POST-GLACIAL LIFE OF WILMETTE BAY, GLACIAL LAKE CHICAGO.

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About two years ago the writer[1] announced the discovery of certain strata west of Bowmanville, Chicago, which quite fully revealed the faunas as well as the history of Glacial Lake Chicago. During 1910 a complete biological and stratigraphical survey was made throughout the length of the drainage canal (over eight miles) and sixty-three separate sections were made, besides several hundred additional examinations between these section stations. The information obtained in a measure corroborates the statements set forth in the preliminary announcement. It also makes it evident that several statements made therein need some modification. The deposits referred to represent the floor of Glacial Lake Chicago and the variation in these strata quite vividly reflect the changes which took place from the time the glacial waters first appeared until the formation of the present Lake Michigan. As the general history of the great lakes is so well known, it will not be referred to here.[2]

The interpretation of these deposits, viewed in the light of later and more extensive information, may be outlined as follows: Above the bowlder clay or till there is a bed of sand from two to twelve inches in thickness (Fig. 1). This represents the Glenwood stage of Lake Chicago and no life is present, as would be expected. During the Glenwood stage the lake stood at from fifty to sixty feet above the present level of Lake Michigan. This places the shore line between the 630-640 foot contour lines. It

[1]Science, n. s., XXXI, No. 801, May, 1910, p. 715.

[2]See the following works where the history is very fully worked out:

The Geography of Chicago and Its Environs, by Rollin D. Salisbury and W. C. Alden. Bull. Geog. Soc., Chicago, No. 1, 1899.

Geological Atlas of the United States, Chicago Folio, No. 81, by W. C. Alden, 1902.

Physical Geography of the Evanston-Waukegan Region, by W. W. Atwood and J. W. Goldthwait, Bull. 7, Ill. State Geol. Survey, 1908. The Pleistocene Features and Deposits of the Chicago Area, by Frank Leverett, Chi. Acad. Sci., Bull. II, Geol. & Nat. Hist. Surv., 1897.

is probable that the sand found in the canal, which is 4½ miles east of the Glenwood shore line, was deposited just previous to the first low water stage, as a bed of sand of this thickness would scarcely form in fifty to sixty feet of water nearly five miles off shore.

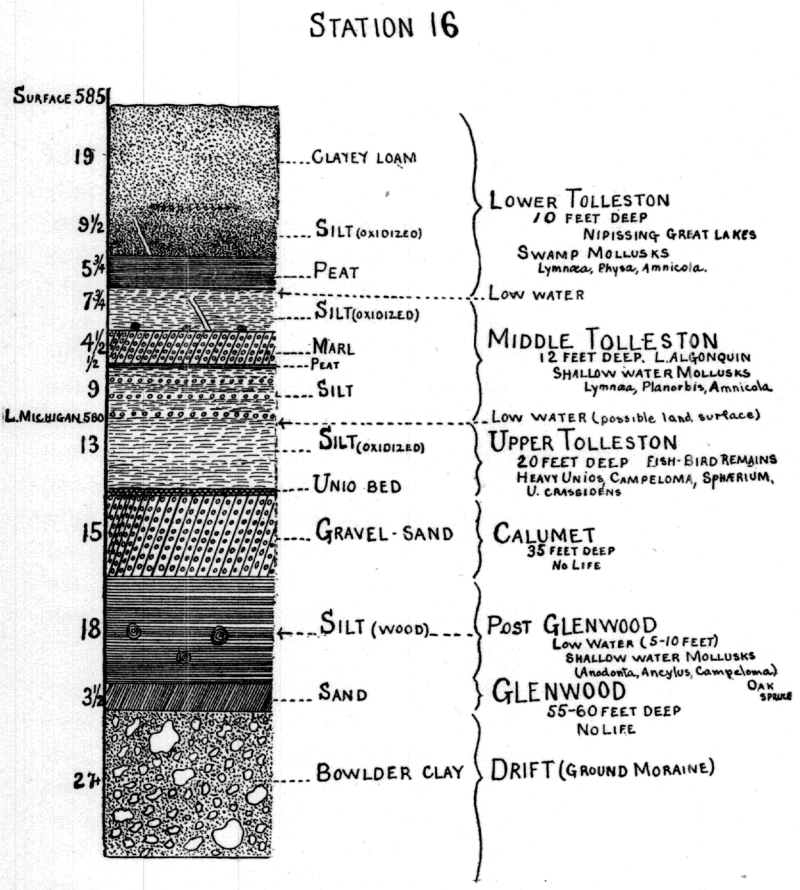

Figure 1. Section through post-glacial fluviatile deposits of Wilmette Bay, Glacial Lake Chicago.

