

## GEOGRAPHY AND GEOLOGY OF KELLEY'S ISLAND

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### HISTORY

After the turn of the nineteenth century, a few whites began to visit Kelley's Island for the purpose of trading, but at the outbreak of the war of 1812, they were driven away by the menacing attitude of the hostile Indians. General Harrison, then commanding the Army of the Northwest, stationed a guard on the west shore for the purpose of reconnoitering the movements of the British and Indians on the lake. The squadron of Commodore Perry lay for a time in the harbor south of the island, prior to its history-making engagement with the British north of Put-in-Bay. The successful outcome of the Battle of Lake Erie forced the Indians to flee the Island region. "Cunningham's Island," as it was originally known, after its first white trader (1803), did not become permanently settled until after 1833, when Irad and Datus Kelley acquired title to the whole island. For a hundred years, it has been called Kelley's Island.

Evidences of former Indian occupation are numerous. There are remains of earthworks on the Huntington property, inclosing an area of nearly seven acres. Most noted of all is Inscription Rock, which formerly bore deeply engraved pictographs on its glacially-smoothed surface. The wear of sightseers feet and the zeal of initial carvers has for the last decade rendered the inscriptions illegible. Inscription Rock measures approximately thirty feet long, twenty-one feet wide, stands ten feet above the water and is located at the water's edge of the south shore near Lay Bros. dock, where it has been separated by wave action from the main island mass of Columbus limestone. This famous Indian relic was discovered by Charles Olmstead, of Connecticut, in the year 1833, while on the island studying the glacial grooves. Its symbols were later authoritatively interpreted as depicting the occupation of this region by the Eries, the coming of the Wyandots, the final triumph of the Iroquois, and the flight of the Eries, who gave the lake its name.

