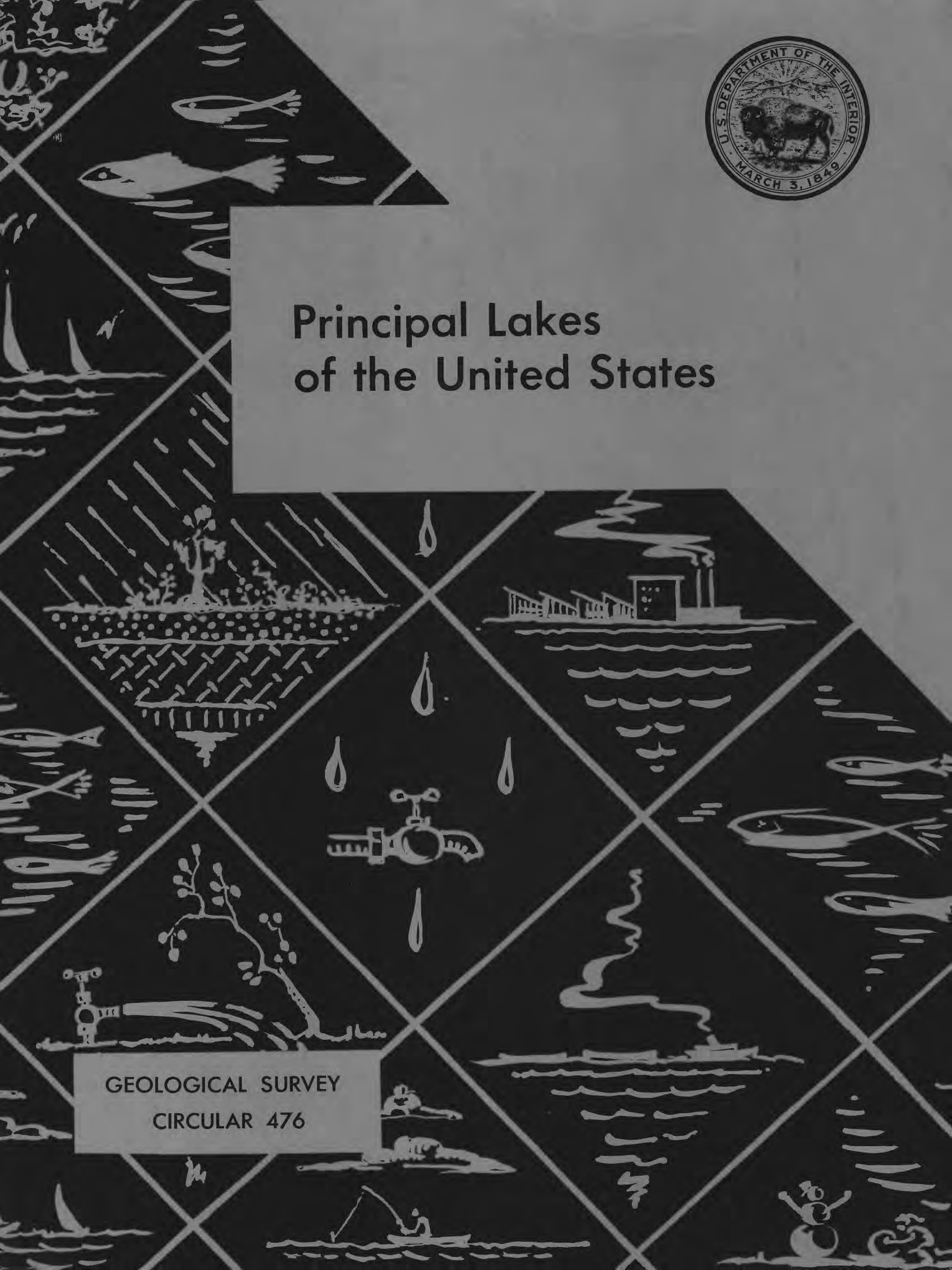

U.S. DEPARTMENT OF THE INTERIOR · MARCH 3, 1849

Principal Lakes of the United States

GEOLOGICAL SURVEY
CIRCULAR 476

Principal Lakes of the United States

By Conrad D. Bue

GEOLOGICAL SURVEY CIRCULAR 476

Washington 1963

United States Department of the Interior

ROGERS C. B. MORTON, *Secretary*

Geological Survey

V. E. McKelvey, *Director*

First printing 1963
Second printing 1964
Third printing 1965
Fourth printing 1967
Fifth printing 1970
Sixth printing 1973

Free on application to the U.S. Geological Survey, Washington, D.C. 20244

CONTENTS

ILLUSTRATIONS

TABLES

Principal Lakes of the United States

By Conrad D. Bue

ABSTRACT

The United States has about 250 fresh-water lakes that are known to have surface areas of 10 square miles or more. Nearly 100 of these are in Alaska, and 100 in Minnesota, Wisconsin, Michigan, New York,, and Maine.

Thirty-four fresh-water lakes, exclusive of the Great Lakes, are known to have maximum depths of 250 feet or more. Twenty of these are in Alaska, and Alaska undoubtedly has more lakes of that depth which have not been sounded.

The amount of water stored in natural lakes—even exclusive of the Great Lakes—is much greater than the amount stored in artificial reservoirs. With the exception of the Great Lakes, however, the economic value of natural lakes is surpassed by that of artificial reservoirs. Natural lakes are best known for the recreational advantages they afford.

INTRODUCTION

This report is primarily a glossary of lakes in the United States that have surface areas of 10 square miles or more. A few known statistics on depths and some brief narrative information are included. The report was prepared to fill a need for general information on lakes suited to nontechnical readers.

Comparatively little statistical information on natural lakes has been collected in a systematic manner or according to uniform criteria. Agencies in most of the States that have many lakes have, at some time, issued inventory reports on lakes within their States, but the scope of the information varies considerably from one State to another. The most recent and comprehensive report—one that merits special mention—is a report on the lakes of western Washington (Wolcott, 1961) published by the Washington Department of Conservation. (A similar report on lakes in eastern Washington is in preparation by the State.)

Some of the lakes listed in this report have dams at their outlets so that the lakes can be regulated between prescribed levels, and thus provide a certain amount of artificial storage (Thomas and Harbeck, 1956). The areas of those lakes are the average areas under present regulation. With some possible exceptions, it is unlikely that the areas of regulated lakes have been changed very much by artificial regulation.

Because of their variable nature, saline lakes in the Great Basin are discussed at some length. Some of the lakes shown on older maps are now dry, or are much smaller than would be inferred from the maps. These saline lakes have no outlets, and hence are regulated entirely by climate, but their shrinkage, or disappearance, during the past few decades cannot be attributed to climatic changes alone; diversion of water from their tributaries for Man's use has been an important factor. The saline lakes that now exist in the Great Basin are the persistent leftovers from a time, thousands of years ago, when the Great Basin contained numerous lakes (Feth, 1961,) most of which have long since dried up. Two of these lakes, Bonneville and Lahontan, were huge—Lake Bonneville was nearly as large as Lake Michigan, and Lake Lahontan was nearly as large as Lake Erie.

The statistical data presented in this report have been compiled from many sources, some of which could not be checked. A reader who finds an error will render a service if he calls it to the attention of the Geological Survey and cites his authority for the correct figure.

ACKNOWLEDGMENTS

The names and surface areas of natural lakes in the United States have been compiled from many sources over a period of years, and for the purpose of this report were reviewed and revised in the district offices of the Surface Water Branch. Acknowledgment is made to Margaret P. Mahey for coordinating the review, and collating and assembling the final figures. The author is indebted to K. N. Phillips and M. T. Wilson, district engineers in Portland, Oreg., and Salt Lake City, Utah, respectively, for their helpful review of the manuscript and for some of the information presented, particularly in the sections on origin of lakes, and on saline lakes in Oregon and Utah. E. E. Harris, district engineer in Carson City, Nev., furnished most of the statistical data on saline lakes in Nevada. Much of the general information was gleaned from the references listed in "Selected Bibliography," at the end of this report.

ORIGIN OF NATURAL LAKES

The origin of natural lakes is associated with glacial action, volcanic action, warping of the earth's crust, and other natural phenomena. Once a lake is formed it depends for its existence upon a continuing source of water—inflow to the lake and precipitation directly upon the lake—to balance outflow from the lake and evaporation from the lake's surface. The origins of a few selected lakes are discussed briefly, as examples. The lakes selected are mostly those 10 square miles or more in area and are listed elsewhere in this report.

Glacial lakes are far more abundant than those of other origins. In the Northern States east of the 100th meridian, thousands of lakes were formed by the continental ice sheets during the great ice age. Comparatively little of the northwestern United States (except Alaska) was glaciated by continental ice sheets, but many lakes were formed by glaciers that might be classified broadly as the mountain-valley type. Glacial lakes occupy basins that were formed by the scouring action of moving ice, or the damming of stream channels by debris deposited by melting ice, or by a combination of these two processes. Of the thousands of glacial lakes, very few are as large as 10 square miles in surface area.

The Great Lakes came into existence as a result of the great ice age. It was once believed that the basins of the Great Lakes were formerly broad lowlands, which were scoured out and deepened by the continental glaciers. Recently evidence has been discovered that indicates that these basins may have been cut down to their present depths by the streams that flowed through them before the ice age, and that the scouring action of the glaciers may not have been as great as was once believed. Offshore drilling in Lake Superior by geologists from the University of Michigan revealed deep valleys on the lake floor which probably were cut by a mighty preglacial river system emptying either into Hudson Bay or the St. Lawrence River valley (Water Newsletter, Aug. 7, 1961). Regardless of the origin of these great depressions, they were filled with water when the glaciers melted and retreated.

