

Evolution of Till Stratigraphy in Union County, Ohio¹

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ABSTRACT. Initial, Superconducting Super Collider-related fieldwork in Union County employed the stratigraphic scheme successfully used by the Division of Geological Survey in north-central Ohio. Descriptions and laboratory analyses of tills collected from outcrops and cores demonstrated that this scheme worked remarkably well. Tills, from youngest to oldest, were the clayey Hiram and Hayesville tills; the compact, silty "upper" Millbrook Till; the clayey "middle" Millbrook Till; and the sandy "lower" Millbrook Till. The sandy, noncompact Navarre Till appeared to be absent. The clayey Hiram and Hayesville tills become thin at the Powell Moraine and are absent south of the moraine. Southward from the Powell Moraine, a noncompact, sandy till closely resembling the Navarre Till was observed. West of Marysville, the entire sequence of tills becomes appreciably more clayey. Observed variations in the till stratigraphy may reflect an actual change of till sheets, a facies change, or both. Historically, stratigraphic schemes developed by Totten, Forsyth, and Goldthwait have been utilized in the Scioto Lobe. As a result of these multiple schemes, a complex and somewhat overlapping variety of names are available for tills observed in Union County. This paper reviews the relevance and utility of previous schemes, suggests correlations between them, and makes recommendations for their use. Additionally, a summarized scheme for Union County is presented.

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INTRODUCTION

Previous studies of the glacial geology of Union County are limited to broad regional overviews (Dreimanis and Goldthwait 1973, Fullerton 1980, 1986) or to more intensive studies based upon small geographic areas (Forsyth 1967, 1968; Paris 1985; Strobel 1990). Whereas such studies touch on the nature of till units found in Union County and ascribe names to them, an encompassing modern study of the area is lacking.

Initial field work and sampling in Union County was done by the Ohio Division of Geological Survey (DGS) in conjunction with a siting proposal for the Superconducting Super Collider (SSC) in 1987 (Fig. 1). Insufficient time was available for a thorough literature review to determine the most appropriate stratigraphic scheme and till names; thus, an informal stratigraphic scheme was employed that had been used successfully by the DGS in north-central Ohio. At the time of the study, there was uncertainty as to whether this lithostratigraphic scheme, devised and employed in the Erie Lobe for Seneca, Wyandot, Sandusky, and Erie counties, would work farther to the south. Crossing boundaries from the Erie Lobe to the Scioto Lobe (Fig. 2) is a test of whether tills can be correlated over distance, based on field and laboratory characteristics of the lithologic units.

The SSC study encompassed much of northeastern and north-central Union County (Fig. 1), as well as adjacent portions of south-central Marion County and western Delaware County. Upon completion of the SSC project, research was continued in Union County as part of the ongoing DGS County Mapping Program. The reason for a major part of the research was to investigate the purported major change in the nature of the surficial till units south of the Powell Moraine into the Darby Plains. This change

from clayey to more loamy tills has long been emphasized in regional studies and was delineated by the Soil Survey of Union County (Waters and Matanzo 1975).

MATERIALS AND METHODS

Field studies (exclusive of the SSC) were conducted in Union County and immediately adjacent portions of Logan, Champaign, Delaware, and Franklin counties. Pertinent information was utilized from additional field reconnaissance conducted in Franklin and Delaware counties, primarily in conjunction with a 1988 Society of Economic Mineralogists and Paleontologists Field Trip (Fernandez et al. 1988).

Field descriptions of tills included texture, facies, structure, degree of pebbliness, Munsell color, and depth of leaching. Fifteen auger cores taken in conjunction with the SSC project were described using standard DGS criteria. Laboratory procedures included textural studies by sieve and pipette (Folk 1974) and carbonate determination by Chittick apparatus (Dreimanis 1962, Kemmis and Hallberg 1980). Diffraction intensity (D.I.) ratios were determined by x-ray diffraction following the procedures of Szabo and Fernandez (1984) for selected unweathered tills.

