

utilizing these deposits. Salt is now being produced on a small scale. Brines from pits in the upper muds or from furrows filled with rain water that has become saturated are concentrated and crystallized by solar evaporation in shallow vats dug in the playa, and the salt thus obtained is bagged for sale.

COMPOSITION OF THE BRINES

Samples of the brines were tested for potash by A. R. Merz at the Cooperative Laboratory, Mackay School of Mines, Reno, Nev. Partial analyses of the brines and more nearly complete analyses of composite samples of the brines also were made by Walton Van Winkle in the Cooperative Laboratory of the United States Geological Survey at Willamette University, Salem, Oregon.

The analyses show that the brines from the main salt body are essentially solutions of sodium chloride remarkably uniform in composition and concentration. Analyses Nos. 1, 2, and 4, of waters from borings Nos. 3, 6, 11, 12, and 14, indicate that the brines contain less than 2 per cent. of sulfate and 0.02 per cent. of carbonate. Only traces of borate were found. These brines on evaporation would yield a mass containing about 90 per cent. of sodium chloride and the character of the other ingredients makes it certain that a much purer product could be obtained by one crystallization. The differences in the amounts and proportions of the alkaline earths are especially noteworthy, as they indicate progressive steps in the concentration and deposition of those substances.

The content of potassium is too low to be of commercial importance. The anhydrous residues of the brines represented by analyses Nos. 1, 2, and 4 average 2.64 per cent. in content of potassium (K). The average potassium content of the same brines according to Merz is 2.23 per cent. of the saline residue dried at 105° C. This apparent discrepancy in estimates is, however, caused mostly by difference in unit of expression, the actual determinations of the radicle being equivalent respectively to 0.79 and 0.69 gram of potassium (K) per 100 cc. of brine.

SUMMARY

Silver Peak Marsh is a salt playa containing a high grade of sodium chloride. No extensive deposits of potash-bearing salts were found. To a depth of 50 feet the formations are chiefly salt clays and muds with layers of crystallized salt covered irregularly by gypsum-bearing clays. It is estimated that 15,000,000 tons of salt lie within 40 feet of the surface of the playa.

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COMPOSITION OF THE WATER OF CRATER LAKE, OREGON¹

By WALTON VAN WINKLE AND N. M. FINKBINER

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Crater Lake, in the heart of the Cascade Mountains of Oregon, is one of the most interesting spots in the United States, both to scientist and to tourist. Popular accounts of its beauties have been published in magazines and its chief features of scientific interest

¹ Published by permission of the Director, U. S. Geological Survey.

have been admirably set forth.¹ But though analyses of typical rocks are given in Diller and Patton's paper, no analysis of the water of the lake has yet appeared in print, and the subjoined analysis may, therefore, be useful to those interested in this remarkable body of water.

The following brief description of the lake, based on Diller's report and on personal observations by the senior author, makes the analyses more readily understandable. Crater Lake is situated in a geologically recent caldera occupying the site of a once lofty volcanic peak—Mount Mazama—in the midst of the Cascade Range, about 55 miles northeast of Medford, Oregon. The rim of the caldera is from 7,000 to 8,000 feet above the sea, and the lake surface was 6,175 feet, above sea level in 1908. The inner slope of the rim bears, in some places, a sparse growth of pine, but in many

ANALYSES OF WATER OF CRATER LAKE AND WOOD AND ROGUE RIVERS, OREGON

	Milligrams per liter			Percentage of anhydrous residue		
	Crater Lake ¹	Wood River ²	Rogue River ³	Crater Lake	Wood River	Rogue River
Total dissolved solids (heated to 180° C.)....	80	81	71
SiO ₂	18	37	26	22.36	49.82	38.86
Fe.....	0.02	0.20	0.01	0.02	0.27	0.02
Ca.....	7.1	5.7	5.7	8.82	7.68	8.51
Mg.....	2.8	2.0	2.6	3.48	2.69	3.89
Na.....	11	7.2	7.2	13.67	9.69	10.76
K.....	2.2					
CO ₂	0.0	0.0	0.0	21.11	18.85	29.89
HCO ₃	34	28	40	a	a	a
SO ₄	11	7.6	3.8	13.67	10.23	5.68
Cl.....	11	0.6	1.5	13.66	0.67	2.24
NO ₃	0.38	0.06	0.10	0.47	0.10	0.15
PO ₄	0.01	b	b	0.01

¹ Collected August 27, 1912, by M. Mecklem about 1 mile from shore at depth of 6 ft. Analysis by N. M. Finkbinder.

