CAVES IN THE LAKE ERIE ISLANDS

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The origin and historical background of the South Bass Island caves have placed them among the most interesting and controversial caves known. The first available information on the caves was by Newberry (1874) when he described the surface of the island as having depressions: "... which are nothing else than caves of which the roofs have fallen in ..."

Mosely (1898) and Gilbert (1898) recorded that the water found in the caves fluctuates with the lake level, Newberry recorded this fact for Perry's cave. Although Newberry speculated as to how the caves were formed, he did not leave the impression that they were of the solution type. While most of the caves common to the limestone and dolomite bedrock of Ohio are of the familiar solution type, the caves of the Islands are apparently due to collapse. It remained for Kraus (1905) to give the first theory on the formation of the caves. Kraus theorized and Cottingham (1919) agreed that the caves were produced by the expansion of anhydrite into gypsum upon coming into contact with the water. Later White (1926) doubted Kraus' theory of formation because of the lack of gypsum in the Put-in-Bay dolomite. Langlois (1951) reviewed the historical background of some of the caves and described several new ones.

THEORY OF FORMATION OF THE CAVES

The caves on Put-in-Bay are usually crescent shaped and sloping approximately 30 degrees with the surface of the ground. In some caves, as Victory cave, the slope may be as great as 60°. One cave, Perry's, has not completely collapsed and is oval shaped. The sides, however, dip down and away from the center of the dome showing that partial collapse has taken place. Kraus' theory of anhydrite into gypsum is not invalidated by White. White rightly questioned the source of gypsum to produce the caverns, as none is found in the Put-in-Bay dolomite. The Tymochtee shaly dolomite which underlies the Put-in-Bay outcrops on the west shore of South Bass Island, some thirty feet from the top of the exposed Put-in-Bay (Carmen, 1947). Newberry (1874) states that anchors of vessels in the South Channel frequently drag up masses of gypsum from the lake bottom. Kraus also mentioned that gypsum was found in alternate layers at a depth of 100 feet on the southwest part of the island. The formation of the caves is not due to the gypsum in the Put-in-Bay, but in the Tymochtee.

The tilting of the rock strata during the upheaval of the Cincinnati anticline caused the bedrock to be weakened and jointed (Cook, 1925). The weakening and jointing of the bed rock provided easy access for water to come in contact with the anhydrite. Earlier reports of cave water oscillating with the lake level were confirmed by means of a portable water level recorder placed in Kindt's I cave. The cave water lags about three hours behind the lake oscillation. Water samples were taken and compared to the lake water and to deep wells on the island. The total alkalinity of the cave water has doubled when it is compared to lake water, but only half that of the three wells tested. The seepage of lake water is not direct into the caves, but through well filtered rock layers (table 1).

Water seepage into the anhydrite lenses could be from three possible sources: rain, pre-glacial rivers, or lake water. With the jointing of the rock layers during the Cincinnati anticline it is possible that enough rain water could have been

filtered through to reach the anhydrite lense. This theory is doubted because evidence shows that only the upper portions of the known caves are wet and the lower sections are fairly dry. The travertine is also much thicker in the upper portions of the caves as compared to the deeper parts. Pre-glacial rivers were known to exist in the island regions and could have supplied ample water or water...
could have been supplied from lakes formed during the glacial period. The fact
that several caves have large stalactites several feet under the surface of the water
may well indicate that the caves were formed when the water was at a much lower
level, possible during interglacial periods. According to Mosely (1898) this indi-
cated that the islands were sinking, he computed the rate at eight to nine inches
per century. It may be both. The hydration of the anhydrite into gypsum
produced the doming of the overlying strata (figure 2). According to Kraus the
expansion of anhydrite to gypsum is between 33 to 63 percent. This increase in

### TABLE 1

<table>
<thead>
<tr>
<th>Water Source</th>
<th>Total Alkalinity (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kindt's cave I.</td>
<td>180</td>
</tr>
<tr>
<td>Lake Water</td>
<td>80-90</td>
</tr>
<tr>
<td>Wells (3 tested)</td>
<td>270-360</td>
</tr>
</tbody>
</table>

volume, calculated at one ton per square inch for the lower figure, produced an
elliptical dome. The force exerted by the expansion probably produced the
doming of the Put-in-Bay dolomite which is so noticeable on the island. The
gypsum was then dissolved and carried away in solution leaving a large subterranean
cave (figure 3). The collapse of the dome into the original cavern, figure 4, left
crescent shaped caves at the edges. The collapse or faulting of the dome may have
been from rain water weakening the joints with some solution taking place or

