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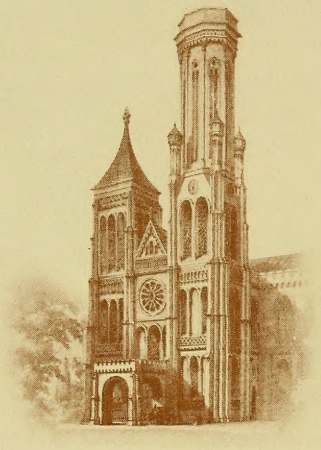

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THE NATIONAL GEOGRAPHIC MAGAZINE

AN ILLUSTRATED MONTHLY

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Vol. XXI, No. 1 WASHINGTON January, 1910

THE NATIONAL GEOGRAPHIC MAGAZINE

THE NATIONAL GEOGRAPHIC SOCIETY'S ALASKAN EXPEDITION OF 1909

By Ralph S. Tarr, of Cornell University, and Lawrence Martin, of the University of Wisconsin
Leaders of the Expedition

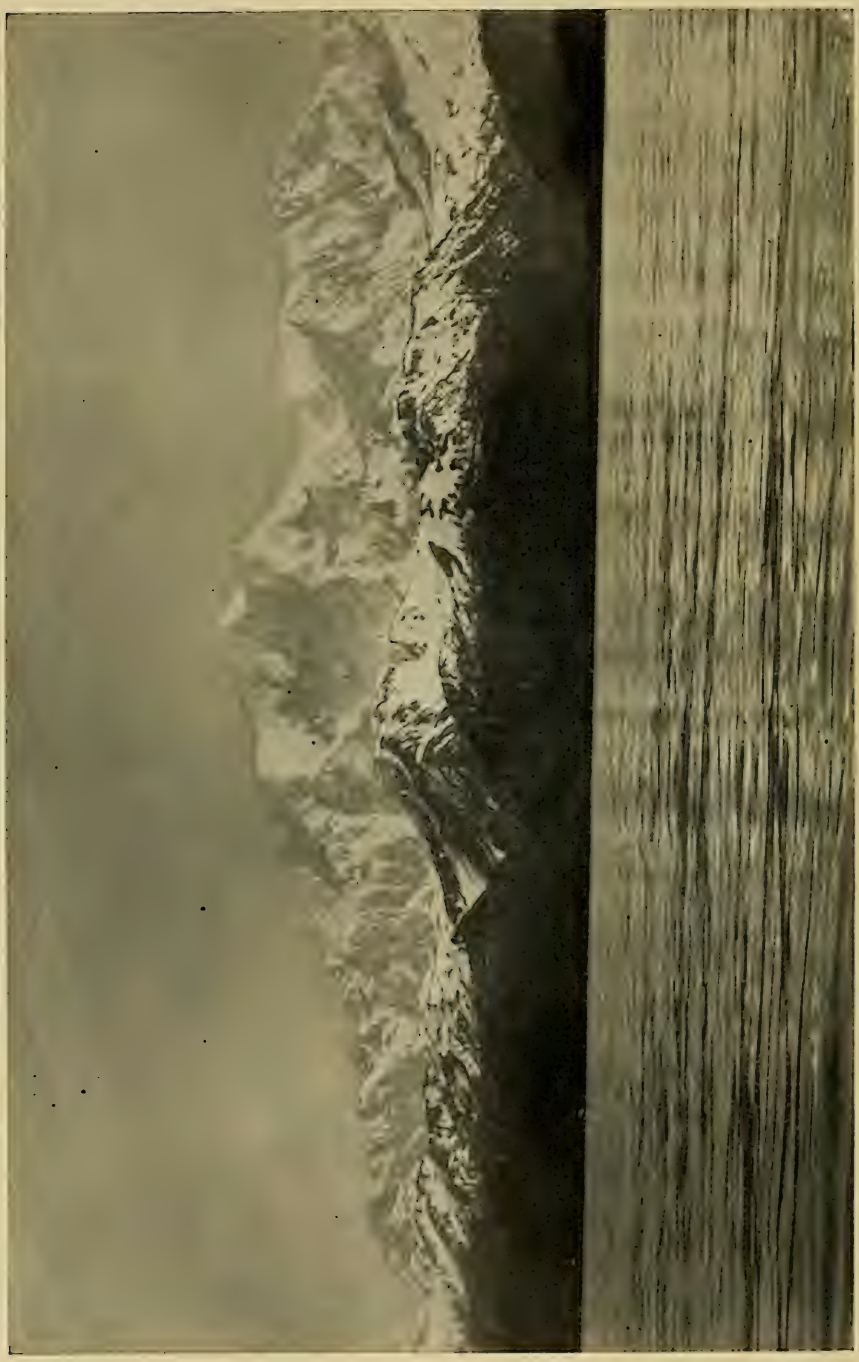
THE research expedition sent out by the National Geographic Society in 1909 devoted the season to a study of glaciers in Yakutat Bay and eastern Prince William Sound, Alaska. Beside the leaders of the expedition, the party consisted of six men. The topographer, Mr W. B. Lewis, of the U. S. Geological Survey, was furloughed by the Survey in order that he might be employed by the expedition. The other members of the party were a photographer, Mr Oscar von Engeln, of Cornell University; a geological assistant, Mr E. F. Bean, of the University of Wisconsin; a boat engineer, one camp hand, and a Japanese cook. The senior author had previously spent two seasons in Yakutat Bay, the junior author one season there and part of another in eastern Prince William Sound.

The party sailed from Seattle June 24, going via the Inside Passage and Juneau, and reaching Yakutat five days later. A 28-foot whale-boat with 4-horse-power gasoline engine was used in transporting the party and outfit throughout the summer, though taken on the steamship from Seattle to Yakutat and from Yakutat to Valdez. The first six weeks of the summer were spent in and about Yakutat Bay (June 29 to August 14), the remaining time in eastern Prince William Sound and around the lower Copper River. Two main camps and seven temporary camps were occupied in Yakutat Bay, and three main camps in eastern Prince William Sound. The glacier studies were accomplished by means of travel by water in launch and row-boat, travel by land and glacier on foot, and, in one case, travel by railway automobile over the Copper River and Northwestern Railway.

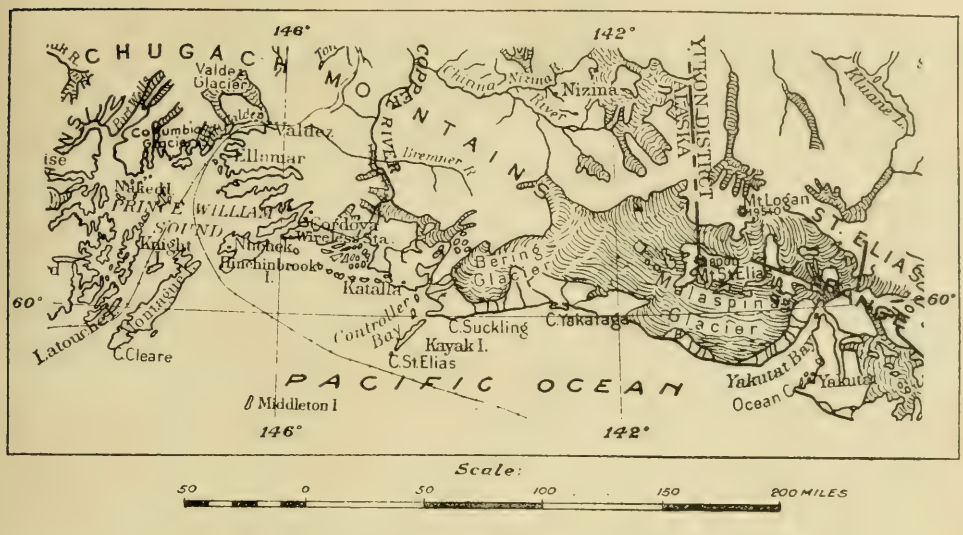
THE COUNTRY VISITED

The country studied is the mountainous region of the Pacific Coast slope of the Saint Elias and Chugach ranges. These mountains rise to heights of 8,000 to 10,000 feet, with peaks reaching 15,000 to 18,000 feet, and with snow fields covering the whole upland above 2,000 to 3,000 feet, except where the slopes are too steep. The upland is bare, cold, and cheerless; the lowland, quite in contrast, may be covered with spruce and hemlock forest or with luxuriant grass and flowers.

The region has a mild temperature,



MOUNT FAIRWEATHER (15,292 FEET HIGH). PHOTOGRAPHED FROM THE PACIFIC OCEAN BY THE NATIONAL GEOGRAPHIC SOCIETY'S EXPEDITION



THE PACIFIC COAST OF THE GULF OF ALASKA

Showing the location of Yakutat Bay, eastern Prince William Sound, and the lower Copper River region, where the National Geographic Society's Research Expedition spent the summer of 1909 in glacier study.

although in the latitude of Hudson Strait the lofty mountains, rising from the coast in the path of the prevailing westerly winds, cause heavy precipitation—81 to 190 inches annually—a large percentage of which falls on the mountains in the form of snow. Great excess of snow accumulation over melting has resulted in the formation of large valley glaciers, which descend from all the mountains, uniting to form the piedmont Malaspina and Bering glaciers and many intermediate piedmont bulbs.

THE LARGEST GLACIERS OUTSIDE THE POLAR REGIONS

The dimensions of the ice masses present is commensurate with the heavy snowfall and the northern latitude, many of the valley glaciers being of exceptional size. The Hubbard glacier* in Yakutat Bay, for example, has a total known length of 28 miles, only the lower portion being explored. It reaches the sea and discharges icebergs from a tidal cliff nearly five miles long and 250 to 300 feet high. Upon its lower surface three of the largest and best known Swiss glaciers—the Aletsch, Rhone, and Mer de Glace—might be superposed without covering the whole width of the glacier, as shown in the figure (see page 5).

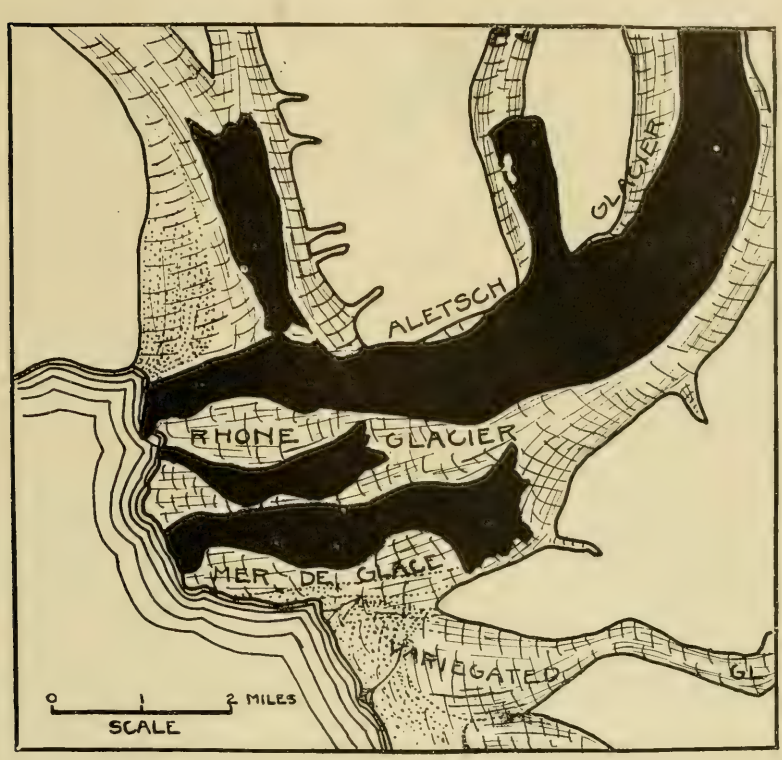
The front of this glacier is so high that a man's figure looks puny against it, and, indeed, a lofty modern office building, such as the Masonic Temple, in Chicago, might stand beside it and the roof would barely overtop the ice cliff, which also extends deep beneath the waters of the fiord. The *Times* building, in New York city, approximately equal in height to the Hubbard or Turner glacier front, is dwarfed by the giant mountains whose 8,000-foot peaks tower in the background.

The whole city of Washington, laid out upon the surface of Columbia glacier, gives a specific conception of the magnitude of these ice masses. One who has walked from the Capitol to the White House, or from the Navy Yard to the

* Named after Gardiner Greene Hubbard, first President of the National Geographic Society, by Prof. Israel C. Russell, who discovered the glacier in 1890 while leading the National Geographic Society Expedition to Alaska of that year.

MAP OF MALASPINA GLACIER, MOUNT SAINT ELIAS, AND YAKUTAT BAY

By Lawrence F. Martin, Department of Geology, University of Wisconsin. This glacier was discovered in 1791 by Alejandro Malaspina, a native of Italy in the service of Spain



THE LOWER PORTION OF THE HUBBARD GLACIER, WITH THREE GLACIERS OF THE SWISS ALPS SUPERIMPOSED UPON IT

All four glaciers are drawn upon the same scale, those from Switzerland being shown from the snowfields to the end of the ice tongue. The contrast of width and length of these glaciers in Switzerland and in Alaska is notable.

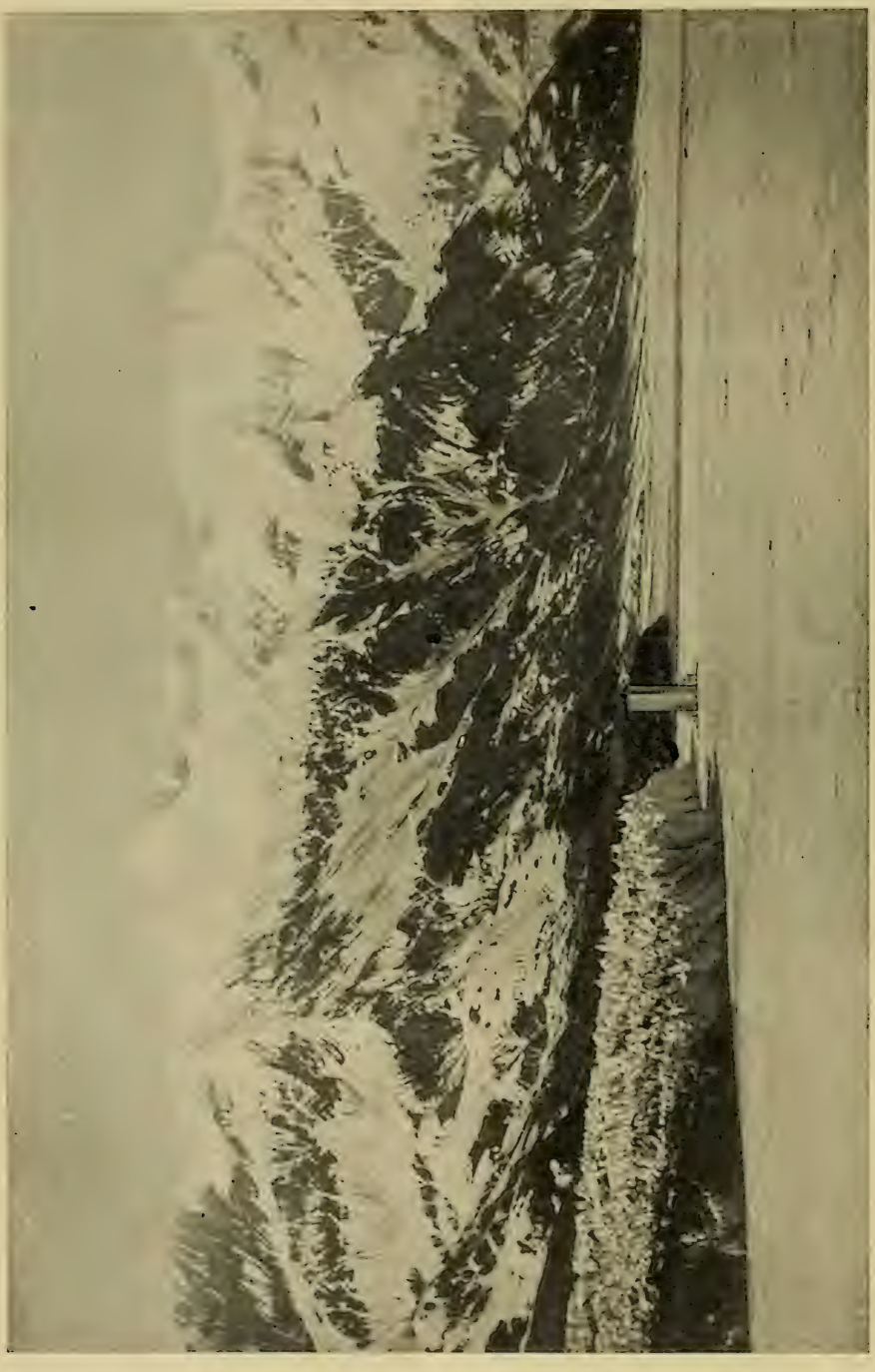
Zoological Park, can appreciate this distance across Columbia glacier (see p. 10).

The Malaspina glacier, however, fed by Agassiz, Seward, Marvine, and other valley glaciers which rival or exceed the Hubbard and Columbia in size, is so large that the whole State of Rhode Island could be laid out upon its 1,500 square miles of surface, or all of eastern Massachusetts. On the accompanying map it may be seen that if Boston were located in the eastern part of the Malaspina glacier the cities of Worcester and Gardner, in central Massachusetts, would be near the west edge (see page 9).

It was with ice masses varying in magnitude from that of Malaspina, Hubbard, and Columbia glaciers to the almost innumerable minor ice tongues that the investigations of the National Geographic Society's Alaskan expedition of 1909 dealt.

INCIDENTS OF A DAY

The day's work in Alaskan glacier study naturally introduces a variety of incidents, with the whole party sometimes united and sometimes divided; one group engaged in observation of the ice tongues, another in making topographic maps, a third in sounding in the fiord, etc. The day may start as early as half past four, and, in one case, began an hour earlier, because the Japanese cook made a mistake. Breakfast is eaten, apparatus and lunches are packed, and the start is made. It is light for twenty to twenty-four hours, so the start and return can be made at convenience.



TURNER GLACIER CLIFF COMPARED IN HEIGHT WITH THE NEW YORK TIMES BUILDING

Mountains in background, 10,000 to 11,000 feet

THE HUBBARD GLACIER CLIFF COMPARED IN HEIGHT WITH THE MASONIC TEMPLE IN CHICAGO

The innumerable branches of a glacial torrent often interpose obstacles to direct travel; the crevasses of a glacier surface make frequent detours necessary. While we were stopping for lunch at a glacier margin one day a series of avalanches built up a deposit of mud and stones 50 feet by 100 and from 5 to 30 feet thick. It contained boulders as much as 6 feet by 4 by 4 and shifted a stream 50 feet laterally into an alder thicket.

A brown bear with a half-grown cub, meeting one on the march and coming up to within 20 feet, lead one to sometimes wish for a gun, and, subsequently, to regret lack of presence of mind in utilizing the camera. The submerging at midnight of a camp on the beach by an exceptionally high tide, so that the water stands 14 inches deep on the tent floor, is not the pleasantest of incidents.

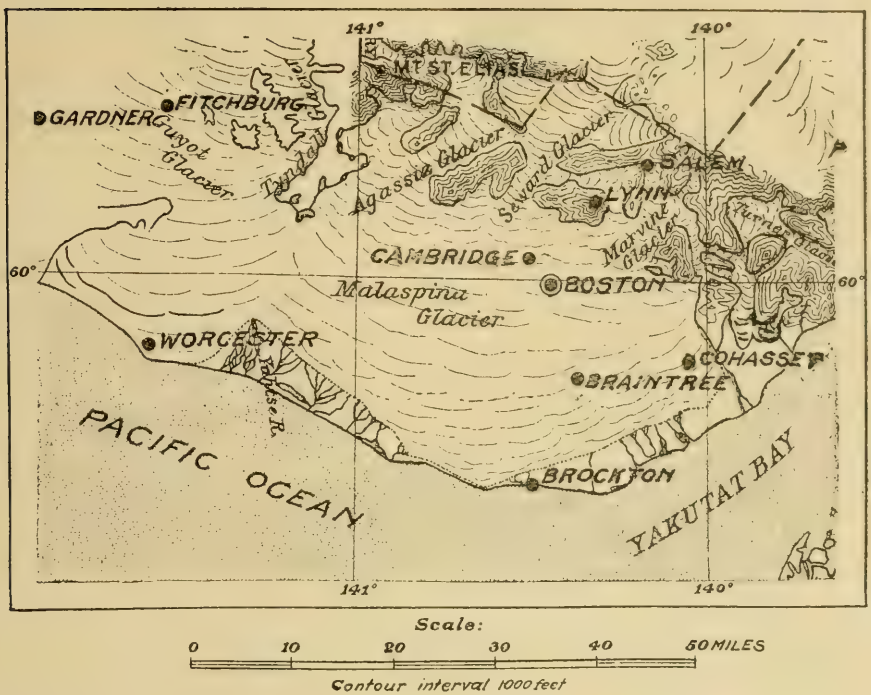
These accidents, however, are easily forgotten exceptions to the general rule of glacier study in Alaska. The series of beautiful panoramas of mountain and plain, fiord and glacier, the excellence and variety of glacial phenomena exhibited—all these lend zest to the work and make the season among the Alaskan glaciers far too short.

THE ENTERPRISE OF VALDEZ

In the regions visited by the National Geographic Society's Expedition the relations of the glaciers to life are striking. When stagnant and moraine-veneered the glaciers are the seat of abundant vegetation, which is destroyed when the ice tongues advance and when they melt and the moraine soil slumps down. As glaciers retreat, vegetation follows. The gravelly stream bottoms are the seat of vegetation which is easily destroyed by the rapidly shifting glacial streams.

The Malaspina and adjacent glaciers are used as highways of travel, the former being utilized by the mountain climbers, Russell, Bryant, and Abruzzi. The Nunatak and Fourth glaciers were crossed by hundreds of prospectors during the gold rushes, the latter being still a highway to the Alsek Valley. Glaciers and glacial streams also erode, transport, and deposit the gold which later concentration has made it profitable to wash on some of the Yakutat Bay beaches.

NUNATAK GLACIER AND ITS ICEBERGS (SEE ALSO PAGES 40 AND 41)



THE MALASPINA GLACIER, THE LARGEST IN THE WORLD OUTSIDE THE POLAR REGIONS

It is larger than Rhode Island or the eastern half of Massachusetts. The distances are shown by the location of the cities of Boston, Worcester, Gardner, Brockton, Cohasset, etc.

In eastern Prince William Sound Valdez glacier is the most famous of the glacier highways, and was traversed in the years of the gold rushes by four or five thousand prospectors.

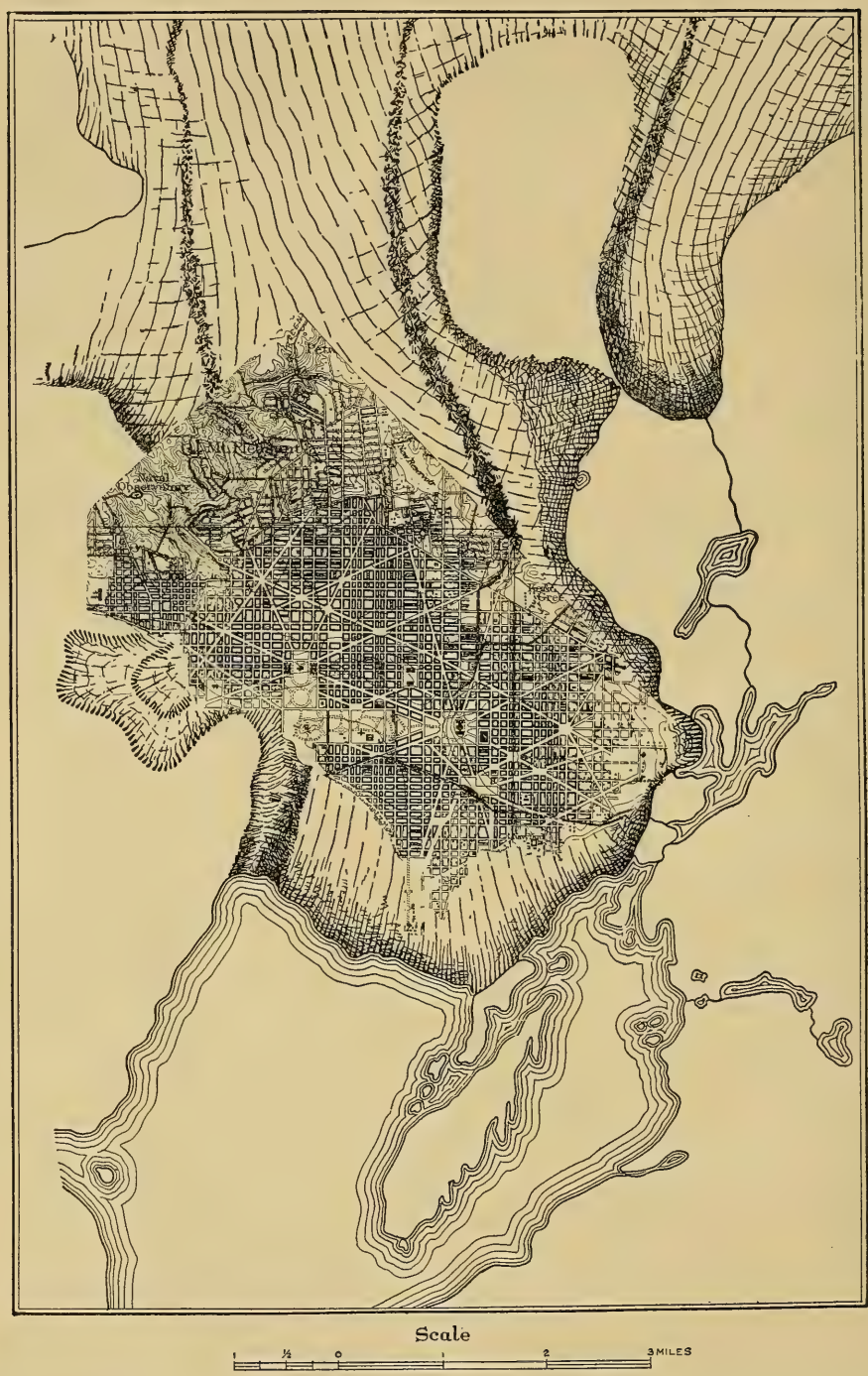
The city of Valdez was located here because this ice-filled pass was possible to cross, and the exact location is determined by the head of ocean navigation on the fiord and a convenient plain built by glacial streams. Not long ago the city was threatened by floods from these same glacial streams. The glacier highway is no longer utilized, but the townsite is an equally convenient terminus to the government telegraph line, trail, and wagon road, several proposed railways, and the winter mail route to the Fairbanks gold camps on the Tanana River.

The enterprise of Valdez citizens has provided an automobile service between the town and the glacier, and on days of steamer visits the automobile makes many trips over the four-mile roadway that connects the glacier and dock. This is probably the only place in the world where automobile service over a glacial outwash plain takes the traveler to the very edge of an ice tongue.

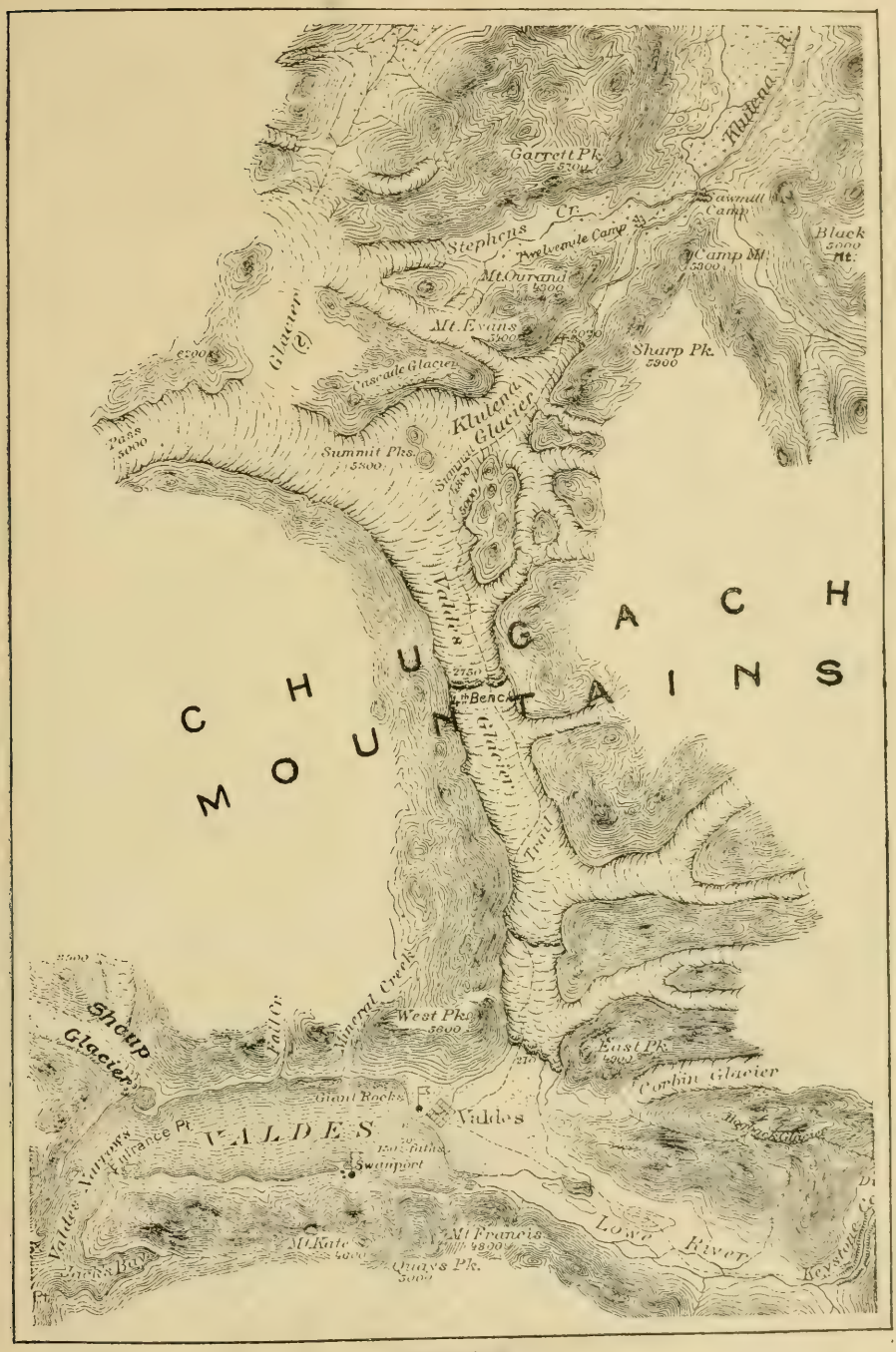
The Shoup glacier, near by on Valdez fiord, is utilized by the United States Army as an ice-house, the soldiers from Fort Liscum, across the bay from Valdez, filling a lighter periodically with small icebergs from this glacier and towing them ten miles to the fort.

FORESTS DESTROYED BY ADVANCING GLACIERS

Around the Columbia glacier, as near the Lucia glacier of Yakutat Bay, the advance of the glacier into mature for-



THE COLUMBIA GLACIER, PRINCE WILLIAM SOUND, WITH THE CITY OF WASHINGTON DRAWN TO THE SAME SCALE FOR PURPOSES OF COMPARISON (SEE PAGES 30-33)



THE VALDEZ GLACIER HIGHWAY (AFTER SCHRADER, MAHLO, AND LOWE)

An ice-filled pass across the Chugach Mountains, crossed by thousands of prospectors. The Shoup glacier, used as an ice-house by the soldiers at Fort Liscum, near Swanport (see page 9)

THE CASCADING GLACIER AND MOUNT DRAPER

That the ice is able to remain on so steep a slope is due to a series of rock terraces, descending westward, which were sculptured by glacial erosion during a higher stage of Nunatak glacier. These terraces form steps upon which the ice rests, giving the appearance of an ice cascade.

ests during the summer of 1909 was resulting in the large-scale destruction of life. Ten years before, Dr G. K. Gilbert and the Harriman Expedition had found that the Columbia glacier was retreating from an advance into the forest, dated tentatively as in 1892. Professor U. S. Grant found that the Columbia glacier retreated 160 feet between 1899 and 1905, and readvanced 112 feet between 1905 and 1908. In the spring of 1909 he observed the continuation of this advance, seen also by the National Geographic Society Expedition in August. Mature trees had grown up to the very edge of Columbia glacier, and a readvance, overturning trees, thrusting splinters of ice up among their very branches, and rolling the peaty soil into great bolsters and terminal moraine ridges, include some of the profoundest effects of glacial conditions upon life (see pp. 32 and 37).

Where the great Copper River breaks through the lofty Chugach Mountains are displayed some of the most striking relationships between glaciers and human life. This water route to interior Alaska has always been blocked by lateral glaciers entering the Copper River Valley and causing ice barriers and rapids in the stream course. Few of the Russians succeeded in getting up the Copper, and difficulties here led to the utilization of the glacier highway at Valdez by most of the prospectors.

The army officer, Abercrombie, ascended to the Miles and Childs glaciers in 1884, and his photographs showing the glaciers and river there are almost identical with present conditions. Lieutenant Allen, in his brilliant explorations of 1885, passed these glaciers, as did Dr C. W. Hayes and Lieutenant Schwatka in 1891.* Hayes made the first detailed map of Miles, Childs, and Baird glaciers.

The map reproduced herewith, modified with a map made in 1900 by Schrader, Gerdine, and Witherspoon, shows the conditions. Miles and Baird glaciers, emerging on opposite sides of the valley, expand in piedmont bulbs. The Copper River writhes between them, forced first against one mountain wall, then the other. Above the glacier dams are lake-like stretches of the river. Childs glacier thus dams the Copper, causing a lake into which Miles glacier discharges icebergs from a cliff three miles long. There are similar slack waters above Miles and Baird glaciers. Opposite the glacier ends the river is constricted into foaming rapids (p. 25).

THE GREATEST SCENIC RAILWAY IN THE WORLD

Under these difficult conditions a railway is being built. Its difficulties include three great bridges across the shifting glacial torrent of Copper River. They include expensive rock cuts, curves, etc., at Abercrombie Rapids, where Miles glacier and the river occupy the whole valley, forcing the railway to the mountain side. They include the laying of five miles of track *on the ice* of Baird glacier, whose advance would destroy the line and whose melting will keep it continually under repairs (see pages 23–25).

The project is daring, unique, but possible. Careful study has determined the necessities. Large capital has enabled wise work. Able engineers, including Messrs E. C. Hawkins, M. J. Heney, and Alfred Williams, who built the White Pass and Yukon Railway, are coping with the problems one by one. Men have never before built railways close to, between, and on great glaciers. But that it can be done is being proved in Alaska. The rich copper deposits north of the Chugach Range, near Mount Wrangell, and perhaps the valuable coal fields of the Controller Bay region, will soon be connected by rail with the growing port of Cordova, on eastern Prince William Sound.

Moreover, this will be the greatest scenic route in the world. Nowhere else can one step from an ocean steamship to a railway car, and ride through foothills, then over a great glacial delta to and between giant ice tongues two and eleven miles respectively in width, around the stagnant, moraine-veneered bulb of the

* National Geographic Magazine, vol. iv, 1892, p. 126.

northern part of Miles glacier, past the beautiful Abercrombie Rapids, and over five miles of the stagnant Baird glacier. Here ice underlies the ties and rails, and a moraine with alders and cottonwoods covers the icy slope on one side, while the other is washed by the Copper River. All this we saw from a railway automobile or on foot, but readers of the NATIONAL GEOGRAPHIC MAGAZINE may see it next year from a train.

MANY GLACIERS SUDDENLY BEGIN A RAPID ADVANCE

In 1890 and 1891, when Professor Russell visited Yakutat Bay, during his explorations of the Mount Saint Elias region, under the auspices of the National Geographic Society and the United States Geological Survey, and in 1899, when Messrs Gilbert, Gannett, and other members of the Harriman Alaska Expedition entered the bay, the glaciers were found to be in a state of general recession. The authors of this article, in 1905, found clear evidence of continued recession of the glaciers of Yakutat Bay, the one notable exception being Galiano glacier.

In 1890 this glacier was covered by a dense growth of alder and cottonwood on its lower, stagnant, moraine-covered end, but in 1905, to our amazement, this forest cover was entirely destroyed. This remarkable change in condition of Galiano glacier puzzled us greatly, and the only hypothesis which we were able to suggest was that the series of vigorous earthquakes that visited the Yakutat Bay region in September, 1899, had in some way caused such an advance in the Galiano glacier as to completely destroy the vegetation which had previously clothed its lower end. The explanation was proposed as only a vague hypothesis forced upon us by the failure of other possible explanations; and we were not only ignorant of the nature of the process and its behavior, but wholly unprepared for the results which the hypothesis necessitated in other neighboring glaciers; for an advancing glacier under earthquake impulse was hitherto an unknown phenomenon of nature.

It was therefore a great surprise to the senior author when he returned to the Yakutat Bay field in the following summer (1906) to find that, although some glaciers had remained unchanged and others had continued their recession, so long in progress, four glaciers had undergone an abrupt and absolute transformation, similar to that of the Galiano glacier prior to 1905. One of these, the Variegated glacier, an alpine glacier of moderate size, which expands in a piedmont bulb beyond the mountain base, was carefully studied in 1905. Its lower end was essentially stagnant and covered with a sheet of ablation moraine arranged in bands of various colors, whence the name of the glacier. Over this moraine we could travel at will in any direction, and up the valley glacier within the mountain walls we made an excursion, in August, finding no other difficulty in traveling over the ice surface than that of an occasional crevasse which broke the otherwise smooth surface, and here and there a mound or ridge of moraine which rose above the clear ice that constituted the larger portion of the glacier within the mountain walls.

Nine months later all this was changed. The smooth, clear ice of the valley portion of the glacier was transformed to a sea of crevasses and seracs, like the broken ice of the ice falls in alpine glaciers; and the crevassing extended out into the moraine-covered piedmont bulb beyond the mountain base. Here not only was the ice so broken that it was impossible to travel on it, but it had thickened perceptibly and advanced noticeably. So great and absolute was the change in so short a time that it seemed almost incredible, and was wholly without precedent.

THE HAENKE GLACIER ADVANCES A MILE IN ONE YEAR

To the west of Variegated glacier lies the great Hubbard glacier, and still farther on the Turner glacier, also large, but

A MEADOW NEAR THE SEA, WHERE THE LUXURIANT VEGETATION CONTRASTS WITH THE BARE, COLD UPLANDS OF THE SAINT ELIAS RANGE

PANORAMA OF HUBBARD GLACIER: HUBBARD MOUNTAIN (12,064 FEET) IN BACKGROUND IN CENTER

This glacier and mountain were named for Gardiner Greene Hubbard, first President of the National Geographic Society. The mountain on the right is Mount Seattle

much smaller than the Hubbard. These two glaciers, ending in the bay in lofty ice cliffs, from which icebergs are constantly being discharged, had not suffered any notable change, but between them are two glaciers, to which no name had as yet been given, one of which, now called the Haenke glacier, had been subjected to changes similar to that of the Variegated glacier, while the other was unchanged. From a nearly stagnant, moraine-covered condition the Haenke glacier had become crevassed to an impassable condition, and its end had moved forward for about a mile. In September, 1905, its visible terminus was on an alluvial fan a quarter of a mile or more from the sea, but in June, 1906, the front was in the sea discharging icebergs and its sea cliff was united with that of Turner glacier.

Still proceeding westward, beyond Turner glacier came the Black glacier, which was unaltered; Galiano glacier, already mentioned, and then Atrevida glacier. In 1905 we were able to ascend the moraine-covered margin of the Atrevida with ease, and we wandered over its ablation moraine at will, while as late as September, 1905, the junior author made a trip completely across the glacier, as Russell had done on his way to Mount Saint Elias in 1890.*

*NATIONAL GEOGRAPHIC MAGAZINE, vol. iii, 1891, p. 92.

REMARKABLE CHANGES IN THE ALTREVIDA GLACIER

In June, 1906, the Atrevida glacier was marvelously transformed. Its margin was no longer moderately sloping and moraine-covered, but in its place rose a jagged ice cliff, advancing into the forest, and pouring into it a stream of boulders and other morainic debris that was constantly sliding down the newly formed ice cliff. The ice was in motion before our very eyes, and the cracking of the glacier, the tumbling of boulders, and the dislodging of huge ice blocks was heard on every hand. Viewed from a neighboring mountain top it was seen that the entire surface of the Atrevida glacier, from its valley head far out into its expanded, alder-covered piedmont bulb, was a mass of yawning crevasses. Travel over this tumultuous sea of broken ice was utterly impossible, and even the ascent of the margin was possible only by cutting ice steps all the way (see p. 39).

In a period of nine months a stagnant, or nearly stagnant, moraine-covered glacier had advanced, thickened, and become broken into an impassable condition, but neighboring glaciers showed no change from their condition of the previous year. For instance, the Lucia glacier, whose piedmont bulb joins that of the Atrevida on the west, and the Hayden glacier, further west, were unchanged.

West of the Hayden glacier the next large glacier is the Marvine, which descends from the mountains to form the eastern lobe of the great piedmont Malaspina glacier. This had been transformed as the Variegated, Haenke, and Atrevida had been. Where Russell easily crossed it in 1890, near its emergence from the mountain valley, the Marvine was now an impassable sea of seracs, and the eastern portion of the Malaspina, as far as Point Manby, at the western entrance to Yakutat Bay, was so broken that travel over its surface was no longer possible; yet it was over this portion of the Malaspina glacier that Russell traveled in 1890 and the Duke of the Abruzzi and Mr Bryant in 1897. The junior author saw the Malaspina and terminus of the Marvine in September, 1905, when it seemed exactly as in 1890. In 1906 the whole eastern margin of the Malaspina was observed by the senior author as a broken, jagged ice cliff, which was advancing in August, 1906, and destroying the forest that grew in the ablation moraine that had accumulated on this stagnant portion of the glacier.

EXPLANATION OF THE ADVANCE

In seeking an explanation for these phenomena there was no assistance to be gained from previous records of glacial changes, for such abrupt transformation of glaciers had never before been witnessed. Some unusual cause must have been in operation to have transformed stagnant ice into the broken, crevassed condition of rapidly moving glaciers, and to have caused a sudden forward movement and thickening of the lower portions of the glacier. Such an unusual cause at once suggested itself, for in September, 1899, the Yakutat Bay region was the center of a series of earthquake disturbances of great severity, and to the study of the effects of these earthquakes we had in 1905 given much attention, finding clear evidence of an uplift of the coast line (in one place to an elevation of 47 feet), of depression, of several fault lines, and of numerous avalanches.

As a result of a consideration of the phenomena observed in 1906 and of their possible explanation the senior author put forward the following theory as the only one that could adequately account for the facts, and against which there were no fatal objections:

In September, 1899, the severe shaking of the mountains during the earthquakes caused extensive avalanches of snow, ice, and rock from the lofty mountains into the reservoir of the glaciers of the Yakutat Bay region. This added so much to their supply that in time a response must necessarily be felt in the glaciers themselves. In the short Galiano glacier, and perhaps in others where not observed, the response occurred before 1905, and in 1906 the four glaciers mentioned were

SHOUP GLACIER, PRINCE WILLIAM SOUND

A glacier front of only moderate height, but one beside which the man's figure (left of lower center) looks puny. The American soldiers stationed at Fort Liscum obtain their ice supply from this glacier cliff (see page 9).

exhibiting the full effects of the response in the sudden addition to their snow supply. As the abrupt melting of snow in the headwaters of a river causes a flood which, in time, sweeps to the very river mouth, so in these glaciers the great and unusual addition of snow and ice during the earthquakes has given rise to an ice-flood which has swept down to the glacier ends. On this theory, therefore, the phenomena observed are explained as the result of a glacier flood started by earthquake impulse.

The observations of 1905 and 1906 were sufficiently extensive to at least lend strong probability to this theory, and it has been quite generally accepted. It was, however, of great importance to apply further test to the theory and to study the later phases of the phenomena attending such glacier advance; and therefore it was with keen interest that the authors again turned their attention to the Yakutat Bay region in 1909 under the auspices of the National Geographic Society.

If the earthquake theory were the correct explanation of the remarkable changes observed in 1906, three things were to be expected: In the first place, other glaciers should by that time begin to show the effects of the glacier flood; secondly, those glaciers which had already been under the influence of the glacier flood should begin to show signs of its diminution, though just what these signs would be or how rapidly the glacier flood would subside could not be predicted; thirdly, no such profound, spasmodic changes in the glaciers should be found in regions on either side of Yakutat Bay outside the area of severe earthquake shaking.

A study of these three points was the foremost object of the expedition of 1909, and the results of this study were in all cases in support of the theory previously proposed. If further demonstration of the accuracy of this theory were demanded than that previously presented, the results of the expedition of 1909 supply enough to establish the theory on a firm foundation. This additional evidence will be considered under the three phases mentioned above, beginning with a consideration of the new advance.

ADVANCE OF GLACIERS BETWEEN 1906 AND 1909

Several of the glaciers of Yakutat Bay have as yet suffered no change as a result of the earthquake shaking, so far as can be seen. This is true, for instance, of the Fourth glacier, which lies just east of the head of Yakutat Bay; of the tidal Nunatak glacier, that has continued the recession which has been in apparently uninterrupted progress since 1891, and whose ice cliff is now a mile and a half or more farther back than in 1899; of the tidal Turner glacier, which appears to be almost as it was in 1890, 1899, 1905, and 1906; of the Hayden glacier, the easternmost tributary to Malaspina glacier, which is in the same state as in 1905 and 1906; and of several smaller glaciers which are in the same state as in 1905 and 1906. But three large glaciers have come under the influence of the glacier flood since last seen in 1906.

Of these the largest and least effected is the tidal Hubbard glacier, which seemed, in 1909, to have just begun to come under the influence of the glacier flood. This is an active glacier, and since first observed by Russell, in 1890, has been crevassed from side to side and has poured a steady stream of icebergs into the fiord from its 5 miles of ice cliff. But beyond the mountains the extreme eastern margin, blanketed by a cover of lateral moraine, has been in a semi-stagnant state, and, where it projected into the sea, rose as a dirt-stained ice cliff from which the discharge of icebergs was infrequent. Back from this ice cliff, on the land, was a moraine-covered ice slope in which little ice showed, and up which it was easy to climb to the glacier surface (see pages 16 and 35).

HUBBARD GLACIER IS EVIDENTLY ON EVE OF GREAT MOVEMENT

In 1909, however, this moraine-covered land slope of the glacier margin was being destroyed; the ice was pushing out

BRAIDED STEAM COURSES WHICH EXPLORERS FIND DIFFICULT TO CROSS

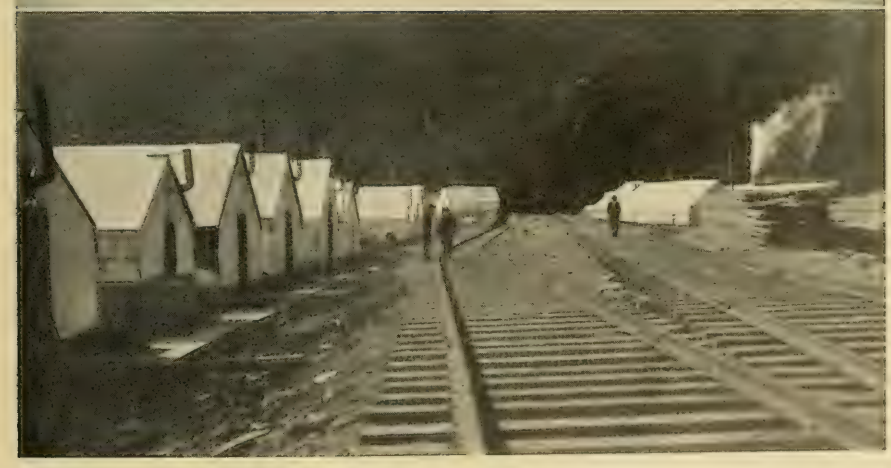
TRAVEL TO THE GLACIERS BY BOAT AMONG THE ICEBERGS AND OVER THE GLACIER SURFACES ON FOOT

THE AUTOMOBILE IN FRONT OF VALDEZ GLACIER (SEE PAGE 9)

through the moraine, and bare, steep, ice cliffs were developed in place of the former morainic slopes. The ice cliff was broken, and blocks of ice, dislodged, were falling to its base, while the moraine, in the grasp of running water liberated from the newly exposed ice, was being deposited on the mud flat at the base of the glacier, burying willow bushes and annual plants that had previously been growing there. From the sea cliff many icebergs were being discharged, proving still further that this margin of the glacier had begun to advance; but we could not be certain that the main part of the glacier was also moving forward more rapidly than before, although it seemed to us that the cliff was higher and there was more ice in the fiord, and more frequent discharge of icebergs than in 1905 and 1906.

From the condition of Hubbard glacier we conclude that an advance under the flood impulse had just begun in the summer of 1909, certainly along the eastern margin, and perhaps throughout the entire glacier. It would, therefore, be of great interest to return to it in 1910 to see exactly what change follows, for in this case we seem to have discovered a glacier showing the very first signs of advance. It will also be interesting to observe whether all or only a part of the glacier feels the flood impulse, for Hubbard glacier is made by the union of two very large tributaries, and each of these has large feeders. By the flood explanation it is not to be expected that glaciers of different lengths, with different numbers of tributaries, and with different conditions in their reservoirs, will advance at the same time.

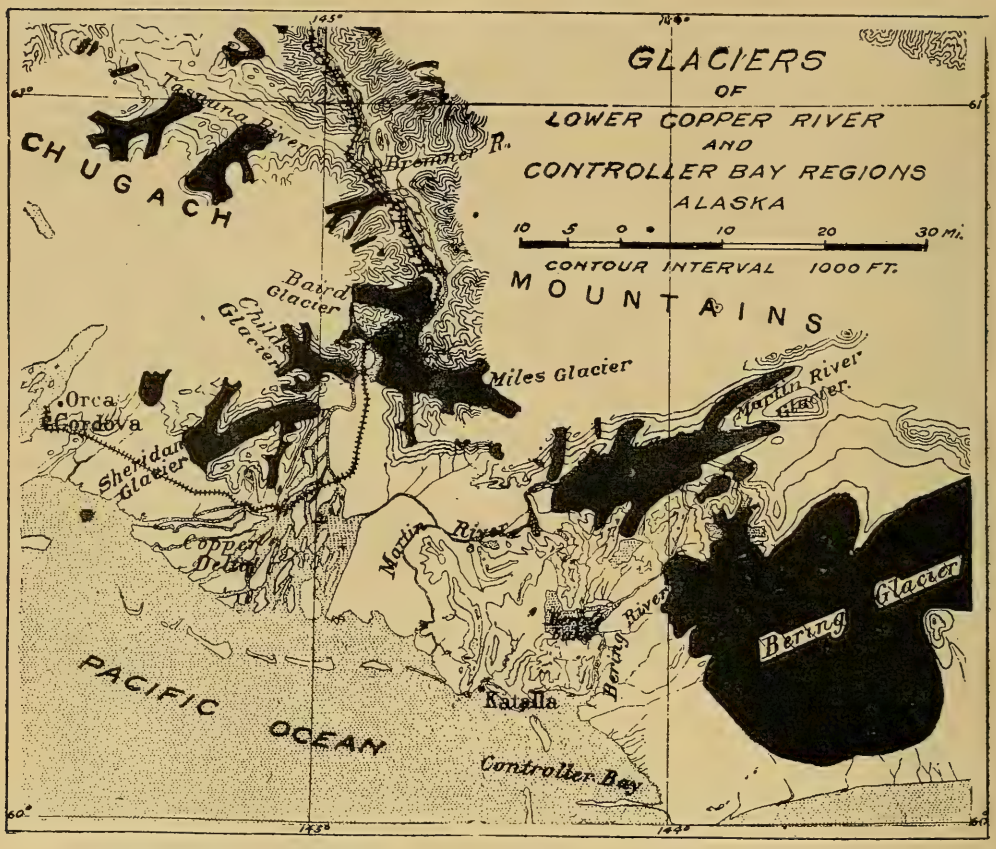
It is quite possible that the eastern side of Hubbard glacier will respond to the glacier flood at a different time and in a different amount than the western margin, which is supplied from an entirely different source. Indeed, even the same side may advance under the influence of the flood from some of its larger feeders, then halt, and later advance again under the flood impulse supplied from more re-



MILES GLACIER AND LAKE (SEE PAGE 13)

FERRY SLIP: STAGNANT PORTION OF MILES GLACIER ON LEFT

M. J. HENEY'S CONSTRUCTION CAMP 55, WITH TENT HOUSES



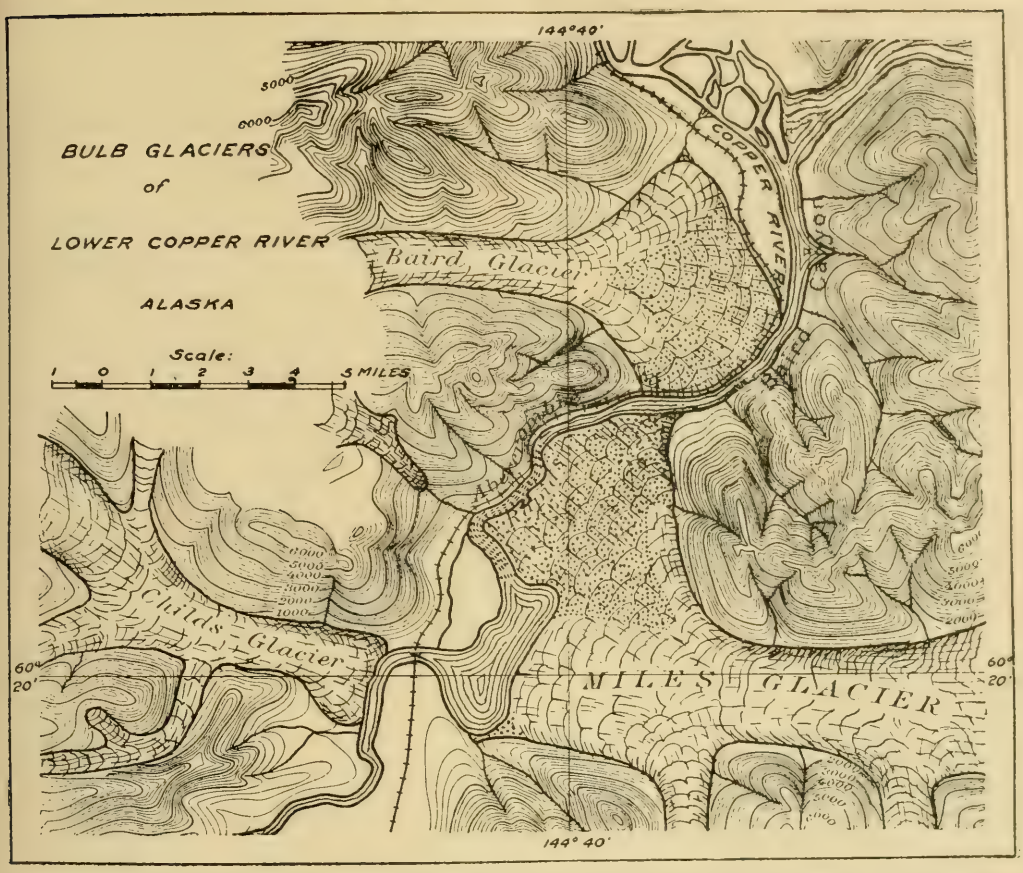
MAP OF PART OF ALASKAN COAST (AFTER U. S. GEOLOGICAL SURVEY)

Showing glaciers of lower Copper River. The water at the delta is so shallow that the terminus is at Cordova to the west. There are valuable coal fields between Bering and Martin River glaciers and rich copper deposits north of the Chugach Mountains (see pages 13 and 37).

mote reservoirs. The entire phenomenon of advancing glaciers as a result of earthquake shaking is so little known that it is difficult to accurately predict results, and consequently it is highly important to maintain observations so that this novel and interesting phenomenon may be more thoroughly understood.

LUCIA GLACIER HAD BECOME IMPASSABLE

The second glacier that has been brought under the flood impulse since last seen in 1906 is the Lucia glacier, which lies next west the Atrevida, and whose lower, stagnant end coalesces with the Atrevida glacier. The expedition of 1906 crossed the Lucia glacier from west to east in order to study the western margin of the Atrevida glacier, which had become so crevassed between 1905 and 1906 that it could no longer be crossed. The Lucia was then in the same condition as when crossed by the junior author in 1905 and by Professor Russell in 1890—that is, the Lucia glacier, fed by many tributaries, emerged from its mountain valley as a partly moraine-covered glacier, with so little crevassing that it could be easily traversed in any direction. Beyond the mountains it expanded into a piedmont bulb covered with moraine, and its outer margin was so stagnant that it was covered by a dense growth of alder and cottonwood. On the western side, near



THE COPPER RIVER AND NORTHWESTERN RAILWAY PASSING BETWEEN CHILDS AND MILES GLACIERS AND OVER THE STAGNANT ICE OF BAIRD GLACIER

Trains now cross the Miles Glacier Lake on a car ferry, pending completion of the bridge across Copper River. (Map after U. S. Geological Survey.) (See pages 13 and 37.)

Floral Pass, the glacier split against a rock hill, or semi-nunatak, sending a small tongue part way down the valley on the western side of the nunatak.

In 1909 the Lucia glacier was absolutely transformed. It was crevassed from side to side, so that the route to Floral Pass, so easily followed in 1890, 1905, and 1906, was no longer passable. The glacier was broken by great rents, enclosing table-topped areas of unbroken ice, on which the ablation moraine still stood, and along the margin, as well as within the mountain valley, was a maze of crevasses, seracs, and pinnacles, giving the ice surface the appearance of an ice fall, where but three years earlier one could walk in any direction with only an occasional crevasse to impede the journey. Along the eastern margin the breaking of the glacier was still in progress and the cracking of the ice and the falling of ice blocks was heard every few moments, while the moraine was all the time sliding down the ice face or into crevasses (p. 41).

Where in 1906 was a moderately sloping embankment of moraine-covered ice, up which we could easily climb at any point, there was in 1909 an ice precipice with jagged, serrated skyline, due to the recent breaking of the glacier. On the western margin, which we were unable to

visit, but saw from a distance, the ice had crowded up on the stoss side of the nunatak nearly to its top, while the distributary west of the nunatak had protruded entirely through its valley and was nearly, if not quite, united with the main glacier below the nunatak.

In the central part of the glacier the new-formed rents extended down into the previously nearly stagnant bulb, but not into the alder-covered zone. There the advance of the Lucia had not extended so far as that of the Atrevida in 1906, when the broken ice affected even a part of the alder zone of its piedmont bulb. But it seems probable that the advance of Lucia glacier, which was certainly in progress in the summer of 1909, was not as far advanced as that of the Atrevida in 1906. As will be seen from the descriptions which follow, the flood impulse is rapid and soon dies out. Quite probably the flood of the Lucia will have attained its height by 1910.

REMARKABLE TRANSFORMATION OF HIDDEN GLACIER

While the Hubbard glacier is apparently in a very early stage of advance, and Lucia glacier has not yet reached the maximum of its flood stage, the Hidden glacier has entered upon and completely passed through flood condition in the interval between 1906 and 1909. In late June, 1906, the Hidden glacier was seen and photographed from near the sea, but it was then so like its condition in 1905 that it was not studied further; but in 1905, because of certain interesting phenomena, it was studied carefully, and photographed from various points. It was then, and in 1906 still was, a low grade, smooth-surfaced glacier, almost, if not quite, stagnant, ending in a gently-sloping front, quite free from débris, over which one could easily travel in all directions. The ice front lay about 2 miles from the sea, and in the interval between Gilbert and Gannett's visit in 1899 and ours in 1905 it had receded about a quarter of a mile. Beyond the apparent front of the glacier, between it and the sea, lay a pitted gravel plain, partly resting on stagnant ice still connected with the glacier. Altogether the Hidden glacier was so perfect a type of an inactive valley glacier in a waning state that one would never have thought of predicting for it a sudden change to activity and complete transformation to a broken condition. Yet that is exactly what happened immediately after it was last seen in 1906, and possibly even late in that year (see pages 42–43).

Notwithstanding the almost magical transformation of glaciers to which we had by that time become accustomed, our astonishment was so great as almost to make us disbelieve our own senses when Hidden glacier burst upon our view in July, 1909. Russell called this Hidden glacier because, as he sailed up Russell Fiord, it was almost hidden from view, appearing for only a short time as its valley opened, revealing the glacier nestled between the steep mountain walls over 2 miles from the sea. As we rounded the northern wall of the valley in July, 1909, the glacier burst upon our view so high and so near that we at first thought it tidal. As a matter of fact, its front was still a quarter of a mile from the sea, but it was nearly 2 miles farther down its valley than in 1905 and 1906, and higher and steeper than the front then was. It had advanced over all of our bench-marks and important photographic sites which we had located primarily for the purpose of recording future recession. The most important of our sites was beneath 500 feet of ice and in front of it stretched 2 miles of glacier.

Not only had the glacier advanced, but it had become profoundly crevassed. However, the advance had occurred so long ago that ablation had healed much of the crevassing, making it possible for us to travel over parts of the glacier surface, though only when the party was roped together, and then by the use of much care, and with many detours around yawning crevasses. The glacier surface was far different from the smooth state of 1905 and 1906. It was a tumultuous series of great swells and troughs, with abundant crevasses, in spite of the pronounced

A SHARP CURVE IN THE RAILWAY AT ABERCROMBIE RAPIDS: A NARROW SHELF BLASTED OUT FOR THE ROAD

THE COPPER RIVER AND NORTHWESTERN RAILWAY UNDER CONSTRUCTION ON THE STAGNANT ICE OF BAIRD GLACIER (SEE PAGES 13-14)

Copper River on one side, ice beneath, glacial ice with moraine and forest on the other side

THE RAILWAY AUTOMOBILE AND MR WILLIAMS, ASSISTANT ENGINEER OF THE RAILWAY

Forest-covered Baird glacier in the background. The leaders of the National Geographic Society's Expedition traveled 125 miles in the car, through the courtesy of the Katalla Company, who are building the railway, and Messrs Hawkins and Williams.

ablation which had evidently been in progress since the glacier spasmodically rushed forward. So much ablation had taken place that we are certain that the advance occurred at least as early as 1907 and perhaps in 1906. The advance must have been rapid, occupying only a small period of time, for, at most, there were only three years for the advance, breaking, and partial healing by ablation, to a state permitting travel over the surface. It is a pity that there was no one at hand to witness the beginning and progress of this marvelous change in glacier condition, the most spectacular of all so far recorded in the Yakutat Bay region, or, for that matter, in all the world.

PRESENT CONDITION OF THE GLACIERS THAT ADVANCED IN 1906

Our second principal line of inquiry was with reference to the condition of the four glaciers whose remarkable advance was discovered in 1906. In the summer of that year the Variegated, Haenke, Atrevida, and Marvine glaciers were in a state of activity which contrasted strikingly with their inactive condition nine months before. The observations of 1906 were upon glaciers in full flood stage, and if, as proposed by the theory, this spasmodic transportation was the result of an impulse due to the accession of large quantities of snow and ice shaken down into the reservoir in a period of three weeks of earthquake shaking, it was to be expected that the full force of the advance would soon be spent.

It was, therefore, with great interest that we returned to an examination of the transformed glaciers. Our expectations were more than realized, for we were quite as unprepared for so sudden a cessation of activity as we had been for the spasmodic advance and breaking observed in 1906. From our study in 1909 it has become evident that the advance of the glaciers, begun between September, 1905, and June, 1906, ended before the summer of 1907. By this it is not meant to assert

that *all* forward motion ceased thus abruptly, though this also may have been true, but merely that the rapid movement which broke the surface of the glaciers into impassable condition came to an end at least as early as the beginning of the summer of 1907, and that the spasmodic advance, from beginning to end, was accomplished within a period of not over one year.

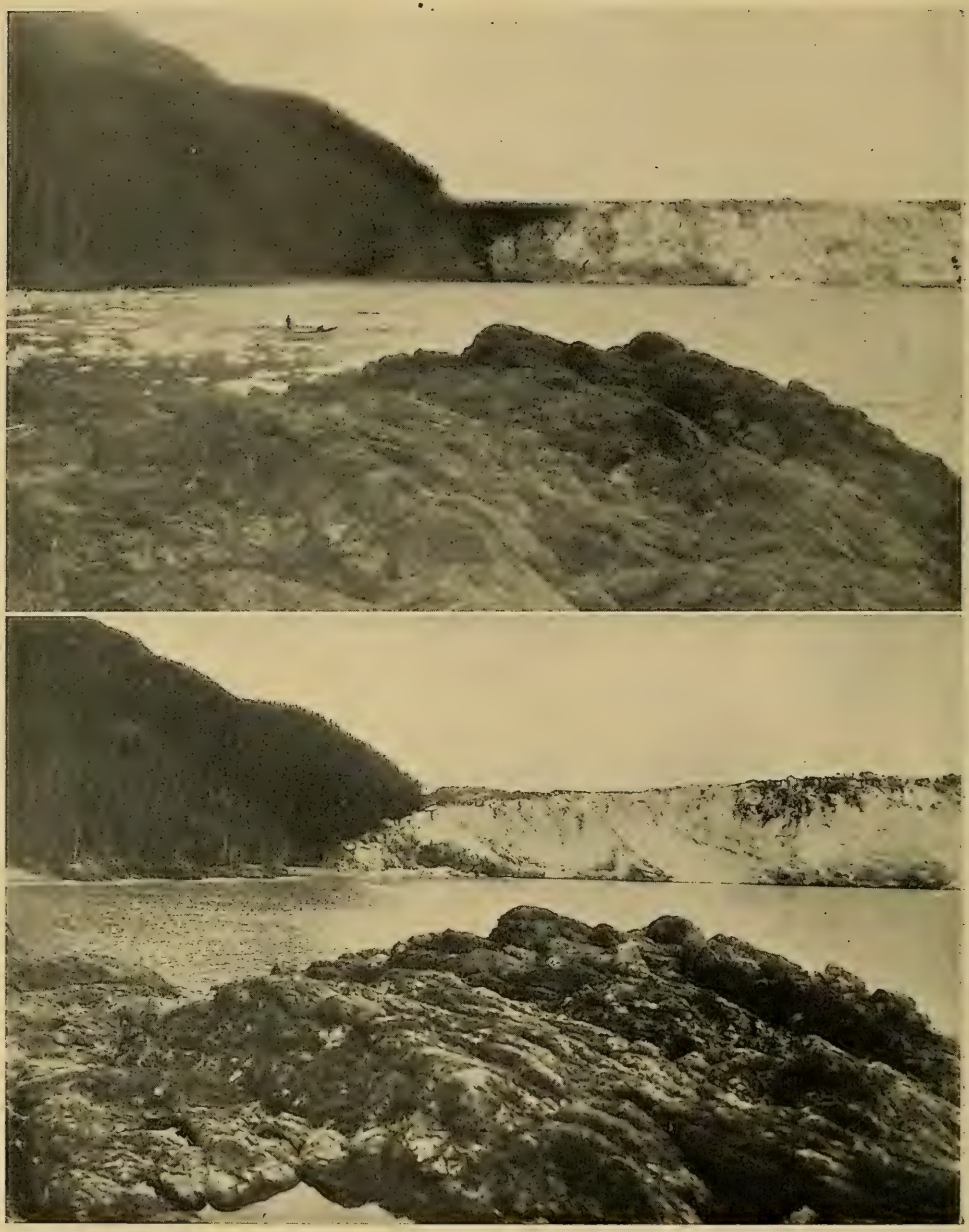
The evidence of this almost incredibly rapid change from stagnation to great activity, and then back again to stagnation, is clear and convincing, though in an article of this length it cannot be discussed with sufficient fullness to marshal all the proof. The proofs of the abrupt advance have already been stated in this paper, as well as much more fully in other publications relating to the studies of earlier years. That the advance so actively in progress in the summer of 1906 did not extend into the summer of 1907, is suggested by the extent to which ablation has healed the crevassing caused by the spasmodic advance. The ice surfaces upon which we could not travel at all in 1906 were again passable in 1909.

We walked across the lower end of the Variegated glacier, and crossed the Atrevida glacier to Terrace Point, and although we did not go to them, it was evident that both the Haenke glacier and the eastern, or Marvine, lobe of the Malaspina glacier could be traversed without great difficulty. For ablation to so heal the broken ice surface as to permit travel over it time is required, and it is inconceivable that the single season of 1907 was sufficient for this extensive ablation. In the period of time required must certainly be included the summer of 1907. Contributory evidence is supplied by Hidden glacier, whose entire advance and ablation to passable condition took place after June, 1906; but travel over this glacier is more difficult than over those glaciers which advanced early in 1906, for there has been less time available for the reduction of the roughened surface by ablation.

Other more definite proof that the advance ceased within a few months after our study of 1906 is furnished by each of the glaciers. The front of the advancing portion of Variegated glacier has gone no farther than where it stood when last seen in 1906; Haenke glacier front is not quite so far out now as then; the eastern margin of Atrevida glacier advanced a little further, but the extent of breaking out in the alder-covered stagnant bulb is the same as in 1906, even the same rings of broken ice in the alder thicket being present; and along the eastern margin of Malaspina glacier the forest growth on the ablation moraine of the stagnant ice was not entirely destroyed, although in the summer of 1906 it was disappearing at a rapid rate.

In a word, although the change in glacier condition between September, 1905, and June, 1906, was marvelous in these four glaciers, the changes between August, 1906, and July, 1909, have been of almost no consequence, excepting only such extensive ablation as to render the glaciers once more passable. It is not to be inferred, however, that ablation has so reduced the irregularities caused by the breaking of the glaciers in their flood stage as to bring about again the undulating, easily traversible surfaces of 1905. The condition of the glacier surfaces is far different from that of the period before the advance, and travel over them is as yet by no means easy. The surface rises and falls in a series of great waves and troughs, and crevasses are encountered at frequent intervals. Nevertheless, the ice surface of these glaciers more closely resembles the condition of 1905 than that of 1906. It is evident that they have once more relapsed into the stagnant or semi-stagnant state by which they have been characterized since first discovered and studied.

The observations of 1906 proved that the advance of the glaciers under the impulse of increased supply furnished by earthquake shaking was rapid, and the observations of 1909 prove that the impulse is spasmodic and of brief duration. The entire cycle, from gently undulating ice surface, through the broken stage of the glacier flood, and back to the normal

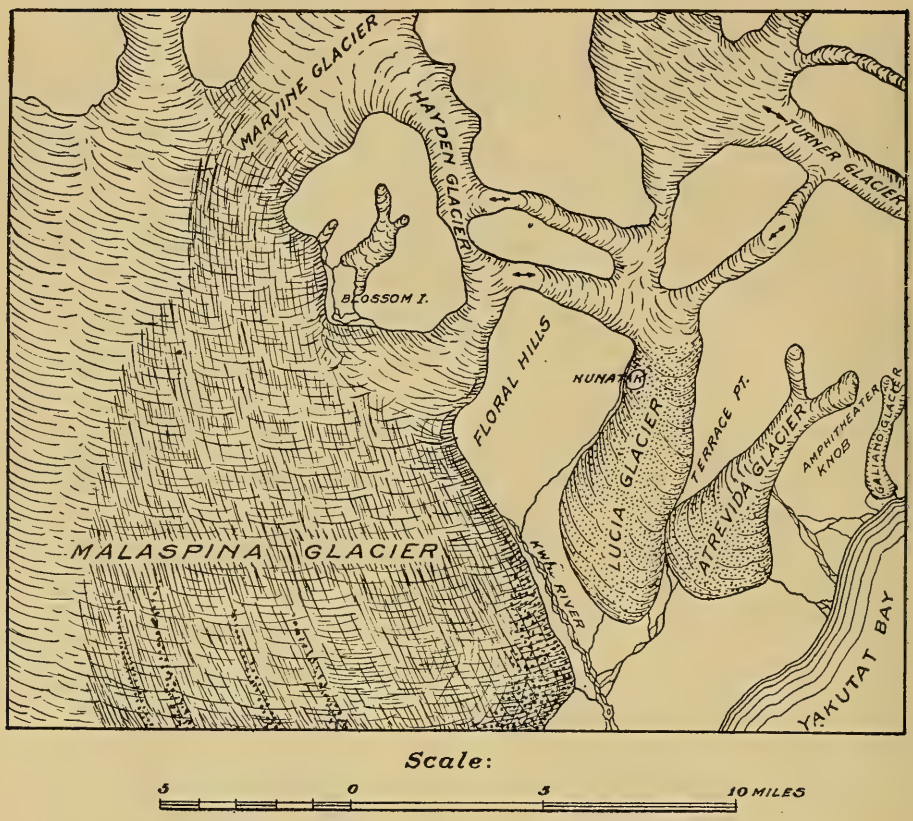


WEST MARGIN OF COLUMBIA GLACIER, AS PHOTOGRAPHED BY GILBERT IN 1899, AND BY THE NATIONAL GEOGRAPHIC SOCIETY'S EXPEDITION IN 1909, AFTER THE RECENT ADVANCE (SEE PAGE 37)

EAST SIDE OF COLUMBIA GLACIER, PHOTOGRAPHED IN 1909 FROM EXACT SITE UTILIZED BY GILBERT TEN YEARS BEFORE: ADVANCE SHOWN IN LOWER PHOTOGRAPH

COLUMBIA GLACIER ADVANCING INTO FOREST, OVERTURNING TREES AND SHOVING UP A MORAINE (SEE PAGES 9–13, AND 37)

ICE OF COLUMBIA GLACIER OVERTURNING MATURE FOREST



ATREVIDA, LUCIA, AND MARVINE LOBE OF MALASPINA GLACIER

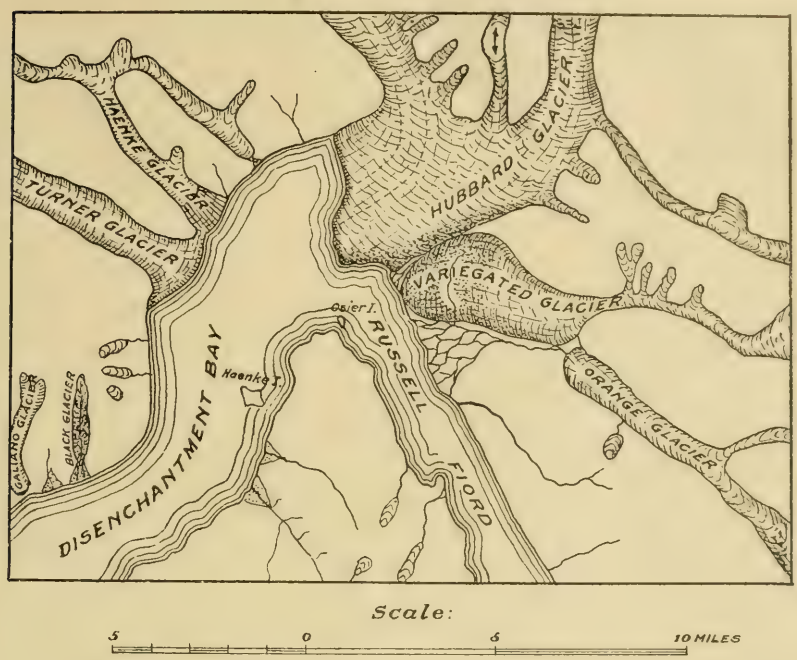
Atrevida and Malaspina glaciers advanced between 1905 and 1906, while Lucia glacier was advancing in 1909 (see pages 17, 24 and 25)

condition of the stagnant glacier, is compassed in a period of but a few years, say from four to six years. Surely the term glacier flood is warranted for such a sudden change in ice condition.

This is not the place for a discussion of the validity of the earthquake theory for these remarkable changes, but it may, nevertheless, be pointed out here that, while this theory accounts for all the facts, and stands all the tests applied to it, no other explanation that has so far been suggested can be considered even rational enough to be retained as an alternate hypothesis. We believe, therefore, that we are warranted in claiming that a new cause for glacier advance has been discovered, for the theory of advance under earthquake impulse, first put forward by the senior author as a result of his observations of 1906, has, by the additional evidence discovered in 1909, been put to such tests as to completely verify it.

GLACIERS OF OTHER SECTIONS SHOW NO EVIDENCE OF SPASMODIC ADVANCE DUE TO 1899 EARTHQUAKES

There is, however, one further test that we were able to apply as a result of the field work of the 1909 expedition. It has seemed to us reasonable to expect that, since the earthquakes of September, 1899, were centered in and about the Yakutat Bay region, the spasmodic advance of glaciers should be confined to that region, or, at least, should not be



VARIEGATED AND HAENKE GLACIERS

Which were stagnant and easy to cross in 1905, crevassed and impassable in 1906, and stagnant and passable in 1909. Hubbard glacier, perhaps, began an advance in 1909 (see pages 16, 17, 19 and 22).

noticed far to one side of the area of vigorous shaking. Just what is to be expected near the periphery of the area of maximum shaking we are not in a position to predict, though it is to be expected that there, also, some response, probably less spectacular, should occur. In a single field season we could not, of course, cover an extensive area in personal field work, but we were able to do some work in the Prince William Sound region and in the Copper River Valley, and we made some observations on glaciers visible from the steamer and made inquiries regarding them.

So far as we could learn from our inquiries none of the glaciers of the Inside Passage have undergone any notable transformation since 1899, excepting that of recession as exemplified especially in the Muir glacier. The Brady glacier, near which our ship anchored for the night, has not changed notably since 1905, when we last saw it, and we could not detect any changes in the great glaciers which descend the western face of the Fairweather Range, although it should be stated that most of these were seen from such a distance that we could have detected only extensive changes. These glaciers, together with the Brady, Muir, and others in this vicinty, are within the area shaken during the September, 1899, earthquakes and may be expected to respond, to some extent at least, to the effects of this shaking.

The natives residing at Dry Bay, 60 miles southeast of Yakutat Bay, report that in the summer of 1909 there were remarkable and long-continued changes in the volume of the Alsek River, which may be related to the advancing and breaking of some of the glaciers whose ends lie up this valley. We may expect advance in these glaciers, for their sources lie in the snow fields of mountains within the area of vigorous shaking during the 1899 earthquakes.

THE HUBBARD GLACIER IN 1909 FROM OSIER ISLAND

Our actual field work on areas outside of the Yakutat Bay region was entirely to the northwest. Here, in Prince William Sound, we found the large Valdez glacier continuing the recession which has been in progress, with one possible slight advance, since 1899. There has also been a retreat since 1898 of the Shoup glacier, which, however, is smaller than the Valdez. On the other hand, the still larger Columbia glacier, the greatest in this region, and comparable to the Hubbard, was again advancing into the forest in 1909, as it had seven years before 1899, when studied by Dr Gilbert. Prof. U. S. Grant has shown that there was a period of recession in the Columbia glacier between 1899 and 1905, followed by slight advance between 1905 and 1908. The present advance, which has gone beyond that of 1892, does not appear to be of the same order as that of those Yakutat Bay glaciers which are advancing under the impulse of earthquake shaking. It may be the beginning of a spasmodic movement, or it may be a slow forward swing such as comes from moderate variation in snow supply. Moreover, we would hardly expect the largest glacier to be the first to advance under the earthquake influence. However, it will be important to watch this glacier in the next few years (pp. 30–33).

In the Copper River Valley, although several other glaciers were seen, and showed no sign of recent notable advance, we gave special attention to the three largest, the Baird, the Miles, and the Childs. That the Baird glacier has long been stagnant is proved by its moraine-covered piedmont bulb, bearing a growth of mature alder (see pages 24–25).

The Miles glacier is more active and discharges icebergs into the Copper River from a long ice cliff; but its alder-bearing, moraine-covered piedmont bulb on the north side shows a long period free from advance, photographs and maps by Abercrombie in 1884, Allen in 1885, Hayes in 1891, and Schrader in 1900 verifying this inactivity.

The Childs glacier, which is also actively discharging icebergs into the Copper River directly opposite the Miles, has not recently been much farther out than now, but it is reported by the engineers of the Katalla Company, who are building the Copper River Railway, to be more active in 1909 than previously, and to have advanced somewhat.

In view of the great economic importance of these three glaciers, between two of which, and *on* one, the Copper River Railway is now built, it is of high importance that these three glaciers be carefully mapped and studied. The fate of the railway to the copper fields depends upon the behavior of these three glaciers, and since they are now so easily accessible and so interesting—the only case in the world where two large iceberg-discharging glaciers can be seen from a railway train which passes between them—they are likely to be much visited in the immediate future.

From our observations and inquiries of 1909 we are led to believe that the spasmodic advance of glaciers, so vividly illustrated by six of the glaciers in the small area of Yakutat Bay, has probably not been duplicated in the regions to the northwest and southeast. It is, of course, recognized that such negative evidence is not wholly conclusive, since our observations have not included all the glaciers or even a large proportion of them. But it is, nevertheless, considered as contributory evidence that in our search to the northwest and southeast of the Yakutat Bay region we have so far failed to find a duplication of the marvelous transformation of glaciers observed there. So far as it goes, this evidence tends to verify the theory of local cause for glacier advance in Yakutat Bay. Further study in the areas beyond the limit of vigorous shaking by the 1899 earthquakes should be expected to bear similar testimony.

There have been world-shaking earthquakes originating near the Prince William Sound and Copper River regions, of which those of October 9, 1900, and February 14, 1908, are good examples, though less severe than the three weeks of earthquakes at Yakutat Bay in Sep-

MORAINE-VENEERED EAST MARGIN OF HUBBARD GLACIER IN 1909

Showing dark-colored ice projecting through moraine, as if glacier were about to advance

tember, 1899. Avalanches accompanied these shocks also. These facts may complicate the situation somewhat.

OTHER RESULTS OF THE NATIONAL GEOGRAPHIC SOCIETY'S 1909 EXPEDITION

The problems connected with the remarkable changes in the Yakutat Bay glaciers, and with the explanation of these changes, have claimed first attention from the authors, for these seemed to be the most inviting and important phases of work on Alaskan glaciers at present open to the student. It scarcely requires statement, however, that other problems also received attention of students of glaciers and glaciation whose good fortune it was to be given the opportunity to study in a field so rich in glacial phenomena as that of the Alaskan coast. This is not the place for a full statement of the results of our summer's work; that must be deferred until the appearance of our final report. Still a summary of some of the more important phases of these other results may appropriately be introduced here.

The Alaskan Coast region is not only the seat of the largest glaciers on the continent, and in fact of some of the largest in the world, outside of the Arctic and Antarctic regions, but also of some of the most interesting and least known. Therefore any study of these glaciers promises important results, and studies of one year will serve as a basis for future comparative studies. From this latter standpoint it has seemed to us highly important not only to provide descriptions of glaciers, but also to prepare maps of such detail as to give an accurate basis for future comparative study. Accordingly, the topograhper of the expedition, Mr W. B. Lewis, whom the U. S. Geological Survey detailed for this work, assisted by Mr E. F. Bean, has made a series of detailed contour maps of the principal glaciers studied. These will be published with our final report. Supplementary to maps, photographs from

THE ADVANCING MARGIN OF ATREVIDA GLACIER BROKEN BY RECENT FORWARD MOTION

In 1905 this was a moderately sloping, moraine-covered ice margin; in 1906 it was a jagged cliff from which blocks of ice and stones were constantly falling into the forest, which was being overwhelmed (see pages 17 and 29).

selected points, which can again be occupied, are of high importance. The expedition was fortunate in having the services of Mr O. D. von Engeln, a skilled photographer trained also in physiography, to the results of whose work we are much indebted; and his photographs taken during this expedition as well as those which he took on the expedition of 1906 will be of great value in all future work on these glaciers. To these three men the authors are especially indebted for careful, conscientious work in their fields, as well as for generous assistance whenever and wherever needed. All future students in these fields will profit from their excellent work.

The glaciers of the Alaskan coast are especially interesting to the student of continental glaciation because here large masses of ice descend into a cool, damp, temperate climate, much as was the case at the base of the Alps and other mountains during the Glacial period. The wasting margins of these glaciers furnish much information of value in the study and interpretation of the phenomena of continental glaciation in Europe and

NUNATAK GLACIER IN 1899 (PHOTOGRAPHED BY G. K. GILBERT)

NUNATAK GLACIER TEN YEARS LATER

Photograph by the National Geographic Society's Expedition from exactly same site, glacier having retreated out of sight (see pages 8 and 44)

LUCIA GLACIER IN 1909 FROM TERRACE POINT

It is crevassed and moving rapidly. In 1890, 1905, and 1906 it was stagnant and without crevasses. The nunatak in the background is being overridden (see pages 24–25)

VIEW OF HIDDEN GLACIER IN 1909, TAKEN FROM SAME POINT AS THE PICTURE SHOWN ON PAGE 43 (SEE PAGE 26)

HIDDEN GLACIER IN 1906

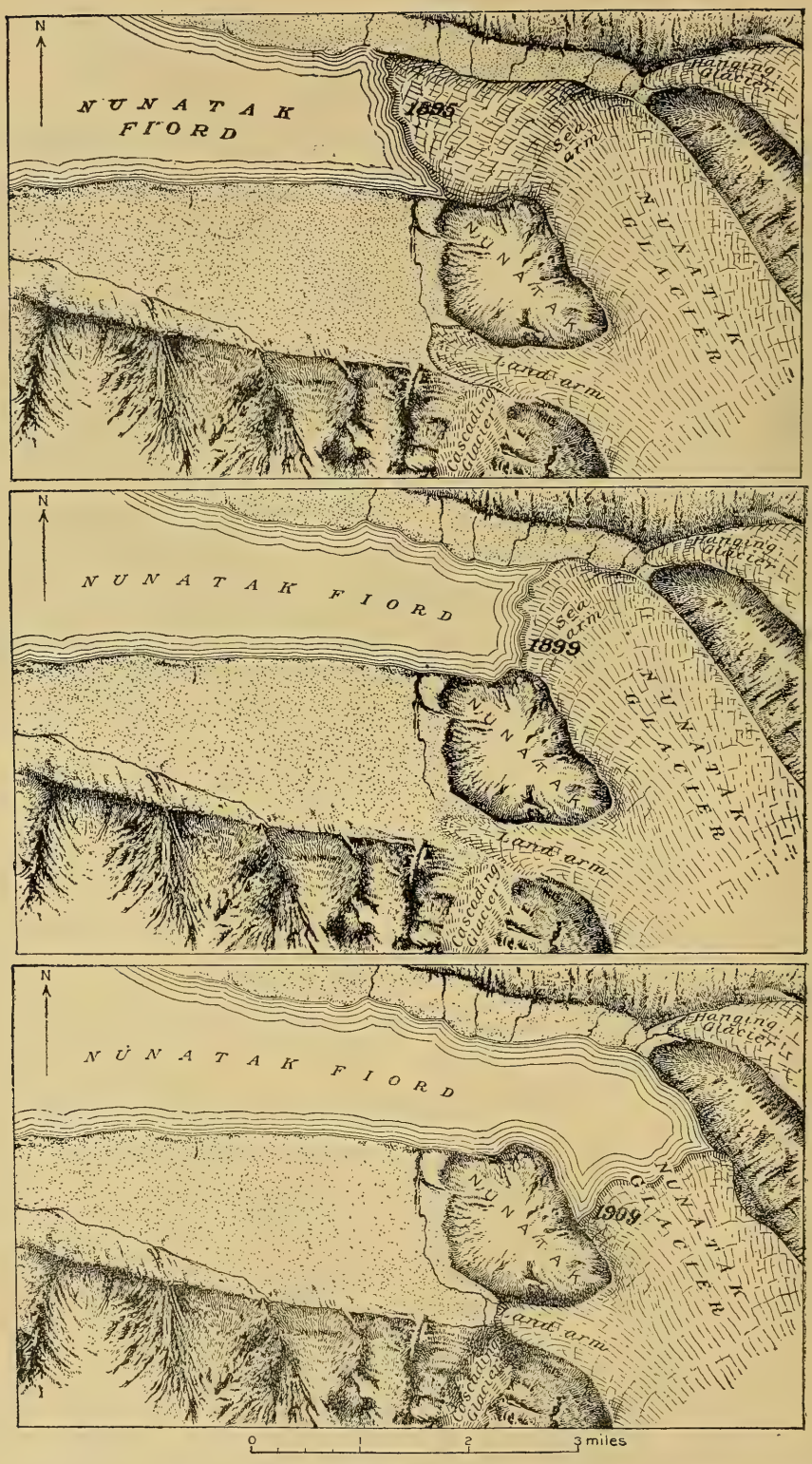
This photograph was taken from the same point as the view of Hidden glacier in 1909, given on page 42. The glacier has advanced nearly two miles in three years

America. In our expedition especial study was made of the piedmont ice bulbs into which so many of the glaciers expand on emergence from their mountain valleys; and in this connection the ablation moraines which accumulate on the wasting surfaces of the stagnant piedmont ice masses, and the deposits accumulating around their margins, were given particular attention. A statement of the results of these studies must for the present be postponed.

Another line of inquiry to which attention was given was the cause of glacier motion, upon which the advancing glaciers throw light. The sudden forward movement of a glacier, such as observed in Yakutat Bay, is difficult to explain on the basis of some of the current hypotheses for glacial motion. On the hypothesis of plastic or viscous flowage, on the other hand, the phenomena are all easily explained. A number of facts of observation in the summer of 1906 and 1909 tend toward the verification of this hypothesis. The discussion of this subject must also be left for our final report.

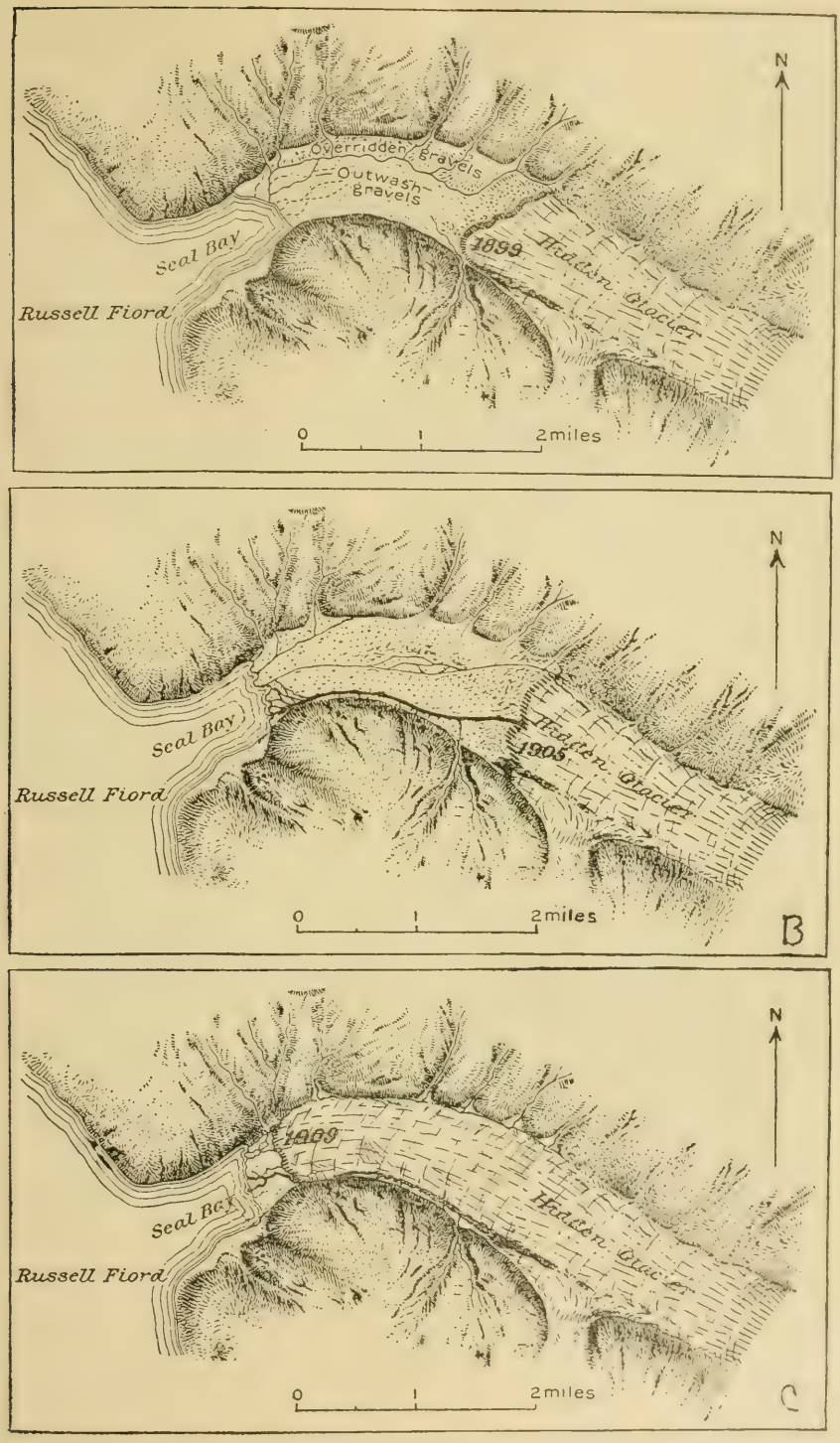
Other problems which will be discussed in the full report deal with questions relating to the former extension of the glaciers. During the period of maximum glaciation, ice filled the entire Yakutat Bay inlet and discharged icebergs into the Pacific; and at the same time the Copper River Valley was filled, and ice occupied the entire Prince William Sound, at least on the eastern side to which our studies were confined. The erosive work performed by these great glaciers has, in part, shaped the various inlets and valleys, while their deposits have left records of considerable scientific interest.

In view of the fact that only two parts of the coast have so far been studied, it will not, of course, be possible to enter into a comparative study of the phenomena of former glaciation of all



NUNATAK GLACIER IN 1895, 1899, AND 1909 (TOPOGRAPHY AFTER GANNETT)

This has had continuous steady retreat, but may yet advance under the earthquake-avalanche impulse (see page 40)



HIDDEN GLACIER IN 1899, 1905, 1906, AND 1909 (TOPOGRAPHY AFTER GANNETT) (SEE PAGES 26, 42–43)

BROKEN EASTERN MARGIN OF THE MARVINE LOBE OF MALASPINA GLACIER, FROM ALLUVIAL FAN OF KWIK RIVER (SEE PAGES 17 AND 28–29)

The broken ice cliff has protruded through the morainic soil and the forest. Blocks of ice fell from this cliff as the party passed, trees crashed down, and the morainic soil was constantly sliding down. Photograph taken August 11, 1906.

BLOCKS OF ICE PROTRUDING THROUGH MORAINIC SOIL AND FOREST COVER, EASTERN MARGIN OF MALASPINA GLACIER (SEE PAGES 17 AND 28–29)

Cottonwood trees, in full leaf, overthrown by the recent thrust that broke the glacier margin. Photograph taken August 11, 1906

THE SURFACE OF MARVINE GLACIER IN 1906, SHOWING THE DEEP CREVASSES WHICH MADE ITS CROSSING IMPOSSIBLE

The National Geographic Society's Expedition three years later, 1909, found these crevasses healed and the surface comparatively smooth and easy of traverse (see pp. 17 and 28-29)

Alaska; but enough has already been seen to make it possible to compare two widely separated regions, and to show that their glacial history has been different. While in both cases ice formerly extended beyond the present limits, the Prince William Sound and Copper River regions have not shared in an important episode of recent great ice advance, of which the evidence is so clear and convincing in Yakutat Bay and Glacier Bay. Why one part of the Alaskan coast should have been favorable to an advance of glaciers to a distance of many miles, and then to recession of these glaciers, while another part gives evidence of no such oscillation, is an interesting question. Other notable differences in glacier condition are also found, such, for example, as the difference between Columbia glacier, which is now farther out than it has been for at least a century and is still advancing, and the Valdez, Nunatak, Muir, and other glaciers, which are now greatly shrunken as compared with their condition a few years ago. Some of these problems cannot be adequately discussed until a wider area has been studied and a greater body of fact accumulated.

In conclusion, the authors wish to express their opinion that the problems of Alaskan glaciers and glaciation present a field for geographical research of the very highest scientific importance. In so large a field not all the glaciers, and in

GALIANO GLACIER (SEE PAGES 14 AND 59–62)

This picture represents in miniature all the conditions of the Malaspina glacier. The white snow fields in the background are constantly feeding the glacier, while in the foreground the ice has been so thickly covered with earth and rocks from the mountain sides that sturdy shrubs have grown up and make it difficult to believe that only a few feet beneath is the solid glacier ice.

MORAINE-COVERED FORESTED EASTERN MARGIN OF THE MARVINE LOBE OF MALASPINA GLACIER

The ice, recently thrust forward, has protruded through the soil; the trees are tilted at various angles and overturned; and the underlying ice, exposed to air and rain, is rapidly melting. Streams of water and of liquid mud descend the slope.

fact not all the larger glaciers, can be given careful study for years to come; for not only are there hundreds of such glaciers, many of which are still unnamed, but large numbers of them are so inaccessible that they can be studied only by special expeditions, expensive from the standpoint both as to time and of money.

While ultimately it is to be hoped and expected that all of these glaciers will be studied and mapped, the present needs can be met by a study of a few selected areas in which it is to be expected that the principal phenomena of Alaskan glaciation will be exhibited, and from which facts can be observed which will solve some of the larger problems and furnish basis for future study which will solve others.

In selecting these areas first consideration should be given to the scientific promise; second, to the variety of phenomena, and third, to the expenditure of time and money. From the latter standpoint accessibility is the key. Alaska is being rapidly opened up by road and railway building and river navigation, and what is today quite inaccessible, may in a few years be easy of access; therefore it seems hardly wise, in view of the broad field of opportunity, to expend large amounts of time and money in a study of what a few years hence may be reached with ease in far less time and at a far less expense.

ADVANCING ALTREVIDA GLACIER IN 1906 (SEE PAGES 17, 28–29, AND 39)

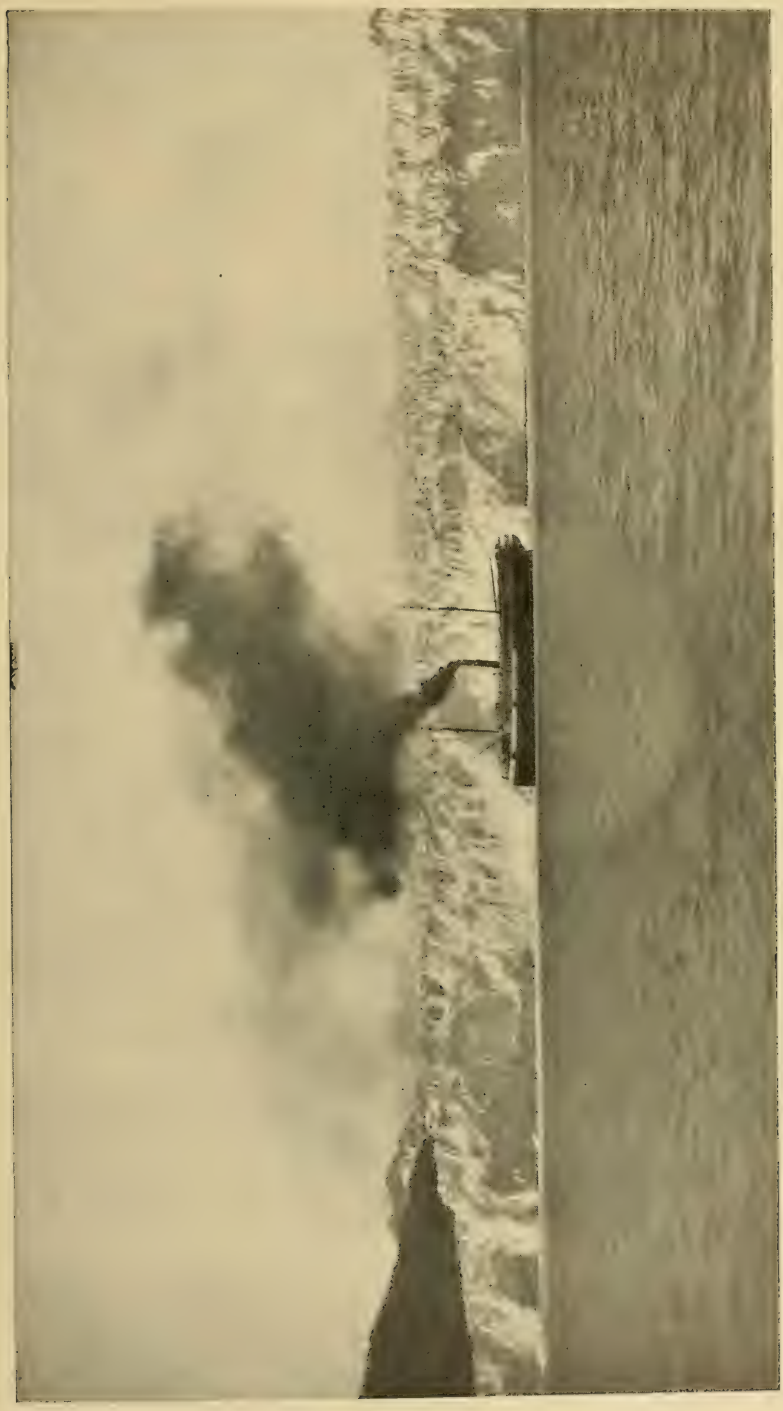
Showing the deep, impassable crevasses which are characteristic of a glacier during its advance

ALTREVIDA GLACIER IN 1909 FROM SAME SITE

Showing crevasses healed and surface covered with ablation moraine, an accumulation of earth and rocks from the mountain slopes (see pages 17, 28–29, and 39)

THE RESURRECTED FOREST: NEAR MUIR GLACIER

Photo from "Harriman Alaskan Expedition." Copyright, 1902, by E. H. Harriman



COLUMBIA GLACIER IN 1899

Photo from "Harriman Alaskan Expedition." Copyright, 1902, by E. H. Harriman (see also pages 30–33)

In view of the promise which this field of research holds forth, and of the considerations just stated, the authors have set themselves the task of outlining what seems to them a desirable program for the study of Alaskan glacial phenomena, so as to bring forth the results which seem to them most important, as follows: (1) Annually for several years a brief visit to Yakutat Bay, perhaps combined with a further study of Malaspina glacier if the advance of its tributaries permit travel over it, a study of the large glaciers of the Alsek valley, the Fairweather coast, etc.; (2) a more detailed study of the glaciers of Prince William Sound and the lower Copper River Valley; (3) the glaciers of the Inside Passage from the Canadian boundary to Cross Sound and the Muir Inlet; (4) the Controller Bay region, and the great piedmont Bering glacier; (5) the glaciers on the north side of the Saint Elias Range and in the Mount Wrangell region; (6) glaciers and glaciation in the great Alaska Range, the Endicott (Rocky) Mountains, the Alaska Peninsula, etc. If such work could be carried on consecutively, as part of a matured plan, the highest results for comparative purposes would be secured; it would be a notable contribution to science if the National Geographic Society should undertake an investigation of this scope.

PHOTOGRAPHY IN GLACIAL ALASKA

By O. D. von Engeln

Photographer of the National Geographic Society's Alaskan Expedition of 1909

ALMOST every subject of geographic interest has one or more phases of which photographic records can be made. It may therefore be inferred that a large number of the readers of the National Geographic Magazine are photographers, and that many of them are engaged in the fascinating task of carrying the camera into the remote places of the earth, as the pages of the Magazine itself testify.

The opportunity to focus a lens on scenes hitherto unpictured is compensation in itself, but an equal interest in such work lies in the difficulties which must inevitably be encountered and overcome when working with the camera away from the conventional dark-room, with its electric ruby-light and other conveniences. To "bring out" a collection of good negatives under such conditions becomes a worth-while task, and one which is in few places more difficult, probably, than in glacial Alaska, especially from that part of this region which is its focal point—the coast along the center of the great Gulf of Alaska.

It has been the privilege of the writer to do the photographic work of two expeditions to this region—that of the National Geographic Society's party of the past summer, and, in 1906, with a United States Geological Survey party. The following paragraphs have been written in the belief that the experiences recorded may be of interest and value to others who are engaged in similar work.

The photographer on a trip to Alaska will find subjects for his camera on the first morning after the sailing from Seattle in the personnel of the passengers. It must be understood that this does not apply so particularly to the excursion steamers, which carry tourists to the interesting points along the Inside Passage, but refers more especially to the boats which carry both passengers and freight to the mining towns and fishing stations scattered along the southeastern and southwestern Alaskan coast, with longer stops at the coast terminals of important routes to the interior mining fields. The second-class passengers on such a steamer are in the main typical

Alaskan "sour-doughs," old-timers, but include a few new-comers or "chechakos." The "sour-doughs" are characters of the greatest interest, representing as they do the last of the American pioneers to westward. The Scandinavian type predominates—men of splendid build, whose eager, alert attitudes as the boat approaches each Alaskan village afford good subjects for the kodaker.

The cabin passengers present more diverse types. Mining, railroad, and construction engineers; successful prospectors; capitalists, judges, and commissioners; scientific men in the fields of geology and forestry; store-keepers, cannery managers, and perhaps a writer or two, make up their number. These are more shy of the camera man, but from their conversation one may acquire an all but complete history of Alaska and the current events of its present-day rapid development.

In passing through the narrow reaches of the Inside Passage, such as Grenville Channel, the photographer is offered many opportunities, from the deck of the vessel, for pictures of the steep, glaciated cliffs of these passages among the islands. Waterfalls, sometimes extending all the way from a high mountain summit to the sea, but more often emerging from the lips of hanging valleys high up on the slopes, descend between the sheltering green of the luxuriant vegetation which everywhere covers the mountain sides, the water in each case appearing as slender threads of foaming, white, high-light.

The first opportunity, however, for securing a truly imposing picture is afforded by the lofty peaks of the Fairweather Range, all snow-covered, with valleys buried in glacial ice, and towering from 10,000 to 15,000 feet straight up from the sea-level. These mountains are to the northward of the Inside Passage, and the ship is from 10 to 15 miles out to sea while they are in view. A good picture is, therefore, contingent on a clear day and a suitable lens; that is, a lens with sufficient length of focus to enable one to get a large image of the distant peaks on the ground glass.

For such work a telephoto lens is usually recommended, but I have found these very unsatisfactory, because the very small aperture at which they work makes focusing very difficult. In this case it would render their use impossible, as the motion of the steamer would preclude an exposure of the necessary duration. A rapid rectilinear lens, furnished by Bausch and Lomb, of 17½-inch equivalent focus, working at f/16 and fitted with a shutter having a maximum speed of 1/100 second, was found admirable for all kinds of distance work.

The other great peak and mountain range visible from the steamer, as one sails to the north and westward, is Mount Saint Elias and its setting, the latter sometimes inaccurately termed the Saint Elias Giant Alps. Although Mount Saint Elias rises directly from the low ice-plateau of the Malaspina glacier, it is so far distant from the sea that imposing pictures of its pyramidal mass are difficult, if not impossible, to get. One opportunity for a striking snap-shot was missed (because the cameras were stowed away) on the first evening after our landing at Yakutat. That was at the last of June, and the sun set directly behind the peak, outlining it in fire and at the same time casting a triangular shadow of the mountain on the sky, high above the summit. The sky-space between the mountain and its shadow was filled with the varied colors, lights and shadows of the sunset glow, while in the foreground the lower mountain ranges gleamed white in their all-enfolding mantles of snow.

Such opportunities for photographing the peaks of southeastern Alaska are rare, because of the almost continual presence of clouds, and the steady downpour of rain for much of the time on the lowlands. Again, it is the rain and the consequent humidity which make photographic processes so difficult. On the other hand, the same humid conditions provide the snow-fall on the higher ranges, which, in turn, gives rise to the glaciers, on whose presence is dependent much of the pictorial interest of the region.

WASHING FILMS IN SEA WATER AMONG THE ICEBERGS: "EVERY NEGATIVE ON THE STRIP PERFECT"

The experience gained in the summer of 1906 made it possible to plan to meet the conditions more adequately in 1909, but the hurried outfitting which circumstances necessitated left no time for trying out any of the outfit, and, in fact, gave no opportunity for the inspection of much of it until we arrived in the field. In consequence it was found, for example, that the front board of the plate camera was not accurately centered, and many pictures were taken which were slightly out of focus on one side before this defect was noticed and rectified as well as possible with the tools available in the field. It is possible that this defect was caused, or aggravated, by the moisture of the air causing the wood of the camera-box to swell and draw. In any case, a difficulty such as this illustrates the value of a careful try-out of apparatus before taking it into the field. It may be worth while to remark, in this connection, that in testing a kodak or other hand camera it is well to see that the focus for the 100-foot point of the scale, or infinity mark, has been accurately marked and gives sharp and clear negatives.

The difficulties attendant on loading plate-holders under blankets (especially as it is light all through the night at this latitude in early summer) experienced on the previous expedition led to the purchase of the only *dark-room tent* which could be found listed in the available catalogs. This tent, when examined in the field, proved to be an affair about 8 feet high and square, made up of black duck with a lining of red cotton cloth, the whole sewed up into a cube-shaped sack which fitted over four corner-posts and laid on a framework tying the posts together.

The flat top of this contrivance would not shed rain, and, as we had no extra fly, it was necessary to push up the top with a center pole. Its ungainly appearance earned it the name of the "dog kennel" when first set up. Moreover, the light which filtered through fogged plates only momentarily exposed to it, and, as the black duck faded almost immediately to a dingy brown, it soon became altogether unsafe, and the old blanket expedient had again to be resorted to. However, it served as an outer protection, making it possible to load plates "by feel" inside a lidless grocery box set up on end and lined and heavily curtained with black cloth.

It seems to the author that it would be a both profitable and appreciated enterprise for some photographic supply-house to undertake the manufacture of a trustworthy dark-room tent for use in the field. Such a tent need not be large, but it should have high walls, and, if this necessitates a flat top, be provided with a fly. The outer covering should be of some water-proof material, such as is used for buggy curtains, and it should have a lining of fast-dyed red cloth. If the outer covering of such a tent were torn, under camp usage, it could readily be mended and rendered light-tight by the use of adhesive tape. A tent of this kind would make the loading of plates and their transference from the plate-holders to the developing solution both safe and convenient. The many scientific parties which are working in Alaska should alone make the enterprise profitable.

The greatest pleasure of the summer's work was afforded by the convenient method, and the highly successful results attained by the use of the Eastman Kodak Company's film and plate tanks. Again and again the films came out of the tank every negative on the strip perfect. Where this was not the case the fault was very clearly shown to be with the man who made the exposure.

The same thing was true of the plate tank, but in minor ways this has not been perfected to work so conveniently as the film apparatus. There ought, for example, to be a series of perforations along the edges of the bottom of the plate-carrier, so that the end plates would receive a better washing before transference from the pyro developer to the hypo bath. As it is one must rinse very carefully to avoid getting pyro stains on the end plates. This trouble can be

avoided, however, by rinsing and transferring to the hypo bath in the dark-room, when there will be no opportunity for the action of light while the developer is still on the plate.

Photographers are accustomed to messing in cold water, but most will agree that an average temperature of 44 degrees Fahrenheit for washing waters does not add particularly to the zest of the pursuit. Melted snow, mountain brook, and sea waters alternately served the photographer's purposes. Nor was it always possible to bring the temperature of the solutions to the desirable mean of 60 degrees. Yet the results for time of development as given in the manual were uniformly good. Unless one cares for dense negatives it is well to remember that the time of development must include the time required to remove the lid of the tank and to pour off the developer. A most convenient method of washing is to place the strip of film, or the plates in their carrier, in a bucket or tank, and weight this to the bottom of a pool in a clear, swift-flowing stream.

To combat the excessive moisture of the region (it sometimes rains constantly for a week, day and night, and if there are two clear days in seven one is in luck) we adopted various expedients. Film packs as large as five by seven inches get out of plane under these conditions, so we carried glass plates. These we kept in a specially constructed box, which had a clamping, rubber-sealing device to render it as nearly moisture-proof as possible. As an additional precaution a quantity of calcium chloride was kept in the box with the plates.

The films were kept in sealed tin cans. After attempting, unsuccessfully, but without spoiling it, to dry a strip of film in the tent, a soaking in grain alcohol was resorted to, and drying in a short time resulted. To use the alcohol effectively it is necessary to immerse the plates or films for at least ten minutes, and, if the gelatine shows a tendency to frill, to admix about 1 per cent of formaldehyde.

A surprising thing, when first encountered, was the short exposure required when photographing in glacial regions. One-hundredth of a second, with a stop of f/6.3 sufficed on overcast days, and on a day only slightly hazy the same exposure with a stop of f/11 was ample. This is accounted for by the enormous amount of actinic light which the blue glacier-ice, the water, the white snow of the mountain peaks and the rock slopes, which latter are bare of vegetation near the glaciers, reflect on all sides. It is to be remembered that diffused light is the most actinic—that the blue of the sky is in fact due to this diffused light. Making a panorama from the white ice-top of the Hidden glacier, the lens had to be pointed directly toward the sun, and the picture included snow-covered mountains and the sunlit sea—surely a chance or two for halation and fog.

The necessity of securing all the record pictures required by the scientists, and the limited number of clear days available for camera work in this region, are conditions which combine to restrict very narrowly such aspirations as the photographer may have for doing pictorial work. The record pictures must be taken with more regard to encompassing all possible detail than to the effectiveness of the composition. Again, the scientific notes and observations at any one site generally require much less time to secure than is necessary for the exposure of the requisite number of plates. The party is, therefore, ready to move on as soon as the photographer has once more shouldered his camera and tripod.

To focus on the gleaming front of some tidal glacier, whose ice-wall is perhaps 300 feet high, and wait deliberately for the chance to snap the birth of an iceberg as it is detached from the parent cliff and falls with a thunderous crash into the sea—that is a craving that has possessed me on both trips, but was never satisfied. We many times witnessed the spectacle, but there was no opportunity to photograph it from a near-by site.

Mentioning the thunderous crashes which announce the birth of new ice-

bergs recalls an idea I had one evening when we were encamped on the west shore of Yakutat Bay. This was to the effect that a city photographer ought to feel perfectly at home in glacial Alaska. The Arctic wilds have been termed the "silent places," but no phrase could have been farther from the truth as applied to this time and place. The rain was beating upon the side and top of the tent, and the wind kept snapping its loose flap endlessly.

In front of the tent the surf roared in ascending and diminishing crescendos, sending surge after surge over the iceberg-littered sand beach. Farther out in the bay the occasional breaking up and overturning of a big iceberg gave rise to a continuous sound like the rattle of a near-by express train. At rarer intervals one heard the distant boom, like that of a big gun, sent forth by the detaching of an iceberg from the glacier front.

Nor was this all. To one side of the tent a mountain torrent came rushing across the flat, while from the mountains in the rear one heard the low rumble of avalanches among the cascading glaciers occupying their steep valleys. The combination, and simultaneous occurrence, and continuance of all these noises gave rise to a very pandemonium of sound, and of a volume which would easily overtop the roar of the busiest of busy city streets at the height of the day's activities.

THE PHOTOGRAPHER'S PACK

While the pictorial interest of the scientific-record pictures often suffers because the point of view must be chosen with more regard to showing the detail of some particular phenomenon than to the composition or the character of the foreground, still there are opportunities for securing many striking effects in a country of such scenic magnificence, even though the pictures are to have their chief value as records. Sometimes, too, a whole geological story may be included in one picture, as is the case of the photograph of the Galiano glacier reproduced on page 48 of this Magazine.

This illustration is unique in that it reproduces a view where are shown in miniature all the conditions and phenomena of the extensive and famous Malaspina glacier and its feeder tributaries. On the mountain summits of the back-

LOOKING SEAWARD FROM THE HIDDEN GLACIER

Camera pointed directly toward sun. Snow, ice, clouds, sea, and mountain summits in one view, detail in all and no halation (see page 58; also page 42)

HIDDEN GLACIER, LOOKING SOUTHEAST: A STUDY IN GRAYS (SEE PAGE 58; ALSO PAGE 42)

ground are the snowfields, giving rise to a series of cascading glaciers, typically crevassed, which flow down the steep slopes of the cirque-like valley. The contributions of these cascading glaciers form the main stream of the valley glacier below, showing white, crevassed ice at its upper end. As this glacier emerges from between the mountain walls, however, it expands, its crevassing disappears, and in the middle distance of the picture the ice surface is already thickly mantled with ablation moraine (an accumulation of earth and rocks). In the immediate foreground the ablation material has buried the ice so deeply that one would hardly suspect that there was ice underneath. Vegetation has gained a foothold, and the only sign to betray the inert glacier below is the occasional slumping induced by its very slow melting.

In Yakutat Bay and its extensions there is, except on the low ocean foreland, an entire absence of forest growth—a condition accounted for by the recency of the glaciation. When working here the outdoor photographer comes to realize how much he is dependent on trees to lend grace and softness to his compositions. The succession of pictures that he secures in this wonderful region are monotonous, harsh, and forbidding, because they so much lack the soft shadows and the graceful contours furnished by the forest citizens of other climes.

In Prince William Sound, however, especially in the region about the Columbia glacier, a forest of spruce and cedar advances close to the ice margin. A thick turf of peat covers the floor of these woods, and this peat in turn is dotted with little lakelets which have their edges hemmed with bright flowers. When climbing the slopes of the mountains of this neighborhood one is afforded most interesting vistas of water, woods, ice, and snow through the forest glades and lanes.

I have been informed that Curtis, the famous photographer of Indians, intends eventually to picture the Alaskan natives. He will find some very interesting material in the neighborhood where we worked. At Yakutat, however, the Thlinkets have been in contact with the white man so long that typical studies are difficult to secure. At Dry Bay, a village to the south, a tribe of the same nation still live in their primitive environment, and probably do not demand a fee of "two bits" (25 cents) when asked to pose, as is customary at Yakutat. If the fee is not forthcoming the women will cover their faces and run. The children, however, are more docile and afford some interesting studies.

To the untutored mind this desire on part of the white man to secure many pictures of everything with which he comes in contact must present a perplexing problem. This was indicated by the attitude of our Japanese cook. On each favorable day we would leave camp early in the morning, taking with us our cameras and instruments. But on our return late in the evening we brought back no gold or trophies of the hunt. The cook's curiosity was aroused to such a pitch that he begged permission to accompany us on one of our trips. This proved to be a hard morning's work, climbing over mountain spurs and struggling through alder thickets. At noon we came to a glacier front, set down some notes, exposed a number of plates, ate a light luncheon, and prepared to return. That was too much for the cook; he burst out: "Walk so long—so hard trip—only picture take! Mak' me sick!"

In conclusion I would emphasize this caution: Do not attempt to carry exposed but undeveloped plates or films back to civilization from a region whose humidity is equal to that of the southeast coast of Alaska. Only a few will develop up as perfect negatives. Most will be mealy, or, worse, be peppered with opaque spots the size of a pinhead, whose origin is difficult to explain. Develop in the field, and as soon as possible after exposure.

THE DISCOVERY OF THE NORTH POLE

THE principal feature of the Annual Banquet of the National Geographic Society, December 15th, was the presentation of a special gold medal to Commander Robert E. Peary, United States Navy, for the discovery of the pole, and of Hubbard medals to Captain Robert Bartlett for attaining the farthest north, and to Grove Karl Gilbert for achievements in physiographic research. Telegrams of congratulation were read during the evening from former President Theodore Roosevelt, who, on behalf of the Society, presented the Hubbard medal of the National Geographic Society to Commander Robert E. Peary in 1906; from the Duke of the Abruzzi, and from the Geographical Society of London and the Geographical Society of Berlin.

About five hundred members and guests attended the banquet, including representatives from many foreign countries and from all parts of the United States. Toasts were responded to by the Dean of the Diplomatic Corps, the Italian Ambassador, Baron Mayor des Planches; the French Ambassador, Hon. J. J. Jusserand; the British Ambassador, Hon. James Bryce; Speaker Cannon, Andrew Carnegie, Admiral Colby M. Chester, Professor J. Howard Gore, General Thomas Hubbard, President of the Peary Arctic Club, and Hon. John Barrett.

The medals have been inscribed as follows:

> A Special Medal Awarded by the National Geographic Society to Robert E. Peary for the Discovery of the North Pole, April 6, 1909.
>
> The Hubbard Medal Awarded by the National Geographic Society to Robert A. Bartlett, Commander of the S. S. *Roosevelt*, for attaining the Farthest North, 87° 48′, March 31, 1909.
>
> The Hubbard Medal Awarded by the National Geographic Society to Grove Karl Gilbert for original investigations and achievements in Physiographic Research during a period of thirty years.

The telegrams received were as follows:

NAIROBI, *December* 12, 1909.

National Geographic Society, Washington:

Extremely pleased. Desire through you to extend heartiest congratulations Peary on his great feat which you have thus recognized.

ROOSEVELT.

LONDON, *December* 15, 1909.

National Geographic Society, Washington:

Hearty congratulations to Peary on medal. Highly gratified at medal to Bartlett.

DARWIN,
President, Royal Geographical Society.

BERLIN, *December* 15.

COMMANDER PEARY,
National Geographic Society, Washington:

The Geographical Society of Berlin sends to its honorary member heartiest congratulations on these honors well deserved because of your conquest of the pole which is rich in results, and hopes early in the spring to be able to similarly honor you here.

WAHNSCHAFFE, *President.*

THE TOASTMASTER, WILLIS L. MOORE, PRESIDENT NATIONAL GEOGRAPHIC SOCIETY

On behalf of the Board of Managers of the National Geographic Society and of the fifty thousand and over members of the organization, and especially of the three hundred and fifty members of the Society gathered at these tables tonight, I extend to you, our guests, a hearty greeting. We are met to celebrate a great achievement. This is an Arctic night at the pole. But we trust that the fervor of our greeting for you will be tropical in its significance.

And with that word of greeting to you we will begin the exercises of the evening, and we shall endeavor to dismiss the gathering within a reasonable time. That is a little intimation that we do not expect very long speeches from any particular individual. I will make exceptions to that on the part of the three Ambassadors on my right and left. They cannot talk too long for the National Geographic Society. One comes to us from that nation that has given so much

to the world in literature and art, the mellowing influence of its beauty and antiquity shedding a soft refulgence throughout the entire world. A member of the royal family of that nation was entertained in this very room three or four years ago, who has achieved great honor in Arctic exploration, and we have a word from him tonight. I shall introduce the Ambassador from Italy, Baron Mayor des Planches, to say a few words and give us that message. The Ambassador from Italy.

THE ITALIAN AMBASSADOR—BARON MAYOR DES PLANCHES

Mr President, ladies and gentlemen: I remember having been present at another banquet given by the National Geographic Society, in which Commander Peary was, as he is now, the guest of honor.

Commander Peary had already at that time reached the highest polar latitude, beating the record of a young Italian explorer, the Duke of the Abruzzi. I had not, then, special instructions to congratulate the Commander for the splendid result he had already obtained, but I was sure that His Royal Highness, chivalrous as he always is, was applauding the achievement of his fortunate rival. I expressed to the winner the felicitations of the defeated, and the Duke afterwards cordially approved of what I had done.

Now things are different. As soon as I received the kind invitation of your President to be here tonight, I cabled to the Duke that I would have the pleasure of meeting the glorious conqueror of the pole. A few hours after I received the cablegram which I ask your permission to translate:

"Many thanks to you for giving me the opportunity to express to Commander Peary my heartfelt felicitations. Tell him in my behalf that I am happy that the pole has been discovered by the explorer whose courage and perseverance deserved such a reward.

LOUIS OF SAVOIA."

THE FRENCH AMBASSADOR—HON. J. J. JUSSERAND

Mr President, ladies and gentlemen: Two years ago we were gathered together, almost day for day, in this same room, under the same chairman who has just spoken in such touching words of my country, and such undeserved ones of her representative; and we were gathered together also to commemorate a pole discovery. It was the discovery of the magnetic pole. I was asked to say a few words. Offering to you excuses for quoting myself, I beg permission to recall that, considering the time to come, I expressed myself thus: "Some new expedition, led through air or through water, by some maybe among the men present here today, will certainly, in the near future, gain the first sight of the long-sought North Pole." And looking at the list of those present on that day, I find that there appeared the name of "Commander and Mrs Robert E. Peary." I think I may say that, once in my life, I spoke as a prophet.

Momentous changes have come to pass in the world and in this land. For a very long time, during the period to which our chairman alluded just now, America was not the land that produced explorers, but the land for explorers to seek. The day in August, 1492, when a certain Spanish ship left Palos and floated across the unknown sea, resulted in the revelation to wondering nations of a new, unsuspected, and immense world; and the energies of all those who wanted to discover, to learn, to win, to explore, to get fame and wealth for themselves and their country, were bent for centuries toward this continent more than toward any other part of the globe. The ocean was crossed and recrossed by the tiny crafts of some of the best sons of France, England, Italy, Holland, Spain, Portugal, Scandinavia. We French certainly did our part, as we explored further inland than any, and made known to the world the resources and beauty of the valley watered by the "Mechacébé."

For a very long time, indeed, it was the desire of the pluckiest to come to these shores and explore those new regions so extraordinary, so beautiful, yet so thoroughly unknown that it took till our own lifetime to get a somewhat accurate idea of their contents. Many of us were already in our manhood when the Yellowstone Park was revealed to the admiration of the world.

But before that moment a great change had taken place; the field for exploration had begun to produce explorers, and it has never ceased since; explorers of unknown lands, like Rockhill, Crosby, and many others; explorers of the depth of the seas, like Agassiz; of the realms of electricity, like Graham Bell and Edison; of the sun, like Doctor Hale; of ancient Babylonic civilizations, like those scientific missionaries sent abroad by the Chicago University, and explorers, above all, of that unknown world into which French Montgolfier was the first to rise, the world of air, mastered by the plucky men of our day, in the front rank of whom stand your famous compatriots, the brothers Wright.

And while so many explorations went on, one remained ceaselessly striven for, ceaselessly unachieved: the one that had for its object the conquest of the pole. The longing for that discovery is of a comparatively recent date, but once its hold on mankind began, it proved one of the most ardent men had yet experienced.

The ancients had not evinced any great anxiety about the polar regions. They knew the north was a strange frozen place with weird legends about it, a region, said Tacitus, where looking toward the east one can see Phœbus rise: "The sound he makes on emerging from the waters can be heard, and the form of his steeds is visible."

In the last century, the problem became for mankind one of intense interest, one which *had* to be solved, were it, as indeed it was, at the cost of many an heroic life. And the great labor began, never to be interrupted until could be possible such a gathering as today's, in which the National Geographic Society of America is to bestow its medal on the now most famous of its members. Long was the search and hard was the toil, from the days of Sir John Franklin and Kane to those of Nansen, Nordenskiold, royal Abruzzi, and your admirable Greely remaining three years unrevictualed in the frozen north.

I well remember how, in days long past, I followed as a child, with my brother and sisters, our hearts beating with emotion, the efforts of one of the imaginary heroes of that prophet-novelist, Jules Verne; a prophet-novelist indeed, for most of what he fancied has become reality; his fancy submarines have become our real ones, the world he announced where everything would be done by electricity is now near at hand; his dream dirigibles have become our tangible ones, and the conquest of the pole, which he foresaw, is now a fact. He described it in advance, and not so badly, for he told us that, at the pole, there was no land, but only sea, and Commander Peary has just returned to tell us that it is so. Truth to say, the writer asserted that the sea was an open one, and I have present in my mind, as if it were a thing of yesterday, a view of that open sea pictured in his book, and along its shore quantity of birds, the like of which, I am afraid, Commander Peary had not the satisfaction of killing and eating. But as you know, there is no prophet so good that does not make now and then some little mistake.

Well, after that long search, and so many proofs of endurance and valor given by many, the deed is done and the coveted prize belongs to you, Americans. If we, French, did not do much for the solution of the problem, busy as we were, and usefully busy, exploring elsewhere in Asia, Africa, South America, we know full well what peerless merit there was in doing what your compatriot has accomplished, and about which what there is to say is going to be expressed by our learned chairman tonight. Commander Peary will allow me to offer him a tribute of admiration, and the congratulations of my country for the fame he

has won and the deed he has accomplished.

THE TOASTMASTER

We have at our tables many representatives from our National Congress from both houses of that great body. We mean no disparagement to the legislative institutions of any other country when I say that the American people have a proper reverence and respect for their own representatives. I do not believe that there is a cleaner, an abler body of national representatives met anywhere in the world than the National Legislature of the United States. We are honored tonight by having at our board the Speaker of the House of Representatives. People do not apply an endearing term to a public man that they do not down deep in their hearts respect, and I shall, as an honor to the National Geographic Society, ask the Speaker of the National House of Representatives to say a word at this board.

SPEAKER CANNON

Mr President, ladies and gentlemen of the National Geographic Society, and guests: It is supposed that the present incumbent of the Speaker's chair is a czar. Such being the case, the rules of the House in committee of the whole on the state of the Union will be enforced; that is, the five-minute rule. Note the time and let your gavel fall at the end of five minutes, unless I leave the floor earlier than that.