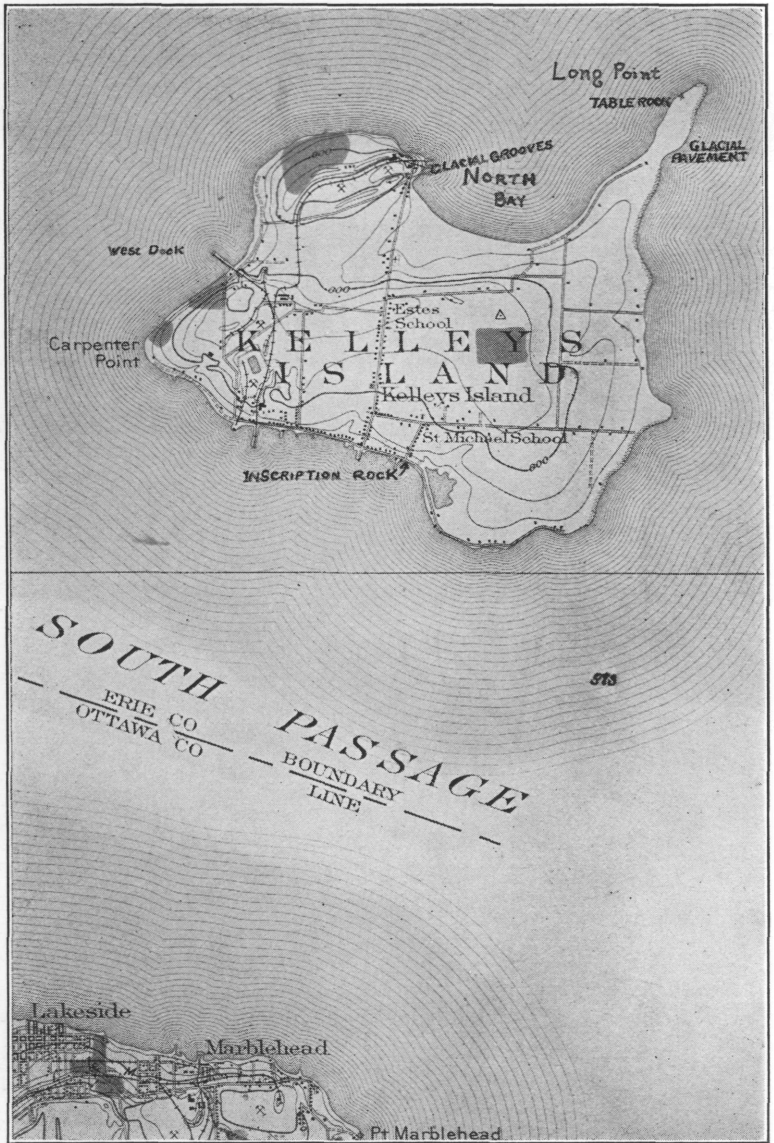


FIG. 1. Map of Kelley's Island

## GENERAL DISCUSSION

This picturesque island lies three and one-half miles off the mainland of Marblehead on the Ottawa peninsula and nine miles directly north of the city of Sandusky. It is second in size to Pelee Island and the largest of the islands in Lake Erie, belonging to the United States. The island is widely known for its extensive limestone quarries and the glacial grooves on the promontory near the west shore of North Bay.

In outline, Kelley's Island may be readily described as possessing a marked resemblance to the continent of Australia (Fig. 1). Eighteen miles of predominantly rocky shoreline surrounds the twenty-eight hundred and eighty-eight acres of the island. A cobble-stone beach is characteristic but numerous other types of shoreline lend variety and beauty.

The west shore, and the south shore as far east as Inscription Rock, is a cliff generally six to seven feet high, fronted by a beach made up of limestone cobbles of various sizes. Nor far east of Inscription Rock there is a good example of a bay-mouth bar, on the crest of which the south shore road has been constructed. From this point eastward and along the east shore to within half a mile of the end of Long Point, the beach is composed of limestone cobbles with occasionally a few erratics; from this beach the island rises gently to the interior. The remaining portion of the east shore of Long Point is rocky, but without high cliffs or loose stone.

The east slope of Kelley's Island is a gradual rise from Lake Erie, the result of exposure to the full force of the southwestward moving ice mass, whereas, the lee slopes not exposed to the ice action are bordered by bold cliffs. The best illustration of this process is that of Long Point. The west shore is an almost continuous line of cliffs ten feet in height that have been protected from much of the direct force of the ice and increased in sharpness by the breaking off of huge blocks by weathering and wave action along the joints. The main joints trend N. 30° E. and are generally parallel to the shore. Table Rock is an example of a moderately sized block that has been separated from the mainland by wave erosion along joints; it has been undermined by wave action to such an extent that it is almost ready to topple into the lake.

The shore of North Bay, from a point south of the "L" in "Long Point" to the North Side quarry docks, is a stretch

approximately a mile in length, of the only sand beach on the island, except for a short stretch north of the West stone-loading dock. The northwest shore is bordered by bluffs that are the highest on the island.

#### PHYSIOGRAPHIC AND GLACIAL HISTORY

During Pliocene time, before the advance of the glaciers of the Pleistocene, Kelley's Island was a part of the mainland. The shallow depression now occupied by Lake Erie was the location of a large eastward-flowing trunk stream into which flowed tributaries from the north and south. The islands of Lake Erie, including Kelley's, were then the higher portions of the divides between the streams. The glaciers that later advanced over this section from the north and east scooped out the residual material in the stream valleys and to some extent added to the excavations that had been produced by the erosive force of the streams. The passages among the islands were finally created when Lake Erie arrived at its present level of 573 feet A. T. Because the Pliocene tributaries flowed generally northeast into the trunk stream and because the direction of dominant glaciation was from that general direction, the total effect of these two factors has been to produce the present-day, parallel, island passages that trend N. 80° E.

