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2						2
3						3
4						4
5						5
6						6
7						7
8						8
9						9
10						10
11						11
12						12
13						13
14						14
15						15
16						16
17						17
18						18
19						19
20						20
21						21
22						22
23						23
24						24
TOTALS						TOTALS

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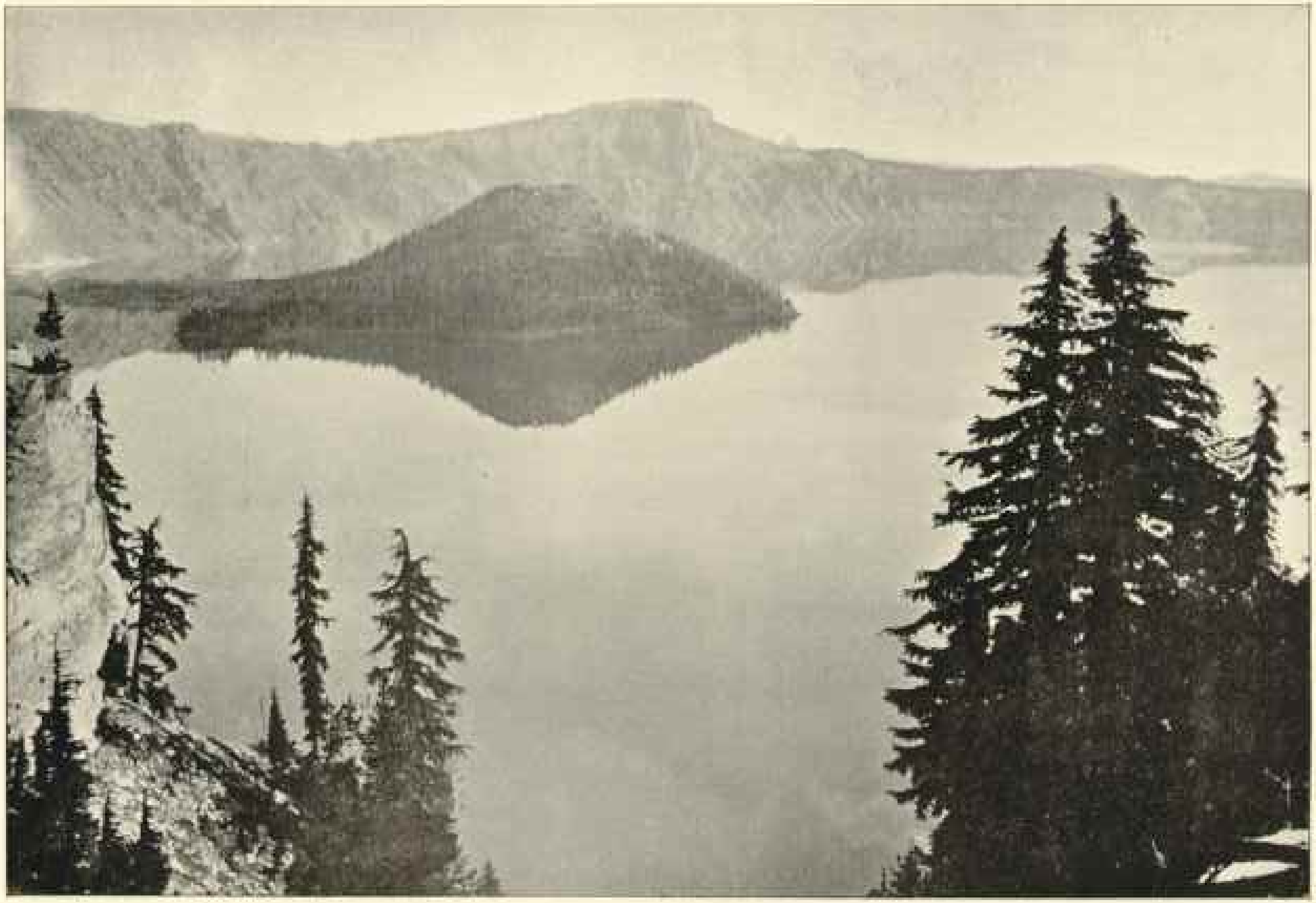


CRATER LAKE, OREGON

WIZARD ISLAND; DEVILS BACKBONE AND LLAO ROCK IN THE DISTANCE

From a photograph by M. M. Hazeltine

THE

National Geographic Magazine

VOL. VIII FEBRUARY, 1897 No. 2

CRATER LAKE, OREGON*

BY J. S. DILLER,

United States Geological Survey

Of lakes in the United States there are many and in great variety, but of crater lakes there is but one. Crater lakes are lakes which occupy the craters of volcanoes or pits of volcanic origin. They are most abundant in Italy and Central America, regions in which volcanoes are still active; and they occur also in France, Germany, India, Hawaii, and other parts of the world where volcanism has played an important rôle in its geological history.

The one in the United States belongs to the great volcanic field of the northwest, but it occurs in so secluded a spot among high mountains that it is almost unknown to tourists and men of science, who are especially interested in such natural wonders. Crater lake of southern Oregon lies in the very heart of the Cascade range, and, while it is especially attractive to the geologist on account of its remarkable geological history, it is equally inviting to the tourist and others in search of health and pleasure by communion with the beautiful and sublime in nature.

According to W. G. Steel,† the lake was first seen by white men in 1853. It had long previously been known to the Indians, whose legends, as related by Steel,‡ have contributed a name, Llao rock, to one of the prominences of its rim. They regarded the lake with awe as an abode of the Great Spirit. The first travelers of note who visited the lake were Lord Maxwell

*Published by permission of the Director of the U. S. Geological Survey.

† The Mountains of Oregon, by W. G. Steel, 1890, p. 13. ‡ Ibid

and Mr Bentley, who, in 1872, with Captain O. C. Applegate, of Modoc war fame, and three others, made a boat trip along its borders and named several of the prominences on the rim after members of the party.* Mrs F. F. Victor saw the lake in 1873 and briefly describes it in "Atlantis Arisen."†

The first Geological Survey party visited the lake in 1883, when Everett Hayden and the writer, after spending several days in examining the rim, tumbled logs over the cliffs to the water's edge, lashed them together with ropes to make a raft, and paddled over to the island. In 1886, under the direction of Captain (now Major) C. E. Dutton, many soundings of the lake were made by W. G. Steel, and a topographic map of the vicinity was prepared by Mark B. Kerr and Eugene Ricksecker. Dutton was the first to discover the more novel and salient features in the geological history of the lake, of which he has given, for his entertaining pen, an all too brief account.‡

Under the inspiration of the "Mazamas," a society of mountain climbers at Portland, Oregon, of whose work an account is given in this magazine (page 58), a more extended study of the lake has just been made by government parties from the Department of Agriculture, the Fish Commission, and the Geological Survey.

Crater lake is deeply set in the summit of the Cascade range, about 65 miles north of the California line. As yet it may be reached only by private conveyance over about 80 miles of mountain roads from Ashland, Medford, or Gold Hill, on the Southern Pacific railroad, in the Rogue River valley of southern Oregon. This valley marks the line between the Klamath mountains of the Coast range on the west and the Cascade range on the east. The journey from the railroad to Crater lake affords a good opportunity to observe some of the most important features of this great pile of lavas. The Cascade range in southern Oregon is a broad irregular platform, terminating rather abruptly in places upon its borders, especially to the westward, where the underlying Cretaceous and Tertiary sediments come to the surface. It is surmounted by volcanic cones and coulees, which are generally smooth, but sometimes rough and rugged.

* The names Watchman, Glacier, Lion, and Vidae, which appear on the map of the lake, have recently been adopted by the United States Board on Geographic Names.

† "Atlantis Arisen," by Mrs Frances Fuller Victor, p. 179.

‡ Science, vol. 7, 1886, pp. 179–182, and Eighth Annual Report of the U. S. Geological Survey, pp. 156–159.

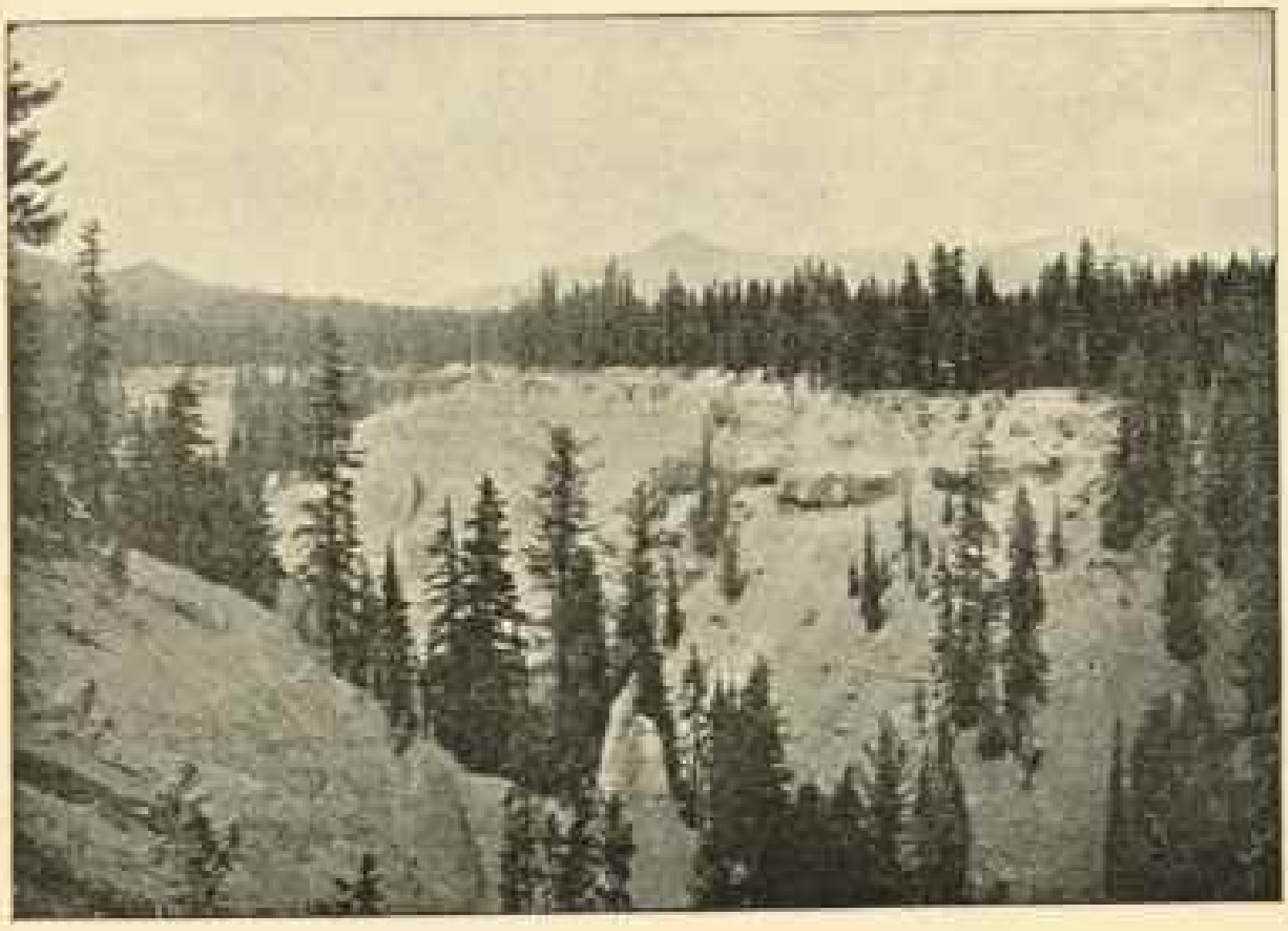
MAP SHOWING ROUTES TO CRATER LAKE FROM ASHLAND AND MEDFORD ON THE OREGON AND CALIFORNIA LINE OF THE SOUTHERN PACIFIC RAILROAD

Reduced from U. S. Geological Survey Ashland Sheet, Oregon

The cones vary greatly in size and are distributed without regularity. Each has been an active volcano. The fragments blown out by violent eruption have fallen about the volcanic orifice from which they issued and built up cinder cones. From their bases have spread streams of lava (coulees), raising the general level of the country between the cones. From some vents by many eruptions, both explosive and effusive, large cones, like Pitt, Shasta, and Hood, have been built up. Were we to examine their internal structure, exposed in the walls of the canyons carved in their slopes, we should find them composed of overlapping layers of lava and volcanic conglomerate, a structure which is well illustrated in the rim of Crater lake.

