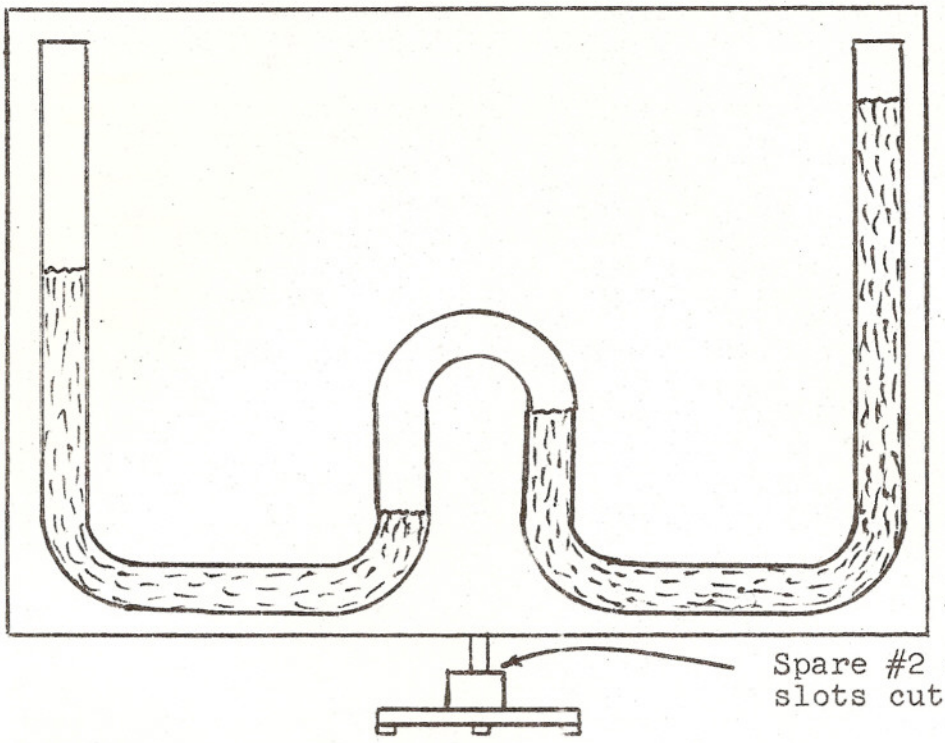
M-7 S-2




Use a W-shaped glass tube partially filled with water to which analine dye has been added. (See Notes 1 and 2.) Set the apparatus on the lecture table with its back toward the students. Not being able to see the tube, students will not know the answer in advance.

It is said that in the early days, having heard that water seeks its own level, many carpenters claimed that a hose with a transparent tube at either end and filled with water, could be used to ascertain when two widely separated points were at the same level, and this regardless of whether the hose might have "hills" and "valleys" between the two ends. While all agreed that levels so obtained were trustworthy if water was present throughout the entire length of the hose, there was disagreement as to whether levels so obtained were correct if a length of air was trapped in the hose.

Pose this question and inquire whether students think the presence of a length of air makes any difference. Then turn the apparatus around so students can see that the presence of air does invalidate levels obtained in this manner.

It can easily be shown that when air is trapped in the water column the only condition under which the water stands are the same height at the two ends of the tube is that under which the sum of the heights of the two ends of the lefthand water column above any arbitrary level is equal to the sum of the heights of the two ends of the righthand column above the same level. Since the sum of these heights for a given column depends upon the amount of water in the column, it is clear that these two sums are generally not equal.

Notes: (1) Do not tip the apparatus sufficiently to change the amount of water on either side of the trapped air. The amounts are presently proportioned to demonstrate most clearly the point being discussed. (2) Corks with air channels cut in their sides are placed in the ends of the tube to minimize evaporation. Their presence does not affect the demonstration. Nevertheless, to avoid confusing the student, it is suggested that the corks be removed prior to the demonstration. They should be replaced after the demonstration is concluded.