the continent, and, in fact, far antedates the glacial period. It is believed that at one time it was an outlet for the vast inland sea which covered much of the northern portion of the United States before the St. Lawrence was carved out to carry the glacious torrents. Throughout the valley there is evidence that an enormous volume of water at one time flowed through it, and at the end of the glacial period there was still a much greater discharge than any since, with the result that the bed of the river is of considerably greater proportionate area than found with later Western and Southern rivers. Because of this large area the stream rises very little above its banks in time of flood. Its bed consists largely of gravel, and, except where scoured by some ice gorge, has remained almost unchanged for ages. feet and to heights of 17, supporting heads of 14 feet. None of the various other types in use, such as the chanoine wicket, the drum wicket and bear-trap, have yet been employed for normal lifts above these figurs. The last two are simple in principle, but require a head of water for operation, while the needle-dam becomes difficult of operation with as much as 12 feet on the sill, and the openings are long and shallow instead of narrow and deep ones. Their character was not suited to the high lifts and great depths on the sills, which alone could secure an economical canalization of the Mohawk.

For the Mohawk dams a depth of 20 feet on the sill was established as maximum, the range diminishing to 16 feet, while the lifts vary according to the conditions at

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There is very little erosion of its prism, owing to this gravel lining, which has contributed in no small degree toward the preservation of the steep slopes. In the present time a flood range of twenty feet is very rare, while one of fifteen feet is quite unusual. On the Ohio and Mississippi Rivers and on many of their tributaries, where the cross-section of the beds is much smaller in proportion to the basins, such ranges are common, while extreme floods often reach to fifty feet or more above low water.

The system of movable dams with Boule gates chosen for the Mohawk comprises nine units, five of which will be between Schenectady and Schoharie Creek, three from there to Mindenville, and the ninth is the existing feeder dam at Rocky Rift, on which a low, movable crest is to be placed. The various locations were determined with reference to



avoiding the flooding of land, the adoption of lifts which would not unduly exceed precedents while allowing the use of a minimum number of dams and the obtaining of as much deep water as possible, so as to reduce the dredging required at the upper ends of the pools.

The river being of a milder character than those on which movable dams have proven successful, it was deemed practicable to use pieces of larger size, which would sustain an unusual head of water As certainty of operation is of prime importance, the bridge and gate type of dam, in which all pieces are suspended and worked from a bridge, seemed under the existing conditions to be the most feasible. In principle the Boule gate is practically a sluice gate, the original of which was a plank, supported at each end, and pulled up or pushed down to regulate the flow. These gates when first used for movable dams were only $3\frac{1}{2}$ feet long and a foot high, supporting a head of $3\frac{1}{4}$ feet, but have been increased in size to lengths of eight different dams from 8 to 15 feet. In the completed studies the area along the axis of each dam, from sill to top of lock walls, was made equal to the natural area of the river up to the same elevation. Thus, when a flood rises above or to the level of the lock walls, it has then the same total area of discharge as originally existed, while below that level the area is greater, since the abutments have vertical sides, while formerly the limits were the sloping banks.

The sill is placed at the same level all the way across, which allows uniformity in the structures; the gates are of a uniform length of 30 feet in all the dams, and, with an overhand of 7½ feet, act as cantilevers. The uprights supporting the gates are spaced uniformly 15 feet apart, and the bridge spans and depths on the sills are kept uniform as far as possible. The space between abutments varies in length from 370 feet, that of Dam No. 9, located at Yosts, to 590 feet, of Dam No. 7, at Amsterdam.

The general principles of the designing, as explained by D. A. Watt, C.E., briefly summarized, "were to reproduce the natural area of discharge at each site, so as to avoid changing flood heights; to use high dams, so as to reduce their number and length, and, therefore, their cost; to use few pieces, so as to concentrate the strength and reduce the



number of pieces to be handled; to place a minimum amount of steel-work permanently under water because of rusting; to make all parts of plain workmanship and similar as far as practicable; and to incorporate only such features as had been successfully adopted elsewhere, or about whose success there appeared to be no reasonable doubt."

In estimating the cost the principal item in each case was the foundation, the cost of the superstructure being a minor portion of the whole. The final estimate gave a cost of about \$575 per linear foot in place, including foundations, piers, abutments, bridges, and all other iron work, riprap, and office expenses. "The Boule gate dams on the Elbe, Moldau, and on the Seine have given every satisfaction, as they prove easy to manœuvre, and are certain in their operation, and there appears every reason to believe that the adoption of this type for the Mohawk, although with lifts and depths somewhat in advance of existing practice, will secure a satisfactory canalization."