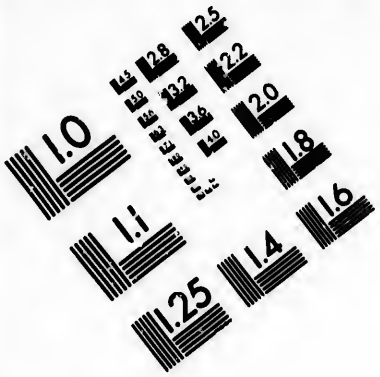

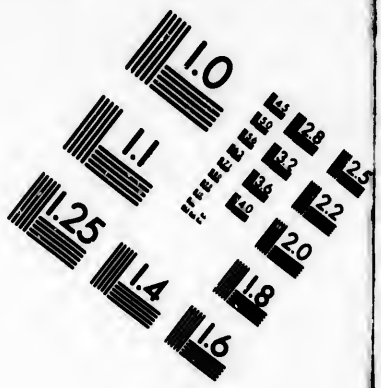

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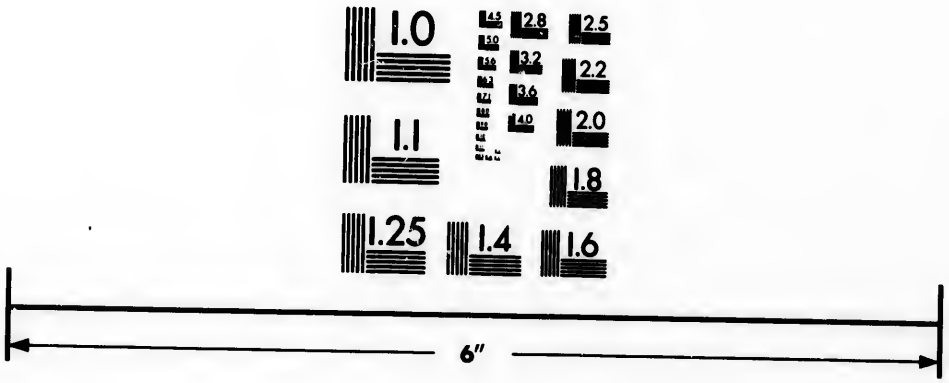

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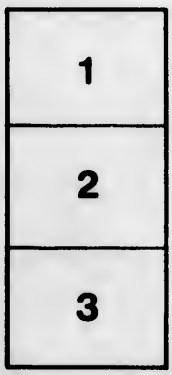

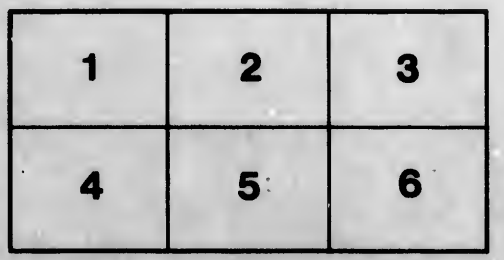

RIVER VALLEYS OF THE NIAGARA ESCARPMENT.

BY D. F. H. WILKINS, B. A., BAC. APP. SCI., HEAD MASTER, HIGH SCHOOL, BEAMSVILLE, ONT.

Read before the Hamilton Association, May 8th, 1890.

That salient feature of the landscape of Western Ontario known as the Niagara escarpment, in its course through the counties of Lincoln, Wentworth, Halton, Wellington, Dufferin, Simcoe, Grey, and Bruce, as well as on through the Manitoulin islands, possesses among other interesting characteristics, a large number of river valleys of all sorts and sizes. Some are recent; others, ancient: some tell the story of repeated submergence beneath the waves; others, again, are almost of yesterday. Some have gently sloping sides; others with their precipitous, picturesque, angular walls, resemble in miniature the canyons of the far West. In some the drainage of the upland is slowly but surely carving its way to the plain below; in others, the dried-up stream-bed and the bare rock-ledges speak of diminished rain-fall and of complete erosion. In some a jungle of tree and shrub clothes the entire glen; in others, the traveller pushes onward amongst grass and herbs only.