The Great Lakes underwent many changes before they reached their present outline. At one time before the close of the ice age, Lakes Superior, Michigan, and Huron were a single lake, which has been named Lake Algonquin. It had an area of 100,000 square miles, as compared with 77,230 square miles, the present area of the three lakes, and was more than 1,500 feet deep in places, as compared with 1,300 feet, the present maximum depth of Lake Superior. Lake Algonquin existed for several thousand years. Lake Erie was in existence, much as it is now, but the area occupied by the present Lake Ontario was covered by a much larger lake, called Lake Iroquois.

Lake Okeechobee in Florida is a remnant of a shallow sea, known as the Pamlico sea, which once occupied what is now the Everglades-Lake Okeechobee basin. The basin was formed when the Florida plateau emerged from the ocean as a result of movement of the earth's crust (Davis, 1943).

Reelfoot Lake in Tennessee was formed by the New Madrid earthquake in 1811–12, through a combination of sinking and upheaval of the earth's crust. The bed of the present lake was formerly low, marshy ground, which sank 5 to 20 feet or more as a result of the earthquake.

The Finger Lakes in New York are two groups of long, narrow lakes suggesting the fingers of a hand. Geologists are not in full agreement as to the origin of these lakes. except that the lakes occupy the valleys of streams that existed before the great ice age, and that the basins of the streams were greatly modified by the moving ice. The two largest of these lakes are Cayuga and Seneca. Lake Cayuga is 381 feet above sea level and it reaches a maximum depth of 54 feet below sea level; Lake Seneca is 444 feet above sea level and it reaches a maximum depth of 174 feet below sea level (Fenneman, 1938). A hole drilled to a depth of nearly 600 feet below the bottom of Lake Seneca did not reach the rock floor of the valley of the preglacial stream. An unanswered question of great interest is how these basins attained their great depth.

Crater Lake in Oregon (fig. 1), the deepest lake in the United States (see table 4) and well known for its intensely blue water, occupies a caldera 6 miles long and 4 miles wide. (A caldera is a crater formed by the collapse of the central part of a volcano.) Most of the original volcanic mountain disappeared when the top of the cone collapsed into the crater after the last eruption. The name Mount Mazama has been given to this ancient volcano, which was active until late in the Pleistocene[1] epoch (Hussey, 1947). Recent studies (Briggs, 1962) indicate that Mount Mazama erupted about 6,500 years ago after a long period of quiescence, and that the cone collapsed soon after. When the crater had cooled off, water began to collect in the bottom of it, and Crater Lake was formed. No surface stream flows into or out of Crater Lake (see also p. 13). The lake is fed entirely by precipitation—rain and snow—which averages 66 inches of water annually. The lake loses water only through evaporation and seepage, which balance the

[1]The Pleistocene epoch, which began about a million years ago, coincides approximately with the great ice age. According to geologic time divisions in rather common usage, the Pleistocene epoch ended some 10 thousand years ago, and we are now in the Recent epoch.

Figure 1.—Crater Lake, Oregon, in winter. Water level is about 6,175 feet above sea level. The crater walls, rising as much as 2,000 feet above the water, are remnants of a mountain more than 12,000 feet high. Wizard Island, in the middle ground, is the result of volcanic activity that continued after the main peak had collapsed. Photograph by Oregon State Highway Department.

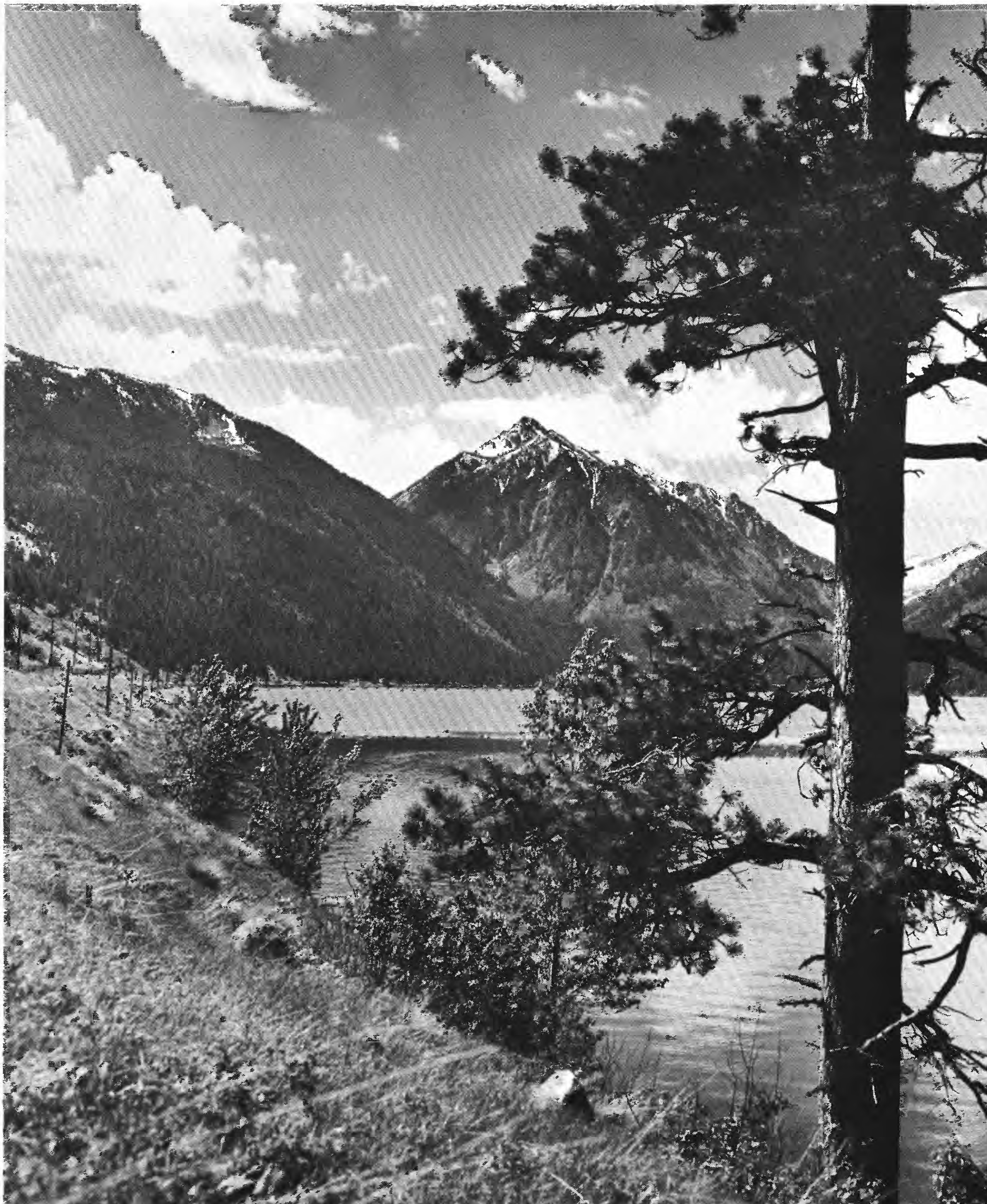

Figure 2.—Wallowa Lake, Oregon. Water level is about 4,370 feet above sea level. Bench in left foreground is a lateral moraine. Peaks of the Wallowa Mountains in background rise to altitudes of 8,500 to 10,000 feet. Photograph by Oregon State Highway Department.

precipitation so that the lake level fluctuates only 1 to 3 feet per year.

Lake Tahoe in California-Nevada occupies a structural valley formed by geologic block faulting and modified by glacial action. A lake of rare beauty, and on the routes of two transcontinental highways, it is probably the best known and most visited lake in the western United States.

Lake Chelan in Washington, which is exceeded in depth only by two lakes (see table 4), and Flathead Lake in Montana, in surface area the largest fresh-water lake in western conterminous United States (see table 3), were both formed by mountain-valley glaciers. Lake Chelan occupies a depression more than 300 feet below sea level gouged out by a glacier that moved nearly 90 miles down the Stehekin Valley from Cascade Pass.

There are many small lakes (less than 10 square miles) that are of great local interest. Among these, Wallowa Lake in Oregon (fig. 2) was formed by a mountain-valley glacier. Davis Lake in Oregon was formed by a lava dam across Odell Creek; Spirit Lake in Washington was similarly formed by volcanic ejecta from Mount St. Helens. In August 1959 an immense landslide, caused by an earthquake, dammed the Madison River in Montana and formed a small lake. The Uinta Mountains in northeastern Utah are dotted with small lakes of glacial origin.

Lakes are not permanent features of the landscape but, in terms of geologic time, are transitory. Ever at work to destroy lakes are natural forces which include among others, erosion of the outlet, filling with sediment carried by inflowing streams, and formation of peat on the lake bottom. In the natural course of events most lakes are destined to become swamps and eventually dry land, although this transformation may require hundreds or thousands of years.