RESULTS

Five tills have been identified within the SSC study area. Surficial tills are limited to the very clayey, sparsely pebbly Hiram Till and the clayey Hayesville Till. Three units of the Millbrook "group" underlie these two clayey tills. They are informally referred to here as the compact, silty, stony "Upper" Millbrook till; the clayey "Middle" Millbrook till; and the compact, very sandy, stony "Lower" Millbrook till. The "Lower" Millbrook till is observed only in deeper cores taken in the proximity of the Broadway Moraine (Fig. 1). These five tills are also present in north-central Ohio (Table 1). Field characteristics, and especially laboratory

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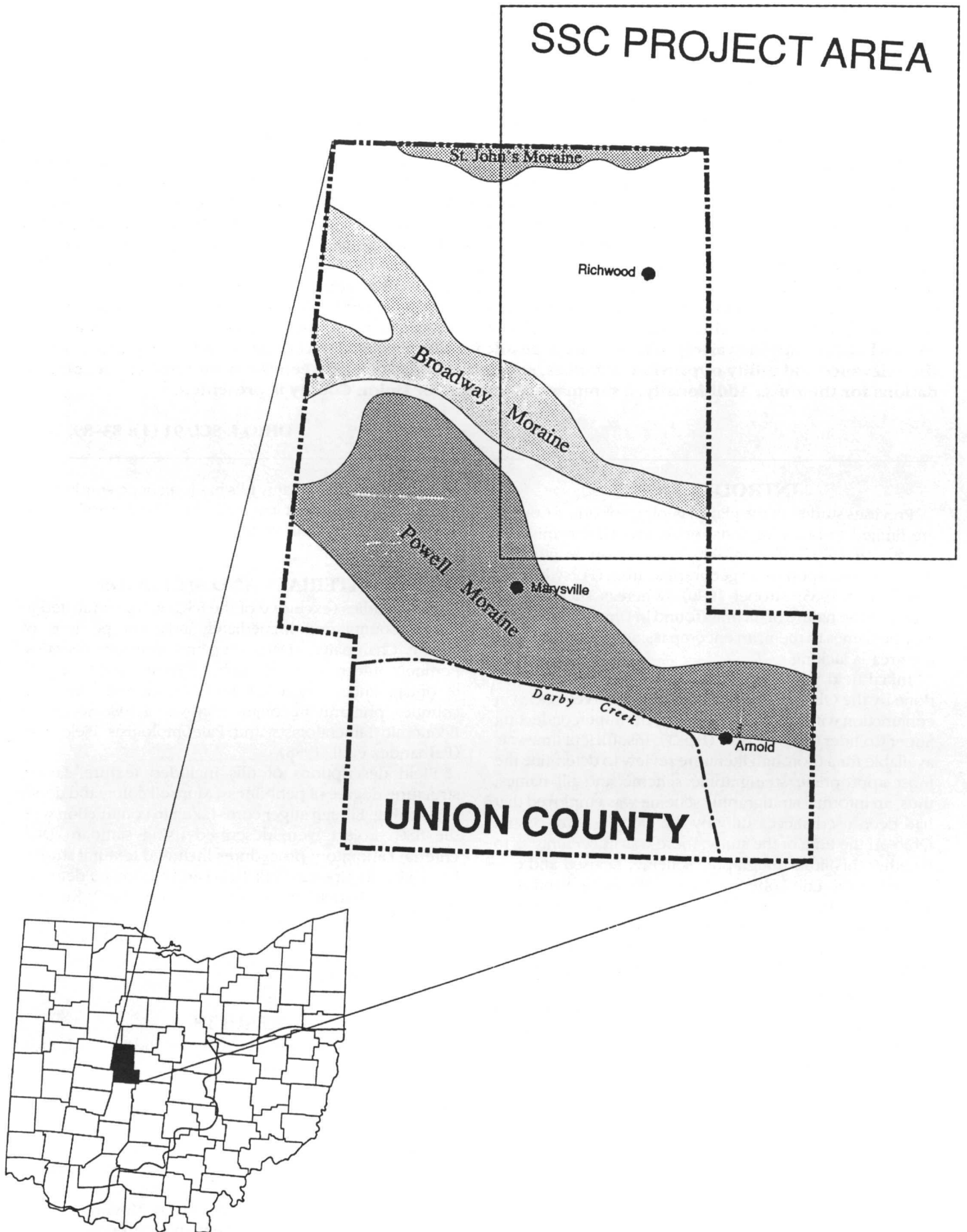


FIGURE 1. Location of the SSC project area and Union County. Moraines, major cities, and Darby Creek are depicted.

TABLE 1

Mean values of laboratory parameters for north-central Ohio tills. Note similarity between Sandusky County and the SSC area.

