The Evolution of Ontario's Dundalk 'Island'

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ABSTRACT

This paper presents an alternative scenario to the research literature's depiction as to how southern Ontario's topographic high evolved. The morphology of this highland, known by various names that relate to the nearby Town of Dundalk (e.g., Dundalk Dome, Dundalk Highlands, Dundalk Till Plain, Dundalk Plateau), is typically described as having been shaped by thick sheets of glacial ice. In contrast, the scenario presented here attributes the origins of this area to its emergence from seawater and floating polar ice at some point prior to the beginning of the Holocene. Continued emergence from seawater, with periodic regressions, ultimately formed what is now known as the Ontario Peninsula. Evidence of these former water levels was obfuscated by the impact of floating masses of sea ice. The suite of weakly etched but lowering shoreline profiles did not originate from the opening of outlets as the glacial ice receded. Rather, the area's shorelines are attributed to its having rotated through the polar region as the Earth's axis shifted.

INTRODUCTION

Although variations on the theme exist, Chapman and Putnam's The Physiography of Southern Ontario (1966) has been the accepted standard for the portrayal of glacial ice movements in southern Ontario for half a century. Their depiction has glacial ice over-running Ontario before finally stopping in southern Ohio. It was not until the ice "melted back about 150 miles … that the first land was uncovered in southern Ontario." Through a series of well-known diagrams, they show that the melting of the ice sheet was not just a simple uncovering of the land surface from south to north but rather several lobes that split apart near Orangeville, Ontario (Figure 1). These lobes were "highest in the centre and sloped towards the edges; which means that the relief was often opposite to that of the present land surface." Apparently drainage flowing into the crease between the lobes brought in sand and gravel that ultimately produced the Orangeville and Waterloo Moraines. Given the massive amounts of water draining off the ice in this scenario one would expect an ice-impounded, long, deep, narrow lake without an outlet, perched on the highest area in southern Ontario. The description evokes an image not unlike a huge expanding and contracting swimming pool.

From Chapman and Putnam's first stage the lobes (the Huron, Georgian Bay, and Erie) were involved in a series of advances and retreats that are marked by a sequence of moraine ridges as well as associated spillways that channeled water away from their respective ice-fronts (Figure 2). A gap ultimately stayed open between the Huron and Erie lobes to allow water to drain into the Erie basin. Lake Maumee, the glacial lake that evolved, eventually reached a level that enabled it to drain over a sill at Fort Wayne, Indiana. Calkin and Feenstra (1985) place the initiation of drainage over this sill at about 14500 BP. What followed was an ephemeral lake characterized by rising and falling water level phases that involved down-cutting at Fort Wayne and an oscillating ice retreat into the Huron basin that ultimately allowed drainage westward through outlets on Michigan's "Thumb". The result of this 'to and fro' movement of ice and water was the emergence of what Chapman and Putnam refer to as 'Ontario Island' (Figure 3).

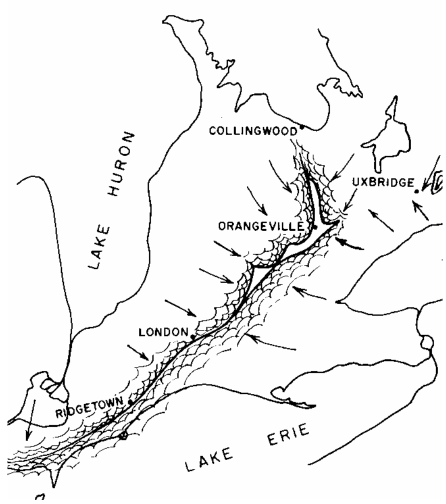

Figure 1. The suture-like opening of the three ice lobes in the Orangeville area according to Chapman and Putnam (1966).

