THE GLACIAL HISTORY OF THE SANGAMON RIVER VALLEY AT DECATUR AND ITS BEARING ON THE RESERVOIR PROJECT

MORRIS M. LEIGHTON
STATE GEOLOGICAL SURVEY, URBANA

Glacial Geology seems so far removed from applied science that one might pass the judgment that it has no utilitarian end; that its chief justification lies in its contributions to pure geology, in helping to reveal to mankind that history of his surroundings. Without doubt one of its chief functions is that of supporting pure science, but one needs only to come in touch with the soil specialist, or the tunnel engineering expert, or the hydrographic engineer, or the materials-survey man to be reminded that in all states north of the glacial drift boundary and in glaciated mountains, Glacial Geology has a very definite bearing on certain industrial projects.

Experience has taught the engineer that the construction of a dam across any valley in the glaciated area must be undertaken with caution. The materials beneath the dam must have sufficient bearing power to support the weight of the dam, and must be tight enough to prevent seepage from beneath. The materials at the ends of the dam and in the natural walls of the reservoir must also be impervious to excessive leakage. In order to pass judgment upon the character of glacial material for these purposes the engineer desires to know the properties of these materials, the possible relationship of the porous to the nonporous, and the characteristics of the drift-sheets at his particular locality. Obviously this involves the principles of glacial and aqueo-glacial sedimentation and in some cases the differentiation of drift-sheets.

THE DECATUR DAM

At Decatur, Illinois, a dam is being constructed across the Sangamon River Valley, which will be 15 feet high above the present river level and which will impound the waters upstream for a distance of about 12 miles and create a reservoir over 3,900 acres of territory. The base of the

dam will be 72 feet wide including a concrete apron but exclusive of a 30-foot clay apron on the upstream side. It will extend to a depth of 3½ feet below the lowest part of the bed of the river, and cut-off sheeting will be driven to a maximum depth of 30 feet below the base of the concrete portion of the dam. The ends of the dam will be earth instead of concrete and cut-off sheeting will reach to somewhat less depth than in the central portion of the valley.

Before undertaking the construction, the engineering company made a series of test-holes across the valley to ascertain the character and thickness of materials. Samples were collected, but due to the fact that these were from a "churn-drill," which separated the coarse from the fine, nothing but sand and gravel was reported, whereas till was found later to be involved. Upon these data the specifications were drawn and the work was undertaken. In driving the cut-off sheeting, a hard-pan was encountered at varying depths which was practically impossible to penetrate. It, therefore, became desirable to know the nature of this hard pan, its thickness, and relations to underlying materials. A geological examination was consequently requested.

GEOLOGICAL PHENOMENA

Decatur is situated on the eastern border of the Shelbyville Moraine, which has a width here of several miles. The altitude of the moraine at the river bluff is said to be about 650 feet above sea-level. The valley here is about 50 feet deep, but farther west in the moraine it is 75 feet or more. West of the moraine it is scarcely over 50 feet, but is much wider than in the moraine. This seems to indicate that the portion beyond the moraine is pre-Wisconsin in age, and this is supported by some of the tributaries which are beheaded by the Wisconsin deposits.[1] The incision of this part of the valley in Illinoian drift would therefore make its age post-Illinoian and pre-Wisconsin.

Leverett states that the average thickness of the Shelbyville drift is 100 feet, an estimate based on the relief of

1. Leverett, Frank: The Illinois Glacial Lobe, U. S. Geol. Surv., Mono. 38, 1899, p. 518.

the moraine above. If this were the case, it would seem that the valley through the moraine must have been completely filled, but this figure seems excessive, and there are reasons for believing that the valley was not buried.

After the hard-pan was discovered, a new series of well-borings was made, this time in such a way that samples of the material as it actually occurs were taken at desired intervals. Three well-borings and four test-pits were put down on the north side and eleven well-borings and four test-pits on the south side. These revealed the following strata, as shown in Figure 1.

GENERALIZED SECTION OF THE STRATA IN THE SANGAMON RIVER VALLEY NEAR DECATUR, AS DETERMINED FROM BORINGS AND TEST PITS.

		Thickness Feet
3.	Soil and flood-plain alluvium, a brownish sandy silt toward the valley walls, becoming darker near the stream.....	5-10
2.	Sand and gravel, distinctly sandy, thins out toward the valley walls, thickens toward the stream, maximum thickness.....	35
1.	Till, called "hardpan" by the drillers, dense, compact clay with scattered pebbles and bowlders, difficult to penetrate, contains a few thin layers of sand, of which the thickest, 12 feet, is on the south side, maximum thickness penetrated.....	54

An examination was made of the glacial till exposed in the new sewage ditch along the valley farther west in the moraine. The till here contained considerable masses and thick lenses of gravel and sand, some of which show marked contortion by ice movement. One of these lenses was about 200 yards long. If such a lens were to occur in the till beneath the dam, it might permit excess leakage. But the till in the sewage ditch seems quite clearly to belong to the Shelbyville moraine, while the till beneath the dam appears to be Illinoian, of the ground moraine type. If so, their difference in origin would appear to have a direct bearing on the question of dam construction. The reasons for this discrimination will now be considered.

