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The Schmidt Site: A Geologic Report

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THE SCHMIDT SITE - A GEOLOGIC REPORT

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INTRODUCTION

The Schmidt Site (20 SA 192) is located in Saginaw County, south of the Cass River and just east of the Grand Trunk Railroad in the NE 1/4, sec. 19, T 11 N, R 4 E, of the Bridgeport Township (figs. 1, 2, 3). The area is a remnant of a glacial lake bottom. There is very little local relief. Higher elevation exists to the north that is called the Port Huron Moraine and to the southeast, the Juniata, Owosso and Flint Moraines. All of these systems are associated with the last advance of ice, namely the Valders Advance (fig. 1). The area has been cultivated for some time. The major crops are corn and pickles (cucumbers). There are few places that contain stabilized vegetation. This fact coupled with the flat terrain allow the westerly winds to transport much of the soil during the plowing seasons.

A geologic interpretation was conducted at this site to see if we could reconstruct the environment at the time of human occupation. From sediment analysis we could interpret the physical processes operating within the area at the time the grains were deposited. Physical processes are indicative of certain environments. If we could add this physical evidence to the technological, fauna, and flora remains uncovered, then a more accurate reconstruction of the environment could be depicted. With use of all this data the environment could be pinpointed within the glacial sequence, thereby obtaining a relative date for occupation. This date would help establish the sequence of Michigan's initial occupation. It could also give some insight as to the origin of these people and their migration routes.

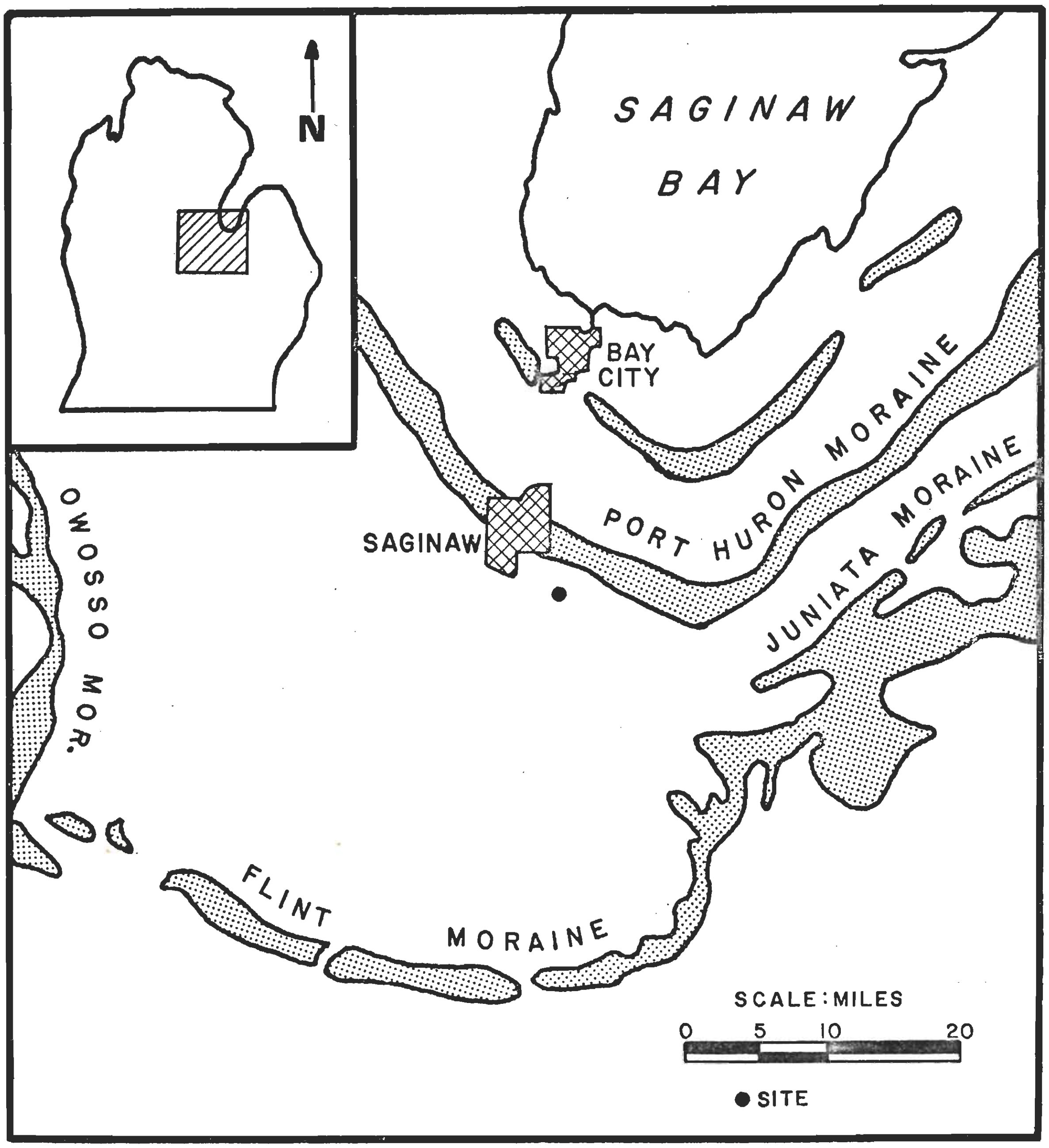

Figure 1. Moraines deposited in the Saginaw Basin area during Wisconson glaciation (Leverett and Taylor, 1915).

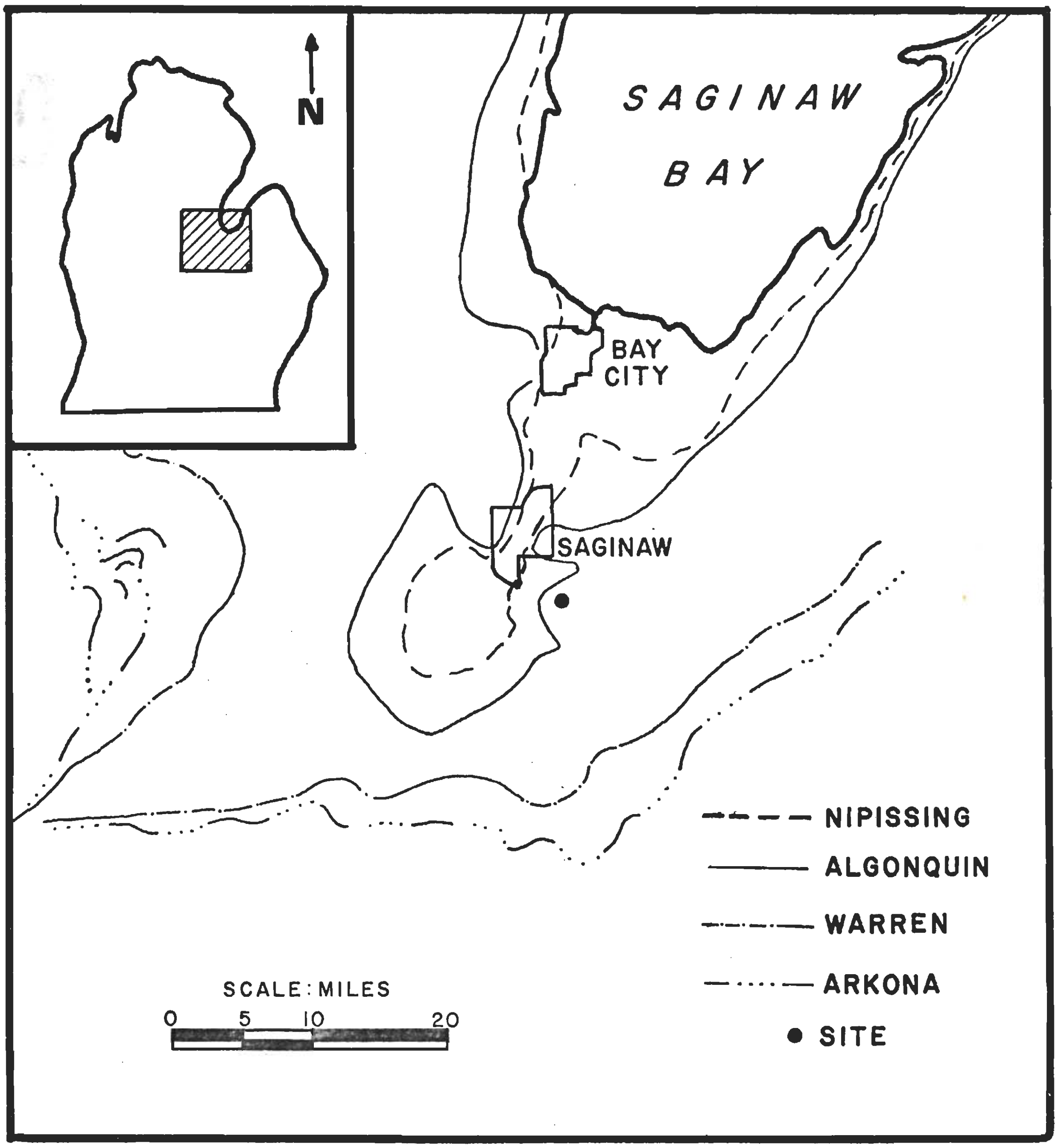

Figure 2. Ancient shorelines reconstructed for sequense of glacial lakes (Leverett and Taylor, 1915).

