BALNEOLOGICAL USE OF THERMAL WATER IN THE USA

John W. Lund
Geo-Heat Center

INTRODUCTION

In the United States, the use of natural springs, especially geothermal ones, have gone through three stages of development: (1) use by Indians as a sacred place, (2) development by the early European settlers to emulate the spas of Europe, and (3) finally, as a place of relaxation and fitness.

The Indians of the Americas considered hot springs as a sacred place of Wakan Tanka ("Great Mystery" or Great Sacredum" in the Lakota language) and thus, were great believers in the miraculous healing powers of the heat and mineral waters. Every major hot springs in the U.S. has some record of use by the Indians. They were also known as neutral ground, where warriors could travel to and rest unmolested by other tribes. Here they would recuperate from battle. In many cases, they jealously guarded the spring and kept its existence a secret from the arriving Europeans for as long as possible. Battles were fought between Indians and settlers to preserve these rights. The early Spanish explorers such as Ponce de Leon and Hernando DeSoto were looking for the "Fountain of Youth," which may have been an exaggerated story of the healing properties of one of the hot springs.

The early European settlers in the 1700 and 1800s, found and used these natural hot springs, and later realizing their commercial value, developed many into spas after the tradition in Europe. Many individual developments were successful such as at Saratoga Springs, New York; White Sulphur Springs, West Virginia; Hot Springs, Virginia; Warm Springs, Georgia and Hot Springs, Arkansas. However, the U.S. did not have the government, trade unions, social security and a national health insurance program to support these developments. Thus, in spite of the benefits of spa therapy that had been proven successful in Europe and elsewhere in the world, the U.S. lagged behind in the development of these mineral springs even though some were acquired by state and the federal government. By the 1940s, the interest in spas languished, and most of the majestic resorts went into decline and closed.

The health and fitness industry has recently been stimulated by increasing consumer interest worldwide, resulting in high growth in revenues and profits. Health spas and resorts, representing a major part of the health and fitness industry, have grown in popularity and offer high investment potential in the United States. Revenues from spas in the U.S. presently are estimated at $10 billion annually. The number of spa-goers is projected to grow from 31% of the adult population in 1987 to 45% in 1997. The most traditional type of health spa is the geothermal spa, featuring baths and pools of natural hot mineral waters.

This recent interest in hot springs soaking and physical fitness has renewed the development of spas in the United States. This natural way of healing and the "back to nature" movement has in many ways rejected formalized spa medical treatment developed in Europe. In fact, the average person in the United States knows little of spa therapy and its advantages as many of the medical claims have been outlawed in the U.S., and the natural waters have required chlorination or other chemical treatment. The main reason people in the U.S. go to geothermal spas are to improve their health and appearance, to get away from stresses, and to refresh and revitalize their body and mind. Unlike European spas where medical cures of specific ailments are more important, U.S. spas give more importance to exercise, reducing stress, lifting depression and losing weight. A recent interest is the development of "health conservancies" to preserve natural areas for health and fitness activities.

The use of mineral and geothermal waters has developed along three lines in this country: (1) the more plush hot springs resorts with hotel-type services and accommodations, (2) commercial plunges or spring pools and soaking tubs with perhaps a snack bar or camping facilities, and (3) the primitive undeveloped springs without any services (Sunset Magazine, September 1983). Many resorts and natural hot springs have an informal dress code while soaking, including nude bathing. They have satisfied health department requirement for chemical treatment by allowing the water to continuously flow through without treatment. Several publications have been written on the subject, documenting these facilities and their use. In the case of the resorts, two books are available: "The Best Spas" by Van Itallie and Hadley, 1988, and "The Ultimate Spa Book" by Sarnoff, 1989. Plunges and hot springs are well documented in several publications, such as: "Great Hot Springs of the West" by Kaysing, 1990; "Hot Springs and Hot Pools of the Northwest and Eastern States" by Loam and Gersch, 1992, and "The Hiker's Guide to Hot Springs in the Pacific Northwest" by Litton, 1990. Similar publications are also available for other parts of the country.