I am glad to be here. I am glad that the National Geographic Society have settled one thing. Peary or Cook found the North Pole, and you stated which, and I have implicit confidence in your judgment. How marvelously the nineteenth century has witnessed the opening of events which three hundred years prior thereto the nations of Europe sent in their colonies to the new continent to struggle for mastery. Their bones are dust and their souls are with the saints, but the coming of the French and the German and the Scandinavian and the inhabitants of Great Britain, and the present coming of the Italians and the Hungarians, and the Spanish who came first and wrought great things in the new continent, have settled all questions. We are glad to congratulate ourselves in the United States that we have the most enterprising and of the best of those countries that have made our own country their country, and have been assimilated and form our civilization. You cannot sing the *Banzai* national air, you cannot sing "The Campbells Are Coming," you cannot sing "The Watch on the Rhine"—which always seemed to me in comparison with all the other music like the grinding of a great glacier—you cannot sing them anywhere in the boundaries of the Republic but what the huzzas will come. How marvelously the progress!

I am but yet a young man, and yet I recollect very well when it was gravely proposed in the Senate of the United States that a statue should be erected to the god Terminus on the peaks of the Rocky Mountains, and that should be our western boundary. All questions of territory have been settled, and the United States is the common territory of what we can gladly say is the best blood of the European countries. I say best blood because the enterprising young men come to new countries that promise in their judgment a reward for their enterprise and courage. I am glad that the North Pole has been found. I am glad for many reasons. In the first place it will stop adventurers after notoriety or adventurers in fact from endeavoring to discover the pole. We know now whether there is land there, and I am glad to know there is no land there and I can prove it by Peary, because there is no chance for any discussion about the conservation of natural resources. There can be no ice factory, because it is brackish and the ice would be worthless.

I am glad to be with this Society. I have had many invitations. It has so happened that this is the first one that I have been able to accept. But, after looking into your faces and congratulating you over the history of this Society—over the founder of the Society, who has

crossed over, but his work is still with us—and after congratulating Commander Peary, I pay my respects to the representatives of the many great governments here tonight and will just in one sentence sit down. When next, Mr President, John Gilpin rides, may I be there to see.

THE TOASTMASTER

Many of our guests are familiar with the aims and objects of the National Geographic Society; all are not, and so I shall introduce for a few minutes our Professor J. Howard Gore, Professor Emeritus of George Washington University, a member of the Board of Managers, to tell you something of the aims and objects of this institution.

THE NATIONAL GEOGRAPHIC SOCIETY—BY JAMES HOWARD GORE

In some future edition of the Book of Proverbs it may be written: "Whoso tooteth not his own horn, yea verily the horn of the same may not be tooted." The President of this Society must have anticipated the wisdom of this injunction when he asked me to be the horn soloist for the Society.

To our colleague, Mr Henry Gannett, is given the credit of having originated the flattering invitation, "Sit down five minutes and tell me all you know." If this idea was in the mind of our President when he asked me to tell all I knew of the activities of the National Geographic Society in ten minutes I hope he intends that I shall keep the change, for it will not need so much time to traverse in outline this topic, though its bounds be the points in which the ultimate east meets the ultimate west and the north has the south for its antipode.

That we exist is attested by a membership of more than 50,000, and the question as to why we exist must be answered favorably by the thousands who each year come into our ranks.

I was greatly impressed a few years ago by a set of drawings showing the way in which geography is taught in the public schools of Brussels. The first of the series showed the plan of the classroom, with the position of the pupil's desk. The second gave the floor-plan of the building with special indication to mark the room which was the entirety of the first lesson. As lesson followed lesson the pupil had located the building with respect to the prominent buildings of the city, the situation of the city with respect to the other cities of the kingdom, the outlines of the kingdom, the place of the same in the continent of Europe, Europe's place on the eastern hemisphere, and finally a map of the entire world.

In this way the pupil oriented himself with respect to his playmates and their immediate surroundings with respect to the great world of which they were parts. But in the lessening scale the pupil, though great in his own conceit, dwindled as lesson followed lesson and the world of which he formed a part grew vastly in importance.

The proper study of mankind is man—not man in his littleness, in his finiteness, but the house in which he lives, the town in which he dwells, the land he calls home, and the world over which he roams. Each day's walk takes him to a different point and every day's journey gives to him a new geographic position.

The air he breathes is wafted along by purifying currents whose movements we strive to know. The water that slakes his thirst follows courses whose meanderings we want to trace; the paths he treads, the roads he travels and the oceans on which he journeys must find places upon our charts.

The purpose of our Society is to know these things and to diffuse abroad our knowledge. We seek new facts through exploration and we scatter them over the civilized world on the pages of the best geographic magazine that finds a place on the reader's table.

Our affairs are directed by a board selected from every walk in life fitted to aid in our great endeavor. The ablest business men of our city guide its financial interests. By their side sit those who have explored the frozen regions of the north and others who have labored under

tropical suns. Astronomers who follow the orbits of celestial worlds, geologists who read the testimony of the rocks and tell us the story of the earth on which we dwell; physicists to measure the stress and strain of those great cosmic forces that shape our globe, and geodesists to compute its resultant form; botanists to trace the migrations of plant life and meteorologists to chart the winds that waft the seed; a physician to direct our studies of the relation of health to locality and a biologist who gives to each form of animal life its metes and bounds; a statistician who places in stately columns the figures that show economic development and achievements and a journalist lays for us a course through the world of letters. The world's greatest inventor gratifies our Athenian thirst for new things, and officers of the Army and of the Navy see to it that our facts are well marshaled and our conclusions prove invincible.

These men—busy men—gladly give their time to the great work of this Society, and, seeking no reward, find full compensation in the conviction that under their guidance the Society is living up to its avowed purpose to increase and diffuse geographic knowledge, and sister societies throughout the world gladden our ears by repeating the vesper anthem of the sixth day of creation when the Maker, in looking upon His work, said, "It is good."

THE TOASTMASTER

It might very fitly be said that the only reason that a man may have for the acquiring of more wealth than he needs for his own material wants is that he may give wisely and give well; that he may aid in the betterment of mankind, in the uplifting of civilization, in doing something to make the burdens of his fellows a little lighter, and to add more to the intellectual appreciation of those who study the great problems of the universe. There is no man in the world who has done more to help in that great work of uplifting mankind than that little giant, Andrew Carnegie. He does not expect to speak to you tonight, but I know that no matter where you place him, no matter from what altitude you drop him, he will always land upon his feet. Therefore I introduce to you now to give us a few words—and they are always words of inspiration when they come from him—Mr Carnegie.

MR ANDREW CARNEGIE

I have often been surprised in my short life, but never quite as much as at this moment. I promised to talk to the Associated Press in New York, now banqueting at the expense of the New York *Times,* and I had just spoken to the party there through the telephone. I met Commander Peary and he had just preceded me. He is not only a fellow Pennsylvanian, but he comes from the crest of the Alleghanies at Cresson, where I spent my summers when a young man. I had the pleasure of presenting to Commander Peary honorary membership of the Pennsylvania Society recently and did it in these words, and I was so glad that Master Shakespeake came to my relief: "Fellow Pennsylvanian, your hand in mine—'Yours is a triumph where honor travels in a path so narrow that but one goes abreast.'"

I listened to what you said about giving surplus wealth. Well, I said to the gentlemen and ladies I addressed last night at the Carnegie Institute here, as I pointed to the professors that were gathered from various stations, from the Pacific, from the Atlantic, and the work they had done—I pointed to the trustees who have one and all given years of their life to this work—"theirs is the credit, theirs the triumph. I only gave money—mere dross in itself—these men have given their lives, themselves, to the great work of obtaining knowledge and spreading it throughout the world, not for one country, but for all the world. No rivalry, all anxious to help each other in the obtainment of knowledge."

That is what makes human life sublime. I, who only give money, give the material body only. It is those workers who have infused into the dead, inert

matter the soul within, and these are the men who are entitled to the credit. And so it is with all the money I give.

When I gave Doctor Billings one morning seventy-eight libraries for New York—that was the biggest wholesale order I have ever filled—I was met with congratulations the next morning when walking down the street. "What do you congratulate me for?" I asked. "Why, for giving New York seventy-eight libraries," was the answer. "Cannot receive your congratulations, gentlemen," was my reply, "but if you will congratulate me upon the bargain I made with New York, by which she agreed to maintain seventy-eight branch libraries free to all the people, shake."

I thank you for inviting me here. I thank you gentlemen for your applause and ladies for your smiles. I am the happiest man in the world, because I know that it is not what I have done that I pride myself upon. It is rather upon what I have induced others to do. Ladies and gentlemen, let me assure you I make splendid bargains with all the money that I apparently give away for nothing.

THE TOASTMASTER

Mr Carnegie gives all the credit to those who are doing the work under his beneficence, but I would say to him that that good old Scotch brain of his never gave a dollar that he did not in his wonderful divination see far at the end some beneficent purpose, and I would say to him that a stream never rises higher, sir, than its source.

We have on our Board of Management, I am proud to say, a very wide diversity of talent, and I shall introduce now Admiral Chester, of the United States Navy, formerly Director of the Naval Observatory, who had charge of the party that went to Africa several years ago to view and to observe the eclipse, and who has done a great deal of highly creditable scientific work. We shall ask him to say a few words with regard to the work of Commander Peary in the polar regions during the past 20 years.

TWENTY YEARS' SERVICE IN THE ARCTIC—REAR ADMIRAL COLBY M. CHESTER, U. S. NAVY

My distinguished colleague has given an account of the objects of the National Geographic Society, and it is my privilege to present a brief statement of the work done by our doubly honored and highly esteemed member, Commander Peary, work that has resulted in such signal success as to probably make him the honorary member of nearly all geographic societies of the world.

Beginning back in 1886, Mr R. E. Peary, then a young civil engineer of the U. S. Navy, originated and put into operation an entirely new project for Arctic exploration, and with a Dane, Maigaard, reached a point near Disco, Greenland, some 50 miles from the sea. With the experience and whetted appetite for Arctic exploration gained on this trip, he soon organized a second voyage to the Polar Seas and landed at McCormick Bay, in August, 1891, and although his leg was broken in crossing Melville Bay, and he had nothing more than an Arctic winter and its attendant discomforts before him, he persisted in his determination to go north, and but few people can realize what he courageously must have passed through during that long Arctic night.

His primary object was to study the Esquimos with a view to utilizing them as a force with which to eventually reach the North Pole, and he took upon himself their habits and customs to better enable him to gain their confidence and command them when ready for the campaign quite on the same principle as our army has organized Porto Rican and Philippine Scouts to deal with military subjects which the natives of the country can best negotiate.

Early the following spring Peary, now able to travel, made a brilliant sledge journey of 1,300 miles, crossing the divide of 5,000 feet elevation between Whale Sound and Kane Sea, in Greenland, reaching the northern edge of the inland ice, near 82° north latitude, and discovering Independence Bay.

Again in 1894, after struggling and sacrificing his personal comfort and means to raise funds for his third expedition, we find Peary back in the frozen north with a slightly increased force, making a remarkable sledge journey of 134 miles in 13 days to an elevation of 5,500 feet.

Here he was met by violent gales and cold weather, and with his dogs dying and his men disabled, he sent his main party back to the coast, while with almost superhuman effort he plodded on another 85 miles to the good, only to be finally overcome by the elements and forced to return to his base of supplies.

In spite of the fact that he had insufficient food and fuel and that there was but little hope of replenishment, Peary would not return to the United States when the visiting steamer *Falcon* arrived in 1894 to take him back, and he spent the following winter in accumulating the resources of the region at Bowdoin Bay, living with Lee and his ever faithful Hensen as the Eskimos live, and gaining recruits for the next march to the north.

This began in April, 1895. With his two men and 63 dogs he had made but three marches when one of his Eskimos deserted with the outfit he had struggled so hard to accumulate; but Peary, undiscouraged, pushed on.

After a journey full of hardships such as had never been successfully overcome on any previous Arctic voyage, he again reached Independence Bay, whence he returned to Bowdoin Bay, with man and beast on the verge of starvation and everything but Peary's indomitable pluck entirely exhausted.

On board the little steamer *Kite* his party reached Newfoundland, September 21, 1895, and thus ended the third expedition.

General Greely speaks of this trip as follows: "If Peary's advance beyond his buried cache (on the highlands of Greenland) was one of the rashest of Arctic journeys, yet the courage, fertility of resource, and physical endurance displayed by him and his companions placed their efforts among the most notable in Arctic sledging."

Peary by this time had a thorough knowledge of the men with whom he was to finally reach the goal for which so many generations have struggled in vain. He had weeded out the dishonest ones, honored the good ones, and educated them all.

In June, 1898, Peary left New York on board the *Windward* for a four-years' expedition against the pole, this time carrying on explorations on the west shores of Baffin Bay, where he determined the continuity of Ellesmere and Grinnell Lands, and in December he was badly crippled and nearly lost his life, his feet being so badly frozen as to cause the loss of eight toes by amputation, yet he took the field again in a few weeks after the operation. In the spring he discovered Cannon Bay, and probably Heiberg Land. The winter of 1899-1900 was spent at Etah, from which place he made his first effort to reach the pole. After following the west coast of Greenland to the most northern point in about 83° 35′ north, he started north over the polar pack, but could only make good about 20 miles of ice travel before turning back in latitude 83° 54′ north. Though the North Pole was not reached, he made a valuable contribution to geography by the discovery that Greenland was an island.

In the following year, 1901, Peary again made the attempt to reach the pole by the Cape Hecla route, but was forced to abandon the attempt in April.

Still undismayed, Peary started again for the goal in February, 1902, proceeding from Payer Harbor to Fort Couger in twelve wonderful marches, and covering 400 miles in one month, with temperature ranging from—38°-57°. Leaving the land at Cape Hecla on April 6 with seven men and six dog sledges, he now surpassed all previous explorers and attained the highest latitude reached in the Western Hemisphere, 84° 17′ north latitude.

For the sixth time Commander Peary started on his quest for the pole in July, 1905, leaving New York in the *Roosevelt*, a powerful steamer with auxiliary sailing power, the first vessel to be built

in America for Arctic work, for which she was designed especially by the Commander. Fighting her way up through Kane Basin and Kennedy Channel by the Baffin Bay route, she reached Point Sheridan, on the north coast of Grant Land, where winter camp was made. Early the following spring he divided his force into four parties, each with its sledges and dogs, Eskimo drivers and hunters. This expedition is of such recent event that I need not remind you of it. Suffice it to say that now after having occupied points, "one on the most northerly point of Grant Land, and thus of the North American Archipelago; another on the most northerly point of Greenland, and the third on the northern point of Peary Land, the most northerly point in the world ever visited by man, he wins the pennant for highest north in latitude 87° 6′."

All this was a schooling for that "last great struggle to plant the American flag at the pole," the story concerning which the members of the National Geographic Society have been privileged to hear from our honored guest's own lips. Was there ever a campaign carried out after so much physical and mental effort as Peary's last? If, as Dr Lyman Abbott has said, its Commander has done nothing else, he has taught the youth of our country the lesson of hard work and perseverance to their everlasting benefit.

Remember the last and final effort of his life in this direction was based on an original design. As he says, "the Eskimos with their dogs are the factors that make the search for the pole feasible." He became one of the tribe—the leader of the tribe. They called him their father; he called them his children. A theme could be written on this one text, and yet how little it is understood except by those who have been Peary's companions.

Captain Bartlett told me that the Eskimos would follow the Commander as they would no other man under the sun; that they were afraid of the sea ice as a little child was of the sea water, but they would follow Peary anywhere; that there was not another living man that could get an Eskimo far away from the land; that even Peary had doubts on this subject at times, and he would say confidentially to his ever faithful assistant, Bartlett, "Are there any signs of desertions?" to which the latter would reply, with a strong voice but fearful heart, "Oh, no, don't think of it; they will follow you to the last," and so they did. I am satisfied that Bartlett was right—that while their love was tested to the extreme the Eskimos would follow Peary to the ends of the earth, but that they could be led by no other man more than "two sleeps" from land.

After returning from this last expedition I heard Peary say once, "I can never go again to the Arctic regions; I am getting too old," but his never-say-die grit overcame his yearning for the home life and rest he so much needed, and he is soon in training for the death struggle of his life. Acting under the laws of Congress, to the effect that as far as practicable all hydrographic work of the U. S. Coast and Geodetic Survey shall be done by naval officers, he was detailed by direction of President Roosevelt, the patron of all such efforts as Peary's, to that department to carry on hydrographic investigation in Arctic seas in association with the Peary Arctic Club of New York. And let me say here that the one sounding of 1,500 fathoms without reaching bottom made by Peary near the pole is worth to the country more than all the money expended in the entire expedition, but the great mass of scientific data accumulated in his 23 years of effort has enriched the land beyond the expenditure of any possible amount of money.

The last of Peary's campaigns was a masterpiece of strategy. His force was divided into four grand divisions, led by brilliant chiefs. We can hardly overestimate the value of this organization.

I would call your attention right here to the selection of Captain Bartlett for the command of his fourth division, the post of honor. Remember that this was the one man who alone was fully competent to take the *Roosevelt* from her ice

anchorage at the farthest north of any previous navigation back to civilization with all her priceless cargo of Arctic heroes. To take the second in command from this important post for a forlorn hope was beyond the borders of rashness—it was tempting Providence. Read the story of the *Polaris* expedition, and you will find that by all good rights Bartlett should never have left his ship.

But overcome by his regard for his faithful assistant, by the knowledge of Bartlett's great value to the land party, as well as by his desire to do honor to our kindred race, living under the cross of Saint George, he was given the post of honor—the advance, when it meant that had the expedition ended at latitude 87° 48′ north, the second in command would become the first in honor, for he first reached this parallel two hours ahead of the main party. As it is, Bartlett hangs on his escutcheon "The Highest North" up to that time, to give away only to his chief in the still higher claim of "no north, no south, no east, no west."

Even if Peary dared do so, he could not have given the charge of his highly honored returning party to any other man under his command and do justice to those faithful children of his who were entitled to his protection. As far as a witness to Peary reaching the pole is concerned, if he needed one, he had the best one living—Hensen—a faithful colored man whose truthfulness had been tested in twenty-three years of manly and intelligent effort with his chief. Besides this, he was a man fully competent to at least record observations, and it is believed he could have made them himself.

I have often been asked what is Commander Peary's real title in the navy, and some have questioned the propriety of my calling him Commander. While Commander Peary is not a commander in the navy, he belongs to one of the most important and highly respected corps of the service—the Corps of Civil Engineers—and really outranks, or soon will do so, every commander in the navy.

However this may be, if, after being in command of the Peary Arctic expeditions for nearly twenty-three years, displaying the highest degree of executive and administrative ability, he is not a commander, then I do not know what the term implies.

The North Polar Arctic Expedition of 1908-1909, led by Commander Peary, was not a "dash to the pole," as it is popularly termed by the public, but was a grand campaign laid out on truly military lines like one of Napoleon's brilliant inspirations, and as original in conception as any of that great soldier's. Peary first went through a long span of years in the study of Arctic conditions and in the preparation of the force he was to handle. This, when ready, was followed by an advance of his lines from the east, and resulted in the discovery of the insularity of Greenland, and that the route to the pole was not landward. He then retreated to reconnoiter and find a weak point in his adversary's defenses. After a while he tried to blaze another trail, but was driven back by the elements, those great forces of nature before which man is impotent. While his advance here was made from a base west of the position first attempted, it led him into fields where the ice was broken, and the leads—"those nightmares of Arctic explorers," as Peary calls them—left him no recourse but to retreat again.

The final assault on the North Pole, the best defended and long resisting stronghold of nature, was begun from a point still farther west, where the land jutted out into the Arctic Sea of ice much nearer the pole than any other land from which an advance was possible. From here was begun that "last of the world's great stories" which so simply and modestly, and yet so graphically, has been told by him.

The forces were led up by divisions with marvelous precision and discharged their weapons, the only ones possible to use in this campaign—provisions—and then fell back, leaving the Commander on the one hundred and thirtieth-mile line to begin the real "dash to the pole." From this point began the "Charge of

the Light Brigade" that ended successfully a campaign comparable with those of Alexander, Napoleon, or Grant. Long after all of us have passed away, Peary's name will be emblazoned on the scroll of fame as one of the great commanders of the world.

THE TOASTMASTER

It is certain that in all the history of our Arctic exploration there is one commanding figure that stands out preëminent. It is fitting that now at this time I should give a brief recount of what will not be celebrated here tonight, but what is essential as we are step by step leading up to the honor of this great American.

He was born in Cresson, Pa., in 1856; was graduated from Bowdoin College in 1877; entered the United States Navy as civil engineer in 1881; was assistant engineer in the Nicaraguan Ship Canal under Government orders in 1884–85; was engineer in charge of the Nicaraguan Canal survey in 1887–88; in 1886 made a reconnaisance of the Greenland icecap; was chief of the Arctic expedition sent by the Academy of Natural Science of Philadelphia in 1891–92 to the northeast angle of Greenland; discovered and named Melville and Heilprin Land lying beyond Greenland; received the Patron's gold medal of the Royal Geographical Society of London and the medal of the Royal Geographical Society of Edinburg for determining the insularity of Greenland; made a study of the little Arctic islanders; in 1894 discovered three meteorites, one of which, the largest known to exist, weighed ninety tons; in 1896–97 brought these meteorites from Cape York to the United States. Commanded the Arctic expeditions under the auspices of the Peary Arctic Club of New York in 1898 to 1906, on which expeditions he rounded the northern extremity of Greenland Archipelago, the last of the great land groups, naming the most northerly land in the world, which is situated at 83° 39′ north latitude, and attaining the highest north at 87° 6′, for which he was awarded the Kane gold medal by the Philadelphia Geographical Society, the Daly gold medal of the American Geographical Society of New York, and the Hubbard medal of the National Geographic Society.

In 1908, under the auspices of the Peary Arctic Club of New York, in the good ship *Roosevelt,* commanded by that indomitable commander, Captain Bartlett, he again sailed for the north. No expedition ever was more perfectly planned or efficiently manned and officered. Why, it was the result of twenty years of a master mind, and the North Pole was reached on April 6, 1909. This was accomplished not only by the expenditure of tremendous physical energy, but by the employment of a high degree of intellect in planning to conserve this energy and to expend it so as to gain the greatest possible efficiency. In no other way could the North Pole ever be attained over land and over ice and water. The time may come—I believe it will come within a decade—when we shall fly over these regions that have seen so much heroic endeavor by the hardy men of nations whose representatives are gathered with us tonight, and I am of the opinion that this is the last great struggle to accomplish the pole overland.

But now, Commander Robert E. Peary, in presenting to you the special medal of the National Geographic Society, in recognition of an achievement that has brought honor to the American people, I wish to add that in all of your twenty years of heroic endeavor there has never been a time when any man associated with you, or any other person, has ever doubted your manly integrity or questioned for one moment your veracity. The American people were willing to believe that you had attained the pole by your simple statement. But science is critical. It accepts no word. It renders no decision without the proof.

And again I compliment you on the fact that before you received honors from any other source you diligently sought to present your credentials and to have them received and certified to by a competent tribunal. Those records were submitted—records made in the Arctic, not

edited or prepared. I had the opportunity to meet with the committee and see the original data, and am satisfied that there was not an "i" dotted or a "t" crossed from the time the record was made, far away there in the cold fastnesses of the north. And so the decision was rendered in accordance with your claims.

And now, in presenting you with the medal of the National Geographic Society—which is voted to you by the representatives of more than fifty thousand people, thinking, active working people in the world, through its Board of Managers of twenty-four, representing nearly every type of scientific knowledge—I wish to say, sir, that in honoring you as the man we honor not only our Society, but—I speak for our guests—honor ourselves.

RESPONSE BY COMMANDER PEARY

President Moore, ladies and gentlemen of the National Geographic Society: I cannot tell you how deeply I appreciate the words of your President, how deeply I have appreciated the chivalrous, magnanimous speeches of those distinguished representatives of two great nations whose own men have done magnificent work in the Arctic regions, and who have kindly spoken here tonight; how much I have appreciated those clear, concise remarks of our greatest philanthropist; how much I have appreciated the friendly words of Admiral Chester.

Far deeper than words is my appreciation of this magnificent trophy, conveying the faith and approval of this great Geographical Society, and awarded in connection with the most extraordinary state of affairs that has ever happened in the entire history of exploration and discovery.

It is particularly appropriate that the greatest Geographical Society in the Western Hemisphere should be the first to officially recognize the winning of the last great geographical prize which the world had to offer, an accomplishment characterized by your distinguished committee as "the greatest which the Society can ever have opportunity to honor."

But mine is only a portion of the credit for which this trophy stands. Had it not been for the unswerving faith and backing (both moral and financial) of Morris K. Jesup, organizer and first President of the Peary Arctic Club; had it not been for the equally unswerving faith and backing of General Thomas H. Hubbard, the present President of the Club, and the members and friends of the Club who have furnished all the funds for the work; had it not been for the splendid loyalty, enthusiasm, energy, and endurance of the members of my party, from Captain Bartlett down, we should not have the North Pole here with us tonight.

As copartner with and representative and proxy for those whom I have mentioned, I accept your magnificent medal with feelings of the liveliest pride and gratification.

Permit me to convey to the Board of Managers of the Society, and through them to the Society itself, my own and my friends' acknowledgments for its instant perception and acceptance of the duties of its position, and its definite and courageous stand at a time when a stand for the truth meant becoming a target for the most virulent attacks from the ignorant, the vicious, and the deluded.

I wish also to convey the thanks of my friends and myself to that brother officer of superb personal and professional reputation, whose clear insight, constitutional hatred of a lie, and unanswerable arguments have done so much toward clearing the atmosphere, Admiral Chester.

Thinking men and officers accustomed to questions of personal and public duty and responsibility have understood matters from the first, and the public now appears to be grasping the fact that a navy officer does not often shirk a duty, and, when an officer of the United States Navy makes a deliberate statement concerning matters of which he has cognizance, that statement is, at all times and under all circumstances, to be taken absolutely at par.

The fundamental keynote of success in the last expedition of the Peary Arctic Club, which, on the 6th of April, 1909, discovered the North Pole, was *experience.*

If the pole could have been won by inexperience, or by a happy combination of fortuitous circumstances, it would have been won long ago.

Nor was it to be won by courage and endurance alone; if it were, England would have had the prize years ago, Norway would have had it in '95 when Nansen and Johansen cast themselves adrift into the unknown, and Italy would have attained it in 1900, when Abruzzi drove her colors to the front in spite of indescribable obstacles.

Accumulated experience, persistence, profiting by mistakes through a long series of years (the prime factors of success in any great work, whether it be the establishing of an enormous industry, the perfecting of a world-reaching invention, or the moulding of a nation)—these were the essentials which permitted the discovery of the pole by the last expedition of the Peary Arctic Club, and the essentials without which it cannot be reached again.

Let me call to your attention that the last expedition of the Peary Arctic Club had at its command the practical experience of twenty-three years of work in one field; that it had at its command a ship specially built for the work, after years of experience, tested in one voyage and then modified as the result of that test; that it had at its command a veteran personnel largely selected from the membership of a previous expedition; that it had at its command the pick and flower of the hardiest and most experienced men of an entire Eskimo tribe; that every item of its equipment was an evolution from years of experience and practical work in the same way that the last cup defender—and winner—was an evolution from preceding international yacht races, and that it had at its command the route to the pole that is recognized by all Arctic authorities as the shortest and best.

And then let me tell you that every atom of this specialized experience and equipment, every nerve of this veteran personnel, was not only utilized but *demanded* in the successful negotiation of the 413 miles of icy chaos, along the Cape Columbia route to the pole, *the route which is 100 miles shorter* EACH WAY *than any other route around the entire periphery* of the Polar Sea.

Here in this magnificent trophy of your great Society lies the final chapter of the last of the great geographical stories of the Western Hemisphere, beginning with the discovery of the new world, ending with the discovery of the North Pole.

Here is the cap and climax, the *finish,* the closing of the book on 400 years of history.

Here in this magnificent trophy of your great Society glitters the splendid frozen jewel of the north for which through centuries men of every nation have struggled and suffered and died—won at last and to be worn forever by the Stars and Stripes.

THE TOASTMASTER

The Board of Managers of the National Geographic Society have voted to Grove Karl Gilbert, a member of the National Academy of Sciences, and for many years an officer of the National Geographic Society, a Hubbard medal for his great achievements in geographic research during many years. Professor Gilbert is not here tonight, and his medal will be presented at a future time.

I shall introduce the Ambassador from Great Britain, one whom we all love so much and who has been with us before, to present to one of his own countrymen, Captain C. A. Bartlett, the medal for twice commanding the *Roosevelt,* and for being one of those heroic characters that have done so much to bring honor to our own nation and honor to that great nation of Great Britain.

THE AMBASSADOR FROM GREAT BRITAIN—HON. JAMES BRYCE

Mr Toastmaster, ladies and gentlemen: If it were not for the honorable duty that brings me to you tonight I should be very

much ashamed to appear before you at so late an hour as this. But I am comforted and encouraged by the reflection, as I introduce myself, that this is a thing which can never occur again. There will never be another occason in which a speaker will arise to present a medal to a man who has taken part in the discovery of the North Pole.

There is just one thought which in the midst of these festivities and congratulations weighs rather painfully upon me, ladies and gentlemen. For some centuries, as you have already been told, the discovery of the North Pole has been an object of curiosity, interest, and aspiration to all the civilized peoples of the world. They have thought about it, they have wondered when and how it would happen. A great German philosopher has observed that the pursuit of truth is even better than the possession of truth. Bold men were excited by the pursuit of the North Pole, and all the world was interested in following their deeds of daring. Now at last that pursuit has come to an end. The pole has been discovered. Commander Peary has found the pole. But the world has lost the pole. We have no longer this achievement to look forward to. The riddle has been solved, the curtain has been lifted, and was it fair to posterity to take away such an object of aspiration from it? I tremble to think, ladies and gentlemen, of what will happen when all the riddles of the earth have been solved and those countless generations that are to follow us have nothing that they do not know about this habitable globe of ours, a small globe, after all, too small for the restless and eager mind of man.

Now, having relieved my mind by this outburst of sadness, I come to the business which you have entrusted to my charge, and that is to present this medal to Captain Bartlett. It was a graceful and charming thought on your part, gentlemen of the National Geographic Society, that you should present this medal to Captain Bartlett, and I can assure you that it will be heartily appreciated in the good country to which Captain Bartlett belongs, and by those who, in other lands, on the shores of many seas, live under the British Crown. I thank you and the National Geographic Society for it. But you have already had an acknowledgment by cable from the President of the Royal Geographical Society—one who bears an honored name, for he is the son of the great Charles Darwin—of the pleasure which it has given to that oldest of the Geographical Societies of the world.

Now, Captain Bartlett belongs to an ancient and famous line of Arctic explorers who have sailed under the flag of England. That line begins with the ever to be honored name of Henry Hudson, who perished in the great bay that he discovered. And it is illumined by many an illustrious name thereafter, among whom perhaps the most famous is Sir Edward Parry, who made his wonderful advance toward the pole, far outstripping any who had gone before him; Sir John Franklin, Captains Ross and McClure, and McClintock, and many another of whom time would fail me to tell, dauntless spirits who bent their strength and their powers to the work of polar and Arctic exploration.

I remember seeing long, long ago, at meetings of the British Association and of the Royal Geographical Society in Britain, some of these ancient weather-beaten veterans of polar exploration, and I know how it would rejoice them now to think that that for which they labored had at last been achieved. And if you want to know that the gallantry which animated those men and which made them bear cold and hunger and ill-health, and face all the perils of snowy wastes and floating ice in the pursuit of discovery, if you want to know that that spirit lives still with undiminished force in men of British stock, you have only to read the lately published narrative of the gallant effort to reach the South Pole made by Lieutenant Shackleton and his comrades, which brought them within 97 miles of that remote and perious goal. This was done by the courage and hardihood of Lieutenant Shackleton.

Ladies and gentlemen, we are proud to think that the United States and Great Britain have been partners in this splendid work of Arctic exploration. The United States took up the work some forty years ago, and the names of Kane and Greely and others, above all of Commander Peary himself, show with what energy and spirit and courage and skill and perseverance you have pursued it.

But do not let us forget, in the pride which we feel in the achievements of the stock to which we both belong, what has been done by the other great nations of the world, to some of whose members reference has already been made, more particularly to the Duke of the Abruzzi, whose representative is present here tonight. Barentz must be remembered, and Weyprecht and Nordenskjöld. And there is another man whose wonderful feat of launching himself out upon the Arctic Sea and voyaging for many hundreds of miles upon ice floes is perhaps without parallel in history for its daring, and ought to be remembered in the presence of the Minister from Norway—I mean Dr Fridthjof Nansen.

Now, ladies and gentlemen, I have the great honor of being asked to present this medal of your Society to Captain Bartlett. You, Captain Bartlett, belong to a calling which has always been able to boast of a host of hardy and adventurous seamen. You have been, on your own grim, tempestuous coast of Newfoundland, accustomed to all the perils of storm and iceberg, and it is in the line of your calling to know how to deal not only with the dangers that icebergs threaten, but with all the other terrors that the northern seas contain. You belong to a family which has signalized itself even in your land by the number of gallant seamen it has produced. I may state that there are so many Bartletts who have made distinguished and successful voyages on the North Atlantic coasts that this one who we see here tonight is familiarly known by his Christian name. He stands out from the other Bartletts as Captain Bob. He has had ten years' experience sailing with Commander Peary as the captain of his ships in his various expeditions. And I want to tell you that in those years that Captain Bartlett was sailing there never was a man lost upon those ships in those expeditions.

Captain Bartlett, I have the honor to present to you this medal. Brave men are always generous, and Commander Peary with characteristic generosity has acknowledged how much he owes to you. Your name will go down along with his in connection with the discovery of the North Pole, and you have in this medal a trophy which you can pass on to those who come after you as a memorial of the honor, the well-earned honor, which the National Geographic Society has paid to you.

Ladies and gentlemen, I rejoice to think that Great Britain and the United States are associated on this occasion. And as we congratulate you, Captain Bartlett, so I venture on behalf of my country to congratulate you, Commander Peary, and you, citizens of the United States, upon this splendid achievement—an achievement which will stand alone to the end of time.

RESPONSE BY CAPTAIN BARTLETT

Mr President, ladies and gentlemen: I would ask you just to bear with me for about three minutes. I am afraid to trust myself in speaking, but I have a few words jotted down here that if you will not mind I will read off.

I have the medal that you have been kind enough to bestow upon me, and I thank you in my heart. To be thus decorated by so eminent a body as the National Geographic Society is an honor of which any man can justly feel proud. To say, however, that the notice which you have taken of me affords me pleasure of the most genuine sort would be to state only a part of the truth. I am more than pleased. I am deeply moved at your distinguished consideration. My happiness in receiving this honor at your hands is increased by the fact that I never expected it. It is as unexpected as it is pleasant. It may be also that my appreciation of this medal is enhanced by the

knowledge that its like can never be conferred again. It was struck off to memorialize a complete work, a work that is done, and well done. Commander Peary, with the pleasure that comes to me as I find myself in the midst of these honors, there comes the solid satisfaction of feeling that I have been of some assistance to a man of such sterling worth as Commander Peary (and I can look you straight in the eye, sir, and say that), a man whose heroic character and high aims make him quite worthy of the great fame that has come to him.

For the very great honor that you have shown me on account of my humble aid in the great work, I once again return my heartiest thanks.

THE TOASTMASTER

We have honored Commander Peary, but I am of the opinion that really the greatest honor that he has received tonight is when the captain of his ship said, "I can look you straight in the eye, sir, and say that. I mean it."

Now we shall have a word from General Thomas Hubbard, the President of the Peary Arctic Club, which has done so much for the accomplishment of the North Pole.

GENERAL THOMAS H. HUBBARD

Mr President, ladies and gentlemen: The extension of time granted by the President to the earlier speakers does not apply to me, and if it did I would not avail myself of it, seeing that Mr John Barrett is waiting to follow me, and I do not wish to cut off his time. But it would be ungracious on my part not to recognize the high honor paid by this Society to Commander Peary and Captain Bartlett, and it would be perhaps more ungracious to make a long speech in recognition of that honor and courtesy.

The Peary Arctic Club is a young institution. Commander Peary is a good deal older than the Peary Arctic Club. I do not mean to imply that he is older than each one of its individual members, but he is older than all of them put together in a corporate capacity. The Peary Arctic Club is eleven years old—an infant—and yet it has witnessed the departure and return of Commander Peary, first upon that long four years' absence in the north, when he came back and said he did not reach the pole; next, after the one year's absence, when he came back again and said he did not reach the pole. Either time he might have said that he reached it. There was nothing to contradict him. It would have been impossible to refute the statement. But each time he came back and said he did not do it. And now he has come back and has said that he did it, and your action, the action of this eminent Society, has approved his record.

The Peary Arctic Club has Commander Peary as its chief asset, and his honor is theirs. They have divided with him labor and danger. I know my hearers will say that in dividing labor the division has been unequal. He has done the labor and they have looked on, and I must admit that their attitude during his absence has been that of a passive trustee. During his presence his own activity has stimulated theirs. They were kept active before he went away this last time, and they have been made more or less active since his return.

I beg to assure you that their activity has not included any conspiracies, has not included any attempt to destroy life, or blow up vessels, or steal records. How far they have shared his dangers I can only say by repeating the conversation that I had with him when he sailed out of the East River July 6, 1907.

It was a frightfully hot day and thoughts of the pole were refreshing. As I shook hands with him he said, "Take care of yourself," to which I replied, "It is an injunction I should give you. You have got to take care of yourself." Then his answer was, "Oh, no. One who knows the conditions of life in the Arctic regions is safer than he is in New York."

Now Commander Peary has made life and work in the Arctic regions comparatively safe. No one can make it safe to travel hundreds of miles over an ocean not frozen, but covered with floes likely

at any time to be disrupted. But so far as the danger of starvation, the danger of loss of supplies, the dangers that have been fatal to former explorers—so far as these things are concerned, Commander Peary has made Arctic exploration safe.

Of the dangers to those who remained here I will not speak. All imagine what they are. They do not relate to Arctic exploration. They do not relate to ice, unless it is the ice trust, and they do not relate to water. In my opinion they relate chiefly to too abundant legislation. The other night I heard a statement from Professor McMillan, one of Commander Peary's companions, who said that the Eskimos were the happiest people in the world. Commander Peary says a trip up in the Arctic is safe as compared with the dangers of New York or of Washington. I think the reason for that happiness of the Eskimo and the comparative danger of those who live in the cities throughout the United States is that the Eskimos are not governed by any laws except the laws of nature, and we suffer from a trinitarian government—the trinity of the legislative, executive, and judiciary. How can a people be safe and happy when laws are passed at the rate of twelve thousand a year, and when one State legislature in recent years made in one session three hundred and seventy-eight new crimes? How is it possible for the public to escape being made criminals?

But I am traveling outside of the subject of Arctic exploration and will come back so far as to say that those who have shared with Commander Peary the labor and the danger are entitled to some of the rewards. What are the rewards? The reward of the Peary Arctic Club is the great unparalleled achievement of Commander Peary, Captain Bartlett, and their companions, and that is sufficient to satisfy the ambition of the Peary Arctic Club and friends of the Commander. The recognition that he has received is not yet complete. His return has been met with some disappointments, but he must remember, as we all may, that such is the fate of explorers. Christopher Columbus at one time was sent a prisoner and in chains from the land he had discovered to the land that he had so much honored. Commander Peary has not been put in chains. In centuries to come his achievement will be recognized, and in behalf of the Peary Arctic Club I thank the members of the National Geographic Society that they have not waited for the lapse of centuries before recognizing the acts and the achievement of Commander Peary.

THE TOASTMASTER

We approach the South Pole from South America, and in closing this meeting I shall ask Mr Barrett to pronounce the benediction.

MR JOHN BARRETT, DIRECTOR OF THE INTERNATIONAL BUREAU OF AMERICAN REPUBLICS

Mr President, ladies and gentlemen: In memory of the lateness of the hour I congratulate President Moore and the officers of this Society and Commander Peary upon the significance and success of this banquet. I have only one observation to make, and that is, let us remember with reference to the future that the North Pole is not the only pole; that there is also a South Pole; that there is a great southland as well as a northland, an Antarctic as well as an Arctic Circle. And may we all gather here, possibly in a year or two years, to present a medal to that hero who shall discover the South Pole, whether he carry the flag of the United States, of Great Britain, or Italy, or France, or of that country which may produce a hero who may emulate the example of Robert E. Peary.

The members and guests present were:

Commander R. A. Ackerman, U. S. N.
Mr A. Aaronsohn
Mr and Mrs C. H. Ackert
Dr S. J. Allen
Mr D. G. Ambler
Representative Daniel P. Anthony, Jr., of Kansas
Mr Henryk Arctowski
Mr C. C. Arosenene, the Minister of Panama
Mr J. A. Aspinwall
Mr and Mrs O. P. Austin
Senator Augustus Bacon, of Georgia

Mr Harwood Bacon
Mr Thos. S. Baker
Mr Chas. B. Bailey
Admiral and Mrs G. W. Baird
Mr and Mrs Samuel N. Barker
Mr John Barrett, Director International Bureau of American Republics
Mrs Kate Walker Barrett
Representative and Mrs Richard Bartholdt, of Missouri
Captain Robert Bartlett
Dr L. A. Bauer, Director Department of Terrestrial Magnetism, Carnegie Institution
Mr Geo. H. Beaman
Mr Edwin C. Beers
Dr Alexander Graham Bell
Miss Aileen Bell
Mr Chas. J. Bell, President American Security and Trust Co.
Mr Gardiner Bell
Mr and Mrs Ira Bennett
Mr and Mrs John G. Bennett
Representative and Mrs Wm. S. Bennet, of New York
Mr and Mrs C. K. Berryman
Mr Ambrose Bierce
Mrs Robert Biggs
Lieutenant F. C. Billard
General John C. Black, Chairman Civil Service Commission
Mr Victor S. Bloeke
Colonel and Mrs H. F. Blount
Mrs Bertha H. Bohm
Captain H. T. Boin
Mr and Mrs Scott C. Bone
Rear Admiral R. B. Bradford, U. S. Navy
Mr Chas. S. Bradley
Mr J. A. Breckons
Mr Stacy H. Briant
Mr Robert Brott
Miss Brooke
Mr and Mrs Wm. A. Browne
Prof. E. F. Brusie
Miss Mary Bryant
The Ambassador of Great Britain and Mrs Bryce
Mrs J. Annen Bryce
Miss Bryce
Mr S. S. Burkett
Senator and Mrs Burkett, of Nebraska
Representative Albert S. Burleson, of Texas
Mr and Mrs W. K. Butler
Mr and Mrs Chas. Henry Butler
Minister of Costa Rica and Madame Calvo
Speaker Joseph G. Cannon, of Illinois
Miss Cannon
Mrs Carmody
Mr and Mrs J. W. Carnahan
Mr Frank G. Carpenter
Mr Fred W. Carpenter, Secretary to the President
Representative and Mrs Champ Clark, of Missouri
Mr Lucien W. Chaney
Admiral and Mrs C. M. Chester, U. S. Navy
Miss C. J. Christiansen
Mrs King Church
Mr W. A. H. Church
Mr and Mrs Price C. Claflin
Miss Margaret Claflin
Mr C. T. Clagett
Mrs Wm. E. Clark
Mr and Mrs B. M. Clinedinst
Representative Wm. W. Cocks, of New York
Mr H. G. Cole
Mr and Mrs Wm. Knowles Cooper
Mr F. V. Coville
General Wm. R. Cox
Mr and Mrs Elijah S. Cowles
Mr H. McC. Crist
Colonel Knowles Croskey
Mr J. M. Culp
Miss Helen M. Cummings
Mr and Mrs J. Harry Cunningham
Senator and Mrs Chas. Curtis, of Kansas
Mr and Mrs Wm. E. Curtis
The Minister of Chili and Madame Cruz
Miss Ida M. Daly
Mr and Mrs Oscar K. Davis
General Geo. W. Davis
Miss Elsie A. Davis
Mr Walter I. Dawkins
Mr Chas. Ray Dean
Mr Emile Diebitsch
Mr Wm. W. Doll
Miss Bertha L. Doty
Mr D. Wallace Duncan
Mr Geo. M. Dunn
Mr and Mrs Albion M. Dyer
Miss Dyer
Mr John Joy Edson, President Washington Loan and Trust Co., and Mrs Edson
Mr and Mrs Fred'k B. Eichelberger
Mr W. A. F. Ekengren, Secretary Swedish Legation
Mr and Mrs J. F. Ellerson
Miss Elliott
Mr and Mrs Edward S. Ellis
Mr Fred A. Emery
Miss Emery
Colonel R. K. Evans, U. S. A.
Mr David Fairchild
Mr Romolo Fanciulli
Mr and Mrs Richard Lee Fearn
Captain and Mrs A. J. Fechleter
Mr and Mrs W. W. Finley
Mr and Mrs Guy Finney
Senator and Mrs Fletcher, of Florida
Miss Louise Fletcher
Miss Nellie Fletcher
Mr Loring Fletcher
Miss Myra B. Floyd
Representative and Mrs David J. Foster, of Vermont
Representative and Mrs Geo. E. Foss, of Illinois
Mr Geo. S. Fowler
Mr and Mrs H. B. Fulton
Mr and Mrs H. M. Fulton
Mr F. A. Furst
Senator and Mrs Robert J. Gamble, of South Dakota

Mr Henry Gannett, Vice-President National Geographic Society
Mr H. E. Gerhard
Mrs Gibson
Miss Laura D. Gill
Representative Fred'k H. Gillett, of Massachusetts
Miss Lucy D. Gillett
Mrs H. A. Gillis
Mrs H. P. Godwin
Mr J. F. B. Goldney
Mr Samuel Gompers, President American Federation of Labor
General and Mrs Green Clay Goodloe
Prof. and Mrs J. Howard Gore
Mr Horace S. Gould
Mr John Graham
Mr O. R. Graham, Jr.
Mr J. T. Granger
Mr Benj. S. Graves
Mr Gilbert H. Grosvenor, Editor NATIONAL GEOGRAPHIC MAGAZINE
Mr Edwin P. Grosvenor
The Minister of Norway and Madame Gude
Mr W. B. Hadley
Mr Henry J. Haight
Miss Adelaide Haffords
Colonel Thos. H. Handbury, U. S. A.
Mrs Geo. A. Hart
Representative G. N. Haugen, of Iowa
Representative William H. Heald, of Delaware
Mr G. F. Heilprin
Miss Heilprin
Mrs Helmbold
Mr J. B. Henderson, Jr.
Mr Calvin W. Hendrick
Hon. and Mrs Robert L. Henry
Mr Hilary A. Herbert, formerly Secretary of the Navy
Mrs Geo. G. Herring
Mr and Mrs Arthur Herschel
Mr and Mrs C. Heurich
Miss Hickey
Representative and Mrs Ebenezer J. Hill, of Connecticut
Mr Samuel M. Hitt
General and Mrs Charles W. Hobbs
Miss Hobbs
Admiral and Mrs R. C. Hollyday, U. S. N.
Mr and Mrs E. M. Hood
General Thomas Hubbard, President Peary Arctic Club
Mr A. J. Huntoon
Mr Geo. W. Hutchison
Mr Frederic B. Hyde
Admiral Richard Inch, U. S. N.
Mr Alfred Mitchell Innes
Mr H. R. Insley
Lieutenant Colonel and Mrs R. B. James
Mr Mahlon H. Janney
Mr Chas. G. Jarboe
Mr and Mrs Carl F. Jeansen
Mr William Jessop
Mr and Mrs C. A. Joerissen
Mr B. F. Johnson
Mr Maurice Joyce
Mr and Mrs George H. Judd
The Ambassador of France and Madame Jusserand
Mr and Mrs Gus Karger
Mr and Mrs Rudolph Kauffmann
Mr and Mrs H. W. Kennard
Mr Clarence P. King
Mr and Mrs Geo. A. King
Hon. Martin A. Knapp, President Interstate Commerce Commission, and Mrs Knapp
Representative and Mrs J. R. Knowland, of California
Mr and Mrs Geo. C. Knowles
Dr Geo. M. Kober
Mr and Mrs John Oliver La Gorce
Representative John Lamb, of Virginia
Mr James L. Lancaster
Miss Helen Landell
Mr and Mrs John B. Larner
Mr B. F. Leighton
Mr Wm. B. Levy
Mr and Mrs Thos. W. Lockwood, Jr.
Mr Homer N. Lockwood
Mr and Mrs Edward H. Loftus
Representative and Mrs H. C. Loudenslager, of New Jersey
Mr and Mrs Edw. Lowry
Mr Craig McDonald
Senator McEnery, of Louisiana
Mr W J McGee
Mr and Mrs Percy McKay
Mr and Mrs Chas. A. McKenney
Mr and Mrs F. D. McKenney
Dr R. E. B. McKenzie
Representative Wm. B. McKinley, of Illinois
Mr N. E. S. McLean
Dr Malcolm McLeon
Mr and Mrs John H. Magruder
Miss Natalie Magruder
Mrs I. T. Mann
Representative and Mrs James R. Mann, of Illinois
Mr W. Sinkler Manning
Mr E. R. Martin
Mr Crittendon Marriott
The Charge d'Affaires of Japan and Madame Matsui
Mr Wm. F. Mattingly
Miss Mattis
Mr and Mrs Wm. A. Mearns
Mr H. G. Meen
Senor Don Merino, Secretary Spanish Legation
Mr and Mrs R. F. Miller
Mr Russell Hastings Millward
Mrs S. Murray Mitchell
Mr and Mrs J. Walter Mitchell
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The Marquis of Villalobar, The Minister of Spain
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Mr Morris Whitridge
Mr and Mrs E. T. Williams
Mr and Mrs S. A. Willis
Mr Nathaniel Wilson
Colonel and Mrs M. A. Winter
Rev. Dr and Mrs Charles Wood
Mrs Woods
Mr S. W. Woodward
Captain J. W. Wright, U. S. A.
Mrs Marie Robinson Wright
The Chinese Minister and Madame Wu
Representative and Mrs H. O. Young, of Michigan
Mr M. W. Zimmerman

THE COAL-FIELDS OF ALASKA*

With a Few Notes on the Mineral Wealth of the Territory

THERE are two known areas of high-grade coal—the Bering River field, in the Controller Bay region, and the Matanuska field, north of Cook Inlet. The Bering River field, lying about 25 miles from tidewater at Controller Bay (see map, page 24), embraces 26.4 square miles underlain by anthracite and 20.2 square miles underlain by bituminous coal. The coal-bearing rocks trend to the northeast into the unsurveyed high ranges, and it is quite possible that there may be an extension of the coal-fields in this direction.

Coal-beds varying from 6 to 20 feet in thickness are exposed in this region, with some local swellings, giving a much higher maximum thickness. In quality the coals vary from an anthracite, with 84 per cent of fixed carbon, to a semi-bituminous, with 74 per cent of fixed carbon, and include some varieties that will coke. There has been much prospecting of these coals, but in the absence of railways no mines have been developed, though a small output from one bed has been taken to the coast in barges.

The Matanuska coal-field lies about 25 miles from the tidewater at Knik Arm, a northerly embayment of Cook Inlet. As Cook Inlet is frozen during the winter, however, the distance to an open seaport must be measured to Resurrection Bay, on the east side of Kenai Peninsula, about 150 miles from the coal-field (see map, page 3).

The known commercially valuable coals of the Matanuska field vary in quality from a sub-bituminous to a semi-bituminous, with some anthracite, and are included in folded and faulted Tertiary (Eocene?) shales, sandstones, and conglomerates, aggregating 3,000 feet in thickness.

The coal-beds vary from 5 to 36 feet in thickness, and the total area known to be underlain by coal aggregates 46½ square miles. However, as much of the field is covered by gravels and none of it has been surveyed in detail, the coal-bearing area may be much larger. The total area of what may prove to be coal-bearing rocks is approximately 900 square miles. Up to the present time there has been no means of transporting this coal to market, so that no mining has been done, but many beds have been opened in prospecting.

The anthracite from Matanuska and Bering rivers has no equivalent on the Pacific Coast, and it compares favorably with the Pennsylvania anthracite. It ought to be put into the San Francisco and other Pacific Coast markets at a cost far below that of Eastern coal, in which case it should have no difficulty in entirely supplanting the latter.

The Bering River semi-anthracite and part of the semi-bituminous coal from Matanuska is also better than anything that is being mined in the West. These coals are the equivalent of the Pocahontas, New River, and Georges Creek coals of the East, and are eminently adapted for use on warships and for other purposes for which a high-grade, pure, "smokeless" steaming coal is required, and for these purposes will command a considerably higher price than any coal now being mined on the Pacific Coast, or, if offered at equal prices, should readily drive the latter from the market.

Part of these coals will produce an excellent quality of coke—better, in fact (except possibly in content of phosphorus, regarding which no data are available), than coke which can be pro-

* From reports of Alfred H. Brooks, Chief of Alaskan Division, U. S. Geological Survey.

duced from any of the Washington or Vancouver Island coals, and equal to the coke from Crow's Nest Pass. If an important smelter industry grows up in Alaska, as now seems possible, the Alaska coking coals should have the advantage, both of quality and of transportation.

Before they can be mined it will be necessary to build about 150 miles of railroad to reach the Matanuska coal, and from 25 to 100 miles (according to the harbor chosen) to reach the Bering River coal. It is believed that either of these projects is feasible, and that if favorable title can be obtained both fields will be producing on a large scale within a few years. Railroads are now under construction to both these fields.

Mining developments in the Bering River coal-fields of the Controller Bay region and in the Matanuska coal-field of the Cook Inlet region have been practically confined to surveys for patents, assessment work, and trail building. The most important features are connected with the problem of railway construction.

No patents for coal land have yet been granted.

The value of these high-grade fuels of Alaska probably exceeds that of the gold deposits, and the exploitation of these coal-fields is of the greatest importance to the entire western seaboard of the continent. These coals will furnish not only the high-grade steam coals needed for various industries, but also the coke for metallurgical enterprises. If the iron ores of the Territory prove valuable, the west coast may yet be supplied from this source with the raw materials for the manufacture of iron and steel. In any event, the copper smelters can be provided with coke of a high grade.

The coals from other known Alaska fields than these are so situated or are of such quality that they can find markets only where excessive rates on outside coals give them an advantage; that is, their markets must be local and probably small. These lignites and lower grade bituminous coals have a wide distribution in Alaska, and some of them will have great value to local industries.

GREAT QUANTITIES OF PEAT

Peat is very widely distributed in Alaska, having been found in nearly every part of the Territory. The climatic conditions, as well as those of plant life, in the central and northern parts of the Territory, seem especially favorable for the accumulation of peat. Everywhere the soil is clothed with a dense growth of moss and other small plants, and the frozen condition of the subsoil and the shortness of the summer season prevent decay.

There is no information at hand on which to base an estimate of the available supply of peat in Alaska. As it is found in every part of the Territory, however, and as the great tundras of the north, occupying at least a quarter of the Territory, appear to be nearly everywhere underlain by peat of greater or less thickness, the supply must be enormous, and may equal if not exceed that of the entire United States.

In the presence of more easily available fuel there has been no occasion to utilize any of the peat deposits, so that little is known of their horizontal extent or thickness. It is not uncommon, however, to see thicknesses of 15 to 30 feet in natural or artificial exposures. The surface layer of peat, which forms the upper layer of the tundra, may not exceed a few feet in thickness, but locally these accumulations are many times as thick.

COPPER AND PLACER MINING

Alaska contains a large variety of mineral deposits, and these, especially gold and coal, are widely distributed. The auriferous gravels are scattered over a very large area, but much of it is unprospected. There are some large auriferous lode mines in southeastern Alaska and promising lode prospects in other parts of the Territory.

Copper mining has been done in two widely separated coastal districts. Very promising deposits of copper ore occur

in two inland belts which are undeveloped because they are not yet accessible by rail, and copper prospects have been found elsewhere in the Territory.

Tin, marble, gypsum, and petroleum have been produced from Alaskan deposits; iron and other minerals probably have future commercial value.

Mining began about 1880 and progressed slowly for nearly two decades, since which advancement has been very rapid. Much of the Pacific seaboard, with its cheap transportation, strong relief, abundant water-power and timber, and equable climate, is most favorable to low costs of mining. These conditions have resulted in the development of one of the largest low-grade gold-mining enterprises in the world, as well as some others of considerable magnitude. They have also favored the successful exploitation of comparatively low-grade copper ores, even at the low market value of the metal during the past year.

Though placer mining has been carried on in Alaska for nearly thirty years, it has been chiefly by the crude methods of the pioneer that more than $100,000,000 worth of gold has been won from the auriferous gravels. The modern epoch of placer mining, with labor-saving machinery, has only just begun, and the field in which such methods are used is capable of much expansion. Though the future discovery of bonanzas, such as have made Alaska famous in the past, cannot be predicted, it is certain that the possibilities of new finds are far from being exhausted, and that there are hundreds of creeks known to be auriferous which may yield gold in commercial quantities when means are found to reduce the present cost of operation.

The inland copper districts await the railway transportation, which will not only lead to the development of known deposits, but also stimulate further search for ore bodies. Such developments of a lode-mining industry will give a larger permanent population—at present Alaska's greatest need.

A full development of the mining industry of Alaska is possible only by the improvement of the transportation facilities. At least one railway must be built to the Yukon gold-fields, and the inland copper-lode districts and coal-fields must be connected with Pacific ports that are open throughout the year. Then, and not until then, can Alaska's mining industry be developed to the extent warranted by her known mineral wealth.

IMMENSE MINERAL OUTPUT

The total value of the mineral production of the Territory since productive mining began, in 1880, exceeds $147,000,000. In the following table the production by years and by substances is presented. This table is based on the best available information, but accurate statistics of the annual mineral output have been collected only since 1905:

Value of Total Mineral Production of Alaska, 1880–1908

BY YEARS

1880–1890	$4,686,714
1891	916,920
1892	1,096,000
1893	1,048,570
1894	1,305,257
1895	2,386,722
1896	2,980,087
1897	2,538,241
1898	2,585,575
1899	5,703,076
1900	8,238,294
1901	7,007,398
1902	8,400,693
1903	8,941,614
1904	9,567,535
1905	16,478,142
1906	23,375,008
1907	20,887,055
1908	19,929,800
	$147,972,701

BY SUBSTANCES

Gold	$142,030,637
Silver (commercial value)	1,120,562
Copper	4,265,136
Tin	92,640
Coal	315,079
Marble and gypsum	148,647
	$147,972,701

The known mineral wealth of inland Alaska is embraced in the two copper-bearing belts of Copper River, lying 100

to 300 miles from tidewater; the Bering River coal-field, 25 miles from the coast at Controller Bay and 100 miles from a good harbor on Prince William Sound; the Matanuska coal-field, 150 miles from an ice-free port on the Pacific, and the Yukon placers, from 400 to 600 miles by feasible railway routes from the Pacific. This inland region is separated from the Pacific tidewater by high, snow-covered ranges, broken, however, by several river valleys.

The full development of the mineral wealth of inland Alaska must await improvements in means of communication, which will need to be of a very radical character. The expensive and uncertain mode of reaching the Yukon placer districts by ocean and river boats or long winter sled journeys places so heavy a tax on the gold-mining industry as to make it in most places impossible to exploit anything but the richest placers. The copper deposits of Copper River and the coal-fields of Controller Bay and the Matanuska basin must remain unproductive until a transportation system has been developed.

Thanks to the Alaska road commission, and in a lesser degree to local enterprise, much has been accomplished in the way of road and trail building. Much, however, remains to be done, for in this Territory, embracing nearly 600,000 square miles, there are only 452 miles of wagon road, 397 of sled road, and 255 of trail. The coastal service of ocean vessels and the river transportation systems of the Yukon and its tributaries are being much improved. In addition to this, steamboats have been placed on Copper and Sushitna rivers. Local transportation facilities have also been greatly bettered by short lines of railway, such as those at the White Pass, at Fairbanks, in Seward Peninsula, and the Copper River Railway, which now extends from Cordova for about 70 miles inland.

All these improvements in means of communication, together with the military telegraph lines, wireless stations, and long-distance telephone systems, have

COMMANDER JENSEN

OBSERVATOR PECHÜLE

Two members of the committee appointed by the University of Copenhagen to pass on Cook's claims of having reached the North Pole

done much to advance the mining industry. They can, however, be regarded only as supplementary to a system of railways, which alone can make available the mineral wealth of extensive areas. In fact, they serve to emphasize the inadequacy of the existing transportation systems. The industrial demands for better communication can be met only by railways which shall connect the mineral deposits with open ports on the Pacific seaboard.

PROFESSOR STRÔMGREN
OBSERVATOR ENGSTRÔM

COMMANDER HOLM
CAPTAIN RYDER

The other four members of the committee appointed by the University of Copenhagen, which examined the papers of F. A. Cook, and unanimously reported that Dr Cook had no proof that he had reached the North Pole.

ACKNOWLEDGMENTS

THE National Geographic Society has much pleasure in expressing its thanks and appreciation to the following companies and individuals for material assistance rendered to its Alaskan Expedition of 1909:

Borden's Condensed Milk Company, 108 Hudson St., New York, N. Y.—Condensed and evaporated milk.

Northern Steamship Co. *Lindsay*, Seattle, Wash.—Half rates, Cordova to Seattle.

Bausch & Lomb Optical Co., Rochester, N. Y.—Loan of 2 pair field glasses, 2 lenses for large camera.

Winchester Repeating Arms Co., New Haven, Conn.—Fifty per cent discount on shotgun, carbine, and ammunition.

Armour & Co., Chicago, Ill.—Extract of beef.

Keuffel & Esser, New York, N. Y.—Double mounted paper for plane table work.

Franco-American Food Co., Franklin St. and Central Ave., Jersey City, N. J.—Soups.

Eastman Kodak Co., Rochester, N. Y.—Discount on photographic equipment.

Williams Bros. Co., Detroit, Mich.—Canned goods, preserves, and pickles.

Schwabacher Grocery Co., Seattle, Wash.—Discount on groceries.

Merrill-Soule Co., Syracuse, N. Y.—Trumilk and truegg.

Katalla Company and Copper River and Northwestern Ry. Co., Cordova, Alaska.—Transportation, subsistence, maps, etc., for R. S. Tarr and Lawrence Martin.

W. and L. E. Gurley, Troy, N. Y.—Discount on topographic equipment.

Alaskan Division U. S. Geological Survey.—Maps and information, loan of instruments and assigning topographer.

U. S. Coast and Geodetic Survey.—Loan of instruments.

U. S. Bureau of Fisheries, Washington, D. C.—Loan of small sounding reel.

Jack Dalton, Cordova, Alaska.—Loan of boat, etc.

THE NATIONAL GEOGRAPHIC SOCIETY

THE Annual Meeting of the National Geographic Society occurred Friday evening, January 14. Reports of the Secretary and Treasurer were submitted and are printed below. The eight members of the Board of Managers whose terms expired at the meeting were unanimously re-elected for the ensuing three years, namely, Henry F. Blount, C. M. Chester, F. V. Coville, John E. Pillsbury, Rudolph Kauffmann, T. L. Macdonald, Willis L. Moore, and S. N. D. North.

At a regular meeting of the Board of Managers, January 19, Mr Henry Gannett, who has been Vice-President of the Society for the past five years and Chairman of its Committee on Research, was unanimously elected President; Mr O. H. Tittmann, Superintendent of the United States Coast and Geodetic Survey, was elected Vice-President, and Messrs O. P. Austin and John Joy Edson re-elected Secretary and Treasurer respectively.

REPORT OF SECRETARY O. P. AUSTIN FOR THE YEAR 1909

The year 1909 shows a large increase in the membership of the National Geographic Society and a general improvement in its condition and work. The number of members at the beginning of the year was 38,696, the number added upon their own application during the year was 18,152, and the losses by death and resignation 3,515, making the net increase during the year 14,637, and the total membership on December 31, 1909, 53,333, of which number 348 are life members.

This large increase in membership and consequent increase in the receipts of the Society has enabled it to give its members a larger and better Magazine, a material increase in the number of popular lectures, and to also set aside a considerable sum as a permanent investment.

The membership is distributed through all the States and Territories of the Union, and includes about 2,363 in the District of Columbia and between 600 and 700 in the Philippines, Hawaii, and Alaska. The membership in foreign countries is over 2,383 and represents fifty different countries and colonies of the world, including all the European countries, Egypt, India, China, Japan, Korea, Australia, New Zealand, the various South American countries, and several of the West Indian islands. The membership in Canada is 655; in Mexico, 391; in the Hawaiian Islands, 266; in

the Philippines, 203; in Alaska, 204; in Porto Rico, 59; in Cuba, 109; in Panama, 96; in Europe, 365, and in Central and South America, 118.

The Annual Dinner of the Society was held at the New Willard Hotel on December 15, and was largely attended.

It is with much regret that the Secretary records the death of Mrs Gardiner Greene Hubbard, October 20, 1909. The handsome building which she and her family presented to the Society and her constant interest in and assistance of the work of the Society from its organization, in 1888, have been keenly appreciated by every member of the Society. The following resolution was adopted by the Board of Managers on behalf of the Society, October 23, and sent to the family of Mrs Hubbard as an expression of the sympathy of the Society in their mutual affliction:

"The death of Mrs Gardiner Greene Hubbard is to the National Geographic Society a great, an irreparable loss, and to each member of the Board of Managers comes as a personal bereavement. Her broad and constant interest in the work of the Society, apparent during the decade in which her husband, Gardiner Greene Hubbard, served as its President, has, since his death on December 11, 1897, been its greatest stimulus to renewed activity in the work to which he devoted so many years and for the conduct of which he, twenty-one years ago, became the Society's first President. Her personal interest in its work in behalf of scientific geography and the diffusion of geographic information among the people, her attendance upon its meetings during the long years of its activities, and her individual recognition of the work performed by others in its behalf have been an inspiration to the officers of this Society, the members of the Board of Managers, the speaker upon the platform, and the Editor at his desk; while her splendid gift of a building which became at once a home for the Society and a memorial to its founder and first President now becomes of added interest as a memorial of her own generosity and a practical aid in the diffusion of information to all parts of the country and to all quarters of the world."

O. P. Austin,
Secretary.

Report of the Treasurer, John Joy Edson, for the Year 1909

RECEIPTS

Cash balance as shown by statement of December 31, 1908		$24,533.82
Dues from members		89,782.02
Life members		2,700.00
Magazine, subscription and sales		9,088.01
Lectures, tickets		5,222.50
Advertising in Magazine		10,233.58
Interest on investments	$812.50	
Interest on deposit in bank	598.13	
		1,410.63
Publications		8,620.69
Grant Squires Medal Fund Endowment		500.00
Sundry		1,848.27
		$153,939.52

DISBURSEMENTS

Salaries, clerical hire, and services		$18,371.39
Magazine, paper, printing, etc.		52,451.27
Pound rate postage on Magazine		3,200.00
Postage		6,575.00
Printing and stationery		8,608.79
Lectures		5,089.69
Hubbard Memorial Hall, lights, heat, furniture, etc.		1,316.65
Publications:		
Printing, binding, etc.	$10,246.36	
Postage and expressage	913.02	
		11,159.38
Research Committee, Alaskan Expedition	$5,496.39	
Research Expedition to Naples and Sicily	250.00	
		5,746.39
Investments:		
Purchase of lot on 16th St.	$11,338.95	
Notes, secured by real estate	15,000.00	
Accrued interest on same	300.00	
		26,638.95
Advertising, commissions		716.18
Sundry		3,451.28
Cash, on deposit in the Washington Loan & Trust Company		10,614.55
		$153,939.52

ASSETS, DECEMBER 31, 1909

Notes secured by first deed of trust on real estate	$30,500.00
Publications on hand, at cost	7,000.00
Real estate, adjoining 28½ feet on 16th St. (purchase price)	11,338.95
Cash, on deposit in the Washington Loan & Trust Company	10,614.55
	$59,453.50
Liabilities, December 31, 1909	none

Respectfully submitted,

JOHN JOY EDSON,
Treasurer.

THE NEW YORK AQUARIUM

THE New York Aquarium had a greater number of visitors during the year 1909 than ever before, the attendance being 3,803,501—an average of 10,417 a day.

These figures show that the Aquarium has a greater patronage by the public than all the other museums of the city, including the Zoological Park, combined, and 1,800,000 more, for the same period, than the New York Hippodrome, which has probably the largest attendance of any theater in the city. These figures are unequaled by those of any other museum in the world of which statistics are available.

C. H. TOWNSEND,
Director.

Photo from Rev. B. St. John

A CAKE STAND: PEKING, NORTH CHINA

The carved tube is a piece of bamboo into which the cash is thrown as purchases are made

Vol. XXI, No. 2 WASHINGTON February, 1910

THE NATIONAL GEOGRAPHIC MAGAZINE

A TRAVELER'S NOTES ON JAVA

By Henry G. Bryant

THE island of Java, in the Dutch East Indies, by reason of the rich beauty of its tropical scenery, its picturesque native races, its varied history, and world-famous archeological remains, deserves attention from the intelligent traveler as a region worthy of special investigation. The writer, recalling how vague his own ideas were concerning Java before his visit to the island, and believing that few have had occasion to acquire special information relating to it, submits these random notes of a journey recently made to that fascinating region.

At the risk of trying the reader's patience somewhat, a few general facts relating to Java are submitted by way of introduction to the general narrative of the journey.

This favored isle lies wholly within nine degrees of the equator and equals in area the State of New York. Its surface is diversified by many lofty mountains, and it is remarkable for the great number of volcanic peaks which rise from the lowlands of the interior. No less than forty-five volcanoes are found on the island, and these range from 2,000 to over 11,000 feet in height, and many of them are constantly in a state of semi-activity. Within historic times several districts have been devastated by these explosive forces, while many will recall the eruption of Krakatoa, in the Strait of Sunda, in 1883, as one of the most desolating disasters of modern times. One result of this ceaseless activity of the forces of vulcanism during past ages has had the effect of covering the greater portion of the island with a thick layer of volcanic material which has produced a soil unequaled in the world for fertility.

This deep, rich soil supports a vegetation which, in luxuriance and variety, is unsurpassed by that of any other region of similar area, and ever since the Dutch established their first settlement on the island, in 1595, a golden harvest of agricultural products has been yearly garnered to swell the granaries of the colonists and the revenues of the home government.

To the visiting American perhaps one of the most noticeable features about Java is the distinctly paternal character of the Dutch colonial administration. This was impressed on us on our first landing at Batavia, where we had to report directly to the chief of police to obtain permits to travel on the island. Before these were granted, full answers had to be given as to our names, nation-

ality, occupation, age, and purpose in visiting Java. During our subsequent wanderings we were obliged to hold these permits in readiness for inspection by officials, and at all times we felt that our movements were a matter of some interest to the authorities. We are not surprised, therefore, to learn that the uniform policy of the government has been, in former years, to discourage foreign travel in Netherlands-India, and the present regulations are only a concession to the modern spirit which demands free intercourse among the nations.

NEARLY ALL LAND OWNED BY DUTCH GOVERNMENT

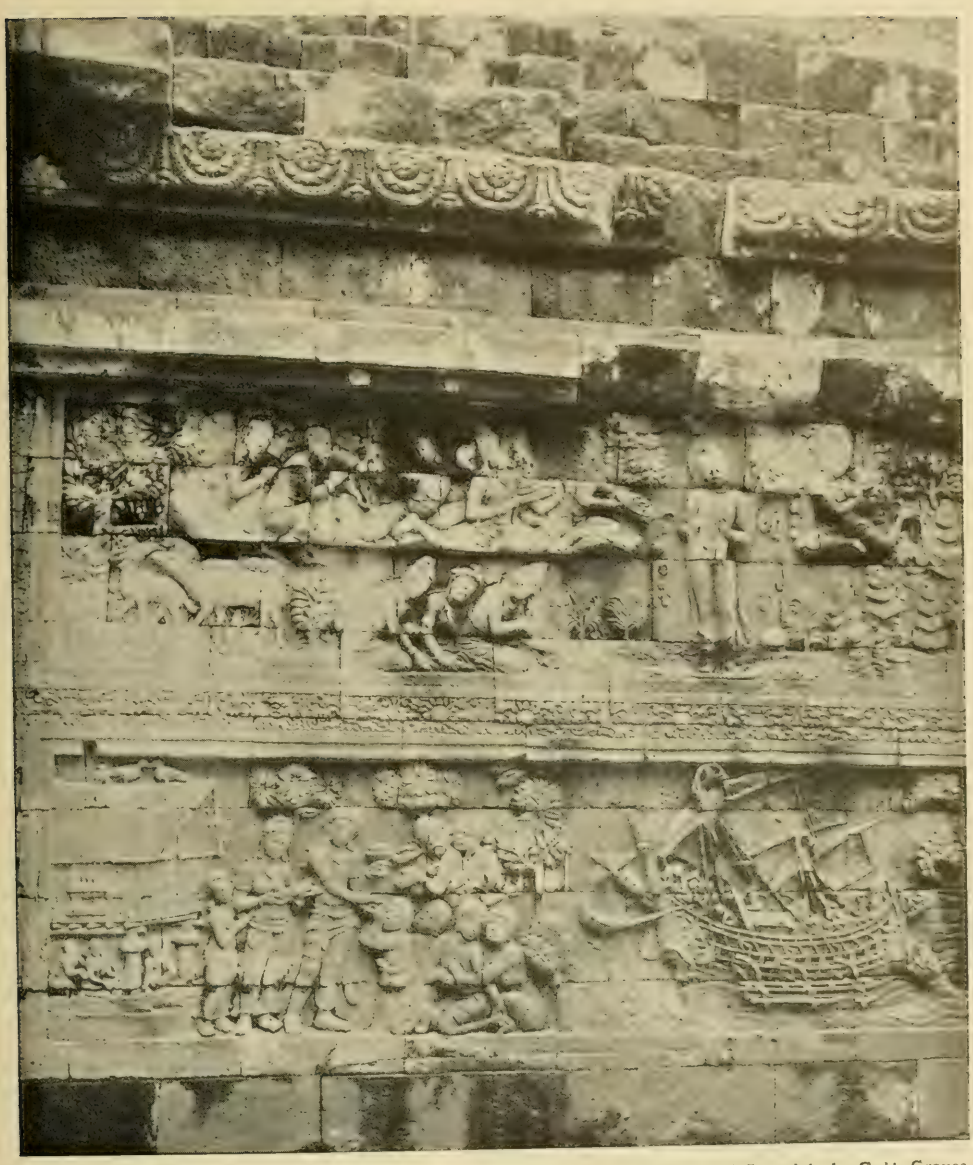
To one who hails from a country where private initiative counts for so much, it is something of a shock to learn that nearly all the land is owned by the government. In securing from the native princes by treaty and purchase the lordship of the land, the Dutch government also inherited the right to receive one-fifth of the produce and the labor of the peasant. This led to the introduction, in the year 1832, of what is known as the "culture system." This was a device to increase the revenues, and consisted in the exaction of forced labor from the peasants, who were compelled, under official supervision, to cultivate tobacco, coffee, sugar, tea, and indigo for their masters. This system of forced labor has been greatly modified in recent years, and I was informed that it now survives only in connection with the government coffee plantations. To most of us, doubtless, the one agricultural product of Java which is best known is coffee. It was something in the way of a disillusion to learn, therefore, that the famous "Government Java" of bygone days is of much less importance as a product of the colony than formerly. A destructive "blight" visited many of the plantations some years since. Some districts have not yet recovered from this, and in the meantime the coffee planters of Brazil have captured the bulk of the world's coffee trade.

While the richest of the Dutch East Indies, Java is also the most densely populated; the number of inhabitants amounts to as many as nine hundred per square mile in some districts. Aside from the sprinkling of Europeans and Chinese, the native population numbers 29,000,000. These all belong to the Malay race and almost without exception profess the religion of Islam.

The early culture of Java can be traced to India, and there is no doubt that this Hindoo influence had the greatest effect on the religion, language, and literature of the island. At the present time this influence is evidenced not only in the language and arts of the country, but by the great temples erected to Buddha. One of these, known as "Great Buddha," or "Boro Boedoer," is by many considered to be the greatest monument of Buddhistic architecture in existence. The Arab Mohammedan invasion occurred in the latter part of the fifteenth century, and when the Dutch began to extend their settlements, in the early decades of the seventeenth century, they found the faith of Islam extended to most parts of the island.

For the purposes of government, the island is divided into 22 residencies under the control of a Governor General, who lives in Buitenzorg. Each province has its Resident, who is assisted by various subordinates. In their dealings with the natives the Dutch find it expedient to collect the taxes and administer the government through an army of native officials. Thus native princes fill the office of regent in some of the provinces and "play" at ruling, but all real power rests with the foreign rulers, who are called "elder brothers."

Lying so close to the equator, the climate is a trying one to Europeans, although the style of dress in use and the manner of life do much to mitigate it. The rainy season lasts from October to April, and at all times showers may be expected. Residents urged upon us the importance of avoiding the direct rays of the sun during the heat of the day. One soon learns that Java is a country of early rising. The ordinary business



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ONE OF THE 988 BAS-RELIEFS OF THE TEMPLE AT BORO BOEDOER (SEE PAGE 104)

man has finished his coffee and is at his shop or office by 6 a. m. Between 9 and 4 o'clock all Europeans endeavor to keep indoors. The midday meal is taken between 1 and 2, and fashionable society does not bestir itself until after 5 o'clock, when driving and visiting is in order until 8 or 9 o'clock, when dinner is served.

Our sail of less than 48 hours over a tropical sea from Singapore to Batavia, the capital city of Java, is full of interest and mystery. Many of the passengers were expecting to cross the equator for

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ON THE WAY TO THE PAPANDAJAN VOLCANO

CUTTING RICE (SEE PAGE 107)

the first time on this voyage, and the captain promised to blow the whistle at the moment our vessel was supposed to cross the imaginary line. After dinner that first evening at sea, we hurried on deck to witness a sunset of rare beauty. As the clouds lifted, we beheld the great orb drop into the sea in a blaze of color whose tints changed even as we gazed on them. We had learned that a partial eclipse of the moon was to occur during the evening, and, to escape the heat below, as well as to see this phenomenon, all hands remained on deck. Presently the mysterious shadow darkened the face of "the bright regent of the sky," and, later on (at 8:15), just as the shadow reached its greatest extent, the ship's whistle sounded on the still air. A strange mingling of sensations, truly, when we gazed on one of nature's marvelous spectacles and at the same time realized that we were entering a new hemisphere, wherein the bright constellation of the Southern Cross beckoned us on to explore new lands and strange peoples.

All next day we sailed southwest, with the great island of Sumatra in plain view to the westward, and, late in the afternoon, entered Banka Strait, keeping on our port quarter Banka Island, so famous for its tin mines.

BATAVIA, THE CAPITAL OF JAVA

Early next morning we docked at Tandjong Priok, the port of Batavia. A swarm of native runners and porters boarded the steamer, directly the gangplank was in place, and such a jabbering and shouting I have not heard since the old days at Atlantic City, before silence was enjoined on the hack drivers.

Our present purpose in visiting Batavia was merely to secure permits to travel, and presently to trans-ship in another steamer to the eastern end of the island. After a short ride in the railway we arrived at Batavia, where we drove at once to the police headquarters for the permits.

The preliminaries attending the securing of permits to travel proceeded with true Dutch deliberation. After answering all the categories of the official, it transpired that the printed forms used for such purposes were all exhausted; hence it became necessary for the clerk to write out by hand the entire document. In due time the necessary credential was obtained, and we then undertook a drive about the city. The ancient city of Batavia proper is a grim, time-worn place, with many warehouses and government buildings grouped amid the intersecting canals. It is said to be unhealthy, and is wholly given over to commercial interests. Delaying here only for a brief survey, we continued our drive on clean, well-kept roads for two miles along canals suggesting Holland to the modern residential suburb of Weltevreden.

Passing under a white arch, we paused a moment to examine the two statues of fierce-looking native gods which guarded the portal, observing also a guard of Javanese soldiers who are being drilled by a native officer. Continuing our drive, we soon arrive at a broad avenue facing the Konigsplein, a great green parade ground, with its bordering streets shaded by rows of tamarind trees. Facing this extensive park are numerous neat villas built in the bungalow style, often embowered in cool foliage, the homes of active and retired officials, army officers, planters, and business and professional men who go to make up the white population of the capital. We soon come to an imposing building of classical design, which proves to be the Museum of the Batavian Society of Arts and Sciences. The copper elephant on a pedestal in front of the building was a gift from the King of Siam, presented on the occasion of his visit some years ago. This museum contains the finest ethnological collection of any institution in the Far East, and its publications rank well among the learned societies of Europe and America.

But the rising sun warns us of the approach of noon and we turn down a side street and soon reach the welcome coolness of the Hotel der Nederlanden. As a rule the hotels were found to be

BEATING RICE FROM THE EAR

A SUNDANESE GIRL

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A DUTCH GENTLEMAN AND HIS NATIVE WIFE AND DAUGHTERS

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PEDDLERS OF SARONGS, THE NATIVE GARMENT

(SEE PAGE 101)

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JAVANESE GENTLEMEN, SHOWING CONTRASTS OF DRESS (SEE PAGE 101)

clean, well kept, and admirably designed to meet the requirements of a tropical climate. They usually consist of a main building openly constructed, so as to admit the passing breeze, with wings containing the sleeping-rooms. The charges in Java are much cheaper than in other parts of the East.

THE RICE-TABLE

Here I made acquaintance with that famous gastronomic institution of Java

known as the Rijst-tafel or rice-table. Seated in a spacious pavilion, an army of beturbaned Malays brought us soup. Then large, deep plates were placed before us in which a supply of rice was deposited. On top of this basic stratum two inches deep we were expected to place an extraordinary variety of vegetables, curries, dried fish, eggs, fowls, and meats flavored with a variety of peppery condiments. After depositing on my plate eight of the dishes offered, limitations of appetite and space demanded a halt, and the remaining half of the sixteen varieties were allowed to pass untouched. Subsequent experience with this rice-table—so fearfully and wonderfully made—taught me discretion; but I shall never forget the bewildering dismay of that first encounter. In this connection, a recent writer remarks that "it is humanly impossible to partake of the rice-table and not to grossly overeat one's self." Perhaps in this daily over-indulgence in the pleasures of the tables we may find the explanation of the fact that the great majority of resident Hollanders are inclined to corpulence.

In the cool of the afternoon we returned to Tandjong Priok and boarded a vessel of the Royal Packet Company's fleet, which sailed the same evening for Soerabaya. A sail of 36 hours brought us to this city, the most important seaport in Java, with a good harbor at the mouth of the Solo River. We anchored off shore and soon after, embarking in one of the native boats, made our way amid the crowded shipping to the landing stage and passed the customs without delay.

Although commercially of great importance, Soerabaya is hot and presents few attractions to the visitor. We observed an air of bustling activity in the streets which seemed to verify the city's reputation for alertness and ascendency in the mechanical arts.

Turning our backs on Soerabaya, a two hours' ride on the railway, through a densely tropical region, brought us to Pasourouan, where we entered the curious carts of the country, called *dos-à-dos,* bound for the delightful mountain resort of Tosari. Ever ascending, we advanced past miles of rice and sugar fields to a pretty little hotel on the lower slopes of the mountain range, where we lunched. The remainder of the climb to Tosari was too steep for vehicles, so horses and palanquins were used for the final stage of the journey. The entire excursion was full of interest, taking us through different climatic zones, each exhibiting their characteristic growths in wild profusion. While two of us were advancing ahead of the main party we surprised a large black ape, which was walking in the road. He viewed us with interest for a moment and then disappeared into the forest.

With a feeling of intense satisfaction we arrived at this delightful sanitarium, where a sojourn of several days in the salubrious air of the mountains gave us renewed strength for our travels in the lowlands.

A walk along the single street of the village gave us some idea of the mode of life of these mountaineers, who are quite distinct from their neighbors of the lower valleys. Here are found the homes of the Tenggerese, that hardy tribe who, at the time of the Moslem invasion, retreated to these mountain strongholds and successfully defended their homes against the invaders.

The lofty location of Tosari, perched on a flank of the Tengger *massif* at an elevation of 5,480 feet above sea-level, invites one, by its invigorating air, to undertake walking trips and mountaineering excursions, which in other parts of the island would be out of the question.

Two of these jaunts which abide in memory as among the choicest of Javanese experiences were the trips to the crater of the active Bromo volcano and another early morning climb to the summit of Penandjaän, a loftier eminence which commands an extensive view of the eastern part of the island.

IN THE HEART OF OLD JAVA

With pleasant memories of our mountain sojourn, we discard our heavier

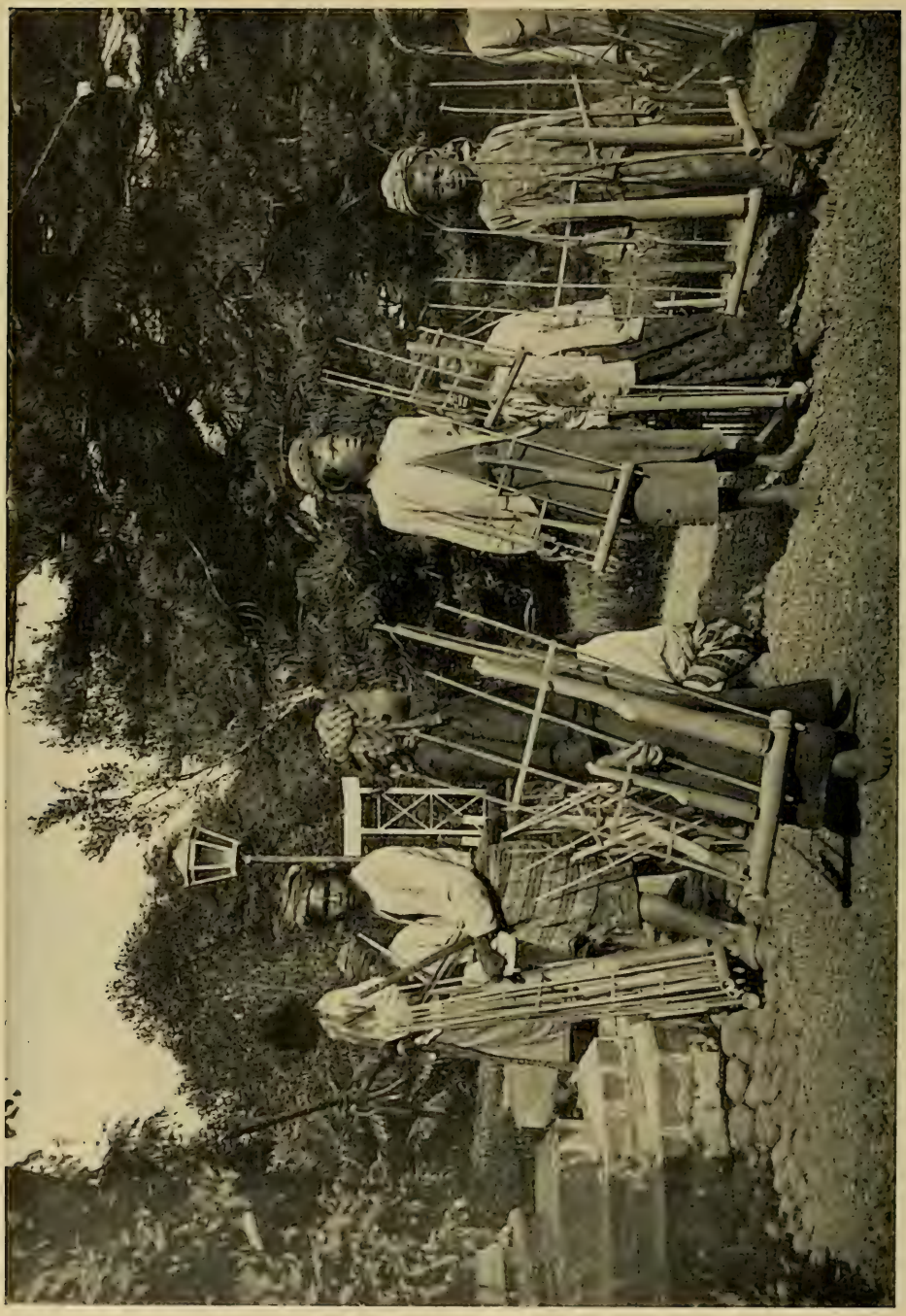

Photo by H. G. Bryant

BOY MUSICIANS WITH BAMBOO INSTRUMENTS

clothing and descend to the plains, and, delaying only one night in Soerabaya, take the government railway and in five hours arrive at Soerakarta, or Solo. This is the seat of one of the two great native princes, called the Soesoehoenan, who receives a handsome annuity from the government and is allowed to pose as ruler over four or five hundred thousand people. Here we are in the heart of old Java, where it is possible to see the native life of the people as it existed centuries ago. Owing to the good offices of the Resident, we were allowed to inspect the Kraton, the great wall-encircled compound of the reigning prince. Accompanied by a Dutch official, the morning after our arrival we drove to the palace. This is built in the center of an area surrounded by walls four miles in extent. An army of over ten thousand servants and pensioners live within the Kraton. At the entrance to the inner palace we were met by the brother of the Soesoehoenan, an agreeable gentleman, dressed in a jacket of European cut, but wearing the universal sarong about his lower limbs. The sash which held this in place contained a jeweled kris or dagger, the weapon which is worn by all persons of any position in this part of Java.

Under his guidance we visited the royal stables and carriage-house, the spacious audience hall and zoological garden, and partook of lunch in the upper room of the clock tower, which commanded a fine view of the enclosure. Here a great variety of food and drink was offered to us by numerous native servants, all presented to us in the servile, squatting attitude assumed in the presence of royalty. Descending, we resumed the rounds of the palace, and everywhere encountered an army of officials and servants. Presently a middle-aged woman, dressed in the careless garb of the country, separated herself from a group of retainers and, walking up to the prince, shook his hand with great assurance of manner. We were informed by our European friends that she was the chief woman official of the palace, for the time being in undress costume. With her frouzy, gray hair, and a great ball of tobacco protruding from her lips, this Javanese mistress of the robes made anything but a courtly appearance.

Thanking our kindly host, we returned to our hotel and, later in the day, went shopping in the busy streets of the town. From a Chinese merchant we secured a number of krises or small swords, said to be of ancient date, but with wooden handles which had a suspiciously modern appearance. Here as elsewhere a number of women peddlers brought to the hotel samples of the artistic cloths from which the sarongs or skirts of the Javanese are made.

STYLES OF DRESS

The universal style of dress consists of the sarong and kabaya. "The kabaya is a sort of dressing jacket, often embroidered. Under it is worn the sarong, a brightly colored skirt falling down straight and narrow, with one simple, deep fold in front, and kept in place by a silk scarf wound around the waist several times."

Here in Solo the old and the new in dress are often found in startling contrasts. At the court festivals held here it is possible to see groups of Javanese nobles, some in the modified European attire and others in the ancient court dress of the country. During our stay we were invited to an evening reception, given by the prime minister of the Sultan, and all the native men present as guests wore the modified European costume. At least once a year the prince gives a great entertainment, when he dispenses a truly royal hospitality. Hundreds of natives and Europeans are invited to the festival, and the best actors and dancers are engaged. After one of these entertainments it is said all sorts of tableware and bric-à-brac are offered for sale in the city—a result of the wholesale thefts on the part of the servants, who seldom receive any pay and take this means to "get even." It is said some one remonstrated with the Soesoehoenan for permitting this condition of affairs to

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"THE THREE GRACES": BRAMBANAM

exist, and he is said to have answered: "Who can my people steal from if they cannot steal from me?"

THE RUINS OF BRAMBANAM

From Solo we made an interesting excursion to the ruins of the temples at Brambanam, which are believed to date from the ninth century and form eloquent monuments of the grandeur of the period of Hindu dominion in Java.

We first visited what remains of the temples dedicated to Lara Jonggran, known in India as the Goddess Durga.

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RUINS OF CENTRAL TEMPLE: BRAMBANAM

Passing the remains of three circular walls, we arrive at the inner area which embraces the ruins of eight pyramidal structures. One of these contains, in one of its four compartments, the eight-armed bronze figure of the goddess which gives the temple its name. A broken statue of her consort, Siva, stands in the inner chamber of this temple, while in the western chamber sits a striking image of Ganesha, the elephant-headed god of wisdom. The images in another temple, dedicated to Siva, are especially notable for a certain dignity of expression, and

are in the main well preserved. In another group of ruins is found a well-executed representation of three women popularly known as "the three graces."

After an hour's repose in a rest-house near the ruins, we entered carriages drawn by four stout little ponies and sped along over well-kept roads toward Djokjakarta, the seat of the second so-called independent prince. The main roads in this part of Java are lined with noble trees and the ride in the late afternoon was one of pure delight. We passed many villages and marveled at the density of the population and the fertility of the land which nourished all these teeming millions.

JAVANESE DANCERS

Arriving at last at Djokjakarta, we established ourselves at a comfortable hostelry and put in two days in viewing the sights of this historic locality. This was the last citadel of native rule on the island and after the final conquest of this eastern empire, in the Mataram war of 1825, Dutch control of Java became supreme. The present Sultan is nothing but a puppet king; but, with the large annuity paid him, he is able to maintain an outward show of royalty, as is evidenced by a showily-uniformed body-guard and a small army of native officials.

These people are passionately devoted to the form of dramatic art known as the Wajang Wong, and to the dances given by their Bejadas, or ballet troupes. Some of my readers will doubtless recall having seen the performances of one of these troupes at the Chicago World's Fair. Their dancing is of the measured, serpentine style, with many graceful turns of the hand and postures of the body. No account of Java would be complete without some reference to the Wajang Wong. There are two forms of these plays, one in which leather puppets are employed, and the shadows of these puppets are thrown on a curtain and the talking is done by a man behind the scenes. In the other form of this drama the characters are taken by living persons. In both instances the plays deal with mythological subjects and serve to perpetuate the ancient epics and legends of the people. I attended one of these performances at the house of a rich native. Of the seven actors, four were women, and music was furnished by five performers. The leader of the orchestra recited the words of the archaic drama, modulating his voice according to the character. All the actors wore masks with prominent hawk-like profiles. The action of the play related to the doings of gods and mortals. The masks were of different colors: gold for gods, white for giants or great men, red or black for devils, and brown for Javanese.

THE GLORIES OF BORO BOEDOER

Just after sunrise one morning we started in carriages for the site of the most famous of all the ruins at Boro Boedoer. It was exhilarating to roll along through this region of mid-Java, illustrating the perfection of tropical landscapes. We encountered hundreds of natives hurrying along, carrying their burdens to a near-by pasar or market. On reaching the village of Temple, where the market was held, while the horses were being changed we had an opportunity to observe hundreds of these brown-skinned people trafficking in their farm produce and exchanging the gossip of the neighborhood. Resuming our journey, we would come at intervals upon villages buried away in the shade of dense tropical forests, and whose existence was unsuspected until we arrived in their midst. Here, in his humble home, the happy, care-free native lives close to nature's heart and concerned with nothing but the performance of his share in the cultivation of the village rice-fields.

The glories of Boro Boedoer have been amplified by every traveler who has visited this ancient shrine, and it would take an entire paper to do justice to its many marvels.

I shall quote a short passage from a recent description of the ruin: "The temple, which is believed to have been built during the end of the ninth century, was

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GANESHA, THE ELEPHANT-HEADED GOD: BRAMBANAM

not discovered until the period of English occupation, when it was partly laid bare by the removal of earth and ashes that had been heaped up against it during centuries of eruptions from neighboring volcanoes.

"Of its kind, the temple is probably the largest Buddhistic edifice in the world, its prominent position on the summit of a hill, above which it towers to a height of 120 feet, lending additional dignity to this marvelous pyramid. . . . The temple consists of a number of terraces, built on a square ground plan.

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BODYGUARD OF THE SULTAN OF DJOKAKARTA (SEE PAGE 104)

Stairways lead to the top from each of the four sides. Rising from the summit is a dagoba, which contains a gigantic image of Buddha.

"An idea of the magnitude of the structure may be gained from the fact that there are over 988 bas-reliefs in a good state of preservation, illustrating the life story of Buddha, while 441 images of Buddha, each within a small dagoba or shrine of its own, are still in existence."* The five lower terraces are

* "A Cruise through Eastern Seas," p. 139 (Ed. Stanford, London, 1906).

of square design, while the three upper terraces are circular.

We marveled at the beauty and chasteness of the bas-reliefs, copies of which attracted so much attention at the Paris Exposition of 1900. The latticed dagobas on the upper terraces are said to be quite unusual in design. "The whole is a splendid epitome of Buddhism just before its decline."

After our protracted sojourn in the rich lowlands of mid-Java we were in the humor to enjoy a week's stay in the cooler air of a delightful little resort known as Garoet, situated in a wide valley in the southwestern part of the Preanger district, at an altitude of nearly 2,400 feet above sea-level, and completely surrounded by volcanic peaks.

One of the pleasant features of travel throughout Java was the friendly attitude of the people toward us. Everywhere we were received with smiling faces and treated with courtesy. Every day during our stay at Garoet we were serenaded by a band of youthful musicians, whose instruments were made of bamboo. By an ingenious sliding device, when the position of the instrument was reversed, impact was made upon the cylinder of bamboo; thus each instrument made its individual note, and, among them, they produced the complete octave.

Many charming excursions can be made from Garoet. I shall refer to one which we made to the crater of the volcano of Papandajan, about seventeen miles distant. We had grown accustomed by this time to early starts, and so did not resent being called at half-past three in the morning. An hour later we entered a wagonette-like vehicle drawn by three horses and drove southward over the undulating surface of the valley. The dawn came at length, and we met many peasants on their way to begin their daily toil in the rice-fields.

IN THE RICE-FIELDS

In Java rice is the staff of life, and the energies of the people seem to be devoted more to its culture than to any other industry. On this drive we had an opportunity to see how it is harvested by the natives, who are apparently able to work all day under the burning sun without inconvenience.

Water is an absolute necessity to its successful culture. By a series of irrigating canals it is led to an upper field from which the water is drained from one terrace to another. In fields where the rice had matured we beheld numbers of peasants cutting the stalks with hand scythes in the old, old style which obtained in the days of the patriarchs.

Later the sheaves are bound in neat bundles and piled together in small stacks. The finest grade of rice is said to come from Japan, but Java rice is also highly esteemed in the markets of the world. In this land of dense population and struggle for the mere necessities of life the human animal is the carrier of burdens, and we found many troops of men transporting the rice to the storehouses. While walking about the village one day I met a company of women engaged in the same service—patient creatures performing their allotted tasks without a murmur.

But the sun is already making its presence felt, and we have covered the first eleven miles of our journey and arrived at Tjiseroepan, a quaint village at the base of the volcano, with houses having peculiar, steep roofs of thatch unlike those seen elsewhere. Beyond here it is impossible to go in a vehicle, and one must choose between a mountain pony and a palanquin.

The six-mile trail to the crater leads at first among coffee plantations and past fields of cinchona trees; but soon we leave all signs of cultivation behind and enter a true tropical jungle, where nature seems to run riot in its many forms of beauty. All about us we see examples of tree-ferns with orchids clinging to their trunks, banks of giant lantana bushes, and occasional clusters of the purple trumpet flower of the deadly belladonna plant. Lofty, overarching trees, with huge creepers trailing from their branches, and groves of the graceful bamboo, made a lovely picture. As we

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EUNUCHS IN GROTESQUE COSTUME: DJOKAKARTA

approached the crater plant life became less prolific and finally gave place to a stony waste, where we crossed rivulets of hot, ill-smelling water. At length we dismount and clamber up the last few steps on foot to the rim of the crater. Following our native guide, we descend into the crater and make our way over the treacherous ground, which is very hot in places. We wonder at the stoicism of our guide, who wears no shoes on his feet. We make our way over the

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GROUP OF DANCERS AT A NATIVE FESTIVAL: DJOKAKARTA (SEE PAGE 104)

broken surface amid hot vapors, past many mud springs and vent holes whence malodorous gases come forth. In a way the place recalls the Devil's Kitchen in the Yellowstone National Park, although the Javanese name Papandajan, meaning "smithy," is just as descriptive in its way.

THE BOTANICAL GARDEN AT BUITENZORG

With many regrets we leave Garoet, with its cool airs and homelike hotel.

WOMEN CARRYING RICE: GAROET Photos by H. G. Bryant

VICTORIA REGIA LILIES: BOTANICAL GARDEN, BUITENZORG

for Buitenzorg, passing on our way the celebrated plain of Leles, which furnishes an example of the elaborate system of land cultivation which prevails in Java.

Buitenzorg ("without care") has a charming situation 870 feet above sea-level, and contains the residence of the Governor General and the famous botanical garden. First impressions count for much, and in this instance the view from our hotel window of the river valley sweeping down from the slopes of Salak mountain was one worth remembering. A short walk brings us to the Botanical Garden, which we enter by a noble avenue of Kanari trees, whose overarching branches form a vault of living green. The garden, which comprises 90 acres, was established by the German naturalist, Reinwardt, in 1817. An annual grant of $50,000 is made by the government for its maintenance.

After visiting other celebrated gardens at Kew, Calcutta, Peradeniya, and the Castleton Gardens, of Jamaica, I cheerfully award the palm of excellence to this one, where man has done much but nature more to develop a veritable paradise of the horticulturist. Wherever one turns charming vistas meet the eye, and we were especially interested in searching out the useful bread-fruit tree and the curious sausage and candle trees. The arrangement of the specimens in family groups adds much to the educational value of the garden.

In the retrospect of travel in this favored isle, the memory of this lovely spot will always stand for what was best "in that enchanted garden men call Java."

AN ANCIENT CAPITAL

By Isabel F. Dodd

Professor of Art and Archeology in the American College for Girls, Constantinople

No archeological discoveries of recent times are more interesting than those made in the last three years of the ancient Hittite civilization in Asia Minor. There are references to the Hittites in the Old Testament (Genesis xxiii, I Kings xi, II Kings vii), but little has been known of them until very recently. The excavations at Boghaz Keouy and elsewhere in Asia Minor prove that the Hittites were a powerful and civilized race who ruled practically all of Asia Minor 4,000 years ago. Hittite warriors overthrew the first Babylonian dynasty about 1800 B. C., and they also checked the victorious advance of the Egyptian kings in Syria and Palestine.

THE traveler who has taken the strenuous journey of eight or more days from Constantinople to Boghaz Keouy will thank his lucky stars that he persevered; that he surmounted the obstacles of bad roads and worse inns and reached that marvelous place.

Of late years the whole reading world has become interested in the Hittites, and, though the sculptures of Boghaz Keouy and the fact that it was an ancient Hittite center have been known for many years, it was not until the excavations were begun there, in 1906, and carried on in 1907, by Professor Winckler and Macridy Bey, that any one realized what a place of wonders it is.

Boghaz Keouy means the "village of the throat," for it is at the end of a deep valley that the modern Turkish village lies, in northern Cappadocia, and the Hittites of the sixteenth and fifteenth

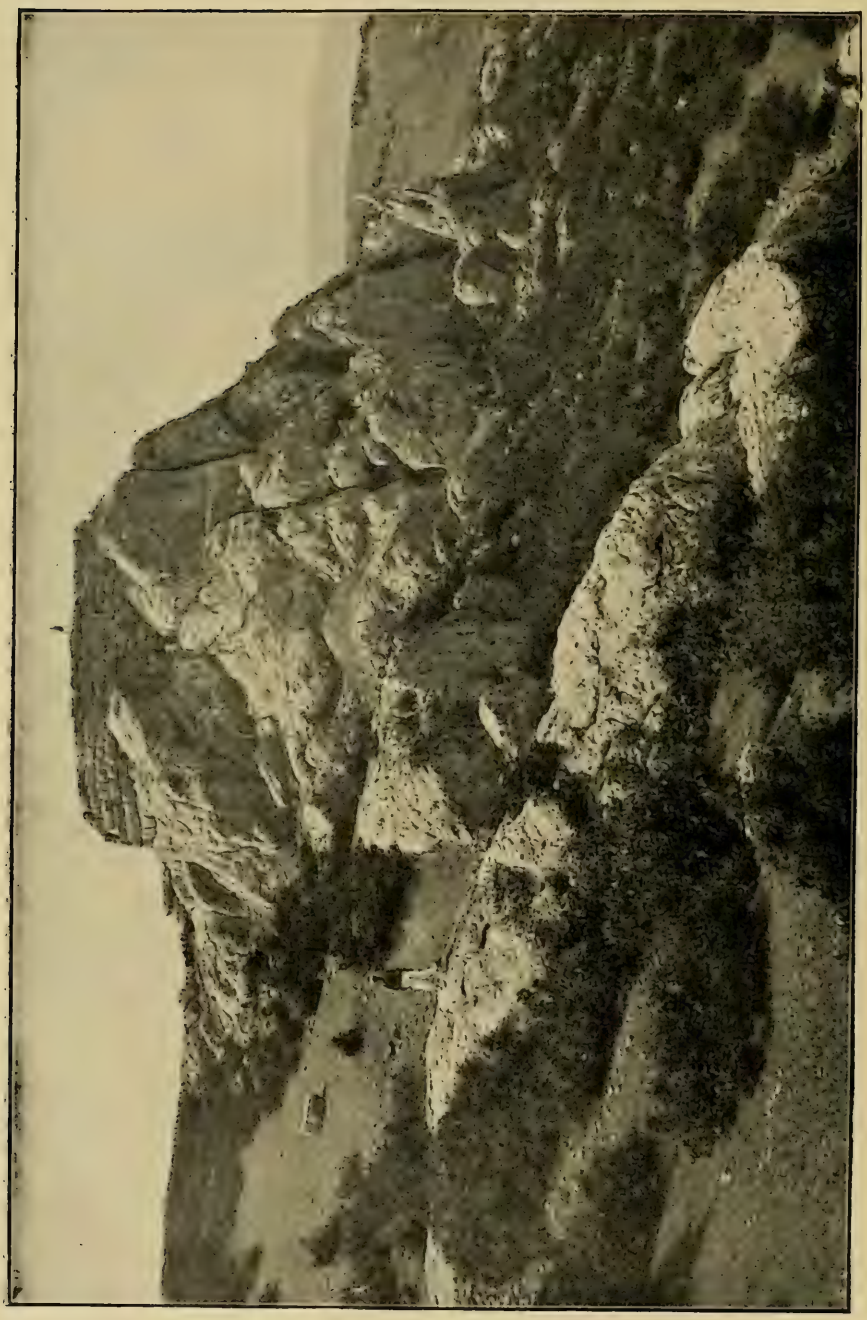


Photo from Smithsonian Institution

THE GREAT CITADEL IN THE CENTER OF BOGHAZ KEOUY (SEE PAGE 113)

centuries B. C. built their great fortified city on the rocky hillsides above the mouth of this valley.

Whether it was Subbi Luliuma or some other musically named gentleman who laid out this city of many great buildings and strong fortifications, he certainly possessed an appreciation of natural beauty as well as statesmanship, for, as one climbs from point to point—from the palace up to the great citadel; from one rock, crowned with massive ruins, to another still more stupendous—one hardly knows which to wonder over and admire more, the strength and skill displayed in these three or four thousand year old remains or the glorious views that greet one's eyes at every turn.

Photo by Isabel F. Dodd

THE HITTITE DOUBLE-HEADED EAGLE

From one corner of the citadel, by the remains of a round tower, you look straight down four or five hundred feet of rock into the gloom of a narrow gorge, at the bottom of which a stream flows darkly, and you can see little but the rock over which you lean, and the swallows that flash in and out of the gorge, and the eagles that sail to their nests on the opposite crags. On another side of the citadel, at the foot of the precipice, the same stream winds softly through trees and grass and flowers, where willows whiten in the breeze and a mill clacks merrily. Here we saw the rare black stork sail proudly through the valley and heard the rock doves cooing in the caves.

On the less steep side of the citadel there have been several trenches dug by the excavators. In the earth thrown out of these trenches some peasants have planted their grain, and thus, fertilizing their seed with Hittite remains, they have raised an abundant crop with little labor.

All over the flat top of this acropolis, as well as everywhere else in the city, one may pick up any quantity of broken pieces of ancient pottery—brown, black, and every shade of red and every degree of fineness. Much of this pottery is painted, most of it with simple decoration resembling that on the proto-Corinthian or geometric vases. Some of it has a beautiful glaze; some is covered with a white slip and painted in three or four colors, while most of it has simply black or dark red markings on red pottery. These pieces are found in the earth below the regular wall of the citadel, as well as above it, thus showing their great age. Here and there are pieces of enormous pithoi, evidently used by the Hittites for storehouses, as by the Greeks.

ASSYRIAN CUNEIFORM CLAIMED MORE IMPORTANCE THAN DID LATIN

A visit to Boghaz Keouy not only makes one feel quite intimate with the Hittites, but also one sees here that they did many of the things that we associate with much later peoples. Did the Turks first use the star and crescent; or even the Greeks of ancient Byzantium? No, indeed; here at Boghaz Keouy (and in the later Hittite city, newly excavated, near Aintab, in South Turkey) the star and crescent may be seen where it was carved in the rocks a thousand years before Byzantium was founded.

Did the Austrians or Russians, or the old Byzantines, or the German Empire, first use the double-headed eagle? None of them. Everywhere in Hittite sculptures we find this symbol. The first peo-

THE EAST GATE, FROM WITHIN (SEE PAGE 116)

Photo from Smithsonian Institution

ple, probably, who practised the noble sport of falconry were the Hittites—so the sculptures tell us. And in that connection it was interesting to hear from the Turkish bey, who is the overlord of all this region, that he and his friends train and use falcons in hunting now, and are very eager in the sport.

Was it Rome that first made the proud boast that all roads lead toward her? Professor Ramsay tells us that all the roads of more ancient times met in Boghaz Keouy. Was it only in medieval Europe that there was one writing and language used for general communication between nations, and for learning and literature? Assyrian cuneiform claimed more importance and a greater vogue than did Latin, since for three thousand years and more it was the language of commerce and literature among all the civilized nations of the world. And to these civilized nations belonged the Hittites.

Here on the citadel in 1906 the explorers unearthed a library of clay tablets all written in cuneiform characters, some of them in the Hittite language, but more in the Assyrian. All these tablets have been taken to Constantinople, to the Museum, and are awaiting the reading that will give us, we hope, much new light on the lives and thoughts of the Boghaz Keouy Hittites.

Of the tablets that have been read, one gives the Assyrian text of the treaty between the great Rameses of Egypt and the powerful Hittite king Khattu-Sil—that treaty of which the Egyptian text was already well known to historians.

And another tablet, as Professor Sayce tells us, shows how much women had to do with politics in those far-off days, since it is a letter from Naptere, the wife of Rameses, addressed to the Hittite Queen, and expresses her great satisfaction over the conclusion of the treaty.

In the summer of 1907 another great library was found in two rooms at the eastern side of the palace. Some of these tablets are very large, 12 x 8 inches in size; others are but 2 inches long. They are mostly of about the same time as the Tel el Amarna tablets, and so cover the age of Moses.

Professor Sayce also tells us that many of these Boghaz Keouy tablets were written by the same disaffected governors of Syrian provinces, who, in the Tel el Amarna tablets, write to Pharaoh of the difficulties in the way of maintaining the rights of the Egyptian government in Syria, but tell how nobly they were working in their lord's interests, while in these newly found writings of Boghaz Keouy the same men tell the *Hittite* king how they are pretending to be the humble servants of Egypt while really obeying the commands of Khattu-Sil, and the political intrigues that are here displayed and the polite sarcasm and meaningless phrases that pass between these old writers might give points to modern diplomatists.

NO KEY TO THESE TABLETS HAS YET BEEN FOUND

Although all the tablets discovered two or three years ago were carried to the Constantinople Museum, the shepherds and laborers who wander over these hills pick up occasionally broken pieces of tablets, and, knowing that any writing on clay or stone seems precious in the eyes of "these queer Europeans," they offer what they find for sale to any passer-by. As one eats one's dinner a boy appears, and, squatting on his heels, produces a few bits of clay from his girdle, or wrapped in a handkerchief (which challenges comparison in age and in dirt with the Hittite contents); or one is awakened in the early dawn by a head stuck between the curtains of the tent and an insinuating voice saying "kyramidi" (clay tiles), the owner thereof being anxious to strike a bargain quickly, before he takes his sheep up on the hills above.

So far, I believe, no bilingual has been found among the tablets; that is, no writing which repeats the same thing in both the Hittite and the Assyrian languages, and which would perform the office for the Hittite which the Rosetta stone performed for the Egyptian hieroglyphics. But the sudden stopping of the history

Photo by Isabel F. Dodd

THE FIGURE OF THE AMAZON ON THE EASTERN GATE

which the tablets tell, as well as the condition of the ruins unearthed, shows us that some time in the thirteenth century B. C. the great city was destroyed, probably by a sweeping down of some barbarian horde, thus anticipating (long ages before) the story of the destruction of Rome. And this Hittite capital was never again inhabited or rebuilt, for there is apparently no trace of Greek or Roman work or influence in the remains. The Hittite power, however, was not destroyed then. Cilicia and the southern part of Cappadocia have numerous monuments which show occupancy by Hittite people till about the eighth century B. C.

What is considered the latest of known Hittite works is the rock sculpture at Ivriz of the god of the harvest and a worshiping king; and this Ivriz, near the Cilician gates, is one of the most beautiful spots in all Asia Minor. The sculptured rock rises above a green dell, through which flows such a mountain stream as fills one's heart with singing. Salmon trout are found in great numbers in its rushing, green waters.

These fish the modern Hittites (and perhaps they learned it from the ancient ones) catch in what any sportsman would declare to be a most iniquitous manner. They use no hook or line, but beat out the juice of a certain milkweed and spread this juice on the water. The trout is intoxicated by it, turns over, and, floating, is picked out by hand. They say that the fish entirely recover in a bowl of fresh water, and that the intoxication does not injure the flesh for food. That the salmon trout caught in this Hittite way taste particularly good I can testify.

The great Ivriz figures by the mountain stream have been known and visited by Europeans for ages, but a replica, much worn and weathered, has lately been discovered two miles farther up a wonderful gorge, where great rocks like those at Boghaz Keouy nearly meet overhead, and here is shown that persistence of sacred traditions about one place which has often been remarked upon, for here also the ruins of three Christian churches cling to the sides of the gorge.

THE AMAZON OF THE EASTERN GATE

As we walk away from the citadel in Boghaz Keouy to see the various points of special interest within the five-mile circuit of the ancient walls, we come first to the one place on this site where there has been found any inscription in the Hittite hieroglyphics (those hieroglyphics which are so common all through the more southern Hittite country). This one inscription of Boghaz Keouy is so badly worn by time and weather that it is quite illegible. Further down the hill slope we come to the Eastern gate. Like the other city entrances, this has two parts, with a square room between the outer and inner gate. The posts of the real door curve in toward the top, as if they once formed a pointed arch. This Eastern gate has long been known and is

THE LION GATE

of grand proportions, but it is only since the archeologists left here, in 1907, that the workmen discovered, almost by accident, on the inner side post, a remarkable bas-relief.

This is a figure, about ten feet high, of an Amazon, apparently, and bears little resemblance to the figures found in other distinctively Hittite places. It is carved in high relief, and finished with great care, even to the finger and toe nails and the delicate metal work of the breast-plate. Having been so recently uncovered, the fineness of its workmanship is excellently preserved, and we can trace all the details of the curious headdress, lappets of which fall over each ear and down the back, while the flowing hair shows clearly beneath the long back lappet. This Amazon has a strong, masterful face, and the treatment of the eye, as well as other details of the carving, seem to belong to some later period than the rest of the city. She wears what seems like chain armor over breast and shoulders, and a short skirt ornamented with rows of lines and circles. She carries a double-headed axe in her right hand and has a short sword girded to her side. The strongly accented muscles of her legs look like Assyrian work, and her feet are bare instead of being encased in pointed Hittite shoes.

SECRET PASSAGES AND TUNNELS

We leave this gate and walk over fields and hillocks to where the wall or fortification forms a high bank, rising eighty feet or more from the fields each side. Here there are two interesting mementos of the Hittites—a tunnel through the fortifications and steps up the bank. There are two flights of these steps, made of limestone, about six feet broad; low and easy, varied by occasional platforms. The tunnel is about one hundred and eighty feet long and perhaps ten feet high in the middle. It is formed of unhewn stones of uniform size, and the ceiling is a true pointed arch with keystone. There are a number of such tunnels as this to be found in Boghaz Keouy.

Photo from Smithsonian Institution

ANOTHER VIEW OF THE OUTER SOUTH GATE, WITH LIONS, AND OF THE LEFT TOWER

THE PICTURED ROCKS AT BOGHAZ KEOUY

Of some only the postern appears, and some are filled with débris and can be penetrated but a short distance.

It seems to have been a Hittite habit to build such underground passages, and this habit was continued by their relatives or imitators, the Phrygians. Professor Ramsay tells us of several secret passages connecting different parts of Hittite and Phrygian fortifications, or an acropolis and some more or less distant hill. This tunnel ends on the outside in a post and lintel gate, with grooves for a door and holes for the closing-bar. On the citadel there was one specimen of the ancient Babylonian door-socket, well worn, but worn into a block of limestone squared and cut as perfectly on all sides as if for a modern building.

Once more following the wall, we come to the famous Southern gate, which admitted to the city the commerce and travel from Cilicia, and which is still guarded by the lion posts, always pictured in every description of Boghaz Keouy. Fine, upstanding lions they are, too, with wide-open jaws and curly hair.

From between the lions one looks outward and downward to a marvelous stretch of hill and dale, while on the inside we look across the mile and a quarter of the city limits, sloping down from this point 870 feet to its northern end. Here and there on the slope rise the great rock fortresses, each bearing on its summit more or less of Hittite masonry. Beyond the northern side of the city stretches a wide and fertile plain which must have furnished the greater part of the sustenance of the capital.

THE PALACES

We also see from this gateway, or on the road to it, a number of palaces whose foundations have been uncovered in the course of the excavations. The largest of these lies on the lower part of the slope and is about 208 feet long by 138 feet wide. It consists of a great central hall and many chambers on each side. On the south side and on the southeast corner there seem to have been splendid entrances with double gates, small courts between, and pillars at each corner. The stones which form these courts, and especially the thresholds, are most beautifully worked with a curved and beveled edge. The stone used is largely the limestone of the region, but part of the pavement of the great hall and many other parts of the building were of imported trachyte.

THE REAPERS IN THE SMALL GALLERY (SEE PAGE 122)

From the lack of any stones which could have formed the upper parts of the building, and from the holes drilled in the upper side of the stones at regular intervals, it has been conjectured that the buildings were of wood, covered within with clay tiles, and were entirely burned at the time of the destruction of the city. This would also be shown by the charred remains found everywhere in the ruins.

One cannot but wonder how the Hittites kept themselves warm in their palaces, what kind of stoves they used, or if they had a central heating plant, and whether it was for hot water or steam. It is a place of very cold winters nowadays. From the great stone bath-tub at one corner of the palace, in a trench, and from the clay receptacle (surely a bath-tub!) in the Hittite room of the Constantinople Museum, we are convinced that the Hittites loved cleanliness.

The lower end of the palace is built upon terraces to correct the slope of the hill. On the northern side, also, is what has been called a sanctuary, a large room with an especial entrance, and what may be an altar, upon one side, while on the other is a small cistern or basin of rock. The Armenian cook of our expedition was inspired by the atmosphere of interest in antiquities, and went over this palace, pacing each room carefully and bringing back in triumph a broken wooden spoon and the lower jaw of a dog. As he displayed his Hittite relics he looked with contempt at the pile of broken potsherds which we had gathered. Crestfallen as he was over the lack of appreciation which greeted his finds, he was later the first to discover some real antiquities. It was the evolution of an archeologist.

NO MORTAR WAS USED ON THESE GREAT BUILDINGS

Time would fail me to tell of all the splendid masonry found on each of the rocky heights of Boghaz Keouy, all made of great stones, one fitted into another by a peculiar sort of curved edge, without mortar. "Yellow Rock" (as it is called) has the most of the building remaining. "Yenije Kaleh" (somewhat new rock) has the most heart-gripping height and extended view. "Storehouse Stone" has many rock-hewn chambers, now used by the shepherds. "Curious

THE LION-BODIED FIGURE IN THE SMALL GALLERY (SEE PAGE 122)

Rock" has a great curved niche hollowed in one side, as though for a colossal statue. Another smaller rock is split in two and has hollows carved all over the top, like old dew-ponds, while at one side is a place with three cut steps just like the altars of Cybele in Phrygia. Still farther down we find "Maiden's Rock," low and flat. No one knows why it is so named. Perhaps the ancient Hittite maidens used it as a dancing floor. Over on the other bank of the river is another great rock with a similar redoubt on its head.

The wall which surrounded the city was of the most solid character; where it remains it is about 14 feet thick, the center a 6-foot core of rubble, while each side is a 4-foot thickness of finely dressed stone.

LOOKING TOWARD THE NORTH IN THE GREAT GALLERY AT BOGHAZ KEOUY

THE PICTURED ROCKS

The real temple of the Hittites of Boghaz Keouy is considered to be found in the so-called "pictured rocks," a mile and a quarter to the east of the city. Over 500 feet above the valley we find one group of rocks, with no difference in its outward appearance from many another, but distinguished by two galleries, both faces of which show a remarkable series of pictures. The galleries now have no connection, though it is supposed that there was originally a way from one to the other, now filled with fallen stones.

The smaller of the two galleries has on one side 12 figures with Phrygian caps and turned-up shoes, carrying reaping hooks over their shoulders.

Opposite them is a strange figure, whose head is human and who wears the usual pointed cap and big, round earrings, but whose body is formed of lions—the shoulders of two half lions, jaws outward, while below these two other lions, head downward, seem to form legs. We know that Cybele, the earth goddess of Asia, was represented with lions as constantly as St. Jerome was in the early renaissance paintings, and it would seem as if these pictures were connected with her worship, the reapers but adding to the probability.

Also, just beyond this weird, lion-bodied goddess is a group of much better workmanship that may be a priest and king, or another god and the king. The god, if it is he, with Hittite cap and shoes and sword, is about six feet high, and is holding his arm about the neck of the smaller figure, who carries the curved lituus, so often seen in Hittite pictures, and who wears a flat cap and long robe.

In the large gallery there are many

THE HITTITE GOD AND KING (OR PRIEST) IN THE SMALL GALLERY AT BOGHAZ KEOUY

more figures, about 67, though some have grown indistinct of late years.

This gallery is more than 90 feet long—a great hall open to the sky, where the Hittites have united art and skill with the use of all the natural advantages of the spot. The floor in some places is simply leveled rock, in others a pavement so cunningly fitted to this that it seems all natural rock floor. The figures, who march from the open side of the hall toward the opposite closed end, are mostly in panels, and are smaller at the entrance, gradually increasing in size to the middle of the north wall, where the two processions meet face to face. I think this increase in size relates to the importance of the characters figured rather than to any Hittite idea of perspective.

There is much difference between the figures in regard to the workmanship, whether because of different periods in art, or simply because made by more or less skillful artists, we cannot tell. Some of the figures are partly or quite covered with a very fine brown enamel or thin, hard stucco, and these are, of course, the best preserved. Some are broken—parts gouged out, probably by the vandal boys of the neighborhood, through mere love of destruction.

There are rows of figures—12 in one place, 13 in another—something like the reapers in the small gallery. Then there are symbols and heraldic signs, and, toward the head of the procession, the figures stand on two mountains, or on the double-headed eagle, or on the necks of captives—these things indicating that here are gods or kings. Sometimes we see the crenelated crown, which, on ancient coins, indicates that the one who wears it represents the city. Some of the figures are dressed in accordion-pleated skirts and plain waists; one has an overskirt and a trail under it. A few wear the little flat cap, more the high, pointed Phrygian one. Some have sleeves almost as long as if they lived in the fourteenth century A. D. Some carry flowers, while almost all wear jewelry, either bracelets or ear-rings; but, unlike the Assyrian figures, there is little embroidery on their robes. Many of them (as has the Amazon at the Eastern gate) have a horn either on the cap or somewhere about them. They do not have the very large nose and inane expression of the Hittite sculptures of Cilicia. Indeed, the features are rather intelligent and refined.

The meaning of these carvings and of this great rock hall which holds them is still a problem. Was this a sanctuary of the earth goddess, and do these processions show the king of the land coming with his priests and his family and people to devote all that he has to the goddess? Or do they commemorate some special event, or represent some rites of nature worship? What are the meanings of the various symbols which accompany the single figures? It may be that the reading of the tablets that are found in Boghaz Keouy will answer all these questions.

Here in Turkey nowadays we are not only searching out much old history, but we are rapidly making new history. The bey of this district (the descendant of a Seljukian Sultan) exercises a truly Eastern hospitality, entertaining freely all visitors to Boghaz Keouy, rich or poor. We had camped on the hillside above the Hittite palace, and the bey came up the first night we were there to protest against such an infringement of his hospitable rule. This Turkish gentleman is deeply interested in the history connected with his land, and took pains to point out to us various places which, in his opinion and that of the archeologists, would be likely to yield important results if excavated. He has three fine boys, the youngest but an infant. The other two have been sent to school in the neighboring town, and he plans to have the oldest go to an agricultural college and the second to become a physician, that they may both work for the health and prosperity of his people.

Perhaps some day a new city will crown these splendid heights, and a happy and progressive people, under the good government of Young Turkey, will build up the life and associations which will make this beautiful spot once more famous.

THE INTERNATIONAL MILLIONTH MAP OF THE WORLD

By Bailey Willis, U. S. Geological Survey

FOR whatever the stature of his guest, however tall or short, that bed fits him to a hair. Because, if a man be too tall for it he lops his limbs till they be short enough, and if he be too short he stretches his limbs till they be long enough. Therefore is he called Procrustes the Stretcher."

Turn the leaves of any atlas and view the countries, large or small. How they are all fitted to the Procrustan page, some drawn to one scale and some to another, but all finally compressed to the same size in the atlas, although widely different in fact. Here is Colorado with 103,925, or Wisconsin with 56,040, or Massachusetts, Connecticut, and Rhode Island, all three together with but 14,555 square miles; but the last, like the first, precisely fills the page. If, in Massachusetts, there be two towns 12 miles apart, there is an inch between them on the map, but if in Colorado there are two 29 miles apart, they also appear upon the map within an inch of one another, the scale in the one case being 12 miles to the inch and in the other 29 miles to the inch.

This adjustment of the maps in an atlas to different scales to suit the size of the page appears necessary, because each page should be fully covered and the states or countries which need to be separately mapped are very unequal in size. In local thought the county is larger than the state and the state larger than the whole country, and atlases are made for local use.

But if we would take a broader view of the world and of nations, wishing to know something of the comparative size of countries—that France, for instance, is about four-fifths as large as Texas—it would be at least a great convenience to have an atlas of the world in which all lands were mapped to the same scale. Such an atlas the International Millionth Map of the World is to be.

The name signifies that the map is to be drawn on a scale of one to one million; that is, that any length measured upon the map is to be one-millionth part of the distance between the same two points measured on the ground. In the metric system this is equivalent to saying that a meter on the map is equal to a million meters or 100 kilometers on the ground. In our English measure it is equivalent to about sixteen miles to the inch. This is a fairly large scale, which allows the engraver to delineate villages as well as cities, railroads and the principal roads, all water-courses of note, and the general features of hills and mountains. Yet the scale is also such that a sheet of convenient size may represent a large area, on an average equivalent to a State of the United States, and thus the scope of the map is sufficiently generous to be useful.

Both in scale and scope we may contrast this one-millionth map with others which are made available to the public by the government surveys. The detailed topographic maps of the United States, which are prepared by the United States Geological Survey from original surveys, are published on a scale of one mile to an inch for the more densely settled regions of the country and of two miles to an inch for the less developed regions. This scale is so large that it is possible to show individual houses, every turn of the roads, and the precise form and altitude of all noticeable hills. With these maps, in advance of other surveys, an engineer may plan the route of a road or even a railroad through a hilly or mountainous country. Thus they are adapted to all detailed studies of local features, but their scale is so large that their scope is very

small. By train or automobile we may traverse the area represented on a single atlas sheet in an hour or two, and one cannot conveniently carry enough sheets to trace the course of an extended journey.

In reducing the scale to 16 miles to the inch we reduce also the details which may be shown, and we must necessarily eliminate the local objects. But that scale is still sufficiently large to comprise all of the essential features which one would wish included in a general view, and the scope becomes such that a single sheet serves for a day's journey.

Maps of various parts of the United States, which approach the one-millionth in scale and scope, are not uncommon. Land Office maps, prepared by the general government, and state maps designed for different purposes have not infrequently been published with 10, 12, or 15 miles to the inch, and for some years past the Geological Survey has had maps in preparation with the design of publishing them on the one-millionth scale. But it has awaited the conclusion of an international agreement before pushing them to publication.

THE ORIGINATOR OF THE PLAN

It was in 1891 that the proposal for a standard international map of the world was first made by Prof. Albrecht Penck, then professor of geography at the University of Vienna and now at the University of Berlin. Professor Penck, who was at that time a young and comparatively little known man, might have found it difficult to arouse interest for his plan except that he was able to bring it before the International Geographical Congress which met in Bern in that year. The geographers who were there assembled knew from their own experience the great inconveniences which arise from the use of maps on many scales, and they appreciated the great advantage which would accrue to the study of geography if we could but have one standard map on a uniform scale. They therefore took up the project, passed resolutions favoring it, and committed the plan to a committee with instructions to report at the succeeding congress.

