

It is well to know what ducks may be classed as safe to eat when the salmon are running.

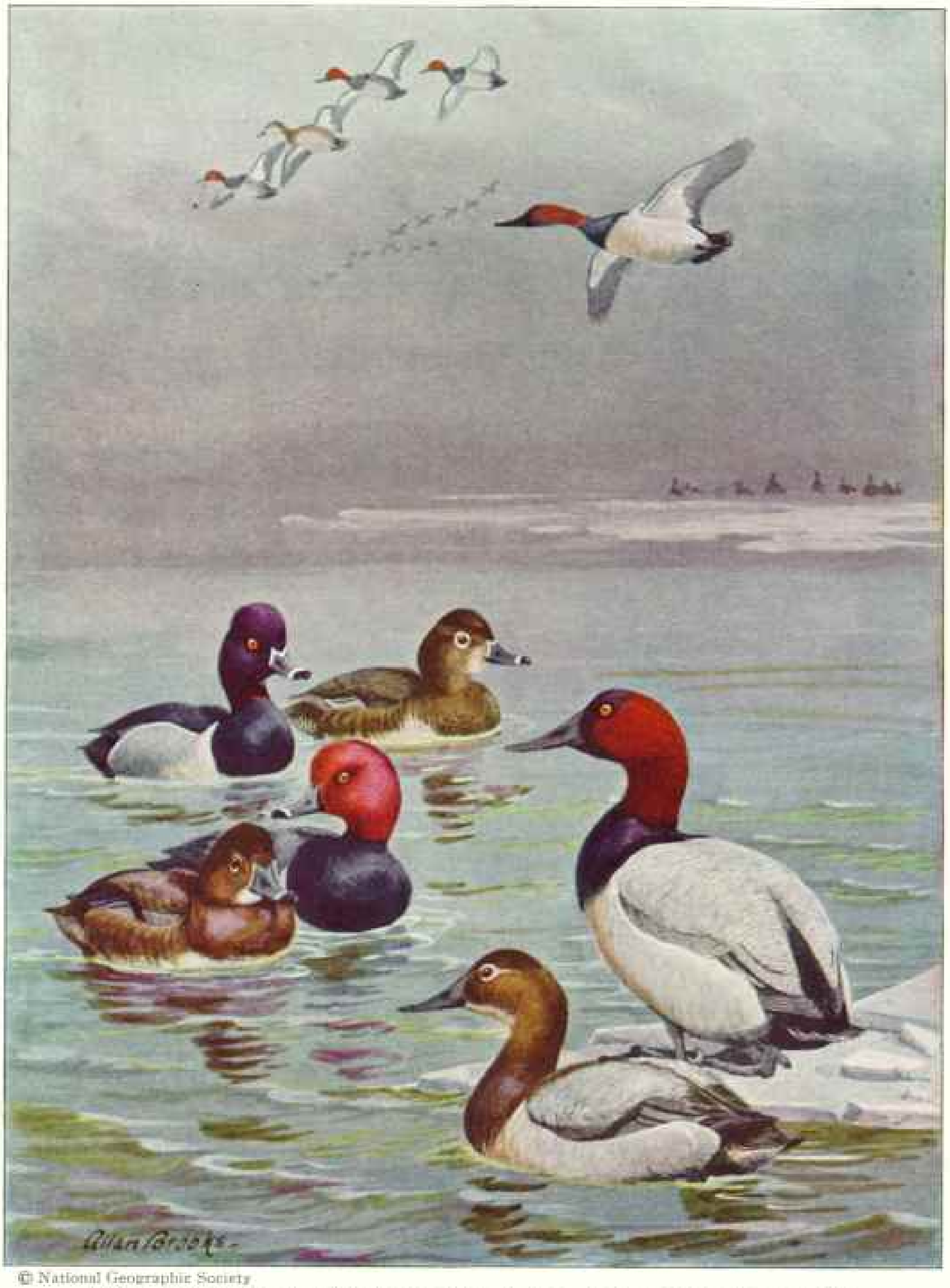
I have never found any of the following species indulging in this accessible but disgusting source of supply: pintail, baldpate, blue-winged and cinnamon teal, shoveller, and wood duck. All other ducks should be avoided under such conditions, but the taint can usually be easily detected in birds that have been indulging in this diet. Ruffle the breast feathers and the putrid smell is evident.

Of all ducks the newly hatched young of the green-wing are the most beautiful. The tiny balls of silky, olive-brown fluff marked



THE SHOVELLER USES ITS LUDICROUS BILL AS A GOLD MINER DOES HIS PAN

"Nuggets" sifted out of the mud are worms, tadpoles, shellfish, and seeds. Some shovellers, or "spoonbills" (left pair and alighting in distance) fly more than 2,000 miles over the Pacific Ocean from Alaska to their winter home in Hawaii. Small relatives are the West's cinnamon teal (pair in center) and the blue-winged teal (pair at right and trio flying at top), which sometimes migrate to central Chile and Brazil, farther south than any other North American duck.



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LORDLY BEARING STAMPS THE CANVASBACK A KING AMONG WATERFOWL

Hardy and strong, splendid flyers and divers, "cans" often stay in the north until the lakes are covered with ice (right pair and "single" flying). From breeding grounds in the far north and west many head for Chesapeake Bay regions, where they feed on "wild celery." Often flights of thousands parade across the sky. Close relatives are the redheads (pair in left foreground and group flying) and the ring-necked ducks (beyond), most widely and aptly called "ring-bills."

with golden yellow are a delight to the eye, and the picture of the little mother with her brood of maybe ten midgets, tightly massed and swimming close to her tail, is one never to be forgotten.

The nest also is a pretty thing, usually at some distance from the water, tucked away at the base of a small bush or bunch of flowers, the olive-cream eggs concealed by a blanket of dusky down.

The spring note of the male is very like that of the pintail, but in a higher key—a soft, broken little whistle often repeated.

European Teal

(Nettion crecca)

This, the Old World representative of our green-wing, has occurred casually and frequently along the Atlantic coast from Greenland to North Carolina. No doubt it occurs on the Pacific, as it breeds on the Aleutian Islands, but it may be easily overlooked. The females are indistinguishable from those of the green-wing. In the male the white crescent in front of the wing is replaced by a longitudinal line of white bordered by black on each side of the back (see Plate VII).

Blue-Winged Teal

(Querquedula discors)

The blue-wing is essentially a more southern species than the green-wing and its northern breeding limit is much farther south. It has been found nesting in almost every State in the Union and Canada, while its normal western limit is through the central portion of the western Provinces, although it is occasionally found farther north. It extends its winter migration farther south than any other North American duck—as far as central Chile and Brazil (see Plate VIII).

Its decrease in recent years on the Atlantic coast is marked by an increase on the Pacific. During the last few years this increase has been especially notable in British Columbia, where its gain is at least 500 per cent over the numbers of 20 years ago.

Much has been written regarding the great speed of the flight of the blue-wing. In this respect it should not be classed as swift as the green-wing, and most of the estimates of the speed of both species should be cut in half. Several times when traveling on a train going about 35 miles an hour, I have seen blue-wings flying parallel make several efforts to pass in front of the engine before they were able to do so.

The white patch in front of the eye and another in front of the tail, together with the dark coloration, make the drake blue-wing a conspicuous bird in summer, but all these characters are lost by mid-July, and the males are practically the same color as the females. The old drakes leave for the south before August, and I have never seen one among the bags of teal at the commencement of the shooting season. The full plumage is not acquired until after December, later than in any other duck.

In weight they will average two ounces heavier than a green-wing, or about one pound as a maximum.

Cinnamon Teal

(Querquedula cyanoptera)

This is a western duck, only stragglers of which have been found on the Atlantic coast, and it has a more southern breeding range than the blue-wing (see Plate VIII).

The center of its abundance is in the interior valleys of California, although it is fairly common in summer north to about latitude 52°. East of the mountains, it becomes scarcer and it is a rare bird in Montana or Saskatchewan.

Cinnamon teal in the summer are confiding little birds, and it is a pretty sight to see the handsome red male with his inconspicuous spouse sunning themselves among the bright-green grasses at the margin of some small pool. They allow a very close approach before the female jumps into the air, closely followed by her handsome mate, and usually they will settle again within 40 yards, or else return to their starting point.

The females and young of the cinnamon and blue-winged teal are practically indistinguishable. Although works of reference point to differences in the size and shape of the bill and color of the breast, these distinctions are not infallible. In spite of this similarity among the females, hybrids are of exceptional occurrence, even when the two species are kept in confinement together.

I have twice seen fights between males of these two ducks. In each case the cinnamon was the winner.

Although classed as a teal, this duck, as well as the blue-wing, is more closely related to the shovellers, both in structure

and coloration, as well as feeding habits. This affinity is very apparent when the species of shoveller inhabiting South America and Australia are compared. The South American shoveller is colored like a cinnamon teal, while the Australian has the markings of a blue-wing.

Shoveller

(Spatula clypeata)

The shoveller, more commonly known as the "spoon-bill" or "spooney," has, like the gadwall, an almost world-wide range. In the New World it reaches in summer to the subarctic regions, but the main nesting ground is on the prairies of the Canadian Provinces and the northern tier of States. In winter it reaches Central America and even the Hawaiian Islands (see Plate VIII).

Aside from the tremendous bill, the shoveller is full of character. When feeding it is a dabbler, sifting the mud through its specialized bill with a lateral motion, rarely tipping up as other surface-feeding ducks do. It rises from the water with a jump, and the rattle of its wings as it does so can be picked out above the noise of other rising ducks. When settling this rattle is once more in evidence, and it alights almost vertically with hardly a splash.

The old historians, such as Alexander Wilson, rated it high as a table bird. "An old hunter will never pass up a spoonbill even when after canvasback." But anyhow, in the West it is not ranked so highly, and it is seldom shot where better ducks are available.

When first hatched the young have a bill shaped as in other surface-feeding ducks, without any evidence of the spatulation that characterizes the older birds.

In size the shoveller is small medium, a fat bird weighing one pound twelve ounces.

Canvasback

(Nyroca valisineria)

This fine duck, so often called the "lordly" canvasback, is distinctly an American bird and has never been recorded outside of its North American range. It breeds from Alaska and Great Slave Lake south to northern New Mexico and in winter reaches well down into Mexico (Plate IX).

Epicures first made the canvasback's reputation, and along the Atlantic States where it can get a plentiful supply of its favorite food, the wild celery (*Vallisneria*), which grows so abundantly in the brackish water of Chesapeake Bay and other similar inlets, it is certainly an outstanding bird. But where this water weed does not grow, the canvasback is not superior to the redhead or many species of surface-feeding ducks. On the bays of the Pacific coast, where shellfish form its principal diet, it becomes almost uneatable.

With the canvasback we start the series of diving ducks, and with its huge paddles of feet, heavy body, and rather small wings, it forms a typical representative of this group.

Aside from its reputation as a table delicacy, there is something regal and outstanding about the canvasback. All its actions are full of character. The big white body that seems to sit so high on the water, surmounted by the slender-shaped head on the long, thick neck, forms a striking picture.

But when a flock is in full flight the big birds are seen at their best. There is such power expressed in the speed and directness of their driving flight, usually made in line formation, that it seems to stamp the "can" as a superduck wherever it is found.

On its nesting grounds it is an early breeder. A full month before its congeners, the scaups and redheads, have started to lay, you can find the female seated on top of a huge pile of rushes, often anchored in water two feet deep and some distance from the shore, with very little attempt at concealment.

She often has a trick of choosing some small pond or slough quite a distance from the larger one that is frequented by the lordly males. Very soon these desert the breeding grounds and leave to the females all the cares of the coming family.

While the canvasback is no larger than a mallard, it is a heavier bird. I would regard four pounds as a maximum weight.

Redhead

(Nyroca americana)

The redhead has a decidedly more southern breeding range than the canvasback, ranging from the center of the Prairie Provinces and British Columbia south to southern California. In winter it does not reach farther south than Mexico (see Plate IX).

The redhead is one of the least maritime of all diving ducks. On the Atlantic it may be found on the brackish inlets, like Chesapeake Bay and Pamlico Sound, in large numbers, but on the Pacific it is practically

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THE RUDDY DUCK IS KNOWN BY 81 DIFFERENT NAMES

With fanlike tail, bull neck, and pugnaciously uptilted bill, a ruddy, alias "fool duck," "sleepy duck," "blatherskite," and so on, proudly escorts his lady. Near the shore, fat male ruddies in winter plumage struggle to rise from the water. Two lesser scaup ducks, sometimes called "blackheads" and often seen in huge rafts on the bays and inlets of the Atlantic coast, swim toward the left, leading a pair of greater scaups, also portrayed above in flight.

NATURE DAUBED THESE DUCKS WITH BOLD, WHIMSICAL STROKES

Fantastic is the harlequin, perched on the rock with his mate, while others fly overhead. The pair in the right foreground and the "single" above are American golden-eyes, nicknamed "whistlers" from the sound of their wings. At the left is a cousin, Barrow's golden-eye. Just in front of the rock and flying low over the water are small kinsmen, bufflehead. The male, with broad white bonnet, has a "swelled head" when he erects his feathers.

unknown on salt water. This fact makes it one of the best of all diving birds for the table.

It is a beautiful sight in southern British Columbia to see the return of the redheads at the first sign of spring to the large lakes of the interior. The first break of the winter conditions used to bring them pouring in (I say used, for they no longer do so) until many hundreds were bedded together out in deep water. These were at first nearly all males in high condition both as to weight and plumage. As darkness fell, the air was filled with the mewing call of the males, exactly like the mew of a cat. This is the spring note, and I have never heard it in the fall.

I know of no lake in the Province where this early movement occurs nowadays, and the birds have quite changed their habits, being found on the small upland ponds where they never used to occur. To nest they resort to lakes with a heavy growth of rushes. One lake close to my home has as many as 300 pairs on the three miles of its length. But hardly any young are reared, although crowds of the little golden downies may be seen in the rushes in July and early August.

One year the nests were badly drowned out by the damming of this lake for irrigation supply; so the ducks laid their eggs in any kind of nest that survived. Some extraordinary combinations of mixed eggs were to be seen.

A little pied-billed grebe whose floating nest had survived was having a hard time, as, in addition to her own eggs, three coots' and two redheads' had been imposed upon her. The little mother was furiously engaged in trying to eject the latter, three times the size of her own, and I saw her at last succeed in rolling one of the huge eggs into the water.

Even under ordinary conditions some ducks have this cuckoolike habit and the redhead is particularly casual in this respect.

Redheads may be classed as large-sized ducks, but the weight of even large, fat birds will be under three pounds.

