Taking all the foregoing into consideration, the conclusions as to the relative cost of the two types are as follow:—

1. The advantage in weight depends on the ratio of height to length. For a ratio less than 1:1, vertical framing will weigh less than horizontal girders. For a ratio less than 75:100 vertical girders will weigh less than horizontal arches.

2. In facility of construction the advantage is with the vertical framing.

3. In cost of walls and sills, there is no very marked difference between the two types.

The next point to be considered with reference to choice of type is the relative efficiency of the types available.

The word efficiency here is intended to mean the ability of the structure to perform its functions with the best results at the least expense for operation and maintenance. The service desired of a lock gate is for the two leaves to swing on their hinges like a door and, when closed, to meet each other accurately throughout their height at the centre line of the lock at the same instant that the lower part of the gate comes in contact with the sill. Both horizontally and vertically framed gates can be depended on to perform this function with more or less success, but a vertically framed gate does so at a less cost for maintenance, for the following reasons:

1. Buoyancy chambers are usually necessary in large horizontally framed gates, because such gates are always built with curved backs and it is not practicable to employ adjustable diagonal braces to take up the sag at the miter end of the gate due to the weight of the gate. In order to reduce this sag, the practice has been to build watertight buoyancy chambers in the interior of the gate so as to reduce the weight of the gate in water. Of course, provision must be made to keep these compartments dry and clean. In streams which carry a large amount of sediment these compartments will need cleaning after every freshet. Vertically framed gates can be, and usually are, built rectangular in shape, making it possible to use adjustable diagonals with which to take up the sag. Buoyancy chambers are not required and the expense incident to their care and maintenance is avoided.

2. There are fewer members in a vertical frame gate and, therefore, less area to be protected by painting and cleaning.

3. There are fewer large horizontal members to collect silt in a vertical frame gate and, therefore, less expense incurred in its removal.

4. The interior of a vertical frame gate is much more easily accessible on account of the absence of a large number of small cells into which a horizontal frame gate is divided by the many intersecting horizontal and vertical members.

The above indicates that the cost of maintenance of vertically framed gates will be less than for the other class.

We have still to consider comparative ease and reliability of operation. To dispose of this point, in the absence of examples of direct comparison, impossible because of the non-existence to date of very large vertically framed gates, I venture the assertion that the latter class will not suffer by comparison when such can be made. I base this assertion on knowledge of the successful working of this type of gate on the small locks of the Kentucky River, and on my inability to discover any reason which would prevent the successful application of the principle to larger lock gates.

All the foregoing seems to point to the desirability of using vertical framing for miter gates whenever the system will not increase the weight and, considering the greater simplicity of construction and the equal if not greater efficiency, the use of vertical framing appears to be justified even if it should result in a slightly heavier gate.

MICROSCOPIC WORK IN ROAD MATERIAL TESTING.

FROM the report for 1914-15 of the National Physical Laboratory in England, it is evident that the use of the microscope has figured a good deal in the attainment of results. In the treatment of specimens tested it is shown that a study of them has been carried out largely by preparing and examining micro-sections of the road at various stages, and the report mentions that one road in particular furnished results which are of interest as indicating the utility of the microscope in the study of road-construction problems. Three different sections of this road were examined, *viz.*: (1) A part of the road as laid down—*i.e.*, previous to the commencement of the test; (2) a part of the road after completion of the test, taken from a place where the road was still in good condition; and (3) another part of the road after the completion of the test where the road was in a bad condition.

From each specimen a small piece was cut at right angles to the surface of the track, and this was carefully polished and examined and photographed under the microscope. In this way the structure both close to the surface and in the interior could be studied. The road in question contained 55 per cent. of ⅜-in. granite, the rest of the mineral matter being of smaller grading. It was found that in this case there was on the surface a "carpet" composed of bituminous matter and fine mineral matter, having a thickness of approximately ⅜ in., all the large ⅜-in. granite lying below this carpet. "The whole work of the road," the report states, "appears to be taken by the carpet, and if for any reason this is either penetrated or removed the road begins to disintegrate rapidly. In that section of the track which was in good condition at the end of the test the structure was found to be identical with that of the road as first laid down, but in the section of the part which was in bad condition the ⅜-in. granite chips were visible in the surface."

Another road tested in the road machine broke up a few hours after the wet test, in which the entire surface is covered with water, had begun. A section of this road gave on analysis a very low percentage of bitumen, and when a similar road was laid again, using, however, a much higher percentage of bitumen, it withstood the water test for fourteen days. "This appears to show that with a certain grading there is a limiting percentage of bitumen which will make the road resistant to water action, although a much lower percentage will enable it to resist the same traffic in a dry state."

With a view to obtaining some information concerning the composition, grading, and micro-structure of various types of bituminous road, actual sections of roads in different parts of the country have been taken up, and are at present being examined. These include roads which have given very good results in practice, and also those which have failed soon after being laid down.