The members of the committee represented ten different countries and were twenty in number. The list of names includes the leading geographers of the time and men high in official rank, whose duties in other directions were already onerous. Mr Mendenhall, superintendent of the Coast and Geodetic Survey, and Major Powell, director of the Geological Survey, represented the United States. It might have been foreseen that so large a committee would be ineffective, because it was impossible to assemble the members for discussion. Recognizing the need of an efficient subcommittee to study the problem and formulate proposals, the general committee invited three representative scientists of Switzerland, at the head of whom was Eduard Brückner, then professor of geography at the University of Bern, to act in an advisory capacity, and to this subcommittee is due the credit of such progress as was made in the development of the question. A report submitted by Professor Brückner at the Sixth International Geographical Congress at London, in 1895,* contains a discussion of all the principal items on which agreement was necessary, and presents clearly the difficulties which arise from different usages in cartography.

But if the general committee failed as an executive body, it served most excellently to make the plan widely known, as is shown by the list attached to Professor Brückner's report of twenty-one articles published in the interval between the two meetings of 1901 and 1905.

At the Geographical Congress held in Berlin in 1899, Professor Penck again brought forward his plan for a world map, but the difficulties of adjusting national differences seemed insuperable. Prominent among these were the absolute refusal of the English geographers

* Brückner, E. Rapport du Président de la Commission pour l'Etablissement d'une Carte de la Terre a l'Echelle de 1 : 1,000,000. Report of Sixth International Geographical Congress, London, 1895.

to accept the metric system and the insistence of the French geographers upon the meridian of Paris as the initial meridian of the international map.

IMPORTANT PROGRESS AT THE WASHINGTON MEETING

At the Eighth Congress, held in Washington in 1904, Professor Penck took advantage of the fact that France, Germany, and Great Britain had separately prepared maps, on a scale of one to one million, of countries as far apart as China, India, Persia, Africa, and the Antilles, to congratulate the assembly upon the progress made toward the world map. Setting aside as relatively inconsiderable the differences in arrangement and execution of the several maps, he dwelt upon their uniformity of scale and took a hopeful view of the outlook for future agreement. He said:

"It is thus for the first time that different parts of the earth's surface are represented so that they can be directly compared with one another. One who is familiar with Cuba needs only to lay the French map of this island at the side of the German or French map of China to see at one glance that space which has been overwhelmed in the Russo-Japanese war. A student of the coast line can now compare the bays of Shantung with those of Cuba, and another can compare the behavior of the rivers in south Abyssinia with those in south China, and a third will be able, by the chosen projection, to determine the exact areas of lands, rivers, basins, lakes, and so on. All this indicates considerable progress in the practical and theoretical study of different parts of the world—a progress which is not essentially affected by the fact that the maps are not so uniform as was desirable."

After discussing the differences existing among the maps undertaken by the European powers, Professor Penck pointed out that there was no general map of North or South America, or even of the United States, such as any student or traveler requires, and he urged that the Geographical Congress should endeavor to induce the United States to do for America what Great Britain is doing for Africa; that is, to prepare a uniform map of both the American continents on a scale of one to one million.*

The action of the Eighth Congress led to no official result, but the arguments presented by Professor Penck for a general map of the United States bore fruit in the work of the Geological Survey. By authority of the director, Mr Walcott, Mr Henry Gannett prepared a number of maps designed to become part of the one-millionth map of the United States. They were, however, not adjusted to any general plan of the map of the world, as no international scheme had then been agreed to. The units chosen were states, and the drawings were made in accordance with the methods of cartography which have become familiar through the atlas sheets of the Geological Survey. The representation of altitudes by brown contour lines was worked out in great detail for the scale, and peculiarly distinguished the maps in contrast to the effects of shading employed by the French and German cartographers.

Mr Gannett's interest in the project for a world map became an important factor in its further development. At the Ninth International Geographical Congress, held at Geneva in July, 1908, he presented through the American delegate, Dr David T. Day, resolutions urging that the Congress take effective measures toward an agreement upon the essential details of the plan, and that these measures be commended to the several map-making powers with a request for an international conference having authority to act upon them. The resolutions were passed, a committee was appointed, and the details of a plan were worked out and adopted. The British representative, Col. C. F. Close, on request of the Con-

* Penck, Albrecht. Plan of a Map of the World. Report of the Eighth International Geographical Congress, pp. 553-557. Washington, 1904.

In the same report is a notice by General Berthaut, of France, and one by Major Hills, of England, on the one to one-millionth maps in preparation by their respective governments.

gress, accepted the responsibility of presenting to his government a suggestion for a conference at London. And thus the plan which a few years before had seemed hopeless of accomplishment was brought within promise of fruition.

THE CONFERENCE AT LONDON

In the summer of 1909 the British government issued invitations to Austria-Hungary, France, Germany, Italy, Japan, Russia, Spain, and the United States to send delegates to a conference to assemble in London on November 16, with power to agree upon details of the standard international map of the world. All of the governments accepted except Japan, and twenty-two delegates assembled in the British Foreign Office, in the council-room where Lord Salisbury had been wont to hold the meetings of his cabinet.

The sitting of the conference was dignified and impressive. The great square chamber was furnished with a round table, at which all the delegates were seated within convenient range for discussion. There was a touch of old England in the soft-coal fire, which dispelled the chill of London in November, and the bunch of quill pens spread before each member was a reminder of the historic documents that had been executed in Britain's capital.

Under the presidency of Col. S. C. N. Grant, of the British Ordnance Office, assisted by Col. C. F. Close, of the General Staff, the deliberations of the conference were conducted not only with courtesy, but with impartiality and fairness. These officers had but one purpose in view: to ascertain the wishes of a majority of the delegates and secure such an expression of opinion as would lead to a unanimous conclusion. And in this they were signally successful.

In the circle sat men who had been associated with the project since its beginning, and who rightly felt a deep sense of satisfaction in its fruition. Professor Penck, the originator of the plan and now the representative of the Emperor William, was the leading figure, but he took his part with that scientific spirit which effaces the personal element, and a bystander unfamiliar with the past history of the plan would not have known from anything which he said that it had sprung from him. Across the table from him sat Eduard Brückner, who, holding the professorship at Vienna which had been vacated by Penck's transfer to Berlin, was the leading delegate from Austria. France was represented by several eminent geographers, of whom Charles Lallemand, a distinguished geodesist, shared with Professor Penck a commanding position among the foreign delegates. Around the table were many others whose names are well known as teachers and writers on geographical subjects. The delegates from the United States were Mr S. J. Kübel, chief engraver of the U. S. Geological Survey, and Mr Bailey Willis, geologist, of the same service.

FRANCE ACCEPTS THE GREENWICH MERIDIAN AND ENGLAND RECIPROCATES BY ACCEPTING THE METER

The conference took up one by one the proposals of the General Congress and debated them in English, French, or German, as the convenience of any individual speaker prompted. There had evidently been much preliminary discussion at home, and there was a dominant purpose to arrive at a satisfactory conclusion which swept away all the international differences that had previously prevented agreement. The initial meridian of Greenwich was adopted unanimously, without debate. The metric system was agreed to by the English and American delegates, with the provision that the scale of distances might also be stated in terms of miles or of any other unit (such as Russian versts) of the country producing a part of the map. The acceptance of the metric scale extended also to the statement of altitudes above sea, with the proviso that the height in feet may be given in parentheses after the number in meters. The conventional symbols to be used for representing water-courses, roads, railroads, towns, cities, and the

names of various features were agreed to in detail after thorough discussion by a large subcommittee. The result embodies practically all the conventions used by the United States Geological Survey, in the form in which they are employed in the government maps.

"FLORENCE," "ROME," "VIENNA" WILL DISAPPEAR FROM THE MAP

In writing and spelling names the Latin alphabet alone may be used and the spelling shall be that of the official maps of the country represented. Thus the international map will show nothing of Russian or Chinese script. You will look in vain for Florence, but will find Firenze; instead of Rome, Roma; of Flushing, Vlissingen; of Vienna, Wien, and so forth. There was no dissent from this last ruling except in one instance. In odd contradiction to the general liberality of feeling, it was emphatically declared that European geographers could not permit Stamboul, the Turkish name, to replace Constantinople. For China the adopted spelling was to be that of the post and customs service, and in all colonies or protectorates the names are to be spelled in accordance with the usage of the governing country. The delegate from Hungary presented the grave difficulty which confronts the cartographer in the fact that nearly all Hungarian towns have two names, one Hungarian and the other German, and some of them have as many as five names, all of which are currently used by the distinct elements of the population. But it was pointed out that this difficulty affects but one or two sheets of the great atlas of the world, and that the question of choosing among these names might well be left to the Hungarian government.

HOW ELEVATIONS WILL BE INDICATED

There is perhaps nothing which more strikingly distinguishes new maps from old ones, or maps of one nationality from those of another, than the manner in which valleys, hills, and mountains are represented, whether it be by drawing the shapes of mountains, as in Chinese maps, or by covering the paper with short dashes, sometimes called hachures, which show the way the water runs, or by horizontal lines that delineate the contours of the slopes, or by shading with high light and shadow, as if the map were a relief model. Hachures, contours, and relief shading, or combinations of two or even of all three methods, characterize modern topographic maps, and one of the most difficult questions before the conference was to harmonize the various methods in current use.

In maps prepared by the United States Geological Survey contour lines alone are used, and the delineation of mountain forms by means of them has been brought to a higher degree of graphic expression than ever before. This is due to the fact that the American topographer regards his work as a profession rather than as a side issue of military training, which is the position which holds abroad.

In Germany and Austria the method of exhibiting slopes by means of hachures has replaced all other systems, because it is so applied that the proportion of dark lines to intervening light spaces bears a mathematical relation to the steepness of the slope. Level plains are white, and slopes of 45 degrees are almost black, and other slopes are shaded according to their grade. These maps are peculiarly adapted to military purposes, since an officer can judge at a glance the nature of a declivity and whether it is passable by infantry, cavalry, or perhaps artillery; but these advantages do not everywhere have weight, and the method is one which is too expensive in execution and too limited in usefulness to be widely adopted. France has brought relief shading to a very high degree of perfection, and leads the world in the artistic beauty of her topographic maps.

The method of representing the topographic relief of the surface which the conference adopted consists in the main of generalized contours, which shall be so drawn as not to unduly obscure other features of the map, and, in addition,

shading is to be used to bring out those minor features which cannot be adequately represented by contours.

The map up to this point will comprise the representation of streams and all water bodies, of towns, railroads, and highways, of political boundaries, of the topographic relief, and the names pertaining to all these features. It will be what may be called a base map, adequate in itself for all ordinary uses of the student and traveler, but capable of receiving additional data which convert it to a special purpose. In connection with our census, it might be used to express density of population by overprinting different shades of color. Similarly, it might be used as a crop map, a weather map, or a geological map, or to bring out the relations between lines of transportation or works of internal improvement, whether national, state, or private. Thus this base map contains in itself and in its adaptability to a large number of special purposes the highest practicable possibilities for usefulness.

The conference in London, having had its origin among geographers, felt constrained to emphasize the geographic side of cartography, and particularly the representation of altitudes of continents and mountains with reference to sea-level. These relations are indeed adequately expressed by contours, if one examines the map with sufficient care, but it is desirable, especially upon a general map of large scope and moderate scale, to bring the distribution of altitudes more strinkingly into view. To that end the conference adopted a scale of colors, which should be printed on different portions of the map, according to the height above sea. The depths of seas and lakes shall be shown by shades of blue; the lower lands, from the coast to 300 meters (984 feet), by three tints of green, shading into pale buff, which at 500 meters passes into light browns, that grow darker up to 3,000 meters. Above 3,000 meters the brown tints tone into rosy violet, and fade away to white in the highest summits beyond 7,000 meters.

As applied to the United States, the effect of this color scheme will be to exhibit light tints of green and buff over the Atlantic slope and throughout the Mississippi Valley, and from their expanse the Appalachian Mountains will stand out in tones of brown. Similar brown tints will indicate the rising plains between the Mississippi Valley and Colorado, while the summits of the Rockies and of the Cordillera will carry the violet notes of high altitude. On the Pacific slope the bands of color will be closely crowded, bringing out at once the gradations in tint and the relatively rapid rise from the sea to the mountain crests.

THE ATLAS WILL CONTAIN ABOUT 1,500 SHEETS

The arrangement of sheets of the one-millionth map is shown for the northern hemisphere on page 131. It will be noticed that each sheet measures 4 degrees of latitude by 6 degrees of longitude. Thus 60 sheets belt the earth and 22½ sheets extend from the equator to the pole. In the discussions of the conference the execution of the circular sheet covering the northern polar regions within the parallel of 88 degrees was courteously committed to the United States. To represent an entire hemisphere would thus require 1,321 sheets, and for the entire world twice that number; but since three-fourths of the earth's surface is ocean, the atlas will probably never comprise more than 1,500 sheets, including the oceanic islands. These sheets are so designed that they may be fitted together, without appreciable gaps, to any number that may reasonably be placed upon a single wall, and since they will be executed through international cooperation, without reference to national boundaries, according to a uniform style and method, they will really constitute a single great map of the world.

THE MAP SHEETS OF THE UNITED STATES

The sheets which fall upon the area of the United States, including parts of the adjacent oceans and of Canada and Mexico, but excluding Alaska, are 52 in

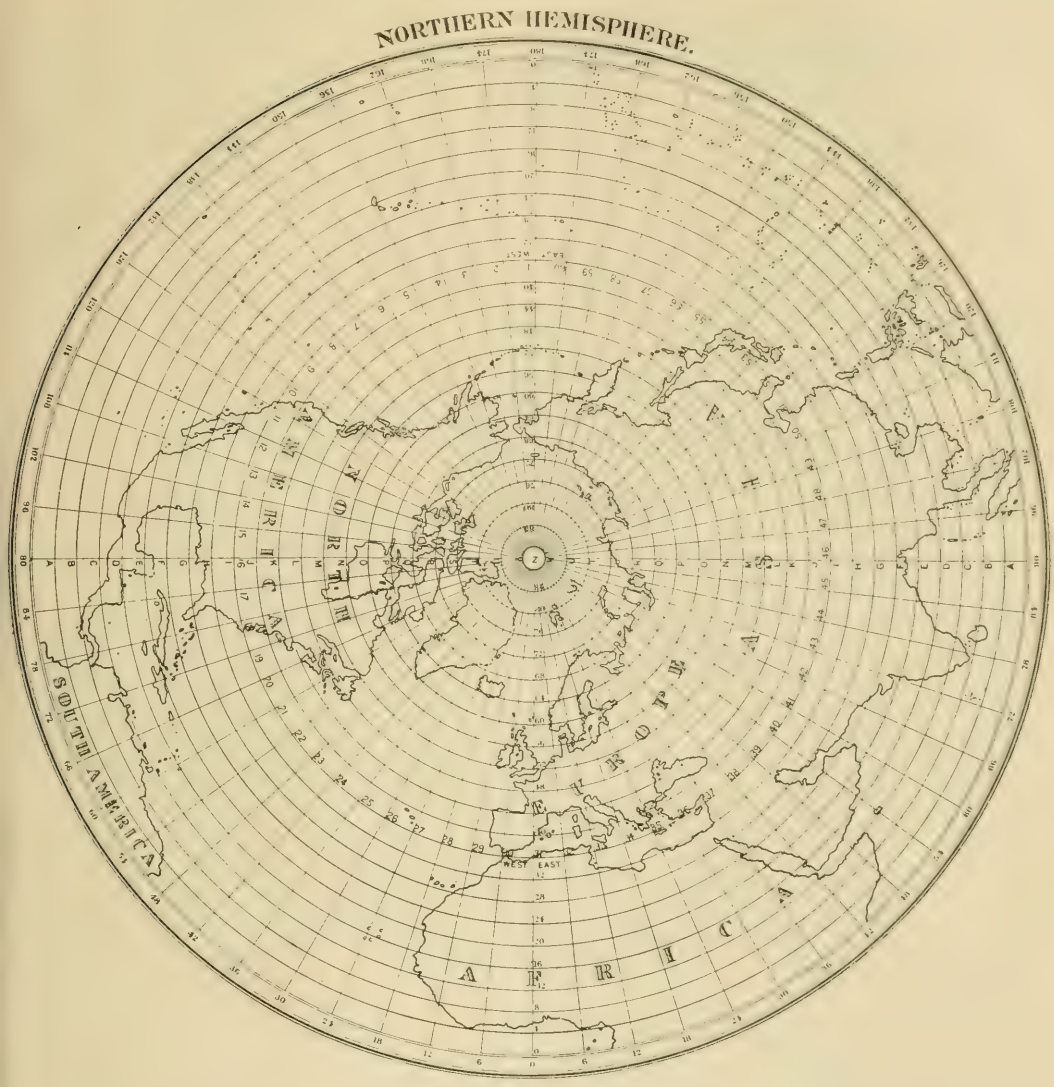


DIAGRAM SHOWING ARRANGEMENT OF SHEETS FOR THE INTERNATIONAL MAP ON THE SCALE OF 1 : 1,000,000

number. The United States Geological Survey now has in course of preparation nine of these sheets, covering parts of the Eastern, Central, and Western States. The originals are being drawn on a scale of one-five-hundred-thousandth, or 8 miles to the inch, and in such a manner that they may be reproduced by photolithography in a clear and effective manner for publication on a scale of 10 miles to the inch. In this form the maps may become immediately available for use by the departments of the government or by individual states; and eventually, as Congress provides the means, they will be engraved and published on the scale of one million (16 miles to the inch), with all the details

required by the decisions of the international conference at London. It may be assumed that they will then be available to any one at the cost of paper and printing, as is now the case with the topographic atlas sheets prepared under the same auspices.

ALL GOVERNMENTS UNITE TO COMPLETE THE MAP

The unanimous conclusions of the London conference have pledged the great powers to the standard map of the world, which Professor Penck proposed eighteen years ago. The need of that map is greatest concerning the countries which have been least adequately mapped, and among these we must count both Americas, as well as Africa, Asia, and Australia. Good maps exist of all of Europe, ranging in scale all the way from one to twenty thousand up to one to one and a half millions.

For Europe the data are all available, and the preparation of the one-millionth map is a question of a contract between some one of the great publishing houses of England, France, or Germany and the governments that are interested. It was understood at the conference that the work would thus be committed to one establishment, so far as Europe was concerned, in order that uniformity might be secured.

But the United States government is gathering the original data for the mother maps of this country, and is compiling and publishing them at a cost much below that which a European publisher would necessarily charge. It therefore, through its delegates at London, declined to send the original data to Europe, and reserved to itself the preparation of these original maps. It is to be hoped that the task may be prosecuted with energy, and that the first edition of the one-millionth map of the United States as a part of the standard map of the world may be engraved and published within ten years.

This compilation will then represent the state of knowledge at the time of completion of each sheet. As surveys progress, corrections and additions will be necessary, and the progress of improvement in the map will become an index to the progress of civilization in our country.

THE LAND OF THE CROSSBOW

By George Forrest

THE journey here described was made with the object of exploring botanically and geographically that portion of the Salwin Valley lying between 26° and 27° 30′ north (for map see page 147).

The tract of country between the parallels mentioned was "terra incognita," and had been persistently shunned by all, Chinese and Europeans alike, as inhospitable, barren, and unnegotiable; certainly, as will be found hereafter, we found it so, but despite these disadvantages it had one point of absorbing interest. Here in this region, comprising the whole of the basin of the Salwin, was supposed to be the home of the Lissoo race; from that point the offshoots spread northeast, east, and south over practically the whole of the province of Yunnan and parts of northwestern Szechuan.

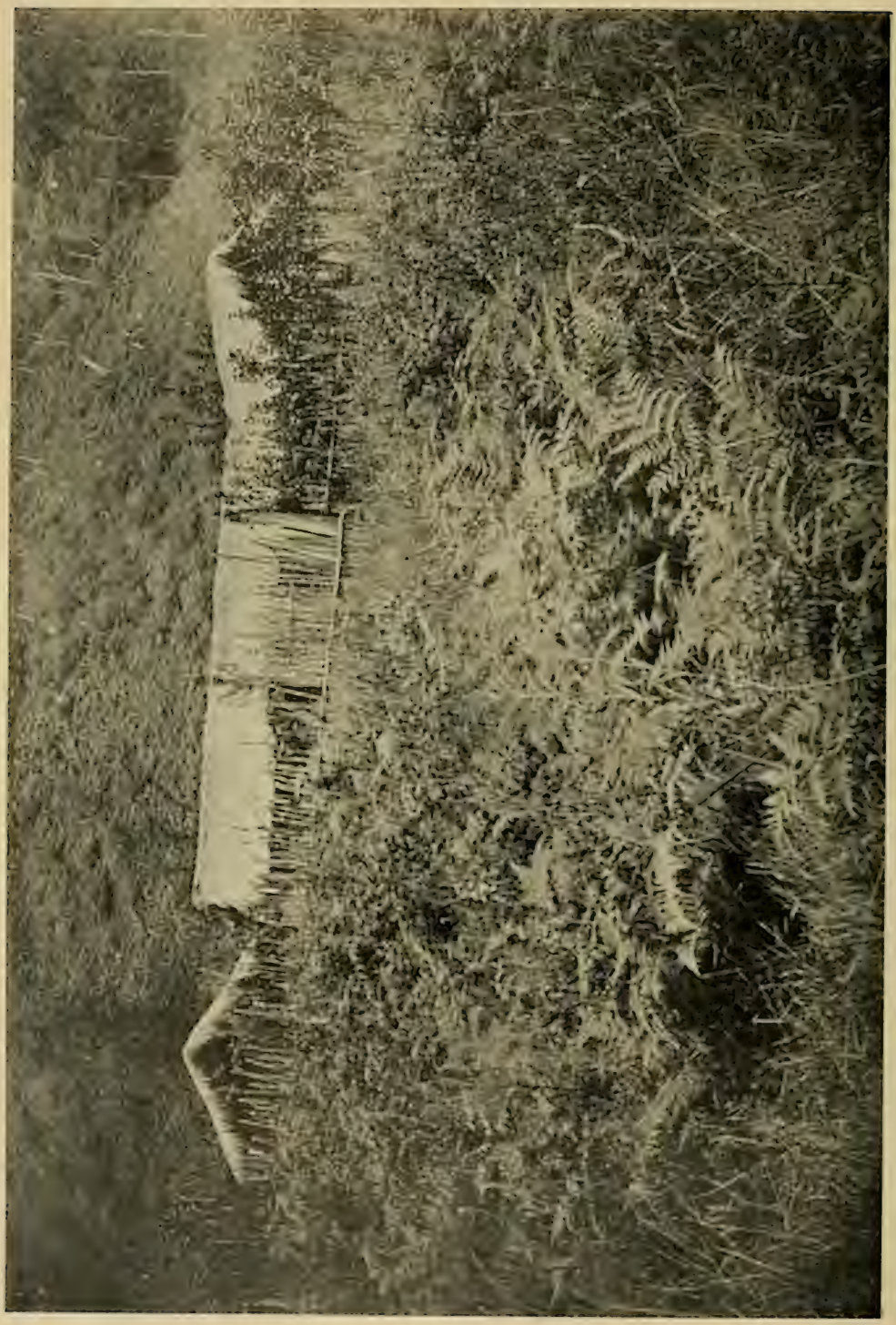
Starting from Teng-yueh-ting in perfect weather, we traveled due north, and on the fourth day passed the last Chinese village and entered the country of the Lissoo, camping near the hamlet of Ta-chu-pa. This, in keeping with most of the Lissoo villages, was only a miserable collection of a half dozen rain-sodden huts, thatched with coarse grass, and with eaves so low that to enter one

THREE LISSOO GIRLS OF TA-CHU-PA

had to bend almost double. It was, however, unique in being surrounded by a stockade of alder logs, most of which had taken root, forming a dense hedge. Probably the reason of this unusual possession was the position it held, being situated at the base of one of the passes leading over the divide into Burmese territory, and therefore liable to raids by the natives of that region.

The head-man of Ta-chu-pa soon found us a sufficient number of men to act as porters, and a day was spent apportioning loads to be carried on the back, consisting of a reserve supply of rice, done up in rawhide bags—a most important item in the baggage, as we could not count on buying food of any description or in any quantity in the country to the north of us. A Lissoo can carry on his back for full stages of 6 to 8 hours, in difficult and mountainous country, about 70 pounds weight, but he daily consumes 1 pound 7 ounces of dry rice.

All preparations for a move forward having been made, our bad luck began. The southwest monsoon returned, and for twelve days an almost continuous



THE LISSOO VILLAGE OF TA-CHU-PA; ALTITUDE, 7,000 FEET

deluge ensued. Camped as we were in the open, surrounded on every side by dense bracken and grass, averaging 4 to 5 feet in height, we were soon in the depths of misery. Even with improvised shelters over them it was with the greatest difficulty we could keep our fires alight. We did resort to the huts, but, with the number of our men added to the inhabitants, the accommodation was so taxed, the smoke of the fires—for which in the heavy state of the atmosphere there was little or no escape—so acrid, and the stench of steaming, vile humans so offensive, that eventually we were glad to return to the cold, damp comfort of our tents.

The weather having become more settled, we crossed the Irrawadi-Salwin divide by the lonely but beautiful Pienma Pass, 10,500 feet, and descended the Ku-tan River, a small tributary of the Salwin. From the village of Ku-tan we turned north, and on October 30 (1906) reached the village of Lu-chang, the residence of a semi-Lissoo chief, where Mr Litton had camped during his previous journey. The village is in a fine and healthy situation, some 3,000 feet above the river, and the people most friendly. The chief, who is a boy of 10 years of age, came to call on us, and a number of men offered their services as porters.

A DIFFICULT TRAIL

From Lu-chang we sent back the baggage animals and proceeded on foot for three marches northward—32 miles by the track, but scarcely 14 in direct line—and here the difficult nature of the country was first thrust upon us.

To travel continuously at the level of the Salwin, or even 1,000 feet above it, means fever in a very short time for native or European, and that even during the dry season; to be completely out of the danger zone one has to be from 2,000 to 3,000 feet above the river. The surface of both flanks of the valley is corrugated with huge spurs, intersected by deep and precipitous ravines, and the tracks, such as they are, lead up and down over a series of these ridges, which descend right from the tops of the divides to the Salwin.

To negotiate them is a trial of strength to the traveler's legs. Thus, starting from Lu-chang, at 6,400 feet, there is a steep drop of 3,300 feet to the Salwin in 4 miles; then follows an ascent of 4,000 feet through grass and pine forests to the top of the next ridge, 800 feet above the scattered village of Mao-chao—14 miles from Lu-chang—which, like Lu-chang, among its log and bamboo huts boasts one tiled house, the so-called yamen, the residence of the hereditary native chief. From Mao-chao there is a rough track which, after some steep ups and downs, plunges 1,500 feet into a tropical jungle of palms and lianes, through which runs one of the numerous mountain torrents which are the only tributaries of the upper Salwin. Then a precipitous climb of 900 feet through cultivated patches leads to the ridge of Shih-pai-li-ti, 6,700 feet and 10 miles from Mao-chao. Between Shih-pai-li-ti and Pei-pa (8 miles) there is an even steeper gully, the bottom of which is 2,000 feet below the level of the ridges.

The above gives only a faint conception of the difficulties negotiated. Later on, where there was practically no communication between the villages, we had to make our own tracks, and it was no uncommon thing for us on rising in the morning to have distinctly in view, only a mile or two distant, the site of the following night's camp, invariably reached only after a long day's exhaustive toil.

In all this country the villages are scattered along the opener sections of the ridge tops or on natural terraces in the mountains at from 5,000 to 7,000 feet. Above 7,000 feet to the top of the divide the country is too steep and rocky and the forest too dense to admit of villages or cultivation; below 5,000 feet the country is too malarious, but every village has its patch of rice-fields 2,000 to 3,000 feet below it by the banks of the Salwin, whither the inhabitants descend to sow and reap much as they did in the time

of Marco Polo. This obtains as far north as the village of Hsia-ku-dè; beyond that nothing but maize, which is the staple food of the people, is grown.

PROFUSE ORNAMENTS WORN BY THE WOMEN

The people are all Lissoo, with a strong admixture of Chinese blood. The men mostly dress in Chinese fashion, but the women, while adopting the Chinese cotton cloth, retain the petticoat and profuse decoration of head, with armlets, bracelets, and necklets, which is so characteristic of the true Lissoo garb. I have seen young girls with ornaments which in the aggregate must have weighed 15 to 20 pounds. It made one positively weary to look at some of them. The necklaces generally consist of discs of polished bone 1 to 1½ inches in diameter, cowry shells, which are said to be imported from Tibet—at any rate, they filter down stream from the north—variously shaped pieces of silver and water-worn pieces of a poor quality of turquoise which is found in the valley. In addition to these there are generally several strings of large blue beads, which, I understand, are brought over as barter from the Mekong Valley by a few Min-chia traders who are daring enough to risk their all dealing with those people. The bangles and armlets are mostly of pure silver, very rarely copper is seen, and in this manner most of the girls carry their dowry about with them.

Few of the people can speak any Chinese except the chiefs and their families. They hardly go beyond their own villages and seem to live happy, quiet lives, only disturbed by the occasional difficulty of obtaining food and by the trouble and petty exactions which attend the work of collecting the chiefs' tribute, or house-tax, of half a tael (= 1 shilling 4 pence) per annum. The usually peaceable condition of this portion of the valley is no doubt due partly to the general absence of interference by the Chinese mandarins, which is owing to the fact that the country is too poor to be worth squeezing. The chiefs have none of the machinery and exercise none of the functions of a regular government, except collecting their dues, in which they are assisted by a Chinese clerk. Each village seems to regulate its own affairs through its headman.

A PECULIAR RIVER

In this section of its course the Salwin at low water varies from 90 to 130 yards in breadth and in most parts is of great depth. There are no falls, but numerous rapids, at some of which the river is contracted to less than 80 yards. The volume of water in the rains is enormous; we found unmistakable signs of the river having risen, in August, over 40 feet above its November level. In the fine season the water is intensely cold. The river is here confined, not indeed between precipices, as was supposed, but between a series of steep ridges, falling down in endless succession from the Mekong and Irrawadi divides. In many places these ridges have a final sheer drop to the river of 500 to 1,000 feet, so steep indeed that, even if climatic conditions allowed of traveling at water level, it would be found impossible to circumvent their bases.

The upper Salwin is quite free from the great bends which characterize the Yangtze; it also receives no tributary beyond a few mountain torrents, the reason of this being, of course, the extreme narrowness of the Salwin basin. At latitude 26° 30′ north an airline of 18 miles would join the east and west limits of the basin, while in latitude 26° 50′ north a line of 40 miles would span it and also the basin of the Mekong.

North of Luchang, on the west or Irrawadi side of the Salwin, the mountains are exceedingly precipitous, and come down in a series of fantastic, jagged ridges, divided by deep gutters. Altogether our advance up the river was slow in the extreme; even the river banks at the few places where we risked following them were encumbered by enormous boulders, piled together like Pelion upon Ossa, rendering progress most difficult.

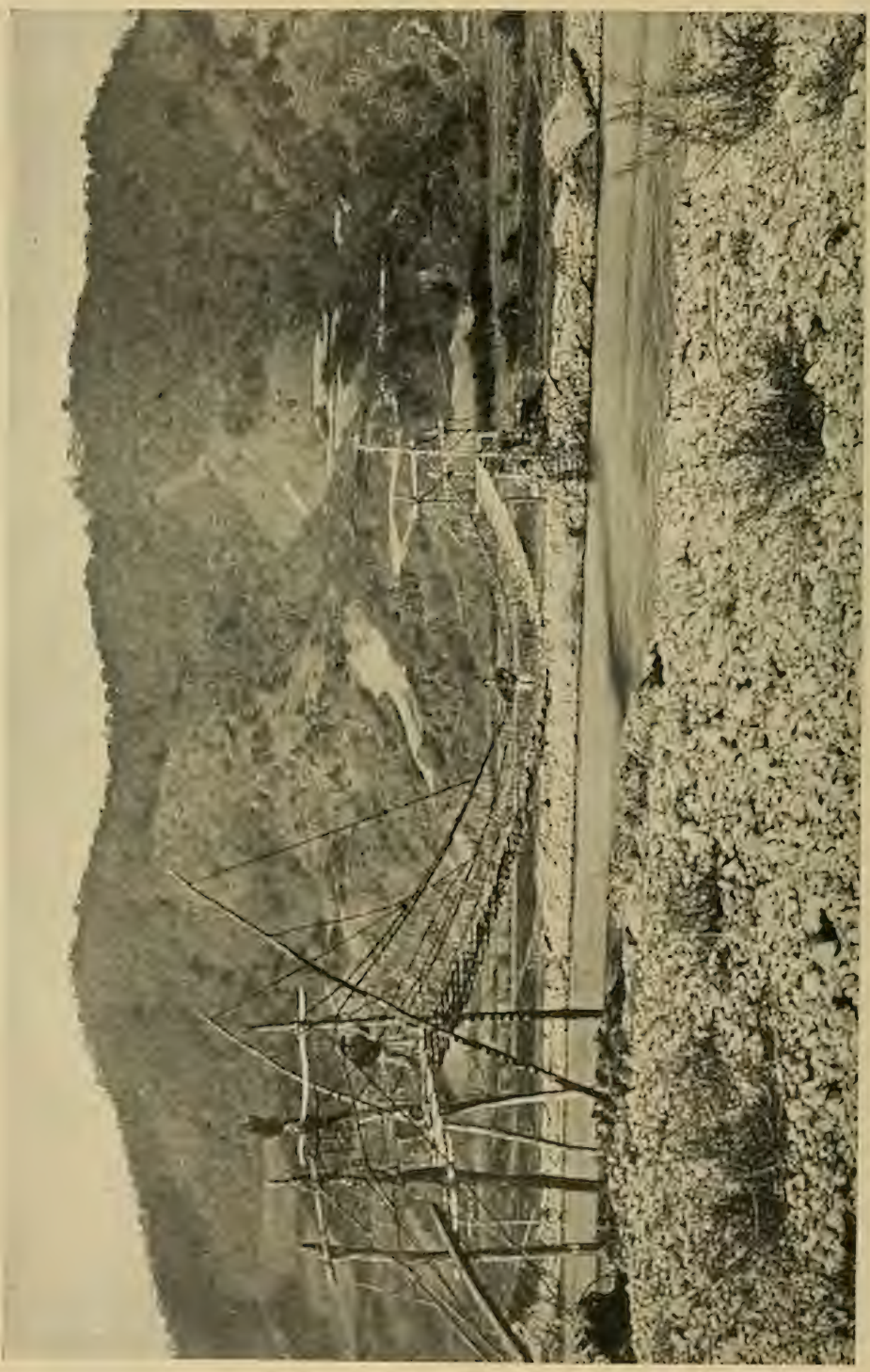
GROUP OF LISSOO NATIVES: TA-CHU-PA

The basis of the rock formation of the Salwin is limestone and the strata of the higher slopes are tipped up so as to point to the sky.

FEW BIRDS BUT MANY TROUBLESOME INSECTS

Animal and bird life along the Upper Salwin is conspicuous by its absence—an important matter for the traveler, who cannot count on replenishing his larder with game. On the other hand, the river banks at a low altitude, and where wholly sheltered from the northwest winds, have an almost tropical climate, and as the result vegetable and insect life is both vigorous and troublesome. Creatures with inconveniently long legs plunge suddenly into one's soup, great caterpillars in splendid but poisonous uniforms of long and gaily-colored hairs arrive in one's blankets with the business-like air of a guest who means to stay. Ladybirds and other specimens of coleoptera drop off the jungle down one's neck, while other undesirables insert themselves under one's nether garments.

The light in the tents attracts a perfect army of creatures, which creep, fly, crawl, buzz, and sting. Scissor insects make the day hideous with their strident call, and the proximity of Lissoo coolies introduces other strangers, of which *Pulex irritans* is by far the least noxious. The mere act of walking in this country is a work of much physical exertion. The villages under the Chinese chiefs have a laudable custom of cutting out their roads every year after securing their harvest, but in the country north of Cheng-ka constant feuds between neighboring villages prevent this useful work; the paths are narrow tracks choked with the luxuriant growth of the previous rains, slippery and lop-sided, and as often as not leading along the very brink of a precipice. In some places we had to haul ourselves over boulders by pendant branches or scramble along the face of cliffs by notches in the rock, work suitable for



SUSPENSION BRIDGE WITH SPAN OF ABOUT 125 FEET, CONSTRUCTED OF LIANA CANE AND SAPLINGS; NEAR TA-CHU-PA

monkeys, Lissoo, or other creatures gifted with more prehensile feet than a European.

MAGNIFICENT SCENERY

Poisonous-looking scarlet fruits hang from the overarching jungle, lianes and tree-roots trip up the unwary traveler; if he clutches the nearest plant to save himself the chances are it is a stinging nettle of the size of a laurel and poisonous in proportion. In some places especially around their maize fields, the natives provide a further diversion in the shape of "pan-ji." These are sharp-pointed, fire-hardened pieces of bamboo, which are driven into the ground among the grass, and will, if trodden upon, pierce even through a leather boot and deep into the foot. It is only when the traveler, scratched, bruised, and with torn clothing, emerges on a quiet sand bank by the river, or on to some open terrace high above it, and finds the campfire lighted, the tents pitched, and a pailful of hot water ready for a bath, that he begins to think exploring the Salwin a game worth the candle.

The vegetation in that part of the country is almost as great a nuisance as the insects. Every sort of seed attaches itself to one's person; some are provided with hooks, others with natural gum, others pierce the skin or work down under one's socks. An hour's march leaves the traveler caked with the seeds of enough plants to form the material of a work on the methods of the natural dispersal of flora.

But the scenery of the Upper Salwin can never be forgotten by any one who has wondered at it in the rich sunshine which prevails after the autumn rains have given way to the first touch of winter. The great variety of rock formation, the abundant forests and vegetation, and the diversity of light effects between the summits of the ranges at 10,000 to 13,000 feet and the abyss in which the river flows produce a vast panorama of ever-changing beauty. In the morning the sun, as it touches the top of the Mekong divide, sends wide shafts of turquoise light down the side gullies to the river, which seems to be transformed into silver. The pines along the tops of the ridges stand out as if limned by the hand of a Japanese artist. In the evening all the wide slopes of the Mekong side are flooded with red and orange lights which defy description or photography and would be the despair of even a Turner. The traveler whose fortune it has been to explore the great rivers of this our northeast Indian frontier will admit that the Salwin, while it is inhospitable, difficult, and barbarous, far excels in natural beauty all the valleys of the sister rivers, the Yangtze, the Mekong, and the Irrawadi.

OUR FIRST MEETING WITH THE CROSSBOW

Continuing our march from the sand bank below No-li-ka, 7 miles from Pei-pa, we toiled up a steep slope to the terrace and village of Shih-chi-di, 1,500 feet above the river; here we had a good reception from the Lissoo, deputations from several villages round offering us small presents of eggs and rice. From this point northward the people were clad in the Lissoo style, and few or none could speak Chinese.

On clearing the top of a ridge we found ourselves confronted by a number of warriors with huge crossbows, headed by the local "ni pa" (prophet or medicine man). He produced a paper scrawled over with rude imitations of Chinese characters, and declared he had received instructions from heaven to go and kill somebody, and that he thought the headman of Cheng-ka was the most suitable person, but he desired our advice. We strongly recommended him to go home and see to the grinding of his maize crop.

All along the road we met a number of warriors hastening to follow the prophet to Cheng-ka, but they were far from wishing to molest us; indeed, several of them left the warpath to escort us on our way, and, after seeing a twelve-shot repeating Winchester rifle fired, desired our alliance and assistance in the projected raid on Cheng-ka.

After leaving our bellicose friends we crossed another gully to Hsia-ku-dé, a

A LISSOO OF THE SALWIN VALLEY

large village for this country, consisting of some 40 houses of the true Lissoo type, constructed of rough logs and bamboo matting, raised on piles, with one room only and a tumble-down verandah. A stone hearth occupies the center of the room, and around this the family eat and sleep. The head-man was a typical old Lissoo, tall and thin, with a close-shaven gray head, bleary eyes, an aquiline nose, huge earrings of silver and cornelian, and a profusion of bracelets and beads hung about his person and over his dirty hempen clothes.

SINGLE-ROPE BRIDGES

It was near here that we first saw a single rope bridge across the Salwin. These single-rope bridges of the Upper Salwin are far more difficult to cross than the double ropes of the Mekong, by which the passenger always starts from a higher level than that at which he lands on the other side, and is thus rapidly car-

A GROUP OF LISSOO OF THE VILLAGE OF LO-MA-DI (SEE PAGE 145)

ried across by his own weight and with little or no exertion. On a single-rope bridge, however, after having been trussed by cords onto a runner, it is necessary to haul one's self across hand over hand; as one is tied with face to the sky and back to the water, this is a difficult operation. As the Salwin ropes are made of very roughly twisted cane, there is always the chance that the whole affair will break in the middle, and the certainty in any case that one will arrive on the opposite side with hands full of painful splinters off the rope.

After leaving Hsia-ku-dé we found that the country increased in wildness with every march, and the inhabitants in squalor, poverty, and barbarism. Every village which we passed gave us terrifying accounts of the ferocity and savagery of the next, where we should infallibly have our throats cut, etc. On the Lower Salwin we had heard stories of people on the upper river who never attempted to

LISSOO WARRIORS OF THE SALWIN VALLEY

The arrow shot by the crossbow is poisoned, and travels with such speed that it will pierce a deal board an inch thick at 70 yards (see page 155)

LISSOO WARRIORS ARMED WITH THE CROSSBOW (SEE PAGES 146 AND 155)

A BRIDGE OF CANE AND LIANAS ACROSS A TRIBUTARY OF THE SALWIN IN THE LAND OF THE CROSSBOW

wash and who smeared their faces with grease and filth; this was perfectly true of the inhabitants we were now meeting.

The food question, however, was the most difficult for us to solve, and on November 9 we stopped at the considerable village of La-tou-wa-dé (4,500 feet) to endeavor to raise supplies. Here all the people, men, women, and children, were dressed in hempen garments of pure Lissoo style; none of them spoke a word of Chinese or acknowledged any sort of Chinese or other authority. They had not even a head-man of their own. They were, however, willing to trade, and suggested that Mr Litton and I should barter our breeches for a bag of rice, but, as we had only one pair in serviceable condition, we could not accede; but a Chinese coolie who was with us did a deal with one of his ragged and lousy jackets, which he bartered for some maize and salt.

Cloth was the object in greatest demand, but unluckily we had none to spare; therefore one skinny chicken, a few pounds of bad rice and maize, and two bamboo tubes full of honey were all we could get from this village of thirty houses, and even this purchase upset the local market.

Beyond La-tou-wa-dé the country became wilder at every step. We were able to do a good long march of 11 miles, mostly along the river, here broken by many rapids and under beetling cliffs, to an opening in the mountains, where, above some padi patches, is situated the picturesque village of Chong-wa. The few inhabitants fled at our approach, but we captured one, and through kindness shown to him managed eventually to coax some of the bolder spirits back to our camp. We found they had feuds with all their neighbors, and were afraid to guide us a mile in any direction, unless we were anxious to attempt a little-frequented pass which, they declared, led up from their village in three days' march to some friendly Lissoo villages on the other side of the Irrawadi divide. Our chief object, however, was to reach a point farther north, whence it would be possible to get an extensive view up the Salwin, and thus discover the general geographical features of the country.

WHERE FIREARMS WERE UNKNOWN

Learning of the existence of a rope bridge across the Salwin a few miles farther on, we decided to cross the whole party to the other side, where, we were told, the villages were larger and more civilized, and that there were passes eastward over to the Mekong. Luckily we found a native of the important village of Lo-ma-di, on the left bank, returning home from the right bank, and he at once volunteered, in consideration of a bead necklace, to fetch his comrades with the ropes and runners necessary for crossing our party, which consisted in all of 35 persons and a dog.

Meanwhile the people of the village on the right bank, where we were camped, had heard of our arrival, and came down to see us, and a wild lot they were. It then appeared there was a feud about this rope bridge between the two villages on the right and left banks respectively, each party claiming that the right and profit of assisting travelers across belonged to them alone. We offered to give an equal present to both parties, but when our friends from the left bank returned with the runners we saw at once we were in for a serious disturbance. The right-bank party was led by a bullying savage, who shouted that the left-bank party should not help us across. The lefts had rashly left their weapons on the other side, but proceeded to tie up one of our loads for the passage; whereupon the leader of the rights whipped out a poisoned arrow, ran back along the path several paces, fitted it in his bow, and shot it over our heads into the river—a sign, like Mr Snodgrass taking off his coat, that he was about to begin.

As we were all crowded on a narrow path, near a tree to which the end of the rope bridge was secured, and the bellicose Lissoo was about to draw his bow again with an arrow in it which might find a billet in the body of any of us, the situation was critical. Mr Lilton and I at once rushed him, and I fired several

shots from my Winchester repeater over his head at a boulder on the other side of the river. The effect of seeing the bullets smash against the stone at such a distance was immediate, and then, through our interpreters, we told the man and his friends that if they made a show of stringing their bows again the next bullet would find a resting-place in some of their carcasses. They had little, if any, idea of firearms, and they at once subsided into an awe-struck silence; but still we had to stand on guard, and at intervals give exhibitions of our marksmanship and the power of our weapons, till all our party had been safely hauled across the rope to a sand bank on the opposite side, where we pitched camp, together with our friends from Lo-ma-di, who expatiated on the savagery of the low people who lived on the right bank, congratulated us on the manner in which they had been suppressed, and promised us a hearty reception at their own village next day.

Early the next morning we ascended steeply from the river through carefully cultivated patches of maize, millet, and buckwheat to 6,500 feet, when we came in sight of Lo-ma-di. Our friends of the previous day and a number of their friends were now with us, and, though all armed to the teeth, were most amiable and childishly delighted with our firearms, our clothes, and the pointer dog.

What was most interesting to us was an extensive view we obtained from that point looking straight north up the funnel-like valley of the Salwin. As far as the eye could reach we could trace the almost direct north-and-south course of the river, and the succession of ridges falling down from the high ranges to the river from the east and west divides in a manner so regular as to suggest the ribs of a huge skeleton.

We found Lo-ma-di the largest, cleanest, and best built Lissoo village we had yet seen: some 90 households were scattered along a broad slope at an altitude of 6,500 feet, looking down on the Salwin more than 2,000 feet below. Groves of pine and fruit trees gave grateful shade, and the small garden plots were divided by neat bamboo fences. The picturesque inhabitants, with their beads, cowries, silver ornaments, and long hempen garments, came out *en masse* to welcome us, and several of the village elders brought trays of rice, eggs, vegetables, etc., which they offered on their knees. We met several Chinese-Minchia traders from the Mekong; they bring cotton cloth, opium, salt, and goats, which they exchange for local produce, the staple being a varnish produced by tapping a varnish tree similar to one which is known in the province of Kwei-chou. Beeswax, some drugs, and a small supply of gold dust are also exchanged. Trade with the Lissoo, we were told, is a profitable but risky matter, as there is no sort of government in the country, and even the comparatively civilized tribes on the left bank of the Salwin are continuously fighting among themselves.

The attentions of the Lo-ma-di crowd became so embarrassing that we resolved to push on into the mountains. Marching southeast by an excellent path through oak scrub, we halted for the midday meal at the hamlet of Ji-Ji, situated at 7,200 feet on an open, wide ridge commanding extensive views down the mountain ranges to the south.

AN ARMY CORPS OF CROSSBOW WARRIORS

The men of Ji-Ji were at war with the people of a neighboring village higher up the hill, and we had the pleasure of watching the progress of the fight during our tiffin. The cause of the trouble was the theft of some maize, and a whole army corps, consisting of some fifty warriors, had been mobilized. These fellows, with their grotesque ornaments of silver, deers' horns, pebbles and cowries, their blackened faces, their flowing hempen robes, their war-bows 5 feet broad, their war-swords 5 feet long, and their broad ox-hide shields 5 feet high, moving in a line beyond their village, presented an image of the "pomp and pride and circumstance" of war. The enemy occupied a position higher up the hill and a fierce bombardment of oppro-


Sketch Map of
THE UPPER SALWIN
10 5 0 10 MILES
Lo-ma-di
Chong-wa
Pass 12500
Lu-po
Lu-po Pass
Yako Peak
Hsia-kuli
Chi-milli Pass 1300
Shih-chi-di
No li-ka
Cheng-ka
Pei-pa
Shih-pai-li-ti
Mao-chao
Pien-ma
Pass 10500
Lu-chang
Ku-kang
Hu-tsao-li
Teng-keng
Ta-chu-pa
TENG-YUEH-TING
(MOMEIN)
Salwin Riv.
Shweli Riv.
Mekong Riv.
BRAHMAPUTRA R.
BURMA
MANDALAY
RANGOON
0 50 100 200 MILES

brious epithets was maintained, but neither side got farther than swearing and stringing bows until the time arrived for the afternoon meal, when the combatants dispersed to their respective homes.

Ji-Ji was the last village on the path leading up to the Mekong-Salwin divide, which we now determined to cross. On the evening of November 13 we made good way into the mountains, marching along an easy but narrow path through woods high above a feeder of the Salwin. Camp was pitched 4 miles from the river, under a large rock overhanging the path, which gave the men some shelter from the damp of the forest, and early next day we negotiated the pass.

Crossing the head of the stream, above which we had marched the day before, a long and steep but not difficult ascent through bamboo and pines brought us out on an open alp at 10,500 feet. Hence a climb by a rocky path took us up on to a bare, wind-swept col which forms the pass at 12,500 feet, 20 miles from the Salwin.

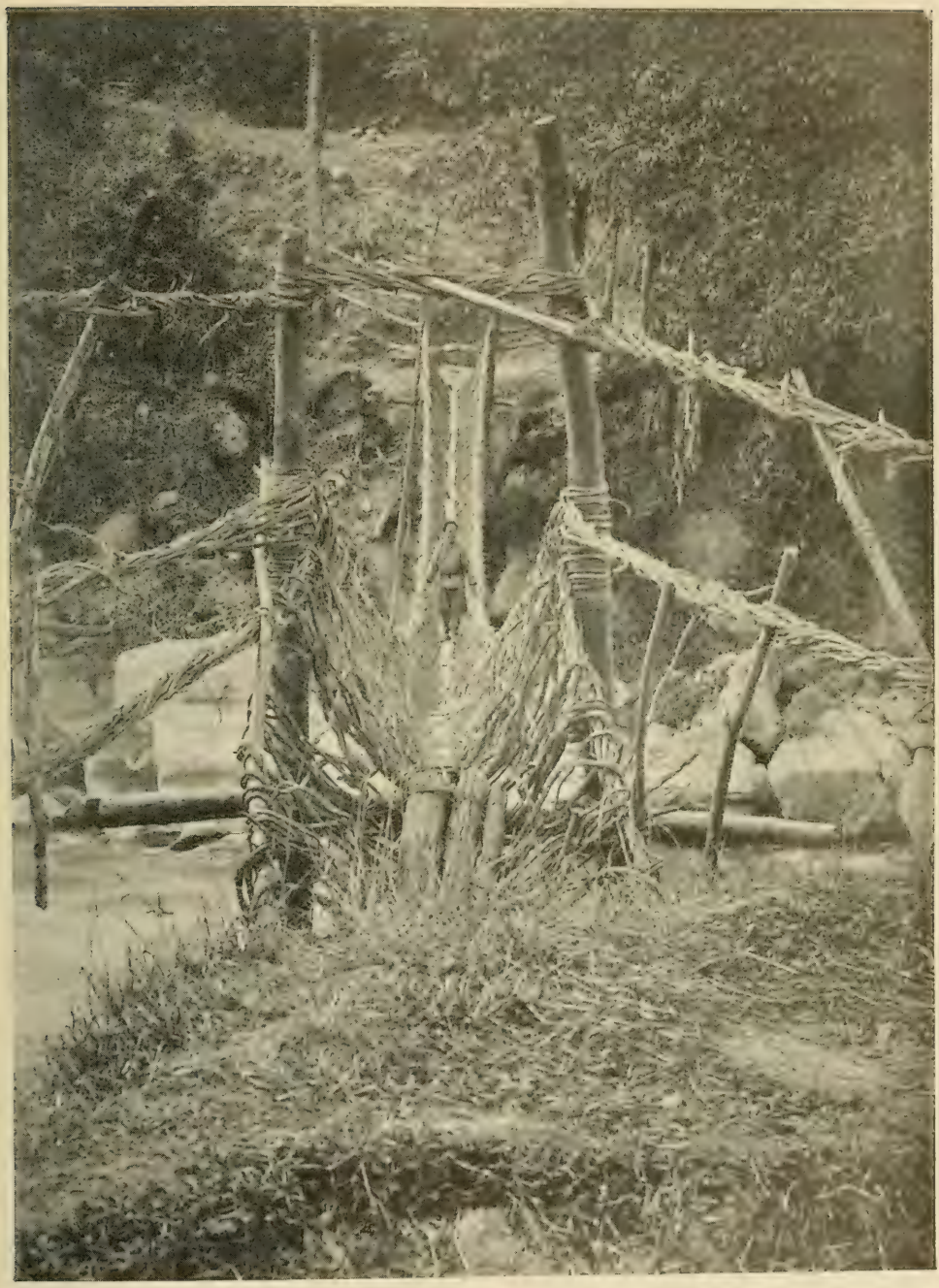
Unluckily mist was being blown along the ridge and this obscured our view, but several bare limestone peaks were seen, rising 1,000 to 2,000 feet above the pass. The men were all benumbed by the intense cold, and at the first sheltered spot, some 500 feet below the summit, we lit a roaring fire of bamboos and enjoyed, so far as the mist allowed us, an immense view of the Lichiang and Tali prefectures beyond the Mekong. In the afternoon we got on to a convenient but steep spur and made rapid progress down toward the Mekong; we camped in a wood at 9,400 feet after a march of 15 miles. We were over 5,000 feet above the Mekong and some 20 to 25 miles north of the Chinese market of Ying-pan, situate on the left or east bank of the river. This is a salt bazaar and the center for all the petty trade between the Minchia inhabitants of the Mekong and the wild Lissoo, and there we intended to replenish our exhausted commissariat.

Turning south we found an excellent high-level road, by which, on the afternoon of November 16, after a 25-mile march, we reached the mud-built Minchia village of Pu-mu-tou, 7,500 feet altitude, from which Ying-pan bazaar could be seen dimly across the river far below us.

The people of Pu-mu-tou, at first apprehensive that we had something to do with the Yamen, soon became friendly, and brought fowls, eggs, and a pig for sale. Also some of our men were sent down to the market next day and returned laden with supplies; therefore we were again in a position to face the terrors of the foodless Salwin, and the headman of Pu-mu-tou volunteered to guide us up to the divide by a different pass from that by which we had come on condition that we would not expect him to approach any of the villages of those "terrible, wild Lissoo."

This part of the Mekong differs widely from the Salwin valley in the same latitude. Instead of sharp crags and cliffs of limestone, dense semi-tropical jungles, extensive forests, and wild Lissoos with their poisoned arrows, we viewed a peaceful scene of wide, bare, cultivated slopes of clay or disintegrated sandstone, shelving down in terraces to the river below. The basin of the Mekong at this point is twice the breadth of the Salwin, though the altitude of the latter river is 1,000 feet less. The people, like the scenery, are altogether less wild than on the Salwin. The houses of mud brick are built into village streets, instead of being scattered about over the hillside. Large villages of 50 to 100 houses occupy all the good sites where water is available for rice irrigation.

In customs, dress, mode of life—in fact, in everything but in language and race—these people are, to all intents and purposes, Chinese. They are too far off from their "father and mother," the Lichiang official, to be troubled much by Yamen underlings, Lichiang being distant eight long mountain stages. They live, if not a strenuous, at least a peaceful and not unprosperous life, and, being far more industrious in cultivation and



ANOTHER TYPE OF LIANA BRIDGE IN THE LAND OF THE CROSSBOW, SHOWING APPROACHES AND FASTENINGS

SINGLE-ROPE BRIDGE, OWNED BY THE VILLAGERS OF LO-MA-DI, SHOWING A NATIVE IN THE ACT OF CROSSING: SPAN FULLY 300 FEET (SEE PAGES 140 AND 145)

ONE OF OUR CAMPS IN THE MOUNTAINS AT AN ALTITUDE OF 11,000 FEET, SHOWING THE LICHIANG RANGE

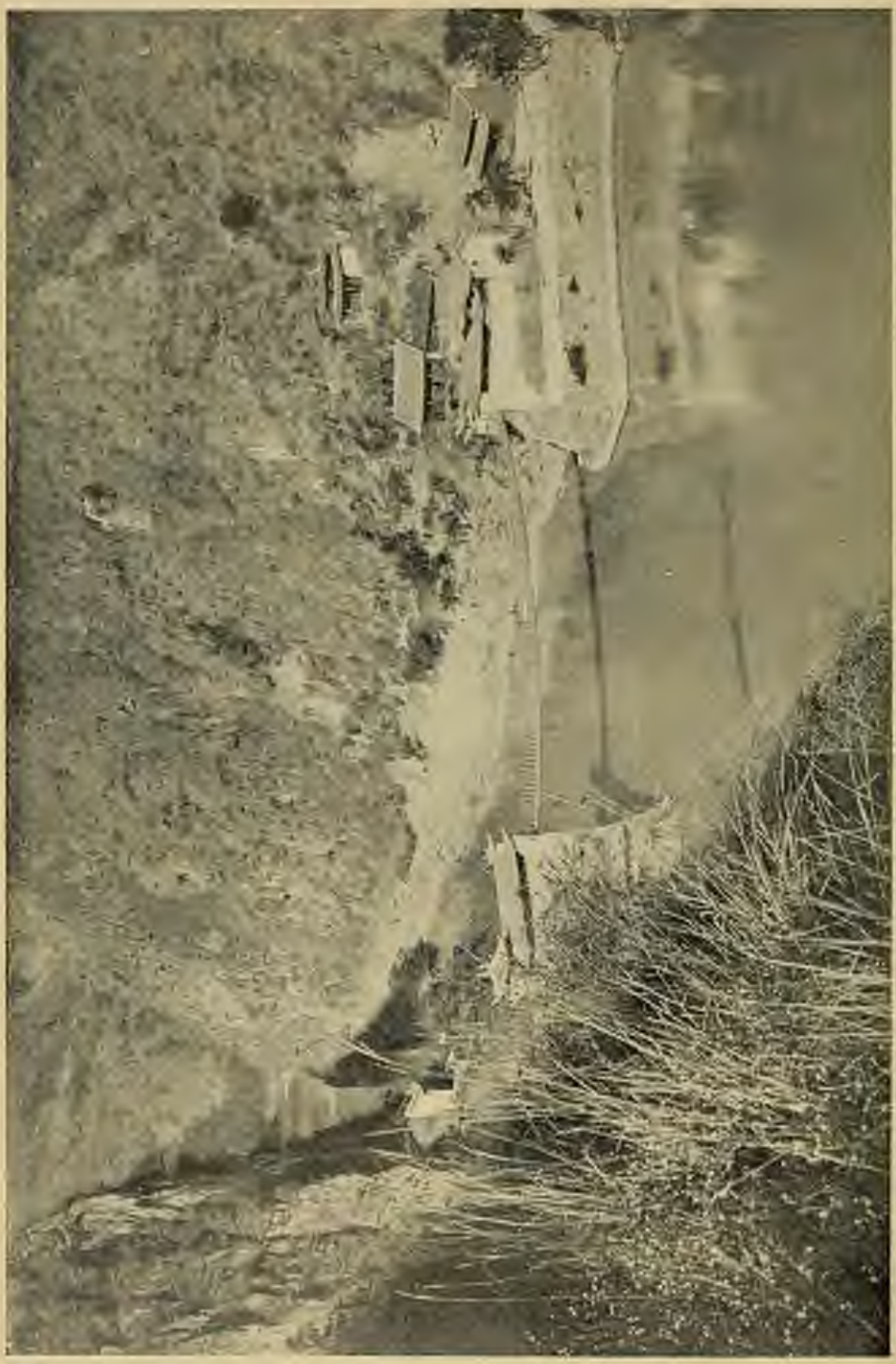
less troubled with clan fights than the Lissoos, are less frequently subject to the ravages of famine.

SUPERB MOUNTAIN RANGES

From Pu-mu-tou we ascended a spur through oak scrub and over grassy slopes, rising in the day's march from 7,400 to 10,500 feet on the slope toward the Salwin divide. At this altitude there was a superb view of all the great ranges of northwestern Yunnan east of the Mekong from Talifa to the borders of Tibet. Most of those northwestern Yunnan panoramas are dominated by the glittering snow mountain of Lichiang.

After an intensely cold night on the mountain side at 10,500 feet, we proceeded on November 19 up the pass, the summit of which we reached at 12,300 feet altitude. Here a surprise awaited us, for the view to the west was perfectly clear, and the whole of the great Salwin-Irrawadi divide was spread out before us. From a little below the pass this range could be followed to the north as far as the eye could reach, until at a distance of about 100 miles from where we stood, and in approximate latitude 28° 30′ north, it was merged in a huge range of dazzling snow-peaks, trending westward. This range is doubtless the east source of the Irrawadi, and forms the divide between it and the Zayal, the Bramaputra system. The upper slopes of the Salwin-Irrawadi divide resemble a vast wall trending most regularly from north to south, and there are no very conspicuous peaks. The average height of the summits in that latitude, 26° 55′ north, would be probably 12,500 to 13,500 feet. There was practically no snow on it in November.

Below the wall-like ridge forming the backbone of the range, limestone spurs, crags, and precipices in bewildering confusion fall down to the Salwin. It was easy to see why the upper slopes of the



SUSPENSION CHAIN BRIDGE ON THE MEKONG RIVER, ON THE MAIN TRADE ROUTE FROM UPPER BURMA TO YUNNAN

It is formed of 12 iron chains and plank roadway 8 feet wide. Breadth of span, 70 yards

THREE WOMEN OF PU-MU-TOU (SEE PAGE 148)
The central figure has her arms withdrawn from sleeves to within gown

range are uninhabited, and why this mountain barrier is an ethnographical boundary between the Lissoo and Kachin races.

On this pass, as at many other places on our journey, we saw several moulder-ing skeletons by the sides of the pathways, victims either of the famine of the previous season or of a savage temper and a crossbow. The Lissoo have a superstitious terror of human remains and give them a wide berth. In the afternoon, after crossing the pass, we made good way along the top of a well-defined winding spur which rose up from the Salwin. Descending to 8,600 feet, we camped at the small Lissoo village of Lu-po, from which place the pass derives its name, after a march of 15 miles.

The next day, when, by a break-neck descent on a slippery declivity, we reached the Salwin at 3,700 feet, near the village of U-a-lo, we found that three of its enterprising inhabitants had just made a rude raft of bamboos, loosely tied together, and were prepared to take our party across. As the *ship* could only carry two men and two loads in a journey, and as the Lissoo do not shine as watermen, the crossing was not completed by nightfall. Next morning the crossing was hurried to a finish, as we were becoming seriously alarmed at the inroads fever was making in our little party, exhausted by the labors of a flying march; two very bad cases had to be carried on the backs of two of our coolies, and our stock of drugs was soon exhausted. Luckily we got through without the loss of a single life, and by forced marches returned to our base camp, near Lu-chang, on December 1, in good spirits if in ragged clothes.

SCENE IN TIBETAN FOREST, ON THE EASTERN FLANK OF THE MEKONG-SALWIN DIVIDE: ALTITUDE, 10,500 FEET

REMARKS ON THE LISSOO TRIBE OF THE UPPER SALWIN

The Lissoo race, if not powerful or very numerous, occupies a large tract of territory. The tribe is undoubtedly an offshoot from the southeast of Tibet, probably before the introduction of Buddhism into Tibet. None of the Lissoo, even those who live among or near Tibetans, shows the least trace of Buddhist influence or belief. Their religious practices closely resemble those of the Kachins, who believe in numerous "nats" or spirits which cause various calamities, such as sickness, failure of crops, etc., unless propitiated in the most suitable manner. The most important spirit is the ancestral ghost. Lissoo graves are generally in the fields near the villages; over them is put the cross-bow, rice-bags, and other articles used by the deceased. It is probably from foundations such as these that the fabric of Chinese ancestor worship was constructed. Food is also placed on the grave for many days. The upper part of the structure is a roughly hewn board, of the shape but larger than a coffin-lid, to protect the articles hanging on the upright post from the weather.

The Lissoo may be said to form practically the whole population of the Salwin Valley from 27° 30′ to 26° north. They have spread in considerable numbers along the mountains between the Shweli and the Irrawadi, and in isolated groups far away down the Burmese frontier and, I am told, into the Shan States.

In parts of Burma, under British rule they have been found readily amenable to civilization and are more docile than the Kachins. But those whom we saw on the upper Salwin were utter savages.

Most of the villages have not even a regular head-man; nearly every village, too, speaks a different dialect, and two Lissoo sepoys from the Burmese frontier below Tengyueh, whom we had with us, could not make themselves understood beyond 26° 30′ north. There are also

a number of tribal subdivisions—a source of constant feuds. The Chinese official theory that the country belongs to the hereditary Minchia chief "Lo," who resides at Tu-wo, latitude 26° 8′ north, on the Mekong, has no foundation whatever; in fact, on the contrary, no sort of official person would dare to go anywhere near the country.

The villages are nearly all at war with one another; few of the people have ever in their lives been more than a day's journey from their own huts; suspicion, rumor, and terror sit enthroned among those limestone ridges. It is almost impossible to get a guide, and quite impossible to get any accurate information about routes, distances, and such details. None of these wild Lissoo ever seem to have asked whence the River Salwin, which occupies so large a place in their lives, comes or whither it goes, or what is at the back of the great ranges which confine their view of the world. The object of each little community seems to be to keep its neighbors at a distance.

The people are also exceedingly lazy. In the spring they do a few day's work in scraping a patch of soil just large enough to yield subsistence, and in planting their maize, the site of the patch being changed yearly. Then in early October they put in a few day's more work getting in their crop and cutting their hemp, or looking after their tobacco patch. All the rest of their lives is spent in eating, sleeping, and squatting round the hearth, varied by a rare expedition to obtain wood for a crossbow, poison for their arrows, or a stock of salt or wild honey. Under these conditions it is not surprising that, in spite of the sparseness of the population and the great extent of land suitable for maize and other cultivation, famine is of frequent occurrence.

WILD HONEY FOR FOOD

Rice is a luxury; coarsely ground maize, buckwheat, and wild honey are the staple food of the people. Where we passed along there were practically no domestic animals or fowls, as they had all been killed during the famine of the previous season. Wild honey as a change is an agreeable sweetmeat, but after a few days constantly partaking of it the European palate rejects it as nauseous and almost disgusting. Our experience extended over a fortnight, during which period our food consisted solely of it and maize. It has escaped the Biblical commentators that one of the principal hardships that John the Baptist must have undergone was his diet of wild honey.

A draughty hut of rickety logs and bamboo matting, consisting of one room 15 to 20 feet in length and 6 to 8 feet in breadth, the whole raised 3 to 4 feet above the ground on piles, and provided with a verandah and a stone hearth in the middle of the floor—such is the true Lissoo hut. The roof is thatched with grass. A large iron pot, a few wooden bins or bamboo baskets to hold grain, and some bamboo tubes to hold water or honey, with occasionally a few rude stools and a rude loom for weaving their hempen garments—such is the furniture which supplies the Lissoo in his simple life.

THE CROSSBOWS ARE VERY POWERFUL

The crossbow is the characteristic weapon of the country and the Lissoo tribe. Every Lissoo with any pretensions possesses at least two of these weapons—one for every-day use in hunting, the other for war. The little children play with miniature crossbows. The men never leave their huts for any purpose without their crossbows; when they go to sleep the "nu-kung" is hung over their heads, and when they die it is hung over their graves. The largest crossbows have a span of fully 5 feet and require a pull of fully 35 pounds to string them. The bow is made of a species of wild mulberry of great toughness and flexibility; the stock, some 4 feet long in the war bows, is usually of wild plum wood; the string is of plaited hemp and the trigger of bone. The arrow, of 16 to 18 inches, is of split bamboo, about four times the

thickness of an ordinary knitting needle, hardened and pointed; the actual point is bare for a quarter to one-third of an inch, then for fully an inch the arrow is stripped to half its thickness, and on this portion the poison is placed.

The poison used is invariably a decoction extracted from the tubers of a species of aconitum which grows on those ranges at an altitude of 8,000 to 10,000 feet. The poison is mixed with resin or some vegetable gum to the consistency of putty, and is then smeared on the notched point. The "feather" is supplied by a strip of bamboo leaf folded into a triangular form and tied in a notch at the end of the arrow, with the point of the angle outward. The reduction in thickness of the arrow where the poison is placed causes the point to break off in the body of any one whom it strikes, and, as each carries enough poison to kill a horse, a wound is invariably fatal. Free and immediate incision is the usual remedy when wounded on a limb or fleshy part of the body, but at Cheng-ka the uncle of the Lao-wo chief showed us a preparation which resembled opium dross, and which he said was an effective antidote. Its nature and preparation is a secret known only to the prophets. We saw one man at Cheng-ka who had been wounded through the fleshy part of the arm in a fight, and through the use of the remedy had quite recovered, but in its passage the head of the arrow had not broken off.

The marvelous Chinese stories which one hears of the Lissoo have to be taken with a good deal of salt. The Lissoo are not a fighting people, and, with few exceptions, seemed to us to be arrant cowards, but the crossbow and poisoned arrow is certainly a most diabolical weapon. An arrow from a war bow will pierce a deal board an inch thick at 70 to 80 yards; some of my servants were so expert that they could hit a mark 4 inches in diameter repeatedly at 60 to 80 yards. As no one goes anywhere without his crossbow and his bearskin quiver full of those poisoned arrows, and as every village is at feud with every other, mutual suspicion, of a nature to absolutely prevent social intercourse, is inevitable.

In open fight the Lissoo are usually careful to keep at a respectable distance from each other and behind their three-sided ox-hide shields; these protect the whole body, which is still further safeguarded by a heavily-padded cloth belt extending from the breast down to the hips. But if battle is rare, murder and sudden death by ambush in the jungle are common. The Lissoo has all the lack of self-control which marks the savage, and it is so easy to bend down, string a bow, and send an arrow into any one with whom one has a difference. I can recommend any traveler who falls in with a tipsy or bellicose Lissoo with a crossbow to shoot first and argue afterward. The first step in civilizing these people would be to deprive them of their horrible weapons.

The wild Lissoo are much addicted to strong drink; they make a fermented, not a distilled, liquor out of millet or maize, which resembles strong Japanese saké. They are so improvident they habitually use for wine grain which is required for food.

We were able to lift a corner of the curtain which has hidden them hitherto from the outer world, and I think they may in future be safely left to enjoy in obscurity their dirt, their fever, their limestone ridges, their poisoned arrows, and their wild honey.

THE GREAT NATURAL BRIDGES OF UTAH

By Byron Cummings, University of Utah

We used to be much interested in the descriptions and illustrations in our readers and geographies of the Natural Bridge of Virginia. People travel from all parts of the world to behold this strange natural phenomenon and enjoy the picturesque scenery of the Appalachian Mountains, and feel well paid for their effort. But Utah is the home of really great natural bridges. She astonishes us with not merely one but half a dozen, any one of which surpasses the Virginia structure in grandeur and beauty. The three remarkable bridges—the Edwin, the Carolyn, and the Augusta—which were discovered in Utah several years ago and described in this Magazine,* are now eclipsed by another more marvelous structure in the same State.

Overlying the southeastern part of Utah are the "red beds"—strata of red and yellow sandstone hundreds of feet thick. For the most part this formation rests in a horizontal position; but in places sections lie tipped at an angle of 45 degrees and more, and great faults have occurred. Ages ago this entire region was pushed upward until it checked and cracked in zigzag lines away from the mountains that were formed by the material from beneath being forced upward through the superincumbent sandstone. Thus came into being the La Sals, the Abahos, the Bears Ears, Navajo Mountain, and the many deep canyons radiating from them.

This process of elevation was a gradual one, and, as the waters from the mountains sought a lower level, they took their courses through these irregular cracks and seams, searching for the ocean, which was then not far away. Their rushing currents and surging eddies wore off the sharp corners, sought out the soft places in the yielding sandstone, digging out deep caverns and recesses in the cliffs, and left behind them a series of graceful curves and fantastic forms that amaze and delight the traveler at every turn. As the formation was pushed upward from time to time, these rushing torrents kept on with their work of smoothing, cutting, and filling until they have produced the deep box canyons so prevalent in this section. Sometimes they widen out into small valleys of rich alluvial deposits and again narrow down to a mere slit between huge masses of cliffs.

This elevation and opening of the formation often left a narrow point of the cliff extending outward for rods around which the stream had to make its way as it rushed onward in its course. The constant surging of the waters against this barrier often found a soft place in the sandstone, where it helped to eat out a half-dome-shaped cave. In a few instances, as the waters swirled around the other side of this barrier, they found a similarly soft place opposite the former and ground out a similar half dome on that side. When in the course of time the backs of these two semicircular caves came together, the waters found a shorter course through that opening and quickly enlarged the archway and smoothed off and rounded into graceful curves the sides of the massive buttresses. Thus a bridge was formed and became a mighty span of enduring rock whose foundations and graceful superstructure were laid by the ages.

THE EDWIN BRIDGE

West of the Bears Ears in White Canyon and its tributary, the Armstrong, are three large bridges that have thus been carved out of the sandstone by the forces of nature. A short distance off from the old "Mormon trail" to Dandy crossing, on the Colorado, in Armstrong Canyon, is found the Edwin or Little

* See National Geographic Magazine, vol. xv, p. 368, and vol. xviii, p. 199.

THE EDWIN OR LITTLE BRIDGE: HEIGHT, 108 FEET; SPAN, 194 FEET Photo and copyright by S. M. Young

(SEE ALSO PAGE 166)

bridge. It is a graceful structure, as will be seen from the accompanying illustration, having a span of 194 feet and an elevation of 108 feet. The top of the bridge is 35 feet wide, while the arch in the center is only 10 feet thick. Thus these proportions give an impression of lightness that is very pleasing to the eye. Round about are domes and turrets fashioned by the same forces that produced the graceful lines and curves of the bridge, and nestling in a cave worn in the sunny side of the cliff near one end is a deserted cliff-dwellers' village.

Passing on down Armstrong Canyon about 3 miles, you find your way almost blocked by a projecting cliff that towers above you in amazing proportions. On the right and on the left similar cliffs seem to be elbowing you out of the way. At the right, however, you notice that the barrier has been worn away; but this is many feet above where you now stand and plainly marks the course of a mighty stream that once forced its way among these cliffs.

Continuing on down the bed of the present-day stream, now nearly dry, you find a few rods farther on that you have reached the end of Armstrong Canyon and stand in the shadow of a vast archway which the waters of White Canyon have cut through this barrier that just now seemed to block the course of the Armstrong. This is the Carolyn bridge, a massive archway carved out of the same red sandstone formation and still showing the unfinished work of the artisan in the sharp corners and broken lines of the arch and buttresses. Nature has not yet given the finishing touches to her work, but wind and storm and driving sand will continue to chisel and polish until the lines are all graceful curves, adding greater beauty to this the most massive of the bridges.

The span is 186 feet wide and from the top of the bridge to the bottom of the gorge is 205 feet. The roadway is 49 feet wide and the arch 107 feet thick in the narrowest part, giving such an impression of massive strength and solidity that one marvels at the mighty power of nature's work.

THE AUGUSTA BRIDGE

Turning to the right underneath this arch and passing up White Canyon, winding in and out between lofty cliffs that send out their towers and battlements, and in the hollows of whose seamed and scarred sides are seen the abandoned homes, fortifications, and granaries of an ancient population, after a walk of 2½ miles you stand under the arch of another of nature's wonders, known as the Augusta bridge. It rises before you in graceful proportions 222 feet high and 261 feet between the abutments. The majestic arch is exceedingly regular, entirely spans the canyon, and you can hardly realize that it has not been designedly placed there as a bridge. The thickness of the stone arch is 65 feet and the roadway is 28 feet wide.

The Augusta, therefore, is the queen of the White Canyon bridges. It combines massiveness with gracefulness of proportions to an extent that gives an altogether pleasing and satisfying effect. Sitting within its shadow and gazing up at the mighty arch curving above, you wonder how many ages it has taken to fashion such a magnificent piece of work. You climb to the cliff above and watch the play of sunshine and shades upon the rich reds and light browns of the sandstone that forms its arch and buttresses and comprehend the gracefulness of its outlines and proportions as a whole, and you seem unable to tear yourself away from the spell of its might and beauty. You feel you would like to take up your abode in one of the ancient cliff dwellings near by and become a child of nature again.

To reach this interesting region people from the north and west should leave the Denver and Rio Grande Railroad at Thompsons and take the stage to Moab, a ride of 35 miles. From Moab one must travel by private conveyance to Monticello, 60 miles farther. At Monticello saddle horses and pack animals can be secured for the trip of 50 miles over Elk Ridge to the bridges. Parties coming from the east or south should leave the railroad at Mancos, Colorado, taking

THE AUGUSTA BRIDGE: HEIGHT, 222 FEET; SPAN, 261 FEET

Photo and copyright by S. M. Young

Photo and copyright by S. M. Young

THE CAROLYN BRIDGE: HEIGHT, 205 FEET; SPAN, 186 FEET

Photo and copyright by S. M. Young

THE GREATEST NATURAL STONE ARCH KNOWN—THE NONNEZOSHI ARCH: HEIGHT, 308 FEET; SPAN, 275 FEET

Photo and copyright by S. M. Young

ANOTHER VIEW OF THE NONNEZOSHI ARCH

Photo and copyright by S. M. Young

THE PRITCHETT VALLEY BRIDGE NEAR MOAB: HEIGHT, 49 FEET; SPAN, 122 FEET

the stage to Bluff, a distance of 75 miles. From Bluff one must travel with saddle and pack animals 55 miles northwest to the bridges. Both these routes seem long, hard trips by stage and on horseback, but if one enjoys outdoor life every hour of the trip will be a delight and the atmosphere will prove a veritable "fountain of youth."

THE LARGEST NATURAL BRIDGE KNOWN

By going down the San Juan River from Bluff 25 miles to the new oil town of Goodridge and crossing the river over the new steel bridge now nearly completed, and then taking a southwesterly course of about 50 miles across the country, one may visit the recently discovered natural bridge known to the Indians as Nonnezoshi (the stone arch).

This is the largest natural arch yet found and measures 308 feet in height and 275 feet between the abutments. It extends from a bench on one side across into a cliff on the other and hence spans the canyon in which it is found. This canyon, called by the Indians Nonnezoshi-boko, extends from the slopes of Navajo Mountain northwest and joins the Colorado River a few miles below the mouth of the San Juan. It is a deep, irregular gorge, in places so narrow that one has to walk in the stream in order to make his way along its course. The arch is situated about 6 miles above the mouth of the gorge in an exceedingly picturesque and beautiful part of the canyon.

This region formerly belonged to the Navajo reservation, then was segregated and held open to entry for a time, and now is included in that part of Utah recently set aside as a reservation for the Pahutes. It is seamed by deep gorges extending north and northwest toward the San Juan and the Colorado and broken by high cliffs and stretches of smooth, steep sandstone, so that it is almost impenetrable.

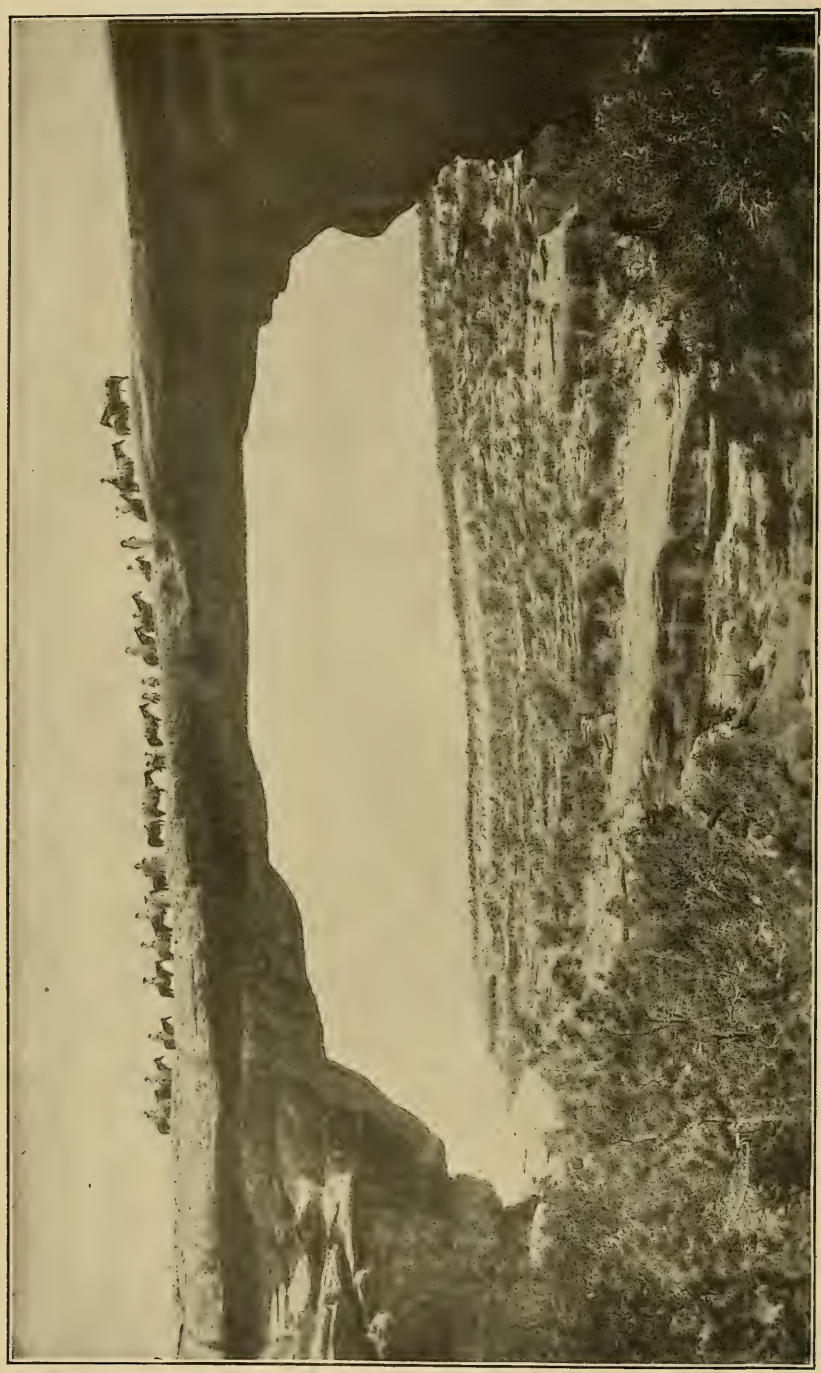
Few even of the Indians are well acquainted with this region. It is celebrated as the place where Hoskinimi, one of the most revered leaders among the Navajo, successfully evaded Kit Carson, in 1866, when the latter taught the Navajo such a terrible lesson; but not even Hoskinimi seems to have penetrated as far as the Nonnezoshi. The members of the Utah Archeological Expedition and of surveying party of the U. S. General Land Office, who visited the bridge together August 14, 1909, are evidently the first white men to have seen this greatest of nature's stone bridges.

As shown by the accompanying illustrations, this remarkable freak in the earth's crust is hardly a bridge in the true sense of the term, but is more properly an enormous flying buttress that has been chiseled out by the ages and left as a specimen of the handiwork of the Master Builder. The surface formation of this section is the same thick bed of red and yellow sandstone found in the region of White Canyon, and Nonnezoshi has been cut out of the cliff in the same manner that the White Canyon bridges were formed. It is a graceful arch, looked at from any position, and is only about 20 feet thick in the narrowest part.

This slender arm of the cliff stretches out across the canyon like a rainbow. In its shadow on the bench at one side are the remains of what was probably an ancient fire shrine. One can easily imagine a group of cliff-dwellers gathered around the sacred fire with offerings to the Sun Father and the Earth Mother. The Pahutes look upon it with awe, and Mr C. A. Colville, who took a party there in November, tells us that their Pahute guide, Whitehorsebiga, would not pass beneath the arch because he had forgotten the prayer that must be said before doing so.

On the slopes of Navajo Mountain you pass two smaller arches that would each be an attraction by itself were they not overshadowed by the grander Nonnezoshi.

In Pritchett Valley, 12 miles by trail southeast of Moab, in Grand County, is a stone arch that plainly has been formed in a different manner from those above described. All about this valley the



THE EDWIN NATURAL BRIDGE: SAN JUAN COUNTY, UTAH Photo and copyright by Chas. Goodman

Span of arch, 194 feet; height of arch, 98 feet; thickness of arch at keystone point, 10 feet; total height, 108 feet; width of roadway on top, 32 feet (see page 158)

thick red and yellow stratum lies on the surface and stands out in weather-worn domes and spires that remind one of an ancient Moslem city.

In numerous places over these bare cliffs large cisterns have formed, into which rush the waters from the surrounding rocks every time a storm sweeps over this region. It happened that in one place where a cave was worn out of the side of the cliff one of these cisterns formed back of it in the cliff above. Gradually the cistern kept growing larger and deeper and the cave kept extending its area backward inch by inch until the bottom of the cistern broke through into the back of the cave near its floor. The rushing of wind and water with every storm has kept enlarging the opening until the arch of the cavern has become a graceful bridge having a height of 49 feet and a span of 122 feet. There are two other similar structures near this where the cisterns broke through at the back of the caves near the top so that you have the arch in front and an immense skylight at the back. The architect has not yet finished the contract. Here natural bridges can be seen in process of construction.

In Dark Canyon, below the western slope of Elk Ridge, is another arch that has been shaped from the cliff under conditions similar to those that produced the natural bridges in Pritchett Valley. Its span of more than 100 feet forms a regular curve on the side of a slope heavily wooded with pinion and cedar.

The above are the most striking examples of the great natural arches of southern Utah. They should be classed among the world's wonders.

THE SOUTH POLAR EXPEDITION

To the Members of the National Geographic Society:

ON February 1 Commander Robert E. Peary made a proposition to the Board of Managers of the National Geographic Society that the Society and the Peary Arctic Club should together send out an expedition to the South Polar regions to explore the coast of Weddell Sea and, if possible, reach the South Pole via this route. The proposed expedition would leave the United States in August of this year and cross the Antarctic circle about January 1, 1911. Commander Peary offered on behalf of the Peary Arctic Club to place the steamship *Roosevelt,* which it will be remembered was built by the Club specially for polar work, at the disposal of the expedition, provided the Society would assume the initial expense of $50,000. He also proposed that expenses above $50,000 be divided equally between the Peary Arctic Club and the National Geographic Society. He estimates the total expense of fitting out and maintaining an expedition in the South Polar regions for one year at between $75,000 and $100,000.

Commander Peary stated, moreover, that the *Roosevelt* was in very good condition; that she could not be duplicated at present for considerably over $100,000, and that all the equipment of his recent polar expedition, including sledges, fur clothing, and camp equipment, would be placed at the disposal of the party, and that if funds could be found for the expedition Captain Bartlett and the major portion of the members and crew of his last expedition, who were of such invaluable assistance to him in his conquest of the pole, would be glad to take part in the work. He himself was ready to devote his time and energy to planning and equipping the expedition, but could not take command of the party. Captain Bartlett will command the expedition.

Your Board of Managers agreed with Commander Peary that the present is a most opportune time for an American expedition to the Antarctic. A British expedition under Captain Scott will leave England about August, 1910, and spend the year of 1911 in Victoria Land and will attempt to reach the South Pole

SKETCH MAP OF THE SOUTH POLAR REGIONS

from that quarter. Simultaneous observations taken by an American party exactly opposite the English base would be of great benefit to science.

Your Board of Managers referred the matter for consideration to the Finance and Research Committees of the Society. On February 8 favorable reports from these two committees were received by the Society. The following resolution was thereupon unanimously adopted by the Board:

"*Resolved:* The National Geographic Society believes that it is of great importance to science that tidal, magnetic, and meteorological observations shall be obtained at or in the vicinity of Coats Land during the same period that the British expedition under Captain Robert F. Scott, R. N., is making similar observations on the other side of the Antarctic area, 1,800 miles distant, and at the same time that this recently discovered land shall be explored.

"The Society is ready to accept Commander Peary's proposition that it shall undertake jointly with the Peary Arctic Club an expedition to the Antarctic regions, provided that the Board of Managers, after consultation with the members of the Society, finds that the project will receive sufficient financial assistance to warrant the undertaking."

The Board of Managers heartily endorse Commander Peary's project, and, if the resources of the Society were larger, would make an appropriation for the work. All our funds, however, are required at home.

The membership and popularity of the National Geographic Society have been increasing so rapidly that the Association requires additional space for its working force. During the past year the Society has expended about $40,000 in purchasing a frontage of 85 feet on Sixteenth street, with a depth of 90 feet, adjoining its present home. Your Board of Managers propose on this site to erect an additional building which will afford room for the clerical force of the Society and for the future growth of its business. This expenditure will require all of the available funds of the Society.

We realize, however, the unusual opportunity afforded the National Geographic Society by Commander Robert E. Peary for the increase of geographic knowledge of the South Polar regions. We believe not only that the members of the Society should be given an opportunity, but that they should be urged to assist the project.

An American expedition could be equipped at the present time with great economy of money, could benefit by Commander Peary's unequaled experience of polar conditions, and could use the officers and crew picked and trained by him during many years of campaigns on the ice.

As Peary says, "At some sacrifice and cost of time and money on my part, and large cost of money on the part of my friends, a certain capital of experience and equipment has been assembled which has no duplicate, and I feel that it is perhaps a duty not to let that capital be thrown away when a little further expenditure of time and effort will enable it to bring in still greater returns."

As evidence of his desire to see an American expedition despatched in search of the South Pole, Commander Peary has deposited $10,000 in a New York bank as his subscription to such an expedition. This sum had been presented him by Governor Hughes on behalf of the American people February 8 at a large meeting in the Metropolitan Opera House.

No region in the world presents such problems for exploration and the advancement of science as are to be found around the South Pole. Here is a continent greater than the United States and Alaska combined, much larger than Europe, which has been penetrated in only one direction, namely, by Scott and Shackleton from Victoria Land. Even its coast lines are little known. It is believed that the greater part of this continent ranges in altitude from 8,000 to 14,000 feet above the sea, making it probably the largest continental mass above sea-level in the world.

Planted on the fringe of this vast continent of snow and ice are lofty volcanoes like Terror and Erebus, which are belching continually smoke and fire. Here lives the most remarkable bird known to science, the penguin, which lays its egg on a cake of ice in the blackness of a polar night, when the temperature is not less than 30° below zero, and then holds the egg and chick on its feet until the young bird can take care of itself.

A glance at the map shows the dense pack ice which surrounds the Antarctic area and makes the approach to land so difficult from all directions. But the great engines and heavy frame of the *Roosevelt,* which is more powerful than any vessel hitherto employed in South Polar work, should enable her to pound a path where previous ships have been helpless, and thus to carry the American party to an advantageous base. Exactly where this base shall be cannot be determined until the party get in the ice and find where they can go, but Commander Peary proposes that the American expedition should make its headquarters somewhere on the coast of Weddell Sea, probably in the vicinity of Coats Land, which was discovered by Captain Bruce, of the Scottish expedition, in 1904. It is hoped that a base can be found here less than 900 miles from the pole. The primary object of the expedition would be to plant the Stars and Stripes at the South Pole, but for those who seek a different motive, it should be explained that every mile made from Coats Land to the pole would be over unpenetrated and unknown regions.

This section is probably the least known in the Antarctic area. Bruce succeeded in getting within a few miles of the coast, but he did not land. Ahead of him were ice-clad slopes which he believes ascend to a plateau which may be an extension of Victoria Land. All explorations in this region would be absolutely new discoveries and would benefit geology, zoology, and all kindred sciences.

If the plan of exploration outlined above is put into successful execution we hope it will arouse such interest that our government or an association of scientific organizations, or both in combination, will later undertake the exploration and scientific investigation of the entire circuit of the unknown Antarctic regions, including the exploration of Wilkes Land and the verification of discoveries made 70 years ago.

Campaigning against the pole in some respects is easier in the South than in the North. The weather is much harsher and more boisterous in the South, but the working season is longer. The North Pole is surrounded by an ice-covered ocean, which must be crossed in spring, before the ice breaks apart under the summer sun. The South Pole, on the other hand, is situated on a great ice plateau, which may be traversed during almost the entire period of daylight. Thus, while Peary was compelled to complete his dash from the most northern land to the pole and back in a period of less than 60 days, the South Polar explorer has more than 120 days at his disposal, and even this period can be extended by utilizing Peary's methods and equipment.

WILKES' AND D'URVILLE'S DISCOVERIES IN WILKES LAND

By Rear Admiral John E. Pillsbury, U. S. Navy

In January, 1840, two national expeditions were in the Antarctic, one the United States Exploring Expedition, consisting of four ships, the *Vincennes, Peacock, Porpoise,* and *Flying Fish,* under the command of Lieut. Charles Wilkes, U. S. Navy, and the other a French expedition, consisting of *L'Astrolabe* and *La Zélée,* under command of Capitaine de Vaisseau M. J. Dumont d'Urville.

It has generally been accepted by foreign authorities that d'Urville sighted the land of the Antarctic Continent, which he named Adélie Land, on the same day (January 19) that Wilkes discovered land 400 miles to the eastward, which he named Cape Hudson, and also that d'Urville's Cote Clarie, in longitude 131° east, was sighted by him the day before it was seen by Lieutenant Ringgold, on board U. S. S. *Porpoise.*

Investigation shows that both of these assumptions are in error, and in fact d'Urville first sighted Adélie Land the day after Wilkes sighted Cape Hudson, and he sighted Cote Clarie the same day that it was sighted by Ringgold, but at a later hour. The story of the investigation which led to these conclusions will be given in the order in which it was made.

In d'Urville's narrative it is stated under date of *January 29* that at 4 p. m. he sighted one of the ships of the American expedition (the *Porpoise*) and he "hoped that she intended to speak us." Through a misunderstanding of the maneuvering of the French flag-ship, Ringgold thought d'Urville wished to avoid a meeting, and, although but "a cable's length distant" from the ship, he put his helm up and stood off to the southward.

Ringgold states that at 4 p. m. *January 30* he sighted two ships which afterwards proved to be the French vessels. He approached them "within musket shot," when to his surprise he saw them making sail, whereupon he hauled down his colors and stood off before the wind.

The discrepancy in dates was not noticed in reading the narratives, but, wishing to see just where the meeting of the ships took place, their tracks were plotted on the same chart, when it appeared that the noon positions (d'Urville's January 29 and Ringgold's January 30) were near each other, and that the tracks crossed in the afternoon.

The discrepancy in dates seems to be remarkable, since both expeditions had crossed the 180th meridian from east to west some months before and had sailed for the Antarctic — one from Hobart Town, Tasmania, and the other from Sydney, Australia, where the dates must have been identical.

We find in Wilkes' narrative, volume 2, page 159, this statement: "On crossing the meridian 180° we dropped the 14th of November, in order to make our time correspond to that of the Eastern Hemisphere, to which our operations were for some months to be confined."

That d'Urville made no change of date in crossing the 180th meridian, but maintained the same chronology, appears from d'Urville's narrative, "Routes des Corvettes," volume I, page 134, where, under date of October 13, 1838, the longitude is given as 179° 31′ west, and on page 136, under date of October 14, 1838, it is given as 178° 53′ east. He therefore made no change of date in crossing the 180th meridian, as otherwise the second date would have been October 15 instead of October 14.

Further investigation of d'Urville's daily positions shows that every day is accounted for until June 22, 1840, which appears in volume 1, page 340. On page

342 appears the date of June 24, with an asterisk, and at the bottom of the page is this note:

"Nous reprenons la date d'Europe,"

so that the date he dropped was June 23, 1840, five months after the visit to the Antarctic and more than twenty months since he crossed the 180th meridian.

This means that in d'Urville's narrative of his discoveries and on the chart of his Antarctic voyage every noon position must have its date advanced one day in any comparison to be made with the noon positions and the discoveries of Wilkes' ships.

Wilkes believed that he sighted the Antarctic Continent on January 16, 1840, at about 158° east longitude. On January 19, however, he states that "land was now certainly visible from the *Vincennes*, both to the south-southeast and southwest, in the former direction most distinctly. Both appeared high," etc.

D'Urville says, in volume 8 of his narrative, under date of January 19 (which should be January 20, to correspond with Wilkes' time), "At 9 a. m. we saw in the E. S. E. a great black cloud, which seemed stationary and had the appearance of a raised island." "Toward 3 p. m., M. Gervaize, who was officer of the watch, thought he saw once more an indication of land in the east." "At 10:50 p. m. this luminary (the sun) disappeared and showed up the raised contour of the land in all its sharpness." This land on January 21 (true date, 22) he named Adélie Land.

Returning now to the meeting of the *Porpoise* and the French vessels. On the day following the meeting d'Urville reports: "At 6 o'clock the man on lookout had sighted the ice pack to the south and I brought the ship to the wind in order to go nearer to explore it. At 10 o'clock we were not more than three or four miles distant. It appeared prodigious. We saw a cliff with a uniform height of 100 to 150 feet, forming a long line westward," etc.

It will be noticed that at 6 o'clock the *ice pack* and not the *barrier* was sighted.

Wilkes' narrative of the movements of the *Porpoise* for this day states: "The beginning of the 31st the gale continued; at 7 a. m., moderating, they again made sail to the westward; in half an hour discovered a high barrier of ice to the northward, with ice islands to the southward; at 10 a. m. they found themselves in a great inlet formed of vast fields of ice which they had entered twelve hours previously; the only opening appearing to the eastward, they were compelled to retrace their steps, which was effected by 8 p. m." "They now found themselves out of this dangerous position, and, passing the point, kept away to the westward."

"February 1.—The immense perpendicular barrier encountered yesterday was now in sight trending as far as the eye could reach to the westward," etc.

The *Porpoise*, therefore, at 7:30 a. m., January 31, was in the entrance of the great inlet on the southeast side of d'Urville's "Cote Clarie," and had sighted the high barrier of ice, the northern side of which d'Urville reached about 10 o'clock the same forenoon.

It is established from this investigation that, even if Wilkes' sighting the Antarctic Continent on January 16 is not admitted, it is certain that he did sight Cape Hudson a day before d'Urville sighted Adélie Land, and that Cote Clarie was sighted by the *Porpoise* on the same day that it was seen by d'Urville, but at an earlier hour.

Wilkes cruised along the coast of this continent for more than 1,600 miles from his first landfall. Future exploration may, and, indeed, probably will, find that much of the land discovered by him was placed too near the barrier, or, in other words, too far north, for it is well known that distance estimated by the eye is liable to great error, and particularly is this the case in the polar regions.

Whether this proves to be so or not, this investigation establishes Wilkes' priority over d'Urville. The English sealer Balleny, in 1839, got a glimpse of land in about 121° east, but all he says regarding it is, "Saw land to the south-

ward." Neither d'Urville nor Balleny had any notion nor made any suggestion that they were on the edge of a continent. Wilkes, on the contrary, not only sighted at frequent intervals some 1,600 miles of this coast, but he recognized that it must be part of a continent. The name he gave to this land, the Antarctic Continent, must belong to the entire continent the existence of which he revealed. Some geographers have recognized that part of Antarctica he discovered needed a special name and therefore gave it the name of Wilkes Land. When it is remembered that Wilkes changed the conception that the Antarctic was an ocean by demonstrating that it was a continent, the least that his discoveries demand is that the name of Wilkes Land be retained on all of Antarctica lying between the longitudes of 95° and 158° east.

THE GREAT ICE BARRIER

By Henry Gannett

In his notable expedition of 1840 to the Antarctic, James Ross discovered a great ice cliff rising from the sea to an average height of nearly 200 feet and stretching from King Edward VII Land to South Victoria Land, a distance of about 400 nautical miles. Of its origin nothing was known, and, although later expeditions also visited it, they added little to our knowledge. It was not until Scott, in 1902, and Shackleton, in 1907, made their remarkable sledge journeys in the interior of Antarctica that the nature of the Great Ice Barrier became known.

The barrier is simply the southern limit of a great sheet of ice extending southward up a great bay which penetrates the land at least 300 miles and possibly double that distance. Indeed, it is possible that it may extend entirely across, joining with Weddell Sea on the opposite side and dividing Antarctica into two continents. From the barrier southward this bay, with a known area of at least 100,000 square miles, is entirely occupied by this ice sheet. It is bordered on the west by high mountains from which stretches westward a still higher plateau, which reaches an altitude of over 11,000 feet at Shackleton's farthest southern point. The land on the east side of the bay is unknown, except at the point of King Edward VII Land, where the barrier joins it, but it also is probably mountainous.

From the high land on the west side numerous glaciers descend to this field of ice. Notable among them is that by which Shackleton ascended to the summit of the plateau in his wonderful sledge journey toward the South Pole, a glacier 100 miles long and 50 miles wide, with a descent of 8,000 feet. From the east side of the bay, and especially from its south end, probably other great glaciers contribute to the great ice field.

The name "Great Ice Barrier," originally applied only to the ice cliff forming its northern limit, has been extended and applied to the ice field itself, and even to the bay which it covers. It is unnecessary to say that these extensions in the application of the name are inappropriate, and it is to be hoped that suitable names will be selected for these features. I would suggest for the ice field the name of Shackleton glacier, since Shackleton has made the most extensive explorations of it and its surroundings; moreover, I hope to show that it is in truth a glacier, although both Scott and Shackleton refuse to accept that explanation of the phenomenon. It is their belief that it has been formed from snow falling upon its surface much as the sea-ice of the Arctic is formed. But sea-ice nowhere accumulates to any such thickness as this or presents an ice wall at its borders.

On the other hand, every glacier that reaches the sea presents just such an ice wall. There are scores of such glaciers on the Alaskan coast, and probably hundreds on Greenland, Grant Land, and Spitzbergen, whose fronts extend out into the sea, even into water so deep that they must be afloat, as is much of the barrier.

The snow which falls upon the surface of this ice field could not possibly supply the waste from the barrier, and another source of supply must be found. This supply is in the numerous and large stream glaciers which bring down the ice from the highlands on the east, west, and south of the bay. The area thus drained must be enormous—amply sufficient to maintain the supply.

The fact that this great ice field is moving northward at the rate of about one-third of a mile a year, as ascertained by Shackleton, would seem in itself as a conclusive demonstration that it is a glacier. Sea-ice, unless driven by wind or currents, is quiescent, while the glacier always moves toward lower levels.

Thus Shackleton glacier is a great mother glacier, into which drains the snow and ice from enormous areas of highland. This glacier collects the ice and transports it northward to the Great Ice Barrier, where it is dropped as bergs into Ross Sea.

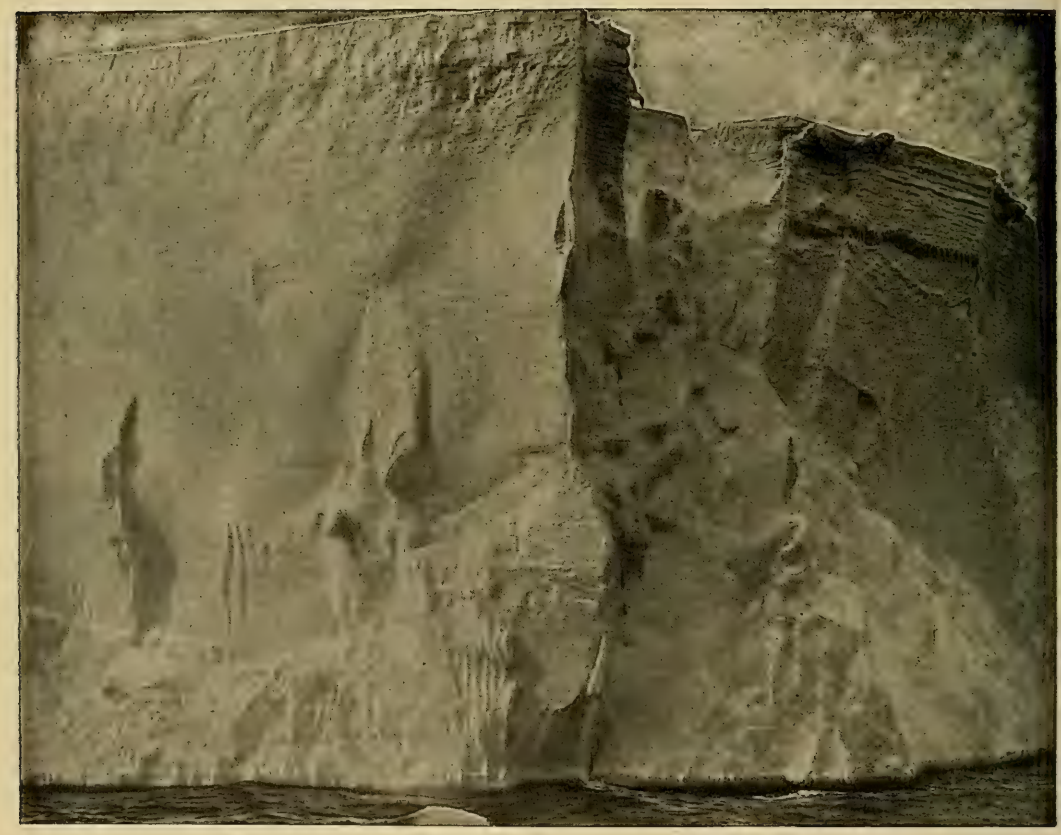


Photo from Capt. Robert F. Scott, R. N.

FRONT OF THE GREAT ICE BARRIER

THE BARRAGE OF THE NILE

By Day Allen Willey

THE most historic and one of the greatest inland navigation waterways is the Nile, the river and its tributaries affording over 4,000 miles suitable for the passage of steamers and other craft between North and East Africa and Cairo.

The head of the navigable waterways may be said to be the town of Gondokoro, on the White Nile, about 1,000 miles above the city of Khartum. Gondokoro is the terminus of several caravan routes extending into the Congo, as well as Uganda and Unyoro. Small steamers ply upon the water-courses between Khartum and Gondokoro, connecting at the former city with steamers for Cairo. In recent years tourists have extended their trips from the Lower Nile as far as Gondokoro, but the rivers are utilized principally for the transportation of products from the territory beyond Gondokoro and to Khartum.

There is one very serious obstacle on the section of the Nile between Khartum and Gondokoro which has at times obstructed the channel so that continuous navigation has been delayed months at a time. This is the vegetation growth known as sudd, which is a translation from the Arabic term El Sett.

On one occasion the channel was blocked by a bar of sudd which actually measured 25 miles along the channel, while within a distance of 150 miles were three more growths aggregating no less than 60 miles. A fleet of vessels especially equipped and a large force of men were working continually for nearly six months before an opening large enough for the smallest river steamer could be made through the mass.

In studying the growth the investigators have found that it is more rapid under certain conditions. For example, it spreads very rapidly after an unusually extensive flood in the upper rivers, which carry down such an amount of sediment and vegetation, while when the rainy season is short the growth is checked considerably, and the current in the upper rivers is usually strong enough to carry out the young vegetation before it becomes dense enough to be able to resist the action of the water.

Since the obstruction of the Nile has such a serious effect in interrupting the transportation between upper and lower Egypt and in cutting off what is really a route between Cairo and Mombasa, the Egyptian government has built a fleet of steamers and barges especially constructed for removing the sudd and retains a large force of men in removing and destroying the vegetation. These vessels are stationed at different points on the Upper Nile, so that they may reach an obstruction without delay.

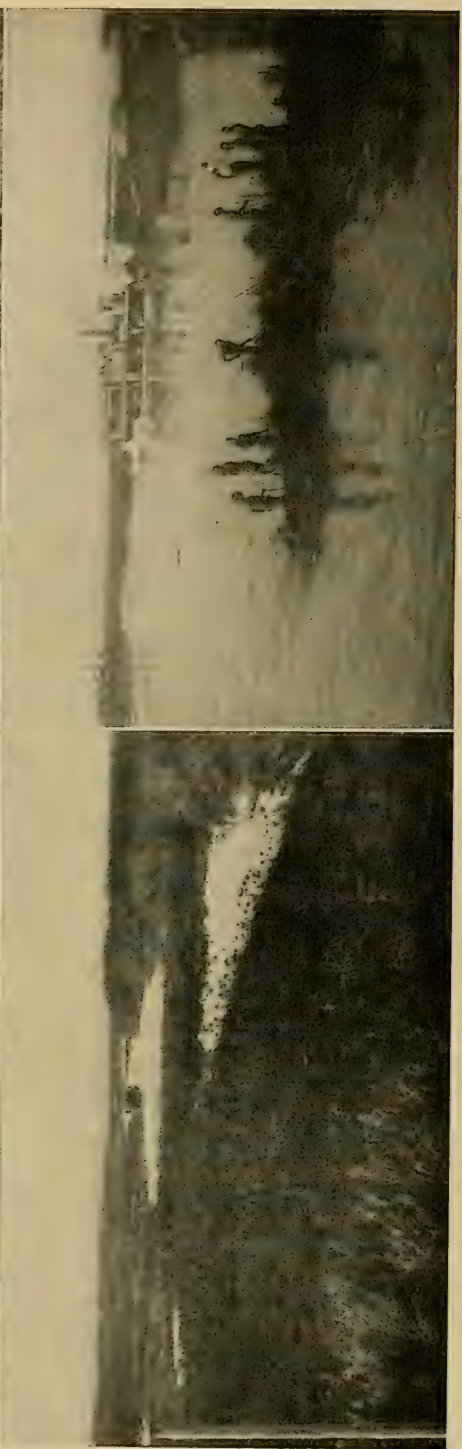
In clearing the river channel of sudd the engineers have devised several schemes. The top growth frequently becomes so dry that they can burn it over like so much grass. This removes much of the weight of the plants, but they are so matted together that saws are actually used to separate the growth, as it cannot be removed in any other way. The vessels employed for sudd clearing, while light-draft boats, are strongly built and have blunt bows, so that they can be forced against the bank of vegetation. They are provided with steel cables or hawsers, saws, and axes, and carry crews of natives who are experts in working upon the sudd.

The way in which the channel is cleared is as follows: Often the water is so completely hidden that the first difficulty when you are encountered by a barrier of sudd is to discover where in this sudd the river bed runs. This is done by "sounding" through the sudd with long poles. The average depth of water in the sudd may be only a few feet, but when the actual river bed is reached this suddenly increases to a

VILLAGE SCENE ON THE NILE NEAR GONDOKORO

SCENE ON THE NILE ABOVE KHARTUM

A SUDD SWAMP ON THE EDGE OF THE NILE, SHOWING THE DENSITY OF THE VEGETATION: CUTTING OFF THE TOP TO DESTROY IT: THE RIVER IS FLOWING BENEATH



SUDD-CLEARING STEAMER TEARING OUT THE OBSTRUCTION WITH STEEL CABLES

HOW SUDD BLOCKS THE NILE CHANNEL: A VIEW OF A BAR OF IT ACROSS THE RIVER, WITH A STEAMER HELD UP

A SUDD ISLAND IN THE CHANNEL, SHOWING HOW IT SUSTAINS WEIGHT ON ACCOUNT OF ITS DENSITY

THE SUDD IS SO DENSE AT TIMES THAT IT IS NECESSARY TO CUT OFF THE TOP GROWTH OR BURN IT OFF BEFORE PULLING THE MASS APART

SUDD-CLEANING STEAMER RUN INTO A MASS OF IT TO TEAR OUT THE GROWTH: THE BOW OF THE BOAT CAN BE SEEN IN THE LEFT-HAND CORNER OF THE PICTURE

SUDD-CLEARING STEAMER TEARING OUT THE OBSTRUCTION WITH STEEL CABLES

THE TOP OF A SUDD GROWTH REMOVED AND READY TO BE PULLED TO PIECES TO CLEAR THE CHANNEL

TOWING OUT A MASS OF THE GROWTH FROM THE CHANNEL

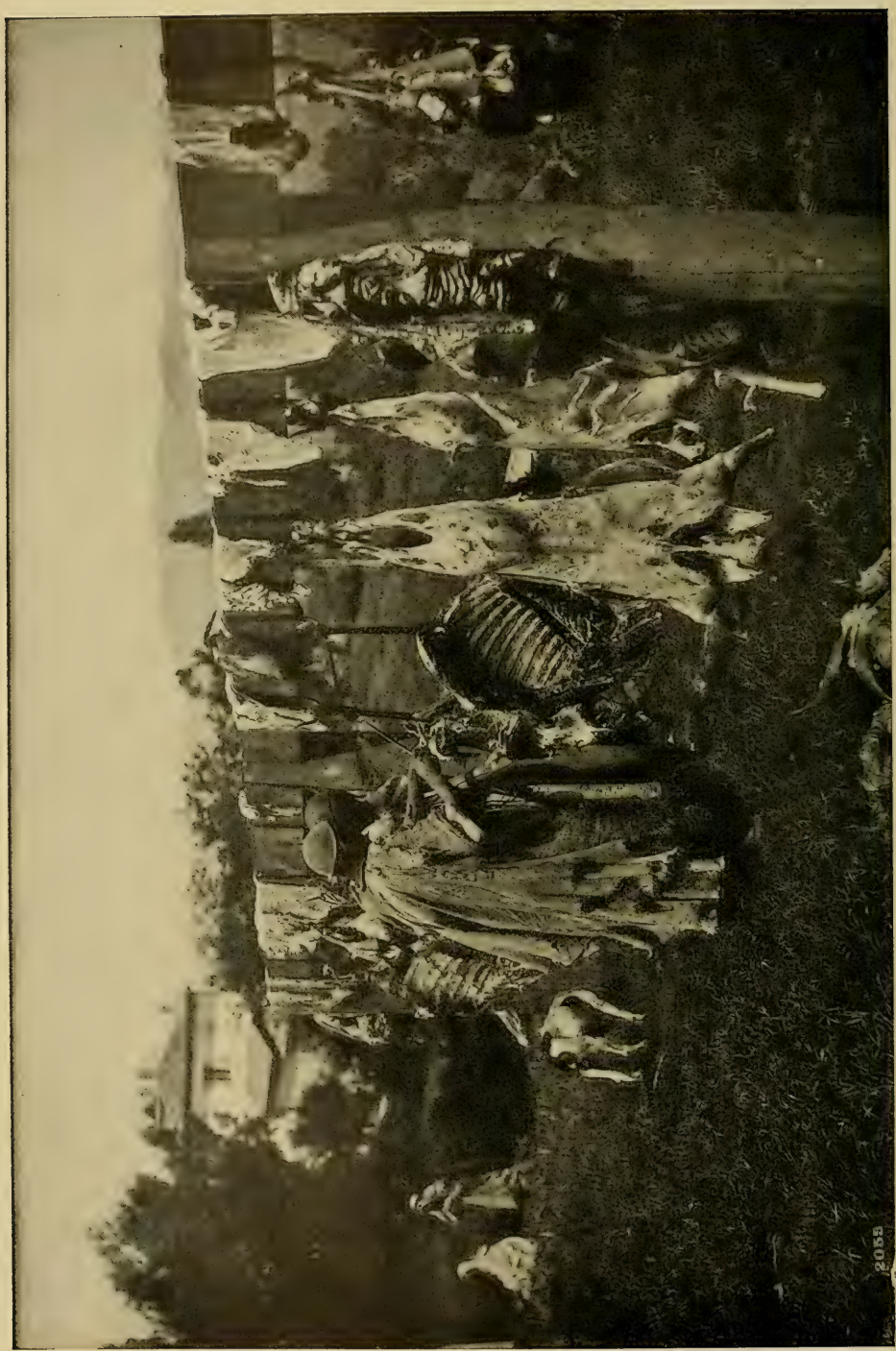


Photo from Bishop J. C. Hartzell

A MARKET SCENE IN NORTH AFRICA

A GIRL OF NORTH AFRICA Photo from Bishop J. C. Hartzell

depth of 15 to 18 or 20 feet. Having found the real river bed, the first thing to do is to cut down or burn the top growth, consisting mostly of papyrus.

Having cleared the top of the sudd "block," the men are landed with large saws to cut along the true river bank, which may be either submerged with a few feet of water over it and papyrus and sudd on it, or solid ground with ant heaps, the solid ground never being of any great extent and always surrounded by swamp. Cross and parallel cuts with the saws are then made through the sudd, dividing it into blocks of a convenient size for the steamer to tear out, the size of these blocks, of course, depending on the consistency of the sudd and the power of the steamer.

Having cut the sudd into convenient blocks, the bow of the steamer is run into the block, a loop of steel hawser is placed around it, when the rods of the cable are passed over the bows of the steamer. Here it is taken by the men on board and placed in what is called the trench cut, and held down with their feet. The steamer then goes full speed astern, the men all standing on the hawser to keep it in position. In the case of tough sudd, as many as twenty trials may have to be made before the block of sudd eventually tears away.

When the block is torn out, the steamer goes slowly astern till the mass is pulled clear into the current, if there is one, when it is cast adrift to float downstream, where it is gradually disintegrated. If there is no current, it is towed to a piece of open water, where as a temporary measure it can be tied by ropes to the bank, leaving a wide enough channel for the steamer, and on the appearance of a current to be cut adrift to float downstream.

While the composition of the sudd is usually the water papyrus, it is mixed with what is called elephant grass—a kind of bamboo growing to a height of 20 feet or more. To these climbs a creeper of a kind of convolvulus. Another portion of the sudd consists of ambatch and a long sword grass that cuts like a knife.

Strange as it may seem, the sudd interferes but little with the flow of the river, and the Nile passes under it with little resistance. This is because the growth is principally near or on the surface. As the river is over a mile wide in some places and the deep channel may be only a hundred feet, it is often hard to tell where to find the channel to clear it, as all of the water may be hidden.

The density of the vegetation even in deep water is remarkable. Again referring to the photographs, these show how the men can walk over it without sinking into the mass, such is its tenacity and strength. Animals such as the rhinoceros have been seen crossing the Nile upon this great water carpet, which is woven as deftly and strongly as by the loom.

NATIONAL GEOGRAPHIC SOCIETY

LIEUT. SIR ERNEST H. SHACKLETON, who will spend April and May in the United States lecturing, will address the National Geographic Society March 26. President Taft will attend, and at the conclusion of the lecture, on behalf of the National Geographic Society, will present to Lieutenant Shackleton the Hubbard Gold Medal of the Society, which was awarded him some time since for his important explorations in the South Polar regions in 1908-1909.

March 4.—"A New Era for the South." Dr Charles W. Stiles. The speaker will describe the methods by which science and money hope to eradicate the hookworm, or "lazygerm."

March 11.—"The Waste of Human Life and Resources in the Mining Industry." Mr Joseph A. Holmes, of the U. S. Geological Survey. Dr Holmes will tell of the Government's efforts to stem the tide of fatalities, in which the United States leads the world at a ratio of three to one, and the Government's effort to devise ways of saving the great waste, not only of human life, but of our coal, gas, and other mineral resources. Illustrated.

March 18.—"The Panama Canal." Colonel George W. Goethals, Chief Engineer of the Panama Canal. Illustrated.

March 25.—"The Spirit of the West." Mr C. J. Blanchard, of the U. S. Reclamation Service. The wonderful agricultural development of the West since the work of irrigation was started by the Government and private enterprise. Illustrated and moving pictures.

March 26.—"Nearest the South Pole." Lieut. E. H Shackleton. Illustrated.

April 1.—"Patagonia to Paraguay—or the Story of Argentine." Mrs Harriet Chalmers Adams. Illustrated.

April 8.—"The Pearl Fisheries of Ceylon." Dr Hugh M. Smith, Deputy Commissioner, U. S. Bureau of Fisheries. Illustrated.

VOL. XXI, No. 3 WASHINGTON MARCH, 1910

THE NATIONAL GEOGRAPHIC MAGAZINE

THE RACE FOR THE SOUTH POLE

INTEREST in the American expedition to the South Polar regions has been very much increased during the past month by the coming to the United States of Sir Ernest H. Shackleton. This distinguished explorer gave his first lecture in America in Washington, March 26, to 5,000 members and guests of the National Geographic Society. At the conclusion of the address the President of the United States, on behalf of the Society, presented him with the Hubbard Gold Medal of the National Geographic Society, recently awarded Sir Ernest for his important discoveries in the Antarctic regions and for gaining farthest south—88° 23′—January 9, 1909.

"No private citizen has ever received a more auspicious welcome to America. Statesmen, diplomats, scientists, artists, men of letters, and men of distinction in every walk of life united in a great chorus of greeting to one of the most distinguished Englishmen of the present day. The audience included the President of the United States, Commander Robert E. Peary, the Ambassador of Great Britain and the entire staff of the British Embassy, the ambassadors of France, Germany, Japan, and Mexico, the ministers of Costa Rica, Portugal, Norway, The Netherlands, Denmark, Switzerland, and Sweden, the Secretary of the Treasury, the Secretary of War, the Secretary of the Navy, the Secretary of Commerce and Labor, the Admiral of the Navy, and many Members of Congress. Shackleton bore the honors crowded upon him with the spirit which he has shown since he emerged from the Antarctic regions nearly a year ago—with modesty and simple grace."

The expedition which formed the subject of his address has been fully described in previous numbers of the NATIONAL GEOGRAPHIC MAGAZINE.* Sir Ernest will repeat his lecture in many parts of the United States during April, May, and June.

His narrative is one of the most inspiring stories of adventure and accomplishment ever told, the courage, wit, pluck, resourcefulness, and good comradeship of the leader and his men making a most thrilling tale. Particularly interesting are moving pictures of the strange penguin, a bird 4 feet in height and weighing 90 pounds, which cannot fly and waddles something like a seal.

Lieutenant Shackleton holds the record, not only for getting 400 miles nearer the South Pole than any of his predecessors, but also for the unparalleled importance of his contributions to scientific knowledge of conditions in the far south. The cost of his expedition was much greater than the funds he had personally raised, so that when he returned to England in 1909 he found himself $175,000 in debt. The British government knighted him for his achievements and made him a grant of $100,000. The balance he is now paying off by lectures and by his book, "The Heart of the Antarctic."

* NAT. GEOG. MAG., April and November, 1909.

PRESENTATION OF THE HUBBARD MEDAL BY PRESIDENT TAFT

Sir Ernest Shackleton: It is my pleasant duty to represent the National Geographic Society in presenting to you the evidence of its high appreciation of the marvelous work that you have done in the cause of science; and the endurance, courage, and intelligence shown in the pursuit of a definite object. I am sure that you will the more appreciate this medal, as it comes from the National Geographic Society, that has among its prominent members that distinguished American, Commander Robert E. Peary, who, while you were working at the South Pole, was himself surrounding the North Pole.

I do not know that nature had in mind the variety that was to be added to the lectures by the differences between her at the North Pole and at the South Pole, but certainly the different character of the surroundings of the North Pole and the South Pole make of entrancing interest the stories with respect to both.

You will permit me, therefore, to have the honor of handing you the medal of the Society, which gives its evidence of how highly they appreciate your services to science and to mankind.

RESPONSE BY SIR ERNEST SHACKLETON.

Mr. President: It is a very great honor for me to have this medal from the National Geographic Society, and especially as it is given to me by the hands of the distinguished President of the United States. It could not mean more for me than to have it given in this way in this great hall. But while I am standing I would like to say that Commander Peary will have as warm a welcome over in England as I have received from your great American society tonight. Commander Peary's work belongs not only to America, but to the world.

We are all pleased, and we wish, of course, a good measure of success to any forthcoming American expedition to the South Polar regions, because they have got a very hard job to tackle on the other side.

And, sir, I thank you. It is a very great honor to me. I thank you very much for having presented this medal.

THE RACE FOR THE SOUTH POLE

During the past month each member of the National Geographic Society has received an invitation to subscribe to the American expedition to the South Pole under the auspices of the Peary Arctic Club and the National Geographic Society. Such generous responses have been received from a large body of the members that it is believed the expedition will be able to leave in September.

Sufficient funds at this writing have, however, not been secured, and those members of the Society who are interested in the work and have not yet sent in their subscriptions are earnestly requested to do so immediately. The subscriptions range from $1.00 to $500. While large subscriptions are welcome, the Society hopes that all members will be sufficiently interested to subscribe from $1.00 to $5.00.

The reasons why an expedition should leave this year are as follows:

1. The expedition can be equipped at approximately one-half the cost necessary to equip an expedition any other year, owing to the fact that the *Roosevelt* and all the material used on Commander Peary's last expedition are immediately available.

2. Peary's four lieutenants—Captain Bartlett, George Borup, McMillan, and Doctor Goodsell—and practically the entire crew of the last expedition are eager to join the American South Polar Expedition, provided it can leave this year. The American party could thus take advantage of men whose experience in polar work is unequalled.

3. From a scientific point of view, tidal and magnetic observations obtained at the same time that the English expedition are making simultaneous records on the other side of the South Pole will be vastly more important than if taken during another year, when there is no other expedition in the south. Similarly the work of the British expedition will be benefited by the American.

4. As Sir Ernest Shackleton has said, every step taken by the American expedition from its proposed base on the shores of Weddell Sea will be an entirely new discovery. No region in the world offers such an opportunity for the acquiring of new knowledge.

ROMANTIC SPAIN*

By Charles Upson Clark, of Yale University

SPAIN is still almost a *terra incognita.* The stern and yet fascinating country whose sons once dominated Europe and brought their language and their civilization to the western world has not yet been spoiled by the tourist. Cut off from the rest of Europe by the Pyrenees and the sea—forming, in fact, a detached bit of Africa—Spain has gone on through the centuries preserving countless ancient traits which give her life and people a peculiar stamp.

Since Spanish railways and hotels make traveling almost as simple a matter as in Italy, and the people are fully as courteous and honorable as any other, the American need not hesitate to include Spain in his itinerary, and may look forward to a wonderfully interesting experience. He will not, however, get the full benefit of it unless he is at home in Spanish history and not wholly ignorant of the language.

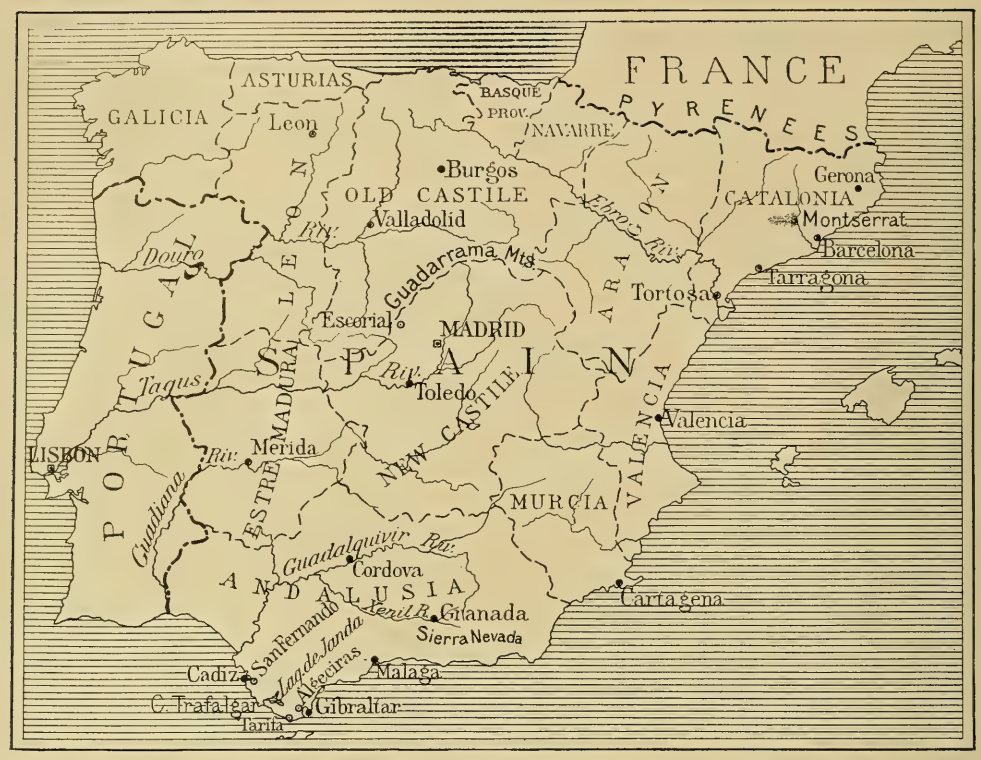
Nowhere else does the past, with its great warnings against pride, intolerance, and extravagance, so impress even the casual passer-by; and one is about as likely to find an English-speaking person in Spain as to find one who knows Spanish in New England.

Journeying into Spain from France, the traveler is promptly notified by a change of gauge at the frontier that even the railroads in Spain are different. Their gauge is over a foot wider than that of central Europe and of America; so passengers must change cars and freight be transshipped. This wide gauge is a great advantage, and American railroad men sigh for it. It enables more powerful locomotives and more capacious cars to be used, though the Spaniards have not yet risen to their opportunities. Their railway equipment is in general behind the times, although one or two through trains are equal to the best elsewhere, and I remember seeing a new Munich locomotive so powerful that it whisked twenty loaded passenger coaches up a grade with little effort.

By noticing the plaques on the engines, which tell when and where they were made, one can watch on Spanish railways the entire development of the locomotive. They come from everywhere, and seem never to be made into scrap. I have seen engines dating from the 50's still in use, and it was especially interesting to see machines which announce that they hail from Gravenhausen, Département du Bas-Rhin, thus proving that they date from before 1870, when Alsace became German territory.