When feeding in deep water—and they can bring up their duck-weed food from a depth of 40 feet or more—redheads are commonly attended by baldpates and coots. Both of these watch the redhead's return to the surface, its bill full of weed, and this is deftly tweaked away, without any protest from the much-enduring redhead, which at once proceeds to dive for a fresh mouthful. This goes on for hour after hour until all are satisfied.

Ring-Necked Duck

(Nyroca collaris)

"Ring-bill" is a commoner and much more appropriate name than ring-neck for this little duck. The ring on the neck is an obscure character confined to the old males, but in life the two bands of brilliant white on the bill are a conspicuous character in both sexes (see Plate IX).

"Black-jack" is another common local name, but this is also shared with the lesser scaup.

The range of the ring-neck is very much the same as that of the redhead, even more southerly, and it is rare or absent from the New England States and along the northeastern coast of Canada.

Usually the ring-neck is compared to a lesser scaup, which it resembles in size; also, the black heads of the males are similar. But actually it is a very close relative of the redhead, the female ring-neck being a miniature of the female of that duck.

Ring-necks are very fast flyers; few ducks can equal them when going at full speed.

Of late years the species has shown a decided decrease throughout its range. That may be only temporary, as it has always been a duck which showed wide fluctuations between abundance and scarcity.

Ring-necks are usually exceptionally fat and will weigh from one pound and a half to a few ounces heavier in this condition, which classes it as a medium-small duck.

Greater Scaup

(Nyroca marila)

Scaups, more generally known as "blue-bills," "blackheads," and "raft ducks," are divided into two species, the great similarity of which is responsible for much confusion, especially in the delimitation of their nesting ranges (see Plate X).

The greater scaup is an Arctic-nesting species, breeding along the northern rim of the continent north of the tree limit, east to the Hudson Bay region; it winters as far south as California and the Gulf of Mexico, where it is much scarcer than the lesser scaup.

It is also found over the whole northern portion of the Old World.

Scaups are hardy birds and the most maritime of the "pochard" group of ducks, which includes the canvasbacks, redheads, and ring-necks in America.

In the stormy waters of our northern coastline they can be seen holding their own with the typical sea ducks—eiders, scoters, and old-squaws—diving just outside of the line of tumbling breakers for the shellfish which constitute the food supply of all these birds. At such times they are "fishy" and practically uneatable, but when found inland their food is much the same as a redhead's and they are then excellent eating.

Greater scaups may be called large medium ducks, weighing in good condition about two pounds, with two and a half as a maximum.

Lesser Scaup

(Nyroca affinis)

Lesser scaups are much smaller-sized birds than the preceding species, but even at that the weights will overlap. To distinguish them reliance must be placed on the much smaller bill, the purple instead of green reflections on the head, and the smaller extent of white on the wing in the smaller species. The last-named character is the most reliable, the inner primaries, or long flight feathers, having their outer webs white in the greater scaup and pale brown in the lesser (see Plate X).

The breeding range of the lesser scaup is well to the south of that of the greater. It extends well up into Alaska and northern Canada, south to the northern Prairie States and southern British Columbia. Throughout this range it is one of the commonest ducks, nesting both in small ponds and larger lakes, wherever plenty of cover is available. For this is a marsh breeder and the nest is always close to water and usually has a waterway, such as a muskrat's passage, leading to it. It is a late nester and young broods are sometimes unable to fly when the first ice of the early northern fall is forming.

The "little blue-bill," the commonest name of this duck, is of universal distribution, but generally speaking it is more of a marsh lover and less of a seacoast duck than its larger relative. In the winter it is the common and confiding duck you see along the Indian River in Florida, on the bayous of Louisiana, or the sloughs of California, and it is seldom molested where better ducks are available. Under such conditions it often becomes so tame that it will take bread from the hand.

At its nesting grounds it is equally confiding and I have often stroked the sitting birds as they sat on their nests. An exceptionally charming sight was a drove of 40 dusky ducklings headed by one mother, while the other three females acted as whippers-in of their united broods. This was on their breeding grounds in central British Columbia.

Lesser scaups may be classed as of small medium size, or exactly the same as the ring-neck in weight.

Ruddy Duck

(Erismatura jamaicensis rubida)

No bird rejoices in a greater assortment of vernacular names than this curious little duck. A full list of these may be found in Dr. J. C. Phillips' wonderful work, "A Natural History of the Ducks." In few regions of America is it known to duck-shooters by the same name. Many of these are attractive in their vulgarity and depict the comical appearance and quaint actions peculiar to this duck (see Plate X).

The ruddy is a duck of southern distribution, nesting from southern Canada through all the States into Mexico. It is notable among ducks for many characteristics. Chief of these is the faithfulness of the male in his parental duties. As soon as the young are hatched—and these are huge compared to other downy ducks—the male escorts them in all their forays for food. Not that he interrupts the continuance of the bobbings and gulpings that constitute his display during the breeding season, but he ever keeps a watchful eye for danger, ready to fight any bird or mammal, regardless of size, that threatens his charges.

This courage, not to say irascibility, is common to both sexes. I once found a small female being tumbled about in the surf of the Pacific. Slammed down on the sand by each breaker, she pulled herself together and met the towering descent of the next with wide-open beak and stretched to her full height. I managed to capture her and carried her across the sand dunes to a spot where I had my canoe on a protected lagoon.

Placed on the floor of the canoe, she kept up a determined attack on my feet until I released her at a suitable haven, where she sat on the water scowling at her deliverer.

MOTHER EIDER DUCK LINES HER NEST WITH DOWN PLUCKED FROM HER OWN BREAST

In Iceland and parts of Europe man provides nesting sites and in return takes some of the eider down for quilts and coverlets. In the right foreground is a pair of American eiders of the North Atlantic coast with another drake flying above them. Near the North Pole dwells the king eider (left pair in foreground). Garrulous old-squaw ducks dressed for winter swim beyond; three others in summer garb fly above.

ESKIMOS KILL EIDERS WITH CLUBS AND MAKE THE SKINS INTO CAPS

A favorite victim is the spectacled eider (left pair and "single" flying) when in summer it is molting and cannot fly. Pacific eiders, lazily floating in center, are the largest of North American ducks. In contrast, Steller's eider (right pair) is small, trim, and swift on the wing. All three kinds live in the freezing waters off Alaska and Siberia.

A final wave of the paddle towards her was regarded as an insulting climax and she hurled herself forward, seized the paddle in her bill, and hung on like a bulldog.

There is a marked discrepancy in size between the sexes of the ruddy duck. The male might be called small medium, slightly smaller than a little blue-bill, about a pound and a half. The female is decidedly small.

The wonderful color of the bill in the male must be seen to be appreciated. During the nuptial season it is a vivid turquoise blue, and this, with his bull neck, striking colors, and tail held cocked over his back like a wren's, make him notable in any company. In the fall and winter the plumage changes and the bill is dark gray.

American Golden-Eye

(Glaucionetta clangula americana)

More commonly known as "whistler" or "whistle-wing," the golden-eye belongs to a group of ducks characterized by striking pied plumage in the males and a tree-nesting habit. The last character limits their nesting range to regions where trees are large enough to afford them nesting sites.

The American golden-eye's breeding range follows the tree limit of the subarctic forest and extends south to southern British Columbia and east through the northern tier of States to Maine. Its winter range is governed by the ability to find ice-free water, but on the Pacific coast it extends to Baja California (see Plate XI).

Golden-eyes of both species are notable for the chiming music of their flight; this whistling is peculiar to the old birds, especially the males. Younger birds fly with no more noise than other ducks.

They nest in hollow trees and very often they have to go far from the nearest water to find a suitable hole. This entails a long tramp for the newly hatched brood, often over rough ground, and these journeys are fraught with many dangers from predatory birds and mammals.

Settlers in regions where golden-eyes nest are often surprised by females coming down their chimneys while searching for suitable nesting holes, while in the Old World the habit is turned to account by putting up nesting boxes and utilizing some of the eggs and down.

As in all the members of this group, the male golden-eye is very much larger than the female and weighs as much as two and a half pounds in good condition. Females may be called small medium in size, with a weight of one and a half pounds.

Young males are nondescript-looking birds and do not acquire the full plumage until their second winter.

The golden-eyes of the Old World are slightly smaller than the American subspecies.

Barrow's Golden-Eye

(Glaucionetta islandica)

Barrow's golden-eye and the harlequin duck are alike in possessing an extraordinary range. Both breed in Iceland and southern Greenland, and also in the Rocky Mountains and the region from these mountains west to the Pacific. But their summer homes are almost or entirely deserted in winter, the ducks of the Iceland colony being found along the northern American coast from Newfoundland to New England, and those of the mountains wintering on the Pacific coast (see Plate XI).

In the regions between these two colonies the species are unknown except for a very occasional straggler.

Barrow's golden-eye is also notable in being a thoroughly distinct species which any child could separate in the plumage of the adult male, but the females and young males are almost indistinguishable from the American golden-eye. The shape of the bill, which in Barrow's is tapering, with a raised nail, is the infallible distinction.

In the interior of British Columbia Barrow's golden-eye is a common bird. Every pond in the rolling foothills has a pair or more, as soon as it is free from ice in the spring. By early June the handsome drakes have returned to the seacoast from whence they came, and soon after the females and their broods may be seen. The latter are pitifully small as a rule. On their journey from some hollow tree, a long way back in the wooded hills, they have had to run the gauntlet of various enemies.

Even when the lakelet is reached, their troubles are not over. Crows and magpies watch for every chance to get a duckling separated from the mother, and the latter as well as the young may fall victim to the red-tailed hawks nesting in the neighborhood.

These hunt the ducks in exactly the same manner in which the bald eagle gets them in their winter quarters—they follow the course of the diving birds while hovering over the victims and pick them up deftly as they come to the surface.

"Broods" of one are common and once I saw a single young one attended by two mothers, one a golden-eye and the other a bufflehead.

But for this incessant persecution Barrow's golden-eye would be a common species, as the birds have almost all left for the salt water, where no one molests them, before the opening of the shooting season.

A few Barrow's golden-eyes winter in rapid water of mountain streams, where even an occasional old drake may be seen at that season. These birds seem to be visitors from the northern mountain region and arrive in winter after the resident birds have left for the coast.

Bufflehead

(Charitonetta albeola)

The bufflehead is another duck that is peculiar to North America and of an unique type. Like the golden-eyes, its breeding range is governed by the character of the country that affords it nesting sites. This is found from the Hudson Bay region through the northern Canadian Provinces to Alaska and south in the mountains to northern California. In winter it extends to Florida and Mexico: also, as a straggler, to Bering Island, Hawaii, and the British Isles (see Plate XI).

Buffleheads, or "butterballs," as they are usually called, have a reputation for diving "at the flash," which does not seem to be warranted when they are compared to other diving ducks. Old-squaws and harlequins have always seemed to me to be quicker.

At their nesting grounds they are more than usually engaging; even while the males are still displaying to attract the females, the latter are apt to fly off in search of a nesting hole. These, in my own experience, are invariably the nest holes of the flicker, which run between three inches and three and three quarters inches in diameter.

In selecting the hole, the little female clings to the edge like a woodpecker and peers into the depths of the cavity. The ivory-colored eggs are laid on the chips at the bottom of the hole and later a mass of white down is added. Several times I have sawed out the hole with a keyhole saw right down to the sitting bird, and on lifting out the front the little duck would be disclosed snuggling in the snowy puff of down.

Like the golden-eyes, the female is much smaller than the male. The latter can be classed as small, weighing about a pound and a quarter, but the tiny female weighs less than a pound.

Harlequin

(Histrionicus histrionicus)

The harlequin has been divided into an eastern and a western subspecies, but the distinction is barely recognizable. Under "Barrow's Golden-Eye" allusion has already been made to its extraordinary distribution. Harlequins are exceptionally maritime ducks, frequenting the outer reefs. Here they feed in the tumbling surf, climb out on the rocks to rest, and run nimbly to their topmost peaks. It is exceptional to see them in quiet inlets or bays in the winter (see Plate XI).

When the spring is well advanced, harlequins appear on the mountain lakes of the interior, from Alaska to California, and ascend the rivers until these become foaming torrents of glacial water. Here is their summer home, and they find the turmoil of these cascades as easy to negotiate as the breakers of the storm-beaten coast.

As soon as the eggs are laid the males desert the females and reappear on the seacoast, often hundreds of miles from their nesting quarters. Here they molt their striking plumage to one that resembles the female dress, becoming flightless as the wing feathers are shed. Flocks of these "flappers" may be observed, giving rise to the stories of young broods on salt water.

Females and young follow in the early fall as soon as the young can fly, and at only a few points can the harlequin be seen throughout the winter anywhere in the interior.

The nest is made in a cliff, steep bank, or log jam.

The harlequin is a small medium duck, about the same size as an old-squaw, and like that duck the sexes do not differ much in size, being about a pound and a half in weight when in good condition.

Old-Squaw

(Clangula hyemalis)

The old-squaw, or long-tailed duck, is a circumpolar species, being found without variation in the northern portions of both hemispheres. In America it breeds on all the Arctic tundras from Atlantic to Pacific and south along the mountain ranges into extreme northern British Columbia. In winter it can be found at times as far south

UNEASY ACTIONS OF AMERICAN SCOTERS SOMETIMES FORETELL A STORM

Largest of these tough, deep-diving "sea coots" is the white-winged scoter (right pair, and young drake taking off). The surf scoter (left, female, male, and alighting on water in distance) thrives on shellfish, swallowed whole. In the near background a pair of American scoters swims in characteristic "chin-up" fashion, the lady first; others flash silvery under-wing feathers in flight.

THE MERGANSER'S BILL IS EDGED WITH SAWTEETH SO THE BIG ONES WON'T GET AWAY

Even during a New England winter "sawbills" may be seen, swimming and diving for fish in the cold open stretches of a rapid stream. They usually nest in hollow trees. Rivers and other inland waters are frequented by the American merganser (left foreground, drake and hen). The beautiful hooded merganser, on the dead limb with his mate, likes small ponds. Both seacoasts and inland waters are visited by red-breasted mergansers, pair swimming and drake in swift flight.

as California and Florida on the seacoasts and many winter on the Great Lakes (see Plate XII).

Here they are caught at times in nets set in deep water for ciscos, a species of herring. In 1917 Mr. W. E. Saunders, investigating reports of large numbers being caught and utilized for fertilizer, found at one factory 12 tons of these ducks, estimated at 1,500 birds to the ton.

On the Pacific coast the old-squaw is decreasing each year. Not more than 10 per cent of their former abundance can be found on the waters around Vancouver Island, and no cause, such as the catastrophe of the Great Lakes, is apparent. As it is never hunted in these regions by man, the loss must occur at the nesting grounds and may be caused by loons.