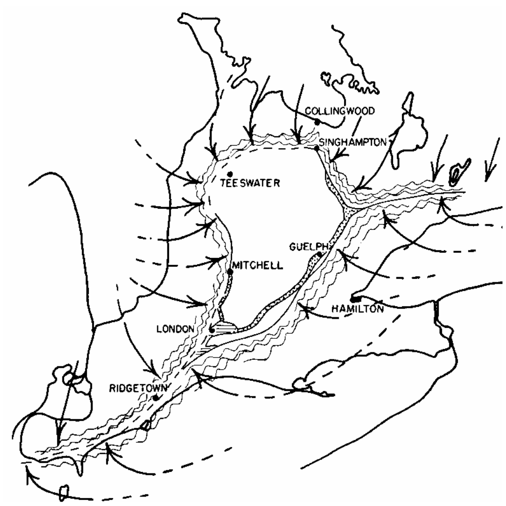

Figure 2. Chapman and Putnam's (1966) configuration of the three ice lobes when the Mitchell and Westminister Moraines were constructed.

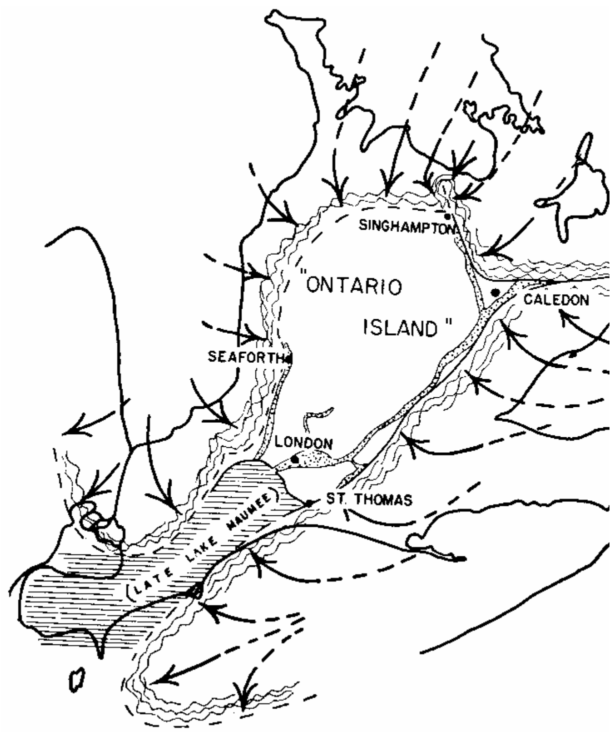

Figure 3. Chapman and Putnam's (1966) depiction of the ice lobes when the Seaforth and St. Thomas Moraines were constructed.

AN ALTERNATIVE SCENARIO

I always doubted the above scenario but grudgingly accepted it given its widespread acceptance in the research literature. It had little relevance to me anyway since most of my geomorphological work, with the exception of Manitoulin Island, occurred on Ontario's Precambrian Shield. That changed, however, in 1999 when I was involved in a project that centred on Chapman and Putnam's 'Ontario Island'. My analysis of aerial photographs and topographic maps of this area, augmented by road traverses, led to a scenario that differed from Chapman and Putnam's. So different, that keeping within the confines of their descriptive framework was difficult.

The notable difference was my belief that the highest elevations of their Ontario Island had been submerged by water and impacted not by thick lobes of glacial ice but floating and grounded ice. The research literature, however, shows no lakes on the Ontario Island above London, Ontario. If I was right, then Chapman and Putnam's interpretation was constricted by the concept of continental glaciation itself. In following the concept they were trying to force 'a square peg into a round hole'. In my scenario the Orangeville Moraine was not the oldest 'glacial' event in Ontario. Simply put, there was no newly melted water because there wasn't an ice sheet. I concluded that the water that was there was diluted polar seawater and that Chapman and Putnam's Ontario Island was moving through the Northern Hemisphere's polar region when it emerged from it. Evidence of such a scenario is difficult to discern due to the steeply tilted nature of the shoreline profiles; their segmented nature; their obfuscation by sea ice; the pre-Holocene age of these features; and the erosional processes that impacted these features in the interim.