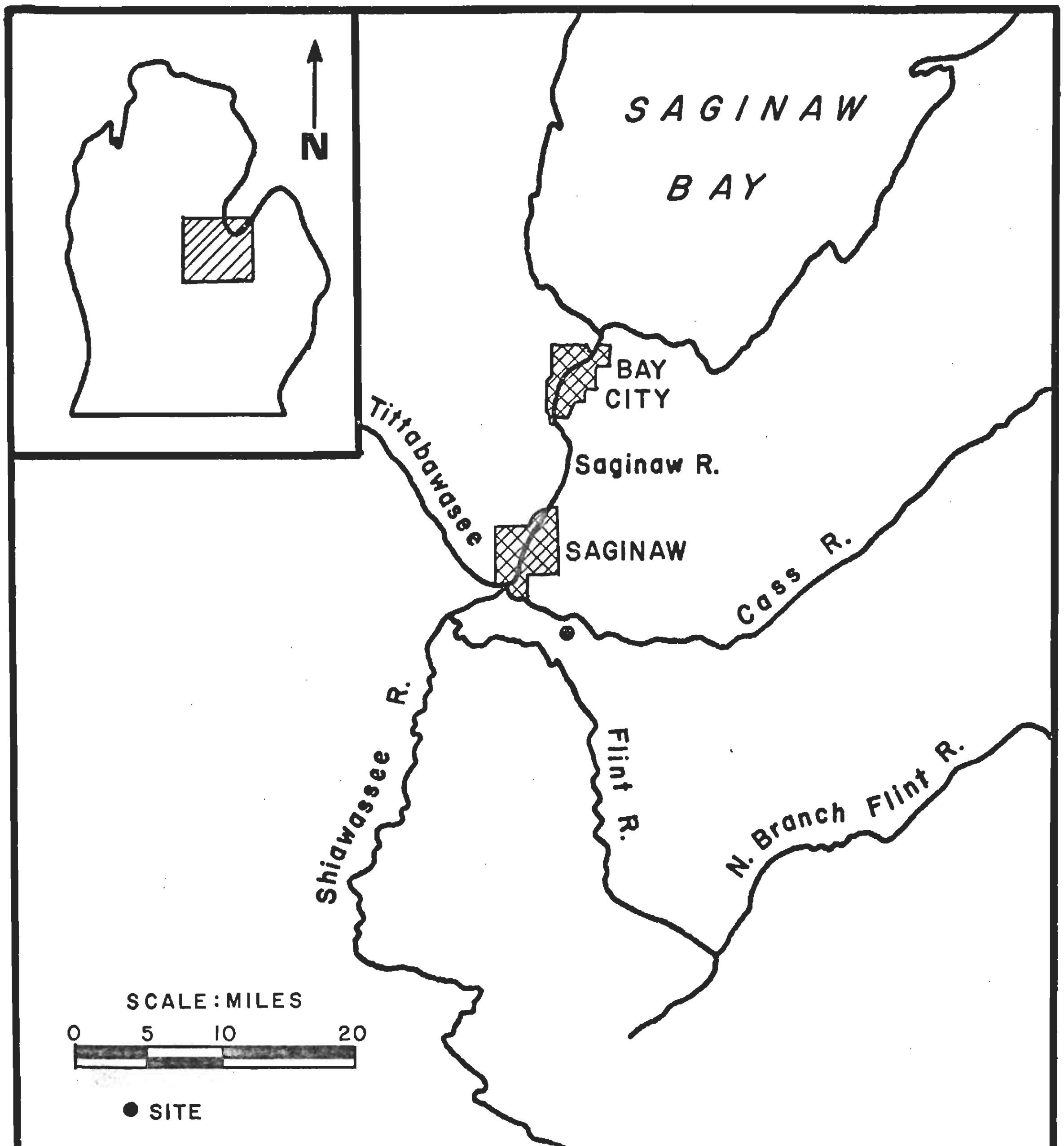

Figure 3. Present drainage of rivers contained in the Saginaw Basin (Leverett and Taylor, 1915).

GLACIAL HISTORY

A survey of the regional glacial history is necessary for understanding the varying environments and pinpointing the occupation intervals. According to Leverett and Taylor (1915), Hough (1958), and Hough (1963), about 14,000 B.P. the Saginaw Area was covered by a huge sheet of ice named the Cary Advance. As this ice sheet began retreating across Michigan, Lake Maumee formed in the present Lake Erie basin and Lake Chicago in the Lake Michigan Basin. Lake Maumee drained across Michigan along what is now the Grand River and emptied into Lake Chicago. It, in turn, flowed south through the Chicago outlet to the Mississippe River. With a retreat of the ice a new lake formed in the Erie-Huron Basin that extended into the Saginaw Valley lowland (Shiawasse Bay). This lake, called Arkona, was subsequently subjected to fluctuating elevations because of downcutting that was occurring in the Grand River outlet (Table 1).

The Port Huron advance (about 13,000 B.P.) stabilized Lake Saginaw in Saginaw Bay at an elevation of 695'. Once again, with wastage occurring in the drainage outlet across the Thumb, the lake level began to drop. This fact coupled with the opening of the outlets to the east, brought the water in the bay through the early Lake Algonquin I stage (elevation of 605'), to the Lake Kirkfield level at 565'. This was a lower water stage than present Lake Huron and it coincided with what is called the Two Creek interval at 11,850 B.P. This warm period produced spruce, pine, and birch forests in Wisconsin and presumably Michigan. But the good weather was not to last long, for at 11,500 B.P. the ice readvanced to the Valders Maximum. Ice blockage of the lake outlets caused the water to

DATE	GLACIAL EVENT	LAKE NAME	ELEVATION	DRAINAGE OUTLET
recent		Huron	580'	St. Clair River
3,000		Algoma	595'	St. Clair River
4,000		Nipissing	605'	St. Clair River and North Bay
9,500		Stanley	190'	North Bay
		Post Algonquin Upper Group		Various - to Ontario Basin
11,500	Valders Maximum	Algonquin	605'	St. Clair River
11,850	Two Creek (warming)	Kirkfield	565'	Drained eastward from a northern outlet (Trenton Lowland)
		Early Algonquin through various stages	605' 680to 605'	Across Mackinaw to Lake Michigan Basin and out Chicago Outlet
		Warren	690'	Grand River
13,000	Port Huron Mankato	Saginaw	695'	Grand River
	Valparaiso Morraine	ice.		

Table 1 The glacial sequence of the Saginaw Bay area taken from Dorr and Eschman (1970, p.167).

rise and, in the Saginaw area, it again reached an elevation of 605', thus producing Lake Algonquin II. Again there was downcutting in the various Ontario Basin outlets bringing water in the Huron Basin down to a new low of 190' (Lake Stanley). At this level the drainage changed to flow out of the North Bay channel eastward across what is presently Canada to rejoin the St. Lawrence. At this time glacial ice had disappeared from Michigan. The North Bay outlet was produced because the newly uncovered land was at a lower elevation due to the weight of the ice. After this time (9,500 B.P.) all elevation fluctuations were due to the changes in drainage outlets. These changes were caused by erosion of glacial sediment and by isostatic rebound of the land. At 4,000 B.P. the Huron Basin's outlets allowed the lake to rise to an elevation of 605' and Lake Nipissing occupied the Saginaw area. The North Bay outlet had rebounded above the water level, the Chicago outlet had cut down to resistant bedrock and only the St. Clair River outlet drained these three Great Lakes. With continued drops in elevation, caused by erosion of the new outlet, the lake reached modern Lake Huron at an elevation of 580'.

To sum up the rather confusing sequence of lake levels: The Great Lakes have been subjected to periodic rise and fall. There was water at 695', was lowered, returned to 605'; lowered, ice invaded, water returned to 605' at 11,000 B.P.; slowly dropped to a low 190' at 9,500 B.P.; only to rise again to 605' 4,000 B.P.; since then it has steadily gone down to the present level of Lake Huron at 580'.

