The Origin Of Joe's Pond

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Part I – The Bedrock Geology Sets the Stage

Joe's Pond is a familiar body of water to many local Vermonters and visitors. All of us fortunate enough to experience Joe's Pond will find our own special attachments and delights here at any time of the year.
For the inquisitive mind, Joe's Pond can pose some baffling curiosities. Have you ever wondered why the pond has such a peculiar shape; why, in fact, is it really a string of three ponds, or even five if we include the two kettle ponds to the north? Why is the pond nearly a hundred feet deep on one side, and sandy and shallow out in the middle at the "Sunken Island"? Where did the angular granite boulders come from along the south and southwest shores? Why does Joe's Brook flow through a rugged hilly ridge and drop over a steep, rocky falls in West Danville? What were the conditions that created this odd-shaped depression now occupied by the waters of Joe's Pond and when did they occur?

A pond, quite simply, is a natural body of standing fresh water occupying a relatively small depression on the Earth's surface. The water level depends upon the elevation of the lowest portion of the rim. The lowest portion of Joe's Pond's rim is maintained by the bedrock falls in Joe's Brook in the notch in the hills at West Danville (ignoring for the moment the concrete dam built in 1917 for hydro-electric power). The elevation of the pond will remain at this level until Joe's Brook erodes the bedrock to a lower level. We need not fear this to happen for a long time, for the process is, fortunately, a slow one. But why is there a hole for water to be ponded in the first place, and why is it located where it is, and in such a peculiar boot shape? The answers to these questions are related to both the nature of the earth materials and the vicinity of the pond and the processes and geological events that served to shape those materials.

In Vermont the origin of most ponds fall into two categories: (1) those that occupy depressions excavated by the scouring action of continent-sized glaciers, and (2) those that occupy valleys or low areas clogged with soil and rock debris released by melting glaciers.

To understand how the pond formed we must first consider what the "bowl" is made of. Let's wander around the vicinity of our pond in both space and time. Let your imaginations float back through time – to a time before vacation camps, to a time before our ancestors cleared the wild, primeval forest that once surrounded Joe's Pond, to a time well before the days of the earliest ancestors of old Indian Joe, himself. It will have to be an extraordinarily fast trip, for our adventure must cover some 400 million years, but we will never be more than a few miles from the area.

Our story begins in the Devonian Period of geologic time between 395 and 345 million years ago. The climate was warm and subtropical then, and the region was inundated by a shallow sea. About 10,000 feet of limey muds and fine sandy sediment was slowly accumulating in thin layers. Compressed under their own weight, the mud eventually became cemented into shales and sandstones, collectively named the Waits River Formation. At the old quarry in West Danville near the railroad tracks and Highway 2 [U. S. Rte 2] we can see the layering of these old sediments still preserved in the rock. This exposure is typical of the rock that underlies Joe's Pond south of an imaginary line drawn between North Shore Road to the east and Meadow Lane to the west.

The rocks under the northern part of the pond and the area north toward Walden are made up of a 4000-foot thickness of somewhat younger Devonian sandstones and shales that make up the Gile Mountain Formation. These rocks are more resistant to erosion and thus tend to form ridges, such as the Kittredge Hills to the northeast. Small outcrops can be seen at the water's edge at two prominent points in Joe's Pond along the North Shore Road. Better exposures, however, can be seen along the paved highway between Marshfield and Cabot.

Near the close of the Devonian Period about 350 million years ago, tremendous forces within the Earth's crust caused the rock masses to compress and fold, fault and crack; the seas were compelled to retreat as mountains were uplifted in their place. The awesome heat and pressure slowly transformed the original sandstones and limey shales into quartzites, slates, and schists.

