

## THE SCIENTIFIC SEARCH FOR UNDERGROUND WATER\*

L. E. WORKMAN

*State Geological Survey, Urbana.*

Many cities and large industrial plants in Illinois are faced with the problem of finding increased supplies of good water. In every case two major possibilities must be considered: sinking a well or several wells to a water-bearing rock formation, and impounding surface water in a reservoir. Inasmuch as the impounded surface water is much more expensive than well water—on account of the first cost of buying land, constructing a dam, and building a filter plant, and the continuous cost of treatment after the improvement is completed—an attempt is usually made to secure water from an underground source if it is obtainable in large enough quantity and of sufficiently low mineral content. Failure often results in this search because there is no water-bearing rock formation to yield the desired supply, but in some cases a potential supply is not discovered because of a lack of understanding of the geological conditions governing the location of the water-bearing deposit. Every locality has its peculiar set of geological conditions, the understanding of which is very important in the fullest development of the underground water resources.

### BED ROCK

The availability of an underground water supply depends upon the geographical location, depth, thickness, extent, and porosity of the water-bearing deposit. Important data on the character of the subsurface material at any proposed location can be obtained from a study of drilling records already on file at the State Geological Survey. It is possible indeed, to predict with some degree of confidence the water possibilities of a well into the consolidated bed rock formations at any place in the northern third of the state, because of the compilation of numerous records of wells and the publication of several geologic and water reports on the region. The bed rock formations generally maintain their

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characters through long distances, but there are a considerable number of exceptions which make geologic advice previous to and during drilling high desirable.

Throughout northern Illinois the St. Peter sandstone is a prominent aquifer; nevertheless it yields but little water in the vicinity of Chicago because it is already too heavily drawn upon by wells in the region. At Gardner, also, the sand is so fine-grained and closely packed that a well to the St. Peter has proved a failure. East of Des Plaines the rocks have been faulted, so that, when a well to the Cambrian sandstones was attempted, it was necessary to run the casing down to the bottom of the hole as drilling proceeded, in order to protect the well from filling up with the caving broken rock; as a result, when the well was finished, all water was likewise effectually cased out. In contrast to these illustrations of undesirable conditions, there is in the vicinity of La Salle a sandstone formation lying under the St. Peter, known as the New Richmond sandstone, which reaches a known thickness of 188 feet and is an important aquifer in that region; laterally it thins rapidly to a thin layer of dolomitic sandstone which carries very little water.

#### GLACIAL DRIFT

The problem of finding water-bearing sand and gravel deposits of suitable extent, thickness, and porosity in the glacial drift is more complicated than the study of bed rock aquifers. The drift deposits, being much more irregular in location and extent, require not only a comparison of available well records but a field study of the topography, streams, rock outcrops, drift exposures, springs, and local wells of all kinds for several miles in all directions from the place of demand. Chemical tests of water from significant wells in the community are also important. The survey should not only reveal all known sand and gravel deposits, but provide a knowledge of the Pleistocene history of the region which will lead to the discovery of deposits not directly apparent. Such studies have often yielded very satisfactory and at times spectacular results. Almost the entire southern two-thirds of Illinois must rely for city water supplies upon glacial and recent sand and gravel deposits or impounded surface water, as the water in the bed rock is usually very highly mineralized. Although it is recognized that for many cities no amount of prospecting will disclose

an adequate supply of underground water, especially those further south, for some cities there still lie hidden large supplies or water of better quality than have yet been obtained.

#### TAYLORVILLE

The most recent successful search for a better underground water has just been completed at Taylorville. An entirely adequate supply can be obtained from the two wells now in use there, but as the water contains an average of 682 parts per million of hardness it was hoped by city officials that a water of better quality could be found. Accordingly, the State Water Survey and the State Geological Survey were requested to study the situation and recommend locations for test holes.

A comparison of numerous coal test records on file at the Geological Survey revealed the fact that a preglacial valley extends in a northeast-southwest direction across Christian County through Taylorville as shown by the contours in figure 1. The logs also indicated that numerous and thick beds of sand and gravel are present in the drift above the bed rock. The conditions are emphasized in the field by the lack of bed rock outcrops in all valleys for several miles from Taylorville, the presence of outcrops outside the area of the preglacial valley, the presence of sand and gravel beds exposed in cut banks of drift in the area, and the locations of several springs. Thus it is apparent that the region of this preglacial valley was at one or more times the site of deposition of sand and gravel poured out by glacial streams.

Inasmuch as the investigation was made primarily to locate a water of better quality, a number of samples of water were taken from significant wells in the vicinity and were analyzed by the State Water Survey. It was found that the water is progressively softer toward the northeast part of the city, where the Hopper Paper Mill and Wabash Railroad wells yield water with a hardness averaging 200 parts per million. Four test holes were drilled in different directions from the Hopper Paper Mill at distances of over 1000 feet, and samples of the material encountered were saved at depth intervals of five feet or less. Each new location was made only after a careful study of the samples and a correlation of materials from the preceding wells.

The test holes revealed the fact that the "glacial sand and gravel deposit," indicated in figure 1, which supplies water to the



various wells in the city, has filled to the brim and obliterated all traces of a valley in the glacial drift, more than half a mile wide and 100 feet deep, extending in a northeast-southwest direction along the line of the bed rock depression. The coarsest part of the gravel deposit was found at the bottom in all test holes, and the largest pebbles and greatest thickness of coarse material were found in the test hole farthest northeast.