The journey from Ashland by the Dead Indian road crosses the range where the average altitude is less than 5,000 feet. The road passes within a few miles of Mount Pitt and skirts Pelican bay of Klamath lake, famous for its fishing. After following northward for some twenty miles along the eastern foot of the range, it ascends the eastern slope, along the castled canyon of Anna creek to the rim of Crater lake.

From Medford or Gold Hill, the trip is a trifle shorter by the Rogue River road. It affords some fine views of the canyons



RIM OF CRATER LAKE IN THE DISTANCE, AS SEEN FROM THE SOUTH, ACROSS THE CANYON OF ANNA CREEK

From a photograph by J. S. Diller

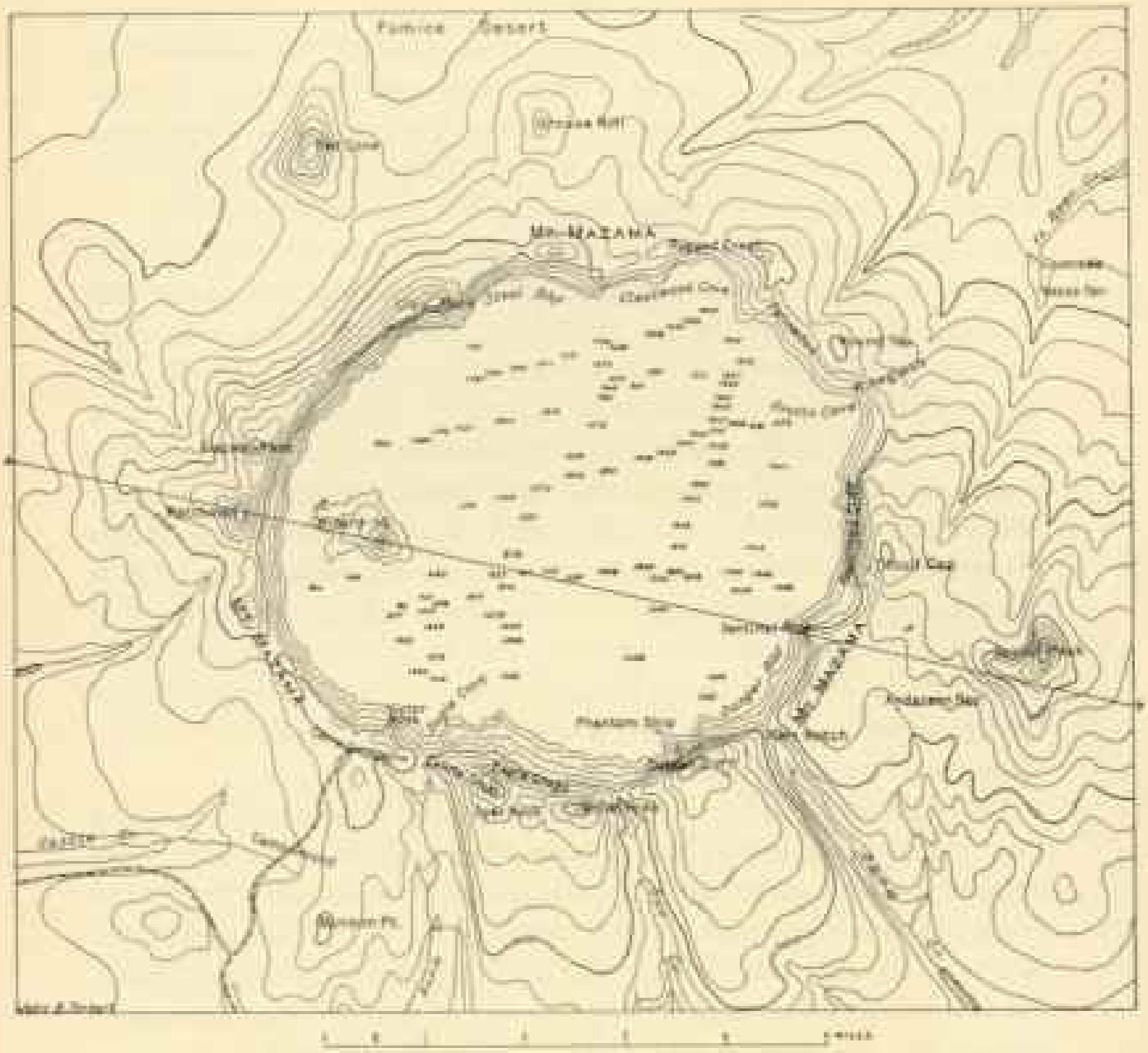
and rapids of that turbulent stream and of the high falls, where it receives its affluents. Striking features along both roads, within 20 miles of the lake, are the plains developed upon a great mass of detritus filling the valleys. Across these plains Anna creek and Rogue river have carved deep, narrow canyons with finely sculptured walls, which the roads follow for some distance.

Approaching the lake from any side, the observer sees a broad cluster of gentle peaks rising about a thousand feet above the general crest of the range on which they stand, but not until after he has left the main road, three miles from the lake, does he begin to feel the steepness of the ascent. The way winds over a large moraine littered with lava boulders and well studded with firs. Arriving at the crest, the lake in all its majestic beauty comes suddenly upon the scene, and is profoundly impressive. Descending the wooded slope a short distance within the rim to Victor rock, an excellent general view of the lake is obtained. The eye beholds 20 miles of unbroken cliffs ranging from over 500 to nearly 2,000 feet in height, encircling a deep blue sheet of placid water, in which the mirrored walls vie with the originals in brilliancy and greatly enhance the depth of the prospect.

The first point to fix our fascinated gaze is Wizard island, lying nearly two miles away, near the western margin of the lake. Its rugged western edge and the steep but symmetrical truncated cone in the eastern portion are very suggestive of volcanic origin. We cannot, however, indulge our first impulse to go to the island, for the various features of the rim are of greater importance in unraveling the earlier stages of its geological history.

The outer and inner slopes of the rim are in strong contrast; while the one is gentle, ranging in general from 10° to 15°, the other is abrupt and full of cliffs. The outer slope at all points is away from the lake, and as the rim rises at least 1,000 feet above the general summit of the range, it is evidently the basal portion of a great hollow cone in which the lake is contained.

The map of Crater lake, prepared from the U. S. Geological Survey special sheet, fully illustrates this feature, and also in part another feature, namely, the occurrence of a number of small cones upon the outer slope of the great cone. These adnate cones are of peculiar significance when we come to consider the volcanic rocks of which the region is composed. The rim is ribbed by ridges and spurs radiating from the lake, and the head of each spur is marked by a prominence on the crest of the rim. The variation in the altitute of the rim crest is 1,469 feet (from 6,759 to 8,228)



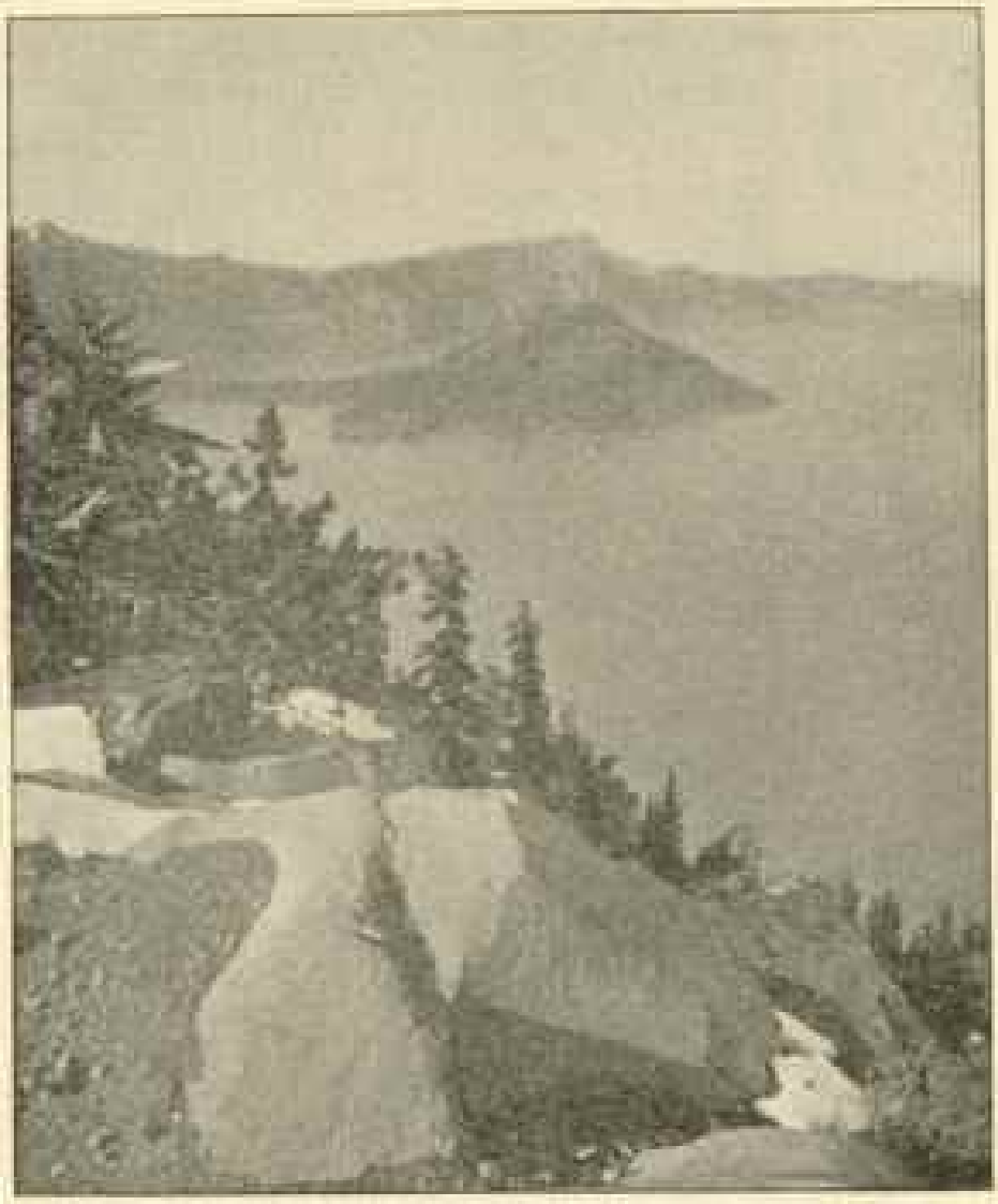
MAP OF CRATER LAKE, OREGON

Reduced from U. S. Geological Survey Special Sheet

with seven points rising above 8,000 feet. The crest generally is passable, so that a pedestrian may follow it continuously around the lake, with the exception of short intervals about the notches in the southern side. At many points the best going is on the inner side of the crest, where the open slope, generally well marked with deer trails over beds of pumice, affords an unobstructed view of the lake.

