ALTITUDES IN SOUTH DAKOTA

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A common fact that all tourists learn after they have been in South Dakota a short time is that Harney Peak is the highest point between the Rocky Mountains and the Atlantic coast. Early maps indicate that the altitude of the top of Harney Peak is 7242 feet above sea-level. In contrast to this, the lowest altitude in South Dakota is 966 feet above sea-level, which is the surface of Big Stone Lake.

Although it is the lowest altitude, it is also a continental divide. a delta of sand separates Big Stone Lake from Lake Traverse to the north. From here Lake Traverse is drained northward to Hudson Bay by the Bois de Sioux River and Big Stone Lake is drained southward to the Gulf by the Minnesota River.

The Missouri River falls from an altitude of 1567 feet above sea level at the North Dakota boundary to 1080 feet at Sioux City, Iowa, a total drop of 487 feet in a river distance of 548 miles, although the airline distance is only 315 miles, and it is in a trench over 400 feet deep (Figure 1).

A highland area in line with Brookings northwestward through Waubay called the Coteau des Praireis has a summit of 2099 feet above sea-level. An east-facing escarpment that slopes abruptly downward over 600 feet is present in the vicinity of Veblen-Sisseton-Milbank.

The James River lies nearly flat in its 300 mile course from Hecla to Yankton. It falls from 1280 to 1170 feet altitude as it crosses the state (a gradient of four inches per mile).

The Missouri du Coteau is a highland area between the Missouri and the James Rivers where altitudes are up to 2100 feet above sea-level in Potter County.

The Missouri Plateau is west of the Missouri River and East of the Black Hills; it consists of plains, mesas and buttes with altitudes up to 3600 feet above sea-level.

The measuring of elevations began in South Dakota before the turn of the century; since then, thousands of bench marks or elevations have been established all over the state, by the Coast and Geodetic Survey of the U. S. Departmen tof Commerce.

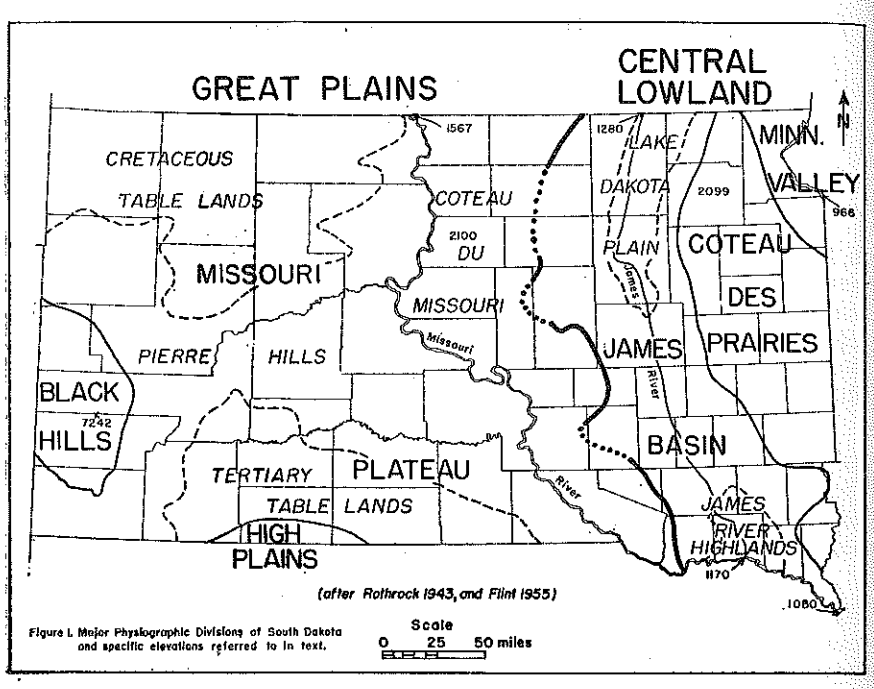

Figure 1. Major Physiographic Divisions of South Dakota and specific elevations referred to in text.