European railroad practice is far behind ours in the use of air brakes on freight trains, and Spain is especially backward here, since few of her freight cars have even hand brakes. That leads to amusing methods of switching cars. When a brakeless car is started down its track the brakeman runs beside it and sets pebbles on the rail before it. These soon overcome its momentum. In the Madrid yards one sees a refinement of this system. At the end is a track running at right angles across the others; on this moves an electric engine, pushing a large platform on wheels, like one of our turn-tables. By means of a chain and capstan, the engine hauls the car to be switched upon this platform, and then pushes the load to the proper track. The car, when released, has considerable momentum; when the brakeman wants to stop it, he sets an ingenious iron shoe on the rail in front of the car. The car mounts the shoe, which is thereby knocked off the track; the brakeman

* The illustrations are from photographs by the author unless otherwise indicated.



SKETCH MAP OF SPAIN

picks it up, runs ahead and repeats the operation. Needless to say, the car soon stops.

The Spanish railways have the best mileage-book system in the world; the more mileage you buy, the lower is the rate per mile (or, rather, per kilometer) and the longer the validity. One book is good for a family or members of a firm. If one plans to travel several thousand miles, it is possible by the use of these books to ride first-class (that is, Pullman accommodations) for not much more than regular third-class rates.

But travelers who know a little Spanish and have learned by experience in other lands that the genuine people, whom one comes to know, travel third-class, go in with them, regardless of bare wooden seats and crowded quarters. One can be very comfortable with a rug or two; and, instead of sophisticated French-speaking travelers, one has as neighbor an intelligent Castilian farmer, who uses an American harvester and whose wife has an American sewing machine, and who laments Spanish illiteracy and official corruption as the chief cause of her troubles; or it may be a Barcelona commercial traveler, who lays Spain's ills—which all admit, saying, "Pobre España!" (poor Spain)—to her highly centralized administration, which taxes the whole country, and especially rich and populous Catalonia, for Madrid office-holders.

The ancient divisions of Spain, for centuries independent and often hostile countries, still hold somewhat aloof from each other. The Catalans even speak a different language, allied to Provençal, as different from Castilian as Dutch is from English. They are an enterprising

Photo and Copyright by Underwood & Underwood

THE GREAT BRIDGE WHICH SPANS THE GORGE OF THE GUADALEON AT RONDA, AND CONNECTS OLD AND NEW RONDA AT A HEIGHT OF 400 FEET

Photo and Copyright by Underwood & Underwood

FARM-HOUSE RESEMBLING SWISS CHALET, TYPICAL OF THIS SECTION OF COUNTRY: LAMONA, SPAIN: THE OXEN ARE YOKED BY THE HORNS

Photo and Copyright by Underwood & Underwood

HOW THE DATE ORCHARDS OF ELCHE ARE WATERED—AN IRRIGATION CANAL AMONG THE FRUITFUL PALMS: SPAIN

Photo and Copyright by Underwood & Underwood

LOOKING ACROSS THE HALL OF THE TWO SISTERS TO THE "WINDOW OF LINDARAXA"

The tall vase in the right hand corner is the "Alhambra Vase," said to have been found full of gold after the flight of the last Moorish king. The figures are dressed in the costumes of the days of the Moorish kings (see page 214).

Photo by Louise Coleman

DANCING GIRLS OF SEVILLE

commercial and manufacturing people, and the country is dotted with cotton mills and factory chimneys.

As one comes from the north, the first important town is Gerona, memorable for the heroic defense against the French a century ago. The besiegers even poisoned the river. The city has several ancient churches, one with an old baptistery beside it, which a utilitarian age has turned into a lumber-room.

Barcelona, Spain's largest and busiest city, is a most attractive place, possessing the best climate in the western Mediterranean—more equable than that of Nice. A stroll along the Rambla, the chief boulevard, is full of interest. This part of it, the Rambla dels Flors (in Catalan, "of the flowers"), is given up for some blocks to flower booths. Just beyond are many-colored birds, twittering away in little wooden cages. One can take a delightful ride on the top of a double-decked trolley car to the Tibidabo, a pine-covered hill overlooking the city and its magnificent harbor.

A few miles down the coast is Tarragona, whose stately aqueduct is a reminder that she was the chief city of Roman Spain. In her museum is an old Roman grain mill, on which a humorous boy once cut in Latin: "Work, little donkey, the way I worked, and much good 'twill do you."

A few hours further south lies Tortosa, on the Ebro, the only large river in Spain emptying into the Mediterranean. Its waters are largely diverted into irrigation canals, which make the fields and gardens a delight to the eye; and the combination of date palms and waving wheat shows what a variety of products the country produces. One can still see on the streets huge jars which remind one of Ali Baba and the Forty Thieves, and in the wine stores wine is sold in pig-

RAMBLA DELS FLORS: THE PRINCIPAL BOULEVARD OF BARCELONA

VIEW OF GERONA (SEE PAGE 193)

skins, calked with pitch, which gives it a taste much like that of the dilute spruce-gum into which wine degenerates in Greece.

Turning inland one is soon met by the strangely toothed ridge of the Montserrat (about 4,000 feet high). This was the traditional home of the Holy Grail, and its monastery is a famous pilgrimage spot. A cog-wheel railway makes the trip an easy one. Cultured Benedictine monks still dwell under those tremendous cliffs, but their artistic treasures were looted by the French, who have several times found Spain a convenient gold and silver mine. The mountain is endlessly beautiful, with its views over to the Pyrenees and its wealth of vegetation. Its spring flowers are largely of blue color — violets, hepaticas, flax, larkspurs, hyachinths, and many others.

THE COMBINATION OF DATE PALMS AND WHEAT FIELD SHOWS THE VARIETY OF PRODUCTS

Now the train labors up to the bleak highlands of Castile, bare and forbidding. Central Spain is a high plateau, crossed by rugged mountains, scorched in summer and frozen stiff in winter. The Castilian farmer, too poor to purchase fertilizers or drill wells for irrigation, generally leaves the land fallow every other year. Then it seems a barren desert, and one is constantly struck with the contrast of the green wheat-fields on the strips under cultivation.

Here and there shepherds accompany their heavy-fleeced merinos, nibbling even as they cross ploughed land. The good-natured herdsmen, with their rough coats and skin trousers, have not much changed since Don Quixote's day, when the *mesta*, the sheep-owners' corporation, was as despotic as any western ranchers' association. Literally millions of sheep used to be driven across the country in the change from summer to winter pasture; they cropped close all vegetation—Spain's lack of forests is partly their fault—and the *mesta* was legally entitled to the hundred yards each side of the roadway for the sheep to graze upon. It is less than a century since the corporation lost its monopoly and the farmer got his rights.

Seeing León's massive Roman walls and towers, one can easily believe that its name comes from the Roman legions once quartered here. The high church tower in the background is of Saint Isi-

THE ROMAN WALLS OF LEON, SAINT ISIDORE (SEE PAGE 195)

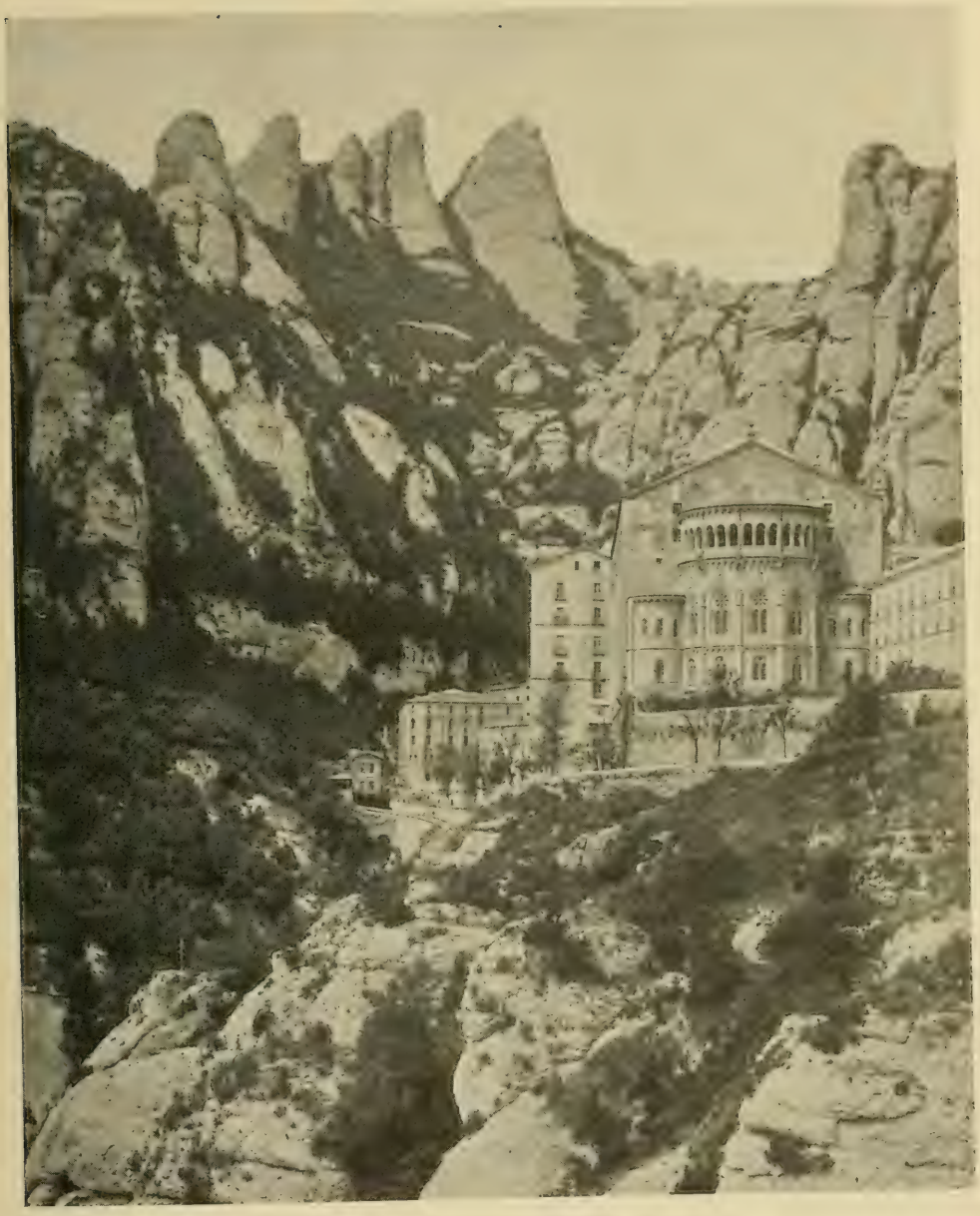
AN OLD BAPTISTRY AT GERONA, NOW USED AS A LUMBER ROOM

THE RUINS OF A ROMAN AQUEDUCT AT TARRAGONA, WHICH WAS THE CHIEF CITY OF ROMAN SPAIN

THE REMAINS OF ANOTHER ROMAN AQUEDUCT: MERIDA (SEE PAGE 205)

ALI BABA JARS AT TORTOSA (SEE PAGE 193)
It was in jars like these that Ali Baba concealed his Forty Thieves

COG-WHEEL RAILWAY UP THE MONTSERRAT (SEE PAGE 195)



THE MONASTERY OF THE MONTSERRAT (SEE PAGE 195)

Photo by Louise Coleman

THE PUBLIC FOUNTAIN IN A SPANISH TOWN

dore; the saint's relics were brought here in 1063 by Ferdinand I of Castile and León.

At the end of the main street, with its lively groups and here and there an ox cart, is the famous cattle market. The mouse-colored oxen are short-horned and much like ours; they are yoked by the horns; skins are used to keep the yoke from galling. In another part of the town a general market is held Saturday mornings. The square is crowded with booths and with peasants buying and selling. The section devoted to local pottery is especially interesting. The peasants dress largely in homespun—they still practise the household arts in Spain. The men wear knee-trousers, and one sees here, as in many parts of Spain and our own Southwest, the *alpargatas*—low canvas shoes with hempen soles.

The Guadarrama Mountains, running across the Castilian tableland, overlook the Escurial, Philip the Second's imposing palace. This was his hobby; to it he devoted millions of dollars, at a time when he was often at his wit's end for money. In its wild, rocky surroundings the enormous pile is extraordinarily impressive. Within, one is shown the funeral niches where rest the kings and queens of Spain, and the chamber where Philip himself died of a loathsome and lingering malady.

More interesting, perhaps, is the wonderful collection of manuscripts. In spite of disastrous fires, the Escurial remains one of the world's great libraries. Many of the manuscripts are illustrated. In one we see our first parents, as a tenth-century Spanish monk pictured them; they eye one another with recriminatory glances; but the serpent, twined about the tree, leaves no doubt who was guilty. Another manuscript, written in 1047, has as its frontispiece the Cross of Oviedo—the Christian symbol in the

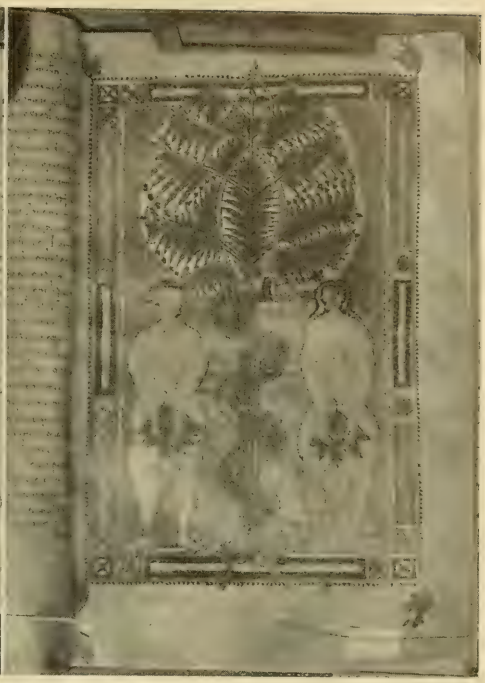
SHEPHERDS AND THEIR FLOCKS OF MERINO SHEEP IN CASTILE

MOORISH BRIDGE AT CORDOVA (SEE PAGE 205)

CASTLE OF SAN SERVANDO: TOLEDO

THE ESCURIAL, BUILT BY PHILIP II (SEE PAGE 200)

CROSS OF OVIEDO: ILLUSTRATIONS FROM OLD MANUSCRIPTS IN THE ESCURIAL



OUR FIRST PARENTS AND THE SERPENT AS PICTURED BY A SPANISH MONK OF THE TENTH CENTURY (SEE PAGE 200)

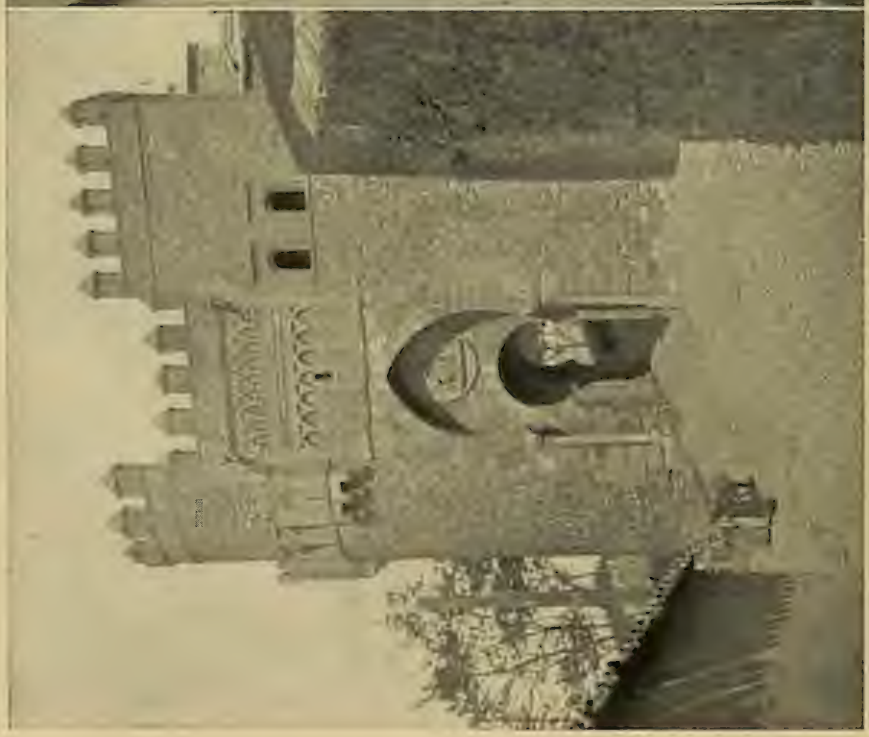
fight against the Saracen—with Alpha and Omega hanging from it.

Madrid is a well-built, modern city with busy offices and bustling trolley cars. Like our own capital, it is an artificial city, depending upon the government, tourists, and society for its subsistence. Its picture gallery, in the Prado, is the peer of any in the world, and must be visited by students of Titian, whose paintings here preserved rival those of Velasquez in beauty and interest.

A greater attraction to the populace is the huge bull ring, seating nearly 15,000. On Sunday afternoons a gay throng gathers there; the bull-fighters march out in their brilliant costumes, and the ceremony of slaying the bull begins. It is almost a ritual, and every detail must be punctiliously observed. First, the bull is made to charge the horsemen, the *picadores,* who jab him with short-pointed spears; the horses wear a blinder over one eye, so that their rider can keep them from seeing the bull's onset. If they are not killed at once when the bull gores them, they are sewed up and made to meet another attack. This is the revolting part of it. After enough of this, nimble *banderilleros* throw their darts into the creature's neck and shoulders at just the proper place and interval. These men, and the *espadas* who follow them, show great dexterity and grace. The *espada* is a seasoned bull-fighter; his function is to plunge his rapier into the bull's heart, and his calmness as he maneuvers the beast into a favorable position, teasing him the while, is fascinating to watch. The audience, with eyes keen as hawks', applaud every good stroke, and hoot in derision at any misplays.

The net influence of the sport is demoralizing, and much of the best element in Spain is against it, unless it can be

GATE OF PARDON: SEVILLE (SEE PAGE 208)



PUERTA DEL SOL: TOLEDO (SEE PAGE 205)

reformed; but the same can be said of our present form of football, and the one is as likely to disappear as the other. The same arguments are heard in Spain in favor of bull-fighting which are used here for football—it makes the participants brave, alert, quick to act and to help out a fellow-fighter; but at least the bull-fighters maul only animals, not their fellow-men. A Spaniard considers the latter brutal.

THE ALCAZAR OF TOLEDO, ONCE A FAMOUS CASTLE, NOW USED AS A MILITARY SCHOOL

Not far from Madrid lies Toledo, the ancient Visigothic capital. The Tagus flows about it in a deep gorge on almost every side. High above the old mills looms the Alcázar, the one-time castle, now a military school. Toledo is a fascinating city, with narrow, winding streets, and shops where one can still buy Toledo blades, tempered in the Tagus, and inlaid with gold. Down its widest street, in which two carts can actually pass, rises the great Gothic spire of the cathedral, which replaces the Moorish mosque. The main square, the Zocodover, keeps the Arabic word *zuq* (market) in its first syllable; one of the Moorish gates, the Puerta del Sol, of 1100, is still intact; and in the Casa de Mesa are beautiful Moorish arabesques and tiles, nearly 500 years old.

Beside the city shepherds drive their parti-colored flocks along the highway; above rises what is only too truly a type of "castles in Spain"—the dismantled fortress of San Servando.

A day's journey to the southwest lies Mérida, once a Roman metropolis. It still possesses Roman bridges and its ancient theater, and outside the city are still standing several arches of the old Roman aqueduct—"Los Milagros" (the miracles) they are called by the peasants, and it is a miracle that this arcade remains, after so many centuries of earthquakes and invasions. On top of the aqueduct storks, sparrow-hawks, and black-birds nest together in apparent amity.

At Cordova one enters southern Spain, with its highways bordered with aloes and prickly pear (both American importations, like tobacco, maize, and potatoes), and its groves of olive trees. Spain leads the world in the production of olive oil; but it is mostly refined for export in France and Italy; Spanish wines are also largely altered abroad for the consumer's palate. One of Spain's

THE MILK-DELIVERY SYSTEM OF GRANADA

IN MADRID

Photos by Louise Coleman

A SPANISH BOY

Photos by Louise Coleman

ANOTHER SPANISH FOUNTAIN

THE FOREST OF PILLARS IN THE MOORISH MOSQUE AT CORDOVA

great needs is capital and enterprise to elaborate these products at home. She has cheap and willing labor, as our Vermont quarries can testify; Barre and Montpelier are full of Spanish workmen.

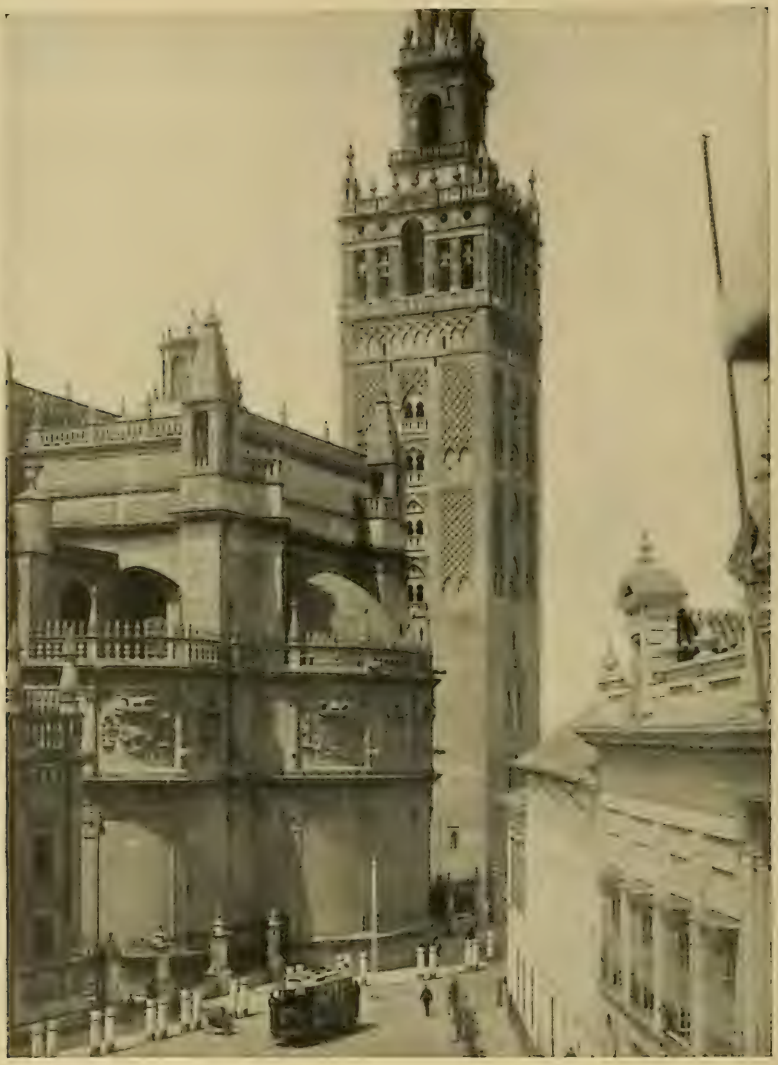
Cordova lies on the Guadalquivir, here crossed by a Moorish bridge on Roman piers; the Moorish keep is still preserved. A thousand years ago Cordova was the intellectual and artistic center of western Europe; its university drew students from everywhere, and its products, especially leather (cordwain, *i. e.,* Cordovan), were famous. Today its narrow and sunny streets, with their picturesque churches, seem deserted; but the cathedral chapter has preserved one memorial of past magnificence in the Moorish mosque, the greatest Mohammedan building west of Mecca. Entering its precincts by the Orange Court, one finds the portal flanked by two Roman milestones. With exquisite taste the canons have set to the left one dating from the year of Christ's birth; to the right, from that of the crucifixion. Thus they typify Christianity's conquest of both the Roman empire and Mohammedan Moor.

The mosque itself is a forest of pillars, which divide the huge, low building into a score of naves. There are over 900 of these columns; some were sent here even from Constantinople, mates, perhaps, of those sent at the same time to Charlemagne for his palace at Aix-la-Chapelle. Those were the days of Haroun-al-Rashid and the Arabian Nights; but the splendor of Cordova rivaled that of Bagdad. Abderrahman's wonderful palace—far more sumptuous than the Alhambra, to judge from the descriptions of the Arabic historians—has perished utterly; but the mihrabs, or prayer niches, in the mosque give some idea of the beauty of Cordova at the height of her glory.

Descending the Guadalquivir, one feels the Moorish presence on all sides. The men who sit idle in the market-place, the women who bring their graceful jars to draw water, often have strongly Moorish features, and with good reason, for the Moors held the kingdom of Seville for over 500 years.

The proudest memorial in Seville is the lofty Giralda, once the muezzin-

MOORISH TYPES
AT A WAYSIDE TROUGH



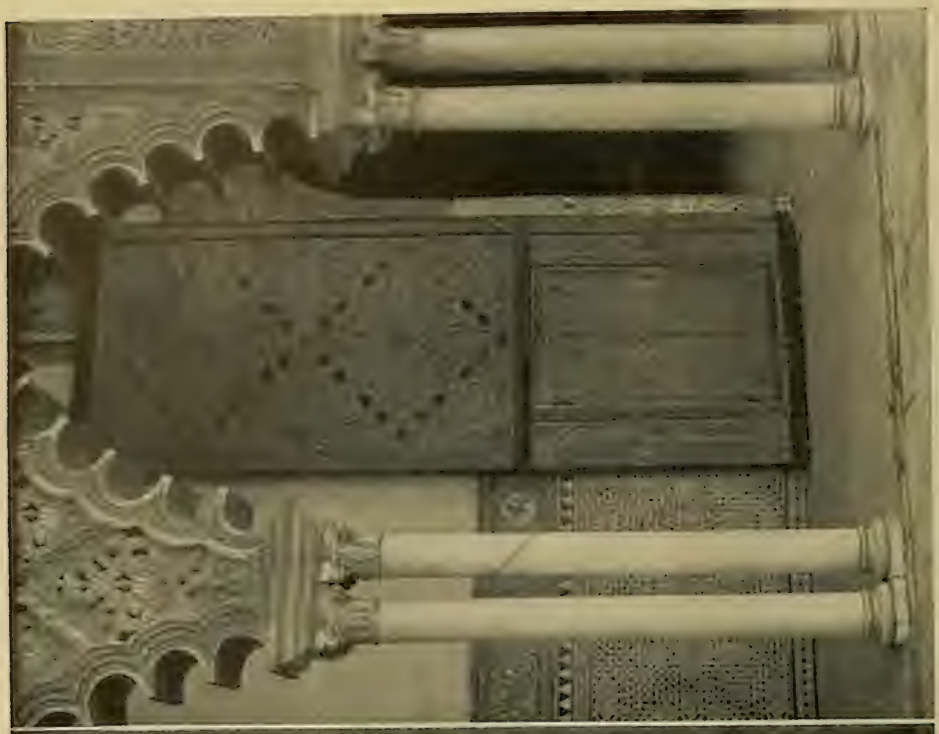
THE GIRALDA: SEVILLE (SEE PAGE 208)

tower of the mosque. Finished in 1196, it rises 300 feet above the street. The ascent is easy, up a corkscrew inclined plane, and the view down upon the massive cathedral and over the city and plain is most impressive. The great bells swing and clang from time to time, scaring away the myriads of little sparrow-hawks which make their home here. The Orange Court of the cathedral keeps its Moorish Gate of Pardon; but the mosque, which vied with that of Cordova, was razed to make room for the noble Gothic cathedral.

Not far away, however, the Moorish Alcázar is still preserved as a royal palace. Though built by Christian kings of Castile, its architects were Moors, and they employed all the delicate refinements of their art. Standing in the Court of the Damosels, where Charles V married Isabella of Portugal, one can hardly be-

UP THE DARRO VALLEY: GRANADA

COURT OF THE DAMOSELS: ALCAZAR, SEVILLE



A DOOR IN THE COURT OF THE DAMOSELS

SALOON OF THE EMBASSADORS: ALCAZAR, SEVILLE

HIGHWAY ABOVE CORDOVA LINED WITH ALOES AND PRICKLY PEARS

STAGE-COACH: SAN FERNANDO TO ALGECIRAS

SPANISH CHILDREN

lieve that this stone lace-work is merely a stucco cement, molded and fastened upon wood. Very beautiful are the dados of enameled tiles, or *azulejos,* and the folding doors are marvels of Arab carpentry. The horseshoe arcades of the Saloon of the Embassadors are the most graceful and ornate in Spain.

Granada, long a decaying provincial city, is now alive with trolley cars and electric lights, and tourists are so common here that the small boys have even learned a few English words with which to coax away small coin. But the herds of goats, and an occasional cow—an economical milk-delivery system — give a pastoral touch to the town. One sees the same thing at Naples, and the Neapolitan milkman has even discovered a unique way of increasing profits. Under his coat he puts a hot-water bag, with a long rubber tube running down his coat sleeve, and, as he milks, he injects into the pail that percentage of *aqua pura* which milkmen of all ages and peoples have found desirable.

Granada lies at the point where the Darro and the Xenil, running down from the mountains, unite as they enter the fertile plain of the Vega. Above the city rise the foothills—one crowned by the Alhambra — and beyond them the snow-capped ridges of the Sierra Nevada, 10,000 feet higher. Granada has, therefore, a singularly beautiful situation, and it enjoys a mild and agreeable climate. The romantic interest of its history completes the spell. Here was the last Saracen court in western Europe; here Isabella of Castile, with the money loaned her by a Spanish Jew, financed the Genoese adventurer's foolhardy quest; here Ferdinand and she, in that same momentous year of 1492, decreed the expulsion of the Jews from Spain; and here their ashes now repose, in the great Renaissance cathedral which they built in gratitude for their triumph over Islam.

Strolling first up the Darro Valley, between lines of whitewashed houses, glaring in the spring sun, one soon reaches the gypsy quarter. These nomads, whom George Borrow sketched so intimately, have settled here in cave-dwellings among the aloes and Indian figs, and issue forth to meet the tourist with guitar and invitation to a dance. Beyond lie bare hills, from which a wonderful view may be gained.

The Alhambra looms up over the valley, commanding the city and the nearer plain; like the Parthenon, its strategic value led to its undoing. But, ruinous though it is, the Alhambra remains the best western reminder of Saracen culture and magnificence. Its Myrtle Court, with a sunny pool, leads to the main enclosure, the Lion Court, off which open the gorgeously decorated rooms which Irving has immortalized. Every detail is worth noticing; the dados, with their varied tile designs; the ornamental friezes, in which verses, often from the Koran, border intricate arabesques; the beautifully fretted arches and the delicate Moorish windows. What remains is so exquisite that one hardly dares imagine its original grandeur.

The trip from Granada to Gibraltar is now easily made by railway; but no one

knows Spain who has not taken a stage ride over its breezy plains and aromatic hillsides. The ride from San Fernando, near Cadiz, to Algeciras, across the bay from Gibraltar, is a fascinating experience. Relays of four or five horses rush the coach along over good roads at a steady trot, below Moorish wind-mills, past ruined castles, and beside wide marshes, where storks, cranes, herons, flamingoes, and wild fowl watch its progress. Everywhere the perfumed breeze pursues it, under the brilliant blue of the southern heaven. Now it skirts the seashore, looking over the strait to the forbidding African mountains; now it toils up bleak hillsides, brilliant with the yellow of the fragrant broom. "Pepe," the driver, handles the clothes-line reins for all the 60 miles; his postilion occasionally hurls a stone artistically at one of the leaders, to bring him to reason; but in general Pepe drives with his voice, bestowing encouragement and malediction at the top of his lungs upon each of the horses by name; and better driving it would be hard to find.

At the relay stations, a half dozen in number, there are waits of 20 or 30 minutes, in which one can stroll about, watch the larks and countless other songsters, and pick the tiny blue irises and other charming wild flowers. As the coach carries the mails, it is constantly accompanied by one or more civil guards, as the Spanish gendarmes are called. In their striking hats, they are remarkable figures, especially in combination with the herdsboy, whose sheep and goats are browsing under the olive trees.

This ride has an added charm in its historical associations. Within a mile or two of the road are the battle-fields of the Salado, where the Visigoths vanquished the Vandals, in 417, and drove them over to Africa, and where, also, in 1340, Alfonso XI defeated the Moors, in the first battle in Europe, it is said, in which Damascus cannon were used. Near by is the Laguna de Janda, where, in 711, the great battle began in which the Moors won Spain from Roderick and his Visigoths. One of the stops is the picturesque city of Tarifa, where Guzman el Bueno saw his own son slain before his eyes rather than give up the castle to a traitor; and from Tarifa's Alcázar one can see Trafalgar, off which England won the empire of the seas. As the stage, after passing the Moorish aqueduct, draws up at Algeciras in the early evening, the search-lights from "the Rock" remind one again of the consequences of that battle.

"Quien dice España, dice todo"—he who says Spain, says all. And, indeed, Spain has everything, from snow-clad peak and wind-swept *mesa* to fragrant orange groves and waving palm trees. If the traveler comes to her to learn, she sends him away richly rewarded, and her austere charm will surely draw him back.

A NEW NATIONAL PARK

By Guy Elliott Mitchell, U. S. Geological Survey

THE nation that leads the world in feverish business activity requires playgrounds as well as workshops, says George Otis Smith, which is but an application to America of the old saw that all work and no play makes of Jack a dull boy. When Secretary Seward was endeavoring to enlist the support of the people for his project to purchase Alaska one of the somewhat æsthetic arguments by which he sought to gain advocates was that this great northwestern territory should be acquired if for nothing else than that it would afford a magnificent summer playground for the American nation. Alaska's purchase is doubtless justified on this score alone, and, while its varied topography affords in truth a wonderful field to the tourist, there are much more readily accessible

"playgrounds" within the United States. Indeed, some lie at our very doors, although for lack of good transportation facilities they may be more difficult of access than far distant points.

The nation owes it to itself, to the people of the present day, and even more to those of a future congested population to create into national parks the magnificent regions of the Rocky Mountains and the High Sierra, which have little, if any, economic importance, and thus preserve always their natural, wholesome beauties. Transportation methods will quickly follow and thus new "playgrounds" become accessible.

A NATIONAL PLAYGROUNDS ASSOCIATION

A national playgrounds association for grown-ups, organized on some such basis as that of the Sierra Club of California, but with the United States for its field of activities, would find important work to be done and would enlist many ardent supporters. Numerous national parks have already been established by the government, some because of their recognized standing as natural wonderlands, such as the Yellowstone, and others through insistent championship of enthusiasts.

The youngest member of the playground family, now knocking at the door for national protection, is the proposed Glacier National Park in northern Montana. There are some people in the East who do not even know that there are glaciers in the United States today, but think of them as extinct monsters belonging to a past geologic era. To such the very name, Glacier Park, is an education. There are no longer, it is true, vast continental glaciers; even the great frozen regions of Alaska are small in extent compared with the ancient glaciers, but the remnants of the one-time universal ice-sheets, such as can be seen in Glacier Park, are so majestic and numerous as to awaken in the mind of the traveler sentiments of unbounded awe and wonder at Nature's matchless handiwork.

"Give a month at least to this precious reserve," says John Muir, some ten years ago, in speaking of the delights of this region. "The time will not be taken from the sum of your life. Instead of shortening it will indefinitely lengthen it and make you truly immortal."

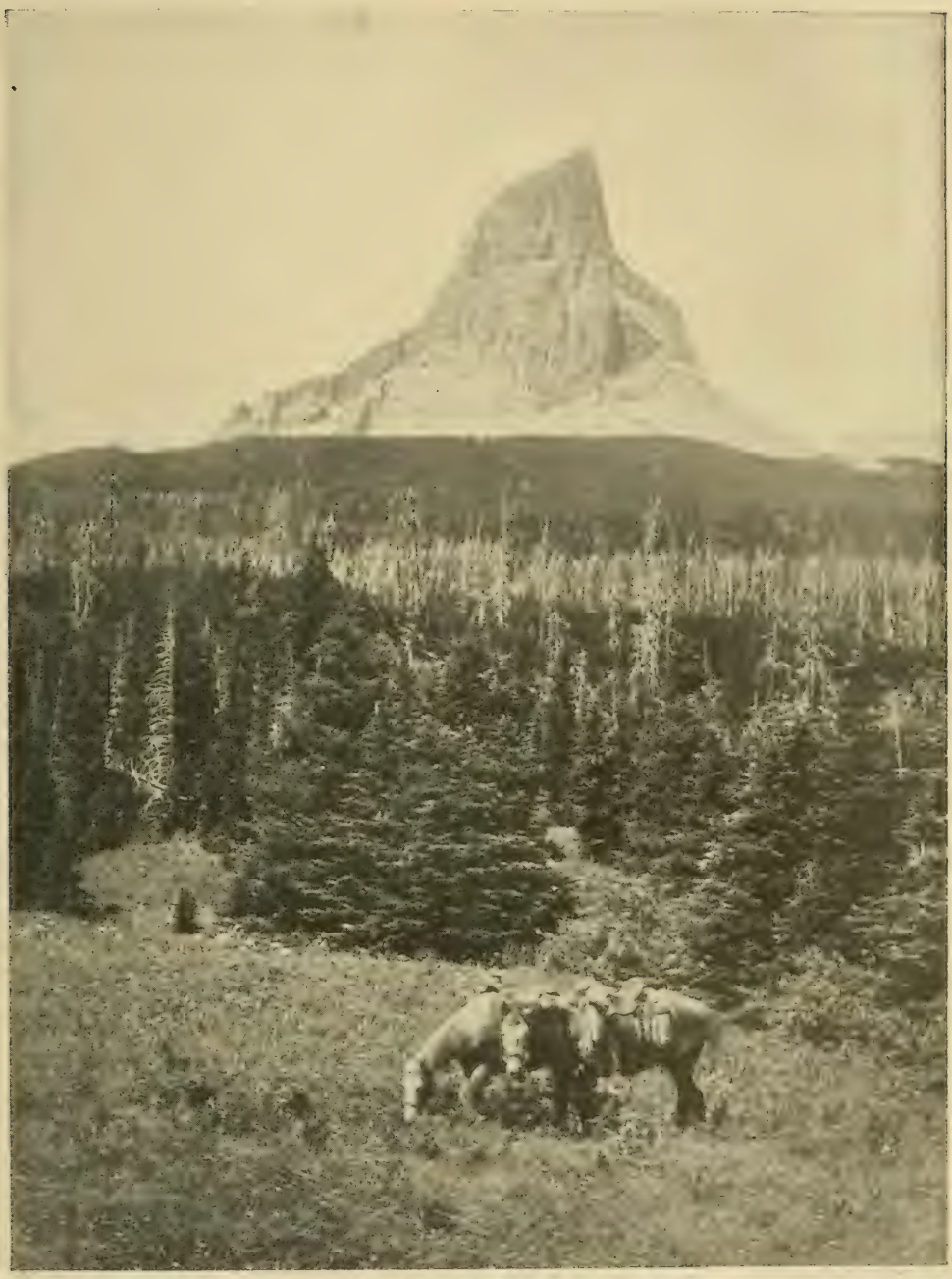
Nor are the attractions of the Glacier Park region confined to the scenic. Here lies, for instance, the majestic Lake McDonald, full of brisk trout, as described by Mr Muir, in the heart of the splendid Flathead forests of giant pine, spruce, and cedar, while 10 miles above is Avalanche Lake, shimmering at the foot of a group of glacier-laden mountains. Far up the white peaks one can hardly fail to meet the white goat or American chamois, while in other retreats dwell deer, elk, and bear and many smaller, sleek-furred animals enjoying their beautiful lives in company with numerous bird species.

It is hoped that the present session of Congress will preserve for the nation this latest playground and constitute it another of our national parks. It will then be our second largest park, surpassed only by the Yellowstone.

FAVORABLY REPORTED IN CONGRESS

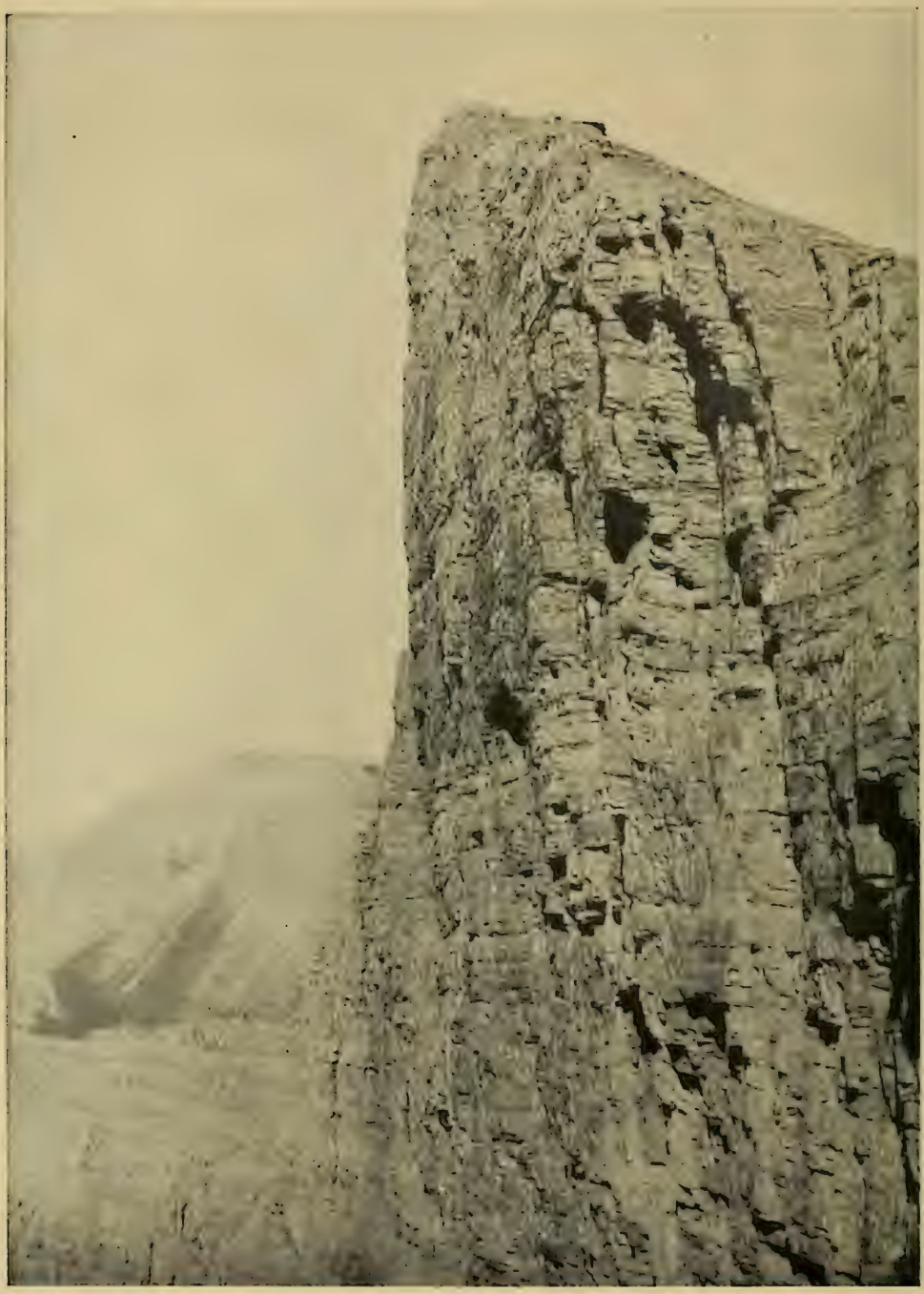
The Sixtieth Congress made a favorable report on a glacier park bill, which had also the strong support of the Secretaries of the Interior and Agriculture. This report was based largely upon a topographic survey made four years ago by a United States Geological Survey party, and upon a later compilation by Robert H. Chapman, one of the party, embracing a total area of about 1,000,000 acres lying just south of the Canadian line and between Flathead River and the Blackfeet Indian reservation. This area contains 60 or more true glaciers, ranging in size from small glaciers of a few acres each to those covering 5 square miles. It also contains over 250 glacial lakes from a few hundred feet to 10 miles in area.

The Rocky Mountain system in the United States abounds in regions of wild and magnificent scenery, but it is doubtful if any of them surpasses in grandeur



CHIEF MOUNTAIN, 10,000 FEET ABOVE THE SEA: A LANDMARK FOR AN EXTENSIVE AREA OF THE PLAINS

It is a turning point in the boundary between the Blackfeet Indian Reservation and the Forest Reserve



GOATHAUNT PEAK: A SPUR OF MOUNT CLEVELAND, LEWIS RANGE
A 2,400 foot vertical limestone cliff. Goat trails extend across the cliff face

and interest that of Glacier Park. From its area water flows to Hudson Bay, the Gulf of Mexico, and the Pacific Ocean. Mount Cleveland, its highest peak, reaches an elevation of 10,434 feet, and there are many other rugged mountains ranging from 6,000 to 10,000 feet above sea-level. This area of the Northern Rocky Mountains, says Mr Chapman, which lies to the north of the Great Northern Railway and to the south of the Canadian boundary, is one of the most beautiful mountain regions in the world. Approaching the divide from the plains region to the east, the mountains present to the traveler a rock wall of great steepness extending northwest by southeast for unbroken miles except where cut by deep U-shaped canyons. These have been largely formed by the great glaciers which once slowly flowed from the mighty snow-covered peaks and ridges forming the divide between the drainage of the Atlantic and the Pacific oceans—the northern Continental Divide.

THE WHITE MOUNTAIN GOAT

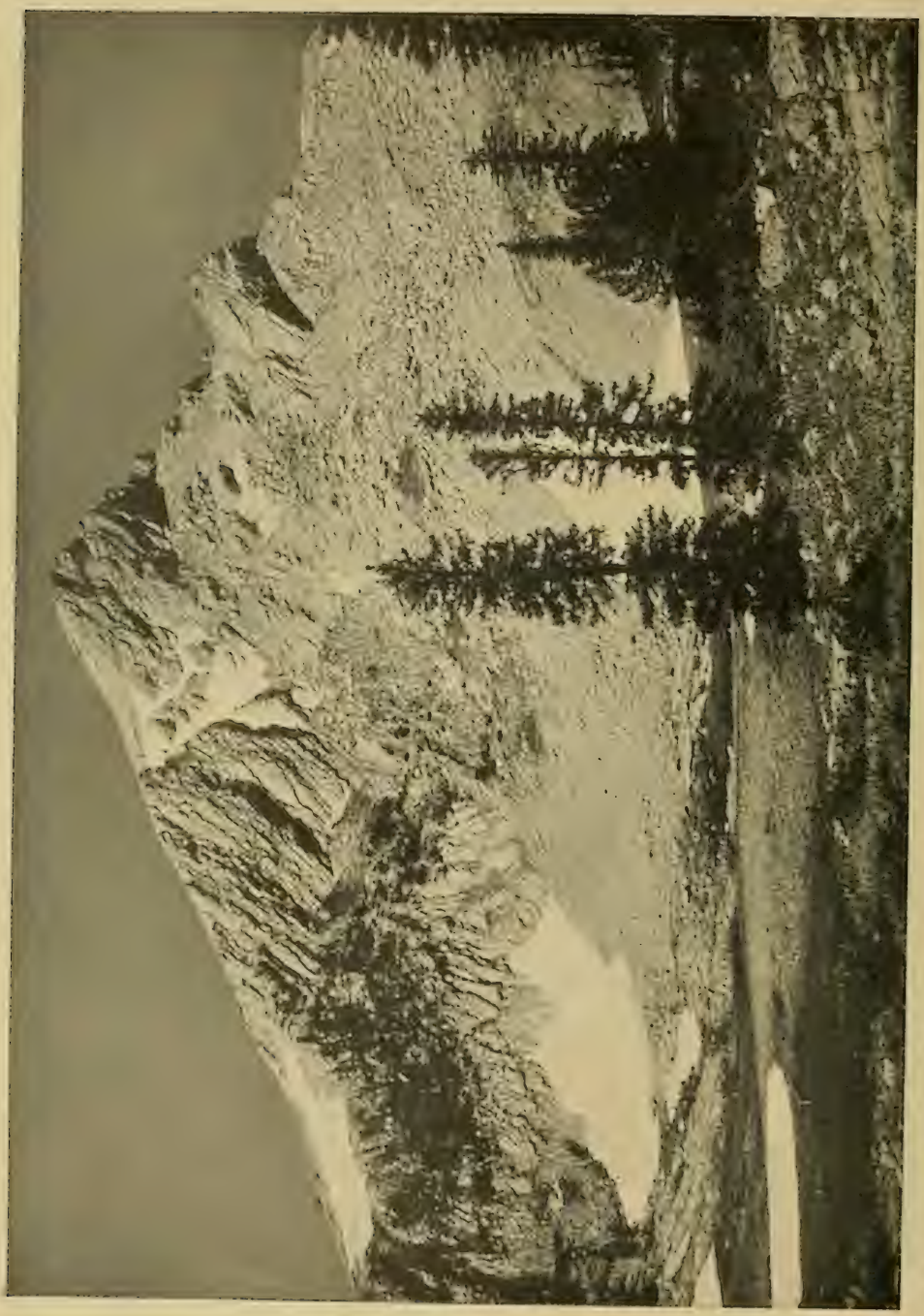
An animal delighting in the most rugged topography; yet in the greatest danger of extermination, unless protected in its natural breeding places.

FED BY GLACIAL ICE

Deep in the canyons are roaring streams, coming from the melting ice and snow and flowing into placid mountain lakes and thence into the arroyos of the plains below. Between the canyons the long finger-like ridges rise to considerable heights, the timber-covered slopes ascending steeply until a region of brush-grown broken rock is reached, which in turn leads to the base of precipitous cliffs. The canyons at the head usually terminate in great amphitheaters, rising cliff over cliff in a stairway of tremendous proportions. Many of the steps of these giant's stairways retain ice masses which slowly flow across them, each fed from a large ice mass above until a region of huge snow-banks is reached.

The main Rocky Mountain mass is actually made up of two principal parallel ridges, the Lewis and the Livingston ranges, which run approximately through the center of the proposed park. These ranges are the remnants of what was once a much wider plateau-like region of rock, which, however, has been mightily carved and shattered by the forces of erosion, principally those of the great ancient glaciers. Resting upon this great mass are the higher peaks, huge pyramids and blocks, with cliffs and precipices of hundreds and sometimes thousands of feet, plunging away down to the roaring streams of the canyons, or ending in the great crevasse at the head of some glacier.

To the westward the mountains break precipitously, and from the foot of the steep, long, timber-covered ridges reach out toward the valley of the Flathead River. Between these ridges and extending up the canyons of the higher range are many miles of lakes, joined by rushing streams similar to those on the eastern side.



THESE GLISTENING, BARREN PEAKS, ALMOST AS WHITE AS THE SNOW BANKS WHICH COVER THEM, IN PLACES RISE FROM A PLATEAU WHICH IS ITSELF ALMOST AS BARE

MISSION RIDGE, MONTANA: GEOLOGICAL SURVEY TRIANGULATION PARTY
In high mountain regions, October snows are likely to be from two to four feet deep

THE PARADISE OF BIG GAME

The whole park is inhabited by wild animals and birds, and the streams and lakes abound in many kinds of fish. In the higher barren rock areas the white goat is found in great numbers, while on the slightly lower ridges, where some protection is afforded by stunted timber growth and brush and jagged slopes, the Rocky Mountain sheep, or "bighorn," has his haunts. In the valleys and on the lower spurs are many white-tail and black-tail deer and moose; in places a few elk are found, and over the whole area, from high glacier and snow-field to huckleberry-bush region of valley and flat, roams the giant grizzly bear.

All the game animals use the higher mountain districts for summer range only, as the area is too high and the snowfall too heavy to permit of winter use. As in the case of the other national parks, these game animals, protected by law from interference, will increase to such an extent as to furnish in the overflow from the park a tempting supply to sportsmen for all time; on the other hand, without such protection of a breeding ground, many of the animals, especially the bighorns and the white goats, will soon become practically extinct.

There are numerous passes through the higher ranges. Across these the game trails lead from valley to valley. Following the game came the Indians; the hunter and the trapper, looking for easy routes of travel, followed the Indians; then came the government engineers exploring and mapping, and finally the hardier of the tourists and lovers of nature. Most of these passes are closed for many months of each year by snow; some of them are available only after the use of the axe to give footing on the hard ice of glaciers lying close to the Continental Divide, but across one or two of them wagon roads may be built by

"HEAVEN'S FOLD"

Distortion of Algonkian strata, as seen from Mount Heavens, Livingston Range. From snow bank at base to summit of peak is over 2,000 feet

which persons unfitted for the strenuous efforts now required to reach the higher country may have opportunity to view it at close range. None of the passes that are south of the Canadian boundary will ever be used for a railway route.

There is interest in Canada which looks with favor upon the creation of the proposed Glacier Park, and at some future day the locomotive may cross from the Dominion to the waters of the Flathead River and wend southward to the towns and farming valleys adjacent to Columbia Falls and Kalispell, forming a link between the Canadian Pacific and the Great Northern railroads. A route on the west side of the Flathead River, says Mr Chapman, is very available for the location of a railroad track.

In order to open this region of superb and unique scenery for the public, a few main roadways will be required along the streams, together with horse trails to points of especial interest. Lake McDonald, it is pointed out in the Senate report, lying near the southwestern boundary of the proposed park, is a sheet of water of unmatched beauty, surrounded by scenery of such signal grandeur as to make a roadway along its eastern shore extremely desirable, but this, it is stated, is a matter for the future consideration of Congress.

AN IDEAL NATIONAL PLAYGROUND

The region combines all the elements of an ideal "playground" as it stands. It needs only official designation to insure its protection and perpetuity as such to stimulate the establishment of transportation facilities, making it more readily available to visitors. While of interest geologically, it is of little, if any, economic importance. The conditions are particularly adapted to the study of the structure and history of mountain building, as the ancient forces of nature were most active and a tremendous folding and warping of the once horizontally bedded rocks is in many places apparent. At one time prospectors for copper flocked to the region, but no finds were made indicative of any economic deposits, and the same may be said as to oil. From the reconnaissance made by the Geological Survey it is not believed that Glacier Park contains any mineral-bearing formations of commercial importance. However, if such are discovered following the creation of the park there will be nothing to hinder their development.

THE MOST CURIOUS CRAFT AFLOAT

The Compass in Navigation and the Work of the Non-Magnetic Yacht "Carnegie"

By L. A. Bauer

Director of Department of Research in Terrestrial Magnetism, Carnegie Institution of Washington

Illustrations from Photos by Magnetic Expeditions of the Carnegie Institution

A RECENT newspaper clipping brings the following interesting information:

"Mr Carnegie's non-magnetic yacht, the *Carnegie,* which is making sea surveys for the Carnegie Institute, has made the discovery that American charts show errors of three degrees between Madeira and Bermuda. 'These errors,' it is stated, 'could not have been discovered in other than a non-magnetic vessel.' That being the case, what was the good

of discovering them? There is only one non-magnetic vessel afloat, and that is the *Carnegie,* and the 'magnetic' vessels seem to have got along very well in spite of the errors."

This clipping is interesting from various points of view and serves splendidly as a text for what we have to say. The pardonable misapprehension of the reporter as to the purpose of mapping out the earth's magnetic forces, as accurately as possible, gives point to the following quotation from Thomas Hood's amusing essay on "The Ocean":

"The importance of the mariner's compass to the sailor is as well known universally as the utility of the little one-eyed instrument, for which Whitechapel is so famous, to the tailor: but its mode of action and the manner of application must be far less generally understood."

Hood draws the comparison here between the tailor's one-eyed instrument and the compass needle which, because of its antics and "variations," gave the sailors "stitches." And he says:

"The needles have sometimes been fatal to mariners."

At the time of the launching of the *Carnegie,* on June 12, 1909, accounts and explanations of the unique features of this, the most "unattractive" craft afloat, as one paper put it, appeared in newspapers and periodicals, not only in all parts of our own country, but in all civilized regions of the globe. Since then clippings are received almost daily with respect to the work done by the vessel. In view of this wide-spread interest, I have accepted with much pleasure the invitation of the editor of the NATIONAL GEOGRAPHIC MAGAZINE to describe, in untechnical language, the *Carnegie's* work, and to set forth the purposes of her mission.

Let me say first that the name of the institution under which the *Carnegie* is operating is the "Carnegie Institution of Washington," not the "Carnegie Institute," as the reporter has it. The latter is located in Pittsburg, and is an entirely different organization.

HOW DO WE TELL THE NORTH?

From early childhood we are taught that, if we face the north, then our right hand is pointing eastward. But suppose we were suddenly transplanted to a region utterly unknown to us, and where a dense cloud covered the sun by day and the stars and moon by night. How could we tell then which direction was northward? This is precisely the problem the mariner has set before him on the trackless seas when the skies are overcast with heavy clouds, completely shutting out all view of celestial bodies.

Fortunately there is one natural agency — independent of wind and weather, night or day—which comes to our rescue, and upon which the navigator, in spite of its so-called "fickleness," has come to rely, namely, the earth's magnetism, by whose subtle power a definite direction is imparted to a delicately poised magnetized bit of steel. Take a compass needle, such as can readily be purchased for a mere trifle and is often found inserted in watch charms; hold it on the table, where it will not be exposed to jarring. When the needle has come to rest, note its direction, then draw it aside by bringing sufficiently close to it a pocket knife or any other article of iron or steel; next, quickly remove the article. The needle swings back and forth, first through a large arc and then through a gradually diminishing one, until finally it comes to rest; if the proper precautions have been taken this position will be found identical with the first. Repeat the experiment and once more, after various oscillations back and forth, the needle settles down to the same direction as before. Why is this?

Sir Isaac Newton, from seeing the apple drop, concluded that the cause of this "phenomenon" was to be referred to the "force of gravitation": the earth "attracted" to itself the apple. And were we to suspend a heavy mass, from the ceiling, let us say, it will hang in an invariable direction—the vertical, or that shown by the plumb-line. Draw the mass aside, then release it. It swings

VIEW OF THE NON-MAGNETIC YACHT "CARNEGIE" AT FALMOUTH, ENGLAND

back and forth just as did the magnetic needle, and, when it comes to rest, it again hangs vertical. The force which was in operation during this experiment was precisely the same as that acting on the falling apple. Is this also the force which acted on the swinging compass needle? No, because the latter was moving to and fro in a horizontal plane, and gravity only acts in a vertical direction.

THE MAGNETIC DIP NEEDLE

Suppose we were to take now a "dip needle," such as was used for the first time by an ingenious and painstaking English instrument maker, Robert Norman, in 1576. This needle is so mounted that, instead of being able to swing in a level plane, it swings in a vertical one. Norman discovered that no matter how carefully he had balanced the needle before it was magnetized, after touching it with the lodestone, so as to magnetize the needle, then there was no longer a perfect balance, but "that presently the north point thereof would bend or decline downwards under the horizon in some quantity." He at first thought that, in spite of his care, he had overweighted the end that dipped below; however, upon repetition of the experiment, he invariably found the same result, and thus was discovered the so-called "dip of the magnetic needle." If the two ends of the magnetized needle are precisely equal in weight, and still the needle won't remain level after magnetizing, then evidently we must have some other force acting than gravity. And the mystery increases, for, if we use a brass needle instead of a steel one, no matter how much we stroke it with the "magnetizing irons," it persists in remaining level.

Evidently we are dealing with a force different from that acting on a falling body. While gravity affects all substances alike, magnetism affects but a

THE SCIENTIFIC STAFF AND CREW OF THE "CARNEGIE" ON THE CRUISE FROM SAINT JOHNS, N. F., TO FALMOUTH, ENGLAND, OCTOBER, 1909

In the foreground is seen one of the two special observation houses in which the instruments are placed. The dome can be revolved and an open panel pointed to any part of the skies, thus making possible both astronomical and magnetic observations, and affording protection from wind and weather.

very few, chiefly iron, steel, nickel, and cobalt. The last two substances respond so feebly to a magnetic force that compasses made of them would be almost as useless as those made of brass. In one other respect magnetic force differs in its action from that of gravity: the force exerted on a magnet is not the same on the two ends—equal in strength and likewise parallel, to be sure, but *opposite* in direction.

If, therefore, as has long ago been concluded, it is the earth itself, as a magnet, which is exerting the force we saw acting on the compass and on the dip needle, then its action is that of a couple. That is to say, were we to float, as Robert Norman did, over three centuries ago, a magnetized needle on a cork in a bowl of water, then, if the liquid is not agitated, the cork will not move from place to place, but simply turn around until the needle points in the direction it occupied at the end of the experiment of vibrations made above.

VAGARIES OF THE COMPASS

If the compass invariably points out some definite direction, where does it point? To the exact north — to the North Star or to the true North Pole? "True as the needle to the pole," the old saying has it, but, alas, considerably far from the truth. In northeastern Maine the compass stands 20 degrees west of north; in the northwestern part of the

BREAD OVEN: GUATEMALA

MOUNTAINEER'S HOME: GUATEMALA

State of Washington 24 degrees east of north; in western Ohio and South Carolina it points either exactly north or nearly so. Taking a trans-Atlantic liner at New York bound for England, the compass continually varies its direction along the entire route traveled, starting out with about 10 degrees west at New York and increasing in the mid-Atlantic to about 30 degrees west, and then dropping to about 17 degrees west at Southampton.

Suppose the earth were an iron ball and it were magnetized symmetrically about the rotation axis, then the magnetic poles would be precisely where

KAIETEUR FALLS, BRITISH GUIANA (741 FEET HIGH)

the true poles are. In this case the needle would everywhere point exactly north and south; or, as the mariner would say, "there is no variation of the compass." The problem of navigation would then be extremely easy: if you wished to go due east, for example, all you would have to do is to set your course east by the compass, and once set it would remain set for the whole cruise.

Assume, now, that the magnetic poles are no longer coincident with the true poles, but are displaced by equal amounts. This case represents an earth uniformly magnetized about a diameter making some angle with the axis of rotation. The magnetic poles are still truly opposite to each other, but, needless to say, a more complicated condition of affairs for navigation is presented. We must now deal with a "variation of the compass," for no longer does the compass point truly north and south. If the mariner knew the location of either magnetic pole, he could readily figure out, for an earth thus simply magnetized, how the compass actually pointed at any place for which the latitude and the longitude were known.

Ralph Walker, of Jamaica, published a book in 1794 in which elaborate tables of the compass direction were given. He believed that the "poles of the ecliptic are the magnetic poles." After exalting the Supreme Architect for having given us this great gift of the earth's magnetism, by which "He enables us to behold

WOODEN PLOW USED IN THE INTERIOR OF GUATEMALA

His works and our fellow-creatures in all the different corners of the world," etc., he goes on to say:

"I hope that I shall be excused for this short digression, it being only the result of my feeling, when I conceived that the longitude might be found by magnetism (with the improvements which I have made upon it) without any trouble or calculation, and with as much certainty at sea as any other way now in use." Alas for Ralph Walker's fond hopes! In spite of his "improvements" upon the Supreme Architect's magnetism, we have not yet been able to find the longitude at sea so simply as he hoped, nor have we been able to make use of his elaborate "Tables of Variation."

THE EARTH'S MAGNETIC POLES

The earth, far from being magnetized in the simple manner above supposed, is instead most irregularly magnetized, the distribution of land and water evidently playing an important rôle. In place of the magnetic poles being on opposite sides of the earth, the North Magnetic Pole is in about latitude 70° north and longitude 97° west, and the South Magnetic Pole is approximately in latitude 73° south and 156° east. Draw a straight line connecting the two poles and it will pass through the earth 750 miles off from the center. No formula has as yet been found which, even if we knew the exact positions of the two magnetic poles, could give the direction of the compass at any point of the earth sufficiently close to satisfy the demands of the navigator and the surveyor.

CATHEDRAL ENTRANCE: HUEHUETENANGO, GUATEMALA

NATIVE HOUSE: PUNTA GORDA, BRITISH HONDURAS

Hence, instead of mathematical tables, charts must be supplied to the mariner showing him, wherever he is likely to go, just how the compass points. But, to construct these charts, some one must have found previously, by actual observation, the relation or angle between the true north and the magnetic or compass north. The mariner knows these charts by the name of "Variation Charts," and the lines drawn on them as, "Lines of Equal Variation," which connect all places where the "variation" or compass direction is the same, just as the isothermal lines on a weather map join the places of the same temperature. The

GRANITE COLUMNS, TEMPLE OF THE SPHINX, GHIZEH, EGYPT

more scientific term is "Lines of Equal Magnetic Declination."

The first one to construct such a chart was the noted Astronomer Royal of England, Edmund Halley, who, at the expense of the English government, sailed over the Atlantic Ocean on the ship *Paramour Pink* between 1698 and 1700, and in 1701 published the first "Lines of Equal Magnetic Variation," chiefly, of course, for the Atlantic Ocean. Since then various expeditions have been sent out and new charts have been issued. Of such expeditions, the most recent and extensive was that of the *Challenger,* 1872–1876, again supported by the English government. In fact, to that government and to its various scientific bodies must be given the credit of having contributed most hitherto, of any nation, to the advancement of our knowledge of the earth's magnetism. One of its most noted scientific men, Prof. J. A. Fleming, thus concludes his excellent address* on "The Earth, a Great Magnet," delivered to the workingmen of Liverpool, September 10, 1896, at the time of the meeting of the British Association for the Advancement of Science:

"That great empire which has its center in these islands, but its dominions scattered over distant seas, has been built up primarily on the art of navigation, in which the magnetism of the earth is a central fact. Neither its world-wide commerce, nor the naval power which defends its coasts, could exist for a day without the aid of the magnetic compass."

THE MAGNETIC SURVEY OF THE EARTH

But, if so much splendid work has already been done, why is it necessary for the Carnegie Institution of Washington to do so much? From 1905 to 1908 it had the brigantine, the *Galilee,* on the Pacific Ocean, the aggregate length of whose cruises amounted to 60,000 miles. Now it has a specially constructed vessel engaged in magnetic work on the Atlantic. Its magnetic observers have already penetrated to nearly every part of the earth—Greenland, Baffin Land, Labrador, Newfoundland, British North America, Mexico, Central America, Panama, Colombia, Ecuador, the Guianas and

FOUNTAIN IN THE ALABASTER MOSQUE OF MOHAMMED ALI, CAIRO, EGYPT

* Published in the Journal "Terrestrial Magnetism and Atmospheric Electricity," vol. II, 1897.

DESERT SCENERY: HELWAN, EGYPT

Venezuela, West Indies, Bermuda, Africa, Turkey, Asia Minor, Persia, Asiatic Russia, China, and the South Pacific Islands. It is, furthermore, coöperating with various polar expeditions, and is thus securing magnetic data in those far-off regions. In another five years it is confidently expected that the Carnegie Institution of Washington will be able to issue new sets of magnetic charts for nearly the whole earth, as based for the first time upon uniformly and systematically acquired data.

Why was all this work needed, and why is it that this country has now taken the lead and has the good-will and the effective coöperation of every civilized country in the prosecution and completion of a project covering the entire globe—"the magnetic survey of the earth"?

"THE MAGNETIC STATE OF OUR GLOBE IS ONE OF SWIFT AND CEASELESS CHANGE"

In the year 1634 Henry Gellibrand, professor of mathematics at Gresham College, found, upon careful observation, that the compass pointed, at London, 4 degrees 6 minutes east of north. His predecessor had observed, in 1622, not quite 6 degrees, and Borough and Norman, in 1580, had noted 11¼ degrees east. Hence between 1580 and 1634, the easterly direction of the compass had changed by 7 degrees. Before Gellibrand's time it had become generally known that the compass changed its direction from place to place over the earth, but it was supposed "fixed and invariable at any one place"; but now an entirely new fact became known.

Since Gellibrand's time the fact that the compass changes its direction with time has become definitely known, and has painfully impressed itself upon every surveyor who has attempted to relocate land bounds by the bearings recorded in the original deeds of conveyance. He must make due allowance for the changes, and that is just where the trouble comes in—the amount of change to allow since the original survey. For the same reason navigators' compass charts are soon put out of date and so require to be corrected.

Sir John Herschel aptly said:

"The configuration of our globe—the distribution of temperature in its interior — the tides and currents of the ocean—the general course of the winds and the affections of climate—whatever slow changes may be induced in them by those revolutions which geology traces—yet remain for thousands of years appreciably constant. * * * But the magnetic state of our globe is one of swift and ceaseless change. A few years suffice to

TRAVELING IN PERSIA ON CAMEL

alter materially, and the lapse of half a century or a century to obliterate and completely remodel the form and situation of those lines on its surface which geometers have supposed to be drawn in order to give a general and graphical view of the direction and intensity of the magnetic forces at any given epoch."

We thus see the need of repetitions of magnetic surveys.

MAGNETIC STORMS OCCASIONALLY PARALYZE THE TELEGRAPH WIRES AND PREVENT THE TRANSMISSION OF TELEGRAMS

By this time the reader will doubtless have received the impression that the earth's magnetism, at best, is certainly a most unsatisfactory source of guidance, and so it undeniably is. But matters are still worse than already shown. The magnetic needle is subject to all sorts of fluctuations in addition to the one already described. Fortunately most of them are of too short duration or of too small an amount to require attention for the practical purposes of navigation. However, in time of a severe magnetic storm, as occurred on September 25, 1909, the compass may change its direction 5 degrees and more in a quarter of an hour, even at a place so far distant from the North Magnetic Pole as is the city of Washington. But

BEGGAR AT MAHUN, PERSIA

these are more or less temporary derangements, and after a certain time the needle recovers its normal direction. Frequently during the so-called "magnetic storms" there are electric currents generated in the earth of sufficient strength to interfere seriously with telegraphing and cabling.

Were it possible to substitute something else for the magnetic compass it would be a waste of funds, as judged from the "purely practical standpoint," to carry on the extensive magnetic operations of the Carnegie Institution of Washington. However, nothing has been found as yet which "fills the bill" as well as the compass, in spite of its manifest defects.

THE "GYROSCOPE COMPASS"

The papers have recently had considerable to say regarding the so-called "gyroscope compass." This instrument is not dependent for the maintenance of its direction upon the earth's magnetism, but is an embodiment of the principle of the spinning top. The spinning is done by an electric motor, a 9-pound wheel rotating about 21,000 times a minute. Just as the axis of the top maintains an invariable direction while the top is in rapid motion, so does the axis of the gyroscope remain unaltered for some time in the direction originally set; this direction may be due north and south, for example. The precise advantage of this instrument is, that it is unaffected by any neighboring iron, and hence this sort of a compass is peculiarly useful on the modern steel vessels and on war-ships. Instead, however, of displacing our old standby, the magnetic compass, it must be regarded chiefly as an adjunct to the

MAGNETIC SURVEY CARAVAN THROUGH COPPER HILLS, PERSIA

FORT AT BAMPUR, PERSIA

THE "CRESCENT": ADEN, ARABIA

present appliances for controlling and checking a ship's course and her position.

When the solar azimuth attachment was devised, with the aid of which the surveyor was enabled to run true lines instead of magnetic ones, some believed that the compass needle for surveying was doomed. But the sun and stars are not always visible, whereas the earth's magnetism is ever in evidence, and the temptation to resort to the needle could not be resisted. Then again, for running a line through dense forests, or for laying a trial course between two non-intervisible objects, the transit instrument presents difficulties; the line must be cut open, trees must be felled to permit the surveyor to sight ahead and plant his stakes. The compass surveyor, however, may pick his way unaided through the thickly-wooded jungle, and, while his line may not be as true as that of the transit-man, it frequently suffices for the purposes, if traced with some care.

So it is with this recently invented Anschuetz-Kaempfe gyroscope compass now being installed on German war vessels, and said to be used with success by them. Let those use it who can afford to do so, and who, above all, have the time and facilities for studying it and checking its indications thoroughly. It is safe to say that, even on vessels thus equipped, the magnetic compass will not be wholly discarded. In fact, it may turn out that the new instrument will be most serviceable if used as a control or check upon the mariner's compass. For ordinary vessels the expensiveness, cumbersomeness, and frequent necessary control by sun or stellar observations of the new instrument will be prohibitive. It should be stated that if the gyroscope is set whirling with the axis pointed due north at the port of departure, and a due east course is set, for example, the axis will not continue to point due north—this because of the convergency of the meridians. Hence this instrument will also have its errors or deviations, not due this time to the iron in the ship, but simply

A NATIVE TYPE: TRANSCAUCASIA

because the earth is not flat, but round. The ordinary mariner would not find it easy to determine and check up on these errors.

Hence the gyroscope compass, while a most useful and ingenious invention, also has its limitations, and will not at present answer the requirements for continual and universal use. Thus we are again brought face to face with the necessity of making a most careful study of that which the Supreme Architect has given us—the earth's magnetism.

WHY DO THE MAGNETIC POLES MOVE?

I trust the why and wherefore of the magnetic work of the Carnegie Institution of Washington has now been made clear: To make the most complete study possible of the earth's magnetic forces, both as regards their direction and their strength, and, having done this, to determine the changes forever going on, in order that magnetic charts may be kept up to date for the use of the navigator, the surveyor, the explorer, and the man of science.

Thus far only the purely practical and sordid side of a "Magnetic Survey of the Earth" has been presented, but, happily, man will not thus be contented; he wants to know, not simply the "how," but the "why" as well. The many intelligent questions received at the office in Washington and those put to us by persons of all walks of life who visit the *Carnegie,* when in port, must be taken as evidence of genuine interest. I question whether ever before so many people the world over have been led to inquire, What is "terrestrial magnetism," anyway? To be sure, some of the letters are addressed to the "Department of Celestial Magnetism," or to the "Department of Terrestrial Rheumatism," etc. In the main the questions asked are: Where is the Magnetic North Pole? Does it move, or is it fixed? If it moves, is this the reason why the compass changes its direction from year to year? What makes the magnetic poles move? What is the cause of magnetic storms, and what is their connection with auroral lights, electric currents in the earth, and sun spots?

For most of these queries the data are at present either lacking or not sufficient to give definite and complete answers.

THE NON-MAGNETIC YACHT "CARNEGIE"

Now to return to the clipping quoted in our opening paragraph. First of all, let me correct a popular misapprehension: the *Carnegie* is in no wise either owned or controlled by Mr Andrew Carnegie. To him, however, who has acquired his wealth from the successful

manufacture of steel is due the construction of a vessel in which *every effort was made to avoid steel.* The *Carnegie* is owned by the Carnegie Institution of Washington, founded by Mr Carnegie. She was built solely from the funds of the Institution, and has been placed by the trustees directly in the charge of the writer as director and managing owner. The command of the vessel has been intrusted to Mr W. J. Peters.* The vessel is classified as a "yacht" to facilitate port entries as to customs, etc.

CAMEL IN GARI: SHEIKH, ARABIA

PRINCIPAL FACTS REGARDING THE "CARNEGIE"

Dimensions: Length over all, 155½ feet; length on load water-line, 128⅓ feet; beam, molded, 33 feet; mean draft, 12 feet 7 inches; displacement, 568 tons; registered tonnage, 246.

Materials used: White oak, yellow pine, Oregon pine, teak.

Fastenings: Locust treenails, copper and Tobin bronze bolts, composition spikes.

Anchors: Four of manganese bronze; total weight, 5,500 pounds.

Anchor chains: None; instead, three 11-inch hemp cables, each 120 fathoms.

Sail power: Brigantine rig, 12,900 square feet of plain sail; rigging, special Russian hemp; all metal-work on spars, rigging, and blocks of bronze and gun-metal.

Auxiliary power: 150 indicated horse-power producer gas engine, built practically of non-magnetic metals, chiefly bronze and copper and non-magnetic manganese steel.

*Mr Peters was the representative of the National Geographic Society on the Second Ziegler Polar Expedition, being second in command and in charge of the scientific work. Upon his return he accepted the command in 1906 of the *Galilee,* then engaged in magnetic work in the Pacific Ocean for the Carnegie Institution of Washington.

Boats: Two non-magnetic 20-foot whale-boats, one 16-foot gig.

Cooking ranges and refrigerating plant: Bronze and copper.

Cutlery: Mexican silver.

Personnel: Scientific staff — 7 men; crew, 14; 21 in all.

Naval architect: H. J. Gielow, of New York; builder, Tebo Yacht Basin Co., Brooklyn, under the management of Wallace Downey.

First vessel built non-magnetic.

First sea-going vessel equipped with a producer gas engine. In calm weather, a day's run can be made, with auxiliary power alone, of 144 nautical miles, at total cost for coal consumed of $7.

Her object: Sun and stars serve to shape a ship's course only when visible; the earth, however, by its magnetic power, directs the mariner's compass unfailingly, be it night or day, cloudy or foggy. To reap the fullest benefit possible from this natural agency the *Carnegie* is mapping out the magnetic forces as they prevail over the oceans, for the good of all countries. Her mission is hence international.

Thomas Hood, in his amusing poem, "The Compass with Variations," must have anticipated the building of a *Carnegie:*

> "They found no gun—no iron none
> To vary its direction."

Newspaper reporters have accused us of being so fastidious that the applica-

BOSTAN, AT THE FOOT OF THE HIMALAYAS

MAGNETIC SURVEY PARTY STARTING FROM HONANPU, CHINA

SAND DUNES NEAR KHOTAN CHINESE TURKESTAN

CARAVAN OF MAGNETIC EXPEDITION ALONG KARAKASH RIVER

THE CARAVAN AMONG THE HIMALAYAS, SEPTEMBER, 1909

THE LEADER OF THE MAGNETIC EXPEDITION CROSSING HIMALAYA MOUNTAINS

tion of a competent sailing master was "turned down" solely because of his "iron" constitution, and that we allowed only "bronzed" sailors on board the *Carnegie!*

But, why was it necessary to build a vessel practically without iron, and just what is the advantage in discovering chart errors with her?

As the reporter correctly says:

"There is only one non-magnetic vessel afloat, and that is the *Carnegie,* and the magnetic vessels seem to have got along very well in spite of errors."

EFFECT OF SHIP'S IRON ON THE COMPASS

The iron on board a vessel affects the compass needle generally in the following two ways: First, it disturbs and alters the normal direction of the needle and hence introduces the error known as the "deviation of the compass"; secondly, it weakens the component of the earth's magnetic force acting on the compass. Both effects require to be considered; they are neither of them constant, but vary from place to place. They depend upon the ship's course and change with every alteration in the ship's own magnetism, due to variable cargo and other causes. Even the continuous impact of waves on an iron vessel has an appreciable tendency to "set" or "unset" the lines of magnetic force in the vessel and thus produce a change in the deviation error.

To overcome the baneful effects of an iron vessel on a compass, the latter is "adjusted"—that is, other pieces of iron and magnets are placed in the vicinity of the compass in such a way as to exert an equal and opposite effect to that of the ship's own iron and magnetism. To make this "adjustment" it is necessary to know first how the compass would point were it mounted on a vessel with no iron whatever in her—*i. e.,* on a non-magnetic vessel like the *Carnegie.* Whether a thing is wrong, and, if so, how much it is wrong, cannot be told until one knows what is correct.

To determine the size and strength of the compensating magnets it does not suffice to know merely the correct compass direction at the port of embarkation; the dip of the magnetic needle and the strength of the earth's magnetic force must also be known. Suppose that after various trials the adjuster has succeeded in "correcting" the compass, so that it points just as it would have done in the first place had there been no iron or steel in the ship. Starting off on a trans-Atlantic voyage, we soon find that our compass has not remained "put," but, instead, again shows "deviations" from the magnetic north, due to some of the many possible causes already mentioned.

What does the mariner do? Whenever the sun or a star is visible he makes an "observation" and finds how his disturbed compass is pointing. Thus, for example, in latitude 43°.8 north, longitude 58°.9 west, the north end of his compass shows 25° west of north. Turning to his charts, he learns that, according to the British Admiralty Chart, the bearing or "westerly variation of the compass" should be 22°.2; according to the U. S. Hydrographic Office, 23°, and by the German Admiralty Chart, 22°.4. Taking the average of the three best charts now in actual use, he finds that, where his ship is, the compass should stand 22½° west, but he actually found 25° west; hence, assuming the charts to be absolutely correct, he concludes that the deviation error of his compass at that place is 2½° west for a particular heading of ship. And, if he is a cautious captain, he will embrace every chance to "check up" when astronomical observations are possible.

IMPORTANT ERRORS ON CURRENT CHARTS CORRECTED BY THE "CARNEGIE"

But we, on the *Carnegie,* having no effect from iron to contend with, found, on September 22, 1909, that in 43°.8 north and 58°.9 west, the compass actually pointed 23°.7 west. If the mariner had known of this correct value he would have found as the deviation error of his compass 1°.3 west instead of 2½° west. I have taken a favorable case; greater differences between the *actual* and the

GLACIER, SASER PASS, HIMALAYA MOUNTAINS

A MAGNETIC OBSERVER TRAVELING ON A YAK: SANJU PASS

apparent deviation errors may readily occur. It is thus seen that, before the navigator can determine successfully the outstanding errors of his compass and make proper allowance for them during the interval of night and cloudiness, when celestial objects are obscured, he must know what is the correct "variation" of the compass—*i. e.*, the direction which would prevail had he no source of disturbance beneath him. *The purpose of the work of the Carnegie is to give the mariner correct information.*

With the appliances on board the *Carnegie* there were disclosed, in the short space of six weeks (September 1 to October 14, 1909), systematic errors of importance in the best charts now available. The existence of these errors had been more or less suspected during the past ten years, but, in spite of many thousands of observations on iron vessels by expert and conscientious men, they could not be definitely laid bare. The *Carnegie's* results are accepted as correct by the leading hydrographic offices of the world. Similar systematic errors of consequence have been disclosed on the cruise from Madeira to Bermuda and New York. The *Carnegie* returned safely to the latter port on February 10 last, having completed a cruise of 8,000 miles since September 1, 1909. She successfully weathered the many severe storms of the early part of this year. Her next cruise will be a circumnavigation one of the globe.

ESKIMO GIRL: KANGERDLOOKSOAH, GREENLAND

ESKIMO WOMAN AND BABY: GREENLAND

SHIPWRECKS MAY BE CAUSED BY COMPASS ERRORS

Those in command of vessels, for one reason or another, frequently entrust the compensation of their compasses to some hired adjuster who, after completion of his work and when the vessel has been swung, furnishes what is called a "deviation card," namely, a table showing the corrections or errors of the compass on the various headings of the ship. I was

METHODS OF CARRYING INSTRUMENTS AND BAGGAGE IN NORTHERN CANADA

shown at St Johns, N. F., last September, a card furnished to a coast liner by a New York compass-adjuster. This card was so manifestly wrong and impossible that, if the captain himself had not suspected its incorrectness and had not made observations at the earliest opportunity when his vessel left port, she would surely have gone ashore.

When some years ago a great liner was wrecked by going on the rocks, there was a great deal said about "local magnetic attraction of the rocks," where, as a matter of fact, practically no attraction existed. It is of interest to know, however, that the same man who had adjusted the compasses on board that liner had previously performed a similar duty on a private yacht whose owner, a scientific man, found just in time that grave errors and "misadjustments" had been made. This may be simply a coincidence, but there is no question that a captain cannot wholly trust to adjustments made for him, and that he must have the means of checking up as often as possible. For that purpose he must know, in the first place, just what the correct or undisturbed "variation" or direction of the compass is in all the waters he is likely to traverse.

LOCAL ATTRACTIONS OF THE COMPASS

One further source of danger to navigation must be cited. A number of regions have been found which attract the compass, due frequently to large local deposits of magnetic iron ore. These regions thus have the same effect as the iron on board ship, with this difference, however, that, in general, they exert a constant effect, which, when once determined, can thereafter be allowed for. For example, the Madeiras, the Bermudas, and, in general, islands of volcanic origin are places of more or less pronounced local attraction. Along the inner passage from Seattle to Alaska, there are several places where the attraction from the shore is so strong as

MAGNETIC OBSERVER AT WORK IN CANADA

MOSQUE AT MAHUN, PERSIA

to seriously affect ship's compasses a mile away. Did the mariner not know of them or not allow for their effect while passing them during the night or in fog, his vessel would surely go ashore.

It is a part of the work of a "magnetic survey of the earth" to locate the areas of local magnetic attraction and to make known their effect for the guidance of the mariner.

THE DUKE OF THE ABRUZZI IN THE HIMALAYAS

IN recent addresses to the Alpine Club at Turin, and to the Royal Geographical Society of Rome, the Duke of the Abruzzi spoke on his Himalayan explorations of 1909. May and June were passed in unsuccessful efforts to ascend the huge pyramidical mountain known as K^2. From the base camp at Rdokass, near the center of the Baltero glacier, an advance bivouac was made at the foot of the southern wall of K^2. Unavailing efforts were made to locate practicable trails on the east and west sides, but everywhere were either very steep ridges of loose, broken rock or sheer precipices and impassable glaciers.

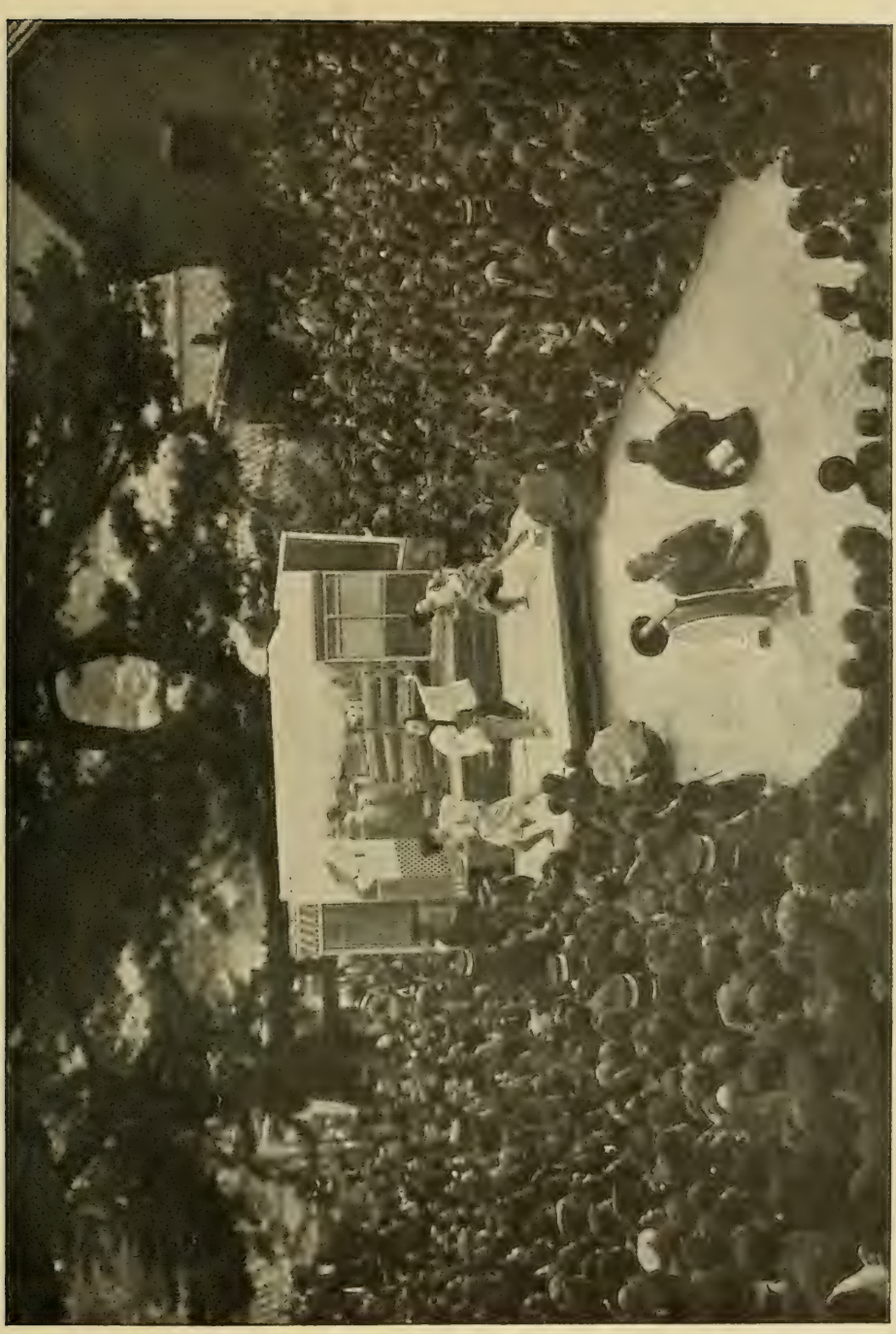
However, the Duke attempted an ascent up the east-southeast ridge, where the conditions were so difficult and dangerous as to cause him to turn back at an altitude of about 16,000 feet. A second unsuccessful attempt was made on the west flank. The upper basin of the Austen-Goodwin glacier was surveyed, and the Duke was enabled to get views of the north side of K^2 and of the hitherto unknown district to the east.

In July efforts were made to ascend Brides Peak, on whose flank a base camp was established on the Chogolisa saddle.

The Duke passed three weeks at an altitude exceeding 21,000 feet, and made two attempts under conditions of great discomfort and considerable danger, owing to the monsoon weather, which brought heavy snow and dense clouds. Reaching 24,000 feet in one attempt, he

DANCING AT A SHINTO RELIGIOUS FESTIVAL: JAPAN

Photo from Rev. H. B. Johnson



JAPANESE THEATER AT RELIGIOUS FESTIVAL

Photo from Rev. H. B. Johnson

Photo from J. R. Joy

A JAPANESE FIRE BRIGADE DRILLING

attained on his second definite climb, on July 18, with two guides, the record height on Brides Peak of 24,583 feet. The ridges were dangerous and difficult, while further progress was barred by a dense fog which enveloped the party about 500 feet below the summit, which is 25,119 feet.

This unsurpassed height of 24,583 feet supplants the previous world record of 24,000 feet on Mount Kabru, attained by Norwegian mountaineers in 1908.

The Duke supplemented his strictly mountaineering feats by extended surveys, hypsometrical observations, meteorological records, and other scientific data of value and interest. His work is entitled to the highest possible recognition from geographers of all nations.

A. W. G.

IN VALAIS

By Louise Murray

Illustrations from Photographs by Jullien Frères, Geneva

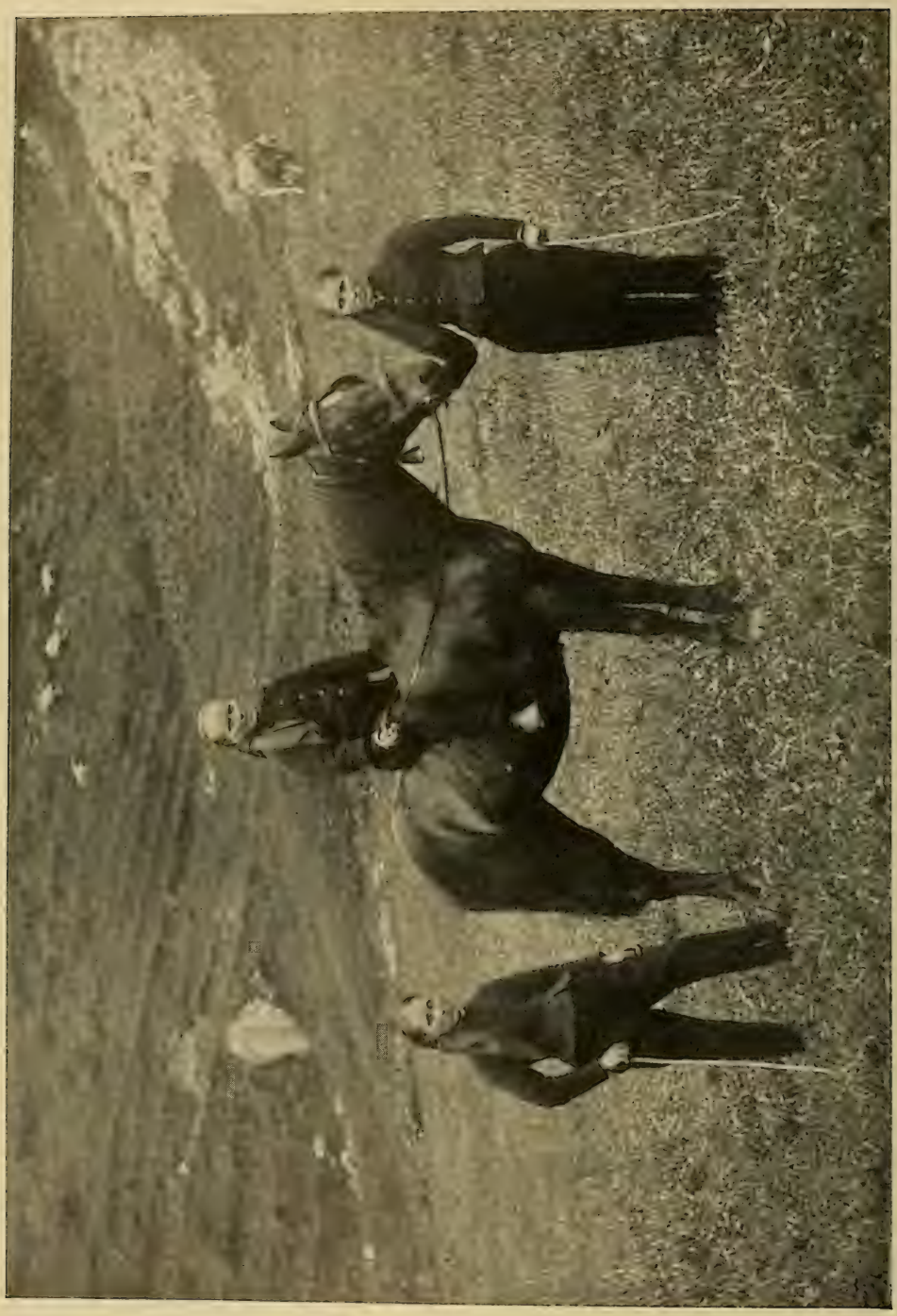
APROPOS of all the present talk about woman suffrage, let us take a glance at the inhabitants of a small village in Switzerland, or, more accurately, the dwellers on the mountain slopes about Champéry, in the canton of Valais, that sequestered and charming hamlet which lies contentedly at the feet of its famous neighbor, the Dent du Midi.

There the sturdy peasant women have solved the "equal-rights" matter to their own satisfaction. Votes were never a factor in the question, but trousers were, and have been calmly appropriated for their own use; so it is as man's equal in freedom of movement and attire, at least, that the feminine half of the community tend their herds, cut hay on the almost perpendicular hillsides, and clamber up and down the stony and tortuous paths leading to their mountain homes.

If Americans are as yet in almost total ignorance of this little spot, successfully hidden for years at the extreme end of the lovely Val d'Illiez, it is by no means undiscovered, and, owing to the recent foreign invasion, these fair traitors to the conventional skirt have become as shy as the proverbial chamois, and one must seek them upon their own heights during the summer season, when the new electric tramway which has supplanted the old-time diligence renders this village almost too accessible to the ever-growing tourist army.

En route from Italy, one leaves the Simplon line at Saint Maurice, rides for a few minutes in a shuttle train of doubtful comfort, and, arriving at Monthey, takes the tram, which immediately commences an ascent of the fertile valley. Through vineyard and chestnut grove, over roaring mountain streams and past various hamlets, the little train wends its way, ever upward.

Leaving the heat of the plain below, one gradually emerges into an atmosphere of crystalline coolness. Champéry, the end of the railway and the last village in the valley, lies 3,500 feet above the sea. Except its bracing air, one is unconscious of the altitude, as all about tower the infinitely greater heights of the Dents du Midi and the Dents Blanches, their white "teeth" so dazzling in the sunlight that one welcomes the almost ever-present curtain of cloud which veils their brightness. Some 300 feet below the village the rapid and noisy Vièze, home of that delectable fish, the "ombre," rushes down the bed of the valley from its source in the Col de Coux, another mountain, at whose summit lies the frontier of Savoy and a customs-house, and from whence one may



FEMININE COSTUMES OF CHAMPÉRY

ON A COUNTRY ROAD NEAR CHAMPÉRY

THE DENTS DU MIDI

CHAMIÉRY AND THE "DENTS BLANCHES"

THE VILLAGE STREET: CHAMPÉRY

"LE CALVAIRE"

continue one's walk in France to Chamonix.

The country abounds in walks and climbs to suit the most expert or inexperienced mountaineer. First and foremost of these is the ascent of the Dent du Midi, more than 10,000 feet in height. Of its seven teeth, the Haute Cime is most popular and least dangerous. Parties usually leave Champéry in the afternoon, sup at Bonaveau, snatch a few hours of sleep, and are off before dawn in order to reach the summit for a far-reaching panorama of the sun-kissed Alps awaking from their sleep.

It was at this little chalet of Bonaveau that one party, finding their hopes of an ascent shattered by torrential rain, resolved to play bridge and amuse themselves as best they could until the wee sma' hours; but "English as she is spoke" and accompanying laughter evidently jarred upon the proprietor's nerves, for in the morning their modest bill was embellished with the strange item, "Extra: Pour bruit fait pendant la nuit (for noise made during the night), 5 francs."

To return to the village, its one street lined by chalets with gayly flowering window-boxes and neat gardens, hotels, pensions, and little shops, let us occupy ourselves with the cosmopolitan throng that wanders back and forth on any August day.

The Hotel Dent du Midi, Champéry's largest and most modern hostelry, is the best point of vantage for such a survey. Choosing a comfortable chair from beneath its striped awnings, we call a waitress wearing one of the typical scarlet kerchiefs on her head to bring us tea. While waiting we may listen to the orchestra and marvel at the many countries of the world represented in this small corner of it. The English and French element predominate, and as yet the American is in the minority, but electricity, steam heat, and all the commodities of modern life that especially recommend a place to his luxury-loving heart are fast doing away with its former simplicity. What a field in which to study human nature, national characteristics, and that intangible something which stamps indelibly the types of each country for its own.

There goes a former prime minister of Austria off for a walk with his beautiful wife, his fox terriers bounding in glee at his heels. A distinguished Roman and his two sons are returning from an all-day climb, their arms filled with Alpine roses. Here comes an English army officer, pack on back and alpenstock in hand, off with his guide for "the Dent." A little Indian princess tosses a bit of cake to her squirming and anticipatory dachshund. Out in the garden four hilarious Parisiennes are settling their accounts at bridge. A Greek countess flicks the ashes from her cigarette, as she sips her tea in company with a young Roumanian. An Italian admiral strolls into the "poste," and the inevitable American girl returns from tennis. So one might continue indefinitely, for Swiss, Dutch, Russian, Hungarian, and even Egyptian are all represented in this out-of-the-way little place to such an extent that during the annual tennis tournament lodging of any sort, be it ever so homely or primitive, is at a premium.

It is in June, however, that Champéry is at its loveliest. Then the fields are carpeted with masses of wild flowers of the most extraordinary beauty and variety, delicate orchid-like blossoms that might have been hot-house grown mixing with the more sturdy ones, and it is with real regret that one sees them swept away by the relentless scythe in haying time. In the heart of the village lies the newly restored parish church, with its unique and ancient crown-capped bell-tower, from which a veritable chaos of chimes peal forth on feast days.

Mention of Champéry would not be complete without a word as to its favorite strolls, the "Petit" and "Grand Paradis"—two lovely wooded spots by the rapid Vièze, where one may sit beneath the pines and listen to its noisy music—and "les Galeries," a natural rock formation in the sheer cliff rising from the right bank of the river, and from which a splendid view of the village is to be had.

But it is toward the east, a half hour distant, that we wend our way most frequently, for there lies "Le Calvaire," a stone cross set upon a projecting knoll which dominates the entire Val d'Illiez far down to the peaceful Valley of the Rhone and across to the distant peaks of Chaussy, Gummfluh, and the Mont d'Or glistening in the sun. From this point, midway between the valley and the mountains, seated beneath that cross, eternal symbol of death, one may best watch the mystery of the departing sun as it sinks behind the Col de Coux. Then the veil that hangs all day before the Dent du Midi lifts, and the dying rays slowly flood the mountains' cold, dead whiteness with the rosy glow of life and eternal promise.

Photos from Paul Thompson

A CAR EN ROUTE UP THE WETTERHORN: GRUNEWALD VALLEY, UPPER BERNOIS, SWITZERLAND

A FUNERAL IN THE ALPS IN WINTER

Photo from Paul Thompson

TWO CARS ON THEIR WAY—ONE IS GOING UP AND THE OTHER DOWN: THE WETTERHORN RAILWAY. EACH CAR HOLDS 20 PASSENGERS

Photo from Paul Thompson

A CAR ARRIVING AT THE UPPER STATION OF THE WETTERHORN : SWITZERLAND

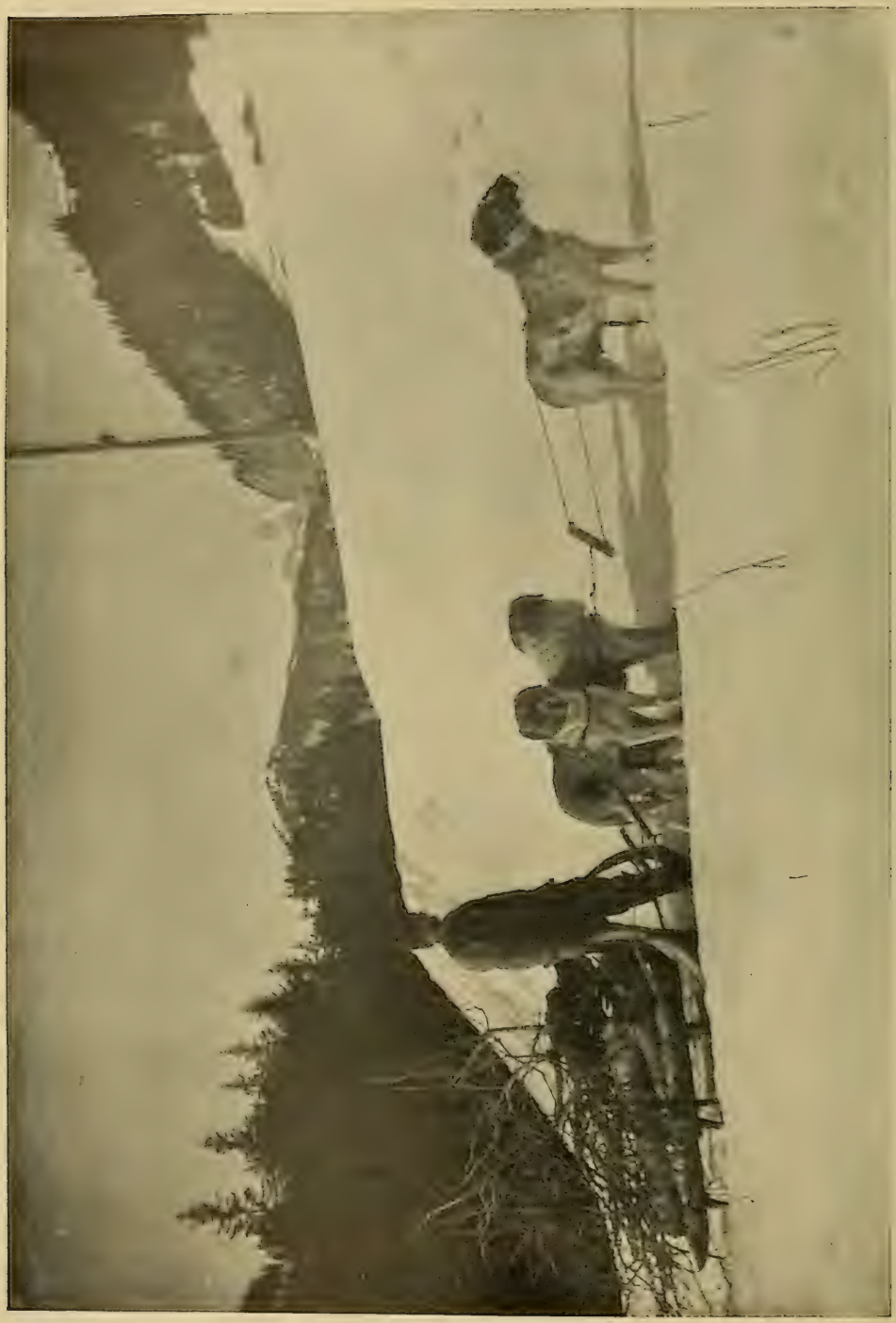


Photo from Paul Thompson

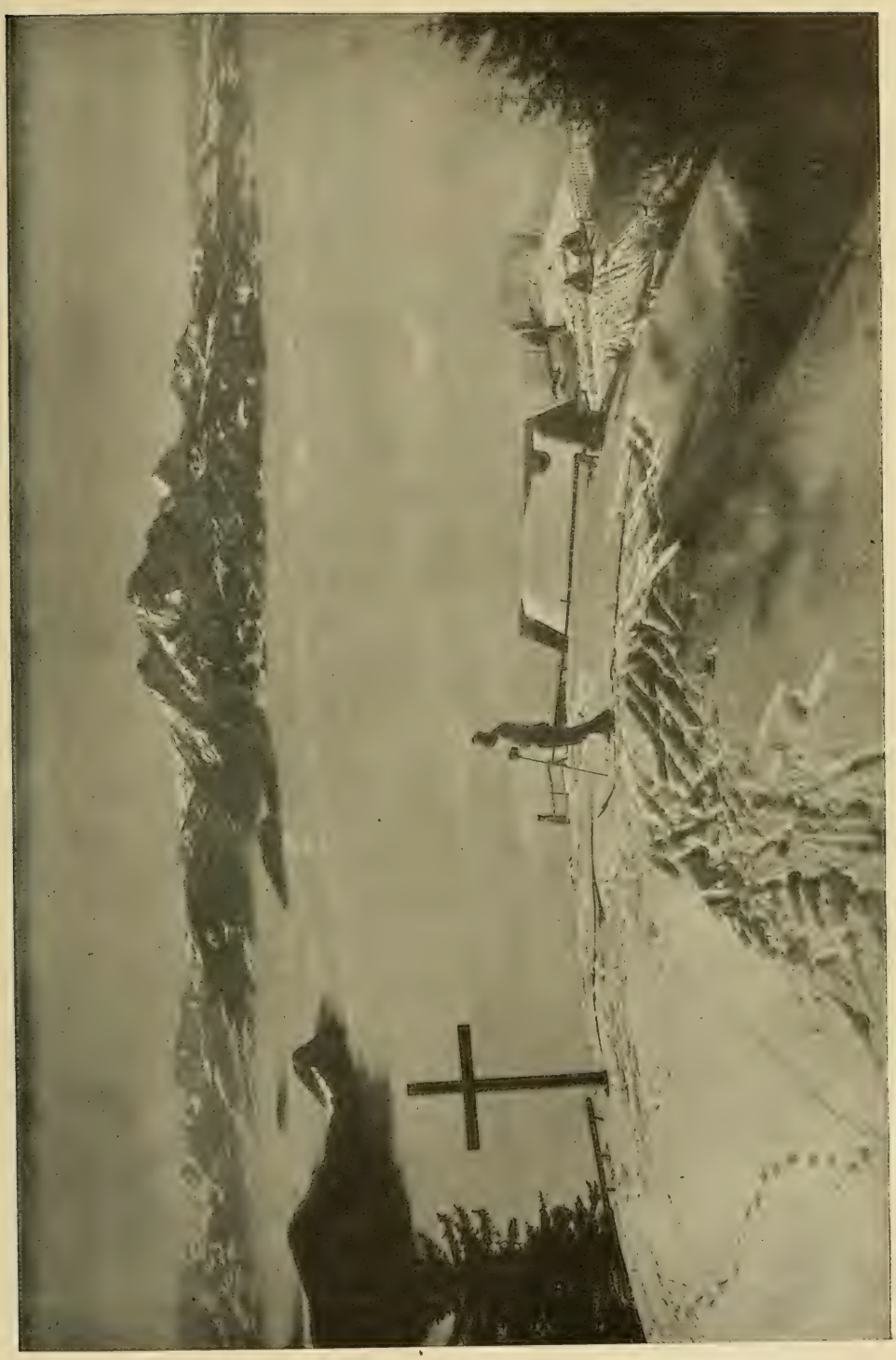
IN THE FRENCH ITALIAN ALPS: USING DOGS FOR CONVEYING GOODS AND PEOPLE DURING THE WINTER MONTHS

Photo from Paul Thompson

TRAVELERS AT THE HOTEL ON MOUNT FLUELA, IN THE ALPS, IN WINTER

Photo from Paul Thompson

HIGH VALLEY OF DOEFFLI-LETTIG BETWEEN THE VALLEY OF DAVOS AND ENGADINE



A SEA OF CLOUDS—A RARE SIGHT: TAKEN IN THE ITALIAN ALPS

Photo from Paul Thompson

TOP OF MALOJA, UPPER ENGADINE, SWITZERLAND Photo from Paul Thompson

The valley of the Upper Engadine is famous as a health resort, the most popular place being Saint Moritz

Photo from Paul Thompson

THE PASS OF SAINT GOTHARD IN WINTER

The road over this pass, constructed 85 years ago, is one of the best in the Alps, and is free of snow for four or five months. It is remarkable for the grandeur of its scenery, but has not been much used since the building of the railway and Saint Gothard tunnel.

Photo from Paul Thompson

A VILLAGE IN THE ALPS

Photo from Paul Thompson

TRAIN GOING UP THE JUNGFRAU

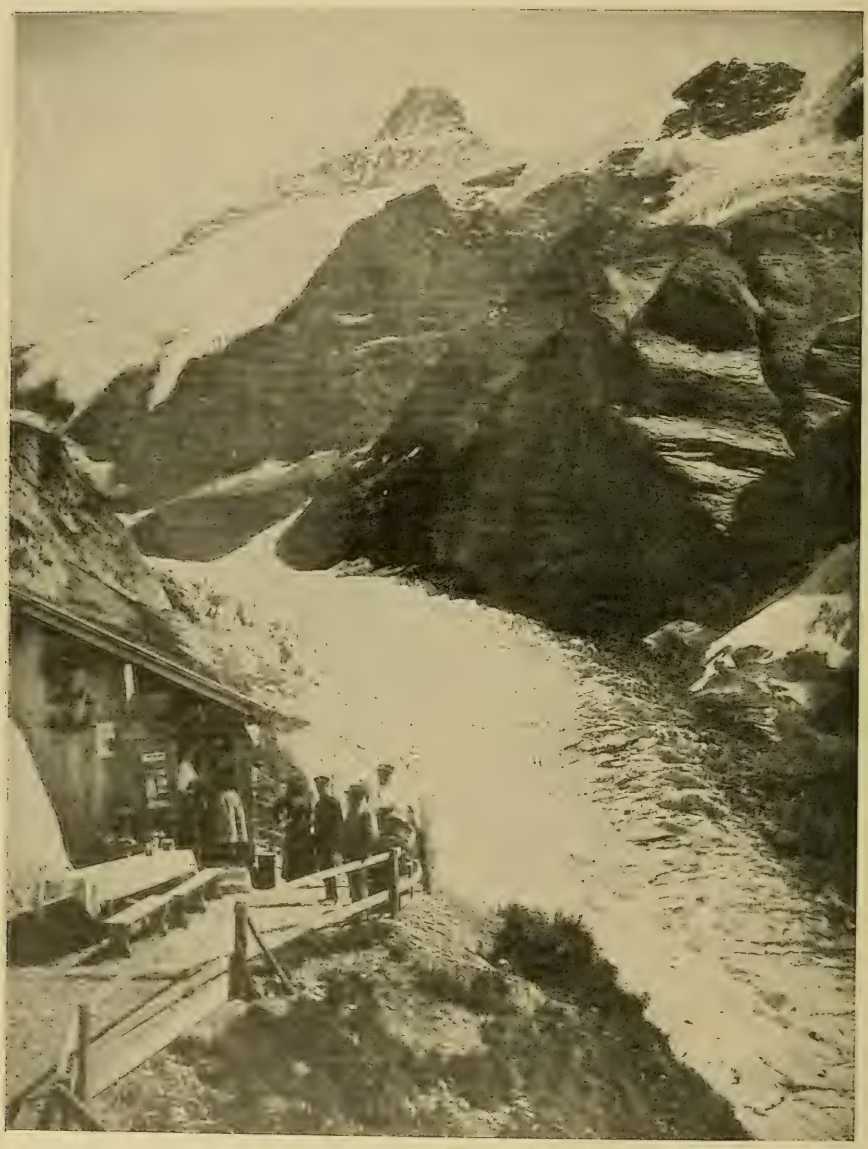


Photo from Paul Thompson

THE STATION RESTAURANT, 2,338 METERS IN HEIGHT, ON THE WETTERHORN: THE GLACIER OF GRUNEWALD IN THE DISTANCE

DEER FARMING IN THE UNITED STATES *

That the rising prices of beef and mutton in the United States can be partially overcome by raising deer for venison, is maintained by Dr C. Hart Merriam, Chief of the United States Biological Survey. According to Doctor Merriam elk meat can be produced cheaper than beef or mutton in many sections of the United States, and, with comparatively little effort, it is possible to make raising deer for venison as profitable as any other live-stock industry. Every one who has seen the large numbers of deer browsing on private estates in England as peacefully as cattle and sheep wonders why American enterprise has not long since developed breeding deer for food in this country.

SEVERAL species of deer are suited for breeding in inclosures in the United States; the axis deer, the Japanese and Pekin sikas, the red and the fallow deer of Europe, and especially the Rocky Mountain elk, or wapiti, and the Virginia deer. While experiments with the foreign species named offer every promise of success to the owners of American preserves, the elk and Virginia deer are recommended as best adapted for the production of venison in the United States.

The flavor of venison is distinctive, though it suggests mutton rather than beef. In chemical composition it is very similar to beef. A lean venison roast before cooking has been found to contain on an average 75 per cent of water, 20 per cent of protein or nitrogenous material, and 2 per cent of fat; a lean beef rump, some 65 to 70 per cent of water, 20 to 23 per cent of protein, and 5 to 14 per cent of fat; and a lean leg of mutton, 67 per cent of water, 19 per cent of protein, and 13 per cent of fat.

The general popularity of venison is so great and the demand for it so widespread that overproduction is improbable. The other products of the deer—skins and horns—are of considerable importance, and in countries where deer are abundant, and especially where large herds are kept in semi-domestication, the commerce in both is very extensive.

THE ROCKY MOUNTAIN ELK, OR WAPITI

The wapiti, known generally in America as the elk, is, next to the moose, the largest of our deer. It was once abundant over the greater part of the United States, whence its range extended northward to about latitude 60° in the Peace River region of the interior of Canada. In the United States the limits of its range eastward were the Adirondacks, western New Jersey, and eastern Pennsylvania; southward it reached the southern Alleghenies, northern Texas, southern New Mexico, and Arizona; and westward the Pacific Ocean.

At the present time the elk are found only in a few scattered localities outside of the Yellowstone National Park and the mountainous country surrounding it, where large herds remain. Smaller herds still occur in Colorado, western Montana, Idaho, eastern Oregon, Manitoba, Alberta, British Columbia, and the coast mountains of Washington, Oregon, and northwestern California. A band of the small California Valley elk still inhabits the southern part of the San Joaquin Valley.

The herds that summer in the Yellowstone National Park and in winter spread southward and eastward in Wyoming are said to number about 30,000 head, and constitute the only large bands of this noble game animal that are left. Although protected in their summer ranges and partially safeguarded from destruction in winter by the State of Wyoming, there is yet great danger that these herds may perish from lack of food in a succession of severe winters. Partial provision for winter forage has been made within the National Park, but the supply is inadequate for the large num-

* Abstracted from Farmers' Bulletin 330. By D. E. Lantz, U. S. Biological Survey

bers of animals. Further safeguards are needed to place the Wyoming elk herds beyond the reach of winter starvation.

In addition to the wild herds, there are a considerable number of elk in private game preserves and parks, as well as in nearly all the public zoological parks and gardens of this country. The herds in captivity form the nucleus from which, under wise management, some of the former ranges of this animal may be restocked and from which a profitable business of growing elk venison for market may be developed. At the present time this species affords a most promising field for ventures in breeding for profit.

HABITS OF ELK

The elk is both a browsing and a grazing animal. While it eats grasses freely and has been known to subsist entirely upon pasture, it seems to prefer a mixture of grass and browse.

The elk is extremely polygamous. The adult bulls shed their antlers annually in March or April, and new ones attain their full size in about ninety days. The "velvet" adheres until about August. While the horns are growing the bulls usually lead solitary lives; but early in September, when the horns are fully matured, the mating season begins. Fights for supremacy then take place, and the victor takes charge of as many cows as he can round up and control.

Although the elk is less prolific than the common deer and some other species that have been bred in parks, it increases fully as rapidly as the common red deer of Europe. Moreover, it makes up for any lack of fecundity by its superior hardiness and ease of management. It has been acclimatized in many parts of the world, and shows the same vigor and hardiness wherever it has been transplanted. In Europe it has been successfully crossed with the Altai wapiti and the red deer, and in both instances the offspring were superior in size and general stamina to the native stock.

The flesh of the elk, although somewhat coarse, is superior in flavor to most venison. That of the bulls is in its best condition about the time the velvet is shed. In October their flesh is in the poorest condition. As the open season for elk is usually in October and November, and only bulls are killed, it follows that hunters often obtain the venison when it is poorest. The meat is not best when freshly killed, but should be left hanging for four or five days before it is used.

ELK FARMS

With few exceptions the early attempts to domesticate elk were made by men who were wealthy enough to disregard all thought of profit in raising them. They were usually placed under the care of servants, and the bucks were left uncastrated until they became old and unmanageable. Soon the serious problem of controlling them outweighed the novelty of their possession, and one by one the attempts at domestication were abandoned.

A desire to preserve this important game animal has caused a renewal of attempts to breed it in confinement, and at present there are small herds under private ownership in many places in the United States. The Biological Survey has recently obtained much information from owners of herds in regard to their experience in breeding and rearing the animals, and also their opinions as to the possibility of making the business of raising them profitable. Of about a dozen successful breeders, nearly all are of the opinion that raising elk for market can be made remunerative if present laws as to the sale of the meat are modified.

One especially important fact has been developed by the reports from breeders. It is that the elk readily adapts itself to almost any environment. Even within the narrow confines of the paddocks of the ordinary zoological park the animal does well and increases so that periodically the herds have to be reduced by sales.

The fullest reports that have been received by the Department of Agriculture from breeders of elk are from George W. Russ, of Eureka Springs, Ark.

Mr Russ has a herd of 34 elk. They have ample range in the Ozarks on rough land covered with hardwood forest and abundant underbrush. The animals improve the forest by clearing out part of the thicket. They feed on buds and leaves to a height of 8 feet, and any growth under this is liable to be eliminated if the range is restricted. If not closely confined, elk do not eat the bark from trees, nor do they eat evergreens. In clearing out underbrush from thickets they are more useful than goats, since they browse higher. Goats, however, eat closer to the ground; and as the two animals get along well together, Mr Russ recommends the use of both for clearing up brushy land and fitting it for tame grasses.

ROCKY MOUNTAIN ELK: AN ANIMAL WHICH CAN BE PROFITABLY RAISED IN ALMOST ALL PARTS OF THE UNITED STATES

The increase of elk under domestication is equal to that of cattle. Fully 90 per cent of the females produce healthy young. An adult male elk weighs from 700 to 1,000 pounds; a female, from 600 to 800 pounds. The percentage of dressed meat is greater than with cattle, but, owing to hostile game laws, experience in marketing it is very limited. An offer of 40 cents a pound for dressed meat was received from Saint Louis, but the law would not permit its export. Mr Russ says:

> From the fact that as high as $1.50 per pound has been paid for this meat in New York City and Canada, and that the best hotels and restaurants pronounce it the finest of all the meats of mammals, we are of the opinion that if laws were such that domesticated elk meat could be furnished it would be many years before the supply would make the price reasonable compared with other meats. Elk meat can be produced in many sections of this country at less cost per pound than beef, mutton, or pork.

Mr Russ thinks that large areas of rough lands in the United States not now utilized, especially in localities like the Ozarks and the Alleghenies, could be economically used to produce venison for sale, and he regards the elk as especially suited for this purpose.

Another feature of Mr Russ's report is of more than passing interest. He says:

> We find from long experience that cattle, sheep, and goats can be grazed in the same lots with elk, providing, however, that the lots or inclosures are not small; the larger the area the better. We know of no more appropriate place to call attention to the great benefit of a few elk in the same pasture with sheep and goats. An elk is the natural enemy of dogs and wolves. We suffered great losses to our flocks until we

learned this fact; since then we have had no loss from that cause. A few elk in a thousand-acre pasture will absolutely protect the flocks therein. Our own dogs are so well aware of the danger in our elk park that they can not be induced to enter it.

Elk thrive best in preserves having a variety of food plants—grasses, bushes, and trees. Rough lands, well watered with clear streams and having some forested area, are well adapted to their needs. About as many elk can be kept on such a range as cattle on an equal area of fair pasture. There should be thickets enough to furnish winter browse, but this should be supplemented by a supply of winter forage.

Except when deep snows cover the ground, elk will keep in good condition on ordinary pasture and browse; but a system of management that provides other food regularly will be found more satisfactory. Hay and corn fodder are excellent winter forage; but alfalfa hay has proved to be the best dry food for both elk and deer. A little oats or corn—whole or chopped—may be fed each day. Elk are fond of corn, and feeding it affords excellent opportunities for winning their confidence and taming them. The same may be said of salt, which should be furnished liberally to all deer kept in inclosures. Running water, although not essential, is of great importance in maintaining elk in good condition.

Elk are much less nervous than ordinary deer, and less disposed to jump fences. When they escape from an inclosure they usually return of their own accord. If tame, they may be driven like cattle. Ordinarily, a 5-foot fence of any kind will confine elk. Henry Binning, of Cora, Wyo., writes us that a 4-foot woven-wire fence is ample for these animals. A small inclosure in which a vicious bull elk is to be kept should be higher and of stronger material.

The cost of stocking an elk preserve is not great. Usually surplus stock from zoological parks or small private preserves may be obtained at low cost, varying with the immediate demand for the animals. At times they have sold for less than $20 a head, and, with the present restrictions on sale, low prices are likely to continue. A few years ago T. J. Wilson, of Lewisburg, Ohio, paid $165 for three animals. A Michigan breeder recently offered to deliver a dozen head, sex and age not given, all fine specimens, for $500. This is, of course, a low price, not more than cattle would bring and less than the venison would be worth if it could be sold. If restrictions on the sale and shipment of venison from private preserves were removed, prices of the stock would, of course, soon advance, and necessitate a greater outlay in starting the business.

BREEDING THE VIRGINIA DEER

The Virginia, or whitetail, deer is the common deer of the United States. Including the half dozen geographic races that occur within our borders, it is distributed over most of the country, except Nevada and the major portions of Utah, Arizona, Washington, Oregon, and California. It is extinct in Delaware and practically so in a number of States in the Middle West. South of our borders a number of closely related species occur.

In view of the wide natural range of the Virginia deer, its adaptability to nearly all sections of the United States can not be doubted. Testimony as to its hardiness in parks and preserves is not so unanimous as that concerning the elk; but the general experience of breeders is that with suitable range, plenty of good water, and reasonable care in winter, raising this deer for stocking preserves or for venison may be made as profitable as any other live-stock industry. Not only do deer thrive on land unsuited for cattle or horses, but, like elk, they may be raised to great advantage in brushy or timbered pastures fully stocked with cattle or horses, as the food of deer rarely includes grass.

Advocates of the Angora goat industry state that within the United States there are 250,000,000 acres of land not suited to tillage or to the pasture of horses, cattle, or sheep, which are well

adapted to goats. Much of this land is suited also to deer and elk, and can be utilized for these animals with less injury to the forest cover than would result from its browsing by goats.

Virginia deer have often been bred in parks for pleasure or in large preserves for sport, but the economic possibilities in raising them have received little attention. Recently breeders have recognized the fact that they are profitable under proper management and would be much more so were conditions for marketing live animals and venison more favorable.

The Biological Survey has reports of successful experience in raising Virginia deer from more than a dozen persons, located in different parts of the country, who are now engaged in the business. The management of the herds varies slightly with the surroundings and the object for which they are kept.

Thomas Blagden, of Washington, D. C., began raising deer in 1874. After an experience of over a third of a century he is confident that the business can be made profitable. In his own herds he has carefully avoided in-breeding by securing new bucks from time to time. His stock is vigorous and of the large size characteristic of the Adirondack and other northern deer. Consequently the animals are in demand for breeding purposes, the bucks bringing $50 each and the does $75. He feeds grain, using corn and a mixture of bran and meal, and during the summer cuts as much wild forage as possible. He finds that the animals prefer the rankest weeds to the choicest grass. Of the various kinds of hay, they prefer alfalfa. He provides abundant water at all times.

John W. Griggs, of Goodell, Iowa, writes that he has been engaged in raising deer for about fourteen years. Until two years ago he sold all his surplus stock for parks, but since then has disposed of about half of it for venison. For park purposes he gets $20 to $30 a head, but they bring fully as much or more when fattened for venison. As to management of deer, Mr Griggs writes:

In raising a large herd the park should be divided into two or three lots, and one plowed each year and sown to red clover, mustard, rape, and seeds of different kinds of weeds. Bluegrass and timothy are useless. Corn is the principal grain I feed. I feed it winter and summer. In winter I feed also clover hay, oat straw, and weedy wild hay. Deer when rightly handled are very prolific, and from 50 does one can count on 75 fawns. They can be raised profitably for venison—very profitably until overdone; but I would not advise one to go into it on a large scale without previous experience with deer.

The report received from C. H. Roseberry, of Stella, Mo., although less enthusiastic than others, is quoted because his herd approaches more nearly a state of true domestication. Under the date of January 13, 1908, Mr Roseberry wrote as follows:

My experience in breeding the common or Virginia deer covers a period of seventeen years, beginning in March, 1891, when, as a boy of 16, I built a small inclosure of 1½ acres to confine a single doe that was captured as a fawn in the neighboring forest.

A buck and other does were secured from year to year, until in 1900, by purchase and natural increase, my herd numbered 25 head of all ages.

From 1891 to 1901 I lost every year from disease an average of 20 per cent. The climax came in the drought year of 1901, when my loss was 50 per cent from the disease known as "black tongue."

I am convinced that, like cholera in swine, individuals recovering from this disease are immune from further attack. Apparently all of my herd were afflicted. The survivors and their progeny constitute my present breeding stock. I have made no purchases since 1901, nor have I suffered any loss from disease.

For the last seven years my herd has averaged 70 per cent increase, all of which I have sold at satisfactory prices. I began selling at $20 per pair of fawns at 4 months of age, and $30 per pair of adults. I now get $40 and $60, respectively. I sell almost exclusively for pets and for propagating purposes, although a few surplus bucks have been sold for venison, averaging me 15 cents per pound gross weight.

If we except the goat, I know of no domestic animal common to the farm that requires so little feed and attention as the deer. My herd has a range of only 15 acres, two-thirds of which are set to white clover, bluegrass, and orchard grass. I provide also a small plat of wheat or rye for winter pasture. With the above provision, in this latitude, no feed is required between April 15 and November 15. During the rest of the year a ration of corn, bran, or other mill feed somewhat smaller than that required for sheep, in connection with a stack of clover or pea hay to which they have

HERD OF DOMESTICATED VIRGINIA DEER BELONGING TO R. H. HARRIS, CLARKESVILLE, TEXAS

free access, is sufficient to keep them in good condition. Deer eat with relish nearly all of the common coarse weeds, and for clearing land of brush they are, I think, second only to the common goat.

Probably the greatest expense connected with the business of raising deer is the fencing. Another item of trouble and expense, when the animals are raised for pets, requiring that they be handled and shipped alive, is the fact that the fawns must be taken from the does when 10 days old and raised by hand on cow's milk. They are quite easily raised in this way, with but slight percentage of loss, but require frequent and careful attention for the first month. When they are allowed to run with the does their natural wildness cannot be overcome, no matter how gentle the does may be.

I have found the business profitable on the lines indicated. I believe they could be profitably bred for venison alone—certainly with less trouble and expense, since the fawns would be reared by the does and the trouble and expense of raising by hand would be eliminated.

My experience does not coincide with that of some other breeders in respect to the weakening of reproductive powers of deer by the confinement in parks. I have no barren does. Usually they produce a single fawn at two years of age; afterwards twins, and in rare cases triplets.

While deer are chiefly browsing animals, in captivity they eat nearly every kind of vegetation, including most kinds of garden stuff. They are fond of acorns, beechnuts, chestnuts, and other mast. Lily pads, leaves, lichens, and mosses are freely eaten. With plenty of range and an abundant variety of plants there need be, therefore, no apprehension concerning the deer's food. A good supply of running water must be provided, and the animals should have access to rock salt. If the browse and pasturage are scant, a small ration of grain should be fed. Of the grains, corn is generally recommended as a food; there is no waste, as the deer pick up every grain. Coarse hay full of weeds is preferable to timothy or other tame hays, except alfalfa. Of clover hay, deer usually eat the blossom heads

greedily, but waste the other parts. In winter feeding is necessary everywhere, and in the northern half of the United States shelter of some kind should be provided.

WILD DEER IN PRIVATE GAME PRESERVES

Individual owners, as well as associations, have established large private preserves in many parts of the country and stocked them with deer and other big game. The objects have been to preserve the animals and to provide sport for the owners. In the free life under the protected conditions generally provided, deer do remarkably well, the increase being even more rapid than in small parks.