Even the Great Lakes are not immune from destructive forces. Although the lakes should last thousands of years, conservationists are concerned that sewage and industrial wastes being dumped into the lakes may be speeding up the natural aging process (Water Newsletter, 1961b). The eroding of the Niagara River channel, unless controlled by the works of man, is another force that could eventually affect the lakes by lowering the level of Lake Erie. The bottom of Lake Erie is higher than the surface of Lake Ontario (fig. 3); the Niagara River, not shown in figure 3, is the natural connecting channel between the two lakes. The Niagara Falls is gradually cutting its way up the Niagara River towards Lake Erie. Fenneman (1938) estimates that the main cataract is receding upstream at a rate of between 4 and 5 feet per year, and that the falls has receded upstream a distance of $6\frac{1}{2}$ miles since it came into existence. Although the falls might deteriorate into a series of rapids before it reaches Lake Erie, it is conceivable that, in time, the Niagara River could lower its channel enough to have a marked effect on the level of Lake Erie.

THE GREAT LAKES

Because of their great size, the Great Lakes are tabulated separately. The lakes are, in effect, inland seas, and cannot be compared with other, much smaller, lakes. In surface area, Lake Superior is the largest body of fresh water in the world, and Lakes Huron and Michigan rank third and fourth, respectively.[2] Statistics shown in table 1 have been published by the U.S. Lake Survey (1952).

The Great Lakes have played an important role in the industrial development of the

[2]The second largest is Lake Victoria in Africa, which has a surface area of 26,800 square miles and a maximum depth of 270 feet.

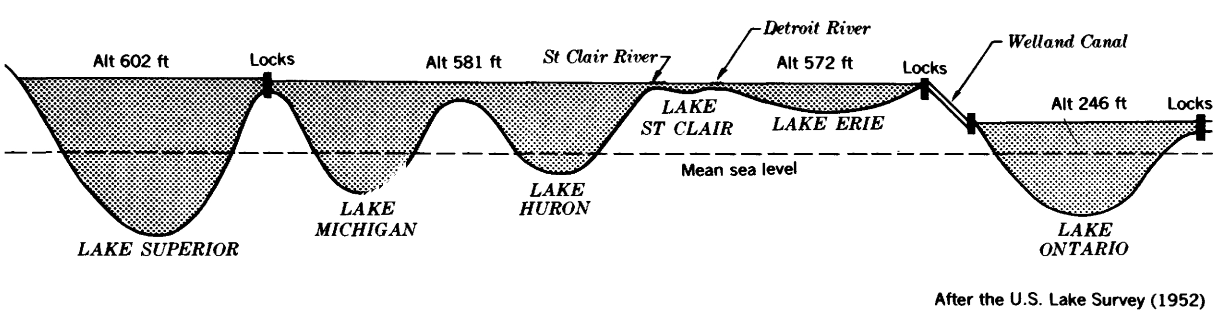

Figure 3.—Schematic section of Great Lakes, showing profile and relative depths.

Table 1.—*Statistical data on the Great Lakes*

Lake	Surface area (square miles)			Maximum depth recorded (feet)	Mean elevation (feet above sea level) 1960–1951
	United States	Canada	Total		
Superior	20,710	11,110	31,820	1,302	602.21
Michigan	22,400	0	22,400	923	580.57
Huron	9,110	13,900	23,010	750	580.57
Erie	4,990	4,950	9,940	210	572.31
Ontario	3,560	3,980	7,540	778	246.00
Total	60,770	33,940	94,710		

United States, as attested to by the industrial centers that have sprung up on the lakes' shores. With the completion of the St. Lawrence Seaway, seagoing ships of up to 25,000 tons displacement can sail between the Atlantic Ocean and Duluth, Minn., a distance of some 2,300 miles.

NATURAL FRESH-WATER LAKES

This section lists, by States, the names and surface areas of lakes (exclusive of the Great Lakes) having surface areas of 10 square miles or more. Some of these lakes are regulated by dams at their outlets, and the areas shown are the average areas under present regulation unless otherwise qualified. The total number of lakes listed is 245; their total surface area is 13,700 square miles.

Twenty-three States have all the lakes of 10 square miles or more, and numerous smaller lakes. Minnesota has 40 lakes of 10 square miles or more, but the "Gazetteer of Meandered[3] Lakes of Minnesota," published in 1928 by the Minnesota State Department of Drainage and Waters, lists 6,489 meandered lakes, of which 1,009 are unnamed, and states that the nonmeandered lakes may well outnumber the meandered lakes. Michigan has 17 lakes of 10 square miles or more, including Lake St. Clair, but the "Michigan Lakes and Streams Directory," published in 1931 by the Magazine of Michigan Company, lists 4,189 lakes with names. Other sources credit Michigan with more than 10,000 lakes. New York has 10 lakes of 10 square miles or more, but an unpublished gazetteer lists 2,300 lakes and ponds of 0.01 square miles (about 6 acres) or more. Washington has three lakes of 10 square miles or more, but Water Supply bulletin No. 14, published by the State Department of Conservation, lists 3,813 lakes and reservoirs in the western 19 counties alone (about 37 percent of the State), for a total surface area of 174,734 acres, an average size of 46 acres, or about 0.07 square mile.

There is no rule that states how large or how deep a body of water must be to be called a lake, nor is there a clearly defined distinction between a lake and a pond. Biologists think of a pond as a body of water shallow enough that vegetation can grow all the way across it, but a better known definition of a pond is simply that it is a body of water too small to be called a lake. Although we commonly think of a pond as a small manmade body of water—millpond, stock pond—a pond can be a natural body of water; in fact, a natural pond may be a stage in the gradual extinction of a previously existing lake (see also p.5).

Although a natural lake may contain a large volume of water, this water is not all available for uses that require withdrawal. Only the natural outflow is available for use; if more water were withdrawn, the lake would be lowered below its natural level. Many natural lakes are regulated between prescribed limits by dams at their outlets, and thus provide a certain amount of water in storage that can be released as desired. In this way, a natural lake can serve the same purpose as an artificial reservoir. With the exception of the Great Lakes, however, the economic value of our natural lakes is probably not as great as that of our artificial reservoirs.

[3] A meandered lake is one whose boundary has been surveyed.

Natural lakes are better known for the recreational advantages they offer than for their contribution to our national economy. Lakes are among the earth's most scenic features and make ideal sites for summer homes, tourist resorts, and other recreational facilities. Of the lakes mentioned in this report, the following are in National Parks, and hence afford certain facilities extended by the National Park Service:

Yellowstone Lake	Yellowstone National Park
Lake McDonald	Glacier National Park
Jackson Lake	Grand Teton National Park
Lake Crescent	Olympic National Park
Crater Lake	Crater Lake National Park

In the list of lakes by States, (table 2), the locations of the lakes are given by counties except those in Alaska, for which locations are given by latitude and longitude. The degree of accuracy with which the areas were measured is not known; it is unlikely that the accuracy is of the same degree for all the States, but the figures shown are the best available.

For the convenience of those who are interested in the ranking of the largest lakes, a separate list (table 3) ranks the lakes of 100 square miles or more.

Table 2.—*Natural fresh-water lakes of 10 square miles or more, excluding the Great Lakes, arranged by States*

Name	Latitude	Longitude	Area (sq mi)
Alaska:			
Iliamna	59°35	155°00	1,000
Becharof	57°50	156°25	458
Teshekpuk	70°35	153°30	315
Naknek	58°35	156°00	242
Tustumena	60°25	150°20	117
Clark	60°10	154°00	110
Dall	60°15	163°45	100
Inland[1]	66°30	159°50	95
Imuruk Basin[1]	65°05	165°40	80
Upper Ugashik	57°50	156°25	75
Kukaklek	59°35	155°00	72
Lower Ugashik	57°30	156°55	72
Nerka	59°20	158°45	69
Nuyakuk	59°50	158°50	64
Aropuk	61°10	163°45	57
Tazlina	61°50	146°30	57
Nanwhyenuk or Nonvianuk	59°00	155°25	56
Nunavakpak	60°45	162°40	53
Kaghasuk[1]	60°55	163°40	52
Skilak	60°25	150°20	38
Chauekuktuli	60°05	158°50	34
Chikuminuk	60°15	158°55	34
Beverly	59°40	158°45	33
Whitefish	61°20	160°00	33
Aleknagik	59°20	158°45	31
Brooks	58°30	155°55	31
Kgun	61°35	163°50	31
Nonvianuk	59°00	155°30	31
Takslesluk	61°05	162°55	31
George	61°15	148°35	29
Nunavak Anukslak	61°05	162°30	29
Unnamed	60°55	164°00	28
Grosvenor	58°40	155°15	27
Tetlin	63°05	142°45	27
Alaska—Continued:			
Chakachamna	61°10	152°30	26
Imuruk	65°35	163°10	26
Nunavakanuk	62°05	164°40	25
Louise	62°20	146°30	23
Minchumina	63°55	152°15	23
Klutina	61°40	145°30	22
Unnamed	61°30	164°30	22
Do	71°05	156°30	21
Beluga	61°25	151°30	20
Unnamed	60°05	164°00	20
Do	61°40	160°25	20
Kenai	60°25	149°35	19
Kyigayalik	61°00	162°30	19
Tikchik	59°55	158°20	19
Bering	60°20	144°20	17
Kulik	59°50	158°50	17
Upnuk	60°05	158°55	17
Unnamed slough	62°40	163°30	17
Teloquana	60°55	153°55	16
Unnamed	60°30	161°40	16
Do	61°00	163°45	16
Do	61°30	164°55	16
Five Day Slough	62°05	162°00	15
Togiak	59°35	159°35	15
Unnamed	59°55	163°15	15
Black	56°25	159°00	14
Ualik	59°05	159°30	14
Walker	67°05	154°25	14
Unnamed	60°20	164°25	14
Do	60°50	163°30	14
Do	59°50	163°30	14
Amanka	59°05	159°10	13
Whitefish	60°55	154°55	13
Unnamed	71°00	156°00	13
Crosswind	62°20	146°00	12

See footnotes at end of table.

