

HOT SPRINGS, SOUTH DAKOTA

John W. Lund
Geo-Heat Center

Hot Springs, located in the southwest corner of South Dakota and on the southern edge of the Black Hills, is the only place where extensive development of curative waters (balneology) has been undertaken in the state. It is built along the banks of the Fall River, immediately below the junction of Hot Brook and Cold Brook (Figure 1 and 2). Hot Brook is so named because of the thermal springs originating along its banks and flowing into Fall River. It is entirely spring fed and thus is a dry channel above the Springer Ranch where the last springs flow into the channel. It is the water from these warm springs that are the basis for the hotel, baths and sanatoria

that were once part of the city's industry (Natural Resources Commission, undated). The town should probably have been called Warm Springs, since the springs only range between 81° and 92°F (27° and 33°C). Except for Evan's Plunge, there is very little geothermal use in the town today. A combination in the lack of interest and belief in the therapeutic use of mineral waters, and corrosion and scaling of pipelines led to the demise of the industry in the 1950's.. There are over 80 capped wells and springs in town, however, there appears to be a slow revival of some of these past uses, especially the spa therapy (Beth Peters, personal communications).

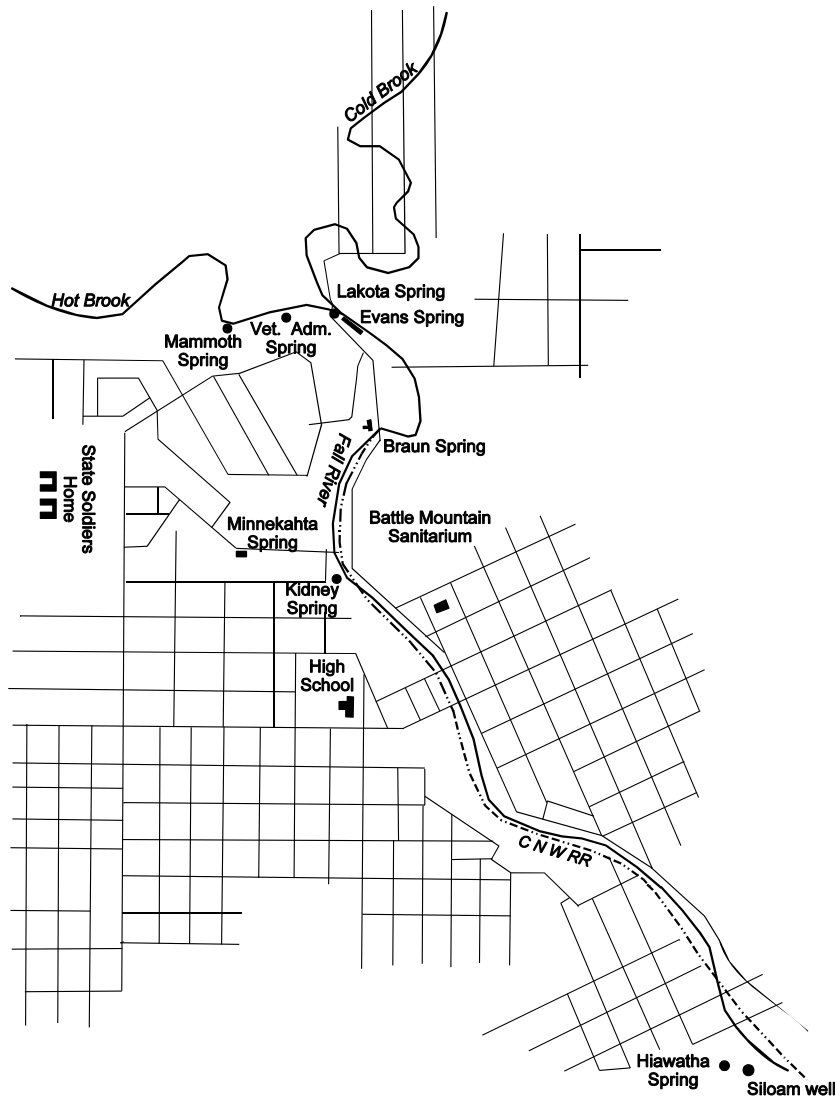


Figure 1. Map of Hot Springs showing the various hot springs.