Reference has already been made to the glacial phenomena of the outer slope of the rim. There are boulders not only upon the surface, but also in piles of glacial gravel and sand spread far and wide over the southern and western portion of the rim, extending down the watercourses in some cases for miles to broad plains through which the present streams have carved the deep and picturesque canyons already observed on the ascent. At many points the lavas are well rounded, smooth, and striated by glacial action. This is true of the ridges as well as of the valleys, and the distribution of these marks is coextensive with that of the detritus.

A feature that is particularly impressive to the geologist making a trip around the lake on the rim crest is the general occurrence of polished and striated rocks, in place, on the very brow of the cliff overlooking the lake. The best displays are along the crest for three miles northwest of Victor rock, but they occur



GLACIATED CREST OF RIM OF CRATER LAKE

From a photograph by M. M. Hazeltine

also on the slopes of Llao rock, Round Top, Kerr Notch, and Eagle crags, thus completing the circuit of the lake. On the adjacent slope toward the lake the same rocks present rough fractured surfaces, showing no striæ. The glaciation of the rim is a feature of its outer slope only, but it reaches up to its very crown. The glaciers armed with stones in their lower parts, that striated the crown of the rim, must have come down from above, and it is evident that the topographic conditions of today afford no such source of supply. The formation of glaciers requires an elevation extending above the snow line to afford a gathering ground for the snow that it may accumulate, and under the influence of gravity descend to develop glaciers lower down on the mountain slopes. It is evident that during the glacial period Crater lake did not exist, but that its site must then have been occupied by a mountain to furnish the conditions necessary for the extensive glaciation of the rim, and the magnitude of the glacial phenomena indicates that the peak was a large one, rivaling, apparently, the highest peaks of the range.

The Mazamas held a meeting last summer at Crater lake in connection with the Crater Lake clubs of Medford, Ashland, and Klamath Falls, of the same state. Recognizing that the high mountain which once occupied the place of the lake was nameless, they christened it, with appropriate ceremonies, Mount Mazama. The rim of the lake is a remnant of Mount Mazama, but when the name is used in this paper reference is intended more especially to that part which has disappeared.

The inner slope of the rim, so well in view from Victor rock, although precipitous, is not a continuous cliff. It is made up of many cliffs whose horizontal extent is generally much greater than the vertical. The cliffs are in ledges, and sometimes the whole slope from crest to shore is one great cliff, not absolutely vertical, it is true, but yet at so high an angle as to make it far beyond the possibility of climbing. Dutton cliff, on the southern, and Llao rock, on the northern, borders of the lake are the greatest cliffs of the rim. Besides cliffs, the other elements of the inner slope are forests and talus, and these make it possible at a few points to approach the lake, not with great ease, but yet, care being taken, with little danger. Southwest of the lake the inner slope, clearly seen from Victor rock, is pretty well wooded, and from near the end of the road, just east of Victor rock, a steep trail descends to the water. Where talus slopes prevail, there are no trees, and the loose material maintains the

steepest slope possible without sliding. Such slopes are well displayed along the western shore opposite the island and near the northeast corner of the lake under the palisades. At the latter point the rim is only 529 feet high, and a long slide, called from its shape the *Wineglass*, reaches from crest to shore.

The best views of the rim are obtained from a boat on the lake, which affords an opportunity to examine in detail the position and structure of the cliffs. They are composed wholly of volcanic conglomerate and streams of lava arranged in layers that dip into the rim and away from the lake on all sides. Both forms of volcanic material are well exposed on the trail descending the inner slope, and although most of the cliffs are of lava many are of conglomerate.

On arriving at the water's edge, the observer is struck with the fact that there is no beach. The steep slopes above the surface of the lake continue beneath its waters to great depths. Here and there upon the shore, where a rill descends from a melting snowbank near the crest, a small delta deposit makes a little shallow, turning the deep-blue water to pale green.

As the boat skirts the western shore and passes toward Llao rock, the layered structure of the rim is evident. On the whole the lava streams predominate, although there is much conglomerate. Of all the flows exposed upon the inner slope, that of Llao rock is most prominent and interesting. In the middle it is over 1,200 feet thick, and fills an ancient valley down the outer slope of the rim. Upon either side it tapers to a thin edge against the upper slope of the valley, as shown in Plate 1, and to the lake it presents a sheer cliff—that is, it is abruptly cut off—and one wonders how much farther it may have extended in that direction. Beneath the rock the outline of the valley in cross-section is evident, and it rests upon many layers of older lavas forming the rim down to the water's edge. The direction of flow in this great lava stream forces us to believe that it was erupted from a large volcano which once stood upon the site of the lake. Every layer of lava in the rim is a coulee, dipping away from the lake. This is especially well shown in the canyon of Sun creek, cut in its outer slope. The sections of these radiating flows exposed upon the inner slope of the rim all tell the same story as to their source. By projecting the lavas in their course toward a common center we can reconstruct in fancy the great volcanic mountain that once occupied the place of the latter—that is, Mount Mazama—and, like Shasta or Rainier,

formed a great landmark of the region. Proceeding eastward from Llao rock, the rim loses somewhat in height, and at the head of Cleetwood cove one sees the remarkable spectacle of a lava stream descending the inner slope of the rim. It is the only one that has behaved in this way, and its action throws much light upon the disappearance of Mount Mazama.

The Palisades are less than 600 feet in elevation above the lake, and are composed almost wholly of one great flow. The streams of lava extending northeast from this portion of the rim are broad and much younger in appearance than those forming the great cliffs south of the lake, where the flows are thinner and more numerous.

Round Top is a dome-shaped hill over the eastern end of the Palisades, and is made up chiefly of the lava stream that formed the Palisades, overlain by two sheets of pumice separated by a layer of rhyolite. The upper surface of the Palisade flow, where best exposed upon the lakeward slope of Round Top, bears glacial strie that extend beneath the layers of pumice and rhyolite of later eruption from Mount Mazama. It is evident from this relation that Mount Mazama was an active volcano during the glacial period. The occurrence of eruptions from a snow-capped volcano must necessarily produce great floods, and these conditions may account in some measure at least for the detritus-filled valleys of the streams rising on the rim of Crater lake.

Returning from this glacial digression to the boat trip on the lake, it is observed upon the eastern side of the lake that Red Cloud cliff is rendered beautiful by the pinnacles of reddish tuff near the summit, where it is capped by a great, dark flow of rhyolite filling a valley in the older rim and extending far to the northeast. Here the springs begin to gush from the inner slope and cascade their foaming rills to the lake. They recur at Sentinel rock, Dutton cliff, and especially under Eagle crag, as well as farther westward. Their sources in many cases can be seen in the banks of snow above, but in others they gush forth as real springs whose water must find its way in from the snow upon the outer slope.

The boldest portion of the rim, excepting perhaps Llao rock, is Dutton cliff, which is made more impressive by the deep U-shape notches on either side and the Phantom Ship at its foot. The notches mark points where the canyons of Sun and Sand creeks pass through the rim to the cliff overlooking the lake. These canyons, due to erosion on lines of drainage, belong

SOUTHERN SHORE OF CRATER LAKE, AS SEEN FROM KERR NOTCH. DUTTON CLIFF ON THE LEFT; EAGLE CRAGS AND CASTLE CREST BEYOND THE PHANTOM SHIP

From a photograph by J. S. Diller

to the period when the topographic conditions in that region were quite unlike those of today. They were carved out by streams of ice and water descending from a point over the lake, and their presence, ending as they do in the air thousands of feet above the present water level, affords strong evidence in favor of the former reality of Mount Mazama.

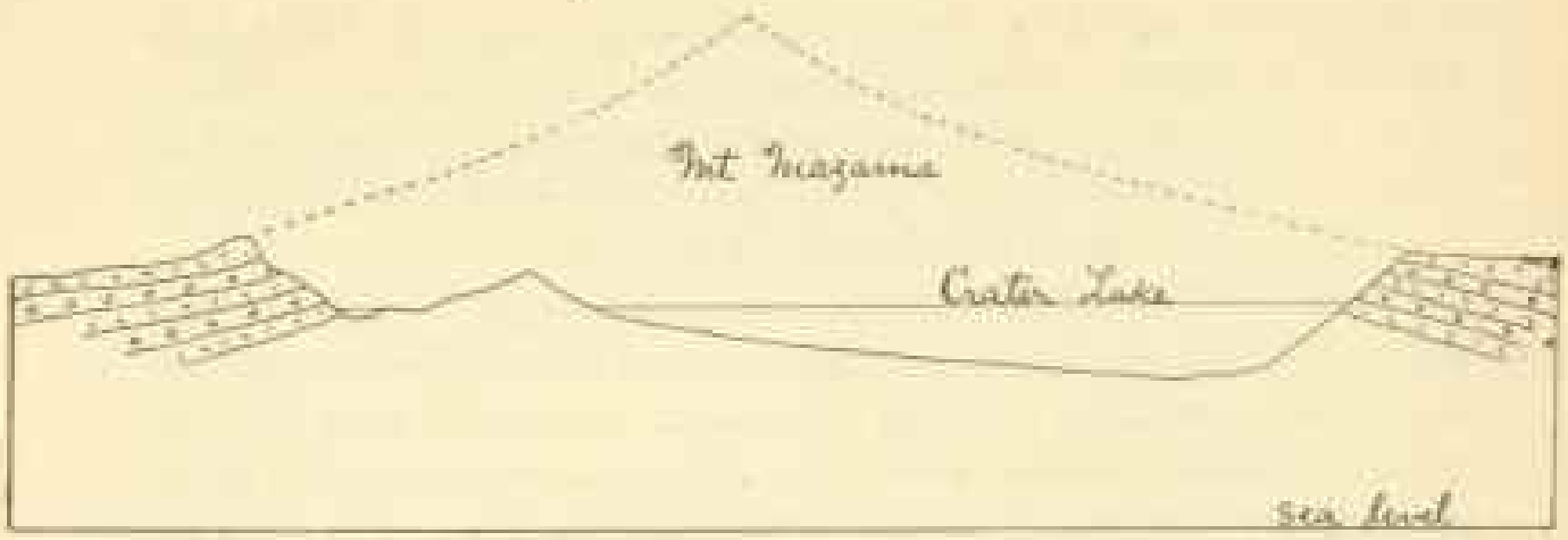
The Phantom Ship is a craggy little islet near the border of the lake under Dutton cliff. Its rugged hull, with rocks towering like the masts of a ship, suggests the name, and, phantom-like, it disappears when viewed in certain lights from the western rim. Standing in line with an arête that descends from an angle of the cliff, it possibly marks a continuation of the sharp spur beneath the water, or perhaps, but much less likely, it is a block slid down from the cliff. Whatever its history, it attracts everyone by its beauty and winsomeness.

At times of volcanic eruption the lava rises within the volcano until it either overflows the crater at the top or, by the great pressure of the column, bursts open the sides of the volcano and escapes through the fissure to the surface. In the latter case, as

the molten material cools, the fissure becomes filled with solid lava and forms a dike. The best example of this sort about Crater lake appears along the inner slope directly north of Wizard island, and is locally known as the Devil's Backbone. This dike rock standing on edge varies from 5 to 25 feet in thickness and cuts the rim from water to crest. Dikes are most numerous in the older portion of the rim under Llao rock. They do not cut up through Llao rock and are clearly older than the lava of which that rock is formed. Dikes occur at intervals all around the lake, and radiate from it, suggesting that the central volcanic vent from which they issued must have been Mount Mazama.

