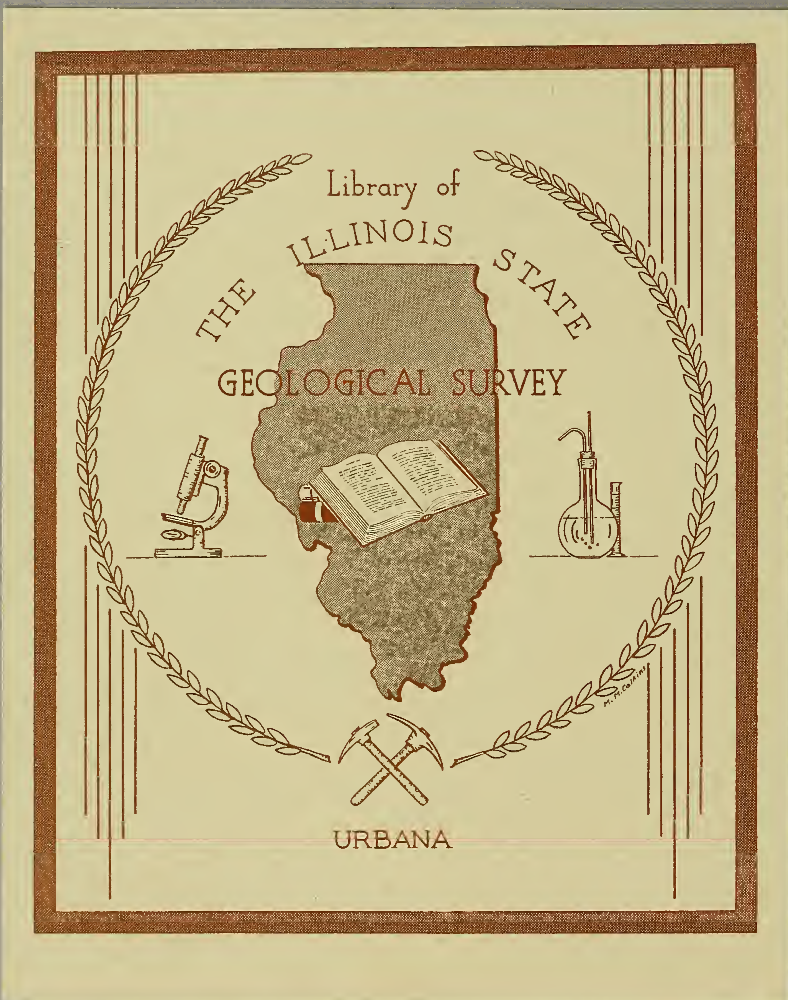

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M. M. LEIGHTON, *Chief*
URBANA

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ENGINEERING ASPECTS OF THE GEOLOGY OF THE VIENNA CITY RESERVOIR

BY

GEORGE E. EKBLAW

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Engineering Aspects of the Geology of the Vienna City Reservoir*

George E. Ekblaw

State Geological Survey, Urbana, Illinois

During the latter part of 1936 the city of Vienna, in the southern part of Illinois, undertook to construct a dam to impound water for a municipal water supply. The dam obstructs the valley of McCorkle Creek, a tributary of Little Cache Creek, in the SE ¼ NE ¼ sec. 3, T. 13 S., R. 3 E., just north of State Highway No. 146, about two miles east of Vienna. Examinations of the geologic situation at the damsite were made during early phases of construction.

The valley of McCorkle Creek is relatively long and narrow. At the damsite the northwest wall of the valley is nearly vertical for about 30 feet, the stream channel is narrow, and the southeast wall of the valley is a gentle slope. Farther upstream the stream channel is less prominent and both valley-walls are moderate slopes.

The Menard, Waltersburg, Vienna, and Tar Springs formations of the Chester (Upper Mississippian) series comprise the bedrock in the vicinity of the damsite and are covered generally by a mantle of loess so thin that outcrops are numerous. Dark-colored limestone of variable texture and containing some chert, comprising the middle member of the Vienna formation, forms the northwest wall of the valley at the damsite but farther upstream it lies in the bed of the stream and extends across to the southeast wall of the valley. Excavation for the northwest end of the dam exposed beneath the limestone about 4 feet of dense, sticky, plastic, gray, clayey shale (the lower member of the Vienna formation) with a layer of coal or coaly material 0-1 foot thick about a foot below the top. The lower part of this shale member, with another coaly streak near the base, is exposed along the upper part of the banks of gullies on the southeast valley slope.

Along the northwest slope of the valley the limestone grades up through silty limestone with shaly structure, constituting the upper member of the Vienna formation, then through shaly sandstone into firm, thin-bedded sandstone several feet thick—the Waltersburg formation—overlain by the Menard limestone. The massive, well-bedded Tar Springs sandstone underlying the Vienna formation is exposed in all the gullies along the southeast slope of the valley. Not far below the damsite the valley changes in character in that it is filled with slack-water deposits several feet thick which effectively conceal the bedrock, and the slopes are consequently modified so that the loessial mantle also becomes an effective cover for the bedrock. All of the formations dip or slope northwesterly at an appreciable angle that is roughly represented by the southeast slope of the creek valley.