Table 2.—*Natural fresh-water lakes of 10 square miles or more, excluding the Great Lakes, arranged by States*—**Cont.**

Name	Latitude	Longitude	Area (sq mi)
Alaska—Continued:			
Kakhomak	59°30	154°10	12
Karluk	57°20	154°05	12
Mother Goose	57°10	157°20	12
Unnamed	60°25	164°10	12
Do.	59°50	163°25	12
Do.	62°15	162°20	12
Do.	70°50	153°30	12
Coleville	58°45	155°40	11
Harlequin	59°25	138°55	11
Unnamed	60°25	164°10	11
Do.	60°55	162°20	11
Bear	56°00	160°15	10
Chignik	56°15	158°50	10

Name	Latitude	Longitude	Area (sq mi)
Alaska—Continued:			
Ewan	62°25	145°50	10
Kontrashibuna	60°10	154°00	10
Kukaklik	61°40	160°30	10
Kulik	58°55	155°00	10
Do	61°45	160°40	10
Miles	60°40	144°45	10
Susitna	62°25	146°40	10
Unnamed	60°20	162°00	10
Do	60°25	162°00	10
Do	60°55	162°10	10
Do	59°55	163°15	10
Do	62°00	162°00	10

Name	County	Area (sq mi)
California:		
Tahoe[2]	Placer, Eldorado	193
Clear	Lake	65
Eagle[3]	Lassen	41
Florida:		
Okeechobee	Hendry, Glades, Okeechobee, Martin, Palm Beach.	700
George	Putnam, Marion, Volusia, Lake.	70
Kissimmee	Osceola, Polk	55
Apopka	Orange	48
Istokpoga	Highlands	43
Tsala Apopka	Citrus	30
Tohopekaliga	Osceola	29
Harris	Lake	27
Orange	Alachua, Marion	26
East Tohopekaliga	Osceola	19
Griffin	Lake	14
Monroe	Seminole, Volusia	14
Jessup	Seminole	13
Weohyakapka	Polk	12
Talquin	Gadsden, Leon	11
Eustis	Lake	11
Blue Cypress	Osceola, Indian River.	10
Hatchineha	Polk, Osceola	10
Lochloosa	Alachua	10
Idaho:		
Pend Oreille	Bonner	148

Name	County	Area (sq mi)
Idaho—Continued:		
Bear[4]	Bear Lake	[5]110
Coeur d'Alene	Kootenai	50
Priest	Bonner	37
Grays[6]	Bonneville, Caribou	34
Henrys	Fremont	10
Iowa:		
Spirit	Dickinson	12
Louisiana:		
White[7]	Vermilion	83
Grand	Iberia, St. Mary, St. Martin.	64
Caddo[8]	De Soto	60
Catahoula[9]	La Salle	32
Grand	Cameron	32
Six Mile	St. Martin, St. Mary	30
Fausse Pointe	St. Mary, Iberia	24
Lac des Allemands.	St. John the Baptist.	23
Verret	Assumption	22
Polourde	St. Martin, St. Mary, Assumption.	18
Maine:		
Moosehead	Piscataquis, Somerset.	117
Sebago	Cumberland	45
Chesuncook[10]	Piscataquis	43
West Grand	Washington	37
Flagstaff	Somerset, Franklin	28
Spednik[11]	Washington	28
Grand Falls[11]	do	27

See footnotes at end of table.

Table 2.—*Natural fresh-water lakes of 10 square miles or more, excluding the Great Lakes, arranged by States*—Cont.

Lake	County	Area (sq mi)
Maine—Continued:		
East Grand [11]	Washington, Aroostook.	26
Mooselookmeguntic.	Oxford, Franklin	26
Twin	Penobscot, Piscataquis.	25
Chamberlain and Telos.	Piscataquis	22
Graham	Hancock	19
Churchill and Eagle.	Piscataquis	17 17
Baskahegan	Washington	16
Umbagog [12]	Oxford	16
Brassua	Somerset	15
Square	Aroostook	14
Millinocket	Penobscot, Piscataquis.	14
Great	Kennebec	13
Richardson	Oxford	13
Schoodic	Piscataquis	11
Sebec	do	11
Aziscohos	Oxford	10
Canada Falls	Somerset	10
Rangeley	Oxford	10
Michigan:		
St. Clair [13]		460
Houghton	Roscommon	31
Torch	Antrim, Kalkaska	29
Charlevoix [14]	Charlevoix	27
Burt	Cheboygan	27
Mullet	do	26
Gogebic	Ontonagon, Gogebic.	21
Manistique	Mackinac, Luce	16
Black	Cheboygan, Presque Isle.	16
Crystal	Benzie	15
Portage	Houghton	15
Higgins	Crawford, Roscommon.	15
Hubbard	Alcona	14
Leelanau	Leelanau	13
Indian	Schoolcraft	12
Elk	Antrim, Grand Traverse.	12
Glen	Leelanau	10
Minnesota:		
Lake of the Woods. [15]	Lake of the Woods.	1,485
Minnesota—Continued:		
Upper and Lower Red.	Beltrami	451
Rainy [15]	Koochiching, St. Louis.	345
Mille Lacs	Aitken, Crow Wing, Mille Lacs.	207
Leech	Cass	176
Winnibigoshish	Itasca, Cass	109
Vermilion	St. Louis	77
Lac La Croix [15]	do	53
Cass	Cass, Beltrami	46
Basswood [15]	Lake	46
Namakan [15]	St. Louis	44
Kabetogama	Itasca	40
Pepin [16]	Goodhue, Wabasha	39
Mud	Marshall	37
Saganaga [15]	Cook	32
Pokegama	Itasca	24
Minnetonka	Hennepin, Carver	22
Otter Tail	Otter Tail	22
Gull	Cass, Crow Wing	20
Pelican	St. Louis	19
Traverse [17]	Traverse	18
Big Stone [17]	Big Stone	17
Crooked [15]	St. Louis, Lake	17
Sandy	Aitkin	15
Swan	Nicollet	15
Island	St. Louis	14
Bowstring	Itaska	14
Burntside	St. Louis	14
Sand Point [15]	do	14
Trout	do	14
St. Croix [16]	Washington	13
Lac qui Parle	Chippewa, Lac qui Parle.	13
Pelican	Crow Wing	13
Dead	Otter Tail	12
Minnewaska	Pope	12
Thief	Marshall	12
Nett	St. Louis, Koochiching.	12
Osakis	Douglas, Todd	10
Bemidji	Beltrami	10
Lida	Otter Tail	10
Montana:		
Flathead	Lake, Flathead	[18]197
Medicine	Sheridan	[19]15
McDonald	Flathead	10

See footnotes at end of table.

Table 2.—*Natutal fresh-water lakes of 10 square miles or more, excluding the Great Lakes, arranged by States*—Cont.

Name	County	Area (sq mi)
Nevada:		
Tahoe[2]	Ormsby,Douglas	193
New Hampshire:		
Winnipesaukee	Belknap, Carroll	72
Umbagog[12]	Coos	16
Squam	Gafton, Carroll	11
New York:		
Champlain[20]	Clinton, Essex	[21]490
Oneida	Oswego, Oneida	80
Seneca	Seneca, Schuyler	67
Cayuga	Cayuga, Seneca, Tompkins.	66
George	Warren	44
Chautauqua	Chautauqua	21
Black	St. Lawrence	17
Canandaigua	Ontario, Yates	17
Skaneateles	Onondaga, Cayuga	14
Owasco	Cayuga	10
North Carolina:		
Mattamuskeet[22]	Hyde	67
Phelps	Washington	25
Waccamaw	Columbus	14
Oregon:		
Upper Klamath	Klamath	[23]142
Crater	do	21
South Dakota:		
Traverse[17]	Roberts	18
Big Stone[17]	do	17
Tennessee:		
Reelfoot	Lake, Obion	22
Texas:		
Caddo[8]	Marion	60
Utah:		
Utah	Utah	140
Bear[4]	Rich	110
Vermont:		
Champlain[20]	Chittenden, Franklin.	[21]490
Washington:		
Chelan	Chelan	55
Washington	King	35
Ozette	Clallam	12
Wisconsin:		
Winnebago	Winnebago, Calumet, Fond du Lac.	215
Pepin[16]	Pierce, Pepin	39
Poygan	Winnebago	17
Koshkonong	Jefferson	16
Mendota	Dane	15
St. Croix[16]	St. Croix	12
Green	Green Lake	11
Wyoming:		
Yellowstone	Yellowstone National Park.	[24]137
Jackson	Teton	[25]39
Shoshone	Yellowstone National Park.	11

1 May be salt water.
2 California and Nevada.
3 Mildly saline, less than 1,000 ppm.
4 Idaho and Utah.
5 136 sq mi including Mud Lake.
6 Submerged marsh.
7 Originally brackish; now kept fresh by controls on salt water intrusion.
8 Louisiana and Texas.
9 Shrinks to small area at extremely low stages.
10 Includes Ripogenus and Caribou.
11 Maine and Quebec.
12 Maine and New Hampshire.
13 Michigan and Ontario.
14 Formerly called Pine.
15 Minnesota and Ontario.
16 Minnesota and Wisconsin.
17 Minnesota and South Dakota.
18 At normal high water; 188 sq mi at medium low water; lake regulated for power between these limits.
19 Includes 4 islands having area of about 1 sq mi.
20 New York, Vermont, and Quebec.
21 Includes islands totaling about 55 sq mi.
22 The lake originally landlocked, was drained and provided with outlet and is fresh water; level regulated to some extent by control works on canals draining the area.
23 At upper level; dam at outlet allows regulation so that area varies between 93 and 142 sq mi.
24 Includes islands totaling 3 sq mi.
25 Enlarged by dam; original area, 30 sq mi.

