

Professor Daniel Willard Describes the Lakes of the Missouri Coteau

The standard geography of North Dakota in the early twentieth century was *The Story of the Prairies*, by Daniel E. Willard.¹ Much of the mid-section of Willard's work is devoted to the glacial lakes of the coteau. Key descriptions and explanations are transcribed below.

12. THE LAKES OF NORTH DAKOTA

The Kinds of Lakes.—If we glance at a map of North Dakota it will be seen that all that portion of the State west of the Red River Valley and east of the Missouri River, except the Mouse River Valley, is dotted with lakes, and there are hundreds, yes, thousands, of small lakes not shown on even the largest maps. These are “glacial lakes”—that is, lakes which occupy basins or hollows amongst drift hills. They are more common among the hills of terminal moraines, and hence are often called “morainic lakes.” . . .

The Cause of Existing Lakes.—All existing lakes in North Dakota owe their being to the fact that the rainfall is greater than the evaporation, and the hemming in of their waters by morainic hills or other land barriers which form the sides of their basins. They are “glacial lakes,” therefore, not because their waters came from the melting of the ice of a glacier, but because the glacier which was once here caused their basins to be formed among the heaps and ridges of earth left where it melted.

A good deal of the drift is clay, and this holds water about as well as a porcelain dish. Wherever there is a hollow in which more water falls or collects than disappears by evaporation or soaking into the ground there will be a lake, and it is called a “glacial lake” if its basin was formed by the action of the ice of the great ice-sheet. All the lakes in North Dakota are glacial lakes. . . .

The lakes of North Dakota vary in size from tiny ponds only a few rods across to those several miles in diameter. . . .

Sometimes the depths of glacial lakes are very great in proportion to their sizes and sometimes they are large and shallow, broad, flat clay-pans filled with water. Sometimes the bottom drops suddenly to a great depth, and sometimes there is a gradual slope of the bottom from the shore toward the centre.

In a similar manner, on glaciated” land surfaces hollows are sometimes deep with their sides abrupt and steep, and sometimes a broad “flat” merges gradually into surrounding hills. The deeper and steeper sided hollows in glaciated regions have been called “pots and kettles.” The broad and more shallow ones might as properly be called “pans.” “Pots and kettles” are very common in terminal moraines, and “pans” are common on rolling prairies between moraines.

¹ Daniel E. Willard, *The Story of the Prairies, or, The Landscape Geology of North Dakota* (Chicago: Rand, McNally, 1902). Willard's work went through multiple editions. It was his first book. He served on the faculties of the State Normal School, Mayville, and of North Dakota Agricultural College, Fargo, before going on to work for the Northern Pacific Railroad. [Read Willard's obituary in the American Journal of Science here.](#)

Exactly the counterpart or opposite of the “pots and kettles” are the steep, rounded knobs of knobby hills of terminal moraines. Pots and kettles and knobby hills wherever seen are a pretty certain indication of a terminal moraine. A gently undulating prairie with shallow depressions generally indicates a ground-moraine.

The great irregularity of the shores of many lakes in North Dakota is due to the fact that they are hemmed in by knobby hills, and if the lake is large there may be several “pots” covered by the water of one lake, the water being very deep where are the pots and quite shallow between them, or knobs may rise up, forming islands.

Lakes may diminish in amount of water they contain during the dry, hot seasons, or they may dry up entirely during the driest part of the summer. Such are often called “dry” lakes. Lakes may also be “dry” for a period of years when the summers are seasons of unusual drought, and become lakes again during a series of rainy seasons. If a hollow is not deep enough to hold sufficient water to form a lake but rushes and marsh grasses grow on its bottom it will be a slough or bog. There are thousands of such sloughs in North Dakota, and they afford some of the most valuable “hay-meadows” in the State. . . .

Since the walls which hem in the waters of glacial lakes are the materials dumped from the melting ice, and since these materials are often left in very irregular piles and ridges, the outlines or shores of glacial lakes are often very irregular, the shore-line of the lake winding around all the irregularities of the hills which hem in the waters of the lake. Sweetwater Lake, in Ramsey County, is a good example of such a lake having very irregular shape, though there are many hundreds of smaller lakes in the State which are equally good examples. . . .

13. SALT AND ALKALINE WATERS IN LAKES

The Salts in Lake Waters.—The waters of many lakes are not only “salt,” but they are often bitter. This is because there are bitter “salts” in the water. Our common table salt is what the chemist calls Sodium Chloride. This gives the “salt” taste to the water. There is also Sodium Sulphate and Magnesium Sulphate in the water of many lakes, and this is bitter to the taste and affects the digestive organs of animals that drink it. There are also other salts such as the Sulphates of Potassium and Calcium (lime), and the Carbonates of Magnesium, Potassium, and Calcium. If common salt or Sodium Chloride is present in the water in larger quantity than any of the others the water is called “salt” water. If it contains a larger quantity of some salt which is bitter to the taste it is apt to be spoken of as “bitter” or “alkali” water. . . .

The Sources of the Salts and Alkalies.—The explanation of the origins of the salts in “alkali” waters lies in the fact that these minerals are in the rocks of the earth. The Cretaceous shales contain them, for they were present in the sea-waters at the time these rocks were deposited on the bottom of the ocean. We shall see in a later chapter that a great arm of the ocean once covered North Dakota and the rocks which underlie the drift were deposited as sediments on its bottom. The ice of the Great Ice-Sheet ploughed up these rocks and ground them into the fine soil, sand and clay which now covers the old land surface. . . . The till or drift earth which was thus ploughed up from the Cretaceous shales has given to the soil its alkaline character. The

salts, Sodium Sulphate and Magnesium Sulphate, are among the minerals in the soil, but other salts which dissolve in water, such as Potassium Sulphate and Sodium Carbonate, also occur, and altogether make up the “alkali” which distinguishes the soils and the waters of this region from those of the northern states farther east.

The minerals or salts which make the water “hard” are Calcium Carbonate (limestone) and Calcium Sulphate (gypsum). These have been derived also from the Cretaceous shales. Pure limestone is the mineral Calcium Carbonate, and the drift which has come from a limestone region contains this rock pulverized in the soil, and so this becomes a source of hardness of the waters. . . .

These salts are therefore to be seen in the soil and when the rain falls upon the ground it dissolves them and becomes “hard” or “salt” again, and as the waters flow down the coulees or streams into the lakes and there again are evaporated the lakes become “salt” or “alkali.” . . .

15. LAKES AS A LANDSCAPE FEATURE

The Meaning of Lakes on a Landscape.—Lakes as a landscape feature mean “youth,” that is, the landscape is young in the sense that there has not been time for river systems such as were described in the first chapter to be developed. The landscape is as yet undrained by streams. A comparison of that portion of the State lying west of the Missouri River with the great portion east of it will show the difference between an “older” and a “younger” landscape.

We have noticed already the many lakes scattered over that part of the state which is east of the Missouri River. West of the river we see none marked on the map, for there are none. . . . What has been the cause of these marked differences we have already seen. It was the great ice-plow which leveled down the hills and filled the valleys of the original landscape and piled these hills on the surface as it melted away.