Above the sand deposit occurs a bed of silt ten to eighteen inches in thickness. This deposit is filled with molluscan remains of species which live in shallow water usually not exceeding ten feet in depth. The following species are represented by thousands of individuals, showing that life was notably abundant:

Anodonta grandis.
Pisidium (several species).
Sphaerium simile.
Goniobasis livescens.
Amnicola lustrica.
Amnicola limosa.
Valvata tricarinata.
Campeloma integrum.
Ancylus sp.
Physa ancillaria warreniana.
Planorbis trivolvis.
Planorbis campanulatus.
Planorbis bicarinatus.
Planorbis deflectus.
Lymnaea stagnalis appressa.
Galba reflexa.

The presence of this life in a silt deposit, overlying a sand deposit, is conclusive evidence that the early statement of Dr. Andrews[3] concerning a post-Glenwood low-water stage was correct, although this is questioned by Dr. Goldthwait in a recent paper in which this deposit is referred to the Calumet period.[4]

That this stage was one of very low water is apparently proven by the fact that these shell deposits do not extend far beyond the 585 foot contour or about a mile and a half north of Foster Avenue. As the leaves of an oak and the cones and wood of a spruce are also found in these strata, it would seem that this deposit represents mainly shallow ponds formed, possibly, in large kettle holes in the ground moraine. The ground moraine at this point, as seen in cross sections, is strikingly undulating, forming depressions from six to ten feet in depth, and of a sufficient size to form a pond of good area. It is interesting to note that at Lemont a bed of silt with shells is encountered overlying the Niagara limestone, which may represent this stage. It is overlaid by six feet of carbonaceous soil and peat containing mollusks. As both deposits contain the same genera and nearly the same species, it seems evident that the fauna near Foster Avenue migrated thence by way of the Des Plaines outlet.

It must be borne in mind that during the several advances of the ice all life was either exterminated within the englaciated area, or was driven south of the ice border. Consequently, a return of life to the country left by the receding ice sheet could only be from the south. The aquatic life could return only by way of the natural waterways provided by the glacial streams issuing from the ice-bound lakes. The oak (*Quercus marceyana*) and the spruce (*Picea evanstoni = canadensis?*) probably grew on the higher ground. The latter does not at the present time grow within about one hundred miles of this locality. The spruce cones are notably abundant in deposits near Devon Avenue.

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[3]Trans. Chi. Acad. Sci., II, pp. 1-24, 1877; Leverett, Bull. Geol. Surv. Chi. Acad. Sci., II, p. 71, 1897; Alden, Chicago Folio (81) p. 9, 1902.

[4]Bull. 7, Ill. Geol. Surv., p. 61, 1908.

Following the post-Glenwood stage, the water again rose and flooded the area above the 610 foot contour. This is marked by a heavy deposit of sand and gravel of an average depth of a foot (2-19 inches). It was at this time that the Rose Hill bar was formed. It seems evident that if the entire length of this bar was formed at the 615 foot level it was constructed largely under water as this depth of water (thirty-five feet) would submerge the greater part of the bar from five to fifteen feet. It seems more probable that the greater part of this bar south of North Evanston was largely formed during the Upper Tolleston stage, at which time a beach ridge was formed on the submerged off shore barrier, which was doubtless built up to a considerable size during the Calumet stage. Resting on the Calumet gravels is a large bed of Unios and other mollusks comprising the following species:

Unio crassidens.
Unio gibbosus.
Obliquaria reflexa.
Plagiola elegans.
Lampsilis ventricosa.
Sphærium stamineum.
Amnicola letsoni.
Amnicola limosa.
Goniobasis livescens.
Quadrula trigona.
Quadrula pustulosa.
Quadrula undulata.
Quadrula verrucosa.
Quadrula lachrymosa.
Quadrula coccinea paupercula.
Campeloma integrum.
Pisidium (several species).

These mollusks evidently lived during the Upper Tolleston stage when the water had fallen to a depth of twenty to twenty-five feet and flooded everything below the 600 foot contour. At this time the area behind the Rose Hill bar was a large bay seven miles long, from one to 2½ miles in width and from five to twenty feet in depth, except near the shore, where it doubtless formed an extensive marsh. The beach ridge called the Rose Hill bar was probably built up during this stage, as was also a part of the Graceland barrier and beach, extending from Rose Hill cemetery to Lincoln Park. Above the Unios follows a deposit of silt about a foot in depth which contains the remains of a bird (humerus of a duck) and the bones of several species of fish. This deposit is highly oxidized and probably was a land surface recording the low water stage preceding Lake Algonquin. The presence of fish remains in these deposits clearly indicates the means by which the Unios were brought to Wilmette Bay from the populated regions south of the Valparaiso moraine.

