

THE MIAMI CONSERVANCY BULLETIN

NOVEMBER, 1921



FIG. 329.—LOCKINGTON DAM COMPLETED, SEPTEMBER 28, 1921.



FIG. 330.—THE DIRECTORS AND CONSERVANCY COURT AT TAYLORSVILLE ON SEPTEMBER 19, 1921.

Left to right, upper row: C. O. Shively, assistant engineer, Taylorsville Dam; Judge F. M. Hagan, C. H. Locher, construction manager, Judge R. L. Goudy, Judge A. C. Risinger, Henry M. Allen, Judge J. D. Barnes, J. H. Kimball, construction engineer, Judge O. B. Brown, Judge E. T. Snediker, H. M. Sherwood, superintendent Taylorsville Dam. Lower row: Ezra M. Kuhns, secretary, C. N. Phillips, office engineer, O. N. Floyd, division engineer Taylorsville Dam, Col. E. A. Deeds, H. S. R. McCurdy, division engineer Englewood Dam. Judge Geiger, Judge Wright, Judge Murphy, Judge Hoffman, Judge Jones, and Chas. H. Paul, chief engineer, were not present when the picture was taken.

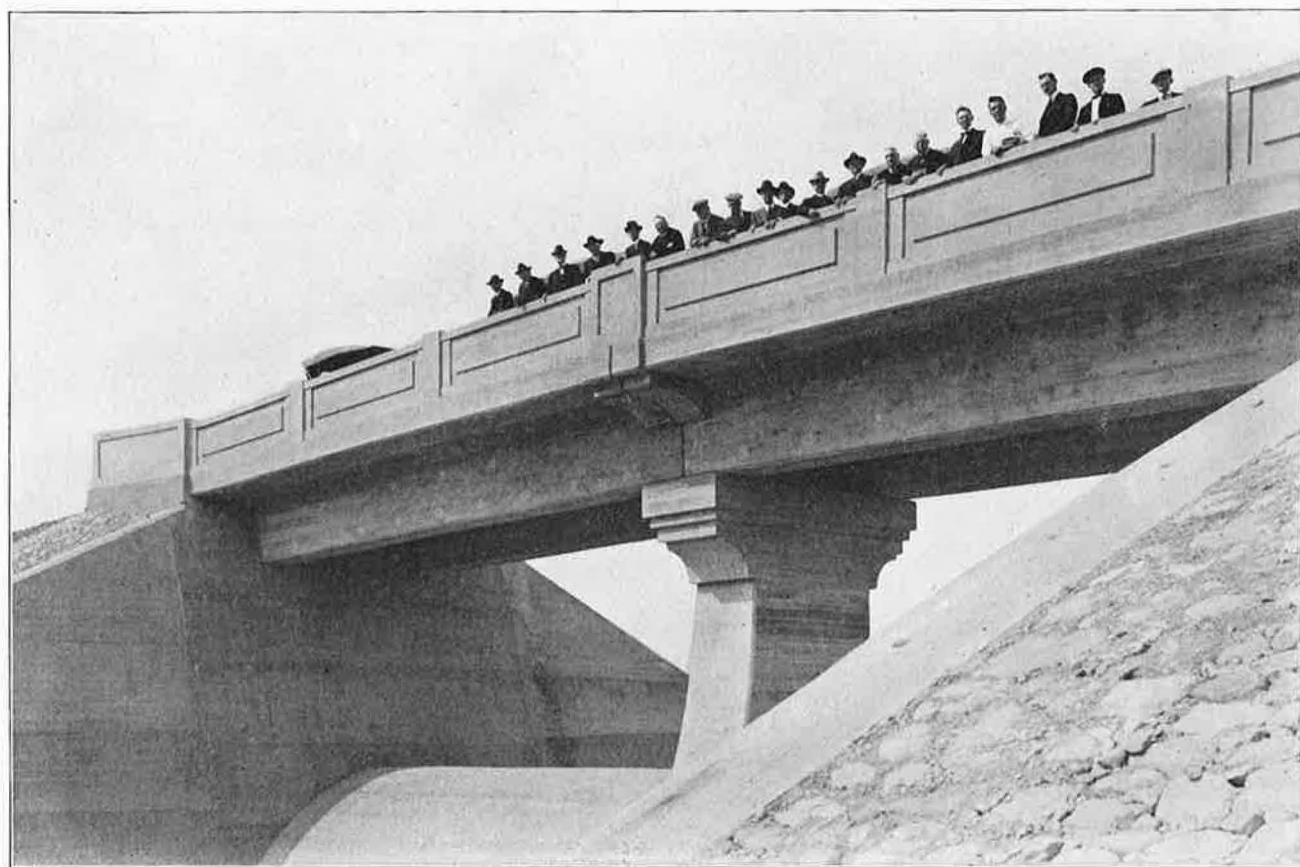


FIG. 331.—THE INSPECTION PARTY ON THE LOCKINGTON SPILLWAY BRIDGE, SEPTEMBER 21, 1921.

BOARD OF DIRECTORS
Edward A. Deeds, President
Henry M. Allen
Gordon S. Rentschler
Ezra M. Kuhns, Secretary

Chas. H. Paul, Chief Engineer
C. H. Locher, Construction Manager
Oren Britt Brown, Attorney

THE MIAMI CONSERVANCY BULLETIN

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DAYTON, OHIO

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Subscription to the Bulletin is 50 cents per year. At news stands 5 cents per copy. Business letters should be sent to Office Engineer, Miami Conservancy District, Dayton, Ohio. Matter for publication should be sent to Bulletin Office, Miami Conservancy District, Dayton, Ohio.

Conservancy Court Visits Work

The directors of the Miami Conservancy District conducted a trip of inspection on September 19, 20, and 21, 1921, at which time they were highly honored by the presence of the judges of the Conservancy Court.

The weather was ideal for the purpose and every facility was afforded to make this trip worth while. The whole of the Conservancy works was covered and the judges were able to see the work as a comprehensive whole as well as to inspect and examine what is being done in each locality. Those members of the Court who have been sitting in the Conservancy case from the beginning, particularly appreciated the trip, as they were able to see the practical working out of the principles brought out in the various hearings.

As the work is rapidly reaching completion, it is probable that this will be the last trip undertaken on so large a scale, but it is hoped that the judges may, either in a group or singly, accompany the officers of the District at some later time, on a similar trip. Every one expressed gratification at the protection afforded the Miami Valley by this enormous undertaking.

Mr. Morgan Leaves

On September 1st, Mr. Arthur E. Morgan resigned as chief engineer of the Miami Conservancy District, to devote his entire time to his duties as president of Antioch College and to general engineering work.

He first came to the Miami Valley in May, 1913, in response to the urgent request of the Dayton Flood Prevention Committee. His achievements in the development of the flood prevention plan, in the securing of needed legislation, and in enlisting popular support of the proposed work, and finally in the organizing of the forces and equipment to actually carry out the great project, are so well known that they do not need reiterating here. He carries with him the respect and affection of every man in the employ of the District, and carries with him their best wishes for the success of his new undertaking.

He was succeeded as chief engineer by Mr. Chas. H. Paul, who had been assistant chief engineer since November, 1916, and was construction engineer for a year before that. The shift of the duties of chief engineer to Mr. Paul had been in progress for a number of months before Mr. Morgan left, and the actual change did not affect the policy of the District in any way, nor cause any interruption to the construction program.

More Jobs Finished

September saw Lockington dam finished, the second of the five dams to be completed. On October 27th, traffic was turned over the last link of the Ohio Electric relocation that remained uncompleted, and the last of the relocation jobs were disposed of. Other parts of the work are rapidly nearing completion. All of the five dams are ready now to handle another 1913 flood, and by the first of the year will be practically completed.

Lockington Dam

Longest Conservancy Dam Completed in September. Review of Its History.

The Lockington Dam is located one-half mile northwest of the village of Lockington and four miles north of Piqua on Loramie Creek, an important tributary of the Miami River. The creek has a drainage area of 255 square miles above the dam, and is subject to sudden and violent floods. Although the retarding basin provided will benefit the entire Miami Valley in time of flood, the principal effect will be at Piqua and Troy. During a flood equal to that of 1913 it will reduce the flood discharge from Loramie Creek from 33,000 cubic feet per second to 8600 cubic feet per second, and will hold 63,000 acre feet of water. An acre foot of water is the amount necessary to cover one acre one foot deep. At the maximum stage of such a flood the water will back up behind the dam diagonally northwest, nearly across Shelby county, and will cover 3,600 acres of land. In seven days after reaching its maximum stage, the basin will be empty.

The dam is a massive earth embankment with concrete outlet and spillway structure. It contains one million cubic yards of earth, is 6,600 feet long, 25 feet wide at the top, 460 feet thick at the base, and 78 feet high from the floor of the conduit to the top of the dam. Of the total length of one and one-quarter miles, 3,500 feet is in a low dyke at the west end. (See Fig. 333.)

The decision to construct the dam on its present location was reached only after careful study of a

number of alternate sites, notably one above the present location, and another in the Miami just below the mouth of Loramie Creek. The site selected gives the most protection for the least money.

A railroad siding to allow the unloading of the equipment and supplies from the freight cars directly onto the site of the work, was the first thing needed. Therefore, the first shovelful of earth was thrown on March 1, 1918, on the grading work for a siding leading from the Western Ohio Electric Railroad down over the hill, to the site of the gravel plant and repair shop at the entrance to the outlet structure. Clearing the damsite was also started within a few days, the timber being cut into ties for the railroad siding. A transmission line, supplying the power by which most of the machinery was run, was built from Piqua to the damsite. A dragline, narrow-gauge locomotive and cars, and other equipment were shipped in, erected, and as early a start as possible made in excavating for the outlet structure. Houses with sewerage, water, and electricity, for the married employees, bunk-houses for the bachelors, a mess hall, store, and office, were built as promptly as possible, so that by July 15th the employees were housed and the work was well under way. A gravel and concrete plant, gasoline locomotive, two big derricks, another dragline, rock drills, and the many small pieces of equipment necessary for such a job, were assembled and put into running

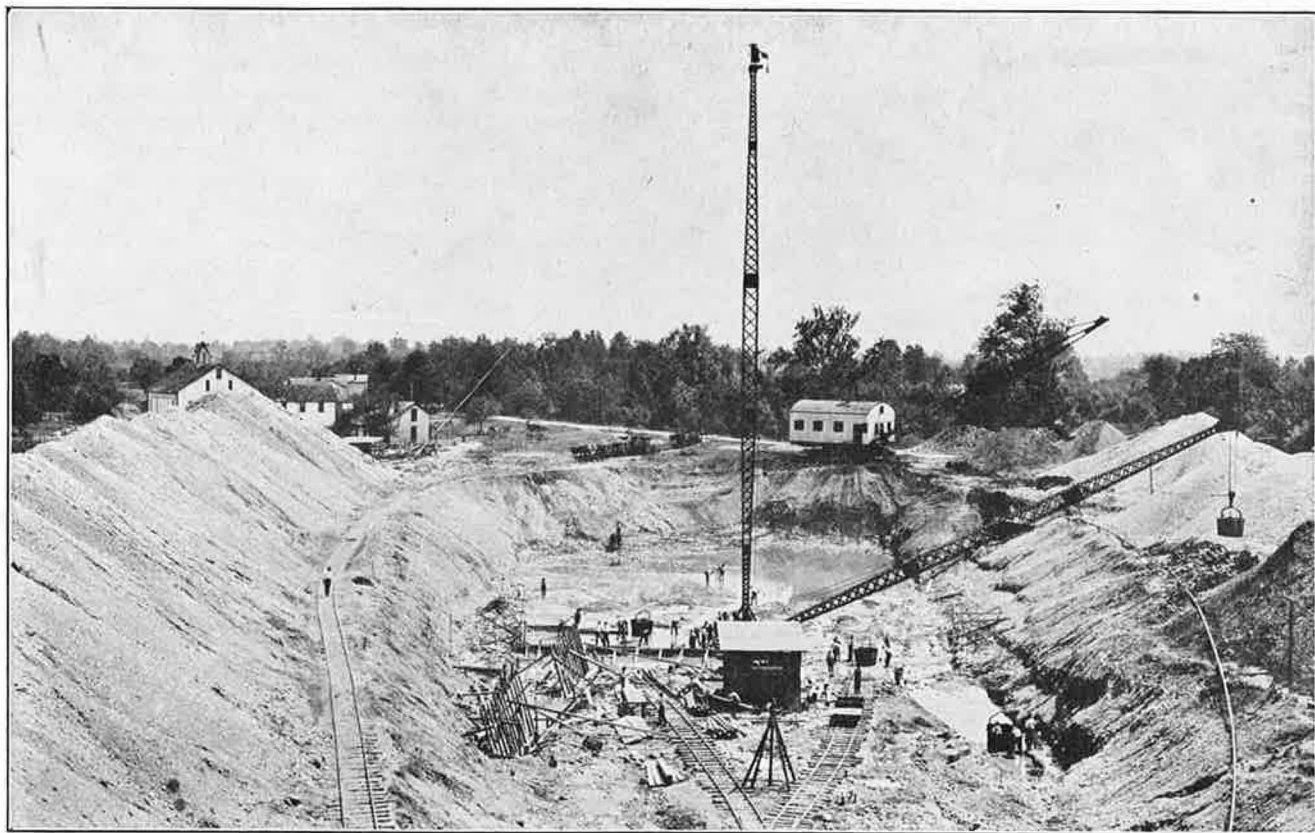


FIG. 332.—LOCKINGTON OUTLET STRUCTURE AUGUST 12, 1918.

The overburden has been removed by the dragline in the background. The derrick is removing loose rock preparatory to placing concrete. The first forms are being placed in position.

order. A contract for stripping and cleaning the damsite and preparing it for the fill, was let, the work was started promptly, and completed by mid-summer.

Before the earth dam could be started, Loramie Creek had to be shifted from its natural channel into an artificial one that would keep the waters away from the growing embankment, particularly during floods. The best way to do this was to construct the outlet works in part, and divert the creek waters through the partially completed structure.

The conditions for building the outlet structure were good. Bed rock on which to place the concrete, occurs to the east of Loramie Creek, only a few feet below the elevation of the creek bed. The first job, therefore, was to strip off the gravel and earth that lay on top of the rock, clean off loose rock, and prepare the foundation. The stripping operations were performed with a Lidgerwood Class K dragline; the rock was shaken up by blasting, loaded into buckets, and hoisted out with a derrick (see Fig. 332). The gravel taken out of the excavation proved to be of good quality, suitable for concrete, and was piled to one side for use later, as can be seen in both Fig. 332 and Fig. 334. Such good progress was made that the first concrete was poured on August 10, 1918. Englewood was engaged in the same operation, and progressed at about the same speed. The two jobs had a spirited race to place the first batch of concrete, reached the tape neck and neck, and both claimed a victory.

The Lockington outlet structure is of the retaining-wall type, and is entirely of concrete. It forms a gigantic trough through the dam, from toe to toe and from top to bottom, its edges being coincident with the outlines of the dam. Its sides are formed by two massive retaining walls, passing entirely through the embankment at right angles to its center line, parallel to each other in the middle, and diverging at both ends to facilitate the entrance and exit of water. Its floor is of heavy concrete, laid on the bed rock. At the downstream end is the "hydraulic jump pool," a device to reduce the velocity of water. When the basin above is full, the waters will rush through the conduits at forty miles an hour. Such a stream at such a speed would prove disastrous to the channel below, and the energy must be used up before leaving the dam. The hydraulic jump, with its "stairsteps," "jump," and "pool," uses up energy when the water lifts itself up in the standing wave, and dissipates its fury in fighting with itself in the turmoil below, leaving the lower end quietly at a harmless speed. (Fig. 336.)