DUNDALK ISLAND ANOMALIES

To avoid confusion with other topographic highs in Ontario (e.g., the Algonquin Dome, the Algoma Highlands, Upsala-Raith, Pukaskwa, etc.), I use the term 'Dundalk Island' to refer to the area that they designate 'Ontario Island'. My analysis of the Dundalk area indicates a number of anomalies in the accepted chronological order and geographical extent of certain events relating to the glacial ice scenario. There has been much discussion in the research literature pertaining to the high upland plateau in the Dundalk area. Much of it pertains to various till types and their respective ages, in particular, the Newmarket Till-Elma Till-Catfish Till relationship. Barnett et al (1991) map this area as Catfish Till, which is the oldest till in Ontario, in that it was laid down while the ice was enroute to Ohio and Indiana during the Late Wisconsinan's Nissouri Stadial. This ice supposedly passed over the Dundalk area roughly 23,000 years ago and reached its terminus in the U.S. about 18,000 years ago. Catfish Till, which is the basal till in southern Ontario, is found mostly subsurface, except for exposures in the Woodstock area and, according to Barnett et al., in the Dundalk area. Previously, the Dundalk area was thought to be covered by the younger Port Bruce Stadial Newmarket Till that moved out of the Georgian Bay-Lake Simcoe area (Gwyn, 1972). Sharpe (1975, 1977) indicates that the Elma and Catfish Tills are indistinguishable north of the Durham area. Given that the till rests on bedrock and is lithologically the same from top to bottom, Sharpe refers to it as Elma-Catfish Till.

My differences fall into two categories, namely, till differentiation with respect to ice movements during the Port Bruce Stade and ice margins and associated lake-levels during the Port Huron Stade. A concern relating to the Port Bruce Stade is the literature's depiction of southeast-trending eskers (e.g., Egerton, Keldon and Hatherton Eskers) as single, contiguous ridge systems in an area that supposedly involved two separate advances and two distinct tills. After the oldest of the two advances laid down the Tavistock Till, the Georgian Bay and Huron lobes are described as acting independently near the end of the stade in that the Georgian Bay lobe advanced and deposited the Elma Till and the Huron lobe deposited the Rannoch Till. The distinct time difference between the Elma and Tavistock Tills presents a problem for most renditions of the regional esker systems in that the two tills and the time difference infer distinct glacial advances. Recent mapping (Sharpe and Broster, 1976; Barnett et al, 1991) shows the Elma Till extending southeasterly to roughly the boundary separating Wellington and Grey Counties. If this is true, it is difficult to envision each esker as one contiguous ridge system straddling two till types deposited at different times (i.e., the older Tavistock Till at the beginning of the Port Bruce Stade and the Elma Till near the end). Would the lower and upper ends of each esker system in this belt align in these circumstances? If Elma Till is an up-ice phase of the Tavistock Till, it would not be contemporaneous with the Rannoch Till. In the two advances scenario the southern end would form in association with retreating Tavistock ice and the northern end with retreating Elma ice. In this case, there should be evidence along the ridge system marking where the advancing Elma ice halted. If one follows the glacial ice scenario, some 'esker' segments even have the appearance of 'end moraines' deposited into water. Additionally, some areas in the eastern part were over-ridden from different directions at least three times forming a system of composite drumlins.

Most researchers class that portion of the Singhampton Moraine bordering the northern edge of Chapman and Putnam's Dundalk Till Plain as a recessional moraine. Using the glacial scenario it could only represent an advance given that the southwest-trending drumlins on the Dundalk Till Plain negate its being a recessional moraine. Features on the upland east of Dundalk indicate to me that an earlier ice event impacted elevations in front of (i.e., above) the Singhampton Moraine and that this event essentially defined the northeast corner of the Dundalk Till Plain. This same event truncated an arm of the literature's so-called Shrigley Esker. However, it had nothing to do with lobes of glacial ice pushing up the side of the Niagara Escarpment to impact the lip of this highland area.