Table 3.—*Natural fresh-water lakes of 100 square miles or more, excluding the Great Lakes, ranked by size*

Name	Location	Area (sq mi)	Name	Location	Area (sq mi)
Lake of the Woods	Minnesota and Ontario.	1,485	Mille Lacs	Minnesota	207
			Flathead	Montana	197
Iliamna	Alaska	1,000	Tahoe	California and Nevada.	193
Okeechobee	Florida	700			
Champlain	New York, Vermont, and Quebec.	490	Leech	Minnesota	176
			Pend Oreille	Idaho	148
St. Clair	Michigan and Ontario.	460	Upper Klamath	Oregon	142
			Utah	Utah	140
Becharof	Alaska	458	Yellowstone	Wyoming	137
Upper and Lower Red.	Minnesota	451	Tustumena	Alaska	117
			Moosehead	Maine	117
Rainy	Minnesota and Ontario.	345	Clark	Alaska	110
			Bear	Idaho and Utah	110
Teshekpuk	Alaska	315	Winnibigoshish	Minnesota	109
Naknek	do	242	Dall	Alaska	100
Winnebago	Wisconsin	215			

DEPTHS OF LAKES

Table 4 (see page 12) includes lakes that are 250 feet deep or more. The sources of some of the figures are unknown, but the figures are believed to be fairly reliable. The list probably is incomplete; there may be other lakes deeper than 250 feet, particularly in Alaska. The lakes in this list are not limited to those having surface areas of 10 square miles or more, but those smaller than 10 square miles are footnoted.

Some of the Alaskan lakes are very small in area, considering their depth; Crater Lake has an area of only about 1 square mile, and Long and Deer Lakes have areas of only about 2 square miles. Grant and Swan Lakes were both sounded only a short distance offshore, and might be considerably deeper than the figures shown.

Of the 34 lakes in this list of deep lakes, 20 are in Alaska, 10 are in the far West, and 4 are in the Northeast.

AMOUNT OF WATER IN LAKES

The amount of water stored in lakes is very large compared with the amount stored in stream channels at any given time. However, a greater part of the water stored in lakes is in a few lakes of great size. The Great Lakes, which are shared by the United States and Canada, hold about 5,500 cubic miles of water.[4] By way of comparison with streamflow, about 400 cubic miles of water, on the average, flows into the ocean from the conterminous United States (exclusive of Alaska and Hawaii) each year, only a small part of which would be in temporary storage in the stream channels at any given time. Eight of the deepest known lakes in the conterminous United States (table 4), whose depths range from 316 feet to 1,932 feet and whose areas exceed 10 square miles—Tahoe in California and Nevada, Pend Oreille in Idaho, Chelan in Washington, Crater in Oregon, Champlain in New York and Vermont, Seneca and Cayuga in New York, and Sebago in Maine—contain about 55 cubic miles of water. Lake Okeechobee in Florida, although large in surface area, is shallow, and probably contains less than 2 cubic miles of water. The six deep lakes in southwestern Alaska, whose areas exceed 10 square miles (table 4)—Aleknagik, Beverley, Chauekuktuli, Clark, Nerka, and Nuyakuk—contain about 13 cubic miles of water. By way of comparison,

[4]For the purpose of this report, volumes of natural lakes were estimated by the formula, Volume = 1/3 maximum depth x surface area. This formula gives results that probably are too low, but they are satisfactory for making comparisons. A more accurate method is given by Hutchinson (1957), but it requires more information than is available for most lakes. Hutchinson gives 5,900 cubic miles of water as the contents of the five Great Lakes.

Table 4.—*Natural fresh-water lakes 250 feet deep or more, ranked by depth*

Name	Location	Depth (feet)	Name	Location	Depth (feet)
Crater[1]	Oregon	1,932	Cooper[4,5]	Alaska	>400
Tahoe[2]	California and Nevada.	1,645	Champlain	New York, Vermont, and Quebec.	400
Chelan	Washington	1,605	Kasnyku[4,5]	Alaska	393
Pend Oreille	Idaho	1,200	Chakachamna[5]	do	380
Nuyakuk[3]	Alaska	930	Ozette[6]	Washington	331
Deer[4,5]	do	877	Aleknagik[3]	Alaska	330
Chauekuktuli[3]	do	700	Sebago	Maine	316
Crescent[4,6]	Washington	624	Swan[4,5]	Alaska	>314
Seneca[7]	New York	618	Baranoff[4,5]	do	303
Clark[3]	Alaska	606	Payette[2]	Idaho	>300
Beverley[3]	do	500	Quinault[4,5]	Washington	About 300
Nerka[3]	do	475			
Tokatz[4,5]	do	474	Crescent[4,5]	Alaska	291
Long[4,5]	do	470	Wallowa[4,8]	Oregon	283
Lower Sweetheart.[4,5]	do	459	Chilkoot[4,5]	Alaska	282
			Odell[4,9]	Oregon	279
Cayuga[7]	New York	435	Silver[4,5]	Alaska	278
Crater[4,5]	Alaska	414	Grant[4,5]	do	>250

[1]Sounded by U.S. Coast and Geodetic Survey in 1959. In 1886, Mark Kerr measured 1,996 feet at approximately same point. According to Hutchinson (1957), Crater Lake is the second deepest lake in the Western Hemisphere, exceeded only by Great Slave Lake in Canada, depth about 2,010 ft.
[2]Russell (1885, p. 72).
[3]Interim report on southwestern Alaska, by the Corps of Engineers, 1954, and Mertie (1938, p. 19).
[4]Less than 10 square miles.
[5]Sounded by U.S. Geological Survey.
[6]Wolcott (1961).
[7]Fenneman (1938).
[8]W. D. Smith, Northwest Science, December 1939.
[9]Sounded by K. N. Phillips, Aug. 10, 1940.

Note:—Pyramid Lake, a saline lake in Nevada (see p. 14) is about 280 feet deep at its present level, according to M. T. Wilson (written communication, 1962).

the 1,300 reservoirs listed by Thomas and Harbeck (1956) would contain about 80 cubic miles of water if all were full at the same time.

Little is known about the almost countless small lakes that dot some parts of the country, but their total content probably is small as compared with the few large lakes.

SALINE LAKES

All lakes contain some dissolved solids. There is no specific criterion for distinguishing between fresh water and saline water, but the following classification, in terms of ppm (parts per million) of dissolved solids, has been used by the Geological Survey (Winslow and Kister, 1956; Kreiger and others, 1957):

Description	*Dissolved solids (ppm)*
Slightly saline	1,000 to 3,000
Moderately saline	3,000 to 10,000
Very saline	10,000 to 35,000
Brine	More than 35,000

Water containing as much as 1,000 ppm of dissolved solids is acceptable for drinking, although in some areas water of higher salinity is used for drinking. In parts of the western United States water containing as much as 4,000 ppm of dissolved solids is used for irrigation. Ocean water contains about 35,000 ppm of dissolved solids, mostly sodium chloride.

Most of the saline lakes in the United States are in the Great Basin, which includes nearly all of Nevada, the western half of Utah, and parts of Oregon, California, Idaho, and Wyoming. The Great Basin has no outlet to the ocean. The rivers and streams that originate in the Great Basin eventually empty into lakes and sinks from which the water has no escape except by evaporation.

All lakes are either closed or open. Lakes from which water leaves only by evaporation are termed closed; those with any kind of effluent, whether it is seepage or a surface outlet, are termed open (Hutchinson, 1957). The saline lakes in the Great Basin are closed; they have no surface outlet, nor do they lose water by seepage. These saline lakes occupy sealed basins (Harding, 1962) and lose water only by evaporation. Evaporation removes water in the form of pure water vapor and leaves the dissolved solids; hence the waters of closed lakes tend to become saline. Occasionally, a saline lake fills up and spills over into an adjoining basin and thus freshens temporarily. Absence of a surface outlet does not, by itself, indicate that a lake is saline. Crater Lake in Oregon (see also p. 3), for example, has no surface outlet, but it loses water by seepage as well as by evaporation, the salts that tend to accumulate are carried out with the seepage water, so that the water in the lake remains fresh. All fresh-water lakes are open.

The largest of the saline lakes is Great Salt Lake in Utah, the water of which is much saltier than ocean water. It is a remnant of ancient Lake Bonneville, which at its highest level covered an area of some 20,000 square miles (fig. 4). Lake Bonneville came into existence during the great ice age. Ice was not a direct factor in forming the lake, but as a result of the cooler and moister climate that brought on the great ice age, water accumulated in the basin and formed Lake Bonneville. The lake reached a maximum level about 1,000 feet higher than the present level of Great Salt Lake; it overflowed at Red Rock Pass in the northern rim of the Great Basin (fig. 4) and its water reached the Pacific Ocean by way of the Portneuf, Snake, and Columbia Rivers. Geologic evidence indicates that the overflow occurred 30,000 to 40,000 years ago (Trimble and Carr, 1961).