PRESENT TOPOGRAPHY OF THE AREA

The Saginaw area was at one time a lake bottom. This is expressed by topography that is relatively flat. The featureless plains are interrupted by ridges that represent sediment associated with the fluctuating shorelines of glacial lakes. The Schmidt Site is located on one of these ridges (fig. 2) which is continuous over a wide area and encircles the ancient Shiawasse Bay (fig. 4). This bay was filled with a shallow, swampy lake at various times during the transitions of the glacial lakes that occupied the Huron Basin.

Problems of interpretation

The topography of the area is difficult to reconstruct for glacial times because it has been altered by the meandering Cass River and aeolian erosion since the 1800's when it was lumbered and farmed. When the sediment is plowed much of it is released for transport by aeolian processes. Fences running north-south catch the sand transported by the west wind. The fences may eventually be buried and the ridge may then become a dominant topographic feature. One such ridge runs through the Schmidt Site and caused the plow zone to be extremely thick in areas of the excavation. This ridge is labeled "fence" in the upper right corner of the topographic map (fig. 5).

The second post-glacial feature at the site is the Cass River which flooded frequently in the last few years. Flooding has caused deposition of muds and sand in the lower elevations adjacent to the river channel. The channel has also been subjected to changing positions because the Cass River has large migrating meanders. The present channel can be viewed in the far upper right

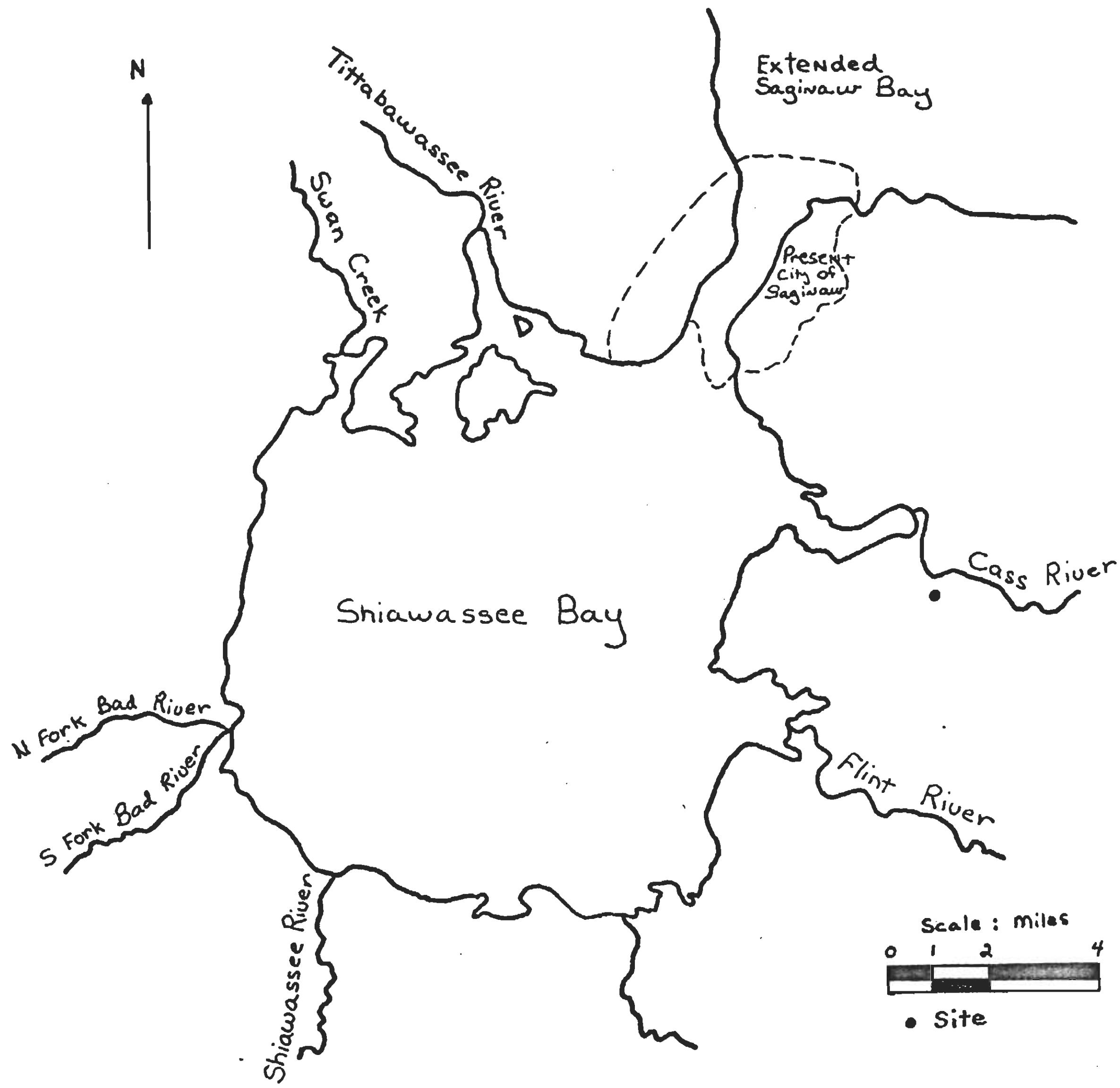

Figure 4. The Shiawassee Bay during Algoma Stage (3,000 B.P.) of the Great Lakes. The elevation is reconstructed at 595' (Fitting, 1970, p. 71).

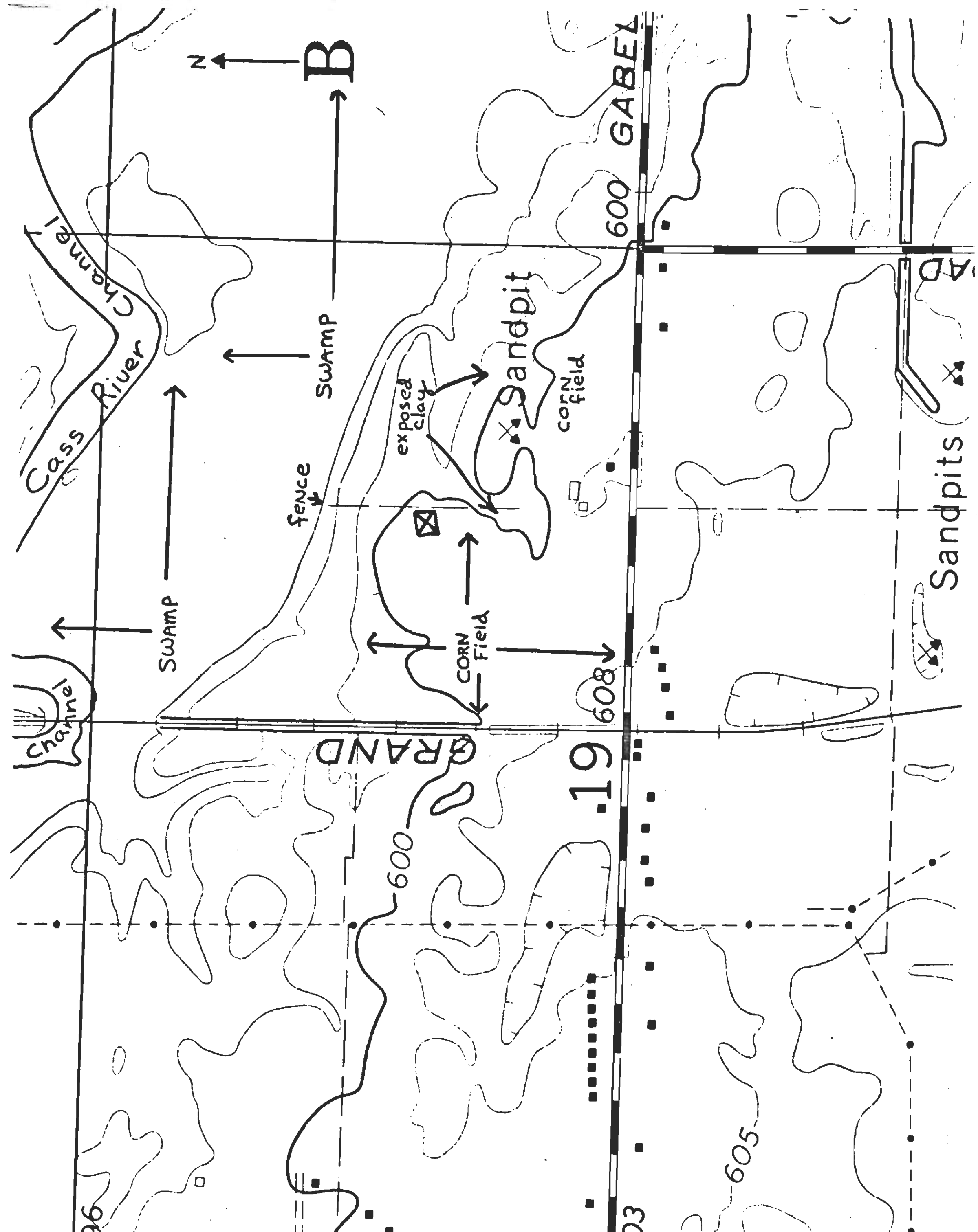

Figure 5. Topographic map of area directly adjacent to site. One mile blowup of NE¼, sec. 19 T 11N, R 4E, Bridgeport Township, Saginaw County, Michigan.

corner of the topographic map where it is labeled Cass River (fig. 5).