The course of the creek was determined and the development of its valley has been controlled by the character and structure of the bedrock formations. Undoubtedly it originally started in the soft lower shale of the

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Vienna formation which is less resistant than any of the subjacent or superjacent strata. As the stream normally cut down, it encountered the more resistant Tar Springs sandstone beneath the shale, and being able to erode the less resistant shale more rapidly than the sandstone, the stream migrated northwestward down the slope of the rocks, gradually deepening as well as widening its valley but being constantly "bottomed" by the sandstone. As it eroded the shale laterally it undercut the overlying limestone, of which blocks broke away, gradually slipped down into the stream bed, and there were eventually worn away by the stream. The softer silty limestone and

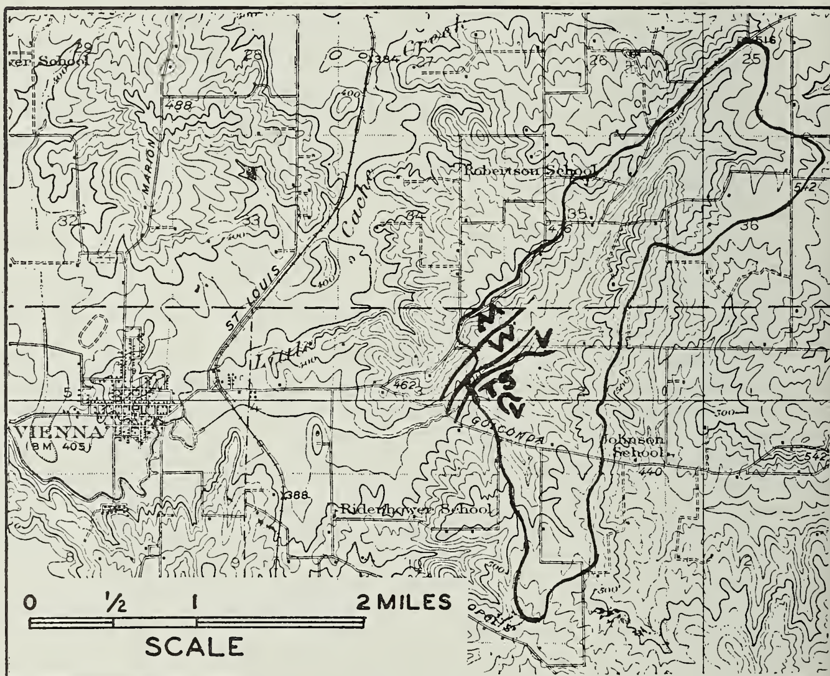

Fig. 1.—Part of Vienna quadrangle topographic map, showing location of dam for Vienna city reservoir, the limits of the contributing watershed, and areal distribution of bedrock at damsite. M = Menard limestone, W = Waltersburg sandstone, V = Vienna limestone and shales, TS = Tar Springs sandstone.

sandstone above the Vienna limestone weathered back more rapidly than the limestone, creating a gently sloping shelf that extends back to the massive Menard limestone, which in turn forms a relatively steep slope that rises to the top of the valley and which is spotted with sinkholes created by subsurface solution of the limestone.

In extending itself headward the creek happened to cross the limestone bed before it had deepened itself in the lower shale, so that in its upper course it follows the upper silty shale of the Vienna formation, also relatively less resistant, and at the present time this crossing of the limestone bed occurs where an east-west road crosses the valley a short distance above the damsite. As the stream migrated down the slope, it had a rubbly bottom which was abandoned as the stream migrated, leaving a layer of rubble over the sandstone bottom. Tributary gullies crossing to the stream bear additional rubble. The abandoned rubble was then covered by loessial silt, either as deposited directly by the wind or as washed down from higher positions.

The geological examinations were made in the first instance to ascertain whether or not the rocks were of such character that appreciable leakage from the reservoir might be expected and if so, what might be done about it. Based on the available data and consequent interpretations, it was concluded that the bedrock would not offer any such hazard. It was found that some of the Vienna limestone along the northwest wall had become disjointed in blocks that were somewhat separated from the main mass and that there were some solution channels in it, but these all seemed effectively filled with clay, and whatever possible minor hazard they might offer could be easily removed by reasonable precaution in construction, such as removing all loose blocks, flushing out soft fillings, and grouting.

However, it was pointed out that a real problem existed in the probable presence of rubble in the bottom of the valley, as large amounts of water could seep through it under a dam built only on top of the surficial loessial silt and might eventually undermine and so destroy the dam. Consequently, it was recommended that consideration be given to extending at least a core-wall through the rubble down to bedrock. A channel excavated across the valley as one of the early stages of construction in line with the above recommendation confirmed its value, as there was exposed rubble through which flowed an amount of water sufficient that the question as to whether it might serve as an adequate supply was raised. This question was, of course, answered negatively, in view of the limited amount of rubble that existed above the damsite and could serve as a subsurface reservoir.