With the return of warmer drier climate, inflow to Lake Bonneville diminished and evaporation from the lake surface increased, and the lake level began to drop. The recession of Lake Bonneville was not gradual and uniform. Morrison (1961) shows that the lake has passed through five cycles of recession and advance, and may have dried up completely during one of the cycles.

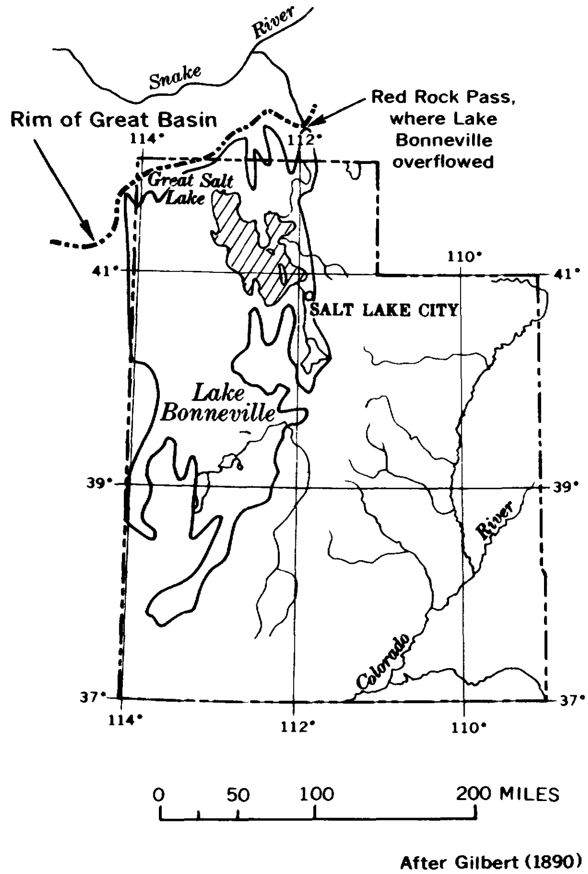

Figure 4.—Sketch map of Utah, showing approximate outline of Lake Bonneville and Great Salt Lake.

The maximum water surface elevation of Great Salt Lake since 1851 was 4,211.6 feet above sea level in 1873; the minimum was 4,191.6 in 1961. During the three decades preceding 1960 the lake level fluctuated between about 4,195 and 4,200 feet. During 1960 and 1961 the lake level dropped about $3\frac{1}{2}$ feet as a result of drought. At the highest level in 1873, the area of the lake was about 2,400 square miles; at the lowest level in 1961, the area was about 950 square miles.

The general downward trend in the level of Great Salt Lake since 1873 doesn't necessarily mean that the lake is drying up. The lake level tends to maintain a balance between the amount of water evaporated from the lake surface and the amount of water contributed to it by inflow and by direct precipitation. In other words, the lake is always seeking to stabilize its level. During a period of dry years the level drops and the area decreases rapidly, so that the total volume of evaporation is considerably diminished. Thus less inflow is required to maintain an existing lake level. During a period of wet years the level rises and the area is materially increased, providing for a larger volume of evaporation to compensate for the greater inflow. An important factor contributing to the decline of the lake level is the diversion of water, for Man's use, from the streams that flow into the lake.

The water in Great Salt Lake is a brine. According to Langbein (1961), the salinity of the lake was 138,000 ppm in 1877 when the surface area was 2,200 square miles, and 276,000 ppm in 1932 when the area was 1,300 square miles.

Several closed lakes exist in the Lahontan Basin in western Nevada and the eastern edge of California. The Lahontan Basin is a subbasin within the Great Basin. It is tributary to ancient Lake Lahontan, which existed at the same time as Lake Bonneville (Russell, 1885; Gilbert, 1890) and had a similar history except that it did not overflow its basin. At its highest level, Lake Lahontan had a surface area of more than 8,000 square miles and had a maximum depth of about 900 feet.

The two largest lakes in the Lahontan Basin[5] are Pyramid and Walker Lakes, both of which occupy depressions in the bed of former Lake Lahontan. There is some uncertainty as to whether or not they are actual remnants of Lake Lahontan. Their waters are relatively fresh, not strong brines like the water of Great Salt Lake, but Langbein (1961) has shown that the salt content of a closed lake is no measure of its age.

In addition to Pyramid and Walker Lakes, the following were listed by Russell (1885) as existing in the bed of former Lake Lahontan when he made his field investigation in 1882: Honey Lake in California; Winnemucca, Humboldt, North Carson (Carson Sink), and South Carson (Carson) Lakes in Nevada. These lakes are shown on some maps, although all except Pyramid and Walker Lakes have dried up or are dry periodically.

Other lakes in the Great Basin have likewise dried up in recent years, or are dry periodically: Sevier Lake in Utah; Goose Lake in California-Oregon; Abert, Summer, and Silver Lakes in Oregon; and perhaps other smaller lakes. Abert, Goose, and Summer Lakes were dry or almost dry in the mid twenties or early thirties; all were fairly high in 1958, especially Abert Lake where the salty water killed juniper trees as much as 60 years old.[6] Some maps show Malheur and Harney Lakes in Oregon as lakes of considerable size. They are playas—flats covered periodically by ephemeral or intermittent lakes—and since 1895 their combined surface area has ranged repeatedly from about 125 square miles down to about 2 square miles (Piper and others, 1939). (The two lakes are interconnected; when Malheur Lake, the larger of the two, fills up it overflows into Harney Lake.) Owens Lake in California, which in 1872 prior to any upstream irrigation had an area of 110 square miles, was down to 35 square miles in 1943. There has been no surface inflow into Owens Lake from the Owens River since 1943, and the lake has been dry parts of each year since then.[7]

Salton sea in southern California, which occupies a depression known as Salton Sink, is a well-known body of saline water. According to geologic evidence, Salton Sink was once part of the Gulf of California, perhaps only a few thousand years ago. The mouth of the Colorado River was then near Yuma. The delta of the river built up and cut off the upper end of the gulf, creating the ancestral Salton Sea, known as Lake Cahuilla. Evidently, the river shifted back and forth across its delta and discharged alternately into the gulf and into Salton Sink (Brown, 1923). In between such occasional floodings the sink would dry up, leaving a salt flat about 270 feet below sea level (the lowest point in the sink is 273.5 feet below sea level). The last flooding from the Colorado River occurred in 1905–7; a large area of farmland was threatened with inundation, until the breach was closed largely

[5]Lake Tahoe, although in the Lahontan Basin, is not included with the Lahontan lakes. Lake Tahoe is a fresh-water lake (see p. 5), in the high Sierras near the western edge of the basin, and has an outlet to Truckee River.

[6]K. N. Phillips, written communication, 1961.

[7]M. B. Scott, written communication, 1961; information from City of Los Angeles, Dept. of Water and Power.

through the efforts of the Southern Pacific Co.

Salton Sea attracted considerable attention during the early 1950's when its level started to rise. The flooding from the Colorado River in 1905–7 raised the level of Salton Sea to 195 feet below sea level and covered an area of about 650 square miles. The level then began to drop and reached a low of about 251 feet below sea level in 1924. During the 1940's the level was fairly constant at about 240 to 241 feet below sea level. The rise in the 1950's was due to increased return flow resulting from increased irrigation with water from the Colorado River. The level now (1962) appears to be fairly well stabilized at about 235 feet below sea level, with a surface area of about 350 square miles. The salinity of Salton Sea is approximately that of sea water.

Devils Lake in North Dakota is shown on some maps as being of considerable size. In 1867 the total lake surface covered about 140 square miles, but by 1940 the lake level had dropped 37 feet and the lake had shrunk to a shallow body of stagnant water covering a little more than 10 square miles (Swenson and Colby, 1955). Since 1940 the lake level has been generally rising. Because of its shape, Devils Lake is apparently a blocked pre-glacial drainage channel.[7a]

It is not possible to give a single unqualified figure of area for most of the saline lakes in the Great Basin. Being closed, they are subject to considerable fluctuation because of climatic variations. Furthermore, some of these lakes are relatively shallow and have gently sloping shores, so that even a small change in lake level results in a comparatively large change in area. In table 5 the present area is given, according to the most recent information available, and also the maximum area known since occupancy of the land by white man, the area the lakes might conceivably reach again as the result of a succession of wet years. Only those lakes are listed, however, that are known to have exceeded 10 square miles in surface area.

In addition to the closed lakes, there are a number of saline lakes near the Gulf of Mexico that are at sea level, and are subject to tidal fluctuation through channels connecting them with the Gulf. The five largest of these are in Louisiana and Texas; they are listed in table 5.

[7a] W. M. Laird, written communication, 1965.

Table 5.—*Principal saline lakes*

Lake	Present area (square miles)	Remarks
California:		
Salton Sea	350	About 650 sq mi at highest stage in 1905–07.
Owens	Dry at times each year since 1943.	110 sq mi in 1872, prior to diversions from Owens River; 35 sq mi in 1943.
Mono	76	Maximum, 89 sq mi in 1919.
Goose (in California and Oregon).	About 100	Maximum, 186 sq mi, 125 in California and 61 in Oregon; overflowed into Pitt River in 1869 and 1881; dry in 1930; 150 sq mi in 1958.
Eagle	41	Some question as to whether Eagle Lake should be considered saline or fresh water. It has no surface outlet (Martin, 1962), but since 1924 it has been tapped by tunnel to Willow Creek. Salinity is considerable less than 1,000 ppm, according to California Dept. of Water Resources. During period 1895–1925 lake rose to highest level since at least 1650 (Harding, 1935); rise believed due to closing of subterranean outlet by earthquake in 1890 (Antevs, 1938).