The old-squaw is a vivacious duck, both when swimming and in flight. On the water the tail is carried low; when feeding, often dragging on the surface; but when courting and displaying, it is held almost erect and the male then presents a beautiful appearance. Sitting lightly on the water, with head held high, he utters his musical cry again and again. This cry has been syllabified in nearly all its vernacular names and, as Dr. Phillips puts it, "more ink has been devoted to describing the call of the male than is the case with any other duck."

The call must be heard to be appreciated fully. It has the sweep of a saber in its final inflection and the emphasis on the second syllable is the keynote. Probably its New England name gives the best idea of this—"South-south-southerly." The call is repeated again and again on the wing, and in flight no duck can surpass the old-squaw.

The short neck and long, pointed wings, dark above and below, are the field marks that distinguish it. In flight the bird is impetuous, tilting from side to side, and as erratic as a sandpiper or plover.

King Eider

(Somateria spectabilis)

Eiders are specialized sea ducks with peculiarities of coloration common to all the species that comprise the group. The drakes have black or dark underparts with the back mostly white, and all have more or less "eider green" on the head. The females are handsomely marked and suggest the coloration of some of the larger species of grouse. Both sexes have the tertials, the basal flight feathers of the wing, strongly sickle-shaped. Except for one species, they are all large to extra large-sized ducks (see Plate XII).

The king eider is of circumpolar distribution, nesting along the Arctic coasts of both hemispheres and wintering for the most part along our northern shores. Of all the eiders it is the one that is most likely to be taken south of its natural range as a straggler, and has turned up as far south as California, Georgia, and some of the Central States, as well as frequently on the Great Lakes.

The keel-like erection on the forehead at the base of the bill in the male is a seasonal adornment, shrinking materially at the close of the breeding season when the drakes go into eclipse, and assuming its fullest expansion only as the nuptial season returns.

This eider is a very large duck, although considerably smaller than the Pacific and American species.

American Eider

(Somateria mollissima dresseri)

The American eider, a subspecies of the eider of the Old World, nests from the southern portion of Hudson Bay and Labrador south to the coast of Maine. In winter it is found but little south of its summer range, rarely as far south as Virginia (see Plate XII).

Like all the eiders, this is very much of a sea duck and, like the harlequin, it frequents the outer reefs and rocky stretches of storm-beaten coast. The food is almost entirely shellfish and the flesh of all eiders is strong and rank in consequence. They are now protected at all times in the United States and Canada, except on the Arctic coasts.

Eiders are among the best known of ducks, owing to the quality and commercialization of their down. On parts of the Canadian coast this is affording a considerable revenue and eventually the "farming" of the birds will be as carefully systematized as it is in Iceland. There the protection of centuries has produced a semi-domesticated condition where the ducks have nesting places made for them, sometimes even inside the homes of the people, who take the first layings and the down.

The spring notes of the male are a musical cooing, but without the resonance of voice that is found in the old-squaw.

One of the largest of ducks, the American eider will weigh five to five and a half pounds when fat.

In Greenland, northern Labrador, and west to the northern Arctic islands, a closely allied subspecies occurs—the northern eider, *Somateria mollissima borealis*, differing mainly in bill characters. This form is found associated with the resident American eiders in winter as far south as Connecticut.

Pacific Eider

(Somateria V-nigra)

This, the largest of North American ducks, replaces the species *mollissima* on the western Arctic coasts of America and the eastern portion of Siberia, also nesting on the Aleutian Islands and the Alaska Peninsula. On account of its range along the Arctic coast, it is very likely to occur in winter in the interior of America and has already been taken twice in Manitoba.

The principal mark of distinction from the eiders of the Atlantic is the conspicuous black V, point foremost, on the white throat of the male, from which it gets its scientific name (see Plate XIII).

In habits it does not differ from the Atlantic species, but no attempt has been made to commercialize its down product. Large numbers are shot by the Eskimos for food, even in the spring, but it still persists in vast numbers in its Arctic habitat.

I can find no record of its weight, but as it is considerably larger than the Atlantic species, this must be in the neighborhood of six pounds.

Spectacled Eider

(Arctonetta fischeri)

No bird or mammal better deserves its common name than the spectacled eider, the eyes in the male being surrounded by short, velvety feathers with a black rim around the outer edges of these circular patches. Even in the female these "spectacles" are defined in light-colored patches around the eyes (see Plate XIII).

A duck with a very restricted range, the spectacled eider breeds along the Arctic coast from Point Barrow westward and down the coast of Bering Sea to the mouth of the Kuskokwim River. Even in winter it is not found much to the south of this region. In Siberia it is found west to the Lena River.

The spectacled eider feeds in shallower water than do most eiders and is said to dabble or "tip up" like surface-feeding ducks to some extent.

Although a large duck, it is smaller than any of the preceding species of eiders.

Steller's Eider

(Polysticta stelleri)

The smallest of the eiders, this species is of the same proportionate size to the larger species that a teal is to a mallard.

In northwestern America Steller's eider nests throughout the same restricted area as the spectacled eider, but is found much farther along the Siberian coast than that species. In winter it is found as far south as the Kurile Islands and eastward to northern Norway. It may even nest in the latter region (see Plate XIII).

Steller's eider is a trim duck with little of the heavy appearance of other eiders, and the shape of the bill suggests that of the extinct Labrador duck (p. 486). But the coloration is essentially that of an eider and the sickle-shaped tertials are similar.

It is a frequenter of rocky shores and seeks its food in deep water, often in company with harlequins and old-squaws.

On the wing it is very swift, as might be guessed from its long wings which whistle like a golden-eye's.

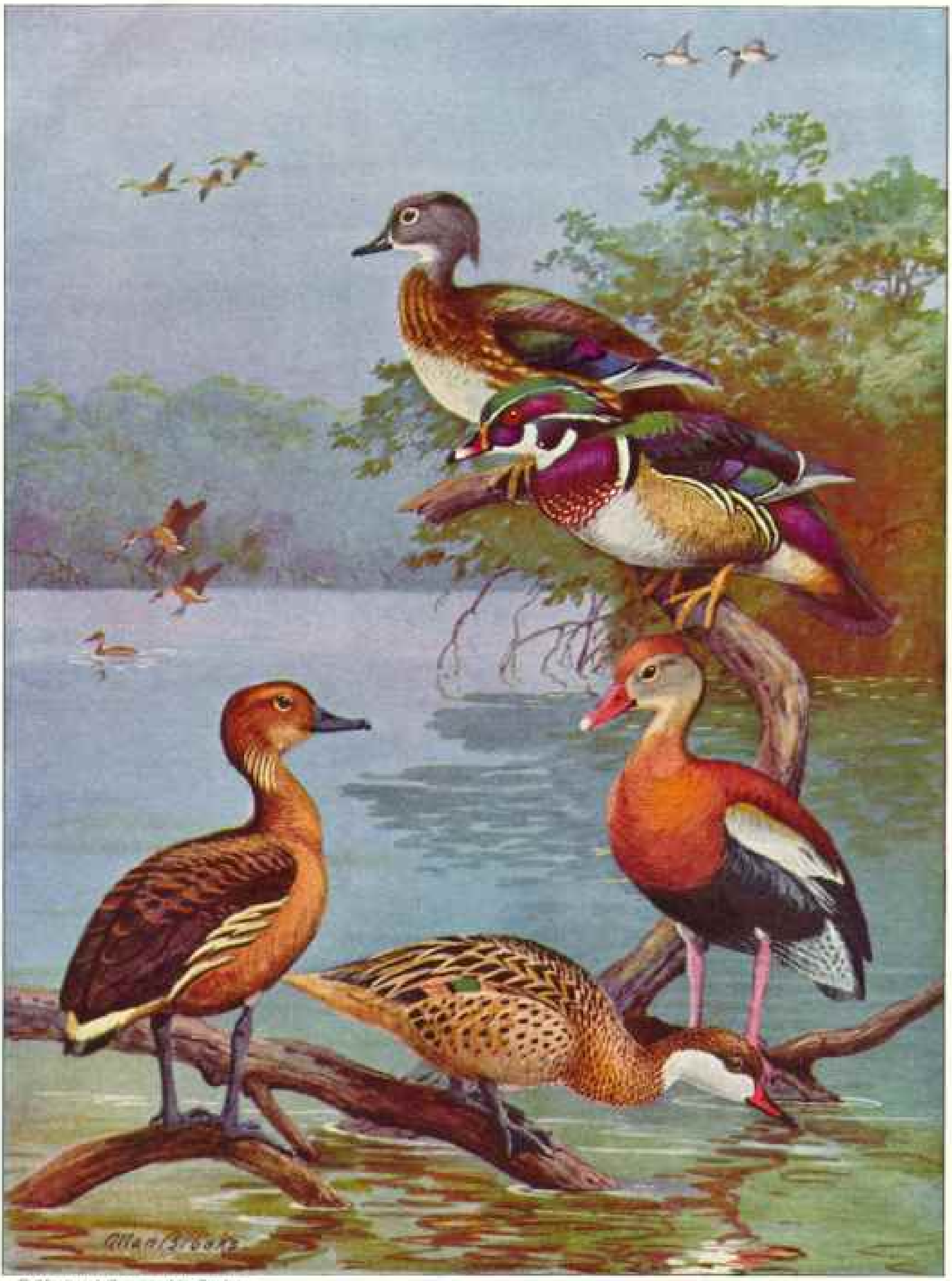
White-Winged Scoter

(Melanitta deglandi)

Scoters are sea ducks of large size and dark coloration, black in the males and dark brown in the females. They are not confined to salt water but require large bodies of deep water for their inland homes. Five species are found throughout the Northern Hemisphere, of which three are North American (see Plate XIV).

The white-winged scoter is represented in eastern Asia by a closely allied subspecies, the Asiatic velvet scoter, and in Europe by the European velvet scoter, *Melanitta fusca*; the latter has occurred in Greenland. The white-winged scoter is the commonest of the three American species. It nests from Alaska to Ungava Bay, south to North Dakota and the Gulf of St. Lawrence. In winter it is found in large numbers along both coasts south to South Carolina and Baja California, on the Great Lakes and many inland bodies of water.

On the Atlantic coast the "white-winged coot" is hunted to some extent, but on the Pacific it is rightly regarded as unfit for



A MASTERPIECE OF NATURE IS THE WOOD DUCK'S GORGEOUS SUMMER COAT

He clings to the dead branch just below his less showy spouse, while another pair flies above them. True to their name, they often wander into the woods, far from water, to eat insects or swallow acorns whole. Their nest is in a hollow tree, or even in a farmer's hayloft, and their numbers are increasing, thanks to protection. From the South come the long-legged and broad-winged tree ducks (black-bellied, extreme right; fulvous, left and flying above). The sleek and elegant Bahama duck (lower center) occasionally reaches American shores.

food even by the coast Indians, who have a decided penchant for the *haut goût*. The latter eat gulls, guillemots, and even eagles, but as for a scoter, "too much smellum inside," as an old Haida told me. Around the wharves of many Pacific ports these scoters can be seen diving along the piles beneath one's feet and they are equally at home in the surf of some wind-swept shoreline.

It is a fine sight to see the overland migration of these birds when on their way to their nesting grounds. I have often been in the line of their flight from the Puget Sound region to the valley of the Mackenzie River. Often they will rest at some deep water lake en route, flock after flock pouring in from high in the air until thousands are bedded down, every bird with its bill buried in the feathers of the back and actually fast asleep. They never feed under such conditions, but continue their flight a day or two later. Resuming their journey, flocks get up separately, usually just after sunset, and indulge in a sort of march, the separate flocks passing and repassing in all directions until at last, having acquired the requisite altitude, they all move off to the northeast in wavering lines high over the mountain tops.

The males return by the same route in small flocks often as early as the first week in July, the females and young following about three months later.

White-wings are the largest of the scoters. A big male will weigh as much as four and three-quarters pounds, the females a full pound less.

Surf Scoter

(Melanitta perspicillata)

The surf scoter is much the smallest of the three scoters. Its range is almost exactly the same as that of the white-winged scoter, the nesting range not quite so far south—extreme northern British Columbia, the northern section of the Prairie Provinces to James Bay and the Gulf of St. Lawrence (see Plate XIV).

It is outnumbered by its larger congener in all its winter resorts and is quite scarce in the interior lakes.

In actions and habits it is but little different from the white-wing, being the same low-flying, clumsy-rising duck. Its most striking characteristic is the deep whistling of the wings, which is made only when the bird is rising and again for a few strokes before alighting.

Of American ducks only the two species of golden-eyes, the present species and Steller's eider, make this musical noise with their wings, and it is pronounced only in the case of adult birds.

Surf scoters of all ages can be distinguished from all other ducks in life by their action when alighting. As the bird touches the water, the wings are extended upward and held so, as the body plows through the water to a standstill.

The eclipse present in nearly all northern ducks is absent in all the scoters. In the surf scoter the white patch on the nape of the neck is deciduous and falls out, leaving a smooth, black-feathered surface during the late summer months. Much care should be exercised in identifying the species of scoters by the white head markings, especially in the case of females and young birds.

The surf scoter can be called a large duck, males weighing as much as three pounds. Females are very much smaller and should be classed as medium in size, weighing about two pounds.

American Scoter

(Oidemia americana)

The range of this scoter is very northern in the breeding season, when it is found from eastern Siberia along the Arctic coast of America to Newfoundland. In winter it is found on both coasts and also on the Great Lakes (see Plate XIV).

My own experience with the American scoter is limited to the Pacific portion of its range, where I have found it to be absolutely and exclusively maritime, all the so-called records of the species from inland localities proving to be merely all-black specimens of the surf scoter, a common condition in the late summer.

In life the American scoter is an utterly different duck from the other two species. Like the harlequin, it loves the exposed rocky points and beaches, rarely seeking shelter even in exceptional weather. Also, like the harlequin, it is an active, restless duck, much given to rambling flights. In fine weather the males, often four or five to each female, pursue and surround the latter like a bodyguard. These flights are more common in fine, calm weather, when numbers of little parties may be seen turning

and twisting in the air, to return eventually to the starting point. The call of the male is musical, with a mournful and haunting cadence, and is uttered continually both on the wing and in the water, even sometimes when conditions are stormy.

Much has been written as to how to distinguish the scoters in life by the character of the white markings, but to anyone who knows the American scoter it stands out from the others by the carriage of the head when on the water. This is held high, as a rule, the bill always horizontal or even tipped up, never deflected downwards, as in the surf and white-winged scoters. On the wing the American scoter has a much finer flight, the underside of the flight feathers showing silvery in both sexes.

The American scoter is a large, heavy duck, males weighing three pounds or even more, the female about two and a half.