Above this stage occur deposits aggregating twenty-two inches in thickness, composed of silt, peat and marl beds, containing such mollusks as

Lampsilis luteola.
Sphærium striatinum.
Sphærium rhomboideum.
Pisidium (several species).
Campeloma integrum.
Goniobasis livescens.
Valvata tricarinata.
Amnicola limosa.
Physa ancillaria warreniana.
Physa integra.
Planorbis trivolvis.
Planorbis campanulatus.
Planorbis bicarinatus.
Lymnaea stagnalis appressa.
Galba reflexa.

The marl deposit is nearly five inches in thickness and is a solid mass of shells. These deposits probably represent the Middle Tolleston stage, which corresponds with the Lake Algonquin stage of the Great Lakes. At this time Wilmette Bay was three miles long, a mile wide and five to twelve feet in depth behind the Rose Hill bar. It extended, however, five miles south of this bar and was protected from Lake Michigan by the Graceland bar, upon which Clark Street is constructed, which rose above the lake nearly ten feet. This bay south of Foster Avenue was five miles long and about one mile wide, with a depth of water of five to twelve feet. The shallowness of the bay is attested by the presence of *Potamogeton* and *Chara,* plants which live in comparatively shallow water. The Middle Tolleston lake bed above the 590 foot contour was an extensive marsh nearly three miles long and over a mile wide, in which the following mollusks lived abundantly:

Succinea ovalis.
Succinea avara.
Physa gyrina.
Planorbis trivolvis.
Segmentina armigera.
Galba caperata.
Galba reflexa.
Calyculina securis.

The upper deposit of the Middle Tolleston is oxidized and contains the burrows of crayfish, indicating that this deposit was for a time a land surface. Above this land surface occurs a deposit of peat over five inches in thickness overlaid by twenty-eight inches of silt. This doubtless represents the Nepissing Great Lakes and the Lower Tolleston stage. The water is believed to have been from three to ten feet in depth and the area flooded was probably nearly equal to that of the Middle Tolleston.[5] The life of this stage was the same as that of the Middle Tolleston. Following this stage the lake fell to its present level.

The interpretation of these deposits is not in accord with that of Dr. Goldthwait,[6] who places the peat and silt beds found beneath the Rose Hill bar in the period previous to the Upper Tolleston

[5]Goldthwait, Bull. 7, Ill. Geol. Surv., p. 64; Bull. 11, p. 56, p. 81; Bull. Wis. Geol. & Nat. Hist. Surv., XVII, p. 6, 7, et. seq.

[6]Bull. Wis. Geol. & Nat. Hist. Surv. XVII, p. 4; also Bulls. 7 and 11, Ill. Geol. Surv.

gravels. The evidence offered by the study of the canal section seems to point to the conclusion that the post-Glenwood and pre-Calumet interpretation is correct, since the whole history of Wilmette Bay corroborates it. The strata near Evanston which underlie the Rose Hill Bar contain no evidences of life (excepting the remains of wood) and probably represent a land surface (Goldthwait, Bull. 7, Ill. Geol. Surv., p. 65) bordering a swamp.

It has been stated by several writers[7] that at the time of the post-Glenwood deposits a climate and flora existed similar to that of Alaska. The presence of the spruce (*Picea evanstoni* or *canadensis*), which does not now grow within about one hundred miles, seems to afford ample evidence of a colder climate.

The presence of *Unio crassidens* in the Upper Tolleston deposits is of great interest. This has been thought[8] to indicate a warmer climate than now prevails, especially in view of the fact that the species has also been found in deposits near Green Bay.[9] It may be, however, that this is a case in which the mollusk was not able to adapt itself to a new environment and so became extinct so far as these regions are concerned. The Green Bay fauna evidently followed the Wisconsin River-Lake Nicolet route. The northern limit of this species at present is as follows:

	South of Green Bay Record.
Wisconsin, between Prairie du Chien and De Soto[10]	80 miles
Minnesota, not recorded.	
Iowa, Lansing[11]	80 miles
Michigan, not recorded.	
Illinois, Utica, La Salle County[12]	220 miles
Ohio, Scioto River[13]	260 miles
Indiana, Tippecanoe River[14]	230 miles

Of the other species represented in this deposit, all are now living in the Chicago area excepting *Amnicola letsoni*,[15] which was first discovered in the gravel deposits of Goat Island, Niagara Falls.[16] *Quadrula coccinea* is also quite different from the usual form as found in northern Illinois and appears to be the same as the variety *paupercula* of Simpson. As the species enumerated as having been found in the Upper Tolleston deposit also live as

[7]For example, Higley and Raddin, Bull. Chi. Acad. Sci., II, No. 1, p. XIV.
[8]Science, n. s., XXXI, p. 716.
[9]Wagner, Nautilus, XVIII, pp. 97-100, 1905.
[10]Chadwick, Bull. Wis. Nat. Hist. Soc., IV, p. 95, 1906.
[11]Museum record.
[12]Baker, Bull. Ill. State Lab. N. H., VII, p. 77, 1906.
[13]Sterki, Proc. Ohio Acad. Sci., IV, p. 392, 1907.
[14]Daniels, 27th An. Rep. Dept. Geol. Ind., p. 650, 1902.
[15]Bull. Buf. Soc. N. Sci., VII, No. 1, p. 241, fig. 165.
[16]This species has since been found living by Mr. Bryant Walker.

far south as Texas and as far north as southern Wisconsin and southern Michigan, it is perhaps unwarranted to infer that because of the presence of *Unio crassidens* there was a warmer climate at this time, yet this seems not at all improbable in view of the Green Bay record.

