

Glacial Lakes Quincy and Eminence

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It is the purpose of this paper to discuss the origin and development of two glacial lakes which occupied portions of Owen, Morgan, Putnam, and Hendricks counties during the Illinoian and Wisconsin glacial stages. The existence of these lakes is indicated by the presence of extensive lacustrine flats in the area under discussion. The presence of these lake plains was recognized by early geologists, but no careful study has previously been made of their areal distribution, origin, or ages. The location of the area discussed in this paper is shown in Figure 1.

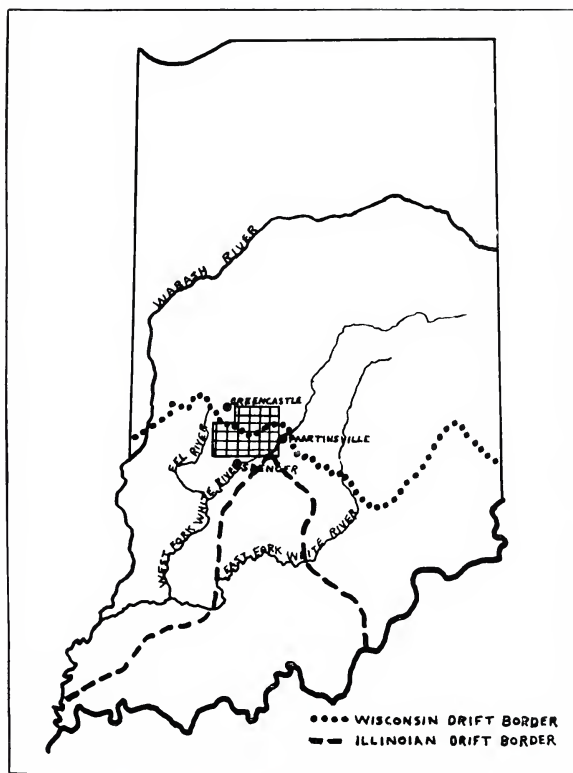


Fig. 1. Outline map of Indiana showing location of area under discussion and its position with respect to the Illinoian and Wisconsin drift borders.

Glacial Lake Quincy

Early descriptions of Lake Quincy.—The name Lake Quincy¹ is proposed for one of these glacial lakes. The site of the lake so named is now marked by a lacustrine plain covering between 40 and 50 square miles lying in portions of northeastern Owen, southeastern Putnam, and western Morgan counties. The name is taken from the small village of Quincy in northeastern Owen County, where extensive portions of the lacustrine plain are still preserved.

Probably the earliest reference to what is here called Lake Quincy was made by Collett.² In his discussion of the effects of the Glacial Epoch upon the geology of Owen County, he says:

"For a probably short time the ice sheet extended over nearly the entire area of the county. . . . It is probable that the foot of the ice flow for a long time lodged, and was heaped up against the ridge running east and west through Spangler's hill just south of Cataract, where the wintry accumulation was melted and discharged down Mill, Rattlesnake, Fish, and Lick creek valleys. . . . Today a cut of less than 70 feet would carry the water of Eel River, above the falls, into Rattlesnake Creek, its old channel. . . .

"That the valleys of Eel, below the cataracts, and White river, below the mouth of McCormack creek, are recent, much more recent than that above, is obvious. They are at once contracted to from one-fourth to one-twentieth their former width, that is, the width of the ancient channel higher up stream. The question at once arises, how was the new channel obtained? During the evident long period that the foot of the glacier rested against Cataract ridge and the highlands in the north part of Monroe county, the continuous retreating and advancing process of the ice scooped out a deep, wide basin in White river, east of Gosport, and north and east of Cataract, just as the basins of the lakes were excavated far below the river and outlet. As the ice by climatic change withdrew to the north, these basins became sluggish streams, or filled by the excessive precipitation common in cold regions, temporary lakes. . . ."

". . . Wells dug in the valley plain, between Quincy and Cataract, in the old river bed leading to the 'flat woods,' and in the wide bottoms above Gosport, indicate beds of laminated sand and muck of lacustral character."