Description

The present topography of the Schmidt Site (fig. 5) can still be useful when interpreting glacial environments and landscapes if the previously mentioned effects are kept in mind. The Schmidt Site is located on a high point bordered on the north, northeast, and northwest by the floodplain of the Cass River. This floodplain consists of swamps and dense vegetation growing in a clay-rich soil. To the southeast there is a bottle-neck-shaped extension of lower elevation also underlain by exposed clay-rich substrate. To the southwest there is a gentle rise underlain by sand similar to that which is found at the Schmidt Site. Straight south at a greater distance there is also an increase in elevation. If the ridge associated with the Schmidt Site is followed, it curves to the north and west forming a semicircle. This ridge is the shoreline of Lake Algonquin of 10,000 B.P., and/or Lake Nippissing of 4,000 B.P. (fig. 2, and 4). F. Leverette has reconstructed the two beaches as being separate. But both are reported at a 605' elevation and therefore are difficult to decifer.

THE ARCHIAC PERIOD

The culture at the Schmidt Site belongs to the cultural subdivision termed Archiac. Categorations of any type are abstractions formed for the purpose of classification. They are based on numerous tool assemblages and other archeological artifacts associated with sites from the same age. The culture of the Archiac people of Michigan can be characterized by the time of occupation, subsistence pattern, technology, or a combination of these factors.

The Archiac is dated by Griffin (1964, p. 225) at 10,000 B. P. to 3,000 B. P. for the northeastern area of North America. Fitting believes (1970, p. 64) that this date encompasses Paleo-Indian sites and therefore is too early.

Another way of defining the period is by the peoples subsistence pattern. Griffin (1964, p. 252), Ritchie (1965, pp. 31-36), and Willey (1966, p. 250-266) all emphasize the shift from pliestocene climate and big game hunting to the hunting, gathering and fishing of the local fauna. This faunal assemblage includes deer, small game, fish, fowl, wild tubers, fruits, nuts, and berries.

Technology is described by Fitting (1970, p. 65) to be the most indicative way of defining the Archiac people. The assemblage consists of notched, stemmed, and shouldered projectile points. The appearance of these point types on Paleo-Indian sites, (categorized by fluted points), indicates to Fitting that these people might have been living in Michigan contemporaneously during the transition period from Paleo-Indian to Archiac.

However one wishes to define the Archiac, the material retrieved in Michigan reflects the introduction of a hunting, gathering, and fishing economy that was adapted to the regional variations in deciduous forest-ravine environments. Subsistence appears to have been sufficiently easy for the Archiac people that time was available for the development of craft skills. Beautifully polished and carved bannerstones reflect aesthetic dimensions in the Archiac way of life. Semi-sedentary existence led to construction of shelters of some type, thus implying larger concentrations of people living together and specialization of occupation in the social system. So throughout the period we see an increase in technology, a turn to semi-sedentary subsistance, and the first evidence of religious practices.

THE SCHMIDT SITE

The site was excavated over a four week period in July and August of 1973, by the Western Michigan University archeological field school conducted by Dr. Elizabeth Baldwin, under the field supervision of Jerry Fairchild. The site was discovered by Fairchild in 1964, and he assisted the University of Michigan in the Schmidt Site excavation of the same year.

Previous Interpretation

In the report written by Harrison, (1966), Crumley (1966), Allison (1966), and Cleland and Kearney (1966), the technology, geology, flora, and fauna, of the Schmidt Site has been reviewed. Harrison recovered two types of projectile points, a Lamoka-like "Dustin Complex" that was first named in this area by Binford and Papworth (1963, p. 105). They described Dustin points as comparable to the Lamoka tool complex in New York which has been dated at 4500 B.P. Ritchie (1961, p. 29-30), who first described Lamoka, accepts the Dustin association but he dates the Michigan complex as later in time. The second type of point found at the Schmidt Site was the Laurentian-like complex which is also found in New York. This broad-bladed form is found stratigraphically below Dustin points at the Schmidt Site, while in New York the opposite is true. In the Annis Shell Mound of Kentucky Laurintian-like points are found throughout the levels, while Dustin is concentrated only in the top layers.

From the three locations just described, projectile point stratigraphy has been used to point out the entrance and thus the migration of Late Archiac people.

If it is believed that only one population of people manufactured Lamoka-Dustin points then we could say that the technology was developed in New York, spread south to Kentucky, then up to Michigan. But because of the possible, contemporary Laurentian migration and the lack of datable sites, these Lamoka-Laurentian Migrations are disbuted. It is therefore safely concluded that "both groups occupied the Schmidt Site" (Harrison, 1966, p. 68).

Late Archiac sites and the fauna remains from these sites indicate that at the time of occupation the water level was higher, forming an inland bay in the Shiawassee Flats. This could have occurred at Algonquin (11,500 B. P.), Nipissing (4,000 B. P.), or at an even later stage, Algoma (3,000 B. P.). This shallow bay was probably full of fish and fowl, providing a lush environment for people of a subsistence economy.

Faunal remains from the Schmidt Site (Table 2) bear out this environmental interpretation with 26 aquatically oriented species recovered. Dog and deer are the only land forms. Deer are believed to be the primary food source of Archiac people, which is reflected in the number of individuals found (Table 2). There was no verticle change in concentration of animals reflecting that Dustin and Laurentian people (if distinguishable) were using the points for the same economic activities.

Radiocarbon dates for the site range from 6,000 B. P. to 4,000 B. P. But there was an inversion of samples which produced oldest above youngest. Because of this anomolous relation the dates could not be validly reported.

Aerial Extent Excavated

From point concentrations found on the surface and previously dug test

ANIMAL REMAINS FROM THE SCHMIDT SITE

Species	No. of bones	%	Minimum no. of individuals	Lbs. of usable meat	%
Deer	60	22.1	12	1020	77.4
Dog	3	1.1	3	45	3.4
Racoon	1	0.4	1	17.5	1.3
Muskrat	8	2.9	6	12.6	0.9
Canid	1	0.4	1		
Total mammal	73	26.9	23	1095.1	83.1
Hooded merganser	25	9.3	16	33.6	2.5
Blue & or green wing teal	49	18.2	26	18.2	1.4
Baldpate	20	7.5	10	10.5	0.8
Pintail	3	1.1	2	2.8	
Ruddy duck	4	1.5	4	2.8	
Wood duck	2	0.7	2	2.1	0.8
American coot	1	0.4	1	0.7	
Common mallard	1	0.4	1	1.75	
Anas spp.	1	0.4	1		
Total bird	106	39.1	63	72.45	5.5
Soft shell turtle	2	0.7	2	20	1.6
Snapper	1	0.4	1	10	0.8
Total Herp.	3	1.1	3	30	2.4
Sturgeon	1	0.4	1	36	2.7
Drum	9	3.3	7	20.7	1.6
Walleye	4	1.5	3	19.2	1.5
Largemouth bass	7	2.6	6	14.4	1.1
Bowfin	25	9.3	8	14	1.0
Channel catfish	3	1.1	3	9.6	0.7
Longnose gar	1	0.4	1	3.2	
Yellow perch	3	1.1	3	1.2	0.4
N. yellow bullhead	1	0.4	1	0.4	
Catfish fam.	31	12.6	13		
Bass fam.	4	1.5	3		
Total fish	89	32.9	50	118.9	9.0
GRAND TOTAL	271	100	139	1317	100

Table 2. Amounts of meat in pounds from the different species found at the Schmidt Site (Cleland and Kearney p.83).

pits, squares were excavated in an area 160' by 70' (fig. 6). The total area was divided into smaller clusters described as follows:

Area I - 4 10" by 10' pits forming a 20' by 20' square set in the northwest side of the ridge. All sedimentary layers dip slightly to the north-northeast.

Area II - 3 10' by 10' (later reduced to 5' by 10') staggered in a line to form 30' of exposed wall. They are set on the top of the knoll and thus they have the greatest elevation of any of this excavation. Sedimentary layers are horizontal.

Area III - 1 25' by 5' trench, and 1 5' by 5' square setting off to the east of the knoll, well beyond the base of the ridge. The sedimentary layers are horizontal.

