The Crawfordsville and Knightstown Moraines in Indiana

INDIANA DEPARTMENT OF CONSERVATION

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By WILLIAM J. WAYNE

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By William J. Wayne

ABSTRACT

The main advance of glacial ice into central Indiana during Wisconsin time had two distinct pulsations within a span of about 1, 000 years. The first, about 21, 000 years ago, reached farthest south and built the segmented Shelbyville Moraine near its margin. After this first advance, the ice melted somewhat and then readvanced to a new position a few miles short of its previous position about 20, 000 years ago. Because the readvance crossed and buried the Champaign and Bloomington Moraines, these names should not be used for any of the few moraines that can be traced eastward out of the interlobate complex in west-central Indiana. The name Crawfordsville Moraine is proposed for the moraine that lies near the distal margin of the drift sheet left during the second ice advance. The Knightstown Moraine is the name given to a recessional moraine that was deposited later than the Crawfordsville Moraine and that merges with the continuation into eastern Indiana of the Farmersville Moraine of Ohio.

INTRODUCTION

The East White Sublobe of the Ontario-Erie Lobe was the continental ice sheet that covered most of central Indiana during the Wisconsin Age (fig. 1). It left few readily traceable moraines between the Wabash River on the north and the Wisconsin glacial boundary on the south. Frank Leverett, who supplied most of the names now in use for the moraines that he mapped in Indiana, lacked topographic maps of the glaciated part of the State. He, as well as later glacial geologists, was forced to trace and map subtle geomorphic features from ground study alone, a difficult task. Revision and refinement of Leverett's basic mapping have become possible only during the past few years since the completion of modern topographic maps for that part of Indiana called the Tipton Till Plain (Malott, 1922, p. 104-112**).** These maps have been used in conjunction with stereoscopic study of aerial photographs, soil maps, and the plethora of new exposures that have been made by man to restudy the moraines and their relationships to the drift sheets of central Indiana.