Malott³ in discussing the physiography of the Mitchell plain in this section of Indiana recognizes the existence of extensive lake deposits in this area and states:

"The Mitchell plain north of Ellettsville in northwestern Monroe County has been modified by glaciation. The chief effect of glaciation has been to mantle the rather dissected and locally nearly destroyed plain with glacial material, and eventually farther north to cover over and entirely obscure the plain. Locally, where the plain has been deeply dissected by surface streams, it has been restored to its original level by glacial

¹This represents the formal proposal of the name Lake Quincy for the lacustrine area which occupies portions of northeastern Owen, southeastern Putnam, and western Morgan counties. The naming of this lake area, however, should be attributed to Dr. C. A. Malott, of the department of Geology and Geography of Indiana University. In the Handbook of Indiana Geology (P. 210) he refers to this lake region but does not give it a name. He seems to have adopted the name Lake Quincy for this region in his own usage, for A. R. Addington, in a paper on Porter's Cave, which is located just east of the Lake Quincy lacustrine plain, refers to this lake region as Lake Quincy as if it had already been so named. Addington's paper was published in 1927, five years after the Handbook of Indiana Geology appeared. It thus appears that the use of the name Lake Quincy had been informally adopted by both Malott and Addington as a result of their verbal discussions of the area. They were both members of the geology staff at Indiana University.

²Collett, John, 1875. The Geology of Owen County. Indiana Geol. Surv. Ann. Rept. 7:306-307.

³Malott, C. A., 1922. Handbook of Indiana Geology. Pp. 210-211.

material chiefly in the form of lake deposits. Two areas of this kind are of more than ordinary interest. One of these, known as the Flatwoods, lies chiefly in Monroe and Owen counties. . . .

"The other lake area developed in part on the Mitchell plain is quite extensive. It lies along Mill Creek, or Eel River, in northwestern Owen, southeastern Putnam, northwestern Morgan, and southwestern Hendricks counties. It is terminated at its western edge by the double fall of Mill Creek, or Eel River. The lake plain above the fall of Eel River is approximately on the level of the Mitchell plain, which was largely removed in this locality by stream dissection before the region was glaciated. The area of the former lake, or the area affected by ponded drainage conditions, was 50 square miles or more. The altitude of the present lake flat, or lacustrine plain, is 750 to 775 feet. Portions of the Mitchell limestone plain are seen about the margin of the silt-covered area.

"The lacustrine plain above the falls of Eel River is due principally to the obstruction of the pre-Illinoian Mill Creek, or Eel River, in the vicinity of Cataract in northeastern Owen County. The Illinoian glacier completely filled the entrenched valley in this locality to or somewhat above the level of the upland Mitchell plain surface. Following the retreat of the ice the waters in the drainage basin above, which also was probably somewhat modified, found outlet at the level of the bedrock surface high above the old entrenched valley. The waters, however, re-entered the old valley somewhat lower down. Falls were formed where the accumulated waters of the basin above entered the old entrenched valley. In time the basin of the ponded drainage became filled to the level of the bed-rock surface of the stream above the falls, thus giving rise to a lacustrine plain. Inwash in the upper portions of this lacustrine plain has built it up still higher. Portions of it are very flat and poorly drained, as for example along Mud Creek in northwestern Morgan County. This locality west of Monrovia and north of Eminence is known as 'The Lakes' or the 'Lake Country.'

"The falls of Eel River near Cataract are very picturesque. The descent of the stream into the entrenched valley takes place over a stretch of a mile or more, and in a series of rapids, and two falls of approximately 25 feet each, a total descent of nearly 100 feet occurs. Picturesque gorges of several hundred yards in length occur below each of the falls.

"It is not known what influence the Wisconsin glaciation had on the lacustrine plain above the falls of Eel River. Possibly part of the plain itself is due to the Wisconsin glaciation. Few details concerning the region are at present available. A possible connection of the pre-Illinoian Eel River with Rattlesnake Creek has been suggested, but it is not likely that any such connection existed."

Another reference to Lake Quincy is found in Addington's⁴ discussion of the relation of Porter's Cave, which lies just beyond the eastern edge of the Lake Quincy lacustrine plain, to glaciation in that area. Addington states:

"The area is marginal to the Early Wisconsin Drift. Along the margins of this drift Glacial Lake Quincy had its inception. Similar to any marginal lake formed along the border of an ice mass, this lake had a number of overflow outlets. The positional relation of the lake flat to the Porter's Cave region is such as to suggest a partial escape for the lake waters in the vicinity of the cave.

"If it is not too much speculating I venture the suggestion that during a short period overflow from the lake was by way of the valley now abandoned and at the same time part of the waters were escaping by subterranean passages along the route of the cave, the subterranean routes receiving more water than they could transmit.