Area IV - 1 5' by 10' trench north of the ridge situated on a flatter, less sloping area. Sedimentary layers dip northward slightly.

Area V - 25' by 5' trench running east to west 80' south of the other areas. Set in the east side of the knoll. Layers dip to the east but level off to almost horizontal at the eastern-most extent of the trench.

Statum Description

The glacial chronology is not easily interpreted from sediments deposited at the Schmidt Site. The stratigraphy is therefore based not on depositional changed but primarily on color changes, cultural bearing components, and feature contact surfaces (fig. 7). The sedimentary units will be described first followed by an environmental interpretation. Refer to the stratigraphic section

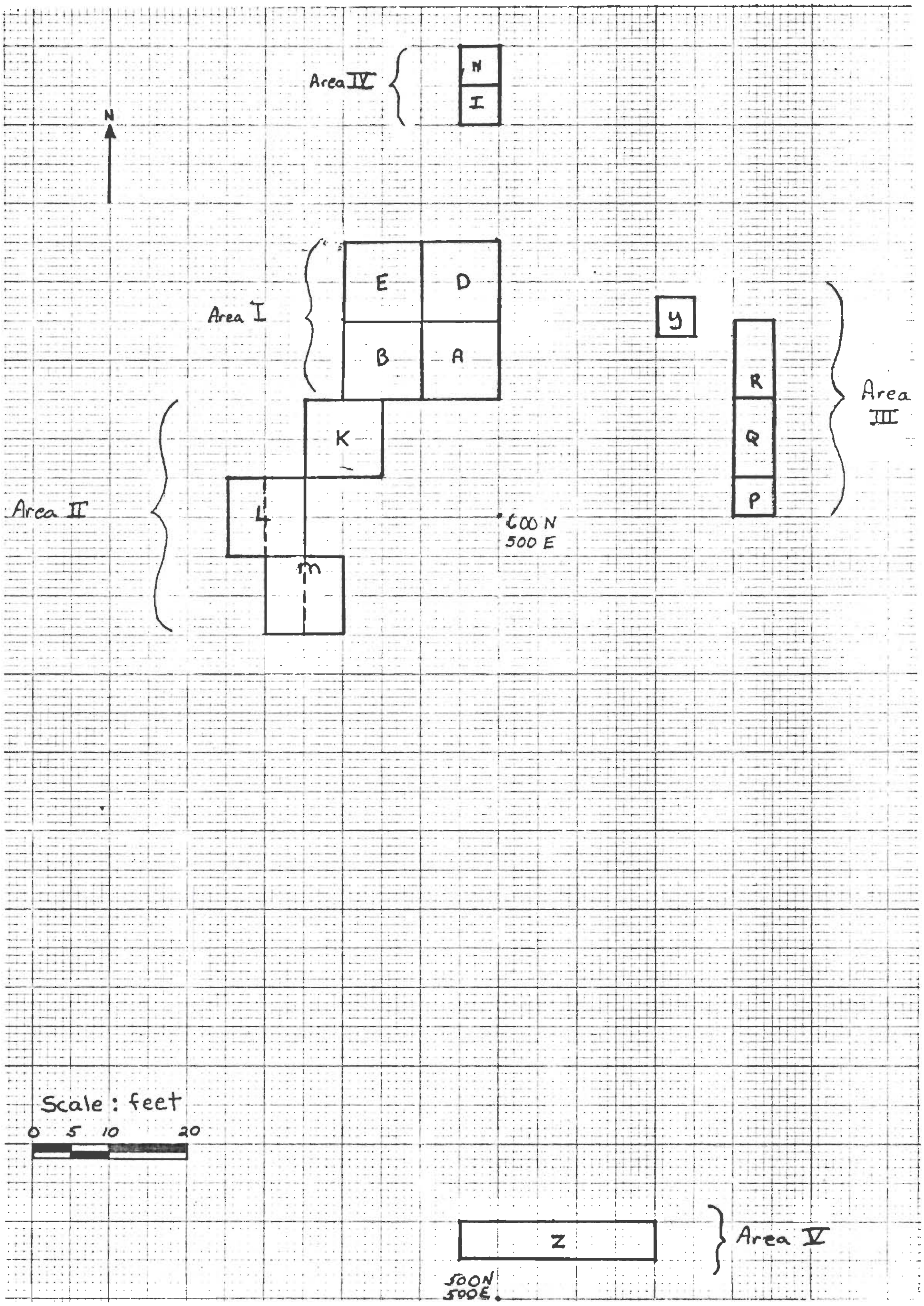

Figure 6. Aerial extent of excavation 1973 archeological field school.

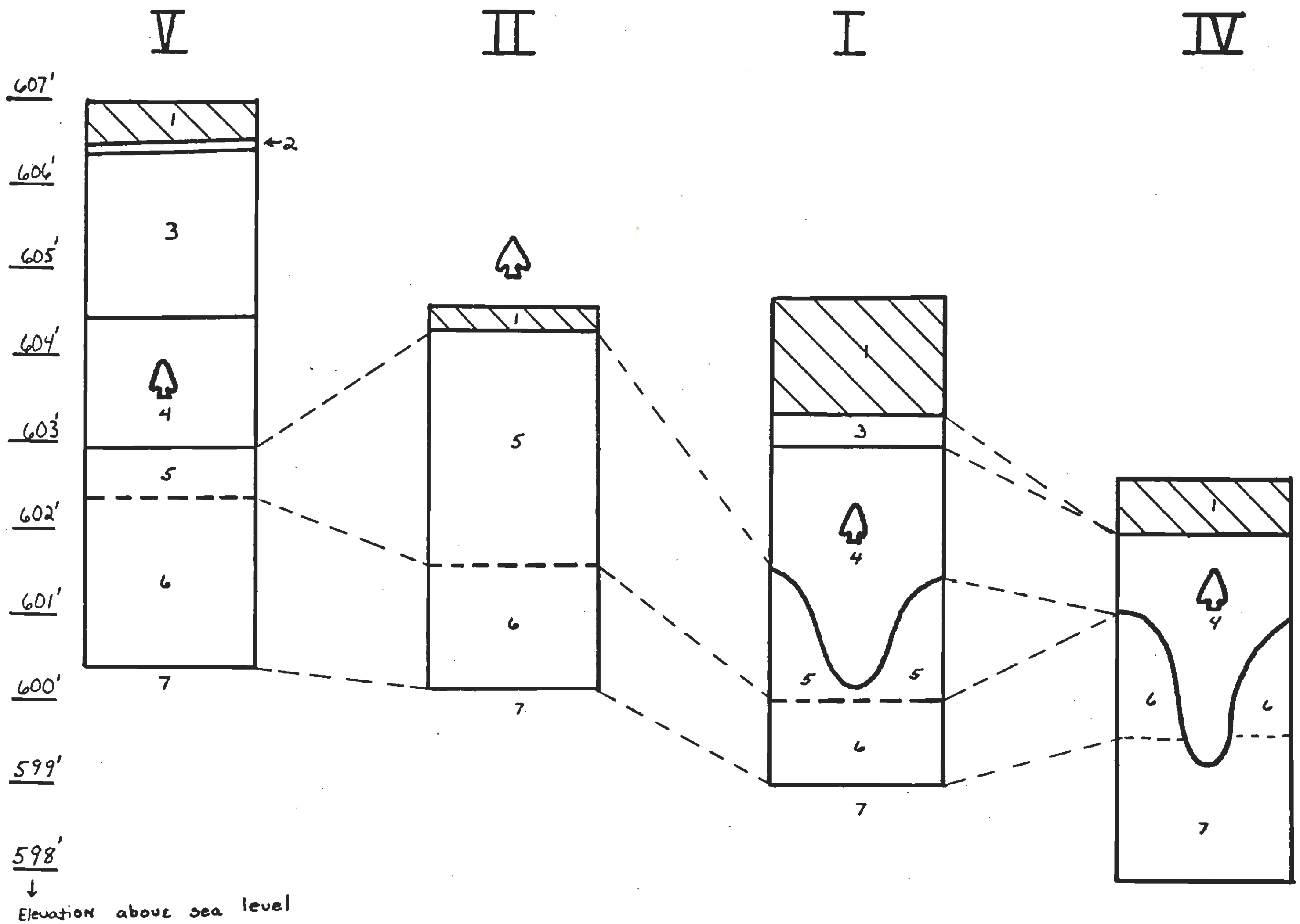

Figure 7. Idealized stratigraphic sections showing the horizontal extent of stratum layer from Area V to Area IV. In Area II the stratum 4 (cultural layer) was encorporated into the plow zone and subsequently removed. The depth of stratum 7 (clay) was never determined.

(fig. 7) for the verticle relationship in various areas of excavation.