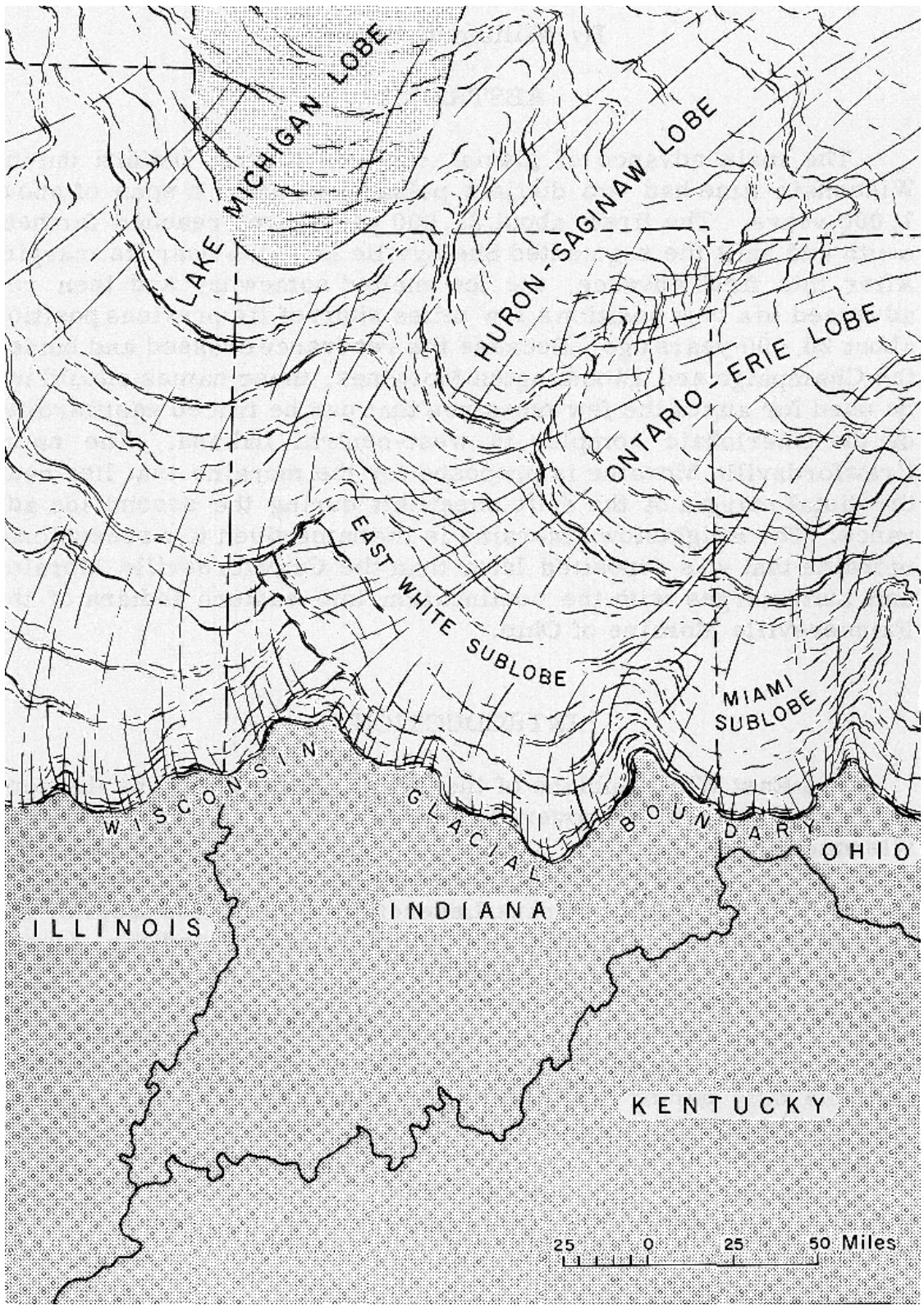

Figure 1. – Map showing glacial lobes and sublobes of Indiana.
Terminology from Horberg and Anderson, 1956

High bedrock along now buried parts of the Norman and Crawford Uplands (Wayne, 1956, fig. 3) caused the ice to develop a complex interlobate reentrant along the west side of Indiana (fig. 1), so that the drift of the East White Sublobe was separated from the drift of the Lake Michigan Lobe to the west. At least seven named moraines enter Indiana from Illinois only to become indistinguisable in the jumbled morainic mass along the Wabash Valley in Parke, Montgomery, Fountain, Warren, and Benton Counties (fig. 2). No continuous morainic ridge can be followed eastward from this interlobate area.

Leverett correlated the segments of morainic topography that he mapped incentral Indiana with some named moraines that he had studied in Illinois and western Indiana and extended some morainic names eastward through the interlobate area (Leverett and Taylor, 1915, pl. 5) to suggest ice marginal positions and to interpret the glacial history. The morainic systems that Leverett correlated from Illinois across central Indiana are the Shelbyville, Champaign, and Bloomington (fig. 2). These three names have been used by most authors since 1915 (Gooding, 1963; Malott, 1922; Thornbury, 1937; Wayne, 1954).

MORAINES OF THE EAST WHITE SUBLOBE

During the past decade stratigraphic and physiographic studies in central Indiana have provided convincing evidence that the Champaign and Bloomington Moraines of Illinois cannot be traced east of the interlobate reentrant in western Indiana. Wayne (1958; 1963) recognized two distinctive drift sheets that comprise the surficial materials deposited by the East White Sublobe of the Ontario-Erie Lobe (Horberg and Anderson, 1956) of the Wisconsin glacier. These two units were named the Center Grove Till Member and the Cartersburg Till Member of the Trafalgar Formation (Wayne, 1963). Radiocarbon dates indicate that the Center Grove till was deposited when the ice reached its maximum extent about 21,000 years B. P. [1] (table 1) and that the Cartersburg till is about 1,000 years younger (table 1). A fossiliferous silt bed, called the *Vertigo alpestris oughtoni* bed (Wayne, 1963), which lies at the top of the Center Grove till and separates it from the overlying Cartersburg till, is the source of the wood fragments that were used to date the younger till.

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[1] B. P. , a standard abbreviation used in reporting radiocarbon ages, means "before the present." The reference year for "the present" is 1950.