After the final withdrawal of the Wisconsin Ice Sheet, a lake was impounded between the glacier front to the north and the watershed on the south. As the ice-front melted to the northeast, lower outlets were uncovered causing the level of the lake to drop rapidly to the elevation of the new exits. During the successive stages of Lake Erie, known as, Lake Maumee, Lake Whittlesey, and Lake Warren, Kelley's Island remained submerged. During the Lake Lundy stage, a rectangular island of about one-third the size of the present one appeared above the surface of the cold, glacial waters. The shore of this island is evident at various places, especially prominent a short distance north of Estes School, at an elevation of 610 feet A. T. Here are abandoned, water-worn cliffs seven to eight feet high, now partially overgrown with scrub growth, but yet conspicuous and bearing adequate testimony to the fact that the Lake Lundy stage must have been of long duration to have enabled the waters to nip out these prominent cliffs in the limestone rock of the island. Near Carpenter

Point and at other locations on the island this ancient shore-line may be observed at an elevation of thirty-seven feet above the present lake level.

The next lowering of the level of Lake Erie resulted in the emergence of the western end of the lake and the confinement of the water in the eastern half of the basin. This was the final stage in the shrinkage of the post-glacial lake. Since the removal of the ice from the area of eastern Canada, the land has gradually risen and tilted the Great Lakes to the southwest. The rise of the water level in western Lake Erie has produced estuaries at the mouths of the Maumee, Portage and Sandusky Rivers, the good harbors at Toledo, Port Clinton and Sandusky. If the present rate of tilting continues, Kelley's Island will probably remain an island for perhaps the next twenty-five hundred years, after which Niagara Falls may cease to be and the Great Lakes drain into the Mississippi River by way of the Illinois River and by way of the Maumee, Wabash and Ohio Rivers.

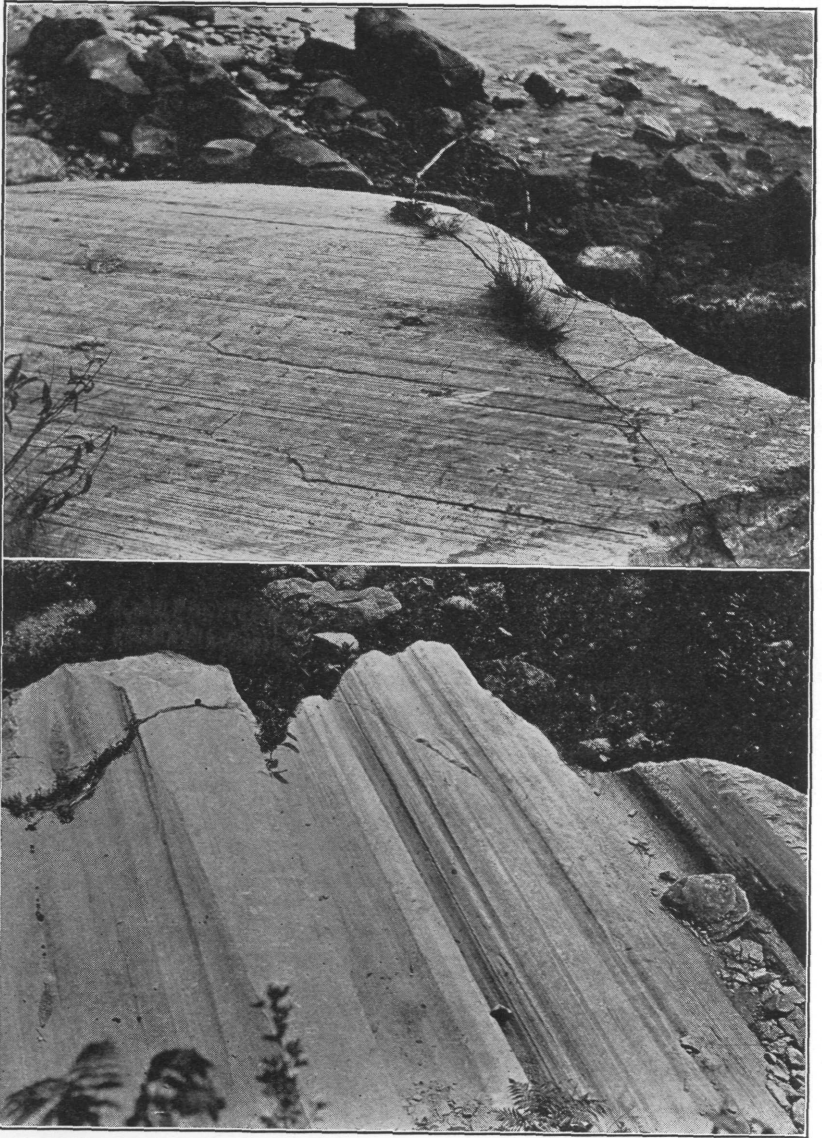
Professor E. L. Moseley, of the Bowling Green State Normal College<sup>1</sup> made a thorough study of the island region and arrived at the conclusion that the rise of the water for at least the last four centuries has continued with a nearly uniform rate of about two and one-seventh feet (2.14) a century. If this rate has been uniform, according to Moseley, approximately a thousand years ago the Indians may have walked from Sandusky to Kelley's Island at any season, it being necessary to swim across only one or two streams and wade through some marsh.