Another concern relating to the Port Bruce Stade is that no water levels have been identified for this period on Dundalk Island. My analysis indicates that there were many of them and that they have counterparts elsewhere in the province and in adjacent Michigan. I also have concerns relating to various elements in the literature that purportedly took place during the Port Huron Stade. The literature's standard glacial lake chronologies for the south end of the Huron basin reflect a major lowering of lake levels from Lake Maumee through the Arkona levels that occurred as the ice front retreated north during the Mackinaw Interstade. This was followed by the Port Huron Stadial Advance that instigated a corresponding rise in water to the Lake Whittlesey level (some renditions insert an Early Lake Whittlesey between the Maumee and Arkona levels). In these scenarios the Port Huron Advance terminated at the Huron lobe's Wyoming Moraine position and the Georgian Bay lobe at the Banks Moraine with the lobes' meeting at Paisley 'Island'. Both moraines consist of St. Joseph Till. A third view presented by Totten (1985) negates this chronology for the Lake Erie basin where certain Maumee, Arkona and Wayne ridges were apparently drowned or washed over by later levels (e.g., Whittlesey submerging Arkona). Totten found no support for the "yo-yo" water level fluctuations presented in the classic studies but rather an inline sequence of younger and lowering levels in which the Arkona levels follow the Whittlesey level.

THE DUNDALK ISLAND EMERGENCE SCENARIO

The highest area on Dundalk Island is located between the Town of Dundalk and a rural road crossing called Shrigley. Based on Gwyn's (1972) mapping of the surficial deposits the area is primarily a drumlinized sandy silt till plain with peat-dominated wetlands in the areas between the drumlins. Given their orientation the glacial scenario would have the drumlins forming under an ice sheet that was moving to the southwest. It is assumed that the ice margin melted back producing what is depicted on most maps as a system of parallel and branching (dendritic) eskers that dropped onto the fluted till plain that had been formed by the advancing ice. Paradoxically, the eskers here are perpendicular to the direction of ice flow, which is unnerving in that the orientation of the ridges relative to ice-flow direction leads one to believe the ridges should mark ice-halt positions and not dendritic drainage patterns within the ice. The specific esker in this area, the Shrigley Esker, is centred on where a branching ridge meets what is purported to be the main stream to form a confluence just north of Shrigley.

Based on aerial photos I don't believe that the glacial ice scenario is correct. My analysis indicates the drumlins were formed by tidal water and floating ice impacting this land surface as it passed through the polar region or very near to it. The so-called esker ridges are related to ice floating over an offshore escarpment and grounding on land and near-shore. The east-west branching esker ridge west of the main ridge is related to an older event. The main stream portion of the so-called Shrigley Esker system is a later feature that is probably the result of a surge of floating ice impacting this same area (Figure 4). In my scenario drumlins are a tidal water-sea ice phenomenon associated with relatively rapid axial shift cycles. Depending on the accuracy of the National Topographic System (NTS) contours (NTS Map 41A/01), I estimate that those drumlins northeast of Dundalk emerged from seawater at roughly the 540 metre (1770 feet) elevation. Subsequent lower water levels are faintly etched on the flanks of the drumlins. The race for emergence is shared with an area roughly 35 km (22 miles) southeast near Orangeville (NTS Map 40P/16) that I informally call Fraxa Ridge in Amaranth Township.

At roughly the 530 metre (1735 feet) water level a small drumlin field, consisting of a few drumlin knolls, stuck out of the water (Figure 5). A hill at Kingscote, approximately 13km (8 miles) southwest of Dundalk, exhibits this same shoreline, however, due to axial tilt, it is at roughly the 518 metre (1700 feet) level. The next landfall for this level to the southwest is on the south side of the Erie basin where it is traceable up the major river valleys to locations that mark its truncation by later water level events. For example, this steeply tilted level is traceable up the

