wire. Occasionally brush and stones or slag are used. The author employed as a temporary expedient for the Ogden Distributing Reservoir, until a more permanent paving could be put down, a paving of red pine boards extending 3 feet above and 6 feet below the flow-line along the slope and nailed to joists 3x8 imbedded in the bank and anchored at intervals. A very common method is to use a foundation, a compact, impervious and stable bank, on the inner slope of which is spread a layer of gravel or broken rock of sufficient depth to prevent the water from washing away the earth beneath. Upon this porous layer is laid the stone pitching or rip-rap, which may vary in depth from 1 to 2½ feet, depending upon the height of the waves and the action of ice and frost, the interstices of the stone pitching being filled with gravel spalls or broken stone. The usual form of cement concrete paving is a layer of screened gravel or broken rock well rammed, upon which is laid the requisite thickness of concrete. For a short distance, both above and below the flow-line, stone-pitching laid in cement mortar upon a thin layer of cement concrete should be substituted for the cement concrete paving. A concrete composed of clean sand, gravel and liquid asphalt in about the following proportions is sometimes employed:

Gravel	70	per cent. by weight.
Sand	30	" "
Liquid Asphalt	10-15	" "

The sand and gravel are heated to a temperature of over 300 Fahr. and mixed with the liquid asphalt at a slightly lower temperature.

It is put on hot in a manner similar to street paving and varies from 1 to 4 inches in thickness.

A paving formed of brick and asphalt is also advocated. The brick on the bottom may be laid flatwise on the lower portion of the slope 4 inches and near the flow line, 8 inches, in thickness. to prevent the brick from absorbing moisture a thin layer of asphalt mortar, composed of 90 per cent. by weight of clean sand mixed with 10 per cent. by weight of liquid asphalt, is first spread over the rammed gravel; the brick are then dipped in hot asphalt, and after being laid grouted with the same material. A thin surface coating of asphalt of about ⅛th of an inch in thickness completes the lining. In discussing the relative merits and demerits of each type of paving represented above, little need be said of the first two named, since the early decay of both willows and lumber render periodical renewals necessary.

Many failures are recorded of stone pitching or rip-rap, but in nearly every instance they were caused by the washing away of part of the embankment immediately beneath the rip-rap. Under ordinary conditions wash can be prevented by placing a sufficient thickness of gravel or broken rock back of the pitching, and carefully filling all interstices of the latter with coarse sand and gravel. The general success which has attended this kind of paving does not warrant, in the opinion of the writer, the following severe censure from the pen of Samuel McElroy, C.E., of Brooklyn, N.Y.:—

"The only way to protect an earth reservoir bank, or floor, is to keep it dry; otherwise pressure, storm wash, motion, leakage, frost or animals may weaken and destroy it. Dry work, properly laid, requires much more time for selection and fitting than cement work, for the same section and slope; it requires a better class of stone throughout; and the cost of hydraulic cement mortar, in itself, does not add more than $1.20 per cubic yard, or about the cost of the cement mortar, to that of dry work, for the same stone. At Ridgewood we paid $1.50 for the dry stone lining, and $2.50 for similar wall in cement with full joints. The repair accounts of dry walls on various public works has been a formidable item. Experience also shows that a well-puddled and brick-covered reservoir floor would have prevented some costly bottom leaks and ruptures. In a Report on the Hudson River and Champlain Canal Improvement, made to the State Engineer of New York in 1867, I had occasion to show that a solid masonry canal slope wall one-third to one with 4½ feet concrete footing and 30-inch wall, could be built and coped for less than the 1¼ to 1 dry slope wall, which has been an endless cause of wash, rupture and repair along the entire canal system of the State. If the experience of our reservoirs similarly lined was collected it would certainly end their construction, as it would similar constructions for mill-power races, dams and other faces exposed to wash and frost. For both Brooklyn reservoirs the following specification was adopted: The inside slopes to be carefully puddled for two feet in depth, then covered with a substantial layer of cement, mortar and gravel (concrete), not less than three inches thick, over which a wall of brick masonry shall be built eight inches thick to the embankment top, and covered with a flag coping not less than three feet wide by five inches thick. The bottom of the apartments to be similarly puddled and covered with best paving brick laid on their edges and carefully grouted. In the Ridgewood case this theory was fully confirmed by negative experience. A change in the direction took place in 1856, and some changes in plan in 1857. The slope lining was thus specified: The water-slopes, unless otherwise directed, to be paved with a well-laid stone paving one foot thick, the stone used to be sound and of proper shape to make neat and compact work; and openings between said stone to be well pinned and packed; to be equal in every respect to the receiving reservoir of the Croton work. The paving to be laid on a bed of gravel or small stones. A considerable length of slope was lined under this specification, under Mr. Kirkwood's personal inspection, as a pattern for the rest; it was as cheap for the sub-contractors to use 15 to 18-inch stone, and the wall was thus laid, with about five inches of small stone backing. When about seven feet of water was pumped into the eastern division in 1858, the wave-wash cut the embankment behind the wall so rapidly that the water was drawn down, the injured sections repaired, and the entire lining carefully filled in with cement, grout and pointing. This involved a change in the dry wall of the new Croton reservoir, then under contract, to cement-stone masonry. The Mount Prospect reservoir, built according to the original specifications, illustrates to-day its advantages. For convenience of construction, however, it is best to increase the concrete thickness and reduce that of the puddling."

In the case of the Ridgewood reservoir, cited by Mr. McElroy, five inches of broken stone behind rip-rap is too thin to prevent wash. Again in the paving for the Brooklyn reservoirs, which he recommended, it is not good practice to lay cement concrete on clay, since the weight of the water which may accumulate back of the lining, or the liability of both clay and water freezing, will loosen and break the concrete.

Water slopes lined with cement concrete fail usually in one of two ways; either the foundation is insecure or the bank settles. Quite often a layer of clay is first put down with no intermediate porous