Glaciation has been the dominant factor in the physiographic history of Kelley's Island and evidence of its presence is everywhere conspicuous. The islands in western Lake Erie present some of the most marked indications of glacial erosion anywhere to be found in the United States. The grooves gouged by the glaciers on the rocky shores were noticed by the first settlers of Kelley's Island (Fig. 2) and new grooves are continually being uncovered during the course of removing soil for the extension of quarrying operations.

The prominence of glacial markings is due to the fact that the soft shales to the east offered little resistance to the glacier, but the harder limestones of the Cincinnati arch were a difficult barrier to the progress of the Erie lobe. The deepest grooves

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<sup>1</sup>Moseley, E. L. "Formation of Sandusky Bay and Cedar Point," Ohio State Academy of Science, Vol. IV, Part V.



- FIG. 2. (Upper.) Glaciated limestone pavement located on Long Point in the northeast portion of the island. Cross-sections of colonial corals, two to three feet in diameter, are exposed here.
- FIG. 3. (Lower.) Kelley's Island glacial grooves, located at the old North Side Quarry, on the west shore of North Bay. This region is now a state park.

are found on the higher elevations of the island which were naturally more exposed to the leveling action of the ice.

Nearly all of these magnificent glacial grooves have fallen prey to the economic activity of man, and only near the north-west shore of the island may the huge gouges be seen today (Fig. 3). Here the State of Ohio has created (1931) a state park to preserve them for posterity. Unfortunately, the impress of the initial and name-chiseling vandal is too evident on the surface of these invaluable glacial carvings; since they became state property, additional names have been chiseled deeply into the grooves and further destroyed their beauty.

The Kelley's Island Glacial Grooves are located at the terminus of a line of bluffs overlooking North Bay and may easily be reached, from the steamboat dock at the foot of Division Street, by continuing northward across the island to the west shore of North Bay. The grooves are located at the edge of the old North Side quarry and were set aside by Mr. Younglove, former president of the Kelley Island Lime and Transport Company. A part of one of these grooves was acquired by the Western Reserve Historical Society of Cleveland and another portion may be seen in the National Museum at Washington, D. C. National interest in these grooves was first aroused by an excursion of the American Association for the Advancement of Science, while meeting in Cleveland, Ohio, in 1888. It is an inspiring geological phenomena—like so many Corinthian columns lying side by side. They constitute a convex surface that dips slightly ( $1^{\circ}$  S.  $80^{\circ}$  W. under four feet of overlying glacial till. Six distinct columns may be distinguished, but no two have the same size or degree of curvature. The largest is at the crest of the arched surface and is shaped somewhat like the modern steel or concrete burial vault; its crest is about five feet above the lowest groove. Chatter marks are very distinct. The columns are not all mathematically symmetrical, but in a few cases branch out or disappear. Occasionally some obstruction forced the tools of the glacier to deviate and scratch a shallow furrow at an angle to the parallel striae.