Of the valleys, the most important to the north is certainly that of the Sydenham, in Grey county; for a glance at the map shows that it, in former days, carved out that large and beautiful and now valuable expanse of water known as Owen Sound. There we find that the present unimportant stream, after winding on gently through field and forest, plunges down two or three picturesque falls, and flows onward through a flood-plain, its former valley, of which more anon. Moreover, the stream has excavated, after the manner of Niagara, a deep and narrow gorge in the limestone, the ledges of which have caused the cascades just referred to; and that this erosion is very recent, will be apparent to all who carefully study the district. The ancient valley just mentioned deserves here a little longer notice. Its breadth increases from a few hundred feet at the south end to over a mile at the present river-mouth, and it extends further as we go northward to a width of three miles. Its length,

as far as has been traced, is nine miles, six of which are under the water of the Georgian Bay, and three covered by the thriving, enterprising city of the north, Owen Sound. Its depth is very uneven. In some parts, not the deepest, the Niagara limestone is met with at the surface; in others rock is not reached until a depth of thirty or forty feet has been gained. The valley, too, has been filled with blue clay, brown clay, sand and gravel, by no means in regular sequence, often stratified, and all capped with a series of terraces, which reach the higher ground. However, to the writer's knowledge, no minute survey of the valley has been hitherto attempted; and it may be that if this were done, some of the facts above stated might be given more in detail. While, therefore, it were unsafe to speculate further, it may be stated that at present the region seems to indicate a former area of high elevation, and drainage by means of a river, the course of which greatly resembles that of the modern Sydenham, but the volume of which was vastly greater.

Apologising for digressing upon ancient river beds, let us take our journey southward, following the escarpment. Here a series of picturesque ravines and valleys meets us, some of which are due to water erosion, and the others to the action of sub-ærial causes upon the joints and fissures of the limestone. Referring particularly to the latter, it may be stated that large cracks and dangerous crevices have resulted, here separating areas of rock which sometimes exceed an acre, there tumbling down mass after mass of stone and boulder in inextricable confusion; in many cases too these crevices have in course of time become interesting ravines, steep-walled and moss-clad. Still, none of these rise to the dignity of true valleys, nor in fact does any one until we reach the Beaver river, which, plunging down a precipice of seventy-five feet at the Eugenia Falls, Artemesia Township, Grey County, has excavated for itself a beautiful fertile dale. The breadth of this valley is at its widest over three miles, and the length about eight. This valley, so far as examined, which examination has been but superficially done, appears quite modern in geological time. So far as known, the deposits upon its flood-plain are quite recent, and evidently have been derived from the highland above.

Traversing the highland in a general westerly direction at a distance of some twenty miles west from the above, and from ten to thirty miles south of the Sydenham, are the beautiful valleys of the

five or six streams of the Saugeen river. Of these one, the central or Big Saugeen, deserves especial notice, for its valley in some places exceeds a mile and-a-half to two miles in width and over a hundred feet in depth, its banks being ridges of stratified gravel. Here and there in its bed the rock reaches the surface; but while exposures are abundant on the more northern tributaries that flow through Durham and the Rocky Saugeen further north, as a rule these rock exposures are absent from the main stream, until Ayton is reached in Grey County and Walkerton in the adjacent County of Bruce. The valley of the branch in which Durham is situated is in like manner over two miles in width from mouth to mouth, and in depth over a hundred feet.

Returning to the escarpment's edge, the next valley of importance is that of the Credit in Caledon Township. This presents a great resemblance to the valley known as Glen Spencer, Dundas, but exceeds this both in breadth and depth. It is evidently a valley of erosion, the Credit having cut its way down through three hundred feet to the lower beds of the Medina rock, and in so doing formed a romantic fir and pine-clad glen of half a mile to a mile in width. From the fact that the superficial deposits seem, so far as noticed, to occur only sparingly, it would seem that in the Credit we have an ancient river, re-cutting its bed to a lower level.