Deer in Buckwood Park, a New Jersey preserve of 4,000 acres, belonging to Charles S. Worthington, increased in the ten years between 1892 and 1903 from 19 to about 400 head, and the number was then lessened because it was thought too large for the permanent sustaining capacity of the park. The St. Louis Park and Agricultural Company have about 1,000 deer and 400 elk in their 5,000-acre preserve in Taney County, Mo. The Otzinachson Rod and Gun Club six years ago placed about 90 deer, mostly does, in their 4,000-acre park in Clinton County, Pa. These have multiplied to nearly 3,000 head.

The good effect of such preserves on the supply of game in the State should not be overlooked. While they may temporarily restrict the hunting privileges of a few citizens, they ultimately become a source of game supply secondary in importance only to State preserves or game refuges. Already a number of private reserves have become overstocked, and game has escaped or been turned over to the State to become the property of the people. The success of private enterprise in propagating large game in inclosures has thus become an object lesson for State game commissioners and others, and suggests the feasibility of the State's undertaking a similar work for the people.

GAME LAWS RESTRICT DEER FARMING

The chief obstacle to profitable propagation of deer in the United States is the restrictive character of State laws governing the killing, sale, and transportation of game. Many of the States, following precedent, lay down the broad rule that all the game animals in the State, whether resident or migratory, are the property of the State. A few States except game animals that are "under private ownership legally acquired." A few others encourage private ownership by providing a way in which wild animals—deer and the like—may be captured for domestication. Generally, when private ownership of game is recognized by law, the right to kill such game is granted, but the owner is hampered by the same regulations as to season, sale, and shipment that apply to wild game. One by one, however, State legislatures are coming to recognize the interests of game propagators, and game laws are gradually being modified in accordance with the change of view.

The chief source from which deer and elk may be obtained for stocking preserves is from animals already in captivity. These must be transported from place to place or there can be no commerce in them, yet the laws of many States absolutely forbid their shipment. The laws as to possession and transportation of deer carcasses make the shipping of venison also illegal. General export of venison is legal from only six of the States, and three of these have no wild deer left to protect.

The laws concerning the season for killing and the sale of deer are often equally embarrassing to those who would produce venison for profit. The owner of domesticated deer cannot legally kill his animals except in open season. Owners of private preserves are similarly restricted and are limited to the killing of one or two animals in a season. More than half the States and Territories absolutely forbid the sale of venison. A few forbid the sale of venison produced within the State, but permit the sale of

that imported from other States—a most unjust discrimination against home industry.

Instead of hampering breeders by restrictions, as at present, State laws should be so modified as to encourage the raising of deer, elk, and other animals as a source of profit to the individual and to the State.

Safeguards against the destruction and sale of wild deer in place of domesticated deer are not difficult to enforce. For this purpose a system of licensing private parks, and of tagging deer or carcasses sold or shipped, so that they may be easily identified, is recommended.

It is believed that with favorable legislation much otherwise waste land in the United States may be utilized for the production of venison so as to yield profitable returns, and also that this excellent and nutritious meat, instead of being denied to 99 per cent of the population of the country, may become as common and as cheap in our markets as mutton.

NATIONAL GEOGRAPHIC SOCIETY

HON. J. HAMPTON MOORE, Member of Congress from Philadelphia, and for some years a life member of the National Geographic Society, is sending to each member of the Society a copy of his speech, "Peary's Discovery of the North Pole," presented to Congress March 22, 1910. The address, which makes a pamphlet of 36 pages, and is an historical summary of the organization and achievements of the last Peary Expedition, contains much valuable information not previously published.

Particularly interesting is the first publication of the original order of President Roosevelt, in July, 1908, directing that Robert E. Peary be detailed to the U. S. Coast and Geodetic Survey, to make tidal observations along the shore of the polar sea.

Twenty-one large volumes of tidal records were obtained by Commander Peary, November, 1908, to June, 1909, and were delivered to the Government in October, 1909. The experts of the Survey who are reducing and discussing the records report that the tides along the northern coast of Grantland and Greenland are quite different from what had been heretofore supposed, and they expect to obtain important new knowledge after these records have been thoroughly examined.

The Hydrographic Office of the Navy Department has already prepared a chart showing the line of soundings made by Peary. The last sounding was made five miles from the pole. The methods and apparatus used for making the soundings are fully described.

Mr Moore's speech was to advocate the passage of a special resolution which he had recently introduced, and which is also published in the pamphlet as an appendix, that the Congress should accept the verdict of the National Geographic Society commission which examined Peary's records and found that he had reached the North Pole.

The decision of the National Geographic Society has been accepted without question by the Royal Geographical Society of London, and the geographical societies of Berlin, Paris, Geneva, Rome, Brussels, Antwerp, Vienna, Dresden, Madrid, Edinburgh, Saint Petersburg, Tokyo, Mexico, Lima (Peru), the geographical societies of Chicago, New York, and Philadelphia, and practically every geographical society in the world.

IMPORTANT NOTICE

Members of the Society desiring the address for the magazine changed are requested to give the Society three weeks' notice.

VOL. XXI, No. 4 WASHINGTON APRIL, 1910

THE NATIONAL GEOGRAPHIC MAGAZINE

LANDSLIDES AND ROCK AVALANCHES

By Guy Elliott Mitchell

THE recent disastrous avalanches of snow and earth in the Northwest, while of a different character, recall to mind the tremendous mountain slide which destroyed a portion of the town of Frank, Alberta, a few years ago, and also lend interest to geological investigations covering an extensive area in our own San Juan Mountains of Colorado, which have been subject to monstrous rock and landslides, in some instances the entire faces of large mountains having been demolished.

It is the younger mountain systems, geologically speaking, which are most subject to these rock avalanches. Thus the Himalayas, which represent but infant industries, though lusty ones, in the mountain building line, have a way, like other youngsters of immature character, of tumbling about in a wholesale fashion which would result in great catastrophes were their slopes and valleys populated to any great extent.

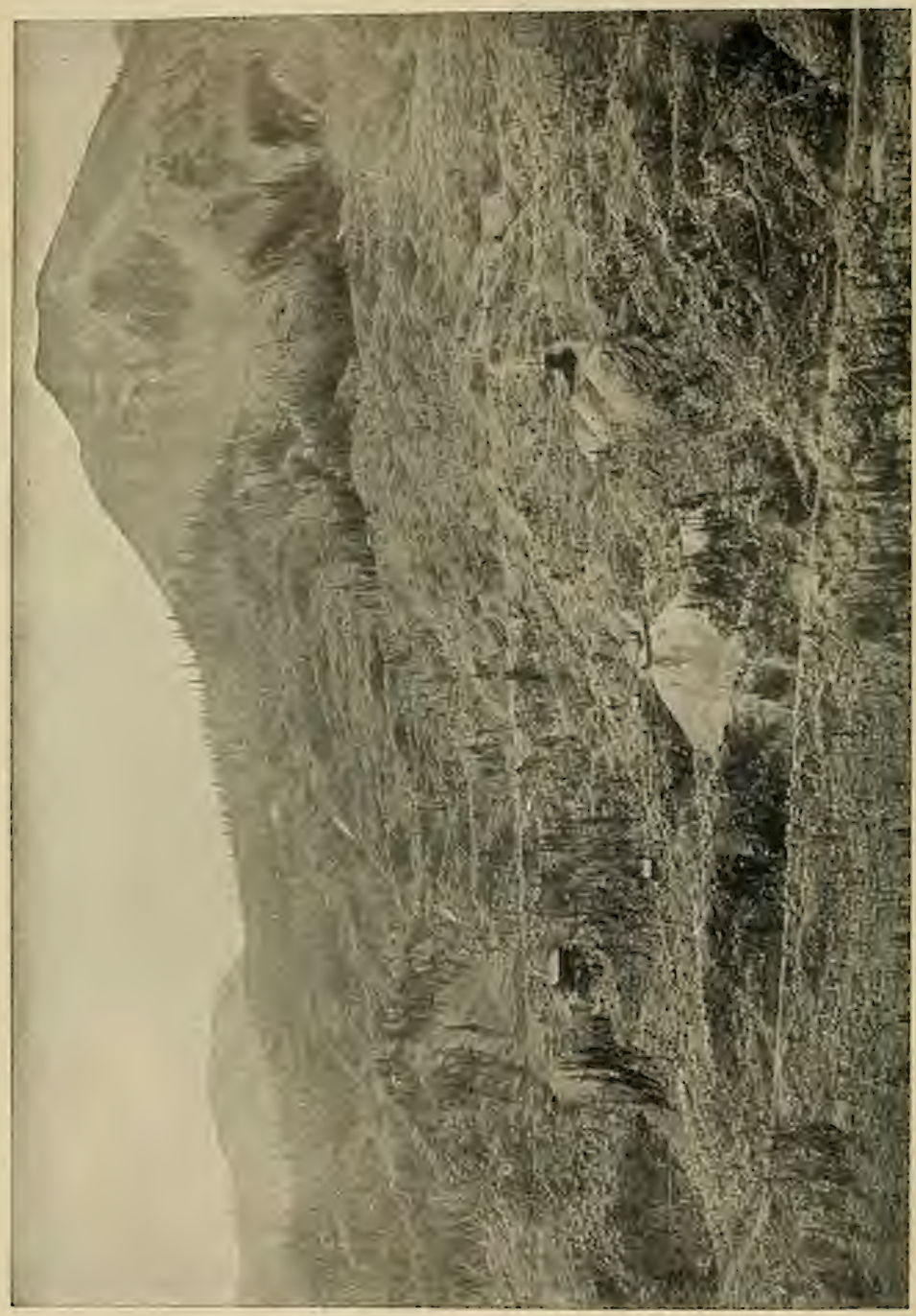
Sir William Conway describes the matter of a little shifting of rock which caused the formation of Gohna Lake, in the Central Himalayas, where the spur of a large mountain mass pitched bodily into the valley below. The front of the mountain had been undermined by springs until there was no longer sufficient support, and in the twinkling of an eye a large part of the mountain slid down and shot across the valley, damming its river with a lofty and impervious wall. *Masses of rock were hurled a mile away, blocks of limestone weighing* 30 *to* 50 *tons being sent through the air like huge cannon shots. It is estimated that this slide carried with it* 800,000,000 *tons of rock and debris.*

Plenty of Himalayan landslips quite as extensive as this have been recorded in the last half century, while among the remote and uninhabited regions of the great ranges numbers more are of constant occurrence.

The formations of the San Juan Mountain landslide area point to many such slides as these having occurred. Fortunately this catastrophe era has ended for the mountains of the United States, although it is true that some movement is still in progress, and as in the Alps and in Alberta, man's mining operations may precipitate disasters.

CAUSE OF LANDSLIDES

Aside from the study of landslides with reference to the safety of human life, there is economic value in their investigation as bearing upon man's search for the precious metals. The geologist



LANDSLIDE SURFACE OF ONE OF THE SUMMITS OF RED MOUNTAIN

The entire area is covered with the landslide débris (see page 279)

and the mining engineer look for gold or other metalliferous deposits in certain rock strata, and in ordinary mountain formations these strata are fairly regular; at least their positions can be determined. There may be rock faults, but these the keen geologist can trace. However, it is evident that even men who are supposed to see down a thousand feet into the earth's crust must be perplexed when the surface of a mountain slides off, and two or three strata come tumbling down to pile up on the slopes and the valleys to a depth of from ten to several hundred feet. This chaotic condition of the rocks in a landslide area is therefore the despair of the miner and most trying to even the experienced geologist.

The failure to recognize the true significance of the landslide phenomena and to perceive their extent, have led to very great loss of time, labor, and money in prospecting of the Rico Mountains—a portion of the San Juan—says Dr Whitman Cross, of the United States Geological Survey. The reason that much of the areas prospected have not been recognized as landslide in character is due to the fact that the great slides of the San Juan region, such as that described in the Himalayas, occurred long ago, perhaps about the time of the Glacial period, and many of the surface traces have been obliterated to the casual eye.

Landslides are believed to be due generally to moisture, which, under favorable conditions, undermines foundations and causes a breaking away of overlying rocks. In the San Juan area the surface rocks are volcanic and porous. These are underlain by a likewise porous conglomerate which rests upon a sandy shale. There is no drainage, and the rains and snows sinking through the two surface strata soften the shale and render it plastic.

The earlier physical forms of the San Juan Mountains were much bolder than at present. High, narrow ridges must have existed, but the slipping down of billions of tons of their materials has not only lowered the ridges, but filled the ravines, resulting in the present irregular topography of low relief.

Some of the landslide areas of Colorado show that in the earlier days, quite recent geologically, but probably scores of centuries before the coming of man, there must have been terrific times among her mountains. There have been thousands of slides, and some of them of great magnitude. Possibly the great saber-toothed tigers which ranged in the plains below, and the giant sloths upon which they preyed, along with other prehistoric animals, heard the roar of the descending rocks. But if so, man knows it not, for the age of the older disturbances can be but guessed.

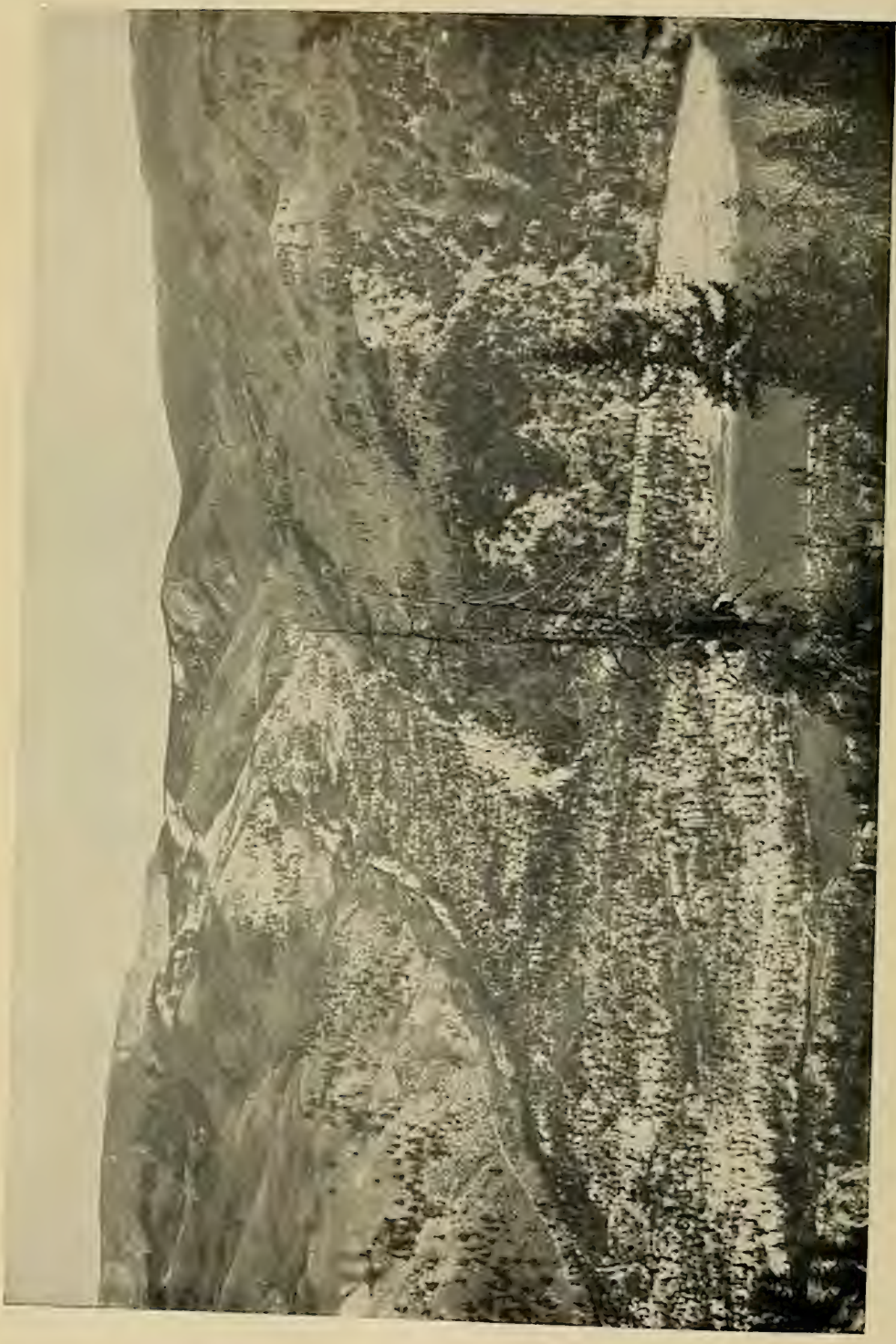
One of the greatest of the early convulsions is known as the Silver Mountain Slide. It covers ten square miles, and the amount of rock which crushed down the mountain sides is beyond conjecture. On the northwestern slopes of Red Mountain about six square miles are covered with landslide debris, while many other landslide areas cover from one to five square miles.

GLACIERS OF ROCK

A singular feature of the San Juan region is the presence of rock streams, veritable rivers of stone, which have flowed down the mountain sides. When seen from a distance they resemble glaciers covered with debris. Ernest Howe* describes these rock streams of which Pierson Basin, in the Silverton quadrangle, is typical.

"Nearly the whole floor of this large basin," he says, "is covered by angular rock debris to a depth of 50 to 100 feet. The length of this rock stream is more than three-fourths of a mile, while its average breadth is about one-third of a mile." with an estimated volume of materia of 13,000,000 cubic yards. "In viewing this enormous mass of debris from a distance, one is at once impressed by its very peculiar form, which is like that of a great tongue of some viscous

* Professional Paper No. 67, U. S. Geological Survey.



A REMARKABLE ROCK STREAM: SAN CRISTOBAL QUADRANGLE, COLORADO

The flow was six miles long and dammed a fork of Gunnison River, creating a lake (see page 281)

substance that has slowly flowed down from the cliffs at the back of the cirque and gradually extended to the outer edge of the basin. The singular billowy surface and the curved, often concentric lines near the front or foot of the mass, and which closely resemble those caused by the cooling of lava streams, strongly add to the appearance of slow movement."

Scores of such rock streams can be seen in the San Juan Mountains. An interesting variation is what is termed by Doctor Cross "Slumgullion mud flow," which dammed a fork of the Gunnison River and formed Lake San Cristobal. At the head of a tributary of Slumgullion Gulch, 11,500 feet altitude, certain rocks had been decomposed into a soft, crumbling sand, underlying, however, other rock masses. In time, perhaps during some abnormally wet season, this incoherent decomposed material became so extensively softened as to be unable to bear the load of rock above, and gave way; the overlying rocks broke into fragments, and the whole mass of mud and rock fragments rushed as a flow down the lateral gulch to the main Slumgullion Gulch, and down that to the Lake Fork, six miles from the place of starting. On reaching the Lake Fork, whose course is here at right angles to Slumgullion, the flow turned north and ended about three-fourths of a mile below the mouth of the Slumgullion. The volume was sufficient to dam the main stream and to cause the formation of Lake San Cristobal, which now extends for nearly two miles up the Lake Fork Valley. The end of the flow is at about 8,900 feet altitude, 2,600 feet lower than its starting point. A sparse forest growth on the surface of the flow shows that the flow occurred many years ago. On the upper part of the flow the trees are in many places overturned or tilted at various angles, testifying to recent movement.

RECENT LANDSLIDES IN THE SAN JUAN

While the great landslides of the San Juan region are doubtless a thing of the past, the recent disaster at Frank shows that American mountains are not entirely trustworthy, and in the case of the San Juan there has been an actual though not very tremendous landslip within the present generation. However, had a city been located upon the three square miles of disturbed area, the movement was sufficient to have ruined it as effectually as did earthquake and fire the cities of San Francisco and Messina.

Late in July, 1886, there appeared in the Denver newspapers a report that an earthquake had occurred in the Cimarron Creek Valley. A few days later Dr Whitman Cross, of the U. S. Geological Survey, accompanied by a photographer, visited the area. The scene of the so-called earthquake was a well-timbered basin, and evidences of such disturbances as had been described were everywhere visible. In some parts nearly all the trees were overturned; in others they stood at various angles, presenting a weird picture. In places were bare slopes, presenting a fissured and step-like structure as if from the dropping down of successive sections of the earth. The movement as described by Cross was a downward sliding of the whole surface, unequal in different places. The impression produced was that a sliding or almost a flowing movement had taken place, involving the whole area of some three square miles. The mischievous agent which had produced the result was unquestionably water. Mud streams were here and there found in which tree trunks and rocks were embedded, while columns and mounds of moist earth were pressed up through cracks by movements of some part of the mass. This appears to have been more in the nature of a surface soilslip than a rock or landslide.

In another locality in the San Juan, namely, the C. H. C. Hill, near the town of Rico, progressive slipping is actually in effect at this time. At one point the stump of a tree has been split open since the tree was felled, and the two portions have separated about five feet in a period of four years. The crack was traced for some hundreds of feet. It is suggested

THE SLID-OFF FACE OF LANDSLIP MOUNTAIN, SHOWING THE SHARP LINE OF DEMARCATION WHERE THE SLIDE BEGAN

that similar cracking and subsequent saturation may have started the Cimarron slide.

Cross and Howe, in a reconnaissance of Ute Creek, a tributary of the Rio Grande, in 1903 found evidence of a landslide that had occurred in comparatively recent times, intermediate in character between that of the Cimarron slide and the incipient slide near Rico. The area covered by the Ute Creek slide is about one-fourth of a square mile, and while no trees appeared to have been actually thrown down as a result of the slip, most of them had been disturbed and stood at considerable angles from the vertical; the trunks of many were buried for several feet by fine sandy soil, which stood in steep slopes in an extremely unstable condition. Although this soil was dry, the horses sank into it so deeply that they were extricated with no ltitle difficulty. The general condition of the locality suggested that a series of heavy rains might so saturate the soil as to cause a renewal of the movement with a violence comparable to that of the Cimarron landslide. So we may hear of more "earthquakes" in the San Juan region, with possible destruction of mining towns.

TREE SPLIT BY LANDSLIDE MOVEMENT NEAR TOWN OF RICO

This area may be preparing for a general landslip

THE MOST TERRIBLE ROCK AVALANCHE IN HISTORIC TIMES

To realize the terrific effect of recent landslides, when associated with human activities, one must turn to the accounts of such catastrophes as the great Elm landslide in Switzerland in 1881, or the Frank slide in Alberta in 1903.

The town of Elm is the highest village in the Sernf Meadow. Overshadowing it rose the steep Plattenbergkopf, the outmost buttress of a greater mountain mass. About half way up this hill was a fine slate bed, which was mined in a careless manner for school slates. A crack began to form above the mine, steadily widening, and splitting the top of the hill. It grew to be over 12 feet wide, swallowing up all surface drainage. Every one seemed to have agreed that the mountain would ultimately fall, but no one thought the danger imminent. Rocks began to fall at intervals. September 11 was a rainy Sunday. Rock masses kept falling, and the mountain groaned and rumbled. People gathered at the foot of the laboring rocks to watch the falls. Many were interested, but none foresaw real danger. Yet the villagers then stood viewing an impending convulsion that not all the human engineering ability in the world could avert.

Suddenly a mass of the mountain broke away from the Plattenbergkopf, crashed down over the slate quarry and spread out upon the flat. No one was killed by this fall, though the rocks

ROCK STREAM AT HEAD OF SILVER BASIN, SILVERTON LANDSLIDE AREA

Showing concentric wave-like formation resembling lava flow, which is characteristic of many rock streams

reached within a stone's throw of where the sightseers were gathered. The people of the upper village now became mildly alarmed. This first fall came from the east side of the Plattenbergkopf; seventeen minutes later a second and larger rock mass crashed downward from the west side.

The gashes made by the two united below the peak and left its enormous mass isolated and unsupported. Then four minutes later, as if pausing only to catch its breath for the final plunge, those who were watching the mountain from a distance beheld the whole upper portion of the Plattenbergkopf—10,000-000 cubic meters of rock—suddenly shoot from the hillside. The great mass pitched downward with tremendous velocity until it reached the quarry. Then the upper part shot forward horizontally straight across the valley and up the opposite hill slope.

A cloud of dust accompanied it and a great wind was flung before it. Trees were blown about like matches and houses lifted through the air like feathers and broken up as though little toys by its force alone.

The avalanche, shooting with incredible swiftness across the valley, struck the opposite hill slope obliquely, and was immediately deflected, like water, down the level and fertile valley floor, which it covered in a few seconds to the distance of nearly a mile and over its whole width with a mass of rock debris 30 feet deep.

Most of the people who had run up onto the opposite hillside were killed instantly. Only when the avalanche had struck this slope and begun to turn aside from it did the people in the lower village, far down along the level plain, have any suspicion that they were in danger. Twenty seconds later all was over, and the rock torrent had swept away half that village. The sharp edge of the avalanche cut one house in two. All within the fatal edge were destroyed; all without were saved. One or two men had a race for life and won, but most who were in the path of the destroyer were doomed.

In brief, 12,000,000 cubic yards of rock fell about 1,500 feet, shot across the valley and up the opposite hillside to a height of over 300 feet, then deflected and poured like a torrent over a horizontal plane, covering it uniformly throughout a distance of 5,000 feet and over an area of 1,000,000 square yards, to a depth of from 6 to 65 feet. Before the avalanche there lay a peaceful village and fertile green fields; within one minute a solid gray rock carpet had been spread, beneath which rested the remains of 150 human beings, their houses and their fields, while the familiar Plattenbergkopf had vanished and a great hole was in its place. Few were the wounded requiring succor, and few the dead whose bodies could be recovered.

Those who witnessed the catastrophe from a distance hurried down to look for their friends. One such was Burkhard Rhymer, whose house was untouched at the edge of the debris. He ran to it and found the doors open, a fire burning in the kitchen, the table laid and coffee hot, but no living soul was left. All had run forth to help or see, and had been overwhelmed—wife, daughter, son, son's wife, and two grandchildren. Such was the rockslide of Elm.

THE GREAT FRANK LANDSLIDE

Only slightly less dramatic and quite similar in character to the Elm rockslide, was the one which partially swept the town of Frank, Alberta. By a hair's breadth only did the community escape complete annihilation. This slide was of much greater magnitude than the Elm disaster, although not so many people were killed.

Turtle Mountain, the scene of the avalanche, is a lofty, narrow ridge situated about 14 miles east of the Continental Divide, and is surmounted by a number of rocky peaks. The range is pierced, north of Turtle Mountain, by a narrow gap, through which flows Old Man River. Near the gap, and where the valley is broadened by the debouchment of Gold Creek, and close to the foot of the mountain, nestles the town of Frank, an

ROCK STREAM OF IMOGEN BASIN, SILVERTON AREA

Three-quarters of a mile long. Note packtrain ascending trail along its edge

important coal-mining center. The mountain itself is an exceedingly precipitate series of cliffs of limestone, sandstone, and shale rising over 3,000 feet above the river.

At dawn on April 29, 1903, a huge rock-mass nearly half a mile square, and from 400 to 500 feet thick in the center, suddenly broke loose from the mountain and crashed with terrific violence into the valley beneath, overwhelming everything in its course. The great mass, broken into innumerable fragments by the fall, plowed through the river bed, crossed the valley and hurled itself up the opposite slopes to a height of 400 feet. Within a minute or a minute and a half over a square mile of pleasant valley was covered with a rock-flow from 3 to 150 feet deep. Most providentially the greater portion of the town lay outside the course of the slide; nevertheless, 70 people were killed.

One man, hearing the noise of the rock-fall, rushed to the door of his house in time to see the slide flash by, only a few feet in front of him. Its passage seemed practically instantaneous. Another man, hearing a great noise, looked in time to see the fall of the mountain and almost instantly the spread of the material over the valley like a viscous fluid. Yet some of the rock pieces constituting the "flow" are 40 feet square. A gang of coal miners was entombed in the coal mine by the stoppage of the entrance by the debris, but they dug themselves out through the roof.

Two and a half miles were traversed by the slide, from the top of the creek on the mountain to the foot, while the material dislodged is estimated at 40,000,000 cubic yards. This is over three times the size of the Elm slide. While it is believed that the coal mining in the valley may have hastened the slide, the primary cause was undoubtedly the structure of Turtle Mountain. The huge mass was in a state of unstable equilibrium, and possessed a weak base.

Although this great slide was a sufficient catastrophe to make men gasp throughout the land, especially those living with overshadowing mountains as their daily companions, it might have been far worse. But one peak of Turtle Mountain slipped. The steep shoulder of the mountain which looks directly down upon the town of Frank stood firm. Had this, too, gone, the entire community would have been smashed to atoms in the twinkling of an eye, and none left to tell the tale.

Moreover, there is likelihood that such a catastrophe may happen at almost any time. The town of Frank, according to the Canadian Geological Survey,* might exist on its present site uninjured for ages, but there will always be a possibility of a second destructive slide. The fact that the north shoulder withstood the shock of the first slide is no proof that it is too solid to fall. Almost the same conditions exist on the north peak and shoulder today that obtained in the central peak before it broke away. Unusually heavy rains, rapid changes of temperature, a slight earthquake, or falls in the coal mine at the base of the mountain following the closing of the chambers, perhaps long after the people have lost all dread of the mountain, may snap the supports which retain this huge mass in place and precipitate it upon a career of destruction compared to which that of the recent slide would be child's play. The suggestion seems a wise one that the people of Frank move a short distance up the valley to a point of safety.

* Report great landslide at Frank, Alberta.

SCENE IN MANCHURIA, ON THE ANTUNG-MUKDEN RAILWAY

MUKDEN, THE MANCHU HOME, AND ITS GREAT ART MUSEUM

By Eliza R. Scidmore

Author of "China—The Long-Lived Empire," "Jinrikisha Days in Japan," "Winter India," "Java—the Garden of the East," etc.

MANCHURIA is a country as large as Texas or as large as France, but the Manchuria that the world knows—and it has only known it for these fifteen years—is a little stretch of seacoast, the Liaotan peninsula, and the valley of the Liao River, the latter a fertile region some 30 miles wide and 900 miles long.

From the time when Shunche, the Manchu chief, was invited in through the "First In-Going-Gate in the World" to assist the rebels in their revolt against the Ming emperor—and the Manchus ousted him and sat down upon the Peking throne themselves for 250 years—nothing ever happened in Manchuria until the Japan-China war, the Boxer outbreak, and war again put it in the forefront of the world's interest. It promises to hold the stage for another decade or two, and is a storm center of world politics.

China has done next to nothing to develop or defend these three eastern provinces beyond the Great Wall, wholly outside of the eighteen provinces of China proper, although, as the early home of the Manchu rulers, Manchuria should have been the chief jewel in her cap. All has been impermanence and change in Manchuria during these fifteen years of stress and storm, and the rapid change of officials, from viceroy to lowest minion, has been the only policy of the distracted Manchus at Peking.

MANCHURIA AND KOREA ARE OVERRUN WITH TOURISTS

Since the war, travel has followed in the steps of the victorious army, and General Kuroki was unconscious advance agent of an army of tourists—a forerunner of scores of independent expeditions in search of excitement, the picturesque and the unexpected—something never seen before. The grand detour from the grand tour of the world now is—from Japan across the narrow straits to Fusan, in Korea; thence by train to Seoul; and from Seoul to the Yalu River, and on to Mukden, precisely following in Kuroki's footsteps. There is an American standard-gauge railway, with American cars, locomotives, and rails across all of Korea, and he travels in comfort to the Yalu's banks. Those historic banks are lined with the rafts of timber floated down from the headwaters of the Yalu, and are about to be linked with a great railway bridge.

From Antung, on the Manchurian bank, a toy railway, a Decauville tram line, of two-foot gauge only, traverses the 180 miles of rough, mountainous country to Mukden. This is the famous Antung-Mukden Railway, with which yellow journals filled their frenzied columns in 1909, between the adjournment of the tariff Congress and the discovery of the North Pole. After Doctor Cook came home, Antung-Mukden affairs were forgotten, and only by fits and starts did the yellow journals declare that the peace of the world and the rights of an army of American merchants and miners were imperiled by the Antung-Mukden convention concluded between China and Japan. That has since been shown to be a simple and innocuous arrangement between the two governments directly concerned, and officially declared so by our Department of State.

This comical little railway was laid by General Kuroki's troops to bring up their

supplies as they marched across from the Yalu to Liaoyang. After the war, it continued to run as it was, with terrific grades, switchbacks instead of tunnels, and rolling-stock of the simplest. It was intended to maintain communication only until such time as the improvements being concluded on the main line of the South Manchurian Railway, there should then be chance to reconstruct the line, make it a real railway, give it a few tunnels and some rolling-stock. The work is now in hand, and will be completed in 1911.

It traverses a most picturesque country, all hills and valleys and winding rivers—an old country with ruined fortresses and pagodas, valleys packed with waving crops, and terrace culture to the hilltops. The few adventurous tourists who have made the trip in the funny little springless cars, who have survived the hotel at Antung, and forgotten the half-way house in the hill country where one night was spent, are enthusiastic over the region.

THE JAPANESE HAVE RECHRISTENED DALNY

Dalny, "far away," has been rechristened Tairen, and is a wonderful place. De Witte's city has felt the touch of Japanese progress and sanitary science, while the Good Roads movement, the Village Beautification societies may find object lessons there. Tairen has changed its face as well as its name, and is a city redeemed, where the steam roller has rolled continuously for three years, and heard the rolling of other steam rollers as they progressed over the beds of broken stone that are fast transforming Kwangtung mud sinks and clay bogs into smooth park roadways. A film of green on the hillsides shows where afforestation's miracle has begun its work.

The Russians left their droschkies, the Japanese brought their jinrikishas, and have since provided electric cars, more luxurious and up-to-date than some of the green chariots that are propelled through the streets of Washington.

The Japanese are not pulling the jinrikishas, driving the vehicles, or doing any such manual labor in Manchuria. They are the employers of labor—and labor in unlimited supply comes over from Chefoo. Fifty thousand husky Shantung coolies cross over to this land of silver and opportunity as to a lesser America each year, and return after the harvest is gathered and outdoor work is suspended for the winter.

A CITY OF EXPERTS AND SPECIALISTS

Tairen is a city of experts—of high-priced experts and specialists in all technical lines—and nearly all of them are graduates of American institutions. Brick works, cement works, mills, and factories fringe the town, and a palace of a bank, as splendid as anything in Washington, gives the humblest all the marble, and mosaic, black iron and plate glass a depositor is supposed to want. A wonderful Japanese laboratory at Tairen is always discovering something for the benefit of Manchuria, undertaking new and stimulating and increasing the older industries of the province.

The insatiable young scientists and technologists assure one that, after beans, wild silk or pongee is the future great crop of Manchuria. The silkworms, fed on the leaves of oak trees instead of mulberry, produce the thread for pongee or tussur silk. Besides the steadily increasing demand for pongee as clothing in China, Europe, and America, pongee is the best material for the wings of flying machines and the bodies of dirigibles, and the Chefoo market was stripped last year after the great flight of the aeroplane across the English Channel. As we will all be flying on wings of pongee in a few years, it becomes a matter of interest that the world's supply of pongee should be increased.

Beans are the great crop, however, and by beans alone Manchuria could live and supply the world. The bean plant should be the crest, the symbol, the coat-of-arms of Manchuria. It is a fortunate thing that there is one great food crop that never fails, and that can be depended upon to feed us when land gets too scarce

THE LATE EMPRESS DOWAGER AND SOME OF HER ATTENDANTS

to plant it in America, and wheat flour is the food of kings. Along with the banana, upon which we shall all be supporting life in a few generations, and, after the kaoliang or giant millet, beans are the most prolific crop. Thirty varieties of these soy beans grow in Manchuria, but the black and the yellow are the valuable oil-producing varieties. They have always been sent by tons by junks to south China for food, fertilizing, and illuminating, and a little to Japan. After the China-Japan war of 1895, when the Japanese commissariat learned their value for man and beast and crops, the exportation to Japan increased three times, replacing, fortunately, the failures in the herring fishery that year as a fertilizer. General export continued to increase until, in 1899, beans, bean-cake, and bean-oil were exported to the value of $12,000,000, and in 1909 the value was nearly $75,000,000.

THE GREAT BOOM IN BEANS

Tairen harbor was crowded all last winter with waiting ships. One hundred ships at a time lay at anchor waiting their turns, ten at a time, at the stone quays, and loading went on day and night.

The beans, when ground and pressed, yield 10 per cent of oil, and the refuse, compressed into great cartwheel cakes weighing 60 pounds and more, provides the best of all fertilizers for the rice-fields of Japan and the sugar-fields of Formosa, the Philippines, and even Java. The beans are converted into soy and bean curd in both Japan and China, and furnish those two popular articles of food—soy, the dark brown, pungent sauce resulting from a fermentation of bean dough. This bean soy is sent to England and America by the shipload, and, when treated to cayenne pepper, becomes our familiar red-labeled Worcester sauce. Bean curd, or bean cheese, is a

THE LATE EMPRESS DOWAGER IN HER IMPERIAL YELLOW DRESS

ANOTHER VIEW OF THE EMPRESS DOWAGER, TAKEN AT THE SAME TIME AS THE PRECEDING PICTURE

A CHARACTERISTIC EXPRESSION OF THE LATE EMPRESS DOWAGER

common and most nourishing article of food, popular with all the people, and is a clean and most attractive looking dish.

The Japanese, with their mania for investigation and analysis, have found that the liquid left from making the bean curd, and which used to be thrown away, has the same chemical value as milk, and is, of course, many times cheaper.

Europe at present uses the beans for making candles, soap, and dog biscuits, and as an adulterant for other flours. The oil is a substitute for olive oil that threatens to displace our cotton-seed imitation of olive oil.

Beside the great Japanese firm of the Mitsui, who started the boom in beans by their gigantic transactions, several English firms, including the representative of the Rothschilds and several German firms, have gone into this bean export business, and have established bean mills or oil mills and built godowns on a large scale—the open door quite satisfactorily open to them. Before the war, the beans were carted to the river bank in winter, when the ground was frozen as hard as a road, and sent down to Newchwang by junks. The trade by junks has not fallen off, and this enormous railroad freight

to Tairen, and to Vladivostock as well, and foreign shipment only represents the development of the province since the last war.

The new tenants, or rather the old tenants, on their return cleaned and tidied Port Arthur, paved the streets, and made the place a model of sanitation and order. Every wreck has been raised and sold, every bit of scrap iron dredged up from the harbor, every fragment of the dead interred with honor.

Port Arthur affords a day or two of the most tragic sight-seeing one can endure. A good carriage road connects all the dismantled forts and another leads to the Two Hundred and Three Meter Hill, the world's most awful slaughter-ground. A great mortuary temple has been built to the spirits of the dead on the high hill facing the harbor entrance, and also a great column to their memory, built with the granite blocks taken from the blockading ships which Hirose and his fellows sunk at the harbor entrance—that ballasting of their ships with their own tombstones the last word of the wonderful Japanese prearrangement.

At Tairen one meets the butterfly crest of the South Manchurian Railway, and thence northward "the company" is all in all. The letter M, whose loops are suggestive of a butterfly's wings (the butterfly being one of the Chinese symbols for good luck, long life, and immortality, and a favorite art motif), and the profile of a cross-section of a rail, greatly resembling the Chinese character for industry, compose a monogram that greatly delights the Chinese eye and mind. One soon gets bewitched with this butterfly crest of the South Manchurian Railway, as he sees it on every locomotive, car, and piece of railway property, on the uniforms of employees, even to the patterns of the kimonos and neck-folds of the little waitresses at the railway hotels.

BUILT OF AMERICAN STEEL RAILS AND EQUIPPED WITH AMERICAN CARS AND LOCOMOTIVES

The railway, 440 miles long, without a single tunnel, was a mere track, without bridges or rolling stock, when the Japanese acquired it as almost the only prize of the war. They floated a loan of $100,000,000 at 5 per cent and double-tracked the road with steel rails from Pittsburgh, equipped it with Baldwin locomotives from Philadelphia, Pullman cars from Chicago, and spent many more millions in the purchase of railway materials in America, as they are again about to do for the Antung-Mukden Railway. Beside paying 5 per cent interest on this loan and 6 per cent on the stock, the South Manchurian Railway reaps a surplus each year. Receipts are increasing by leaps and bounds, partly owing to the wonderful bean trade and to the opening and working of more and more coal mines—coal that is said to be second only to Cardiff in quality.

Because of its Pullman sleepers and dining-cars, and its long day coaches, American travelers have only words of praise for the railway, and European travelers sneers and open complaints. The Russians and Belgians loudly jeered at the Pullman cars, with their great expanse of glass windows, and said that they would never do in a Manchurian winter, being ignorant of just how many hundreds of such glass coaches daily traverse our most northern and western States and all parts of Canada through the blizzard season. The Japanese have also introduced the American baggage check into Manchuria; but, as the connecting railway across to Tientsin and Peking is of British ancestry, and the Trans-Siberian is a law to itself, the excellent example is not likely to spread.

When I checked my trunk from Tairen to Mukden, I held on to the check and the South Manchurian Railway held on to the trunk until I was ready to take train on to Peking. Then the trunk was tossed into an open truck, and third-class passengers roosted on it like so many chickens, any one of whom might have carried it off at any way station.

This British-built railway has dining-cars, a little less splendid than the Pullman-descended ones on the South Manchurian Railway, and the Chinese, with

THE GIANT MILLET FIELDS OF MANCHURIA LOOK LIKE OUR OWN PRAIRIE STATES

their childlike frankness and directness, call them "kitchen cars"—for one may dine, *i. e.*, eat, in any and every car, but you can only cook in a kitchen car.

LIKE OUR PRAIRIE COUNTRY

Nearly all of Manchuria that one sees from the railway is covered with crops of giant millet, and the short millet, which is the same as our sorghum. The giant millet, under the primitive culture employed, repeats itself 3,000 times and the short millet 800 times, so that even scientific agriculture can teach little to the Manchus. Giant millet grows 10 and 12 feet high, and can conceal a man and a man on horseback. This kaoliang furnishes food and fuel and distilled drink, mats for the floors and for a thousand economies of farm life, and the stalks, daubed over with clay, provide a good building material. When stacked in the autumn, kaoliang gives the landscape much the look of our prairie country. In fact, these vast flat fields of kaoliang stalks need only the pumpkins and James Whitcomb Riley to be exactly Indiana.

The poppy fields of Manchuria, covered for solid acres with billows of soft pink or white blossoms, are more beautiful than the tulip fields of Holland; but, with the growing moral sense and the rule of reform, the poppy must now disappear and the ground will be given up to the harmless and profitable soy bean.

As one journeys across the prairies of Manchuria, past Haicheng, Liaoyang, Shaho, and Hunho—names of burning interest five years ago, when the great armies were halted before Mukden—no sign of war or battle remains. As far as one sees are luxuriant fields of beans and sorghum and newly-built houses, the very newness of their mud walls significent of the utter waste and desolation left on that same plain when the two armies had gone by. In such vast levels one cannot understand how any one could know, not seeing, where the battle was going on or what the combatants were doing—a battle-field of all-out-doors, with no strategic point greater than a gully.

A CITY OF DIRT

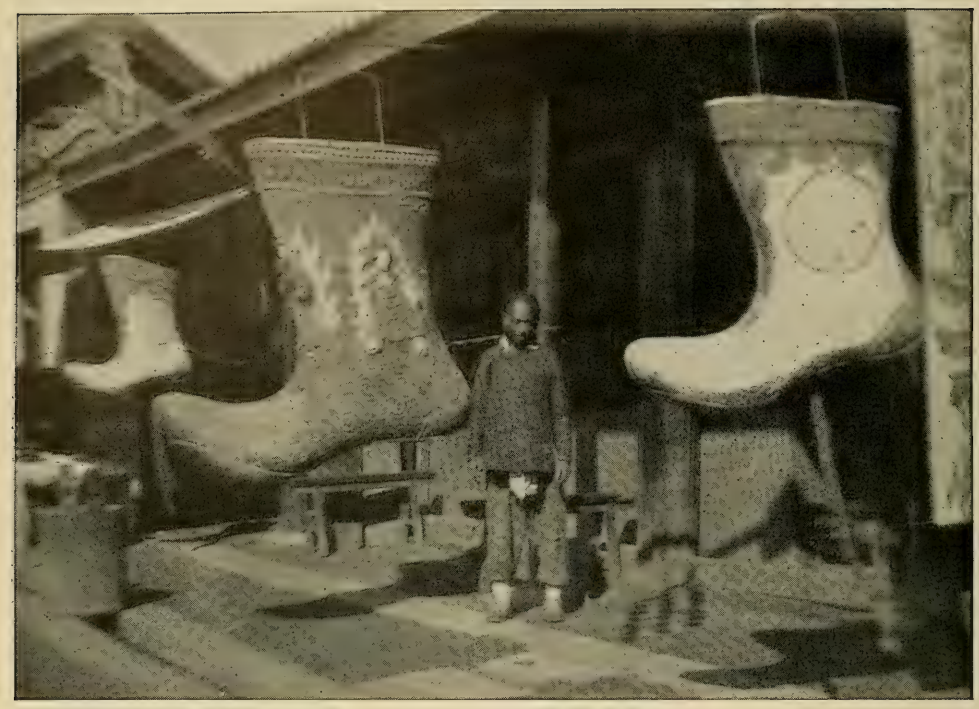
Liaoyang is the oldest capital of the Manchus, but the war has given Liaoyang its only interest for the tourist.

THE GORGEOUS STREET SIGNS OF MUKDEN: THE MAIN STREET AND BELL TOWER
(SEE PAGE 301)

One rides into the walled city and around its slummy streets on the most comical man-power tramway, two small benches on a tiny truck, some poles and cotton curtains constituting the standard rolling-stock. A husky Manchu in a loose dressing gown of wadded cotton, long, flopping trousers, and cotton shoes runs and pushes the clumsy toy for a while, and then jumps on and enjoys the ride until "the old cat dies," and he has to speed her up again. When one meets another special on the single track both cars stop, exchange their passengers and return on their same routes, the passenger paying another five cents at each transfer and at most switches.

One is jolted around the uninteresting, unpaved streets, with their blank walls and poor shops, avoiding innumerable head-on collisions, until he reaches a mountain of rubbish, a hillock of garbage, ashes, and brick-bats quite 30 feet high in the very heart of the city—a fitting altar to the deity of Dirt, which the Liaoyang people seem to worship with their whole hearts. From this lofty scrap-heap, as from the city walls, one sees the whole panorama of the battle plain, surrounded by low hills that were ideal for purposes of defense, "if the defenders could throw stones," one American officer said, after a tour of the battlefield. Yet the two armies shot away more ammunition in those three days than the combined French and German armies used during the whole war of 1870!

The Japanese children in the settlement can point to the strategic spots in the great plain—where Kuroki came out from the hills; where Kuroki cut through and was cut off for hours; where the Russian retreat began—and tell how the Russians fled, setting fire to the mountain of stores they had to leave behind, and burying cases of champagne, music boxes, and other delightful munitions of war for their pursuers to resurrect at their leisure one whole winter long.



A SHOE SHOP IN MUKDEN (SEE PAGE 302)

The Chinese show where the Russians deliberately breached and entrenched on the city walls, using the parapets for gun platforms and rifle trenches, inviting and drawing the enemy's fire into the peaceful city, packed with helpless non-combatant country folk, in addition to the terrified city folk—almost the most cruel, most wantonly cruel, act of the whole war.

DUST-STORMS WHICH HIDE THE SUN AND CHOKE MAN AND BEAST

The railway to Mukden does not get there—that is, to Mukden—not by three miles. In the original concession to the Russians it was not to come within 20 versts of the old home of the Manchu chiefs, but the exigencies of war brought the rails closer than that. It is a long, uninteresting three-mile ride through a one-story suburb from the gray brick station marked "Mukden" to the gates of the real Mukden, the permanent camp of the all-conquering Manchus.

Russian droschkies and Japanese jinrikisha and ancient horse cars from all parts of Japan, soon to be succeeded by the most modern of electric trams, carry one about Mukden, and the two-wheeled cart of the country is only for country folk and freight nowadays. The Japanese macadamized the roads up to the city gates and a shame-faced governor did the rest for the main streets of the inner city.

The long ride to and from the station is a penance, whether in the scorch of midsummer or the below-zero of winter, or in the dust-storms and rain-storms which rather evenly divide the days of the milder seasons. And it can rain at Mukden, especially in September. Torrents every day; deluges every night!

When it does not do that, the wind blows, rudely, fiercely, and, beginning far away in the desert of Gobi, sweeps up the solid earth and carries it along in clouds that fill the air, hide the sun,

choke man and beast, and penetrate every crevice and pinhole, until all the outer world and indoors is an inch deep with gritty brown dust. After the summer deluges and dust-storms there is a long and bitter winter.

A shabby dagoba, with crumbling images and peeling ornaments, a group of dilapidated temples up a mud bank, and some new temples, which have in turn served as Russian and Japanese military offices, and now shelter the American consulate, mark the way toward the iron grille, which replaces the tumbled-down gate tower in the outer city wall. Half way to the gate of the inner or Tartar city another temple, whose gateway and guardian lions are islanded in a reflecting lake after every rain, is falling to ruin on one side of the highway; and, on the other side, other tumbled-down temples show Buddhism in its last decaying stages.

A MANCHU SAMOVAR (SEE PAGE 302)

PICTURESQUE MUKDEN

One-third of Mukden's people claim to be Mohammedans, forswear pork, take many baths, and prostrate themselves toward the west at every sunset; but the mass of the townsmen have no religion at all, modern, material progress and foreign example having shattered the old creeds and left neither hope nor fear in their place, giving them no new code or standards. "Better Buddhism than this," said one despairing evangelist.

Mukden, the permanent camp of the all-conquering Manchus, is an epitome of Peking—a smaller Tartar capital, with a lesser palace in an inner city, with ancestral tombs to north and east. It is a picturesque and fascinating place, its street crowds brilliant in color, and its street signs the most bewitching and fantastic decorations any Manchu can imagine.

There is local color to exaggeration—color on the carved and gilded shop fronts and street signs, color in the costumes of men, women, and children, and color of the most violent, vivid cerise on the women's cheeks, and on the peonies, chrysanthemums, and sunflowers set in bouquets at either end of their towering "double-loop" head-dresses. When the sun shines on an every-day Manchu street crowd it presents the gayest carnival scene. What it may be like in Mukden streets on high holidays and great festivals, I am ready to travel there again to see.

Mukden has its drum tower and its bell tower like Peking; each keep a

FRONT VIEW OF THE HEAD-DRESS OF MANCHU WOMEN
(SEE PAGE 305)

BACK VIEW OF THE HEAD-DRESS

grand cross-roads, where city life centers and gay street signs are thickest; each keep a solid old three-story tower with faded red columns and shabby old green-tiled roof.

Order of the most rigid kind is maintained in Mukden streets by flat-chested police and sentries, who wear top boots and semi-foreign uniforms, their queues coiled in psyche knots under the brims of their girlish sailor hats or upturned turbans. Rifle in hand, they have taught the public that street traffic is no longer a go-as-you-please affair, and the husky Manchurian cart driver follows the rules of the road as abjectly as the lately-tamed cab driver of New York. The local levies have learned military style and manners from two grand armies of occupation and re-occupation, and the people learned well their lesson that the man with the gun was not to be trifled with. When they severely nod the traffic to right and left, the carters no longer bellow and bluster, but obey.

WHITE FOX AND SABLE SKINS (SEE PAGE 302)

A SPLENDID RACE OF STALWART MEN AND HANDSOME WOMEN

Once through the deep-vaulted gateway of the Tartar city or citadel, color and picturesqueness surround one, and the streets are moving pictures of Manchu life—the life of brave horsemen and strong northmen, of bold hunters and fighting tribesmen, but lately come from nomad life on broad, dry plains to this permanent camp with its high brick walls. The Shantung people, in their dull clothing, are not numerous enough to spoil the picture.

These hearty Manchus, descended from northern Tungusic Tartar tribes, are a different people from the soft, sleek, languid, lemon-tinted yellow men of the steamy rice fields of the south—the common Chinese of commerce, the strictly-excluded, emigrating Cantonese who alone are known in the outer world. Their cold, dry northern winter has made men of these Manchus, given them backbone, brawn and "sand," sinews and muscles of iron.

Their women, when protected, are creamily instead of greenishly yellow. The Manchu women walk free and untrammelled on their natural feet, and their fine Manchu eyes are set straight in their heads, their eyelids not caught together at the corners. They, with their long robes of brilliant colors and their tremendous head-dresses, add the last, best touches to the brilliant pageant of street life—streets whose carved and gilded shop fronts, with gold and vermilion "beckoning boards," are as gay as any in south China.

THE GORGEOUS SHOP SIGNS

Mukden's streets have an additional glory in the shop signs, that make gorgeous cornices, shoot from the door-

posts, and stand on tall masts outlined against the sky. Golden scepters and dragons sprout from the eaves, horses, unicorns, and peacocks perch there, and gods and goddesses, fiends, and fairies jump from gigantic flower cups and ride on mythical monsters, along with every other fantastic and highly-colored thing Manchu fancy can invent. Besides these, there are the gigantic images of the articles sold within—hats, beads, pipes, and Brobdignagdian boots that dwarf the shopkeeper who stands beside them.

There were many more fantastic shop signs along the streets before the Boxers burned the rich shopping quarter in 1900, and after the rebuilding many of the new signs had to be moved to inner courts when the telegraph poles were erected, and many more put out of sight when the streets were paved.

One must lament any such sacrifice of picturesqueness to the demon Progress, and I begged the governor of Mukden to offer prizes for the most gorgeous shop signs of each year, to reward such public benefactors by an omission or reduction of taxes.

City life centers around the mediæval bell-tower and drum-tower that block the main street and make busy four corners of gossip and trade, and fend off the evils of the north from the palace. The rich silk shops and fur shops are near these old towers, and in the autumn every other shop is a fur shop. Fur coats, fur robes, and dressed skins are hung out and piled up on the counters of the open-fronted shops, along blank walls and on the ground.

Pursuing side streets and narrow alleys of bottomless mud, and crossing untidy courts, we found the storehouses of dealers in sable and ermine—second and third rate reddish-brown Manchurian sables and the superior dark, smoky-brown treasures from beyond the Amur—all put at the preposterous prices dealers dream of getting from strangers and greenhorns.

There are many shops for the sale of foreign goods, many more than drew the fury of the Boxers in 1900, and the popular fancy now seems to run to our enamelled tinware—pink and blue tea kettles, and, choicest of all, rose-du-Barry and turquoise wash basins that are always put last on the top of the big wicker market basket with netted cord cover, which is the most *chic* piece of luggage that a great personage carries on his railway travels.

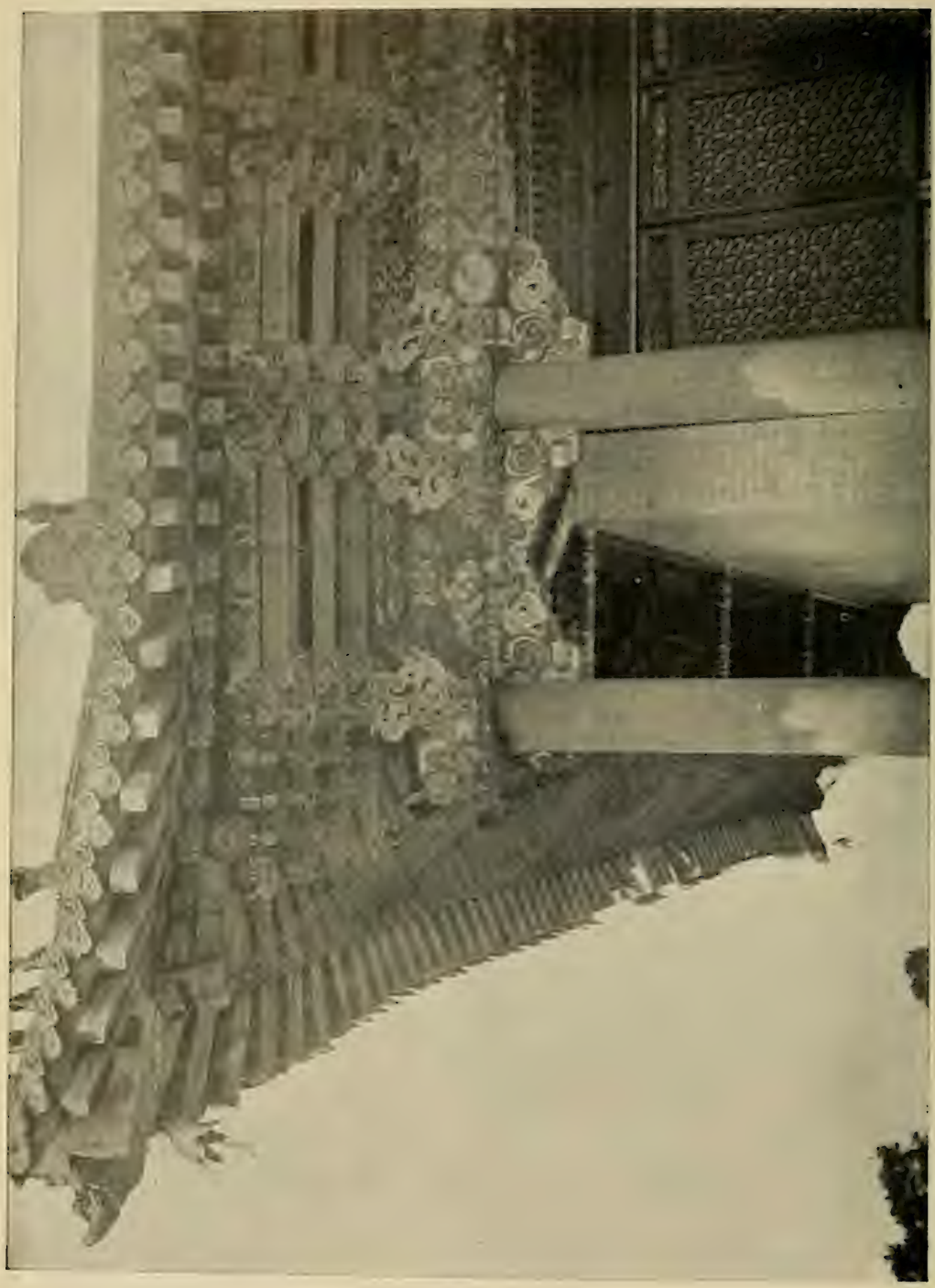
THE MANCHU SAMOVAR

The viceroy and the governor ride in "glass carriages"—broughams with windows on all sides in Shanghai style—and the first automobile has come, in the shape of a steam roller that parades the streets and snorts in the lunettes of the old red gateways, whose tiled roofs wave with weeds and bushes, and have archaic cannon niched in quiet corners. Progress, with a very large "P," blares its presence when two young men in enormous spectacles drive up and down the main street in a real American buggy, clanging the gong of a police or hospital ambulance.

Far better to the eye is the two-wheeled Manchurian cart with three mules straining at the traces ahead of the shaft animal, and a soft, boomy bell sounding from under the body of the cart, instead of being hung on the animals' necks. When these carts are filled with country women rouged to the eyebrows, and their headdresses set with sunflowers, Mukden shows one street sights unequaled outside of the three provinces.

There is a purely Manchu samovar to be seen at every tea booth and street restaurant in Mukden and in Peking, which is plainly of the place and the race, and undoubtedly parent of the samovar, which the Russians did not have in Russia before the Tartar raids and conquests. The Manchu samovar burns wood, coal, charcoal, grass, and anything that comes along, and the shining, graceful, copper or brass body, with its beautiful and unmistakable Persian lines, has any sort of an iron or tin chimney thrust down its throat to draw the

DETAIL OF GATE-HOUSE OF IMPERIAL PALACE: GREEN FAIENCE DRAGON PANELS ON BRICK COLUMNS (SEE PAGE 305)



DETAIL OF RAFTERS AND BRACKETINGS OF THE PALACE EAVES OF THE IMPERIAL PALACE

smoke and flame up through the hollow core. In the early morning and at the noon "rice-time" these great water boilers are fired up freshly, and send out clouds of cheering smoke and steam. For the rest of the day they simmer gently, always ready to pour a bubbling stream into the teapot. They are forged and hammered out in the brass bazar, a narrow street opening from the main street, and the ear is the only guide needed for one who would find the place.

THE MANCHU WOMEN ARE THE MOST STUNNING FIGURES IN ALL ASIA

The Manchu women are the most stunning figures in all Asia, and the tall *lian-barh-to* of Manchuria is the most magnificent head-dress I have ever seen. In the last decade the *lian-barh-to* has mounted and spread, until it is a towering, gabled affair that stands eight and ten inches above the smooth, blue-black head, the golden cross-bar wound with loops of black satin instead of hair. The simple guan-zan of the old Empress Dowager, balanced across the head and held there by loops of hair, has broadened as well as mounted, and its ends droop like railway signal arms. If they did not, it would be impossible for a Manchu lady to enter a house door or a cart without turning the structure sideways.

This exaggerated Merry Widow affair is so heavy that women must remove it indoors, and they cannot walk facing the wind nor turn on their course without certain scalping. On rainy and on dusty days this magnificent structure of satin and flowers, tinsel and jewels is shrouded in a cotton cloth, and their brilliant silk robes and gay little jackets are hidden in long sheath garments straight and tight as bolster cases or Parsee's coats.

To see the Manchu women in all their glory in the sunshine, I stayed on day after day in the Mukden hotel, sufficient test and proof of admiration and appreciation. That "Astor House!"—the Mukden-Astoria!—where all the rooms were back rooms, dark and damp, and the place cheerless enough in the rain, to drive any one to suicide! Where the tourists came raging down from Harbin every midnight, to sleep on the floor as long as there was any floor space left—and where the tourists came raging up from Tairen at daylight, berating the universe and the fate that had landed them breakfastless in such a dilemma at the end of the long drive from the railway station—raged madly as only tourists will, until that genius of a French cook, lately turned hotel proprietor, always dressed in military khaki, gave them such a midnight supper or morning coffee that they thanked their ancestors that they—and he—lived.

A SILVER CHEESE

The palace of the Manchus, as built in 1656, was doubtless a very simple affair. It was rebuilt in 1750 by Kienlung the Magnificent, a very Louis XIV for splendor, a Cosmo de Medici for learning and love of the arts. Kanghsi and Kienlung and the early great ones of the Manchu line revisited the ancestral home often in those days, when traveling meant something. They came to Mukden once in every ten years, at least, to thank their ancestors, to worship the tablets, to make offerings and to deposit the dynastic records, bringing with them gifts and treasures of every kind to the rarely occupied palace, until it became and remains a great storehouse of eighteenth century art—an Art Museum bursting with incredible treasures.

There was the theory that the Manchu rulers were preparing against a rainy day—preparing against any chance of fortune sending them for refuge to the old home—and there was a fable that they stored solid treasure there against the time when the next conqueror should push them from the dragon throne at Peking. They did not send bags of loose coin to be sifted along the highway. Even the bars and shoes of silver bullion were not put in final storage in any such convenient shape.

The Manchus knew themselves—that is, their own people; and, as the fable goes, they took an old dry well in the

THE DRAGON THRONE, MUKDEN PALACE: THE DAIS COMPLETELY COVERED WITH PILES OF IMPERIAL YELLOW PORCELAIN BOWLS AND PLATE (SEE PAGE 309)

palace compound and set up a mud furnace at its edge. Then, melting the ingots, they poured the treasure down the well until it was full to the curb with a solid cylinder of pure metal. They cemented that well over and filled another and others with more bullion in safe cold storage.

When the rainy day should arrive, the Manchus were to retreat to Mukden, and, chipping away at the silver treasure, nibbling at their precious silver cheese, live on in happy idleness forever after. In Mukden they scoff at this story of buried treasure, but one does not like to give it up. It is so plausible, so characteristic, so Manchu, that even Prince Ching might have devised it last week.

NEGLECTED FOR 100 YEARS

Tao-kwang was the last emperor to visit the ancestral home. After his stay in 1805 the caretakers assiduously neglected the palace, dusting out a corner or two every ten years, when the imperial prince, who could not escape the honor-

THE GREAT PAVILION OF THE IMPERIAL PALACE AT MUKDEN BEFORE THE REPAIRS

able penance of imperial proxy, came to bring the records of the preceding ten years to add to the ancestral chronicle, and to bring more precious things to the palace storehouses. Prince Ching was starting on that errand—but comfortably, in a through railway train, in October, 1908—to deposit the records of Manchu rule from 1898 to 1908! From the coup d'etat to the promise of a constitution! And a fine series of fairy stories the imperial historians must have concocted, too, to save face before the ancestors! For the bald, disgraceful truth about these last ten years would make the Manchu forbears rise from their grave mounds.

The red entrance gate and the pailows of honor admitting to the Chin Lan palace face the south gate of the Tartar city, and five courts on rising terraces lead back to the garden at the far north end of the compound. All the pavilions, save the first audience hall, and the Hall of Worship, where the Emperor Taitsung died, have been nearly rebuilt in the

BLUE-AND-WHITE VASES, IMPERIAL YELLOW BOWLS AND PLATES OF THE PERIOD OF KIENLUNG

course of the very thorough restorations undertaken since the Japan-Russia war. Both armies respected the sacred precincts during the war. When the Japanese General Kodama came to visit the grateful viceroy after the peace, the latter asked his advice as to what he should do to improve his provinces and help his people, so long the sport of contending armies. "Pave your Mukden streets and make roads, so that your country people can bring their crops to market first," said the great military genius.

"What next?" asked the contrite viceroy.

"Well," said the candid friend, looking around at the sagging and weed-grown roofs, the broken windows, torn mattings and blinds — everything in the last stages of dilapidation and deeply dirt-encrusted—"if you Chinese had half the respect for your ancestors that you talk about you would never let this old palace remain in this condition. Clean it up. Repair it, or it will fall down on your heads in another year."

It was the year for plain talking and the visitor improved his opportunity, saying, incidentally, that he would repair the palace at the expense of the Japanese government, if the local officials would not do it, and charge it against the revenues of the province.

The viceroy commanded and the minions fell to with such zeal that when General Kodama came back six months later the place was hardly recognizable. To save face before the Japanese general they did what reverence for the imperial ancestors had not moved them to do for nearly a century, and, after a frenzied house cleaning, they painted, papered, mended, plastered, and slicked things over to a miracle. Chinese pride was roused to prodigies of activity, and, as pride grew and money was granted for the "sacred places," the later repairs have been entire reconstructions. "Clean and

LARGE BLUE-AND-WHITE KANGHSI VASES TEMPORARILY STORED IN TUBS AND COVERED WITH DUST: MUKDEN PALACE (SEE PAGE 310)

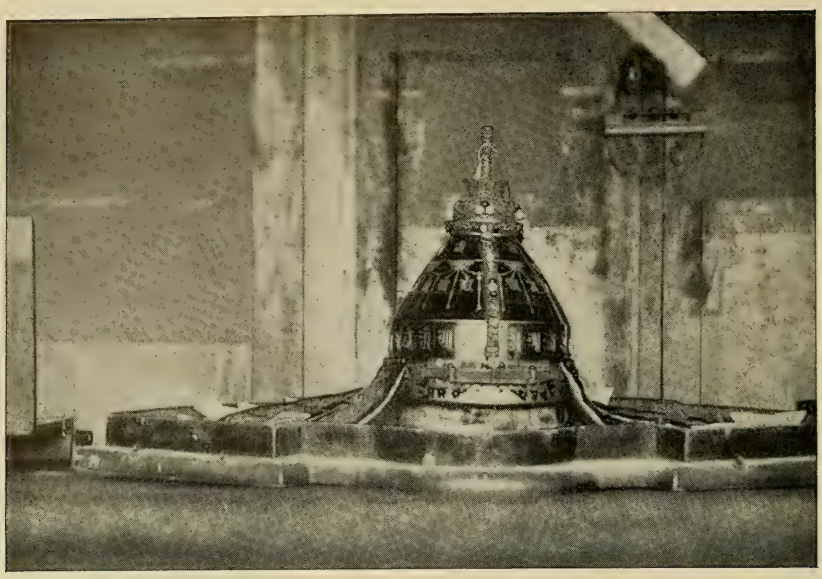
Peaceful," the inscription over the door of the pavilion which was the study of the Emperor Taitsung, is no longer a mirth-provoking legend to western visitors.

THE DRAGON THRONE

The audience hall is not as vast as the great temples of throne-rooms at Peking, but it is sufficiently impressive, and the red-raftered ceiling, with its fine ribbing and its great beams covered with rainbow decoration, gives excellent setting for the ornate ark sheltering the chair of state. The attendants tell one that it is the chair of Shunche, Kanghsi's father; and then they tell one that Kanghsi's successor, Kienlung, sent the chair from Peking—a much more likely tale, since it is plainly a replica of the "imperial seat" in the Pao Ho Tien, the great audience hall in the old palace in the Forbidden City at Peking.

The state chair is a mass of interlaced dragons carved to a miracle, covered with vermilion and gold lacquer, and stands on a dais approached by three stairways under a canopy supported by splendid dragon-wreathed columns. When the jeweled person of the great Kienlung sat upon that golden throne it must have been a sight to dazzle the eyes of the simple tribesmen who garrisoned the old citadel.

On either side of the audience hall are the great storehouses and the famous imperial library, and behind it is a terrace twenty feet higher on which stand the great palace pavilions, where the sovereigns lived and passed their hours of ease and occupation. Chief of these is the great three-story tower where the Emperor Kienlung spent all his time during his Mukden visits—in the Manchu "old home weeks." It was in the most fearful state of dilapidation in



BLACK LACQUER JEWELED HELMET OF THE EMPEROR KIENLUNG

1905, but now, having been completely rebuilt, is practically the same thing of joy to the eye as when Kienlung first surveyed the completed palace.

All now is new, clean, and perfect, from the first red-latticed doors and rainbow beams under bracketed eaves to the last roof of shimmering yellow tiles, with scaly dragons coiled like rampant shrimps on the ridge pole, and dogs and lions parading down every angle to keep away evil spirits.

Wind bells of gilded copper swing from every angle of the tip-tilted roofs, and the restoration has been faithful and exact. In the side court, the two-story pavilion of the empress, the eunuchs' quarters, and a little study or library with quaintly gabled end walls, all glow with new tiles, latticings, fresh gilding, vermilion, and polychrome decorations on the broad beams and rafter tips. There are a few ceilings with square sunken panels, where golden dragons grin in coils, but others, like the audience hall, have timbered roofs, the rows of slender red ribs of rafters defined against a flat gold ceiling—a direct suggestion of the primitive lodge poles of their tented ancestors. Some wonderful old panels of glazed pottery with dragons and devices in high relief have been reset in walls and screens, and used in ornamental constructions in these courts.

The great imperial library of more than 6,000 cases of volumes, deposited by the Emperor Kienlung, is a duplicate of those also deposited at Peking and at Golden Island monastery, on the Yangtse.

THE MOST MARVELOUS COLLECTION OF PORCELAIN IN THE WORLD

The palace storehouses contain more than one hundred thousand pieces of porcelain of the best period of the imperial potteries at King-te-Ching. Tens of thousands of pieces of porcelain were sent up to the Peking palace every year, and the supply for Mukden was in proportion. The eastern storehouse, the Fei Lung Ko, where the thousands of vases, plates, bowls, and cups were kept, had so very nearly sagged to the ground by 1905 that it had to be completely rebuilt.

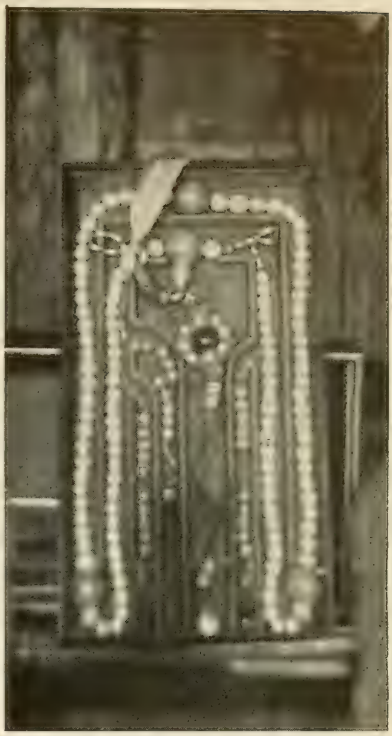
All this ceramic treasure was taken to the audience hall, where it covered the floor, the dais, and even the imperial

chair itself. In the side rooms large blue and white vases of the Kanghsi period were tumbled recklessly together in huge casks, without as much as a rag or a wisp of straw to protect them. Smaller vases were ranged on shelves in duplicates and duplicates of rare blue and white beauty past counting.

The throne room was only a grand palace pantry when I saw it, imperial yellow, powder-blue, and chicken-liver-red plates and rice bowls stacked all over the floor to the area of nearly an acre. All were dirt-encrusted and spider-webbed together in a way to make one gasp, and the attendants pottered around over and among this fragile treasure, sorting it and carrying out by the basketful to the court, where leisurely ones scraped off the first dirt crusts with twigs, and then washed the pieces to near-clean stages.

Things that are treasured in glass cases and satin-lined boxes in western museums were strewn all over the flagged court. When Tang Shao Ii was starting off on his spectacular tour of all great nations, he had permission to choose from this storehouse gifts for all the potentates and benefactors he was likely to meet. He chose for American gifts eight pairs of great ribbed celadon vases, some famille vert jardinieres, and some smaller celadon and sang de bœuf pieces, and a single peach-blow vase as the particular gift to President Roosevelt, who promptly sent it to the National Museum, where it is now on exhibition with other such official gifts from foreign rulers.

The Yale-graduate governor of Mukden listened to me with doubt when it was suggested that he offer this palace porcelain collection as security or collateral for any loan he might wish to raise for the colonization and development of Manchuria. He looked with more incredulity when it was suggested that a certain American banker might jump at it at two per cent, with such a collateral, and then pray and pray for a chance to foreclose.



ROSARY OR OFFICIAL NECKLACE OF LARGE PEARLS WHICH BELONGED TO THE EMPEROR KIENLUNG: MUKDEN PALACE (SEE PAGE 312)

TREASURES NOT TREASURED

The western storehouse, the Hsiang Feng Ko, is a still richer treasury. It contains personal relics of the Manchu emperors, a great accumulation of jeweled arms, ancient bronze mirrors, jewels, and precious stones, crystal, enamel, bronzes, and more than ten thousand paintings of the Ming and early Ching dynasty. All is kept without much order or care in big red cupboards, closed by padlocks as large as a hand, and sealed with strips of paper that the keepers paste on and lift off with their long talons of finger nails with a simple ingenuousness that is startling, considering the tales of craft and graft and villainy that run up and down the empire and the incredible value of the contents of those cupboards.

NORTHERN TOMBS: MUKDEN

They seem to have the strongest feeling for the money value of these treasures and relics, and give one plain figures when they produce the great seals of Kienlung—a pair of solid gold cubes four inches square, with crouching, dragon-like tortoises run through with imperial yellow cords, the characters of the imperial cypher cut sharp and clear.

They show one the imperial yellow satin robes of Kienlung, embroidered with the finest gold thread, the dragons worked in seed pearls; his overcoat of plum-colored satin, with more gold thread and seed-pearl dragons; his Mogul helmet of black lacquer encrusted with gold, set with pearls and rubies; his diamond-hilted Indian daggers and his jade-handled swords.

Best of all is his rosary, or official necklace, of one hundred and eight half-inch pearls. The four "regent beads" of this rosary are *lapis lazuli,* the pendent "disciple strings" are coral, with large sapphire "dewdrops" at their ends. The reliquary, or central medalion, has one huge, burning ruby in a circle of creamy button pearls, and a last and largest pear-shaped pearl hangs from that cord.

Fully one-third of these large pearls are dead—dull and lustreless. They have been lying there untouched, unworn, shut away from light and air in the satin-lined box for more than a century.

Everything is Kienlung's in Mukden and in its palace. Kienlung did this and that, built the city walls and towers, the palace and the mortuary temples without the walls. Kienlung deposited the great treasures there, the collection of paintings that is alone of its kind as an imperial possession, and the library that the Chinese were always fearing the Russians might seize and carry off to St. Petersburg. One almost grows weary of Kienlung with the incessant repetition of his magic name, but no other emperor ever impressed himself upon Peking as did this great one—shadows only, names merely, those others.

The Russians built a very splendid administration building that would be a fine prefecture in any European city, and Tang Shao Ii, while governor of Muk-

THE EMPEROR OF CHINA, HENAN TUNG, AND HIS BABY BROTHER

den, built himself a greater brick palace in foreign style in an incredibly short space of time. The viceroy of Manchuria has been much in the lime-light since 1900, and remains a conspicuous satrap of the empire.

When I saw the viceroy and his suite at a Japanese fête at Tairen, whither he had gone to pay a state visit, I was convinced as never before of the common origin of the North American Indian and the Chinese or Manchu-Tartars. There might as well have been Red Cloud, Sitting Bull, and Rain-in-the-Face, dressed in blue satin blankets, thick-soled moccasins, and squat war bonnets with single bunches of feathers shooting back from the crown. Manchu eyes, Tartar cheek bones, and Mongol jaws were combined in countenances that any Sioux chief would recognize as a brother's.

THE TOMBS OF THE MANCHU ANCESTORS

The tombs of the Manchu ancestors are in two great parks, the one to the north and the other to the east of the city. Tung-Ling, the eastern tombs, are the most extensive, the grove of gnarled cedars surrounding them the oldest and most impressive. In the face of all the talk of ancestor worship, the sacred burial place is sadly neglected, and the enclosures unapproachable after any heavy rain and often cut off from the world for weeks at a time by deep mud sloughs and gullied water courses untended for a century. Any pretense at a road, any vestige of the imperial highway that once existed, has long ago been swept away and forgotten by Kienlung's degenerate descendants, who have so misruled and so nearly wrecked his empire, bringing it again to the stage of decadence it had reached when Confucius strove to awaken the rulers of his day.

The Peiling, the northern mausoleum, where Taitsung is buried, is less than five miles from the city wall, its groves of cedars and yellow-tiled roofs visible

THE EMPEROR OF CHINA, HSZAN TUNG

PRINCE CHUN, THE REGENT OF CHINA, WITH HIS TWO SONS: THE EMPEROR HSZAN TUNG STANDS BESIDE THE CHAIR

Photo and Copyright by Underwood & Underwood

GRINDING THE GRAIN, MANCHURIA

The illustrations accompanying this article, unless otherwise indicated, are from the author.
Eliza R. Scidmore

across the level plain. They are the Ming tombs in miniature, noble pieces of eighteenth century architecture and decoration, a long series of gate towers, courts, and pavilions leading to the tower of the imperial tablet, immediately before the simple earthen mound. The brilliant colors, the red walls, green and yellow tiled roofs, rainbow bracketings, and vermilion eaves are all softened by time to the mellowest bloom and tones.

There is an avenue of stone animals and guardian figures, as at the Ming tombs, and at the top of the steps of the last of the marble terraces a broad door-step, a solid slab of jade (green-veined jadeite), leads to the hall of worship.

Both armies respected these tombs during the war, and their venerable cedars were the only trees spared on the whole plain. The Russians did maintain an outpost at the gates and stabled horses in some of the outer green-tiled buildings, but that was taking a great risk with really fine horses, as the roofs were then leaking and leaning almost to the point of collapse.

THE MANCHURIANS DID NOT SUFFER MATERIALLY BY THE WAR

There are no signs of war or battle on any of this great Mukden plain, this vast Manchurian outdoors, covered with rich crops of kaoliang, beans, and corn. Only the bayonet spire on Putiloff Hill, far to southward, a Japanese memorial column,

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PAGODA GATE AND TOWNSPEOPLE OF MUKDEN

Photo and Copyright by Underwood & Underwood

THE DRUM-TOWER AND THE EXTRAORDINARY SIGN-POSTS IN THE PRINCIPAL STREET: MUKDEN (SEE PAGE 301)

Photo and Copyright by Underwood & Underwood

BEAUTIFULLY SCULPTURED STONE ARCH BY THE TOMB OF AN ANCIENT MANCHU EMPEROR: MUKDEN, MANCHURIA

Photo and Copyright by Underwood & Underwood

FINE PAGODA GATEWAY ENTRANCE TO THE MANCHU EMPEROR BAYLING'S TOMB

speaks for the million men who lay at arms all of that one winter, and for the silent thousands who remained.

When fugitives and pursuers disappeared to northward, and the incessant din of cannonading ceased for the first time in six months, the country people crept back to the places where their homes had been. Nothing of their houses remained, and their fields were filled with pits and trenches and dugouts where the troops had hibernated.

Marshal Oyama gave all the quarters, the dugouts, and their contents to the peasant owners of the soil, and, by the end of March, the little communities had reassembled and were busy with spring plowing. They soon rebuilt their wattle and dab houses, their mazes of mud walls that mean safety, propriety, and orderly life to them, and to this day the man with the hoe and the man behind the plow are turning up unexploded shells in their fields. As they always open any such strange finds with a stone or a hammer, the mission hospital is never without some such gunshot case in its wards.

In the large sense, the province did not suffer materially by the war, for, while the people were driven from their homes, their property seized or destroyed, and payment rarely made to them for such losses, the presence of those two great bodies of troops stimulated all industries, and gave employment at high wages to thousands who would otherwise have been idle through the winter months.

Altogether, the two armies spent more than four hundred million roubles for provisions, clothing, labor, and transport in the province, although sums equivalent to their individual losses did not always come to the same sufferers. The townswomen made money beyond all their dreams by sewing on the fur and wadded garments required for the Russians.

Country women and children shared in this silver shower, and the keen Manchu middleman reversed the old advice, "*eplucher le mandarin,*" and plucked the Russian, cruelly, to the last.

Photo by A. C. Barlor, Chicago

ON THE ISLAND OF CAPRI

Photo from Paul Thompson

A RELIGIOUS FESTIVAL PARADE AT PALERMO: THE CAR OF THE BLESSED VIRGIN

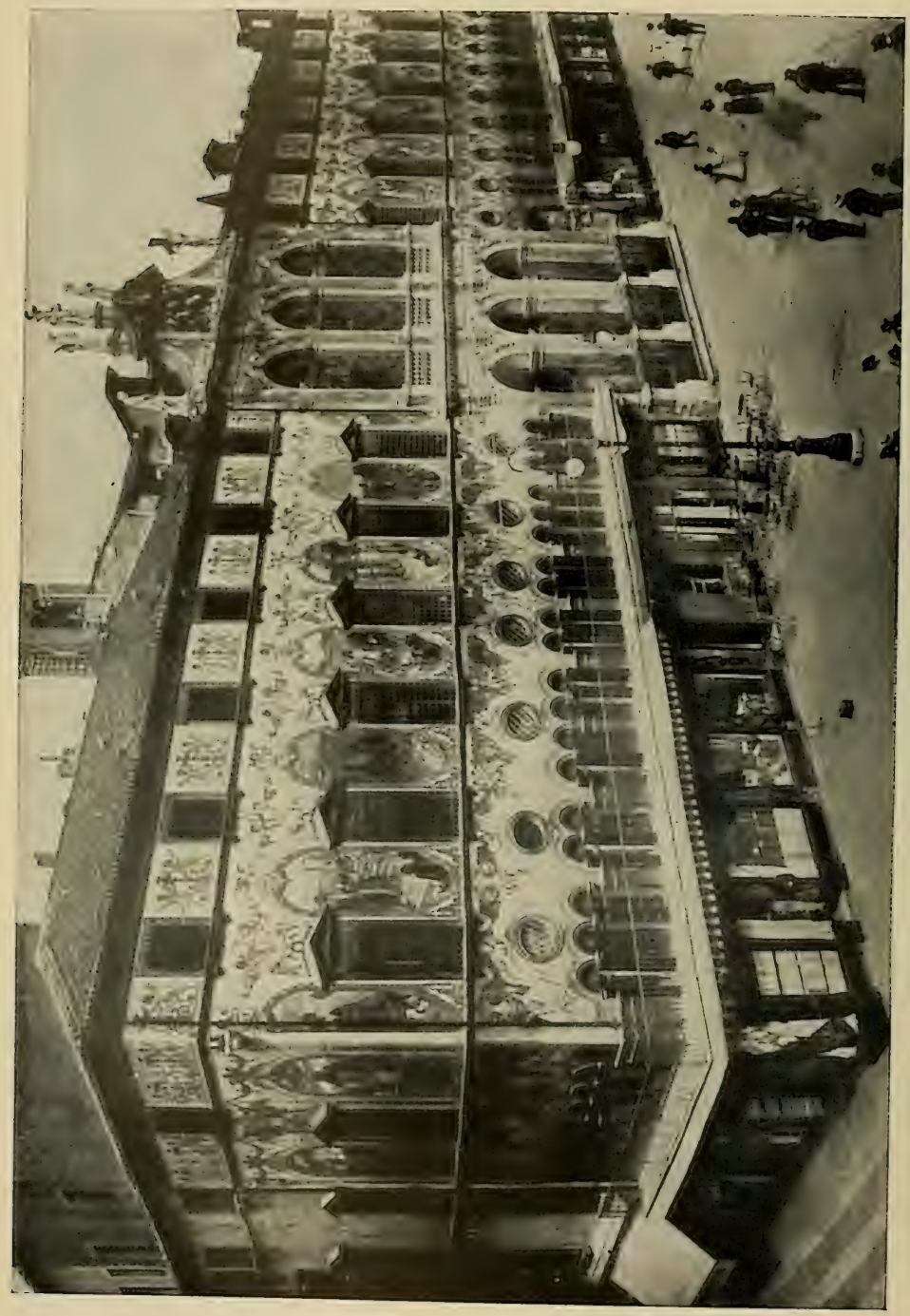


Photo from Paul Thompson

ONE OF THE GRANDEST FRESCOES IN ITALY, ON THE PALACE OF THE MONT DE PIETI, IN VENICE: PAINTED BY THE FLORENTINE ARTIST, BRUSCHI

These very alarming persons are not, as might be supposed, night riders or vigilantes surreptitiously disposing of a victim, but men from all stations in life who have come at the call of a bell to help convey some unfortunate to the hospital. These Italian "Brethren of the Misericordia" are laymen who do penance or fulfill some vow by serving as stretcher-bearers in carrying the sick, burying the dead, or collecting alms for charitable purposes. The society has been in existence some hundred years, and this peculiar garb was adopted as disguise, for the cardinal principle is to conceal their identity from each other and the public.

This is one of several very beautiful China medallions of babies by Andrea della Robbia, which adorn the outside walls of the old Foundling Hospital built by the silk-workers of Florence, Italy.

THE CERTOSA OF THE VAL D'EMA IS BELOVED OF ALL TOURISTS IN FLORENCE, ITALY

It stands like a fortress on a hill, an afternoon's drive from the city. Within its garden is this beautiful old well. Around lie the graves of monks. In the gardens were cultivated flowers and herbs, from which the brethren distilled their Chartreuse and sweet perfumes. The monastery is now closed and the monks all gone but one or two who linger on suffrance and sell the perfumes to Americans.

Photo from Paul Thompson

A MARBLE QUARRY, CARRARA: PREPARATION OF A CHARGE OF DYNAMITE TO DETACH A BLOCK OF MARBLE FROM THE MOUNTAIN SIDE

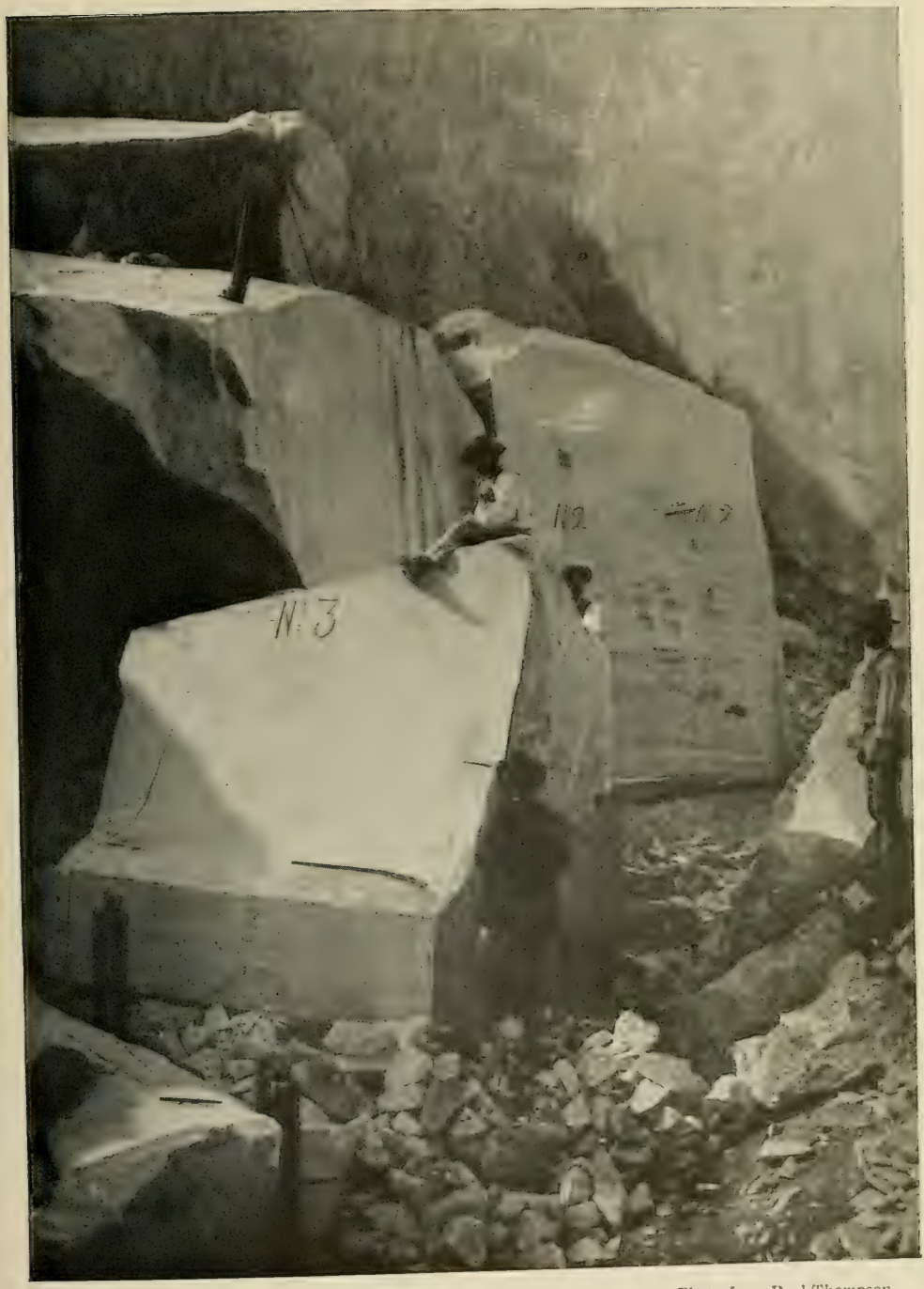


Photo from Paul Thompson

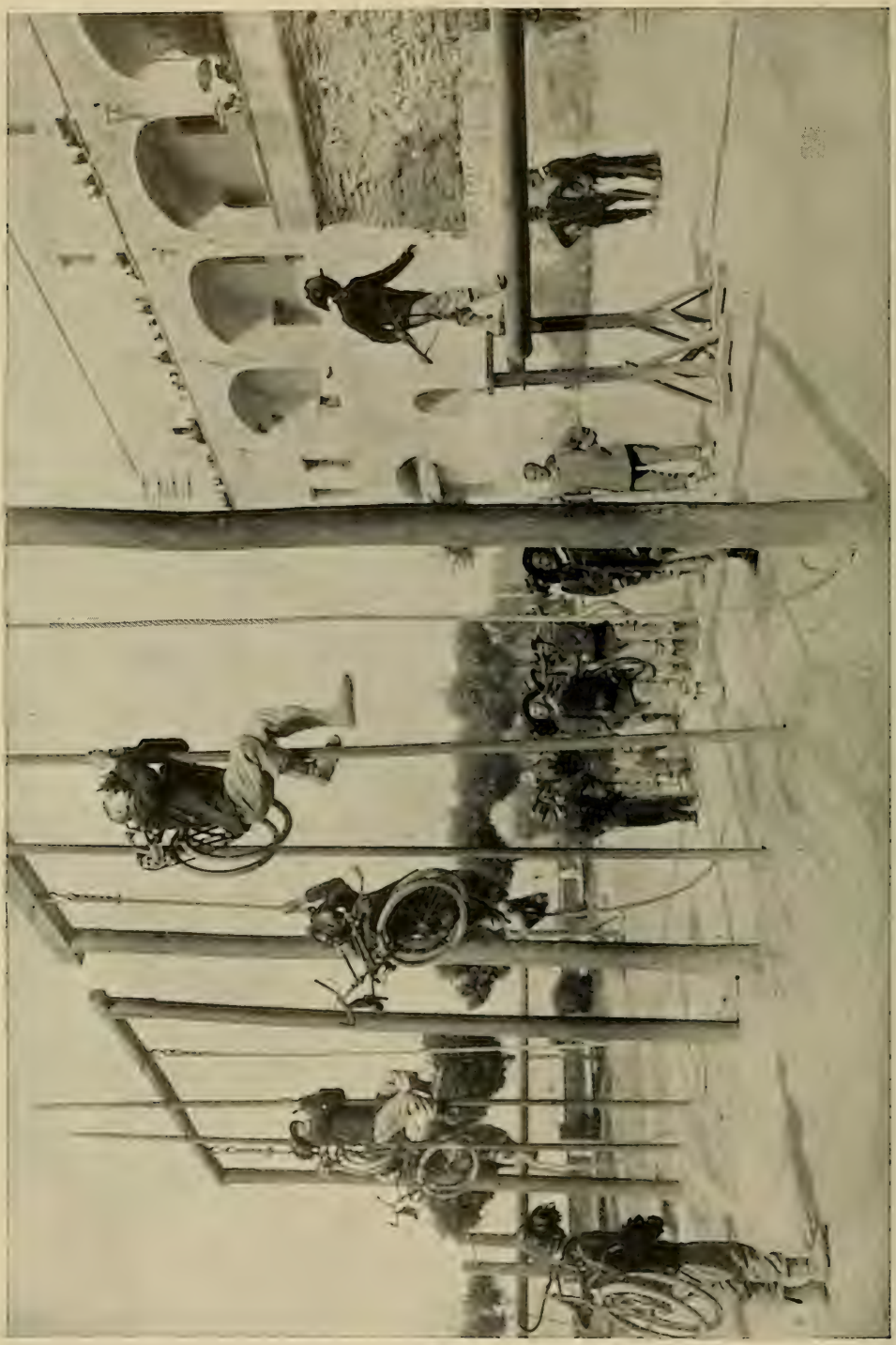
CUTTING A BLOCK OF MARBLE TO ORDER: CARRARA

THE PICTURESQUE SETTING OF THE CARRARA MARBLE-WORKERS' LABORS Photo from Paul Thompson

Photo from Paul Thompson

OXEN DRAWING A BLOCK OF MARBLE THROUGH THE STREETS OF CARRARA

Carrara owes its fame and prosperity to the marble hills which surround the town; 5,000 men are employed in the neighboring quarries to cut and ship the beautiful white Carrara marble, which is sent to all parts of the world to be carved into exquisite statuary.



THE CYCLE CORPS OF THE CRACK ITALIAN CAVALRY REGIMENT

Photo from Paul Thompson

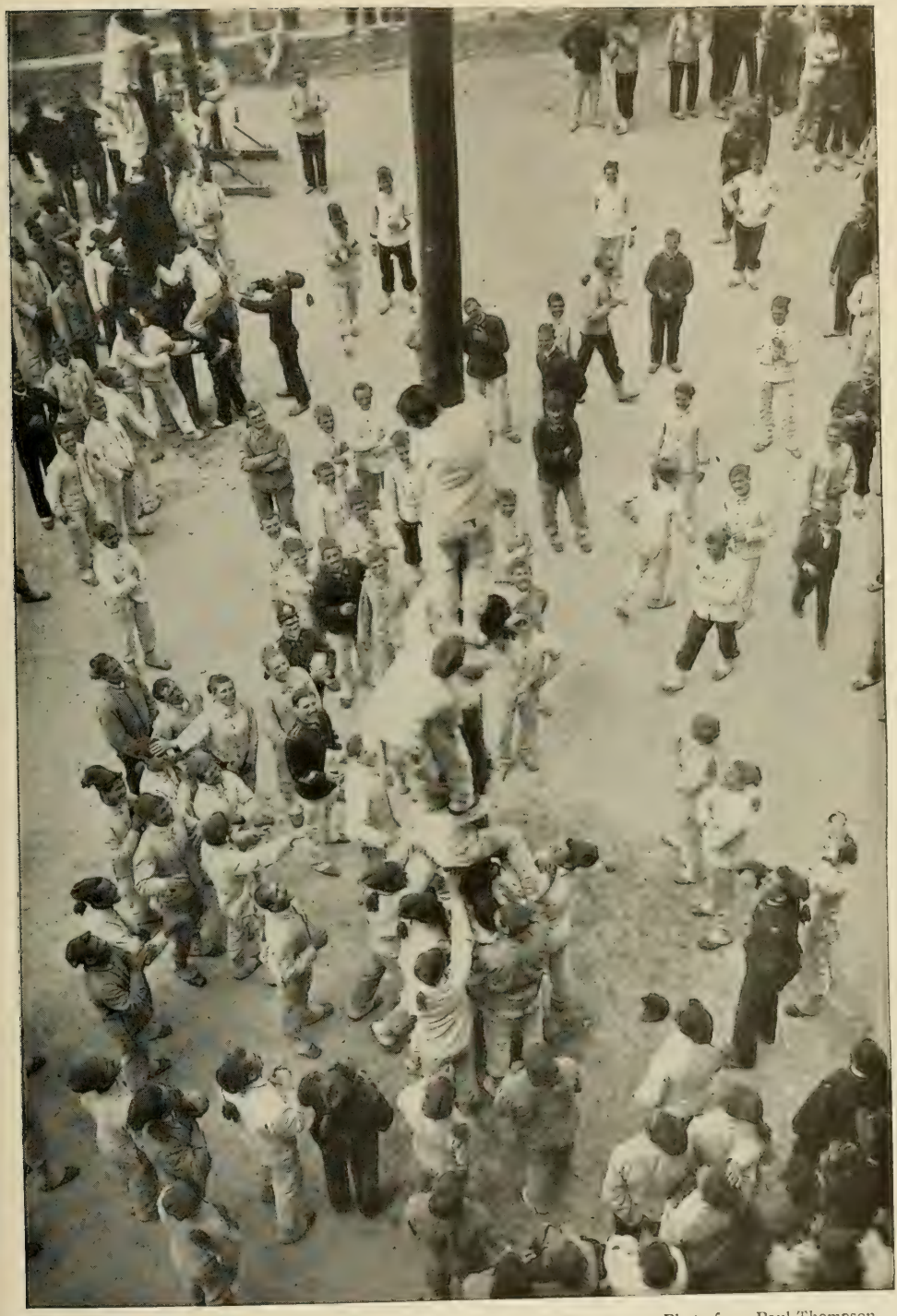


Photo from Paul Thompson

ITALIAN SOLDIERS CLIMBING A GREASED POLE

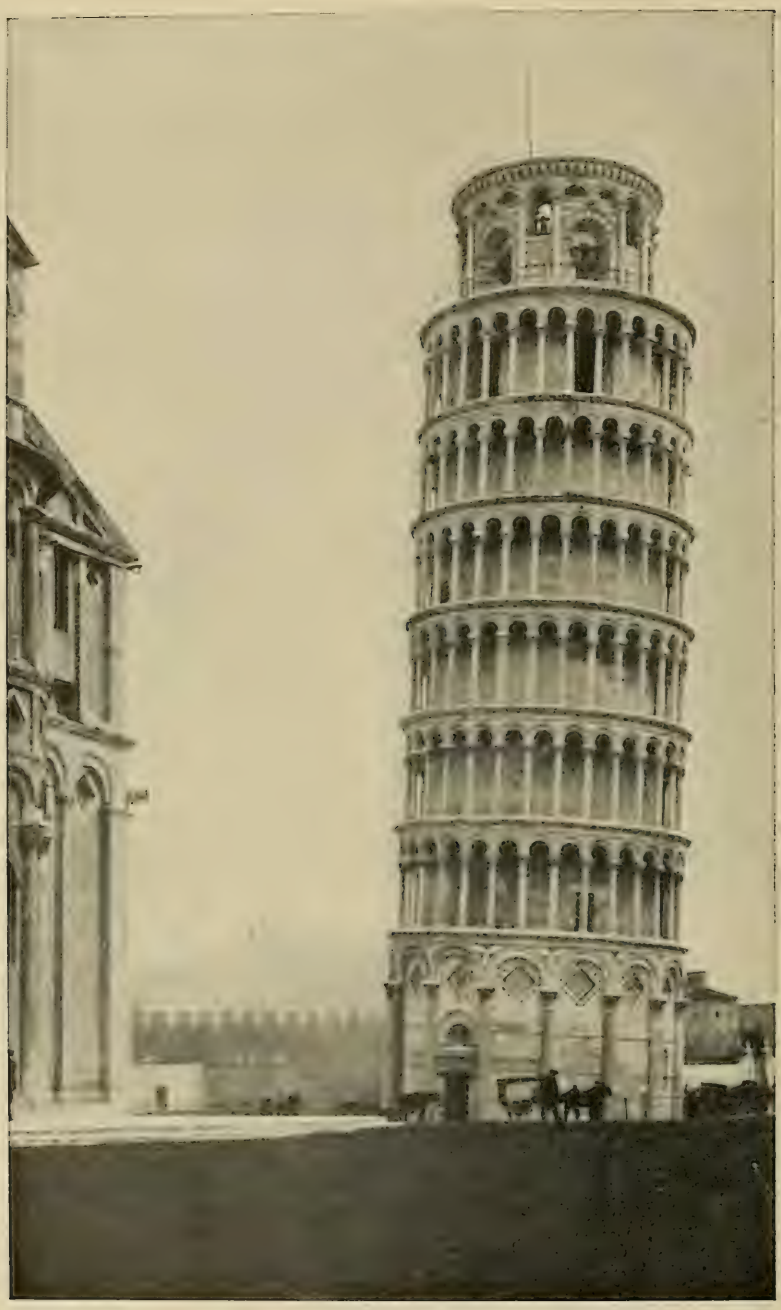


Photo by A. C. Barlor, Chicago

THE LEANING TOWER OF PISA, BUILT OF WHITE MARBLE

The view from the top, reached by 300 steps, is wonderfully beautiful, embracing the Carrara and Apuan mountains, the city and the blue sea

THE SPIRIT OF THE WEST *

The Wonderful Agricultural Development Since the Dawn of Irrigation

By C. J. Blanchard, U. S. Reclamation Service

THE spirit of the West is optimism and progress. It is the spirit that fired the hearts of our forefathers who erected in the primeval forests of New England the superstructure of the greatest nation on earth. It is the optimism and faith which imbued their descendants who carved an agricultural empire of unparalleled richness from the Mississippi Valley.

Once a wilderness so unpromising that it evoked derision in the halls of Congress, the West has become today the land of fortune and opportunity. In this land of boundless distances the altitude is stimulating, the air is a tonic, giving health to the infirm and courage to those who have failed elsewhere. Its constant sunshine encourages optimism and cheerfulness. The glories of its opal-tinted dawns, the indescribable beauty of its sunsets, and the nameless witchery of its twilight softly melting into night are the work of a divine painter.

There is mental and spiritual uplift in its mountains, whose summits are in regions of perpetual snow. Its sapphire lakes, excelling in beauty those of Switzerland, open up a wondrous field of interest and pleasure to the sight-seer and those in search of rest and recreation. The monarchs of its forests cast their shadows on the earth before the coming of the gentle Nazarene.

Its canyons, sculptured during uncounted centuries by wind and wave, are unrivaled in their wonderful and varied coloring and in their awe-inspiring depths.

Its deserts, in vastness of area, in potential wealth of soil and climate, and in rivers of constant supply, are sleeping empires awaiting exploitation and development. Here nature offers to every man his birthright—a wide sky, the sunshine, the wind, and a sure reward for intelligent effort. Here things are writ in characters too vast for human pen.

It is our own land of mystery and enchantment, of crumbling ruins, and of lost races which have vanished utterly.

On the lofty mesas of the painted desert are "tribes whose ceremonies bridge the years between ages of stone and steam," living antique lives in a modern day. Their houses are fortresses erected a hundred years before Columbus sailed the unknown western seas. On their walls the watchman still holds vigil, and in their kivas strangely clad priests recite their prayers, which may antedate those of our own religion.

The late Governor John A. Johnson well said the West symbolizes "homes for the homeless; food for the hungry; work for the unemployed; land for the landless; gold for the penniless; freedom for the enslaved; adventure for the restless; dangers for the brave; an unknown world to conquer, and room for all."

Irrigation has wrought its miracle, and 13,000,000 acres reclaimed are annually producing harvests valued at more than $250,000,000, and supporting in homes of their own more than 300,000 families. The wealth of that portion of the country which great statesmen in Webster's day were wont to declare worthless is greater now than that of the entire nation in 1860.

In the swift march of national events during the past decade, the development of the West has focussed the attention of the world. It furnishes one of the

* For previous articles on this subject by the same author see "Winning the West," February, 1906; "Millions for Moisture," April, 1907; "Home-making by the Government," April, 1908; "The Call of the West," May, 1909, Nat. Geog. Mag.

THE WAY THEY ADVERTISE THEIR MARVELOUS CLIMATE AT YUMA, ARIZONA

A climate where crops ripen every month in the year, and a region remarkably like that of the Valley of the Nile

most inspiring pages in the annals of our commonwealth. It is a story of progress and human achievement—a battle with nature in her sternest and most forbidding aspect.

Future writers will record the irrigation movement as an epoch in our history the far-reaching influence of which overshadowed in importance any other progressive movement since the opening to settlement of the Mississippi Valley. The reclamation of vast areas of our arid and semi-arid regions, which is being promoted by the Federal Government and by large corporations working in conjunction with several States, is of profound economic importance to the nation.

The additional opportunities thus created for homemakers are already serving to check the undesirable efflux of the country people to the city. Millions of acres of desert, unleached by rain and storing in its bosom the fertility gathered there by centuries of washings from hills and mountains, are being quickened by life-giving waters.

Cities, populous and great, have sprung up; rural communities, attractive and prosperous, broad vistas of fertile fields, and blossoming orchards whose yields are prolific beyond comparison, replace the wastes of sand and sage-brush.

Economic forces are at work today in the country, and particularly in the arid West, which are gradually but surely shaping our agricultural development along new lines. In many parts of the irrigated country agriculture now occupies a position of greater dignity among the vocations than ever before. Its place among the scientific professions is now recognized and it is calling more strongly every day for the best talent and brains the nation affords.

Agriculture in the desert is intensive and calls for and encourages a higher degree of intelligence than is found in humid regions. Farms are small and settlements are compact. There is constant interchange of ideas among the farmers, whose relations become intimate in the transaction of daily business.

Individualism, which is a characteristic of the farming regions of the East, as well as provincialism, are less known in the irrigated sections. The irrigation canal is the connecting link which binds the community together.

This great public utility is controlled and operated for the common benefit. Coöperative management of the irrigation system is a fundamental principle on each of the Government projects. The inevitable tendency of such management has been coöperative organization, which today is extended to all the farmers' activities — individual, educational, and social.

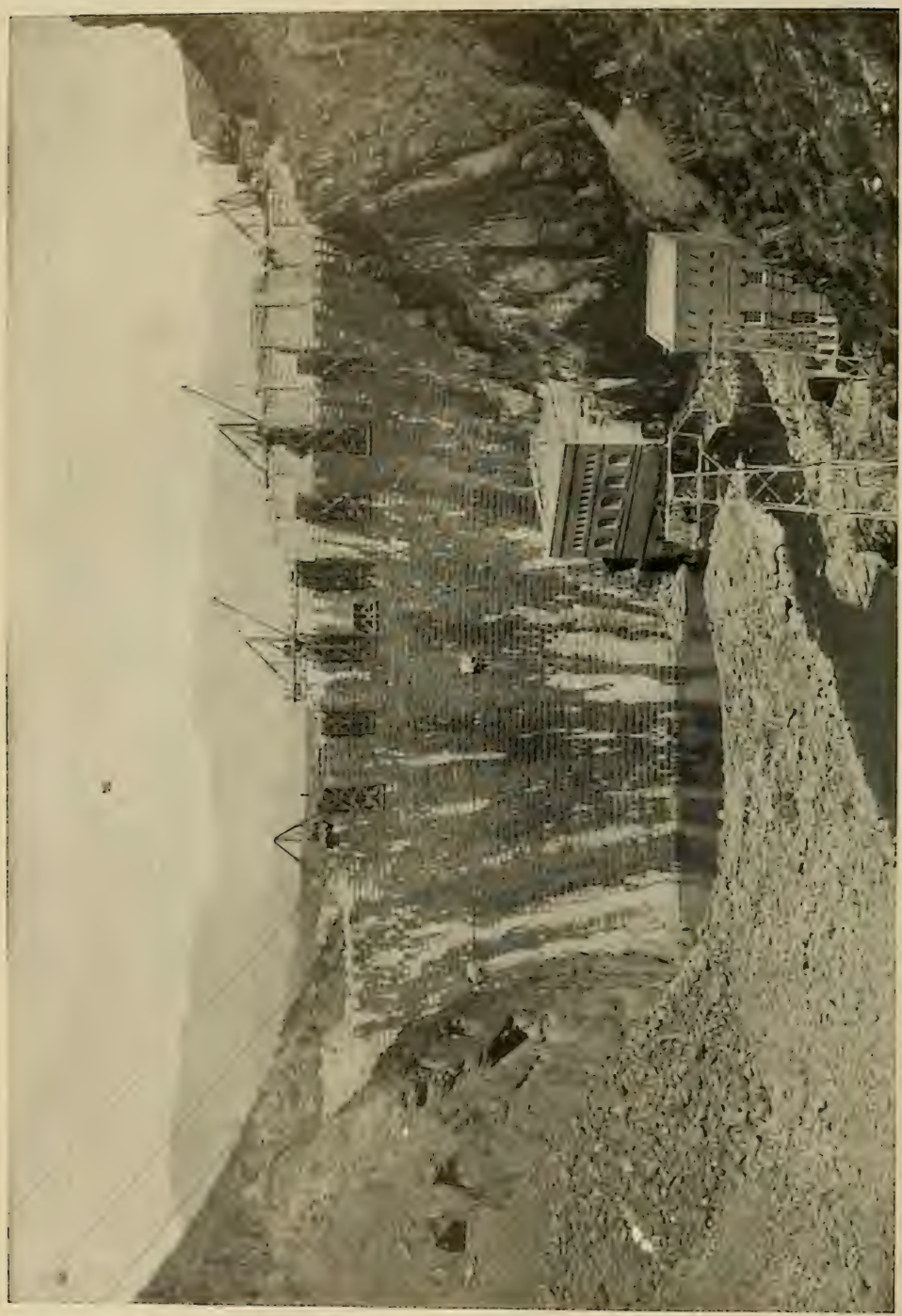
Gradually there has grown up a desire for betterment of conditions, and with the coming of ample financial returns there is evidence of a desire to improve the character of home life. The country is becoming citified, and life on the irrigated farm is growing attractive. The isolation and loneliness of farm life where farm homes are far apart are eliminated.

Farm life and its duties under these conditions are regulated today very much the same as the man of business orders his affairs. The old haphazard methods of agriculture have no place here, where every acre must be made to give its maximum yield, and where the crop itself is carefully considered with regard to markets and cost of production.

There are today in the irrigated West a dozen or more rural communities which in artistic and beautiful homes, or in the nearly ideal conditions of home life enjoyed by the people, have no rivals in the East.

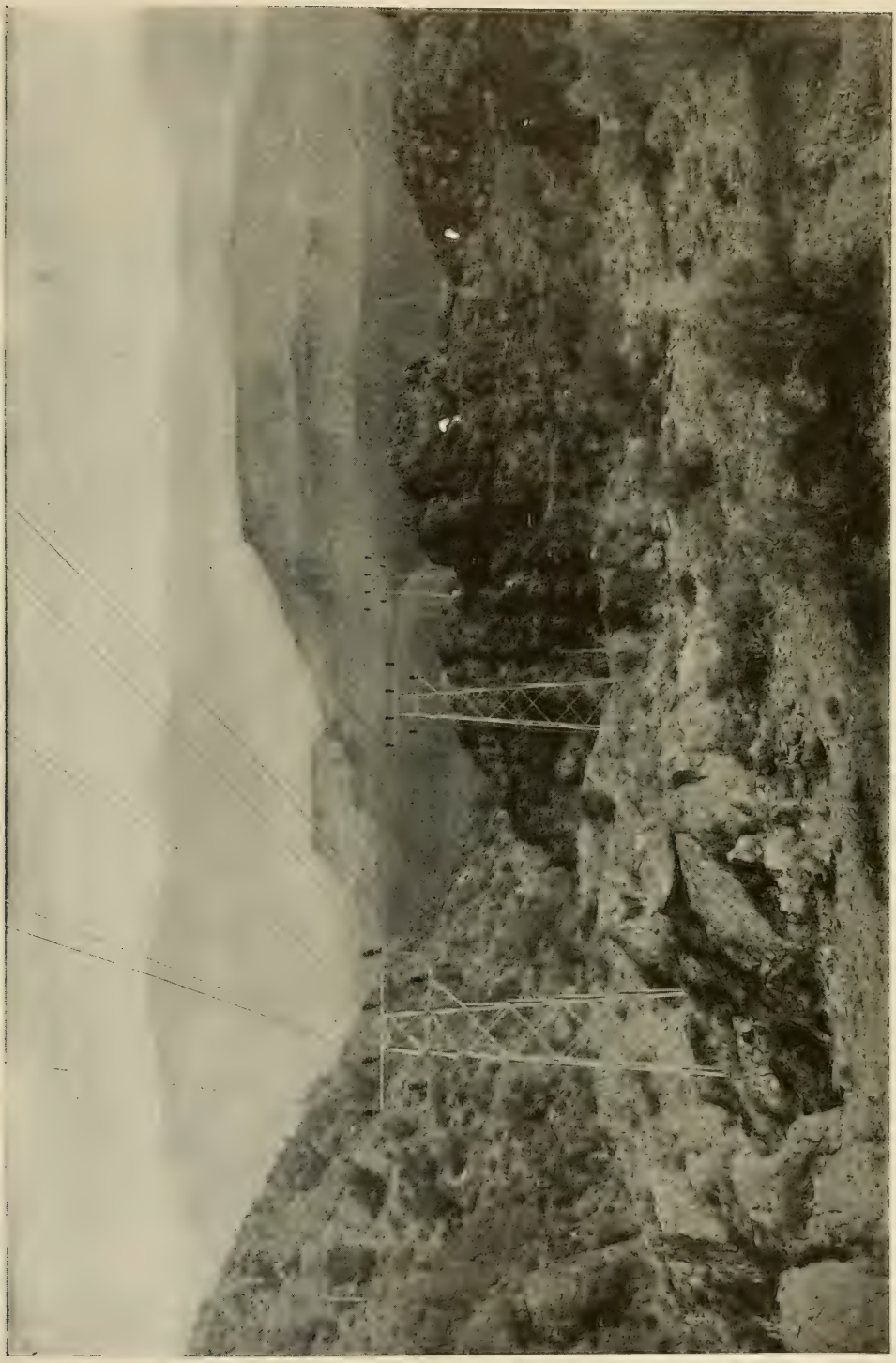
As new communities rise, provision is made at once for the educational and religious needs of the people. The centralized graded school is growing in popularity, and is being established in many sections. The children are carried to and from the school in carriages. Elementary agriculture is being taught, and an effort is being made to inculcate in the child a love of nature and a respect for life in the country.

The daily newspaper keeps the farmer in touch with the outside world and its



THE ROOSEVELT DAM: TYPE RUBBLE MASONRY ARCH GRAVITY (SEE PAGE 360)

Maximum height, 280 feet; length of crest, 1,080 feet; contents, 326,000 cubic yards. Below the dam is the power house where 7,500 horse-power is developed. In the nearer foreground is the transformer house and transmission towers



TRANSMISSION LINE THROUGH THE ROUGHEST PART OF ARIZONA TO CONVEY POWER FROM THE GREAT ROOSEVELT DAM TO THE SALT RIVER VALLEY

The character of the country traversed by the transmission line of the government is clearly shown

HAYING SCENE IN THE STRAWBERRY VALLEY, UTAH, ONE OF THE MOST BEAUTIFUL VALLEYS IN THE WEST (SEE PAGE 355)

Alfalfa is the farmer's bank account in the arid country

markets; the circulating library introduces the best literature into his home; the trolley lines now being extended through many irrigated valleys bring the city to his very door.

Throughout the arid West there is evidence of an orderly arrangement of detail and a planning of duties which in time will give us office hours on the farm. When crops are intelligently diversified there is little of the back-breaking, heart-discouraging work of the old time one-crop farm. Crops ripen and are harvested at different intervals, giving the farmer and his family ample time without crowding. Where harvests are sure and there is no interference by reason of rain, the farmer can apportion his time and his work with some degree of accuracy.

It is remarked everywhere in the West that the mental attitude of the farmer has undergone a pronounced change. The factors of better roads, rural delivery, telephones, trolley lines, coöperation, and frequent association with neighbors are primarily responsible.

For several years nearly all professions, from bootblacks in Butte to steeple-climbers in New York, have been organizing, except farming. Acting alone, the farmer has been for years at the mercy of the commission man or the elevator company.

In the irrigated valleys of the West today there have been perfected a number of strong and successful business organizations for handling special crops. Fruit-growers' associations in several districts are marketing crops each year valued at millions of dollars, and, largely as a result of up-to-date methods, have secured control of the best markets of the world for their products.

The success of these organizations, the opportunities they offer for first-class business ability, as well as the assurance of profits in agriculture, have excited widespread interest among many city-bred people, and have drawn thousands back to the country who could never have been induced to leave the city to take up the old system of farming.

The agricultural colleges report among their students an increasing number of city-bred youths who are perfecting themselves in the advanced lines of agriculture and horticulture preparatory to taking up the profession of farming.

The Reclamation Service began its work in 1902 on the passage of the Reclamation Act. The first contract was let in September of the next year, and, on June 17, 1905, an important project in Nevada was formally opened.

GIGANTIC TASKS ACCOMPLISHED IN FIVE YEARS

Progress has been rapid and the activities of the bureau have been extended to 26 or more projects, which to date have involved the expenditure of $60,000,000. In the seven and one-half years of its work the Service has built 4,215 miles of canal. Placed end to end, these canals would reach from Washington to San Francisco and back to New Orleans. Several of these canals carry whole rivers.

It has excavated 17 miles of tunnels.

Before the end of the year it will have completed four of the highest dams in the world. Its excavations of rock and earth amount to the enormous total of 60,000,000 cubic yards.

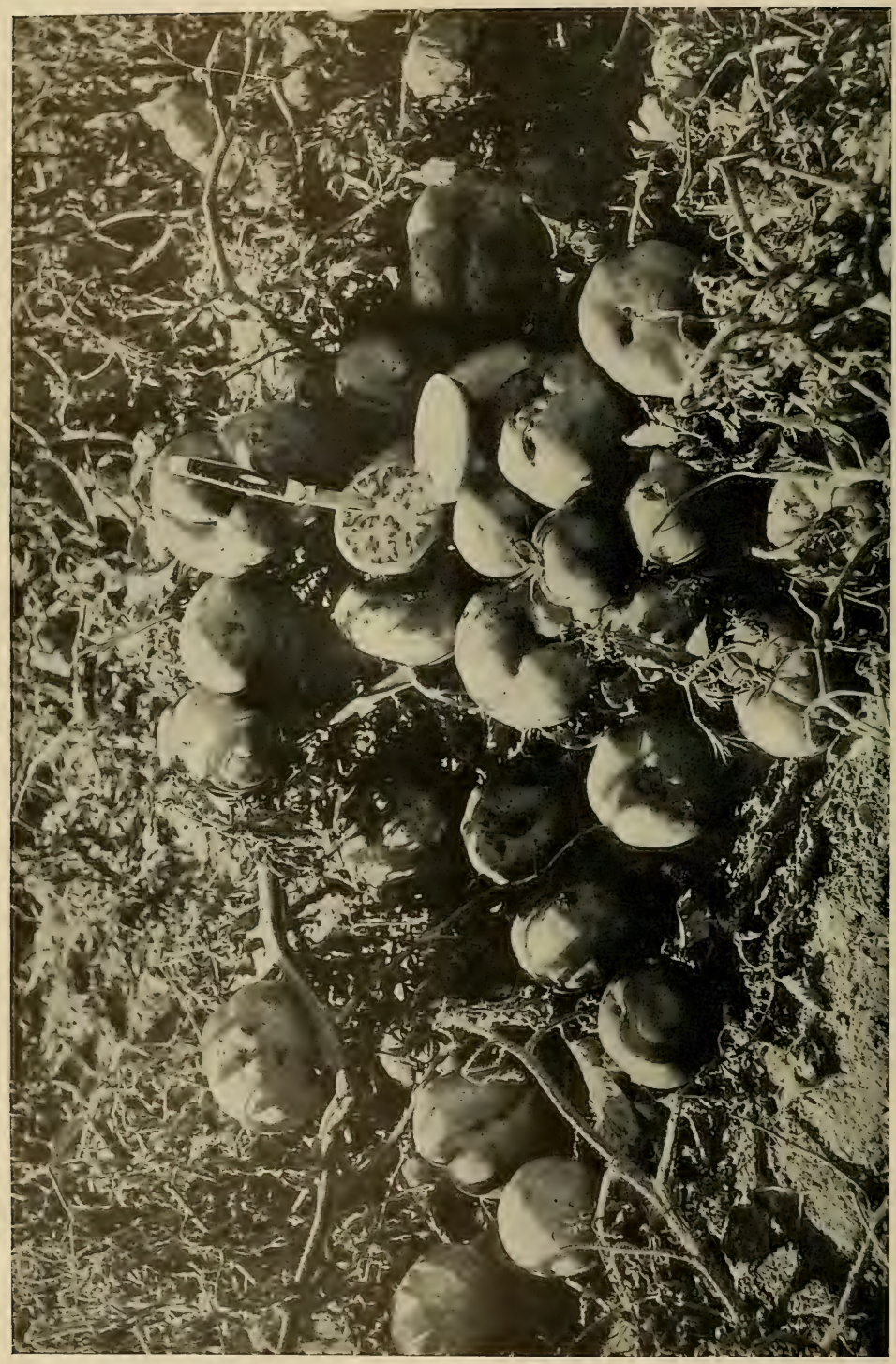
Its roads have a total length of 417 miles; telephones, 1,127 miles; levees, 70 miles.

It has purchased 915,751 barrels of cement and has manufactured in its own mill 340,000 barrels. As a result of its work, water is available for 750,000 acres on 13,000 farms.

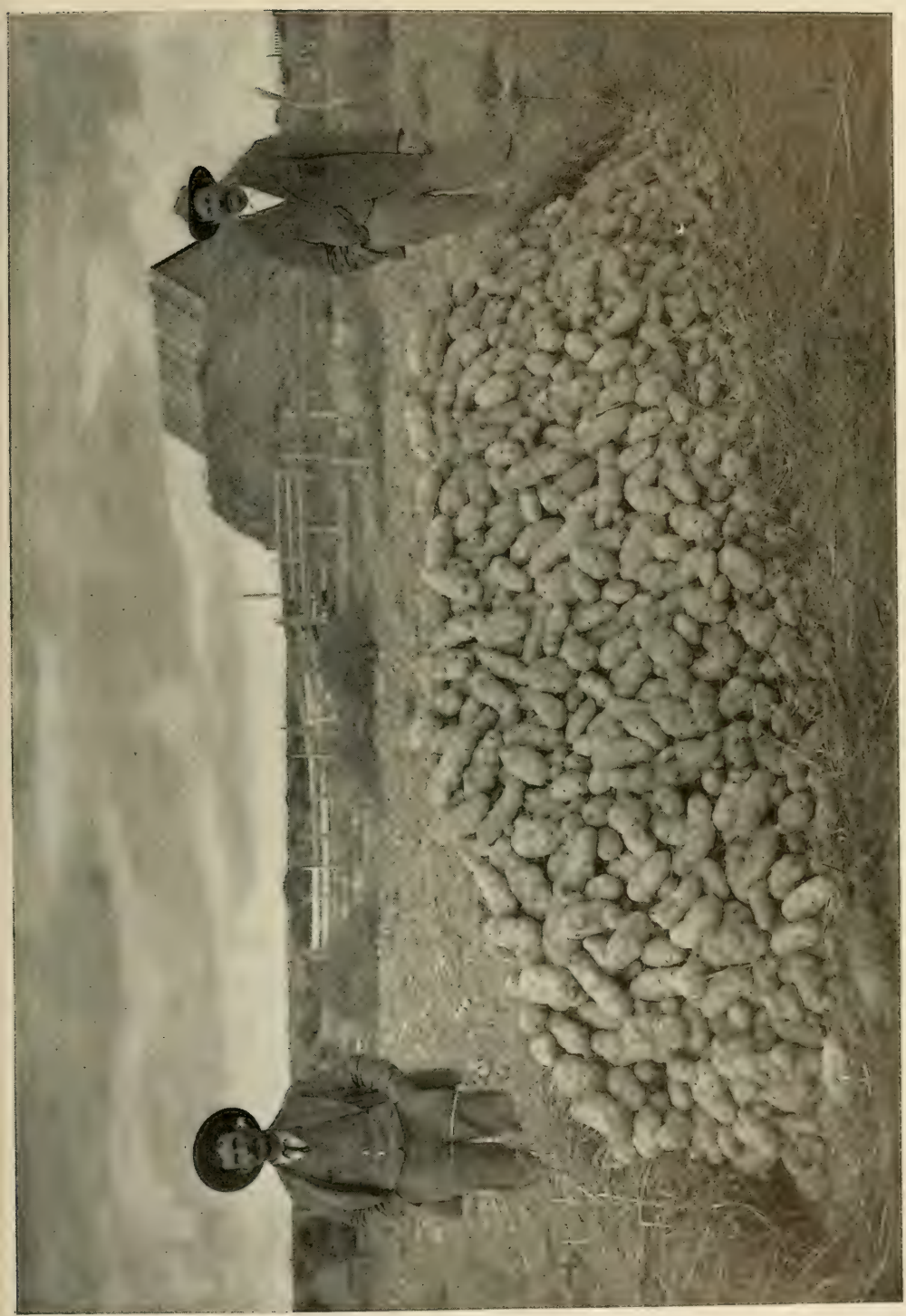
The gross value of crops produced on the lands irrigated by the Government projects in 1910 was $14,038,000. As a result of the work of the Government it is estimated that land values have increased more than $105,800,000.

The Reclamation Service is entering 1910 with money and plans for completing most of its larger and unfinished masonry structures, and with about three-quarters of a million of acres of arid land under irrigation.

It will finish this year the great Roose-



TOMATOES GROWN ON THE JAMES WARNER RANCH, NEAR SPANISH FORK, IN THE STRAWBERRY VALLEY, UTAH (SEE PAGE 355)



POTATOES GROWN ON THE A. J. SMITH RANCH OF THE MINIDOKA PROJECT, NEAR RUPERT, IDAHO

Representative of the first crop of potatoes on this project

THE SITE FOR A GOVERNMENT RESERVOIR: UPPER MEDICINE LAKE, IN THE STATE OF MONTANA

velt dam in Arizona, one of the most massive in the world. It has completed the Shoshone dam, in northern Wyoming, the highest structure of its kind ever built; the Pathfinder dam, in southern Wyoming, and the Laguna dam, in Arizona. It will for the first time utilize the Gunnison tunnel, whose completion was celebrated by President Taft last summer.

The funds available for construction are somewhat less than in previous years, and the organization, which is very elastic, has been cut down to fit reduced expenditures. About 50 skilled men—engineers, experts, and technical assistants—have either sought private employment, have been transferred to other bureaus of the Government, or put on furlough, in order to keep the overhead charges consistent with the expenditures.

Reviewing the history of the Reclamation Service as a whole, its maximum activity and expenditures were in the year 1907. In 1902 the expenditures were less than $100,000, and in 1903 less than $1,000,000. In 1904 they were $2,500.000; in 1905, $5,000,000; in 1906, a little less than $10,000,000; in 1907, nearly $14,000,000. Then the expenditures decreased to $10,000,000 in 1908, to about $9,000,000 in 1909, and in 1910 they will be a little under $8,000,000. It is expected that in 1911 they will shrink to about $7,000,000, which sum will probably continue to be available during after years, assuming that the water-right charges are paid as they fall due.

If Congress should make a loan to the fund it would, of course, be possible to increase or even double the outlay and finish extensions of various systems in half the time otherwise required.

This is the most critical period in the history of national irrigation since the passage of the Reclamation Act, in 1902. By public notices of the Secretary of the Interior, issued last year, hundreds of water-right installments, involving approximately $1,000,000, became due on April 1, 1910. That date is a memorable one, not only to the settlers, whose entries are liable to cancellation for failure to make the payments due, but also to the Reclamation Service, which is concerned in securing the return of its investment in the engineering works. It is also a matter of interest to citizens of the number of sections containing feasible projects, the construction of which cannot be undertaken without additional funds. As the repayments are made through the local land offices and not directly to the Service, some time must elapse before the actual amounts collected are known. On a number of the projects, like Sun River, Shoshone, and Huntley, the settlers have already made their initial payments, and will not be delinquent on the second installment until April, 1911, which enables them to market two crops between payments. On several other projects, such as the Minidoka, Klamath, Lower Yellowstone, Belle Fourche, Carlsbad, Truckee-Carson, North Platte, and others, the first settlers have had the use of water for two crops, and it is probable that a majority will be able to meet their obligations without difficulty.