"The abandonment of the valley by the stream and the diversion of the waters to subterranean routes would come as a result of lessened supply due to the lake finding a lower outlet. If this assumption is correct, the drainage condition near the cave had its inception during the Early Wisconsin Glacial Stage.

"Before the exact relation of Lake Quincy to the Porter's Cave region can be ascertained, a detailed study of the lake basin with a view of determining the various overflow outlets will be necessary. This in itself is no small matter. . . ."

⁴Addington, A. R., 1927. Porter's Cave and recent drainage adjustments in its vicinity. *Proc. Indiana Acad. Sci.* 36:116-117.

It was for the purpose of supplying more details concerning the Lake Quincy area in order to work out its history that the present study was undertaken.

Description and history of Lake Quincy.—Glacial Lake Quincy developed as a pro-morainal or marginal lake in front of the Illinoian ice sheet due to the ponding of the southwest drainage of Mill Creek.⁵ Mill Creek apparently drained in somewhat the same general direction to the southwest, as at present, prior to the Illinoian glaciation. The damming of Mill Creek occurred in the neighborhood of the village of Cunot in northwestern Owen County. The lacustrine deposits which accumulated in Lake Quincy can be traced down the valley of Mill Creek to a point just about one mile southwest of Cunot in Section 28, T. 12 N., R. 4 W. This morainial dam was approximately three miles below the present site of the upper Cataract Falls on Mill Creek.

The maximum areal extent of Lake Quincy is shown in Figure 2. This map represents fairly accurately the areal extent of Lake Quincy but may not be correct in every detail, as no detailed topographic mapping of the area was done. The map is based upon barometric determinations of altitude. Lake Quincy extended from approximately the Owen-Morgan county boundary on the east westward for a distance of about 12 miles. The northern limits of the lake are not so easily determined for it is partially obscured on the north by deposits of Wisconsin outwash over the Lake Quincy lake deposits. It may have extended somewhat north of the Early Wisconsin moraine (Shelbyville) which crosses Mill Creek near the village of Eminence in western Morgan County. Lacustrine deposits associated with Lake Quincy extend over an area covering between 40 and 50 square miles. It is probable that the lake at no one time covered all of this area. It seems likely that the eastern portion of the lake was the first to develop, and recession of the Illinoian ice front northwestward allowed an expansion of the lake to the west, but as this occurred it is probable that the lake shrank in size at the east. The reason for this conclusion will be pointed out when the outlets of the lake are discussed.

The lake plain which represents the former site of Lake Quincy is most typically developed between the altitudes of 755 to 770 feet but at the eastern and northern ends of the lake the floor of the lake plain rises up to altitudes between 785 and 790 feet. The higher altitudes here are due to inwash of materials from the Wisconsin drift which lies just north of the site of Lake Quincy. This Wisconsin outwash is especially noticeable in the area east of Cloverdale and south of Eminence.

From an altitude of about 790 feet at the east and north the lake

⁵The name Mill Creek will be used in this paper for the stream which flows southwestward through Hendricks, Putnam, Morgan, and Owen counties and joins Eel River near the southwest corner of Putnam County. In many of the older reports the term Eel River was sometimes applied to this stream, but the newer maps designate it as Mill Creek and apply the name Eel River to the stream into which Mill Creek flows. Eel River may be considered as beginning at the junction of Little and Big Walnut Creeks about four miles southwest of Greencastle. Eel River lies a few miles to the west of the area described in this paper.

plain descends to the southwest to an altitude of about 755 feet at its westernmost limits. This is a slope of about 35 feet in a distance of about 15 miles, or a slope of slightly over 2 feet to the mile. The western half of the lacustrine plain has a much slighter gradient than the eastern part. In the section of the lake plain west of Quincy the slope is about one foot to the mile.

Considerable dissection of the Lake Quincy lacustrine plain has occurred in the lower part of the area. Mill Creek has cut out considerable amounts of the silts and clays deposited in the lake. At the point where State Road 43 crosses Mill Creek, Mill Creek has cut its valley down to an altitude of 720 feet, but the terraces which represent the level of the lake plain are at an altitude of 755 feet. However, extensive terraces composed of the lake deposits are preserved along the valley of Mill Creek. In the area above the village of Quincy, in northeastern Owen County, there is preserved an extensive area of the lacustrine plain which is as yet little dissected. A very good cross



Fig. 3. View of the lacustrine plain of Glacial Lake Quincy about one and one-half miles northeast of the village of Quincy in northeastern Owen County.

section of the lacustrine plain can be obtained by following the route of the Monon Railway from Cloverdale southeastward through Quincy to the southeastern limits of the plain about two and one-half miles southeast of Quincy.