Till unit	Number of Samples	% Sand	% Silt	% Clay	% Total CO ₃	C/D
Hiram						
Sandusky Co.	9	11	39	50	14	1.2
SSC area	19	10	42	48	13	0.5
Hayesville						
Sandusky Co.	39	18	42	40	18	1.2
SSC area	33	17	43	40	20	0.6
“upper” Millbrook						
Sandusky Co.	57	22	44	34	23	0.9
SSC area	31	22	44	34	26	0.6
“middle” Millbrook						
Sandusky Co.	11	12	44	44	18	0.9
SSC area	15	13	50	37	22	0.6
“lower” Millbrook						
Sandusky Co.	6	30	45	25	26	0.7
SSC area	23	33	44	23	34	0.4



FIGURE 2. Location of glacial lobe boundaries in Ohio.

parameters, are surprisingly similar between Sandusky and Union counties. The sandy, friable Navarre Till, a mappable unit stratigraphically between the Hayesville and Millbrook tills in northeastern Ohio, appears to be absent in both north-central Ohio and the SSC area. Presence of the Navarre Till in north-central Ohio is questionable and, if present, is represented by only a thin platy till.

Field observations south of the SSC study area reveal two major changes in the nature of surface and near-surface tills. South of the Powell Moraine and along portions of the extreme southern edge of the moraine, the clayey Hiram and Hayesville tills thin substantially and are absent south of Union County. In their place, a sandy, loamy, friable till known as the Darby Till is at the surface. Although this till is similar to the “Lower” Millbrook Till texturally, lower carbonate values (Table 2) and higher stratigraphic position indicate that these two tills are not correlative. Compact, silty “Upper” Millbrook Till underlies this loamy, friable unit in some deeper stream cuts near Arnold, in southeastern Union County. This surficial till extends well into western Franklin County.

Surficial tills are unusually clayey along the crest and just north of the Powell Moraine in a belt running from Marysville westward to Logan County (Table 2). Laminated lacustrine silts and clays are interlayered between tills or, in some locations, overlie the till units.

DISCUSSION

Occurrence of Loamy Till

The presence of a mappable loamy till in southern Union County and adjacent Franklin County, and its absence to the north in central Ohio, is perplexing. Several possible explanations exist for the presence of this loamy till south of the Powell Moraine. Perhaps this unit represents the products of an earlier ice advance which is exposed beyond the margin of subsequent advances. This possibility is unlikely in view of absence of this unit or any possible equivalent in the subsurface in north-central Ohio. Secondly, the unit may represent a facies change from active ice, which deposited lodgment till to

TABLE 2

Mean values of laboratory parameters for Union County tills. "M" denotes clayey facies samples taken nearby Marysville.

Till unit	Number of Samples	% Sand	% Silt	% Clay	% Total CO ₃	C/D
Hiram	13	9	41	50	13	0.5
Hiram-M	15	6	38	56	24	0.9
Hayesville	69	16	42	42	20	0.7
Hayesville-M	22	12	39	49	21	0.8
Darby	8	31	45	24	32	0.4
"upper" Millbrook	27	22	44	34	26	0.6
"middle" Millbrook	7	13	52	35	22	0.6
"lower" Millbrook	6	30	41	29	42	0.5

stagnating ice, which deposited ablation till. Lack of evidence for ablation to the north remains a problem. Moraines and boulder belts in south-central and south-western Ohio may reflect some poorly understood shearing process which, overall, imparts a sandier, more friable nature to surficial tills of this region. The clayey area of western Union County appears to be localized. Forsyth (1956, 1967, 1968) and Waters and Matanzo (1975) speculate that these tills were perhaps deposited in a watery environment or may have incorporated abundant local lacustrine sediments. Unlike many other similar areas of lacustrine-influenced tills in central Ohio which occupy lows between moraines or in valleys, lacustrine deposition in western Union County appears to have occurred on a relative topographic high. This high represents the complex coalescence of the Powell, Broadway, and Bokes Creek moraines (Forsyth 1967, 1968) along the eastern margin of the Bellefontaine Outlier. Perhaps the lake represented major ponding against a divide or perhaps it was ice walled.

Stratigraphic Nomenclature

A variety of potential names exist for the tills observed in Union County (Fig. 2). Although some of these names have been previously used in Union County, most have been loosely applied elsewhere in central Ohio. The following discussion provides an example of the complex and confused state of stratigraphic nomenclature in this region. Past researchers have developed localized stratigraphic nomenclature schemes which vary widely in origin and focus. Tills have been differentiated on the basis of their proximity to specific moraines, by their relation to various soil types, by lithostratigraphic properties, and by their assumed age and stratigraphic position. The names of some units have extended past their original geographic boundaries and may now refer to more than one till. Conversely, some unique tills may have multiple names

ascribed to them. The origin and usage of these various names will be briefly discussed, and correlations will be attempted where possible. It is the intent of this paper to suggest a name for each discrete till identified in the study area. This name will reflect both past usage and present utility. No new names, which could further complicate the situation, will be introduced. The selected names will hopefully be both representative and in current common usage.