Figure 2. Fall Creek looking downstream near Kidney Spring.

USE BY NATIVE AMERICANS

The Minnekahta Springs near the center of town was used by the Indians who had hollowed out a rock basin into which in the spring water flowed and was used as a bath tub. Most likely, the town received its name from this springs which means “Hot Water” in the Lakota Sioux language. In fact the city was first called Minnekahta and later changed to the English translation of the Indian word. A sign opposite Evan’s Plunge states:

“Long before the white man discovered the valley of healing waters, the Sioux and Cheyenne Indian tribes fought for possession of the natural warm water springs. Legend tells us that the battle ranged on the high peak above the springs and the Sioux emerged victorious.”

“The mammoth spring at the north end of the interior of the plunge is known as the “Old Original Indian Springs.” Here the Indians drank and bathed in its warm healing water.”

EARLY DEVELOPMENTS AND USES

In the springs of 1876, Colonel W. J. Thornby arrived at the present site of Hot Springs and “discovered” the source of the warm creek. Near the big spring where the Plunge was later built, he lopped off the top of a cedar sapling, blazed the trunk, and wrote with lead pencil: “This is my spring. W. J. Thornby” (Evan’s Plunge brochure, undated).

In 1881 the spring was owned by Joe Brimdschmidt, who traded his rights to Joe Petty for a horse valued at thirty-five dollars. Petty in turn sold the spring to Dr. Stewart, who filed on the surrounding land. Finally, according to the sign opposite the Plunge (metric conversions inserted by the author):

“The Evans Plunge was built in 1890 over numerous small sparkling springs and one mammoth spring of mineral water with a temperature of 87 degrees (31°C) and of medicinal qualities proclaimed on good authority, to be superior to that of the famous Warm Springs, Georgia.”

“From the inflow of 5,000 gallons of water per minute (315 L/s) from the springs arising out of the pebble bottom there is a complete change of water 16 times daily, thus insuring clean, fresh, living water at all times.”

“The pool 50 x 200 ft. (15 x 61 m), ranges in depth from 4 ft. to 6 ft. (1.2 to 1.8 m) with two shallow enclosures for children.”

“CHEMICAL ANALYSIS
Prof. Charles B. Gibson
of Chicago, Illinois

Water temperature.....	87 degrees
Total residue.....	87.9995
Inorganic & non-volatile.....	4.9160
Organic & volatile.....	8.050
Sulphate of sodium.....	8.824
Sulphate of potassium.....	3.331
Sulphate of calcium.....	16.290
Nitrate of magnesium.....	0.150
Iron susqui-oxide.....	0.260
Alumina.....	0.021
Silica.....	1.830"

The above numbers are probably in grains per gallon (x17.12 = ppm or mg/L), thus the total dissolved solids from the above would be: 87.9995 x 17.12 = 1506 ppm (mg/L).

Figures 3 and 4 are early photos showing the construction of Evan’s Plunge and use in the 1890’s (courtesy of Evan’s Plunge).

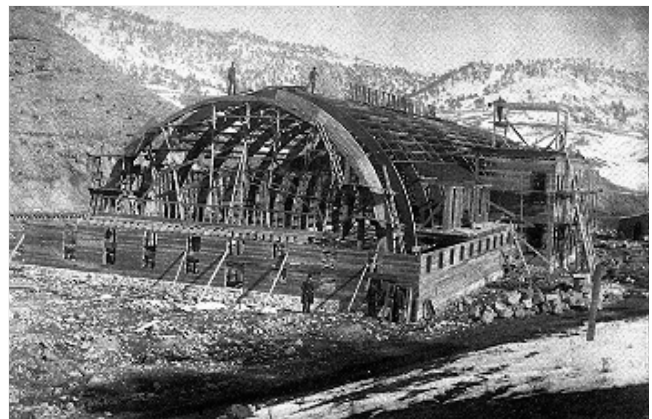


Figure 3. Construction of Evan’s Plunge in 1890.