LOCATION AND CHARACTERISTICS OF THE U.S. SPAS

There are over 115 major geothermal spas in the USA, and many more smaller ones along with thousands of hot springs (1,800 reported by NOAA, 1980). The majority of these are located in the volcanic regions of the western states; but, several famous ones still exist in the east. The major spas are estimated to have an annual energy use of

1.531 x 10^{12} kJ, or an equivalent of 340 thousands barrels of oil (BOE). Details of some of these U.S. spas are presented in Geo-Heat Center Quarterly Bulletin, Vol. 14, No. 4, March 1993, and in Lund, 1996. Thermal waters in geothermal spas vary greatly in composition from place to place. Table 1 shows some analyses of the major constituents of water from thermal springs and wells in several locations. "N/a" indicate that no value were available and does not necessarily mean that components were absent. Concentrations are in mg/L. The composition of average sea water is included for comparison (Woodruff & Takahashi, 1990).

Table 1. Composition of Waters from Several Locations (mg/L)

	(1)	(2)	(3)	(4)	(5)	(6)
Na	4.0	326.2	520	690.0	290.0	10500
K	1.5	89.6	82	15.0	0.08	380
Mg	4.8	121.6	38	0.2	0.08	1270
Ca	45.0	624.0	150	210.0	34.00	400
Cl	1.8	217.6	n/a	1300.0	106.00	19000
SO_4	8.0	n/a	420	170.0	491.00	2650
SiO_2	42.0	24.0	58	96.0	n/a	n/a
HCO_3	165.0	n/a	n/a	17.0	n/a	140

(1) Hot Springs, Arkansas (2) Thermopolis, Wyoming
(3) Indian Springs, Colorado (4) Belkap Springs, Oregon
(5)Desert Hot Springs, California (6) Average sea water

Interest in spas in the U.S. was not entirely lacking after the turn of the century, as both the federal and state governments became owners and managers of several important ones. Five examples follow (Fig. 1)(Lund, 1996).

Saratoga Springs, New York, located 250 km north of New York City, had approximately 18 springs and hot wells discharging 13°C carbonated mineral water along a fault. The Mohawk and Iroquois Indian tribes frequented the springs during hunting trips in the area. The first written report of the springs by European settlers was in the early 1600s (Swanner, 1988). Since this time, the springs have been used for drinking and bathing, to cure everything from skin disorders to digestive problems. The water and carbon dioxide has also been bottled and sold as a commercial product. Because of use and decline in flow in the springs in the early 1900s, the state of New York formed Saratoga Spa State Park, and now manages the geothermal activity including the only spouting geyser east of the Mississippi River. Several of the older bathhouses, Lincoln and Roosevelt, have been restored providing mineral baths, hot packs and massages. Two commercially bottled water are available: Saratoga Mineral Water and Excelsior Spring Water. The present Saratoga Spa Park has 10 springs with seven other springs located in the surrounding areas of the city.

Figure 1. Location of geothermal spas described in the text.

Warm Springs, Georgia is another famous mineral springs in the U.S. The springs were used by Indians from as far away as New York, as they were on a major trail system. The trails later became military and post roads, with a tavern built in the early 1800s. A number of resorts were built in the area, including the very victorian Meriwether Inn. It is know chiefly for the treatment of polio from the early 1920s to the 1960s. It was promoted by President Franklin Delano Roosevelt, who had polio and established the "Little White House" on the premises in 1932. The Georgia Warm Springs Foundation, who managed the springs, dedicated itself to the conquest of polio. It provided treatment in various pools supplied by warm springs flowing around 58 L/s at 31°C. With the advent of polio vaccines in the 1950s and 60s, use of the facility declined. Today, the Roosevelt Warm Springs Institute for Rehabilitation of the state of Georgia provides medical rehabilitation and therapy for a broad range of disabilities. The Institute also uses the water for bathing, heating and cooling, assisted by water-to-air heat pumps.

