

A CASE OF GEOLOGIC PREDESTINATION

Address of the Retiring President of the
New York State Geological Association

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After a hiatus of several years or geologic periods, depending on your point of view, the New York State Geological Association has found its way to Skidmore College. The site of this meeting is appropriate due to the fact that Skidmore and the City of Saratoga Springs owe their existence to an unusual geologic phenomenon. Certainly any geologist worthy of the title can, with sufficient rumination, devine a geologic explanation for the occurrence and location of any municipality or event in human history. However, in the case of this college and city there is no need to wax creative or stretch the fabric of credibility. We are here as a direct result of the unique occurrence and chemistry of Saratoga's Springs.

Popular histories of this area typically begin with aboriginal tribes of the Iroquois Confederacy, who knew the region as Kayaderossera (land of crooked waters) and the original spring (High Rock) as the Medicine Spring of the Great Spirit (Waller, 1966). The water which babbled and flowed from the spring's tufa cone was salty to the taste and revered as a cure for bodily ailments. In either 1767 or 1771 (Dunn, 1974, p. 541) members of the Mohawk tribe carried their blood brother, Sir William Johnson, the British Crown's Superintendent of Indian Affairs in northern America, to the Medicine Spring to restore his health. At that time, Sir William was suffering from dysentery, gout, and the ill effects of a French musket ball which he had been carrying in one thigh for over a decade (Waller, 1966, p. 8). Following a four day visit, Sir William returned to his duties partly repaired and thoroughly impressed with the Medicine Spring's curative powers. He told some neighbors about the spring and sent for a doctor to analyze its waters. The course was set, there would be no turning back.

In 1783 Philip Schuyler, who owned much of what is now Saratoga County and had heard of the Medicine Spring from Sir William, brought his friends George Clinton, Alexander Hamilton, and George Washington to High Rock for a little relaxation. By that time six additional springs had been discovered in the immediate vicinity. Washington was so impressed that he considered purchasing the area for a summer home, but never did. Following Washington's visit the springs' popularity grew so rapidly that by 1787 it was profitable for Alexander Bryan to open a "public house" on the cliff overlooking the springs to accommodate those who desired beverages other than spring water.

Bryan's public house was a prelude to the area's rapid "development". In 1884 a bath house was constructed for the pleasure and convenience of visitors at the site of Old Red Spring (Dunn, 1974, p. 193). Soon the original springs became too few and too small, so the spade was used to "discover" new ones. Since all known springs flowed in a muck-bottomed valley bounded

on the east by sandy hills and on the west by a prominent "limestone" cliff, early exploration was simple and digging easy. The highly-carbonated, saline, mineral-rich, sulfur-free springs, which flowed in ever increasing abundance, were judged to be on par with the mineral spas of Europe, to which the elite flocked to take "the cure". Not to be outdone, the elite of America required their own watering holes and converged on Saratoga to bathe and drink. Each spring was reputed to possess unique mineral and healthful attributes. Saline springs are cathartic while alkaline springs ease gastric discomfort and improve digestion. Bath and drink houses sprang up like mushrooms after a rain. Entrepreneurs bottled spring water for those unable to visit Saratoga. While a visit to the springs themselves could cure circulatory problems, skin ailments, arthritis, rheumatism, and the like, the bottled waters were advertised as cures for everything from lead poisoning to foul temper. A bottle factory and a village to serve it were built in nearby Greenfield. While plentiful employment in service positions sparked rapid growth of a permanent population, those who came for water and health lingered during the summer season for relaxation and entertainment. Horse racing and casino gambling displaced the more sylvan pleasures of earlier times. Ever increasing demands on the springs eventually exceeded the spade's abilities and the first drilled well penetrated the dolostone aquifer in 1870. A youthful carbonated soda pop industry saw the drilled well as an inexpensive CO₂ source, water became a waste product bound for the ditch. Prior to the end of the 19th century the mineral contents and flow-volumes of most springs were noticeably diminished and some springs had totally ceased to flow.

At the time of Sir William Johnson's visit the Medicine Spring rose within, but did not flow from, its four foot tufa cone. It had flowed freely in earlier times, and aboriginal folk wisdom attributed its decline to the Great Spirit's displeasure with some Mohawk women who had bathed in its waters (Mather, 1843, p. 96). It is not at all unusual for Saratoga's springs to decline, be temporarily interrupted, or cease flowing altogether. In most cases it was found that the spring's vent had become clogged with dirt or boiler scale and that the flow was easily restored. However, by the end of the 19th century there was no doubt that the general decline of free-flowing and pumped springs, as well as the pronounced decline of the mineral concentrations in all springs, were due to excessive pumping and not to boiler scale or the Great Spirit's wrath. In 1909 New York State passed a law enabling it to purchase the springs and mineral rights to them by eminent domain (Dunn, 1974, p. 201). This was an auspicious time as Skidmore was in its formative stages, the Village of Saratoga was about to become a city, and geologists were encouraged to study the springs in hopes of discovering unlimited potential for development.