Originally, Evans Plunge and other mineral baths in Hot Springs were sought as a cure-all for a multitude of illnesses typical of other natural hot springs in the United States at the time. Dr. William E. Fitch (1927) stated: “They were (the springs) the resort of Indians long before the white man found his way into the jealously guarded realms of the Black Hills and were considered by the red man as a panacea for all ills. This water has been found useful in the treatment of chronic diseases of the gastrointestinal tract, diseases of the liver and biliary passages, and in rheumatism and arthritic joint disturbances, gout and others.”

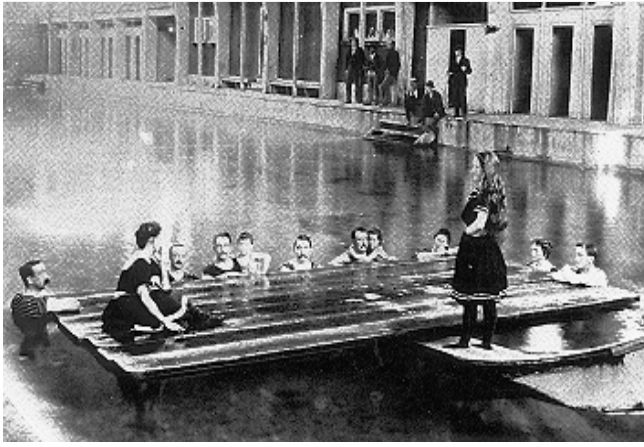


Figure 4. Users of Evan's Plunge in the 1890's.

DETAILS OF OTHER HOT SPRINGS

There are eight other large springs along Hot Brook and Fall River in addition to the springs used by Evan's Plunge.

The total average discharge of all the springs, exclusive of Hot Brook is 22.92 cfs (649 L/s) and does not vary throughout the year. Hot Brook contributes an additional 1.98 cfs (56 L/s) (Rahn and Gries, 1973).

The upper springs on Hot Brook, Springer Ranch Springs, are the source of the city water supply. They produce over 1,000 gpm (63 L/s) of 81°F (27°C) water. The water in low in dissolved solids (398 ppm - mg/L) of which the majority is calcium carbonate (based on analysis by the State Chemical Laboratory in 1938), and thus was felt to have limited medicinal uses (Natural Resources Commission, undated).

Mammoth Springs is the first of the hot springs encountered in traveling down Hot Brook. It emerges from the base of a steeply dipping limestone cliff at 92°F (33°C), and has been used to supplement the flow from Evan's Springs to Evan's Plunge. An analysis by Charles B. Gibson and reported by the South Dakota Geological Survey in 1900

gave a total residue (dissolved solids) of 1420 ppm (mg/L) of which the major constituents were calcium sulfate at 618 ppm sodium sulfate at 398 ppm, potassium sulfate at 96 ppm, calcium chloride at 96 ppm, magnesium chloride at 70 ppm, and magnesium carbonate at 60 ppm.

A little further down Hot Brook is Veterans Administration Spring with temperature and chemical content similar to Mammoth Springs. The spring was developed by the Veteran's Administration for use in its local hospital. The spring was entirely enclosed in a concrete tank and thus the flow was concealed. The use of the water was stopped in the 1950's, with the speculation that the new medical staff did not believe in the benefits of mineral waters.

Lakota Springs located at the junction of Hot and Cold Springs has been used for drinking only. Its source appears to be the same as for Mammoth Springs. The name means "Indian" in the Sioux language, but was not the one used by the Indians for curative purposes.