At the northeast the lake plain abuts against the Early Wisconsin (Shelbyville) moraine, and at the east the lake deposits feather edge out against the sink-hole topography of the Mitchell plain. There is already some indication of encroachment of the southeastward drainage into White River upon the drainage of Mill Creek as numerous sink-holes may be seen at the eastern edge of the lake plain. As mentioned above, Addington has suggested that Lake Quincy may have had a partial subterranean outlet through Porter's Cave, but this does not seem likely to the writer for reasons which will be discussed later.

That the age of the Lake Quincy silts and clays is Illinoian, as suggested by Malott, and not Wisconsin, as suggested by Addington, is indicated by the depth to which the lake deposits have been leached of their calcium carbonate. Numerous determinations of the depth to carbonates were made both from exposures of these silts and from borings with a soil auger upon the floor of the lake plain. In all cases the lake silts were leached of their carbonates to depths between 12 and 15 feet. This clearly indicates an Illinoian rather than Wisconsin age for these silts as this depth of leaching corresponds very closely with the depth to carbonates in the Illinoian till of southern Indiana. Previous work by the writer⁶ has shown that the Illinoian drift in southern Indiana is leached of its carbonates on an average to a depth of slightly over 13 feet, whereas the Early Wisconsin drift is leached of its carbonates to an average depth of about five and one-half feet. There is enough difference between the two that there can be no question as to the Illinoian age of the Lake Quincy deposits.

In Collett's discussion of the Lake Quincy region he suggested that Mill Creek formerly discharged into White River by way of Rattlesnake Creek. His suggested southward outlet of Lake Quincy was across Spangler's ridge, which runs east and west between the present course of Mill Creek and the headwaters of Rattlesnake Creek. Careful barometric determinations of the altitudes along the divide between Mill Creek drainage to the west and the various streams which flow southward into White River have indicated that there could not have been any outlet for Lake Quincy into Rattlesnake Creek. The altitudes along Spangler's ridge are given in Figure 2. The divide between Mill Creek and Rattlesnake Creek is everywhere well above 800 feet. An elevation of about 800 feet would seem to represent about the maximum altitude of the lake in its initial stage since the lake deposits are all below that elevation.

It does appear, however, that for a time Lake Quincy did have an outlet into White River, but it was not by way of Rattlesnake Creek as suggested by Collett, nor does it seem likely that it was by way of the underground route of Porter's Cave as suggested by Addington. It appears likely that during the initial stage of the development of Lake Quincy the lake covered roughly the area east of the village of Quincy. During this stage the lake discharged southeastward into Little Limestone Creek and thence into White River just east of Gosport. There is a very prominent col connecting the southeast end of the lake plain with Little Limestone Creek in the northwest part of Section 5 and the northeast part of Section 6, T. 11 N., R. 2 W. This col occurs at an altitude between 760 and 765 feet and unquestionably was the main, if not the only spillway through which Lake Quincy discharged its surplus waters to the southeast into White River. This spillway is designated as the Little Limestone Creek spillway in Figure 2, and its position is indicated by the arrow pointing toward Little Limestone Creek.

As the front of the Illinoian ice sheet receded to the west the lake expanded westward and eventually found an outlet at a lower altitude

⁶Thornbury, W. D., 1937. Glacial geology of southern and south-central Indiana. Pub. Indiana Cons. Dept., Div. Geol. P. 49.

to the west near the village of Cunot in northwestern Owen County. This outlet was probably some 10 feet lower than the eastern outlet as the level of the lake flat near Cunot is at an altitude of about 755 feet.

Lake Quincy must have persisted as a lake for a considerable period before lowering of its western outlet resulted in draining, for a considerable thickness of deposits was spread over the floor of the lake. No very accurate data as to the maximum thickness of the lake deposits were obtained, but probably at least 30 feet of silts were deposited in the lower end of the lake. Collett⁷ gives the section shown in Table I from a well in Quincy.