Stratum 7 - Gray clay of an undetermined thickness, that is continuous throughout the site. Its surface seemed to dip to the northeast and is extremely uneven. This may represent erosion by intermittent streams and runoff after the water had again retreated to a lower elevation.

Stratum 6 - Orange-white mottled sand that contains iron and secondarily deposited calcium carbonate. This suggests that it is the B-horizon of the soil profile. The sediment has been oxidized by well oxygenated, percolating ground water which produces the orange stain (rust). Variable thickness of overburden effects the level of this unit. It ranges in depth from 2' to 5'. The contact surface is not well delineated from stratum 5 because the water's height fluctuates through time. Therefore, the contact line is drawn on the stratigraphic section (fig. 7) with a dotted line.

Stratum 5 - Yellow-tan, culturally sterile sand. Thickness varies according to area and elevation. In area II where the knoll is highest this unit is extremely thick. In area IV it is almost gone.

Stratum 4 - Brown-black mottled sand containing bone, charcoal, lithic artifacts, cultural features, and fire-cracked rock. Thickness ranges from 1' to 215' in areas I, where there was pits and heavy artifact concentration. In area II artifacts were found only in the plow zone indicating that overlying sediments had been eroded away to the level of Stratum 4. The color reflects the organic matter usually deposited in fire hearths, and surrounding areas of human residence. Some areas were totally black with outlines that formed pits. These are believed to be the remains of fire pits, due to the intense concentration of charcoal and organic debris. The upper and lower surfaces of this unit are extremely undulatory and difficult to decipher. This, I believe, is caused by the infiltration of organic matter and artifacts into the sediment, and erosion of the sediments before and after occupation.

Stratum 3 - Dark tan sand that contains no cultural remains. The thickness is greater than 1' in some places of area I and V, but it narrows to 3" in area III. It does not exist in area II. This is the area of highest elevation where artifacts are found in the plow zone. Therefore this unit has been previously removed by deflation thus exposing the cultural unit-stratum 4. Also found in stratum 3 are decaying pieces of large roots reflecting the previously stabilized condition of the area by a vegetation cover.

Stratum 2 - Brown mottled sand containing charcoal, ash and burned mulch in area III, IV, and V. This layer is .5" to 4" in thickness. It is believed to be associated with one or all of the forest fires of 1800's. (Crumley, 1966, p.73).

Stratum 1 - Plow zone. Brown-tan mottled sand at an elevation of 611'. Thickness exceeds 1' in area II, on top of the knoll, but thins to 4" on the east side of the ridge, area III. It contains organic remains, recent charcoal, bone, glass and other modern material. Cultural remains do occur in this deposit only in area II where deflation has removed overlying sediment.

INTERPRETATION OF SEDIMENTS

Basis of Interpretation

From the above descriptions and statistical grain size parometers speculation about the types of environments and processes which existed when the units were deposited is possible.

In sciences that deal with interpreting what happened in the past the Law of Uniformitarianism is applied. This law states that events that occurred long ago "may be understood and explained in accordance with processes now operating" (Gilluly 1951, p. 18). Therefore, if we can find a modern environment of deposition similar to those at the Schmidt Site, we can infer operation of similar processes. A sedimentary environment is defined as a part of the earth's surface which is distinct from other parts because of its particular biological, physical, and chemical processes. So we must compare these processes to compare environments. Biological processes can be distinguished by fossils, both faunal and floral. Chemical processes analyse the leaching, weathering, and secondary minerals present. Physical processes are actually determined from the rock (sediment) that has accumulated. A sedimentary facies (body of rock) is distinguished from other facies by its geometry, sedimentary structures, paleocurrent pattern, horizontal and vertical gradients, and lithology. Geometry reflects: the predepositional topography, the environment, and the postdepositional history. Sedimentary structures, if present, enable and interpretation of the intensity of water flow. Paleo-current analysis can tell us the direction of source area, direction of depositional basin, current orientation, direction of facies elongation, and tectonic history. They are recorded in the sedimentary structures. Horizontal and vertical gradiants suggest the use of the Law of Superposition. That is where facies "...that have not been disturbed by folding or overturning since accumulation, the youngest stratum is at the top and the oldest at the base" (Gilluly, 1951). Lithology is divided into two parts, mineralogy, and texture. Mineralogy is the type of rock contained in the facies. Texture is the size, shape and distribution in space of the constituent grains and matrix of a sediment of rock. They both reflect source area and amount of weathering the sediment was subjected to. Texture may be further subdivided into three properties each of which reflects a different environmental parameter. 1) Grain size depends on the sizes available to the environment by the source, and the competence of the current. 2) Sorting reflects the range of sizes supplied to the environment and the current characteristics. 3) Roundness depends on the amount of abrasion the grains have been subjected to if all other factors are held constant. The significance of these textural paramenters is not yet well known. More data must be compiled to use them as absolute indicators of environment. But a reasonable guess can be formed if we combine textural findings with all the physical, chemical, and biological processes (Folk, 1974, p. 3-13).

Determination of Physical Processes

The geometry and vertical sequence can be seen by the stratum distribution shown in the stratigraphic section (fig. 7). Sedimentary structures were not visible in the cross-sections. This could have been due to cultural remains (fire-cracked rock) that made their appearance obscure or because of the similarity of grain size and mineralogy making them hard to decifer in unlithified sediments.

The mineralogy and roundness reflect the weathering and abrasional history of the sand contained in the source area, and the force exerted by the glaciers in transporting the sand. Therefore these properties were inherited and do not reflect events that happened at the time of deposition. Grain size and sorting seem to be determined by processes contemporary with deposition so these textural parameters will reflect some aspects of the environment. Mean size, standard deviation, skewness, and kurtosis are all statistical means of describing grain size distributions.

Mean size is determined by the formula (Folk, 1974)

$$Mz = \frac{\phi 16 + \phi 50 + \phi 84}{3}$$

where $\phi 16$, $\phi 50$, and $\phi 84$ stand for the phi diameter (phi= $-\log_2$ A; A= diameter in mm) at the 16, 50, and 84 percentile of the distribution read from a cumulative curve.

Inclusive graphic standard deviation (σ_I) is a measure of sorting. It is measured by the formula

$$\sigma_I = \frac{\phi 84 - \phi 16}{4} + \frac{\phi 95 - \phi 5}{6.6}$$

If the grain size distribution is normally distributed about the mean then 68 percent of the sample will lie within $\pm 1\,\sigma_I$ of the mean.

Skewness measures the symmetry of distribution about the mean. The formula used was

$$Sk_I = \frac{\phi16+\phi84-2\phi50}{2(\phi84-\phi16)} + \frac{\phi5+\phi95-2\phi50}{2(\phi95-\phi5)}$$

symmetrical curves have $Sk_I = .00$. As finer sediment is added it becomes (+), coarser material makes it (-).

Kurtosis measures the normality of the distribution by comparing the sorting in the central part with the sorting in the tails.

$$K = \frac{\phi95-\phi5}{2.44 \times (\phi75-\phi25)}$$

is the formula used. Normal curves of any sorting value will have a K= 1.00. Higher values reflect better sorting in the central part, lower values are better sorted in the tails. (Mason and Folk, 1958, p. 216-218).

A Comparison of The Schmidt Site to Aeolian Flat and Low Energy Shoreline Processes.

PURPOSE

The grain size distributions for five samples from the Schmidt Site were determined by sieving (Folk, 1974, p. 33) and grain-size parameters were obtained using the above formulas. The grain size data obtained is recorded in Table 4 along with grain size data published by Mason and Folk (1958) for samples from Mustang Island, Texas. The similarity of the Michigan and Texas samples suggests that they may have been deposited by similar processes. Another possible interpretation of the sediment in the samples is that they were products of low energy shoreline processes. These two interpretations will be described so the physical conditions can be understood and compared to those causing deposition at the Schmidt Site.

DESCRIPTION AND COMPARISON OF MUSTANG ISLAND

Mustang Island is a barrier island off the South Texas Coast which has been the subject of study for Mason and Folk (1958). The island was chosen as a testing ground to determine if there was statistically valid differences in grain size distribution for the three environments present on the island. Beach, dune, and aeolian flat deposits were tested in hopes of distinguishing similar environments in ancient deposits. A study of the differences in the three grain size distribution was also to aid in the understanding of the geologic processes present during deposition.

A schematic cross-section (fig. 8) of Mustang Island shows the spacial relationship of the three environments. Sediment is supplied to the area by the Colorado River 100 miles to the northeast. It contributes normally-distributed, well-sorted and exceedingly uniform fine sand to the island beaches. According to LeBlanc (1972 p. 165) two basic conditions are necessary for wind blown sand deposits: A large supply of dry sand and a sufficient wind velocity. If we assume that these conditions were met and the direction of transport is from the beach, to dune, to aeolian flat then no finer or coarser sediments could be contained in the systems than are contained on the beach. This is shown to be the case when a review of the extreme grain sizes is observed (Table 3).