Braun Springs was used by the Braun Hotel for baths and drinking water. Two springs were used by the hotel, both located on the west side of Fall River. Each springs was reported to discharge enough water to fill a two- or three-inch pipe (Natural Resources Commission, undated). The water temperature was 90°F (32°C) and had a total dissolved solids of 1496 ppm (mg/L) according to an analysis by Denton Dales (undated). The major constituents were calcium sulphate (428 ppm), calcium carbonate (351 ppm), sodium sulphate (296 ppm), sodium chloride (211 ppm) and magnesium sulphate (185 ppm) with a trace of silica, alumina and iron oxide. Since this water contained Epsom and Glauber salts and some common salt, they were useful for therapeutic purposes. Unfortunately, the springs are no longer used by the hotel, however the new owner is considering reopening the bath house in the basement.

The Minnekahta Springs, used by the Indians, was later used by the Hot Springs Hotel which operated a bath house and plunge (Figure 5). The source appears to be the same as

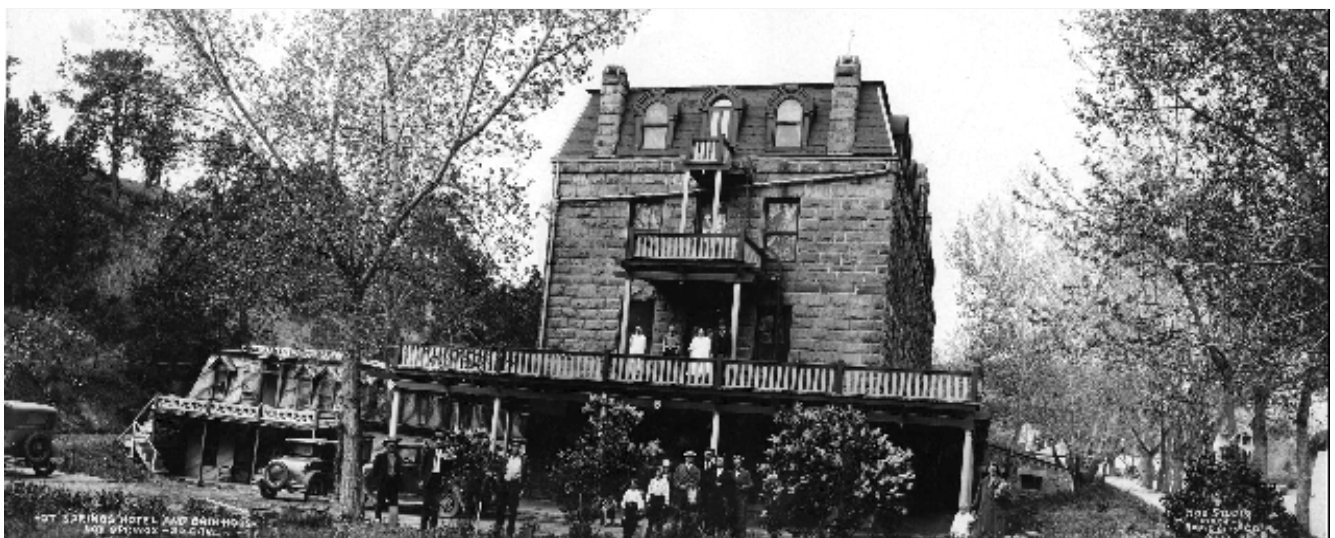


Figure 5. Hot Springs Hotel and Minnekahta Bathhouse probably taken in the late-1920's . Photo courtesy of Patty Hamm of Rapid City, whose grandmother, Anna May Carroll, is second from the right on the balcony.

Mammoth Spring with a temperature of 90°F (32°C) and a total dissolved solids of 1071 ppm (mg/L). These springs are again primarily sulphate and sodium chloride waters. The hotel was built in 1889 and the bathhouse was the first in Hot Springs. The complex was torn down in 1963-64 (source, Rapid City Journal, September 11, 1997).

Hygeia or Kidney Springs has a lovely gazebo, built in 1920, located next to it and is still a tourist attraction (Figure 6). In the past, the waters of this spring have been bottled and sold as an aid in the treatment of kidney diseases. A fountain located behind the gazebo is available to the public. A sign at the springs states:

“Useful in the treatment of chronic diseases of the gastro-intestinal tract, diseases of the liver and biliary passages, disorders of the genito-urinary tract and in sluggish condition of the alimentary tract.”