Under northeastern Vermont, a large hot bubble of molten rock (called a batholith, in technical jargon) was slowly rising in the Earth's crust, forcing its way up into the older rocks of the Waits River formation. Near St. Johnsbury some of the molten material breached the surface and oozed out as lava. A great arch formed in the overlying rocks extending from Barton to Strafford, Vermont. The liquid rock squeezed into cracks (usually only a few feet wide) in the older rocks and cooled to form "dikes" of granite-like material. The dikes occur in a band called a mixed contact zone, about a mile or so wide around the main mass of the batholith. One of these dikes can be seen at the falls of Joe's Brook just below the dam. The batholith eventually cooled into solid granite (named the Knox Mountain Granite), which underlies the rugged country inside Groton State Park. The deepest part of the main pond, the "Middle Pond," and the "First Pond" all occur in the mixed contact zone, with the granite batholith to the south of Route 2 along Joe's Pond toward Cow Hill.

Thus the stage was set, but our beloved pond was still not to appear for many billions of years. There is little evidence of what happened after those powerful roce-forming events of the Devonian Period. Most geologists suppose the area was mountainous, or at least well above sea level. We know that thousands of feet of rock eroded away. We walk today on the eroded stumps of much higher mountains of the past. We know the landscape, climate, soils, and life forms have profoundly changed since those cataclysmic times of the Devonian Period.

About two million years ago, for reasons that are not completely clear, the warm climate that had prevailed for so long dramatically cooled and became wetter. By this time, the Green and White Mountains and the major river valleys had acquired their approximate sizes, location, and shape, yet no ponds existed. Joe's Brook probably flowed to the southwest through what is now a very low divide between Joe's and Molly's Ponds. It is continued down today's Molly's Brook valley to discharge into the upper Winooski River. Molly's Brook valley is disproportionately large in comparison to the small brook that flows in it today. The valley must have been formed by a stream with a larger drainage area such as would have been provided by the larger Joe's Brook. Unless forced to do otherwise, streams tend to form valleys that course away from mountain ridges rather

than cross through them. Streams that do breach through a ridge were probably forced in that direction by other processes that we'll consider later, in Part Two of this Series.

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Part II – The Great Ice Age

The mild climate that had prevailed for so many millions of years suddenly cooled and became wetter about two million years ago. The new climate marked the beginning of the Pleistocene Epoch of geologic time, which most of us know as The Great Ice Age. The Ice Age consisted of at least four large-scale glaciations, separated by warmer, inter-glacial periods. The last glaciation ended a mere 6000 years ago. The entire planet felt the impact of momentous climate changes. In the Northern Hemisphere continent-sized bodies of ice formed from the accumulation of snow that persisted year round.

As the masses of snow piled up in northern Canada, the great weight of the material gradually hardened and compacted into ice. The ice increased in thickness to many thousands of feet and slowly acquired a plastic or viscous consistency and flowed southward, covering and engulfing everything in its path. In New England this massive ice sheet topped the highest mountains including Mount Washington in New Hampshire at 6288 feet above sea level. The ice sheet spread as far south as Long Island, New York and Nantucket Island, Massachusetts. So much of the Earth's water was captured on land as ice that the ocean levels actually dropped 800 feet! We know from evidence in the Midwest that the event repeated itself at least four times and undoubtedly occurred in New England each time, as well. But, in this rugged part of the country, the last episode seems to have erased virtually all traces of the three earlier events.

The last ice sheet terminated in southern New England about 18,000 to 20,000 years ago. The amazing process of melting, thinning, and retreat soon commenced. As the ice thinned and the high hills and mountains started to project up through it like islands, the sheet became fragmented