Another large flood is an ever-present possibility. As such a flood would be disastrous during the construction period unless provided for, the outlet structure was left as described above, a wide, concrete-lined water way, capable of carrying a flood nearly as large as that of 1913, until late in the season of 1921, when the dam was nearly done. Then, in the middle, along the center line of the dam, was placed a thick wall or weir, pierced at the bottom by two arched openings, nine feet wide by nine feet two inches high, and placed side by side, to carry the waters of Loramie Creek. This weir reaches to within sixteen feet of the top of the dam. The opening, seventy-seven feet long and sixteen feet deep,

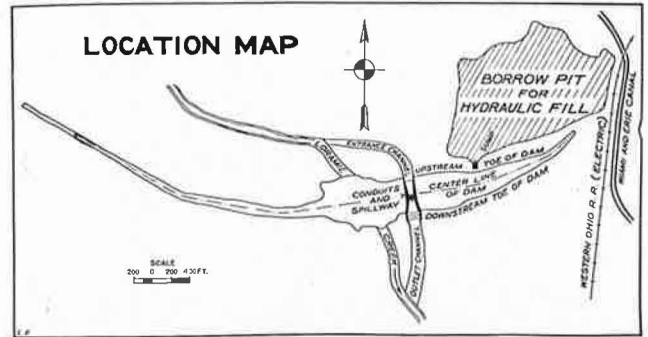


FIG. 333.—GENERAL PLAN.

formed by the top of the weir and the side walls of the structure, is the spillway built as an added factor of safety. It would take a flood more than 40 per cent greater than 1913 to cause water to run over the spillway.

The entire outlet structure is 82 feet in height, 140 feet in maximum width, and 525 feet long. It contains 32,000 cubic yards of concrete.

The gravel for the concrete was washed and screened, and the concrete mixed, in a Dull plant situated near the upstream end of the conduits. The concrete was transported from the mixer in bottom-dump buckets, by a train of narrow-gauge flat cars, drawn by a gasoline locomotive. Two guy derricks, 120 feet high, with booms 105 feet long, handled the concrete buckets from the cars to the forms, and shifted the movable forms. The walls were built in sections, as is seen in Fig. 334. Some grouting under pressure was necessary to seal seams in the rock underneath the concrete.

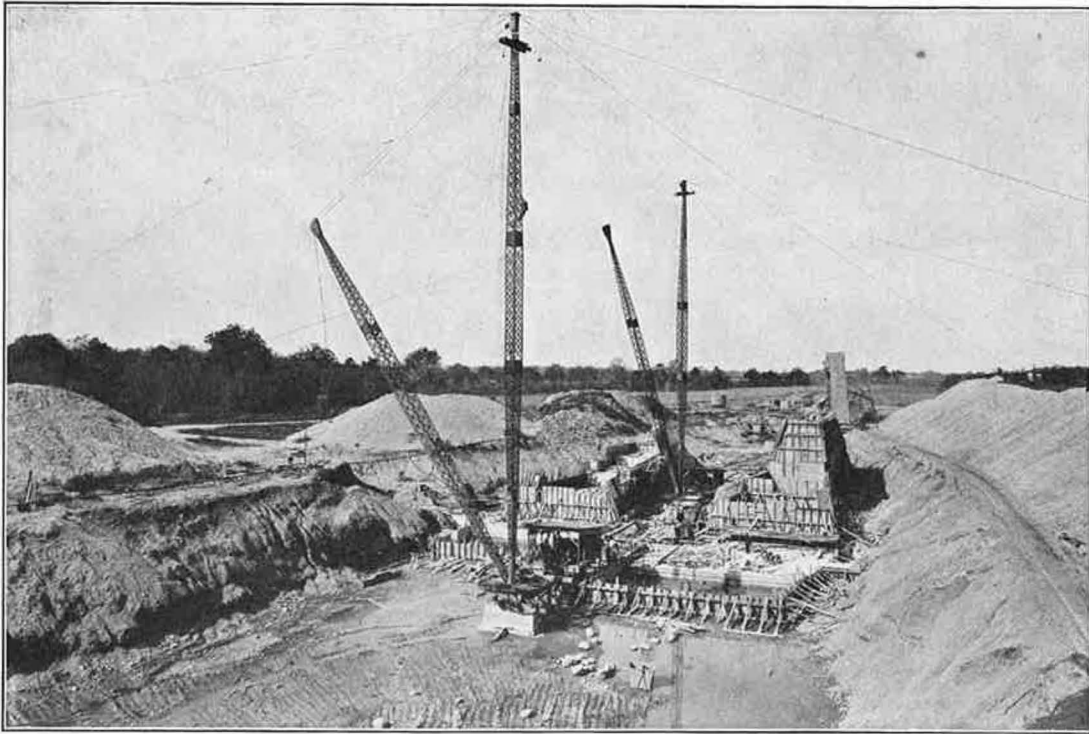
Detailed articles on the concrete construction were published in the Bulletin of November, 1918, and August, 1919. The hydraulic jump was described in the May, 1920, and March, 1921, numbers.

The dragline excavated a channel from the old location of the creek to the entrance of the outlet structure, and cut a straight channel downstream from the structure, until the line of the channel intersected the old stream bed. The bridge crossing the Loramie Creek below the dam, was moved to the new channel, and the road altered to fit. The sides of the new channel were riprapped with random stone.

On May 27, 1919, the concrete work in the walls, floor, and hydraulic jump was completed, and on June 11th, Loramie Creek was diverted into its new channel. Pumping of the hydraulic fill material was started June 12, 1919.

The borrow pit area is located on the east side of Loramie Creek, above the stream level, and just above the damsite. See Fig. 335. Situated on a sloping hillside, it afforded opportunity for sluicing the material down to the dredge pumps by gravity instead of transporting it by train, as at Englewood, Huffman, and Germantown. The equipment installation was, therefore, comparatively simple.

The Miami and Erie Canal conveniently runs a few hundred feet east of the east end of the dam. The use of water from this canal saved many thousand dollars in pumping expense. About twenty cubic feet per second were required for the hydraulic operations. This was more water than the canal could carry in its dilapidated condition, so repairs



This picture was taken from the roof of the dragline and is looking upstream. The two derricks in the middle of the picture handled the forms, and hoisted the concrete buckets to the forms. The sand and gravel was washed and screened and the concrete mixed in the washing plant seen in the background. The concrete was run from the mixer into bottom dump buckets set on narrow gauge cars and hauled by a gasoline locomotive to a point where the buckets could be reached by the derricks. The hydraulic jump was built in the pit shown in the foreground.

FIG. 334.—THE LOCKINGTON OUTLET STRUCTURE AUGUST 14, 1918.

were made on the Port Jefferson diversion dam and the Sidney feeder, so that a larger volume of water could be carried. A further complication was caused by the fears of the citizens of Piqua that their water supply would be interfered with. This was met by the installation of an emergency pump at the Piqua water station. A small forebay was built just below the Miami and Erie Canal, at a considerably higher elevation than the borrow pit. Two eight-inch and one fourteen-inch electrically driven centrifugal pumps were placed at the west end of the forebay. Pumping into a fifteen-inch spiral riveted pipe, these pumps supplied the hydraulic giants used to tear down the hillside. By various combinations of the pumps in series and parallel, a nozzle pressure of from 40 to 175 pounds was obtained, using from a $2\frac{1}{2}$ to 5-inch nozzle. The pressure and nozzle best fitted to work the material being excavated at the moment was used. About ten second-feet were used by the giants. The remainder of the twenty second-feet taken from the canal was carried from the forebay around the top of the borrow pit in a ditch. Water was drawn from this ditch as needed to supply extra water for the sluice ditches.

The dredge pumps were situated at the toe of the dam, east of the creek and the outlet structure and at the lower end of the borrow pit area. Two dredge pumps, directly connected to Allis-Chalmers motors and capable of pumping against 115 feet head, were used to lift the material and water from the sump to the dam. Both fourteen-inch United Iron Works and fifteen-inch American Manganese pumps were used at different times. Twelve-inch special pipe, made by the American Rolling Mills, one line for each pump, carried the two streams of material. The pumps were set in a house with the usual switch-board and grids. Grids were necessary because of the variable load on the pumps. The sump was a

timber-lined pit. The sluice ditches ran directly into it. Rocks too big to go through the pumps were kept out of the sump by an iron grating. The borrow pits yielded a considerable volume of "oversize" rocks, and these were hauled out and utilized in paving the slopes of the dam so as to avoid the rather difficult job of inducing vegetation to grow on gravel slopes. The pumps were placed as high as possible, so as to avoid getting the motors wet in time of flood, and the sump as low as possible, so as to get as much material as possible from the borrow pits. This made the lift from the sump to the pump, from twelve to fifteen feet, which is high. Air leakages were avoided by careful packing and caulking.

The hole in which the pump-house was placed was excavated by a derrick, rigged as a dragline. After pumping was started, the derrick remained in place and was used to hoist oversize rock from the grizzlies, and to handle replacement parts for the pumps. It was also available to hoist the motors clear of flood waters, but was not called upon for this service.

The giants started to tear down the hillside immediately in front of the dredge pumps. At first, the material could be pushed into the sump by the giants directly. As the material close at hand was exhausted, the material was excavated and broken up by the giants, pushed into "sluice" ditches on slopes from $2\frac{1}{2}$ feet to the 100 feet, to 5 feet to the 100 feet, and transported by the stream of water rushing down the ditch, to the sump. The stream of water in the sluices was fed by the water from the hydraulic giants, and by the ditch around the top of the borrow pit. As the work progressed, the "face" of the borrow pit was pushed farther uphill, and it became increasingly difficult to transport the material through the long ditches. There was a considerable quantity of ground water flowing into the

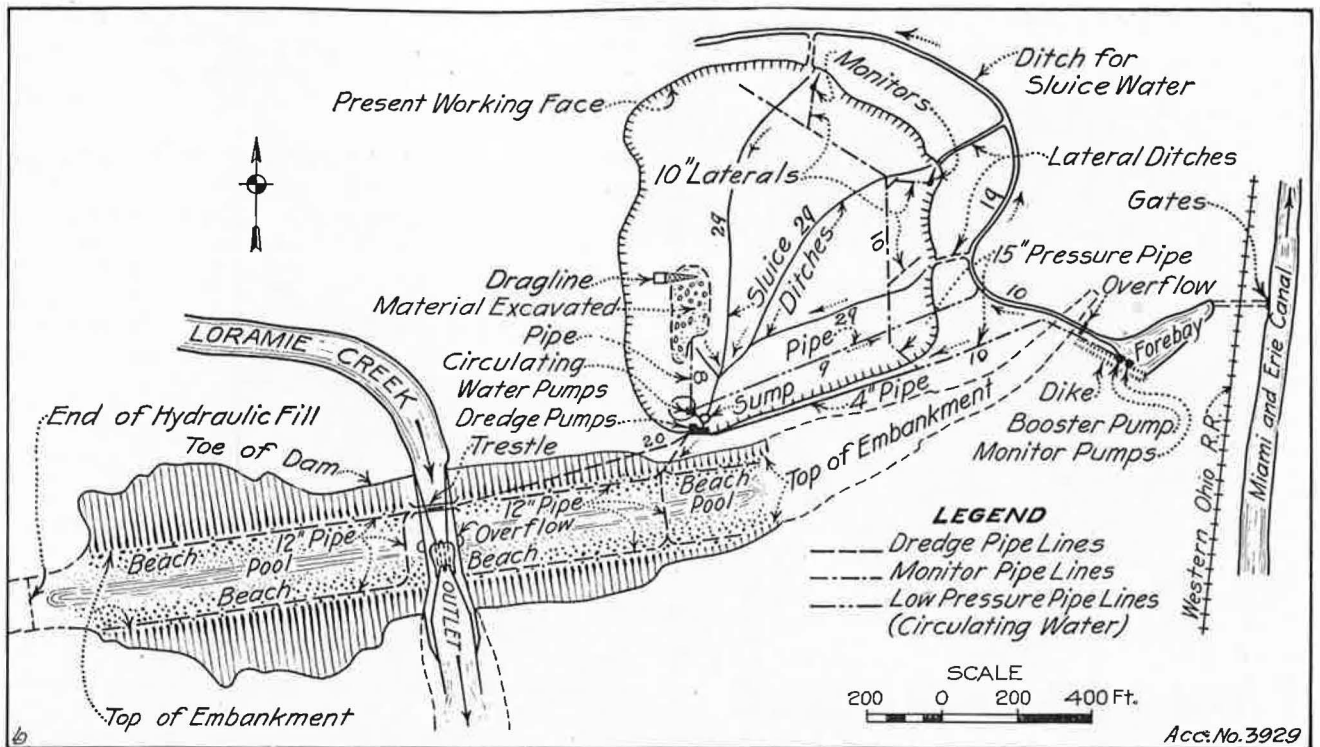


FIG. 335.—BORROW PIT AND PUMPING LAYOUT AT LOCKINGTON DAM IN AUGUST, 1920.

sump which was taken care of by installing a low-head pump which elevated it from the sump to the ditch carrying the sluice water from the forebay to the pit. In this manner this water helped carry material down the sluice ditches from the monitors to the dredge pumps. It did not pass through the dredge pumps but was kept circulating from the sump to the supply ditch. Later, the amount of circulating water was increased by admitting more water from the forebay. While it is true that, in general, the steeper the slope of the sluice ditch the more easily is material transported by it, yet in this

case the grades of the ditches had to be kept below five per cent, as the borrow pit would "run out" if steeper slopes were used. Careful study was given this, with the result that material was successfully moved on grades as low as $2\frac{1}{2}$ per cent. This particular phase of the work was considered in detail in the September, 1920, issue of the Bulletin. A small amount of particularly suitable material, situated too low to be handled in the usual way, was thrown uphill into the path of a sluice ditch, by the dragline. The material in the borrow pits varied in character and hardness to such an extent that con-

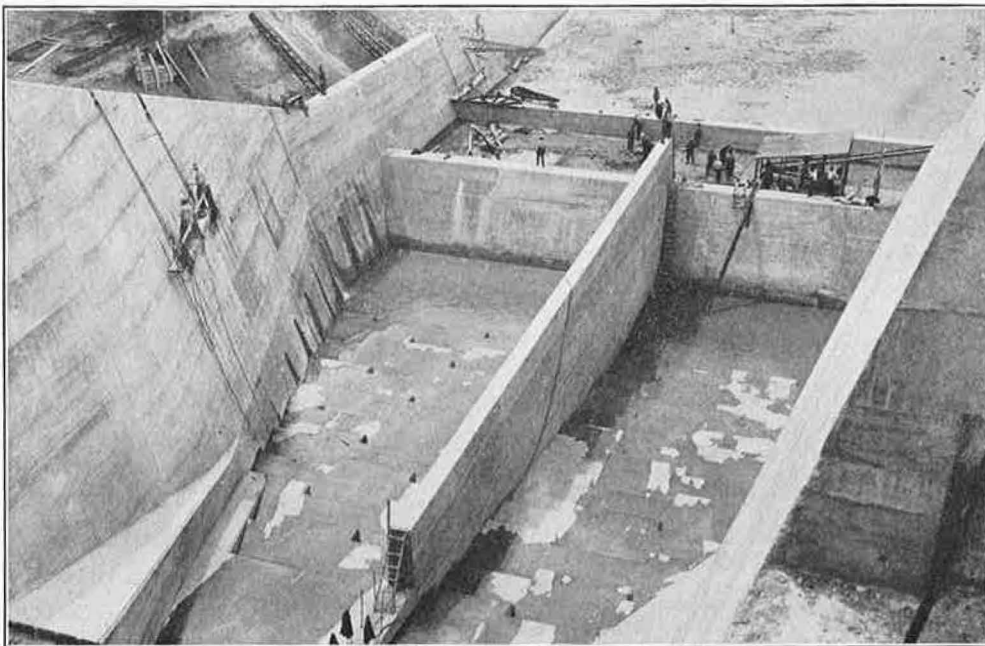


FIG. 336.—THE HYDRAULIC JUMP AT LOCKINGTON JUNE 11, 1919.