Maumee River valley in Ohio to just beyond "The Bend" where it was truncated thousands of years later by my Erie-Huron level at roughly the 244 m (800 feet) elevation in the flanking areas (e.g., Hicksville, Ohio) (Noble, 2004). About this time, or just previous to this level, floating ice impacted the eastern side of the Dundalk tableland where it formed an ice push ridge and terrace feature (i.e., the main branch of the literature's Shrigley Esker that passes through Shrigley). The almost continuous north-south contact slope is detectable from south of Shrigley to the Brewster Lake area in the north. The north-south orientation of this complex feature forms an important watershed divide. The older, higher terrain, that floating and grounded ice impacted earlier, serves as the headwaters for the Saugeen and Grand River systems. The incised drainage systems on the younger terrain behind the ice and water-impacted scarp drain east off the escarpment (e.g., the Noisy, Pine and Boyne Rivers). Their development is very complex in that it involved a number of emerging-submerging cycles related to axial shifts that occurred over many thousands of years (i.e., water re-entered the river valleys).

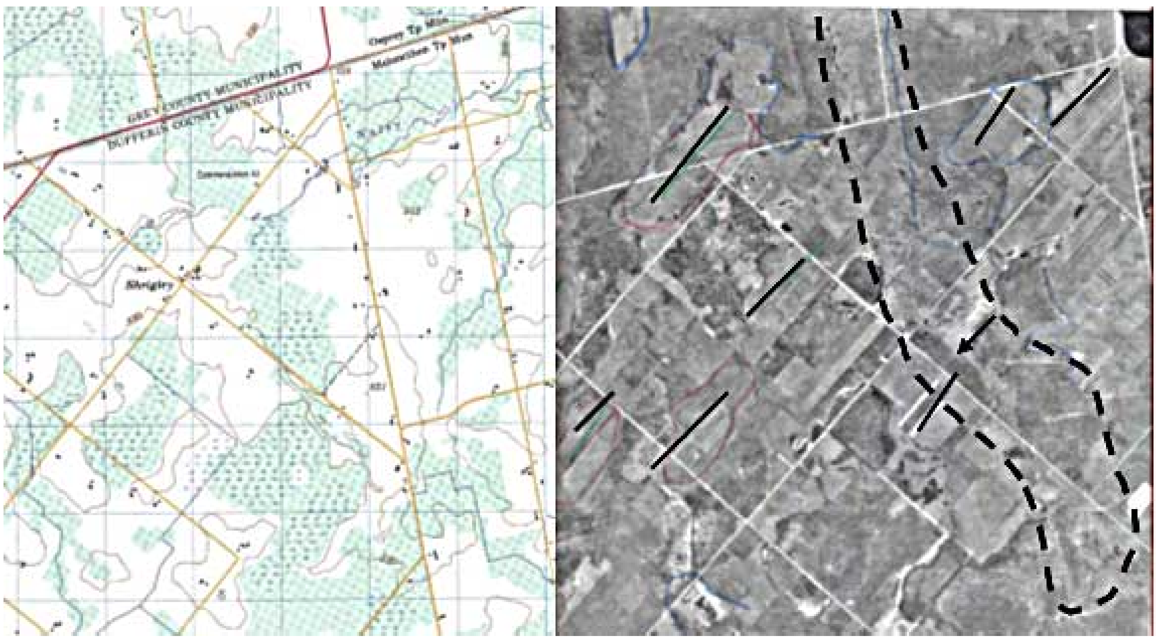

Figure 4. A portion of the drumlin field near the summit of Dundalk Island. The arrow in the aerial photograph points to a truncated drumlin. The dashed line denotes what the literature refers to as the main ridge of the Shrigley Esker. Curiously it cuts across the grain of the drumlin field. I believe the area enclosed by the dashed line is an ice-rampart zone.