The Grand River, with its tributaries, the Irvine, the Speed, and the Canestoga, presents picturesque valleys, especially the canyon of the Irvine at Elora, north of Guelph. There the river Irvine has excavated a narrow gorge to the depth of nearly a hundred feet in Guelph limestone, and from the fact that no recent deposits are found on the sides, one may infer that the gorge is of modern formation. Other picturesque valleys occur at various points along the line of the main stream, especially at Galt, where the ancient river-valley is plainly visible, and where the present diminished stream wanders through flats of its own making.

Again, coming eastward to the edge of the escarpment, the valleys of the Twelve and Sixteen Mile Creeks of Halton county are worthy of a brief notice. Deep and wide glens, wooded to their tops, visible from a long distance, both of lake and of land, break the uneven outline of the summit. Like the Sydenham, the Beaver and the Credit, too, the streams wander on through deep gorges cut far into the plains; that of the Sixteen Mile Creek being remarkable

for showing near its mouth at Oakville, the Loraine (or Lorraine) shales of the Hudson river group on the eastern side, and on the western, the red Medina shales and sandstones. Moreover, in the Twelve Mile Creek valley near Bronte Station, extends a bed of stratified gravel, now eroded, showing clearly the ancient character of the stream. This bed of gravel is about seventy-five feet thick, and is made up largely of Hudson River fragments.

Of similar formation are the gorges of the "Grindstone Creek," Waterdown, and "Glen Spencer," at Dundas—glens with steep, wooded sides, the former almost straight in its course, the latter much curved; glens carrying moreover upon these sides strips of stratified sand and gravel; glens of great breadth and depth.

Turning the escarpment at or east of Copetown, and continuing along the ridge to Niagara, we encounter a series of creeks, some larger, some smaller, which have cut their way down through Niagara, Clinton and Medina rock, and of course, through those overlying deposits known as the ancient Lake Beaches. They are known as the Albion Mills Creek, the Fifty, Forty, Thirty, Twenty, Sixteen, Fifteen and Eight Mile Creeks respectively. To these we must add sundry dried up torrent beds, which present similar features to the creeks; and these features are like those above referred to, namely—glens or canyons of large or of small size, cut into the rock, and winding, straight-walled valleys in the plain. From the sediment brought down by the Albion Mills Creek, Burlington Beach has been made; and at the mouth of each of the others, bars are being built of larger or of smaller volume, according to the usual conditions of more or less material, and the set of the Lake currents. Like the other creeks on the north side of the escarpment, too, the present streams exist in vastly diminished volume. Picturesque waterfalls, moreover, are another feature well marked in the still existing streams, while, in the dried-up water-courses, their action can be plainly noticed.

The canyon of Niagara, so well-known to all, and yet so sublime in its magnificent, ocean-like rapids, and its majestic sweep of water down the steep cliffs, should detain us for a moment. For here, before our eyes, we see the work of erosion and excavation going on; here we have the key to our lesser river-valleys, those excepted which have resulted from the slow-weathering of former joints and fissures. We must remember, too, that Niagara is, after all, a very

recent river; we must not forget the Post-Pliocene beds of Goat Island and of the river banks, through which this deep and dark stream has cut its way; we must not forget the former, now drift-filled, outlet from the present whirlpool to St. David's village.

But chiefly this magnificent mass of thundering water should recall to us the formation of, so far as known, the ancient valley of the escarpment, the valley at Hamilton. A valley diminishing in width from eight miles to one, and traceable, as has been most ably shown by Dr. J. W. Spencer, Director of the Geological Survey, Georgia, as far as Caledonia, thence southeastwardly to Lake Erie, thence across the present lake to Pennsylvania and to Western Virginia—such a valley as this makes Niagara dwindle into insignificance. What a landscape, too, of boiling rapids, tumultuous surges, mountain-like waves and noble falls this must have presented—a glorious spectacle, upon which no human eye ever gazed! Nor did the work of the waters end there, as the slopes and terraces at the bottom of Lake Ontario to-day bear witness. Yet this channel from Hamilton to Lake Erie is choked with drift, so that its very existence lay unknown till about ten years ago; upon the sand and the clay filling the channel, farming has been carried on for well nigh a century, and still goes on to-day.

