The Miami Conservancy District

By H. F. Stolz, B. C. E. '20. *Taylorsville Dam.*

THE beginning of the year 1922 practically saw the completion of the Flood Prevention work in the Miami Valley, with the exception of the channel improvement in the various cities. With the completion of the dams comes protection against floods, which have in the last few years become great problems, especially this last year when Pueblo, Colorado, and San Antonio, Texas, were swept by disastrous floods. Dayton faced the same problem in 1913, which these cities are now facing. The people of Dayton and the cities in the Miami Valley brought about a flood prevention project, which at first seemed to be impossible, but it has finally become a reality.

In this brief article, I will try and cover a little of the early history of the development of this flood prevention project. Immediately following the 1913 flood, three committees were appointed to study the problem of flood prevention, finance and public improvement. Through the advice of these committees, the Morgan Engineering Company of Memphis, Tennessee, was engaged, forming the Miami Valley Flood Prevention Association. Through their advice D. W. Mead of Wisconsin, S. M. Woodward of Iowa, and J. W. Alvord of Chicago were engaged as consulting engineers. The following year, after a careful study of the conditions, they made their report of three possible methods of flood prevention:

1. Channel Improvement to provide safe passage of floods.
2. Reservoirs for the partial or entire retention of flood water, until it can be safely and slowly released.
3. Such combination of the above two methods as the local conditions may render most practicable.

The third method was adopted as the best to meet the conditions in the Miami Valley. The plans were examined and approved by a board of Consulting and Hydraulic Engineers.

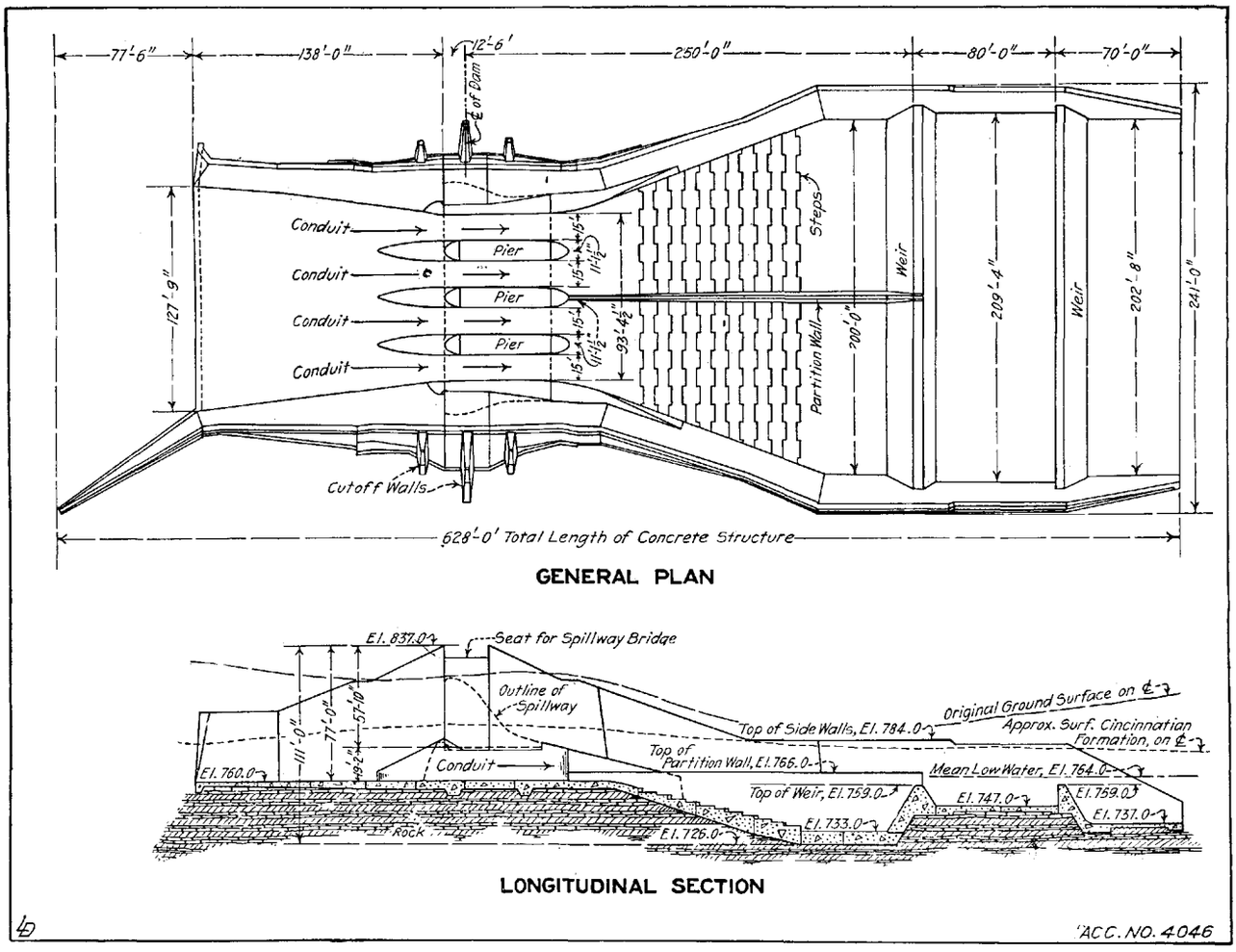
The financing and especially the acquiring of property of such an extensive project brought about great opposition, and for the protection of the project, a new law was asked of the State Legislature of Ohio, and after many stormy scenes, was enacted and upheld by all the courts as high as the U. S. Supreme Court, thus forming the Miami Conservancy District, which includes portions of nine counties and including the cities of Piqua, Troy, Dayton, Middletown and Hamilton.