Saratoga's springs have long been the subject of scientific inquiry. The first report of their existence and medicinal attributes dates to 1535 and the French explorer Jacques Cartier. As we have seen, Sir William Johnson had the minerals of High Rock Spring analyzed in the early 1770's. During the following decade several additional analyses were performed in connection with the springs' curative powers. In his report on the First Geological District, Mather (1843) recognized that the springs rise from a "limestone" and noted their location on the east side of a prominent "limestone" cliff. By the time of his geologic survey thousands of people were annually visiting the handful of then known springs. Perhaps with an eye to the future, Mather suggested that greater mineral concentrations would be had if

the "calciferous sandstone" (Potsdam Formation) beneath the "limestone" (Gailor Formation) was penetrated. Kemp (1912) reported that by the early 1870's it was realized that the springs emanated from the down-dropped side of a long north-south trending fault. In his own work, Kemp regarded this relationship to be critical and concluded that the mineral waters derived from eastward sources. He conducted an extensive review of the springs' chemistry as well as Saratoga's geologic setting, and developed an interpretation of the springs' origins (Kemp, 1912) which presaged some aspects of more recent work.

Kemp's (1912) account of the springs' origin involves several components. Flowing westward through lower Paleozoic sandstones and carbonates from locations near or beyond the Hudson River, meteoric water is influenced by buried volcanics (Stark's Knob is the model) which emit "carbonic gas, the chlorids, bromids, iodids, fluorids, and sodium carbonate" (p. 63-64) and possibly add "juvenile water" to the total volume. On the recommendation of H. P. Cushing and R. Ruedemann (published in 1914), Kemp considered the volcanics to be at least pre-Tertiary and probably Triassic in age. Thus charged with carbonic acid the water dissolves passages within the limestones and dolostones through which it flows. Ultimately the westward-moving mineral-laden water is trapped against the Saratoga-Mc Gregor Fault where it mixes with artesian water from the west (p. 64) and rises through fissures in the rock. Since the time of Kemp's work, aspects of his interpretation have been refined but the essential components remain valid.

Kemp's Stark's Knob model was soon regarded as insufficient and altered to a more general heat-source in the form of deep-seated metamorphism (Cushing and Ruedemann, 1914). Colony (1930) suggested the waning phases of Grenville metamorphism while Haertl (1930) supposed a batholith to be nearer the mark. In opposition to these ancient happenings, Young and Putman (1979) postulated secular thermal upwelling possibly related to local Neogene rifting. They also reported the locations of several brine wells not far to the south and south-west of Saratoga Springs. This report is intriguing in its bearing upon the interpretations of Lester W. Strock (1944), a longtime friend of Skidmore's Geology Department. At one time or another, the springs' saline contents have been attributed to connate sea water, igneous exhalation, dissolution of undiscovered salt deposits, and weathering of the Adirondacks. During a quantitative study of the springs' geochemistry, Strock (1944) found the enrichment of Br and I over Cl to be anomalous relative to lithospheric averages. Unable to account for this through the above mechanisms, he sought a specific proximal lithology as a potential source. He found that Silurian "bittern" shales, such as the Camillus, are geochemically similar to the springs and noted that Silurian strata extend to within about 40 miles south and south west of Saratoga. Noting that in central New York the Cambrian Potsdam Sandstone contains brines, Strock proposed that downward percolating ground waters leach salts from the bittern shales and, entering the Potsdam, flow to the north and east mixing with water bodies from eastern sources and rising as the Saratoga springs. He considered this interpretation to be supported by the fact that the Camillus Shale and the springs have similar K^{39}/K^{41} ratios. In the final (at least current) analysis, Kemp's conclusions that the springs occur due to the interactions of faulting, dissolution of Paleozoic strata, thermal input, and mixing of diverse waters is as viable as ever.

Having followed the connecting threads of the preceding pages you can see that terra infirma has staged a punctuated billion-plus year show pre-determining that Homo sapiens, intrigued by the whence and wherefore of the planet, would eventually gather here on the tropical shores of Cambro-Ordovician North America. No single field trip during this the 57th meeting of the NYSGA specifically concerns itself with Saratoga Springs, but most scrutinize one or more of the acts in terra infirma's show which produced them. While you are here to probe the distant past, why not take an example from the recent past (202 years BP) and follow George Washington to the Great Spirit's Medicine Spring. Perhaps you will find, as he did, that it can make a regular person of you.

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