Hooded Merganser

(Lophodytes cucullatus)

This is another duck peculiar to North America, although, like some others, it has occurred as a straggler in Europe. The hooded merganser's range is a rather southerly one, as it nests in nearly all the States that provide it the requirements of hollow trees, north to northern British Columbia and the wooded portions of the Prairie Provinces, while in the East it does not nest north of southern Ontario and New Brunswick. In winter it may be found as far south as Mexico and north to southern British Columbia (see Plate XV).

Its range and requirements very closely parallel those of the wood duck, and, like that species, it loves the wooded ponds and winding, slow-running streams in preference to large bodies of water. Its safety must suffer from such an environment and its numbers certainly do show a decrease, but how much this is due to the clearing away of the timber along the streams it loves and to the decrease in nesting facilities it is hard to say. Certainly it is able to take care of itself under the most dangerous conditions, and very few adult birds, especially males, are shot.

The nest is in a hollow tree, usually very close to water, and the eggs are unique among those of American ducks, being very round, of an ivory-white color, with the shell very thick. The downy young are unlike those of any other duck.

The beautiful flattened crest of the male hooded merganser is only rarely displayed in all its beauty. When feeding it is folded down, and in flight there is never the slightest indication of it, the head being held straight out like a slender stick, while the small wings move with great rapidity, giving an appearance of speed even in excess of the really rapid rate that it achieves.

There is not much difference in the size of the sexes, and this merganser may be classed as a small duck of a little more than one pound in weight.

American Merganser

(Mergus merganser americanus)

This is the largest of the mergansers, or "sawbills," and it has a wide distribution in North America, from Alaska to Newfoundland in summer, and south in the mountains to California and New Mexico in winter, wherever open water and food conditions are to be found (see Plate XV).

A line of these handsome birds resting at the water's edge along some gravel bar is a beautiful sight. The sun reflected from the water on the deep cream of their breasts makes them glow like gold, showing off the coral red of their feet.

Just how much damage they may do to game fish is dependent on local conditions; where coarse fish abound, they do not bother trout much, and where bullheads are plentiful on the spawning beds of trout and salmon, the merganser is a positive benefit. But where trout and small salmon are the principal fish inhabiting a stream, the presence of sawbills is disastrous, as their voracity means the destruction of large numbers of fry and larger fish.

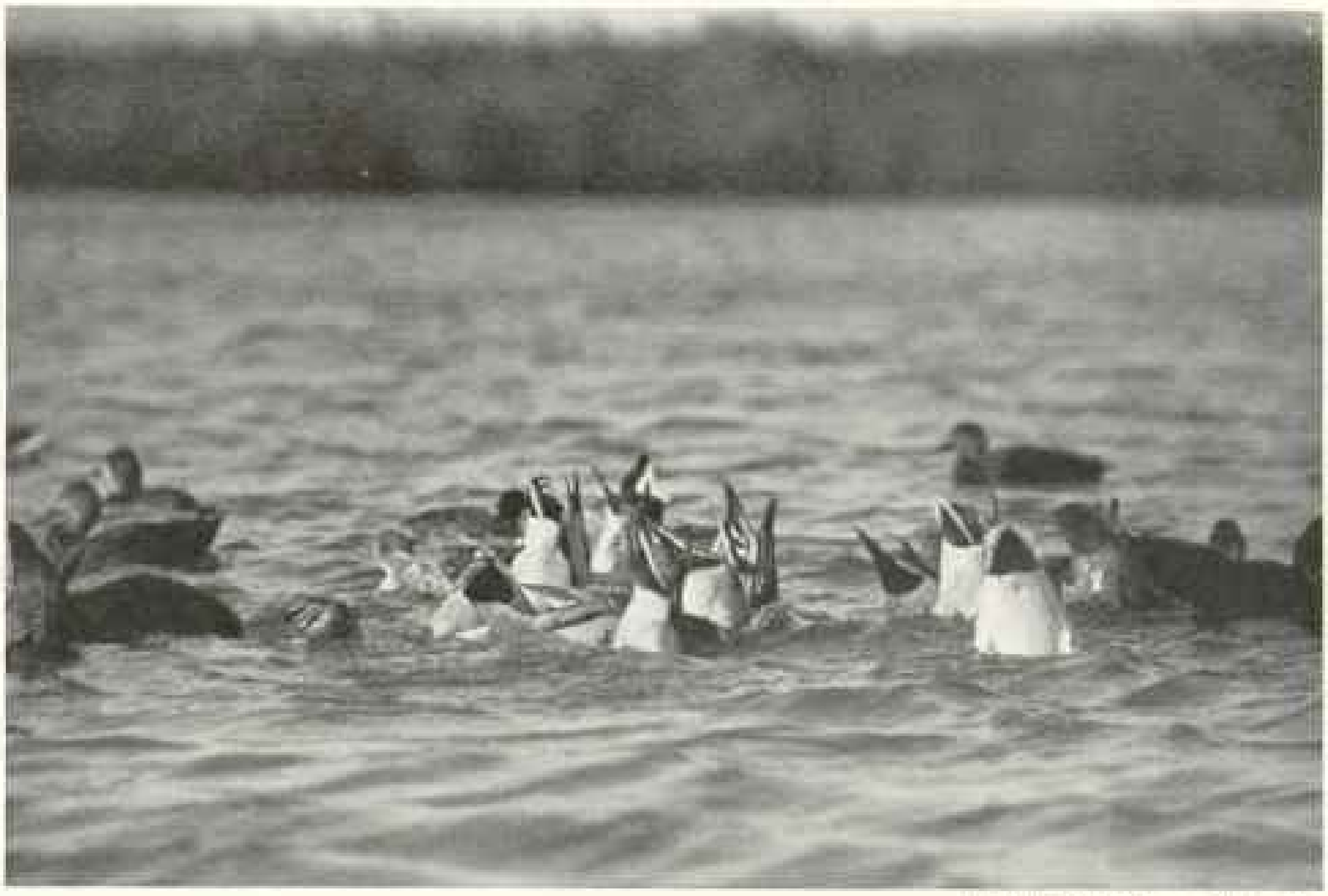
The American merganser usually nests in hollow trees, but where these are not available the nest may be under rocks or in cliffs. A pretty sight that I once saw was the spectacle of two females sitting on nests in clefts on opposite sides of a cave, their white chins showing above a mass of white down. The following season they were absent, as one of the clefts was occupied by a horned owl with one large youngster.

The American merganser is a very large-sized duck. The male will weigh four pounds, the female about half a pound less.

Red-Breasted Merganser

(Mergus serrator)

The red-breasted merganser has a more northern range than the other two sawbills,



Photograph by George Shiras, 3d

SURFACE-FEEDING DUCKS "STAND ON THEIR HEADS" FOR THEIR DINNER

To reach the succulent morsels of aquatic life on the bottom, the pintails, despite their long necks, have to "tip up," as do the mallards and black ducks feeding with them in the shallow waters of Currituck Sound, North Carolina (see Color Plates V and VII).

and it may be called an Arctic species, in summer breeding along the northern rim of both the Old and New Worlds and south in America to Michigan and Maine. I have never seen it nesting in southern British Columbia, many of the so-called records being the result of misidentification, but on the Queen Charlotte Islands and northward along the coast it gradually replaces the American merganser. In winter it reaches the southernmost States and Mexico (see Plate XV).

The red-breasted merganser is much more maritime than the larger species and at the proper season attends the spawning of the herring schools as its chief object in life. As soon as the wireless of the sea fowl tells of the spawning in some bay, all the mergansers are headed for that locality until thousands are congested above the doomed fish. To see the turmoil of sea birds on such occasions is to wonder that any of the herring or their eggs survive after the first onslaught.

Gulls generally are the first to locate the feast; mergansers are soon on the spot, followed by murres, guillemots, and three species of loons; grebes (Holboell's and western) and cormorants of several species are the last to arrive. To see the large loons arriving, flying straight and swift, low over the water and hurling themselves headforemost into the melee, causes one to wonder that birds as well as herring are not killed.

Females of the American and red-breasted mergansers are very much alike, but in the flesh are easily distinguished by their build and weight. The red-breasted merganser is a much smaller bird, being slender in shape. Males will weigh a little less than three pounds, females about two and a half pounds.

Fulvous Tree Duck

(Dendrocygna bicolor helva)

Tree ducks, usually known to gunners as "fiddler ducks," are long-legged and broad-winged, with a very erect carriage when standing (see Plate XVI).

The flight is unducklike, and their ample wings, dark both above and below in the present species, are moved slowly while their long legs trail behind.

The fulvous tree duck possesses the most extraordinary range of any species of bird,

being found in five widely separated "colonies": India, eastern Africa, including Madagascar, southeastern South America, northern South America, and northern Mexico to California and southeastern Texas.

In the last area, it is fairly common in the San Joaquin Valley, arriving early in April. The majority leave for the south before the duck-shooting season opens, in October. Stragglers have occurred as far north as British Columbia.

A medium-sized duck with rather goose-like habits, the fulvous tree duck is notable for the enormous numbers of eggs to be found in one of their nests, thirty or more, probably the product of several females. In California the nests are always on the ground, but in their more southern colonies they nest in hollow trees at times.

Tree ducks are of a retiring disposition and very nocturnal in their feeding. Often the only evidence of their presence is the whispering whistle of their cry as they pass overhead in the darkness.

Black-Bellied Tree Duck

(Dendrocygna autumnalis autumnalis)

The only region within the United States where this duck may be found is the coastal strip of the Gulf of Mexico, from Corpus Christi southward. It is more common in Mexico and has occurred as a straggler in Arizona and California (see Plate XVI).

The black-bellied tree duck is arboreal in its habits, perching freely, and its nest is always in the hollow of a tree.

There is a conspicuous white patch on the forward portion of the wing above, but the wing shows all black from below in flight.

Wood Duck

(Aix sponsa)

No duck has such an æsthetic appeal as the wood duck. The plumage of the male is usually described as "gorgeous," but this does not do justice to its combination of delicate vermiculations and bold slashes of white against a rich, dark background (see Plate XVI). And it is essentially and wholly an American duck, with no relatives save the still more strikingly garbed mandarin duck of Asia.

It is dispersed throughout the southern Canadian Provinces and all of the United States south into Mexico wherever the combination of water, woods, and hollow trees affords it a home.

A long period of protection throughout the United States and Canada has brought about a fine recovery from its former precarious state, and it is now a common bird wherever conditions are favorable. The essential requisite is a good supply of hollow trees in which it may nest.

In the valley of the lower Fraser River, flocks of a thousand birds or more have been seen in recent years, and I shall never forget a residence during the winter months at a point in the interior of California where winding sloughs bordered by oaks and willows afforded it both shelter and food. I knew that the wood duck was a loquacious bird for a duck, but had not expected anything like the chorus of squeals and clucks that reached me through my open window all night long! The birds were attracted by the acorns, many of them two inches long, with one end of exceeding sharpness, that were dropping into the water from the overhanging boughs.

These were swallowed whole, and it would be difficult to conceive of a more indigestible food.

In this same locality, Mr. Joseph Dixon made careful investigation of how the young reached the water from their hollow-tree nests. No evidence of their being carried or assisted by the mother was observed. They simply planed down by themselves, tiny wings and feet extended, in response to the call of the mother from the nearest water. The movement was so rapid that the camera could record only a little meteor-like blur.

Wood ducks in flight look somewhat like baldpates, the size and white lower surface being similar. The distinctive marks are the dark breast, wings, and tail, the latter being large for a duck, and, above all, the down-turned bill, not pointed forward as in a baldpate.

Bahama Duck

(Dafila bahamensis bahamensis)

Sometimes known as the "Bahama pintail," this duck owes its inclusion in our list to casual records in Florida and Wisconsin. It should occur more frequently, as it is common on the near-by islands that give it its name, as well as in most of the West Indian region (see Plate XVI).

The sexes are similar, and it gives the impression of sleekness and elegance, a graceful mover both on land and water. The tail has not the long central feathers of the pintail, but looks as if it had been whittled to a point from a piece of soft pine.

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AT an expense of over $50,000 The Society sent a notable series of expeditions into Peru to investigate the traces of the Inca race. Their discoveries form a large share of our knowledge of a civilization waning when Pizarro first set foot in Peru.

THE Society also had the honor of subscribing a substantial sum to the expedition of Admiral Peary, who discovered the North Pole, and contributed $55,000 to Admiral Byrd's Antarctic Expedition.

NOT long ago 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 of California were thereby saved for the American people.

THE Society's notable expeditions to New Mexico have pushed back the historic horizons of the Southwestern United States to a period nearly eight centuries before Columbus crossed the Atlantic. By dating the ruins of the vast communal dwellings in that region The Society's researches have solved secrets that have puzzled historians for three hundred years. The Society is sponsoring an ornithological survey of Venezuela.

TO further the study of solar radiation in relation to long range weather forecastings, The Society has appropriated $65,000 to enable the Smithsonian Institution to establish a station for six years on Mt. Brukkaros, in South West Africa.