The loamy till physically resembles the Navarre Till (White 1961, 1982; Totten 1973) of the Killbuck Lobe; however, the type section of this unit is over 200 km to the northeast in Stark County (Fig. 2). The Navarre Till is best exposed in Stark and Wayne counties, a setting which differs markedly from Union County. Surficial exposures are limited to a narrow zone abutting the Allegheny Plateau. This zone is dominated by high relief, large valleys, clastic rocks, and acidic soils. Ablational topography, numerous kettles and bogs, and ice-contact deposits in the area indicate the close proximity to the ice margin just south of the type area. The apparent lack of any mappable Navarre Till between southern Union County and northeastern Ohio makes correlations problematic.

Totten (1973) and White (1982) thought that their stratigraphy of northeastern Ohio extended into the northeastern section of the Scioto Lobe in Morrow, Richland (Totten 1973), Ashland (White 1977), and Knox (Viani 1986) counties. According to the convention of the time, crossing the lobe boundary from the Killbuck Lobe to the Scioto Lobe required a concomitant change in names (Fig. 3). Forsyth had previously introduced the Centerburg, Mt. Liberty, and Knox Lake tills while conducting mapping in Knox (Root et al. 1961) and Licking (Forsyth 1966) counties. The Centerburg, Mt. Liberty, and Knox Lake tills were directly correlated to the Hiram, Hayesville, and Navarre tills of the Killbuck Lobe by Totten (1973).

Additionally, the Jelloway Till (Totten 1973) was introduced as the Scioto Lobe equivalent of the Millbrook Till. Unfortunately, the origin of these two schemes was extremely different; Forsyth's names were based upon specific soil series names adopted from soils field mapping sheets, whereas Totten's names were based on lithostratigraphic units whose type sections were far removed. Although the tills did appear to be coincidentally correlative in the northern fringe of the Scioto Lobe, this one-to-one stratigraphic correspondence does not exist south of the Powell Moraine (Young et al. 1985, Weatherington 1978, Forsyth 1989). The Centerburg Till has been mapped south of the Powell Moraine (Forsyth 1966), however, it cannot be correlated with the Hiram Till in this area as the Hiram Till is absent. The Hayesville Till becomes discontinuous south of the Powell Moraine which makes a correlation between the Hayesville Till and the Centerburg or Mt. Liberty tills questionable as well. In essence, the till names have vastly different origins and some correlations have been extended too far geographically.

Problems associated with naming tills after soil series are illustrated in the following discussion. The Centerburg, Mt. Liberty, and Knox Lake tills (Root et al. 1961, Forsyth 1966) were based upon soil series names derived from acidic soils which ultimately reflect the clastic nature of local bedrock in Knox and Licking counties. According to Forsyth (1989), these soil series and their respective tills should not be extended westward into the Scioto Lobe, where alkaline soils and carbonate bedrock predominate. Forsyth (1956, 1967, 1968) developed names in western Union County based upon applying local geographic

names to distinctive differences in soil types. Hence, the names Marysville Till (clayey), Bellefontaine Till (loamy), and Pickrelltown Till (loamy) were utilized. Like the names used in Knox and Licking counties, these till names were based upon soil series distributions, rather than lithologic descriptions. Different till names have, therefore, been applied to potentially the same till sheet. Lithologic-based correlations are difficult to make as the tills reflect differences in soil types. For example, in a multiple till section or core, criteria for differentiating the Bellefontaine and Pickrelltown tills are lacking.

Correlation problems between tills also exist when morphostratigraphic terminology is utilized. The Darby Till and the underlying Caesar Till (Goldthwait and Forsyth 1965, Goldthwait and Rosengreen 1969) were defined on the basis of being continuous till sheets related to specific moraines. For example, the Darby Till is a morphostratigraphic term loosely applied to the loamy surficial till occupying the area north of the Reesville Moraine (Teller 1967, Rosengreen 1974) and extending to the Powell Moraine (Goldthwait and Rosengreen 1969). Forsyth (1965) also relates this till to major soil associations. Although the terms Darby and Caesar tills have been commonly used in the southwestern Scioto Lobe (Goldthwait et al. 1981), they are informally defined and lack complete lithologic descriptions and type sections. In a multiple till exposure or core, lithologic criteria for differentiating the Darby and Caesar tills is lacking. Forsyth (1965) related the Darby Till to major soil associations, however, this also does not aid in lithologic distinctions between tills. Paris (1985) used the term Darby Till for the surficial loamy till south of the Powell Moraine in Union County.