This picture was taken from the top of the wall the day water was turned through the outlet structure. The water coming from the conduits descends the stairway into the hydraulic jump pool which is divided into halves by the partition wall. The water then goes on over the first wall, into the stilling pool, then on over the second wall into the outlet channel. The standing wave occurs in front of the first wall. The proportions of the structure were determined after extensive experiments with models. The floods in the spring of 1920 and 1921 gave this structure a good tryout. Pictures of the jump in action at Lockington were shown in the May, 1920, number of the Bulletin. A full description of the hydraulic jump was contained in the April, 1921, number.

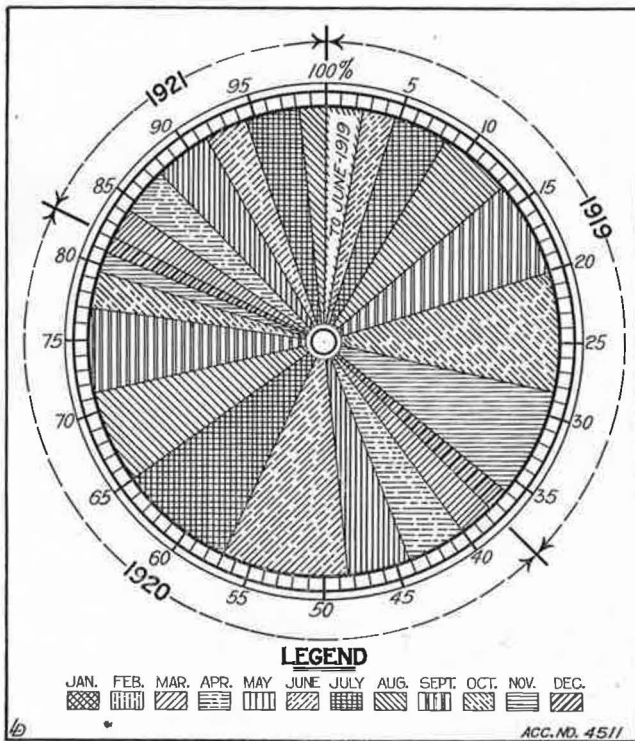


FIG. 337.—LOCKINGTON PROGRESS DIAGRAM.
The placing of the earth embankment is shown in terms of the per cent of the total yardage placed each month.

stant study was necessary to meet the ever-changing conditions.

The first dirt was put through the dredge pumps on June 12, 1919. The first season 195,000 cubic yards were placed, all on the west side of the outlet structure. Two pipe lines were used to carry the material, one on each toe of the dam. The standard methods of hydraulic work were used. The technique of this class of work has been covered by many articles in the Bulletin, notably the February, 1920, number.

The dyke which forms the west 3,500 feet of the dam was placed by the dragline during the season of 1919. The fill east of the outlet structure was not started until after the spring flood season in 1920, so that a possible extraordinary flood, too large for the outlet trough to take care of, could find a safe passageway for its surplus water. On April 5th, the aqueduct on the Miami and Erie Canal feeder at Plum Creek was washed out, thus interrupting the sluicing operations for eight days, while repairs were being made. On April 20th a minor flood occurred without damage to the work. It demonstrated that the hydraulic jump was a success. After the

danger season was passed, work on the east side was pressed until it caught up with the west side, and then both sides were carried up to an elevation high enough to be safe against a 1913 flood, should one as great occur.

While, in general, the surplus water from the central pool was drawn off through "chimneys" in the walls of the outlet structure, a syphon was rigged up which drew a part of the water from the pool and discharged it at the upstream toe of the dam. Enough fine material remained in suspension in the water taken off by this syphon, to form an extensive impervious blanket along the upstream toe of the dam, especially in the old creek bed.

The major part of the road relocations made necessary by the retarding basins was completed during this season.

Another minor flood passed without harm, on March 28, 1921. On the night of April 16, during a heavy storm, the dredge pump house partly burned. Despite the extent of the damage, but one week was lost. A washout near the west end of the hydraulic fill on the upstream toe, took out some of the gravel slope but did little damage to the dam. It was caused by the central pool overflowing and running down the slope. A vexatious delay resulted while repairs were made. But despite the annoying delays which slowed up the completion of the job somewhat, the dam was finished on August 20th, and the road across the top put in shape for traffic.

In June, work on the spillway weir was begun, and finished on July 31st. The construction of the bridge followed at once, and was completed September 2nd. Details of this phase of the work are described on Page 15. Dismantling of the equipment and clearing up the job, proceeded so rapidly that when the Conservancy Court visited the work on September 28, this work was nearly finished. A guard rail along the highway across the top of the dam, remains to be placed. A contract has been let for its construction. Except for the care of the vegetation and seeds planted on the slopes, the construction job is a thing of the past.

The Lockington Dam cost complete, with engineering, superintendence, depreciation, clerical, labor, materials, supplies, and everything expended on construction included, \$1,280,000. The hydraulic fill cost 75 cents per cubic yard, the dragline fill at the west end of the dam 23 cents per cubic yard, the excavation for the outlet works and channel 69 cents per cubic yard, and the concrete work an average of \$9.84 per cubic yard. Labor rates during the period of construction varied considerably from time to time, rising during the war period and falling sharply during 1921. During the period in which

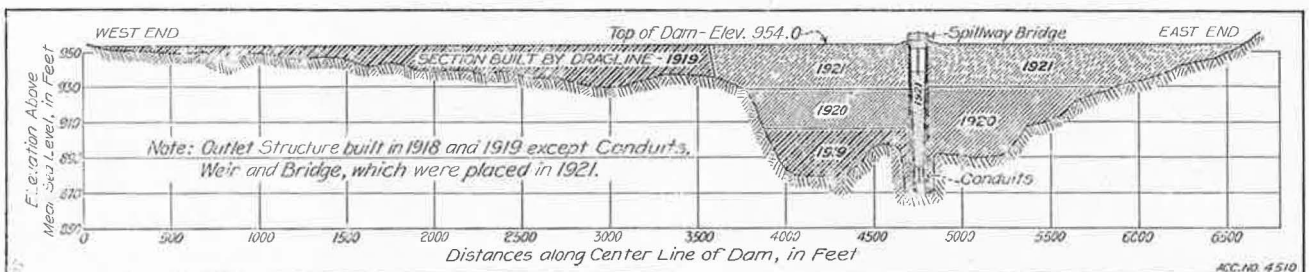


FIG. 338.—PROFILE OF LOCKINGTON DAM SHOWING PROGRESS BY YEARS.

the most of the work was done, common labor received from 38 cents to 46 cents per hour, and good carpenters, 65 cents to 80 cents per hour, with ratio to other classifications in proportion. Materials varied widely. The major part of the cement was purchased f. o. b. Lockington for \$3.06 per bbl. with

25-cent sacks, \$2.92 with 15-cent sacks, and recently \$2.91 with 10-cent sacks. Coal was purchased for \$4.19 to \$4.65 per ton, run of mine, f. o. b. Lockington. Much of the material used was special, and the prices paid are not comparable with prices paid on other work.

Progress on the Work from July 1 to November 1

ENGLEWOOD

Since the date of the last report, June 30th, the hydraulic fill has maintained its scheduled rate of progress. During the month ending July 25th, the pumping amounted to 157,640 cubic yards for the month ending August 25th, the output was 163,520 cubic yards, and for the month ending September 25th the progress was 142,960 cubic yards, at which time a total of 3,350,900 cubic yards, or 93 per cent of the completed structure, was in place. From now on, however, the rate of pumping may be expected to decrease somewhat, due to the increased lift and the greater length of discharge pipe.

The supply of satisfactory material for building the dam is about exhausted in the portion of the borrow pit south of the National road, and one dragline is now operating north of the road.

The average elevation of the top of the dam at present is about 878, or 100 feet above the river bed and 14.5 feet below the finished crest.

The westerly barrel of the discharge conduit now has its permanent concrete floor and is carrying the river flow. The easterly barrel is unwatered and the concrete bulkheads are being placed. As in the westerly barrel, sand and gravel will be pumped to fill the lower portion and provide a foundation for the permanent concrete floor. For handling this material a discharge pipe is run to the conduit from sump No. 3 and the material placed in the same manner as it is being pumped into the dam.

The spillway concrete is finished with the exception of one block under the derrick. A small amount of grading remains to be done to complete this structure.

The construction of the spillway bridge has advanced 70 per cent. The abutments, walls, and piers are built and the concreting of the girders and the floor slabs is in progress.

The grading and graveling of road No. 7, across the valley five miles north of the dam, is practically completed. A short stretch cannot be completed until the bridge abutments at the Prairie ford and Brush creek bridges are finished.

The Prairie ford bridge for road No. 7 over the Stillwater river is being constructed. Piles have been driven for the center pier and concreting is in progress. Excavation for the easterly abutment has been carried to rock and is ready for concrete. The piers and abutments for the bridge at Brush creek are about 50 per cent completed.

The grading and graveling of road No. 6 is completed.

H. S. R. McCurdy, Division Engineer.

October 25, 1921.

LOCKINGTON

On August 20th the hydraulic fill was completed. The dragline then backfilled the gravel pit just north of the dam, and moved to the east end where it placed 750 cubic yards of fill in the gap at the extreme end of the dam through which the pipe lines supplying the monitors were laid.

On July 31st the last concrete was placed in the spillway weir. The construction of the spillway bridge followed without interruption, and this structure was completed on September 2d.

Dismantling of the plant is practically completed and the camp has been sold and is being torn down by the purchasers of the houses.

Lyons and Cole, contractors of Blanchester, Ohio, have been awarded the contract for the construction of guard rail on top of the dam, and this work is now under way. With the exception of the guard rail the entire Lockington job is now completed.

J. J. Loehr, Assistant Engineer.

November 1, 1921.

TAYLORSVILLE

Twenty-three hundred feet of the west end of the dam has been finished to final grade. The remainder, or river section of the dam, is up to an average elevation of 828 feet above sea level, or 9 feet below the top of the dam. By the middle of November the entire hydraulic fill should be completed.

The concrete spillway was finished in September and the concrete bridge over the spillway was poured the last of October, excepting the guard rails. These will be poured the first week in November. By the tenth of November, 180 cubic yards of slope paving on the upstream slope of the dam adjacent to the outlet walls will be finished. This last will complete all of the concrete work at Taylorsville. Charles Crampton has the building of the approach from the east end of the bridge over the Baltimore & Ohio down to the top of the dam under contract, and also the finishing of the approach of road No. 15 to the top of the dam. He has now done about two-thirds of these jobs and should finish in another week.

Road No. 15, across the valley at Dugans bridge, has been raised to the elevation of the bridge floor.

The outlet channel has been completed and the Lidgerwood dragline is being moved over to the railroad to be dismantled.

Roberts Bros. finished their contract on the rock slopes at Taylorsville in September.

O. N. Floyd, Division Engineer.

November 1, 1921.

HUFFMAN

During the months of July, August, September, and October, the placing of material by the hydraulic process in the main embankment of the dam has continued over the entire length of the structure. On October 28th the embankment was completed to within 8 feet of the top. But 35,000 cubic yards of fill remain to be placed in the section of the dam north of the outlet. Work is progressing in the short section of the dam south of the outlet. The material in this section is being placed in thin layers by teams and compacted by rolling. On October 28th, 9,000 cubic yards remained to be placed in this section.

Concreting on the conduit piers and spillway started on July 24th and was completed on October 21st.

All rocks too large to pass through the dredge pumps have been screened out of the material before it reaches the pumps, and have been placed as paving on the upstream face of the dam.

Work was started on September 27th on the gap in the relocation of the Valley pike at the north end of the dam. This work was completed on October 25th.

C. C. Chambers, Division Engineer.

October 28, 1921.

DAYTON

Dragline D-16-8 has completed all levee embankment between the Big Four railroad and the new South Broadway highway bridge. It has also constructed the highway embankment between the Broadway bridge and the Springboro pike. The machine is now engaged in excavating the cut-off channel west of Broadway. D-16-15 is continuing channel excavation and levee construction on the right bank of the river below Stewart street. D-16-16 is making good progress between the D. & U. railroad and Washington street bridges, and the east levee is now complete. This machine has been working in conjunction with train haul to spoil banks near Stewart street since September 20th and is now about to build the west levee. D-16-19 has completed all work on the south side of Wolf creek and is now working on the north bank between Broadway and Sunrise avenue.

Since the report of June 30th, several small concrete retaining walls have been constructed. The large wall

work in Dayton is complete except for a small portion of the DeKalb street wall and the placing of some coping. Work is now under way on various sewer headwalls and extensions of existing pipes. This class of work is about 90 per cent complete.

J. C. McCann has completed all embankment on Mad river west of Findlay street. He is now working, under contract, on the levee embankment and enlargement of the old Erie railroad embankment between Findlay street and the bridge over Mad river.

Price Brothers Co. is placing revetment along the north bank of Wolf creek upstream from Williams street.

Up to the end of September, 99,800 cubic yards of sand and gravel had been issued from the Sunrise avenue gravel plant.

Contract has been let for the establishing of one gravel screening plant on Wolf creek and two plants on Mad river to check the movement of material into the improved channels. The Wolf creek plant is now under construction and will be ready for operation about November 1st. It is situated on the south bank just west of the Pennsylvania railroad bridge.

Channel excavation to October 1 amounted to 1,151,500 cubic yards. Levee embankment amounted to 345,600 cubic yards. The total yardage handled in accomplishing these quantities was 2,825,000 cubic yards.

C. A. Bock, Division Engineer.

October 18, 1921.

HAMILTON

The total amount of channel excavation, item 9, to date is 1,250,000 cubic yards. The filling of the south spoil bank has been completed and the trackage and hauling equipment is being moved to the north spoil bank. While this moving is in progress, the electric dragline, D-16-18, is excavating the last cut on the west side of the river at the south end of the improvement, wasting the material thus excavated. After completing this cut it will cross the river and move to the north side of the Main street bridge and begin work on the east side of the channel.

The class 14 Bucyrus dragline has completed the levee between the Main street bridge and the Champion Coated Paper Mill. It is now grading a track bed along the east bank, leading to the north spoil bank.

The small Marion dragline has been used for grading, track-shifting, and excavating for the South avenue sanitary sewer outlet. It is now grading for the dump tracks on the north spoil bank.

Concrete walls have been completed at the south end of the Champion Coated Paper Mill and along the Bottinger lot at the west end of the Main street bridge. The South avenue sanitary sewer outlet has been completed. This is a 3-foot-diameter, submerged concrete sewer, 150 feet in length.

Fourteen flood-gate man-holes on city sewers, have been completed.

All arches and spandrel walls on the Black street bridge have been completed. The falsework and forms have been removed. The concrete railing will be completed in about ten days. This will complete all of the concrete with the exception of that part of the sidewalk which is to be laid on the backfill. Work is just being started on the water-proofing of the arches and spandrel walls.

Price Bros. have completed the slope and flexible slab revetment between the Columbia bridge and the Champion Coated Paper Co. wall, a stretch of about one mile. This completes their work here for the season. The manufacture of concrete blocks has been completed and the block plant dismantled. The total number of blocks cast was 225,377.