An integral element of the Shrigley ice rampart feature, and possibly the most discernible level in the Dundalk-Shrigley area, is the 518 metre (1700 feet) shoreline (it also occurs on Kingcote Hill at about the 506 metre (1660 feet) level) (Figure 6). From the Shrigley area a succession of ice-rampart features, marking lowering water levels, can be traced stepping down off the dome's eastern flank. The well-known Singhampton Moraine on the northern flank is also an ice rampart ridge system that is associated with a specific water level. Later, and at much lower levels, the same process would create the so-called Oak Ridges Moraine, which is a somewhat segmented but pro-grading foreland. In fact, the same process was taking place around the entire periphery of the Dundalk tableland to the extent that this upland area was taking on a stepped wedding-cake configuration, albeit elongated east-west along the Oak Ridges Moraine and northeast-southwest towards London, Ontario. Each of these pro-grading ridge systems would be truncated by later events (i.e., Oak Ridges in the vicinity of Rice Lake (Noble, 2003a)) and the ridges separating the Huron–Erie watershed divide by the high-level proto-Erie-Huron freshwater lake level (Noble, 2004). The last water bodies on the Dundalk Till Plain's highest elevations were small lakes that occupied former seawater embayments. These are now shallow, saturated peat-filled basins whose drainage affiliations undergo subtle changes with each shift. The events and processes described above can be traced down-slope in both the Grand and Saugeen River valleys to their associated present day water bodies, namely, Lakes Erie and Huron.