into isolated chunks that finally melted in place in the low areas. The glacier was, of course, very dirty, having picked up nearly everything loose in its path. Sometimes the ice was quietly oozing cloudy, dirty water; on warmer days, rivers of melt-water carried large quantities of silt, sand, and gravel liberated by the melting ice. Where stagnant blocks of ice persisted in low areas, sediment often accumulated in temporarily ponded water next to the ice. In many places, valleys were so choked with material released by melting ice that rivers had to seek new courses around the blockages. Occasionally, the rate of forward (southerly) motion of the ice sheet would equal the rate of the northerly retreat of its melting margin. When this happened, the front would stagnate in an area for years or maybe decades, during which time the moving glacial ice acted as a conveyor belt heaping up mounds of loose soil and rock along the stagnant edge of the ice sheet. Such was the case about 12,000 years ago when, in its process of retreat, the margin of the great ice sheet halted in the Joe's Pond area for awhile, stalling on the lower north side of Cow Hill, which may have been a barrier to the flow of the ice. Active ice sheared up and over itself, gouging and eating up the soft rock of the "mixed contact zone." Large, angular fragments of granite were ripped out of the dikes. Those big boulders as well as some of the softer schists were piled into ridges on the south side of what is now the pond, near Edgewood Avenue. The ridges, therefore, reflect the margin of the active ice during this brief period of standstill. The boulders are significant since we know that there are no appreciable outcrops of granite for many miles to the north; their angularity suggests a very short distance of transport – boulders tend to get rounded in the process of being moved any great distance. The boulders clearly were derived from dikes in the mixed contact zone along the line of the First and Second Pond and the deep southern portion of the main pond. The deepest part of Joe's Pond at 98 feet, located a few hundred feet north of the State fishing Access, was at the focus of intense ice erosion during the temporary pause in the recession of the ice sheet.

Other features that formed during this pause include mounds of loose soil and rock fragments deposited, again, along the stagnant margin of the active glacier. These mounds are abundant along Route 15 between West Danville and Walden. Joe's Pond's two islands, the so-called "Sunken Island," and the Point Comfort Peninsula, are good examples of these mounds. Finally the ice sheet became so thin that it was no longer

rejuvenated by thicker ice to the north. It disintegrated into many large, detached blocks. As the great chunks of ice melted in place, sediment, mostly silt and fine sand, was deposited around the blocks. Water-filled depressions (small ponds, marshes, and bogs) now occur where the chunks of ice were wasting away. The three southern pools of Joe's Pond next to Route 2, some of the deeper holes to the north including the two kettle ponds, and Molly's Pond to the southwest, were all occupied by stagnant ice blocks.

The landscape was a tundra-like scene with small herbs, spruce and hemlock trying to take root in the uplands and ice-free areas. What was happening to the flows of Joe's Brook at this time?" We said earlier that the pre-Ice Age drainage of Joe's Brook was to the southwest toward what is now Molly's Pond. The north-south trend of today's main pond follows the old valley of Joe's Brook. This olf valley was deepened and widened by the scrubbing action of the continental ice sheet. The foot of Joe's Pond's boot, consisting of the first and second ponds and the deepest part of the main pond, was especially attacked by active ice because the underlying bedrock was already weakened by the forceful injection of the granite many millions of years earlier. During recession of the glacier, stagnant ice conditions lead to the formation of separate but joined ponds sharing a common water elevation. Since the Joe's Brook valley was lowered by glacial scour in the vicinity of today's Joe's Pond and since stagnant ice was choking the upper Molly's Brook valley, melt water was forced to find new courses. Water spilled over the low saddles in the hills just south of the pond for awhile until, at last, the lowest saddle at West Danville became ice-free. Thus the outlet of the pond was established the way we see it today.

Technically speaking, we might consider all of Joe's Pond as a series of unusually deep and wide pools which Joe's Brook must negotiate in its passage through the area. The brook and other small streams and springs keep Joe's Pond continuously filled to its brim at the notch in West Danville. Thus the geologic history of Joe's Pond can be read in the subtle clues that the rocks, soil, and the surrounding landscape provide us. The next time you have an opportunity, visit some of the features we discussed and locate them on a topographic map. Our pond has had a spectacular history!

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Northeast National Technical Center in Chester, Pennsylvania. John's great-great grandfather, James S. McKillop, farmed in West Danville in the 1860's. John and his wife and two children enjoy summers at Joe's Pond in a cottage that has been in his family since 1953.

Written in 1990 for the North Star Monthly, of Danville, Vermont, about the formation of Joe's Pond and the surrounding landscape.