C. H. Eiffert, Division Engineer.

October 25, 1921.

PIQUA

Since last July the levee work has progressed steadily. The scarcity of suitable material for levee work forced a double throw of the material from station 33 to station 51. The big dragline has made its first throw of this, and is making its second throw on its return trip, being now at station 46. Thirty-three thousand yards of material were handled by this machine last month.

The placing of top soil on the levee and the planting of grass seed has reached station 32. A good stand of grass is being secured on the levee.

November 1, 1921. Albert Schroeder, Assistant Engineer.

UPPER RIVER WORK

Troy. Since July 1st, the dragline D-16-21, under the direction of Donald Jeffrey, has completed the channel and levee work above Adams street bridge and also placed 22,000 cubic yards of embankment in the levee between Adams street and Market street on the right bank of the river. This levee is now ready for top soil, revetment, and parapet wall.

T. Daniels & Son have practically completed their channel excavation, except the north approach to Adams street bridge. This work will be started as soon as Market street is opened to traffic.

Price Brothers completed their work around Market street and S. T. & P. bridges about September 1st, and then started work on the underpinning of the three existing piers of the Adams street bridge. This work has progressed favorably, and concreting will soon be started.

The Finke Engineering Co. returned to Troy July 12th, and after completing their levee embankment, the raising of the Dixie Highway and the D. & T. traction line was undertaken and completed by the middle of September. Since then, the contract for the paving of the approaches to Market street bridge was let to the same company and this work has also been completed.

The contract for the new steel span for Market street bridge was let to the Central States Bridge Co. They started work on July 12th, and completed the bridge floor on September 24th. The repairs on the two old spans were completed on October 1st.

The District work on the Adams street bridge, under the direction of Mr. Rogers, began with his arrival on September 10th. To date a good share of the necessary plant has been accumulated and erected. The carpenter and blacksmith shop is working and the mast for the derrick has been raised into place. As soon as Market street is opened to traffic, Adams street will be closed. Daniels will excavate for the new north abutment, and Rogers will start concreting.

Tippecanoe City. The dragline D-16-4 completed the levee north of Main street on July 1st. The greater share of the time since then has been spent in casting about 45,000 cubic yards of material into place for final throw into levee. About 600 lineal feet of levee has been built below Main street. Double shift on levee work started on October 10th.

The work on the canal interceptor will probably be completed by the 1st of December. The excavation work in the canal has been done by a small dragline. Less than 1,000 lineal feet of 36-inch concrete sewer remains to be done.

The Fourth street sewer was let to J. C. Mercer & Sons of Piqua, Ohio. Construction work was started on September 19th. A Keystone excavator is being used for the trench excavation. To October 10th, about 80 feet of trench has been opened up and 60 lineal feet of 66-inch concrete sewer poured. A new and heavier Keystone excavator has just been added to their equipment and better progress is expected.

The contract for the Bull Run ditch with culverts at Second and Third streets, has been let to Wm. Oberer of Dayton. He started work October 10th with six teams. This work includes approximately 10,000 cubic yards of excavation and 500 cubic yards of concrete in culverts.

A. F. Griffin, Assistant Engineer.

October 20, 1921.

LOWER RIVER WORK

Miamisburg. The east levee is now complete with the exception of a short gap from the tail race of the Miamisburg Paper Co. to that of the Ohio Paper Co. The total yardage in this levee, including the gap, is about 158,000.

On the 1st of August, Wm. Oberer completed the levee along the east and west banks of the canal from the locks at Lock street southward to a point opposite the main east levee. This contract amounted to 9,700 cubic yards. In September Oberer completed the lower Germantown road elevation, amounting to 1,725 cubic yards, filled a gap in the levee below Linden avenue amounting to 1,200 yards, and placed 1,800 yards of top soil on the levee above Linden avenue.

A 4x5-foot reinforced concrete culvert in which a sluice gate will be placed was built on the lower Germantown road by the District's forces. There are 63 cubic yards of concrete in this structure.

Price Bros. have completed the flood gate structure in the M. & E. canal north of Sycamore creek, and within a few days will have completed the structure in the tail race of the Miamisburg Paper Co. Total concrete in these two structures is 337 cubic yards.

Franklin. The dragline is rapidly completing the last cut of the channel excavation. The total quantity excavated to date is 76,000 yards. Of this amount 54,000 yards was loaded into 4-yard dump cars and placed in the levee, 12,000 yards was hauled to the spoil bank, and the balance was deposited in the levee by the dragline. The levee above the suspension bridge will be completed in two weeks.

Concreting on the Miami avenue wall was begun July 29th and on September 26th 1,937 cubic yards had been poured. The upper section of the wall, 5 feet 3 inches in height, will not be poured until the fill back of the wall is made. This fill amounts to about 5,000 yards and is being handled by a 70-foot boom stiff-leg derrick and a one-yard clam-shell bucket. This is the rig that made the excavation for the wall and handled the concrete buckets and forms. The concrete apron for the protection of the existing wall along Miami avenue has been completed. This apron is 700 feet long, 8½ feet wide, and contains 200 cubic yards of concrete and 700 lineal feet of 8-foot to 12-foot steel sheet piling.

The Front street crest wall is now being constructed and will be completed in two or three days. This contains 80 cubic yards of concrete.

Middletown. Levee maintenance work, consisting of cutting weeds, seeding bare spots, etc., has been completed for this season. Geo. Shartle has completed the levee along the Big Four spur back of the traction station.

October 20, 1921. F. G. Blackwell, Assistant Engineer.

RAILROAD RELOCATION

Big Four and Erie. Completed.

Baltimore & Ohio. Completed.

Ohio Electric. Since July, 1921, the track-laying and ballasting of the section of the relocation lying between Fairfield and Carlisle Junction has been completed by Roberts Brothers, the contractors who had the work. Shifting 1,000 feet of line near Huffman dam, has also been

completed, and the Springfield pike which parallels the Ohio Electric at this point, has also been shifted to its final location. The bridge over Mad river has been completed by the Brookville Bridge Company. Traffic over the new line between Fairfield and Carlisle Junction was turned on October 27th, and except for dismantling the old line above Fairfield all the Ohio Electric work is completed.

November 1, 1921. Albert Larsen, Division Engineer.

RIVER AND WEATHER CONDITIONS

July to October, 1921

River and weather conditions during the months of July to October, inclusive, were not marked by any very unusual occurrences. Fluctuations in meteorological factors were not abnormal; and there were no storms of sufficient intensity to cause appreciable rises in the streams. Rivers were comparatively low except during the first week of August when there was a slight rise due to the two-week rainfall of August 1 to 3.

The mean values of the different factors during the months of July to October, taken from the U. S. Weather Bureau summaries for the Dayton station, are given in the following tabulation:

Factors	July	Aug.	Sept.	Oct.
Rainfall, 1921, inches.....	1.34	3.30	4.76	1.79
Rainfall, normal, inches.....	3.28	3.01	2.50	2.40
Excess or deficiency, inches.....	-1.94	0.29	2.26	-0.61
Temperature, 1921, degrees	80	72	71	54
Temperature, normal, degrees	76	73	67	54
Excess or deficiency, degrees.....	4	-1	4	0
Number of clear days	18	16	9	16
Number of partly cloudy days	13	10	17	6
Number of cloudy days	0	5	4	9
Number of days with rainfall of 0.01 inch or more	8	9	14	10
Prevailing wind direction	SW	SW	SW	SW
Average hourly velocity, miles.....	7.9	7.6	8.1	10.6
Maximum 5-min. velocity, m.p.h....	48	35	54	35

Ivan E. Houk, District Forecaster.

November 1, 1921.

Savings From Little Things

Salvage Operations Successful in a Relatively New Field.

The Miami Conservancy District is doing the major part of its construction work with its own forces. Besides employing an engineering and construction organization, it has purchased all of the equipment, material, and supplies necessary for the prosecution of the work. About one-half of the District's construction expenditure has been for labor, and the other half has been for materials, equipment, and supplies.

The handling of equipment and material on construction work has, in the past, received careful thought from engineers and contractors. Benefiting by the experience of others, the District was able to establish a satisfactory and economical method of handling these things, at the very start of the work. With supplies, however, the general practice on construction work has been to buy, use, throw away, and re-buy. The District, by its salvage operations, pioneered to a considerable extent.

A big job just seems to devour repair parts and supplies. A never-ending stream of orders for shovels, rubber boots, padlocks, valves, pipe fittings, steam hose, cable clips, nuts, washers, dowel pins, repair parts, and several thousand other articles, goes through the Purchasing Division continually. It is not hard to see the reason for this. An easy way to lose large sums of money is to waste time on defective machinery. So it is very natural that some of the smaller things such as valves, hose fit-

tings, lubricators, injectors, etc., should be treated with small ceremony when they "go bad." If a \$3.00 valve is caught wasting even a small amount of the precious steam for a \$40,000.00 drag-line, no jury is needed to sentence the culprit. Without ceremony the long arm of the ever-watchful Master Mechanic reaches out and, presto! a shiny new one-hundred-per-cent valve is put on guard, and the offender finds itself down and out, back in some out-of-the-way corner along with a number of other incompetents with an avoirdupois value only.

It is not unusual on construction work, generally, and quite often in manufacturing plants, to pay no attention to the incompetents, after they have once failed, except to sell the junk pile every so often to a thrifty junk dealer at so much a pound. Most construction men are strongly opposed to the use of second-hand supplies. They can hardly be blamed for their attitude. So much second-hand stuff is useless. The use of second-hand supplies often results in a penny-wise and pound-foolish situation.

But on a big job like the Conservancy work, the sum of these little items amounts to an astonishingly large total. For instance, about 3000 valves, of two-inch size or less, little fellows all of them, with a total value of about \$10,000, have been purchased since the job started; and 580 axes, 23,550 cable clips, 300 sledge hammers, 900 picks, and other supplies in proportion, have been furnished to the job by the central warehouse in small lots.

At first, everything was new—the plant was being assembled and extended, and the supplies used were mainly for this original installation. But soon replacements had to be made, and the junk piles began to grow.

But an odd problem bobbed up first, the solution of which paved the way for the exploitation of the junk piles. The work is so big that it has been broken up into divisions, each with a superintendent in charge. Each is a high-grade man, accustomed to being in responsible charge of work. But the District is compact enough so that communication is easy between the divisions, and the work is supervised as a unit, with a constant shifting about of equipment, men, and supplies between the divisions. At first the superintendents and engineers were not used to this, as jobs as big as this one are very rare. Instead they had all previously been on work located a long way from the base of supplies. Being a canny lot, as soon as they had the work well under way, they began to hoard repair parts, pipe fittings, special tools—the many things their jobs might or might not need, but would always need in a big hurry if the emergency came. Nothing hurts a superintendent's feelings worse, or damages his reputation or his costs more, than waiting for repair parts or supplies; so a reservoir of such things soon accumulated at each job, ready for use when the time came.

But the amount of money tied up in those reservoirs of supplies became so large that a survey of the situation was made. In some cases special repairs were held in reserve at six or seven of the divisions, when one or two held at headquarters to be rushed out in case of breakdowns, would have been ample. Jobs fortified themselves against a series of accidents to their steam lines by keeping a considerable number of valves and fittings on hand, when one or two valves and a limited supply of fittings would be enough in the field if a reserve stock were available close at hand. A campaign was started to get surplus supplies back into the central warehouse. It was a campaign of education largely. At first the superintendents, fortified by their experiences of the past, were inclined to resist the efforts made to separate them from their accumulations. But as soon as they were convinced that the central supply depot would actually give satisfactory service in emergency cases, and that the cost of their work would be lowered by turning in their surplus stock, they gladly co-operated with headquarters in the round-up of extra supplies. Organization was found necessary. Periodic visits to the different features were made by a man specializing in this work. Being well posted on the needs of the job as a whole, he often "spotted" an article that could be spared from one division and was badly needed by another. Oftentimes a truck accompanied the collector, and the supplies were brought into headquarters as soon as they were released. By systematically going over the camps, shops, and the jobs themselves, often stuff put away in out-of-the-way places for safe keeping and almost forgotten, was turned up and put to work. After a time every one accepted the innovation as the usual thing, and soon the system was working smoothly and efficiently. While at first the efforts were confined to getting surplus supplies back into the cen-

tral warehouse, it was not long before a wide variety of articles was being handled, transfers were being arranged between divisions, and swaps of machinery engineered.

While all this was going on, the junk piles continued to grow. Despite the precedent long established on construction work, that it does not pay to waste time on anything after it has reached the junk pile, the same organization that was collecting the surplus supplies and handling the equipment transfers, collected a few standard articles from the discards about the repair shops and brought them into the general shop in Dayton. A good, handy mechanic was selected and put to work repairing the different things brought in. Very careful check was kept on the cost, and the result was so encouraging that the operations were greatly enlarged and a great miscellaneous mass of material was rounded up from the jobs and worked over. Valves were so numerous, and obviously in many cases needed so little attention to make them serviceable again, that they were



FIG. 339.—JUNK.

among the first of the products of the salvage division. Then the operations were extended to cover stoves, barrels, air hose, gasoline pumps, boiler flues, rubber boots, wheelbarrows, window sashes, jacks, water pumps, grindstones, chain tongs, oil pumps, dump cars, oil cans, steam gauges, valves, cable clips, and many other things. Nothing was too large or nothing was too small for the salvage division to tackle. A cable clip is a little thing, commonly not even detached from the wire rope when the cable is thrown away. Yet two men equipped with an automobile and an acetylene torch secured 1693 clips of various sizes from the piles of discarded rope out on the job. The saddles were dipped in paint and new U-bolts were put in, and the rebuilt clips issued to the job at somewhat less than the new price. The net saving to the District on this one transaction was \$438.00. Very often it was found that by taking three wrecked wheelbarrows, two usable ones could be produced. Discarded stoves were gathered up. Sometimes it took two or three wrecks to make one good stove. At other times, the addition of a casting or two and the application of a little stove-polish worked wonders.

It was early found that great care was needed to avoid salvaging something that cost more to save than it was worth. Rubber boots are used in large

quantities on the District work, on account of the sluicing operations. They are useless to the job when they begin to leak. At first glance this looked to be a fertile field for the repair man, but a few trials demonstrated that a reclaimed boot strong enough for the severe usage given it on the pipe gang cost more than a new boot. Great possibilities were seen in turning discarded telephone and telegraph poles into fence posts, but the fence posts produced this way persisted in costing more than new ones made in the regular way. Wrecking buildings for the lumber they contained, often proved to be a delusion and a snare. The policy was early established of trying out new operations in a small way before plunging extensively, and nothing was worked upon that did not show a definite advantage or saving to the District.

It was recognized that the junk has a value, as junk, to the division that has it in its possession. Therefore, the practice has been for the salvage division to take in the articles from the field at a price, much as they would buy it if they were outside dealers, do the repair work, and reissue the articles to the job at a figure high enough to cover the price paid to the field plus the cost of repairs. So far, about \$60,000 worth of material has been salvaged and reissued. This had, of course, a value as junk. This junk value was about \$35,000. The cost of reclaiming this, overhead, supplies, and everything, has been about \$3,000, leaving a clear gain of about \$22,000 from the transactions. All this has been made on little things. The division has grown from one man working only part time, to four men working full time. The best results have been secured by centralizing the supervision, conducting the work as a part of the headquarters operations. The engineer in charge has become a specialist.