Hot Springs, Arkansas was one of the most popular commercial spas areas in the U.S., created to imitate the development of great spas of Europe. This natural geothermal resource consisted of about 47 springs producing a total of 4 million liters of 60°C water per day. It is estimated that these hot springs have been used by humans for at least 10,000 years. The "Valley of the Vapors" was an honored and sacred place to the Indians. This was also neutral ground, where warriors of all tribes could rest and bath here in peace--a refuge from battle. Legend reports that Hernando DeSoto, an early American explorer, visited the site in 1541. The springs were developed into a rustic bathing and resort area in the early 1800s. It became so popular with the early European settlers, that it was made into a federal reservation in 1832. By 1878, over 50,000 people visited the springs annually. In 1921, it came under the jurisdiction of the newly formed National Park Service and was renamed Hot Springs National Park. People flocked to this new national park with its large fancy bathhouses along Bathhouse Row. Until 1949, each bathhouse needed to have its own evaporation tower in order to cool the incoming hot mineral water to below 43°C, the maximum generally tolerated by the human skin. In that year, the Park Service installed air-cooled radiators and tap-water cooled heat exchangers to supply cooled water to the system. Now the bathhouses received two supplies of water: "hot" at 62°C and "cool" at 32°C. Of the original 47 springs, only two are presently available for public viewing. Even though activity has declined over the recent years, a full range of options are still available: tub and pool baths, showers, steam cabinets, hot and cold packs, whirlpool, massage, or alcohol rub. Today, the Park leases a number of bathhouses and owns almost 2000 hectars of land.

Thermopolis, Wyoming is located at the mouth of the Wind River Canyon, Approximately 150 km southeast of Yellowstone National Park. The major geothermal attraction in the area is the Hot Springs State Park with the 120 L/s Big Horn Spring. Nearby is the Fountain of Youth resort using natural mineral water from the historic Sacajawea Well flowing at the rate of 60 L/s. At least eight hot springs in the area have created large terraces along the river. These terraces are composed chiefly of colorful lime and gypsum layers known as travertine. The springs, claimed to be the largest mineral hot springs in the world, flow at a temperature of between 22 and 56°C with a total dissolved solids of 2400 mg/L. The early history of the springs include use by Indians; however in 1896, a treaty was signed between the Shoshone and Arapaho Indians and the federal government which gave the public use of the hot springs. The management of the springs was later turned over to the state of Wyoming forming Hot Springs State Park. Today Hot Springs State Park consists of little over 420 hectars of irrigated lawn and developed area within the 26-square km park, providing geothermal bathing in the State Bathhouse, and free water to six other facilities. Among the facilities provided hot water is a Pioneer Center for retired state residents and the Gottsche Rehabilitation Center specializing in helping stroke victims, closed head and spinal injuries, bed sores, cellulating problems, and burn victims.

Calistoga, California area was originally settled by the Pomos and Mayacmas Indians for at least 4000 years. These early people came from miles around to use the natural hot springs, fumaroles, and heated muds to soothe aches and pains. They also built sweat houses and used the local cinnabar for red war paint. To them, this was the "beautiful land" and "the oven place." In the early 1800s, the Spanish explorers visited the area looking for a possible mission site. They referred to this site as "Aqua Caliente." Sammuel Brannan, in the 1850s, envisioned a resort and spa similar to Saratoga Hot Springs--and thus, the name from a combination of California and Saratoga (Archuleta, 1977). He spent an estimated half a million dollars developing the "resort," with his Hot Springs Hotel opening in 1862. Around the turn of the century, over 30 resorts existed in the surrounding area, including bathhouses, mineral springs, and resort hotels. By 1930, many of these resorts had closed due to financial hardship, fires and lack of maintenance. About 15 years ago, Calistoga again became a "boomtown" with six major spas and resorts in operation. All of these resorts have their geothermal water supplied from shallow wells around 60-m deep with temperature from 77 to 93°C. The water for the pools and baths is cooled to 27 to 40°C, and some have mud baths using the local volcanic ash and peat moss. Calistoga also has a mineral water industry and is adjacent to the Napa Valley wine industry.

CONCLUSIONS

Geothermal water has been used extensively for the hot pools and baths, but not for heating or cooling the structures at these spas. Space heating was attempted in the past at many resorts, however, with mixed-to-poor results. Pipes would corrode or plug with deposits and require frequent repairs, replacement and cleaning. The expense was high and thus, "natural" space heating was usually replaced with conventional fossil fuel systems. Today, we at the Geo-

Heat Center, and other geothermal experts, understand and solve these problems on a routine basis. The cost of installing the proper equipment and safeguards are more than offset by the savings in annual heating costs over fossil fuels. The Geo-Heat Center has a technical assistance program funded by USDOE to provide free preliminary engineering and economic design and analysis of any use of a resource for heating and cooling.

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