The original estimate of the total cost, including the river improvements, was $27,778,000, which was made before the cost of materials, labor and equipment had advanced to such a high level. But later estimates in 1921, give the total cost to complete the project to be about $33,890,000. The means for raising this money for the Miami Conservancy District was provided in the Conservancy Law, arming them with all necessary powers to levy taxes, borrow money, take land by condemnation, and in general to do whatever may be necessary to the accomplishment of the work of flood prevention. The property in the Miami Valley will be taxed according to the benefit derived by the protection against floods. The total benefit to property was estimated in round numbers as $77,000,000. Thus the cost of the work, exclusive of interest payments on borrowed money, is expected to be less than half of the benefit derived by the safeguarding of the property alone, to say nothing of the far more important benefit in saving human life, and the freeing of the minds of the people from terror in seasons of floods.

For the construction of the flood prevention works, bids were asked from contractors on a large number of contracts. Several bids were made, but all were extremely high, due to the unsettled war conditions, so they were rejected and the work started by force account.

The design for the flood prevention works, was to provide protection for a flood forty per cent greater than the 1913 flood, which was the greatest flood in the Miami Valley in centuries, according to very extensive investigations on previous floods and storms. This design consists of a series of five retarding basins, made by dams built across the valleys of Stillwater, Miami and Mad Rivers, also Laramie and Twin Creeks. All the dams have permanent openings through their base, which will carry the ordinary flow of the streams. The dam will hold back the larger floods, allowing only the amount of water to pass through the openings, which the river channel through the cities can safely carry, thus permitting the flood to pass by, but over a longer period of time. The river channels have been straightened and widened in some places and in other places made narrower, with concrete walls and revetment where necessary.

Camp Community Associations: Before taking up the general construction of the dams, it would be well to speak of the Camps which were built at each of the dams. The Conservancy District located good camp sites and built dwellings, which were attractive and comfortable, for their employees. Taylorsville was the first to organize a Community Association, adopting a constitution and electing five commissioners, each having charge of some branch of Community Service. It was soon found that the men took more interest in their homes and the camp. Moving-pictures were provided each week, dances and entertainments were given and it soon proved profitable to the Conservancy as well as to the men employed, as a happy, contented man will do more work, stay longer and be more dependable than a discontented man. About 3,000 men have been employed in the construction of the Taylorsville dam in the four year which it took to build. This seems to be a very small labor turnover, when we consider at times there were as many as 400 men employed. This goes to show where construc-



tion work covering several years is undertaken, it is well for the company to see that their employees and their families are comfortable.