Detailed reports from various sources on each of the projects have been received at Washington. The conditions as a whole are described as favorable for a large return to the Reclamation fund. On several of the projects there will be no delinquents. On a number of projects the engineering work is not fully completed, but water is ready for large areas, and is being supplied on a rental basis pending the announcement of the actual cost of water right. The Reclamation Service has derived considerable revenue from these sources, and at the same time the farmers have been enabled to increase the areas in cultivation. The following financial statement is interesting as showing the status of the Reclamation fund and the amounts which thus far have been credited to it through the operations of the Reclamation Service:

Total moneys received and transferred to the Reclamation fund from sales of public lands under Reclamation Act to February 28, 1910, $58,342,617.02. Ap-

SIR KAAN MERCEDES PAUL, BORN JULY 14, 1904: WEIGHT, 1,800 POUNDS, AND VALUED AT $1,000
Owned by Dr J. C. Kloever, Yakima Valley, Washington. Exhibited at the Yakima fair

A BAND OF OSTRICHES COMING DOWN TO VIEW THE NEW CONCRETE TURNOUTS ON A LATERAL IN THE SALT RIVER PROJECT, ARIZONA (SEE PAGE 359)

proximately $4,500,000 are still in the Treasury of the United States, but not yet available.

Moneys received under operations of Reclamation Act from all sources, in cash and credits, for work done, $2,379,475.04, divided as follows: Town-lot sales, $103,673.91; miscellaneous sales, water rentals, etc., $1,694,844.77; collections on water rights, $814,145.34. This does not include any of the moneys collected for the water rights which were due and payable April 1, 1910.

THE HIGHEST DAM IN THE WORLD

Among the several large projects, one of especial interest is located in northern Wyoming. When the springtime showers and sunshine fall upon the snowy peaks of the lofty mountains on the eastern rim of Yellowstone Park, a thousand streams will rush downward to fill to brimming the swift-flowing Shoshone River. An important physical change will occur at that time. The flood that once, unchecked and uncontrolled, swept madly through the rock-walled gorge, will beat itself to stillness against a massive wall of concrete with which man has blocked the canyon. A beautiful lake, 100 feet deep and covering ten square miles, will appear.

In this wonderful gash in the mountains, with perpendicular walls a thousand feet high, the Government has erected the highest dam in the world. It is a wedge of concrete 328 feet from base to top. Its height can only be appreciated when compared with that of some well-known structure. New York's famous Flatiron Building would not reach within 47 feet of the top of the dam, and the tip-top of the dome of the United States Capitol would fall short 21 feet of the parapet.

In the summer, when the crops are thirsty, the big gates will be opened and the pent-up floods will be released into the river below. Another dam, a low structure of concrete, will divert the waters through a tunnel three and one-quarter miles long into a canal which for 40 miles passes along the upper edge of a broad and fertile valley containing 150,000 acres.

Two years ago it was a desolate waste. Today it contains more than 200 farm-houses and three thriving towns. Ten thousand acres produced crops last year on this project. With 16 farm-houses along each mile of the main highways, the valley already has a suburban appearance.

More than 250 farm units of 40 to 80 acres each are now available to entry, and offer exceptional opportunities for men of moderate means to secure homes in a prosperous and growing country.

BELLE FOURCHE PROJECT, SOUTH DAKOTA

Close to the Black Hills, in South Dakota, lies the beautiful valley of Belle Fourche, containing 100,000 acres of grass-covered prairie. Many miles of canals have been laid across its level surface, and what was only a short time ago the finest free cattle range in this country is rapidly becoming a compactly settled agricultural community.

An impressive engineering feature of this project is the Owl Creek dam, one of the longest and highest earthen embankments in the world. This structure, now nearing completion, is 6,200 feet long, has a maximum height of 115 feet, and contains 1,600,000 cubic yards of material.

The reservoir created by it will be the largest lake in the State. By means of a deep and wide canal six and one-half miles long, the entire flow of Belle Fourche River is turned into the reservoir, to be taken out again in the irrigating canals, which will supply 100,000 acres in 1911.

On the second unit, containing 10,000 acres, opened to entry March 1, there are about 60 Government farms awaiting settlers.

MONTANA PROJECTS

The activities of the Reclamation Service in Montana have resulted in the completion of two large projects and the partial construction of several others. The present plans provide for projects in this State as follows:

A FAMILIAR TYPE: THE OPTIMISTIC PROSPECTOR

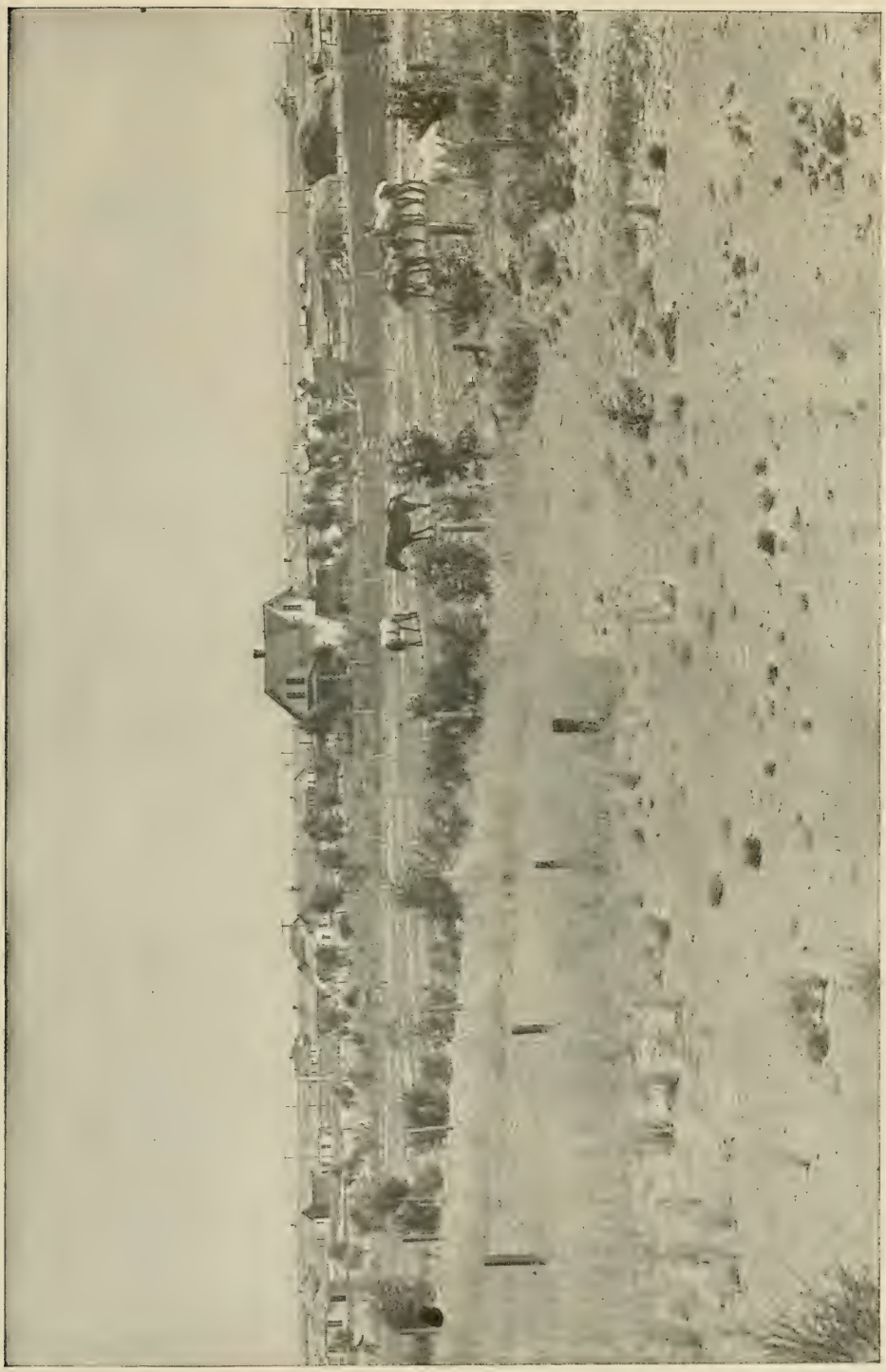
	Acres
Huntley	28,921
Lower Yellowstone	64,622
Sun River	276,000
Milk River	248,000
St. Mary	100,000
Blackfeet (Indian)	132,000
Flathead (Indian)	150,000
Fort Peck (Indian)	130.000
Total	1,129,543

The Huntley and Lower Yellowstone projects are completed, and an important unit of the Sun River project was opened to settlement in 1908. Actual construction has begun on all the other projects, except the Fort Peck. On the Flathead project several units have been completed and water is now available for 13,500 acres, which will be allotted to successful entrymen on May 7.

On the Sun River and Huntley projects there are first-class opportunities for homeseekers to secure farms for which the water is now ready. The Sun River project contains 85 unentered farms, and the Huntley project 224. With the present rate of settlement, however, both projects will be fully taken up before the close of the crop season of 1910.

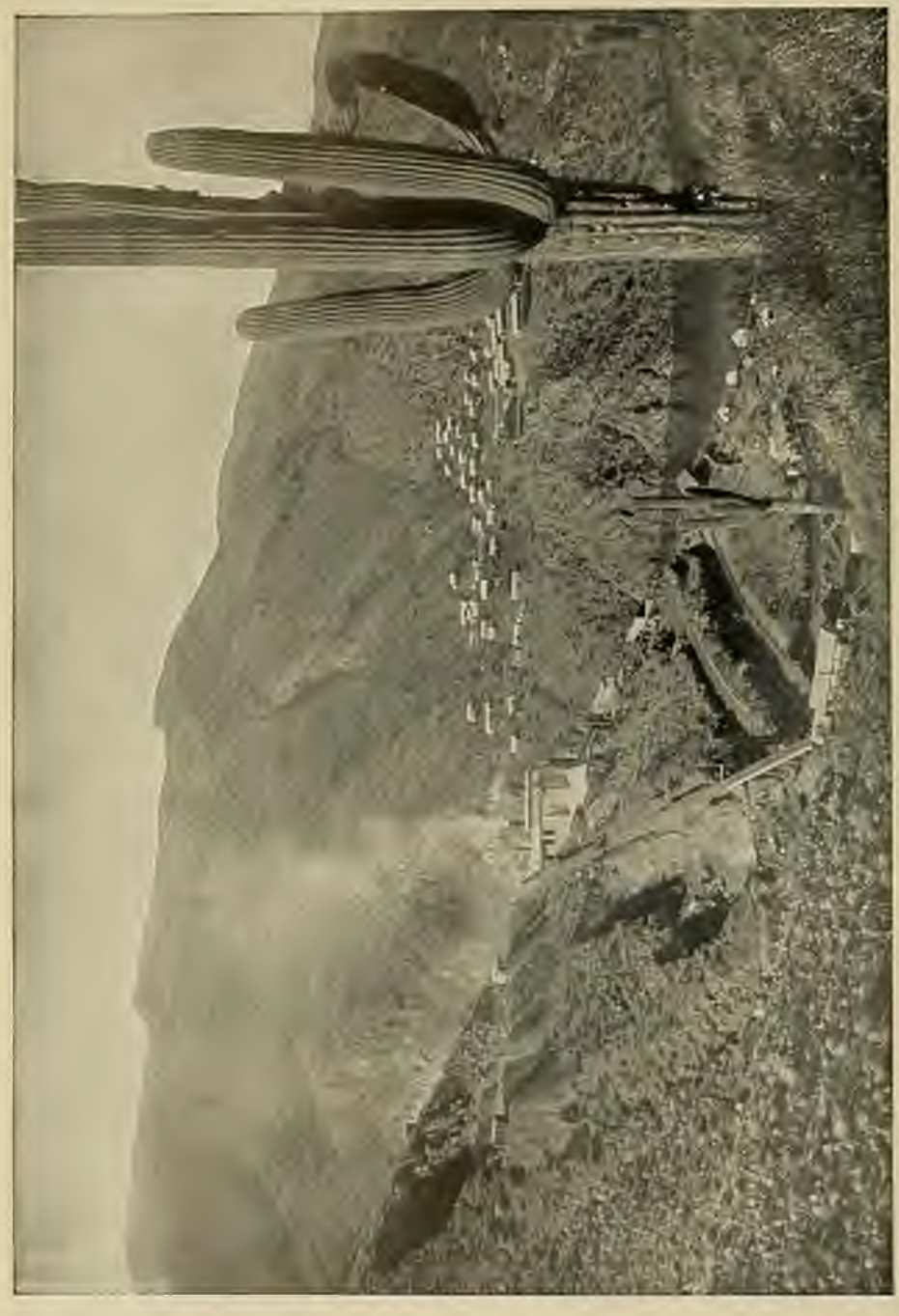
BEGINNING OF THE GREATEST PROJECT OF THE RECLAMATION SERVICE: THE NEW CAMP AT ENGLE DAM SITE, RIO GRANDE VALLEY, NEW MEXICO

The Engle dam will create the largest artificial body of water in the world



COMMUNAL LIFE ON UMATILLA PROJECT, OREGON

A region of small farms intensively cultivated in high-priced products. In 1906 this was a sage-brush desert (see page 355).



U. S. RECLAMATION SERVICE CEMENT MILL, CONTRACTOR'S CAMP, AND THE ARIZONA GIANT CACTUS: SALT RIVER PROJECT, ARIZONA

Nearly 350,000 barrels of cement have been manufactured in this mill. It completed its work on April 28 at 4 p.m., having saved the government more than $650,000

While all the Government land on the Lower Yellowstone project has been entered, a considerable area of railroad grant land is available at a maximum price of $2.50 per acre. The development of the valley since the beginning of the work of reclamation has been very rapid, and the time is not far distant when it will be one of the most prosperous districts in the Northwest.

A HARVEST-FIELD 20 MILES LONG AND 6 MILES WIDE

In the southern part of Wyoming, where the North Platte River flows in a deep granite-walled canyon, another masonry dam has been erected. It rises 215 feet above bed-rock, and back of it there is a lake with a capacity great enough to cover Rhode Island a foot deep.

Located 45 miles from the nearest railway, its construction was expensive and difficult. All machinery, cement, and provisions for men and horses were brought over the long miles of sage-brush desert.

Down the river many miles another structure of concrete turns the stored water into a canal 95 miles long, whence it is conveyed to the gently sloping valley lands in Wyoming and Nebraska.

In the beginning of the work I visited the valley, and at one particular point I gazed over a broad stretch of prairie. Within the radius of my vision I could count only six farm-houses.

Last year, from the same point, I saw a harvest-field 20 miles long and 6 miles wide, and counted 600 homes. Today on the North Platte project there are more than 1,500 families living in homes of their own. The construction of this irrigation system has already increased land values in the valley more than $4,520,000.

THE MOST SPECTACULAR PROJECT IS IN COLORADO

Among the valleys of the western slope, two in Colorado have focused the attention of the citizens of the country for the past few years. These are the Uncompahgre and Grand valleys, in the drainage basin of the Grand River, the most important tributary of the Colorado River of the West. Situated on one of the main traveled transcontinental highways, in the midst of the grandest scenery on the continent, no section of the West is more generally known.

It is only within the past few years that the agricultural importance of these valleys has impressed itself on the public mind. Surrounded by a rich mineral zone, the development of mines served to obscure the far greater wealth which is hidden in a soil of wonderful fertility and in a climate adaptable for the production of high-priced crops.

In the Uncompahgre Valley the Government has one of its most spectacular projects. The progress of construction has been widely advertised. For several years two large forces of men have been burrowing night and day through a mountain 2,000 feet high and 6 miles thick, excavating a tunnel, one portal of which is in a profound canyon 3,000 feet deep and the other at the upper end of a broad and fertile valley. The work is nearly concluded; a great underground waterway 6 miles long and capable of carrying a whole river has been excavated.

President Taft, on September 23, 1909, presided at the formal ceremony. He placed a gold bell on a silver plate and the electric connection released the pent-up floods of the Gunnison, and its waters, passing through the mountain, flowed out upon the Uncompahgre Valley to fructify a thirsty desert. The tunnel is lined with cement, as is also the main canal for several miles.

The irrigable area of the Uncompahgre Valley is 140,000 acres, of which 36,000 acres were public at the beginning of the work. Approximately 15,000 acres are yet unentered, but are not at this time open to settlement. Due announcement of the opening of these lands to entry will be made through the public press when the canals are constructed to furnish water to them.

TRAMWAY IN THE TIETON CANYON AT CAMP NO. 1: YAKIMA PROJECT, WASHINGTON

Length of tram, 1,800 feet; elevation, 600 feet; 33 1/3 per cent grade utilized for the transportation of men and material in connection with the construction of Tieton Canal, which is laid along the upper edge of the canyon, Tieton unit (see page 356).

LOOKING DOWN INTO TIETON CANYON FROM LOWER HEADING OF TIETON TUNNEL, ON MAIN CANAL, THE RIVER LYING 600 FEET BELOW: YAKIMA PROJECT, WASHINGTON

THE HIGHEST DAM IN THE WORLD, THE SHOSHONE DAM, WYOMING, COMPLETED JANUARY 20, 1910: 328 4-10 FEET (SEE PAGE 346)

Creates a large reservoir which will serve 150,000 acres in the valley below

GRAND VALLEY PROJECT, COLORADO

The preliminary plans have been made for the beginning of construction of a project in Grand Valley to irrigate 53,000 acres, of which 35,000 acres are public. It is expected that two years will be required to complete the works. The irrigable area in the project, in the opinion of horticultural experts, includes some of the finest fruit land in the country. The engineering works proposed include a diversion dam of masonry, with a movable crest; maximum height, 13 feet, and 450 in length; 71 miles of canals and 12,000 feet of tunnels.

FOUR PROSPEROUS TOWNS CREATED IN IDAHO

In the spring of 1904 I camped for the night on the banks of Snake River, Idaho. My companion, the engineer, confided to me his plans for a great work in this section which was to create in the desert a garden covering 25 square miles. He drew his plans roughly in the sand as we sat by the camp-fire.

"Here," he said, "I shall build a dam to turn the waters into huge canals on either side." When I returned another year the dam was finished. Pointing to a landscape of desolation, whose outer ends touched the sky, and on which there was no sign of human habitation, he said: "This desert will one day become a show place—a garden rich and productive, and supporting in comfort a thousand families."

Last year, standing where I did three years before, I realized that the engineer's dream had come true. Look where I would in any direction, I saw no desert. Cultivated fields, with harvests ready for garnering; pleasant little homes on each 40 and 80 acres; children playing in the sunshine, sturdy and happy; the garden crops being gathered for winter storage, gave abundant evidence that the soil was productive and, when watered, gave generous rewards to the farmer.

Twenty-two hundred families are living here today, when only a short time ago there was no sign of human life. Four prosperous towns, soon to become cities, have sprung up along the new railroad. This is a transformation to make you rub your eyes with wonder and amazement.

IN STRAWBERRY VALLEY, UTAH

Bringing water, which now flows into the Gulf of California, into Utah's great interior basin, from which no streams reach the sea, is an engineering work which is engaging the attention of the Government.

In a camp situated near the snowy summit of the Wasatch range a large force of men is driving a tunnel four miles long through the mountains, which will bring a tributary of the Colorado River into the Salt Lake Valley. A diversion dam in the stream below now diverts the water into a canal for several miles to a point where a power plant has been erected. The water is dropped through a pressure pipe upon the turbines, and the power generated is transmitted to that camp, now almost buried in the snow, where it is utilized to excavate the tunnel.

Far below a beautiful, sunny valley awaits the completion of the work. It lies at the foot of a lordly range of snow-capped mountains, and, with the present irrigation systems, is one of the richest agricultural districts of the State. Its crops are varied, and many are high-priced. Peaches and apples do exceptionally well here, the fruit being finely flavored and highly colored.

UMATILLA PROJECT, OREGON

On the banks of the Columbia River and in the valleys of its numerous tributaries in Washington and Oregon, there has been a phenomenal development of irrigation in the past four years. It is only a marker for what is due to follow in the coming years. Here is our true Inland Empire, a region vast in extent, drained by the noblest river in the West, with soil of great depth and fertility and a climate unsurpassed for the growing of fruits of unrivaled color and flavor, for vegetables of all kinds, and for the cereals and forage crops of the north temperate zone. In parts of this region

the growing season is as long as that of many favored valleys in California.

Located on the south bank of the Columbia River, in Oregon, and extending up the valley of the Umatilla River, the Service has partially completed the Umatilla project, embracing 20,000 acres of land having an average elevation of 470 feet above sea-level. In the beginning of the work, in 1906, this region was largely a sage-brush desert, unattractive and uninviting.

On the occasion of my first visit there, before construction had begun, one could drive for miles and never see a habitation. Where the thriving young city of Hermiston now stands, with its solid blocks of brick buildings, its fine schools and churches, and its charming bungalows, there were exactly three houses in sight. Today there are probably 700 people residing here.

An attractive feature about life in this community is due to the fact that the farms are small. Many homes have been esablished on five and ten acre farms which are located all about the town. Trees have been planted to shade the streets and lawns, and thousands of acres of orchards are being laid out.

The question of a municipal water supply is being agitated in Hermiston. Near the new city a tract of land embracing 40 acres has been reserved. It contains a spring which will furnish a water supply for a city of 50,000 inhabitants, and its water can be carried in pipes by gravity to any part of the town. A reservoir site has been found on the side of the high butte just outside of town into which the spring water can be readily pumped. This will insure a water system with sufficient pressure to furnish protection from fire.

While land values have increased rapidly, as the result of the Government's work here, the prices are not regarded as unreasonable when compared with other irrigated valleys in the Columbia Basin.

THE LARGEST PROJECT IS AT YAKIMA

The largest irrigation project of the Government is in Washington, on the eastern side of the Cascade Mountains, in the valley of the Yakima River. A number of beautiful lakes have been acquired by the Service and are being utilized as storage reservoirs to supplement the stream flow.

An interesting feature of the work here has been the construction of the Tieton canal, which for several miles hugs the edge of a precipice several hundred feet above the river. This is a cement-lined ditch, and the placing of the lining was a difficult task.

Cement forms made in the valley near the stream were carried up the steep canyon side on cableways, or by means of cars, and then set in place. More than two miles of the canal is in tunnel, and for several miles it winds around the edge of a perpendicular cliff.

In the Yakima River the Government has a concrete dam which diverts the water into the Sunnyside canal and irrigates today 45,000 acres, but which ultimately will supply 94,000.

The Yakima Valley is probably the best advertised agricultural district in the Northwest, and contains some of the most valuable agricultural and fruit lands in the world. It is today a region of small farms intensively cultivated.

The character of farm homes is as attractive here as can be found in any farming region in the world. In variety of crops it is not excelled by southern California, while in profitable yields it probably ranks with that favored section of the Southwest. A crop census of the lands irrigated by the Sunnyside canal in 1909 showed a gross average yield per acre of $70.

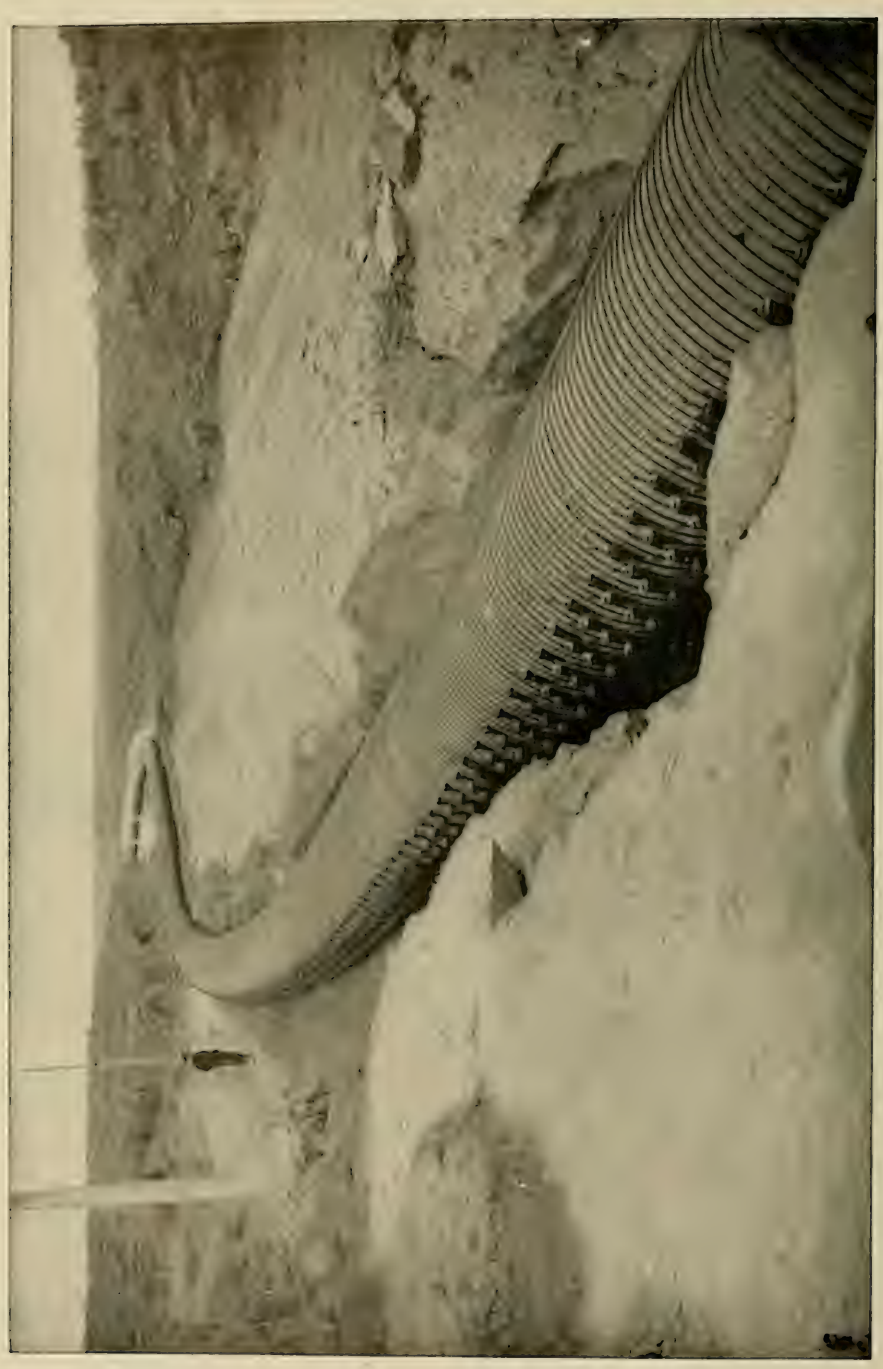
Some of the crop yields reported are difficult to credit.

Strawberries....	$150 to	$400 per acre
Cherries.....	150 to	350 per acre
Peaches.....	200 to	1,000 per acre
Apples.....	200 to	800 per acre

A strong organization of fruit-growers has been in existence here for a number of years, and as a result the fruit of the Yakima orchards finds a market today all over the world. We are glad to pay $1.50 per dozen in Washington now for

Photo and Copyright by Doubleday, Page & Co.

THE "FLATIRON BUILDING" COMPARED TO THE SHOSHONE DAM (SEE PAGE 346)



55-INCH WOOD-STAVE PIPE FOR CARRYING WATER ACROSS ROUGH COUNTRY: SUNNYSIDE UNIT, YAKIMA, WASHINGTON

Yakima Winesaps and Spitzenbergs, or about three times what we pay for oranges.

OKANOGAN PROJECT, WASHINGTON

One of the most interesting sections of the Northwest agriculturally is the Okanogan Valley, in northern Washington. While the project now being built in this valley by the Service is classed as one of the minor works, it is destined in the near future to add 10,000 acres of the most valuable land in the West to the cultivated area of the State. The orchards of this valley are among the most attractive in the world, and the fruit grown ranks with the best on the market.

For many years the valley has been so remote from transportation that its development has been slow. The Great Northern is now building a branch northward into it, and before this season's crops are gathered the Okanogan country will be in position to market its products in competition with the other celebrated fruit-growing districts of the Northwest.

TEN APPLICANTS FOR EACH FARM: THE YUMA PROJECT

The wonders of the delta of the Colorado River have been described so often that the public is now quite familiar with the valley of the American Nile. As proof of the public's interest in this region, nothing better can be mentioned than the recent opening of the first unit of the Yuma project, in California, on March 1, 1910. On that date 174 farms, averaging 40 acres each, were thrown open to entry, and there were approximately ten applicants for each farm. Successive units, to be opened as the work proceeds, are likely to prove as attractive as the first to homeseekers.

Just now the engineers are boring a tunnel under the river, in which it is proposed to lay a concrete-lined siphon 1,000 feet long, with an internal diameter of 14 feet. In this siphon a portion of the waters of the big canal on the California side will be passed under the river to the canal on the Arizona side. Considerable power will be developed at the outlet of the siphon, which will be utilized to lift water to the lands above the gravity system.

SALT RIVER PROJECT, ARIZONA

I shall never forget my first impression of the Salt River Valley. There was a whisper of spring in the soft and fragrant air that morning when I stepped from the Pullman car. After a dusty and tedious journey across the desert, the picture that greeted my eyes was that of another and a tropical land. In the early dawn the summits of the distant hills were glowing "like a Catherine pear the side that's next the sun."

In the grounds about the Capitol the vegetation was almost tropical in its luxuriance and variety. Here and there were wide avenues of magnificent palms, or shapely umbrella trees, with pleasant homes almost hidden by vines and flowers. Almond trees in blossom filled the air with fragrance. In succeeding visits to this sunny valley I have been impressed and fascinated with its future possibilities. The wide variety of crops which may be produced profitably here must attract agricultural experts from all parts of the country.

There is not a single day in the year when nature is not ready and willing to respond to the industry of the husbandman. The oranges are of superior quality and flavor. Dates yield abundantly, as also do figs, lemons, grape fruit, olives, and peaches.

Five to seven cuttings of alfalfa are grown, averaging seven to ten tons per acre.

OSTRICH FARMING IS VERY PROFITABLE

Ostrich farming is proving a very profitable industry, and nearly 8,000 birds are now owned in the valley. I am told each full-grown bird is good for $30 worth of feathers annually. An infinite variety of small fruits and vegetables, harvested early when the markets are best, make the truck industry a profitable one. For eight months in the year the climate here is unsurpassed.

The activities of the Government, which began in this valley almost immediately after the passage of the Reclamation law, have resulted in a large increase in population and in land values.

As an engineering task, the irrigation work laid out here by the engineers, and now nearing completion, is perhaps the most interesting as well as the most important yet undertaken. To provide an adequate water supply for 240,000 acres of land which, when irrigated, jump in value from nothing to $100 or more an acre is a task well worthy of consideration. This is especially true if an investment of $8,500,000 will accomplish it.

Difficult and trying indeed has been the task, owing to the physical conditions and the extremely erratic character of the river which furnishes the water. To understand the problem it is necessary to view the work on the ground.

The journey from Mesa, in the valley, to the scene of the big work covers a distance of 62 miles, 20 miles of which are across the desert. Here is a region quite unique in itself and differing materially from the deserts to the north. Its vegetation is more varied and interesting. The giant cactus here attains a great height and is often found in groves. A hundred species of thorny plants grow here.

At the end of the road across the desert we come upon a range of mountains whose pinnacled peaks rise straight up from the plain. Here our road leaves the desert and we enter a region rugged, upended, with rocks painted in wonderful colors.

The Government has carved this highway for many miles from the walls of rock. It is an inspiring trip, which would be terrifying but for the fact the road is broad and the grades are gentle.

At the end of our journey we stand on the brink of the wonderful gorge Salt River has cut through the mountains. Far below us the stream winds its way in a deep and shadowy canyon. Across the entrance to that gash in the sandstone cliffs the engineers have thrust a massive dam of rock and cement, which for all time will check the floods of the turbulent stream.

THE ROOSEVELT DAM

The Roosevelt dam, which is about completed as you read the story today, is in many respects the most remarkable structure of its kind in the world. Its towering height, 280 feet, its length on top, 1,080 feet, the inspiring scenery in which it is located, and the enormous capacity of the reservoir created by it combine to make it one of the most stupendous engineering works of modern times.

Conceive, if you can, two valleys—one 12 miles, the other 15 miles in length, and each from one to three miles wide—transformed into a lake 200 feet deep in places, and containing enough water to cover Delaware a foot deep.

The Salt River reservoir, when full, has a capacity sufficient to fill a canal 300 feet wide and 19 feet deep extending from Chicago to San Francisco. It would submerge the entire city of Chicago, which embraces 190 square miles, a depth of 11½ feet.

My one regret is that the space allotted me is too little to permit me to describe the charms and advantages of other projects of the Government. I should like to tell you of the opportunities on the Klamath project, located in southern Oregon, in a region of unrivaled scenic beauty; of the wonderful progress made in the Boise Valley, in Idaho, and the promise of even greater advance as the work of the Government nears completion; of the Orland project, in the Sacramento Valley, the land of fruits and flowers; of the Rio Grande Valley, where there will one day be erected the most stupendous dam in the West—a region in which irrigation began before the Spanish invasion, which will become fruitful and prosperous.

The beacon of hope shines brightly in the West. It beckons the landless man to the manless land.

ARTESIAN WATER PREDICTIONS

THE extensive investigations of underground waters carried on by the U. S. Geological Survey have afforded a basis for predicting artesian flows in several areas, and some of the predictions have been verified in the most gratifying manner. One of the most notable of these is a well at Edgemont, South Dakota, recently sunk by the Burlington Railroad Company. This company applied to the Survey for information as to prospects, and the matter was referred to one of the Survey geologists, Mr N. H. Darton, who had made a detailed investigation of the region. He predicted that water should be expected in the Deadwood sandstone about 3,000 feet below the surface.

This artesian well, at Edgemont, South Dakota, is a practical illustration of the value of the scientific work of the U. S. Geological Survey (see text below).

Accordingly the boring was begun, but, meeting with many difficulties which caused great delay and expense, there was at times a disposition to abandon the work. The engineers in charge, having confidence in Mr Darton's prediction, urged a continuance of the boring, and their faith was finally rewarded by striking a great flow of water at a depth of 2,695 feet. The well yields a half million gallons a day of tepid water satisfactory for locomotive and other uses, and, as there is no good water within 60 miles and much of the supply had to be hauled in tank cars, the value of this flow is inestimable.

Several other notable illustrations of artesian predictions are presented along the extensions of the Chicago, Milwaukee and Saint Paul Railroad and the Chicago and Northwestern Railroad, which have recently been built across western South Dakota from the Missouri River to the Black Hills. That country has but little surface water and mostly of poor quality, so that the problem of water supply was of vast importance. A careful investigation was made of the water-bearing strata which pass underground on the slopes of the Black Hills and furnish the supply for the flowing wells in eastern South Dakota. From the data obtained Mr Darton was able to determine not only the depth to the water-bearing sandstone, but the maximum height of land on which flows could be obtained. Eight wells, from 1,395 to 2,135 feet deep, have closely verified the predictions and furnished the requisite supply of excellent

ROYAL GORGE IN THE GRAND CANYON OF THE ARKANSAS BETWEEN PARKDALE AND CANYON CITY

The gorge is about 8 miles long and is a marvelous example of river erosion

water, not only for the railroads, but for several small towns.*

Similar investigations by Mr Darton of underground water conditions along the line of the Atchison, Topeka and Santa Fé Railroad in New Mexico, Arizona, and California have resulted in successful deep wells at Nelson, Picacho, Manila, Gallup, and Chaves. These are in an arid region where the hauling of water for engine use has been a large item in the operating expenses of the railroad.

It is difficult to estimate the money value of a successful artesian well in an arid region, but where it obviates the need of long haulage $50,000 to $100,000 is a moderate figure.

* Geology and Underground Waters of South Dakota, by N. H. Darton. U. S. Geological Survey. Water Supply Paper 227. Washington, 1909.

ASCENDING MONT BLANC, THE HIGHEST MOUNTAIN OF EUROPE

The summit, shrouded by a perpetual snowfield from which descend numerous glaciers, is ascended almost daily in summer. The illustration is from the new edition of "The Playground of Europe," by Leslie Stephen, recently printed by G. P. Putnam's Sons. This book, first published about 25 years ago, comprises 13 descriptive essays of the Swiss Alps. In beauty of expression and word pictures Mr Stephen excels, so that the volume is often called an English classic. Lovers of mountains will welcome the new edition with genuine pleasure.

A FARM-HOUSE IN THE BERNESE OBERLAND

Illustrations from "The Playground of Europe," by Leslie Stephen. G. P. Putnam's Sons

THE SUMMIT OF THE TITLIS

NATIONAL GEOGRAPHIC SOCIETY

AT a meeting of the Board of Managers on April 20 the following resolution was unanimously adopted by the Board:

"*Resolved,* That as the National Geographic Society has been unable in the limited time to raise the entire amount of $50,000 required as its contribution to the proposed South Polar Expedition under the auspices of the Peary Arctic Club and the National Geographic Society, the Society with regret declines participation in the project and all subscriptions be returned to the subscribers."

The Finance Committee had reported that a considerable sum was available, but recommended that the Society should assume no obligations for the expedition until the entire amount was in hand. Meanwhile the time for preparation for the expedition was very short. While the proposed American party would have the advantage of the *Roosevelt* and the equipment of the last Peary Expedition, the Board of Managers and Commander Peary alike felt that so much time had elapsed that adequate preparations could not be made for a satisfactory American Expedition.

The Board of Managers, on behalf of the Society, expresses its hearty appreciation to all members who have shown their interest in the proposed expedition by subscribing to the National Geographic Society fund. The subscriptions will be returned during the month of May. As several thousand remittances have to be made out, members will probably not receive them much before the end of the month.

ADDRESS FROM THEODORE ROOSEVELT

On March 14 the following cablegram was sent to Mr Theodore Roosevelt at Khartoum:

"*Theodore Roosevelt, Khartoum:*

"National Geographic Society sends congratulations on extraordinary success and immense scientific value of your expedition. We rejoice at continued health of you and all your party. We hope you will honor the Society by addressing it at your convenience on your return."

On April 9 the following answer was received:

"*The Palace, Khartoum, Mar.* 15, 1910.

"*National Geographic Society.*

"DEAR SIRS: Mr Roosevelt asks me to express to you his hearty thanks for your cablegram. He will gladly address the Society, but must await his return to America before he can make a definite appointment.

"I am very truly yours,

"LAWRENCE F. ABBOTT."

Mr Lawrence F. Abbott is president of the Outlook Company.

THE ROOSEVELT COLLECTIONS FOR THE U. S. NATIONAL MUSEUM

Mr Roosevelt has summarized his African work in the following letter:

Khartoum, February 15, 1910.

To the Hon. Charles Walcott,
Secretary Smithsonian Institution.

SIR: I have the honor to report that the Smithsonian African Expedition, which was intrusted to my charge, has now completed its work. Full reports will be made later by the three naturalists, Messrs Mearns, Heller, and Loring. I send this preliminary statement to summarize what has been done; the figures given are substantially accurate, but may have to be changed slightly in the final reports.

We landed at Mombasa on April 21, 1909, and reached Khartoum on March 14, 1910. On landing we were joined by Messrs R. J. Cuninghame and Leslie J. Tarlton: the former was with us throughout our entire trip, the latter until we left East Africa, and both worked as zealously and efficiently for the success of the expedition as any other members thereof.

We spent eight months in British East Africa. We collected carefully in various portions of the Athi and Kapitil plains, in the Sotik, and around Lake

Photo from Sir Harry Johnston

NATIVES OF PORT FLORENCE, VICTORIA NYANZA

Photo from Sir Harry Johnston

A FEMALE BABOON FROM THE SEMLIKI FOREST

Photo from Sir Harry Johnston

ANDOROBOS OF THE RIFT VALLEY

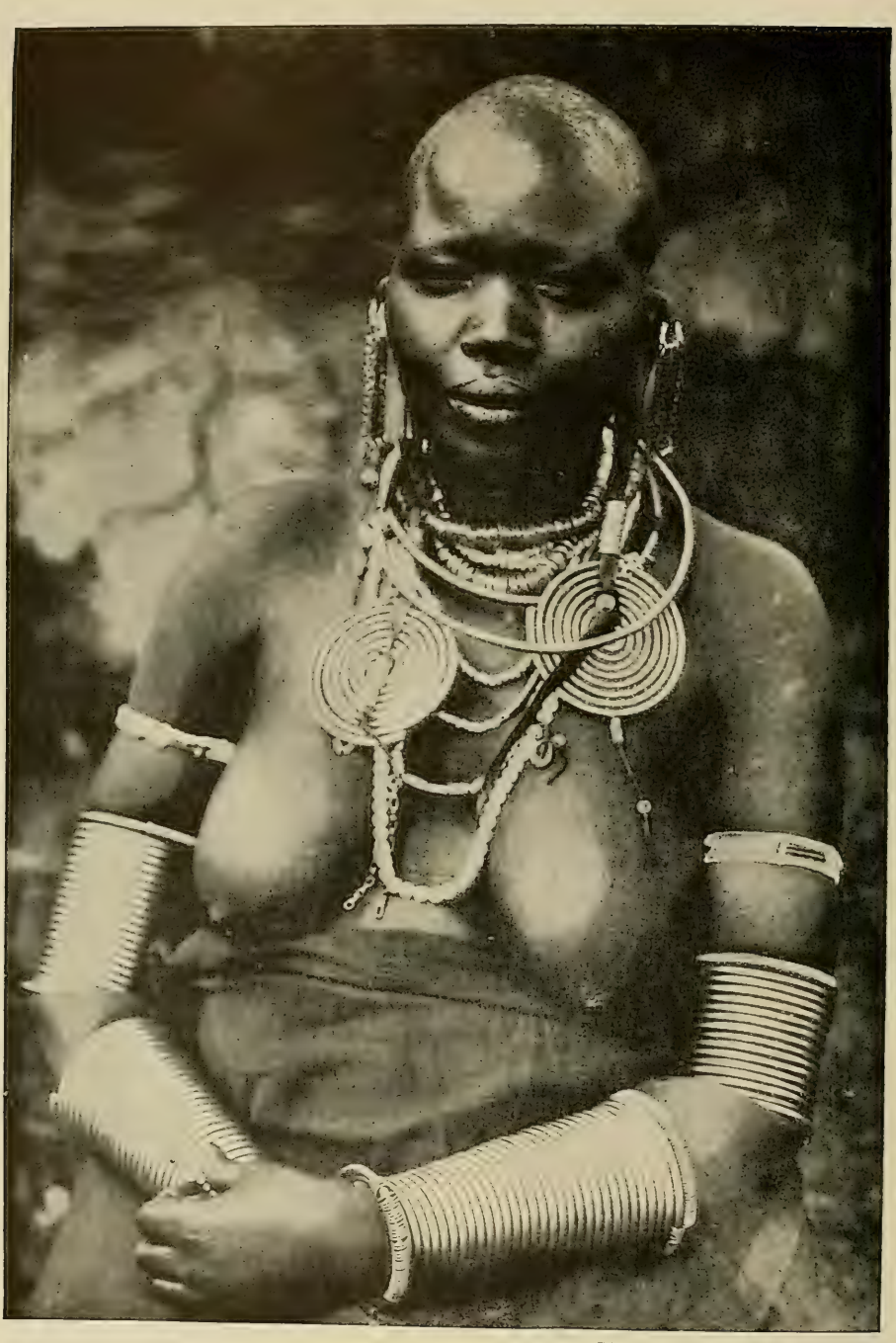


Photo from Sir Harry Johnston

A MASAI MATRON

For a description of the people and country of British East Africa, see "Where Roosevelt will Hunt," by Sir Harry Johnston, in the African number (March, 1909) of the NATIONAL GEOGRAPHIC MAGAZINE.

YOUNG MASAI WOMEN COILING IRON WIRE AROUND THE LIMBS OF A FRIEND

This and the preceding four photos are from "The Uganda Protectorate," by Sir Harry Johnston

Naivasha. Messrs Mearns and Loring made a thorough biological survey of Mount Kenia, while the rest of the party skirted its western base, went to and up the Guaso Nyero, and later visited the Uasin Geisha region and both sides of the Rift Valley. Messrs Kermit Roosevelt and Tarlton went to the Lailsipia and Lake Harrington, and Doctor Mearns and Mr Kermit Roosevelt made separate trips to the coast region near Mombasa. On December 19 the expedition left East Africa, crossed Uganda, and went down the White Nile. North of Wadelai we crossed and spent over three weeks in the Lado, and from Gondokoro Mr Kermit Roosevelt and I again crossed into the Lado, spending eight or ten days in the neighborhood of Redjaf. At Gondokoro we were met by the steamer which the sirdar with great courtesy had put at our disposal; on the way to Khartoum we made collections at Lake No. and on the Bahr el Ghazal and Bar el Zeraf. We owe our warmest thanks for the generous courtesy shown us and the aid freely given us, not only by the sirdar, but by all the British officials in East Africa, Uganda, and the Sudan, and by the Belgian officials in the Lado; and this, of course, means that we are also indebted to the home governments of England and Belgium.

On the trip Mr Heller has prepared 1,020 specimens of mammals, the majority of large size; Mr Loring has prepared 3,163, and Doctor Mearns 714—a total of 4,897 mammals. Of birds, Doctor

Mearns has prepared nearly 3,100, Mr Loring 899, and Mr Heller about 50—a total of about 4,000 birds.

Of reptiles and batrachians, Messrs Mearns, Loring, and Heller collected about 2,000.

Of fishes, about 500 were collected. Doctor Mearns collected marine fishes near Mombasa, and fresh-water fishes elsewhere in British East Africa, and he and Cuninghame collected fishes in the White Nile.

This makes, in all, of vertebrates:

Mammals	4,897
Birds (about)	4,000
Reptiles and batrachians (about)	2,000
Fishes (about)	500
Total	11,397

The invertebrates were collected chiefly by Doctor Mearns, with some assistance from Messrs Cuninghame and Kermit Roosevelt.

A few marine shells were collected near Mombasa, and land and fresh-water shells throughout the regions visited, as well as crabs, beetles, millipeds, and other invertebrates.

Several thousand plants were collected throughout the regions visited by Doctor Mearns, who employed and trained for the work a M'nyumnezi named Makangarri, who soon learned how to make very good specimens, and turned out an excellent man in every way.

Anthropological materials were gathered by Doctor Mearns, with some assistance from others; a collection was contributed by Major Ross, an American in the government service at Nairobi.

I have the honor to be,

Very truly yours,

THEODORE ROOSEVELT.

THE NATIONAL GEOGRAPHIC SOCIETY'S ALASKAN EXPEDITION

The Board of Managers of the National Geographic Society has made an appropriation of $5,000 for an Alaskan Expedition in 1910 under the leadership of Prof. Lawrence Martin, of the University of Wisconsin. The work will be a continuation of the glacial studies carried on by Professors Tarr and Martin for the Society in 1909, and described briefly in the January number of the NATIONAL GEOGRAPHIC MAGAZINE, and more fully in a book now in preparation.

The expedition will leave for Alaska early in June, spending three or four months in field work among the glaciers of the Alaskan coast, where the most active advances of ice tongues that man has ever seen are in progress among the greatest existing glaciers outside the polar regions.

The work will begin with a brief visit to Yakutat Bay, where it is of the utmost importance to determine what glaciers, if any, have resumed activity since 1909, and what has happened to the glaciers which were then so active. Following this the glaciers of the lower Copper River will be examined in detail.

The Columbia Glacier will then be studied to see whether the great advance in progress in July and August, 1909, has continued, and after this the other glaciers of Prince William Sound will be visited and the larger phenomena of glaciation investigated.

The party will consist of a skilled topographer, loaned by the U. S. Geological Survey, a photographer, and several other assistants. The work will include not only studies of the ice, the glacial deposits, relations to life, etc., but precise mapping, observations of nature and rate of ice motion, sounding in the fiords near the fronts of the tidal glaciers, etc.

The present time seems to be one of unusual opportunity for study of these Alaskan glaciers, for scientists might have to wait decades or centuries for a repetition of the ice-flood advances now in progress. They have already revolutionized our theories of the cause for glacier advance. The new theory explains these oscillations of Alaskan glaciers, not by climatic fluctuations, but by avalanching during violent earthquakes. The advance of at least eight glaciers in Yakutat Bay, including part of the great Malaspina Glacier, about 300 square miles of which became crevassed in less than ten months, as well as the Hidden Glacier, which advanced two miles, and many others is thus understood.

Vol. XXI, No. 5 WASHINGTON May, 1910

THE NATIONAL GEOGRAPHIC MAGAZINE

THE HOUSE-FLY

By N. A. Cobb

With photographs made specially for the National Geographic Magazine by N. A. Cobb

THE fly referred to in these pages is the one most commonly found in our houses—the *Musca domestica* of Linnæus. At most seasons nine flies out of ten found in houses are of this kind. In some of the paragraphs, however, the statements are inferences fully justified by experiments with very similar species.

Speaking broadly, man has made the house-fly; it has developed along with the human dwelling. If we had no closed-in dwelling places it is doubtful if the house-fly as at present constituted could continue to exist. It thrives simply because we afford it food, protection, and breeding places.

It is a comforting thought that just as we have made the house-fly, so we can unmake it, but it is discouraging to think how long it will take us at the present rate.

Following man into all but the coldest climates, this fly is found in nearly all parts of the world, and its name in many languages denotes the fact that it is an indoor or household insect. In the past it has been looked upon with indifference, or, at most, struck at with objurgation when too familiar. It figures in fable and poetry, not without some degree of praise occasionally. Its reputation as a harmless, innocent, lively, and interesting creature will die hard.

In reality it is one of our worst enemies. Its relations to human health and sanitation are most important, and yet for years all efforts to bring the facts properly to the attention of municipal authorities met with indifference or ridicule. We had become so accustomed to put up with the losses of life and property directly traceable to flies that we no longer had the capacity to grasp the significance of very simple facts—facts demonstrable by almost any one at the expense of a few minutes, or at most a few hours, of observation or experiment. Again, it was so easy to turn the whole matter into what passed for a joke that the gravity of the subject was lost sight of.

Latterly, however, a gratifying change is taking place in public opinion, due no doubt to what has been discovered about mosquitoes. It has been shown that these latter insects are one of the main factors in the production of diseases that frequently have claimed their victims by hundreds, or even thousands, under most

tragic circumstances. No mosquitoes, no malaria. No mosquitoes, no yellow fever.

In sanitary matters the tragedy that appeals to us strongly enough to make us do something worth while must be a tragedy quick in its action and very awful in its results. One is almost tempted to say that if only a disease is insiduous enough it may proceed without opposition, even though we know all about its cause and the means for its prevention. How otherwise can we explain the prevalence of consumption? One hundred yellow-fever victims per week move us more than the regular mortality from consumption that same week, though the latter may be a hundred times the greater.

If consumption laid hold of its victims suddenly and took them off in a few days, what a difference it would make in our attitude toward it! And yet it does far worse. It lingers and tortures its victim, often for years, making life a burden to him and to his friends, a continual source of care and expense, a continual source of sorrow, and, worst of all, a continual menace to all who come in contact with him or his belongings. It does worse, while we too often continue to tread the old beaten track, more or less apathetic, failing to do what we know we ought to do.

However interesting and horrible this psychological aspect of consumption may be, I wish at the present time to do no more than make it illustrate the attitude we have assumed toward flies, which is hardly less interesting and deplorable.

But people are beginning to ask, if the mosquito is so important a factor in human diseases, whether the people who for a generation or more have been calling attention to the house-fly as a distributor of disease may not have a case worthy of attention. The result has been a slow and partial awakening, so that we now have municipalities with sufficient enlightenment and courage to begin the fight against flies. I say courage very advisedly, because it takes courage of an uncommon sort, in matters of this kind, to act up to convictions we know are not shared by the majority of our neighbors. Fighting public indifference is a thankless task, especially when it is accompanied by an undercurrent of half-conscious guilt.

We have been slow to recognize the important part insects play in the spread of disease, because it is difficult to catch them in the act. The insects themselves are small and elusive, and the disease germs even more so. It is a rare occurrence for us to know at what time, or precisely in what manner, we have become infected with the germs of disease. It is almost always a matter of guesswork. If, therefore, any one is skeptical about the dangerousness of flies, and asks to be shown a case in which it can be proved that flies have infected a human being, he sets a difficult task. There is no difficulty whatever in causing flies to come into contact with virulent germs, nor is there any difficulty in showing that they can transfer these germs to healthy animals, and that the animals in consequence become diseased. This has been done and constitutes one of the main proofs of the dangerousness of flies.

There is plenty of evidence that flies, having come into contact with diseased material, have afterwards by their contact with persons or their food *probably* caused the disease that followed. This, however, does not constitute that rigid and satisfactory proof we would prefer. Nevertheless, such histories can now be assembled in numbers that amount to the strongest kind of circumstantial evidence. There are a number of diseases whose annual increase and decrease harmonize with the abundance of flies in precisely the way they would do if flies were the inoculating agency. The circumstances fully warrant us in accusing the fly of transferring almost any infectious disease that occurs in fly-time.

The fly's power to spread disease is a direct function of its powers of locomotion. It can fly considerable distances at a high rate of speed. It is quickly carried long distances by trains, boats, teams, animals, and man.

It is possible to get a good idea of a fly's rate of flight in a number of ways.

Flies come to ships newly arrived in port across considerable stretches of water. This we know, because a few hours earlier there were no flies on the ship. No communication has been had with land. The flies must have come on their own wings. Occasionally we see a fly follow a team or animal, easily keeping up a good pace. The wing muscles of a fly when weighed are found heavier in proportion than those of any bird so far examined. It is difficult to tire a fly out. Test this by trying to keep one constantly on the wing in a room and you will soon find you have no easy task. All this shows the fly to be no mean navigator of the air.

If such an active and adventurous insect as the fly carries disease germs it will quickly spread them far and wide.

Most of our diseases are caused by invisible germs that lodge and grow in our bodies, destroying our tissues or poisoning us with their excreta. These germs may be brought to us from some sick person by whatever is large enough to carry them and has the opportunity. Combine this fact with what every one knows about flies, and we see at once the tremendous importance of flies as carriers of human disease germs.

The result of this simple piece of reasoning is so startling that it is often sidetracked by its own importance. It looks so incredible that we hesitate, distrusting our own logic. It seems incredible that men have gone on doing as they have done, and as they are still doing, if the facts are as they seem. The consequences of our reasoning seem so tremendous we fear there must have been a mistake somewhere. And so we dismiss the idea.

One way to disturb this false security is to interest people in the habits and structure of flies. The more we know about flies the more clear it will become that they are among our worst enemies.

The photographs illustrating this article have been designed with this end in view. Take for instance the view of the fly resting on glass and viewed from below. Look at the feet, and observe that each of them has two claws and two light-colored pads. The fly clings to rough surfaces by means of the claws, and to smooth surfaces by a combined action of the claws and pads. The fly's pads are covered with thousands of minute short hairs, sticky at the end. There is no suction—merely adhesion.

The action of a fly's pads may be illustrated by means of a piece of sticking plaster and a few threads and small weights. Take a piece of sticking plaster half an inch wide and sew through it some short pieces of thread at intervals of half an inch, and knot the threads on the sticky side so that they cannot pull through. Stick the plaster to a dinner plate or other smooth object and it will be found that if a small weight is attached to each thread the plaster will sustain in this way a considerable weight—that is to say, the sum of all the small weights is considerable.

Now, remove the weights and attach all of them to one or two of the threads at one end. The plaster will promptly be torn loose. Acting on a portion of the plaster at a time, the weights can accomplish what they cannot accomplish when distributed along the whole surface of the plaster.

This experiment illustrates roughly how the fly uses and controls its feet. Of course, in my illustration you can see just how the weights release the plaster from end to end. It is very difficult to make this observation on a fly, because the fly's pad is so small, and more particularly because the whole operation takes place in something like the fiftieth part of a second.

Wonderful as the fly's pads are, they have their disadvantages, for stickiness and locomotion are not always strictly compatible. Humorous use is made of this idea in Uncle Remus tales, "The Tar Baby" and "The Outrageous Prank of Brer Rabbit." In one of these Brer Rabbit takes advantage of the stickiness, not only of his feet, but the rest of his anatomy, to strike terror into the souls of the other animals. Raiding Brer Bar's pantry, he accidentally breaks the

Photo by N. A. Cobb

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FEMALE HOUSE-FLY RESTING ON GLASS AND SEEN FROM ABOVE

The house-fly swallows many kinds of germs and spores, and deposits them all day long at intervals of a few minutes in its excreta, the "fly specks." Those germs and spores pass through the fly in less than an hour, and come out in the fly specks alive and uninjured. Flies spread more germs in this way than in any other. The house-fly sticks close to man and is a dangerous agent in the spread of human diseases. Diseases of animals and plants are spread in the same way. The hairs on the back of a fly are not a haphazard arrangement, but correspond in number and location on all house-flies.

Photo by N. A. Cobb

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MALE HOUSE-FLY RESTING ON GLASS AND SEEN FROM BELOW

In addition to two claws, each of the six feet is supplied with two light colored sticky pads. Germs and spores stick to these pads, and are thus carried from place to place with great rapidity, for the fly travels fast and far on its own wings, and on cars, boats, and other moving things. The fly cleans its feet carefully whenever they become contaminated, thus removing many of the germs that would otherwise be spread, but not all.

Photo by N. A. Cobb

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FRONT VIEW OF THE HEAD OF A HOUSE-FLY

The same head is shown in profile on the opposite page. The fly is one of the most highly organized of insects. The two large areas studded with thousands of facets are the compound eyes. The three simple eyes are seen at the top of the head in the middle. See also top view of the fly. The two large pendant organs with "peacock feathers" on them are the antennæ, or "feelers." A fly can see in all angular directions.

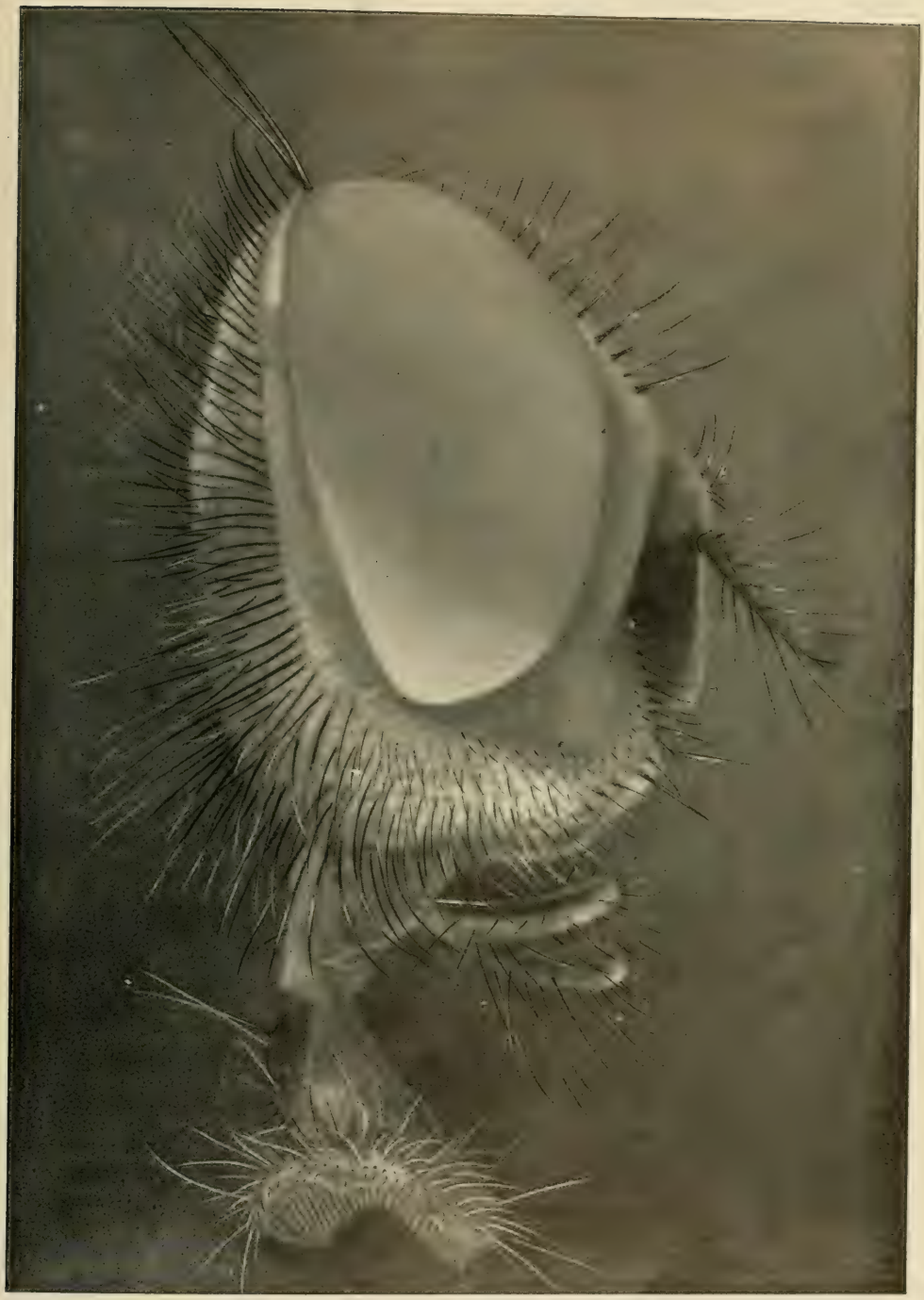

Photo by N. A. Cobb

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SIDE VIEW OF THE HEAD OF A HOUSE-FLY

The same head is shown front view on the opposite page. The end of the proboscis carries a sieve through which all the food is strained. The meshes of this sieve allow germs and all but the largest spores to pass. The house-fly takes in only liquid food. When the fly eats solid food, it first spues saliva on it so as to dissolve it.

honey jar over himself to such a tune that, as Uncle Remus says, "He wan't jes' bedobble wid it, he was jes' kivered." Brer Rabbit soon discovered that this condition was incompatible with convenient locomotion. Things stuck to his feet in such an unusual way as to suggest to this practical joker what a spectacle he would present if he should roll himself among the sticks and leaves in Brer Bar's yard. Carrying out this idea, Brer Rabbit presents himself to the other animals with the usual side-splitting results.

In the "Tar Baby"—"One day Brer Fox rig up a contraption what he call a tar baby." This sticky puppet placed cunningly in Brer Rabbit's path excites Brer Rabbit's ire, because he "won't say nuffin" in response to Brer Rabbit's overtures. In his efforts to teach him manners Brer Rabbit hits the tar baby, and as the tar baby will not let go, and still persists in "sayin' nuffin," Brer Rabbit hits him with the other hand. This is the beginning of such a tangle between Brer Rabbit and the sticky tar baby that Brer Rabbit is completely entrapped and falls into the hands of Brer Fox.

All his grown-up life the fly has to manage with sticky feet. Imagine our plight if the soles of our feet were sticking plaster, perennially renewing its stickiness! Whoever has experienced the sticky mud of certain regions will recall how the boots ball up and what a conglomeration one drags home from a ramble under such circumstances.

To such inconveniences the fly is constantly subject, and it is this that has bred into him a habit of frequently preening himself, particularly his feet. These are constantly becoming clogged with adhering substances, and this contamination the fly must assiduously remove if his feet are to act properly in supporting him on slippery places. If this contamination is too sticky to rub off the fly laps it off, and it then passes off in his excreta.

Thus it is that all sorts of microscopic particles are moved from place to place on the feet of flies. These particles are rarely of sufficient size to be seen with the unaided eye. Nevertheless, they are constantly present, and the amount of matter thus transferred is relatively considerable on account of the fly's activity. When flies have access to diseased or rotten or foul matter the transfers thus effected are dangerous. All sorts of minute organisms are spread in this way, including diseases of man, animals, and plants. It is impossible to go into details in this place, but it is only right to say that the imagination completely fails to grasp the far-reaching consequences of this transfer of germs and spores on the feet of flies.

Unfortunately, this is not the worst of it. The transfer of germs by means of the fly's feet is a small matter beside that which takes place through its excreta.

The following is the defecation record of a well-fed fly (the fly was fed at 9:23 a. m.):

Interval times		*Notes on spores in the excreta*
....	9.35....	
8....	9.43....	
6....	9.49....	Spores in excreta seen to pass.
3....	9.52....	
6....	9.58....	
1....	9.59....	Spores.
2....	10.01....	Spores.
4....	10.05....	
5....	10.10....	
3....	10.13....	
3....	10.16....	
4....	10.20....	
3....	10.23....	
3....	10.26....	Spores.
2....	10.28....	Found one.
1....	10.29....	
1....	10.30....	Spores.
13....	10.43....	Very many spores.
1....	10.44....	
3....	10.47....	Found one.
15....	11.02....	Very many spores.
9....	11.11....	
9....	11.20....	Very many spores.
6....	11.26....	

The time lapsing between the movements varied from 1 to 15 minutes and averaged about 4½ minutes.

No wonder that fly specks are common if the fly evacuates once in five minutes all day long! The number of specks in even the best-kept houses is simply appalling. I might be accused of sensationalism if I should publish records in

my possession gained through the use of a little counter which can be used to estimate the number of fly specks on a given area.

We men-folks are much less observant in this matter than our better halves, but even a man, after a short period of training, finds no difficulty in astonishing himself at the abundance of fly specks in situations that show them off to advantage; for instance, on ordinary window panes. No housewife needs to be told that one of the main reasons for cleaning windows is the presence of fly dirt, but even she will, I think, be surprised at the results of actual counts. The fact is we ordinarily notice only the largest and the darkest. The great majority escape notice because they are small or transparent and colorless. Window panes with from 1,000 to 10,000 fly specks per square foot are not at all uncommon. From 10 to 50 per square foot is a common number in what are considered well-kept homes. Spotless glass is rare, except on house-cleaning day.

This is in situations where the dirt can be readily seen. On neutral tinted objects, less often cleaned, fly specks occur in millions. On wall-paper, chandeliers, outside veranda posts, on cornices, ceilings, and window blinds the numbers are almost past computation.

The amount of this fæcal matter deposited by flies is of course in proportion to the number of flies. When the flies have access to diseased or rotten or foul matter these fæces are dangerous. If there is any infectious or contagious disease in your neighborhood in fly-time, beware of flies!

Flies swallow the germs of typhoid in countless millions while feeding on the excreta of typhoid patients. As a result they spread a thousand times more typhoid germs in their excreta than on their feet. My own experiments have shown that the spores of a variety of diseases pass through various species of flies without appreciable change, and that without doubt certain diseases produce odors that entice flies to swallow the spores so that these latter may be more efficiently spread abroad. The germs are just as virulent after passing through the fly as before.

My experiments show that the greatest variety of spores and microbes can, and normally do, pass through flies and germinate afterwards. In fact, the most delicate spores are little if any injured by the fly's digestion. Among those tried are the spores of some of our commonest and most destructive moulds and spores of nearly all the diseases of sugar-cane and those of numerous other plants. In short, it rarely happens that spores of any kind swallowed by a well-fed fly do not appear in an hour or so in the fæces of the fly in an uninjured condition, such that they germinate readily afterward. Finally, as might be expected, examination of the excretus of flies captured in the open shows it to contain a great variety of spores in a living condition.

I find the digestion of the adult fly to consist in the absorption of those substances readily soluble in its weak digestive fluids and the evacuation of all others. In accordance with this principle the fly is an enormous feeder. At a single meal it frequently swallows nearly half its own weight of food. In the course of a day a well-fed fly probably as a rule swallows more than its own weight of food.

During the summer the fly population of any large town must number millions. Comparing this fact with the food habits of the fly, we see at once the importance of the rôle they play in our affairs, more particularly in view of their disease-carrying powers. I venture to think the most powerful imagination fails to take in the vast multitude of conclusions that follow from these simple lines of reasoning.

What has been said is an attempt to show that the house-fly is a character of much greater significance to us than is indicated by his adornment of a fable. He really does have something to do with the turning of the wheel, but it is the wheel of life. He may have little to do with keeping it going, but he certainly sometimes has much to do with stopping it.

The fly does far worse things than get into the ointment, for unless we take care he gets into or onto pretty much everything we eat or drink. Such an occurrence is not simply disgusting; it is more or less dangerous, and the danger lies in the introduction into our bodies of disease germs. This danger is far more real than commonly supposed. There can be no doubt that much sickness is started in this way.

The question is, What ought we to do about it? The answer is simple, and it is that we ought to take greater precautions, both individually and collectively—

First. To fully inform ourselves on this subject by reading and observation.

Second. To prevent the multiplication of flies. Abolish their breeding places. Protect food and refuse so that flies cannot get at them.

Third. To keep flies out of our buildings and streets.

Fourth. To employ all reasonable agencies to destroy flies that come into existence in spite of our other precautions.*

* For further information on the ravages caused by flies see "Economic Loss to the People of the United States through Insects that Carry Disease," by Dr L. O. Howard, August, 1909, NATIONAL GEOGRAPHIC MAGAZINE, pp. 735-749.

NOTES ON THE DISTANCES FLIES CAN TRAVEL*

By N. A. Cobb

IT is very difficult to make the necessary direct observations as to the distances flies can travel and their rate of speed—flies' motions are so rapid. Nevertheless, in the course of time I have been fortunate enough to witness a number of convincing instances. To these I have added the indirect evidence of comparative anatomy. If the fly's wing muscles are unusually bulky, it is a fair inference that its flight will be quick, or long sustained, or both.

I have never succeeded in tiring my flies very perceptibly if they had a free space to move about in. When confined in a room they may be kept on the wing for hours without showing many signs of fatigue. Though they move twenty feet to the experimenter's one, they will often succeed in tiring him out if he undertakes the task of keeping them always on the wing. The instance of the fly starting to cross the Mediterranean Sea is a very striking one. (See page 382.)

EXPERIMENTS INDICATING THE GREAT POWERS OF FLIGHT POSSESSED BY SOME FLIES

Among insects, as among birds, fliers of two very different types are to be found—those that soar and those that fly. Without entering deeply into the question, this division may be said to be about as marked among insects as among birds. The fliers among insects, to which class the flies belong, correspond, however, more nearly to the extreme limit reached in humming birds.

The rate of wing vibration in flying insects is higher than any wing rate among birds. In fact, the difference is so great that it raises altogether new mechanical and physiological questions. In the case of insects these questions have excited the interest and attention of minds of the highest order, as is apparent on looking over the literature of the question.

The flies belong to the quick-action group of flying insects, the principles of

* Abstracted from "Fungus Maladies of the Sugar Cane," by N. A. Cobb

whose wing musculature appears to have been first explained correctly by Graber. No one has yet, however, fully explained how it is that these insects are able to execute such quick movements. Is it possible that the division of the thoracic muscles into groups, a division that seems to prevail in all the insects that fly in this manner, is a provision by which the muscles act in relays? If we recall the motions that are executed by a single pair of antagonistic muscles, can we recall a single instance where movements are executed at the rate of several hundred per second? I doubt if even in those minute forms where there appears to be the least molecular difficulty—I refer to the cilia of microbes—so high a rate of vibration would be claimed. (I know of no investigations.) Few men can execute more than ten movements per second with any muscle.

It has often struck me when examining the batteries of muscle by which the quick-action insects execute their wing movements, that here is a mechanical and physiological problem that it would be well worth while to investigate.

ENORMOUSLY POWERFUL WING MUSCLES OF FLIES

Ten flies of the smaller of the two sarcophagous species found common at this Station* were weighed after being chloroformed. They were taken as captured in the middle of the day. No doubt a slight amount of the vapor of chloroform added to the apparent weight of these ten flies, which was 478 milligrams. The central thoracic muscles were removed and weighed, and also the two sets of lateral muscles. The result was 67.5 milligrams for the central and 58.5 for the lateral. Thus we have:

Average weight of fly, 47.83 mg.

Average weight of lateral batteries of muscle, 5.85 mg.

Average weight of central battery of muscle, 6.75 mg.

Total weight of muscles, 12.6 mg.

From which we learn that the weight of the central thoracic muscles is 14.1 per cent of the weight of the fly, and the weight of the lateral thoracic muscles is 12.2 per cent of the weight of the fly, and that together these thoracic muscles constitute 26.2 per cent of the weight of the fly.

The method was to fix the flies in 50 per cent alcohol, dissect out the muscles, soak them in water for several hours, remove the excess of water and weigh the muscles barely moist.

Eight females of the commonest species of *Syrphus* about the Station had their great thoracic muscles removed and weighed, with the following results:

Longitudinal muscles, 12.3 per cent of the weight of the fly.

Oblique muscles, 9.2 per cent of the weight of the fly.

Total, 21.5 per cent of the weight of the fly.

A similar trial with ten males weighing 774 mg. gave as a result:

Longitudinal muscles, 17.12 per cent of the weight of the fly.

Transverse muscles, 12.5 per cent of the weight of the fly.

Total, 29.62 per cent of the weight of the fly.

The males of this species have a greater proportion of muscle than the females. This appears to be generally true of flies.

The wing muscles of a notable flier, *Volucella obesa*, often to be seen, especially in the morning, standing in the air in shady places in Honolulu, were removed and weighed in the same manner as described for the two sarcophagous species. The result showed that the longitudinal muscles constitutes 25.7 per cent of the entire weight, while the oblique sets constitute 22.3 per cent of the entire weight, so that together these muscles constitute no less than 48 per cent of the weight of the insect. It should be noted that all the specimens examined appeared to be males, and the absence of gravid females may in some degree account for the difference between these results and those noted in the case of the sarcophagous flies. How-

* Experiment Station of Hawaiian Sugar Planter's Association, Honolulu.

ever, it could not account for more than a portion of the great difference.

This result is from the examination of ten specimens that in the aggregate weighed 674 milligrams.

WING RATES OF POWERFUL INSECT FLIERS

Records of wing vibrations of a specimen of *Syrphus* that had been in captivity 24 hours, and meanwhile fed on sugar and water, gave, as the average of four tests, 400 per second. The voice of this fly when scared by pressure varied from violin A to the C above.

A second specimen gave 378 as the average of five tests. One test in the same quarter-second gave 341 and 578, the slower being at the beginning of an effort, the faster at the maximum speed attained. These rates, which at first appeared to be the true wing rates, proved ultimately to be subsidiary vibrations.

Wing vibrations of *Volucella*, 298, average of six tests. The tests varied remarkably, being as follows: 228, 253, 275, 282, 348, 405. The latter two are remarkably above the others, and are subsidiary vibrations.

Three tests on a green-bottle fly gave 250, 258, 196. Average, 235.

A large sarcophagous fly, female, as the result of seven tests, gave an average of 246 per second. In the course of these tests rates as high as 400 were observed for short periods of time, but these were probably subsidiary vibrations. The tests ran as follows: 199, 206, 227, 257, 268, 281, 281.

The wing vibrations of one of the large sarcophagous flies held captive, on being chronographed, gave as the result of seven different trials 203 vibrations per second.

Golden dragon fly (*Pantala flavescens*, Fab.), 17 per second, five observations, one individual.

Large dragon fly (*Arax junius*, Drury), 22 per second, seven observations, one individual.

Tuning-fork tests on the same paper as the above tests gave results as follows: Pitch, A international. 420, 446, 462. Average, 443.

HIGH WING-RATE FLIERS VS. THE SAILERS

The dragon flies are well known to be powerful fliers. Nearly everybody must have noticed the bold flight of these conspicuous insects, which may at times be seen soaring high above the roofs of houses in our towns, and even over the tops of some of our high hills and mountains. We may, therefore, arrive at a more accurate conception of the flight of flies if we compare it with that of these larger insects which come under more common observation.

The relative powers of flight of the fly *Volucella obesa* and the large dragon fly is shown by the usually futile attempts of the latter to capture the former. I have never seen a *Volucella* captured by one of these dragon flies, though the *Volucella* when standing still in the air offers an unusually fair mark. When the dragon fly arrives the *Volucella* is gone. The fact that dragon flies continue to make passes at them may indicate that the flies are sometimes caught.

A golden dragon fly and a *Volucella*, whose weight were to each other as 297.4 to 64.2 (mg.), had wing areas that were to each other as 46.8 to 1.6.

Or, to speak approximately, a dragon fly weighing only four to five times as much as a fly, both being expert fliers of their respective kinds, had a wing area thirty times as great.

A *Volucella* fly and a large dragon fly, whose weights were to each other as 64.2 to 1598.5 (mg.), had wing areas that were to each other as 1.6 to 82.; that is to say, speaking approximately, the dragon fly, while she weighed only 25 times as much, had a wing area over 50 times as great.

A REMARKABLE FLIGHT

I remember once to have witnessed a very remarkable example of the power of flight of one of the larger flies. On a voyage across the Mediterranean from Algiers to Marseilles in company with Prof. W. T. Swingle, I observed a dipterous insect keeping pace with the steamer so accurately that it almost seemed as if it were joined to the boat

by some invisible rigid connection. The boat left Algiers at noon, and as long as there was any light left by which to observe, the insect kept its place steadily. This was in midsummer. The insect never made any attempt to come aboard.

The boat was not particularly fast, her speed being, so far as I could judge, about thirteen knots. When we consider that the insect was all the time supporting itself in the air while the boat merely floated on the water, and thus had its weight supported, the comparison between the two is all the more striking.

FIGHT THE FLIES

We reprint herewith a circular recently published by the American Civic Association, which is conducting a vigorous campaign against the fly

IT is at this time of the year that the house-fly begins to take on life for the ensuing spring and summer; eggs laid last fall will soon begin to hatch. At first he is only a little worm, wriggling his tiny grub-like form in some incubating pile of filth. He is usually found in the manure pile, the outhouse, or the mound of rubbish or garbage in the back yard. In this condition he is easily killed, and it should be the duty of every person to kill him now. The house-fly could not exist if everything were kept perfectly clean and sanitary. Exterminate the fly-worms, do away with its breeding places, and there will be no flies. If we are to fight the flies this summer we should use every agency possible, and the best way to fight them is to prevent their breeding.

The common house-fly is coming to be known as the "typhoid fly," and when the term becomes universal greater care will be exercised in protecting the house from his presence.

Flies kill a greater number of human beings than all the beasts of prey, with all of the poisonous serpents added. They spread disease which slays thousands, while big, powerful beasts kill single victims.

As soon as the fly comes out of his shell he is full grown and starts out in the world to make a living, and if your home is not clean he knows it by the odor. They can discern an odor of filth for miles.

As much as they like filth odors they dislike other odors. Where a bad odor will attract them the clean odor will repulse them. A pleasant-smelling substance—the fragrance of flowers, geraniums, mignonette, lavender, or any perfumery—will drive them away.

He is a frequenter of offal. The fly lays her eggs in the manure pile or other objectionable filth. All the germs—all the imaginable abominable microbes—fasten themselves on the spongy feet of the fly. He brings them into the house and wipes them off his feet. The fly you see walking over the food you are about to eat is covered with filth and germs. If there is any dirt in your house or about your premises, or those of your neighbors, he has just come from it. It is his home. Watch him as he stands on the lump of sugar industriously wiping his feet. He is wiping off the disease germs, rubbing them on the sugar that you are going to eat, leaving the poison for you to swallow.

He wipes his feet on the food that you eat, on the faces and on the lips of your sleeping children. This does more to spread typhoid fever and cholera infantum and other intestinal diseases than any other cause.

Disease attacks human beings only when they are brought in contact with it. For instance, you cannot get typhoid fever unless you swallow the germs of typhoid, and you do not swallow these

germs unless they get on the food you eat or in the liquids you drink, or on the glasses or cups from which you drink.

Not only does he scatter the seeds of disease from his body over your food, but before your fruit and vegetables are placed before you they have been subjected to his filthy habits, either in the kitchen or in the stores, where he flies from the horse dirt in the middle of the street to the tubercular sputum on the sidewalk, and then back to the foodstuffs displayed for sale.

Many diseases which are attributed to milk and water originate through flies. A polluted brook, river, or lake furnishes germs from sewers, and flies in millions settle on the refuse that washes along the water's edge.

Intestinal diseases are more frequent whenever and wherever flies are most abundant, and they and not the summer heat are the active agents in its spread.

There is special danger when flies drop into such fluid as milk. This forms an ideal culture material for the bacillus. A few germs washed from the body of one fly may develop into millions within a few hours, and the person who drinks such milk will receive large doses of bacilli, which may later cause serious sickness.

Therefore, keep the flies away from the milk.

DON'TS

Don't allow flies in your house.

Don't permit them near your food, especially milk.

Don't buy foodstuff where flies are tolerated.

Don't have feeding places where flies can load themselves with ejections from typhoid or dysenteric patients.

Don't allow your fruits and confections to be exposed to the swarms of flies.

Don't let flies crawl over the baby's mouth and swarm upon the nipple of its nursing bottle.

Clean up your premises inside and out, and then, as much as you can, see that others do the same.

Strike at the root of the evil. The house-fly breeds in horse manure, kitchen offal, and the like. Dispose of these materials in such a way that the house-fly cannot propagate. Screen all windows and doors and insist that your grocer, butcher, baker, and every one from whom you buy foodstuffs does the same.

There is more health in a well-screened house than in many a doctor's visit.

After you have cleaned up your own premises inspect the neighborhood for fly-breeding places. Call the attention of the owner to them and, if he does not remove them, complain to the Board of Health.

Flies breed in horse manure, decaying vegetables, dead animals, and all kinds of filth.

NOT LESS THAN 95 PER CENT OF THE PESTS ARE BRED IN THE STABLE

All stables should have a manure bin with a door at the side and a wire screen on the top, that the larva deposited in the manure before it was placed in the bin will be screened when hatched, and, as flies seek light and come to the top of the bin, they can be easily killed by burning paper or some other device.

The fly has a thirst only equaled by his hunger; place a dish of poisoned water in the stable and a greater part of the flies hatched there will be killed.

Flies are nature's scavengers, fulfilling the same function that some bacteria do, but become an intolerable nuisance and danger when entering human dwellings and by contamination of food.

The presence of flies is a direct evidence of careless housekeeping and of the existence of filth in some form about the premises, and are more dangerous than the good housekeeper's terror found in bed-rooms.

Remember that wherever absolute cleanliness prevails there will be no flies. Look after the garbage cans. See that they are cleaned, sprinkled with lime or kerosene oil, and closely covered.

Remove all manure from stables every three or four days, and when removed keep in a tight pit or vault, so flies cannot breed in it.

Lye, chloride of lime or blue vitriol water, crude carbolic acid, or any kind of disinfectant may be used.

Keep flies away from the kitchen. Keep flies out of the dining-room and away from the sick, especially from those ill with contagious diseases.

Screen all food. Apply this rule not only to food prepared at home, but to foodstuffs offered for sale, and especially fruits, salads, and all other things which do not require to be cooked.

Prevent consumptives from expectorating where flies can feed upon it.

HOW TO KILL FLIES

To clear rooms of flies carbolic acid may be used as follows: Heat a shovel or any similar article and drop thereon 20 drops of carbolic acid. The vapor kills the flies.

A cheap and perfectly reliable fly poison, one which is not dangerous to human life, is bichromate of potash in solution. Dissolve one dram, which can be bought at any drug-store, in two ounces of water, and add a little sugar. Put some of this solution in shallow dishes and distribute them about the house.

Sticky fly-paper, traps, and liquid poisons are among the things to use in killing flies, but the latest, cheapest, and best is a solution of formalin or formaldehyde in water. A spoonful of this liquid put into a quarter of a pint of water and exposed in the room will be enough to kill all the flies.

To quickly clear the room where there are many flies, burn pyrethrum powder in the room. This stupefies the flies, when they may be swept up and burned.

If there are flies in the dining-room of your hotel, restaurant, or boarding-house, complain to the proprietor that the premise are not clean.

CAMERA ADVENTURES IN THE AFRICAN WILDS

Photographs by A. Radclyffe Dugmore. Copyright, 1910, by Doubleday, Page & Co.

TO stand before a charging rhinoceros, holding a fifteen-pound camera, and to wait deliberately until the beast is only a few feet away before releasing the shutter, knowing all the while that only an unerring bullet from his companion can turn aside the leviathan and save the photographer from being tossed 15 yards, is surely as great a test of physical and moral courage as any soldier would like to undergo. The volume which contains Mr Dugmore's photographs of wild game in Africa and also his experiences in obtaining these photographs, is one of the most thrilling, inspiring, and instructive books published in many years.*

Through the courtesy of Messrs Doubleday, Page & Company, the NATIONAL GEOGRAPHIC MAGAZINE is able to reprint eleven of the one hundred and forty remarkable photographs given to the public by Mr Dugmore. The photographs are far more wonderful and beautiful than those by the German, C. G. Schillings, which excited so much enthusiasm several years ago, and which were described and illustrated in this magazine in August, 1907.

Readers will probably find an interesting debate in the question whether photographing rhinos or photographing lions by flashlight is the more nerve-racking occupation.

Mr Dugmore secured his flashlights of lions in the following manner: He built a small hut of branches, open on one side. Outside the hut he arranged the flashlight and three cameras focused on a dead carcass, a zebra or hartebeest, a few feet away. At night he took his position in the hut and waited for the lions to appear.

* "Camera Adventures in the African Wilds." A. Radclyffe Dugmore, pp. 250, with 140 photos from life. 8½ x 11 inches. Doubleday, Page & Co., 1910. $6.00.

RHINOS FEEDING

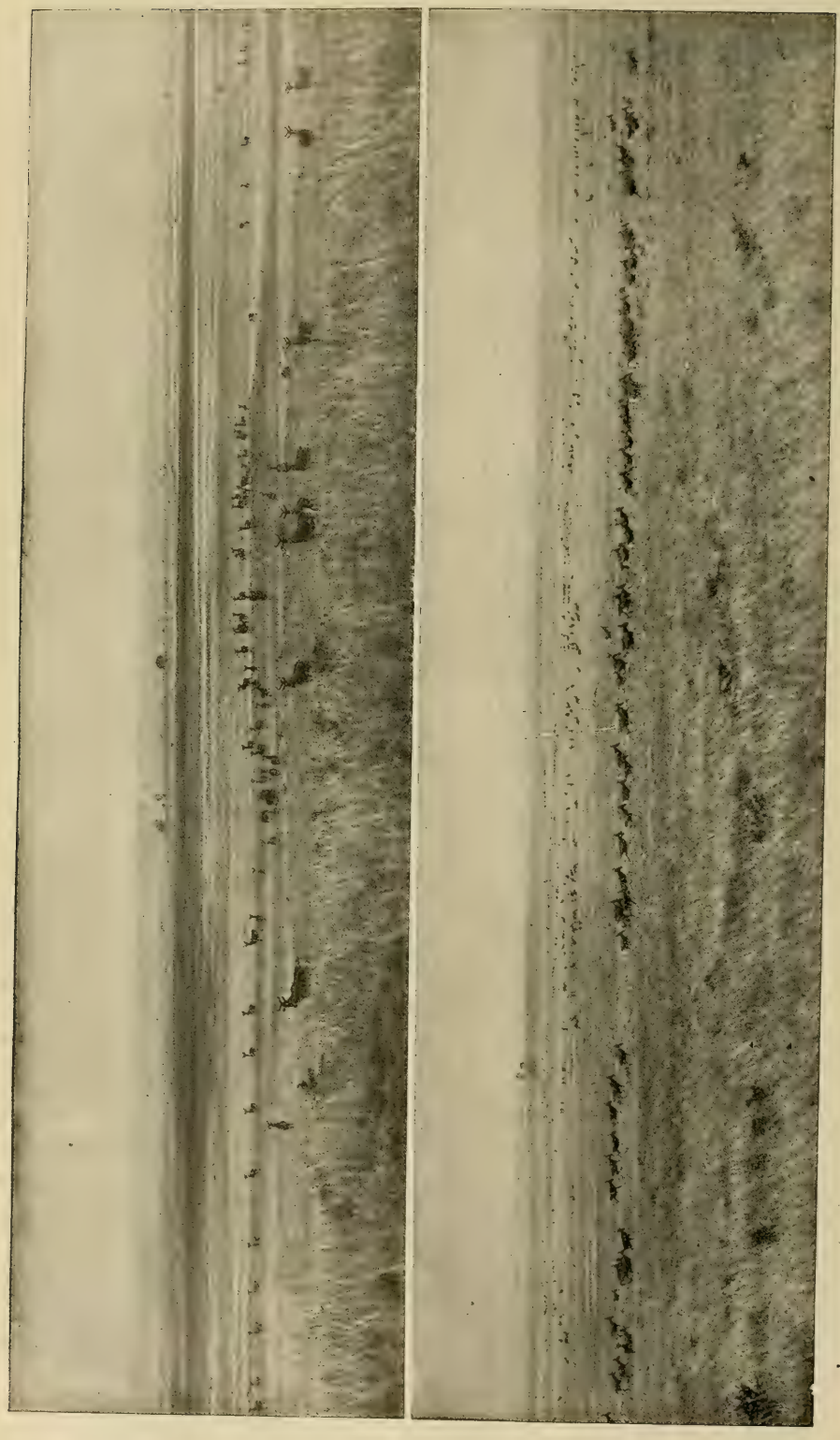
Note the birds on their backs. These birds eat the ticks, which infest the beasts. They also act as sentinels, by their fluttering warning their companions of approaching enemies

THE LOWER PICTURE IS OF ONE OF THE SAME PAIR IN THE ACT OF CHARGING

The horn is about 24 inches long, and is composed of hair or bristles closely pressed. A rhinoceros' horn's only value is as a trophy, though some are sent to China, where they are pulverized and sold for medicinal purposes.

RHINOCEROS PHOTOGRAPHED AT A DISTANCE OF FIFTEEN YARDS WHEN ACTUALLY CHARGING THE AUTHOR AND HIS COMPANION

As soon as the exposure was made a well-placed shot from Mr. Dugmore's companion turned the charging beast

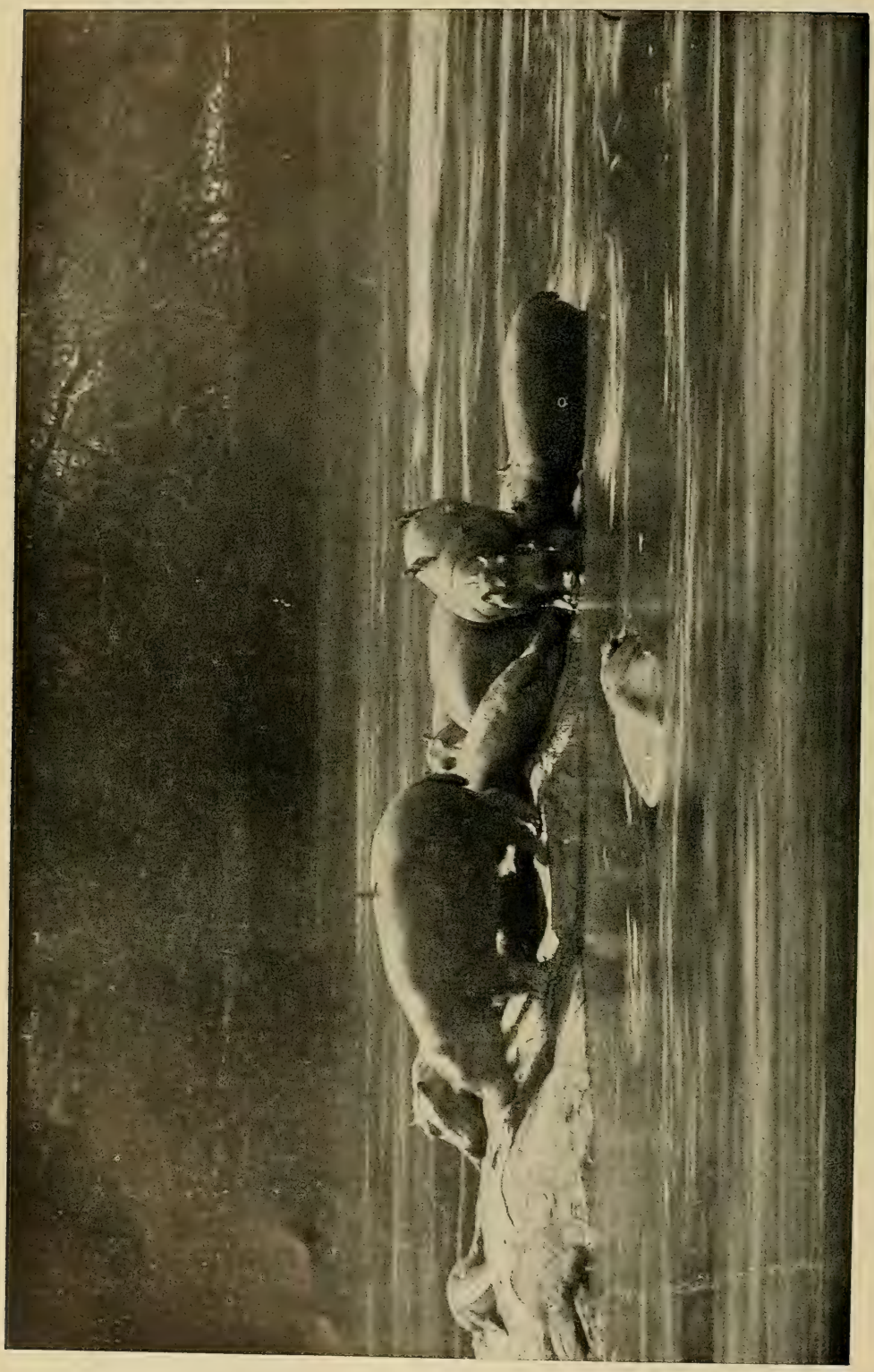


COKE'S HARTEBEEST: THIS PICTURE WILL GIVE SOME IDEA OF THE ABUNDANCE OF THE GAME IN INLAND BRITISH EAST AFRICA

LARGE HERD OF COKE'S HARTEBEEST ON THEIR WAY TO WATER

The people of Nairobi, a fair-sized town and headquarters of the railroad and government, have been compelled to build a double row of fencing around the town in order to keep out the great herds of game. The fence is, however, often broken and a zebra or hartebeest galloping through the streets is a common sight.

HERD OF GIRAFFE PHOTOGRAPHED AT A DISTANCE OF ABOUT 375 YARDS WITH THE TELEPHOTO (ENLARGED)



IMMATURE HIPPOPOTAMUS AND A CROCODILE

The birds seen on the animals' backs eat the parasites—leeches and others—which infest the coarse skin (telephoto made on the Tana River)

"For about two hours I had been straining both eyes and ears, when suddenly, to my astonishment, a huge lion appeared. He was standing close to the zebra when I first discovered him, and I could not understand how he could possibly have come without being seen or heard. Yet there he stood, the king of beasts, the most feared animal in Africa, not twelve yards away."

The lions weigh on an average over five hundred pounds each, and yet their approach was so silent and stealthy that Dugmore always failed to detect their coming until the tearing of flesh and breaking of bones of the bait proclaimed their arrival.

By pressing the electric button the flash was then fired, but the lions would only retreat for one hundred or two hundred yards, where they would make the night hideous with their roaring. It was then the pleasant duty of the photographer to emerge from the protection of his hut, reload his three cameras and the flashlight apparatus, while the chorus of the lions continued. On one night Mr Dugmore secured photographs of twelve different lions.

Mr Dugmore speaks most enthusiastically of the wise precautions taken by the British government to prevent the extinction of game. In addition to the regulations forbidding the shooting of game along the railways, the authorities have set aside about 10,000 square miles as a reserve in which no shooting is allowed. The abundance of game in the free-zone is simply extraordinary.

"We could see countless herds of animals," hartebeest and gazelles, zebra, elands, etc. "Our excitement reached its highest pitch when we discovered a large giraffe standing complacently, scarcely one hundred and fifty yards from the snorting train. How different the huge creature looked in his natural state from those we had seen in zoos or menageries! How different the deep, rich coloring and the dark, well-defined markings from the faded coat of the beast in captivity! This splendid animal, towering above the small trees, after watching us for a few seconds, ambled away to what he considered a safe distance.'

The most unpopular of all the animals in British East Africa, says Mr Dugmore, are the zebras.

"They looked like painted ponies with their strongly defined black stripes, and were beautiful beyond words. It is curious how they appeal to the new arrival, while, if you speak to the settler of the zebra as being even worthy of notice, he smiles sadly, and commences a torrent of abuse against what he considers one of the worst pests of the country. They would like to see them wiped off the face of the earth, and the handsome creatures are killed in great numbers to be used as food for the native workmen, or even for the dogs. And yet they can scarcely be said to be decreasing except in very restricted areas.

"The cause for this common dislike of the zebra is his objectionable habit of disregarding fences. A herd will stampede, and ten or twenty panels of a barbed wire fence are down like a flash, and then, as likely as not, they will wheel round and repeat the operation at another point. In places where fences are measurable by miles, it is of the most importance that they should be kept in a good state of repair. The destruction of a few panels may mean immense damage to crops, and perhaps the loss of valuable ostriches; hence the settlers' lack of love for the cantankerous, though beautiful, zebra.

"So far no practical use for the animal has been discovered. They are not easily tamed and, generally speaking, are extremely bad-temperad, so that they are most difficult to break or handle, and it is almost certain that they are not worth the trouble, owing to their lack of stamina. Contrary to popular opinion, they are not very fast, and have no staying power."

The huge and clumsy hippo conceals in its immense mouth teeth which sometimes attain a length of over five feet, and yet this gigantic pig eats only grass.

"The beast is frequently shot for its ivory, which is quite valuable. Then,

A GROUP OF BUFFALO RESTING AMONG DENSE BRUSH

This telephoto was made when the sun was very low and the wind blowing with such vigor that a time exposure was impossible, hence the blackness of the shadows, where the buffalo can scarcely be detected

A LIONESS ABOUT TO COMMENCE HER DINNER: THE HARTEBEEST HAD BEEN KILLED BY LIONS DURING THE PREVIOUS NIGHT

This flashlight was made when the animal was ten yards from the author

THE SAME LION AS SHOWN ON THE OPPOSITE PAGE, BUT PHOTOGRAPHED FROM A DIFFERENT POSITION

Zebra is the favorite meat of the lion

FLASHLIGHT PICTURE OF THE KING OF BEASTS

At the moment the photograph was made the lion was twelve yards from the author and his companion, who were on the ground beneath some thorn bush

too, their meat is probably more appreciated than that of any other African animal, the immense quantities of fat being greatly relished.

"Agriculture and the hippopotamus do not go hand in hand, as a single hippopotamus will in one night destroy acres of crops; consequently the animals are not much loved by either the native or European farmers.

"The hippopotamus is usually a nocturnal feeder. He spends most of the day in the water, though he may be frequently seen on rocks or sand bars enjoying his sun-bath. As evening approaches he becomes restless, and usually soon after the sun sets he begins to think of dinner. At this time the herd separates, each individual going, I believe, to his own favorite feeding-ground. Whether they feed every night I am not quite sure, for I have noticed certain individuals keeping to a pool all night, while it is not at all an uncommon thing to see them at night asleep on sand bars.

"Certain landing places are used regularly and, judging from the way the banks are worn down and rocks polished, it would seem as though these places have served for many centuries. How far they will go from their day pool is hard to say, but there is every reason to believe that they will sometimes travel ten or fifteen miles or more before landing. Then when they are ashore they will often go a long way before finding the necessary supply of the grass which forms their food.

"It is scarcely credible that such large beasts (for a full-grown bull will probably weigh over three tons) can find enough nourishment in grass, but of course in porportion to their size they do not require nearly as much food as animals of more nervous temperament and active habits of life."

In addition to the lions, rhinos, hippos, and giraffes, most interesting are Mr Dugmore's photographs and descriptions of the filthy spotted hyena, of hartebeests, tiny dik-dik, elands, warthogs, gazelles, oryx, impala, waterbuck, Grevy's zebra, vultures, marabou storks, and other animals, and of the extravagant vegetation.

Several entertaining chapters are devoted to an account of the little-known country around Meru and the native dances.

"The women do most of the heavy work, and it is no uncommon thing to see a girl of perhaps twelve or thirteen carrying a seventy or eighty pound load of firewood on her back, with a bag of corn or a huge gourd of water on the top of it. These are hung by a strap from the head, which is usually clean-shaven. In front, more often than not, hangs a baby, which complacently sucks at its mother's breast as she walks along. The father marches in front, carrying no more than his spear and knob stick, his body smeared with a sickening mess of red earth and grease.

"The costume of the men is usually a red blanket or a brown cotton cloth hung from one shoulder, while the neck, wrists, arms, ankles, and below the knees are decorated with beautiful little beaded bands of wire. Frequently they dispense with covering of any kind. The women wear a short skirt of leather with or without bead work. It is fastened below the breasts and parts in front, so as to leave the knees free.

"Heavy wire ornaments are usually wound around the legs, arms, and neck, and sometimes immense waistbands or beads and cowries are worn. Ear ornaments are used by both sexes, the women preferring clusters of large beaded rings, or heavy wire. In both cases the lobe of the ear is cut and stretched enormously by means of wooden or bone discs.

"It is curious that the women have the head clean-shaven, or nearly so, while the men do their hair, or wool, in most fanciful ways, usually filling the fine braids with a mixture of their favorite red earth and grease. The people are chiefly agriculturists, their live stock consisting almost entirely of goats, sheep, and poultry. The sheep are rather small, and are the fat-tailed variety; the poultry are also small, and lay eggs not much larger than those of the bantam."

THE FIRST TRANSANDINE RAILROAD FROM BUENOS AIRES TO VALPARAISO

By Harriet Chalmers Adams

ARGENTINA and Chile were neighbors, but they could not well be sociable with a mountain barrier between. A passage, however, has at last been opened through the towering, snow-clad Andean wall, and enthusiastic crowds in Buenos Aires and in Santiago de Chile have sped departing trains bound for the adjacent territory. The great Transandine Railway is completed.

On the 5th of last April the Transandine tunnel, the final link in the 888 miles of rail connecting Buenos Aires and the Atlantic with Valparaiso and the Pacific, was officially opened on the Chilian side of the mountains at Caracoles station.

It was a fitting day for a Chilian celebration, since it commemorated the anniversary of the patriotic battle of Maipó, dear to the heart of every native of the far south as the greatest and final victory in the war of independence. Many prominent men of the Republic were present, including members of the cabinet, and at the banquet subsequently held in honor of this historic event Argentina's representatives were entertained before their return to their own country on the other side of the tunnel.

Argentina's official opening of the road was postponed until the 25th of May, which is not only Independence Day in the Republic, but also the inaugural date of the Centenary Exhibition.

The chief feature of this most important of international expositions yet to be held in Latin America is, very appropriately, a railway exhibition, agriculture and art taking secondary place. Buenos Aires, the fourth metropolis of the Americas, the second Latin city of the world, the first Spanish-speaking center, is to be the scene, for six months, of a brilliant demonstration of progressive Argentina's marvelous development. Modern, industrial Argentina has been created by her railways, which not only cross the country from the Atlantic to the Andes, but penetrate those semi-tropical lands adjoining the verdant Republic of Paraguay on the north and those bleak, wind-swept pampas on the south bordering the old Patagonian frontier.

INITIATED BY A MASSACHUSETTS MAN

The story of the Transandine Railway, from its earliest projection by a North American captain of industry to its final completion by an Anglo-American syndicate, is worthy of a prominent place in engineering annals.

William Wheelwright, a native of Newburyport, Massachusetts, was the first to conceive the idea of a transandine road. The plan, which he outlined in 1860, called for the building of a railway from Caldera, on the Chilian coast, eastward through the mountain pass of San Francisco, and thence across the pampas of Argentina to Rosario, a port on the Paraná River—a more northerly route than the one finally adopted.

To the indomitable zeal of the Chilian brothers, Juan and Mateo Clark, however, is due the major honor of the actual achievement. When, in 1872, having fulfilled their contract for the installation of a telegraph line across the Andes, they applied to the Argentine Congress for railway concessions from Buenos Aires to the Chilian frontier, they were regarded by many as idle dreamers. Yet one of the brothers, happily, has lived to realize the triumphant fulfillment of his dream.

In 1874 the Argentine concessions were obtained by the Clarks; in 1878 the contract was signed; but many obstacles arose and it was not until 1886 that a company—The Transandine Railway—

Photo from W. R. Grace & Co.

THE SALTO DEL SOLDADO BRIDGE ON THE TRANSANDINE RAILROAD

Photo from W. R. Grace & Co.

STATION OF USPALLATA, ARGENTINA

was incorporated to carry out the undertaking. Actual work on the road was at last commenced, and in 1888 the first train left Mendoza, bound westward toward the Andes. The construction now continued steadily until 1891, when work was suspended for eight years.

Meanwhile the Clarks had obtained a Chilian concession for a railway from Valparaiso eastward to the Argentine frontier, and work on this end of the line was begun in 1889. Eventually the Clark brothers were obliged, through financial embarrassment, to give up these concessions, and both divisions came under the control of an English company.

In 1899 work on the Argentine side was resumed and steadily prosecuted until the approach of the summit tunnel was attained. Construction on the Chilian side, on the contrary, progressed slowly, and it was not until 1903, when W. R. Grace & Co., of New York and London, were awarded the contract of completing the road, that work at the western end was energetically carried on. In 1906 an agreement was entered into by the companies representing the road on the two sides of the Andes.

THE SUMMIT TUNNEL: A MARVELOUS ENGINEERING FEAT

It was agreed to pierce the summit tunnel, the final connecting link, by means of the same contractors and under one control and authority. The result has demonstrated the wisdom of this decision.

The drilling of this unique passageway, two miles in length and situated two miles above the sea (although 2,000 feet below the mule trail over the mountain pass of Uspallata—12,605 feet), was a stupendous undertaking. Fortunately, engineering science, and improved appliances for tunneling in particular, has made great strides since those early days when the Transandine was projected—when the piercing of this Cumbre, or Summit, tunnel was reckoned as an in-

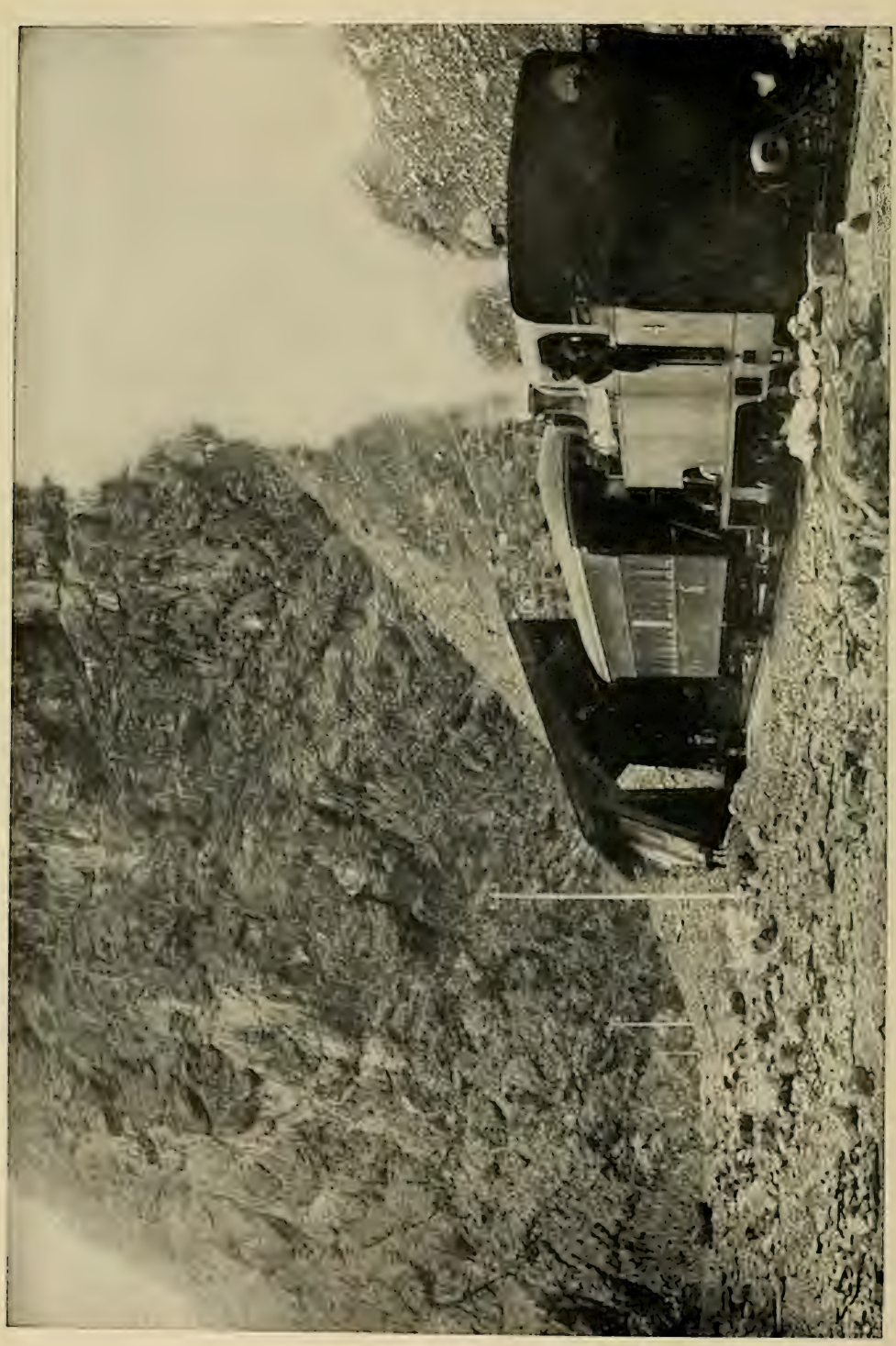
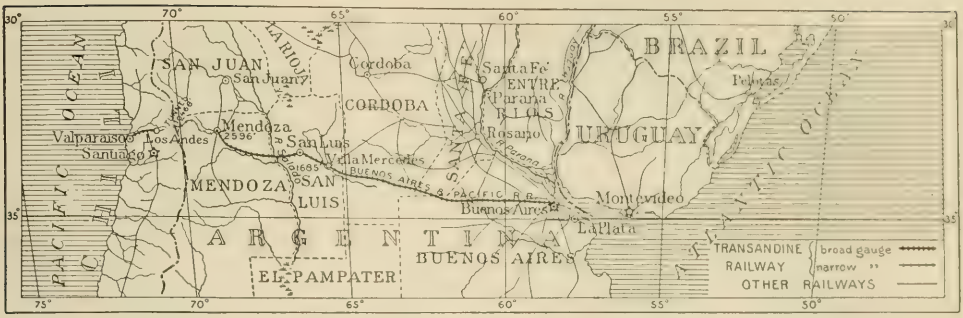


Photo from W. R Grace & Co.

SNOW-SHEDS AT THE ENTRANCE OF ONE OF THE TUNNELS OF THE TRANSANDINE RAILROAD



SKETCH-MAP OF RAILROAD FROM BUENOS AIRES TO SANTIAGO, 888 MILES LONG

superable obstacle in the completion of the road. It was on November 27 of last year that the workmen, approaching from opposite sides of the tunnel, faced the last rocky barrier preventing Argentine and Chilian traffic by rail. It was an old Italian, Felipe Fascio, for many years employed in similar Alpine undertakings, who placed the final fuse of demolition. So came about the conquest of the Andes, and the Buenos Aires-Valparaiso rail route is at last a reality.

It is expected that the "Transcontinental Express" will make the through journey from coast to coast in about 34 hours. Before the completion of the road, when the missing rail gap was covered by diligence and saddle during the summer season (October to May), 3½ days were necessary for the journey. During the winter months of June, July, August, and September, when the Andean snows made passenger traffic at all times dangerous and often impossible, the sea voyage by way of the Strait of Magellan from Buenos Aires to Valparaiso occupied a period of about 11 days. Well-built snow-sheds in the Andean section will now insure safe passage for trains, even under the most unfavorable weather conditions.

DIFFERENCE IN GAUGE A SERIOUS INCONVENIENCE

The Transandine Railway is not, as many suppose, one continuous line under one management, a number of companies being associated with the undertaking. "The Buenos Aires and Pacific Railway" (Buenos Aires to Villa Mercedes), "The Argentine and Great Western Railway" (Villa Mercedes to Mendoza), and "The Argentine Transandine Railway" (Mendoza to Argentine frontier) are three distinct organizations, but have, quite recently, come under the management of the first-named company. "The Chilian Transandine Railway" (Chilian frontier to Los Andes) and "The Chilian Government States Railway" (Los Andes to Valparaiso) are each under separate management.

There is one serious drawback in this railway communication between the two oceans, and this is a matter of gauge. "The Buenos Aires and Pacific" and "The Argentine Great Western" are broad-gauge roads, while "The Argentine Transandine" and "The Chilian Transandine" are narrow gauge, and "The Chilian Government States" broad gauge again. This necessitates a transshipment of goods on both sides of the Andes—at Mendoza, the terminus of "The Argentine Great Western," and at Los Andes, where the two Chilian roads connect. These two changes naturally tend to the making of unduly high freight charges as compared to those now ruling on the longer sea route.

THE POSTMAN OF THE SNOWS

"Across the Andes," meaning the old route via diligence and saddle from Las Cuevas, the former terminus of the railway in Argentina, to the Chilian town of Caracoles, where the traveler again

A STATION ON THE RAILROAD BETWEEN ARGENTINA AND CHILE Photo from W. R. Grace & Co.

Photo from Harriet Chalmers Adams

PASEO DE JULIO, THE WATER-FRONT BOULEVARD OF BUENOS AIRES, THE BEAUTIFUL

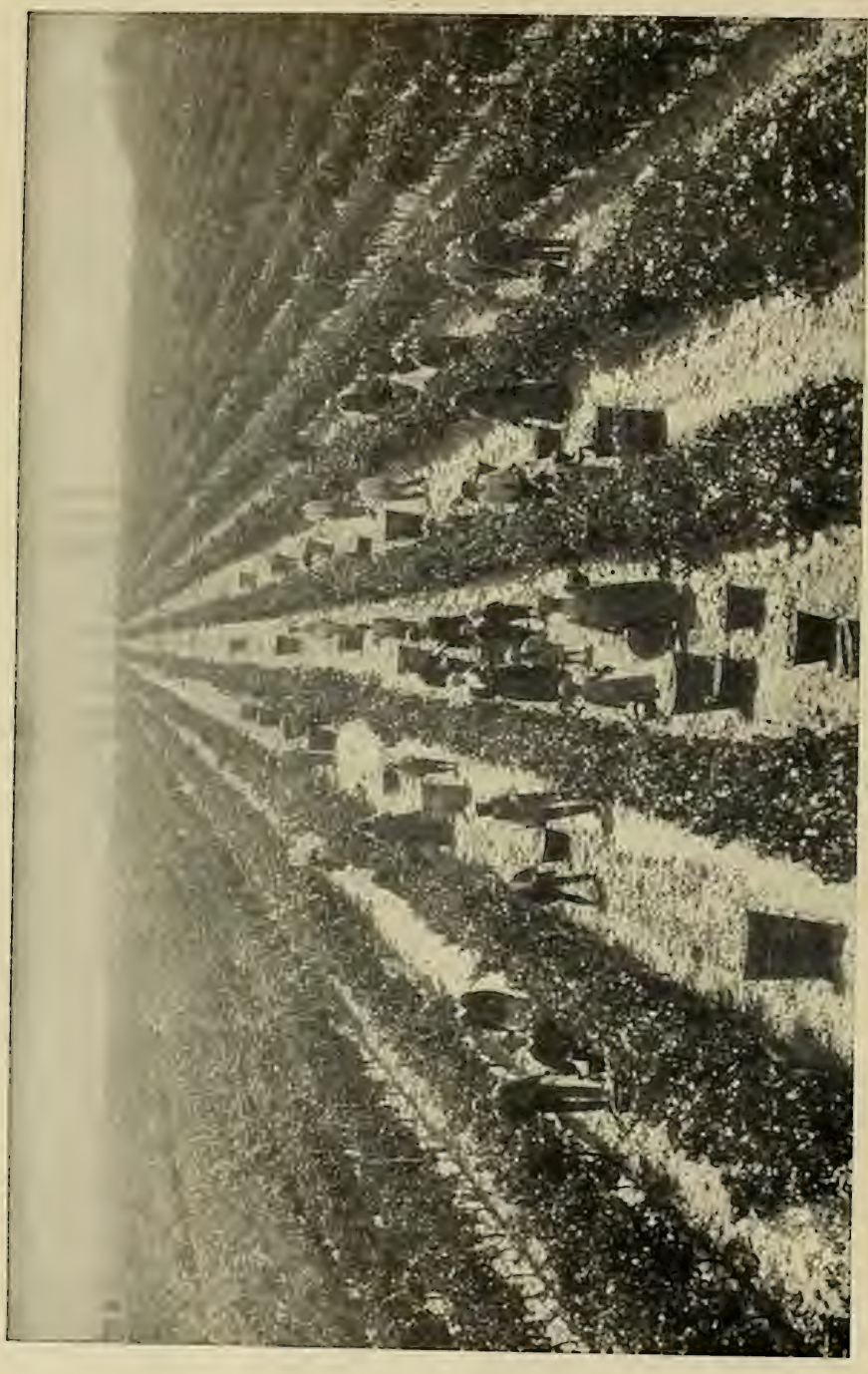


Photo from Harriet Chalmers Adams

THE HEART OF THE VINE INDUSTRY, NEAR MENDOZA (SEE PAGE 410)

boarded the train, is now an experience of the past.

Of the past, too, are those unsung heroes, the mail-carriers of the mountains, laden with letters and packages marked "Via Cordillera," who braved the bitter cold and the savage snows of the Andean winter. It was about the middle of May, under the old régime, when the stage-coach companies suspended traffic, employees and stock making their way to the lowlands.

Rain and blizzard, sleet and snow, now were masters of the uplands, and avalanches "rushed madly down the mountain sides." No pen picture can describe the hardships and privations endured by the men then entrusted with the mails. The precious burden was carried in leather bags strapped to the back, and a curious foot-gear called the "*tomango*" was worn. It consisted of a sheepskin wrapped around the foot, with the fur next to the skin, this unwieldy hose being bound to the leg by thongs of leather which supported an immense leather sole. A poncho, woolen trousers, a long stick with a steel spike, and a small bag containing rations (dried meat, biscuit, and onions) completed the outfit.

The government has built small stone refuge huts ("*casuchas*") along the trail, and into one of these cheerless shelters the exhausted postman of the snows crept at nightfall, shivering through the dark hours, for there was seldom wood obtainable for fuel. Nature resents man's intrusion into her ice-bound domain, and frost-bites are her usual punishment in the Andes. Only too frequently men lost their way in the newly fallen snow—and the mail never reached its destination.

An American now living in Chile made a winter journey across the Andes last season, and he pays a glowing tribute to these "big children of the mountains," the mail-carriers, who were his companions.

"They are the bravest and sturdiest creatures on the face of the earth and have hearts of gold," he writes. "Their wrinkled, leather-like faces bear the marks of the terrible adventures which they related to me, as we huddled together for warmth under the life-saving oven-shaped shelter during the long, bitter night."

THE PARIS OF THE NEW WORLD

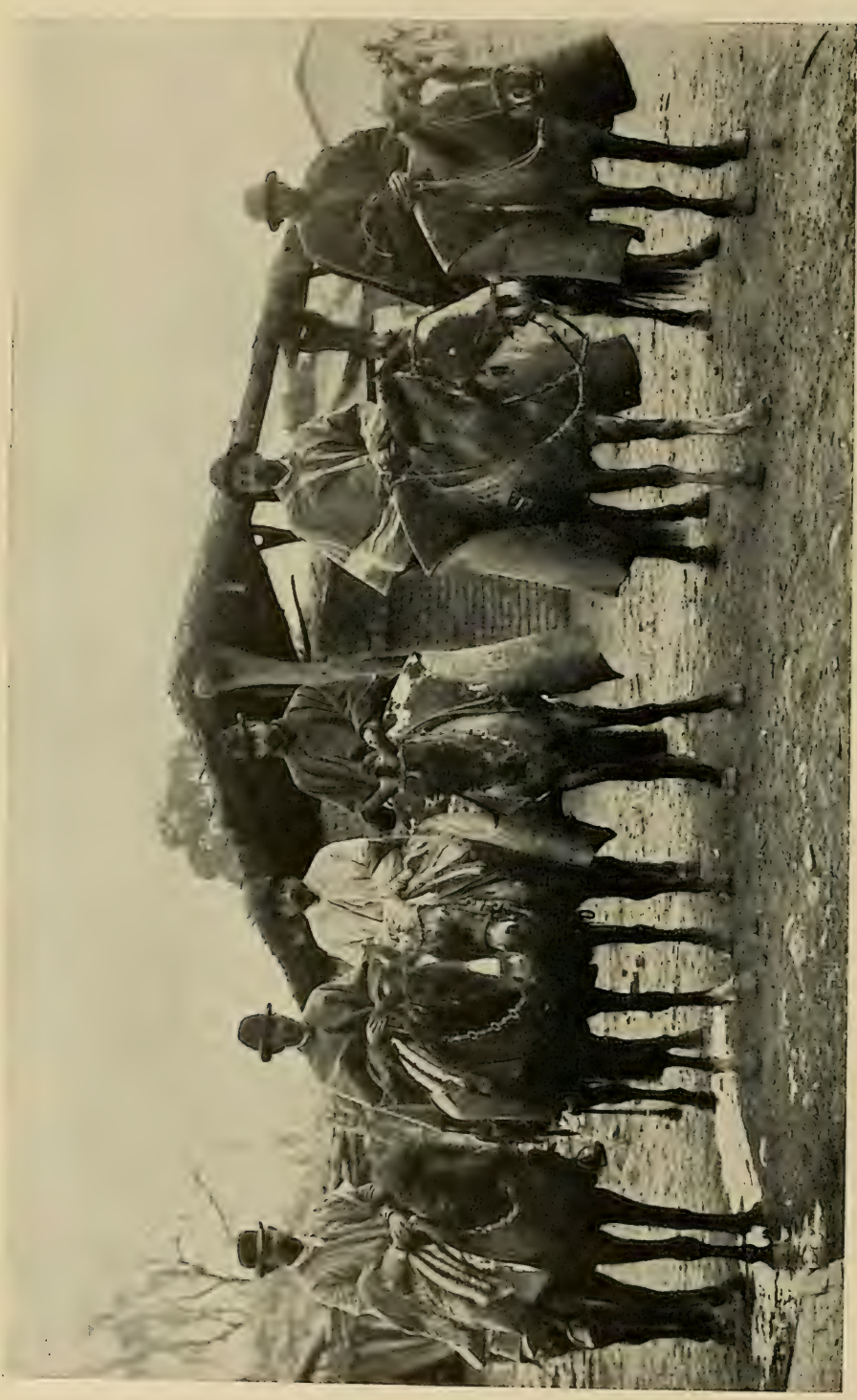
When it is autumn here in North America and we are beginning to think of furs, it is Primavera (first-view), or spring-time, and the peach trees are blossoming in Argentina and in Chile. It is then that the traveler bound across the mountains has a comparatively comfortable journey. We will start from Buenos Aires, traverse the width of Argentina, and cross the Andes into Chile in the old way.

There is hardly a capital in Latin America that has not at some time been labeled "the Paris of the New World." I have visited them all, from Mexico City to Santiago de Chile, from Havana to Panama, and, in my opinion, the title belongs alone to Buenos Aires.

Well built and progressive, artificially beautiful and of cosmopolitan air, the metropolis of Spanish America is a city of which the Argentinos may well be proud. It ranks among the great capitals of the world. The traveler is loath to leave its four miles of splendidly constructed docks, where the flags of every nation wave (save that of the United States of America); its brilliantly illuminated avenues and dazzling cafés; its beautiful Park of Palermo, where the best-gowned women of the South, the pride of the Paris modiste, fascinate the beholder as they drive by in their perfectly appointed victorias. Although founded nearly four centuries ago, Buenos Aires seems as modern as Chicago.

The people who live in this city near the mouth of the Silver River are termed locally *Puerteños*, or "Keepers of the Gate," while those outside the glittering capital, on the vast almost treeless pampa stretching away to the foothills of the Andes, are dubbed *Campoñeros*, of El Campo (the country), or "The Camp."

Buenos Aires is the gorgeous outer



STARTING ACROSS THE ANDES IN THE DAYS BEFORE THE RAILROAD Photo from Harriet Chalmers Adams

The curious leggings are sheepskins wrapped around the foot with the wool next the skin (see page 405)

THE COWBOYS OF THE PAMPA

garment, but the heart of Argentina lies beyond the merry throngs, far beyond the fashionable suburbs of Belgrano and Florista, out on the boundless pampa, through which we will journey by rail.

"The International Express" leaves Buenos Aires in the morning, so we have a day's view of the country stretching southward from the railway before the foothills are reached. The longest straight stretch of track in the world (175 miles) lies between Vedia and Mackenna, on this line.

ARGENTINA EXPORTS MORE FOODSTUFFS THAN THE UNITED STATES

The development of Argentina has been nothing short of marvelous. The Republic is one of the few countries in the world today with advancing trade values. In 1909 there was a yearly gain of $61,000,000 in foreign commerce, and the exports exceeded the imports by more than $94,000,000. The wool and frozen-meat industries have developed rapidly, and when it comes to grains the figures are simply amazing. Two and one-half million tons of wheat and over two million tons of corn went out of the country last year to feed the hungry people of the world. The United States of North America now plays second fiddle to a southern sister in the exportation of foodstuffs. Argentina leads the world in the exportation of grains.

Many of the ranches, or "estancias," in "The Camp" are owned by Britishers. The men who do the work, however, the cowboys of the Pampa, are the *Gauchos*, who are, as a rule, native born. Inferior physically to our cowboys of the West, these men are far more picturesque in costume. They are especially fond of ornamentation—fringed leather and silver trappings, tight boots with silver stirrups, and their saddles are bedecked in a similar fashion. With the encroachment of the railroads and modern civilization, the *Gaucho* is losing much of the old-time charm so long associated with his name, but, with his wild life and his combats, his songs and his dances, he still plays the star rôle in "The Camp."

On our journey across the country we see many of these unique ranchmen at the railway stations. At Rufino, half way to Villa Mercedes, the low-lying land is covered with water, and myriads of ducks, gulls, and other water fowl

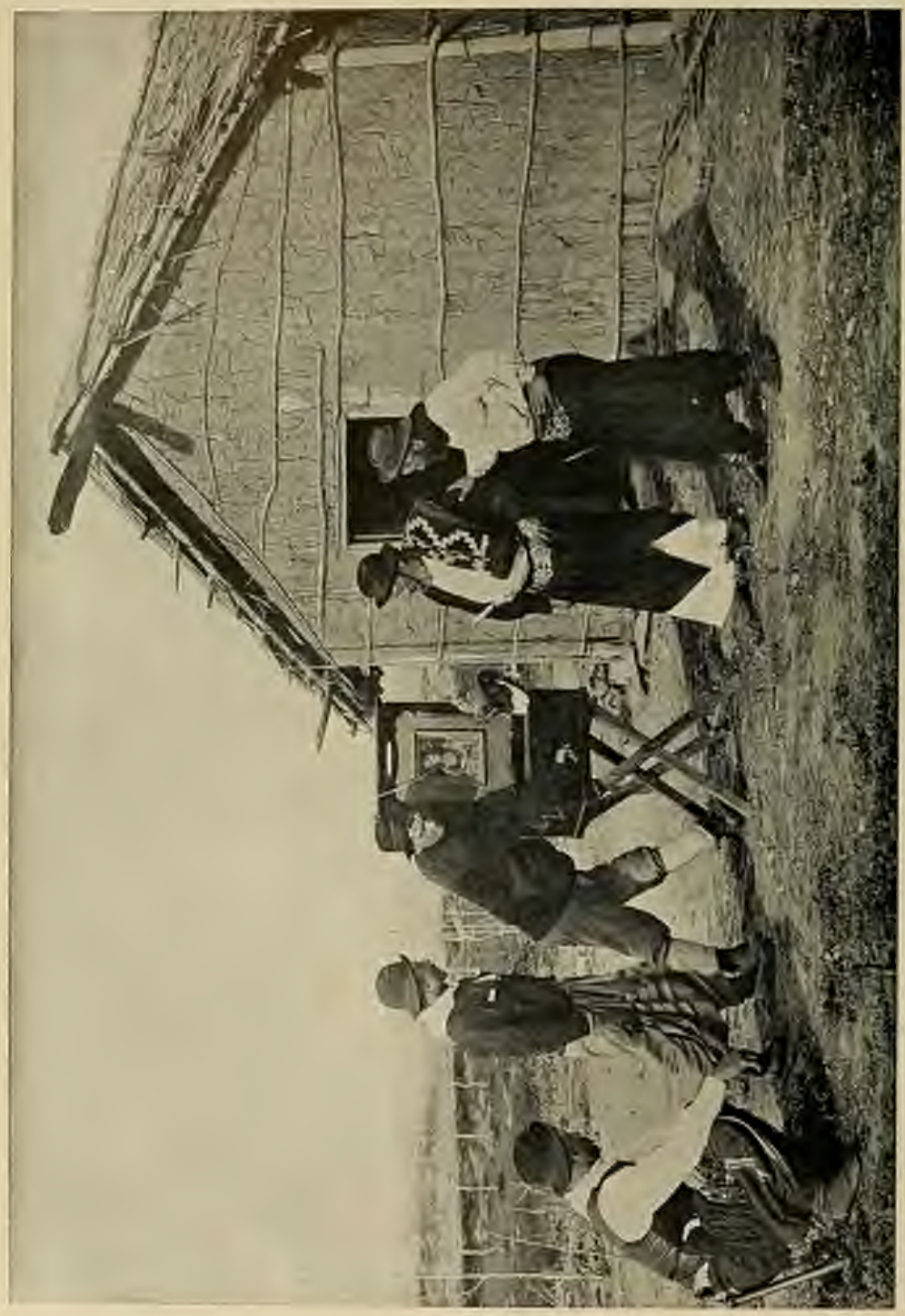


Photo from Harriet Chalmers Adams

CAMP MUSICIAN ON THE PAMPA

Photo from Harriet Chalmers Adams

TYPES OF THE HIGHLANDS: BORDER OF ARGENTINA AND CHILE

darken the ponds as far as the eye can reach.