SUPERPOSED DRIFT-SHEETS IN THE NORTH VALLEY WALL.

In the north valley wall at the dam site, the construction company has opened a clay pit for obtaining clay filling. An unusual section is there exposed, having the following sequence:

3. Wisconsin till, overlain by "wash" from the slopes and capped with soil; upper part, including "wash", is leached 3 to 4½ feet, the underlying 0 to 2½ feet being calcareous; total exposed .....4½ to 7 feet
2. Old soil .....6-8 inches
1. Illinoian till, gray below the soil, brownish below, leached 3 to 4 feet, calcareous below, compact; total exposed.....6 feet

A short distance west, the ditch for the cut-off sheeting, which transects the valley slope, shows the same sequence, but here the trend of the exposure is at right angles to the valley and shows the relation of the pre-Wisconsin surface to the valley. The contact dips steeply toward the valley in conformity with the valley wall. Thus it appears that the present north valley wall is almost essentially that of pre-Wisconsin times. This is in agreement with the belief that the thickness of the Wisconsin drift was not sufficient, at least along the line of the Sangamon Valley, to fill the valley. The failure of the hard-pan to rise as much on the south side of the valley as on the north is taken to indicate that the valley was wider in pre-Wisconsin time than at present. This is in harmony with the characteristics of the valley outside of the moraine.

The hard-pan beneath the dam is at just such a level as one would expect if the slope of the surface of the Illinoian drift were projected into the valley. The sand deposit of the valley, at this point, is, therefore, believed to rest directly on Illinoian drift, with little or no Wisconsin drift intervening. The "hard-pan" is characteristic of the Illinoian. Leverett has recorded the general observation of well drillers that the passage from Wisconsin to Illinoian drift is marked by a difference in hardness, "the earlier drift being partially cemented and much more difficult to penetrate than the overlying later drift sheet."[1]

1. Idem, p. 199.

glacial waters, a valley train was deposited, which may have come from the ice during the building of the Cerro Gordo moraine. Since the disappearance of the ice, the sand and gravel fill has been partly eroded away and a flood-plain, 150 to 200 feet wide, has been developed on both sides of the stream.

RELATION TO THE RESERVOIR PROJECT

According to the foregoing interpretation the "hard-pan," or glacial till, which is to receive the cut-off sheeting, is drift of the Illinoian ground moraine and not drift of the Wisconsin terminal moraine. Since the drift of the Illinoian ground moraine was deposited chiefly beneath the ice, rather than at its terminus, it is a typical clay-till. It is, therefore, unlikely that it contains lenses of sand and gravel thick enough to afford excessive sub-surface leakage as would likely be the case if the drift were a part of the Shelbyville moraine.

SAND AND GRAVEL FILLING OF THE SANGAMON VALLEY.

The sand and gravel filling in the Sangamon Valley has already been noted. No distinct terrace is shown at the dam site, but on the south side of the valley, slightly above the present flood-plain, gravel underlies alluvium and "wash" from the south slope. All of this gravel filling is believed to be correlative with the remnants of gravel terraces which occur both upstream and down, and which appear to have been deposited as a valley train from the ice during the building of the Cerro Gordo moraine.

SUMMARY OF THE HISTORY OF THE SANGAMON VALLEY AT DECATUR

Restricting our discussion to that part of the Sangamon Valley at Decatur, it may be stated that present data indicate that it dates back to the Sangamon interglacial epoch, and probably to the close of the Illinoian glacial epoch. Upon the melting of the Illinoian ice, the area was a flattish ground moraine, and during the Sangamon interval, the drainage cut a relatively broad, shallow valley at Decatur commensurate with that portion of the valley beyond the Shelbyville moraine. Contemporaneous with the valley cutting, the Illinoian till was leached and oxidized and soil was developed, extending down some parts of the valley slope.

The change of climate from warm to glacial resulted in the Wisconsin ice invasion which reached its extreme limit a few miles west of Decatur. For a time the ice edge remained within the zone of the Shelbyville moraine and radically changed the contour of the Illinoian surface by depositing morainic materials. Some of them were deposited directly from the ice, some by the glacial waters. Readvances of the ice contorted the gravels and buried them with till. As a result, the moraine was formed of both till and sand and gravel with complex relations.

The amount of drift deposited across the valley was not enough to fill and eradicate the valley. The concentration of the glacial waters doubtless helped to keep the valley free. Consequently enough of a depression was left to serve as a drainage line upon the retreat of the ice-front. In this inherited depression, after some modification by the