It is interesting to note that the interglacial beds of the Don Valley near Toronto, Canada, contain several of the species which occur in the Chicago deposits. As these are mostly Mississippi Valley species they must have reached this point by way of the southwest and they possibly migrated through an ancient waterway near the present site of Chicago. For comparison, the Unios of the two regions are placed in parallel columns.[17]

DON.	CHICAGO.
undulatus.	*undulatus.*
rectus.	.....
luteolus.	*luteolus.*
gibbosus.	*gibbosus.*
phaseolus.	.....
trigonus.	*trigonus.*
coccineus.	*coccineus.*
occidens.	.....
solidus.	.....
clavus.	.....
pyramidatus.	.....
.....	*crassidens.*
.....	*reflexa.*
.....	*elegans.*
.....	*ventricosus.*
.....	*pustulosus.*
.....	*lachrymosus.*

It will be noted that but five species are common to both deposits, while six species are found in the Don beds which are absent from the Chicago beds, and six species found in the Chicago beds are absent from the Don beds. The Don deposits are believed to have been laid down in a comparatively warm climate, as indicated by both the plants and animals.

It is important that post-glacial deposits on both the east and the west shores of Lake Michigan should be carefully studied and their biologic contents accurately noted, to the end that these facts may be correlated with those herein presented. Sedimentary deposits are known to exist at Green Bay and at Milwaukee, and these should contain ample evidence of post-glacial life. Studies now in progress in other parts of the Chicago Lake basin are expected to add much evidence confirmatory of the interpretation herein presented.

[17]See Coleman, Interglacial Periods in Canada, p. 16, 1906.

SUMMARY.

The study of the strata deposited in post-glacial Wilmette Bay has led to the following conclusions:

1. There was but slight deposition during the GLENWOOD STAGE and no life.

2. A POST-GLENWOOD LOW-WATER STAGE ensued in which the level of the lake dropped to about the 590 foot contour, the water being from five to ten feet in depth. There was a rich and abundant fauna of mollusks, and the neighboring shore supported a vigorous growth of spruce and oak.

3. The lake level rose to the 610-620 foot contours (CALUMET STAGE), flooding the silt deposits and burying them under a heavy deposit of sand and gravel. The Rose Hill bar was extended from the shore near Wilmette, southward below North Evanston, as a huge bar, the southern portion forming a submerged reef. No life present. Wilmette Bay was at this stage an open bay from five to thirty feet in depth, protected on the north by the Rose Hill bar and on the east by the submerged reef, rapidly forming.

4. The water fell to about the 600 foot contour (UPPER TOLLESTON STAGE), the Rose Hill bar extended southward and was built up on the reef formed during the Calumet stage. The beach ridge, upon which Graceland cemetery is located, was probably formed during this stage, first as a submerged reef, and later as a beach ridge. A rich fauna at this time migrated up the Des Plaines River and formed the heavy Unio beds which are found on the surface of the Calumet gravels. This bay was nearly ten miles long, two to three miles wide and from five to twenty feet deep.

5. A low water stage followed the Upper Tolleston. This is indicated by the oxidized character of the deposit overlying the Unio bed.

6. During the next stage, which may be called the MIDDLE TOLLESTON, the water level again rose to a point somewhat above the 590 foot contour, forming a shallow bay about three miles long, one mile wide and five to twelve feet deep. A rich fauna and flora of swamp and shallow water mollusks and plants developed in this bay, forming deposits aggregating twenty inches in thickness. This stage forms part of LAKE ALGONQUIN.

7. A third low water stage followed the Middle Tolleston. Evidences of this are seen in the oxidized character of the stratum

overlying the Middle Tolleston marl beds and also in the presence of crawfish burrows.

8. Following the low-water stage the water again rose and flooded the bay to the depth of ten feet, producing an embayment nearly equal in area to that of the Middle Tolleston stage. This (LOWER TOLLESTON), the last of the Lake Chicago stages, was characterized by an abundant fauna consisting of swamp and shallow water types. This stage must have been of considerable duration as silt was deposited to a depth of over two feet.

9. The water fell to the level of Lake Michigan and the bed of Wilmette Bay became a marsh, wet during the spring and dry in the fall. This condition prevailed until the region was drained by man during the past century.

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