WATERSHED LEAKAGE IN RELATION TO GRAVITY WATER SUPPLIES*

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PROBABLY everyone has noticed the apparent difference in yield sometimes occurring in the case of small adjacent similar drainage areas. When the precipitation, soil and cultural conditions for such areas are similar, the difference in yield is no doubt due to watershed leakage.

Watershed leakage may be defined as the passing of waters underground from one topographic drainage basin into another. The area tributary to a stream at any point may be considered as the drainage basin at that point. Watershed leakage often occurs from the upper to the lower portions of the same drainage basin, that is to say some of the waters naturally tributary to the stream above a certain point do not enter the stream above the point, but pass underground into the stream at some lower location.

Watershed leakage may also be defined as a condition where the boundary of the ground water horizon supplying the stream is not coincident with the surficial watershed line. Nearly all large artesian systems involve watershed leakage, but this discussion will be mainly limited to its occurrence in conjunction with the surficial ground water horizon.

Watershed leakage from the upper to the lower portion of the same drainage basin, or from the lower portion of a tributary to the stream it enters is commonly called "underflow" in the west. Its occurrence requires that the ground water horizon shall lie below the level of the stream bed. In such cases water may be lost from the stream directly by percolation from the stream bed, or there may be no such loss, since the bed of the stream frequently becomes water-tight or impervious as a result of the silting up of the pores in the stream bed material.

A stream channel of this character has been described by O. E. Meinzer as an "insulated stream." If there is loss from the stream channel, all the water may disappear during the dry season and the stream become intermittent in a given reach, having a visible or surface flow only during floods, such run-off as occurs at other times being in the form of underflow. This condition is a common one on rivers of the plains.

Watershed leakage on a large scale, as in the case of plains streams, or underground rivers in limestone regions, is obvious. It is the occurrence of similar conditions on a

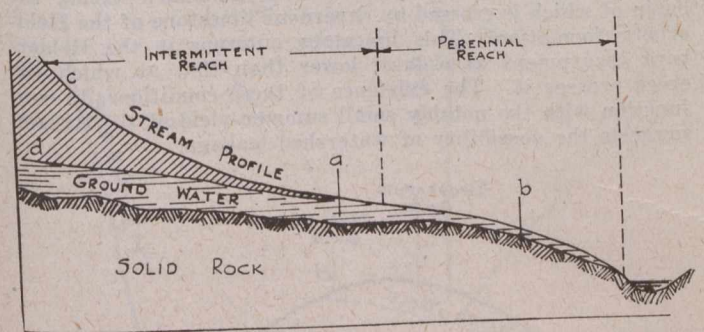

FIG. 1—WATERSHED LEAKAGE FROM UPPER TO LOWER PORTION OF SAME BASIN

small scale, where the phenomenon is not obvious, or might not even be suspected, to which attention is especially called. As will be pointed out, watershed leakage, of sufficient extent to seriously affect the accuracy of estimates of stream yield or run-off, is more likely to occur in conjunction with the basins of small streams than in conjunction with larger rivers.

Many gravity water supplies, and some high head power developments and irrigation systems, are dependent on the yield of relatively small drainage basins, which often lie at high elevations. Rainfall records in such basins, and gaugings of the yield of such small areas, are much less common than in the case of large drainage basins, and in estimating the available yield it is frequently necessary to depend upon studies based on rainfall and water losses, gaugings of other streams, or these data in conjunction with limited gaugings of the stream in question.

On account of the simplicity and uniformity of conditions commonly prevailing over the area tributary to a small

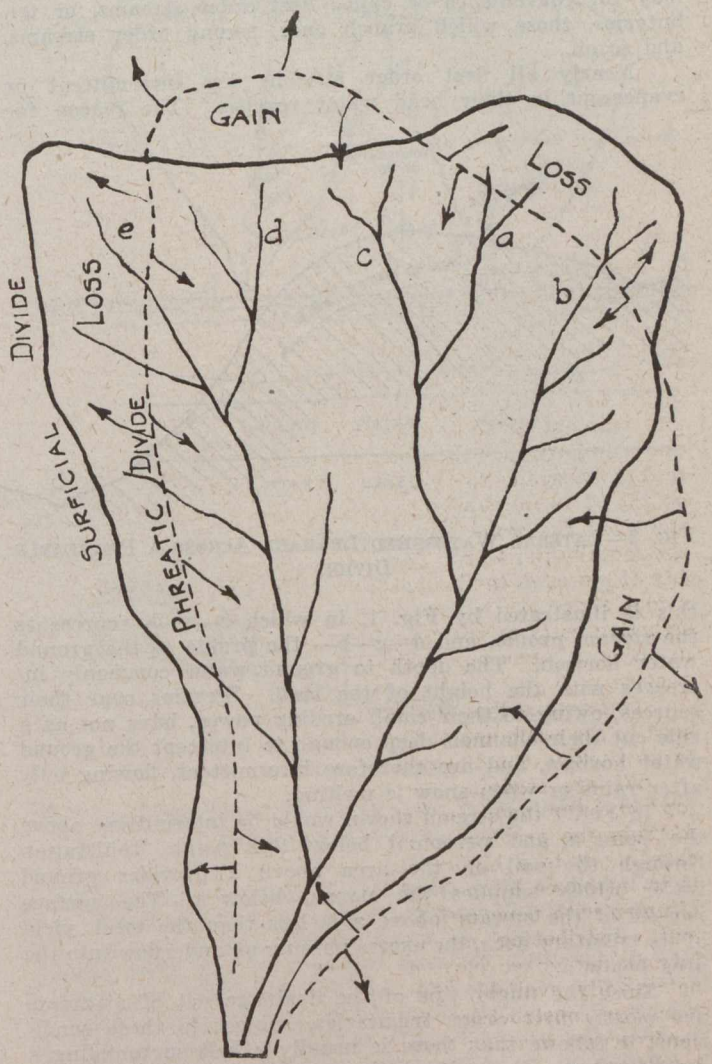

FIG. 2—CONDITIONS FAVORING WATERSHED LEAKAGE
Arrows indicate direction of flow of ground water.

stream, gaugings of the run-off from small areas should afford valuable data for the determination of the laws of stream flow. Conversely, it should be possible to estimate the water losses from such small areas more readily and accurately than in the case of large areas with complex and diversified soil and cultural conditions. In either case it is necessary, in order that the results may be correctly applied, that the basins under consideration should not be affected by watershed leakage.

In view of the considerations which have been presented, it appears that when any small drainage basin is proposed as a source of upland or gravity water supply, or for similar uses, where watershed leakage is liable to occur, if possible, the yield should be determined by gaugings. In the absence of a long gauging record, measurements during a dry period, in conjunction with observations of rainfall, are very desirable. If the occurrence of watershed leakage is suspected, the drainage basin should be examined with reference thereto. During high water, watershed leakage on a limited scale may effect the run-off of a drainage basin but little, since the ratio of ground water supply to surface run-off is then often relatively small, Gaugings taken during low water,

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