² Collected August 26, 1912, by Walton Van Winkle at bridge near Fort Klamath, Oregon. Analysis by Walton Van Winkle and N. M. Finkbinder.

³ Composite of daily samples Aug. 6-15, 1912, inc., collected at power house, near Tolo, Ore. Analysis by Walton Van Winkle and N. M. Finkbinder.

a HCO₃ computed to CO₂.

b Not determined.

others its walls drop sheer to the water's edge, here and there fringed by steep talus slopes. The surficial area of the lake is approximately 21 square miles, and its drainage basin is only about 6 square miles larger. The greatest depth of water is 1,996 feet, and a cinder cone projects more than 760 feet above the surface at the western extremity of the lake to form Wizard Island. Precipitation is more than 70 inches a year, occurring chiefly as snow in winter. Evaporation is less than 55 inches, and this, with loss by percolation, almost completely balances the inflow, there being no surface outlet to the lake. Some of the water may find its way by percolation into Rogue River, but more of it probably goes southeastward appearing as springs in the drainage basin of Klamath Lake.

As loss by percolation is only about one-third of the loss by evaporation, analyses of the water of the lake may be expected to give chemical evidence of slow

¹ J. S. Diller and H. B. Patton, "The Geology and Petrography of Crater Lake National Park," *Prof. Paper U. S. Geol. Survey*, 3 (1902); J. S. Diller, "Geological History of Crater Lake," Department of the Interior, 1912.

concentration. That the analysis really shows concentration almost identical with that of other surface waters of the region is explained, however, by the fact that no sedimentary materials are exposed, the andesites, dacites, and basalts forming the basin of the lake, being nearly insoluble in the cold water, and, therefore, incapable of rapidly increasing its content of mineral matter. Concentration of chlorides is great as compared with that of other materials, an indication of the concentrated character of the water. As the published analyses of rocks indicate that almost no chloride exists in these formations, it is possible that the high percentage of that radicle in the water is due almost entirely to accumulated "cyclic" chlorine precipitated with the rain and snow. The unexpectedly high percentage of sulfates is possibly caused by solution of sulfur that remained in the bottom of the caldera in a more or less oxidized condition at the cessation of active volcanism. No other features of the analysis seem unusual, when it is compared with the accompanying analysis of waters collected from Wood and Rogue rivers in the same season.

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ACTION OF FERMENTING MANURE ON REINFORCING PHOSPHATES¹

By W. E. TOTTINGHAM AND C. HOFFMAN

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INTRODUCTION

For many years phosphorus² has held a position of importance in the established practice of applying fertilizers to the soil. Indeed, this particular element may be the limiting factor of fertility in some normal types of soil³ or it may become such by depletion in excessively cropped soils.⁴

The chief raw materials supplying phosphorus for the fertilizer trade are bones and rock-phosphate. In finely divided condition these materials are known as bone meal and ground rock-phosphate or floats, respectively. They appear to consist essentially of basic phosphates of calcium and supply phosphorus in forms comparatively insoluble in water and in weak saline solutions.

The fertilizer industry furnishes more soluble forms of phosphorus derived from the crude phosphates by treating them with strong sulfuric acid. These products are monocalcium phosphate, soluble in water, and di-calcium phosphate, slowly acted upon by water and attacked by warm, neutral solution of ammonium citrate, which dissolves a considerable part of the phosphorus. Commercial acid phosphate is a mixture of these products with calcium sulfate, also formed in the reaction. The term "available phosphoric acid" as used in the fertilizer trade designates the combined amounts of phosphorus (expressed as P_2O_5) obtained in water extract and citrate extract successively from

¹ Published with the permission of the Director of the Wisconsin Experiment Station.