There is another important feature concerning the kinds of volcanic rocks and their order of eruption and distribution about the rim of Crater lake that is of much interest to the geologist. All the older lavas comprising the inner slope of the rim, especially toward the water's edge, are andesites. The newer ones forming the top of the rim in Llao rock, Round Top, and the Rugged Crest about the head of Cleetwood cove, as well as at Cloud Cap, are rhyolites. Other later flows, all of which escaped from the smaller adnate cones upon the outer slope of the rim, are basalts. The eruptions began with lavas of medium acidity (andesites), and after long-continued activity lavas both rich (rhyolites) and poor (basalts) in silica follow, giving a completeness to the products of this great volcanic center that make it an interesting field of study. Furthermore, the remarkable opportunity afforded by the dissected volcano for the examination of its structure and succession of lavas is unsurpassed. It should be stated, before dismissing the kinds of lava, that there are some rhyolites in the Sun Creek canyon south of the lake that appear to be older than those upon the north side, and that the final lava of the region on Wizard island is andesitic.

The glaciation and structure of the rim clearly establish the former existence of Mount Mazama, but there may well be doubt as to its exact form and size. Judging from the fact that Mount Shasta and the rim of Crater lake have the same diameter at an altitude of 8,000 feet, and that their lavas are similar, it may with some reason be inferred that Mount Mazama and Mount Shasta were nearly of equal height. The slopes of Mount Shasta may be somewhat steeper than those of the rim of Crater lake at an equal altitude, but the glaciation of the rim is such as to require a large peak for its source.



SECTION OF CRATER LAKE AND ITS RIM, WITH THE PROBABLE OUTLINE OF MOUNT MAZAMA

Vertical and Horizontal Scales the same

In the accompanying figure is given a section of Crater lake and its rim, with the probable outline of Mount Mazama. Wonderful as the lake, encircled by cliffs, may be, it serves but to conceal in part the greatest wonder—that is, the enormous pit which is half filled by the lake. The pit or caldera, as it is called by some geologists, is 4,000 feet deep. It extends from the top of the rim half-way down to the sea-level, and nearly a square mile of its bottom is below the level of Upper Klamath lake at the eastern foot of the range. The volume of the pit is nearly a dozen cubic miles, and if we add the volume of the lost Mount Mazama, that amount would be increased by at least one-half. How was it possible to remove so large a mass and in the process develop so great a pit?

The pit is completely inclosed, so that it cannot be regarded as an effect of erosion. The volcanic origin of everything about the lake would suggest in a general way that this great revolution must have been wrought by volcanism, either blown out by a great volcanic explosion or swallowed up by an equally great engulfment. It is well known that pits have been produced by volcanic explosions, and some of them are occupied by lakes of the kind usually called crater lakes. Pits produced in this way, however, are, with rare exceptions, surrounded by rims composed of the fragmental material blown from the pit.

At first sight the rim about Crater lake suggests that the pit was produced by an explosion, and the occurrence of much pumice in that region lends support to this preliminary view; but on careful examination we find, as already stated, that the rim is not made up of fragments blown from the pit, but of layers of solid lava interbedded with those of volcanic conglomerate erupted from Mount Mazama before the pit originated. The

moraines deposited by glaciers descending from the mountain formed the surface around a large part of the rim, and as there is no fragmental deposit on these moraines it is evident that there is nothing whatever to indicate any explosive action in connection with the development of the pit.

We may be aided in understanding the possible origin of the pit by picturing the conditions that must have obtained during an effusive eruption of Mount Mazama. At such a time the column of molten material rose in the interior of the mountain until it overflowed at the summit or burst open the sides of the mountain and escaped through fissures. Fissures formed in this way usually occur high on the slopes of the mountain. If instead, however, an opening were effected on the mountain side at a much lower level—say some thousands of feet below the summit—and the molten material escaped, the mountain would be left hollow, and the summit, having so much of its support removed, might cave in and disappear in the molten reservoir.

Something of this sort is described by Professor Dana as occurring at Kilauea, in Hawaii. The lake in that case is not water, but molten lava, for Kilauea is yet an active volcano. In 1840 there was an eruption from the slopes of Kilauea, 27 miles distant from the lake and over 4,000 feet below its level. The column of lava represented by the lake of molten material in Kilauea sank away in connection with this eruption to a depth of 385 feet, and the floor of the region immediately surrounding the lake, left without support, tumbled into the depression. In the intervals between eruptions the molten column rises again toward the surface, only to be lowered by subsequent eruptions, and the subsidence is not always accompanied by an outflow of lava upon the surface. Sometimes, however, it gushes forth as a great fountain a hundred feet or more in height.

The elevated position of the great pit occupied by Crater lake makes its origin by subsidence seem the more probable. The level of the lowest bed of the lake reaches the surface within 15 miles to the westward. That Mount Mazama was engulfed is plainly suggested by the behavior of its final lava stream. The greater portion of this last flow descended and spread over the outer slope of the rim, but from the thickest part of the flow where it fills an old valley at the head of Cleetwood cove some of the same lava, as already noted, poured down the inner slope. The only plausible explanation of this phenomena seems to be that soon after the final eruption of Mount Mazama, and before

the thickest part of the lava effused at that time had solidified, the mountain collapsed and sank away and the yet viscous portion of the stream followed toward the pit.

It has been suggested, but perhaps not in serious thought, that the cone on Wizard island may represent the summit of the sunken Mount Mazama, projecting above the water. To determine the truth of the matter we must cross over to the island. Wizard island has two portions—an extremely rough lava field and a cinder cone. The lava is dark and has a much more

SNOWDRIFT IN THE CRATER OF THE CINDER CONE ON WIZARD ISLAND

From a photograph by H. E. Patton

basaltic look than any seen in the main body of the rim. It has evidently been erupted from the base of the cinder cone in its present position. The cinder cone, too, is a perfect little volcano with steep symmetrical slopes, 845 feet in height, and surmounted by a crater 80 feet deep. It is so new and fresh that it is scarcely forested, and shows no trace of weathering. Instead of being a part of the sunken Mount Mazama, it is an entirely new volcano built up since the subsidence by volcanic action upon the bottom of the pit. Were it not for the lake the whole bottom of the pit could be examined, and it is pos-

sible that other small volcanic cones might be found. This suggestion is borne out by the soundings of the lake, which appear to reveal two other cases, but they do not rise to within 400 feet of the surface of the water. It is evident that the volcanic eruptions upon the bottom of the pit have partially filled it up. Originally it may have been much more than 4,000 feet deep.

Given the pit with water-tight walls, there is no difficulty in forming Crater lake, for in that region precipitation is greater than evaporation. The lake does not fill up and overflow. The surplus water must have a subterranean outlet, probably toward the southeast, where the region is traversed by extensive breaks in the rocks, and abounds in excellent springs.

The color of the lake is deep blue excepting along the borders, where it merges into various shades and tints of green. It is so transparent that even on a hazy day a white dinner plate 10 inches in diameter may be seen at a depth of nearly 100 feet. It contains no fish, but a small crustacean flourishes in its waters, and salamanders occur in abundance locally along the shore.

The level of the lake oscillates with the seasons. During the rainy winter it rises, and in the summer it falls. In August last observations were made for twenty-two days, and the lake sank at the rate of one inch for every five or six days, depending somewhat on the conditions of the weather. The Mazamas have established a water gauge, and it is hoped that an extended series of observations may be obtained in the future.

Mr B. W. Evermann, of the U. S. Fish Commission, who visited the lake last summer, made some interesting observations of its temperature. At 1 p. m., August 22—

The temperature of the surface water was	60°
At a depth of 535 feet the temperature was	39°
At a depth of 1,043 feet the temperature was	41°
At a depth of 1,623 feet (on the bottom) the temperature was	46°

The increase of temperature with the depth suggests that the bottom may yet be warm from volcanic heat, but more observations are needed to fully establish such an abnormal relation of temperatures in a body of water.

Aside from its attractive scenic features, Crater lake affords one of the most interesting and instructive fields for the study of volcanic geology to be found anywhere in the world. Considered in all its aspects, it ranks with the Grand Canyon of the Colorado, the Yosemite valley, and the Falls of Niagara, and should be set aside as a National Park for the pleasure and instruction of the people.

THE UTILIZATION OF THE VACANT PUBLIC LANDS

By Emory F. Best,

Assistant Commissioner of the General Land Office

No question of public policy has demanded more earnest consideration than the disposal of the public domain. It involved not only the creation of a fund for the redemption of the public debt, but the fundamental principles of government upon which the republic was founded. It has been asserted by some that mismanagement and an inefficient policy have characterized the disposal of the public land from the foundation of the government. On the other hand, it is claimed that a wise and beneficent system has peopled the country with thrifty and energetic settlers, and this is pointed to as one of our greatest achievements.

When the Treaty of Peace was concluded between Great Britain and the United States the unsettled territory west of the Appalachians belonged to certain of the colonies. This fact was one of many obstacles to the ratification of the Articles of Confederation. It was removed by the cession of these lands to the United States. By such cession the United States became the proprietor of a territory greater in extent than France or Spain. This formed the nucleus of the public domain, and the laws enacted for the disposal of the public lands in that region have been extended over all the territory thereafter acquired by the national government except Alaska.

The first step in the disposal of the public lands was the passage by Congress of the ordinance of 1787 for the organization and government of the territory northwest of the Ohio. It provided for the organization of the territories into states, with all the rights of the original states, but declared that the new states should never interfere with the disposal of the soil by the United States, nor with any regulations Congress might find necessary for securing the title in such soil to the purchaser. Upon the admission of new states into the Union, the absolute proprietary power and primary right of disposition of the soil has been uniformly reserved by solemn compact in conformity therewith.

The cessions of territory made to the United States by the several states were upon the condition that the land should be

held in trust, to be disposed of for the common benefit of all the states, and this condition applied as well to all land thereafter acquired by the United States. At first the controlling purpose in the disposal of the lands was to create a fund for the redemption of the public debt. Settlement upon the public domain was not only discouraged, but was actually forbidden. In pursuance of the policy to convert the public domain into cash as rapidly as possible for the extinguishment of the public debt, large tracts of land in the Northwest Territory were sold to individuals and companies under authority granted by special act of Congress prior to the adoption of the Constitution.

In 1790 Mr Hamilton, then Secretary of the Treasury, submitted to Congress a plan for the disposal of the public domain, which has formed the basis of the public-land system. All legislation upon this subject, until the Homestead Act of 1862, embodied the fundamental principle of Mr Hamilton's plan, which contemplated the raising of revenue from the sale of the land. His plan presented two leading features: one, the facility of advantageous sales, which, as a financial operation, claimed primary attention; the other, the accommodation of individuals then inhabiting the Northwest Territory, or who might afterward settle therein, who were permitted to purchase small tracts for homes. Upon this plan our public land system was laid. It provided for the disposal of the public domain at public offering, by private cash sales, and by the allowance of the preference right of purchase to actual settlers under the several preëmption laws. The preëmption laws were at first temporary, being limited in their operation, until the general law of 1841, which continued in force until its repeal by the act of March 3, 1891.