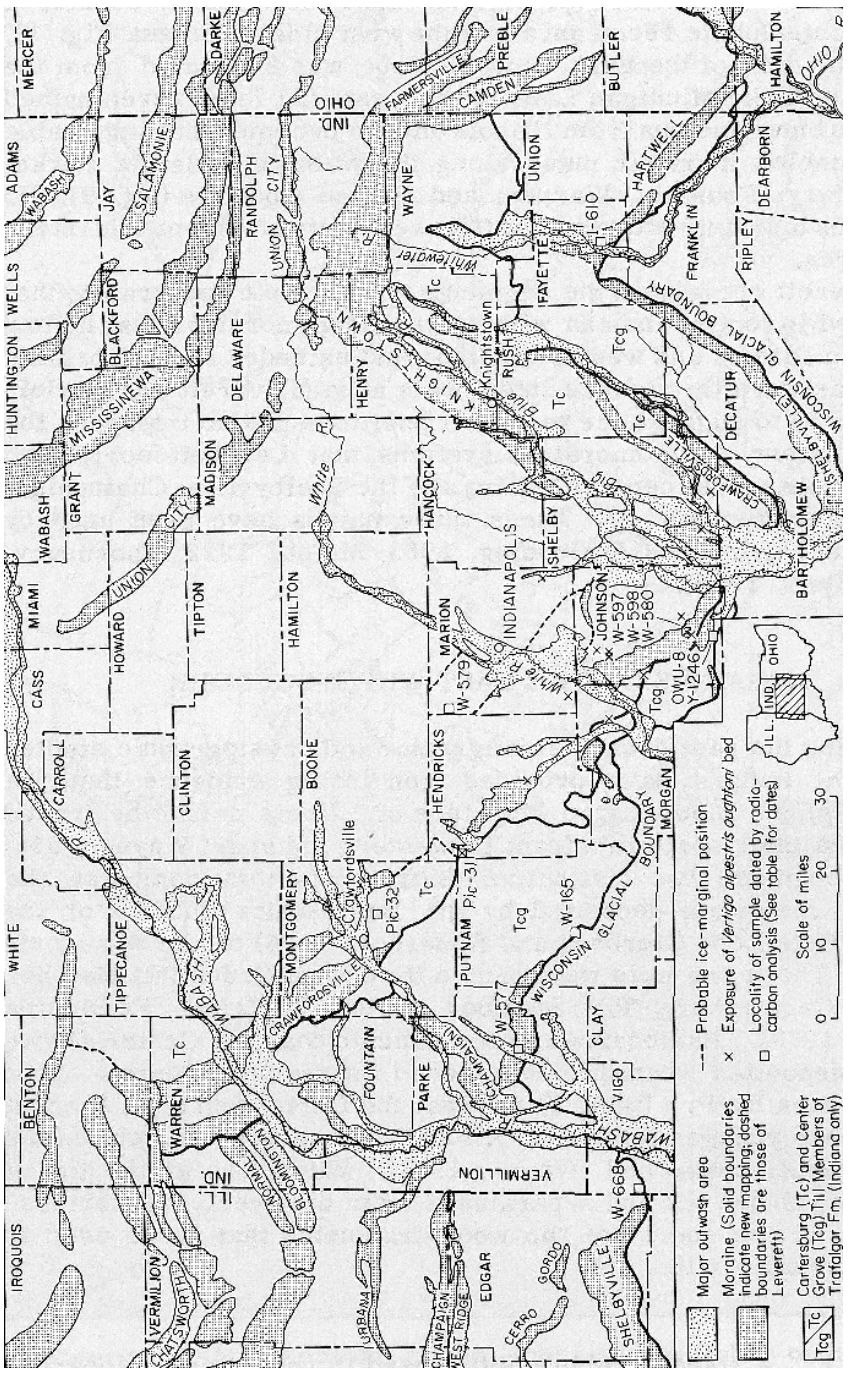

Figure 2. – Map showing glacial geology of central Indiana and adjacent parts of Illinois and Ohio. Moraine names in parentheses are Leverett's names for moraines that have not been restudied.

Table 1. --*Radiocarban dates from central Indiana*

Stratigraphic position	Age (B. P.) and sample number	Sample location (fig. 2) and comments
Vertigo alpestri8 oughtoni bed (silt bed between Cartersburg Till Member and Center Grove Till Member of the Trafalgar Formation)	19,930 ± 900 (Pic-31)	Hendricks County; near North Salem.
	20,300 ± 800 (W-597) 20,100 ± 800 (W-598)	Johnson County; 2 miles east of Trafalgar; (W-597 from wood in silt bed and W-598 from wood in base of overlying till).
	20,000 ± 500 (I-610)	Fayette County; south of Connersville (from silt bed on which Connersville Interstade of Gooding, 1963, is based).
Upper ***Hendersonia occulta*** bed or equivalent stratigraphic position (silt bed at base of Center Grove Till Member of Trafalgar Formation)	21,400 ± 650 (W-668)	Vigo County; near Terre Haute.
	20,500 ± 800 (W-577)	Parke County; 4 miles southeast of Rockville.
	19,500 ± 800 (W-165)	Putnam County; south edge of Greencastle.
	21,400 ± 860 (Pic-32)	Montgomery County; 3 miles east of Crawfordsville.
	20,800 ± 800 (W-579)	Marion County; 5 miles north of Clermont.
	20,900 ± 800 (W-580)	Johnson County; 2 miles east of Trafalgar.
	19,906 ± 691 (OWU-8) 20,230 ± 200 (Y-12486)	Johnson County; 3 miles south of Trafalgar.

