The first Vaughan Homestead Lecture was recorded August 24, 2004, featuring Barry Timson, geologist and long-time Mayor of Hallowell. He graduated from Bowdoin College in 1966. He received a master's degree in geology from University of Massachusetts in Amherst and did doctoral work at the University of Texas in Austin. He returned to Maine to work for the Maine Geological Survey and eventually opened his own geology and environmental consulting business.

Introduction by Ron Kley:

Barry Timson's presentation deals with the shaping of many familiar features of Hallowell's landscape in "recent" geological time – that is, in the 10,000 years or so since the end of the "Ice Age" that had prevailed for most of the preceding million years.

My role is to set the scene by providing an introduction to the half billion years, or thereabouts, of geological time that preceded the Ice Age -- and to say a bit about the continental glacier that Barry's video refers to. How did that happen? Where did it come from? How did it behave? And where did it go?

Let me confess at the outset that in my effort to compress a half billion years into a brief introduction, I'll have to omit a few details.

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If you've ever watched a boiling pot of something thicker than water -- like spaghetti sauce or fudge, you've seen a process that's quite analogous on a very small scale, to what has gone on here in New England over the past half billion years or so. You've seen heated material rise to the surface of the pot right over the hottest portion of the stove burner, then move laterally along the surface toward the cooler perimeter of the pot, and then sink down again to be re-heated and repeat the cycle known as convection.

Admittedly, it's a bit hard to envision solid rock behaving like spaghetti sauce or fudge. But if it's heated hot enough and long enough it does behave like a very thick plastic material. It rises to the surface over hot spots beneath the ocean. It then spreads laterally, and descends to begin another convection cycle.

This laterally spreading hot stuff is made up of material from far beneath the earth's surface – perhaps as much as 20 or 30 miles down. It's rich in iron and other heavy metals. It moves away from a hot spot very slowly – just a few millimeters a year, until it encounters something in its way – not the side of a pot on some cosmic kitchen stove, but the edge of a continent.

And then, because continental crust is rich in lighter elements (especially Al and Si) the denser oceanic crust slides under the edge of the continental mass as it cools and begins descending to be reheated. This descending stage of the convection process drags the edge of the continent down in a process called subduction to form a trough along the continental margin, and the natural processes of erosion by water and wind begin to fill that trough with the debris from the adjacent land -- sand, pebbles, mud, etc. As the trough deepens more and more sediment is deposited until it may reach a total thickness or five or six miles – a depth at which the earth's internal heat can cook that material, like the separate ingredients in a cake batter, until they merge into something new – something that we call rock.

But it's not rock as we know it here at the earth's surface. Instead, it's a hot plastic material that can be squeezed and crumpled into folds like a pile of paper napkins. Sometimes the heat deep within the earth's crust is sufficient to completely melt some of this material, and the surrounding pressure is great enough to squeeze the melted stuff and propel it into cracks and fissures of the surrounding rock.

Eventually (and we're talking tens of millions of years here) the driving convection force weakens and the subduction slows or stops. At that point the lighter continental rock that was formed in the subduction trough rises and floats on the underlying denser material – rising above sea level, to be carved into mountains and valleys by the erosive effects of running water. Geologists refer to this mountain-building process as orogeny.

Over the span of the past half billion years there have been multiple distinct cycles of orogeny in our region – with great thicknesses of sediment being deposited in subduction troughs, baked into rock, squeezed into complex folds and then uplifted and eroded to form mountains and to produce sediment that's then deposited in a new trough along the continental margin. In that process, as I said before, some of the subducted material is heated enough to be melted and squirted into cracks to cool and solidify there into a new kind of rock like the granite that has played an important role in Hallowell's economic history.

The cooked and folded rocks, known as schist, together with once-melted crack-filling granite, form the bedrock framework of what we know today as Hallowell and the Kennebec Valley.,,and most of New England

Then came the glacier. Layers of snow accumulated over tens of thousands of years in the areas that we know today as Hudson Bay and Labrador, and piled up to a thickness of three to five miles. The snow was compressed into ice by the weight of overlying layers, and that same pressure caused the ice to begin squeezing out like silly putty or play dough from that center of accumulation. The moving ice picked up and incorporated loose material and carried it along – with the debris laden ice functioning like a gigantic sheet of sandpaper that scoured the land surface beneath it. You can still see scratches and grooves left by this glacial sandpaper in many bedrock exposures of our area. This so-called continental glacier extended as far south as Cape Cod and New York's Long Island, and as far west as Kansas and Nebraska. The basins occupied by today's Great Lakes were scoured out by the glacier. Cape Cod and Long Island owe their very existence to the fact that the glacier's advance stopped there for a long period of time. The ice kept moving forward, but that movement was offset or balanced by the rate of melting, so the ice behaved like a giant conveyor belt – carrying debris southward and dumping it along the line of the glacier's farthest advance.

Interestingly, there's some controversy as to what might trigger such an episode of continental glaciation. A worldwide cooling seems intuitively likely, and it's thought that an average temperature reduction of just 6 degrees would allow snow and ice to survive year-round in the New England mountains, eventually spawning at least small valley glaciers. On the other hand, it's theorized that a widespread increase in temperature ("Global Warming" in present-day terms) would trigger vast increases in the evaporation of moisture from the oceans, and resulting increases of precipitation, including snow and ice accumulation in circumpolar regions.

Eventually the Ice Age glacier "retreated." It didn't shift into reverse and pull back into Canada, it merely encountered changing climatic conditions under which the rate of melting exceeded the rate of advance. At that point humongous volumes frozen-in mud, sand, gravel and larger rock fragments were released from the ice – some to be dropped in place, and some to be transported and deposited by the gigantic volumes of water released from the melting ice. You can watch the very same processes operating in miniature when dirty snow and ice start to melt along a road with the first hints of springtime warmth. When I used to teach geology I'd tell my students to put on their boots and go play in the gutter on a warm March day to see in miniature what the end of an ice age would have looked like.

The coming and going of the glacier had a profound effect upon sea level, and upon the configuration and whereabouts of Maine's coastline. Initially, the accumulation of glacial ice resulted huge volumes of water being transferred from the ocean to land by evaporation and precipitation. Sea level dropped by as much as several hundred feet, and much of the present Gulf of Maine became dry land where mammoths and mastodons roamed – pursued by Maine's earliest human inhabitants.

As the great thickness of ice occupied the land its weight actually depressed the earth's crust, with the result that when the ice finally melted the sea flooded in to cover much of what we now know as Maine's coastline. That's why you can find marine clay with clamshells up near the airport in Augusta, nearly 200 feet above present-day sea level.

With the weight of the ice gone, the earth's crust slowly rebounded to create the coastline that we know today. There's some evidence that the rebound may have slightly overshot the pre-glacial starting level, and that we're presently in a time of slight crustal subsidence as an adjustment that we perceive as a slowly rising sea level.

And that's just about the point where I should hand this narrative over to Barry Timson and the talk that he presented at Hallowell's Vaughan Homestead back in 2006.