While the preëmption right was generally considered as a special favor or benefit conferred upon those who inhabit, cultivate, and improve a tract of public land, with the intention of making a permanent home, it was practically only the extension of a credit for twelve months to the settler, but with no actual security that he would finally get the land. Up to 1843 there was no land subject to preëmption that could not at any time be bought upon application at the local office, at private cash entry, at the same price the preëmptor was required to pay, and it was not until 1860 that preëmption rights could be initiated by settlement upon unsurveyed lands. Even in the bestowal of the munificent grants of alternate sections to aid in the construction of railroads and other works of public improvement, the

controlling feature in the disposition of the public lands was not abandoned, because the sections of land remaining to the government within the limits of the grant were doubled in price for the purpose of reimbursing the government for the land granted. It was not until the agitation of the question of free homes for the people, which resulted in the act of May 2, 1862, that the general policy of sales for revenue was changed.

The homestead law provided that any citizen who is the head of a family, or who has arrived at the age of 21 years, may acquire title to 160 acres of land by residing upon, cultivating, and improving the tract for five years immediately preceding his final proof, free from all cost except the land office fees. Since the year 1862, when this law went into effect, up to the close of the last fiscal year, 508,936 homestead entries have been allowed, embracing an area of 67,618,451 acres.

How far this beneficent act has demonstrated the wisdom of the measure and fulfilled the expectations of its advocates must be judged by the growth and prosperity of the country since the period of its enactment. It is true that it went into operation at practically the same period that witnessed the extensive grants in aid of the construction of the Pacific railroads and other important works of internal improvement; but this important factor, with the aid of the railroads, was mainly instrumental in converting the boundless domain of wild, unsettled Indian country into thriving communities and states, adding immensely to the material wealth and prosperity of the nation. Thus the government has indirectly derived larger revenues from its bounties than it could have acquired from the cash sales of its lands.

It is unnecessary to give a detailed statement of the extent to which the public lands have been entered under the several laws by which such disposition has been governed. Suffice it to say that about 247,000,000 acres of land have been sold for cash, including commuted homestead entries, for which the government has received about $280,000,000, and that this item, with the grants to aid in the construction of railroads and the donations to states for educational purposes and internal improvements, constitute the largest portion of the public domain that has been disposed of by the government.

It is estimated that there now remain, exclusive of Alaska, over which the general land laws have not been extended, about 600,000,000 acres of vacant public land, of which about 500,000,000 are within a region where the rainfall is not suffi-

cient to insure the cultivation of crops without irrigation. The title to the soil is in the United States, and it is subject to disposal under the general land laws; but the control of the water, which is the important element in the utilization of these lands for agricultural purposes, rests with the state. Unless these two elements are combined, the land is valueless, and until the land can be brought to an agricultural condition, permanent settlement, that will advance the prosperity of the state and nation, cannot be expected. Hence the question is forced upon us, Are the laws which have operated so favorably in the disposal of the well watered and fertile lands of the Mississippi valley adequate to the conditions that confront us in the arid west?

The act of March 3, 1877, authorizing the entry of 640 acres of desert land, conditioned upon the payment of $1.25 per acre and the reclamation of the land by conducting water thereon, was designed to meet these conditions; but whether from the imperfection of the system or from the injudicious administration of the law, it has certainly failed to yield the results most to be desired, even if it has accomplished the purposes of its enactment.

It is generally conceded that the lands lying along the borders of the small streams and rivulets, which can be irrigated by the individual efforts of the settlers, have practically been appropriated by settlers under the homestead and other general land laws, and that the desirable vacant public lands unreclaimed are so situated that they cannot be reclaimed by means at the command of the individual settler. The combined efforts of labor and capital must be employed to insure a reclamation that is economical and practical. Hence the homestead law is no longer of practical application in the arid region, as its operation is rather to retard than to promote the reclamation of these lands.

But a more serious problem is, how to secure the reclamation of the largest possible portion of the 500,000,000 acres of vacant public lands within the arid region. It is estimated that only 20 per cent can, under the most favorable conditions, be reclaimed and brought to an agricultural condition, not because of the lack of irrigable land, but because of the limited supply of water, and the irrigation of this quantity can be accomplished only by the most economical and conservative use of the water and the most judicious selection of the tracts of land to be irrigated. It is therefore evident that as the solution of the problem lies in the economical and practical utilization of the water, the control and

use of this element must be of paramount importance to securing title to the land.

If the waters of the perennial streams which are wasted during the winter months could be stored and reservoirs could be constructed to impound the storm waters, the area of territory susceptible of irrigation could be largely increased. As the irrigable land is far in excess of the available water supply, the land to be irrigated should also be selected with a view to the most economical use of the water, so that the available lands should be irrigated and disposed of as agricultural lands, and the remaining lands be held for disposition for other uses.

The importance of observing the strictest economy in the distribution of water and the selection of lands is forcibly stated in the minority report of the Special Committee appointed by the United States Senate in 1889 to consider the subject of the irrigation and reclamation of the arid lands. It says:

"The irrigable lands are limited in extent. The area of the arid region which can be irrigated is a small fraction of the entire region. This arises from the fact that all the waters that can be used are insufficient to serve all the possible irrigable lands. It therefore becomes necessary to select the lands to be redeemed. On the wisdom of this selection vast interests depend. It is possible to irrigate lands on the mountains and on the high plateaus, but if the water is used there it cannot be used below, and these elevated lands will not make the best homes for the people. The climate there is rigorous, and the variety of agricultural products that can be raised is limited, being chiefly hay and vegetables. To use the water on such lands is largely to waste it, and to drive agriculture into the mountains is to doom the people engaged therein to a dreary life in a subarctic climate. It is therefore manifestly to the interest of the greatest number of people that the agriculture of the arid lands should not be established in the mountain regions. The valleys and plains below are warm, salubrious, and rich, the variety of agricultural products is great, and if the waters are used on these lands they will give support to a prosperous people."

If this is the condition with which we are confronted with regard to the vacant public lands in the arid region, then it must follow that these lands should not be disposed of until they have been brought to an agricultural condition, if due regard be had to the practical and economical disposition of them, and with a view to deriving the greatest benefit for the state and nation.

This may be accomplished in three ways: (1) by the construction of reservoirs and irrigating works and the adoption of an irrigation system under the direction of the general government;

(2) through the agency of irrigation companies; and (3) by the states controlling the waters within their respective borders.

On March 20, 1888, Congress passed a joint resolution directing the Secretary of the Interior, through the direction of the Geological Survey, to make an examination of that portion of the arid region where agriculture is carried on by means of irrigation, as to the natural advantage of the storage of water, and the practicability and cost of construction and capacity of reservoirs, and such other facts as bear on the question of the storage of water for irrigation purposes. This resolution was followed by legislation making appropriations to enable the Director of the Geological Survey to make the necessary examination, and he was authorized to select sites suitable for the storage reservoirs contemplated by the resolution, which were to remain segregated and reserved from entry, occupation, and settlement until otherwise provided by law. Under this authority 120 suitable sites have been selected, and the lands covered by such selections have been reserved from entry, occupation, and settlement, but to this day no provision has been made for their utilization.

The plan of reclamation through the agency of land and irrigation companies would not, in my judgment, be commended by the people, and although it might be effective in putting under irrigation all the territory possibly susceptible of irrigation by the water that could be stored, yet it would hardly be possible to make such limitations and restrictions upon a grant of such power as would absolutely protect the settler against extortion and oppression.

The third appears to be the most feasible plan for the utilization of the arid lands. The right to the use of the water being under the absolute control of the state, it would, if it controlled the land also, be enabled so to direct and govern the appropriation of it as to secure, by a judicious selection of the lands to be irrigated, the most economical and practical use. It would enable the state to check the waste growing out of faulty construction of dams and imperfect systems of applying water. The settler on a tract of desert land who has acquired a right to the use of water is interested solely in the application of it to his particular tract, with no responsibility for its economical use. The land is abundant, but the water is scarce, and if we expect to reap advantages by utilizing the water to the greatest extent, it must be accomplished by reclaiming the lands before they are disposed of. This can be accomplished more effectively by the states than through the general government or other agencies.

The state of California has adopted a policy, based upon the principle of state or common ownership in natural waters, which provides for the ownership by communities of works for the storage and distribution of waters for irrigation purposes. This law, known as the Wright law, which has recently been declared constitutional by the Supreme Court of the United States, has been adopted, I believe, by nearly all the arid land states. It provides for the organization of irrigation districts wherever fifty or a majority of the owners of lands susceptible of one mode of irrigation from a common source and by the same system of works desire to provide for the irrigation of their holdings.

It also provides for the creation of a board of directors, who have power to purchase lands, water and water-rights, and to construct the necessary reservoirs and irrigation works. It also authorizes the issuance of bonds to raise money for the construction of such works, which bonds are to be paid out of revenues derived from annual assessments upon the real property of the district, and all such property subject to taxation by the state is liable to such assessment. I do not attempt to give details, but simply the general features of the law, to show how unjustly it would operate in a district where there was a tract of vacant public land. This land would be susceptible of irrigation by the same system and from the same common source, and would therefore be materially enhanced in value by the construction of irrigation works at the expense of the inhabitants of the district, although the government would not be liable to contribute to it, for the reason that the government lands are not subject to taxation by the state, and are therefore not liable to the assessment. This inequitable feature could be removed if the title to the lands were in the state.

In the arid region an average of about 76 per cent of the land is in the hands of the government. In Nevada about 95 per cent of the area is vacant. These lands contribute nothing to the revenues of the state. With its taxable resources so diminished it is impossible for the state to undertake a system of irrigation. They should be so disposed of as to make them available as resources from which the state may increase its revenue.

The states in the arid region have established laws for the acquisition and protection of riparian rights, based upon the doctrine of priority of appropriation. This has been rendered necessary by the failure of the general government to formulate a uniform system for the protection of the rights of parties and

to secure the economical distribution of the water. Under these laws, which differ in many material respects, rights have been acquired, so that a uniform system could not now be established without involving irrigation interests in serious conflicts. It can be remedied only by giving to each state control of its arid lands, to be reclaimed and disposed of under their separate systems.

The advantages that would accrue to the state through the control of the land and water are, in a measure, attained by the act of August 19, 1894, known as the Carey Act. This law authorizes the Secretary of the Interior to contract with any of the desert land states to donate to the states, free of cost, such lands, not exceeding 1,000,000 acres in each state, as the state may cause to be irrigated, reclaimed, occupied, and cultivated by actual settlers. It also authorizes the state to make all necessary contracts for causing the lands to be reclaimed and for inducing settlement and cultivation, but the state is not authorized to lease or dispose of the lands except to secure their reclamation, cultivation, and settlement.

It is in the nature of a grant, limited in quantity, and conditioned upon reclamation and cultivation. It contemplates that the reclamation shall be accomplished by private capital, but as the land selected cannot be disposed of until it has been patented to the state, it fails to give the state sufficient control over the lands to enable it to pledge them as security for their reclamation, and hence it cannot contract for the construction of works on the most favorable terms. If this law were amended so as to provide for the granting of the lands to the state upon application, leaving the state free to contract for their reclamation and to pledge the lands as security therefor, it would be of practical benefit, and under its provisions the state might be enabled to secure the reclamation of all the lands within its limits that could be utilized. As it is, but two states have applied for its benefits, and the feasibility of the scheme for the reclamation and disposal of the arid lands is yet to be ascertained.