To explain the statistical parameters obtained from samples (Table 3) on the island the following transportational history is postulated. Sand of normal size distribution was deposited on the beach of the island. Finer grains transported by saltation deposition were trapped between coarser grains and escaped further

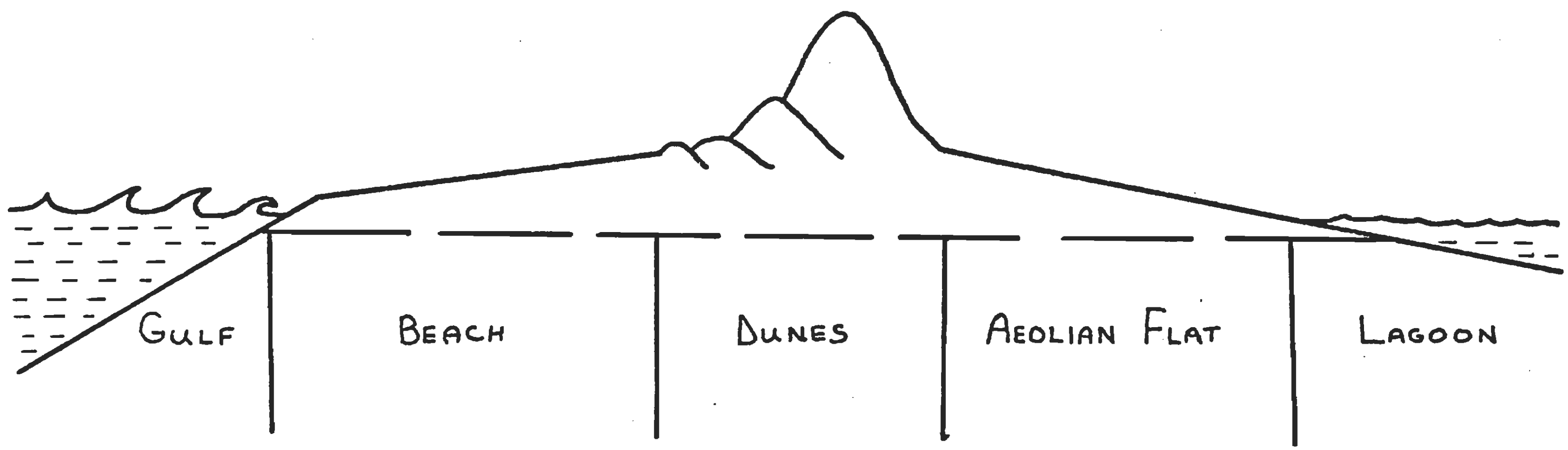

Figure 8. Schematic cross-section of Mustang Island. Distances are greatly distances are greatly distorted; aeolian flat is 1 to 3 miles wide while the beach and dune belt combined average only 500 to 1000 feet wide. (Mason and Folk, 1958, p. 213).

MUSTANG ISLAND

Environment	Mean Size (MZ)	Extreme MZ
Beach	2.82 ∅	2.65∅ to 3.00∅
Dune	2.86∅	2.69∅ to 2.98∅
Flats	2.83∅	2.75∅ to 2.89∅

Environment	Graphic Standard Deviation (σ_I)	Extreme σ_I
Beach	.309∅	.26∅ to .40∅
Dune	.273∅	.22∅ to .32∅
Flats	.286∅	.25∅ to .40∅

Environment	Skewness (Sk)	Extreme Sk
Beach	+.03	+.16 to +.12
Dune	+.14	+.03 to +.26
Flats	+.17	+.04 to +.26

Environment	Kurtosis (K)	K'	Extreme K'
Beach	1.09	.522	.492 to .444
Dune	1.07	.517	.484 to .546
Flats	1.20	.546	.492 to .592

Table 3. Grain size parameters obtained for the three environments of Mustang Island by Mason and Folk (1958, p.214).

transportation out into a lower energy environment. Because of this fact we find a coarse and fine fraction with the extreme sizes recorded in Table 3. The coarsest grains remain on the beach because the wind is not sufficient to transport them up the slope. The middle and fine fraction of these deposits are blown from the beach and heaped into dunes. This selective process produces a size parameter for the dunal environment that is positively skewed and better sorted than beach sands. Sediment is in turn blown off the dunes and deposited in grass-covered, level areas of lower elevation. (Aeolian flats) The grain size curve for this environment remains positively skewed, markedly leptokurtic, and with poorer sorting. This has been produced by adding a large amount of fines to the population. This occurs when very fine sand and coarse silt contained in the atmosphere accumulates on the flat, filters down between the coarse grains, and thus is protected from further transport.

If we compare the Schmidt Site samples to the data obtained on Mustang Island we can see a resemblance to the aeolian flat environment (Table 4). Both have mean grain sizes that are extremely uniform. Standard Deviation (sorting) is rather poor. The curves are positively skewed with a leptokurtic shape.

The smaller average grain size of the Schmidt Site either reflects a limited sediment size available or a highly selective transport agent. (fig. 9). The poorer sorting can be explained by the addition of a larger amount of even finer particles. The smaller size would also cause greater positive skewness. The Schmidt Site sample's leptokurtic nature is caused by addition of a secondary mode to a primary mode

	SCHMIDT SITE	MUSTANG ISLAND'S AEOLIAN FLAT ENVIRONMENT
Stratum	Mean Size (MZ)	MZ
1	3.25ϕ	extreme values
3	3.42ϕ	2.75ϕ to 2.89ϕ
4	3.25ϕ	
5	3.33ϕ	average
6	3.23ϕ	2.83ϕ

Stratum	Graphic Standard Deviation (σ_I)	σ_I
1	.825ϕ	extreme values
3	1.02 ϕ	.25ϕ to .40ϕ
4	.81 ϕ	
5	.9 ϕ	average
6	1.05 ϕ	.286ϕ

Stratum	Skewness (Sk)	Sk
1	+.36	extreme values
3	+.48	+.04 to +.26
4	+.31	
5	+.42	average
6	+.31	+.17

Stratum	Kurtosis (K_g)	$K' = \frac{K_g}{K_g + 1}$	K'
1	1.9	.65	extreme values
3	1.81	.64	.492 to .592
4	1.78	.64	
5	1.92	.66	average
6	1.63	.62	.546

Table 4. Grain size parameter obtained from each stratum at the Schmidt Site (left) in comparison to parameters found on Mustang Island's aeolian flat environment (right) by Mason and Folk (1958, p.214).