SHELBYVILLE MORAINE

A segmented moraine lies near the distal edge of the Center Grove till across central Indiana. It has long been referred to as the Shelbyville Moraine. Although radiocarbon dates from Illinois are not precisely in agreement with those from Indiana and at least one other interpretation is possible, there seems to be no valid reason at this time to question the correlation with the Shelbyville Moraine in Illinois, Therefore the name Shelbyville probably should be retained for the end moraine along the Wisconsin drift border in Indiana.

CRAWFORDSVILLE MORAINE

The limit of advance of the ice that deposited the Cartersburg till lies a few miles north of the Wisconsin glacial boundary (fig. 2). Stratigraphically it is a distinct and important boundary, but it is not marked by a continuous moraine, and neither Leverett nor Malott (1922) connected the segments in the manner that is now possible (Wayne, 1963, fig. 6). Malott's Champaign Moraine more nearly fits the overlap boundary of the Cartersburg till than any other interpretation, but it varies from the present boundary in several places.

A strong moraine marks the boundary of the Cartersburg till near the center of the lobate drift sheet in Johnson County (fig. 2), but from the White River northwestward to southeastern Montgomery County, the drift boundary does not follow any recognizable moraine. Northwestward across Montgomery County the moraine develops two strong fronts that can be traced across the Wabash River through Warren County (fig. 2); near Crawfordsville the moraine crosses the Champaign Moraine and in Warren County overlaps the Bloomington Moraine. North of the Warren-Benton county line it becomes less recognizable as a morainic ridge. The double moraine in Warren County seems to be overlapped from the north by the Chatsworth Moraine from Illinois, although several large kames in Benton County may represent its northward continuation.

Eastward from the large breach through which the Driftwood and Big Blue Rivers flow in Johnson and Shelby Counties, the more southerly of two low narrow ridges mapped by Leverett as running northeastward through Rush County marks the southern boundary of the Cartersburg till. The moraine has been mapped as continuing northward into Henry County (Leverett and Taylor, 1915), but the outer margin of the till sheet associated with it, the Cartersburg,

trends eastward across southern Wayne County and connects with the till of the Camden Moraine in Ohio (Goldthwait, White, and Forsyth, 1961). As in Hendricks County, little morainic topography is associated with the south edge of the Cartersburg till between Rush County and the State line.

This end moraine is marked by many kames, and large outwash plains (fig. 2) emerge from it in Fountain, Montgomery, Johnson, Shelby, and Rush Counties (Wayne, 1958; Wayne, Johnson, and Keller, in preparation). In Montgomery County and in Johnson County the moraine is a broad, massive ridge whose west edge corresponds to the limit of the Cartersburg Till. The exceptionally rugged morainic topography in Montgomery County makes the area around Crawfordsville an excellent place to examine the moraine and to study its geomorphic relationships with the moraines of the Lake Michigan Lobe. The name Crawfordsville Moraine, therefore, is proposed here for this end moraine of the Cartersburg Till Member.

Leverett's original interpretation of the morainic relationships in Montgomery County was similar to that presented here. He regarded the Crawfordsville Moraine as having overridden the Champaign Moraine (1899, p. 224), but after restudy he decided that he could not definitely demonstrate that the two were different in age. He therefore adopted the simpler alternative (Leverett and Taylor, 1915, p. 87) and correlated the moraines on either side of the reentrant. Inasmuch as the Crawfordsville Moraine crosses and overrides both the Champaign and Bloomington Moraines of the Lake Michigan Lobe, neither of these moraine names should be used in Indiana except along the extreme west edge of the State. Possibly the scattered bogs and somewhat undulating topography in Clinton, Hamilton, and Madison Counties may represent the buried course of one of these two moraines.

Many exposures of the *Vertigo alpestris oughtoni* bed, the fossiliferous silt bed that lies between the Center Grove and Cartersburg tills of the Trafalgar Formation, have been found in Indiana between northwestern Hendricks County and Wayne County (fig. 2). So far, however, no exposures of this bed have been found in Montgomery Countyor farther northwest, even though both the Cartersburg Till Member and the Crawfordsville Moraine can be traced much farther on evidence that is largely but not entirely geomorphic.