It is believed that the location of the grooves was originally the site of a small depression formed by preglacial water action, into which the ice crowded the granitic material which constituted the grooving-tool; the rasping, scratching, scraping and polishing went on concurrently and in increasing degree until

this enormous series of furrows resulted. Most of the Kelley Island grooves are straight, but some have been discovered by removal of the local till that are greatly curved and indicate the influence of preglacial or subglacial water action. There can be no doubt that there has been considerable erosion by direct action of ice, but the presence of cross-striae should warn the

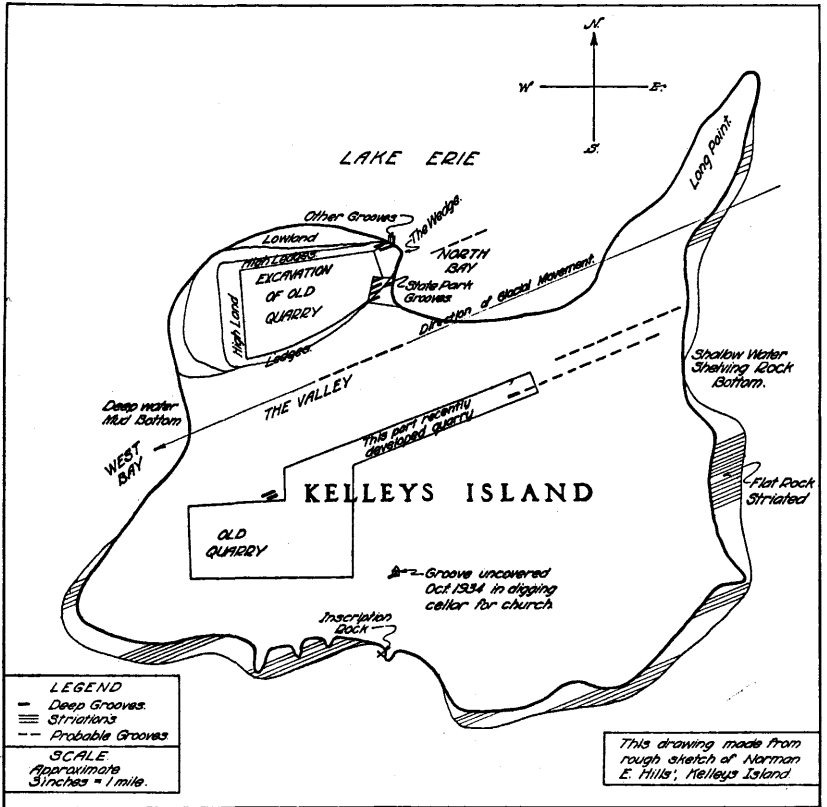


FIG. 4. Kelley's Island

geologist that the power of glacial ice to gouge out solid limestone must not be too strongly emphasized.

Four distinct, successive movements of glaciers, during the Pleistocene, are recorded by the direction of striae on the basement rock of Kelley's Island. Ice was first confined to the Lake Erie valley, but did not extend above and over the summit of the watershed to the south and consequently the lobe was



forced to move to the southwest, scooping out channels between the islands. The thickness of the ice was probably no greater than nine hundred and fifty feet. During the height of the glacial period the ice became thicker, extended over the divide of the watershed and moved from north to south, because the Illinois lobe then blocked the natural southwest outlet. The general southwest movement was resumed on the retreat of the ice front to the Lake Erie watershed and the withdrawal of the Illinois glacial lobe which blocked its path on the southwest. The markings of the previous north-south movement were obliterated on all eastward sloping rock surfaces, but on the lee side the north-south marks were protected. There was a feeble repetition of the north-south movement when the watershed no longer compelled a westerly movement. The evidence is faint, because the movement was not long continued.