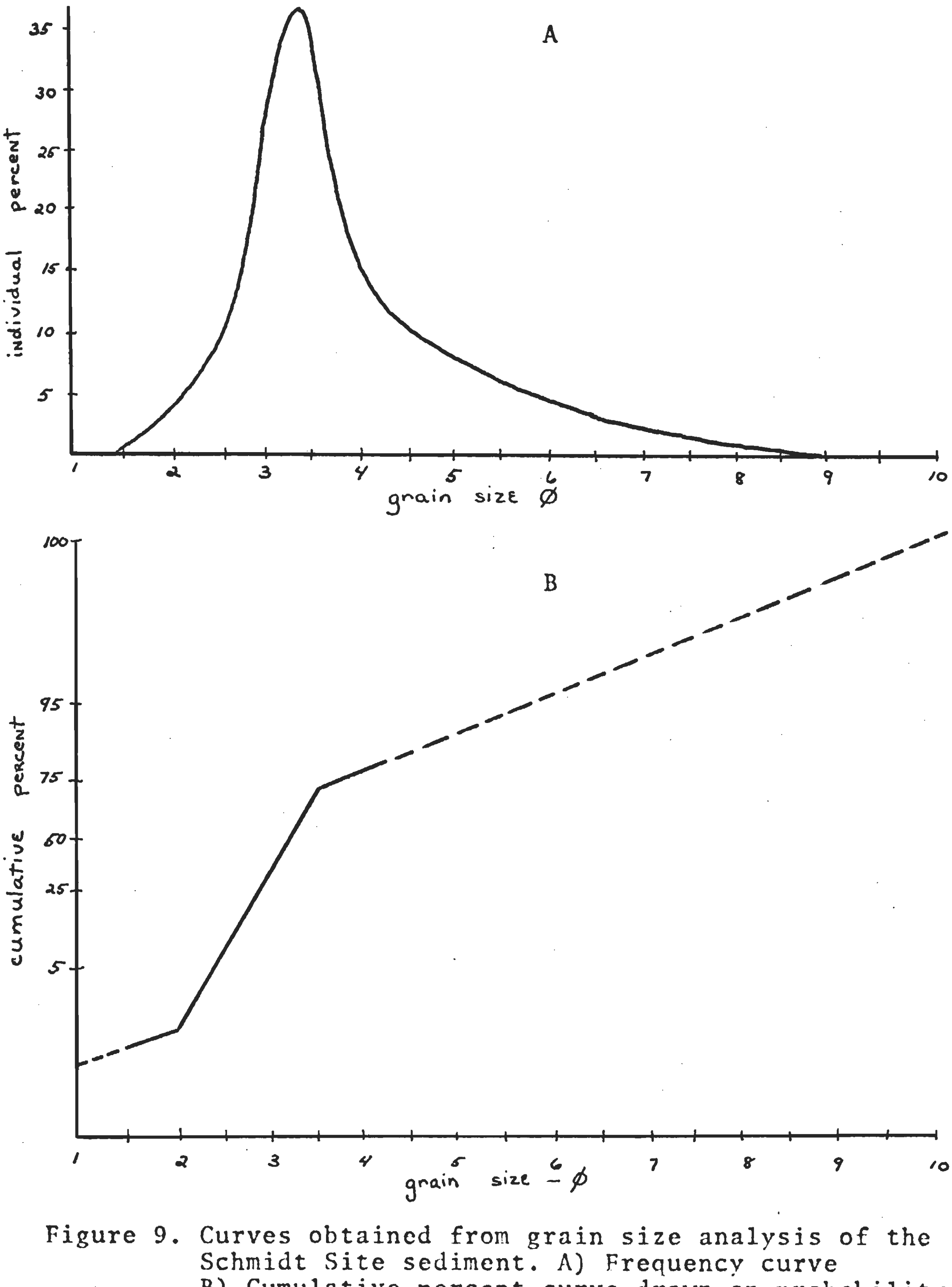

Figure 9. Curves obtained from grain size analysis of the Schmidt Site sediment. A) Frequency curve B) Cumulative percent curve drawn on probability paper,

(Folk and Ward, 1957). Addition of the second mode worsens the sorting in the tails but does not effect the previous sorting in the central part. If we added to the Schmidt's primary mode a secondary population of clay size fines we would produce the higher leptokurtic value we observe. This is defined as being bimodal.

In the sediment from the Schmidt Site, the primary mode consists of very fine sand of 3.3 average size (fig. 9). This constitutes a saltation population. The secondary mode ranges in size from coarse silt to clay and thus is a suspension population. We have a bimodal sediment similar in textural paramaters to an aeolian flat. If processes that produced this deposit are to be reconstructed as similar to the flat of Mustang Island we must also compare the sources for each situation. We stated before that the source is a limiting factor of mean grain size. The aeolian flat can have material no finer than that which is present at the beach. Therefore, the beach associated with the Schmidt Site must contain fines of clay size. Because processes at beaches inhibit the deposition of a suspension population of clay size we have a problem explaining the source of fines at the Schmidt Site.

DESCRIPTION AND COMPARISON OF A LOW ENERGY SHORELINE

Le Blanc (1972, p. 162) refers to an environmental model termed Coastal-Interdeltaic that encompases sedimentation areas that occur between deltas. He also includes in this category areas that are drained by numerous small streams and rivers but that are devoid of any sizable deltas at the shoreline.

Low energy shoreline processes are effective when major floods occur. This produces a sudden influx of sediment at the river mouth. The marine currents are not capable of dispersing the suspended sediment so they plaster it laterally along the beaches. Because of the rapid discharge and large amount of suspended load, extensive mud flats are deposited. Marine currents and waves do not have a sufficient amount of time to rework the mudflats until flooding has stopped and the supply of sediment is reduced. When this occurs the finer beach sediments nearest the shore are reworked and transported seaward. The sand size particles are left behind forming a sandy beach termed a chenier. Through many years and flood stages a series of mudflats interrupted by cheniers will form.

Friedman (1966, p. 339-341) points out the fact that excess fines will be deposited on beaches in the above manner any time the sediment supply of the rivers exceeds the energy of the longshore currents. The beaches could be composed of a various mixture of sand and mud determined by the grain size being supplied. In these beaches there would be a mud fraction causing positive skewness and poor sorting of the distribution curve.

Summary of Physical Processes Operating on Schmidt Site Sediments

The Schmidt Site was located near the mouth of a river that, at the time of occupation, emptied into a shallow bay. The river was draining the area now referred to as the Thumb of Michigan. This region contains old lake sediments and morainal deposits. With the large amount of water and sediment available to glacial rivers it is feasible to postulate the maintenance of a large bedload. The protected Shiawassee Bay would contain only a small amount of energy, thus sediment supply would exceed energy. The situation would produce beaches around the bay composed of excess muds, silts, and fine sands. They would be deposited swiftly, accounting for the lack of sedimentary structures. It would also explain the very fine mean size, poor sorting, strong positive skewness, and extreme leptokurtic shape of Schmidt Site size distribution curves (fig. 9). If the beach was so constructed the dunal and aeolian flat would be within the same size range but positioned behind the beaches. The elevation of the Schmidt Site is 605'. That is the postulated height of the shoreline of Lake Algonquin and Lake Nipissing. The site was then quite close to the shore of the bay. It is therefore not necessary to say these sediments were aeolian deposites (Crumley, 1966) but it is just as feasible to call them lacustrian beach deposits of a low energy shore system.

CONTEMPORARY INDIAN SITES IN THE AREA

Not only the fauna, flora, geological, and glacial evidence point to the occupation of Archiac Indians on a shallow bay but the position of other sites in the area substantiate it as well. Fitting (1970, p. 73-78) reports the Hart Site on the reconstructed western shore of this bay with the Feeheley Site on the southern extent. Both these sites are placed into the late Archiac period. The Feeheley Site was once a major burial area and has been given a date of 3980 ± 150 years B. P. This would place it in the Lake Nipissing - Lake Algoma Stage which is the time that Fitting also places the Schmidt Site.

Cleland (1966, p. 109-16) makes a comparison of these three sites by examining the fauna of each. All three occupations of people were exploiting the resources of the bay but the Schmidt Site, unlike the others, has an extremely large amount of mammal and bird bones. Cleland suggests that the three sites belong to seasonal occupations made by the same people. The Schmidt Site would be a base camp occupied heavily in the fall and winter because of the number of deer and fowl found compared to fish. The other two sites had abundant plant and fish remains suggesting summer occupation with fishing and gathering being the major subsistance activities.

Taggart (1967) has expanded this idea by pointing to the cultural remains. The Feeheley Site has a greater lateral extent with a thinner midden. The Schmidt Site extends a short distance but has a midden two feet thick. These facts coupled with the fauna remains suggest that they were occupied by the same Archiac people at different seasons of the year for the gathering of locally available subsistance material.

These interpretations do not refer to the suspected stratigraphic relation of projectile points at the Schmidt Site. Did the Lamoka-like (Dustin) and Laurentian-type people inhabit both Feeheley, Hart and Schmidt Sites contemporaneously? Or did they occupy all three sites within a short time of each other? Or, maybe the people occupying the Schmidt Site occupied the two other sites only later in history? From projectile points found at the Hart and Feeheley Site we can only say that Dustin people occupied all three sites. If the non-Dustin points found at the Schmidt Site represent a different cultural occupation, then maybe they did not occupy other areas around the bay, or we just do not find the points in a clear stratigraphic sequence.

Radiometric dates for the sites seem to correlate them in glacial time to the Lake Nipissing - Lake Algoma stage, but there still is no absolute proof that the Schmidt Site was not occupied in its lower levels at an even earlier time of Lake Algonquin (11,500 B. P.).

CONCLUSIONS

After reconstructing a geologic interpretation for the Schmidt Site I found that the sediments were deposited by physical processes associated with a lacustrian beach of a low energy shore system. There seems to be no need to apply aeolian processes acting on the sediment since the elevation at the time of occupation (605') does correlate to the elevation of glacial beaches. Those beaches are either associated with Lake Algonquin (11,500 B.P.) or Lake Nipissing (4,000 B.P.), both reconstructed at 605'. If we were dealing with aeolian deposits they would have to be a greater distance from the beach (aeolian flat as seen on Mustang Island) or of a higher elevation (dunes). But we would expect to see grain size parameters to be equal in all three environments because the source (beach) is a limiting factor.

The fauna, flora, associated sites, and radiometric dates all point to an occupation of 4,000 B.P. around a shallow embayment by people of the Late Archiac Period.

The controversial subject of cultural stratigraphy can not be explained to any greater extent from this study. We have only added evidence to the previously perplexing problem. Yet, hopefully this type of geologic environmental reconstruction can be useful in the excavation of future archeological sites.

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