CONSERVANCY PARKS: The Miami Conservancy is retaining a portion of the land close to each of the dams, to be used as permanent parks. In all the five parks, about 3500 acres will be retained, part of which is now in timber and the rest will be planted with young trees from the tree nursery located at Taylorsville. Fourteen hundred acres of this land is in the vicinity of the Taylorsville Dam.

In the fall of 1920, 600 bushels of walnuts were planted in the Taylorsville nursery, producing about 400,000 trees, 75% of the seed growing. In 1920, 80,000 trees were planted, the following year 160,000 more were planted in the various park areas, consisting of: Red Oak, White Oak, White Ash, Poplar, Basswood, Sugar Maple, White Elm, Bald Cypress and many other varieties. Just above each of the dams, trees were planted forming a belt 100 yards wide, with the idea of forming a drift screen to catch the drift-wood coming down the valley during high water.

Another problem which confronted the conservancy is the seeding of the slopes of the dams, so as to prevent washing. Experiments were made on a hundred different shrubs, vines and grasses. It is probably a little early to say which kind will be the most successful to meet the needs demanded at the dams, but according to J. W. Calland, chief forester for the Conservancy, honey-suckle and sweet clover have thus far given the best satisfaction.

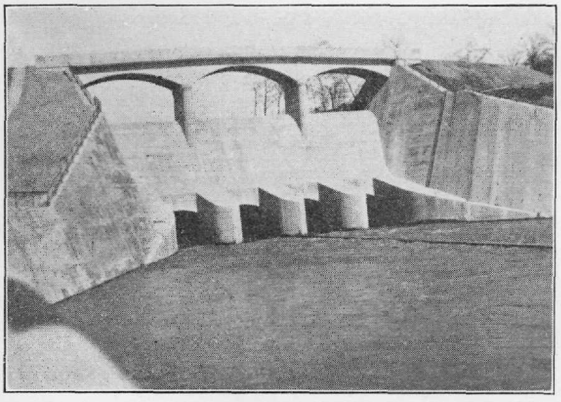
Several lakes are located within the area of the permanent parks, which were made by the excavation of the material for the dams. At Englewood, a lake covering about 100 acres was formed; at Huffman, one covering about 30 acres; also a still smaller one was made at Germantown. These lakes will become great recreation grounds for the people of the Miami Valley.

Taylorsville Dam is situated on the Miami River about eight miles due north of Dayton. This dam is 3,000 feet long, 77 feet high, has a drainage area above the dam of 1,133 sq. miles. It will reduce the flow of a flood similar to that of 1913, from 127,300 second feet to about 51,300 sec. ft., emptying its basin about four and one-half days after its maximum stage. The dam contains 1,235,000 cu. yds. of which 908,500 yds. is hydraulis fill, the Outlet Works contains about 48,000 cu. yds. of concrete.

OUTLET WORKS: The Outlet Works is probably the most interesting, as well as the most important part of the whole dam. It was built upon solid rock, requiring 236,000 cu. yds. of rock excavation, and 482,000 cu. yds. of earth excavation, costing approximately $0.96 per cu. yd.

The Outlet Works at Taylorsville, as well as all of the other dams, were not built just to

allow the water to pass through the dam, but also to absorb the destructive energy of the water, after it has passed through the conduits. The accompanying plan and Longitudinal Section of the Outlet Works shows how this will be accomplished. The water issuing from the conduits with tremendous velocity, strikes the mass of water in the pool near the top step as shown in the section, where it breaks into foam and rises up, making a standing wave, what is known as the "Hydraulic Jump," then flows out over the two weirs into the channel below with practically



Outlet Works showing the conduits, spillway and bridge over Outlet.

all its tremendous force and velocity destroyed. Assuming a Spillway level flood through the Taylorsville outlets, which is unlikely, having a discharge through the conduits of about 53,600 sec. ft., which would be greater than the 1913 flood, and having a velocity of 48 ft. per sec., it would cause a standing wave or "Hydraulic Jump" of lathering foam, 20 ft. or more in height when it enters the large stilling basin below the conduits, and finally pass out into the valley below at a harmless rate of six or seven feet per second.