So successful was the salvage work that it has become very convenient in some cases to repair machinery and to handle a portion of the movement of equipment about the job through the salvage di-



FIG. 340.—NO LONGER JUNK.

vision. At the present time, with the District's work rapidly drawing to a close, equipment and supplies are being released for sale. It has fallen to the salvage division to prepare these articles for sale, and to assist in listing and pricing them.

At first the veterans of the construction force took the delvings into the junk piles as a joke. However, they were glad to help, and were interested in the experiment. They were glad, also, to receive the substantial credits to the costs of their work that were derived from the rehabilitation of the various down-and-out articles. They were inclined at first to be doubtful of the quality of the reclaimed stuff, but after a few trials they were convinced of their utility. It was early found that a careful cleaning, and the application of a little paint, greatly aided in convincing the construction men that the second-hand articles were "as good as new." As with all innovations, the salvage work had to win its way on its merits. Besides the definite saving in dollars and cents that is in plain sight, the indirect saving secured through the interest aroused throughout the job, in the savings in little things, and through the economies evolving from the services of the salvage division as a "go-between" in the movement of supplies and equipment about the job, has been of great value to the Conservancy District.

From Draglines to Toothpicks

Selling the Equipment and "Left Overs" Promises To Be a Large and Interesting Undertaking

When the last shovelful of earth is thrown, about a year from now, the Miami Conservancy District will go out of the construction business, and will have no further need of its locomotives, cars, draglines, construction camps, mess halls, motors, pipe lines—the multitude of different things needed to carry out a widely diversified construction program. Already the completion of the Germantown and Lockington dams, and of portions of the other work, has released a considerable amount of equipment, material, and supplies for sale. A good part of it has already been disposed of. New releases are being constantly made. Selling promises to be a larger problem than buying has been. The articles up for sale range from draglines to toothpicks, and from mess halls to rivets.

As explained in another article in this Bulletin, a good deal of the miscellaneous material for sale is being salvaged from the job. Some of the rest is second-hand, in such good condition that reclamation work is not necessary to prepare it for sale. Some is new, being in part replacement parts and supplies

held in reserve for emergencies that never materialized, and being in part left-overs, odd sizes, and other odds and ends from the commissary stores. By far the greatest part of the money value is in the larger pieces of equipment, such as draglines, locomotives and cars, and in the camp buildings.

Until the Germantown job was finished in January, 1921, the District had practically nothing for sale, except from the railroad relocations, and that is another story. The Conservancy camps were planned to meet not only the unusual conditions incident to the nature and size of the flood prevention project, but also the abnormal difficulty that prevailed at that time in securing and keeping a desirable and efficient body of workers. The houses are attractive, with running water, electric lights, baths, and sewer connections, and are much superior to the ordinary camp dwellings. So when the problem of disposing of some sixty-five odd buildings from the Germantown job, ranging from sheds to two-story houses, came up, no one was prepared to say what the houses were worth. As Germantown

camp had no rail connection with the outside world, it was determined to sell the buildings "as is," to be moved from the premises. Professional wreckers shook their heads.

To ascertain, if possible, the demand for and the value of the buildings, an auction of eight of the properties was held. A live crowd of four or five hundred people gathered on the 26th of January, 1921. Spirited bidding resulted, and values were established at a much higher figure than the professional wreckers had attempted to set. A bride and groom bought one of the first houses put up. The remainder of the buildings were sold at private sale, and brought even higher figures than those of the auction. Lockington camp has been sold during September and October of this year, and even better prices were obtained than were secured for Germantown. In addition two tracts of land with houses on them have been sold to home-seekers, and the water-works were sold in place—something that was not done at Germantown. Three camps, containing several hundred buildings, remain to be sold next spring.

Comparatively little large equipment has been released as yet, but after Christmas a large amount will be offered for sale. The market for this class of stuff is necessarily limited to firms and individuals doing construction work, and consequently the local market is extremely limited. Prospective buyers are being located through advertisements in the technical press, and through correspondence. A wide field is being covered by means of the publicity. But little trouble has been experienced in disposing of the machinery placed on sale so far, and two drag-lines, a locomotive, sixteen cars, eight rock drills, four pumps, and some smaller articles, have already been disposed of.

But the greatest interest lies in the sale of the little stuff coming from the salvage operations, from the dismantled camps, from the commissaries and mess halls, from every nook and cranny of the job. No one anticipated its volume nor the returns that are being secured from its sale. One of the first lists of stuff for sale contained over eight hundred different items, and it was followed with a supplement containing four hundred more.

A fundamental principle in selling is to first catch your customer. The market for the little stuff is largely local. Newspaper advertising has been very effective. The newspapers have co-operated by writing news stories on the subject. Sales lists have been mailed to prospective buyers. Personal visits have been made by District representatives to many customers. The demand for certain articles has been very good; for others a good deal of hustling has been necessary before buyers have been found.

In breaking up a camp, it was early found advantageous to sell as much small stuff as possible right on the ground. The surrounding farmers are glad to buy second-hand lumber, even scrap being disposed of at very good prices, and also many of the small tools, hardware, and mess hall equipment and supplies. Scrap and junk not worth salvaging is disposed of to junk dealers near at hand. A clean sweep is made of the remainder of the small articles by bringing them into the central warehouse in Dayton, cleaning them up, and placing them on sale.

In fixing the prices of the various articles, the original prices are looked up and compared with the present-day prices obtained from retail dealers, wholesale merchants, and mail-order catalogues, the depreciation from age or use is taken into consideration, and a fair price thus established by the purchasing division, salvage division, master mechanic—some one who is especially well fitted to judge of the value of the particular article being priced. In the case of equipment and valuable supplies, an appraisal board is named to fix the price. The prices are reviewed and approved by the chief engineer before they are finally set. The selling is done from these fixed prices. Any one with the cash can buy as much as or as little as he wishes. As the war upset values, sometimes second-hand articles bring more today than when they were purchased new at the start of the work.

The force engaged in selling has been recruited from the District employees, and is mainly composed of men who have other duties. Employment work is at a low ebb. The District's employment manager, besides taking care of his employment duties, does the major part of this class of selling. The salvage division, besides doing much of the preparation work, is also doing considerable selling. The warehouse forces, superintendents, and engineers all help. The purchasing division is disposing of the large equipment. Reports of everything sold, listing each item separately with the prices received, are required from the selling force every two weeks. These reports are carefully gone over by the chief engineer before his final approval is placed upon the transactions listed.

A recent report of sales for two weeks made by the employment manager, contained 275 different items, and a short section of it ran as follows:

- 4 pairs hip boots (used).
- 160 feet radiators (two column).
- 1 doz. ox-blood polish.
- 1 doz. Bee playing cards.
- 1 Estate Dart stove (second-hand).
- 1 box shoe laces.
- 1 stove pipe elbow.
- 1 dish pan (used).
- 1 5-lb. pail Rat Doom.
- 4 lbs. 11/16"x4 3/4" C. H. rivets.
- 1 bottle Barkeeper's Friend.
- 2 ends of dish tables.
- 1 pair shoes, style 2.
- 1 kitchen table (damaged).
- 1 cash register.
- 1 house at Lockington.
- 1 old mop bucket.

The 275 different items covered by that two weeks report brought \$5,691.16.

The successful sale of the equipment and "left-overs" belonging to the District, is very necessary. The customers so far have come from all walks of life and business, and have purchased liberally. The wide variety of articles for sale appeals to an equally wide variety of customers. Much has been advantageously sold so far. More is becoming available every day. This winter will see three more camps dismantled, and excellent bargains offered in many different lines. The District will exert every effort to successfully dispose of its plant and supplies at advantageous prices.

The Construction of the Lockington Weir and Spillway Bridge

As explained elsewhere in this Bulletin, the first step in building the Lockington Dam was to erect in 1918 and 1919 enough of the outlet structure to form a wide, deep trough through the dam, thus providing a safe waterway for large floods that might occur during the construction of the earth embankment. Notches were cast in the side walls of the trough to be used later as a means of keying the weir to the remainder of the structure.

A weir is a dam so built that water can flow over its top without injury. Construction of the Lockington weir started in June, 1921, when the spring flood danger was past. It is a massive concrete wall pierced by two openings at its base nine feet wide by nine feet two inches high. It rests on benches on the side walls and on the pier between the two arched conduits. A discussion of the structure as a whole is given on Page 5 of this Bulletin.

The weir is of the sharp-crested type. The upstream face is vertical. The lower face forms an ogee curve. The word "ogee" is a nickname applied to a curve shaped like a thin letter "S" and tilted half-way on its side. When of the right proportions such a curve will allow a sheet of water to flow over it with very little disturbance, and the lower surface of the sheet of water will be in contact with the curved face throughout its entire length. The weir is a gravity dam. That is, it is stable against sliding or overturning without the aid of reinforcing steel. It is about forty-six feet thick at the bottom and fifty-four feet high above the conduits. The crest is about sixty-two feet above the floor of the outlet structure.

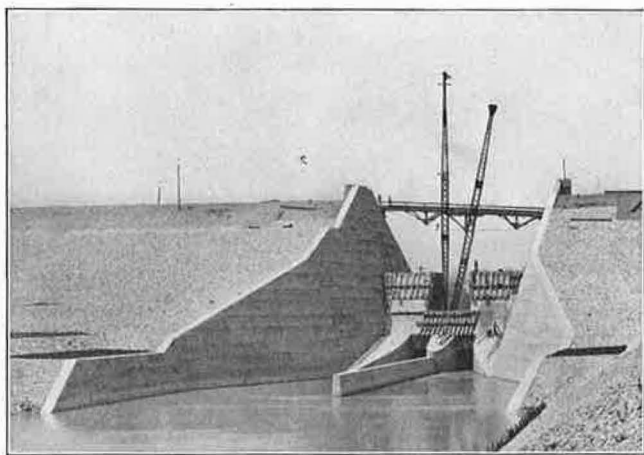


FIG. 341.—LOCKINGTON OUTLET STRUCTURE ON
JULY 11, 1921.

The hydraulic fill is nearly done, and the weir is about two-thirds completed. The forms are the sliding type standard with the District.

In constructing the weir, steps were left in the curved face where the bridge pier was later placed. Thus all of the load of the pier and bridge is carried on the horizontal steps and no shearing stress is developed along the face of the weir.

A highway runs across the top of the dam. As the spillway is a notch in the dam sixteen feet deep, a bridge is necessary to carry the roadway over the spillway. After a careful study of the problems in-

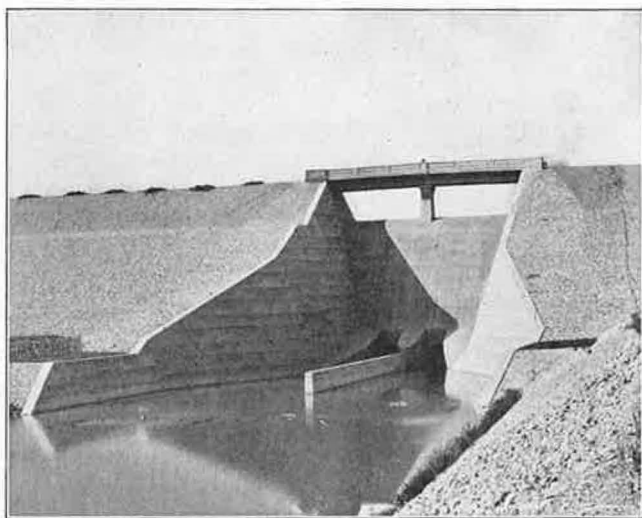


FIG. 342.—THE COMPLETED OUTLET STRUCTURE
SEPTEMBER 28, 1921.

Involved, a deck girder bridge of two spans was selected.

The bridge is designed to take a "live" load of two twenty-ton motor trucks passing each other, an impact or blow equal to thirty per cent of the live load, and the dead weight of the bridge itself.

Due to an optical illusion, a bridge built on a straight line looks as though it sags in the middle.

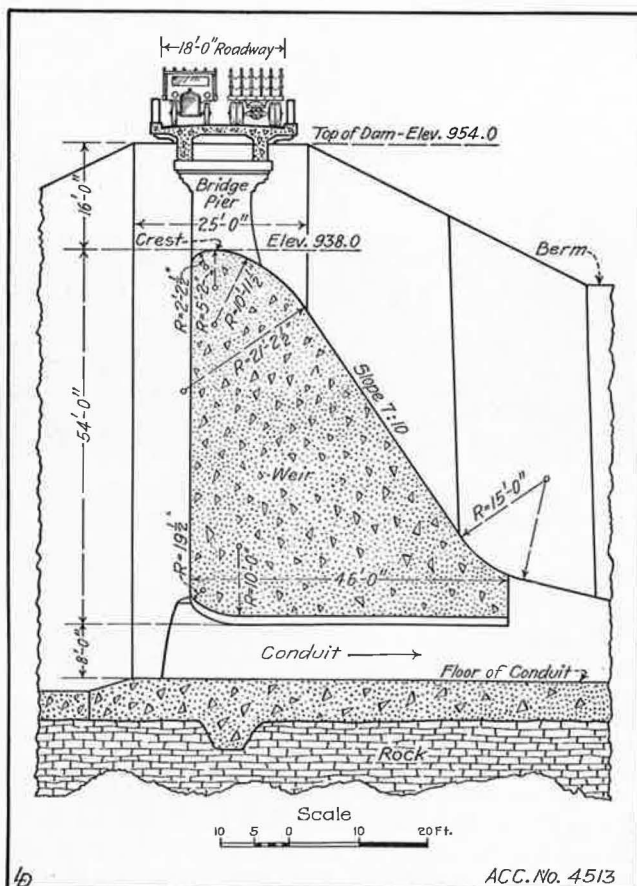


FIG. 343.—SECTION THROUGH WEIR AND BRIDGE.

Therefore this bridge is built on a vertical parabolic curve; that is, it has a hump in the middle. Besides this curve the girders themselves are one inch higher in the middle than at the ends. This is called camber in engineering terms and is put in to take care of deflection or sag in the girders.

The same screening and mixing plant was used that was built for the construction of the outlet works. A guy derrick, placed in the inlet channel, handled the forms and materials. The concrete was brought from the mixing plant to the derrick in bottom-dump buckets, placed on narrow-gauge cars which were pulled by a gasoline locomotive.

The bridge was designed to meet the unusual conditions imposed by its location and the service required of it, and, with its overhanging floor slab and cantilever pier, presents some novel features. In an early issue of the Bulletin the design of this bridge, together with the other spillway bridges, will be discussed at some length.

The Core Pool Overflows at Englewood

On the night of October 25th the core pool on the Englewood dam overflowed on the upstream side of the dam, at a point several hundred feet west of the outlet conduits, and directly west of the gravel-washing plant. The dam was within twelve feet of the top, consequently the pool was quite narrow; it was also very shallow, but its great length (4,600 feet) made the volume of water in it large enough to wash a gully down the slope of the dam. All of the water in the pool ran out of the gap.

This kind of an accident is not unusual in hydraulic work. In this case, only a minor delay of a few days occurred until the washout could be shut off from the rest of the dam by means of low dikes, when pumping was resumed. The wash in the slopes is rapidly being filled up, and at the time this is written (November 1st) repairs will be completed within two or three days.



FIG. 344.—CHUNKS OF CORE MATERIAL AT LOWER END OF WASH, OCTOBER 26, 1921.

An unusual opportunity was afforded to study the condition of the core material, after it had been in place for some time. The upper edge of the wash exposed about 30 feet, in vertical depth, of the core. The material was so firm that it stood up in a vertical wall, almost as if it had been cut down with a great knife. See Fig. 345. It also resisted the rush of the water extremely well, and little of it was washed away. What did go, went in chunks, many of which did not break up much on their trip down the gully. Some of the lumps on top of the gravel debris at the foot of the gully measure over a cubic yard in size. It is very likely that several inches of very soft stuff on top, in the immediate vicinity of



FIG. 345.—CORE EXPOSED AT ENGLEWOOD, OCTOBER 26, 1921.