TABLE I.—Section in Quincy Well

	Ft.	In.
Black soil.....	1	08
White and gray clay with crawfish pipes, with little sand, no pebbles..	10	00
Blue clay, with pebbles.....	3	00
Black mucky clay, with brush and plant remains.....	3	00
Hard pan and fine pebbles.....	3	00
Coarse gravel and boulders, depth unknown.....	3	00
	<hr/>	
Total	23	08

Information obtained from the farmers in the region about Quincy indicated that they obtained their waters from wells sunk into the deposits over the floor of Lake Quincy. They usually obtained their water from sand and gravels at depths of about 24 feet. The depth to these gravels seemed to increase somewhat toward the west. How thick the gravels are cannot be stated as the wells only go a few feet into them. From the meager field exposures of the lake deposits it appears that the gravel deposits are largely in the eastern end of the lake and that the deposits in the western part of the lake plain are largely silts and clays. However, some sand may be seen around the edge of the lake deposits. One of the best exposures of the lake deposits is obtained where State Road 43 crosses Mill Creek. A portion of this exposure, showing the stratified nature of the deposits, is shown in Figure 4. Portions of the deposits are finely laminated, almost varved. The silts here rest upon glacial till which is slightly below the level of the road. The altitude of the base of the deposits is about 730 feet. This is about 25 feet below the level of the lake terrace here; so there seems to have been about 25 feet of filling in this particular locality.

Near the center of Section 32, T. 12 N., R. 4 W., there is an exposure of lake deposits about 30 feet in depth. It thus appears that 30 feet represents the minimum amount of filling in the lower end of the lake, and it seems likely that it was more than that farther east.

Relation of Cataract Falls to Lake Quincy.—Waterfalls are not very common along the streams of Indiana; so the occurrence of the two falls along Mill Creek suggests something unusual in the history of Mill Creek. While the falls would not attract much attention in some sections of the United States, in Indiana they are unusual, and the owner of the land on which they occur charges ten cents to see them.

⁷Collet, John, 1875. The geology of Owen County. Ann. Rept. Indiana Geol. Surv. 7:319.

Reference has already been made to the fact that the valley of Mill Creek above Cataract Falls is quite different in character from that portion of the valley below the falls. Mill Creek flows as a sluggish stream in that portion of its course which crosses the old lake plain. The present floodplain of Mill Creek at the northern end of the lake plain in southeastern Putnam County is at an elevation of 725 feet. In a stream distance of about 12 miles between this point and upper Cataract Falls, the river falls about ten feet. The upper Cataract Falls



Fig. 4. View of Lake Quincy lake deposits at the bridge over Mill Creek on State Road 43, showing stratified nature of the deposits.

are at an altitude of 715 feet. Below Cataract Falls, the valley of Mill Creek changes into a picturesque gorge, and in two falls of about 25 feet each and a series of rapids the stream falls about 90 feet in a distance of less than two miles. Where Mill Creek joins Eel River, the valley floor is at an altitude of about 620 feet. The gorge below the falls is in places about 200 feet deep, as the surrounding upland gets up to over 810 feet in elevation. The site of the upper falls is shown in

Figure 2. The lower falls is about a mile down the valley from the upper falls.

It is not known for certain what the exact course of Mill Creek was prior to the Illinoian glaciation, but it seems likely that it followed a southwesterly course in the same general direction that it now flows. There seems to be no convincing evidence to indicate that Mill Creek flowed to the south into White River as suggested by Collett. The elevations along Spangler's ridge would seem to preclude this possibility. Doubtless the pre-Illinoian valley was more deeply entrenched in the upland than the present valley is in the portion of its course above Cataract Falls. The advance of the Illinoian ice sheet from the northwest blocked the southwest drainage of Mill Creek and resulted in the formation of Lake Quincy as discussed above. For a time Lake Quincy drained out to the southeast into Little Limestone Creek and thence into White River, but after a time a lower outlet was found