With this condition confronting us, can there be any valid reason urged against the cession of these lands to the states, and may we not go farther and inquire if there is any reason why the trust imposed upon the general government for the disposal of all the public lands may not safely be delegated to them? The cession of the Northwest Territory was made upon the express condition that the ceded lands should be considered as a com-

mon fund for the use and benefit of all the states and should be disposed of for that purpose and for no other purpose whatever. During the existence of the Confederation and in the earlier decades of the Republic, it was clearly contemplated that the lands so acquired, as well as those acquired by purchase and treaties, could only be disposed of for the purpose of revenue for the redemption of the public debt, and that any other disposition of them would be a violation of the trust.

But the policy has gradually changed from a system of sales for revenue only to that of free homes for the people. For the past twenty years the tendency of legislation has been to repeal all laws authorizing the purchase of the public lands by cash entry and to subject them to homestead entry only. In 1889 a law was passed withdrawing from private cash entry all the public lands, except in the state of Missouri, which was followed by the act of March 3, 1891, repealing the preëmption law and declaring that no public lands of the United States, except abandoned military or other reservations or isolated and disconnected tracts and mineral and other lands of a special nature having local application, shall be sold at public sale. Since the passage of this law isolated tracts are not subject to public sale until they have been subject to homestead entry for three years after the surrounding land has been disposed of and abandoned. Military reservations containing more than 5,000 acres are now subject to homestead entry only. The public lands are therefore no longer to be disposed of with a view to the revenue to be derived therefrom.

Besides, less than thirty years ago a great part of the vast territory west of the Mississippi river was Indian country, to which the Indian title had not been extinguished, and was practically unorganized territory. Since then all of what was commonly known as the Indian country has been ceded to the United States and become a part of the public domain. The Indian title has been extinguished as to all the territory formerly occupied as hunting grounds, in consideration of which diminished reservations of a permanent character have been established. From time to time states have been admitted into the Union, until the entire country is now divided into separate sovereignties, with all the rights, powers, duties, and privileges of the original states, except the organized territories of Arizona and New Mexico, which are knocking at the door for admission to the sisterhood.

THE MAZAMAS

There was organized on the summit of Mount Hood, on July 19, 1894, a society of mountain-climbers called the Mazamas, whose qualification for membership is the ascent of an acceptable snow-capped peak. Remarkable as it may seem, so much enthusiasm was aroused at that time that 193 people ascended 11,225 feet to attend the meeting. W. G. Steel, one of the leading spirits of the occasion, was made the first president of the organization.

The objects of the society are mountain exploration, the protection of forests and scenery, and the acquisition and dissemination of knowledge concerning them. In the summer of 1895, with Mr Steel again as president and T. Brook White as secretary, parties were organized to ascend Mounts Baker, Rainier, Adams, Hood, and Jefferson and establish intercommunication by heliotroping; but, owing to the smokiness of the atmosphere, the latter part of the program could not be carried out.

With Mr C. H. Sholes as president and Rev. Earl M. Wilbur as secretary, the society continued its enthusiastic work in the spring of 1896 by publishing the first number of a magazine called *Mazama*, a record of mountaineering in the Pacific northwest. This publication contains, besides the presidential addresses, the reports of the historian for 1894 and 1895, and other matters relating to the society, the following papers: The Flora of Mount Hood, by Thomas Howell, who mentions 272 species growing above 2,000 feet; The Elevation of Mount Adams, by Prof. Edgar McClure, who states the height of the mountain, as determined by averaging three hourly readings of a mercurial barometer compared with three synchronous readings at Seattle, Portland, and Eugene, to be *12,401.0 feet; The Heliotrope in Mountaineering, by T. Brook White, describes the instruments used and the Morse code; The Flora of Mount Adams, by W. N. Suksdorf and Thomas Howell, enumerates 480 species (excluding mosses and lichens) above 2,000 feet; in The Glaciers of Mount Adams Prof. W. D. Lyman estimates that at the timber line there are 8 or 10 glaciers, but only 3 are described as larger than those of Mount Hood. The veteran geologist of Oregon, Prof. Thomas Condon, describes the ice-caves of Mount Adams, which years ago furnished the ice for the city of Portland. He ascribes the cold-storage feature of the caves to currents of cold air descending from the mountain along the tunnels once filled with molten lava from the same source. Under the title of The Klamath Mountains the present writer calls attention to the geologic and topographic relation between the Sierra Nevada and the Cascade and Coast ranges.

The Mazama excursion of August, 1896, was to Crater lake, in connection with the Crater Lake clubs of Medford, Ashland, and Klamath Falls in southern Oregon. In all, nearly 500 people attended the meeting, a number of them also ascending Mount Pitt. By previous arrangement

*See Nat. Geog. Mag., Vol. VII, No. 4, pp. 151–153.

four government parties met the excursionists at Crater lake and endeavored in various ways to promote the success of the occasion. H. W. Evermann, of the Fish Commission, studied the fish food and spawning grounds of the lake and made some interesting observations on the lake temperature. Dr C. Hart Merriam, chief of the Biological Survey of the Agricultural Department, assisted by Vernon Bailey and Edward A. Preble, collected a large number of animals about the rim of the lake and upon the island, and Mr F. V. Coville, the Department Botanist, assisted by Mr Lieburg, made a large collection of plants. A geological party under the charge of the writer prepared a geological map of the region. The heads of all the government parties, as well as many others, were called upon for camp-fire talks, addresses, or recitations concerning matters of scientific and popular interest, especially relating to Crater lake. The proceedings were opened August 18 by the Klamath Falls club before the Magnums arrived, but thereafter the great camp-fire of the Mazamas was the rendezvous after the excursions of the day. Among the excursionists, aside from the government parties, were a number of botanists and zoölogists, as well as geologists and professors of various departments. Many were armed with cameras to carry away permanent impressions of the lake. As a whole the excursion was a great success, and its fruits are to be found, not only in the widespread interest aroused in such proceedings, but also in the forthcoming number of the *Mazama*, which is to contain full accounts of the lake, both popular and scientific, from various contributors.

J. S. Diller.

GEOGRAPHIC LITERATURE

Elementary Geology. By Ralph S. Tarr, Professor of Dynamic Geology and Physical Geography at Cornell University. Pp. xxx + 490, with 25 plates and 288 other illustrations. New York: The Macmillan Company. 1897. $1.40.

This is a refreshing book. In the first place the type is large and well leaded, and the printers have realized the true function of punctuation and largely omitted brain-wearying dots in useless places; so the eye is attracted by the clean-cut pages. In the second place illustrations are freely used to supplement the succinct text, and nearly all the pictures are photo-mechanical reproductions from nature: even the minerals and fossils are represented mainly by half-tone engravings; thus the facts of nature are represented with a vividness and brought home to the understanding with a vigor not to be attained in any other way. Again the author has realized, at least in some measure, that the progress of knowledge is ever from the remote toward the near, and he has had the courage to directly assail the last fortress of the unknown by depicting the everyday and commonplace features of the earth which every child may see, and by explaining the principles of earth-science in terms of common things; no geologic book ever written is less affected by mysticism, scholasticism, metaphysics, dialectics, and other pernicious vestiges of intellectual barbarism. Then the work must appeal to the teacher, because

it is adapted to youth and because it fills a need not quite met by any previously issued text-book.

After an introductory chapter the work is divided into three parts, viz., (1) Structural geology, (2) Dynamic geology, and (3) Stratigraphic geology. Professor Tarr half apologizes in his preface for the space given to the second of these divisions; but he might well have spared the explanation and even doubled this eminently practical and useful part of the treatise. The third "part" might better have been divided in name, as it is in fact, into paleontology, or the history of life on the globe, and the geographic development of the continents; for the treatment is essentially historical and not at all stratigraphic. Then it would have been in accord with the general method of the book, which is the emphasis of the actual and the near, to give relatively more space to the life of the later ages; also, and more especially, to explain the earlier stages in geographic development of North America in terms of the later stages. Unfortunately these later stages, which are in themselves of great interest and are now well understood, receive but little attention. The chief imperfections in the work lie in incompleteness of the treatment from the point of view of the geographer, and are due to the fact that it is a complement to the same author's "Elementary Physical Geography." In the main, the facts and principles of geology are well generalized and happily expressed. W J M.

The Lessons of Erosion Due to Forest Destruction. Chart. The U. S. Department of Agriculture. Washington, 1896.

A part of the exhibit made by the United States Department of Agriculture at the International and Cotton States Exposition held in Atlanta during the autumn of 1895 was a series of three models representing (1) the soil destruction consequent on the removal of forests, (2) the processes required for reclamation in the same tract, and (3) the same tract as reclaimed and restored to pristine fertility and productiveness. These models were carefully executed by Howell, under the direction of Bernhard E. Fernow, Chief of the Forestry division, with the co-operation of several geologists, particularly W J McGee. These models attracted much attention, and their exhibition in the region in which old-field erosion is particularly active was undoubtedly productive of much good. Recently the features of the models have been reproduced by chromolithography in the form of a large wall-chart, for distribution among agriculturists and others. The reproduction, unhappily, is not equal to the models in accuracy of representation, and will hardly be serviceable for educational purposes save in a single direction, viz., in attracting attention to a subject of great economic importance in many parts of the country. W J M.

Preliminary Report on the Income Account of Railways in the United States for the Year ending June 30, 1896. Interstate Commerce Commission. Pp. 68. Washington, 1896. Prepared by the Statistician to the Commission.

During the fiscal year 1895–96 the railways of the United States, having an operated mileage of 172,309 miles of line, earned in gross $1,123,646,502.

The operating expenses were $754,971,515, leaving an income from operation of $368,675,047. Two-thirds of the gross earnings were absorbed in operating expenses, leaving one-third as income from operation. High-water mark in railway earnings, as represented by gross earnings and income from operation per mile of line, was reached in 1891-92. In that year gross earnings per mile of line were $7,213, and the income from operation was $2,404. From that time until 1894-95 the gross earnings diminished, and in that year reached their lowest point, which was $6,050 per mile. The income from operation reached its lowest point in 1893-94, when it was $1,946. In 1895-96 the gross earnings had increased to $6,519 and the income from operation to $2,139 per mile. It is evident from these figures that the lowest point in the business of transportation has been passed, and that this branch of business is on the upgrade. This gain is not confined to any one part of the country, but is shown to extend to all parts, with the exception of the states of Louisiana and Texas. The dividends declared by the roads during the year aggregated $54,983,732, an amount almost identical with that of the preceding year.

H. G.

Smithsonian Miscellaneous Collections, No. 1039. Virginia Cartography. A Bibliographical Description by P. Lee Phillips. Washington, 1896.

This is an exhaustive account of the early maps of Virginia. Special attention is given to John Wyth's map of 1585, Capt. John Smith's map of 1608, and that of Augustine Herman of 1670. Of the multitude of maps published in recent years only a few are listed, and it is difficult to see upon what basis selection was made, unless it be the fact that they happen to be represented in the Library of Congress. A singular omission is that of the sheets of the U. S. Geological Survey, which constitute the modern mother maps.

H. G.

GEOGRAPHIC SERIALS

The Bulletin of the Geographical Club of Philadelphia for December comprises "A Trip to Manika Land," by J. Edward Farnum. This is a little known region in southeastern Africa, just south of Zambesi river. The article is accompanied by a sketch map.