After leaving Villa Mercedes we are on "The Argentine and Great Western" until we reach Mendoza, where we change to the narrow gauge of "The Argentine Transandine." If we have anticipated any discomfort, thus far we are agreeably disappointed. We have journeyed in a comfortable "sleeper" and have voted the "diner" excellent.

Mendoza is a hustling little town in the heart of the wine industry. Many Italians come here annually from the mother country to work in the vineyards, returning to Europe when the season is over.

In the past much Chilian wine has found its way across the border, but this export is decreasing with the remarkable development of the wine industry in the Argentine province of Mendoza. The export from Argentina into Chile is mainly that of cattle. Many of the staple commercial products of the two republics are now identical, and it is feared that the producers on either frontier will clamor for protection against one another, now that there is an easier method of transportation. Argentina's important exports of grains, hides, and beef, and Chile's nitrates and copper will be sent abroad by sea as heretofore, but the manufactured goods imported into these countries from Europe and America will probably cross the continent by rail.

THE CHRIST OF THE ANDES

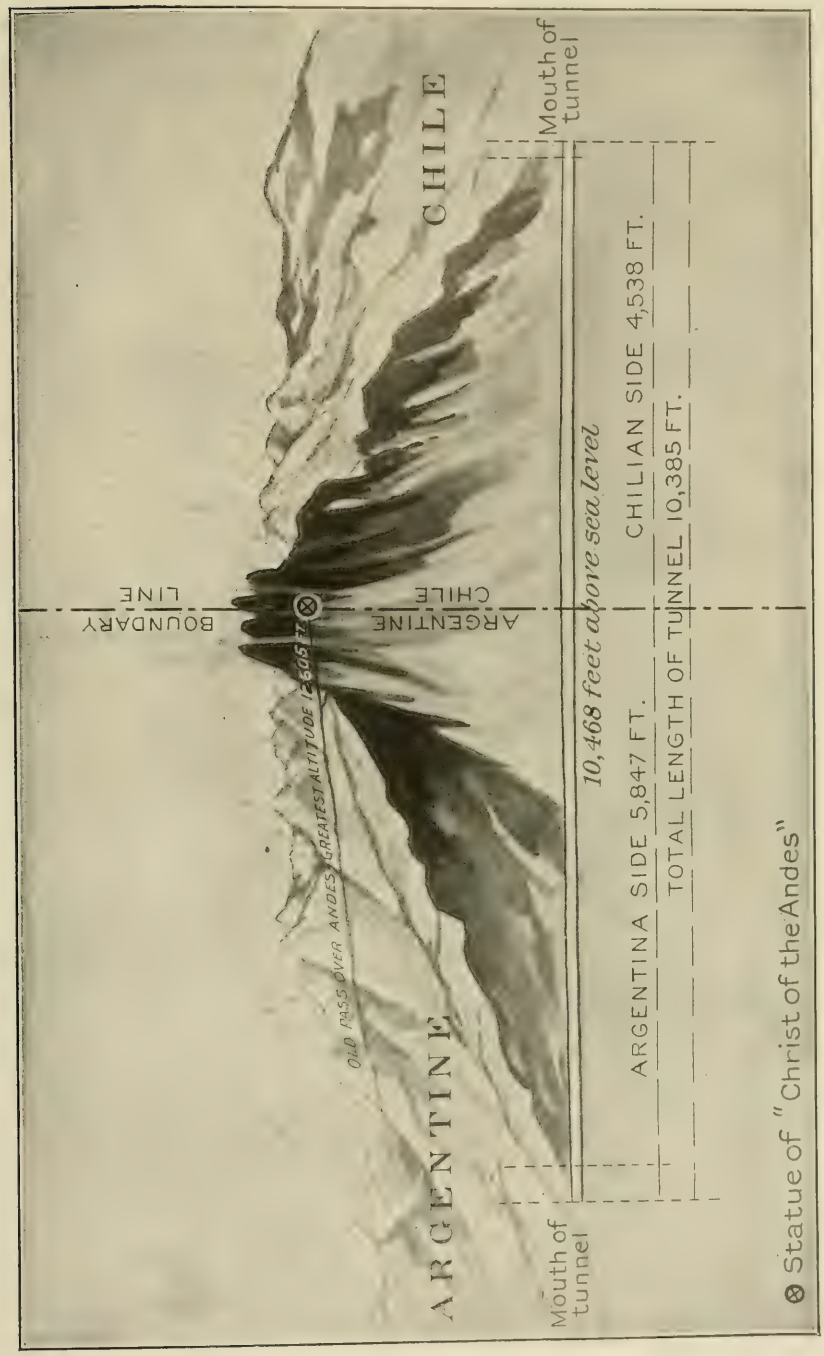
Leaving Mendoza, we begin to climb, and the temperature falls as the altitude increases. At Puente-del-Inca there is a natural bridge spanning the mountain torrent. Here are situated the famous medicinal baths (more accessible to Chilian invalids since the opening of the Summit tunnel). Arriving at Las Cuevas, we leave the train, an army of beponchoed guides and sturdy mules awaiting us. We and our heterogeneous belongings are to be borne by the patient little beasts up over the Cumbre, 12,605 feet above sea-level. Great trunks and hat-boxes bearing flaring European labels, golf clubs, tennis rackets, bags, and boxes of all sorts and descriptions are loaded on panier-wise, and off we all jog on a trot for Chile.

A good-natured crowd of passengers usually, these who cross the Andes, making light of cold and of unaccustomed mounts. It is a different story in the Andean passes farther north, where the occasional wayfarer endures extreme hardships. The Pass of Uspallata has been a highway for so many years that its rugged walls no longer look formidable to the summer traveler.

Less than an hour after leaving Las Cuevas we reach the summit and pause to marvel at the panorama. The guides, meanwhile, arrange saddles and tighten girths for our slide down the Chilian wall. Snow-crowned mountains rise on every side, salient rocky peaks here and there piercing the blue. Dominating the heights, yet ruling through the power of love rather than of might, "The Christ of the Andes" stands on the summit, on the borderland of the two republics.

Cast from the cannon of the two nations, this symbol of peace and fraternity was erected at the time of the border dispute, when the King of England acted as arbitrator. On a gigantic column, surmounted by a globe on which the configuration of the earth is outlined, this colossal figure, 26 feet in height, stands holding a cross in one hand, extending a blessing with the other.

The conception of such a monument came from the hearts of two natives of Argentina, Bishop Benavente and Señora de Costa. It was the splendid woman, Señora de Costa, who, as president of the Christian Mothers' Association of Buenos Aires, undertook the work of securing funds for the creation of the statue. The Argentine and Chilian authorities were later interested in the work and, in March, 1904, three thousand Argentinos and Chilians assembled to witness the unveiling of the monument. The venerable Bishop Benavente himself offered up a solemn mass and blessed the peace flag, which embodies the colors of all the flags of the Americas.



Courtesy of Bulletin of Bureau of American Republics

PROFILE OF THE TRANSANDINE TUNNEL BETWEEN CHILE AND THE ARGENTINE REPUBLIC

STONE REFUGE-HOUSE IN THE ANDES

Photo from Harriet Chalmers Adams

Houses of this character have been built at short intervals along the dangerous parts of the highways over the Uspallata and other frequented passes of the Chile-Argentine Andean Range, the first one having been erected in 1791 by Governor Ambrosio O'Higgins. Violent storms sometimes overtake travelers crossing the mountains and refuge is afforded in these houses until the

Photo from Harriet Chalmers Adams

IN THE ANDES OF CHILE

Photo from Harriet Chalmers Adams

"THE CHRIST OF THE ANDES," ON THE SUMMIT OF THE CORDILLERA BETWEEN CHILE AND ARGENTINA

(SEE PAGE 410)

The motto on this banner proclaims "Peace to all nations," while the statue's base bears in Spanish the following legend: "Sooner shall these mountains crumble into dust than the people of Argentina and Chile break the peace which they have sworn to maintain at the feet of Christ the Redeemer." Long may this symbol of everlasting love guard and guide the two great sister republics of the far south!

ON THE CHILIAN SIDE

It is not an exaggeration to say that we slide down to Caracoles, in Chile. The sure-footed little mules following in the rear resemble alighting aeroplanes, their loads projecting like wings. It is a half hour's jog to the little railway station of Caracoles, and we are off for Los Andes. Down steep grade, through tunnels cut out of solid rock, across many a bridge, we fly; down from the forbidding heights into the zone of farms and on to the lovely, verdant valley, where the pretty town of Los Andes nestles in the shadow of Aconcagua, the highest mountain in the Western Hemisphere.

The mountains which guard the Pass of Uspallata are merely little brothers of the giant Aconcagua, which towers 23,300 feet above sea-level. Those who have attained its summit tell of the incomparable view; of the sheer drop of 10,000 feet to the east; of the vast expanse of snow-clad mountains to the north and south; of the declining peaks to the west, diminishing into the green Chilian lowlands, which melt into the far-away sea.

At Los Andes we again change cars for the capital. Santiago de Chile rivals in situation every capital in the New World, with the exception of Rio de Janeiro. The emerald of its surrounding meadows is in sharp contrast to the towering mountains in the background. After sunset Santiago seems of heaven rather than of earth. Then the *Cordillera de los Andes* gleams flame and gold ere a mantle of purple plush envelops the valley. Less dazzling than Buenos Aires, less practical than Valparaiso, Santiago de Chile possesses a dignity foreign to these others, with more of the Old World charm.

Valparaiso we reach by express in a few hours. It is a half Chilian, half Anglo-Saxon city. The British have come to stay in this great South Pacific seaport. The British-Chilian combination, like the American-Chilian, produces a splendid type. Travelers class as the beautiful harbors of the world Rio de Janeiro, San Francisco, Sydney, Naples, Constantinople, and Cork. We add Valparaiso to the list of portal queens.

And so we have crossed the continent in a little over three days. Via the Summit Tunnel we will cross in 34 hours. The Christ of the Andes will always have its pilgrims; the peasants will follow the trail in the footsteps of their fathers; but the traveler will choose the easier route and will forsake the Cumbre and the mule.

OTHER NOTABLE SOUTH AMERICAN RAILWAYS

In writing of the Transandine, the other important railroads of South America come into view. In Peru are the two highest railways on earth, the Oroya and the Southern Railway. On the Oroya it is possible to climb over 15,000 feet in a single day from the Pacific Ocean to the roof of the Western world. These two roads are a monument to the late Henry Meiggs, a North American engineer. In Northern Peru projected lines cross the Andes and drop down into the Amazonian Valley. In northern Chile railways also ascend to the highlands, and a line nearing completion will connect the Chilian port of Antofagasta and Bolivia's picturesque capital, La Paz, with the northern towns of Argentina.

In Brazil the railways are striking westward from the coast, aiming for Matto Grosso, the rich inland province of the mighty republic. The far-famed interior Madeira-Marmoré road is progressing rapidly. Quaint Quinto is now reached by rail from its port, and Bogatá is connected with its river highway, the Magdalena. Lesser lines in existence

Photo from E. N. Carpenter

CHILIAN SOLDIERS GREETING THE FIRST TRAIN FROM ARGENTINA ON THE TRANSANDINE RAILWAY

and in projection throughout the continent add their note to the "Song of the Ties," and we shall live to see more than one other Transandine railway, although the completed Pan-American road belongs to the far-distant future.

This first transcontinental railway of South America marks a new era in the continent's commercial history, and in our own. With the opening of the Panama Canal we North Americans will have a golden opportunity to win from Germany and England the trade which is ours by the right of contiguity. Through gross lack of understanding of our Southern neighbors, we have lagged behind in the commercial race. European nations have intelligently developed trade with Latin America, but it is only in recent years that we have followed in their wake.

The Transandine Railway sounds the bugle call, not alone of Argentine and Chilian development, but of the growth and prosperity of the entire continent. We owe better acquaintance to our Latin sisters. We owe commercial advancement to ourselves. Ships should carry our flag into Southern waters. We should take first rank in the near future in South American trade.

THE FIRST TRANSANDINE TRAIN

A MEMBER of the National Geographic Society, Mr E. N. Carpenter, of Wilkes Barre, Pennsylvania, who happened to be in Chile in April, participated in the formal opening of the Transandine Railway, April 5. From his letter to the Society the following is printed:

"The special train left Santiago, Chile, Monday, April 4, with about 150 guests, including cabinet ministers, senators, deputies, and government officials. We were comfortably quartered that night in the railroad hotel at Los Andes, from which point the railroad is one-meter gauge to Las Cuevas, on the Argentine side. The altitude of Los Andes is 824 meters and that of the tunnel, 43 miles distant, 3,200 meters. The rack railroad begins at Rio Blanco, on the Chilian side, and climbs 6,000 feet in the 26 miles to the tunnel.

"Our train left Los Andes in two sections early Tuesday morning, April 5, and, after several brief stops, finally reached Carracoles, at the mouth of the tunnel, where it was made up in one section. We then proceeded into the tunnel, where, at the international boundary, which was marked by a string of colored incandescent lights, we met the train carrying the Argentine delegation from Buenos Aires. Greetings over, both trains returned to Carracoles, where we were received by a body of Chilian infantry, while the band played the national airs of Chile and Argentina. A large tent had been erected in which "almuerzo" was served, followed by speeches by prominent representatives of both countries.

"This over, the Chilian train escorted the Argentine delegation through the tunnel to Las Cuevas, and, after farewells were said, both parties started on their homeward journey, we reaching Santiago late the same night."

FEDERAL FISH FARMING; OR, PLANTING FISH BY THE BILLION

By Hugh M. Smith

U. S. Deputy Commissioner of Fisheries

It was nearly forty years ago that the United States Government first awoke to the necessity of conserving the aquatic resources of the country, and began those operations in behalf of fishes, fishermen, and fish-eaters that have now attained such gigantic proportions.

Several of the States had already established their local fish commissions or boards when in 1871 Congress took the initial step toward a national fishery service by the passage of a joint resolution creating the office of commissioner of fish and fisheries.

The early years of the Bureau of Fisheries were devoted to an investigation of the condition of the fisheries of the Atlantic coast, Great Lakes, and other sections; to studies of the interior and coastal waters and their inhabitants, and to exploration of the off-shore fishing banks. The cultivation of useful fishes was soon taken up throughout the country, and quickly attained large proportions. The natural expansion of the work was materially augmented from time to time by acts of Congress, and in a comparatively short time the operations came to have a very wide scope.

From year to year, as the importance of the work has become increasingly evident, additional hatcheries have been built, the capacity of existing hatcheries has been enlarged, the scale of the operations has been extended, and new kinds of fishes have been added to the output.

Today there is scarcely a phase of aquiculture, of the fishing industry, or of biological and physical science as connected with the waters, that does not come within the purview of the bureau.

CULTIVATION OF FOOD-FISHES

It is conceived to be the better policy to expend a small amount of public money in making fish so abundant that they can be caught without restriction and serve as cheap food for the people at large, rather than to expend a much larger sum in preventing the people from catching the few fish that still remain after generations of improvidence.

Public or government fish-culture in America exceeds in extent and importance that of all other countries combined. However, the neglect of some of the states to provide the minimum protection to certain species inhabiting interstate and international waters has not only negatived the fish-cultural work of the bureau and of the states themselves, but has practically inhibited it by preventing the possibility of securing an adequate supply of eggs, thus making desirable and necessary the placing of interstate and international waters under the jurisdiction of the general government.

At the end of the first ten years of the bureau's existence, the fishes that were being regularly cultivated were shad, carp, chinook salmon, Atlantic salmon, land-locked salmon, rainbow trout, brook trout, and whitefish, in addition to which the propagation of several others had been undertaken experimentally. The list now is six times as long and the annual output is ten times the aggregate for the ten-year period ending in 1881.

The main energies are devoted to the important commercial fishes—shad, whitefish, lake trout, Pacific salmons, white perch, yellow perch, cod, flatfish—and the lobster, which are hatched in lots of many millions annually. More widely popular, however, are the distributions of the fishes of the interior waters which are generally classed as game fishes. Although representing only about 10 per cent of the output of the hatcheries, this feature of the work is very important,

HATCHERY CREW MAKING A PLANT OF SHAD FRY ON A NORTH CAROLINA SOUND

Shad culture in North Carolina is now more successful than in any other State, owing chiefly to the support given the government by the State authorities (see pages 429 and 435)

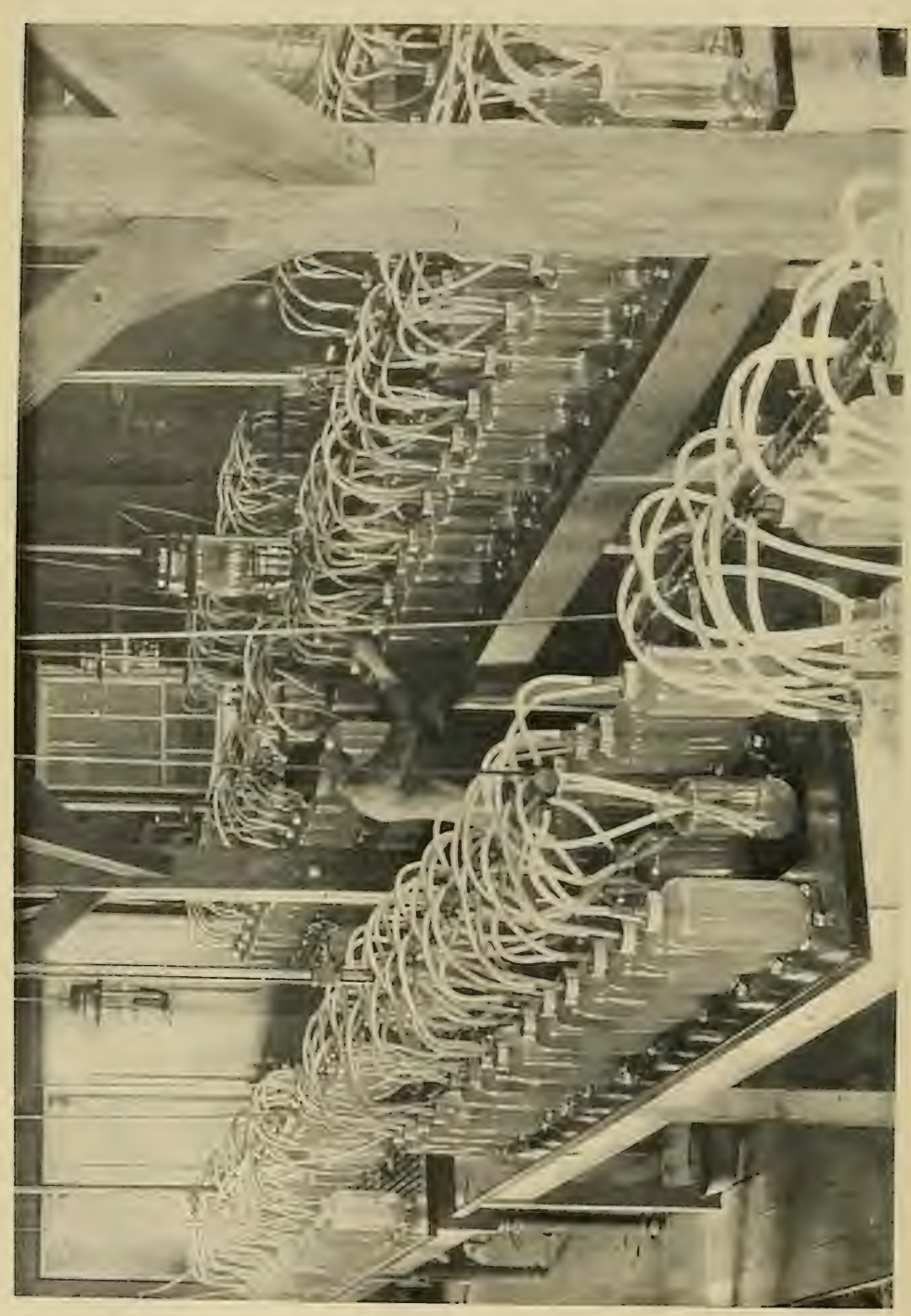
for it supplies choice kinds of fish for public rivers, lakes, and ponds, and for fishing preserves and private ponds and streams in all parts of the United States. The fishes most in demand for these purposes are the land-locked salmon, the different species of trout, the grayling, the basses, the crappies, the sunfishes, and the catfishes, but various others also are handled.

NATIONAL FISH NURSERIES

Fish-cultural stations are established by special act of Congress, and their location and construction are determined after a careful survey of the available sites in a given state. The usual buildings are the hatchery proper, a residence for the superintendent and his family, and necessary outbuildings. At some stations there may be also power house, foreman's or fish-culturist's dwelling, mess hall, and stable. The superintendent's and other quarters are furnished gratis, but station employees provide their own subsistence.

The only permanent marine hatcheries are in Maine and Massachusetts, where the cod, pollock, flatfish, and lobsters are hatched in immense numbers. Other sea fishes that have in previous years been artificially propagated and may again come under the hand of the fish-culturist are the haddock, the scuppaug, the sheepshead, the sea bass, the mackerel, and the squeteague, some of which were hatched on the steamer *Fish Hawk* in Chesapeake Bay and Florida.

The fish-cultural work on the eastern coast streams was centered at 6 hatcheries and subhatcheries in 1909. At 1 of these the principal species handled is the Atlantic salmon, at 4 the shad, at 3 the yellow perch, at 2 the white perch, and at 1 the striped bass. In recent years the bureau has operated a shad hatchery on the



INTERIOR OF A SHAD HATCHERY IN THE CHESAPEAKE BASIN

The semibuoyant eggs of the shad are incubated in glass jars, from 85,000 to 100,000 eggs being put in each jar. The shad fry emerge in 3 to 10 days and are soon planted (see pages 429 and 435)

Delaware River, and has detailed the steamer *Fish Hawk* for shad hatching in Maine, New Jersey, North Carolina, and Florida. The central station, in Washington, is operated largely for experimental and exhibition purposes.

In order to counteract the effects of the very exhausting fisheries of the Great Lakes, the government has maintained hatcheries for many years, and now operates 6 belonging to the United States and 2 belonging to the State of Michigan. The fishes to which attention is given are those which enter most largely into the catch of the fishermen, namely, the whitefish, cisco, lake trout, and pike perch, the annual output of which now exceeds one and a half billions. Under arrangement with the Canadian authorities, two egg-collecting stations for whitefish, cisco, and lake trout are maintained at points in Ontario.

The hatcheries on the rivers and lakes of the Pacific coast are devoted almost exclusively to the various salmons. In California, where the bureau established a salmon hatchery as early as 1872, there is one central or main station, at Baird, on the McCloud River, with important collecting stations on two other tributaries of the Sacramento. In Oregon a central hatchery at Oregon City, on the Willamette River, has 3 subhatcheries on tributaries of the Columbia, in Oregon and Washington, and 3 subhatcheries on tributaries of the Rogue River, Oregon, in addition to several egg-collecting stations.

The interests of the large salmon fisheries of the Puget Sound region are safeguarded by a hatchery on Baker Lake, on the Skagit River, Washington, and will soon be further aided by several other nurseries for which Congress has made provision. The two latest additions to the western salmon hatcheries are at Yes Bay and Afognak, in Alaska, at which points immense numbers of blueback or sockeye salmon are now being put forth.

SHAD AND STRIPED BASS IN PACIFIC

A significant feature of artificial propagation on the Pacific seaboard is that in the Columbia basin the hatching of the acclimatized shad has begun on a small scale, and in the Sacramento basin the cultivation of the acclimatized striped bass has commenced under conditions which indicate that more eggs of this species may be obtained in California than in any of the States to which the fish is native.

The hatcheries in the interior regions constitute the most numerous class, and their output reaches the largest number of people. Their operations are addressed chiefly to the so-called "game" fishes, which, while caught mostly by anglers, nevertheless constitute an important element of the food supply. At these stations large numbers of fish are reared to the fingerling or yearling sizes before being released; for this purpose more or less extensive pond areas are required.

A peculiar kind of station which is included in this general class is that devoted to the collection of fishes of various kinds obtained from the overflows in the upper Mississippi Valley. In the lowlands along the streams in this region the spring floods receding leave disconnected sloughs and pools, which either become dry during the summer or, if they remain until the winter, freeze solid, and the immense numbers of bass, crappy, and other desirable-species therein are lost in the ordinary course of events. By seining these waters the bureau obtains large numbers of fish that would otherwise perish, returning some of them to their native streams and distributing others to adjacent waters.

ENORMOUS OUTPUT OF THE HATCHERIES

The fish-cultural work of the federal government has now attained a magnitude that cannot readily be comprehended, and is increasing at an exceedingly rapid rate. Especially marked has been the increase in the hatchery product during the past ten years, owing in part to the establishment of new stations, in part to the extension of operations at existing stations, and in part to greater efficiency of methods and appliances. The work during the fiscal year 1909 reached larger proportions than ever before, over three

TESTING A LAND-LOCKED OR SEBAGO SALMON AT GRAND LAKE STREAM, MAINE, TO DETERMINE WHETHER ITS EGGS ARE RIPE

billion fish being produced and planted, as shown in the table:

Summary of Output, 1909

Species	Number
Salmons	164,648,170
Trouts	75,839,430
Whitefishes	419,665,000
Shad	57,378,000
Fresh-water basses	1,599,195
Pike perch	644,900,000
Yellow perch	223,661,285
White Perch	343,262,650
Cods	184,426,000
Flatfish	786,626,000
Other fishes	40,617,180
Lobster	164,509,000
Total	3,107,131,910

During the fiscal year 1910 another record will be made, and the output will exceed that of the previous year by several hundred million. A very significant point in connection with these figures is that had the government not engaged in this work about 95 per cent of the food-fish shown would never have existed at all, because they would have been sent to market in the form of eggs.

While the bureau does not lay undue stress on mere numbers and considers the vitality of the fish and the conditions under which they are planted as of paramount importance, the foregoing figures

are certainly very suggestive; and as a further statement of the magnitude of the fish-cultural work it may be of interest to record that the aggregate output of the hatcheries from 1872 to 1909 was about 28 billion, of which over 13 billion represents the work of the past six years.

HOW THE FISH ARE DISTRIBUTED

The first consideration in the distribution of fishes is to make ample return to the waters from which eggs or fish have been collected. The remainder of the product is consigned to suitable public or private waters.

All applications for fish for private waters and many of those for public streams and lakes are transmitted through and receive the indorsement of a United States Senator or Representative. The demand, especially for the basses, crappies, and catfishes, is greater than can be met with present resources.

The supply of particular fishes available for distribution, and consequently the number allotted to individual applicants or deposited in public waters, depends on differences in the methods of taking and hatching the eggs, on peculiarities of the young, and on the facilities for holding the latter at the stations. The area and character of the water to be stocked must likewise be considered.

The water area that would receive a million pike-perch fry would perhaps be assigned no more than 200 or 300 black bass 3 or 4 inches long, or four to eight times that many if the bass were planted as fry. The explanation is in the fact that pike perch can be propagated by the hundred million, while black bass, hatched by other methods or collected from overflowed lands, can be produced only in comparatively small numbers. The bureau does not attempt to assign any applicant more than a liberal brood stock of the basses or sunfishes. With brook trout, which are distributed both as fry and fingerlings, allotments of fry are many times larger than allotments of fingerlings 3 to 4 inches long.

Fishes are distributed at various stages of development, according to the species, the numbers in the hatcheries, and the facilities for rearing. The commercial fishes, hatched in lots of many millions, are necessarily planted as fry. It is customary to distribute them just before the umbilical sac is completely absorbed.

Atlantic salmon, land-locked salmon, and various species of trout, in such numbers as the hatchery facilities permit, are reared to fingerlings from 1 to 6 inches in length; the remainder are distributed as fry.

The basses and sunfishes are distributed from the fish-cultural stations and ponds from some three weeks after they are hatched until they are several months of age. When the last lots are shipped the basses usually range from 4 to 6 inches and the sunfishes from 2 to 4 inches in length. The numerous fishes collected in overflowed lands—basses, crappies, sunfishes, catfishes, yellow perch, and others—are 2 to 6 inches in length when taken and distributed.

Eggs are distributed only to State hatcheries or to applicants who have facilities.

SPECIAL CARS FOR THE FISH

Fish are delivered to applicants free of charge at the railroad station nearest the point of deposit, and for this purpose is maintained a special car and messenger service, which is one of the most important adjuncts of the fish-cultural work. In the early days baggage cars were employed, but these have now been supplanted by an equipment which not only affords more comfort to fish and attendants, but makes it possible to transport the fish much greater distances and with smaller percentage of loss.

The cars, of which there are now six, are of standard size and are attached to regular express and local passenger trains. Each car has 20 or more large water tanks along the sides in which to carry fish, compartments holding more than 1,000 gallons of reserve water, a boiler-room, and a plant for pumping both water and air into the fish tanks. There are also an office, kitchen, pantries, refrigerator, and six sleeping berths, with other facilities

TAGGING A PENOBSCOT SALMON

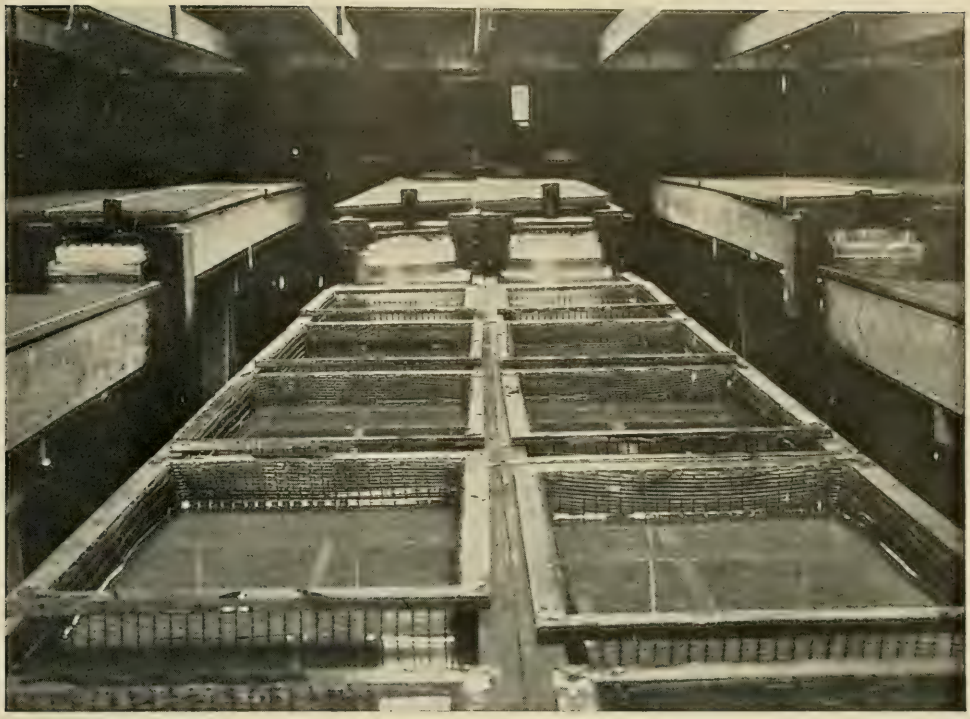
By means of metal tags attached to salmon, which are liberated after their eggs have been obtained, important information regarding the sea life of the New England salmon has been secured when the fish returned to the river to spawn. Similar experiments cannot be made with the Pacific salmon, as the latter fish die after once spawning (see pages 432 and 433).

for the convenience and comfort of the crew of five men (including a cook), who live on the car throughout the year. The government furnishes the cook, fuel, and utensils, but the men provide their own food.

For small shipments of fish and for supplying places off the main railway lines, messengers detached from the cars carry fish in 10-gallon cans in baggage cars. The distributions in 1908 required travel amounting to 83,840 miles by the bureau's 6 cars and 263,196 miles by detached messengers—a total of 347,036 miles—of which 11,826 for cars and 80,816 for messengers were furnished by the railroads free of charge.

POPULARITY OF THE WORK

There are few enterprises undertaken by the United States Government that are more popular, meet with more general and generous support, and have contributed more to the prosperity and hap-



INTERIOR OF A PACIFIC COAST SALMON HATCHERY

The salmon eggs are incubated in wire baskets arranged in double rows in long troughs (see pages 421 and 432)

piness of a larger number of people than its fish-cultural work, an evidence of which fact is afforded by the attitude and action of Congress. The comparatively large budget for the various branches of the bureau's work is voted each year without any opposition whatever and the appropriations are increasing yearly. When special needs arise and their merit is presented to Congress, special appropriations can usually be obtained, and government fish-culture is so popular in the country at large and the demand for new hatcheries is so widespread that an extraordinary number of hatchery bills have been introduced and favorably considered in recent sessions of Congress.

The bureau advocates the building of new hatcheries as one of the best and most remunerative measures that can possibly be undertaken by the federal government, but it rarely has to take the initiative, and on several occasions the establishment of a hatchery has been proposed by Congress before the necessity for it has actually developed.

During each of the recent sessions of Congress, had all the bills providing for new hatcheries become laws, the bureau would have been seriously handicapped in designing and constructing the new buildings and ponds and in supplying competent persons to operate them. In the first session of the Sixtieth Congress there were introduced 101 distinct bills, carrying an aggregate appropriation of $2,142,000 and providing for 74 hatcheries and 4 laboratories in 43 States and Territories.

SCIENCE AND THE FISH SUPPLY

In making his original plans for the systematic investigation of the waters of the United States and the biological and

physical problems they present, Commissioner Baird insisted that to study only the food-fishes would be of little importance, and that useful conclusions must needs rest upon a broad foundation of investigations purely scientific in character. The life history of species of economic value should be understood from beginning to end, but no less requisite is it to know the histories of the animals and plants upon which they feed or upon which their food is nourished; the history of their enemies and friends and the friends and foes of their enemies and friends, as well as the currents, temperatures, and other physical phenomena of the waters in relation to migration, reproduction, and growth.

In pursuance of this policy the bureau has secured the services of many prominent men of science, and much of the progress in the artificial propagation of fishes, in the investigation of fishery problems, and in the extension of knowledge of our aquatic resources has been due to men eminent as zoölogists who have been associated with the work temporarily. Their services have been the services of specialists for particular problems, and through them the bureau has not only been able to give to the public the practical results of applied science, but has contributed to pure science valuable knowledge of all forms of aquatic life.

The small permanent staff of the bureau concerns itself more directly with studies of fishes and their environment, with the conservation of diminishing commercial species, and the development of new or improved methods of increasing the supply. Such lines of work are undertaken as the need appears or as assistance is asked for, and keep the scientific assistants in the field for extended periods each year. Some of the most important work in hand at present concerns aquatic products other than fishes, namely, oysters, fresh-water mussels, sponges, and the diamond-back terrapin, in all of which cases the problem is to find means to offset the results of long-continued overdraft upon the natural supply.

Two seaside laboratories are maintained by the bureau for the prosecution of investigations in pure and applied science. One of these is located at Woods Hole, Massachusetts. It was built in 1883, and is in conjunction with a marine fish hatchery. Here also are extensive wharves, at which the largest vessels may lie, and protected harbors for small craft. A large residence building at this station was for a number of years occupied as the summer headquarters of the bureau, the entire executive and office force being transferred from Washington.

The other laboratory is situated on a small island at Beaufort, North Carolina, and was constructed in 1901. The land for both of these stations was donated by private individuals. In addition to their function in the investigations of the bureau itself, these laboratories are open to the public for study and scientific research. Students and professors in colleges and any other qualified investigators may have the facilities of the laboratories upon request, and these opportunities are largely availed of each year.

CRUISES OF THE ALBATROSS

For the survey of off-shore fishing grounds, the study of pelagic fishes, and the general exploration of the seas, the bureau has had, since 1882, the *Albatross*, a twin-screw iron steamer, rigged as a brigantine, of 1,074 tons displacement, which was specially designed and built for this work and has contributed more to the knowledge of the life and physics of the sea than any other vessel. The complement of officers and men, numbering about 80, is furnished by the navy; there is in addition a small civilian staff, including a resident naturalist and a fishery expert, to whom the practical work of the ship is intrusted.

After spending several years in the investigation of the fishing grounds of the Atlantic coast of North America, the *Albatross* was dispatched to the Pacific Ocean in 1888 and has since confined her operations to those waters. The vessel has made three extended cruises to the

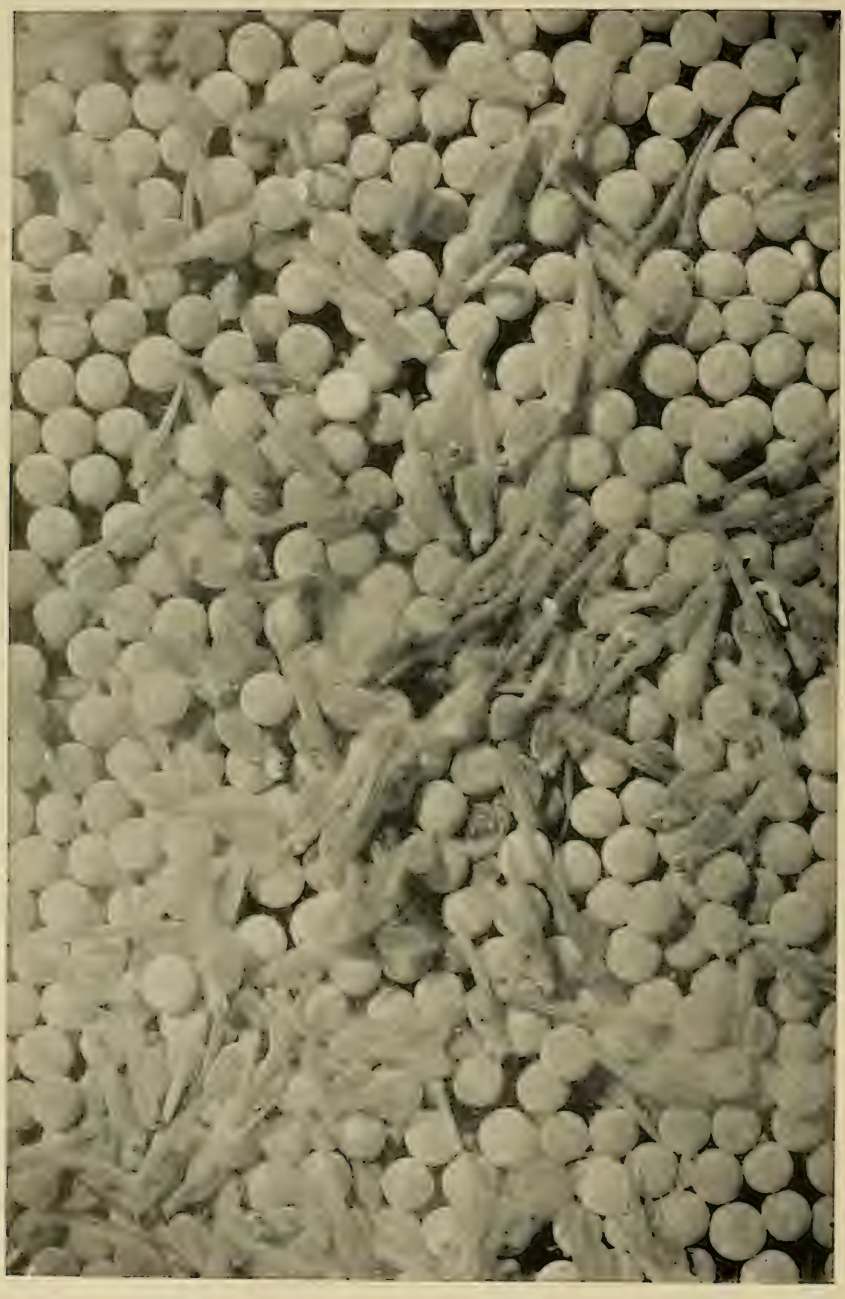
OPEN-AIR TROUGHS FOR REARING SALMON AT A HATCHERY ON THE PENOBSCOT RIVER IN MAINE (SEE PAGES 432 AND 433)

southern and eastern parts of the Pacific, several cruises to the Hawaiian Islands and Japan, and many visits to Alaska, in addition to numerous surveys on the coast of the Pacific States, all having for their object the investigation of the physics and biology of the regions visited, the determination of their aquatic resources, and the study of their fisheries. In 1907 the vessel began a survey of the waters of the Philippine Archipelago and has just completed that work.

The deepest sounding made by the *Albatross*—near the island of Guam—was 4,813 fathoms; the greatest depth at which the vessel found life was 4,173 fathoms; the greatest known ocean depth is 5,269 fathoms, near Guam, ascertained by the U. S. S. *Nero* while using *Albatross* apparatus.

WORK IN BEHALF OF THE COMMERCIAL FISHERIES

The first duty to which the Bureau of Fisheries was assigned, namely, the investigation of the reported decrease of food-fishes in New England, necessarily involved the collection of statistics of production, personnel, and capital. Since that time this branch of the work has been conducted without interruption, and in it have naturally been included the various other subjects affecting the economic and commercial aspects of the fisheries. Among the bureau's functions in this field are (1) a general survey of the commercial fisheries of the country; (2) a study of the fishery grounds with reference to their extent, resources, yield, and condition; (3) a study of the vessels and boats employed in the fisheries with special reference to their improvement; (4) a determination of the utility and effect of the apparatus of capture employed in each fishery; (5) a study of the methods of fishing, for the special purpose of suggesting improvements or of discovering the use of unprofitable or unnecessarily destructive methods; (6) an inquiry into the methods



EGGS AND NEWLY HATCHED FRY OF THE LAKE TROUT: NATURAL SIZE

The lake trout ranges from Maine to Alaska and is the largest and most valuable trout in the world. The fishing is most extensive in Lakes Michigan, Huron, and Superior (see page 432)

of utilizing fishery products, the means and methods of transportation, and the extent and condition of the wholesale trade; (7) a census of the fishing population, their economic and hygienic condition, nativity, and citizenship; (8) a study of international questions affecting the fisheries; (9) the prosecution of inquiries regarding the fishing apparatus and methods of foreign countries.

PROTECTING THE ALASKAN SALMON

The fishing interests of Alaska, representing an investment of $10,000,000 and yielding last year a product valued at more than $11,800,000, have received especial attention from the government ever since the territory was acquired, in 1867. The seal fisheries, at first considered the most valuable sources of revenue, were at once placed under protective legislation. Later there appeared a similar need of regulation of the salmon fisheries, which have now come to support industries many times more valuable than the seal fisheries and standing in large proportion to the total fishing interests of the whole United States.

The Alaska salmon-inspection service has thus grown to be one of the most important branches of government fishery work, and it is one of the few instances where the government has assumed legislative powers over fishing.

The protection of the Alaska salmon fisheries has been a difficult problem. The unheard-of magnitude of the resources invited a corresponding recklessness and improvidence. As the canning industry developed, every device that could be used for wholesale capture of fish was put into operation, and gradually all of the favorite streams of the salmon became so blocked with seines, gill nets, traps, and barricades that but a small proportion of the fish could find passage to the spawning grounds, and the future supply was thus most seriously endangered.

The Alaskan aborigines likewise conducted their fishing in a very destructive way, often placing impassable barriers in streams up which salmon were running, and, through ignorance or indifference, leaving the obstructions in place after the full supply of fish had been secured. It was soon apparent that the laws and regulations were inadequate to meet the special conditions prevailing, and were of such a nature as to make their enforcement very difficult.

In 1903 a special commission was appointed to make exhaustive study of the natural history of the salmons of Alaska and to submit recommendations for an improved regulation of the fisheries. As a result a new code of laws is now in effect and promises to prevent the threatened decline in these enormous industries. With increased restrictions as to fishing methods, obstructions in streams, close seasons, etc., the Department of Commerce and Labor is empowered to set aside any streams as spawning preserves whenever such course shall be desirable, all fishing in such waters to be prohibited. A license tax is required on all salmon products; from the payment of this tax, however, all canning and salting establishments are exempted upon condition of their returning young salmon to the streams in the ratio of 1,000 fry to every 10 cases of salmon canned. Five private hatcheries, representing extensive canning interests, were in operation in 1908 and liberated a total of 150,000,000 young fish.

The seal and salmon fisheries have hitherto overshadowed all other aquatic resources in Alaska, not only in commercial value but in revenue to the government. The rental from the fur-seal islands alone has more than repaid the purchase price of the territory, and the tax derived from the salmon fisheries now amounts to about $100,000 a year. Some long-neglected products are gradually coming into importance, however, and the cod, halibut, and herring fisheries especially have undergone remarkable development in the last few years. Since it became a part of the United States, Alaska has yielded fishery products amounting in value to $170,000,000, of which about $50,000,000 was derived from fur-seals, $96,000,000 from salmon,

and the remaining $24,000,000 from all other aquatic products.

THREE BILLION SHAD HAVE BEEN PLANTED

Much evidence can be adduced to show that the fish-cultural operations of the general government are of direct financial benefit to the country at large. The results in the case of some species have been so striking and so widespread that it would be almost as supererogatory to refer to them as to discuss the utility of agriculture; in the case of other species there can be no doubt of the value of the work, although it may be possible only occasionally to distinguish the effects of human intervention on the fish supply from the effects of natural causes. The outcome of the bureau's efforts to increase the food supply is naturally most evident in the case of small streams, lakes, and ponds, of which thousands have been successfully stocked with the most desirable food and game species.

The leading river fish of the eastern seaboard is the shad. No other anadromous species has been more extensively cultivated and none is now so dependent on artificial measures for its perpetuation. Inasmuch as the principal fisheries are in interstate or coastal waters and the movements of the fish from the high seas to our rivers and back to the high seas place it beyond the claim to ownership which might be urged by the various states were the shad a permanent resident within their jurisdiction, it seemed especially desirable and necessary that this species should be fostered by the general government for the benefit of the entire country. For this reason, and owing to a serious decline that had already set in, the shad was one of the first species whose artificial propagation was taken up by the bureau, and its cultivation is today a leading factor in fishery work, almost every large stream having been the site of hatching operations.

The extent of the work may be gaged when it is stated that nearly 3,000 millions of young shad have been planted by the bureau in coastal streams; and a very significant point is that the eggs from which these fish were hatched were taken from fish that had been caught for market, and hence would have been totally lost if the bureau had not collected them from the fishermen.

EXTINCTION OF SHAD IS THREATENED

The great multiplication of all kinds of fishing appliances on the coast, in the bays, in the estuaries, and along the courses of the rivers resulted in the capture of a very large part of the run each season before the shad reached the spawning grounds, and hence the natural increase was seriously curtailed, and in some streams almost entirely prevented. Yet the shad catch increased, and for many years the fishery prospered in the face of conditions more unfavorable than confront any other fish of our eastern rivers.

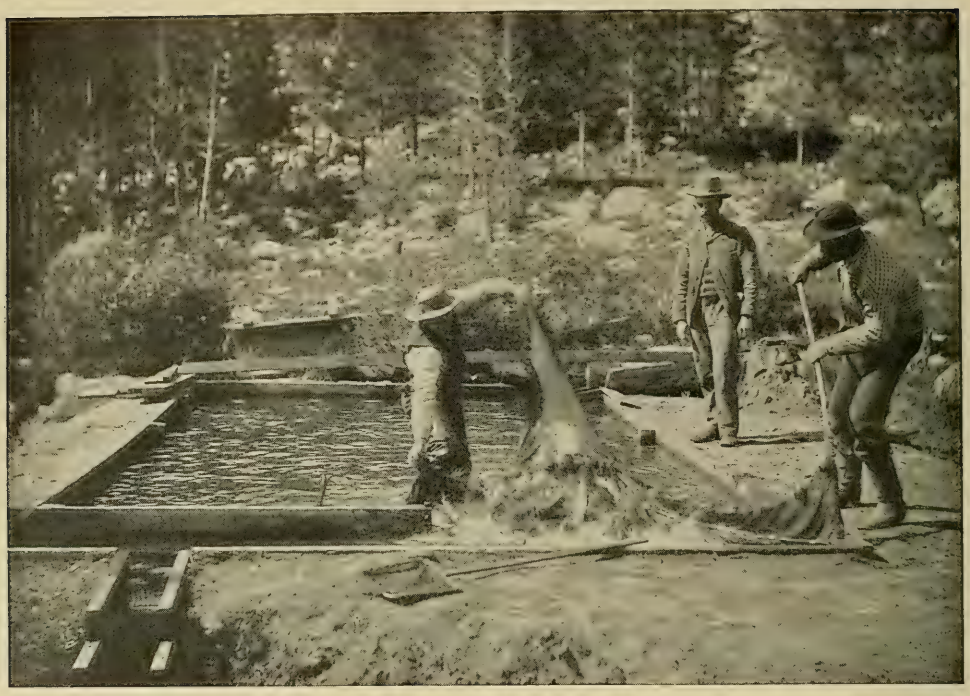
At length, however, the unrestricted fishing became greedy to an overwhelming extent. The mouths of the rivers and the lower waters through which the shad must pass became so choked with nets that fishing gear farther upstream could make but slender hauls; and for several years there has been a steady decline in catch, which threatens to result in the extinction of the fishery. The bureau has continued its efforts in propagation, but these are curtailed by the factor that is also destructive to the fishery.

When they first enter the streams the shad are not ripe and are useless to the hatcheries, and the spawn-takers must therefore wait for the run farther upstream; but with the recent exhaustive fishing in the salt waters so few fish have escaped that the egg collections have diminished to an alarming extent, being reckoned now in millions where formerly they were hundreds of millions.

Under such conditions it is impossible to propagate enough fish to offset the quantities taken, and the shad fishery is fast being deprived of its one support, while the present meager shad catch, together with the enforced curtailment of propagation, speaks even more convinc-

ARTIFICIAL PROPAGATION OF THE WHITEFISH ON THE DETROIT RIVER

Mature fish, destined for the market, are retained in live-cars and regularly overhauled as their eggs are ripening. After being artificially fertilized, the eggs are sent to the hatchery. This work is very extensive and important, and hundreds of million young whitefish are produced on the Great Lakes each year that would be entirely non-existent except for the government's efforts (see pages 422 and 432).



CATCHING AND SORTING THE BROOD-FISH AT A TROUT-CULTURAL STATION IN THE ROCKY MOUNTAINS

ingly of the value of artificial measures than did the preceding increase.

WORK ON THE GREAT LAKES

Evidence is not lacking to show that the long-continued and increasingly extensive fish-cultural operations on the Great Lakes have prevented the depletion of those waters in the face of the most exhausting lake fisheries in the world.

The luscious whitefish, the splendid lake trout, the excellent pike perch, or wall-eyed pike, may be hatched in such numbers as to assure their preservation without serious curtailment of the fisheries. The absence of concerted protective measures, however, on the part of the various states interested has the tendency to minimize the effects of cultivation and would seem to justify, if not imperatively demand, the assumption of jurisdiction by the federal government.

1,700 BUSHELS OF SALMON EGGS DISTRIBUTED IN ONE YEAR

The long continuance of the Penobscot as a salmon stream for many years after all other New England rivers had ceased to carry this fish is directly attributable to the work of the bureau on that stream. So dependent on artificial measures has been the perpetuation of the salmon supply that it is believed the obliteration of the run and the wiping out of a long-established fishery would ensue within five years after the suspension of fish-cultural operations. Physical conditions in the Penobscot have become so unfavorable for the passage of salmon to the spawning grounds that natural reproduction is now almost if not altogether inhibited, and the only noteworthy source of young salmon is the eggs obtained by the bureau from salmon purchased from the fishermen.

The magnitude of the salmon fisheries of the Pacific States has required very

A GOVERNMENT SPAWN-TAKER OVERHAULING THE COD CATCH OF A NEW ENGLAND SCHOONER AND TAKING THE RIPE EGGS (SEE PAGE 435)

extensive artificial measures to keep up the supply. The operations of the bureau, in combination with those of the states, have been gradually extended in both scale and scope until they have now attained a tremendous extent and are addressed to all the species whose cultivation is as yet demanded. The number of Pacific salmon eggs collected by the bureau in 1908 was over 200,000,000, equivalent to 1,700 bushels.

A remarkable fact in the history of the Pacific salmons, of which there are five species, is that without exception all fish which enter any stream on the entire coast die after once spawning, none surviving to return to the sea.

This wise provision of nature to prevent the overstocking of streams has been made foolish by the appearance of man on the scene; he not only catches the salmon in the coast rivers and the lower courses of the rivers will gill nets, seines, and pound nets, in the upper waters with the same appliances supplemented by the fish wheels, and on the spawning grounds with all sorts of contrivances, but in certain sections even carries his foolhardy greed to the extent of barricading the streams so that no fish can reach the waters where their eggs must be deposited.

Natural reproduction, thus so seriously curtailed, is not sufficient to keep up the supply in many of the streams where fishing is most active, for many of the eggs escape fertilization, many more are eaten by the swarms of predaceous fishes that haunt the spawning beds, and many are lost in various other ways during the long hatching period; while the helpless fry and alevins fall a ready prey

FEEDING RAINBOW TROUT IN AN ARTIFICIAL SPAWNING POND AND RACEWAY AT A VIRGINIA STATION

to the same fishes in the upper waters, and the young salmon have to run the long gauntlet of the rivers only to meet new foes in the estuaries, on the coast, and in the open sea.

It is, therefore, no wonder that artificial propagation on a large scale is imperatively demanded in the western salmon streams, and is actively urged and highly commended by fishermen, canners, business men, and the public at large.

The history of the salmon fishery in the Sacramento River, in California, and the recent increase in the catch notwithstanding most unfavorable physical conditions in that stream, afford unmistakable evidence of the value of cultivation.

Some very suggestive, though not altogether conclusive, information relative to the benefits of salmon culture in the Columbia River has been furnished by marking young salmon before releasing them from the hatcheries. The number of marked salmon that returned as mature fish and were captured and reported indicates a very large percentage of survivals and suggests the growing dependence on artificial propagation for the maintenance of the runs.

NEW ENGLAND COD AND LOBSTERS CONSERVED

In the case of marine hatching operations it is so difficult to prove beneficial results that their utility is doubted by some people. When the bureau began

the cultivation of the cod and the lobster many years ago, it proceeded on the principle that the effects of the fishermen's improvidence could be counteracted by artificial propagation. The ultimate success of cod and lobster culture on the Atlantic coast was therefore confidently expected, and the expectations have been more than realized. Practical results of an unmistakable character were first manifested nearly twenty years ago, since which time a very lucrative shore cod fishery has been kept up on grounds that were entirely depleted or that had never contained cod in noteworthy numbers in the memory of the oldest inhabitants.

There is much unsolicited testimony on this point from many people who have profited from the operations of the Maine and Massachusetts stations. The benefits have not been confined to the immediate vicinity of the hatcheries, but have extended westward and southward along the Middle Atlantic coast and eastward along the whole coast of Maine.

The benefits of lobster culture have been slower in appearing, owing, in part at least, to the less extensive operations and the excessive mortality to which the young are liable; but from all parts of the New England coast there are being received reports of more lobsters, particularly of small size, than have been seen for many years, and there is reason to believe that the long-continued decline of the lobster fishery may have been arrested.

PROFITABLE FISH IMPORTED FROM EUROPE

Economic results of great value have come from the transplanting of native aquatic animals into waters in which they are not indigenous and from the introduction of fishes of foreign countries into the United States. The supply of food and game fishes of every section of the country has thus been increased and enriched, fisheries of vast extent have been established, and the pleasures of angling have been greatly enhanced.

As this phase of the work has recently been set forth in detail,* it need not be dwelt on here, and it will be sufficient to note that the acclimatized fishes taken and sold in this country now have a value of fully two million dollars a year. Much more important results, however, are seen in the tremendous quantities of such fish annually caught by anglers and for home consumption, whose money value cannot be reckoned. The aggregate results of acclimatization up to the present time, so far as fish caught and sold are concerned, represent at least twenty million dollars to the fishermen and a fifty-fold return on the government's investment.

By far the most important of the exotic fishes is the German carp, of which in 1908 nearly forty-three million pounds were caught in public waters by professional fishermen, and sold for over a million dollars. These fish were the progeny of carp imported by the bureau many years ago and presented in small lots to farmers and others in all parts of the country for the stocking of private ponds and reservoirs. By the overflowing of these waters or the breaking of dams, streams and lakes have become planted with the carp, which is now the most widely distributed fish in the United States.

HELPING THE SHAD FISHERIES OF NORTH CAROLINA

The long-continued and systematic field and laboratory work of the bureau has resulted in a most thorough knowledge of the distribution, abundance, habits, etc., of the fishes and other creatures of the interior, coastwise, and offshore waters of the United States, Hawaii, and Porto Rico—a knowledge which is indispensable to the government in its fish-cultural work and to the various states and insular authorities in their legislative efforts to preserve their fishery resources. The practical results of this work are apparent in numerous specific instances.

* Our Fish Immigrants: The Acclimatization of Native and Foreign Water Animals in the United States. By Hugh M. Smith. NATIONAL GEOGRAPHIC MAGAZINE, June, 1907.

STRIPPING TROUT OF THEIR EGGS AT A STATION OF THE BUREAU OF FISHERIES IN THE ROCKY MOUNTAINS

(SEE PAGES 418-419)

"It is conceived to be the better policy to expend a small amount of public money in making fish so abundant that they can be caught without restriction and serve as cheap food for the people at large, rather than to expend a much larger sum in preventing the people from catching the few fish that still remain after generations of improvidence."

TRIAL FISHING ON THE "ALBATROSS"

While surveying a new "bank" on the coast of Alaska, this experimental catch of cod and halibut was made in 20 minutes. As a result of explorations of the *Albatross* on the Pacific coast, fisheries of great importance have been established, and the Pacific halibut fishery now surpasses that in the Atlantic (see page 426).

Upon two subjects in particular has the bureau expended much energy and at last achieved results by persistently sounding the note of warning. The utmost efforts in artificial propagation cannot save the shad fishery without the aid of laws to permit a certain number of spawning fish to reach the streams, while on the other hand no practicable protective laws can save the oyster supply without cultural work to keep up the beds. The bureau has no power to do more than hatch fish in the one case, devise methods of culture in the other, and cry out the needs of both, and it lies solely with the states to provide for the needs.

North Carolina rose to the emergency of the shad situation a few years ago and sought the aid of the bureau in determining the actual protection required by the shad, the actual condition of the fishery, and the possible remedies for a rapidly diminishing yield. The bureau's recommendations were asked for by the state legislature, and a commission was appointed to draft salutary laws, which have since gone into effect, confining gear to prescribed areas and leaving clear channels for the passage of the fish.

REMOVING SHAD EGGS AT A STATION IN NORTH CAROLINA

Nearly 3,000 millions of young shad have been planted by the Bureau of Fisheries in coastal streams. All the eggs from which these fish were hatched were taken from fish that had been caught for market, and hence would have been totally lost if the bureau had not collected them from the fishermen (see pages 430 and 435).

Immediate results have been seen at the government hatchery in the Albemarle Sound region. The collection of shad eggs in these waters in five years had dropped from 75 million to 6½ million. The next year, which was the first of enforcement of the new laws, the collection was 25½ million, and in 1908 and 1909 the most successful shad hatchery was in this State, the egg collections exceeding 55 million and 60 million, respectively.

RESCUING THE MARYLAND OYSTER BEDS FROM EXTINCTION

The oyster fishery has had a common history in all of the Southern States, of

SPECIMEN OF ROCK BOTTOM ON WHICH SPONGES GROW, FROM THE SPONGE BEDS OFF ANCLOTE KEY, FLORIDA

This rock bears 13 species of commercial and non-commercial sponges, besides corals, sea-feathers, starfishes, crabs, and other animals characteristic of the fauna of the sponge beds. One-eighth natural size.

which Maryland, once the foremost in oyster production and one of the last to resort to systematic cultural measures, affords the most notable example. The laws controlling the fishery in Chesapeake Bay have been designed to protect the natural beds, but have not encouraged or protected the oyster planter, and the natural beds, thus practically the sole reliance, in time failed to sustain the tremendous draft upon them. Between 1880 and 1897 the product fell 31.6 per cent; in 1904 it was 39 per cent less than in 1897.

The bureau had for many years pointed out the short-sighted policy that was resulting in the steady decline of the oyster industry, and was at length gratified to find that the state had taken heed of the warning and enacted a comprehensive law favoring oyster planting. The work that has now been undertaken by the Maryland Shell Fish Commission to remedy the alarming condition of the oyster grounds will be the most complete and accurate of its kind. It consists of the survey and delimitation, by the aid of the United States Coast and Geodetic Survey and the Bureau of Fisheries, of all natural oyster beds in Maryland waters, to be marked and set aside as public fishing grounds operated under the

SPONGE CUTTINGS VARIOUSLY MOUNTED ON CEMENT DISKS AND READY FOR PLANTING

existing protective laws. All other suitable grounds will then be reserved by the state to be leased to oyster planters, whose enterprise will be encouraged and their rights protected as was not possible heretofore.

OYSTERS IN LOUISIANA AND SPONGES IN FLORIDA

Up to 1898 there were few planted beds of oysters in Louisiana waters. Investigation of the oyster grounds by the bureau in that year, however, led to the passage of beneficial laws and proved a general stimulus to oyster culture in that state, as is shown by the fact that some 20,000 acres of bottom were soon under cultivation. In 1906 the state oyster commission again asked the bureau's assistance, and large areas of utilized bottom were examined to determine their productive capacity. The conditions were found to be exceptionally favorable, and experimental plants produced 3½ to 4 inch oysters in quantities of 1,000 to 2,000 bushels per acre, within two years after the cultch was put down.

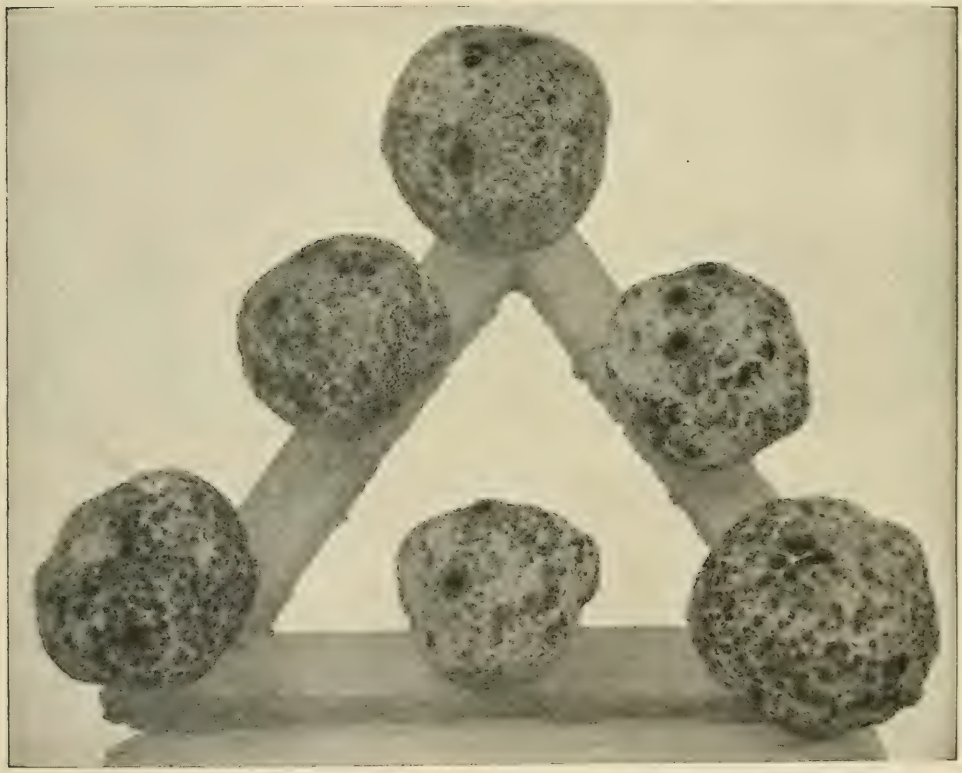
In Barataria Bay, where there had been no oysters whatever, such promising beds were established that several hundred acres of adjacent bottom were immediately leased by prospective planters. Other localities, though they have so far shown no such conspicuous commercial enterprise, may be expected to prove equally productive.

Experiments in sponge culture have been in progress for several years, and have now developed a practical system by which sponges may be produced from cuttings at a cost much less than that entailed in taking them from the natural beds. In view of the more rapid depletion of the natural beds which will undoubtedly result from recent changes in the methods of the fishery, the bureau is convinced that the preservation of the American sponge industry will depend upon cultivation; and as it is estimated that about $1,500,000 worth of sponges were taken in Florida during the past year, the failure of the fishery would be a serious commercial loss to the state.

MUSSELS FOR PEARL BUTTONS

In coöperation with the Rhode Island Fish Commission, the bureau has developed new methods of lobster and soft-shell clam culture which are being applied with success in New England. Experiments with the hard-shell clam are now in progress at Beaufort.

Important work recently undertaken is an effort to establish mussel culture in the Mississippi Valley. The supply of mussels in those waters, on which is based a pearl-button industry valued at about $5,000,000 per annum, with an investment of $6,000,000, is being rapidly exhausted, and the mussel fishermen and manufacturers recognize that without scientific coöperation of the government



SPONGES, PLANTED FROM CUTTINGS AND GROWING ON CEMENT DISKS
(SEE PAGE 440)

SHEEPSWOOL SPONGE, 35 MONTHS OLD

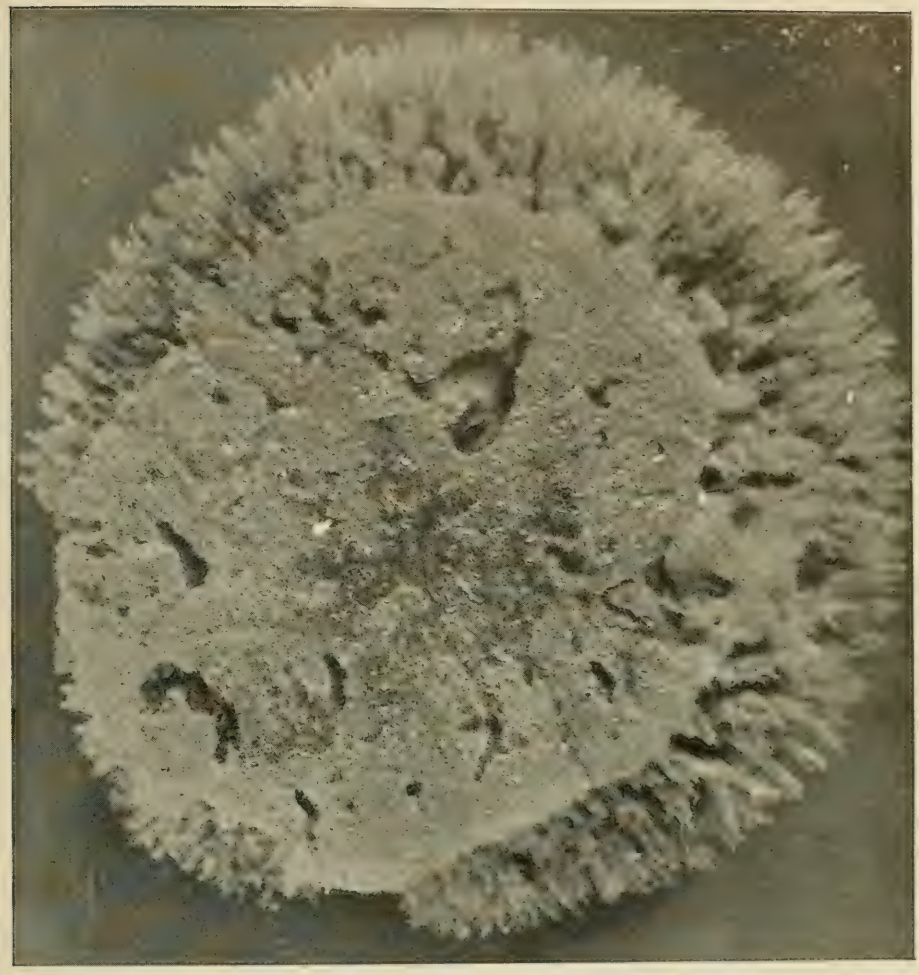
Grown on spindles in Cape Florida Channel from a cutting. Weight, dry and thoroughly cleaned, 1 1/3 ounces. Three-fourths natural size (see page 440)

the business is doomed to early extinction.

The bureau in one season's work has practically, though not conclusively, shown a method by which the pearl mussels can be propagated, and is demonstrating that the work can be carried on at a comparatively small expense in connection with the already established operations in rescuing fishes from the overflowed lands, the fish reclaimed being employed, without injury to themselves, in the dissemination of the larvæ of the mussels.

There have been liberated 25,000 fish, bearing about 25,000,000 young mussels ready to drop and begin their independent existence and already past the stage when they are most subject to fatality.

The work is also capable of application to waters under private control and will probably become a source of respectable revenue to farmers and others whose property embraces streams, ponds, and



THE UNDER SURFACE OF A SHEEPSWOOL SPONGE

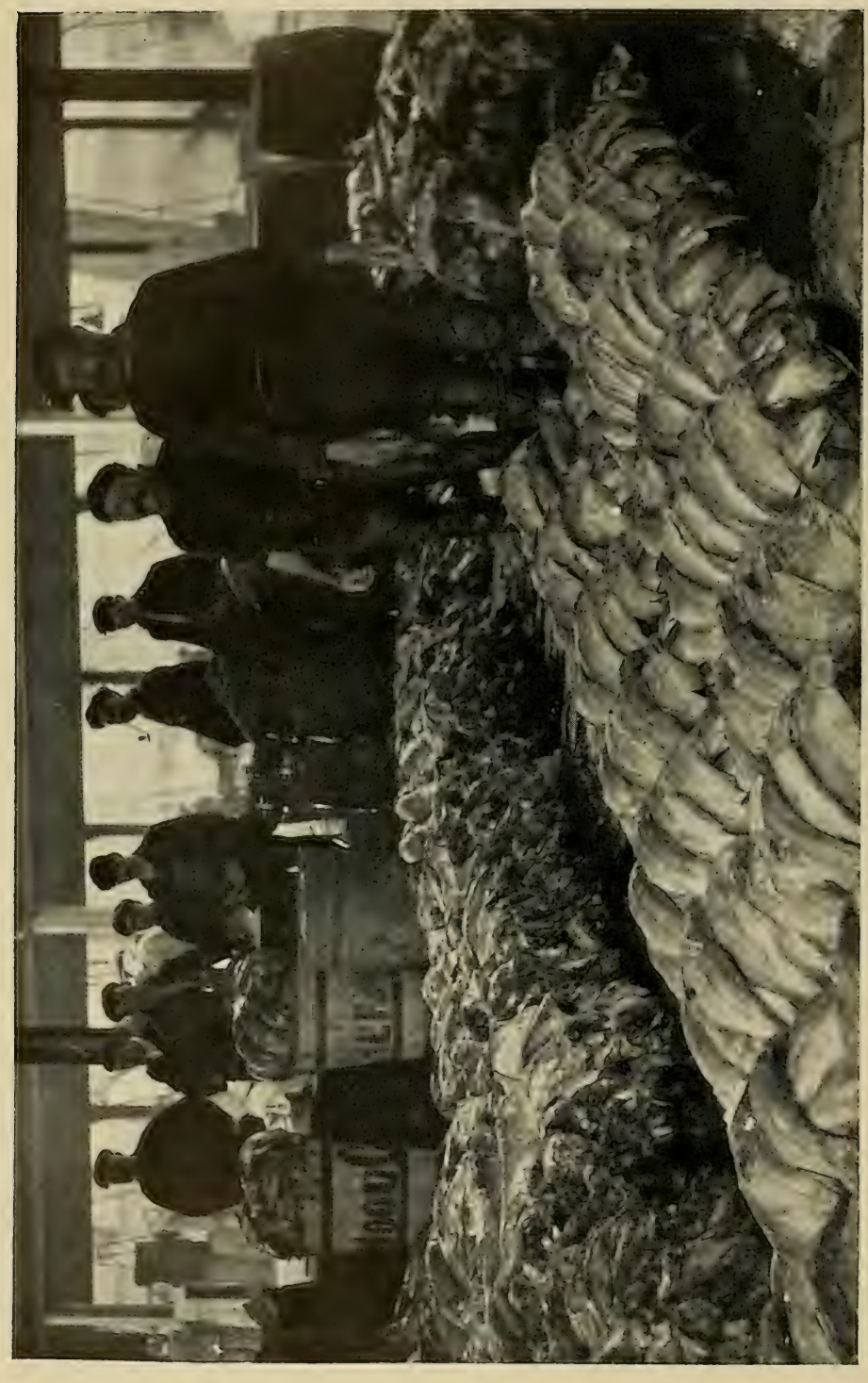
Not over 38 months old; grown on a cement disk at Anclote Key from a cutting. Weight, dry and thoroughly cleaned, 1½ ounces. The root or under surface of natural sponges which grow on rough rock bottoms, as on page 439, and which must be torn from the rock, is raw, like the interior of the sponge, and therefore is the weakest and least durable part of the sponge. The root of cultivated sponges, on the contrary, is the strongest part of the sponge, as contact with the flat cement disk on which the cutting is planted develops a close and soft felt, as shown in this illustration.

lakes. The importance of this work is urgently insisted upon by the National Pearl Button Manufacturers' Association, which embraces practically the entire capital invested in the business.

STUDY OF DISEASES OF THE FISH

In the field of fish diseases great progress has been made in the extension of knowledge of the causes of many of the fatalities which sometimes make a clean sweep of the hatcheries and which heretofore could not be adequately coped with because their etiology was not understood. The services of the scientific staff in this regard have been not only of great benefit to the government, but are highly regarded and frequently availed of by state and private fish-culturists.

Among the direct material aids rendered



A CATCH OF LARGE, FAT HADDOCK IN THE NORTH SEA

By sending its experts to all parts of the world, the government has secured valuable new fish for the country and useful methods for the fishermen. Government fish-culture in America exceeds in extent and importance that of all other countries combined (see pages 429 and 435).

to fish-culture in the past four or five years are the following: (1) Determination of the cause and remedy for the fatal malady known as the "gas disease"; (2) isolation of a bacterial organism producing a fatal disease in trout and discovery of a possible remedy; (3) determination of the cause of a fatal protozoan disease in trout; (4) discovery of a remedy for the diatom disease of lobster eggs and larvæ; (5) studies of the causes for the death of fish in captivity and the determination of a number of cases of responsible peculiarities in the water supply; (6) studies of the character of streams and the effects of various conditions on fishes, which have supplied much information on the subject to the public; (7) determination of the effects on fishes of galvanized iron and other metallic containers used in transportation of fish and fry, and (8) indication of certain undesirable types of vessels for holding fish.

CANCER IN FISHES AND MAN

One of the recent developments in the study of fish pathology has been the discovery of a widely prevalent cancerous affection of the thyroid gland in trout and salmon under domestication. At certain hatcheries the disease attacks a very large percentage of the fish, many of which succumb in a short time.

While it is not believed that fish cancer may be communicated to human beings through the eating of infected fish, the conditions are serious as regards the hatchery work; for, unless the progress of the disease is arrested and preventive measures are discovered, artificial propagation will become inadequate to meet the present growing needs for fish for stocking purposes.

In the opinion of experts, cancer in fishes, while important in itself, is of very great and far-reaching consequence because of its bearing on the cause of cancer in man, and the vast amount of material thus made available for experiment and investigation throughout the country is thought to afford the best possible opportunity for the elucidation of general cancer problems.

President Taft was doubtless prompted by these considerations to send to Congress a special message in which he advocated an appropriation of $50,000 to enable the Bureau of Fisheries to establish a laboratory for the study of cancer in fishes.

NEW FISHERIES AND NEW METHODS DISCOVERED BY THE FEDERAL GOVERNMENT

The importance to the fishing interests of the work of the bureau in connection with the economic fisheries is widely appreciated and freely acknowledged. The statistical inquiries of the bureau afford the only adequate basis for determining the condition and trend of the fisheries and the results of legislation, protection, and cultivation. Among the numerous special matters in which the bureau has benefited the fisheries the following may be mentioned:

By bringing to the attention of American fishermen new methods and new apparatus, new fisheries have sometimes been established and new fields exploited.

By the introduction of cod gill nets the winter cod fishery of New England was revolutionized. In a single season shortly after the use of such nets began a few Cape Ann (Gloucester) fishermen took by this means over 8,000,000 pounds of large-sized fish, and as much as $50,000 has sometimes been saved annually in the single item of bait.

By the dissemination of information regarding new fishing grounds important fisheries have been inaugurated. Thus when the abundance of halibut off the coast of Iceland was made known by the bureau, a fishery was begun which yielded from $70,000 to $100,000 annually to the New England fishermen.

The bureau has experimented with various unused or little-used products in order to determine their economic value and to suggest the best ways of utilizing them. Less than fifteen years ago there was practically no market for the silver hake or whiting (*Merlucius bilinearis*), and immense quantities incidentally taken in pound nets and other apparatus were thrown away. The bureau pointed out

the possibility of preparing a marketable salt whiting, and it is a significant fact that in a few years the sales of this fish in New England have increased from about 100,000 pounds to 5,000,000 pounds.

LOSS OF LIFE FROM STORMS DIMINISHED BY A NEW TYPE OF FISHING VESSEL

Owing to the appalling mortality among the crews of the New England fishing vessels, caused in large part by the foundering of vessels at sea, the bureau many years ago undertook the introduction into the offshore fisheries of a type of craft which would combine large carrying capacity and great speed with enhanced safety. By correspondence, discussion in the daily press, personal interviews, exhibition of models, and finally by the actual construction of a full-sized schooner (the *Grampus*) with the requisite qualities, the bureau was enabled to inaugurate a momentous change in the architecture of fishing vessels; so that for a long time the New England schooners have been constructed on the new lines, with a consequent minimizing of disasters and a decided increase in efficiency.

For other fisheries and regions the bureau has likewise advocated improved types of vessels and boats especially adapted to local conditions, and has published plans and specifications embodying the results of studies of the fishing flotilla of the world.

The results of the bureau's efforts in this line, in saving life and property, in increasing the usefulness of the vessels, and in improving the quality of the catch as landed, cannot be estimated, but the beneficial effects may be partly appreciated when it is stated that during the ten years ending in 1883, when the old types of vessels were in use, there were lost by foundering from the port of Gloucester alone 82 vessels, valued at more than $400,000, with their crews of 895 men, while during the ten years ending in 1907 the losses from this cause aggregated only a fourth as many vessels and men.

OUR COAL LANDS

By Guy Elliott Mitchell

WHAT can the study of fossil shell-fish and ferns have to do with the price of coal? The connection is a closer one than may be supposed, and its explanation shows the intensely practical work of the government geologists in the application of abstruse science to every-day economy.

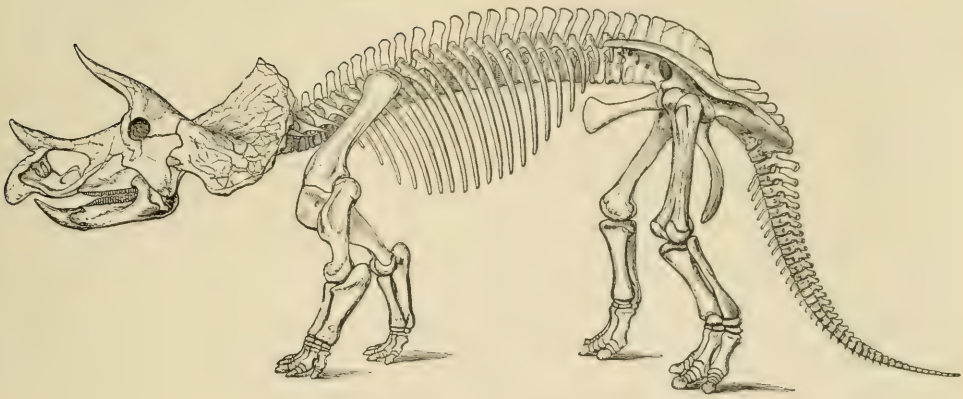
Paleontology is that branch of geology which deals with fossils as they are found in the different rock strata. Their presence easily determines the age of many rock formations which might not otherwise be recognized.

For instance, a certain species of conch may be known to have flourished during the Cretaceous period—too long ago to be estimated in years. During this period vast coal-beds were formed in the western and northwestern part of the United States as a result of the growth of a luxuriant and almost tropical vegetation.

Now here is a most valuable key for the coal geologist. In whatever strata of rocks he finds this fossil conch-shell and its associates he may look for coal of Cretaceous age.

It is due to the previous study of the broad stratigraphic and paleontological problems of the West that Uncle Sam's economic geologists have been able to classify between 35,000,000 and 40,000,000 acres of western coal lands within the short period of 4 years since President Roosevelt withdrew from entry all the government coal lands pending such classification and adequate valuation.

The particular kind of shell shown in the illustration has been of enormous importance in this classification work.



HE POINTS TO COAL

The huge *Triceratops* of the Wyoming Basin, 25 feet long by 10 feet tall, is, where found, a good lead for the coal geologist. His remains, however, are too scarce to be depended upon.

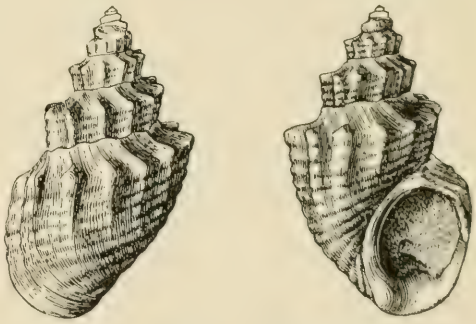
Where the coal geologist finds this conch in a rock formation he knows that no coal beds will be found lower down in the ground. He knows that some coal may be found in the same strata in which the conch lies, but that in the strata immediately above very high-grade coal can be confidently expected. The name of this little helper of Uncle Sam, who was a very abundant resident of the early United States, is *Pyrgulifera humerosa.* He hasn't any American name.

In this coal classification and valuation work, which is the next economic step following the discovery of the coal beds, the geologist comes down out of the realm of high science, with its Pyrguliferas and other things, right into camp with the every-day coal miner and operator. Using the data which the geologists bring in from each field season's work in Wyoming, Montana, Utah, and all the other public coal-land States, the Geological Survey at Washington works out the tonnage on every 40-acre tract of coal land, and, taking into consideration the quality and depth of the coal, places a valuation upon the land.

This valuation ranges all the way from $10 an acre up to several hundred dollars. Some of the land, where the coal seams are very thick, of high-grade coal, or where there are several seams, one over another, has been rated at over $400 an acre.

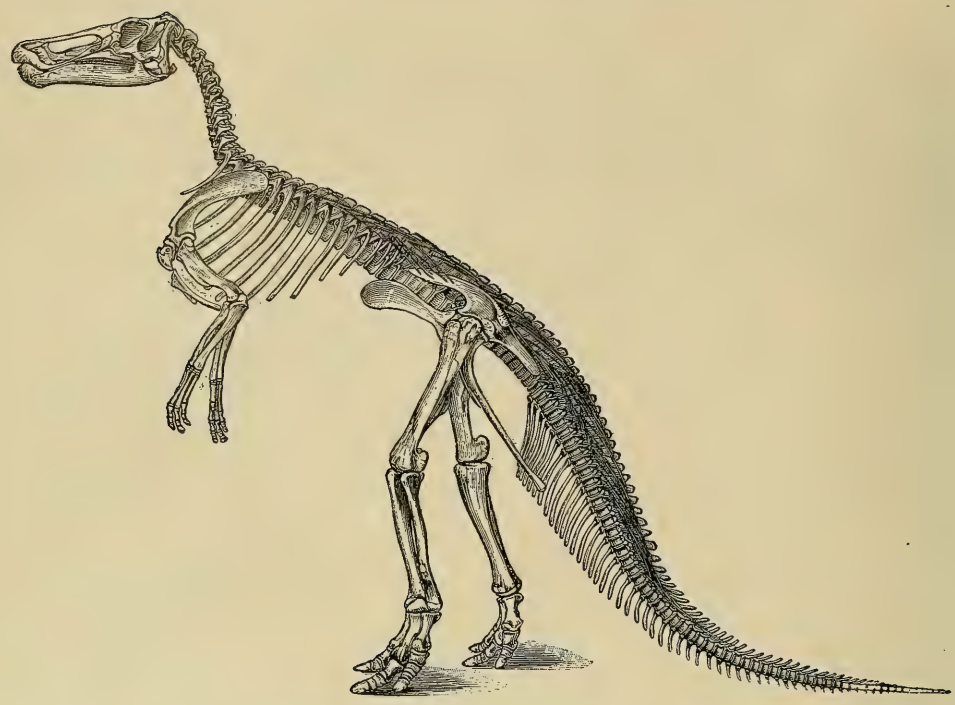
This seems like a big price—$64,000 for a 160-acre tract of coal land which, until the coal-land classification work began, in 1906, was sold at $20 an acre, or $3,200—but, when it is seen what a great amount of coal an acre of such land contains, even the $400 valuation looks small.

Many of the western coal lands are underlain by beds of 40, 50, and even aggregating 100 or more feet of solid coal. An acre of coal 40 feet thick contains 72,000 tons, and the Geological Survey calculates that at least 40,000 tons



FOSSIL SHELL OF A SMALL CRETACEOUS CONCH, PYRGULIFERA HUMEROSA

A most useful geologic key to the western coal beds



ANOTHER SPECTACULAR BUT NOT VERY DEPENDABLE GUIDE TO THE COAL GEOLOGIST: THE GIANT 30-FOOT CLAOSAURUS

He is too infrequent to be counted upon; whereas the little Conch, *Pyrgulifera,* is omnipresent just below the coal formation

of this can be brought to the surface, thus making the very liberal allowance of almost half for loss in mining. Four hundred dollars an acre for such land would thus be a charge of only 1 cent a ton, certainly not much of a burden on the coal operator or the ultimate consumer.

Under Uncle Sam's new classification and valuation scheme, the public coal lands are now handled in a thoroughly business-like manner, and in sharp contrast with the old happy-go-lucky methods under which coal land was sold at a fixed and very low price, without regard to its real value, or even disposed of under agricultural or other laws at a nominal rate.

The coal-land law provides that coal land shall be sold at not less than $20 an acre if lying within 15 miles of a railroad, or $10 an acre if beyond that limit. Until 1907 this price had been regarded as the only price, but it was then decided that the figures named were clearly *minimum.* Since then the coal lands have been classified and valued by the Geological Survey at approximations of their commercial worth. During 1907-1908 valuations were fixed as high as $75 an acre.

In April, 1909, the Department of the Interior inaugurated a valuation plan based on the estimated tonnage of the coal deposits.

Since coal occurs in beds or seams, it is a comparatively easy matter in most instances for the geologists to estimate the tonnage with a fair degree of accuracy. An acre of coal one foot in depth contains approximately 1,800 tons, and 1,000 tons is allowed by the Survey as recoverable. The valuation regulations take into account thickness of beds, depth, whether

A WYOMING TOWNSHIP PARTIALLY UNDERLAIN BY COAL, CLASSIFIED AND VALUED IN 40-ACRE BLOCKS

Price ranges from $20 an acre to $465 an acre. Acreage of coal land in this township, 10,339 acres, valued at $2,779,688; avearge $268 per acre

one or more beds, and quality of coal. Under these regulations a maximum valuation of $300 an acre is allowed for virgin fields where the tonnage estimates are based solely on geologic conclusions, while in fields where mines are already developed and the prospective purchaser knows exactly what he will get there is no limit to the values which may be fixed.

Under these new regulations the area classified as coal land by the Geological Survey up to May 1, 1910, a period of 13 months, has been valued and the sale price fixed at $232,398,000—an average rate of a little over $52 an acre. This acreage would, if sold at the minimum price fixed by law, yield but $76,169,000.

Here is a gain, therefore, of $156,000,000 in coal-land values representing a little over a year of coal classification work.

The values of the coal lands, as fixed by the Survey, of course vary greatly; they run all the way from the minimum price up to as high as $465 an acre in certain lands in Wyoming. Each 40-acre tract is separately classified and valued.

In one Wyoming township, a plat of which is shown on this page, the value of the land classed as coal under the present regulations is $2,779,688. At the minimum price it would bring only $206,780.

During the single month of April ap-

A 30-FOOT COAL SEAM AT HANNA, WYOMING

A new coal field has recently been discovered in Arizona which probably contains more coal than has been mined to date from all the coal mines in the United States (see page 451)

proximately 350,000 acres of coal land were valued at $22,000,000, which is three times the value of the same area at the minimum price. At the present writing, May 24, the coal valuations for May, 1910, have already run $36,000,000.

The question may be asked whether, with 30,000,000 or 40,000,000 acres of coal land in the West now in private ownership, there will ever be a demand for these government coal lands at $200 or $400 or possibly a much higher figure per acre. The answer is that the lands are actually being purchased, and, moreover, these prices are very conservative.

The big coal companies themselves, such as the Union Pacific and the Rocky Mountain Coal Company, are today leasing coal lands from other parties and working them on a 10-cents-a-ton royalty basis, and thus actually paying in royalties several times what the government would charge the entryman as a cash price for similar coal lands.

At the Salt Lake City land office alone, during a single month, $200,000 worth of coal-land sales were made and 50 declaratory statements filed for purchase of additional coal tracts, aggregating probably another $200,000, or a total for a month's coal business in one land office of $400,000.

The government coal classification work has not yet been nearly enough completed to allow for even an estimate at what the total valuation figures will be, but a little rough guessing may prove of interest.

It is estimated by the Survey that there are approximately 50,000,000 acres of public coal lands, located principally in Wyoming, Montana, Colorado, Utah, and New Mexico. Of these it is believed that 30,000,000 acres are underlain with what may be termed fine coal.

Assume that the average valuation which will be placed on these lands is $50 an acre, which according to the rec-

ord of present valuations appears to me conservative, and that on the remaining 20,000,000 acres an average valuation of $25 is placed. This would give a round figure of $2,000,000,000—a sum almost too big to contemplate.

If these figures of acreage and valuation are thought too extravagant, it may be remarked that the coal figures are constantly expanding, and that every year's geologic work by the government adds additional areas to our coal map.

IMMENSE COAL FIELD RECENTLY DISCOVERED IN ARIZONA

Thus, in congressional testimony the other day, Director Smith, of the Survey, mentioned a new coal field in Ariona, not previously included in any coal estimates, which he stated probably contained a tonnage equal to all the coal mined in the United States since the discovery of the first mine.

Two good results from this coal valuation work are, first, that the receipts from the coal-land sales go into the Reclamation Fund, for the irrigation of desert lands by the government and the creation of homes—for every acre of coal land sold at, say, $300 a farm of 10 acres may be reclaimed from the desert by irrigation and a home created—and, second, that the placing of a good-sized price on the land will prevent monopoly of the western coal supply. It precludes the purchase of the lands for mere speculation—holding them indefinitely without mining developments. The management of his big coal-land properties is one instance at least where Uncle Sam is acting the part of the wise landlord in the interests of the people.

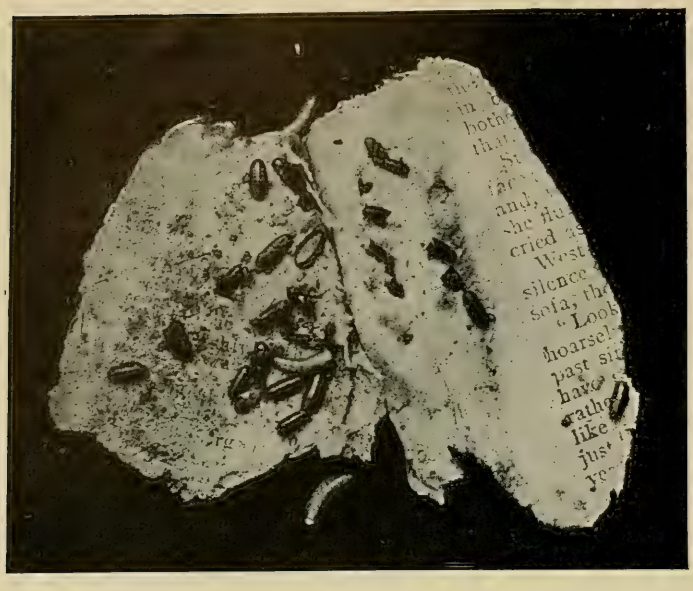
Now follow this work another step. The Geological Survey values the coal lands not only according to tonnage per acre, but according to quality of coal. There are all grades of coal, ranging from brown lignite—only a step removed from peat—to anthracite, produced under enormous pressure and friction, and the fuel-testing work of the Survey determines the number of heat units and the energy values of coals of the various beds.

Further than this, the government has inaugurated a practice with respect to its own coal purchases which will doubtless before long become the rule in private coal buying, namely, paying for coal on the basis of its heating value—the *British thermal unit* basis.

The Geological Survey samples all Uncle Sam's coal purchases and makes tests which show what the coal will do practically. If the coal falls below a certain standard a deduction is made in price; if it exceeds that standard a higher price is paid.

The present practice of coal purchase is to a considerable extent buying a pig in a poke—you get the weight but you don't know the quality. The new practice is eminently fair to both producer and consumer.

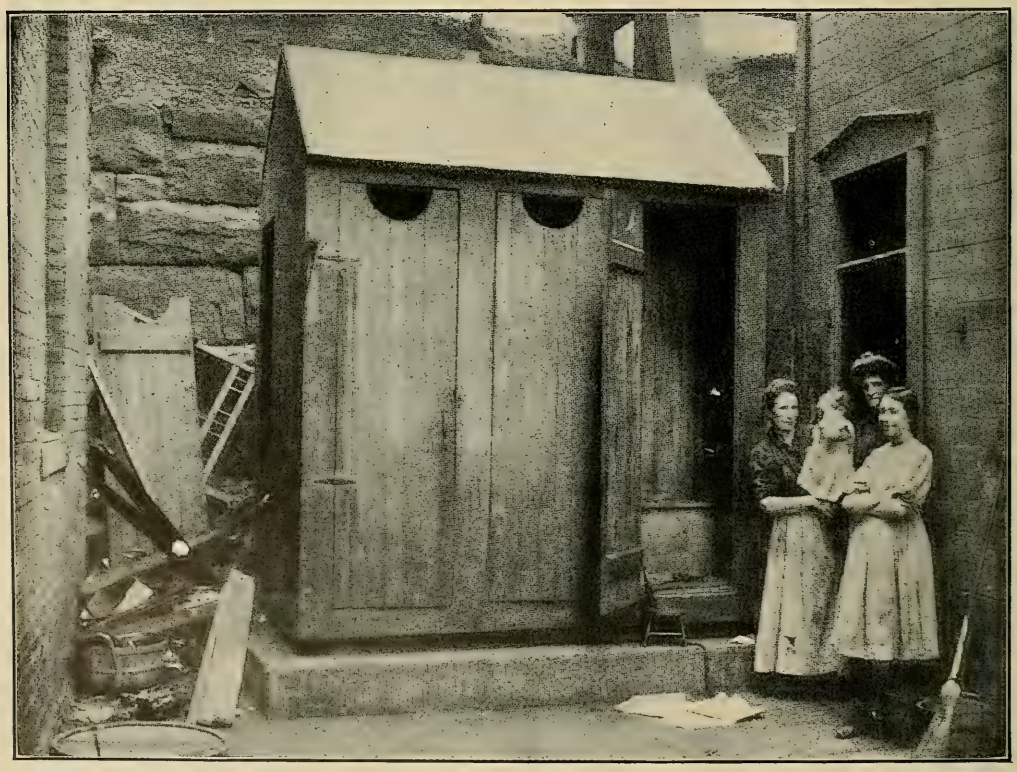
Government purchases alone amount to $10,000,000 annually, and the public saving by this exact method of purchase amounts to hundreds of dollars daily. Applied to the country at large it would represent millions of dollars a year.



FLY LARVÆ AND PUPÆ IN WASTE PAPER (ASH-PIT REFUSE), NATURAL SIZE

Photographs by Robert Newstead; by courtesy of the Liverpool School of Tropical Medicine

Egg of house-fly greatly enlarged, showing the segments of the larvæ through the cuticle



PRIVY VAULTS, SWARMING WITH FLIES, ADJOINING KITCHEN DOOR

These conditions, inviting disease and insuring the pollution of food, are practically duplicated in hundreds of towns besides Pittsburg, in which this photograph was taken

FISHES THAT CARRY LANTERNS

SEVERAL years ago this Magazine published a description of the angler fish, well known along the New England coast because of a device by means of which it lures and catches other fish.* This device consists of filaments or tendrils resembling seaweed, which are attached to the head.

When the angler is hungry it hunts out a convenient place in shallow waters, where its color and markings make the fish indistinguishable from the sea-bottom. Here it lies quietly, often as if dead, while its floating filaments, kept in motion by the tide, decoy other fish, which never discover their mistake until too late to escape from the angler's merciless jaws.

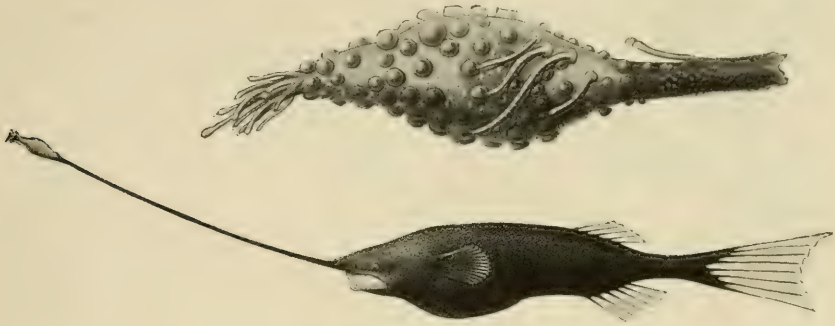
This angler fish is the only one of its kind frequenting the shallow seas of northern Europe and North America, but there are many other related species inhabiting the deep seas of almost all parts of the globe, as well as lurking in the tropical groves and in the sargasso meadows of the Atlantic Ocean. These relatives of the angler are the subject of a bulletin by Theodore Gill, "Angler Fishes, Their Kinds and Ways," recently published by the Smithsonian Institution, and from which these notes are obtained.

The most extraordinary of all the anglers are those that carry lanterns to see with.

"Some stout-bodied anglers resorted to deep and deeper waters, where the light from the sun was faint or even ceased, and a wonderful provision was at last developed by kindly nature, which replaced the sun's rays by some reflected from the fish itself. In fact the *illicium* (a prolongation of the spine) has developed into a rod with a bulb having a phosphorescent terminal portion, and the 'bait' round it has been also modified and variously added to; the fish has also had superadded to its fishing apparatus a lantern and worm-like lures galore.

"How efficient such an apparatus must be in the dark depths where these angler fishes dwell may be judged from the fact that special laws have been enacted in some countries against the use of torches and other lights for night fishing because of their deadly attractiveness. Not only the curiosity of the little deep-sea fishes, but their appetite is appealed to by the worm-like objects close to or in relief against the phosphorescent bulb of the anglers."

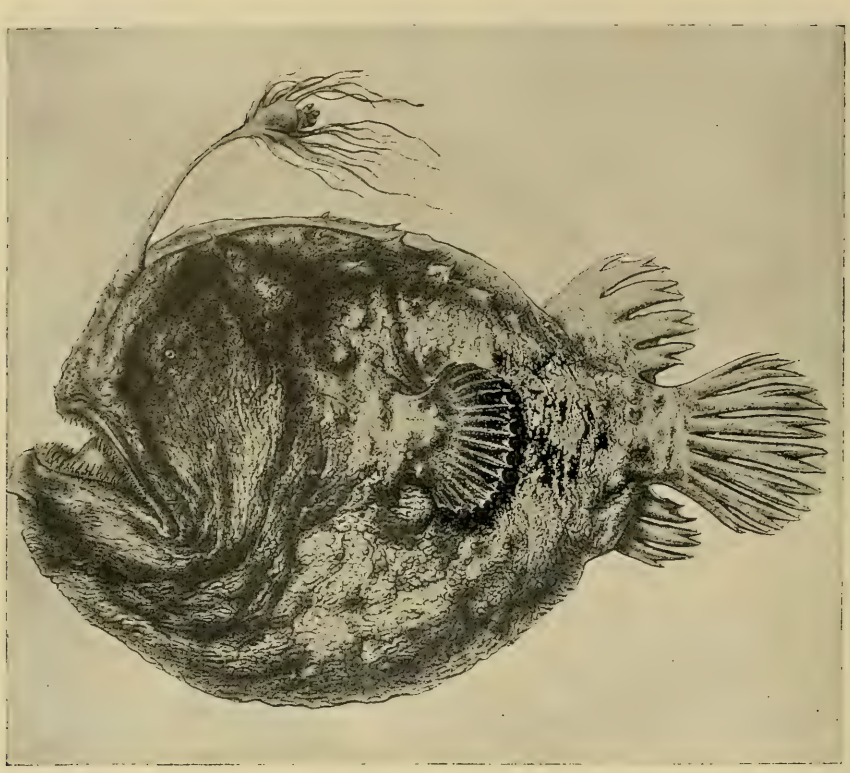
As may be inferred from the size of



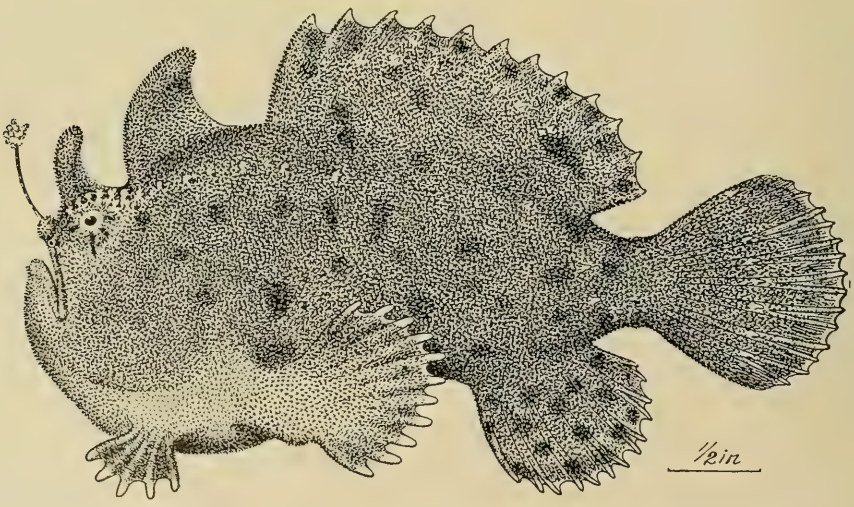
A FISH WITH ITS LANTERN AND BAIT

This tiny fish was dredged in the Indian Ocean at a depth of more than a mile (7,200 feet). The bulb-like upper figure is an enlargement of its torch. The fish is 1½ inches long (excluding the rod and bulb). It swims with the rod and torch pointed straight forward.

* See "The Purple Veil," by H. A. Largelamb, pp. 335-341, NATIONAL GEOGRAPHIC MAGAZINE, 1905.

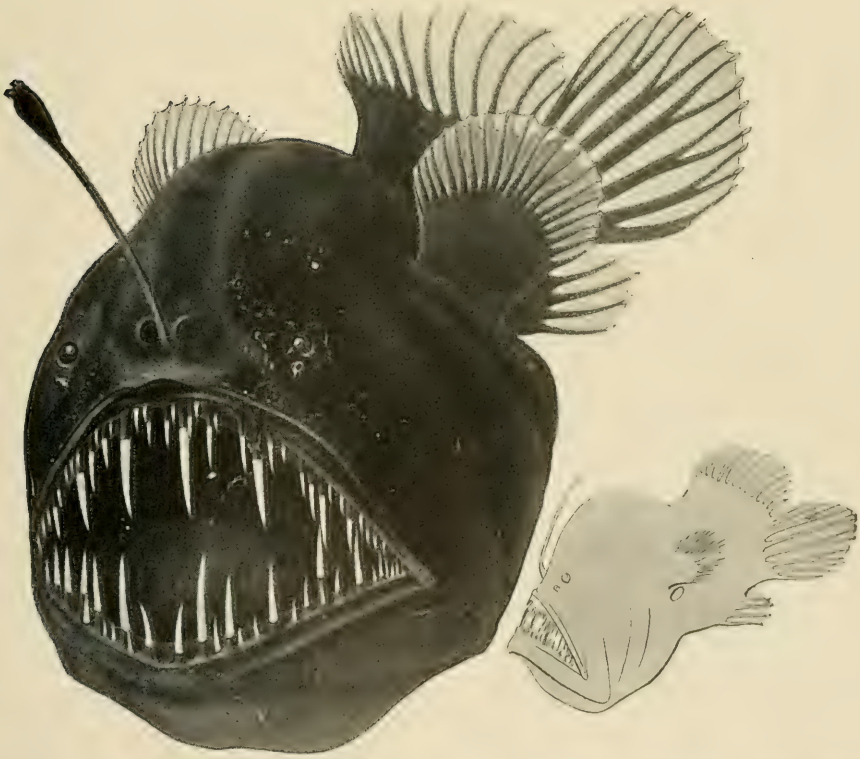


AN ANGLER FISH: NOTE THE FILAMENTS OR BAIT WHICH LURE OTHER FISH



ANOTHER SPECIES OF ANGLER: A SEA TOAD OF THE WEST INDIES

A FROG FISH OF THE SARGASSO SEA



ANOTHER SPECIES OF THE ANGLER, EQUIPPED WITH A DIFFERENT KIND OF BAIT

the mouth and teeth of the fish shown on page 455, certain species are ravenous predatory fishes, which may sometimes seize and swallow fishes much larger than themselves. For instance, a specimen obtained by Mr J. G. Johnson, at Madeira, was less than 4 inches long (3.8 inches), but it had actually engorged a fish about twice its own length (7½ inches). The extensibility of the jaws and connected parts, as well as the dilatability of the œsophagus, stomach, and integuments, enabled the captor fish to accomplish this feat. So completely had the captor ingested (but not digested) its victim that "it was tempted to take a bait," and was thus secured for ichthyology.

Another species of the angler are the sea toads, which are inhabitants of tropical seas (see page 454). The brilliant scarlet and other colors which render the sea toads so conspicuous when seen in the jars of a museum collection are quite in harmony in their natural home and assimilate the fishes to the brilliantly colored coral animals and the other organisms, in the midst of which they lurk in wait for prey.

Most of their lives are spent in coral growths. Selecting a fitting place, such as a fissure just wide enough to get into and hold on to, a fish may assume an oblique or vertical position, sometimes looking downward, sometimes with head upward. It then uses its pectoral fins to obtain a good purchase on the rock, and can thus remain stationary indefinitely, waiting till its victims come sufficiently near to be seized.

Closely akin to the sea toads are the frog fishes, which are mostly inhabitants of the "sargasso seas," or "sargasso meadows," in mid-ocean. The sargasso sea is an egg-shaped area in the latitude of Florida, beginning some 400 miles east of Jupiter, and extending thence easterly for 1,700 miles to about the 39th meridian. It is characterized by an unusual quantity of seaweed, also known as "sea-grape," "sea-lentil," etc., which grows luxuriantly on the surface of the sea.

Although floating on the high seas, and thus at the mercy of the winds and waves, nevertheless, those agents operate in such a manner, in conjunction with the currents, that for year after year and century after century nearly the same areas of the ocean are covered by this peculiar plant. The sargasso meadows appear to occupy the same position at the present time as in the days of Columbus, who first described them.

Amid the seaweed thrive most of the species of swimming crabs, cuttle fishes, and other fishes which are found along the shores of continents and islands. Flying fishes of different kinds are also tenants of these fields, although they may rarely show themselves in the air. All these are lured and caught by the frog fish. A single frog fish, whose stomach contents were examined by Mobius, was found to have taken in four fishes, one of which, a pipe fish, over 5 inches long, was coiled in the stomach; a small cuttle fish, and a small portunid crab. All these were still in a recognizable condition.

Another peculiarity of the angler family is the remarkable "nest" which the fish constructs to protect its eggs.

"The eggs are discharged in a jelly-like mass, which, on contact with the water, become immensely distended and form buoyant raft-like receptacles, which float at or near the surface till the eggs are hatched. The rafts are swollen to an enormous size in comparison with the mother fishes, those of the common angler sometimes reaching a length of 36 feet and those of the frog fish a couple of feet.

"The egg raft, after full expansion in the water, is a soft jelly-like mass, quivering to the touch, but withal rather tenacious, moderately uniform in the width, and tapering abruptly and blunt at the extremities. It is also rather thick, with blunt edges. The entire mass is thickly permeated with eggs, which appear to be in several irregular layers. After some days, and when the eggs have matured, the jelly probably dissolves and embryos are apparently thus liberated."

VOL. XXI, NO. 6 WASHINGTON JUNE, 1910

THE NATIONAL GEOGRAPHIC MAGAZINE

SOME TRAMPS ACROSS THE GLACIERS AND SNOWFIELDS OF BRITISH COLUMBIA

BY HOWARD PALMER

Illustrations from Photographs by the Author

BRITISH COLUMBIA is preëminently a land of mountains. From its eastern boundary—the continental divide of the Rockies—to the rolling Pacific, 500 miles away on the west, the traveler is kept in constant bewilderment by the endless succession of ranges, peak piled on peak and glacier on glacier.

Gaze upward from any forest-filled valley and the gleam from some snow-cap will dazzle you through the tree-tops. Follow that valley to its head and a glacier tongue will stretch downward, luring you still higher to the frigid wonders above.

Other natural features demand admiration — dark gorges, roaring torrents, spraying cataracts, beetling cliffs, dense forests, glorious wild flowers—but the dominant note above all is glistening ice in pinnacle and crevasse.

The climax of this grandeur is attained in the Selkirk Range, whose highest summits indent the clouds 11,000 feet above tide-water. From its rugged shoulders more glaciers hang than are to be counted in all the Alps. Even a native Swiss has acknowledged that the Selkirks "surpass our mountains in labyrinthine organization, in the production of primeval thickets, and the vast number of glaciers."* One can count as many as a hundred of these from even one of the minor summits.

To reach this mountain wonderland there is only one way: take the main line of the Canadian Pacific Railroad and alight at Glacier Station. You are then very nearly at the summit of the range, with splendid peaks and glaciers on every side.

One of the finest of these, the "Great Illecillewaet," pours seemingly out of the sky only two miles away—a short hour's trip from the Pullman car. Another, the Asulkan Glacier, four miles to the south, may be explored by way of an excellent trail leading up through a flower-strewn valley of the same name. At the heads of both these glaciers lie magnificent fields of permanent snow, the one above the Illecillewaet being especially remarkable. Here, at an altitude of 8,500 feet, rounded billows of spotless névé stretch away to the south for 15 square miles—an inexhaustible reservoir for the rifted ice-streams which flow from it at either extremity.

* E. Huber in Schweizer Alpenclub Jahrbuch, 1890-1891, p. 278.

ILLECILLEWAET GLACIER AND ASULKAN PASS: THE GLACIER MOVES NEARLY ONE FOOT EACH DAY (SEE PAGE 461)

"Here, at an altitude of 8,500 feet, rounded billows of spotless névé stretch away to the south for 15 square miles—an inexhaustible reservoir for the rifted ice-streams which flow from it at either extremity."

ILLECILLEWAET NÉVÉ: THE DEVILLE NÉVÉ APPEARS IN THE BACKGROUND, RIGHT OF CENTER

This excellent glacial pass forms one of the few well-defined ways across the long rampart of the Selkirks, though it is hardly practicable for any but mountaineers

EASTERN ESCARPMENT OF ILLECILLEWAET NÉVÉ FROM TERMINAL PEAK

For the past two summers the writer has had the good fortune to spend his vacations in wandering through this Selkirk wilderness. In company with two friends, Prof. F. W. D. Holway and Mr Frederick K. Butters, of Minneapolis, he has "packed" all necessities for extended trips across the passes and glaciers, pushing even into previously unvisited portions of the range.

GEIKIE GLACIER

One of our early excursions was a visit to the Geikie Glacier, which drains the southwestern portion of the Illecillewaet névé as the "Great Illecillewaet" does on the north. The trip promised to be unusually interesting, as the glacier had been traversed only once previously. That, however, was made along its southern margin, while our plan was to keep to the ice itself as much as conditions allowed.

Starting from Glacier, we "trailed it" up the Asulkan Valley and over the pass at its head, 3,700 feet above the hotel, then down 2,800 feet into the further valley, where our glacier lay. Camp was set up near its lower ice-fall shown in the photographs.

This ice-fall was especially remarkable for the way in which the pure white ice, upon reaching the sharp decline, broke up into long, flat-topped ridges or ranks like huge sections of some ancient castle's wall, extending nearly across the glacier. Lower down these were consolidated by the pressure into deep wave-like channels, gradually smoothing out toward the tongue.

Through one of these convenient transverse grooves we crossed the glacier a day or two later. Then, skirting along the steep rocks of its northern margin, we surmounted the fall and took to the smoother ice higher up. After passing over a broad terrace we approached the highest fall of all, where the tremendous mass of ice tumbles down from the névé in a hopeless confusion of splintered séracs.

Glittering towers of ice the size of a city building, grotesquely fashioned and tilted at impossible angles, had been reared aloft by the mighty force from above until the mile of crescent skyline resembled a huge wave frozen by some mystic power as it breaks into thousands of splashes.

It was this great chaos of ice that turned back the Rev. W. S. Green, pioneer explorer of the Selkirks, in 1889. Gazing down upon it from the Illecillewaet névé, he describes the scene as follows: "In its bottom (valley of Fish Creek) a fine glacier wound its sinuous course till lost to sight beyond a bend. Grand precipices flanked it on either hand, and piles of avalanched snow lay half covering the crevasses which were in a regular network over its entire surface. Cautiously we crossed a few snow bridges, but it became too evident that this was no road for the sledges."*

After admiring the impressive spectacle for some time we turned back, for the sun was well down in the west and our position not exactly suitable for a bivouac. We followed our route of ascent to the middle terrace, and then, crossing this, continued to camp along the southern bank.

On the way rather emphatic proof of the glacier's movement was afforded us. During a halt by a tiny stream trickling down a crevice in the ice, one of the party knelt down to drink. His surprise may be imagined on seeing the crack open slightly and the whole stream disappear bodily into its depths.

The movements of the Geikie Glacier, as far as the writer is aware, have never been measured. In all probability they are comparatively small, for the stream, as above mentioned, contains a sharp bend with closely constricting walls, which would greatly retard the motion by their excessive friction.

The Illecillewaet and Asulkan glaciers, however, have been carefully studied, the former from as early as 1888, when the Rev. W. S. Green set out a line of stakes across the ice to measure its rate of flow. His maximum result was 12 feet in 20

* Proceedings of the Royal Geographical Society, vol. XI, 1889, p. 160.

CROSSING GEIKIE GLACIER

CREVASSES IN GEIKIE GLACIER: MOUNT FOX BEHIND (10,576 FEET)

UPPER ICEFALL OF GEIKIE GLACIER

MIDDLE ICEFALL OF GEIKIE GLACIER

"We unanimously decided that the Geikie Glacier was the finest we had seen in the Selkirks. Longer there are and greater, but for purity, variety of ice formations, and general interest the Geikie is unsurpassed"

LOWER ICEFALL OF GEIKIE GLACIER FROM SLOPES ON SOUTH SIDE OF VALLEY

GENERAL VIEW OF GEIKIE GLACIER ABOVE LOWER ICEFALL

DEEP, WAVELIKE CHANNELS OF THE LOWER ICEFALL OF GEIKIE GLACIER (SEE PAGE 461)

days—a rate of nearly a foot and three-quarters per day.

From later measurements of this glacier by George and William S. Vaux, Jr., and the Canadian Topographical Survey (1902), the average maximum rate of flow for several years is made to be about 6 inches per day.*

The Asulkan Glacier for 10 days in 1906 had an average daily motion of 6.7 inches.†

We unanimously decided that the Geikie Glacier was the finest we had seen in the Selkirks. Longer there are and greater, but for purity, variety of ice formations, and general interest the Geikie is unsurpassed. The stream descends for two miles below the Illecillewaet névé, reaching the extremely low altitude of 4,200 feet.

Not long after our day on the Geikie Glacier we struck camp and packed the outfit over Donkin Pass (8,600 feet), the lowest notch in the Dawson Range to the south. Crossing the boiling torrent from the Bishops Glacier, 2,000 feet below the pass, we found a beautiful camping spot on the westerly flanks of the Bishops Range, and set up our tent for a week's stay.

BISHOPS GLACIER AND DEVILLE NÉVÉ

From here we made an interesting trip over the glacier last mentioned to the divide and then down the icy slopes beyond to the Deville névé. This excellent glacial pass forms one of the few well-defined ways across the long rampart of the Selkirks, though it is hardly practicable for any but mountaineers. A survey party, while traversing it, in 1902, very nearly lost one of its members through the breaking of a snow bridge. Mr A. O. Wheeler writes of the incident as follows:

"We were descending the Mitre Glacier (now known as the Bishops Glacier) some distance from the sides, and were threading our way among the crevasses, when a shout behind caused the leaders to turn quickly around. No one was to be seen. My assistant had apparently vanished from the face of the earth. A second shout drew attention to the brim of a hat and an arm appearing above the edge of a crevasse. He had broken through the snow, fortunately catching his ice-axe on the opposite edges of the ice. The pit apparently led to the center of gravity, for we could perceive no bottom. It was a lucky escape."*

The beautiful Deville snow-field lies two miles south of the Illecillewaet névé, severed from it by an ice-walled gap called Glacier Circle. The two bear a striking resemblance to each other. They are of about the same area, both lie north and south at the same elevation, and both are buttressed on the east by a line of small rock peaks which rise with great regularity above the valley of the Beaver River. The Deville névé, however, is nourished by three large feeders, in this respect differing from the Illecillewaet.

BLACK GLACIER AND PURITY RANGE

A second expedition from our Bishops camp was made over the ridge of that name to the south. In the valley beyond a most interesting glacier is to be found flowing parallel to the Bishops Glacier in the same direction. But instead of being a single stream, this glacier is the product of four magnificent confluents, and, instead of having a uniformly white surface, a series of high moraines is freighted along, one from each member. For this reason it has been named the Black Glacier, though rather inappropriately, as a glance at the photographs will show (pp. 472, 478, and 479).

The panorama of this glacial basin as viewed from the Bishops Range is one of the most imposing to be found in the Selkirks. It is as if a bit of arctic landscape had been carried south and dropped down upon a rock-ribbed range far above tree-line.

The "Purity Range" seems a fitting name for the chain. Its dominating peak from this viewpoint is the glacier-draped

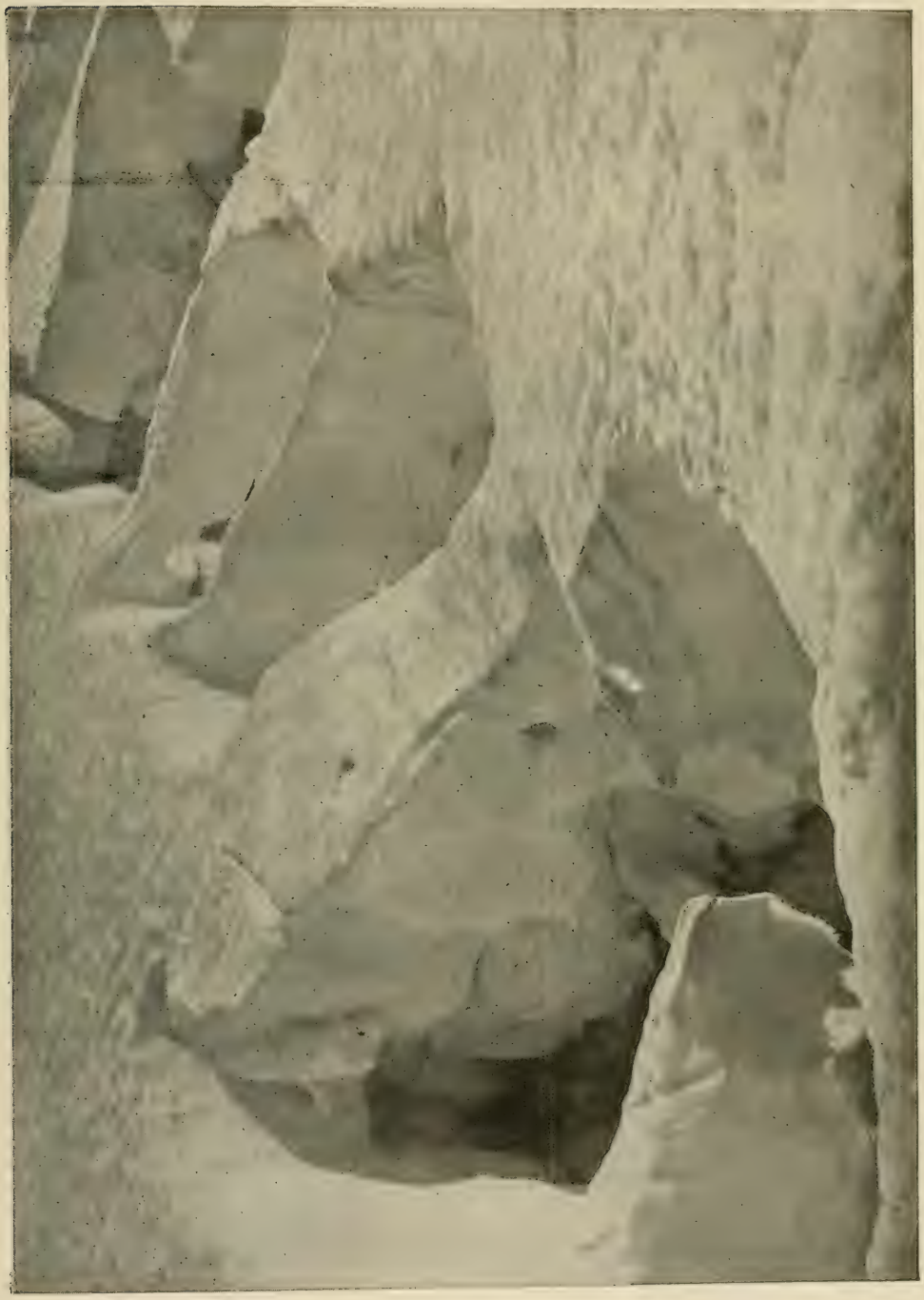
* See "Selkirk Range," by A. O. Wheeler, p. 360.

† Canadian Alpine Journal, Vol. 1, p. 147.

* Appalachia, vol. x, p. 133.

LOWER ICEFALL OF GEIKIE GLACIER

"Glittering towers of ice the size of a city building, grotesquely fashioned and tilted at impossible angles, had been reared aloft by the mighty force" (see page 461)



CURIOUS SNOW BRIDGES AND CREVASSE FORMATIONS ON UPPER PLATFORM OF GEIKIE GLACIER

PASS ACROSS PURITY RANGE WITH NAMELESS PEAK: BLACK GLACIER AT BOTTOM.
The pass is to the left of the central peak (see pages 473 and 484)

massif of Mount Kilpatrick (10,624 feet), first ascended in 1909 by E. W. D. Holway, F. K. Butters, and H. Palmer. To the left, barely visible over the col at the valley's head, rises Mount Wheeler (11,023 feet), second only to Mount Dawson among the monarchs of the southern Selkirks.

Next to the west come four nameless peaks, and then the range terminates in the majestic mass of Mount Purity, perhaps the most striking peak of all. Seen from the upper slopes of the Bishops Range, this silvery spire, with its graceful aretes, symmetrical buttresses, and unique snow curtain lighted by the afternoon sun and outlined against a sky of deepest blue, forms a picture never to be forgotten.

BATTLE RANGE AND BATTLE GLACIER

Beyond the Purity Range to the south the country is practically a *terra incognita*. A strip averaging about four miles wide along the range is shown on the government map, but the data for this was obtained from distant photographs taken on the summits of Mounts Wheeler and Purity, and as far as we could learn no one had actually crossed the range to explore the district in detail. Below this strip the map was blank except for the words "Battle Range" in heavy type.

Since our first view of this region from the Purity Range it has interested us, and we had desired to accept the covert, though none the less alluring, challenge of the map, but previously to July, 1909, conditions had prevented our doing so. That month, however, found our party of three encamped on the flanks of the Bishops Range, all preparations completed for a visit to the virgin valley of the Battle glaciers.

The chief difficulty in our undertaking was to find a way down the southerly slopes of the Purity Range, for from Mount Kilpatrick these appeared to form a continuous wall of practically sheer cliffs along that side. The northerly slopes, on the contrary, looked accessible everywhere, so we selected the deepest notch in the skyline for our first trial. This cut the range near the middle and could be reached with facility from our camp. It took a morning's hard work to solve the maze of crevasses in the intervening feeder of the Black Glacier, but toward 2:30 p. m. we pushed into the col.

One hasty glance over showed that we had probably found a pass, for a steep finger of snow reached up from the further glacier right to our feet, bridging the rock wall in the neatest manner possible. Still, the entire route of descent was not visible, and a crest in the glacier below suggested the beginning of an ice-fall likely to form a serious if not insuperable obstacle, but we unanimously decided to risk it notwithstanding.

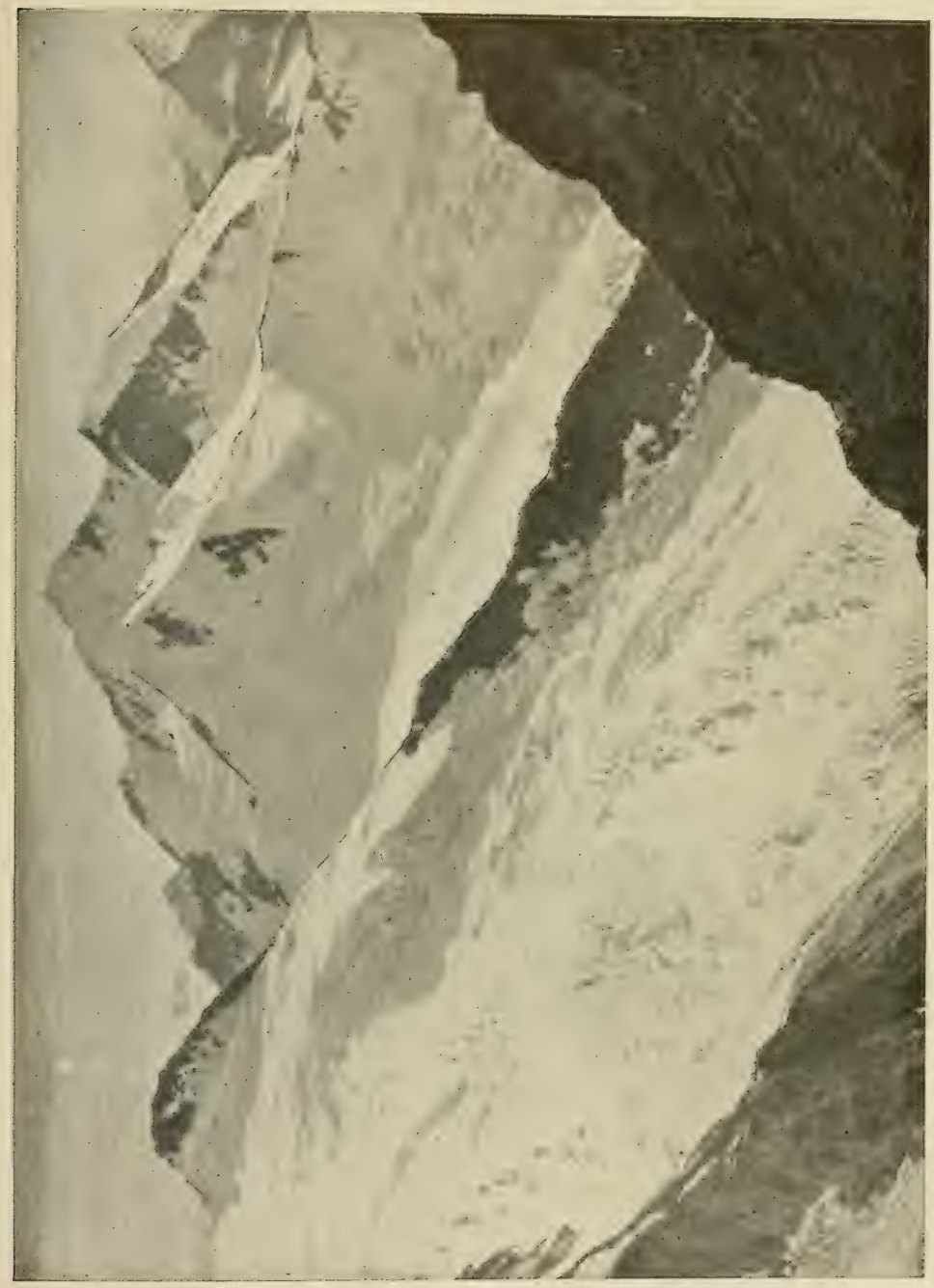
The view of the deep valley of Battle Creek was grand beyond description. On either hand rose rocky walls fringed with hanging glaciers, while below them in the valley wound another, the huge Battle Glacier, four miles from source to tip. Across the valley in the background soared the nameless black peaks of the Battle Range in formidable array. Sharp ridges of nearly equal height walled in high glacier basins, below which black, rocky slopes, shining with moisture, pitched steeply into the valley.