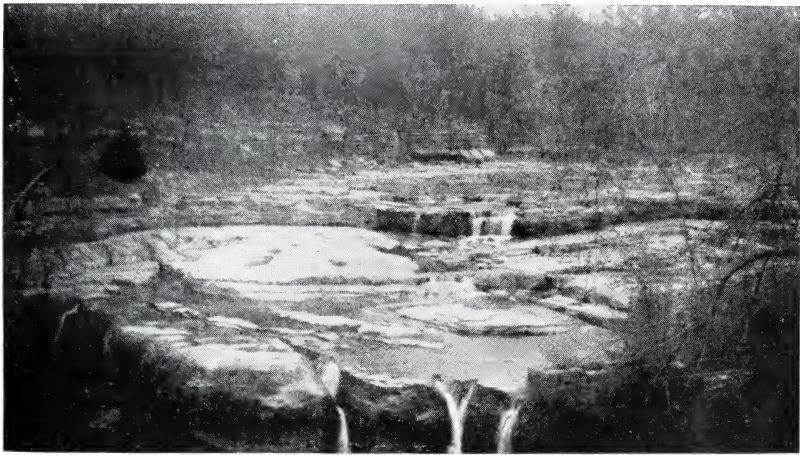


Fig. 5. View of the Upper Cataract Falls.

to the west near the village of Cunot. The lake existed for a long enough time for at least 30 feet of lake silts to accumulate in its basin. Cataract Falls developed at the time that the outlet of Lake Quincy changed from the southeast into Little Limestone Creek to the west into Eel River. Due to the filling which had taken place in Lake Quincy, the new outlet to the west developed at a considerable height above the old valley of Mill Creek, which had been buried under the lake deposits and discharged into the pre-Illinoian portion of the valley below Cataract Falls. After Lake Quincy had disappeared, either through filling of its basin with inwash or through lowering of its outlet, Mill Creek established its present course across the newly exposed lake plain. In the course of cutting out its valley in the lake deposits, Mill Creek encountered a buried ridge composed of the Mississippian limestones of the region, and this buried limestone ridge has pre-

served the falls in Mill Creek. The original site of the falls was probably about two miles farther down stream than the present site. In the time which has elapsed since the draining of Lake Quincy, Mill Creek has removed considerable amounts of the lake deposits, particularly in the western part of the lake plain, where the present valley of Mill Creek is cut from 30 to 40 feet below the upper level of the lake deposits.

Glacial Lake Eminence

Proposal of name.—The name Lake Eminence is proposed for the second of the glacial lakes to be described in this paper. This name is taken from the village of Eminence in western Morgan County. There is no town located upon the lacustrine plain which marks the site of this lake, as is the case with Lake Quincy. The name of Lake Eminence was selected because the lake plain lies just north and east of the town of Eminence, and it also seemed appropriate because the lake was formed back of the Early Wisconsin (Shelbyville) moraine upon which the town of Eminence is located.

Early references to Lake Eminence. One of the earliest references to the lake area which is here designated as Lake Eminence is that of Brown⁸, who, in discussing the geology of Morgan County, has the following to say regarding the effect of the glacial period upon Morgan County:

“The glacial period has left its footprints on the surface of Morgan county in a manner that time will hardly efface. Beginning at the Mill Fork of Eel River, a little north of Eminence, there is a valley about five miles wide, extending in a northeasterly direction; crossing the valley of White Lick Creek a short distance north of Mooresville, it passes into Marion county between West Newton and Friendswood, and thence to the valley of White River. From its western origin, to a point in section 1, range 1, township 13, near Monrovia, the valley gradually narrows to a width of about one mile. Originally, this section of the valley was a continuous lagoon, or swamp, locally known as ‘The Lake’; but now it is drained westwardly into Eel River, by a public ditch, which has become quite a large creek. On the northern side, the depression of this valley seldom exceeds forty feet below the general level of the country, and the descent is commonly quite gradual. On the opposite side, the country rises from fifty to one hundred feet, and sometimes pretty abruptly. From the watershed near Monrovia, the drainage is eastward, by McCracken’s Creek, to White Lick. . . . The topography west of White Lick indicates that this valley was the southern margin of the ice-field for a long time, and received the drainage floods from the disappearing glacier. South of this, I observed no gravel beds, or other evidence of rapid currents that mark a dissolving glacier.”

Another reference to this laked region is that of Edmondson⁹, who, in discussing the topography of Morgan County states:

“In the northwest part of the county is found a wide, low, inland valley, locally known as the ‘Lakes.’ From its outlet, into Eel River, west of Eminence, it extends in a northeasterly direction across Adams Township, touches the northwest corner of Gregg Township and reaches into Monroe Township to a point northwest of Monrovia. Here the wide ridge of rolling upland extending northward from the White River valley, several miles to the south, forms the divide between this and the level country

⁸Brown, R. T., 1883. Geology of Morgan County. Ann. Rept. Indiana Dept. Geol. and Nat. Hist. 13:80.