The Journal of Geology for November-December, 1896, is of special interest from a geographic point of view. It opens with an article on "The Age of the Auriferous Gravels of the Sierra Nevada," by W. Lindgren, of the Geological Survey. These gravels were carefully studied by Prof. J. D. Whitney, who assigned them to the Pliocene age. Mr Lindgren assigns a somewhat greater age to these beds, placing them in the Miocene or even Eocene, the evidence upon which his conclusions rest being mainly derived from plant remains. Mr Harry Fielding Reid contributes an exceedingly interesting article upon the "Mechanics of Glaciers," and Prof. R. D. Salisbury a paper upon "The Loess in the Wisconsin Drift Formation." Mr Carlos Sapper contributes an article on the "Geology of Chiapas, Tabasco, and the Peninsula of Yucatan," accom-

panied by a small sketch map of this little known region. Another contribution by Prof. R. D. Salisbury, entitled "Studies for Students," treats in outline of glacial phenomena.

The Scottish Geographical Magazine for January, 1897, contains as its leading article a paper by Dr John Murray on the "Temperature of the Water of the Scotch Lakes." The observations, which are tabulated in extenso, show as a rule a slight increase of temperature from the surface down to three or four fathoms, and a gradual reduction in temperature down to the greatest depths obtained, viz., 80 fathoms. The article is illustrated by diagrams, which admirably summarize the results.

The Geographical Journal for January, 1897, contains a number of articles of interest, among them being accounts of journeys and explorations in Malay, Africa, Australia, and South America. These are, "A Journey Through the Malay States of Trenggann and Kelantan," by Hugh Clifford; "Researches in Karia," by W. R. Paton and J. L. Myres; "Journeys in Gosha and Beyond the Deshek Wanna," by Clifford H. Crauford; "Lake Mweru and the Luapula Delta," by A. Blair Watson; "Journey from Western Australia to Warina, in South Australia," by W. Carr Boyd. Mr W. L. Sclater continues his series of articles on "The Geography of Mammals," the present article being devoted to the Nearctic region. Mr George G. Chisholm has an article on the "Distribution of Towns and Villages in England," especially with reference to their geologic location, an aspect which is beginning to receive attention.

The Bulletin of the Sierra Club of California opens with an ascent of Mount Lefroy, in the Canadian Rockies, which resulted in the death of Mr Philip Stanley Abbot. Mr Bolton Colt Brown contributes a pleasant sketch entitled "Wanderings in the High Sierra between Mount King and Mount Williamson." The mountain-climber is advised by Mr Howard Longley "What to Take and How to Take It." Mr J. M. Stillman writes of a "Trip to Tehipite Valley from the Kings River and Grand Cañon," and Theodore S. Solomons upon "An Early Summer Excursion to the Tuolumne Cañon and to Mount Lyell."

The Bulletin of the American Geographical Society, Number 4 of the year 1896, opens with a brief summary of the "Topographic Work of the U. S. Geological Survey in 1895." Signor Romero, the Mexican Minister to the United States, furnishes a most admirable descriptive article on the topography, climate, people, government, and resources of his country. It is well that we should have a better knowledge than we have hitherto possessed of our next-door neighbor on the south. Mr J. V. Brower has an article entitled "The Utmost Waters of the Missouri River." The region described, the headwaters of Red Rock creek, Montana, was explored twenty-five years ago, and has since been subdivided by the General Land Office, which by running a line at every mile—east, west, north, and south—surely leaves little room for geographical discovery.

The Geographical Society of Lima, Peru, publishes a report, accompanied by a map, on the "Navigability of the Eastern Rivers of Peru." The map summarizes the information contained in the report, showing, by means of symbols, the head of navigation of the rivers.

The Journal of the Tyneside Geographical Society gives considerable space to Arctic exploration, the first article being on the Jackson-Harmsworth expedition, by Mr A. Montefiore Brice, and the second upon Nansen's expedition, by Professor Mohn. "The Resources of Canada" are treated by Sir Donald A. Smith. It seems strange that with such wonderful resources of soil, climate, and minerals as Canada is said to possess, its development has been so slow. The exceedingly interesting lecture on Venezuela, delivered before the National Geographic Society by Prof. Wm. E. Curtis, is republished in this magazine. Sir Frederic Goldsmid continues in this number his papers upon "Persia and Her Neighbors."

H. G.

PROCEEDINGS OF THE NATIONAL GEOGRAPHIC SOCIETY, SESSION 1896-'97

Regular Meeting, January 8, 1897.—Vice-President Merriam in the chair. Mr J. S. Diller addressed the Society on the subject of Crater Lake, Oregon, with lantern-slide illustrations.

Special Meeting, January 15, 1897.—President Hubbard in the chair. Mr Sidney Dickinson, M. A., F. R. G. S., lectured on Picturesque New Zealand, with lantern-slide illustrations.

Regular Meeting, January 22, 1897.—President Hubbard in the chair. Mr T. S. O'Leary read a paper entitled "Winds and Their Uses, with some Types of Ocean Weather," illustrating his subject with lantern slides.

Special Meeting, January 29, 1897.—President Hubbard in the chair. Major Henry E. Alvord, C. E., read an address, illustrated by lantern slides, on the Geography of a Battle, with special reference to the battle of Cedar Creek, October 19, 1864.

Regular Meeting, February 5, 1897.—President Hubbard in the chair. Joint meeting with the American Forestry Association. Dr B. E. Fernow read a paper entitled "The Gardens, Forests, and Deserts of Arizona," with lantern-slide illustrations.

Special Meeting, February 12, 1897.—President Hubbard in the chair. Hon. Wm. L. Wilson, Postmaster General, read a paper, with incidental anecdotes and recollections, on the Development of the United States Postal Service.

ELECTIONS.—New members have been elected as follows:

January 12.—Henry Black, Jos. R. Buckalew, J. Ross Colhoun, Arthur J. Collie, Geo. E. Corson, Arthur B. Crane, Miss Ida R. Hannaker, Alvin M. Lothrop, Miss Leontine Mackay, Hon. R. E. Preston, W. C. Ralston, Miss Isabella Read, Miss Alice R. Sanger, W. A. Shaw, Dr Max West.

January 22.—Francis B. Austin, Jas. O. Broadhead, Ellwood P. Cubberly, Mrs A. M. Davis, Chief-Eng. Jas. A. Doyle, U. S. R. M., C. C. Duncanson, G. S. Hobbs, Capt. D. H. Kelton, U. S. A., Dr Fridtjof Nansen (honorary), Hon. Edward Lee Plumb, T. C. Powell, Col. Wm. H.

Powell, U. S. A., Albertus McCreary, H. D. Mirick, E. J. Shives, Edward A. Wright.

February 11.—Col. C. J. Allen, U. S. A., M. W. Baldwin, Miss M. S. Boog, Hon. Chas. A. Boutelle, M. C., Oscar Fitz Clifford, James Fraser, E. B. Grandin, Edward Graves, Gen. John P. Hawkins, U. S. A., Leander L. Hawkins, Mrs Mary A. Hepburn, Dr David J. Hill, J. Q. Kern, Frank M. Kurie, C. E., F. A. Lester, Miss Julia C. Lindsley, Miss Harriet A. Luddington, Edgar A. Lynham, Mrs Mary K. Matthews, Mrs B. S. McDonald, F. W. Pettigrew, C. E., Warren W. Phelan, J. Q. Redway, F. R. G. S., P. C. Riley, James Edgar Smith, Herbert G. Squiers, George B. Starkweather, Frank B. Taylor, Matthew Trimble, Thos. P. Woodward.

MISCELLANEA

The North American Review for February contains a valuable article by John Hays Hammond, from which the following items of interest are abstracted: From 1887 to 1895 the Transvaal produced gold to the value of $158,750,000; $144,000,000 of which came from the Witwatersrand district. The central part of this district, 27 miles of reef, is expected to produce $3,000,000,000 of gold, of which two-thirds is in the central section of 11.5 miles; its output for 1896 was $37,000,000, or about 16 per cent of that of the entire world. California produced up to January, 1897, $1,282,000,000 in gold, three-fourths being from placers. Kimberley has produced upwards of twelve tons of diamonds, representing a value of $400,000,000; the present annual production is about 2,500,000 carats, of the value of $20,000,000. A. W. G.

The Rajputs and Brahmans of India are breaking down the barriers of caste and displaying in competition with the Anglo-Saxon race that brilliance and subtlety of intellect for which they are distinguished. Prof. Jagadis Chunder Bose, of the University of Calcutta, has excited the astonishment and admiration of all Europe by his recent papers on the Determination of the Indices of Electric Refraction and of the Wave-lengths of Electric Radiation. The highest honors of the India Civil Service examinations for 1896 also fell to a Hindoo, who vanquished in a keen intellectual encounter many candidates with distinguished academic careers. In England Prince Ranjitsinhji has taken high university honors, besides securing by the brilliancy of his play the very foremost place in the great national game of cricket. Several Indian barristers have won their way into the higher ranks of the legal profession in London, an Indian physician was recently elected to the staff of one of the London hospitals, and two highly educated Indian surveyors are working in British Central Africa. In November the University of Oxford conferred the degree of Doctor of Music upon Rája Svi Sourindro Mohun Tajore, of Calcutta, the principal exponent of the theory of Indian music, who has for 31 years devoted his wealth and talents to the development of music among his countrymen. In this case, however, the recipient of the distinction was unwilling to lose caste, even temporarily, by crossing the ocean, and the degree was conferred *in absentia*. J. H.

THE NATIONAL GEOGRAPHIC SOCIETY

The Forthcoming Course of Lectures on the Effects of Geographic Environment in Developing the Civilization of the World

As supplementary to the general synopsis of this Course, published in the January number of The National Geographic Magazine, the following special synopses have been furnished by the different lecturers:

March 1. *The Effect of Geographic Environment in the Development of Civilization in Prehistoric Man*, by Hon. Gardiner G. Hubbard.

The civilization of man did not originate from within, but has ever been the effect of geographic environment, pressing from without.

While civilization has been on the whole beneficial, yet every advance has been accompanied by suffering and death. Man was originally subject to nature and depended on nature for his food and habitation, and was even less provided than many other animals.

The joy and suffering of the savage were less than those of civilized man, for care and responsibility come with civilization.

Civilization has never advanced steadily in any country or any age. After remaining stationary for ages and often retrograding, beginning in the Orient it has gradually traveled westward, save in its early progress to China in the east and to Egypt in the south.

Nearly three-fourths of the earth have always been and are now occupied by savages or barbarians and nomad races. Three-fourths of the population are civilized and occupy the remaining quarter of the globe.

The earliest remains of man are found in banks of rivers and in caves in England and France, and are accompanied by bones of animals, either long since extinct or now living in the arctic or torrid zones, showing the great antiquity of man, and his manner of life and implements of offense and defense.

Savage and barbarous nations obtain all their food from nature, and, like many animals, have no care or thought for the morrow; this uncertainty of life leads to recklessness and idleness.

The first step in advance seems to have been made by the inhabitants of central Asia, where the geographical environment furnished inducement for the life of the nomad, for here was the home of the sheep, goat, and horse. They were obliged to care for their flocks morning and night, and in summer provide for winter. Thus they were trained in ways unknown to the savage, and took the first step toward civilization. These

nomads have never made further progress; they live the same life today in Arabia and central Asia that they have lived for thousands and perhaps tens of thousands of years.

The next step in civilization, and the first progressive step, was in countries like Egypt, Mesopotamia, and China, where rivers overflow their banks and irrigate the desert, and where the people were taught of necessity to dig irrigating ditches. The land yielded luxuriantly and with little labor, so a large population was soon gathered, and men were thus brought in close contact—for there can be no progressive civilization without the intimate contact of man with man. This contact is impossible where men live by hunting, or by pasturing cattle, for then one man requires for his support the same territory that will sustain many civilized men.