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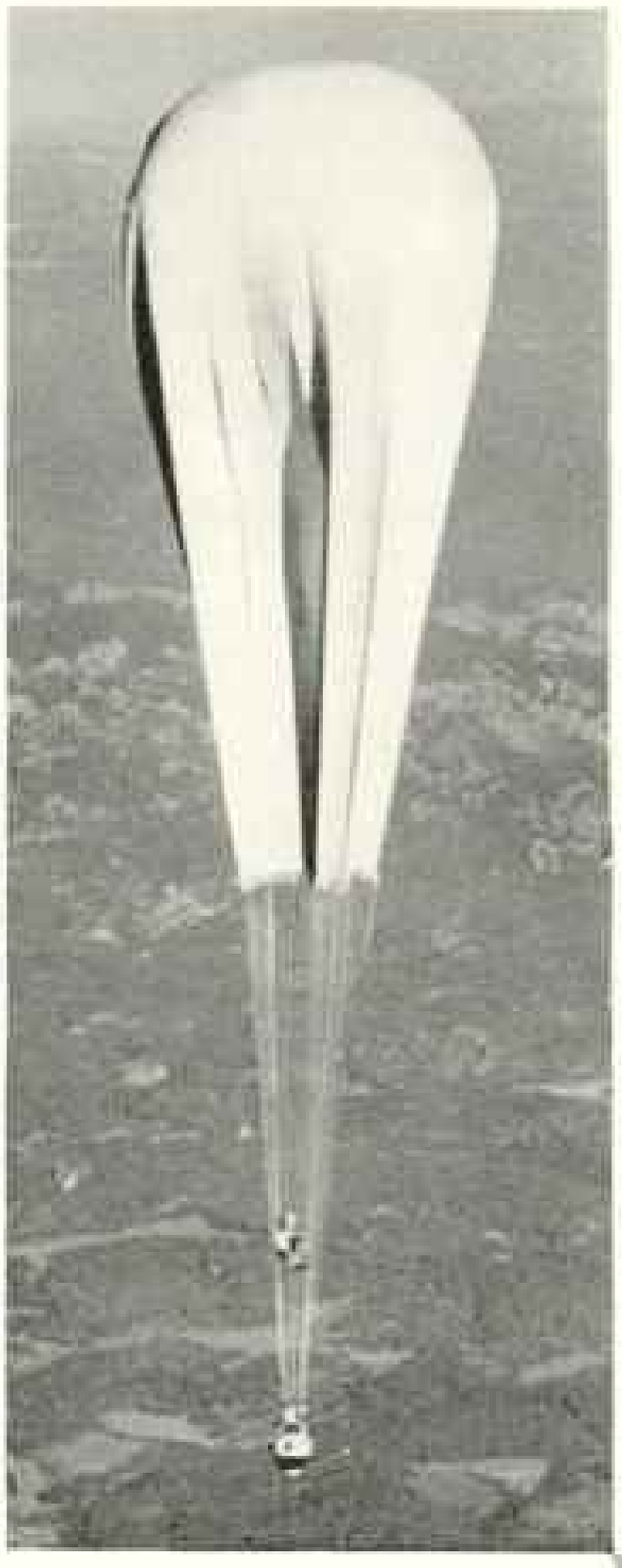

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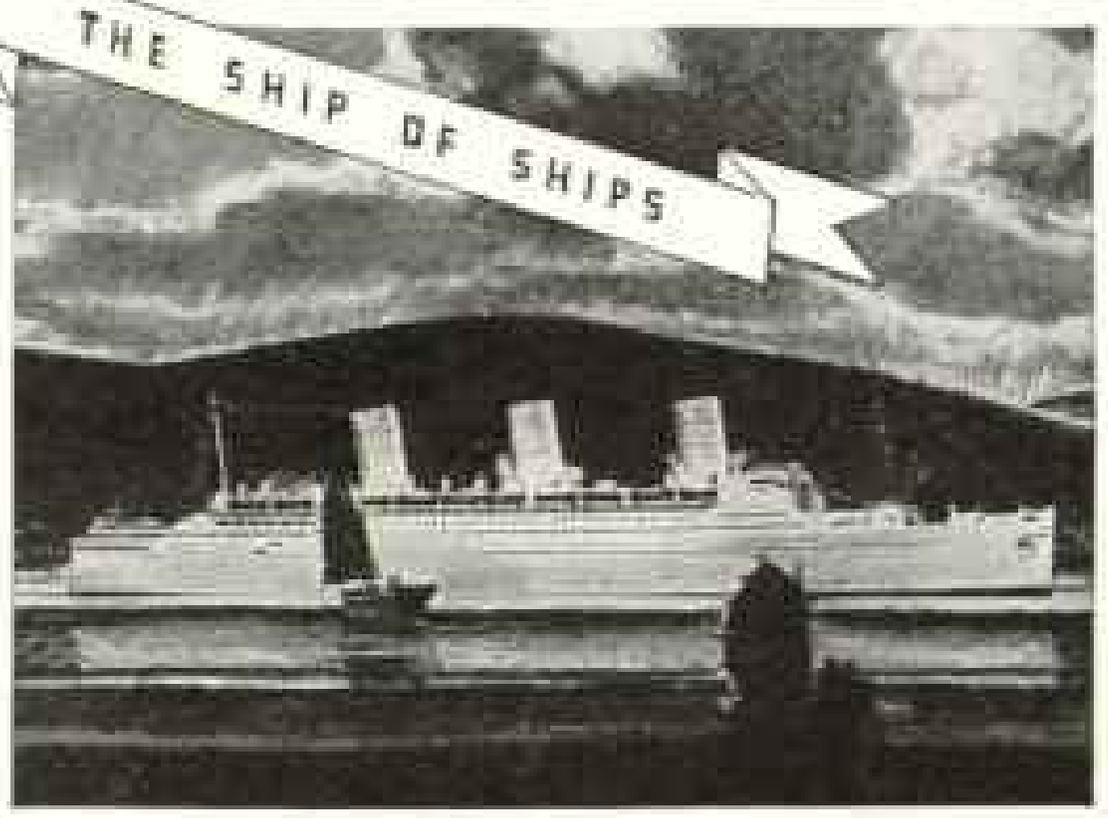

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It is no coincidence that next to many a sportsman's affection for his horses is his pride in the car he drives. Courage, endurance, power, speed in the one have their almost animate counterpart in the other. The conquests of the Lincoln are decisive. A college student driving steadily from Pittsburgh to Denver . . . a citizen of Michigan who has spent on replacements less than $100 in 79,000 miles . . . a Florida business man purchasing his eighth Lincoln in preference to an airplane . . . to these people, and to owners everywhere, the Lincoln *is* as nearly perfect a motor car as it is possible to build. The V-12 cylinder engine, developing 150 horsepower, Lincoln engineers declare unsurpassed by any they have thus far designed. Throughout, the car is a luxurious expression of ideals honestly interpreted. Two wheelbases—standard and custom-built body types.

ENJOY NEW YORK

from The Waldorf point of view

Stand in one of the towers of The Waldorf-Astoria and survey the New York that lies within a few blocks of you. Fifth Avenue, humming with smart shoppers. Broadway, gay with its theatres and amusements. Park Avenue, Madison Avenue, and uptown to Central Park. The New York of clubs, art galleries, museums, churches. But the other New York that interests you lies *within* The Waldorf, and you are part of it the moment you stop there. People who make news and history meet in the lobbies, the ballrooms, the restaurants. The fashionable world is glimpsed over the rim of your cocktail glass. New York that amuses . . . New York that matters meets there. Thus, even your briefest Waldorf-Astoria visit is completely stimulating and enjoyable.

Write for the new Chart Map of New York and Directory of Places of Interest.

THE WALDORF-ASTORIA

PARK AVENUE • 49TH TO 50TH STREETS • NEW YORK

STEICHEN

Dining Salons S. S. Lurline—Photograph taken enroute to Hawaii.

Hawaii

S. S. LURLINE · S. S. MARIPOSA
S. S. MONTEREY · S. S. MALOLO

All the good things of life are on their native soil in Hawaii. You sample them in generous measure on Matson-Oceanic liners—palatial new ships inspired by the Islands they serve. At your command a whole cargo of clever devices for your entertainment and comfort.

Your only duty... go anywhere and do anything...whenever you wish. Sounds like a millionaire's idea of a vacation... and *is*. But all the happy people sailing to Hawaii are not millionaires. Just people who know where to get the most for their time and money. *It's only a 5-day sail to the Islands from California.*

The inspiration of these magic regions invite you to continue through the South Seas. *Only 15 days to New Zealand from California. To Australia...only 18!* Via Hawaii, Samoa, Fiji. *At modest fares.*

Booklets full of ideas free at your travel agency, or

Matson Line · Oceanic Line

New York, 535 Fifth Avenue · Chicago, 200 North Michigan Avenue · San Francisco, 215 Market Street · Los Angeles, 730 South Broadway · Seattle, 814 Second Avenue · Portland, 527 Southwest Pine Street

—but she can't live on a mere pedestal

American men have long enjoyed the reputation of being devoted husbands. But any wife, and especially a mother of growing children, needs more substantial support than a pedestal of adoration.

Some men lavish everything upon their families by living right up to the limit of current income, making relatively little provision for the future.

A more practical devotion combines the right amount of spending in the present with security for the future.

The Equitable offers an ideal plan under which both objectives can be accomplished—and for comparatively small outlay.

Write for information about this easy way to make sure that *your* wife will not have to battle the world single-handed.

Equitable agents are professionally trained to work out life insurance and annuity plans to fit the specific needs of the individual. That is what is meant by the Equitable Case Method.

Let an Equitable agent study your needs and recommend a definite plan.

The EQUITABLE Life Assurance Society of the U. S.
Thomas I. Parkinson, *President.* 57G
393 Seventh Avenue, New York, N. Y.

I am interested in providing an income for my family. Kindly mail explanatory booklet.

NAME

ADDRESS AGE

THE EQUITABLE
FAIR — JUST
LIFE ASSURANCE
SECURITY — PEACE OF MIND
SOCIETY
MUTUAL — COOPERATIVE
OF THE U.S.
NATION-WIDE SERVICE

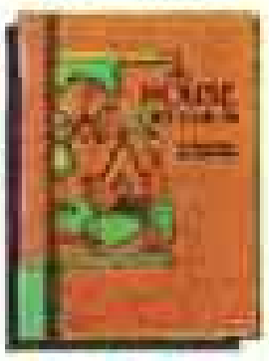
THE DAY it was painted the "cheap" job looked pretty good. And its price looked good, too. It was less than the Dutch Boy job next door.

But now after only 1½ years the "cheap" paint is all through. (See the close-up photo at the right).

Compare this with the Dutch Boy job after 3 years. Dutch Boy does not crack and scale. It *resists* the weather . . . wears down stubbornly by gradual chalking, which leaves a smooth, unbroken surface that needs no burning and scraping at repaint time.

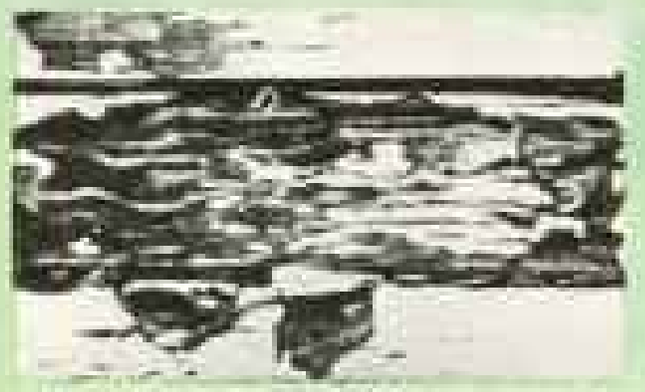
Assure yourself a paint job that is good for years. Call in a Dutch Boy painter . . . a craftsman who mixes Dutch Boy to meet the requirements of your job and tints his paint to the exact color you specify. No one knows paint like a painter.

"The House We Live In" is helpful and useful. Send for it today. Address Dept. 145, nearest branch.



DUTCH BOY WHITE-LEAD

Good Paints Other Name



"CHEAP" PAINT *After 1½ years, first coat $158. Before repainting $85 must be spent for burning and scraping. Totals $235, or $156 a year.*

DUTCH BOY *Same type of house, same city as "cheap" job above. Paint still good, after 3 years. Cost $162..., or $54 a year.*

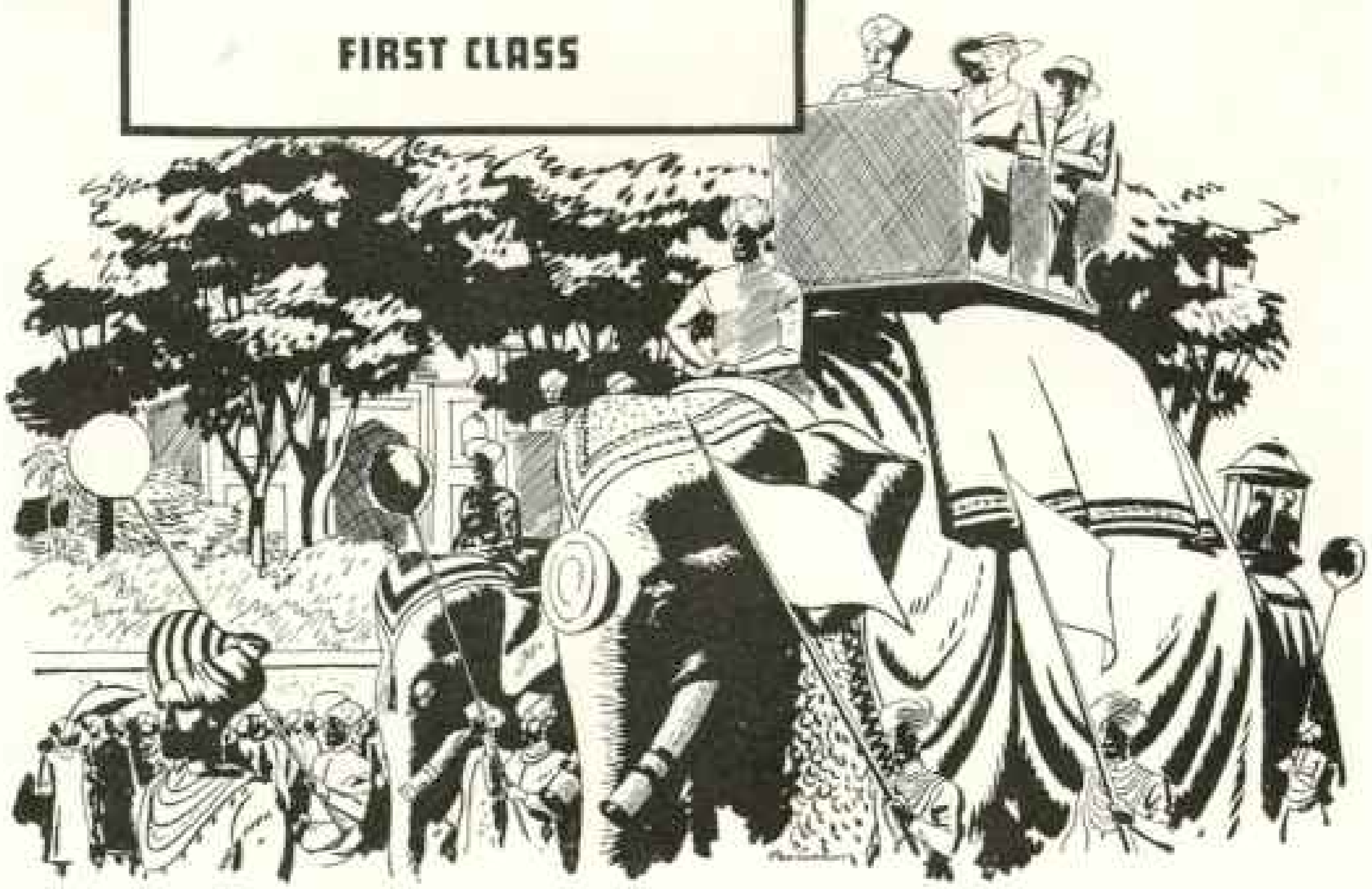
NATIONAL LEAD COMPANY

111 Broadway, New York; 116 Oak St., Buffalo; 900 West 18th St., Chicago; 659 Freeman Ave., Cincinnati; 820 West Superior Ave., Cleveland; 722 Chestnut St., St. Louis; 2240 24th St., San Francisco; National-Boston Lead Co., 800 Albany St., Boston; National Lead & Oil Co. of Pa., 316 4th Ave., Pittsburgh; John T. Lewis & Bros. Co., Widener Bldg., Philadelphia.