The elevations were determined by surveyed lines that began from sea-level observations located on the Atlantic Ocean, Gulf of Mexico, and the Pacific Ocean, on which there are nine tide stations. There are three types of level lines; First-order, Second-order, and Third-order leveling. First-order lines are precise level lines which begin at sea-level on the coast and are transcontinental traverses; there are six in South Dakota (Figure 2), one goes across the northern part of the state through Milbank, Mobridge and Buffalo; another line generally follows U.S. Highway 16 from Sioux Falls to Rapid City. The remaining four First-order level lines run north and south across the state. One of the oldest is the St. Cloud (Minnesota)-Watertown-Sioux-City (Iowa) line, made in 1904 and 5; others are north-south through Mitchell, Pierre, Philip and Rapid City.

Second-order level lines always followed well-established transportation routes such as railroads and highways. In addition, the Missouri River Commission established a line along the Missouri River. There are 124 level lines in South Dakota.

During the course of making such a survey certain points, one to three miles apart, were established as Bench Marks, for which the exact altitude above sea-level in feet was determined.

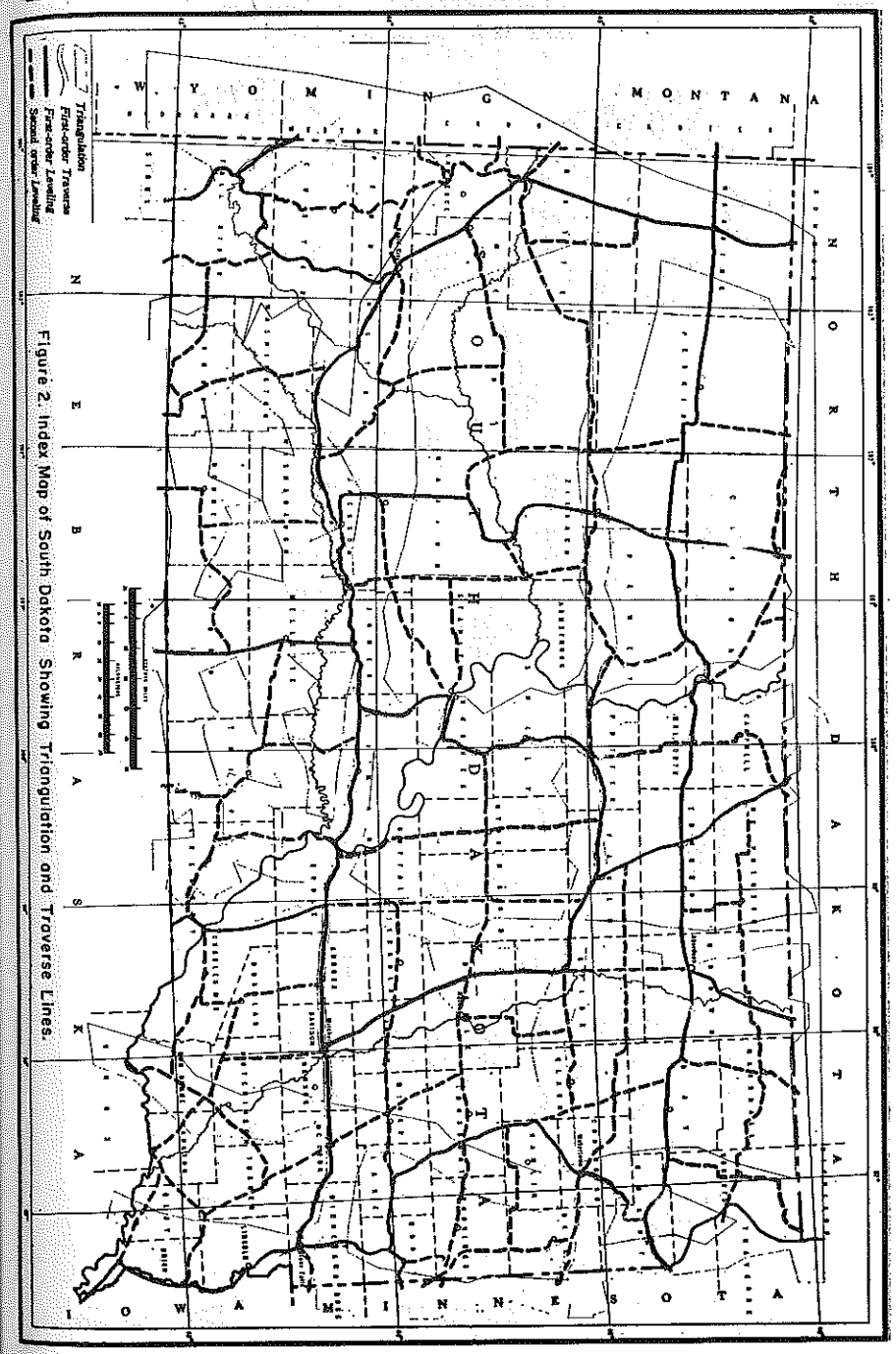

Figure 2. Index Map of South Dakota Showing Triangulation and Traverse Lines.

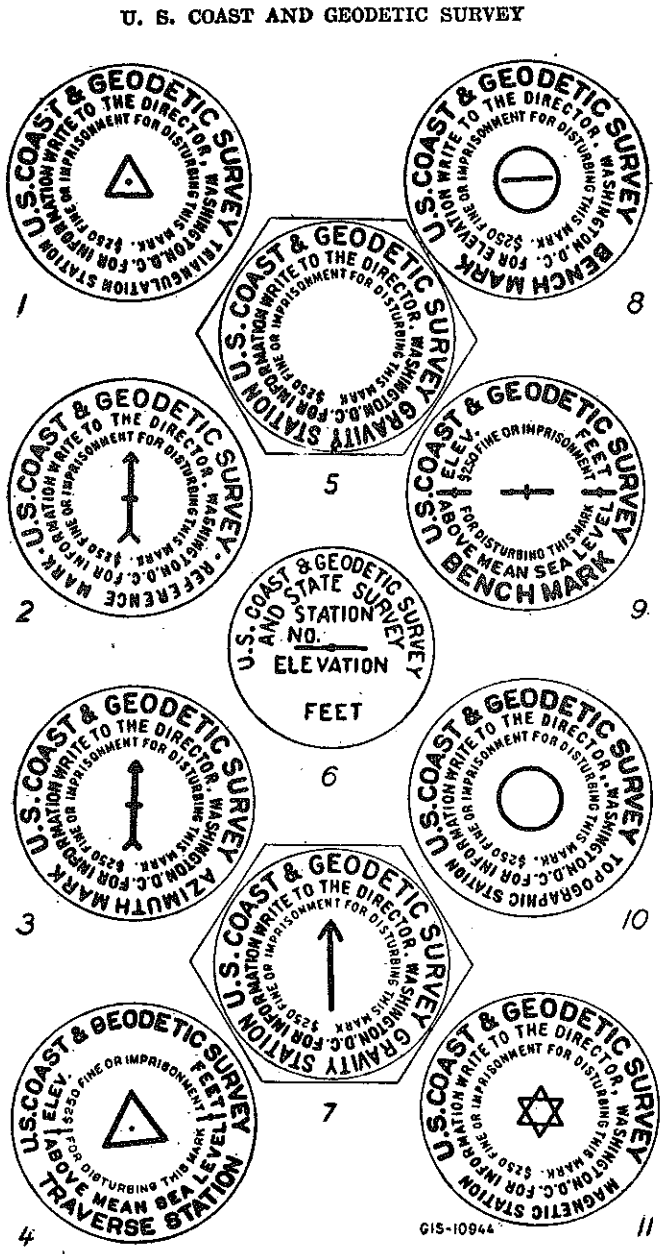

Figure 3. STANDARD MARKS OF THE U. S. COAST AND GEODETIC SURVEY

1. Triangulation station mark.
2. Reference mark.
3. Azimuth mark.
4. Traverse station mark.
5. Gravity station mark.
6. State Survey mark.
7. Gravity reference mark.
8. Tidal bench mark.
9. Geodetic bench mark.
10. Topographic station mark.
11. Magnetic station mark.