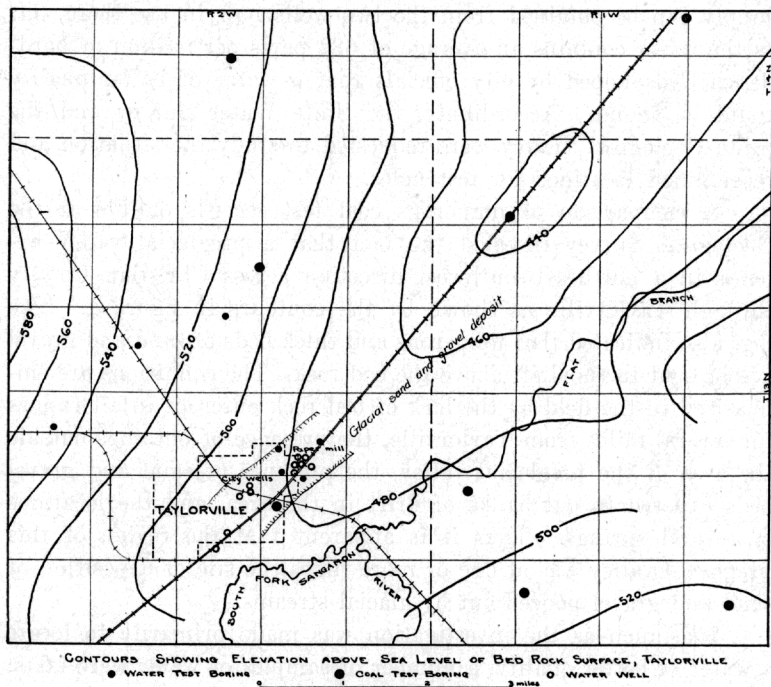


FIG. 1.

The water of lowest mineral content came from the northeast test hole, a sample taken from the bottom of the hole having a hardness of 215 parts per million. It is thought that the water in the gravel may flow from northeast to southwest through coarser to finer material, dissolving minerals as it goes, thus producing a water of highest mineral content in the southwest. If the interpretations are correct, a well drilled northeast of the Hopper Paper Mill will assure the city of a large continuous supply of water having a lower mineral content than the water now used.

## MATTOON

The situation at Mattoon not only illustrates a different type of glacial sand and gravel outwash deposits but also shows how results might be obtained even when the situation looks unpromising. During the last five years the Central Illinois Public Service Company has been trying to find an additional supply of water for the city. Under the direction of Mr. J. A. Rue, Division Engineer, over thirty-five test holes have been drilled in an attempt to locate a thicker portion of a sand and gravel bed which had been noted

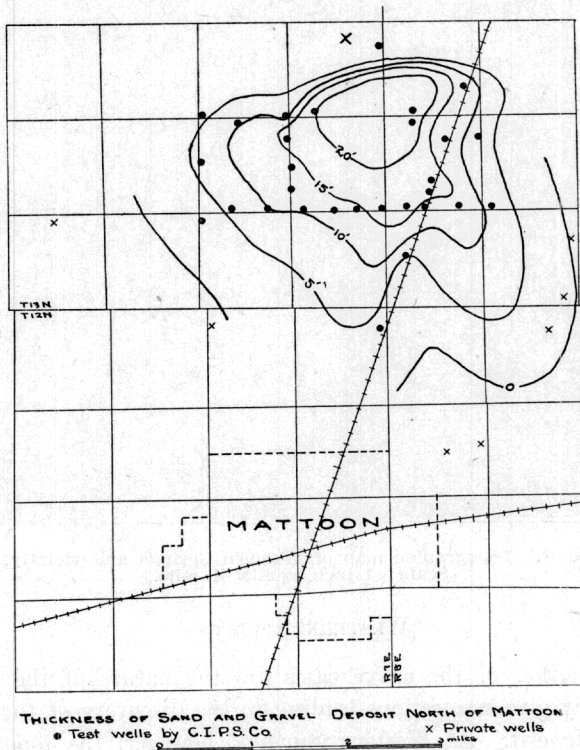


FIG. 2.

in several wells as being a few feet thick and lying on top of an old soil at a depth of from 35 to 50 feet. The search took them five miles north of Mattoon, where the deposit was found to thicken to over 20 feet, spreading out in a fan from the thickest portion at the northern edge as shown in figure 2. The fan occupies an area of approximately nine square miles, and pumping tests seem

to indicate that a larger supply of water has been located than is now used for the city. It is probable that the deposit was made by a debris-laden glacial stream pouring out from the ice while the ice-front stood stationary for a time at the northern edge of the deposit. It was later covered over by the advancing glacier, and no trace of it was left on the surface of the drift when the ice finally retreated.



FIG. 3. Topographic map of Western Springs and vicinity.  
Scale: 1 inch equals  $\frac{1}{4}$  mile.

#### WESTERN SPRINGS

In neither of the above cases did the nature of the present topography give suggestions leading to the discovery of the water-bearing deposit. At Western Springs, however, the topographic map, shown in figure 3, suggests a possible favorable situation. Flagg Creek valley, lying west of Western Springs, was apparently cut by a larger stream than the present Flagg Creek. It is inferred that a larger stream once flowed through the valley and might have deposited important beds of sand and gravel. In fact, a record of a well drilled for bedrock water in the middle of the valley shows 28 feet of gravel on top of the Niagaran

dolomite. It was, therefore, recommended to the city, which was seeking relief from a water of high mineral content derived from the Niagaran dolomite, that several test holes be drilled across the valley to determine the nature and extent of a possible gravel bed. Such an investigation is now in progress.

#### COOPERATING AGENCIES

The State of Illinois has two agencies cooperating in the search for underground water supplies: the Geological Survey, which considers the geological situation, and the Water Survey, which studies the chemical character of the water and the quantity available. Thus it is possible for a municipality to obtain a complete survey of all the natural aspects of a proposed water-supply development.