Table 5.—*Principal saline lakes*—Continued

Lake	Present area (square miles)	Remarks
California—Continued:		
Honey	Dry	90 sq mi in 1867, possibly higher in 1890; dry in 1903; high in 1904; dry in 1924. Contained some water April 1958 to September 1960, and early in 1962.
Louisiana:		
Pontchartrain	625	These lakes are connected with the Gulf of Mexico, and are subject to tidal fluctuation.
Sabine (Louisiana and Texas)	95	Do.
Calcasieu	90	Do.
Maurepas	90	Do.
Salvador	70	Do.
Nevada:		
Pyramid	180	Maximum size, 220 sq mi. Low until 1860; reached extreme high level in 1862 and 1868 or 1869; nearly as high in 1890; began to drop in 1917 (Hardman and Venstrom, 1941).
Walker	107	Maximum size, 125 sq mi.
Winnemucca	Dry	Maximum size, 180 sq mi. Dry in 1840, but began to fill shortly thereafter (Zones, 1961). According to Russell (1885) the lake rose more than 50 ft and approximately doubled its area between 1867 and 1882. Was 87 ft deep in 1882. Dry since 1945.
Carson	Nearly dry	Maximum size, 41 sq mi. A few water-filled pot holes remain. Once called South Carson Lake; received flow of Carson River before Lahontan Reservoir was built.
Carson Sink	Dry	A shallow playa some 250 square miles in area shown on some maps as a body of water. Russell (1885) called it North Carson Lake. Dry in 1882, but probably has had some water at times since. Once received water from both Carson and Humboldt Rivers.
Ruby	----------	Maximum size, 37 sq mi. Shown as swamp on recent maps of Army Map Service and Nevada Dept. of Highways.
Franklin	----------	Maximum size, 32 sq mi. Shown as swamp on recent maps of the Army Map Service and Nevada Dept. of Highways.
North Dakota:		
Devils	24	140 sq mi in 1867; 70 sq mi in 1883; 45 sq mi in 1900; 10 sq mi in 1940. Since 1940 lake has been rising.
Oregon:		
Malheur and Harney	Probably dry	Malheur, the larger of the two lakes, overflows into Harney, which has no outlet. Maximum combined size, 125 sq mi. Reported dry in 1931; high in late 1950's; about 1 sq mi in 1961, and expected to go dry in 1962.

Table 5.—*Principal saline lakes*—Continued

Lakes	Present area (square miles)	Remarks
Oregon—Continued:		
Goose (see California)		
Abert	52	Maximum size, 60 sq mi. Dry in 1930 or thereabouts, but fairly high in 1958.
Summer	Probably dry	Maximum size, 70 sq mi. Nearly dry in 1961.
Silver	Dry	Maximum size, 15 sq mi. Dry in 1961. Because of the transient nature of the lake, the water—whenever there is any—is relatively fresh; hay is raised on the dry lake bed.
Warner	Probably less than 10	A series of shallow lakes; combined area about 30 sq mi in 1953, a wet year, estimated from Army Map Service map based on aerial photographs taken in 1953. Present lakes are all that is left of Pleistocene Warner Lake, which covered about 300 sq mi and was about 270 ft deep.
Utah:		
Great Salt	About 1,000	Maximum size since 1851, 2,400 sq mi in 1870's; minimum, 950 sq mi in October 1961; seasonal high in 1962 was 1,050 sq mi in June.
Sevier	Dry	Maximum size, 125 sq mi; has been dry for several years.

Comparatively few in number, saline lakes have a small utilitarian value compared with freshwater lakes, but they merit mention.

Several saline lakes in the Great Basin are potential sources of sodium bicarbonate, borax, and common salt. Production of salt from saline lakes in Utah alone has ranged in value from $60,000 in 1880 to more than $2 million in 1959 (Mahoney, 1961), totaling some $30 million.

Some of the saline lakes serve as resting and feeding areas for migratory waterfowl,[8] as do, of course, many fresh-water lakes. Abert Lake and Great Salt Lake are sources of brine shrimp, which are removed commercially and processed, and sold for fish food.

In recreational value, the saline lakes are completely overshadowed by fresh-water lakes, but some of them have attractions to offer. For example, Eagle Lake in California is coming into favor with boating enthusiasts. Only mildly saline, it supports one specie of game fish (Martin, 1962). Great Salt Lake has long been a tourist attraction, partly because of the ease with which a person can float in the dense, salty water.

ARTIFICIAL RESERVOIRS

There are important distinctions between artificial reservoirs and natural lakes, although many reservoirs have the outward appearances of natural lakes. For one thing, reservoirs are so constructed that they contain very little dead storage; most of the water is above the level of the lowest outlet and can be released, if need be. On the other hand, almost all the water in natural lakes is dead storage, or below the level of the natural outlet.

[8]Malheur National Wildlife Refuge is adjacent to Malheur and Harney Lakes, and Bear River National Wildlife Refuge is adjacent to Great Salt Lake.

Another difference between artificial reservoirs and natural lakes is that, as compared with their total contents, reservoirs generally have larger inflow than lakes. Or, to state this another way, as compared with their inflow, natural lakes generally have a greater capacity than reservoirs. The 1,300 reservoirs listed by Thomas and Harbeck (1956) have a total usable capacity of some 80 cubic miles, although not all these reservoirs are full at the same time. At any one time, these reservoirs probably contain about the same amount of water as the eight deep lakes in the conterminous United States referred to on page 11. But whereas even the largest of these reservoirs would, if completely emptied, refill in 2 years or so, some of these deep lakes would require many years. Chelan, Sebago, and Seneca Lakes would, if completely emptied, require some 10 years or thereabouts to refill; Lake Tahoe might require as much as 300 years. (Lake Superior, not one of the eight lakes referred to, would require on the order of 150 years.)

Half of the States have no natural lakes as large as 10 square miles in area, but more than three-fourths of the States have reservoirs of that size, or larger. As a matter of interest, the largest reservoir of 10 square miles or more in each State is listed at the end of this section (table 6).

Reservoirs are most commonly ranked in size according to their usable contents, the amount of water than can be stored above the lowest outlet. In this section, however, surface area is given as a measure of size in order to be comparable with the ranking of natural lakes.

In terms of surface area, the largest reservoir is Garrison in North Dakota, with Oahe in South Dakota—both on the Missouri River—a close second. Because of its much greater depth, Lake Mead on the Colorado River in Arizona-Nevada can store half again as much water as either Garrison or Oahe, although the surface area of Lake Mead is less than half of that of either of the other two.

Change in contents of a reservoir is accompanied by a corresponding change in surface area. Because the contents of most reservoirs are subject to rather large seasonal changes, the areas shown in table 6 are the areas at some specified level, such as the maximum waterline, although the water level in the reservoir may seldom be that high.

Many large reservoirs are built to serve more than one purpose. If flood-control is one of the purposes, the space allotted to it is at the top of the reservoir above some specified level, so that the allotted space—the flood-control pool—can, if deemed advisable, be kept available for storing floodwater. After a flood has passed, the floodwater stored can be released gradually and the space again made available. Below the level of the flood-control pool are other allotted spaces—the power pool, the conservation pool, etc. The operation of such a reservoir depends upon the purpose it serves and the priorities assigned to each, and to the flood potential of the area that drains into the reservoir. The prevailing level of a multiple-purpose reservoir may be at or below the bottom of the flood-control pool, even though the area given in table 6 may be the area at the maximum waterline.

Regulated natural lakes are not shown in table 6, only artificial reservoirs. Regulated natural lakes, if more than 10 square miles in area, are shown in table 2. Furthermore, only reservoirs of 10 square miles or more are shown in table 6. Hence, there are no entries in this table for Alaska, Connecticut, Delaware, Hawaii, Indiana, Maine, Minnesota, New Hampshire, New Jersey, Rhode Island, and Vermont.