The civilization of Egypt and Mesopotamia was of a low order, for there could be neither liberty of thought nor of action where there were only two classes, master and servant.

Under the Patriarchal system the father was the head of the family, the children were subject to him and the property belonged to him. As the families increased, the successor of the father, the oldest or most powerful son, became in like manner the patriarch. We see these features exemplified in the life of Abraham, who had absolute control over the life of Isaac.

The continuance of this despotism and slavery in Babylon led to luxury, decay, and the extinction of civilized life.

It was not until civilization reached Greece that personal freedom, with liberty of mind and body, was obtained, and only then was the commencement of arts, science, and true civilization.

March 8. *Babylonia*, by WILLIAM HAYES WARD, D. D., LL. D., of *The Independent*.

It is still uncertain whether civilization began in the Nile or the Euphrates valley. Babylonian history must now be pushed back a thousand years or more beyond Sargon of Agane, who lived 3800 B. C. It is generally asserted that civilization must begin in a river bottom which affords abundant food for a dense population and compels division of labor. Record of civilization begins with writing: all progress before it is prehistoric. Writing was independently invented in these two valleys. The Nile and Euphrates valleys had important differences, though alike in climate and fertility. The Nile valley is accessible only at its lower end, protected on the sides by desert and at the upper end by cataracts. The Euphrates valley is easily attacked from the north towards Syria and Armenia, and from the east towards Elam, and was liable to be overrun by barbarous hordes. The composite Euphrates and Tigris valley differs from the Nile valley in the nature of its floods. The Tigris flood comes first, and the flood is not so much welcomed as guarded against. Irrigation by canals is of first importance. Babylonia is a land of natural swamps, where the mounds of old cities and the banks of great canals are the chief feature of the landscape. As soon as irrigation ceases all returns to desolation. The valley has advanced more than a hundred miles into the Persian gulf since its first cities were built.

In the Nile valley the date palm was first cultivated, while wheat and barley came probably from the Euphrates region. Very ancient monuments show gods adorned with grain and honored with the plow. The native fauna included the buffalo, the wild ox, the ass, the sheep, and the goat, all domesticated in the earliest times and providing an unequaled basis for incipient civilization.

These natural advantages allowed a dense population, but the danger of invasion, especially from Elam, compelled the population, which from the beginning had had to fight lions, leopards, and wild oxen, also to fight their neighbors. This developed a more warlike race than inhabited Egypt. Barbaric invasions also gave a more composite population, and necessitated civil wars. From the beginning of history we find Babylonia attacking Elam on the east and reaching, to the north and west, as far as the Mediterranean. Before the eighteenth Egyptian dynasty Egyptian influence had hardly entered Asia, while Babylonia ruled as far as Cyprus, and it was Babylonian culture which controlled Asia Minor and all the coast, created the Assyrian and Hittite people, and through these and the Phœnician trade gave the chief impulse to Greek civilization.

March 15. *Syria*, by Rev. Dr. THOMAS J. SHAHAN, of the Catholic University of America.

Syria: Its human interest; from time immemorial a battlefield; the scene of West Asiatic conquest and defeat. The empires of Egypt and Africa. The Lombardy of the Orient. The forum of eastern and western civilizations. The converging point of far Eastern trade. Emporium for other Mediterranean nations and the far West. The Phœnician era. Tyre and Sidon. Colonies. The place of ancient Syria in letters, art, and politics.

Orographical formation: Rivers; Table-lands; The Great Steppe. Vegetation.

Geological formation: Cretaceous limestone of the plateaux. Basaltic peaks. Alluvial lands. Clay soils of the Steppe.

Political geography: Pre-Egyptian inhabitants. Egyptian conquest. A subject state of Assyria, Babylonia, Persia. The inheritance of the Greek generals of Alexander. Armenian and Parthian masters. Becomes part of the world-empire of Rome. Chief bazaar and art-museum of the empire. The causes of its decline and early conquest by Arab invaders. Islam and Syria.

March 22. *Tyre and Sidon*, by Professor THOMAS DAVIDSON, M. A., of Brooklyn, N. Y.

The Phœnicians a branch of the Semites. The Semitic character and form of social union. Religion. Devotion to industry and trade. The extent of Semitic civilization. Homeric Greece and the civilization of Agamemnon Semitic.

The Semitic character as affected by surroundings: by the desert (Arabs); by the fertile land (Babylonians, etc.); by mountains and sea (Phœnicians). Phœnicians unwarlike but enterprising. Nature of their civilization, industry, and trade.

Two phases of Phœnician civilization, represented by Sidon and Tyre. In the west, we can trace the former by the deities Poseidon (*i. e.*, Baal-Sidon) and Amphitrite (*i. e.*, Aphrodite); the latter Heraklês (Melcarth) and Pallas (*i. e.*, Baalat) Athenâ. The quarrel between Poseidon and Pallas: the Parthenon group. The Olympia metopes.

The extent of the Phœnician trade, and its effect upon the countries visited. They double the Cape of Good Hope. The Phœnician colonies, Carthage, etc., and their civilization: its strength and weakness. Want of idealism and political sense. The dangers of a merely industrial civilization. Why Carthage succumbed to Rome.

The world's debt to Phœnicia, as an example of industrial enterprise, unrelieved by art, literature, or science.

March 29. *Greece*, by Professor Benjamin Ide Wheeler, LL. D., of Cornell University.

Greece: how its geography explains its history.

Its position. The outpost of Europe; though removed from it by its peninsular form, not severed from connection with it. Greek ideas are representative occidental ideas. The contrast of occidentalism and orientalism. Joined to Asia by a bridge of islands and by the navigable Ægean. Hence open to the reception of eastern ideas and motives, but secured in its capability of assimilating them. The extent and nature of eastern influence. Surrounded by the Mediterranean, hence a distributing medium. Its primacy in Mediterranean civilization. Relations of this civilization to modern European civilization.

Its geography. The irregularity of its coastline. Proximity of all its parts to the sea. Abundance of sheltered beach-harbors. Absence of great rivers. Contrast with the great river civilization of Egypt and Mesopotamia. Partition into districts by mountains. Features of mountain chains: not impassable barriers. Plains of limited size: these encourage particularism and a consciousness of the power of individual initiative. Plains mostly accessible to the sea. Communication by sea rather than by land encouraged. Opened outward rather than inward, motive to union lessened. Variety in relative location of the plains productive of variety in conditions of life, and hence of social and political ideas. Greece a mosaic. The islands so numerous as to set a standard of political and material existence. Extension of the analogy to the Athens of Themistocles and Pericles. Citadels treated as islands.

Its size and the distances between its ports. Superficial area. Distance between important points. Routes and methods of communication. Effect of dimensions upon the Greek sense of proportion and upon the stimulation of individual energy.

Climate and products. Temperature and contrast of seasons. Outdoor life. Sociability. Democracy. Interest in athletics. Winds. Effect on commerce. Rainfall and fertility. Products of soil. Bent toward commerce rather than agriculture. Urban life and attitude toward farmers.

Important sites. Cities: Sparta, Thebes, Corinth, Athens, and their geographical characteristics. Battlefields: Marathon, Mantinea, Chæronea, Salamis. Festal places: Olympia, Delphi.

Impressions of Greek scenery.

April 5. *Rome*, by Rev. Dr ALEX: MACKAY-SMITH, of Washington, D. C.

The name: its significance in history. Differentiation from other world-forces. Its position. The people who founded it. Environment. Mixture of races. The resultant in terms of character. The opportunity of Rome. Clearing the way. The enlargement of power. What the sea did for Rome. What Rome did for man. Evolution and involution. Its growth in certain virtues. The vice of those virtues. The virtue of those vices. The wings and claws of the eagle. The culmination of glory. The sphere of influence. Why the Republic became an Empire, and the Empire waned. Roots and fungi. The Imperial City: its splendor; what it stood for. The upheaval of new forces. Readjustment. The turning over of Europe. Fresh fuel. The barbarian at the gates. Mediæval Rome. Its influence. Its rationale. Its weakness and power. The renaissance. Old foes with new faces. Its meaning in Art and Religion. Reverence and contempt. The dust-heap and ant-hill. The city of today. The "hiding of its power." What it means to the scholar, to the artist, to the traveler. Characteristics. The strength of ruins. The palimpsest of history.

April 12. *Constantinople*, by Prof. EDWIN A. GROSVENOR, of Amherst College.

Rome, though able to build up a universal empire, could no longer retain her place as the world's capital under conditions existent at the end of the third century. A change of site was absolutely necessary. A new world-capital must be planted on some spot possessed of four requisites: the positional, the strategic, the material, and the sentimental. Former emperors had perceived this fact, but the undertaking was beyond their power. The name of Constantine is immortalized and his statesmanship demonstrated in that he took definite and decisive action. Only after years of disappointed examination did he recognize the one prominent site. "No city chosen by the art of man has been so well chosen and so permanent." The history and influence, the whole being of none other, has been so determined by physical causes, by environment. The spot once selected, the city was the creation of nature rather than the result of imperial decree. In the hands of its environment it was a passive and by means of its environment an active factor. It gave strength to the empire rather than derived strength from the empire. From 330 to 1204 it was the queen-city of the world. During these tumultuous nine centuries, while every other continental city was captured more than once, Constantinople did not once succumb to foreign attack.

The crowned heir of Rome and Italy, it was inevitably the heir of Athens and Greece. Hellenismos, deserting the Ilyssos and Kephissos, found its focal center on the banks of the Bosphorus, and under the name Byzantine was distinctly Greek.

When the world's front changed, Constantinople lost for a time its undisputed preëminence, but has never descended to a lower rank than that of capital of an empire. During the last centuries its political importance, because of its political possibilities, has constantly increased. Today the

most stupendous problem of statecraft is the ultimate fate of Constantinople in case of modifications in the east. Its transference from the hands of the Ottomans involves a reorganization and readjustment of European interests no less momentous than resulted from the wars of the Reformation or of the French Revolution. There are but three possible solutions of the problem, none of them satisfactory to all and each distasteful to some one or more of the powers most directly concerned. Between these three time is to choose.

The lecture will treat as fully as possible of the many-sided city, but the central thought will be its political prominence and destiny.

April 19. *Venice and Genoa*, by Prof. WILLIAM H. GOODYEAR, of the Brooklyn Institute of Arts and Sciences.

The German precision and the Byzantine culture in western Europe. The position of Italy in mediæval history as mediator for Byzantine influence in Europe. The Italian towns which were active in this influence. Predecessors of Venice and Genoa. The monuments of Genoa. The monuments of Venice. The painters of Venice.

April 26. *America.* Arrangements not completed.

(*These lectures will be delivered in the Columbia theater, Washington, D. C., on nine successive Monday afternoons, commencing March 1. Each lecture will be accompanied by lantern-slide illustrations.*)

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ERRATA

On page 87, the paragraph relating to Franz Josef Land should be under separate sub-caption "Polar Regions."

On page 152, for 'B. S. Payne' (Director, Oregon State Weather Bureau), read 'B. S. Pague.'

On page 181, article "The Kansas River," line 2, for 'Davis county,' read 'Geary county.'

On page 232, line 39, for 'Plate V,' read 'Plate XXVI.'

On page 238, article "A Journey in Ecuador," line 15, for 'apricots,' read 'aguacates (alligator-pears).'

On page 290, lines 3, 14, 24, 32, and 37, for 'Svendrup,' read 'Sverdrup.'

On page 345, line 2, for 'easterly,' read 'westerly.'

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