The most elevated point seemed to rise at the right, where a single rounded summit pierced the sky at an altitude not far from 11,000 feet. From its shoulders the snow fell away to the largest glacier in the group. All this formed an alluring, although somewhat forbidding, prospect.

We returned to camp and a day or two later again made the col, this time laboring under 40-pound packs. With scarcely a pause we plunged down the snow to the glacier and began a winding march between its crevasses. As we had feared, the crest seen from above concealed a huge ice-fall.

The glacier was gashed from side to side for fully 2,000 feet down. Surely our way was not there. Carefully following the edge, we turned to our left and made for the margin of the stream, where at length we were rewarded by

CYPRIAN PEAK (10,712 FEET) AND BISHOPS GLACIER (SEE PAGE 469)



MOUNT PURITY (10,457 FEET) FROM CYPRIAN PEAK

PANORAMA FROM MOUNT PURITY TOWARDS NORTH AND NORTHEAST

From left to right, Dawson and Bishops Range; then Mounts Wheeler and Kilpatrick at right. The precipitous southern slope of Purity Range is well shown by black cliffs in foreground to right

MOUNT KILPATRICK (10,624 FEET), FIRST ASCENDED IN 1909 BY MESSRS E. W. D. HOLWAY, F. K. BUTTERS, AND HOWARD PALMER (SEE PAGE 473)

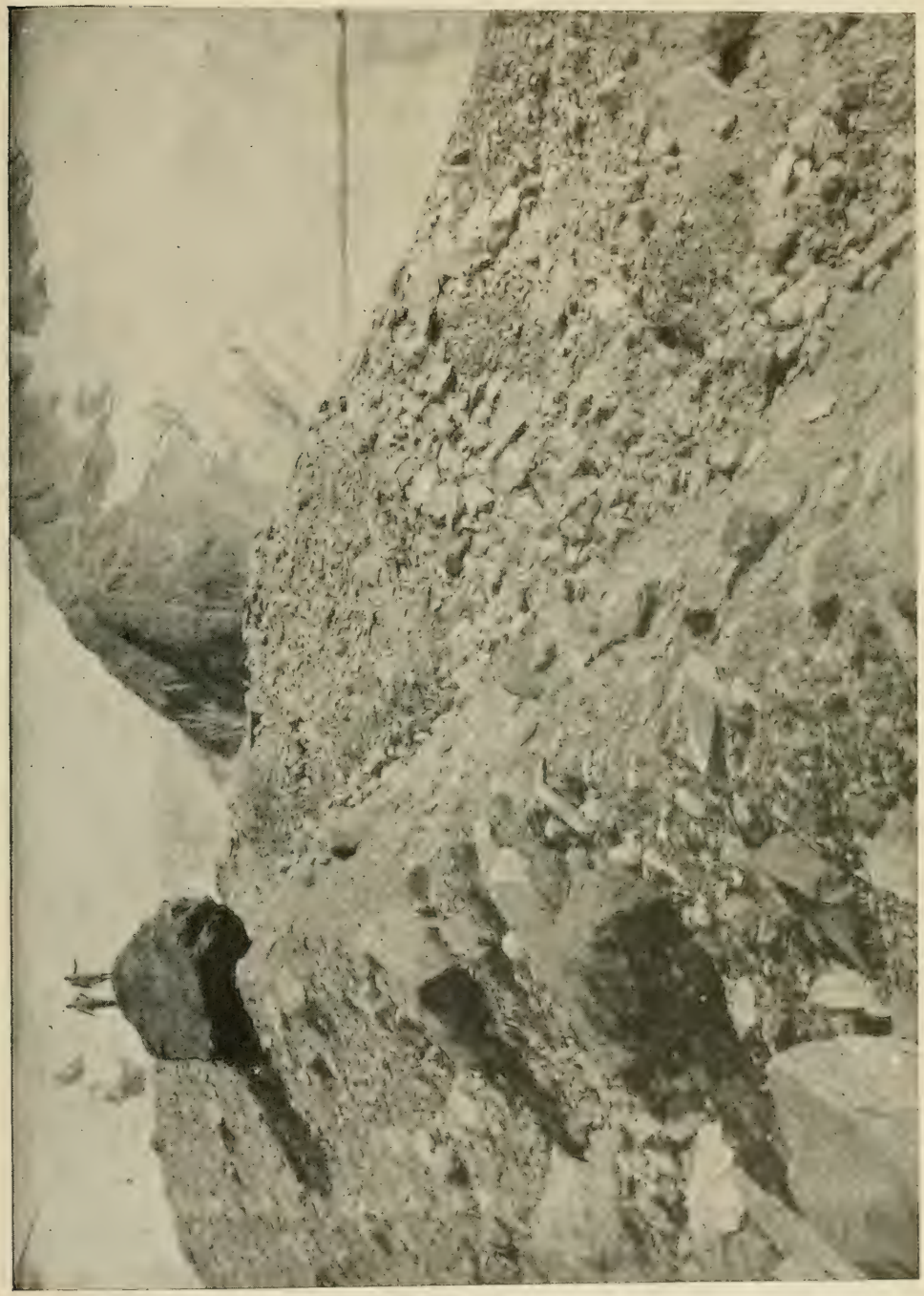
the discovery of a moraine almost hidden under winter snow. Descending its curving crest, in half an hour we found ourselves at the foot of the ice-fall on the great level reaches of the upper Battle Glacier.

The sun had now set for us, though it was but 4 o'clock, burying the glacier as well as the valley below in deep shadow. Only Grand Mountain and the peaks in its chain were still bathed in bright sunlight. Haste was indeed imperative were we to camp before nightfall in the gloomy depression three miles below. Accordingly after only a moment's halt we shouldered our burdens and resumed our way. The next two hours passed in a monotonous grind, first through the slush of the glacier and then over the sharp stones of a great medial moraine which appeared to afford the quickest road to the valley. On our left the other branch of the glacier, emerging from a dark defile, joined ours, the two forming the mile-wide stream of Battle Glacier, shaped like a huge letter Y.

Dusk was upon us as we approached the crest of the high terminal moraine which had hitherto concealed the valley's depths where we hoped to camp. For the last four miles our route had lain through a forlorn waste of ice, snow, and jagged rocks. A few sparse patches of green grass did indeed clothe the slopes to the left here and there, but they only served to emphasize the barrenness by contrast. Not even a marmot's whistle had cheered us with its shrill note.

Unless our surroundings changed very considerably in the next hour, a night on the sharp stones of the moraine, with nothing to eat but crackers, chocolate, and dried fruit, was all we could look forward to. Accordingly it was not surprising that we hurried rather anxiously up the rocky slope toward the top.

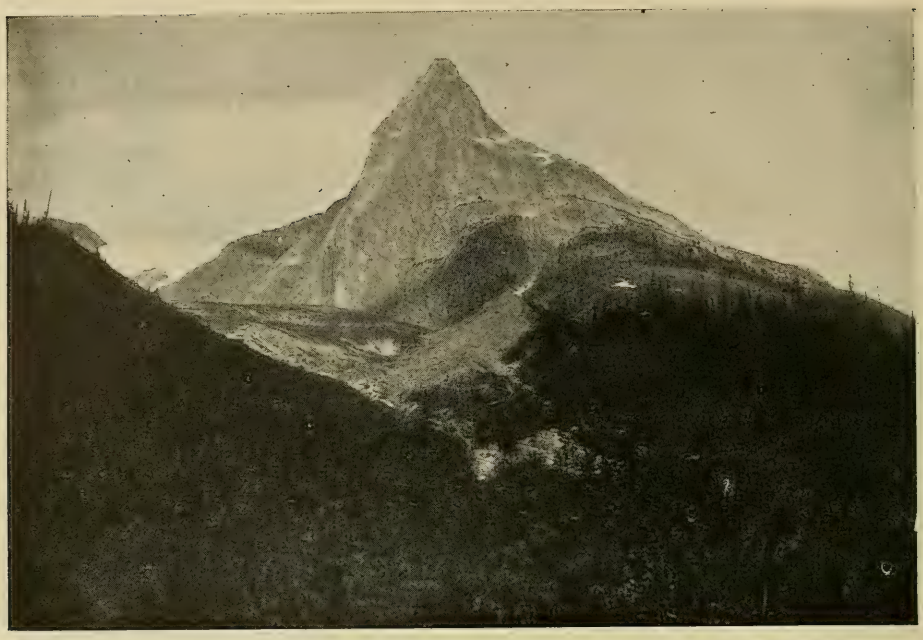
MOUNT KITTATRICK AND BLACK GLACIER (SEE PAGE 469)



THIS MASS OF BOULDERS AND ROCK IS FREIGHTED ALONG BY BLACK GLACIER (SEE PAGE 469)

BATTLE RANGE AND BATTLE GLACIER, SEEN FROM THE SUMMIT OF MOUNT KILPATRICK (SEE PAGE 473)

ANOTHER VIEW OF BATTLE RANGE AND VALLEY FROM MOUNT KILPATRICK



"A SINGLE MATTERHORN-LIKE SUMMIT TOWERED IN LONELY SPLENDOR"
(SEE PAGE 483)

The scene which greeted us was indeed one of wildest grandeur. Two hundred feet below us a raging torrent foamed out from beneath the glacier, racing into a narrow gorge with a thunderous roar. Lower down it emerged, and we could follow its course for perhaps a mile further winding between banks densely overgrown with alders. There the valley widened out and its gradients became gentler, but of forest there was hardly a patch. Alders and steep grassy slopes were the rule. Nearer, on either hand, its sides slanted abruptly back in rough rock-piles, breaking into cliffs higher up, where ice fringed the skyline and sharp summits stood out black against the evening sky.

It was a rather disheartening outlook for a hungry party with nothing but green wood in sight for miles. But we couldn't be worse off than where we were on the glacier, so we prepared to push further down the gorge on the chance that something better would appear.

Just then what was our surprise to see on a ridge of the moraine not 200 feet away a fine yearling grizzly bear. He had been traveling in our direction, but out of sight below the moraine, and his astonishment at finding himself suddenly face to face with three strange creatures was ludicrous to behold. He stopped short, looked us over for a full minute, then gave a deep "hoo wuff" and, turning around, disappeared. Regretting that our cameras were tightly strapped up in our packs, we continued our way down into the gorge.

We had progressed hardly a hundred feet when, above us on the mountain side, lo, another grizzly was sighted, this time a full-grown mother bear with a cub. She was nosing about in the alder bushes apparently unaware of our presence, and looking for all the world like a contentedly grazing cow.

With no arms but our ice-axes and no trees nearer than 5 miles, it did not seem wise to disturb the brute or to give her any reason for desiring to make our acquaintance, so we slid down the slippery forefoot of the glacier to the edge of the

torrent and pushed on down the valley, rather anxious, it must be admitted, as to whether there were any other specimens in the menagerie.

After a half hour's rough tumble over the boulders along the stream and through the alders fringing the canyon's lip, we reached the more open portion of the valley seen from above, and soon found a place in an old avalanche track where dry wood was abundant and the tent could be set up among the stones.

It was anything but an ideal camping spot. The only space for the tent consisted of a 6-foot stretch of water-worn rocks, the interstices between which were only partly filled by glacial silt, leaving their "summits" to indent the particularly weary portions of one's anatomy. Moreover, even this small area had to be cleared of the ever-present alders. But we were in a far from critical mood, and, in comparison with what might have been our lot, this was luxury.

A fire, soon kindled, dispelled the gloom and facilitated our lumbering and culinary operations. Ere long the tent was up (though rather precariously) and copious draughts of hot tea and pea soup were repairing the ravages of a hard day's work.

We had climbed about 4,000 feet under 40-pound packs, and descended the same distance, with 600 feet additional, covering a distance of 10 miles through untraversed country.

Next morning we were up early to view our surroundings. In the gloom of our arrival the heights had shown merely as dim shadows against the sky. Sounds of rushing waters in varying keys had reached us intermittently as the wind blew gustily down the valley, so we hoped for glimpses of waterfalls not far away. Not were we disappointed.

Almost directly behind our camp a beautiful cascade leaped out of the sky and came tumbling down from ledge to ledge in a foaming thread for a full 300 feet. Further to the right another gushed out, evidently the drainage from a glacier that was nearly hidden in a deep notch.

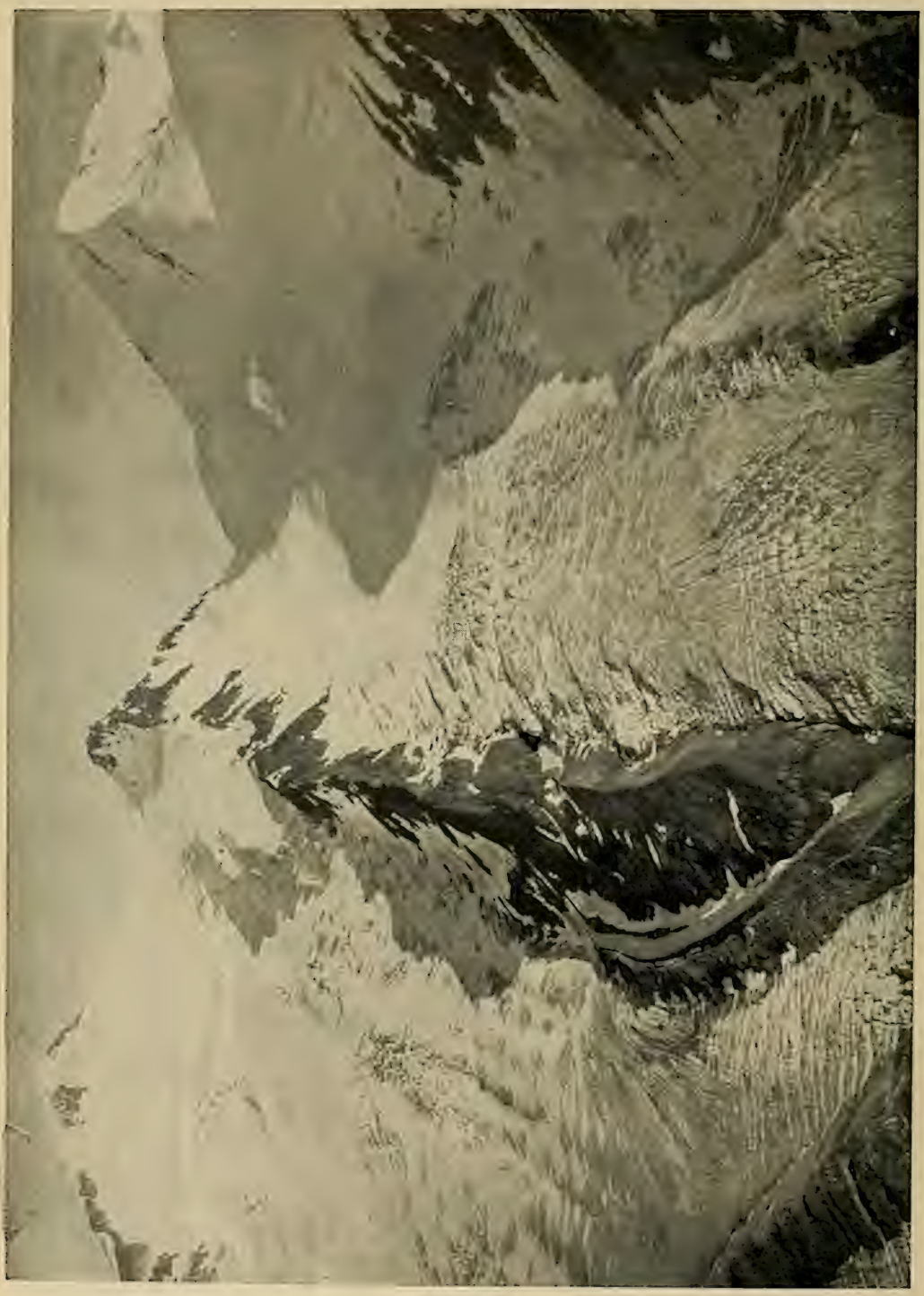
Fifteen hundred feet almost straight above this a single Matterhorn-like summit towered in lonely splendor, forming with its lower and more distant slopes the eastern wall of the valley. The corresponding wall at our backs rose even steeper to a belt of cliffs which extended for two miles along that side (west) and supported hanging glaciers as far as we could see. Its southerly termination was a sharp rock peak, around which the valley swung abruptly to the west.

Opposite this point stood the fine group of peaks shown on page 486. Altogether the scene presented the sharpest contrasts between heights and depths that we had seen anywhere previously.

After a day spent in improving the camp we pushed down the valley in order if possible to view its course beyond the turn just mentioned. We followed a well-worn bear trail that wound through soft grassy alps, where evidently the animals often found comfortable quarters, to a point where the torrent entered a small canyon. Then we turned to the left and struck up a very steep alder-matted slope, attaining at length an altitude of 5,800 feet—2,400 feet above the valley. From here we obtained splendid views up and down its length, including one of a fine glacier basin below Mount Sugarloaf.

We had come a distance of about a mile and a half from camp in an airline, during which the valley dropped 500 feet. The creek in consequence had in places cut its channel through the loose morainic material to a depth of 75 feet below the general level. Lower down the gradient became gentler at an altitude of approximately 3,000 feet, allowing the stream to take a winding course through verdant meadows and groves of evergreens until it once again turned westward and was lost to sight.

Numerous tributaries from the high glaciers of the Battle Range bounded down over smooth rocky slants to join it, in two cases issuing from hanging valleys that cut back into the heart of the range. Our plan was to continue still further, but a heavy shower forced



NAMELESS PEAKS IN PURITY RANGE: THE PASS IS TO THE RIGHT OF THE CENTRAL RIB (SEE ALSO PAGE 472)

VIEW FROM THE SUMMIT OF THE PASS, SHOWN IN PRECEDING PICTURE, LOOKING DOWN INTO BATTLE CREEK VALLEY AND OVER BATTLE GLACIER

OUR CAMP IN BATTLE CREEK VALLEY: PART OF BATTLE RANGE IN DISTANCE

us to turn back, and we reached camp in a soaking condition.

The rain continued intermittently, but during the lulls we managed to cook supper and dry our clothes somewhat. Heavy showers battered the tent in the night, giving a severe test to its waterproofing. This might have been better, but we felt grateful that only a fine mist penetrated.

In the morning, under lowering skies, two of the party ascended the glacier occupying the notch east of camp and reached a knob near the arête joining Grand Mountain and Mount Sugarloaf. From this they obtained unobstructed views throughout the upper reaches of the valley. Everywhere steep rocky walls and jagged cliffs fringed with glaciers met the eye, making it apparent that the camp was not favorably situated for any ascents in its vicinity.

Rain again prevented our accomplishing anything the following day, and, as indications promised a storm of several days' duration at least, it seemed useless to remain longer, especially as our food supply was insufficient to allow us to move down the valley to a more favorable spot. Accordingly we started back on the fourth day over the same route, arriving at our camp on the Bishops Range at 9:30 p. m. in a howling snowstorm. A few days later we ended our outing by returning to Glacier.

Our experiences in the upper portions of the valley support those of W. S. Drewry and P. A. Carson,* both of the Dominion Land Survey, who on different occasions penetrated the valley from its mouth with a view to locating a survey station in the Battle Range. They found the going as bad as possible, and the former was "confronted by sheer precipices of rock and ice at every attempt" to make an ascent.

There is little doubt but that the Battle Range on this side is one of the most difficult in the Selkirks from the climber's point of view. The valley is a low one, which means a long pull to timber line and a bivouac there before snow and ice work commences. Conditions ought to be more favorable on the south side of the range, but nevertheless the sharp aiguilles and threatening towers will doubtless offer most interesting problems to an attempt from that direction.

* Annual Reports of Department of Interior, Canada, for 1892 and 1907.

WHERE WOMEN VOTE

By Baroness Alletta Korff

IN FINLAND for nearly three years women have been members of Parliament, and for the first time in history have "taken their places in a legislative assembly side by side with men, elected by universal manhood and womanhood suffrage."

The law granting the franchise to women came into effect on the first of October, 1906, so that now it is possible to estimate, in some degree at least, the value of the work that the women have done and the effect that woman suffrage has had upon the country at large.

Although at the time the suffrage was granted it seemed to people outside Finland radical and even revolutionary, in Finland itself the change was looked upon merely as an inevitable step in the natural process of the political and social evolution of the country, and was received without any signs of excitement whatever.

It is true that in some ways conditions in Finland have been peculiarly favorable to the advancement of woman's rights, but there have been also certain difficulties which do not exist in other countries, and which made the idea of woman suffrage seem an almost chimerical one

even as short a time ago as 1897, when the first official request was made.*

NOT ENOUGH EDUCATED MEN TO MEET THE REQUIREMENTS OF THE COUNTRY

From an educational point of view the women in Finland have been very fortunate, as there are many excellent schools for girls and a number of co-educational schools throughout the country which prepare students for the University examinations. Girls have been admitted to the University since 1878, and they not only attend lectures but take part in all branches of university life: they participate in all the celebrations and festivities, and are members of the various clubs and student organizations, in which they are on a footing of perfect equality with the men and are frequently elected to various official positions. After they graduate from one of the several high schools or from the University there are many branches of work open to them.

They may become teachers even in the state schools for boys, cashiers or bookkeepers in banks, clerks in the state archives, and in many branches of the civic administration. There are really not enough educated men to meet the requirements of the country, and consequently the cooperation of the women is a matter of vital importance. It not infrequently happens that even married women in comparatively good circumstances seek employment outside their homes.

Having thus such an excellent foundation to build upon, it is small wonder that the woman's movement soon found many active supporters. In 1863 the Diet had accorded the municipal vote to women taxpayers living in the country, and in 1872 to women living in the towns, all of whom were also given the right to be elected members of certain local self-governing bodies. In 1900 the women social democrats included the suffrage in their program, but the special activity for the suffrage began only in the year 1904, although in 1897 a petition had been officially presented to the Diet at the request of the "Finnish Woman's Association."

The reason why so little was done in direct furtherance of the cause of woman suffrage between the years 1897 and 1904 is that just at that time Finland was passing through a severe political crisis. The struggle which the country was trying to wage against what seemed to be hopeless odds roused all the women of the country to action and made them realize the immense influence that political questions had upon the welfare of their country and upon their own individual lives. Thus they learned by practical experience the value of, and the necessity for, organized cooperation.

When all the women of the country had once been thus united by a strong bond of common interest, it was only natural that when the political crisis had passed the women should work together in an attempt to gain a recognized position in the civil and political life of the country.

By the autumn of 1904 the political situation had changed materially and public gatherings were once more allowed. The first large meeting for the discussion of the question of woman suffrage was convoked by one of the women's societies, and was attended by over one thousand women from different classes of society and from different parts of the country. The petition which the women presented to the Diet at this time was not dealt with, however, for the situation of the country was still precarious.* Women nevertheless continued to play an active rôle.

WOMEN CHOSEN TO SERVE AS MEMBERS OF A STRIKE COMMITTEE

After the outbreak of the October revolution in Russia (1905), a sympathetic strike was declared in Finland, and several of the members of the central

* Unofficial requests had been made previously by both the women's societies.

* In this petition equal suffrage for men and women was demanded, and for the first time a demand was made that women be granted the right to sit in Parliament.

committee elected by a mass-meeting to manage the details of the strike were women.

The first action taken by the committee was to close all the liquor shops, saloons, and bar-rooms, and to organize a volunteer police force to keep order. After the second day the markets were reopened and the strikers were not allowed to cut off the water supply. In short, the strike was managed in a most orderly and systematic way, and no outrages of any sort were committed.

During the course of the strike numerous deputations were sent with petitions to the Governor General, and in each deputation there were women members. Thus, even in moments of grave political danger and at times when the utmost moderation and foresight were needed, the Finns were not afraid to trust their women.

The strike was ended by an imperial manifesto issued on November 4, 1905, which reinstated Finland in its earlier rights, and in the manifesto universal suffrage was spoken of as a reform that might soon be realized. This gave a great impetus to the work among the women. They were determined that when the question of the suffrage came up for settlement, universal suffrage should be granted to them as well as to the men. Both of the women's associations arranged numberless lectures and meetings. More than 300 women's meetings were held in different parts of the country. At one large meeting, called by the "union" on December 2, 1905, there were representatives from 122 different places, many communes sending two, three, and four representatives in order that all social groups and all shades of opinion might be represented.*

WHEN WOMEN ASKED FOR SUFFRAGE IT WAS GRANTED AS A MATTER OF COURSE

This was only one of a number of similar meetings. Many of the young women students in the University traveled about the country lecturing on woman suffrage, and there were also numerous meetings arranged and led by peasant women.

Curiously enough there was almost no opposition to the measure, and when it came before the Representation Reform Committee only two members voted against it, and in the Senate also there were only two counter votes. Then the question was put before the Diet, and was included in the imperial proposal submitted to the Czar and signed by him on the 29th of May, 1906.

The Constitution Committee within the Diet recommended women's political suffrage and eligibility for the following reasons: "At present women in Finland get exactly the same education as men, even in the same schools, since co-education has been adopted in wide circles. Women in our days are engaged side by side with men in many different lines of work, and the experience from these ordinary fields of labor, as well as from women's participation in social work and in philanthropy, is such that there is no reason to fear that women should not use their suffrage as well as men. Finally, women themselves have shown a strong desire to get it."*

Thus at the time that the suffrage was extended to women it seemed so natural and inevitable that every one received the news quite calmly, and even at the time of the elections there were no evidences of popular excitement, though by the change from limited to universal suffrage the electorate was suddenly increased from 10,000 to 1,500,000. The extreme orderliness, even on the two election days, was a matter of great surprise to all the foreign correspondents, who seemed to regard it as quite an incomprehensible state of affairs.

The various women's clubs and women's associations played an important rôle at the time of the elections and immediately before. They used every effort to encourage women who could speak well to go about and address meet-

* "Nylid" for November, 1905.

* "Englishwoman's Review," 1907.

ings, and they made it possible for them to do so, and for poor women to go to the polls on election day, by providing competent and suitable women to take care of their homes. Women members were appointed on all the electoral boards, and when the tickets were being made up the women showed great moderation, asking only that one woman's name be inscribed as over against two men's names on each of the party tickets.

As soon as the law had been passed granting the suffrage to women, women's interests were included in the various party programs, and, as each of the already-organized parties was very anxious to gain as many votes as possible, it seemed neither advisable nor necessary for the women to form a new and separate party of their own. The whole object of their endeavor was not to bring a new party into politics, but to infuse a new element into the parties already existing.

MORE WOMEN VOTERS THAN MEN VOTERS

The very great interest that the women took in the elections may be gathered from the fact that in Helsingfors, the capital, at the time of the second elections (in 1908), there were 19,640 women voters and 15,516 men voters registered.* It is true that the majority of the women voted for men, as there were only 26 women elected in a house of 200, but one woman received a larger number of votes than was given to any of the men candidates of her party.

In 1906, of the 11 Agrarians elected, 1 was a woman; of the 25 Swedes, 1; of the 25 young Finns, 2; of the 59 Old Finns, 6, and of the 80 Social Democrats, 9 were women, so that the proportion of women to men was approximately the same in all the parties except the Swedish.

Although the women deputies did not constitute quite one-tenth of the whole Diet (19 were elected in 1906), they proposed no less than 26 bills and resolutions, a statement of which will perhaps give the best idea of the special subjects in which the women were interested.

* At the time of the first election in 1906 no separate count was kept of the number of men and women voters.

THE LAWS WHICH THE WOMEN ADVOCATE

There were three different bills for the abolition of the guardianship of the husband over his wife, and a new woman's property act; one for more rights of mothers over their children; four for raising the age of protection for girls; two for raising the age of legal marriage for women from 15 to 17 or 18; four in regard to the legal status of illegitimate children; two petitions for more extensive employment of women in state service; for a state subsidy in behalf of schools for domestic training; for an annual subsidy of 20,000 marks for temperance; for obliging municipalities to appoint a midwife in each parish; for an amendment of the paragraph of the Agrarian law which stipulates that sale of an estate annihilates all lease contracts; for encouragement and extension of co-education; for abolition of the law on domestic service; for the construction of a specified railway; for the establishment of a maternity insurance fund; for the appointment of women as sanitary inspectors; for amendment of the law on litigation in so far as women shall be granted the same rights as men in regard to legal assistance; for subventions to the distribution of free meals to school children; for pardoning the Finns that took part in the Sveaborg revolt; for the abolition of disciplinary punishments in prisons; for making it a penal offense to insult a woman on the public roads or in any other public place.*

Up to the time of the dissolution of the first Diet (March, 1908) only three of the women's bills had been debated and decided upon—the institution of midwives, domestic training, and the raising of the age of marriage from 15 to 17. Various other bills would probably have been passed by the Parliament if the sudden dissolution of the Diet had not put a stop to all parliamentary work.

* Report for the "International Woman's Suffrage Alliance."

In the elections for the second Diet, which took place in July, the women voters outnumbered the men by more than 4,000 in Helsingfors, and by about 3,000 in the province of Nyland. This time 26 women members were elected. Of the 224 petitions presented to the second Diet, 29 were presented by women, and of these one was for the appointment of a woman sanitary inspector, one for the improvement in the position of women in state service, two for the extension of certain railways, and several for abolishing legal abuses under which women had been suffering. Nearly all the rest concerned various improvements in the care and education of children.

BALANCE OF POWER AMONG PARTIES NOT AFFECTED BY WOMEN

At the time of the second elections the women again joined the already existing political parties and made no attempt to establish a separate party of their own. Once more also the number of women representatives in each party proved to be in direct proportion to the number of men representatives of the respective party. In other words, the election of women members did not in any way affect the balance of power among the parties. This was also true of the third Diet, elected in May, 1909.

The personnel of the women members in the three Diets has been in the main the same. Among those elected to the third Diet were one factory inspector, one principal of a teachers' seminary, two doctors of philosophy (one of them an official in the state bureau of statistics), one principal of a girls' school, one historical writer and lecturer on political questions, one clergyman's widow, one peasant's wife, one girls' school teacher, one public-school teacher, five seamstresses, one editor of a Social Democratic women's weekly (a former servant girl), one hooper's wife, one crofter's daughter, two Social Democratic organizers, one without specified profession. Thus, as among the men, all classes of women are represented.

As the majority of the representatives are over 40 years of age, it is safe to assume that in almost all cases their children, if they have children, are of school age, or at least old enough not to suffer from their mother's temporary absence from home; and, moreover, in all but four or five cases, the women members of Parliament were previously engaged in wage-earning occupations which were more confining and less well paid than their present positions. In other words, the families of the great majority of women members of Parliament have gained socially and economically by their election to Parliament. It is perhaps interesting to note that there are three cases of married couples representing a constituency.

As regards the work of women members of the Diet, it is precisely the same as that of the men members, there being women representatives in all of the various committees. One woman, for example, is a member of four different committees—the committee which deals with questions of constitutional law, that which prepares bills concerning social and labor questions, that which presents the final parliamentary reports to the state, and the Grand Committee.

THE ABILITY TO VOTE HAS IMPROVED THE CONDITION OF WOMEN

Before the suffrage was granted to women the vast majority of requests made by them for the investigation of the conditions of life among women workers—for example, women factory-workers—were treated with polite indifference; now that women have the vote, all of their official requests receive serious consideration. Two women factory inspectors have been appointed, and a special appropriation has been made for the work of an investigating committee.

No one who followed the heated debates aroused by the bills concerning the "Married Woman's Property Act," the "Extension of the Mothers' Rights over their Children," and the "Abolition of the Husband's Guardianship over his Wife," can doubt the practical advantage that women have gained by having

women representatives in Parliament. An article which appeared in the *Jus Suffragii* while the bills were pending says: "The women members of the Law Committee, to which the bills were referred, have had to stand a hard fight. The men members in the committee, of all parties, whether bourgeois or Social Democrat, held that only the 'women's-rights women' urged the revision of the marriage laws, and the rest of womankind was content with the *status quo*. When this became known, protests came from all sides. Women of all sorts and conditions sent signed petitions to some of the women members of Parliament urging the revision of the marriage laws, and most of the women's associations took up the question and passed resolutions giving moral support to the women members, and urging the points in the bills upon the marriage question."

Moreover, the possession of the franchise has been of practical use to women, not only by giving them the possibility of improving the conditions of their work and extending their legal rights, but also by helping them directly to better their economic position. Not long ago a test case was brought up by a woman teacher in one of the high schools, who claimed that as she was doing the same work as the men teachers and had passed the same examinations, she should be given the same salary. After a short discussion her request was granted, whereas similar requests made before women had the franchise had not been granted.

SCHOOLS TO TEACH GIRLS TO BECOME EFFICIENT WIVES AND MOTHERS

But as might be expected, the chief interest of the women has been to improve the condition of children. Over 50 per cent of the bills introduced into the three successive Diets have concerned the welfare of children. Many have been for rendering medical aid to poor women throughout the country districts, and for instructing them in the proper methods of caring for infants; many have treated of the improvement and extension of the public-school system and the care of school children; still others have dealt with special classes of children, orphans, waifs, and juvenile delinquents.

Now that the system of home instruction and private tutoring has passed perhaps forever—practically all children of nine or ten are sent to schools, and a large number of them to public schools—it seems only natural that women should take a tolerably intelligent interest in the management and direction of those schools and the state or municipal laws which govern them. When, too, in these days of democracy, the great majority of boys and a large number of girls also must look forward to earning their own living, it is only to be expected that women should feel the vital importance of investigating and, if possible, ameliorating the conditions of industrial life.

One of the noteworthy reforms undertaken by the women has been the establishment of schools of domestic training throughout the country—schools intended to teach young girls to become efficient and capable wives and mothers. These schools are of great importance, especially in the country districts and among the poorer class of people. They are becoming most valuable factors in the cultural development of the country, and are doing more than could perhaps be done in any other way to raise the general standards of living.

Thus the women have succeeded in materially bettering their own position; but they have done much more, for they have also carried through reforms of wide-reaching importance to the moral and social life of the whole community. A striking proof of this may be shown by the fact that in the church synod held in 1908 it was decided to grant women the elective suffrage for sundry church offices.

This motion was brought before one of the most conservative bodies in the country by a member of the synod who had previously been opposed to granting the political suffrage to women, and who introduced the motion of his own accord, saying that since the women had proved

themselves such efficient social and political workers, he felt that it would be an advantage to the church if they should be made eligible to many church offices.

The experience of three years of woman suffrage in Finland has proved, I think, beyond doubt that the emancipation of women is not a thing to be feared or dreaded, but merely a natural step in the evolution of modern society.

When the suffrage was extended to the women they responded with interest and enthusiasm, and have shown themselves capable of serving on all the various legislative committees. They have not disturbed the political balance of power, but have maintained it precisely as before, uniting as women only for the furtherance of social and legal reforms of importance to women, but also of very vital importance to the welfare and prosperity of the community at large.

Families have not been broken up by the woman's vote; rather have they tended to become more united by a strong bond of common interest. Instead of lessening the interest that women take in the education and the welfare of their children, the suffrage has greatly intensified that interest by making it possible for them to regulate and, in some degree at least, to improve the schools to which their children are sent and the different branches of work which they later undertake.

Experience has shown, too, that when the doors are opened, not all women rush madly into political life, but only those who are specially qualified for it; that for the vast majority of women the duties of the franchise consist in little more than casting their ballots, and that even the women who participate actively in political life devote no more time to it than they devoted previously to their extra domestic occupations or professions—that is, that even the small number of women who actually sit in Parliament need not neglect their homes unduly. But last and most important of all, it has shown that the cause that women have most at heart is the care and welfare of children.

NOTES ON FINLAND

DESPITE the obvious dissimilarity between Finland and the United States, the two countries have, nevertheless, many points in common, for Finland stands in much the same position in relation to Sweden as the United States does in relation to England, from the point of view of language, of social institutions, and the position of its women.

The Swedish language, brought over by the Swedes who early settled along the coast, became the language of culture in Finland, and the written language is still identical with the written language of Sweden, but in Sweden it is spoken as English is in England—with a rhythmic cadence and a rising inflection. In Finland Swedish is spoken as English is in America, less formally and with more variation in emphasis. In Finland, also, certain words in common use have changed their connotation, just as certain English words have in America.

But whereas in America the English language is the common language among all classes of the population, and serves as a bond of union which all foreigners coming to the country are anxious to share, in Finland now the Swedish language has become a great stumbling-block.

Formerly the Swedes were in almost absolute control of the social and political life of the country, and the language of the Finnish peasants of the interior had, in the early days, little influence on the general life of the country.

Within the last few years, however, Finland has passed through a marvelously rapid process of evolution. Many Finns of pure Finnish stock have become doctors and lawyers, Senators and college professors; the Finnish peasants have gained political equality and they are now demanding equal educational advantages, so that now the question of language has become a question of vital importance.

The current belief in America seems to be that the life of the country, politically, socially, and intellectually, is something quite distinct and individual, neither

Swedish nor Russian, Latin, Teutonic, nor Anglo-Saxon, and that the language in common use is Finnish.

As a matter of fact the culture of the country and the political institutions were all derived from Sweden, and Swedish is the language spoken in nearly all of the coast towns and in the country districts bordering on the coast. Swedish has always been the language of the upper classes, and until recent years Finnish was rarely heard except in the interior of the country and among the peasants.

The nationaiistic wave that has swept over England, bringing in its wake the Welsh revival and in Germany the less creditable anti-Polish movement, penetrated even to Finland, and many patriotic Finns are now desirous of abandoning the Swedish language and replacing it by Finnish. At present the movement is a very strong one, but how long it will last and whether or not it will be ultimately successful are matters open to conjecture.

The Finnish language at present possesses no literature with the exception of the *Kalevala,* the Finnish national epic, and certain novels and stories that have been written within the present generation. The literary language is in process of formation, and every present-day writer finds it necessary to coin numberless words to designate objects unknown to the simple peasants and shades of meaning which correspond to the subtler feelings of a more complicated and cultured civilization.

We are not here concerned with the question as to whether or not it is the part of wisdom to foster a language which has 15 cases, bears little relation to any other language except that spoken by the Estish peasants of the Baltic coast, and is a far more difficult language to learn even than Russian. The supporters of the movement have, at any rate, the excellent argument in their favor that it is the native tongue of about 85 per cent of the population, and that any other language must be always, to the great mass of the people, a foreign tongue, and that a people can only attain to the highest forms of poetic and literary expression in their own native language.

BARONESS ALLETTA KORFF.

COSTA RICA—VULCAN'S SMITHY

By H. PITTIER, of the U. S. DEPARTMENT OF AGRICULTURE

FOR 15 YEARS DIRECTOR OF THE PHYSICAL GEOGRAPHICAL INSTITUTE OF SAN JOSÉ, COSTA RICA

THE earth's crust underlying Costa Rica and the whole of Central America is one of mother earth's great laboratories. The chemical work that is going on uninterruptedly deep below her glorious mountains is made evident to the inhabitants of the country by the numerous volcanoes and warm springs, as well as by the almost ceaseless upheaving of the soil, mostly in tremors imperceptible to the senses, but also occasionally in powerful and destructive commotions.

The mountains of Costa Rica are divided into two main systems. The southeastern system, which has one peak of 12,467 feet elevation, is at present without volcanoes, although its skeleton is formed mainly by old eruptive rocks. The peaks of the northwestern system, of less development and elevation, are mostly active or semi-active craters, the base of which is geologically of very recent origin. This chain begins with the conical peak of Turrialba, which rises in an uninterrupted slope from the plains

of Santa Clara, about 1,000 feet above sea-level, to the towering height of 10,965 feet. Its beautiful crater, forming a narrow, elongated basin, is constantly active, a strong current of sulphuric and aqueous vapors, mixed with sand, escaping noisily from a broad vent at its westernmost extremity. The only known violent eruption of this volcano, however, took place in 1869, when it poured forth huge quantities of stones and fine sand, the latter of which were carried by the trade-winds westward to Punta Arenas and farther away over the Pacific Ocean.

Within close proximity of Turrialba is Irazú, about 360 feet higher, and far better known on account of the facility with which it is reached on horseback from Cartago. This volcano shows three large extinct craters, and, far down on its northern slope, numerous solfataras and hot-water springs. It enjoys the undeserved reputation of being the one point from which both the Atlantic and Pacific oceans are visible at the same time—a peculiarity that in reality is shared by Turrialba and several other points of vantage along the ridge of the southeastern system. Its historical eruptions took place in 1723, 1726, 1821, 1822, 1844, and 1847, singularly enough in each instance, except the first (which began in February), during the month of May. The eruption of 1847 was simultaneous with heavy earthquakes, which were felt from Rivas in Nicaragua to the city of Panama.

POÁS, THE WORLD'S BIGGEST GEYSER

From Irazú the range continues westward until it reaches Poás, a picturesque mountain with a geyserian crater, photographed for the first time by the writer in 1888, and which seems to have shown

Photo by Prof. J. Fid Tristan, San Jose

THE WORLD'S LARGEST GEYSER: POÁS GEYSER, COSTA RICA

Geysers or hot-water volcanoes are sparsely distributed on the map of the world, and have been often studied and described. It will therefore be a matter of surprise to many readers to learn that the highest and by far the most formidable of them is not located in Iceland, nor in the Yellowstone National Park, nor in New Zealand, but in the little Republic of Costa Rica, on the northern boundary of Panama. The column of steam and water, shown in this picture, is 1,000 feet high.

A VIEW OF POÁS WHEN SIMMERING

Photo by J. Fid Tristan

The intervals between the eruptions are very irregular. Prof. J. Fid Tristan, who has made several visits to the geyser at different seasons of the year, writes that he rarely saw the geyser in the same condition as on a previous trip. Sometimes it appeared entirely quiet, without an eruption for many hours; at other times it was covered with clouds, the mist being so thick that one could hardly see farther than a few feet below the edge of the crater. At other periods the eruptions were very frequent, and in some of them the column of water and steam reached several thousand feet.

Photo by J. Fid Tristan

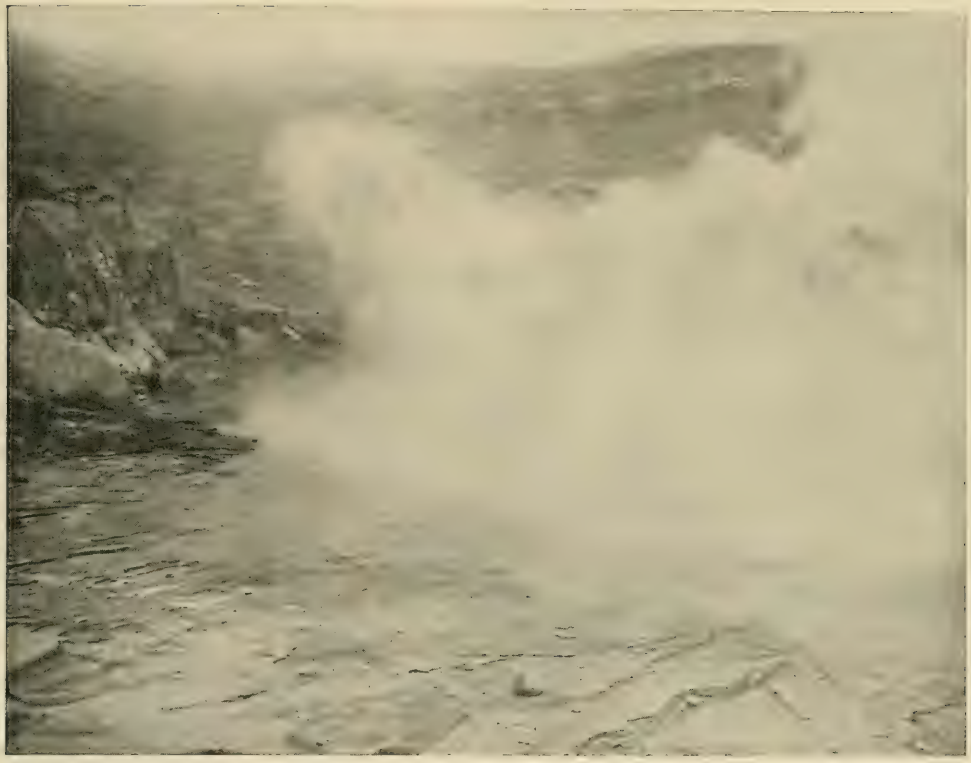
Poás crater is more than half a mile wide. Its walls are steep and precipitous and about 800 feet deep. The geyser ejects mainly water, but sometimes ashes and mud. In this picture rising mud can be seen distinctly in the center.

of late an unusual activity coincident with the long series of quakes that have just afflicted Costa Rica.

Poás has at least two craters. The higher one on the pyramidal top of the mountain is extinct and filled by a marvelous sheet of blue, cold water, framed in an exuberant border of semi-tropical vegetation; the other crater, 1,000 feet lower, showing at its bottom a lead-colored lagoon, is surrounded by almost vertical jagged walls of gray pumice and other eruptive materials. This is a geyserian basin, the eruptions of which occur at irregular intervals of from 12 to 20 minutes or more, and with variable intensity. At times the water, which tastes like strong vinegar, is hardly disturbed; at other times a heavy column accompanied by dense clouds of vapor surges to a variable height, creating a furious tempest on the usually placid lake.

In 1889 the writer witnessed the rise of a column of muddy water about 1,000 feet in height, while in January last it attained, according to official reports, no less than 13,000 feet. Like Irazú, Mount Poás is of very easy access, and of late it has become very popular on account of the variety of its natural beauties. Before the January eruption of the present year it was not known to have had any dangerous outburst in historical times.

The volcanic cordillera of Costa Rica



THE BOTTOM OF POÁS CRATER Photo by J. Fid Tristan

ends near the southwestern extremity of Lake Nicaragua with Mount Orosí, the conical form of which denotes its igneous origin. But between it and the Poás geyser there are a number of other craters, some still in semi-active condition and the others quite extinct. Among the latter, the most conspicuous are Tenorio and Miravalles, well known to the officers of coasting vessels trading between Panama and San Francisco, because they are the beacons which indicate the position of the Gulf of Nicoya and the port of Puntarenas. We must not forget to add that the altitude of the range decreases steadily from Irazú westward, the peak of Orosí having an altitude of only 5,154 feet.

ROCKED BY EARTHQUAKES

The maximum of volcanic activity takes place at the eastern end of the range, and it is also that section of the country, just at its southern foot, between Turrialba and Poás—the so-called central plateau—that is most exposed to disastrous earthquakes. It is at the same time the most densely populated part of the whole country.

This central plateau then is almost constantly rocked by underground convulsions of variable intensity. From 1866 to 1903, inclusive, the average yearly number of recorded shocks was 34, about half of which were generally felt in San José and its immediate vicinity. The maximum number of shocks, 103, was reached in 1900, but during that year there were no very heavy quakes. Contrary to the opinion current among the natives, that these earthquake phenomena are more frequent at the beginning and at the end of the rainy season—a view formerly sustained by the writer

Photo by J. Fid Tristan

CLIMBING OUT OF POÁS

himself—there is no seasonal periodicity, the seisms being distributed almost evenly throughout the twelve months.

The quakes very seldom come singly, but mostly in groups, with one or several culminating shocks at some point of the series. In the 1888-'89 series, of which the writer made a special investigation, the phenomena began October 11, 1888, with almost imperceptible trepidations, and continued to increase until December 30, at 4.12 a. m., when a destructive shock worked havoc in San José and in the neighboring towns, and then steadily diminished, finally ending on February 18. The total number of separate shocks registered by the instrument was 45.

Notwithstanding the fact that in the minds of the highly imaginative and excited natives the volcanoes were the original cause of the disturbance, these hardly showed any unusual activity, as was made clear by a careful exploration; but this failed to satisfy the public, and the responsibility was speedily shifted to a hitherto unheard of crater, the *Cacho Negro,* which gave the investigating commissioner more trouble and headaches than all the real volcanoes and earthquakes taken together.

THE ERUPTION OF POÁS, JANUARY, 1910

In the most recent happenings, the disturbances seem to have started with a colossal eruption of the Poás geyser on January 25 last. On that day, at about 5 p. m., an extraordinary smoke-like column was seen from San José rising to a prodigious height, which the scientific commission, appointed later to investigate the volcano, estimated at no less than 13,000 feet. After reaching its higher point, the column spread into a mushroom-shaped grayish cloud, which, carried by the anti-trade winds, soon covered like an immense screen the whole valley of San José.

An hour after the first indication of the unusual phenomenon, a rain of ashes or volcanic sand began to fall in the capital, situated at about 20 miles, as the crow flies, southwest of Poás. Traveling in the direction toward the latter, it was noticed that the sand increased in quantity as well as in the size of its grains.

In the near proximity of the crater the volcanic mud was strongly mixed with stones, many of which, measuring as much as 1.3 foot in diameter, had broken in their fall thick limbs and roots of trees and penetrated deep into the ground. The geyserian crater itself had resumed its usual placidity, its eruptive manifestations even seeming to have stopped altogether.

From his practical knowledge of the usual course of events, the writer surmises that from the date of the above-described eruption there were repeated earth tremors in the surrounding region,

and these increased in both intensity and frequency up to the date of the two successive catastrophes that befell the unfortunate little Republic. Information, however, is lacking, owing to the regrettable fact that the condition and assistance of the observatory in San José are no longer what they used to be.

SHOCKS IN APRIL

On April 13, thirty-seven minutes after midnight, the population of the central plateau were suddenly awakened from their slumber to realize that everything around—the houses and their belongings, the churches, in the belfries of which the bells were madly ringing, the trees and the ground itself—was violently shaking. Without losing time even to put on the most elementary covering, every one ran to the open, and in a few minutes the streets and plazas were filled by terrified, clamoring crowds, some already discussing the probable origin of the quake, but most of them on their knees, loudly imploring the protection of the Saints.

Meanwhile the earth continued trembling, and up to 8.15 a. m. there were felt no less than 23 shocks, which, however, were of steadily decreasing intensity. Then everything was quiet again until 1.11 p. m., when there was another, apparently isolated shock, followed by two more at about 3 p. m., and again a single one a little after 10 o'clock. On April 14, 24 tremors of minor intensity were recorded, and on the 15th 12 more had been reported up to 2 p. m.; but only the first shock, at 12.37 a. m. of the 13th, and possibly the following shock at 1.07, were of a destructive character.

There was no loss of life, but in San José several public buildings were so badly wrecked as to become unfit for use, and walls of hundreds of private houses, many of them substantially built, were cracked or otherwise injured.

Cartago suffered damages of the same kind, and, moreover, the ground in its surroundings was rent and fissured at several places. The strongest shocks

THE ERUPTION OF POÁS GEYSER, JANUARY 25, 1910 (SEE PAGE 500)

The photograph was taken in San José, about 25 miles distant, by M. R. Soriano, and sent to the NATIONAL GEOGRAPHIC MAGAZINE by Prof. J. Fid Tristan, of San José.

were felt along the foot of the Cordillera volcánica from Siquirres, at the eastern foot of Turrialba, to Lake Nicaragua, but they were most severe in the central plateau. In Port Limon the two first shocks only were felt, but were scarcely perceptible.

After a few days, no more seismical records were reported, though it is doubtful whether the earth tremors ceased completely. The excitement subsided, the throngs, camping in the parks under military tents and other improvised shelters, began to flock back to their usual abodes, and everybody's attention became fixed again on the coming political event, the inauguration of a new administration. This was to take place—as it did, although under the most distressing circumstances in the history of Costa Rica—on May 8.

Photo by J. Fid Tristan

A HOLE MADE BY FALLING STONE ON THE EDGE OF THE CRATER OF POÁS
(SEE PAGE 500)

Some of these holes were 3 feet deep. Note the white ashes which has shrouded the vegetation

The shower of ashes from Poás, January 25, 1910, covered the trees and shrubs for many miles around with a beautiful white powder (see page 500)

Photo from Rear Admiral F. Singer, U. S. N.

A succession of shocks during April so frightened the people of Cartago that they camped out in the parks and open places during the earlier weeks of the month. Gradually the shocks subsided and the people then returned to their houses to be overwhelmed by the terrible quake of May 4 (see page 501).

THE CATASTROPHE OF MAY 4

Meanwhile the underground forces were not inactive, even though the public ceased to pay due attention to the warnings of the seismological apparatus or these had stopped working. On Wednesday, May 4, twelve minutes after noon, a premonitory oscillation was felt at San José and Cartago; but if it again awakened the fears of the timorous ones, it was not enough to render them suspicious of the possibility of worse happenings.

At 6.50 p. m., when the early tropical darkness had sent most people home to prepare for their nightly rest, a sudden shock, coming apparently from beneath their feet, converted Cartago in an instant into an immense heap of rubbish, from which rose in the midst of deafening crashes and underground noises the death shrieks of hundreds of victims and the agonizing appeals of living ones imprisoned beneath the debris of their abodes.

A point on which most witnesses agree is the sharpness of the most destructive shock; it was followed indeed by a series of oscillations which lasted for several seconds, but the disaster was a thing of the first impulse and of imperceptible duration.

Of the people that were taken alive from the ruins, only a few had had time to follow their instinct or the inspiration of a rare presence of mind and to glide under a table or bedstead; among the dead a merchant was found with the pen still between his fingers, crushed flat upon the ledger in which he had been writing; a shoemaker lay with his arm stretched above his head, hammer in hand, as in the act of striking the sole.

No pen could picture the horror of the situation; the uninjured running about blindly through the debris, too dazed to know what to do; the electric-light plant out of commission, and every lantern in the place smashed, so that everything was wrapped in complete

ONE OF THE PRINCIPAL STREETS IN CARTAGO AFTER THE EARTHQUAKE OF MAY 4, 1910

darkness; all means of communication with the neighboring towns cut off.

DR ANDERSON'S EXPERIENCE

Dr Luis Anderson, a well-known Costa Rican lawyer and statesman, who left Washington a few weeks before, after having won for his country fair hopes of an equitable adjustment of a long-disputed boundary question, writes:

"I was just in the act of crossing the street from one sidewalk to the other when I felt something strange, like a sensation of emptiness, for the description of which no words can be found. At the same time an explosive noise, comparable to the almost simultaneous discharge of many rifles, filled the air. I shut my eyes for one second, and when I again opened them the utmost obscurity enveloped me; Cartago no longer existed. I realized that all danger of being crushed was past, since nothing had been left standing, but, at the same time, I felt as though death would come through asphyxiation. The violence of the following oscillations was such that I was thrown on the ground, where I lay stretched for a while."

Persons who were on their door-sills or walking along on the narrow sidewalk tell how they were thrown into the middle of the street, while still others who were far from any falling wall were thrown against these to a certain death.

Dr Anderson soon realized the helplessness of the stricken city, and, failing to obtain any quick means of transportation, started to walk the 10 miles to Tres Rios, about half way to San José, and which he reached a little after 10 p. m. There, after the Morse apparatus had been extracted from under the ruins of the telegraph office and reconnected, he succeeded in wiring the appalling news to the capital, which had had its share

A CHURCH IN CARTAGO, DESTROYED MAY 4, 1910

Photo from J. Fid Tristan

Photo from J. Fid Tristan

A HOUSE IN CARTAGO

Photo from J. Fid Tristan

A SCHOOL FOR YOUNG LADIES IN CARTAGO
The pupils and teachers were crushed in the ruins

A HOUSE IN THE CENTER OF THE CITY OF CARTAGO

of the calamity, although on a lesser scale.

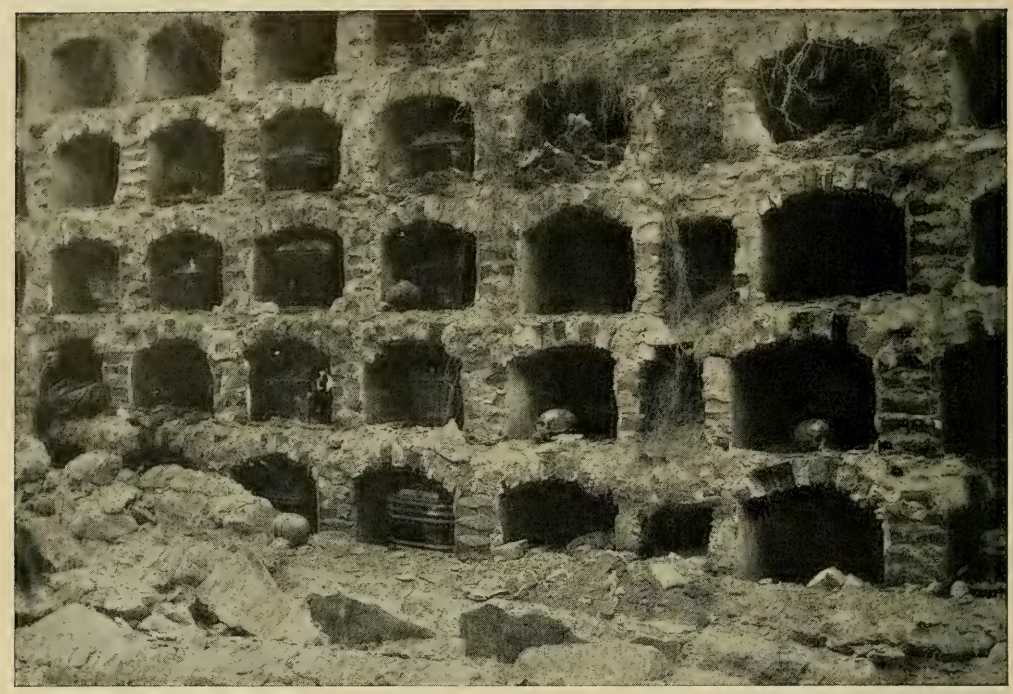
A first relief train was soon started, but at a short distance beyond Tres Rios a huge cleft in the mountain side had twisted the track in such a way as to make impossible any further progress by rail. So the little troup of physicians and other helpers, headed by the President of the Republic, had to continue their way on foot, arriving at the place where formerly had stood Cartago a little before 5 a. m., or nearly ten hours after the direful event.

Unfortunate Cartago, one of the most ancient European cities in America, has had in its past several like experiences, though none so fatal. As a consequence of the long eruption of the Irazú, accompanied by continual earth movements and subterraneous rumblings, the place was largely depopulated in 1723. It grew up again during the next century, but on September 2, 1841, it was utterly wiped out by an earth commotion of unheard of violence; the victims, however, were few, and as most buildings were very unsubstantially built of adobe and roofed with straw or tiles, the damages were of relatively little importance. So the community was again prosperous in 1851, when on May 18 it was partly destroyed by a new series of seismic disturbances.

Although it suffered less than San José from the several shocks experienced in 1888-'89, it would appear that it is located at or near the more exposed portion of the Costa Rican seismic area.

In the present case, however, the little village of Paraiso, a short distance to the east, seems to have stood on the very center; here, except for the newly erected church, the ruins of which are still partly standing, every bit of wall has been razed to the ground, while the proportion of human victims is considerably larger than in Cartago.

A few weeks ago the surrounding country was strewn with small native dwellings, most of which sheltered large families, and which also crumbled into



THE CEMETERY AT CARTAGO, SHOWING THE VAULTS BURST OPEN BY THE EARTHQUAKE

dust under the terrific blow. Today these former abodes of simple and good people look like shapeless tumuli, hiding in many instances untold victims, and all around ownerless cattle are peacefully browsing unmindful of their desolate surroundings.

FUTURE RAVAGES CAN BE PREVENTED BY BUILDINGS OF WOOD AND STEEL

The greater part of modern Cartago was very substantially built of stone and brick with roofs of tile or of corrugated iron, and mostly on the old Spanish plan; that is to say, with four sides forming a square around one or two inner *patios* or courts. There were few two-story houses, and an exceptional number of churches, none of which have been spared. As it was explained above, the principal damage was caused by the first commotion, but the falling in of the buildings that had partly resisted continued as a result of the repeated shocks, which numbered no less than 180 during the four hours directly following the initial movement.

Ninety-six squares have been completely leveled, and the few houses left standing in the remaining part of the city are useless ruins, excepting one, which was left as a practical lesson to be applied in the work of reconstruction. This is a wooden cottage, which was indeed slightly moved from its foundations and somewhat twisted, but stood the shocks well enough not to endanger the life of its inmates.

In view of the fact that Cartago, as also the whole central plateau of Costa Rica, is constantly exposed to a repetition of the same seismic troubles, it is to be hoped that the use of wooden-frame houses will become general, and that the architectonic art will develop along the cottage and bungalow lines rather than in heavy stone or adobe construction.

In the United States, under very vari-

THE TOWER OF EL CARMEN WAS HURLED MANY YARDS (SEE PAGE 513)

able climatic conditions, there are hundreds of towns twice as large at least as Cartago or even San José that are almost exclusively built of wood, and the dwellings of which are in every respect more salubrious and more comfortable than the best houses in Costa Rica. The timber supply of the little republic will be practically inexhaustible when the extensive primeval forests that still cover three-quarters of the entire surface of the country are made accessible by the means of good roads.

The only building materials to be imported would then be, as heretofore, gypsum, iron sheeting, and hardware. No objection could really be made, except those born from a long-acquired prejudice, against the radical abandonment of the cumbrous earth or stone walls and tile roofs, and of a general style of building the origin of which can be traced to the Moors of southern Spain.

Of course this system of light wooden construction is applicable mainly to private dwellings, while a more substantial style may be desirable for public and business buildings. For these structures the steel-frame combination so extensively used in the great American cities affords adequate protection. Steel edifices of two or three stories can be made absolutely earthquake-proof as well as fireproof, and should therefore be generally adopted for schools, public offices, and other establishments where large crowds congregate. San José possesses such a school building that has withstood many heavy shocks without the least damage. It has also a private 3-story steel frame and brick structure which shows very slight damage as a result of the recent catastrophe.

But the public should be protected against the ignorance of so-called architects who pretend to make walls more resistant by including in their mass light

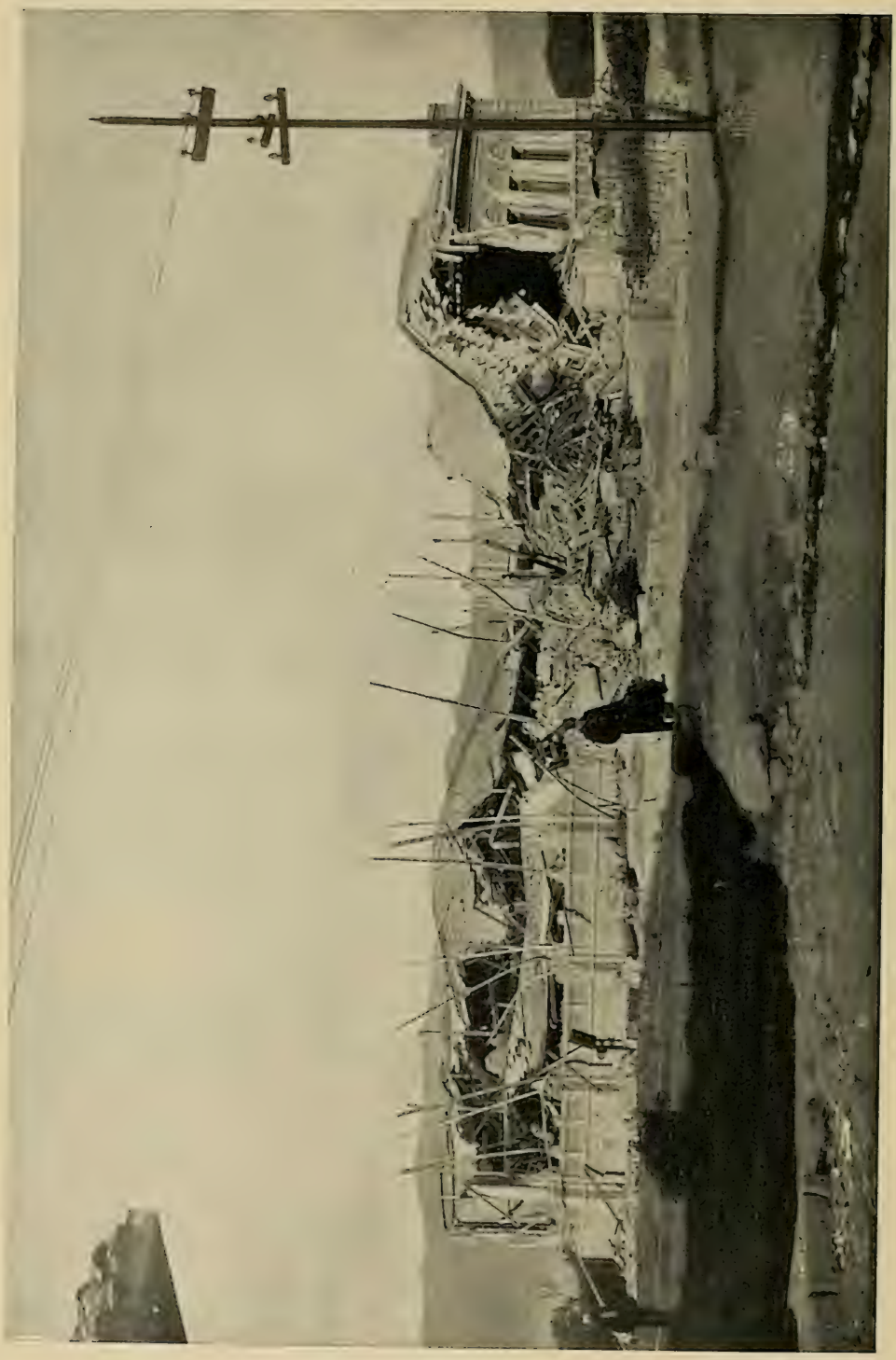


Photo from Rear Admiral F. Singer, U. S. N.

THE CARNEGIE PALACE OF PEACE, DESTROYED BY THE EARTHQUAKE MAY 4, 1910

Mr Carnegie immediately offered to rebuild the palace

Photo from Rear Admiral F. Singer, U. S. N.

THE CARNEGIE PALACE OF PEACE, NEARLY COMPLETED AT CARTAGO, COSTA RICA, AS IT APPEARED THREE WEEKS BEFORE THE EARTHQUAKE OF MAY 4

isolated steel rails, as may be seen, for example, in the pictures of the destroyed Carnegie building in Cartago. The frames protect the structure by their almost absolute rigidity, while isolated steel rails act under the shocks like so many springs that repeat and prolong the initial oscillatory movement, only to make more certain the total destruction of the walls they were intended to strengthen.

MR CARNEGIE'S PEACE PALACE DESTROYED

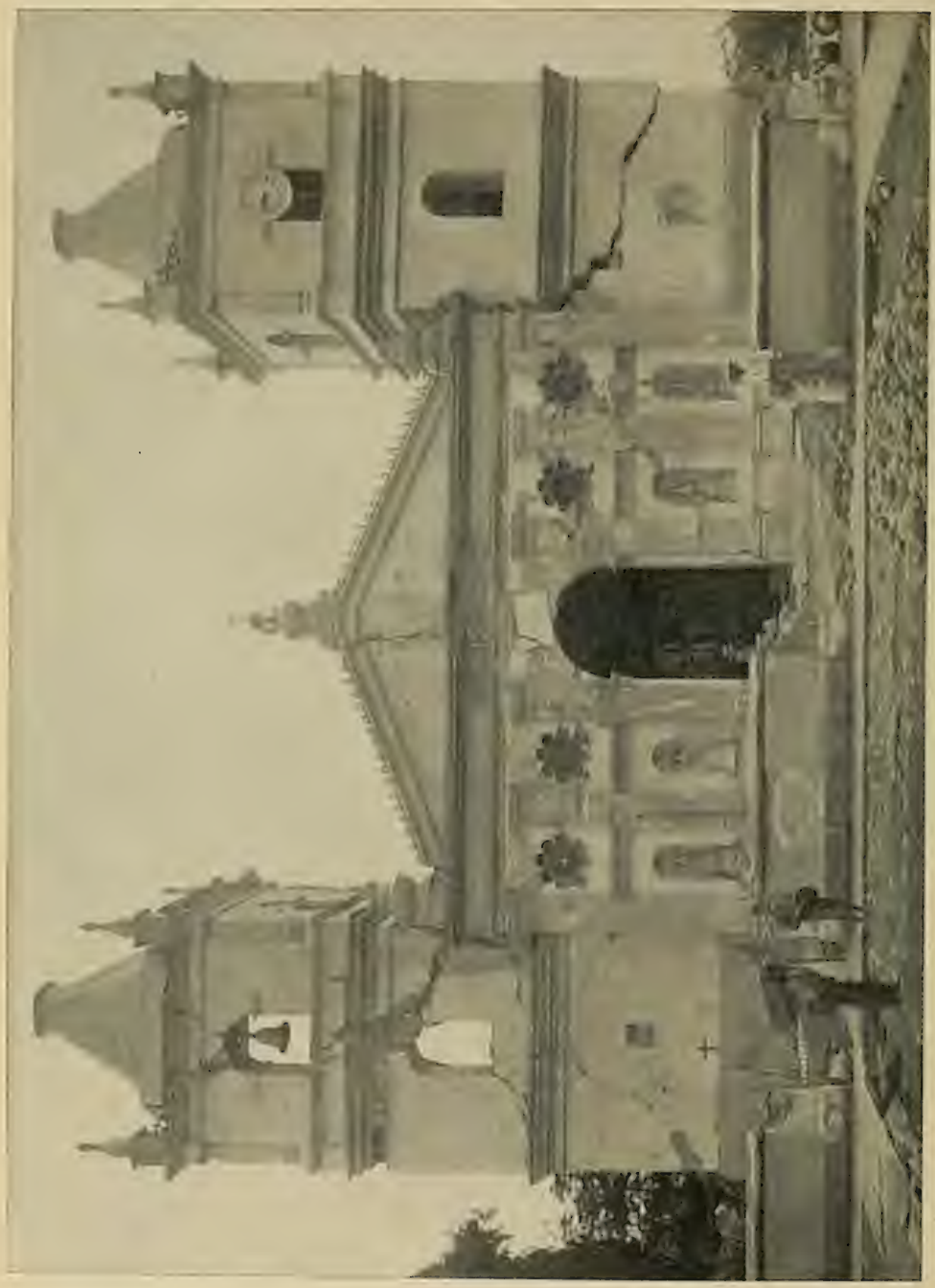
Several incidents are reported that give a further idea of the nature and violence of the seismic storm. All around Cartago the innumerable rounded stones scattered over the fields by former irruptions of mountain torrents had been collected to form the inclosures around pastures and truck gardens. These walls were completely demolished by the quakes, and many of the heaviest blocks, weighing in some instances over two tons, were moved 70 to 100 feet from their original place.

The top of the southern tower of El Carmen, one of the oldest churches, which had in the past resisted many strong shocks, was detached in a single piece and hurled to the middle of the neighboring street, where it demolished the railroad track.

On the plaza in front of the church the statue of Don Jesús Jiménez, a former patriot and president, was merely transferred, without falling, from the center to one of the corners of its pedestal.

The palace built at the expense of Mr Andrew Carnegie, to be the abode of the Central American Court of Arbitration, and which was soon to be dedicated, was converted into a shapeless heap of rubbish but for its foundation and the southern front wall. The new sewerage and water systems, on the other hand, do not seem to have suffered.

Going westward the extent of the damage becomes gradually less until it is almost insignificant at Alajuela, at the



"LOS ANGELES" Photo from J. Fid Tristan

One of the richest churches in Cartago. The treasures kept in this church are worth many thousand dollars

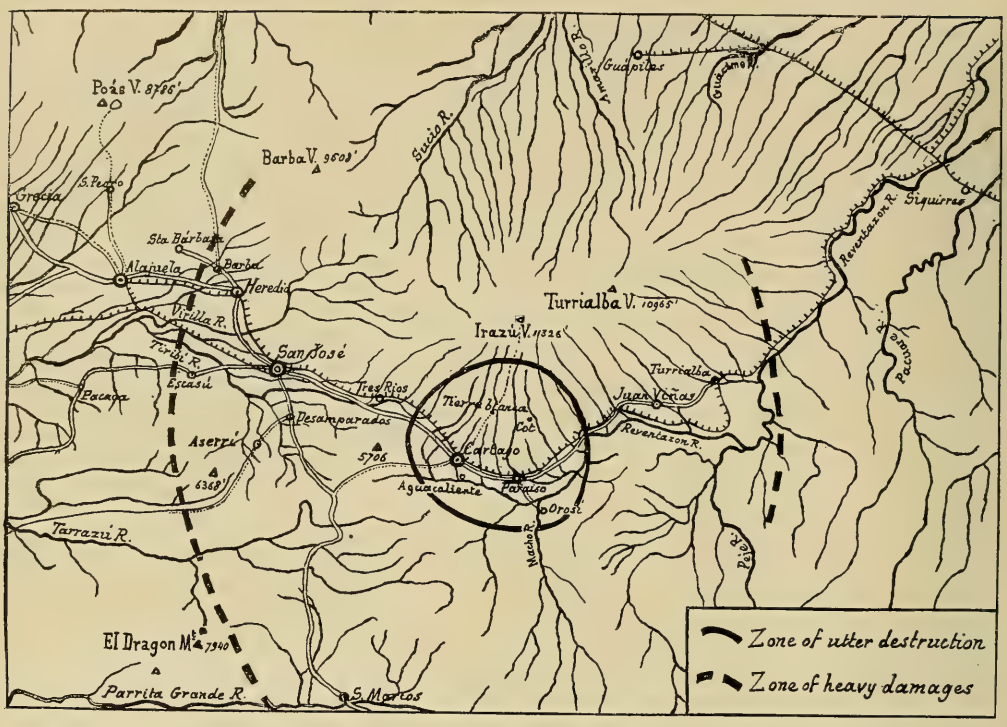
PANORAMA OF THE RESIDENCE SECTION OF CARTAGO AFTER THE EARTHQUAKE OF MAY 4, 1910

foot of the Poás Volcano. In San José the material losses have been considerable. Among the public property, the four buildings of the boys' high school are practically out of use; two other school buildings have lost their upper stories; the old presidential mansion, of late Comandancia de Armas, is a wreck; the new penitentiary building is heavily damaged, and the Supreme Court of Justice had to be evacuated. Of the private residences, it is said that 80 per cent could not possibly stand a repetition of the trial of April 13 last.

At the latest news, about May 23, seismic movements were still felt, although with a reduced intensity, and 6 to 10 shocks were reported daily. All seem to indicate, however, that the worst is over.

During the night of May 13-14 several persons affirmed having seen from San José glaring flames issuing from the volcanoes, disagreeing only as to the identity of the crater, which some called Irazú and others Poás. These two are located, as may be seen from the map, in quite opposite directions. The contradiction is now explained by the fact, attested by many people, that at the moment of the strongest shock a brilliant meteor crossed the zenith exactly from east to west, and further notices from the Pacific coast indicate that that body fell in the middle of the Gulf of Nicoya.

As a matter of fact, none of the Costa Rican volcanoes have shown of late any sign of unusual activity, and the current notices about lava eruptions and the formation of new craters should be accepted with caution.



MAP OF THAT PART OF COSTA RICA WHICH WAS OVERWHELMED BY THE EARTHQUAKE OF MAY 4, 1910, BY H. PITTIER

As usual on such occasions, many instances of miraculous rescues are cited, and a large number of persons at first thought to have perished turned up safe and sound. Nevertheless, the ruins of the old city had already given back over 600 bodies at the date of our latest information, and many more will remain to rest awhile under the débris, lucky if death came instantly and not, as it has been found in several cases, after hours of excruciating agony.

In Paraiso, over 120 dead have been removed from the ruins, and, if the casualty lists of Aguacaliente, El Tejar, Tierra Blanca, Cot, San Rafael, and other villages and hamlets or isolated houses are added to the former, the total number of the victims will certainly reach far above 1,000. Besides, it is feared that many of the 500 or 600 patients filling the hospitals in consequence of the earthquakes may not recover.

The material losses, reaching a sum well up into the millions, may not seem very great to an American, but they are simply crushing to a little country like Costa Rica, especially at the present time, coming upon her as it has in the most serious and trying financial crisis she has ever experienced in her history.

THE PEOPLE OF COSTA RICA ARE VERY DIFFERENT FROM OTHER CENTRAL AMERICANS

The sympathy of the American people and of all civilized nations will certainly go out to the unfortunate little Republic, which is attractive not only on account of its natural beauties, the richness of its flora and fauna, the striking contrast between its warm and fruitful coastal plains, which yield yearly millions of bunches of bananas, and its picturesque mountains, producing coffee of the very finest quality, as well as nearly every

product of the temperate zone, but also because of the history of the past half century of steady fighting, not bloody and cruel, nor for power, nor for the satisfaction of petty ambitions, but for the conquest of knowledge and the enlightenment of its citizens.

For Costa Rica stands alone among the turbulent Central American States in all things pertaining to freedom, self-government, and progress. The country was colonized at first by people from the ancient Spanish province of Galicia, and the colonists have not, as in many tropical countries, amalgamated with the aborigines; they have consequently kept to the present time the original characteristics, as well as the qualities of their race, and the inherent grace and charm of their ancestors. They are laborious, progressive, and peace-loving, and have a record of a long period of absolute internal tranquillity.

Three-quarters of the population inhabit the so-called Central Plateau, the climate of which is the most perfect realization of perpetual spring. The agriculture of this region is very highly developed, the principal product being coffee, maize, beans, and potatoes. The land is divided into exceedingly small holdings. Almost every peasant is a land-owner.

The Atlantic coast, warm, humid, and rather unhealthful, but very fertile, produces on a very large scale bananas and cacao, the exploitation of which is unfortunately tied by contracts with foreign companies. In the banana plantations, covering over a hundred square miles, the laborers are mainly West Indian negroes, the only human beings able to stand hard and continuous work under the climatic conditions.

The Pacific coast does not differ much from the interior but for its warmer temperature and its extensive grass-covered savanas, in which stock raising is the chief industry.

Except for a small part, located in the western province of Guanacaste, the 360,000 inhabitants are crowded into a narrow belt extending across the country from Ocean to Ocean, along the railroad which connects Port Limon and Punta Arenas. The remaining part of the State—that is to say, four-fifths of its entire surface of about 18,400 square miles—is a wilderness, with but a handful of hardly half-civilized Indians inhabiting the valleys of Diquís and Talamanca.

Of the five Central American Republics, Costa Rica was the first to be connected by a railway with the eastern coast, thus getting into close touch with European civilization. In many respects this was a source of real benefit to the country. The Costa Ricans became great travelers. They sent their sons to be educated in foreign schools and universities, and on their return these diffused among their fellow-citizens new ideals and more advanced moral standards. Foreign teachers and professors were brought and kept long enough to establish on a solid foundation an excellent school system, so perfect indeed that illiterate men or women are hard to find, while books and newspapers are common even in the most remote hamlets. The scientific study of the climate and the natural resources of the country was carried on at the expense of the government, and the introduction of modern arts and agricultural methods and implements were given every encouragement.

Sad to say, the uplift in the general education has awakened misdirected ambitions among the poorer classes, attracted the peasants to the cities, created a greed for government positions, these having consequently multiplied beyond all reasonable limits, with a corresponding and necessary increase of public expenditures.

Moreover, on account of a heavy public debt, the result, partly of unscrupulous speculations of foreign and native financiers and of unwise undertakings, the government has become entangled in heavy financial difficulties that have brought the country to the verge of bankruptcy. This deplorable economic situation has been aggravated of late by

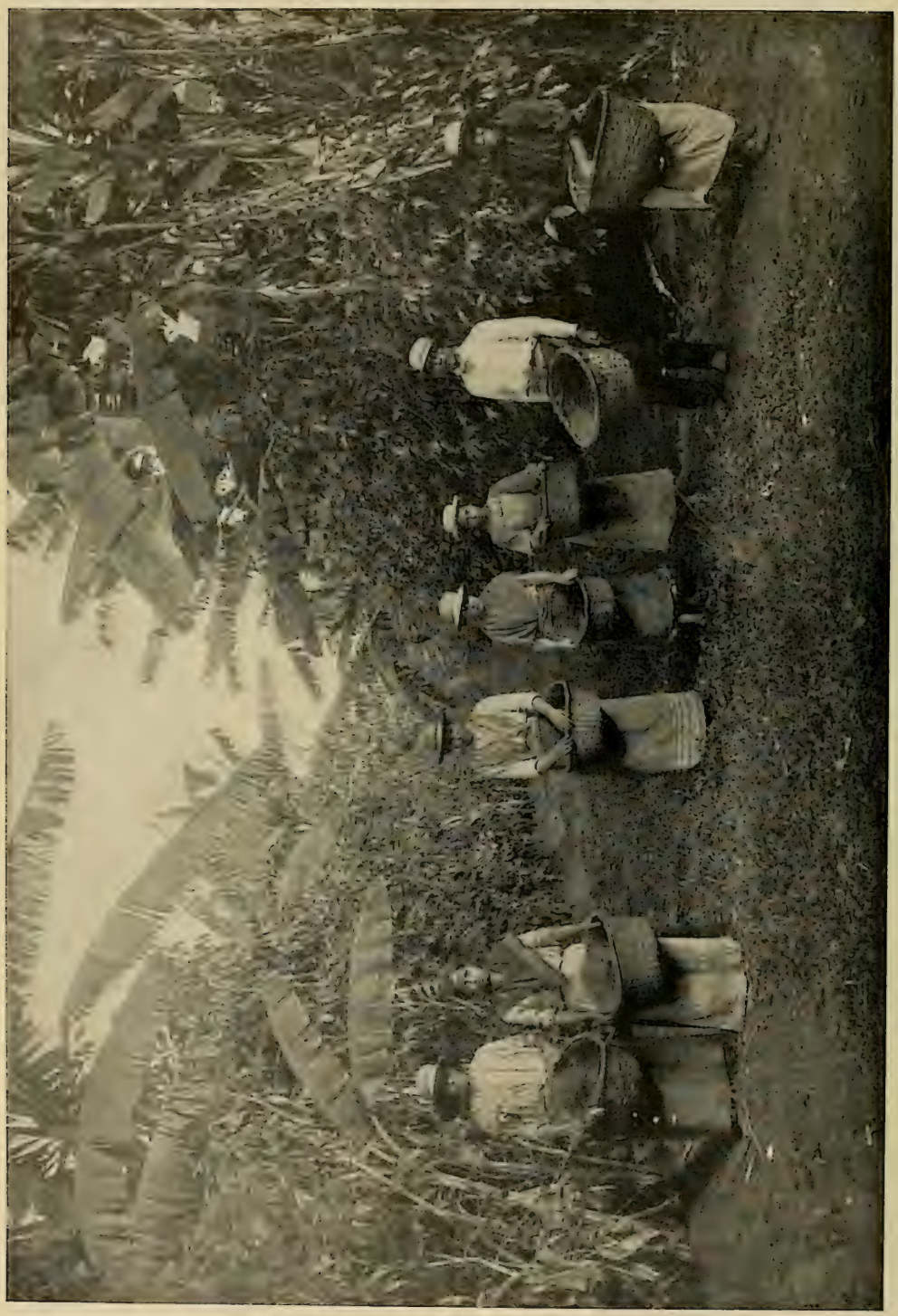


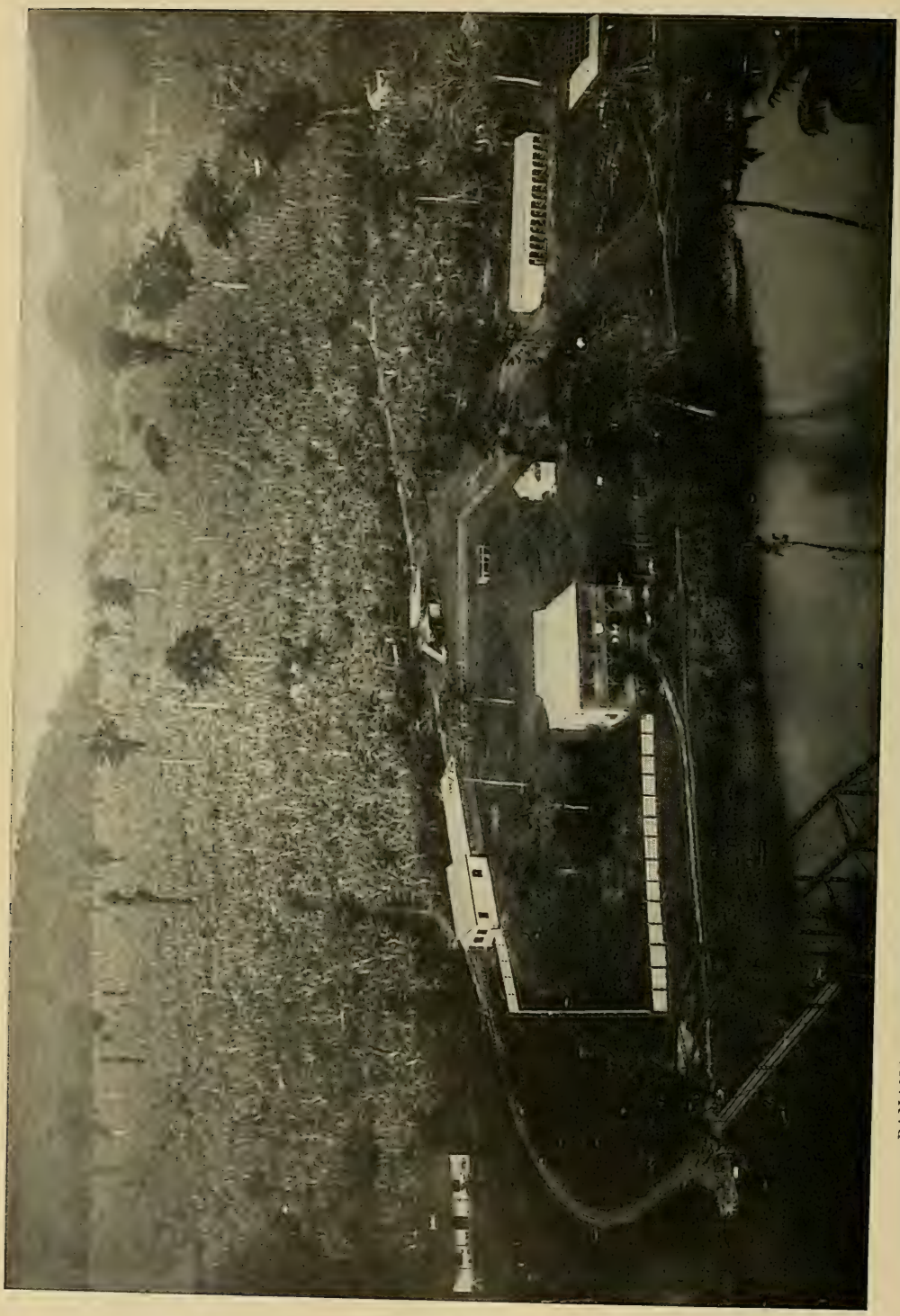
Photo by Rev. Grinter

A COFFEE PLANTATION IN COSTA RICA

Banana trees protect the coffee bushes from the intense rays of the sun

PICKING COFFEE, COSTA RICA

Photo by Rev. Grinter



BANANA PLANTATION OF THE UNITED FRUIT COMPANY AT CHIRRIPÓ, NEAR PORT LIMON Photo by H. Pittier

Zent River in the foreground, Chirripó River and last spurs of the Cordillera in background

Photo by H. Pittier

SHIPPING THE BANANAS, COSTA RICA

Photos by H. Pittier

POLISHING A LARGE JAR WITH A STONE

THE KILN FOR BAKING SMALL PIECES

MAKING POTTERY IN COSTA RICA

MODELING

BAKING A LARGE POT

Photos by H. Pittier

A STREET OF NICOYA, A PACIFIC COAST VILLAGE

NATIVE CART, COSTA RICA

Photos by H. Pittier

several consecutive failures of the coffee crop, by unusual rainy seasons, resulting in inundations, destruction of railroads, and depression of the banana trade.

A catastrophe like that which has just befallen Costa Rica is appalling enough whenever it occurs, but it could not have come at a more unfortunate time in the life of that interesting spot of the American Tropics.

THE ERRATIC

By O. A. Ljungstedt, of the U. S. Geological Survey

WHENEVER your vacation rambles have taken you to one of the Northern States of the country, you have no doubt often been struck by the sight of some unusually large boulder perched on the top of a mountain, or resting, maybe, in such a nicely balanced position by the very edge of the sea that a dashing wave may rock it to and fro.

Examine one of these boulders more closely and you will find several things to distinguish it from others that you may have noticed south of the area shown as white in the map on page 526. Should the rock on which the boulder lies be bare of soil, it will often be found to be of a different kind than that of which the boulder is composed. Thus the boulder itself may be of granite and rest on a surface of limestone, shale, or sandstone.

You will also often find this bare rock polished to a remarkable degree, or marred by scratches, and even deep grooves running in a more or less parallel direction, known as glacial striæ.

To understand how a block of granite as large as a small cabin could be lodged on top of a mountain when there is no similar rock within a hundred miles or more, we must trace its history back to a time at least 200,000 years ago, when the geologic period called the Tertiary was drawing to its close. The first fact to attract our attention, could we have taken a bird's-eye view of the northern part of our continent at that time, would be its greater extent than at present. Looking eastward we would see the shoreline extending in places a hundred miles beyond the shoreline of today, and in vain would we scan for the islands, bays, and reaches that now lend such enchantment to our picturesque coast.

Northward the land probably stretched unbroken over the present Arctic archipelago, and connected on the east by way of Greenland, Iceland, and the Scandinavian Peninsula with Europe and on the west by closing of Bering Strait with Asia.

This circumstance had a very important bearing on the fauna of that day, as it enabled the animals from the one continent to cross to the other. Making a closer inspection of the landscape beneath us, we would be surprised at the total absence of the smaller lakes that now are its most characteristic feature. Even the Great Lakes were missing, with the possible exception of Lake Superior, while in the valleys in which these latter now lie flowed rivers belonging to one or more systems.

The mountain groups of today we would recognize at once, notwithstanding their somewhat more rugged outline, and the same would be true in the case of the rivers. While we would see a number of them in strange courses, the master streams we would know at first glance. For millions of years these had been cutting their channels undisturbed, until at the close of the Tertiary a new impetus was imparted to them, owing to the recent rise of land and the ever-increasing humidity of the climate. So we would probably see them turbulent and swollen and the sides of their water-courses often precipitous and jagged, overhung in

MAP OF NORTH AMERICA AT THE TIME OF MAXIMUM EXTENT OF THE ICE

Showing also the approximate outline of the continent. There were minor ice-centers, not indicated, over most of the high mountain ranges of the west from which glaciers descended the valleys and in some places deployed on the plains.

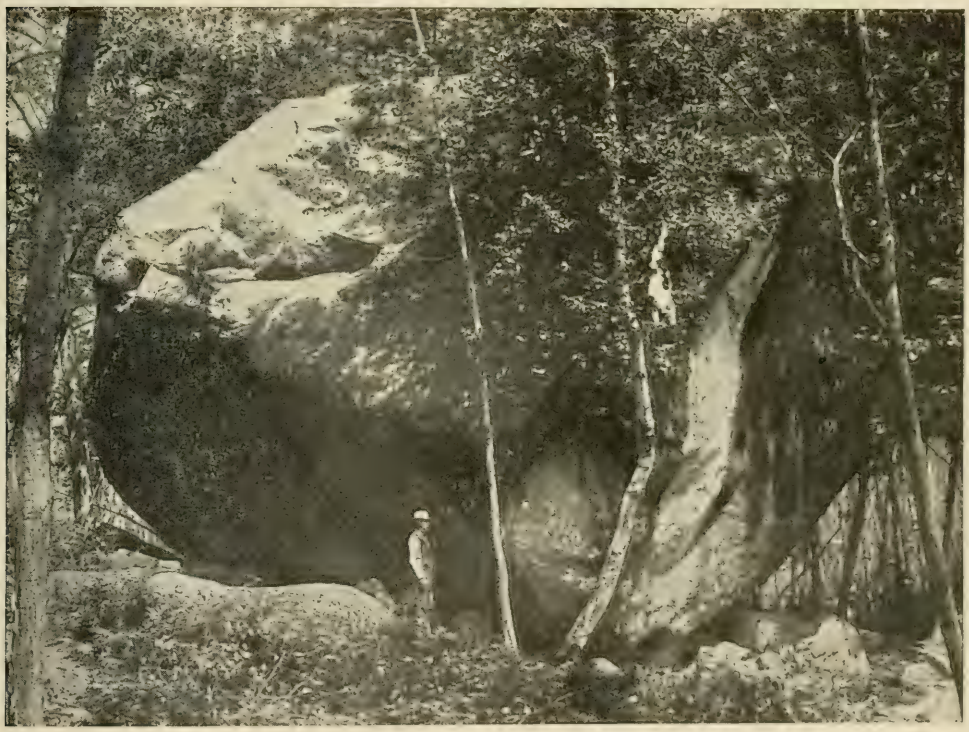
places by great ledges and loose blocks readily dislodged by the least force.

The climate over the whole continent was semi-tropical, or at least temperate, and such plants as the fig and great redwoods of California grew as far north as Greenland and Iceland. And through the almost endless woods of the north roamed herds of mastodon and other herbivore of great size, together with such beasts of prey as the now extinct saber-toothed tiger. But we would find no trace of man.

Over this strange and magnificent world the Ice Age swept down so suddenly, as geologic time is reckoned, that

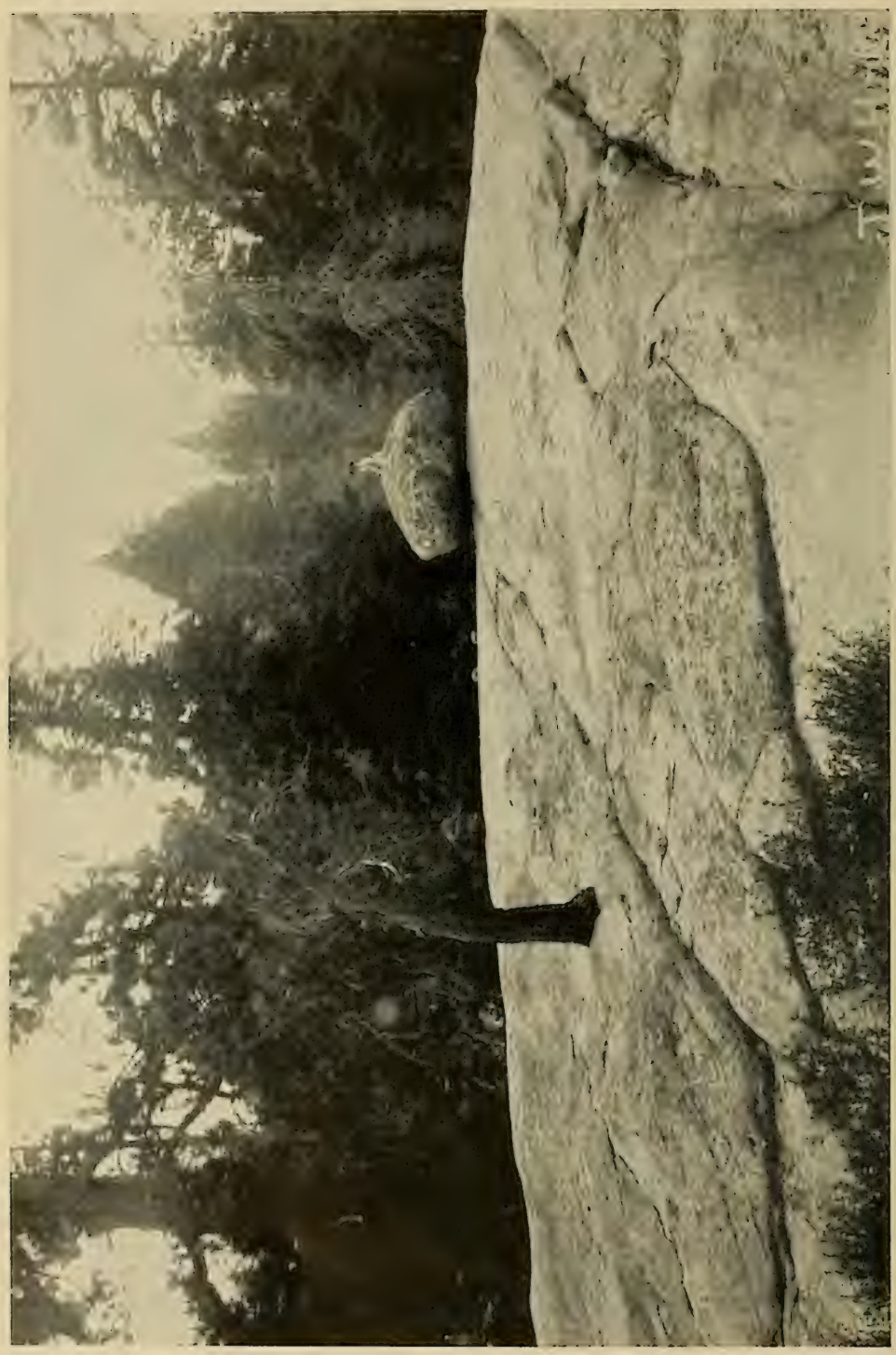
A VERY REMARKABLE CASE OF ONE ERRATIC SUPERIMPOSED ON ANOTHER

The upper one of coarse granite, the lower one of granite gneiss resting on a granite ledge. They are situated at Sunnyridge farmhouse, 3 miles west-northwest from Barre, Massachusetts. From photo by Mr. C. W. Alden, of the U. S. Geological Survey.



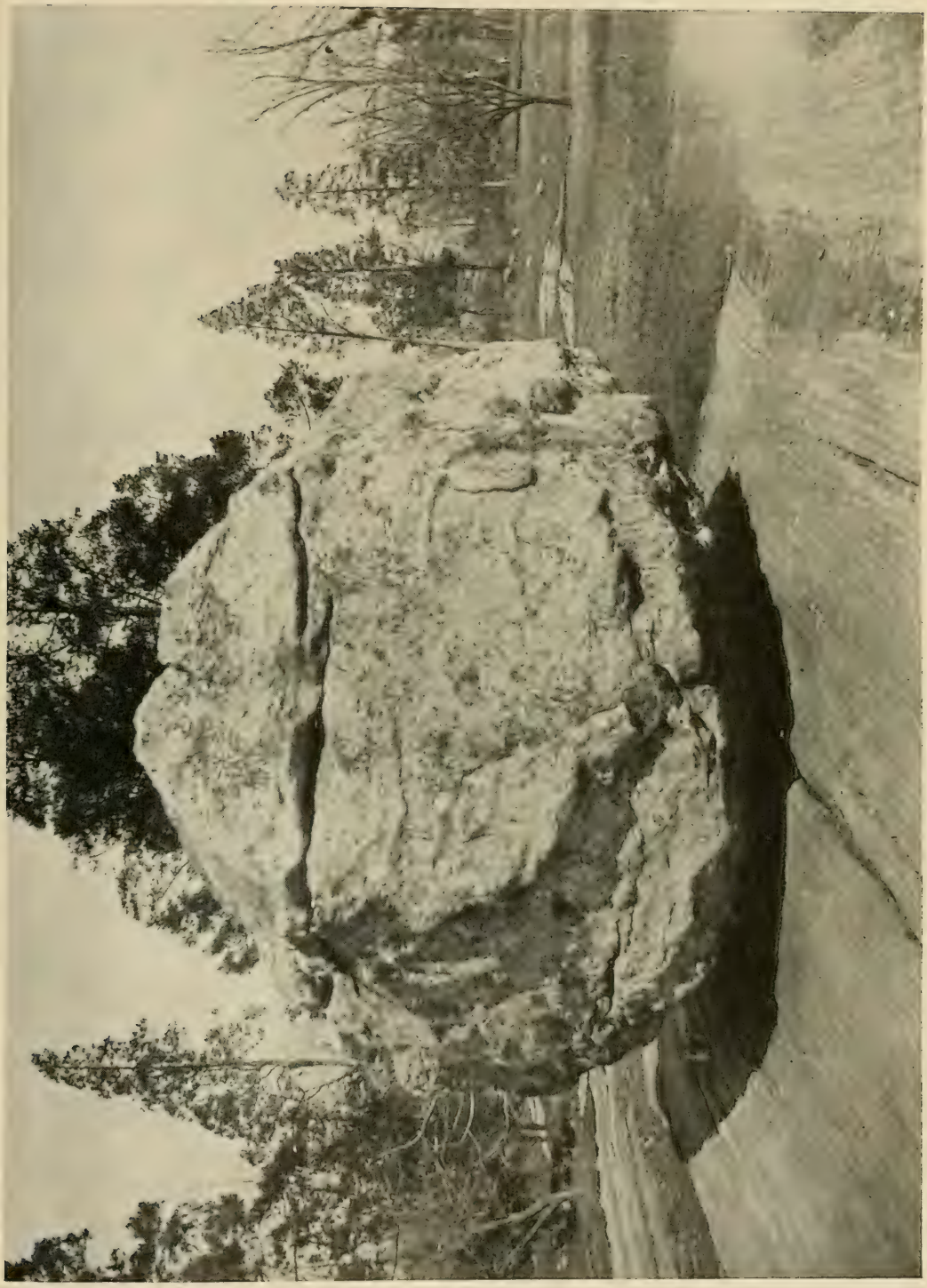
THE WASHINGTON BOULDER NEAR CONWAY, NEW HAMPSHIRE

From negative in possession of the Geological Society of America

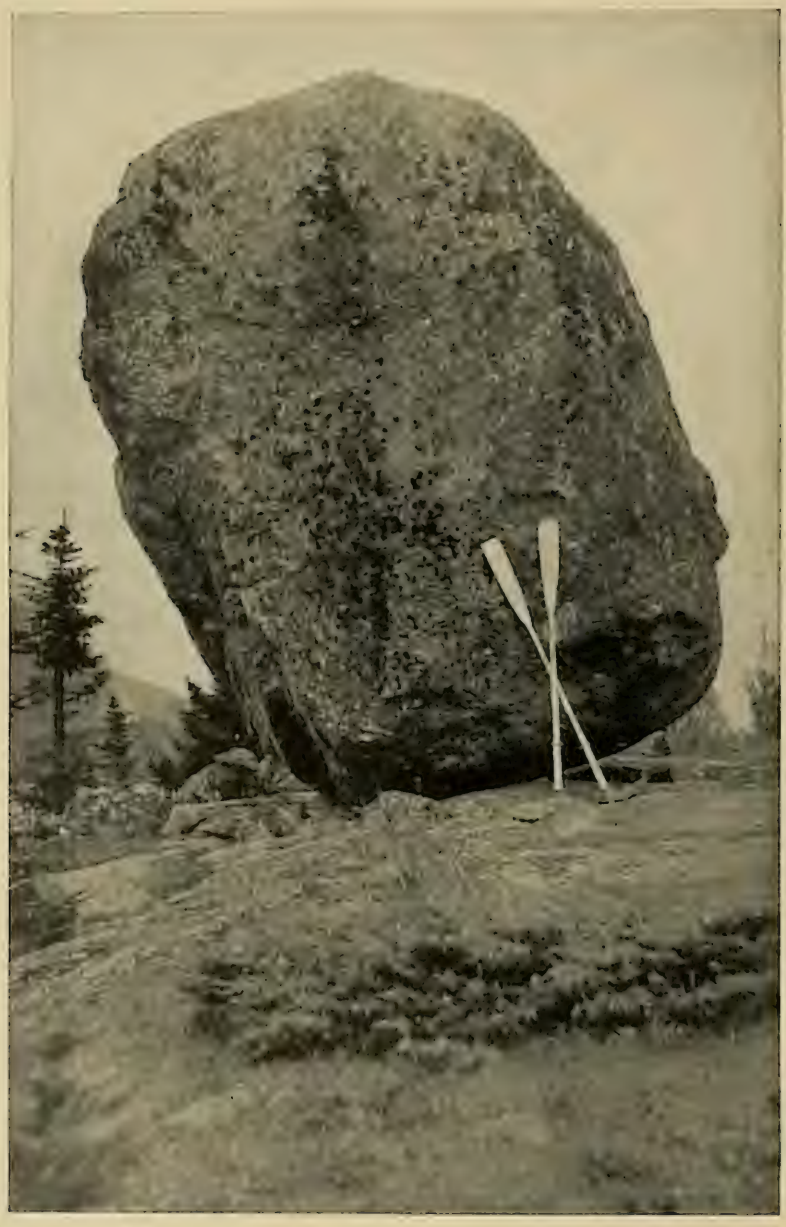


BOULDER ON GLACIATED SURFACE NORTH OF BLOODS, CALIFORNIA

This is the work of glaciers descending the valleys from one of the local ice-centers south of the continental cap. From photograph by H. W. Turner



An erratic often lies on a smooth and striated surface as does this one in Bronx Park, New York City. The grooves show the direction in which the ice moved. From negative in possession of the Geological Society of America



BOULDER AT SOUTHWEST END OF MEGUNTICOOK LAKE, WEST OF CAMDEN, MAINE
From photo by E. S. Bastin, of the U. S. Geological Survey

most of the then existing animal and plant forms, pushed south before its advance, had not time enough to adapt themselves to their new environment, and therefore became greatly altered or exterminated.

As yet there has been no good reason assigned for a change that in a comparatively short time transformed the semi-tropical climate into that of Greenland of today. Probably a combination of circumstances brought it about.

Be that as it may, the fact remains that over certain centers—one on the east of Hudson Bay, the Labradorian; another on the west of it, the Keewatin; and a third in the Canadian Rockies, the Cordilleran — snow, gradually changing into ice, accumulated year after year to such immense thicknesses that finally, impelled by its own weight, motion began, and three giant glaciers crept out over the adjacent country. These finally joined into a continental ice mass that at its greatest extent covered two-thirds of North America—an area of about 4,000,000 square miles.

While there may have been some difference in time at which the various ice centers reached their greatest development, we will be very near the truth in saying that from the southern limit, shown on the map, northward the ice lay in one unbroken expanse, with the exception of the so-called Driftless Area and possibly one of the highest mountain peaks in the East. It is calculated that its thickness at the two eastern centers must have been something like 5,000 to 10,000 feet.

On its way from the north the ice mass gathered to itself immense quantities of soil and loose rock, which were carried along with it. Occasionally huge blocks of rock from mountain slopes and stream bottoms were clutched in the firm grip of the ice and carted for hundreds of miles. Frequently the ice would lift great boulders from the bottom of a valley to the top of a mountain.

Presently the ice began to retreat before a more congenial climate. It was not at first, however, a steady retreat, as not less than four times the ice again advanced after having almost vanished, and each time it was followed by animals and plants adapted to the semi-frigid climate at its edge. During one of these interglacial epochs man appeared upon the scene.

But as the ice melted and disappeared the earth and rocks which it carried were dumped, sometimes as an even mantle, but more often in hills and ridges.

A PRIMITIVE GYROSCOPE IN LIBERIA

By G. N. Collins

THE recent applications of the gyroscope in the Brennan monorail and as a means of steadying steamships, as well as the present popularity of toys based on this principle, recall a gyroscopic toy in use among the Golahs of Liberia, West Africa. Certain members of this primitive tribe have developed a very remarkable skill in manipulating this top-like toy, which they keep spinning for any length of time in midair merely by whipping it.

Interest in this primitive gyroscope has been further increased by the botanical identification of the fruit from which the tops are made. Mr W. T. Swingle, of the Department of Agriculture, points out that these hard-shelled, spherical fruits belong to the genus Balsamocitrus, a very near relative of the ball fruits of India and a more distant relative of the orange.

These fruits may well be described as hard-shelled oranges (see page 532). They are from three to five inches in diameter. The shell is very hard and from one-quarter to one-half inch in thickness.

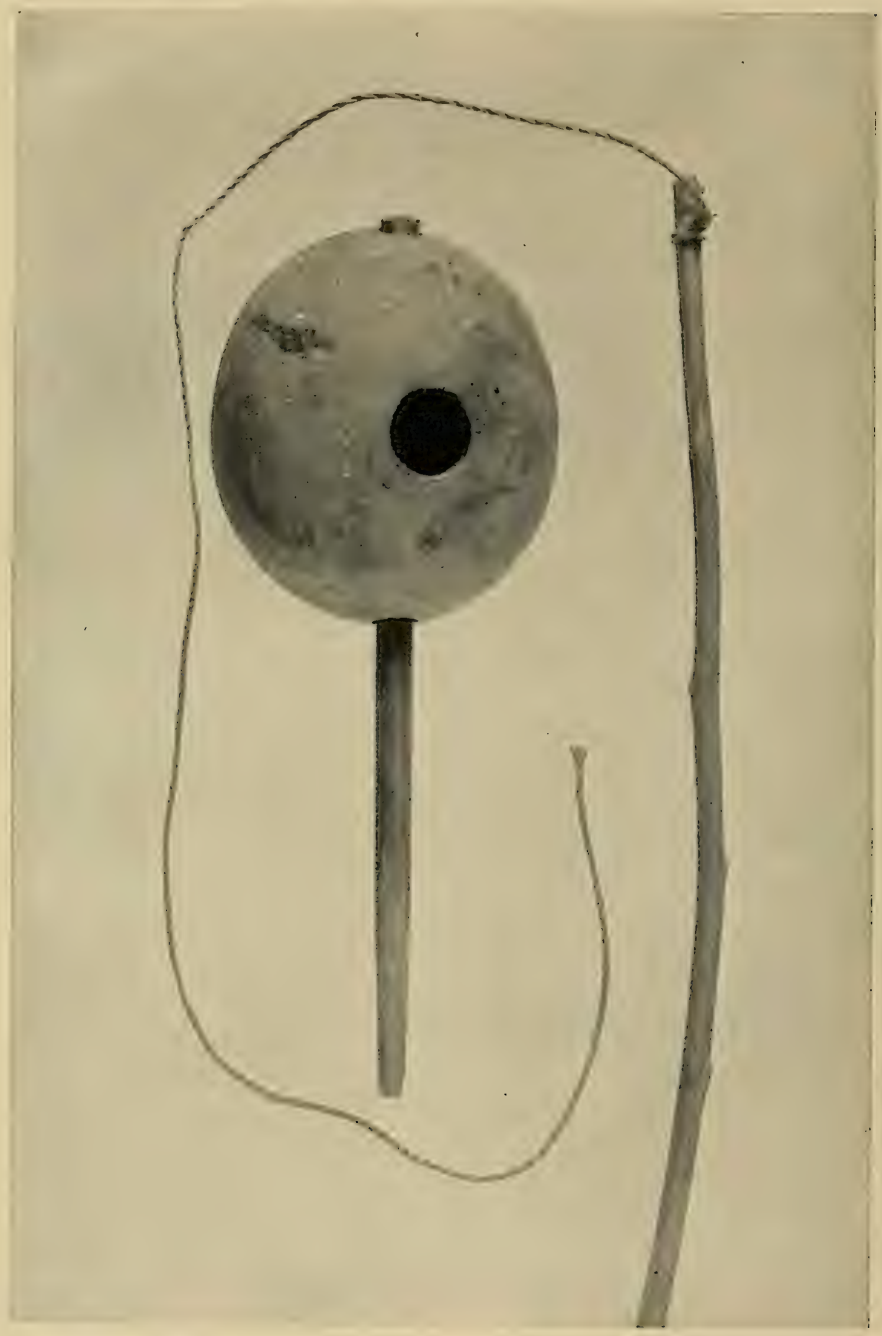


Photo by G. N. Collins

LIBERIA GYROSCOPIC TOP, MADE FROM THE FRUIT OF A HARD-SHELLED ORANGE

The top is made to spin rapidly in midair by the aid of the whip

Photo by G. N. Collins

METHOD OF STARTING THE GYROSCOPIC TOP

The lash of the whip is wound around the body of the top. A sudden upward motion throws the top into the air and starts it revolving

Photo by G. N. Collins

LIBERIAN NATIVE SPINNING THE GYROSCOPIC TOP

The top can be seen in the air above the Golah man's head. The top is kept in the air by repeated strokes of a small whip

The top is formed of one of the fruits from which the interior has been removed, together with a round stick about one-half an inch in diameter and eight inches in length. The stick passes through the center of the fruit, projecting only on one side. A hole is also cut in the side of the fruit so that the top produces a low, mournful sound when spinning rapidly.

The whip by means of which the top is kept in the air consists of a stalk about one foot in length to which a string about 18 inches long, made from the fiber of the wine palm, is tied as a lash.

The method of starting the top is shown on page 533. The lash of the whip is wound around the body of the top, making a little more than one turn. The top is then placed on the ground with the stem to one side. The whip is given a quick upward motion, throwing the top into the air at the same time, imparting to it a spinning motion. As the top drops within reach, but before it touches the ground, it is struck with the whip in such a manner that the lash winds around the stem close to the head. The stroke is immediately followed by another upward motion, which again throws the top up and makes it revolve still faster.

This operation is repeated rapidly, the top going faster and faster with each stroke, until it begins to emit a low musical note. The illustration on page 534 shows the top in the air.

The performance may be likened to the operation of the popular toy called "diablo," but the skill required is immensely greater. The "diablo" is thrown up from the middle, and the ends on either side of the string, being of equal weight, balance each other, while in the Liberian toy the weight is practically all on one side of the place struck by the whip.

Skilled performers have no difficulty in keeping the top in the air for any length of time desired. The performance is varied by catching the top on the stock of the whip and slowly tilting it until the end of the stick rests on the ground, where it spins for some time like an ordinary top. From this position, while still spinning, the top can again be thrown into the air by the whip and the whole operation repeated.

When first seen it seems incredible that the top can be thrown up by the stem, which is on one side, without twisting the top into another position. There can be no doubt that the same principle is involved as when a gyroscope is maintained in a horizontal position, although supported by only one end of the axis.

The skill required to operate this top is possessed by very few members of the tribe. Repeated and patient efforts on my part to acquire the knack were futile. I was never able to keep the top in the air for more than two or three strokes of the whip, and was never able to make it revolve fast enough to produce a sound.

Bwingba, the Golah man who is shown operating this top in the illustration, was the only native I met who possessed the necessary skill. That this man had more than ordinary ability was shown in other ways. His house was the best in the town, he could swim faster and dive farther than any one else, and he was always chosen for the dangerous work of taking the big canoes from the upper reaches of the Saint Paul River through the rapids to the lower river. This skill in aquatics was supposed to be explained by his having a hippopotamus for a totem.

The sound produced by this top is believed by the Golahs to be distasteful to the ground hogs, which often do considerable damage to cultivated fields. This means of driving away pests is considered so effective that men able to perform with this top are in great damand, and are often called a distance of two or three days' travel to rid fields of these pests.

EUROPEAN TRIBUTES TO PEARY

ALL the nations of Europe united to give Commander Peary a royal welcome on his visit to England and the Continent in May and early June. Emperors and kings, scientists, the public, and the press were all equally cordial and enthusiastic in their congratulations and tribute to his perseverance and success.

Commander Peary's trip was not a lecture tour, but was made in response to many invitations from geographical and scientific societies abroad who desired to hear his personal story of the discovery of the North Pole. It was impossible in the brief time to accept the invitations of all the societies, but eleven capitals were visited. Commander Peary gave his first European address in London before the Royal Geographical Society, which provided an enthusiastic audience of 10,000 people. The illness of King Edward prevented his attendance, and his death a few days later also prevented the presence of Emperor William at the Berlin lecture.

Every Society conferred its highest honors upon Commander Peary, in Rome the King Humbert Gold Medal of the Royal Italian Geographical Society being presented in person by the King of Italy. In Edinburgh, besides receiving a special trophy from the Royal Scottish Geographical Society, the degree of LL.D. was conferred upon him by the old University of Edinburgh.

We print below the addresses of the Presidents of the Royal Geographical Society of London and of the Geographical Society of Berlin, which are typical of the unanimous respect and tribute paid in Europe to our great American explorer.

ADDRESS OF THE PRESIDENT OF THE ROYAL GEOGRAPHICAL SOCIETY OF LONDON; DR LEONARD DARWIN, IN PRESENTING THE SPECIAL GOLD MEDAL OF THE SOCIETY.

"Commander Peary was awarded our gold medal twelve years ago, which is sufficient proof that he is an Arctic traveler of the highest reputation, and his efforts have been marked by such splendid persistency as to make success appear to be the inevitable result.

"An exceptionally capable committee of his fellow-countrymen, appointed by the National Geographic Society of America, have examined his original records, and have emphatically indorsed his claim. This judicial task could not have been more appropriately placed.

"It is on these grounds that, armed with the full authority of the Council of the Royal Geographical Society, I welcome Commander Peary as the first and only human being who has ever led a party of his fellow-creatures to a pole of the earth.

"We are not alone concerned with that aspect of Arctic exploration, for, in the course of the many arduous journeys, full of dangers and difficulties, which explorers have made when dragged northward by the lodestone of the Pole, a large amount of scientific work has been done and geographical knowledge has been greatly increased. Commander Peary's expeditions form no exception to this honorable record, and this should not be forgotten, because it has been the policy of the Society not to honor any mere race for the pole."

DR ALBRECHT PENCK, PRESIDENT OF THE GEOGRAPHICAL SOCIETY OF BERLIN, IN PRESENTING THE NACHTIGAL GOLD MEDAL OF THE SOCIETY.

"The members of this meeting have just stated by their great applause what living interest they take in the speaker's report of his expedition of the North Pole. This interest is based in the first place on the sentiment which President Roosevelt expressed when giving to our speaker, three and a half years ago, the Hubbard Medal of the National Geographic Society of America. He mentioned at that time that the firm basis of successful national characters are the fighting qualities of mankind, but that these qualities could not only be demonstrated in war, but also in peace, and that

THE SILVER SHIP WHICH WAS PRESENTED TO ROBERT E. PEARY BY THE ROYAL SCOTTISH GEOGRAPHICAL SOCIETY OF EDINBURGH, MAY 24, 1910

The ship is made entirely of silver, and weighs over 100 ounces. It stands about two feet in height and is mounted on four wheels. This Society had awarded its silver medal to Commander Peary in 1897 for crossing the ice cap of Greenland, and its gold medal to him in 1903 for his Arctic explorations during the preceding four years (see page 540).

Courtesy New York Times. Copyright, 1910

1. The Gold Medal of the Imperial Austrian Geographical Society, Vienna.
2. The Gold Medal of the Royal Belgian Geographical Society, Brussels.
3. The King Humbert Gold Medal of the Royal Italian Geographical Society, Rome, which was presented by the King of Italy.
4. The Gold Medal of the Royal Geographical Society of Antwerp.

Courtesy New York Times. Copyright, 1910

1. The Special Gold Medal of the Royal Geographical Society of London, designed by the wife of Captain Robert F. Scott, R. N., leader of the British South Polar Expeditions of 1901–1904 and 1910–1912.

2. The Nachtigal Gold Medal of the Gesellschaft fur Erdgunde of Berlin (Geographical Society of Berlin).

3. The Gold Medal of the Hungarian Geographical Society, the first and only gold medal ever awarded by this Society.

THE SPECIAL GOLD MEDAL OF THE NATIONAL GEOGRAPHIC SOCIETY, PRESENTED TO COMMANDER PEARY DECEMBER 15, 1909

The medal is four inches in diameter

it is of a special value to effect such qualities during a time of peace, when naturally a tendency to a weakening of the audacious powers is evident.

"We are sure that Commander Peary is one of those heroes disposed to fight, who, with never tiring activity and perseverance and using all their powers, are pushing forward in order to attain a great and difficult aim. But we feel more than that; we think of the enlargement of our knowledge of the globe, due to his courageous deeds.

"The New York Chamber of Commerce, which appointed him honorary member, was right in saying that the success of his last expedition was based neither on luck nor on bravery nor patience, but on experience, gathered by him during a man's life of ardent labor devoted to the exploration of the North Pole. Considering these merits, we celebrate not only the hero who reached the pole, but also the explorer who discovered a great part of the polar regions."

THE SILVER SHIP

At Edinburgh, at the conclusion of the address to the Royal Scottish Geographical Society, Lord Balfour of Burleigh presented to Commander Peary a silver model of a ship such as was used by illustrious Arctic navigators in the olden times. The ship is a copy of a three-masted vessel in full sail, such as was in use in the latter part of the sixteenth century. The model is a beautiful specimen of the silversmith's art. On one of the sails is engraved the badge of the Royal Scottish Geographical Society, while another bears the inscription in Latin from the pen of Mr W. B. Blaikie, which, translated, is as follows:

"This model of a ship, such as was used by John Davis, Henry Hudson, and William Baffin, illustrious Arctic navigators of the olden time, has been presented by the Royal Scottish Geographical Society as an evidence of its congratulation, admiration, and recognition to Robert Edwin Peary, American citizen, an explorer of the frozen Arctic, not less daring than his daring predecessors, who was the first to attain to that thrice-noble goal so long sought by innumerable bold mariners, the North Pole. Edinburgh, May 24th, 1910."

BOOK REVIEWS

Japanese Goldfish. By Dr Hugh M. Smith, Deputy U. S. Commissioner of Fisheries. Many illustrations and 10 colored plates. Washington, D. C.: W. F. Roberts & Co. Price, $2.00 *net.*

Dr Smith, well known to the readers of the NATIONAL GEOGRAPHIC MAGAZINE, is one of the world's foremost authorities on fishes, and his volume on Japanese Goldfishes is the result of a close study of the subject and will be regarded as an authority. The plates of the goldfish are splendid reproductions in natural colors and the book can be recommended in the highest terms. J. O. L.

The Gateway to the Sahara. By Charles Wellington Furlong. Pp. 300, 6½ x 8½. 35 illustrations and 3 maps. New York: Charles Scribner's Sons.

By word and picture the author, a well-known traveler, gives an insight into the most native of the Barbary capitals, its odd and fascinating customs and industries, and a view of those strange and interesting people who inhabit Tripolitania. It was Mr. Furlong who, in 1904, discovered the wrecked hull of the United States frigate *Philadelphia* below the waters of Tripoli harbor, and the book gives the dramatic episode of the vessel's destruction and finding a hundred years later. J. O. L.

London Town, Past and Present. By W. W. Hutchins, with a chapter on the Future of London by Ford Madox Hueffer. 2 vols. Pp. 1130, 8¼ x 8½. Several hundred illustrations. New York: Cassell & Company. Price, $6.00 *net.*

No work of greater importance, or one more likely to hold a permanent place, than "London Town, Past and Present," has yet been published. It is unique, comprehensive, and of marked value. It limits itself to no one period of time or to no one part of the capital, and discusses no abstruse or antiquarian questions. It recounts in vivid language all the important and arresting events from Roman times to the present day. Mr. Ford Madox Hueffer, in a clever and suggestive chapter, essays to lift a corner of the veil behind which is hidden the future of London, and presents, in characteristically rich and pregnant diction, some ingenious speculations on that theme. J. O. L.

Women of All Nations. Edited by T. Athol Joyce and N. W. Thomas. 2 vols. Pp. 772, 8¼ x 8½. Several hundred illustrations and series of color plates. New York: Cassell & Co. Price, $12.00 *net.*

"Women of All Nations" is an authoritative work by such men as the late Prof O. T. Mason, Dr Grumberg, Archibald Colquhoun, and others, being a record of the characteristics, habits, manners, customs, and influence of women ranging from the toilette of the Parisienne down to the scanty skirt of the Fijian belle. The volumes give in word and splendid picture the psychological characteristics of the women of every race. You may read how the gentler sex of China, Samoa, India, or Sweden live and work, together with their curious forms of courtship and marriage. The volumes are illustrated with a collection of rare photographs gathered from every part of the world. J. O. L.

Hunting In British East Africa. By Percy C. Madeira. Pp. 290, 6½ x 9. 130 illustrations and 2 maps. Philadelphia: J. B. Lippincott Co.

A very interesting narrative from the pen of a big game hunter telling of his experience in that sportsman's paradise, British East Africa. Starting with the initial arrangements for the big game hunt, the reader is taken step by step through the wildness of jungle and plain into the heart of the animal kingdom and hardly realizes the study of natural history he is absorbing so graphic is Mr. Madeira's story. The illustrations, actual photographs, are very fine and the maps comprehensive. J. O. L.

Wanderings In the Roman Campagnia. By Rodolfo Lanciani. Pp. 370, 7½ x 9½. 112 illustrations. Boston: Houghton, Mifflin Co.

Camp and Camino in Lower California. By Arthur Walbridge North, with introduction by Rear Admiral Robley D. Evans, U. S. N. Pp. 346, 7⅛ x 9⅛. 32 illustrations and 2 maps. New York: The Baker & Taylor Co. Price, $3.00 *net.*

A book of adventure and exploration in Lower California, a land of desert and mountains. Few regions on the globe are less known than this country at our very door. The volume contains much that is fascinating along the lines of hunting and adventure, at the same time giving valuable description and records of scientific exploration. J. O. L.

The Great Pacific Coast. By C. Reginald L. Enock. Pp. 356, 6¼ x 9. 63 illustrations and several maps. New York: Charles Scribner's Sons. Price, $4.00 *net.*

The book from the pen of this well-known writer on Latin American subjects is rather unique, treating as it does for the first time of the vast region of the Pacific Coast of North and South America as a physical and political entity. Seen from the viewpoint of an experienced traveler, the subject is one of great interest, and especially fine are the photographic illustrations. J. O. L.

Soil Fertility and Permanent Agriculture. By Cyril G. Hopkins. Pp. 650, 6 x 8½. Numerous maps and tables. Boston: Ginn & Co.

The book is written primarily for American land-owners, who must either think and plan for the preservation of the land or allow its

more extended ruin, and secondarily for other students of agriculture and economics, whether in the lecture-room or in the business world.

Geographical Essays. By William Morris Davis. Edited by Douglas William Johnson. Pp. 777, 8 x 5½. Boston: Ginn & Co. 1909.

This is a reprint, in permanent form, of certain of the geographical papers of Professor Davis. As the editor says in his introductory note, they are reprinted without change, except that a few minor modifications have been made in style, and in a few cases, material modifications have been made to bring the matter into accord with recent discoveries. Of the twenty-six Essays which are here reprinted, the first twelve are educational, the remainder being biographic in character. Three of the latter were originally published in this Magazine. H. G.

Descriptive Meteorology. By Willis L. Moore, LL. D., Sc. D. Pp. 344. 6 x 9. Illustrated. New York and London: D. Appleton & Co. 1910.

In his introduction, Professor Moore characterizes the *raison d'etre* for this book as follows:

"To provide, as far as possible, the young men entering the service of the U. S. Weather Bureau with a comprehensive introduction to modern meteorology. But to meet their needs in this particular is to provide equally well for all others who are beginning seriously this important science."

The work is divided into fifteen chapters, and a summary of its contents can perhaps best be given by an enumeration of their subjects, as follows:

The atmospheres of the earth and of the planets.
Atmospheric air.
Micro-organisms and dust motes of the air.
Physical condition of the sun, and its relation to the earth's atmosphere.
Heat, light, and temperature.
Thermometry.
Distribution of insolation and the resulting temperatures of the atmosphere, the land and the water.
The isothermal layer.
Atmospheric pressure and circulation, winds, clouds.
Precipitation.
Forecasting the weather.
Optical phenomena.
Climate.

The first four chapters deal to a large extent with matters only slightly related to meteorology, and might well be greatly condensed. To a less extent this is also true of the fifth chapter—that on heat, light, and temperature. The chapter on thermometry is devoted to a description of instruments and their installation. The next, on insolation, has a broad scope, including the distribution of temperature on land and water areas, its distribution in depth, both in the soil and water, its vertical distribution in the atmosphere, its distribution with latitude, etc.

The chapter on the isothermal layer sums up the results from a vast number of soundings of the upper atmosphere by means of balloons and kites. That on atmospheric pressure begins by describing the instruments used in its measurement. This is followed by an account of the general distribution of pressure over the earth, the general air movements, local movements, cyclonic movements, etc. This subject is concluded in the next chapter, that on winds, in which is included a description of the instruments used in measuring the direction and velocity of air currents. The chapter on clouds is brief, including their classification, formation, height, etc.

Precipitation is treated fully in all its forms, as to cause, distribution in time and space, modifying influences, etc., even to attempts to produce it artificially.

The application of much of what precedes is made in the next chapter, that on "Forecasting the Weather," being a description of the methods employed in this work in the Weather Bureau. Incidental to this are descriptions and explanations of many different phenomena of weather.

Optical phenomena include color of sky, coronas, rainbows, halos, mock suns, etc.

The final chapter defines climate as the average weather of a locality. It enumerates the meteorological data which constitute climate and the factors which modify and control them, such as latitude, altitude, topography, etc. Certain typical climates are described and their effects on the human race are characterized.

In the above attempt to summarize the contents of the book it must be understood that it is possible to hit only the high places, as the number of topics discussed is very great.

The matter is well arranged and the book is *readable*, a most excellent, though rare, quality in works on this subject. It is fully illustrated with maps and diagrams.

At the end of each chapter is a list of books treating on the subject-matter of that chapter.

Altogether this is a most comprehensive and excellent text-book on its subject. H. G.

Across the Sahara from Tripoli to Bornu. By Hanns Vischer, with foreward by Sir Harry Johnston. Pp. 304, 6½ x 9. 45 illustrations and map. New York: Longmans, Green & Co. Price, $3.50 *net.*

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