Figure 6. The gazebo at Kidney Spring with the drinking fountain on the right.

The springs, which issues from a conglomerate that caps the Pleistocene terrace of the valley opposite the Evans Hotel, is 83°F (28°C) has the following composition (as shown on a plaque at the gazebo):

sodium chloride	242.6 ppm
potassium chloride	68.4
magnesium chloride	118.0
lithium sulphate	15.2
calcium sulphate	704.0
calcium phosphate	2.76
silica	2.34

An analysis by Charles F. Metz made for the South Dakota State School of Mines (Natural Resources Commission, undated) gives a slightly different analysis. He reports a total solids content of 1789 ppm (mg/L) with a total sulphate content of 233 ppm and chlorides as 117 ppm.

Minnehaha or Catholican Springs and a well closed by, known as the Siloam Well, are now dry but once were the sites of resort hotels. They are the last springs in the Hot Springs district located about 1.5 miles (2.5 km) below Kidney Springs. At the time it was being used for a health resort, the

first State Geologist, James Todd reported: “It comes from quite a different source from the others. Over it is erected a fine sanitarium capable of accommodating 100 guests. Temperature 82 degrees Fahrenheit. Siloam sanitarium close by is supplied from a well professing to have similar properties.”

CASCADE SPRING

Cascade Springs, located about 8 miles (13 km) south of Hot Springs, is the largest single springs in the Black Hill of South Dakota (Rahn and Gries, 1973). It issues forth at the contact of the Minnekahta and Spearfish formations, and has a steady discharge of 67°F (19°C) and a total discharge of 22.5 cfs (637 L/s). Total dissolved solids are 2530 ppm (mg/L) with 1540 ppm sulfate, 568 ppm calcium, 235 ppm bicarbonate, 92 ppm magnesium, 62 ppm chloride, 60 ppm sodium, 22 ppm silica, 1 ppm fluoride, and <1 ppm iron. The pH is 7.0.

The Carlsbad Springs Company opened a 52 x 122 foot (16 x 37 m) cut-stone bath house and sanitarium in 1893. The interior was finished with highly polished marbles and hard wood, costly tiling, and French plate mirrors. The three-story 72-room hotel (96 x 87 feet - 29 x 26 m) contained 56 bath rooms, and hot and cooling rooms of marble (Carlsbad Spring Company prospectus, undated).

The original prospectus was issued for a capital stock of \$600,000 divided into 12,000 shares. The company also proposed to develop 2500 lots. They state in the prospectus:

“The springs (seven in number), whence the town derives its name, are located in a lovely valley. While all possess valuable medicinal properties, they differ greatly; the waters of one are identical with the famous Carlsbad Springs of Germany (now the Czech Republic); another’s are strongly impregnated with iron; a third with magnesia; a fourth with sulphur; while still another’s are largely composed of phosphates.”

“These wonderful waters relieve and cure rheumatism, gout, stiff joints, contractions of muscles and skin, old wounds, skin diseases, scrofula, scrofulous ulcerations and enlargement of glands, prostrations from long standing sickness or from debility following the use of powerful medicines, spinal diseases, sciatica, lumbago, neuralgia, nervous affections, partial, progressive, lead and writer’s paralysis, St. Vitus dance, muscular and general debility, catarrhs of all kinds, dyspepsia, Bright’s disease, diabetes, goitre locomotor, ataxia, blood poisons, anaemia, spanormia, hemorrhoids, piles, uterine diseases, change of life, sterility, mercurial disease and mercuria, and on spholetic lesions these waters have a marvelous effect on these loathsome and obstinate affections.”

“The chemical analysis of these waters show them superior as a remedial agent to any others heretofore in use. Rheumatism, a disease primarily of the kidneys, but affecting the muscles and joints

from uric acid, is invariably cured by these waters. No failure of a case need be recorded if the patient will use a proper course of treatment at Cascade Springs.”