STAGE	SUBSTAGE	Killbuck Lobe Totten (1973)	NE Scioto Lobe Totten (1973)	SE Scioto Lobe Forsyth (1965)	NW Scioto Lobe Forsyth (1967, 1968)	SW Scioto Lobe Goldthwait (1989)	Union County present study
WISCONSINAN	WOODFORDIAN	Hiram	Centerburg		Marysville	Tymochtee (Lake)	Hiram (Marysville?)
		Hayesville	Mt. Liberty	Centerburg	Bellefontaine	Olentangy	Hayesville
	Navarre	Knox Lake	Mt. Liberty	Pickrelltown	Darby	Darby	
	PRE-WOODFORDIAN ?	Millbrook	Jelloway	Knox Lake		Cesar Boston? Rainsboro?	Millbrook "upper" "middle" "lower"

FIGURE 3. Correlation chart for central Ohio tills.

Numerous other names have been sporadically applied to tills throughout the Scioto Lobe. For example, Goldthwait and Rosengreen (1969) refer to the clayey Lake and Tymochtee tills well north of the Powell Moraine. These tills, much like the loamier tills to the south, are defined on the basis of their morphologic occurrence in conjunction with major moraines, and their relation to changes between major soil associations (Forsyth 1965, Steiger and Holowaychuk 1965). Goldthwait (1989) also introduced the term Olentangy to represent the clayey till in the Powell Moraine just north of Columbus. In addition, Selby (1978) attempted to correlate informal tills that he designated in Darke County with till units in Union County. Fullerton (1980) informally referred to the clayey till of the Powell Moraine as the Powell Till, but mentioned how similar it was to the Hayesville Till of White (1961). Finally, Paris (1985) tentatively referred to the clayey till he commonly observed capping the Powell Moraine in Union County as Hayesville Till and called the underlying unit Darby Till.

As discussed previously, it appears possible to extend north-central Ohio terminology to tills in the SSC project area. The occurrence of loamy, friable till south of the Powell Moraine and excessively clayey till west of Marysville is problematic to strict adherence to this terminology. The classic relationship between the Navarre Till and "upper" units of the Millbrook "group" has recently been questioned (Pavey et al. 1987). Units of the Millbrook "group" in areas south and east of Richland County have been divided primarily on the basis of carbonate content and stratigraphic position (Viani 1986, Szabo 1987, Totten 1987). These units have not as yet been correlated with the names utilized by the DGS in western north-central Ohio. Units determined by the DGS are divided primarily upon the basis of texture and pebbliness. This situation becomes further compounded when the age of the Millbrook "group" is considered. The Millbrook has been classically interpreted as representing the Altonian (early to middle Wisconsinan) substage (White 1982); however, recent evidence (Kempton et al. 1985, Eyles and Westgate 1987) suggests ice was absent at this time in the southern Great Lakes. Hence, units ascribed an Altonian age must be either Woodfordian or Illinoian. The Millbrook "group," therefore, may conceivably encompass a considerable span of time (Totten 1988).

SUMMARY

The above discussion, hopefully, has demonstrated that there is no lack of names available for both the clayey and loamy tills found within the Scioto Lobe, and more specifically, Union County. Many of these till names have a very localized usage, whereas other names have been extended over large geographic regions. The basis and differing criteria for naming these till units makes direct comparisons between tills difficult in many instances. The purpose of the remainder of this article is to suggest a scheme using the most appropriate names available, and to provide the rationale and relevance for the selected terms.

The terms Hiram Till, Hayesville Till, and Millbrook (in the broad "group" sense) Till were selected for usage in Union County because of the excellent correspondence of

these units between the SSC project area and other portions of north-central Ohio. In addition to their widespread usage, these terms also have a lithostratigraphic basis and are, therefore, more useful for both lateral and vertical correlations. Darby Till was selected for the loamy, surficial till found south of the Powell Moraine. This name has widespread usage, and the lithologic nature of this till was described by Paris. The term Darby was preferred over the term Navarre due to the absence of the Navarre Till throughout much of north-central Ohio. As studies progress, other previously utilized names may be recognized as units and / or facies of the above-named till units. For example, the Marysville facies (or unit) of the Hiram (or Hayesville) Till could be used for the clayey-till region to the west of Marysville (Table 2). Perhaps Bellefontaine Till or Pickrelltown Till could represent the very stony Millbrook-like till observed in quarries in eastern Logan County. Caesar Till may have similar future utility as an informal name for a facies or unit. Future studies should not necessarily discard previous names, but instead should redefine them in a lithostratigraphic context whenever possible.

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