With this scanty description of the valleys of the Niagara ridge, let us ascend to the summit, tracing these streams to their source; and in order to be more exact, let us consider the last described series of creeks first in order. Now when we ascend to the highland, we notice one or two features of importance; and of these the first is that the highest part of the escarpment is, in general, at or near the edge, that there is a general southwesterly slope, not exactly the same as the dip of the strata. Thus, while Queenston Heights is three hundred and sixty-seven feet above Lake Ontario, Buffalo, or Lake Erie, is but three hundred and twenty-seven feet; on the Welland railway, in like manner, there is a southerly slope of fifteen feet in the distance between Thorold and Port Colborne, and the brow of the escarpment at Hamilton is seventy-eight feet above Port Dover. True, in the last case, the "Summit," a short distance south of the escarpment, about five miles say, is about a hundred feet higher, and true it is that, between Jarvis and Hagersville, we have a slightly lower ridge; yet this does not lessen the value of the general statement, especially if we remember that the former-men-

tioned ridge is the summit of the Niagara limestone, and the latter a recent deposit of clay and sand. On the whole, it is perfectly safe to reckon a fall towards Lake Erie of fifty feet in twenty-five miles, or two feet to the mile southward, while the dip of the Niagara group is uniformly twenty-two feet to the mile. Moreover, throughout the greater part of this area, the underlying rock is conspicuous by absence, a few places near Buffalo, one near Hagersville, and one or two on the Grand River, affording the only known outcrops of Onondaga, Oriskany or Corniferous groups. This certainly points to an increase of sediment to the southward, as well as to an uplift making the escarpment the northern margin of the area now covered by South Lincoln, Welland, Monck, South Wentworth, and Haldimand counties, omitting for the present, counties lying further west. A second feature of interest is that ridges of clay or of sand cross this area from east to west or nearly so, between which lie stretches of marsh or swamp, in which these creeks take their rise, together with sundry other creeks now flowing southward. These marshy areas and sand and clay ridges point to a former northward extension of Lake Erie, of which, as has been already stated, the edge of the escarpment was the northern boundary. A third point of interest is that in no part of this area does the land rise higher than five hundred feet above Lake Ontario. The creeks referred to then, rise in a marshy area, cut off by sand and clay ridges from Lake Erie, and they have been thus compelled to take a northerly direction.

If we now similarly trace the creek running through Glen Spencer, and the Grindstone Creek, back to the summit, we shall find their sources in an immense rocky and stony swamp, known as the "Beverly Swamp," in which also rises Fairchild's Creek, flowing southwesterly through the extreme west of Wentworth and through North Brant to the Grand River. Moreover, the Twelve and the Sixteen Mile Creeks of Halton County may be traced to this same source. In this area, covering North Wentworth, part of Halton, part of Waterloo, and a small piece of South Wellington Counties, we find the same well-marked features as in the preceding, namely, the highest part of the surface at or near the the summit of the escarpment, and the slope greater than that of the strata; also a swampy area, diversified by ridges of stratified gravel, some stretching east and west, others north and south. As a contrast, however,

we have several lakelets remaining, although rapidly silting up; of these it is necessary only to mention Lake Medad, near Waterdown, and Puslinch Lake, east of Hespeler. Again, too, by way of contrast, this district attains an altitude varying from over five hundred feet to over seven hundred above Lake Ontario, thus showing us another more ancient extension of the present Lakes Erie and Huron.