The concrete in the Outlet Works, including the spillway, cost approximately $10.18 per cu. yd. The proportions used for the concrete varied some; for the lean or mass concrete 1 : 3.37 : 8 was used, while for the stronger and richer concrete 1 : 2.22 : 4.97, also 1 : 1.66 :3.32 were used. Equal volumes of small and large gravel was used for the coarse aggregate for the first two proportions mentioned, while small gravel only was used for the coarse aggregate in the latter one, as that was used where there would be excessive wear on the concrete. The gravel cost $1.10 per cu. yd., which was excavated, washed and screened on the job.

HYDRAULIC FILL: The Hydraulic Fill part of the dam, which comprises most of the material contained in it, is another very interesting feature of the construction. The material, which consists largely of clay, sand and gravel, was washed down from a hillside by means of large hydraulic giants, under a pressure of 100 to 130 pounds per sq. inch at the nozzle. This material and water was run into a large sump hole, then pumped upon the dam by a large 15-inch Morris Dredge Pump, run by a 350 H. P. Motor. The pipe lines were laid near the sides of the dam, and as the material comes out, the coarser settles immediately, while the finer settles nearer the center of the dam, and the core material which is practically in solution in the water, slowly settles forming a thick core of mud, which is sandwiched in by the coarse material on each side, making an impervious dam. In this type of dam, the water pumped with the material places or grades the material itself, at an hourly rate of about 120 cu. yds. an hour depending upon conditions in the borrow pit, the water carrying about 5.2% solids, with a friction Head Loss of about 6 ft. per 100 ft. of dredge pipe. As the dam rose in height, it was necessary to add a 15-inch Booster Pump to carry the material to the top. The cost of Hydraulic Fill will be about 70c per cu. yd.

The Hydraulic Fill at the other dams was very similar to that of Taylorsville, except at Englewood, Huffman and Germantown, where it was necessary to excavate the material by draglines and haul it in cars to hog boxes, where it was washed down and carried through the same process as at Taylorsville.

The total cost of the Lockington dam complete was $1,280,000. The hydraulic fill cost 75c per cu. yd. Concrete Works cost $9.84 per yd. Excavation for Outlet Works, amounting to 151,000 cu. yds., cost $0.69 per yd., which contained very little rock excavation.

RAILROAD RELOCATION: At the Huffman dam site, the old location of the Erie R. R., the C., C., C. & St. L. R. R. and the Ohio Electric Line, passed directly through the site of the dam, requiring a new location for these lines amounting to 15.22 miles. It was necessary to make an excavation of 1,420,000 cu. yds. In the one cut, 657,000 yds. was removed, of which 593,000 yds. was rock excavation. The total cost of construction for the relocation of the two railroads amounted to $2,717,000, but additional damages to the railroad companies for increased cost of operation of the new lines, etc., increased the amount to $3,237,000.

At Taylorsville, the B. & O. R. R. passed

Washing down the hillside with large Hydraulic giants.

through the site of the dam, making it necessary to relocate this line, amounitng to about nine miles. This relocation was made through the west end of the dam, as it was impossible to bring the roadbed up to the crest, on account of the maximum gradient being only 0.2% (2 ft. in 1000). This made it necessary to build levees

(Continued on Page 14)

The Miami Conservancy District

(Continued from Page 7)

on each side of the railroad above the dam. The total excavation necessary was about 850,000 cu. yds. The largest cut amounted to about 145,000 yds. The total cost of construction, not including tracklaying, ballasting and telegraph line or signal system, amounted to approximately $825,000.

The work of the Conservancy on the various dams is about finished, with the exception of removing equipment, building guard-rails, and cleaning up. The dams were completed about one year ahead of schedule and probably by January, 1923, the Channel Improvements in the cities of the Miami Valley will be completed.

I wish to acknowledge my indebtedness to O. N. Floyd, Division Engineer at Taylorsville Dam, for the information on costs contained in this article.