On the east shore of Long Point opposite the end of the road, there is a glacial pavement of remarkable smoothness with shallow grooves plainly discernible, trending in the direction of S. 80° W. The width of this pavement varies from approximately one hundred and fifty to three hundred feet along the lake shore and is about five acres in area. The extent of the glacially-smoothed rock surface under the water of the lake is at least four times the area above water. The recency of the glacial period is strikingly shown by the sharpness of the chatter marks in the shallow grooves. This is remarkable when one considers the fierceness of the "northeasters" that beat upon this exposed shore. Nowhere on the island are there so many huge glacial erratics as lie here on the glacial pavement; many are four and five feet in diameter. Numerous and huge as are the erratics, the vast level sweep of the glacial pavement is hardly broken.

#### STRUCTURE AND LITHOLOGY

Kelley's Island is composed of the Columbus limestone of Middle Devonian age which is underlain by the Monroe limestone of the Upper Silurian. Since the highest elevation on the island is forty-eight feet above Lake Erie and the upper two feet of the Monroe is exposed below lake level in the quarries, all but the upper ten feet of the Columbus occurs on the island. This marks the most northerly outcrop of the formation in Ohio; here about sixty feet thick. The crest of the Cincinnati arch or geanticline is located about twenty miles

to the west and bends northeast across Lake Erie into Ontario. This is evident from the slight southeastward inclination of the Columbus strata; the dip is not noticeable in the sides of the quarries, but at the end of Long Point a local steepening is perceptible to the eye. The dip was found to be  $6^{\circ}$ , S.  $40^{\circ}$  E.

The North Side quarry is the oldest and deepest; there was an early demand for the massive grayish-brown limestone of the "bottom rock" used in breakwaters and other massive structures. An excellent view of the quarry may be obtained from the Glacial Grooves. The quarry section is readily divided into two parts, upper and lower. The upper part is a thin-bedded, fossiliferous, gray to bluish-gray limestone, about twenty feet thick which is slightly more massive toward the bottom. The lower part begins with the "bottom rock" stratum, a massive layer of brownish-gray limestone from seven to eight feet thick. The strata continues to be massive and more fossiliferous to the floor of the quarry, and is generally brown to grayish-brown with some chert layers of minor importance. The lower part of the Columbus limestone is about thirty-two feet thick which makes the total thickness of this formation in the quarry approximately fifty-two feet. One foot of the Monroe limestone has been penetrated and the important Middle Devonian-Silurian unconformity may be readily determined by the sharp faunal break, even though the Columbus and Monroe limestones are disconformable and appear to be one formation.<sup>2</sup>

The rapid falling off in demand for building stone and the increasing demand of crushed stone for lime, flux and road building has made it more economical to quarry only the thin-bedded upper part and some of the "bottom rock" of the Columbus. As a result almost the whole top of the island is being removed from west to east; the average depth of the vast quarry is twenty-five feet. The well-marked bedding planes and numerous joints make the upper part of the Columbus limestone easy to quarry. The abundance of cracks and joints may have been in part the result of subsequent uplifts of the Cincinnati arch; the majority of the vertical planes trend parallel to the axis of the arch which in this part of Ohio is in a direction of N.  $30^{\circ}$  E. The upper part of the Columbus is a very pure limestone and therefore valuable for

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<sup>2</sup>C. R. Stauffer. "The Middle Devonian of Ohio," Geological Survey of Ohio, Fourth Series, Bulletin 10, p. 137.

use as lime and flux. Analyses disclose increasing proportions of magnesium carbonate and decreasing proportions of calcium carbonate from the top to the bottom. In the upper beds the amount of  $\text{CaCO}_3$  is as high as 97% and the amount of  $\text{MgCO}_3$  is as low as 2%, whereas the lower massive beds run as low as 78%  $\text{CaCO}_3$  and as high as 20%  $\text{MgCO}_3$ . Alumina, iron oxide and silica make up the remaining 2%.