The core resisted the rush of water extremely well. The face is standing nearly vertically and looks as if it had been cut with a great knife.

the hole, went out with the water, but if any did go, it was so small an amount that it could not be missed. Out of 6,000 or 7,000 cubic yards of material washed out, only about 750 cubic yards was core.

The evidence produced by the wash was ocular proof of the satisfactory deposition and consolidation of the core material in the District's dams, and was, of course, far better proof than any that has been secured heretofore from sounding and sampling. When the test came, the core "toed the mark" far better, in fact, than was generally expected.

Four Engineers Leave

Upon the completion of the Lockington dam in September, Mr. Barton M. Jones, division engineer in charge, went to Pueblo, Colorado, to assume charge of the flood prevention investigations in progress there, under the direction of the Morgan Engineering company. He was accompanied by Mr. W. J. Smith, assistant engineer, first on the Lockington dam and then on the Taylorsville dam. Mr. A. L. Pauls, division engineer at Germantown, left on October 1st to assume charge of a difficult foundation job for a viaduct at Decatur, Illinois. In October, Mr. C. O. Shively, assistant division engineer on the Germantown dam, and later at Taylorsville dam, left the employ of the District to accept a position on the teaching staff of Purdue University. All four men were among the oldest employees of the District, in point of years of service. Their departure emphasizes the fact that in a few months the greater part of the work will be done, and the organization in which its members have had so much pride, will be dispersed.

THE MIAMI CONSERVANCY BULLETIN

APRIL, 1922

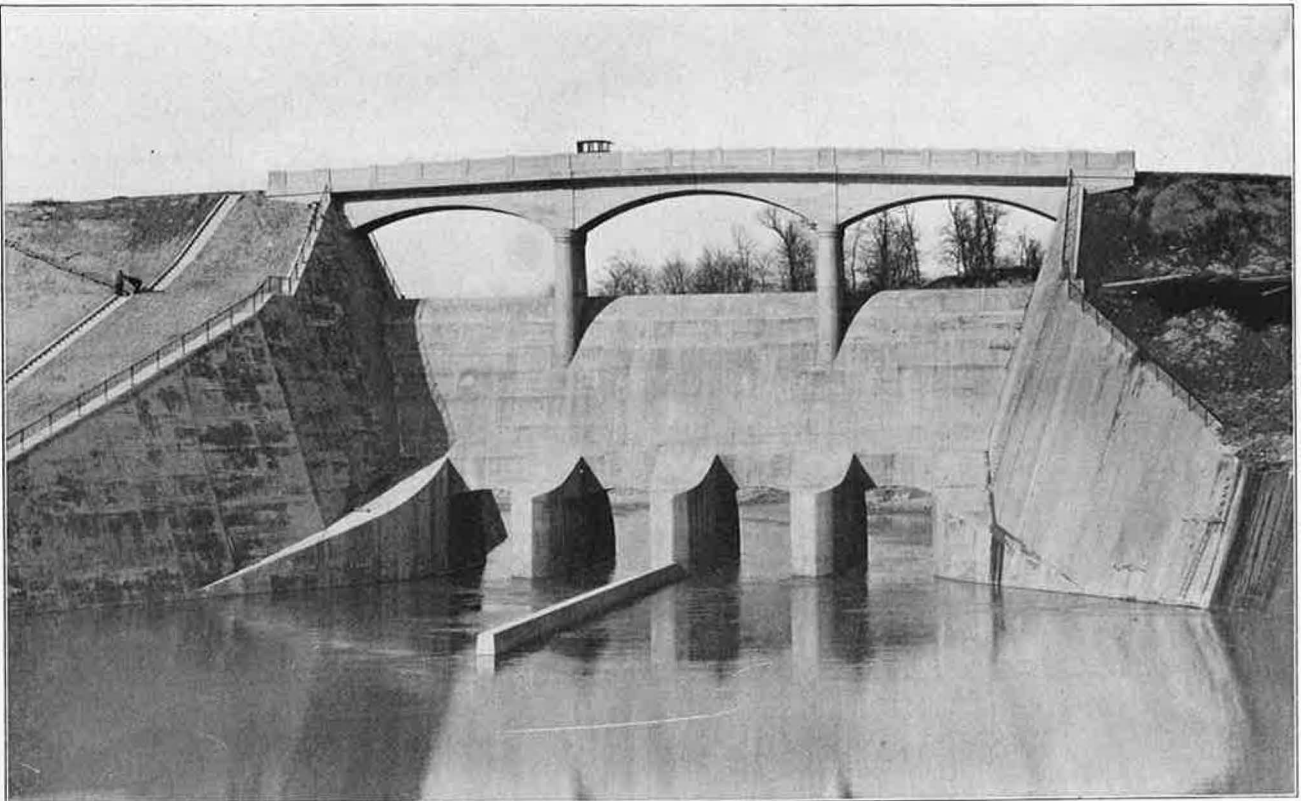


FIG. 346—TAYLORSVILLE OUTLET WORKS, MARCH 3, 1922.

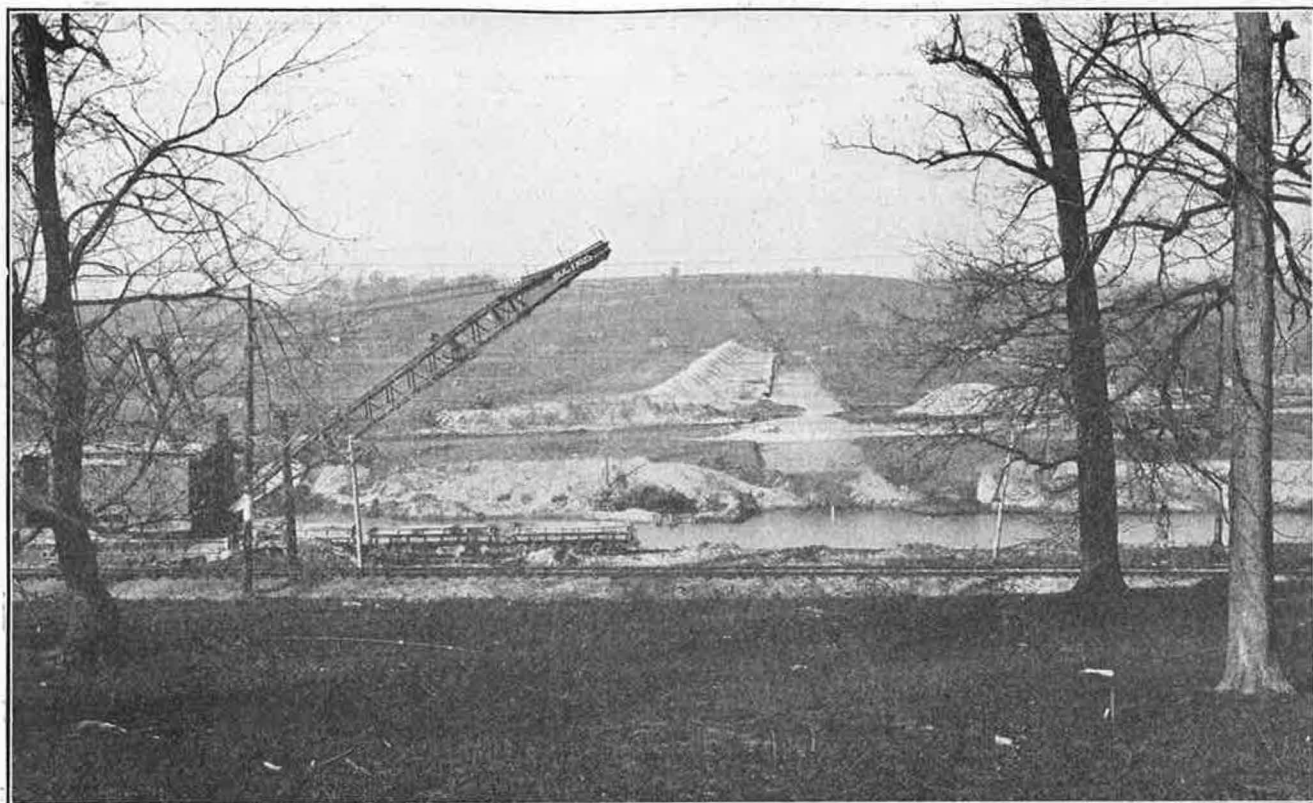


FIG. 347. LOOKING NORTHWESTERLY ALONG THE CENTER LINE OF THE HUFFMAN DAM SITE, DECEMBER 17, 1918.

The track in the foreground is the temporary line of the Ohio Electric; the temporary line of the Big Four is just below the hill. The water just over the hill is in the excavation for the outlet structure. The river channel can be seen just beyond. The ditch full of water running towards the distant hill is the cutoff trench along the center line of the dam.

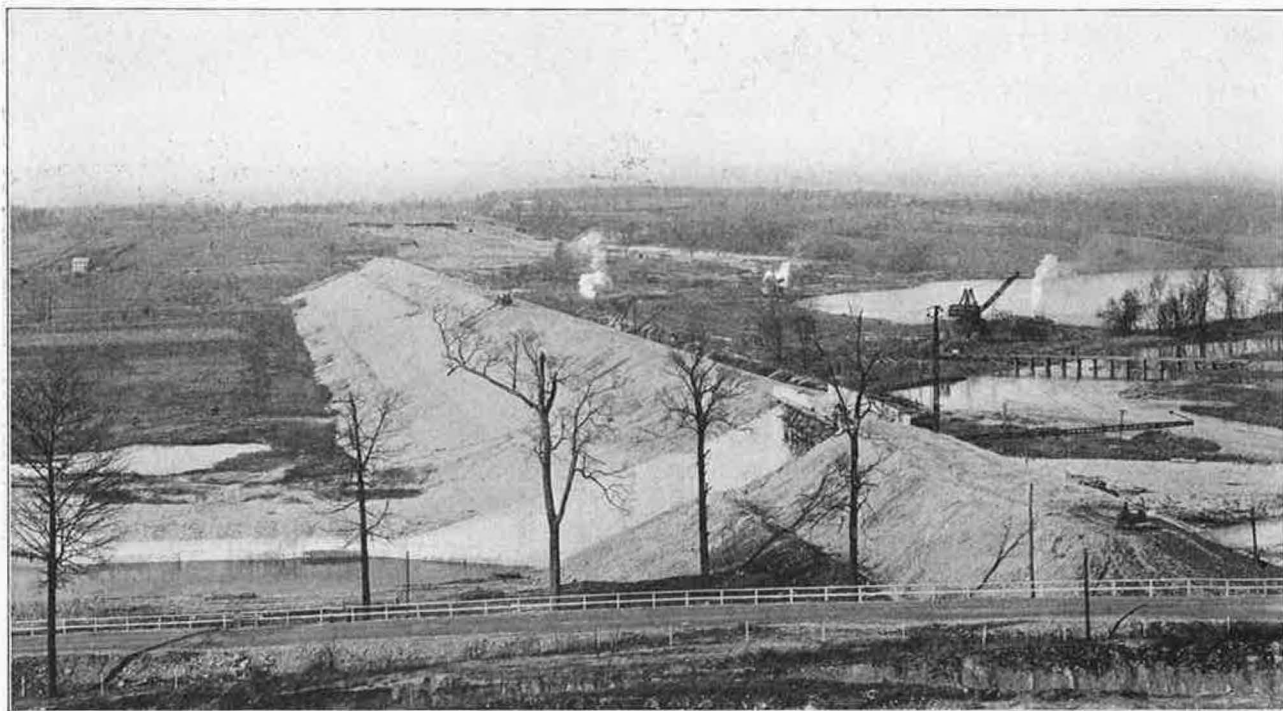


FIG. 348. THE COMPLETED HUFFMAN DAM ON JANUARY 6, 1922, LOOKING NORTHWESTERLY FROM THE EDGE OF THE BIG CUT.

This view was taken from a point higher up and farther downstream than the one from which the view just above was taken. The big cut is at the photographer's back. The cut at the lower edge carries the permanent location of the Ohio Electric. Then comes the relocated Springfield Pike, and then the part of the dam built by teams. The forms are still under the spillway bridge. The men on the hydraulic fill part of the dam are putting the finishing touches to the trimming. The river channel at the right has since been closed off, and a new one opened up.

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Subscription to the Bulletin is 50 cents per year. At new stands 5 cents per copy. Business letters should be sent to Office Engineer, Miami Conservancy District, Dayton, Ohio. Matter for publication should be sent to Bulletin Office, Miami Conservancy District, Dayton, Ohio.

Death of Hon. John Galvin

On March 1, 1922, word was received from Cincinnati, of the death of Honorable John Galvin, age 59 years, former mayor of that city and member of the legal staff of The Miami Conservancy District. The news came as a great shock to his many friends in the Conservancy organization. The Bulletin extends sympathy to his family.

Soon after the Conservancy Law was passed, the Flood Prevention Committee made careful investigation as to a Cincinnati lawyer, and without his knowledge of such inquiry, and without any application on his part or on that of his friends, upon the recommendation of Judge Brown, John Galvin was unanimously chosen as local counsel for Hamilton County.

He came to Dayton at the time of the hearing, was in consultation before the hearing, and took an active part in all proceedings, from the hearing on the establishment of the District until after the appraisals were approved, and subsequently had acted as local counsel in all matters appertaining to Hamilton County. His ability and industry were shown during all these years, and his services were of great value to The Miami Conservancy District and the cause of flood prevention. The people of this valley can never repay their debt to Mr. Galvin for these services.

At the time of his death, Judge Brown, who was then at De Land, Florida, immediately telegraphed his sincere condolences to Miss Galvin, the only daughter, and to the firm of Galvin & Galvin, on the loss of father, brother and partner, stating that the City of Dayton, The Miami Conservancy District and the Miami Valley join Hamilton County and Cincinnati in honoring the memory of Honorable John Galvin, an able lawyer, a faithful officer and a true friend.

A Minor Flood in December

A storm of considerable intensity swept the Ohio Valley during the latter part of December, causing a river stage at Cincinnati unprecedented for December, and causing serious high water conditions at a number of places. The Miami Valley received much newspaper notice because it was not affected by the prevailing high water. The flood protection works received a good deal of undue credit in consequence. The basins all stored water, especially Germantown, where 31 feet was backed up by the dam, and Englewood where 23½ feet was held back. But the total amount stored was a very small proportion of the capacity of the system, and while the river stage at the towns was reduced somewhat by the improvements, the storm would not have produced a flood stage in the Miami Valley even under the old conditions. The principal reason for this was that the storm, very severe in the lower end of the valley, "feathered out" rapidly towards the north, so that a relatively small amount of rain fell on the upper end of the valley, where most of the flood runoff originates. But there was, however, at that time, a beautiful example, in miniature, of how the flood prevention works will prevent floods. A great many people motored out to see the basins, with water in them, and to see the hydraulic jumps work.

The Flood Prevention Work Honored

The Miami Valley and the Conservancy District will be honored by the meeting of the American Society of Civil Engineers in Dayton, early in April, to discuss "Flood Problems." The selection of the meeting place and the topic for discussion is indeed a compliment to the Flood Prevention work.

Huffman, Taylorsville and Englewood Dams Completed

Retarding Basins Now Function 100 Percent During High Water.