⁹Edmondson, J. B., 1911. Soil survey of Morgan County. Ann. Rept. Indiana Dept. of Geol. and Nat. Res. 36:84.

farther to the northeast. (Hence the statement by a former geologist (Brown), that the valley extends entirely across Morgan County and joins the White River valley in Marion County, is hardly possible.) The Lake region which was formerly covered with water the greater part of the year was slowly being reclaimed by the growth and decay of vegetation before the advent of the white man. By the use of large dredges and ditches this swamp has subsequently been converted into one of the richest farming regions in the State. . . .

"The lowest part of the valley extends east across the central part of Adams Township, nearly two miles south and approximately parallel to Mud Creek. This was the original outlet to the area, but the gradient being so slight it availed little as an outlet, becoming so filled in that drainage was stopped and the region was covered with runoff from the surrounding uplands a good part of the year. A few years ago, however, this old drainage course was reopened by a large dredge ditch and the drainage difficulties have been solved. The dredge or 'Lake Ditch,' begins in Monroe Township, northwest of Monrovia, and follows the lowest part of the valley in a southwesterly direction across the townships of Monroe, the extreme northwest corner of Gregg, and across the central part of Adams, emptying into Eel River, northwest of Eminence. The ditch is about twenty miles long and is estimated to drain 64,000 acres of extremely fertile soil. Emptying into it is a number of State ditches and many tile drains. In addition to this, the drainage facilities of the region have been much facilitated by the removal of an obstructing dam from Eel River and the straightening of its channel. By these means the water table in this area has been materially lowered although crops still suffer frequently from floods after excessive rains."

Relation of Lake Eminence to Lake Quincy.—The lacustrine area which is here designated as Lake Eminence lies just north and east from the Lake Quincy lake plain, and the two lake plains form a nearly continuous plain extending from northwestern Owen County into southern Hendricks County. They are developed at such similar elevations that it is not at all surprising that they should have been considered by the earlier geologists as part of the same lake plain. The Lake Eminence lake plain was so obviously the site of a rather recent lake that even the early settlers recognized this and referred to the area as pointed out above as "The Lake" or "The Lake Country." The field work done by the writer has convinced him, however, that the two lakes are of different age and even different origin. There are two convincing lines of evidence which indicate that Lake Eminence was formed much later than Lake Quincy. In the first place, the Lake Eminence lacustrine plain is much less dissected on the whole than that of Lake Quincy. Figure 6 is a view of the Lake Eminence plain taken about two miles northeast of the village of Eminence looking northwest across the floor of the lake flat. It has not been dissected at all throughout most of its extent. Only immediately adjacent to Mill Creek has any terracing occurred, where the present floodplain of Mill Creek has been cut from 10 to 15 feet below the original level of the lake bed. The Lake Quincy lake plain, on the other hand, has been noticeably dissected, particularly in its western portion, where Mill Creek has cut down about 30 to 35 feet into the lake silts and removed a considerable volume of the lake deposits. Only the upper end of Lake Quincy resembles the Lake Eminence plain.

More convincing evidence of the later age of Lake Eminence is found in comparing the depth of leaching in the deposits made in the two lakes. As was pointed out above, the Lake Quincy lake deposits have been leached of their carbonates to a depth of between 12 and 15



Fig. 6. View across the Lake Eminence lacustrine plain, about two miles north-east of Eminence.

feet, which indicates an Illinoian age for the lake. However, the deposits laid down in Lake Eminence have been leached only to a depth of between five and six feet on the average. This clearly indicates an Early Wisconsin age for Lake Eminence, as this depth of leaching corresponds closely with that found in the Early Wisconsin drift of the surrounding uplands. Thus, there is no escaping the conclusion that Lake Eminence was separate and distinct from Lake Quincy, which developed during the Wisconsin glacial epoch rather than during the Illinoian.

Description and origin of Lake Eminence lacustrine plain.—The Lake Eminence lake flat is extensively developed in northwestern Morgan, southeastern Putnam, and southwestern Hendricks counties. It covers a total area of approximately 30 square miles. The ponded condition extended up Mill Creek about to Stilesville in southwestern Hendricks County. The most extensive laked area was in the region between Monrovia and Eminence, east of Mill Creek.

The lake plain occurs at an altitude of 760 feet on the east and north and slopes southwestward to an altitude of about 750 feet where it abuts against the Shelbyville moraine. This gives it a downstream slope of about one foot to the mile. It will be noted that this corresponds very closely with the elevation at which the Lake Quincy plain is most extensively developed in its lower portion.