ROUND THE WORLD

$833.50

FIRST CLASS



Go as you please . . .
stopover as you choose!

Stopover in Japan . . . in China, the Philippines, Singapore . . . Alexandria . . . Genoa, Marseilles.

President Liners allow you to stopover in any or all of the 14 countries in their Round the World itinerary. Visit ashore, or make sidetrips . . . then continue on the next or another of these liners that sail every week from New York, via Havana and the Panama Canal, to California . . . thence via Hawaii and the Sunshine Route (or via the Short Route from Seattle) to the Orient . . . and on, fortnightly from Manila, Round the World.

Actually, you may circle the globe in no more than 104 days (85 days if you cross America by train). Or you may take the full two years to which your ticket entitles you, traveling as freely, almost, as if you traveled on a private yacht.

President Liners are big, smooth sailing liners, luxurious and gay . . . favorites with travelers everywhere. Your stateroom will be outside (every one is), large and airy . . . with deep-springed modern beds. Menus are excellent and varied by good things from all the 21 ports these liners touch, public rooms are ample, decks spacious . . . and every President Liner has an outdoor swimming pool.

Your own travel agent, or any of our offices (New York, Chicago, Seattle, San Francisco, Los Angeles and other principal cities) will be glad to tell you *all* about the President Liners, stopover costs and expenses for sidetrips. And they'll be happy to tell you too of other President Liner trips . . . between New York, Havana, Panama and California (and the reverse) and to the Orient and back—all with stopovers of your own choosing.

DOLLAR
Steamship Lines and
AMERICAN
Mail Line

ATWATER KENT

announces 1935 world-wave

RADIO

IT IS ONE THING
***to get...* FOREIGN STATIONS...AND ANOTHER TO *enjoy* THEIR PROGRAMS**

SHORT WAVE broadcasting in foreign countries adds a thrill to radio that you don't want to miss. But you want more than that thrill when you buy your new radio. You want a radio that lets you *enjoy* foreign programs. You want an Atwater Kent Radio.

In the 27 new sets for 1935—four of which are shown on this page—Atwater Kent gives you every proved improvement that is known to radio science—at prices that make each set an outstanding value. Your dealer will show you others: DC models, sets for battery or 32-volt power, AC-DC radio, Motor-car radio, and the marvelous new invention, Atwater Kent Tune-O-Matic Radio—prices range from $22.50 to $190.00 (subject to change without notice).

FOR SHORT-WAVE RECEPTION, THE NEW ATWATER KENT DOUBLET ANTENNA GREATLY REDUCES BACKGROUND NOISE AND INCREASES VOLUME ON DISTANT STATIONS.

ALL-WAVE—Model 1128 (directly above)—by scientific tests for fidelity throughout entire range of musical sound, this 12-tube superheterodyne is the finest radio Atwater Kent ever built. And we know of no other radio that is its equal at ANY price. **$180.00** f.o.b. factory

ALL-WAVE—Model 559S (at left above)—A revelation to even the most technically-minded buyer, this radio offers complete world-wide, all-wave reception through 4 tuning bands, 540 kilocycles to 18 megacycles, 9 tubes, 2-speed tuning, visual shadow tuning, 3-gang condenser, 11-inch speaker. **$119.50** f.o.b. factory

FOREIGN SHORT-WAVE and BROADCAST—Model 206 (in front at left)—8-tube superheterodyne, hears foreign stations, police, amateur, airplane, and all American broadcasting. Remarkably free from background noises.
$49.90 f.o.b. factory

STANDARD BROADCAST—Model 944 (in front at right)—4-tube superheterodyne receives all regular broadcasting and police band. 8-inch electro-dynamic speaker and precision construction give it excellent tone quality.
$22.50 f.o.b. factory

ATWATER KENT MANUFACTURING COMPANY · *A. Atwater Kent, President* · PHILADELPHIA, PA.

The National Geographic DIRECTORY OF COLLEGES, SCHOOLS, AND CAMPS

Boys' Schools

FORK UNION Honor school. Small classes. Accredited. ROTC. Supervised study. Prepares for college or business. Junior school small boys. House-mother. Athletics, Swimming. Catalog. Dr. J. J. Wicker, Fork Union Military Academy, Box 181, Fork Union, Va.

NEW YORK MILITARY ACADEMY A School of Distinction. College Preparatory and Junior schools. High scholastic standing, excellent discipline, supervised athletics, commercial courses. Catalog. Brig. Gen. Milton F. Davis, D.S.M., Supt., Cornwall-on-Hudson, N. Y.

Girls' Schools

GULF-PARK COLLEGE On-the-Sea. Fully accredited Junior College for girls. 4 years high school, 2 years college. Music, art, expression, home economics, secretaryship. Outdoor sports all year. Riding, swimming (salt water). Write for catalog. Richard G. Cox, President, Box N, Gulfport, Miss.

MARLBOROUGH CALIFORNIA High School and Intermediate Grades. General, College Preparatory, Graduate courses. Music, art. Outdoor sports all year. Recreation at beach, desert, mountains. Catalog. Ada S. Blake, A.B., Principal, 5020 N. West Third St., Los Angeles, Calif.

WARRENTON COUNTRY SCHOOL This school emphasizes ideas of order and economy. Offers a fixed rate, which covers incidental expenses including a weekly allowance. French, the language of the house. Riding, sports. Mlle. Lea M. Bauligny, Box N, Warrenton, Va.

Vocational

ALVIENE SCHOOL OF THE THEATRE 43rd YEAR. Graduates—Fred Astaire, Lee Tracy, Una Merkel, Mary Pickford, Peggy Shannon, Rita Johann, etc. Stage, Screen, Radio, Stock Theatre training. Appearances, N. Y. Debuts. Write Sec'y Landi for Catalog L, 66 West 85th St., N. Y.

Vocational

AMERICAN ACADEMY OF DRAMATIC ARTS Founded 1884 by Franklin H. Sargent. The foremost institution for Dramatic Training. Fall term opens Oct. 3rd. Catalog from Secretary, Room 371-J, Carnegie Hall, N. Y.

ART INSTITUTE OF PITTSBURGH Commercial Art, Illustration, Fashion Drawing, Interior Decoration, Life drawing, Painting; one, two year courses. Low tuition, start now. Low Living Expenses. Students' work and Booklet. 133 Stanwix St., Pittsburgh, Pa., Willis Shook, Dir.

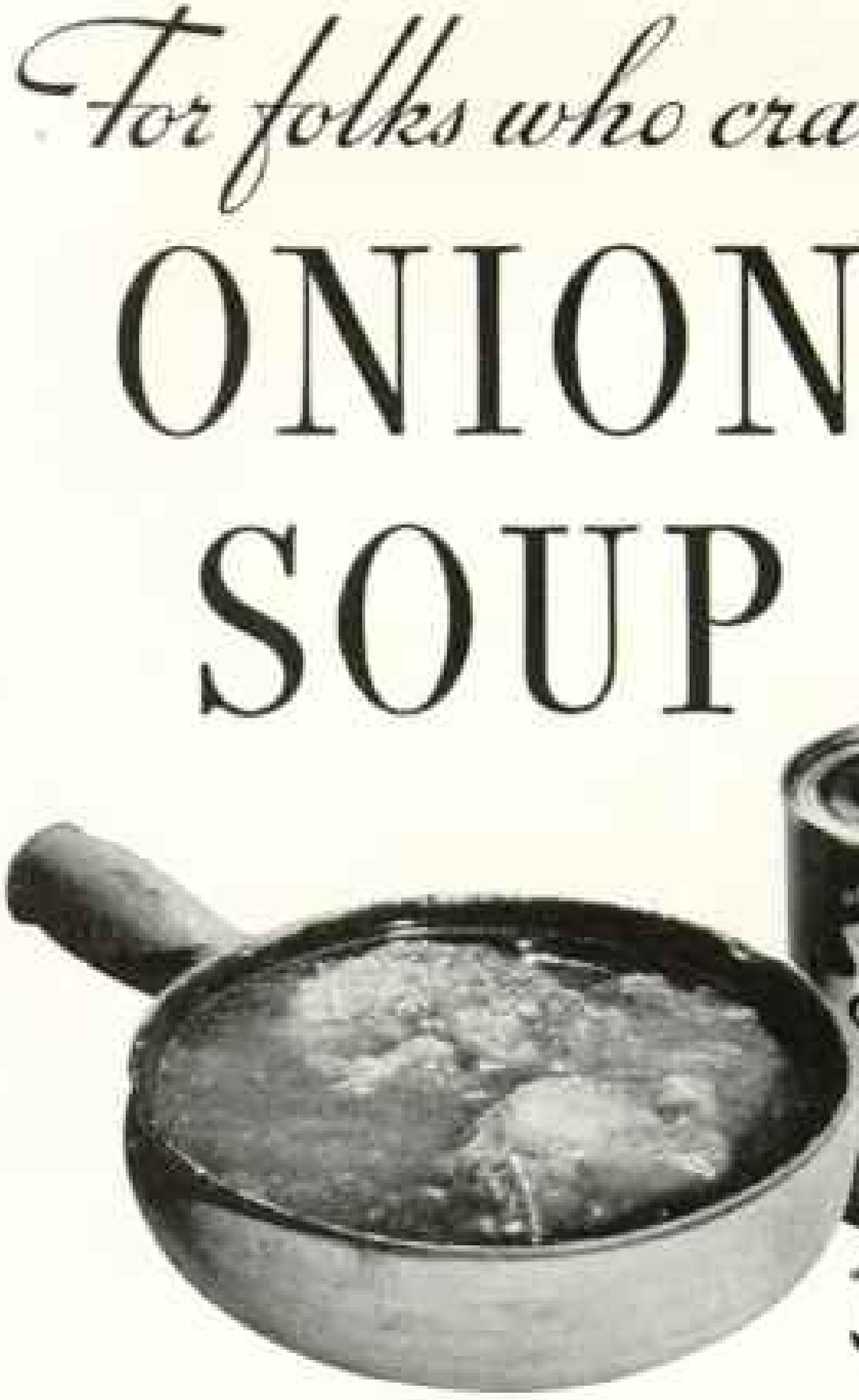
LEWIS HOTEL TRAINING SCHOOLS Come to Washington. Qualify in 4 months for well-paid hotel position. Placement Service free of extra charge. Day classes start Oct., Jan. Catalog Free. Lewis Hotel Training Schools, Div. RHS-1198, Washington, D. C.

PACKARD SCHOOL 47TH YEAR. Registered by Regents. Complete Secretarial; General Business; Accounting; and Special Courses. Co-educational for high school graduates and college students. Placement service rendered. For catalog write: Assistant Principal, 253 Lexington Avenue, New York City.

New Fall terms are starting now in the institutions listed on this page. Inquiries directed to them will receive prompt and thorough attention. "Mention the Geographic—It identifies you."

For folks who crave

ONION SOUP



ONE OF THE
57

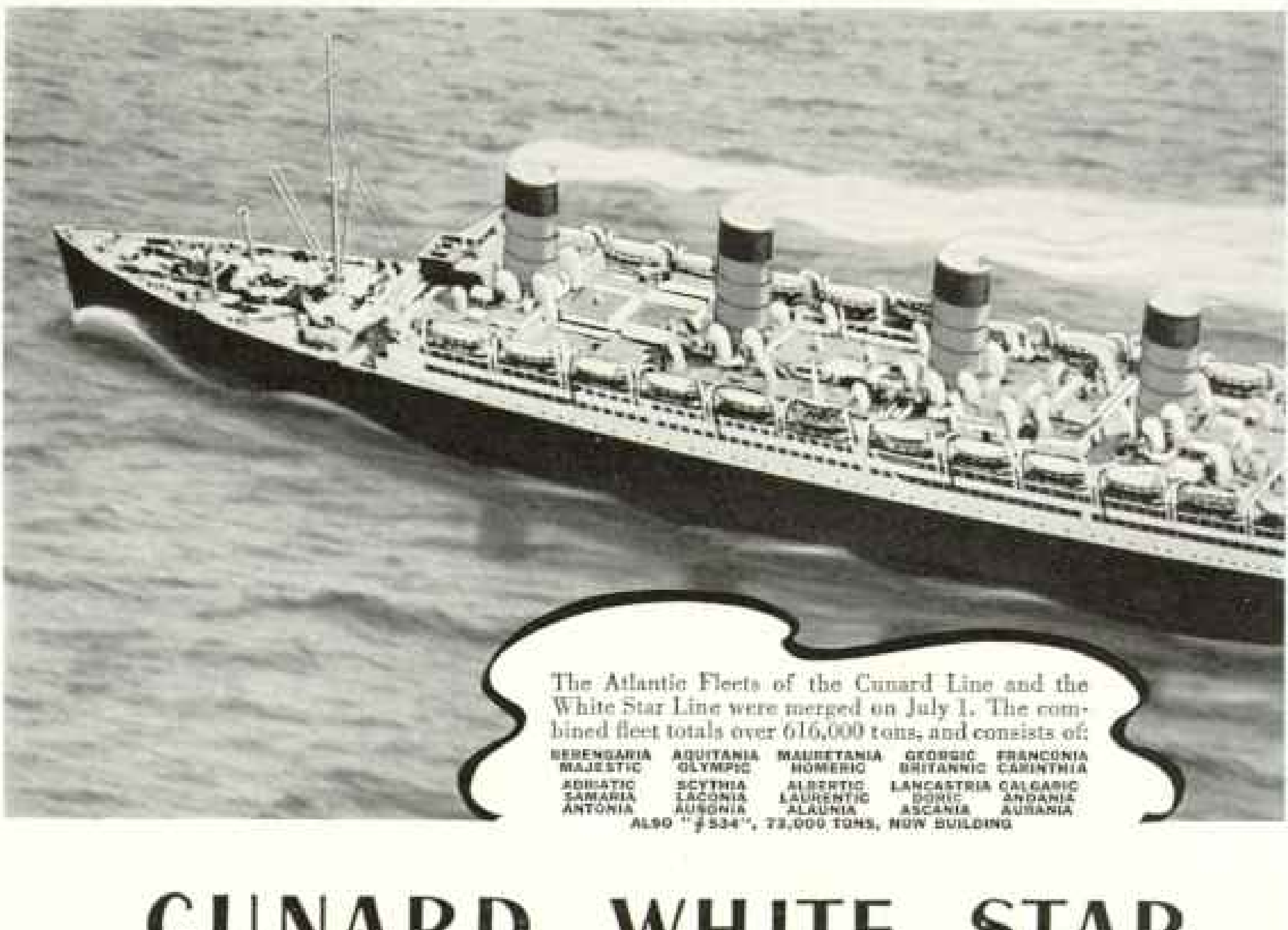
A FAMOUS restaurant specialty now comes home to your own kitchen. Onion Soup, as you like it—in all its mellowed slow-simmered richness. Now you can serve onion soup au gratin—*minutes* after you've decided you want it. It is the newest and seventeenth variety of Heinz Home-Recipe Soups. Tender fresh onions are sliced and pan-browned. They are then immersed in a delectable broth—a broth brewed from choice beef, delightfully seasoned as only a master soup chef can do it.