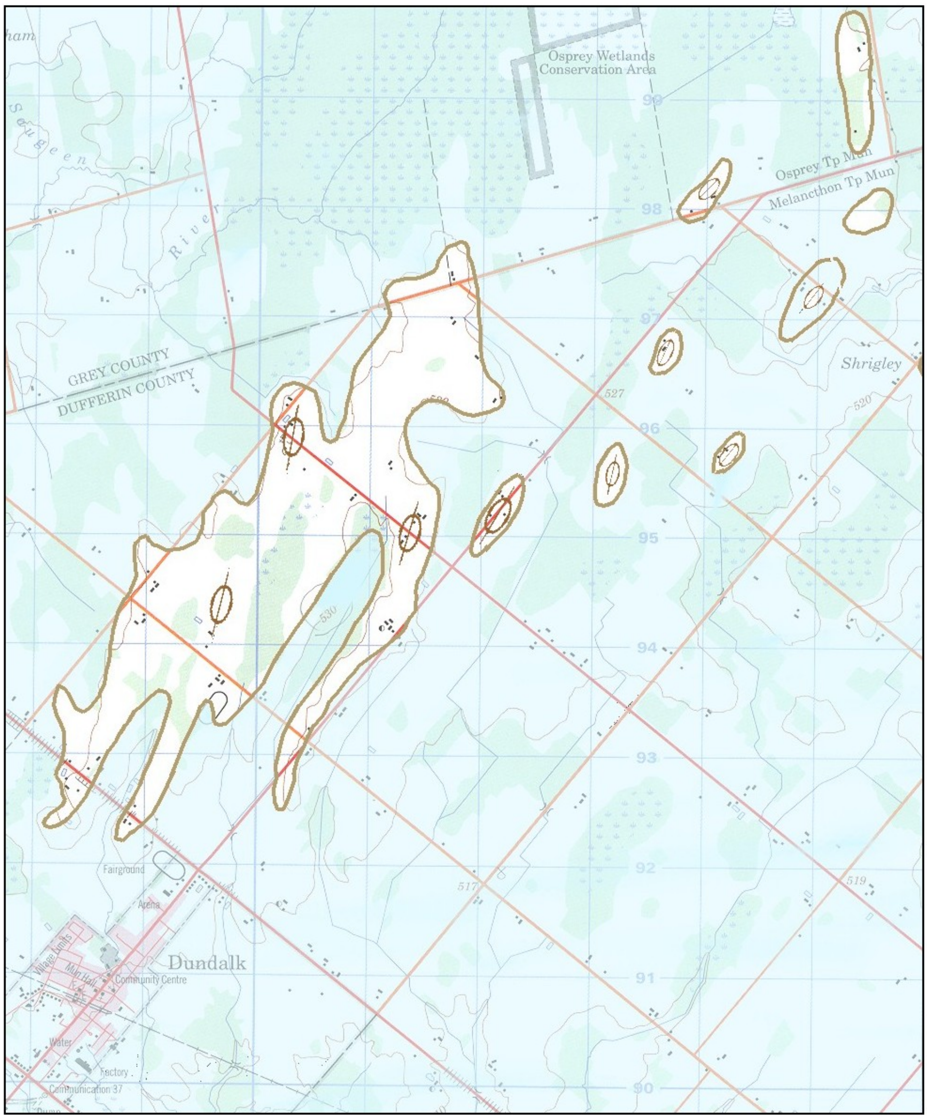

Figure 5. Drumlins beginning to emerge from water on summit area of Dundalk Island. The water level shown is at roughly 529m (1735 feet) but the shoreline profile is tilted up to the northeast.

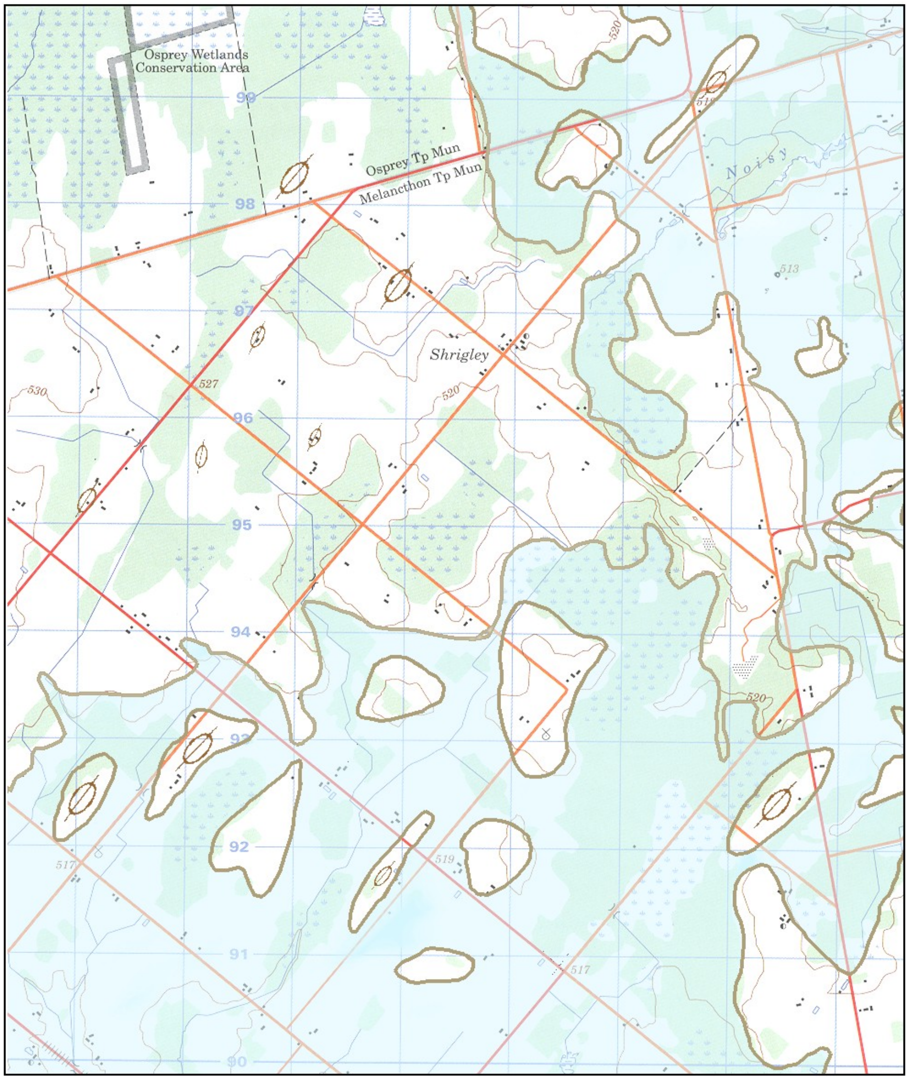

Figure 6. Water level dropping off the eastern flank of the Dundalk Island summit. This is the 518m (1700 feet) level.