Th first bench marks were chiseled on stones and partially buried; now a cement post with a bronze disk in the top is used to mark the exact elevation (Figure 3). The locations of all bench marks are described in great detail so that they can be found by someone else. Over the years most of them have been well preserved. Now that railroads are being torn up and converted back to farm lands, many bench marks will be destroyed. Today the right of way of a highway is more than twice as wide as in former times, so many more Bench marks will be destroyed; however, many will be relocated with a new altitude determined and a new description.

Bench Marks along highways are put on bridges, culverts and near section corners. Survey lines along railroads always establish a bench mark near a depot and a temporary mark on the top of the rail in front of the depot, and generally the top of the rail at each milepost along the right of way. There are also Bench marks placed where section line roads cross railroads.

The object of the First-order lines is that eventually no point in the country will be more than 50 miles from an established Bench Mark, Second-order lines subdivide First-order loops until no point within an area is much more than 12½ miles from First- or Second-order bench marks. Third order lines are never more than 30 miles long and are used to close in large loops of the former two sets of lines.

This leveling program and bench marks is known as vertical control and is run by the United States Coast and Geodetic Survey and the United States Geological Survey. Additional level lines have been established by the U. S. Bureau of Reclamation, Soil Conservation Service, and State Highway and Geological Survey Departments.

Bench Marks can usually be found in the corner of country church-yards, cemeteries, and school yards. In cities and towns, Bench Marks are placed at the courthouse and in school yards; along the main street in small towns they are placed in the wall of masonry buildings about 3 feet above the sidewalk in such buildings as banks and post offices. There is at least one bench mark in every town in South Dakota unless the town is not on a through highway.

Before 1934 the altitude above sea-level to the nearest foot was stamped on the bench mark at the time it was established. After 1934 this was discontinued because the survey parties did not have the exact altitude (to hundredths or thousandths of a foot) until the calculations were made in the office, which might be several weeks after the bench was established.