One explanation for the bed being absent near Crawfordsville and to the northwest fits well the frozen-ground hypothesis suggested for many small patches of patterned ground that were discovered through aerial photograph study of Montgomery County (Wayne, 1964). If some inactive ice still remained as a partial or complete ground cover along and north of the Champaign Moraine at the time

the East White Sublobe advanced to the position of the Crawfordsville Moraine, the ice-free, tundralike environment into which the *Vertigo alpestris oughtoni* fauna migrated in central and eastern Indiana could not have existed northwest of Crawfordsville. A triangular ice-free area between the active glacial margin at the Crawfordsville Moraine and the ice-cored Champaign Moraine probably would have become a "cold pocket" where local patches of frozen ground could have formed.

KNIGHTSTOWN MORAINE

Abandoning the names Champaign and Bloomington because the moraines lack continuity across Indiana also makes necessary the adoption of a new name for the massive moraine in northern Wayne County and in southern Randolph County that long has been called the Bloomington Moraine. This moraine, deposited by ice from the Miami Sublobe of the Ontario-Erie Lobe (fig. 1), is a continuation of the Farmersville Moraine of Ohio (fig. 2); logically the Ohio name could be carried as far west as the interlobate area in northeastern Henry County, Ind. It should not, however, be applied to the moraines deposited by the East White Sublobe of the ice sheet unless its continuation can be clearly demonstrated. Until such time as a good correlation can be made, a local name will have to be applied to the moraine segment that is a positive landscape feature between northeastern Shelby County and northeastern Henry County (fig. 2). Knightstown is on the edge of a rugged part of the moraine; thus the name Knightstown Moraine is appropriate and is proposed here for this feature.

Our present knowledge of the geomorphology and Pleistocene stratigraphy of the central and western parts of the East White Sublobe area does not permit the positive and precise identification of an ice-marginal position continuous with the one that is marked by the Knightstown Moraine. Only a few fragments of moranic topography exist in the area, and ice-marginal geomorphic features distinctive enough to be readily recognizable have been traced only short distances (Harrison, 1963, pl. 1).

Geomorphic and stratigraphic evidence indicates that three former glacier-margin positions probably can be recognized in central Indiana. Any of the three must be considered as a possible correlative of the one marked by the Knightstown Moraine.

One hypothesis is that the second front of the Crawfordsville Moraine, which seems to be represented by an outer and an inner ridge along much of the edge of the Cartersburg till sheet, may split into a third moraine along the southeast flank of the lobe. In

this event, the small morainic segment in northern Johnson County (fig. 2) probably would be part of the Knightstown Moraine. The small moraine in Johnson County lies just east of a large number of kames along White River south of Indianapolis and seems to merge with part of the Crawfordsville Moraine to the west.

Harrison (1963, pl. 1) indicated that a distinct ice-marginal position, probably formed during a recessional stand of the ice, crosses Marion County diagonally from southeast to northwest. Geomorphic features that permit recognition of this ice-marginal position become vague in northeastern Hendricks County and thus the front edge of this glacial stand has not been traced west of Marion County. It may, however be continuous with both the inner ridge of the Crawfordsville Moraine and the Knightstown Moraine.

Harrison (1958, p. 85; 1963, pl. 1) recognized still another ice-marginal position in northern Marion County that evidently represents a minor fluctuation of the edge of the glacier. Geomorphic features suggest it can be traced southeastward and may also extend to the Knightstown Moraine. That it represents a readvance of ice is an interpretation based largely on local till stratigraphy in Marion and Hamilton Counties and on pre-consolidation-pressure values of overridden silt beds (Harrison, 1958).

North of this ice-marginal position, eskers, esker troughs, and disintegration features are abundant, particularly in Hancock, Madison, and Boone Counties. These, as well as the absence of end moraines and outwash plains, indicate that the glacier of the East White Sublobe became a mass of stagnant ice as it disappeared.

The three marginal positions discussed here may all be represented in the massive and rugged Knightstown Moraine, which may have been built along the southeast flank of the lobe while the ice margin retreated to three successive positions around the south and west flanks of the lobe. This explanation would account for the absence of a single correlative moraine and would suggest that the inner front of the Crawfordsville Moraine in Montgomery County and farther northwest may be indeed the western correlative of the Knightstown Moraine. But further study, both geomorphic and stratigraphic, will be needed before such a correlation can be firmly accepted.

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