The Columbus limestone of Kelley's Island is very fossiliferous; corals are especially numerous. The most conspicuous are the huge colonial corals which occur in colonies from three to six feet in diameter. Excellent transverse sections of the corallites are exposed on the glaciated surfaces of the island. Individual horn corals may be easily found, of these are: *Cystiphyllum Ohioense*, *Zaphrentis Wortheni* and *Zaphrentis Edwardsi*.<sup>3</sup> The Middle Devonian is noted for the huge fishes that swam in its seas and their fossilized remains are frequently found; the most important that have been recovered are the jaws of the *Onychodus*, which are a foot long and studded with sharp pointed teeth.

#### ECONOMIC

The Labradorian Glacier scraped all the residual soil from the rocky surface of Kelley's Island and deposited a shallow cover of glacial till that was thinned further by the waves of the shrinking Lake Erie. Over much of the area, grass barely clings to an inch or two of soil; nowhere is the island surface more than two and a half feet above solid rock. Such a thin covering of earth is difficult to cultivate and is more suitable for the growing of vineyards and fruit trees, especially so, since the soil is well charged with lime derived from the disintegration of the underlying rock. The success of grape culture also has been dependent on the equable lake climate that is notably free from late spring and early autumn frosts.

The cedar forests that originally covered the entire island were among the first sources of revenue for the early dwellers. So abundant was this beautiful wood that it supplied building material and fuel. The "Walk-in-the-Water," the first steamer to ply the waters of Lake Erie (1818), was supplied with fuel by the red cedar of Kelley's Island; this ship was wrecked in 1820 in a storm. The red cedar forests rapidly disappeared

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<sup>3</sup>Geological Survey of Ohio, Second Series, Vol. II.

before the woodman's ax and today only a few trees are found scattered on the bluffs. The primeval forest was composed also of white oak on the high land, maples, hickory and hackberry on the lower and more level surface, and sycamore on the low marshy ground near the shore of North Bay. Only six acres were cleared in 1833.

Vines of the wild grape were abundant and large. The first cultivated variety was set out in 1842 from cuttings brought from Rockport, New York, but it was not until 1854 that there was a large increase in acreage. Some Germans who had come from the wine districts of the old world found employment on the island and realized its favorable climatic and soil conditions. The price of land then rose rapidly from fifty dollars to as high as one hundred and twenty-five dollars per acre. Grape rot did not appear until 1862 and for eighteen years no frosts harmed the grape crop. The wine industry increased until after the World War when the storage capacity of the Kelley's Island wine cellars was more than half a million gallons.

The residents derive considerable income from the summer tourists who are attracted by the fishing and quiet of the island. Commercial fishing is an important economic activity during the Spring and Fall. Fish abound on the nearby shoals and are caught in such quantities that the island region ranks high in the fresh water fish industry of the United States. The fish are brought to the island docks from where they are collected and transported to the large wholesale houses in Sandusky for shipment mainly to Chicago and New York markets.

Quarrying is the leading industry of Kelley's Island. Limestone was first quarried in 1833 on the north side and the first shipment was made from a pier on North Bay in the following year. Quarrying is easy and economical, because the loose, thin layer of soil may be rapidly removed from above the limestone. Quarries were later developed on the south and west sides, but today the north and south loading-docks are abandoned and all stone is dumped into freighters and barges from a modern elevated pier on the west shore. Much stone, well adapted for building purposes, was formerly sold, but this use has largely been abandoned and now all the limestone is crushed and sent to Cleveland, Buffalo and Gary for flux or to Duluth to be burned into lime. The Kelley Island Lime and Transport Company formerly burned lime on the island

and at Sandusky, until it was found to be more economical to burn the stone near the markets or the source of fuel supply. At one time sixteen lime kilns operated near the North Bay docks at a capacity of sixteen hundred barrels of lime per day. Cooperage shops were maintained at the time. The population of Kelley's Island during this period of great activity was more than a thousand, but has since decreased to six hundred and thirty-eight, according to the 1930 census. The new modern use for crushed stone in the manufacture of cement, tile and building blocks and the repeal of prohibition are new factors that will tend to aid the economic situation of Kelley's Island.

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