Several stone buildings and a group of dwelling houses were erected in this proposed resort city. The railroad failed to come through, however, and the town was abandoned. The only building left at the site is an old bank building uses as a private residence. The bath house and sanitarium foundation was recently excavated and indicates the massive size of the stone block (Figure 7 and 8).



Figure 7. Excavated foundation for the Carlsbad Spring Company bathhouse and sanitarium at Cascade.



Figure 8. Detail of the excavation. Note the individual bathroom to the left of the people and the old bank building in the background.

CURRENT GEOTHERMAL DEVELOPMENTS

Only two major uses of the geothermal waters are made in Hot Springs today: at Evan’s Plunge and a heat pump installation at the Mueller Civic Center and Chamber of Commerce building. There are also several homes that use the geothermal water for heating (Beth Peters, personal communication).

Evan’s Plunge uses the geothermal springs in the bottom of the pool to supply the 86°F (30°C) water at about 5,000 gpm (315 L/s) (Figure 9). In addition, a 10-ton (35 kW) heat pump is used for space heating and cooling of the weight lifting/exercise room. The spring water is passed through an Alfa-Laval plate heat exchanger (Figure 10), and the secondary water supplied to the heat pump and also directly to an air handling unit to help control the humidity in the building. The waste water from the heat exchanger is then run to an outside water slide and pool, and then finally dumped in the river. The water could not be used directly in the heat pump and air handling unit due to CO₂ gas that caused corrosion in copper pipes. This gas was not detected or reported in the original analyses cited above.



Figure 9. Inside Evan’s Plunge

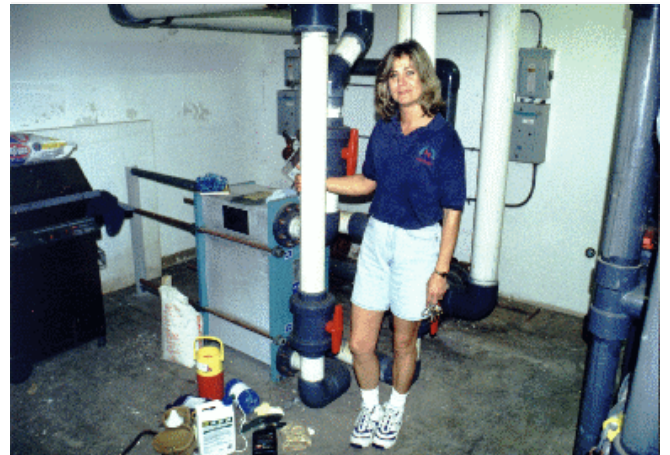


Figure 10. The plate heat exchanger used with the heat pump system.

The Mueller Civic Center also uses a heat pump for heating and cooling. The source is the Fall River, where initially the river water was used directly in the heat pump. However, fine grained material in the river water fouled the compressors, which eventually had to be replaced. Finally, a mat of pipes were a placed in the bottom of the river to form a closed loop system. Six units are now in operation for a total of 77.5 tons (271 kW).

CONCLUSIONS

Hot Springs has had an important geothermal past, when baths and balneology were popular. Unfortunately, due to lack of interest and support by users and the medical profession, interest in development and use declined. The good news is that there is a small group of people in the community, led by Beth Peters, who are attempting to resurrect the use and therapy of hot mineral baths (Figure 11). New construction is being proposed, including the reuse of the springs at the Braun Hotel. As stated in the conclusions of the Natural Resources Commission study:

“Waters from small springs can, in some instances, be developed into watering places and health resorts with either high temperature or dissolved salts as added inducements.”

“It is hoped, however, that what has been given here (in the report) will be used in pointing out that South Dakota should not be overlooked as a place suitable for health resorts not only for the use of its own citizens but for the benefit of outsiders who come to the State to enjoy its recreational facilities and engage in business.”



Figure 11. Sign over the Springs Bath House.

ACKNOWLEDGMENTS

I would like to thank Beth Peters owner of the Springs Bath House, and Don and Robin of Evan's Plunge for their assistance during my visit.

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