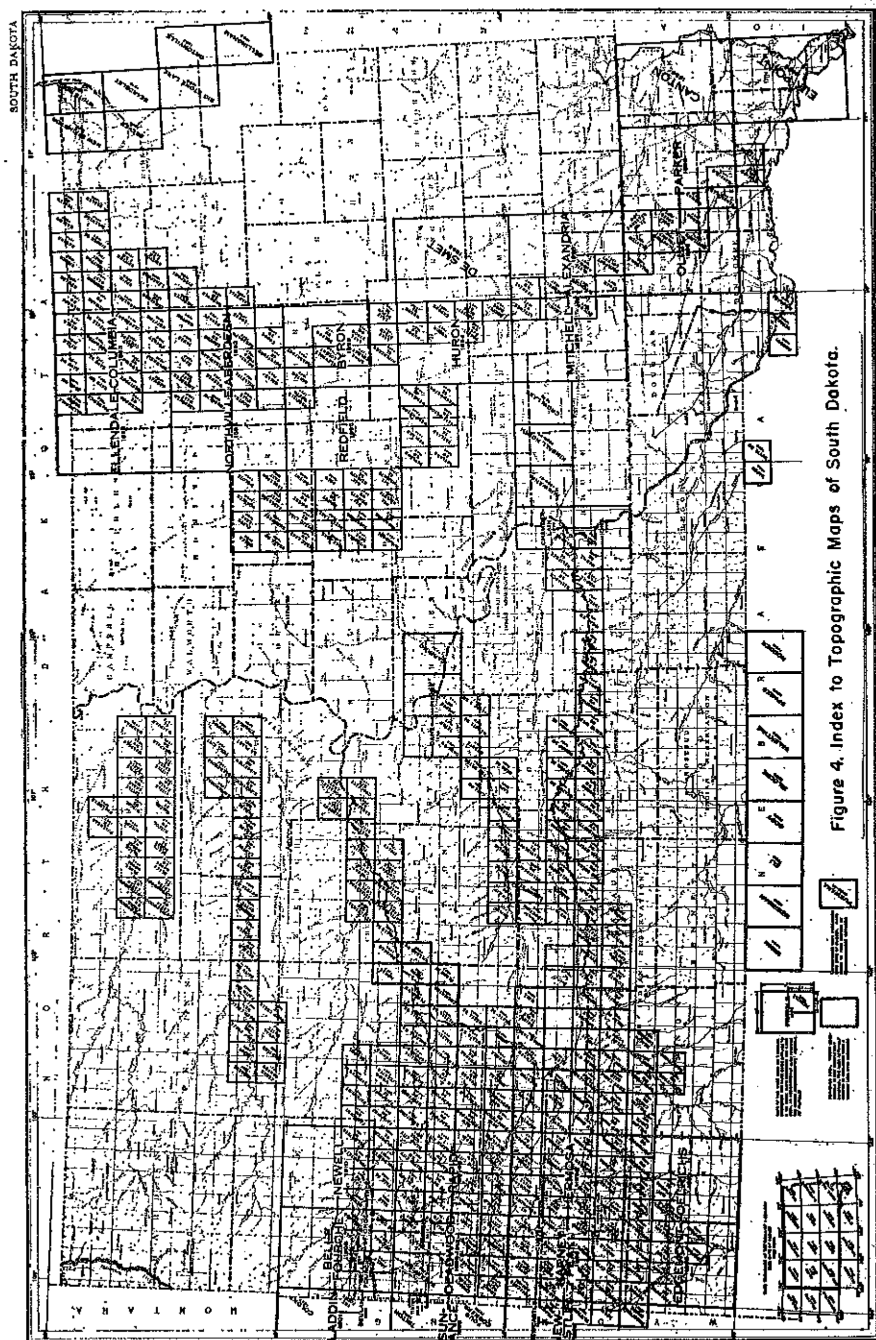

Figure 4. Index to Topographic Maps of South Dakota.

Similarly, the U. S. Coast and Geodetic Survey and the U. S. Geological Survey run horizontal control. In this method, a very precise triangulation survey is made, to locate exactly certain key points in an area. Each Triangulation station is located in reference to at least two others. The surveys must be so precise that they are normally run at night, when heat waves do not bother the telescopic instruments used. Recent refinements are even more astounding, but that is another story. South Dakota is covered with a network of approximately 2150 Triangulation stations (Figure 2).

Triangulation Stations are marked with Bench Marks similar to elevation points. Many are established on buttes, mountains and other prominent high topographic features, where they are purposely located for long distance observation. Other triangulation stations are church steeples, Radio towers, chimneys, water towers, grain elevators, courthouse domes, and forestry look-out towers. These objects are not necessarily occupied with instruments but are sighted in by intersection from at least three triangulation stations.

Topographic maps are prepared by the U. S. Geological Survey, using vertical control, horizontal control, air photos, and additional plane-table mapping. This type of map shows by contour lines the elevation above sea level of any point in the area, to an accuracy of half a contour interval (depending on the scale of the map, this may be one foot, five, ten, or twenty feet.

There are over 400 topographic quadrangles or maps published for South Dakota and they cover nearly 35 per cent of the state (Figure 4). These maps contain all the bench marks that were made during the level-line surveys, plus those made during the later mapping of the quadrangle; on these maps there are also spot altitudes in many places such as at section corners and prominent topographic features.

Elevations are used in construction of canals and irrigation ditches, for watershed studies to determine the height of dams and the size of spillways and bridges. They are used for military purposes. They are especially useful in tunneling through mountains. Air navigation depends on sealevel altitudes because air routes are over mountains, plains and the sea. All geologic work, both surface and subsurface mapping, is based on altitudes. There is a line of levels run to each oil test drilled in the state, so that its exact altitude is determined. This is an aid in locating further oil wells. Water well drillers would also profit by having elevations run to each well that they drill.

A recipe for a cake in Iowa cannot be used in Butte Montana because there is a difference in atitude of more than a mile which makes water boil faster at Butte.

The State Geological Survey recognizes the great value that these altitudes have for many purposes and is publishing maps showing the locations of these Bench Marks, together with their descriptions and elevations. In addition, we are glad to answer any requeststst for information on the elevations of specific points in South Dakota.