Tracing the rivers of the first, the most northerly mentioned district to their sources, we find in the counties of Simcoe, Grey, Dufferin, North Wellington, North Perth and Bruce, the largest and most important area of all, possessing the same general characteristics—the highest part nearest the front of the escarpment, and a slope thence westward and northward; beautiful lakelets, bilberry and tamarack swamps, broken by ridges of stratified gravel, and fine, clear streams of pure water. Often the gravel ridges guide the course of the streams, suggesting as has been already remarked in the case of the Saugeen branches, a deep valley of erosion, a view dispelled by a more thorough examination. Often, too, where the land has been cleared and drained giving a fertile tract to the farmer, the view from one of these ridges is entrancing indeed. The cleared plain, through which the stream meanders, rolls away to the next distant ridge mayhap three, mayhap ten miles; here is a strip of uncleared swamp land, the home of the Linnea borealis and of the pitcher-plant, and the haunt of the white-throated sparrow and of the blue jay; there is one of the many charming, tree-embowered lakelets that dot the landscape of this northern area. Here as before we see the extension still further of the present great lakes, or rather in the great lakes we see the remnant of a once great fresh-water sea which covered the whole western peninsula of Ontario. Now, bearing in mind that the last described area has a mean elevation of eleven hundred feet above Lake Ontario, and that the proof of this having been once submerged is evident, let us state the full significance of this and briefly recapitulate the steps by which our river-valleys, so imperfectly described above, have originated.

A submergence which would place the summit of our western peninsula, Dundalk, Grey Co., seventeen hundred feet above the level of the sea, beneath the waves, would cover not only the whole of Ontario as far as the "Height of Land," or the Laurentides north of the Ottawa, but would submerge all Quebec except the monntains

of the eastern townships, the Gaspe peninsula and the north shore. The lower-lying parts of Vermont, the whole of middle and western New York, northern Pennyslvania, a great part of Ohio, Indiana, Missouri and Michigan, leaving out other more remote provinces and states, would be buried under the waters of a lake whose probable boundaries would be the Laurentides on the north, the Adirondacks, and including Lake Champlain, the Green Mountains on the east, the Catskills and other Appalachion chains on the south-east, certain north-facing escarpments in Ohio and Indiana to the north, and certain other escarpments of Wisconsin on the west. That such a submergence did take place has been ably shown by the researches of Dr. Spencer, who has placed the existence of the resulting lake beyond a doubt, and has named it in honor of the famous American geologist, Lake Warren. By a succession of differential uplifts to the north and the east, the three areas of Western Ontario mentioned in the preceeding paragraphs were up-heaved, leaving us when the St. Lawrence was lowered to its present level, our lake system as we understand it to-day. The movement of uplift was probably slow and gradual since we pass almost imperecptibly from area to area. Such area, too, is not of uniform level, the first varying from nine hundred to fourteen hundred feet in height above Lake Ontario, the second from five hundred to eight hundred, the third from three hundred and twenty to five hundred. As each area was separated from the great lake it became a subordinate sheet of fresh water ponded back by gravel ridges and by the escarpment; a body of water from which issued in greater volume than at present the streams which have carved out the river-valleys above described. As time went on the silting up of these bodies of water caused the formation of marshes and swamps, and the isolation of the lakelets before mentioned; in other words, each became in turn from a noble sheet of water, a tract of bog and swamp, with lakelets dotting the surface here and there. Finally, man appeared on the scene, and by stripping the country of forest and draining the land, reduced the volume of the streams to their present size.

There remain two questions to be answered. The first is that since the escarpment front offers the highest barrier to these swamps, why the creeks described have forced their way through the rock, rather than through the gravel ridges. The answer to this is

that the escarpment face is not an artificially-made, uniform wall, but a natural slope of more or less strength, thickness, hardness, etc., and therefore more susceptible to weathering in some parts than in others. It will be found, on examination, that the streams have invariably broken through weaker parts of their boundary, especially where they are traversed by faults, joints, etc. The second is the date, geologically speaking, at which this inland fresh water sea existed, from which the present system was evolved. With the small amount of information that we at present have, and in the present imperfect state of our knowledge of recent formations, we can only state definitely the later Post-Pliocene as the period when, by the series of uplifts, this lake was formed, and by the help of more of these, it was finally dismembered and drained.