² In the fertilizer industry and in agricultural practice phosphorus is commonly dealt with in terms of phosphoric acid anhydride, P_2O_5 . The term "phosphoric acid" used in this paper signifies P_2O_5 .

³ Hopkins and Pettit, Ill. Expt. Sta., *Bull.* **123**, p. 239.

⁴ Whitson and Stoddart, Wis. Expt. Sta., *Research Bull.* **2**, p. 45.

the same sample. It may include other forms than the mono- and dicalcium phosphates.

The increased cost of phosphorus in acid-phosphate as compared with the crude materials has been rather generally supposed to be justified by superior availability to plants, consequent upon its greater solubility. It is true that acid-phosphate has generally given results in the year of application superior to those from rock-phosphate. Yet it is generally recognized that the phosphorus supplied in this form is rapidly fixed in insoluble form by reaction with calcium carbonate and other soil minerals⁵ or reverted in the dilute soil solution to more basic and less soluble phosphates of calcium.⁶ The efficiency of acid phosphate is to be attributed, therefore, probably to the facility with which it permits phosphorus to be distributed through the soil in finely divided form, rather than to a permanent state of solubility. This important effect of fineness and thorough distribution in promoting availability has been recognized with reference to rock-phosphate and experiment stations have advised the farmer to purchase it under guarantee of fineness as well as of phosphorus content.

Considerable evidence has accumulated³ which indicates advantage from the use of finely ground rock-phosphate directly as a fertilizer, especially when it is applied in conjunction with a liberal supply of organic matter turned into the soil. Thorne⁴ and others have demonstrated considerable efficiency of rock-phosphate when applied to the soil as a mixture with farm manure, and this method of application for both rock-phosphate and acid-phosphate has been widely adopted in practice. The effect of decomposing organic matter upon rock-phosphate under these conditions, as observed in increased yield of crop, has been commonly attributed to organic acids. It has been stated that such acids produced in the fermentation of the organic matter liberate soluble phosphorus from the floats. Favorable results from this treatment have been observed to be generally most pronounced in seasons succeeding the year of application.

Experiments in which solvents commonly used for this purpose have been employed to determine any increase of available phosphorus in fermented mixtures of crude phosphates and organic matter have given, however, negative results. Fleischer⁵ analyzed water extracts from fermented mixtures of moss turf and ground phosphorite in varying proportions and found no appreciable increase of soluble phosphorus during periods of 4½ to 9 months. In many cases the results showed decreases of water-soluble phosphorus. Pfeiffer and Thurman⁶ found that a crude phosphate

⁵ See Farsky, *Abstr. in Bied. Centrbl.*, **1883**, S. 449, and Schreiner and Failyer, *Bur. Soils, U. S. Dept. Agr., Bull.* **32**.

⁶ See Cameron and Bell, *Bur. of Soils, U. S. Dept. Agr., Bull.* **41**, pp. 21 and 35; also Cameron and Seidell, *J. Am. Chem. Soc.*, **26**, 1461.

³ Some of the most extensive data have been obtained by Merrill (Maine Expt. Sta., *Rpt.* **1898**, p. 64), Hess (Penn. Expt. Sta., *Rpt.* **1896**, p. 157), Goessmann (Hatch Expt. Sta., *Rpt.* **1897**, p. 190), Jordan (Maine Expt. Sta., *Rpt.* **1894**, p. 23), Wheeler (R. I. Expt. Sta., *Bull.* **118**) and Patterson (Md. Expt. Sta., *Bull.* **114**).

⁴ Ohio Expt. Sta., *Bull.* **183**, p. 206; *Circ.* **104**, p. 15.

⁵ *Landw. Jahrb.*, Bd. **12**, S. 186.

⁶ *Landw. Vers. Stat.*, Bd. **47**, S. 353.