Heinz Onion Soup, as you like it, comes to you ready to heat and serve. To serve it au gratin, merely heat, add toasted half rolls and cheese, and place under oven broiler for a few minutes.

Try this famous restaurant treat faithfully duplicated by Heinz. Ask your grocer.

HEINZ
ONION SOUP

The story of a fleet that is the an Empire



The Atlantic Fleets of the Cunard Line and the White Star Line were merged on July 1. The combined fleet totals over 616,000 tons, and consists of:

BERENGARIA	AQUITANIA	MAURETANIA	GEORGIC	FRANCONIA
MAJESTIC	OLYMPIC	HOMERIC	BRITANNIC	CARINTHIA
ADRIATIC	SCYTHIA	ALBERTIC	LANCASTRIA	CALGARIC
SAMARIA	LACONIA	LAURENTIC	DORIC	ANDANIA
ANTONIA	AUSONIA	ALAUNIA	ASCANIA	AURANIA

ALSO "#534", 73,000 TONS, NOW BUILDING

CUNARD WHITE STAR

FRANCONIA AROUND-THE-WORLD CRUISE . . . again to the South Seas and Southern Hemisphere . . . an itinerary that is restful all the way. 33 ports . . . over half not visited by any other world cruise . . . 139 days. Sails from New York January 12 . . . from Los Angeles January 26.

DIRECT TO FRANCE AND ENGLAND
Majestic . . . Berengaria . . . Aquitania . . . Olympic. Sail direct to Cherbourg . . . the shortest route to France thence to Southampton. Next sailings from New York . . . Aquitania Oct. 3, Oct. 24 . . . Olympic Oct. 5, Oct. 26 . . . Berengaria Oct. 10, Oct. 31 . . . Majestic Oct. 12.

● **CUNARD WHITE STAR LIMITED NOW OPERATES THE LARGEST**

story of

CUNARD AND WHITE STAR are now one. A story of the sea which is the history of Britain. For seamen founded this island kingdom. Ships were "The wooden walls of England", . . . far-flung boundaries which fostered industry and commerce to keep step with empire. Life was inextricably bound in with the needs of England's growth over the seven seas . . . the best of the land went into her ships, the best of her men to man them. And throughout the last century almost the whole story of Britain on the seas is the history of the parallel development of Cunard and White Star. Together they have gone forward, participating alike in a tradition of ships and seamen which has become almost synonymous with the record of achievement in ocean transportation as we know it today. And now Cunard and White Star are one in fact. Their union brings into being what is by far the greatest fleet on the Atlantic—616,000 tons—with the world's two largest vessels as flagships. These vast resources under one management are immediately significant to the traveller and shipper. But there is another significance that lies behind the veil of statistics. The British tradition of seamanship lives in the hearts and minds of men and there we believe lies the supreme good in the Cunard White Star union. It brings together a great body of officers and men . . . irreplaceable men without whom ships would be so much steel. It joins and vitalizes the traditions of seamen who made ocean transportation what it is today; who today are making it what it will be tomorrow.

LIMITED

SUNSHINE CRUISES . . . Cunard White Star will again provide an outstanding program of their famous Sunshine Cruises this winter to West Indies, Mediterranean, etc. Early application for best accommodations is recommended.

FLEET OF PASSENGER VESSELS PLYING THE NORTH ATLANTIC

★

300 Note sheets
150 Envelopes
Printed with your name and address
$1.00 Postpaid

THE "450" PACKAGE

Here is an exceptionally fine writing paper — a paper made for the pen!

No Splotch
No Splatter

THE big size of our "450" Package, as everybody knows, is unusual. But the really remarkable thing about this stationery is its fine *quality*. It is made of high grade, pure white, *rag content*, bond paper — a paper *made for the pen*. You couldn't ask for better.

Each sheet and envelope is printed with your name and address, the smart and logical way to have your stationery finished. And it is correct for more writing purposes than any other type of stationery you can buy!

Send $1.00 (West of Denver, Colo., and outside of U. S. $1.10). If you've never used American Stationery you've really missed something. Try one package. It costs only $1, and we promise that if you're not satisfied—in fact, delighted—your money will be immediately returned.

THE AMERICAN STATIONERY CO.
300 PARK AVENUE, PERU, INDIANA

AMERICAN STATIONERY CO., 300 Park Ave., Peru, Ind.
Herewith $1.00 (West of Denver, and outside U. S. $1.10) for a package of "450" Stationery to be printed as follows:

Name_____

Address_____

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Sheet size 6 x 7. Envelopes to match. Printed in dark blue ink. Prompt service. Satisfaction guaranteed.

. . . BUT YOU HAVEN'T SEEN JAPAN

YOU'VE traveled—been abroad many times. Probably you've seen the best in Europe and America as well. But you aren't a really "traveled" person until you've seen Japan!

Why not go abroad Westward this year—and really get your money's worth in travel! Steamship fares are the lowest in the world, considering the service and the distance traveled. The yen exchange is *in your favor*. And the Japan Tourist Bureau, a non-commercial organization, offers a remarkable series of all-inclusive tours showing at the lowest cost the most worthwhile regions of Nippon. Write to our nearest office or, better, ask your tourist agent for our booklet outlining these fascinating itineraries in detail.

Japan Tourist Bureau, c/o Japanese Gov't Railways, 551 Fifth Ave., N. Y. C., or Chamber of Commerce Bldg., 1151 South Broadway, Los Angeles, Cal., or c/o Nippon Yusen Kaisha Line, 25 Broadway, N. Y. C. Please address Dept. G in each case to facilitate prompt reply.

JAPAN TOURIST BUREAU

Bottled Health

One quart of milk supplies about the same amount of bodily energy as 9 eggs, or 3/4 lb. beefsteak, or 4/5 lb. chicken, or 6 3/4 oranges, or 2 lb. potatoes, or 3 lb. string beans.

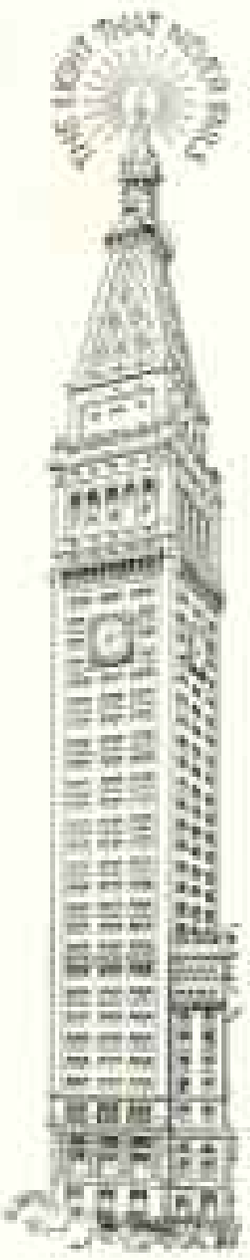
All of these foods build health and are important in the diet. The comparison merely brings out the essential part that milk plays in contributing fuel or energy to the diet.

MILK, as an all-round food, is one of the most essential of our everyday foods. Milk gives you much for little. In choosing your foods, be sure that milk is among the first on the list.

For health, milk is conceded to be the almost perfect food. It contains practically all the elements that the human body needs: minerals, vitamins, proteins, sugars and fats—all necessary for building a healthy body and for warding off disease.

The form in which milk is taken is not important. Some persons like it cold. Others take it when they are ready for sleep and prefer it hot. Still others like it better when it is flavored with cocoa or chocolate or used in soups, sauces or desserts.

Milk should not be regarded as a beverage; it is a food. Sip it slowly; get the flavor out of it. Don't use it merely to quench thirst, and don't drink it rapidly. The gastric juice of the stomach causes milk to curdle shortly after you swallow it. If milk is drunk rapidly digestion is likely to be slow and difficult.



Children especially need plenty of milk. Rest has no charm for them. No healthy child will stay parked while awake. He waits a minute or two perhaps, and then he is an acrobat again. An active, growing child must have fuel and building material for his body. Give him good, fresh milk—a quart a day if you can. And give the grown-ups a pint a day. For underweights and convalescents, a quart. For expectant or nursing mothers, a quart.

Milk has unsurpassed food value. To take milk regularly is the surest and easiest way of making certain that you give your body the variety of food materials it needs to keep you in good physical condition.

To know milk as you should know it, ask for a free copy of the Metropolitan booklet "Milk—An All-Round Food." Address Booklet Department 1034-N.

Believe it or not, this young fellow is going places! And he's going in the most comfortable, safe, healthful way you can imagine—in Body by Fisher. That means he's traveling first-class, in a body notable for rugged strength and durable quiet as well as for luxurious appointments and suave streamline beauty. It means wider, deeper seats, too, and the stretch-out-and-relax kind of room that grown-ups prize so much. It also means Fisher-perfected and owner-approved No Draft Ventilation, enabling enjoyment of crisp autumn and tonic winter air without a draft in a carful. All these are yours in Body by Fisher no matter which General Motors car you may choose.

Body by Fisher

on GENERAL MOTORS CARS ONLY. CHEVROLET - OLDSMOBILE - PONTIAC - BUICK - LA SALLE - CADILLAC

OCTOBER — Nature at her loveliest — aflame with Autumn's myriad-hued scarlets and russets and golds.

See America BETTER *by car!*

WIDE, SMOOTH ROADS, fine hotels, modern tourist camps and conveniently located Texaco Service Stations along our great National highways make touring a real pleasure.

Let us help you see America *better!* On a tour, through any of our 48 States, Texaco *Fire-Chief* Gasoline will always add to your driving pleasure—giving you an extra margin of power, speed, pick-up and anti-knock smoothness.

"Refuel" at the Texaco pump and you will understand why Texaco *Fire-Chief* is bought by more tourists than any other brand of gasoline. Tour with Texaco wherever you go.

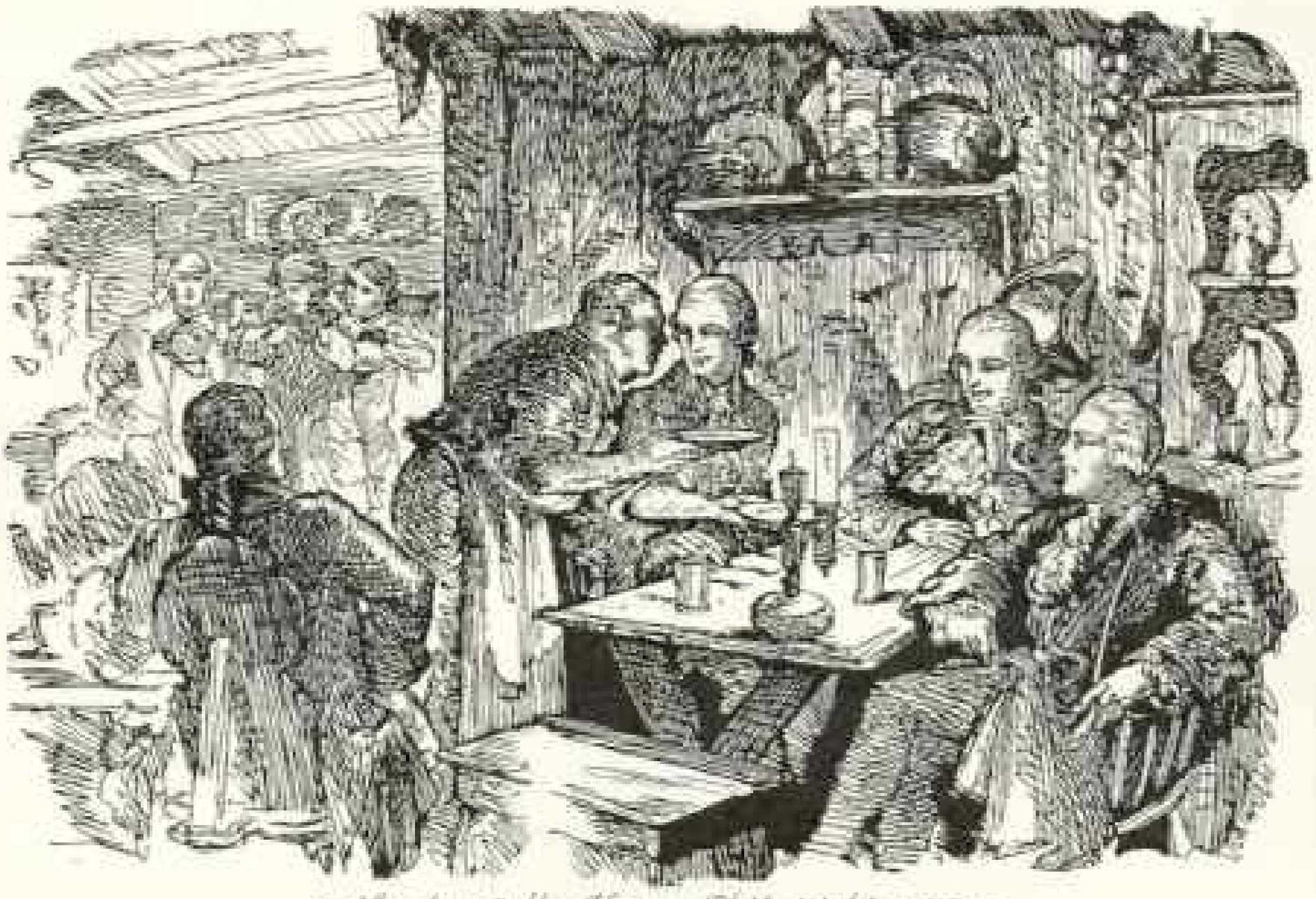
Before You Leave On That Trip—

The Texas Company, New York City, will send you maps, with detailed routings, based on the very latest road information.

"It's the finest gasoline we've ever sold"

THE TEXAS COMPANY • *Texaco Petroleum Products*

TEXACO *FIRE-CHIEF* GASOLINE



...London Coffee House - Philadelphia 1776...

JUST AS THEY ENJOYED IT !