Dundalk Island was the first area in southern Ontario to emerge from seawater. It was not, however, the first area in Ontario to emerge. That honour belongs to the watershed divide separating the Arctic's Hudson Bay Slope from the Atlantic watershed immediately north of the Minnesota-Ontario boundary southwest of Thunder Bay, Ontario (Figure 7). Tower Hill, one of a number of high mesas along the divide, came out of the water a few levels above the Dundalk Island's emergence level. In so doing, these mesa were, for all intents and purposes, forming a somewhat segmented pro-grading foreland, not unlike what would later form along what is now known as the Oak Ridges Moraine in southern Ontario.

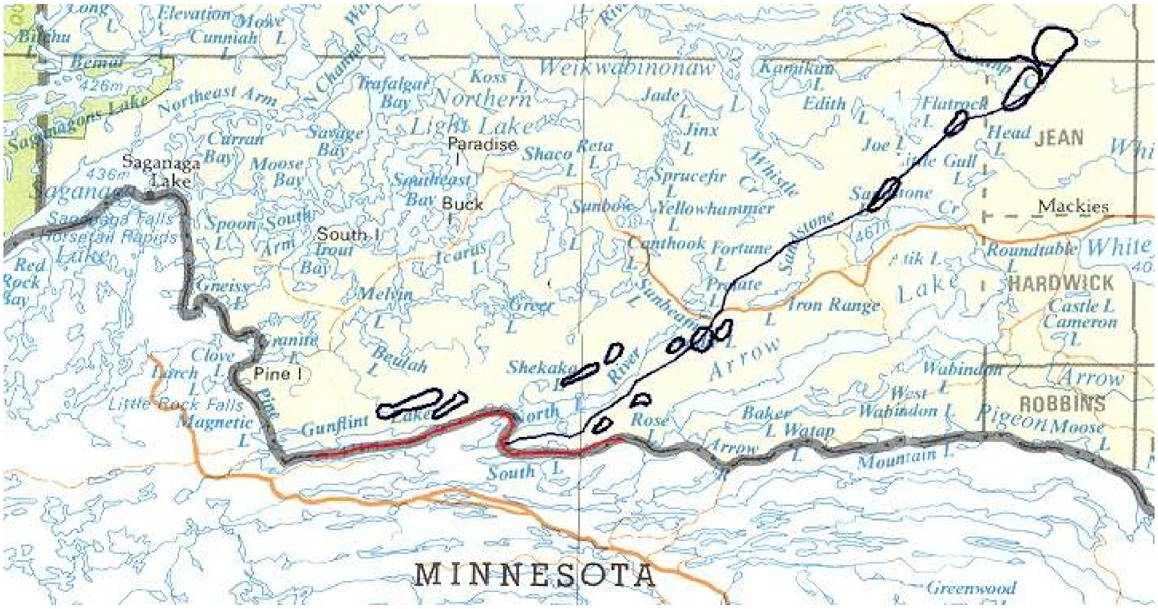

Figure 7. Area along the Ontario-Minnesota boundary postulated to have been the first area in Ontario to emerge from under water. The black line is the watershed divide.

CONCLUSIONS

The physiography of the highest elevations of the Dundalk Till Plain did not evolve from glacial ice advancing over hill and dale to Ohio and then retreating. The features here contradict all of the elements that supposedly relate to an area having been overrun by glacial ice. Rather, the area owes its development to both emergence from and submergence by seawater and associated floating ice while this area passed through the Northern Hemisphere's polar region. The foregoing statement is a major deviation from the scenario portrayed in the research literature. I maintain that the shoreline scarps are discernible on aerial photographs stepping down from these high points and that they have been over-looked because of their steep tilt. Their steeply tilted aspect is not due to isostatic rebound but to axial shifts. The shorelines are also difficult to discern due to their old age; their abbreviated or discontinuous nature; and modification by later erosion. The latter two elements are also directly related to axial shifts.

ACKNOWLEDGEMENTS

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