Figure 2 shows the relation of the Lake Eminence lacustrine plain to the Early Wisconsin or Shelbyville moraine upon which the village of Eminence is located and clearly shows that Lake Eminence was formed back of this moraine due to the ponding of the southwest drainage of Mill Creek by this moraine. The highest point on the Shelbyville moraine about one mile east of Eminence has an elevation of 840 feet.

Most of the moraine reaches up to 800 feet or higher. This moraine thus stands from 50 to 90 feet above the lake plain to the north of it. A considerable upland tract which was not covered by the lake lies in the area between Mud Creek and the Lake Ditch. Most of this upland tract lies below 800 feet in altitude.

One break in the upland which lies south of Lake Eminence is found in the south half of Section 29 and the north half of Section 32, T. 13 N., R. 1 W., about one and one-half miles southwest of the village of Hall. Here a col at an altitude of 760 feet may be seen. It appears likely that this col acted as a spillway for the waters of Lake Eminence into Lambs Creek and thence into White River during the early stages of its existence. The lake probably drained out through this route until the morainal dam across Mill Creek was cut lower than the outlet to the southeast, after which Lake Eminence established its outlet to the southwest through Mill Creek.

On the whole, the deposits in Lake Eminence are somewhat more coarse than those in Lake Quincy. Not many good exposures of these deposits are available, due to the undissected nature of the plain, but where they may be seen, as along the Lake Ditch, they exhibit large amounts of sand and gravel and very little of the finer silts and clays which are so abundant in the Lake Quincy region.

Summary

The existence of an extensive area of lacustrine flats in portions of Owen, Morgan, Putnam, and Hendricks counties was recognized by early geologists, but most of the early observers assumed that the lake plain was all developed as part of one lake. The results of the present study indicate that there were two lakes developed in the region, one during the Illinoian glacial epoch and the other during the Wisconsin glacial epoch.

The name Lake Quincy has been given to that portion of the laked region which represents the site of the Illinoian lake. It developed as a pro-morainal or marginal lake around the border of the Illinoian ice sheet and was the result of the ponding of the upper portion of Mill Creek's drainage. During the early stages of its existence it discharged through a spillway into Little Limestone Creek and thence into White River near Gosport. Later in its history a lower outlet was developed at the west into Eel River. The lacustrine plain which marks the site of Lake Quincy covers between 40 and 50 square miles and is most typically developed at elevation between 755 and 770, but at the east the lake plain rises up to as high as 790 feet. There is no evidence to support the idea that Mill Creek prior to the Illinoian glaciation discharged through the present route of Rattlesnake Creek into White River, but it appears to have had a southwesterly course somewhat similar to its present course. Cataract Falls developed at the lower end of Lake Quincy where the post-Illinoian Mill Creek discharged into that portion of its pre-Illinoian course which had not been ponded. The falls have been preserved due to the fact that Mill Creek in excavating the lake silts in the lower part of the lake plain encountered a buried ridge or spur underlain by limestone. The Illinoian age of Lake Quincy is

indicated by the fact that the silts and clays deposited in it have been leached of their carbonates to depths of 12 to 15 feet, an amount of leaching comparable with that found in the Illinoian drift of the nearby uplands.

The name Lake Eminence has been given to the lake which developed just north of the site of Lake Quincy and back of the outer Early Wisconsin moraine which runs through the village of Eminence in western Morgan County. The lacustrine plain which marks its position is typically developed at an elevation around 760 feet, which is so nearly the same elevation as the Lake Quincy plain that it was thought to be a part of the Lake Quincy plain. The younger age of Lake Eminence is indicated by the fact that the lake deposits of this lake are leached to depths of only five to six feet. This depth of leaching corresponds closely with the depth of leaching in the Early Wisconsin drift and indicates that Lake Eminence was developed during the Wisconsin glacial epoch. The slighter amount of dissection of the Lake Eminence plain as compared with that of the Lake Quincy plain also indicates a younger age. It appears that Lake Eminence, during the early stages of its development, drained out to the south through a spillway into Lambs Creek and thence into White River; but it later developed a western outlet, and now the drainage of the lacustrine plain goes to the southwest through Mill Creek. The Lake Eminence plain covers an area of about 30 square miles and represents one of the most fertile soil regions in Morgan County.