### TABLE 2

<table>
<thead>
<tr>
<th>Cave</th>
<th>Approximate Diameter in feet</th>
<th>Estimated Height of Dome in feet</th>
<th>Depression Below Rim in feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kindt's (3 caves)</td>
<td>300 x 250</td>
<td>12-13</td>
<td>6</td>
</tr>
<tr>
<td>Zur's (3 caves)</td>
<td>650 x 400</td>
<td>14-15</td>
<td>7</td>
</tr>
<tr>
<td>Cedar Forest (1 cave)</td>
<td>200 x 200</td>
<td>14-15</td>
<td>7</td>
</tr>
<tr>
<td>Cedar Forest (3 caves)</td>
<td>75 x 200</td>
<td>18</td>
<td>9</td>
</tr>
<tr>
<td>Brown's (3 caves)</td>
<td>200 x 200</td>
<td>18</td>
<td>9</td>
</tr>
<tr>
<td>Duff's (2 caves)</td>
<td>75 x 150</td>
<td>16</td>
<td>8</td>
</tr>
<tr>
<td>Coil's (1 cave)</td>
<td>75 x 100</td>
<td>10-11</td>
<td>5</td>
</tr>
<tr>
<td>Perry's (in existence)</td>
<td>165 x 200</td>
<td>9</td>
<td>—</td>
</tr>
</tbody>
</table>

from the sheer weight of the overlying strata already weakened by the expansion.
Unsupported arches of 60°, as in Victory cave, are extremely weak and the rocks
are fractured. If the caves were formed pre-glacially the weight of the ice sheet
could have produced the collapse of all the domes. The fact that Perry's cave has
not fallen in tends to disprove the theory. It is possible that some of the caves
were formed during the post-glacial periods. It appears, however, that most of
the present caves are very young.

The caves on South Bass Island are not part of the original cavern but the
edges of the collapsed sections, having water at the lower portions. The presence
of elliptical depressions with crescent shaped caves at the edges indicates that
there was a dome which had caved in. The estimated height and size of the original dome as deduced from surface features is shown in table 2.

At present there are over 30 known caves of the Put-in-Bay type which have or formerly had openings. Surface indications show that there are again that many yet to be opened. Victory cave was recently opened, after being sealed for almost 20 years, by Mr. A. Kindt and son Eugene. One cave on Green Island, discovered by Mr. Wm. Coil in 1951, is definitely of the Put-in-Bay type. The cave has very little travertine, and the floor is fairly flat. The roof slopes the same as the other caves, and it is the typical crescent shaped cave. Coil’s cave does not have water, and it appears to be very close to the top of the Tymochtee. The roof of the cave appears to be freshly fractured and does not have stalactites.

On the mainland two caves appear to be of this type, Crystal rock cave and Brewery cave, both in the Put-in-Bay dolomite and first described by White (1926). White mentions that there are other 'sink holes' in the area which may indicate the presence of more caves nearby.

Three caves are open to the public on South Bass Island, Mammoth, Crystal, and Perry’s cave. Mammoth cave, formerly called Daussa’s was called Danssa’s by Kraus. This cave has its dome collapsed but most of the outer edge is passable, making it one of the largest caves on the island. Opposite Mammoth cave is Crystal cave, an extremely large celestite geode, which has crystals measuring 18 inches long. A small, flat floored, cave exists several feet below the present floor of the cave. According to White the cave was discovered in 1891 and was only three feet in height. Over five tons of crystal were removed from the floor and
sold for the manufacture of fireworks, and the floor was then deepened to permit standing room. Undoubtedly the deepening of the floor opened up the lower cave. There appears to be little doubt that Crystal cave is one of the largest geodes known to exist. Perry's cave is the only opened cave on the island where the dome has not completely collapsed. The cavern is oval shaped and the floor and roof meet at the edges. With the single exception of Crystal cave, all the other caves are of the Put-in-Bay type. No caves have been found on the other islands except for Green Island. The other islands do not show surface indications of caverns being present. The Tymochtee shaly dolomite is well over 100 feet from the surface and if caves do exist they would be far underground. On Kelley's Island the Tymochtee is over 350 feet from the surface.

Flora and fauna of the caves appears to be very scant, perhaps due to the lack of intensive biological research in the caves. Many spiders and crickets are found near the entrances and three caves are known to be inhabited by the Little Brown Bat (Myotis i. lucifugus), Coil's cave on Green Island had one and Duff's I cave and Victory cave has a nest of over 50. The bats found during the winter of 1953 were predominately males. Bats have been reported from Mammoth cave, but are now kept out. Mr. L. Carrick found animal life in the water of one of the caves which was identified as a Collembolan by Dr. N. W. Britt. Dr. Britt suggested that it may have fallen into the water and thus would be an accidental find.

SUMMARY

1. Kraus's theory of anhydrite into gypsum appears to be correct. The source of the gypsum, however, is in the Tymochtee shaly dolomite which underlies the Put-in-Bay dolomite.
2. Water seepage from the lake is not direct but well filtered. The water in the caves lags about three hours behind the primary lake oscilliation.
3. Surface features of elliptical depressions with caves at the edges shows that collapse has taken place. From these depressions the size of the former caves has been estimated.
4. Flora and fauna of the caves appears to be very scant, the Little Brown Bat, spiders, crickets and one Collembolan make up the major part of the fauna.

LITERATURE CITED

Langlois, T. H. 1951. The caves on South Bass Island. Inland Seas, Summer.