Just a few hours before the bells announced the birth of the New Year 1922, the last of the hydraulic fill was placed in the dams of the Miami Conservancy District. To many the end was unexpected. Even among the employees of the District, at the start of the construction season of 1921, the opinion was general that two seasons work would be necessary, to finish at Englewood, if not at Taylorsville and Huffman. The Bulletin had already covered most of the details of construction of Englewood, Taylorsville and Huffman, but little has been said about the final effort that was made to be ready for the flood season of 1922.

It will be remembered by the readers of the Bulletin, that Taylorsville was completely shut down for some five or six months, and seriously held back in placing the hydraulic fill previous to the complete shut down, by the failure of the B. & O. to be moved out of the way on time. When traffic on the railroad was finally shifted, on July 7, 1920, a portion of the best part of the construction season was gone. The conduits on which work had been going forward without interruption were finished in the fall. The dam fill across the river channel could not be made until the critical flood season of 1921 was over, so the remainder of 1920 was devoted to raising the valley section of the dam as high as possible.

The construction season of 1921 opened with about 35 feet yet to go before reaching the top on the valley section of the dam, with the entire river closure yet to be made, and with over one-half million cubic yards of embankment necessary to complete the dam. The topping off of the valley section offered no especial difficulty except that due to the long pipe lines necessary to reach the west of the dam. The river closure was ticklish. It had to be started in April, in order to get it done in time. April meant flood danger. To divert the river through the outlet structure, and to meet the flood hazard to some degree, a rock fill was pushed across the river above the dam, using narrow gauge trains to transport the heavy rock. This phase of the work was described in detail in the June and July 1921, issue of the Bulletin. The flood of 1913 had scooped a hole in the river bed, and it

was filled with "soupy" mud. Cleaning this up was hard work, and extremely exasperating, but it was finally accomplished, and sheltered by the rock buttress above the dam, the closure progressed very rapidly. Handling the number of cubic yards necessary to finish the dam in 1921 was considerably more than could be expected from the single dredge pump installation in use up to that time, so a supplementary unit was placed in a new borrow pit on the east bank of the river below the dam. The following table shows what was accomplished on the embankment in 1921:

March	49,400	cubic yards
April	62,900	cubic yards
May	58,700	cubic yards
June	107,200	cubic yards
July	81,700	cubic yards
August	63,800	cubic yards
September	49,500	cubic yards
October	40,200	cubic yards
November 30th	22,600	cubic yards

The steady reduction in the cubic yards per month in the last few months is normal. As the fill neared the top, the narrow banks, and small amount of embankment placed with each pipe movement, progressively reduced the monthly total.

In addition to the rock fill on the upstream side, a similar fill was placed on the downstream side. This was finished in early summer. When the embankment of the dam had progressed far enough so that it was evident that it could be finished before the spring of 1922, work was started on the spillway and spillway bridge. The former was finished in September, the latter in November. "Cleaning up" was started early in the fall, so when the last fill was placed on November 30th but little work remained to be done. The camp is now being sold, house by house. The Taylorsville job is a thing of the past. The dams and appurtenant structures cost complete, \$2,225,000.

Huffman's history is one of uniform progress made by steady plugging day after day. Like Taylorsville, Huffman was seriously delayed by the failure of the railroads to be moved out of the way on

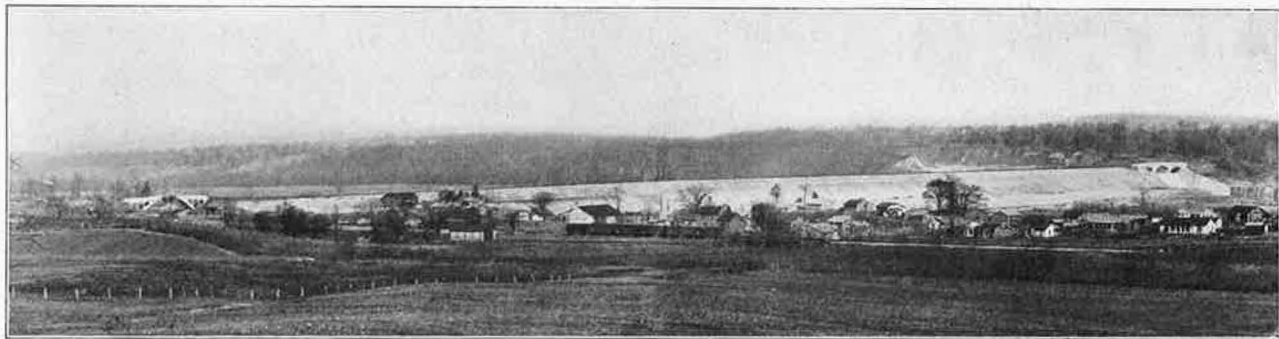


FIG. 349. TAYLORSVILLE DAM, MARCH 3, 1922.

View looking upstream. The dam is all complete, save for the guard rail along the road across the top of the embankment. The bridge at the left is the highway bridge carrying the National Road over the relocated B. and O. tracks. The bridge at the right is the spillway bridge shown on the frontispiece. The buildings in the foreground formed the construction village when work was in progress and are now being sold and removed.



FIG. 350. ENGLEWOOD DAM, LOOKING EAST ALONG THE DOWNSTREAM FACE. MARCH 16, 1922.

The spillway and bridge are in the foreground. A fill is yet to be made connecting it to the Covington Pike, shown in the left hand corner. The tracks of the Dayton, Covington and Piqua will be placed on a fill where the trestle is now, and will pass under the spillway bridge. The dam itself is all complete save for the guard rail along the road over the top. Considerable water was being stored in the basin when this picture was taken. The outlet from the conduits is behind the fill in the middle background, and at the extreme right of the picture. The fill is a part of a temporary spillway.

time. Even the conduits were delayed by delay in the temporary shift that removed the Big Four tracks from the site of the outlet works. The dam fill was started on time, and progressed favorably until the Erie tracks were nearly reached. Then it became evident that the railroad line was not going to be moved in time to permit uninterrupted progress on the embankment. A considerable part of the equipment was diverted to excavating and loading gravel for ballasting the new railroad tracks, and material was placed in the embankment only in between gravel loading times. Even then the dam progressed more rapidly than the railroad work. A low cross dam was built along the Erie tracks, that permitted the work to go forward a little bit, but it was not considered safe to raise the fill much higher than the railroad tracks. Even after the railroad traffic was diverted to the new line on October 4, 1920, the railroad authorities insisted on holding the old line open for a few days to guard against possible interruptions in service on the new line, so that it was the last part of October, 1920 before dirt really began to move as it should. The following is the yardage record from then on to the end:

October 1920	46,700	cubic yards
November	58,300	cubic yards
December	58,800	cubic yards
January 1921	64,400	cubic yards
February	23,600	cubic yards
March	81,200	cubic yards
April	91,600	cubic yards

May	97,400	cubic yards
June	88,100	cubic yards
July	64,200	cubic yards
August	75,800	cubic yards
September	59,600	cubic yards
October	55,600	cubic yards
November	55,600	cubic yards
December 6th	8,000	cubic yards

This steady progress is all the more remarkable when it is considered that but one dragline was used in the pit to supply the single dredge pump, and accidents (which seldom happened at Huffman) shut down the entire works. To call attention to this uniform and uneventful progress is to render the best of compliments to Huffman as it indicates careful planning, anticipation of difficulties, and alertness to prevent accidents and delays, as well as lots of hard, conscientious, work.

A special feature at Huffman was a borrow pit on the hillside at the north end of the dam. This was originally used to supply additional core material, as the regular borrow pits did not supply enough. The surface loam was stripped off by the hydraulic giant, and sluiced by gravity to the dam. Later, when the dam got so high that there was not enough grade for a gravity sluice, a pump was placed in service, and then some "heavys" were also put into the dam from this pit, as well as core material. This particular phase of the work was described in the August, 1920, Bulletin.

As at Taylorsville, the spillway weir and bridge was started when the "topping off" of the dam was in sight, and the last of the bridge was poured in December. At Huffman, some work on the river channel above the dam had to go over until the dam was finished and this work has occupied a small force through the winter. As far as flood protection goes, the dam was done in December. The cost, complete, will be about \$1,900,000.

One million cubic yards a season, with a double outfit of pumps, and an excavation outfit big enough to keep the two pumps busy, was thought to be the limit of yardage that could be expected at Englewood. One million yards each in 1919, 1920, and 1921, would leave 600,000 cubic yards for 1922, which was considered enough for the topping off year. Englewood did not have any railroads in the way to hold things up. Annoyances enough were present, but the Conservancy was not forced to depend upon anyone else to do a part as it was at Huffman and Taylorsville on the railroad work, in order to prevent delay.

This is what Englewood really did. The first year, (1918) was devoted to conduit building, and to preparatory work, which was as per schedule. A little over one million yards went into the dam in 1919, which was also as per schedule. The next year (the "closure" year), one million, three hundred thousand yards were placed, which was beating the schedule with a vengeance. Another one million, three hundred thousand cubic yards was the score in 1921, and the dam was finished on the last day of the year. The following table shows the monthly record for 1921:

March 1921	115,400	cubic yards
April	145,100	cubic yards
May	137,100	cubic yards
June	180,600	cubic yards
July	157,600	cubic yards
August	163,500	cubic yards
September	143,000	cubic yards
October	128,800	cubic yards
November	57,200	cubic yards
December	75,600	cubic yards

Towards the end, the fates seemed determined to prevent completion in 1921. The washout on the night of October 25th was described in the November, 1921 Bulletin. The loss of even the few days involved was serious. Then heavy rains came in December. The tunnels which carry the normal flow of the river, had been built double size to carry flood flows during construction. Due to the uncertainty about Englewood getting done in 1921, reducing these to their normal size was delayed until late in the season, when the end was apparently in sight. The first of the twin tunnels was filled in and floored without difficulty, but it was a different story with the second. The work was flooded out so many times that it seemed that preparations to work on it was the signal for the weather man to send more rain. Finally it was finished in between rains, but just in the nick of time, for the high water of December came almost before the concrete was set, and put twenty feet of water in Englewood Basin. Other perverse things happened on the hydraulic fill. One of the small draglines, used in topping off operations, had needed an overhauling for some time, but work on it was being postponed until the fill was finished. This dragline broke down at an inopportune moment. Even in the last hour of the last day, the pipe line plugged and only by the hardest kind of work was the line cleared, and the last few yards placed before the new year came.

The spillway is a separate structure at the west end of the dam. As flood control during construction was not dependent upon it, it was built during the summer of 1921, quite a while before the fill reached the elevation of the spillway. As all the equipment available was being used to rush the dam work, the approaches to the road across the spillway bridge, and the shift of the D. C. and P. Traction to a location under the bridge, was not made in 1921, but will be completed in the spring of 1922. Quite a few finishing off jobs will be also done then. The force required will be small and a camp will not be needed. It is planned to sell the village at auction on March 29th. Englewood Dam will cost complete with all appurtenant structures, \$3,500,000.

The Design of the Spillway Bridges

Limitations Imposed by Situations of the Structures Cause Development of Unusual Types

Highways cross the valleys on the tops of all five of the dams of the Miami Conservancy District. The concrete bridges which span the spillways of the dams are designed for modern automobile trucks. A number of unusual features are included in the design and construction of these structures.

The present state law (the so-called "Burke Law") places a maximum of ten tons for the gross weight of vehicle and load that may be moved over the highways of Ohio. Motor traffic, in both number and size of machines, will no doubt greatly increase in the next few years, and force a revision upward of the allowable weight. But there is a definite limit to the increase in weight. This limit is imposed in part by practical operation costs and in part by the thousands of bridges, and the many miles of paved

highways that have been constructed at heavy expense, and will not stand traffic beyond this point. Therefore, after careful consideration, two twenty-ton trucks travelling in the same direction and passing over the bridge side by side was selected as the maximum "live" load for the design. The load on the rear axle of each was taken as 14 tons, and on the front axle as 6 tons. The twenty ton truck is probably heavier than the physical limit, mentioned above, imposed by the present highways and bridges. Even if a bigger truck should develop, it would be improbable that two big ones would try to pass over a bridge at once. Besides the "live" load, the bridges are designed for the dead weight of the bridges themselves, and an impact or blow equal to 30 percent of the live load. Under the maximum loading

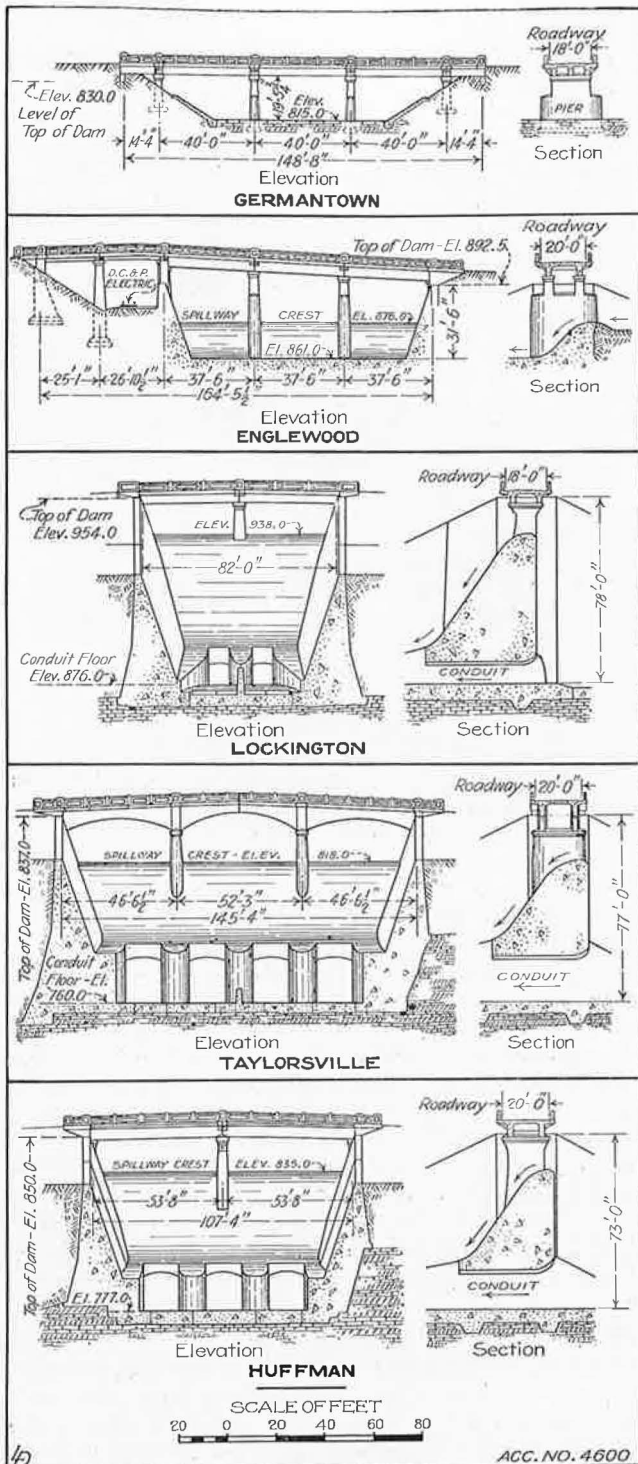


FIG. 351. COMPARISON OF THE FIVE SPILLWAY BRIDGES.

of live load, dead load, and the impact, the concrete is stressed to five hundred pounds, and the steel to fourteen thousand pounds per square inch, which stresses are about one quarter of that which would be required to break the materials. The assumptions about shear will be discussed later in this article.