Real Philadelphia PEPPER POT

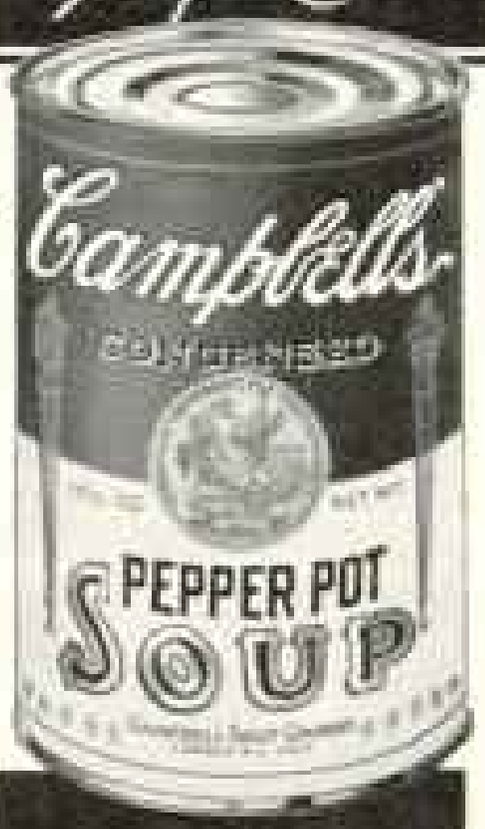
by Campbell's

A MAN'S SOUP

21 kinds to choose from . . .

Asparagus	Mulligatawny
Bean	Mushroom (Cream of)
Beef	Mutton
Bouillon	Noodle with chicken
Celery	Ox Tail
Chicken	Pea
Chicken-Gumbo	Pepper Pot
Clam Chowder	Printanier
Consommé	Tomato
Julienne	Vegetable
Mock Turtle	Vegetable-Beef

LOOK FOR THE RED-AND-WHITE LABEL



Old Colonial Philadelphia gave no more treasured heritage to the dining-table of today than sumptuous Pepper Pot. And Campbell's bring it to you, true to all its mellow traditions.

Tempting morsels of tender meat; diced potatoes and carrots, wholesome macaroni dumplings—with sparkling seasoning of whole black peppercorns, fresh parsley, savory thyme, marjoram and sweet pimientos. Truly "unusual", truly delightful is Campbell's Philadelphia Pepper Pot!

Double rich! Double strength!

Campbell's Soups bring you condensed, concentrated goodness. So when you add an equal quantity of water in your kitchen, you obtain twice the quantity of soup at no extra cost.

NRA CODE

Their traveling home, high above the Earth..

DOWMETAL SELECTED FOR BOTH LIGHTNESS AND STRENGTH

DOWMETAL, because of its strength and extreme lightness, was chosen for the gondola to be used in the stratosphere flight sponsored by the National Geographic Society and the U. S. Army Air Corps. The story of this remarkable flight is told in this issue of the National Geographic. Strength was required to provide a gondola which would carry all heavy instruments and equipment, and which could withstand heavy air pressure from within. This strength had to be secured in the lightest possible form, since every hundred pounds saved meant 1500 feet higher possible flight with the same balloon.

Both strength and lightness were obtainable by the use of Dowmetal. In addition, properties needed for the fabrication of the metal into the form desired were inherent in Dowmetal. *Rolled sheet* was formed into "orange peel" sections. These sections were *welded* together into a one-piece metal ball. *Castings* were *welded, riveted,* or *bolted* into the shell for manholes, windows, and other requirements. Bars and tubes were *extruded* for use as supports for racks and shelving. Nearly every standard form of metal fabrication and machining was used in this Dowmetal traveling air-home, just as it is used in the manufacture of portable machinery, fast moving machine parts, motorized transportation units, and in a great many other places where strength is combined with lightness.

Our booklet describing the uses and properties of DOWMETAL, the world's lightest structural metal, may be had upon request.

THE DOW CHEMICAL COMPANY
Dowmetal Division · MIDLAND, MICHIGAN

DOWMETAL
MAGNESIUM ALLOYS

★ ★ ★ ★ ★ ★ ★ ★

GOOD SERVICE THROUGH TRYING YEARS

THROUGH recent trying years there has been no letting down in the quality of your Bell telephone service. On the contrary, improvement has gone steadily on.

On long distance and toll calls, the percentage of calls completed is now higher than ever before. The average time required for making these connections has been reduced from 2.8 minutes in 1929 to 1.5 minutes. Since 1929, mistakes by operators have been reduced one-third and more than 99% of all telephone calls are now handled without error. Service complaints are now the fewest on record and reports of trouble with instruments have decreased 17% since 1929.

The ability of the telephone system to improve its service in difficult years is due to unified management and a plan of operation developed and perfected over the past half-century. In good times and bad, it has proved the wisdom of one policy, one system and universal service.

BELL TELEPHONE SYSTEM

There seems to be a
Special Magic *in*

TUCSON'S

WARM-DRY-SUNNY CLIME

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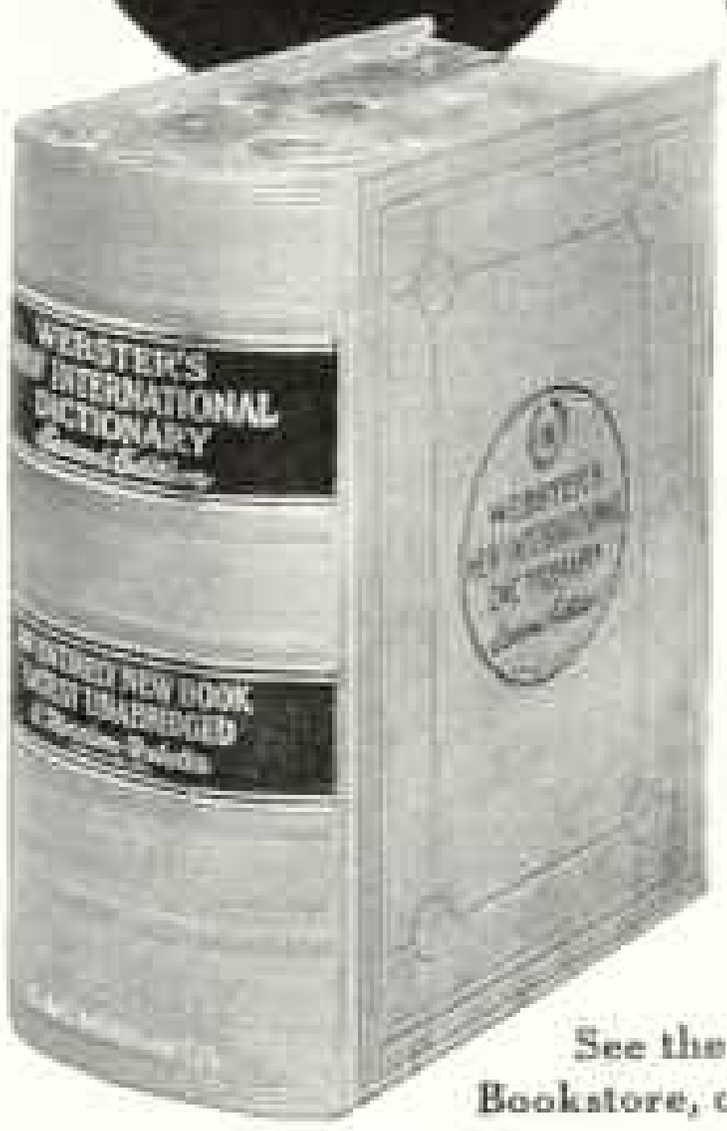

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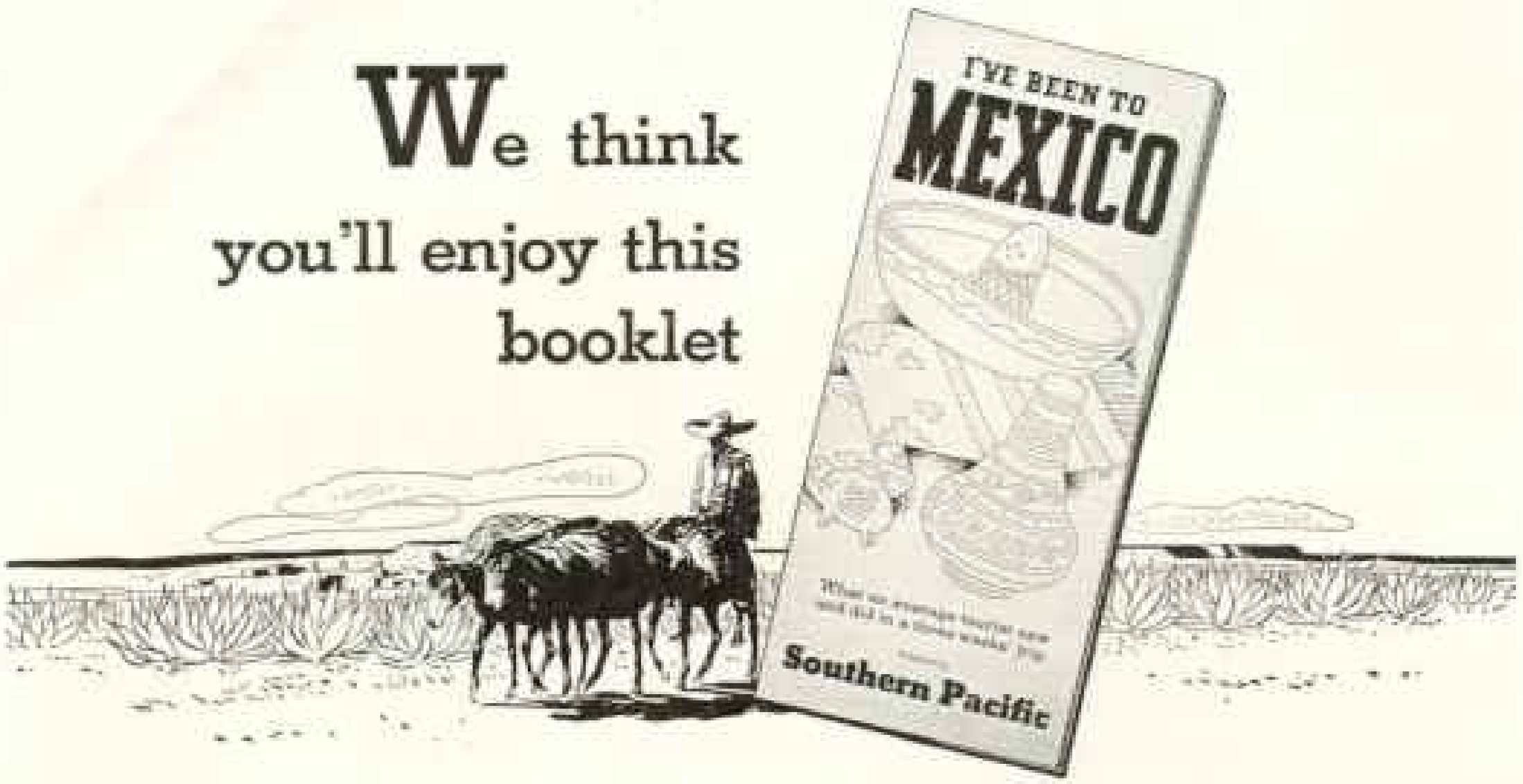

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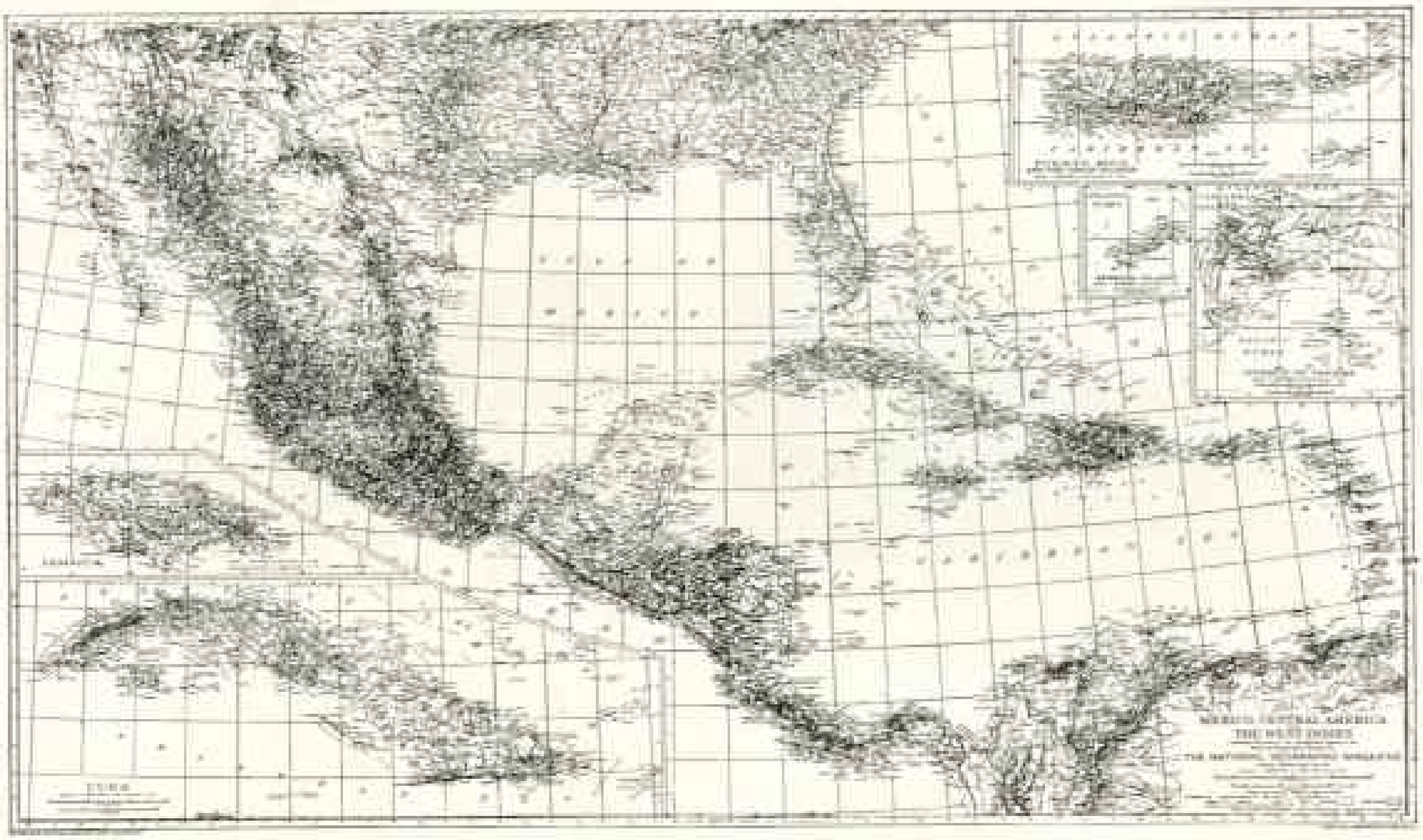

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