Table 6.—*Largest artificial reservoirs of 10 square miles or more in each State*

State	Reservoir and stream	Surface area (sq mi)
Alabama	Guntersville (Tennessee River)	110
Arizona	Lake Mead (Colorado River)[1]	229
Arkansas	Bull Shoals (White River)	111
California	Shasta (Sacramento River)	46
Colorado	John Martin (Arkansas River)	29
Florida	Conservation area No. 1, (Everglades)	216
Georgia	Clark Hill (Savannah River)[2]	123
Idaho	American Falls (Snake River)	88
Illinois	Crab Orchard (Crab Orchard Creek)[3]	11
Iowa	Coralville (Iowa River)[3]	39
Kansas	Tuttle Creek (Big Blue River)	83
Kentucky	Kentucky (Tennessee River)	407
Louisiana	Bayou Bodcau (Bayou Bodcau)	33
Maryland	Conowingo (Susquehanna River)	13
Massachusetts	Quabbin (Swift River)	39
Michigan	Fletcher Pond, Upper South Branch (Thunder Bay River)	13
Mississippi	Grenada (Yalobusha River)	101
Missouri	Lakes of the Ozarks (Bagnall), (Osage River)	93
Montana	Fort Peck (Missouri River)	382
Nebraska	McConaughy (Kingsley), (North Platte River)	50
Nevada	Lake Mead (Colorado River)[4]	229
New Mexico	Elephant Butte (Rio Grande)	57
New York	Sacandaga (Sacandaga River)	42
North Carolina	High Rock (Yadkin River)	24
North Dakota	Garrison (Missouri River)	610
Ohio	St. Marys (Grand), (Beaver and Jennings Creeks)	21
Oklahoma	Lake Texoma (Denison), (Red River)[5]	223
Oregon	McNary (Columbia River)[6]	59
Pennsylvania	Pymatuning (Shenango River)	26
South Carolina	Lake Marion (Santee River)	172
South Dakota	Oahe (Missouri River)	587
Tennessee	Pickwick Landing (Tennessee River)	73
Texas	Lake Texoma (Denison), (Red River)[7]	223
Utah	Sevier Bridge (Sevier River)[8]	17
Virginia	John H. Kerr (Roanoke River)	149
Washington	Franklin D. Roosevelt (Grand Coulee), (Columbia River)	130
West Virginia	Blue Stone (New River)	14
Wisconsin	Petenwell (Wisconsin River)	36
Wyoming	Boysen (Big Horn River)	35

[1] Arizona and Nevada. The largest reservoir wholly within Arizona is San Carlos (Coolidge) Reservoir on the Gila River, surface area, 31 sq mi.

[2] Georgia and South Carolina. The largest reservoir wholly within Georgia is Buford Reservoir (Lake Sidney Lanier) on Chattahoochee River, surface area, 59 sq mi.

[3] Keokuk Lock and Dam No. 19 on the Mississippi River, common to Illinois and Iowa, has a surface area of 44 sq mi.

[4] Nevada and Arizona. The largest reservoir wholly within Nevada is Rye Patch Reservoir on the Humboldt River, surface area, 17 sq mi.

[5] Oklahoma and Texas. Eufaula Reservoir under construction on the Canadian River, and wholly within Oklahoma, may have a surface area as large as that of Lake Texoma, or slightly larger.

[6] Oregon and Washington. The largest reservoir wholly within Oregon is Owyhee Reservoir on Owyhee River, surface area, 20 sq mi.

[7] Texas and Oklahoma. McGhee Bend Reservoir under construction on Angelina River and wholly within Texas, may have a larger surface area than Lake Texoma.

[8] Lake Powell under construction on the Colorado River (dam is in Arizona, but most of reservoir is in Utah) will have a surface area of 250 sq mi.

Artificial reservoirs serve many purposes, such as water supply, irrigation, flood control, and power generation. They are indispensable to our national economy and to our standard of living. Many reservoirs are open to the general public for recreational purposes, and thus offer the advantages of natural lakes. At two reservoirs mentioned in this report, Lake Mead (fig. 5) and Franklin D. Roosevelt Lake, the National Park Service administers recreational areas.

An outstanding example of the use of reservoirs for recreational purposes are the reservoirs of the Tennessee Valley Authority. On their shores are 13 State parks and 60 city and county parks, 330 commercially operated fishing camps, boat docks, and resorts, 40 camps operated by Boy and Girl Scouts, YWCA and YMCA, church and educational groups, and 50 private clubs. About 7,000 persons have acquired lakefront lots on which they have built vacation homes (L. B. Leopold and H. B. Kinnison, written communication, 1962).

Figure 5.—Lake Mead at National Recreation Area. Scene is at Boulder Beach marina. Photograph by National Park Service.

SELECTED BIBLIOGRAPHY

Antevs, Ernst, 1938, Rainfall and tree growth in the Great Basin: Am. Geographical Soc. Spec. Pub. no. 21 and Carnegie Inst. Pub. no. 469, 97 p.

Briggs, L. J., 1962, When Oregon eruptions gave birth to Crater Lake: Natl. Geog. Soc. Jour., v. 122, no. 1, p. 128–134.

Brown, J. S., 1923, The Salton Sea region, California: U.S. Geol. Survey Water-Supply Paper 497, 229 p.

Burns, Helen, 1962, Salton sea story: Palm Desert, Calif., Desert Magazine Press, 34 p.

Corps of Engineers, U.S. Army, 1921, Diversion of water from the Great Lakes and Niagara River: Washington, 415 p.

Davis, J. H., 1943, The natural features of southern Florida: Florida Geol. Survey, Geol. Bull 25, 311 p.

Fenneman, N.M., 1931, Physiography of western United States: New York, McGraw-Hill Book Co., 534 p.

———1938, Physiography of eastern United States: New York, McGraw-Hill Book Co., 691 p.

Feth, J. H., 1961, A new map of western conterminous United States showing the maximum known or inferred extent of Pleistocene lakes, *in* Geol. Survey Research, 1961: U.S. Geol. Survey Prof. Paper 424-B, p. 110.

Gilbert, G. K., 1890, Lake Bonneville: U.S. Geol. Survey Monograph 1, 438 p.

Harding, S. T., 1935, Changes in lake levels in Great Basin area: Civil Engr., v. 5, p. 87–90.

———1962, Evaporation from Pyramid and Winnemucca Lakes, Nevada: Am. Soc. Civil Engineers Proc., Irrigation and Drainage Div. Jour. v. 88, no. IR1, pt. 1, p. 1–11.

Hardman, George, and Venstrom, Cruz, 1941, A 100-year record of Truckee River runoff estimated from changes in levels and volumes of Pyramid and Winnemucca Lakes: Am. Geophys. Union, Trans. of 1941, pt. 1, p. 71–90.

Hussey, R. C., 1947, Historical Geology: New York, McGraw-Hill Book Co., 465 p.

Hutchinson, G. E., 1957, A treatise on limnology, v. 1—Geography, physics, and chemistry: New York, John Wiley and Sons, 1014 p.

Kreiger, R.A., Hatchett, J. L. and Poole, J. L., 1957, Preliminary survey of the saline-water resources of the United States: U.S. Geol. Survey Water-Supply Paper 1374, 172 p.

Langbein, W. B., 1961, Salinity and hydrology of closed lakes: U.S. Geol. Survey Prof. Paper 412, 20 p.

Lobeck, A. K., 1939, Geomorphology: New York, McGraw-Hill Book Co., 731 p.

McGlashan, H. D., and Dean, H. J., 1913, Water resources of California, pt. 3, Stream measurements in the Great Basin and Pacific coast river basins: U.S. Geol. Survey Water-Supply Paper 300, p. 29–33.

Mahoney, J. R., 1961, University lands: Bur. Econ. and Business Research, Coll. of Business, Univ. Utah, 94 p.

Martin, Jim, 1962, Northeastern California's uncrowded Eagle Lake: Los Angeles, Sea and Pacific Motorboat, v. 54, no. 8, p. 34–35.

Mertie, J. B. Jr., 1938, The Nushagak district, Alaska: U.S. Geol. Survey Bull. 903, 96 p.

Morrison, R.B., 1961, Correlation of deposits of Lakes Lahontan and Bonneville and the glacial sequences of the Sierra Nevada and Wasatch Mountains, California, Nevada, and Utah, *in* Geol. Survey Research, 1961: U.S. Geol. Survey Prof. Paper 424-D, p. D122–D124.

Piper, A. M., Robinson, T.W., and Park, C. F., Jr., 1939, Geology and ground-water resources of the Harney basin, Oregon: U.S. Geol. Survey Water-Supply Paper 841, 189 p.

Russell, I. C., 1885, Geological history of Lake Lahontan, a Quaternary lake of northwestern Nevada: U.S. Geol. Survey Monograph 11, 288 p.

Swenson, H. A., and Colby, B. R., 1955, Chemical quality of surface waters in Devils Lake basin, North Dakota: U.S. Geol. Survey Water-Supply Paper 1295, 82 p.

Thomas, N. O., and Harbeck, G. E., Jr., 1956, Reservoirs in the United States: U.S. Geol. Survey Water-Supply Paper 1360-A, 99 p.

Trimble, D. E., and Carr, W. J., 1961, The Michaud delta and Bonneville River near Pocatello, Idaho, *in* Geol. Survey Research, 1961: U.S. Geol. Survey Prof. Paper 424-B, p. B164–B166.

U.S. Lake Survey, 1952, Great Lakes Pilot: Bull. no. 61, 536 p.

Waring, G. A., 1908, Geology and water resources of a portion of south-central Oregon: U.S. Geol. Survey Water-Supply Paper 220, 86 p.

Water Newsletter, 1961a, New York, Water Information Center, v. 3, no. 15, 4 p.

———1961b, New York, Water Information Center, v. 3, no. 17, 4 p.

Welch, P. S., 1952, Limnology: 2d ed., New York, McGraw-Hill Co., 538 p.

Winslow, A. G., and Kister, L. R., 1956, Saline water resources of Texas: U.S. Geol. Survey Water-Supply Paper 1365, 105 p.

Wolcott, E. E., 1961, Lakes of Washington: Washington Dept. Conserv., Div. Water Res., Water Supply Bull. 14, v. 1, Western Washington, 619 p.

Zones, C. P., 1961, Ground-water reconnaissance of Winnemucca Lake Valley, Pershing and Washoe Counties, Nevada: U.S. Geol. Survey Water-Supply Paper 1539-C, p. C1–C18.

☆ U. S. GOVERNMENT PRINTING OFFICE : 1970 O - 387-618