The situation of the bridges imposed certain limitations on the types of structures selected. The abutments for three of them, Lockington, Taylorsville, and Huffman, are the high side walls of the outlet

structures, while the abutments for the bridge at Englewood are the spillway walls of less height, but high enough to be a special problem in themselves. The Germantown bridge is situated unlike any of the other four. See figure 351. The requirements of flood protection imposed other limitations. The spillways are designed for a maximum water depth varying from 10 feet to 14 feet at the different dams. Three feet was decided upon as the minimum distance between the maximum water surface and the bottom of the bridges. Types of structures giving long clear openings to prevent possible clogging by drift, and to permit as large a discharge as possible, were also desirable. Permanence, safety, good appearance, and economy in cost were also necessary features.

Steel truss bridges were planned originally, and the walls that would later be their abutments were designed and built for that type of bridge. A change was made later to concrete as the bridge material to be used, because it is more permanent, and makes a better appearance. Studies were made of many different designs for concrete bridges, and cost compared, before the final designs were selected. Arch bridges were first considered for meeting the conditions. An arch pushes outward on its abutments (see figure 352). The walls of the outlet structures

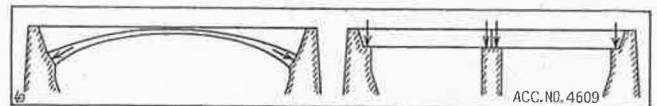


FIG. 352. REACTIONS OF THE ARCH AND GIRDER.

are not heavy enough to stand this outward thrust. To have made them strong enough would have so added to their size that the extra cost was prohibitive. This was even true at Englewood where the walls of the spillway are much lower than the walls of the outlet structures at Lockington, Huffman, and Taylorsville. A bridge whose reactions are shown in the second part of figure 352, that is, that bear straight downwards on the abutments, instead of tending to push them over, is the type best fitted for the conditions. This narrows the field down to the girder bridges, although some thought was given to a concrete bowstring arch. This latter type of structure, while meeting most of the conditions nicely, was prohibitive in cost.

Of the girder types, the most desirable would be a single span, reaching from wall to wall, and without piers in the waterway. However, the dead weight of the girders would have been so great, due to their great length, (80 to 144 feet), that a departure from conservative designs would have been necessary, and a field entered that is not covered by experimental data or practical experience. Such a departure from accepted engineering practice was not thought advisable in such vital structures as these. Therefore, the use of piers, placed on top of the spillway weirs, and spaced far enough apart to give a wide clear waterway, was decided upon (see figure 351) thus reducing the length of girders to within the sixty foot mark. The types of girder

bridges considered were the through girder, and the deck girder. In the former, the floor hangs between the girders, the girders themselves being the railings. In the latter, the floor rests upon the girders, placing the vital part of the structure out of the way. Heavy motor vehicles have been known to wreck through girder bridges by running into one of the girders. In addition, the cost of the deck girder bridges is less, their appearance is superior, and certain advantages are secured in the design of the piers. All these advantages led to the selection of the deck girder type in preference to the through girder type.

Due to an optical illusion, a bridge built on a straight line looks as though it sags in the middle. Therefore all of the bridges, save at Englewood, where there are special conditions, are built on vertical parabolic curves. Not only is the entire bridge higher in the middle than at the ends, but each girder has a slight camber, or arching effect of about one inch, to cover possible slight deflection or sag. Then each bridge floor is higher than the grade of the roadway on each side. This is both for the purpose of supplying waterway underneath, and satisfying the instinctive desire in the average person, to have something to go up over, when crossing a bridge. Elaborate features that would run up the cost were not added, but every effort was made to give grace and beauty to the structures. At Lockington and Huffman but two spans were practical. This forced the use of a plain deck girder bridge at each place. At Taylorsville the length of opening and number of conduits underneath, permitted the use of two piers for the bridge. The simple girders on the two end spans were cantilevered out to form the center span. The graceful curve of the lower edge of the girder is an advantage inherent to the cantilever girder, (See Fig. 346), and is a result of the selection of the most economical proportions. By comparing this type with the others, its good lines are apparent. Germantown is a simple deck girder bridge. Its location, down in a hollow, did not call for special treatment.

The most suitable foundation for the Englewood spillway was a rocky ridge at the west end of the

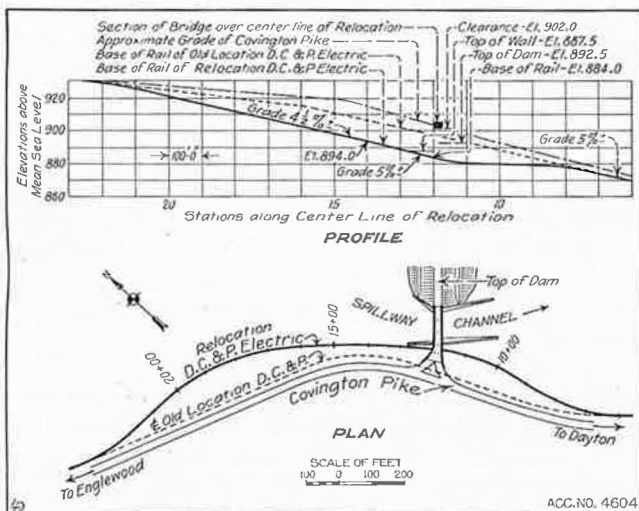


FIG. 353. THE ENGLEWOOD SPILLWAY AND BRIDGE AND THE D. C. & P. RELOCATION.

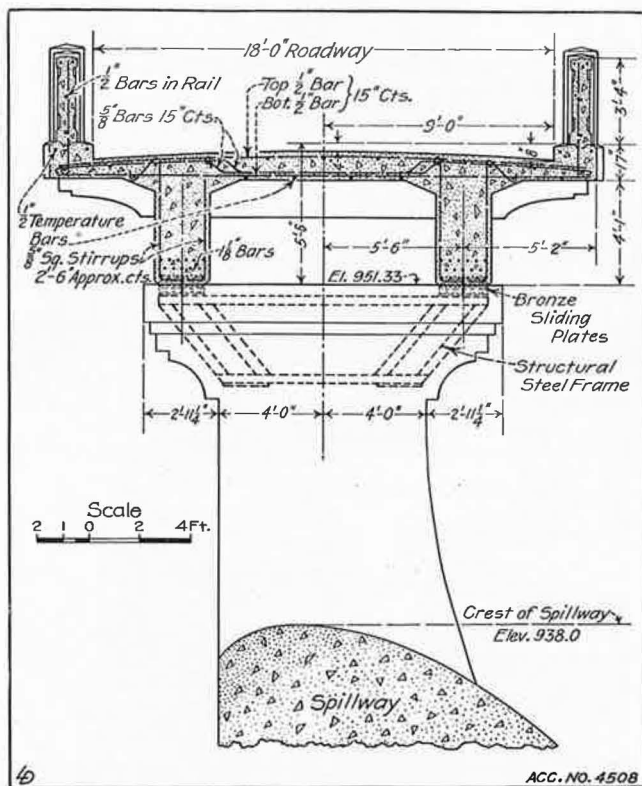


Fig. 354. CROSS SECTION OF THE LOCKINGTON SPILLWAY BRIDGE.

dam, close to the Dayton, Covington, and Piqua Traction, and the Covington Pike. By relocating about 1800 feet of the traction line and running it through a supplementary opening just west of the main structure, a grade crossing at the end of the spillway bridge was eliminated. The elevation of the highway above the top of the dam, and the necessity for clearance over the track resulted in the bridge being built on a 5 percent grade, instead of the usual parabolic curve. The closeness of the structure to the road, and the grades, necessitated a flared out floor on the west end to make a good connection with the pike. Figs. 353 and 350 show conditions. Because of the unequal length of the spans, the shallow beams over the traction and the odd shaped floor, it was impractical to use anything but the deck girder type of bridge.

The spillway at Germantown is in a rocky saddle in the hills, some distance from the dam. A notch has been cut in the rock to the required depth, and some concrete collars placed across the notch, making a very simple structure. The bridge spanning it was not limited in any way as to length, nor in length of pier. Two piers were used, and three parallel girders with a concrete deck comprise each span (See Fig. 351). The use of three girders is the common practice in such bridges. The Germantown structure was designed and built before work was started on the other four.

A different situation existed at the other four dams, especially at Lockington, Taylorsville, and Huffman where the ogee spillway weir is of considerable height. After the Germantown bridge was built, the Lockington structure was considered. As mentioned above, the original intention was to

use steel trusses to span the spillways, and the notches cast in the side walls of the outlet structure to receive the Lockington spillway weir were set well downstream. By the time the construction of the earth embankment had reached the stage where the spillway weir could be placed, a concrete bridge



FIG. 355. HUFFMAN SPILLWAY AND BRIDGE, MARCH 22, 1922.

The view is from the basin side looking directly downstream. The long beak on the piers extending upstream is for the purpose of breaking up ice and debris. The expansion joint in the bridge can be seen just over the pier.

had been decided upon. Even by setting the weir upstream as far as the notches permitted, a pier placed on top, could be but eight feet long. A longer pier could not be secured without shifting the centerline of the bridge downstream from the centerline of the dam, which was undesirable. It was then decided to bracket out the top of the eight foot pier by the use of cantilever projections, but even then the top of the pier was quite short. To meet this unusual condition, a two girder bridge with a cantilever deck was developed that proved to be so advantageous that similar ones were used at Taylorsville, Huffman, and Englewood, although at all three of these places piers long enough to have accommodated three girders could have been placed on top of the spillway weirs.

The advantages of the two girder type over the three girder type are quite interesting. Inspection of Fig. 354 will show that a shorter pier can be used under the two girders, with a consequent saving. Then, a pair of bronze expansion plates are saved, which is another economy. The form work for two girders is less than for three, as the framing for one girder is saved. It is an axiom of design that a floor carried on two supports is a simple structure, while one carried on three is a complex structure which cannot be accurately analyzed, and contains

complex stresses. And last, but not least, the two girder bridge is not as likely to be overloaded as the three girder type. See Fig. 356. The sketches represent the rear wheels of the twenty ton trucks, but the weight on each wheel is taken as unity, in order to simplify the diagram. A and B show the "natural" passing of the two trucks on the two types of girder bridges. This natural passing shows no advantage in the two girder type. But there is another very probable loading that must be considered, and that is one truck passing over the bridge, close to the curb as shown in C and D. This places a live loading of 1.25 on the outside girder of the three girder bridge, which is 35 percent more than its loading from the "natural" passing of the trucks. This makes the total live loading to be designed for in all three girders, 4.65, against only 4 for the live loading in the two girders of the other type.

Now it is possible to raise the factor in the two girder type $7\frac{1}{2}$ percent by having another truck of 20 tons pass the 20 ton truck running close to the rail, both trucks travelling in the same direction, as in E, or even raise it 15 percent by crowding the second truck over close to the first as in F. Such combinations of loads as E and F are conceivable, it is true, but will occur very infrequently, if at all. If they do occur the trucks will be moving so slowly that the impact would be so decreased that the bridge would not be overloaded. One other loading was considered—that of a single heavy piece of machinery. Such a load can be carried by the two girder type with one half the load on each girder, but it would be very hard to distribute such a load over three girders. A single load as high as forty tons can be moved over the two girder spillway bridges of the District, without overloading. It should be remembered that overloading, as used here, means a load in excess of that assumed in the design. If the bridges are overloaded they would

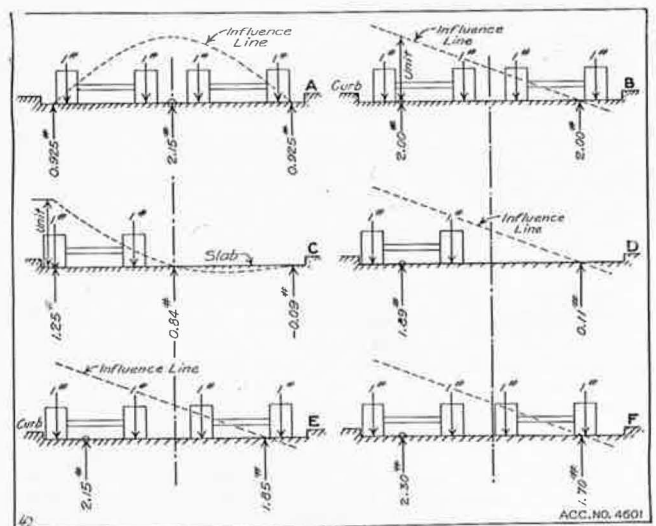


FIG. 356. LOADING DIAGRAMS.

not necessarily fall, for the maximum stresses assumed are only one quarter of those needed to break the materials. To use a much overworked and misunderstood term, the "factor of safety" is four.

Fig. 354 illustrates a typical girder as actually designed and built. It is shaped like a letter T. The load of the weight of the bridge, the passing truck, and the impact from the moving load, tends to bend the girder. This produces compression in the top of the girder, or the head of the T, which is resisted by the concrete itself, and produces tension in the bottom of the girder, which is resisted by the steel bars at the bottom of the stem of the T. The force which tends to bend the girder also tends to cause the particles of the concrete to slide upon each other, both in a vertical and horizontal direction. This latter tendency is called shear.

Readers will remember the theory of the lever,

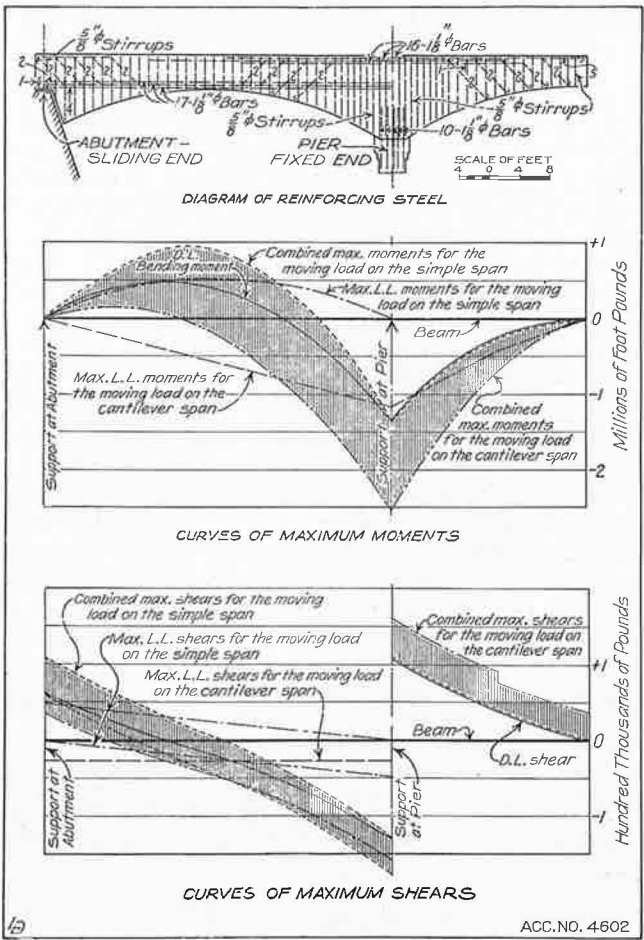


FIG 357. THE CANTILEVER GIRDER AT TAYLORSVILLE.

The lower diagrams were made by plotting the maximum bending moments and shears for each point on the girder, and drawing curves through them. The maximum moments and shears are produced by the dead load plus the live load in the worst position for the particular point being considered, plus the impact from the live load. Take away the live load and impact, and the moment and shear due to the dead load remains. The shaded areas represent the range in bending moments and shears between the dead load alone and the dead load plus the maximum live load and impact. The actual design is worked out from these diagrams, as explained in the text of the article. The influence of the diagrams on the location of the steel is especially well illustrated. It should be remembered that the design is a cut and try affair, and that a change in the dimensions of the bridge would change the dead load, and consequently the diagrams. The ones shown above are for the final design. Before they could be made, many preliminary diagrams were made and discarded.

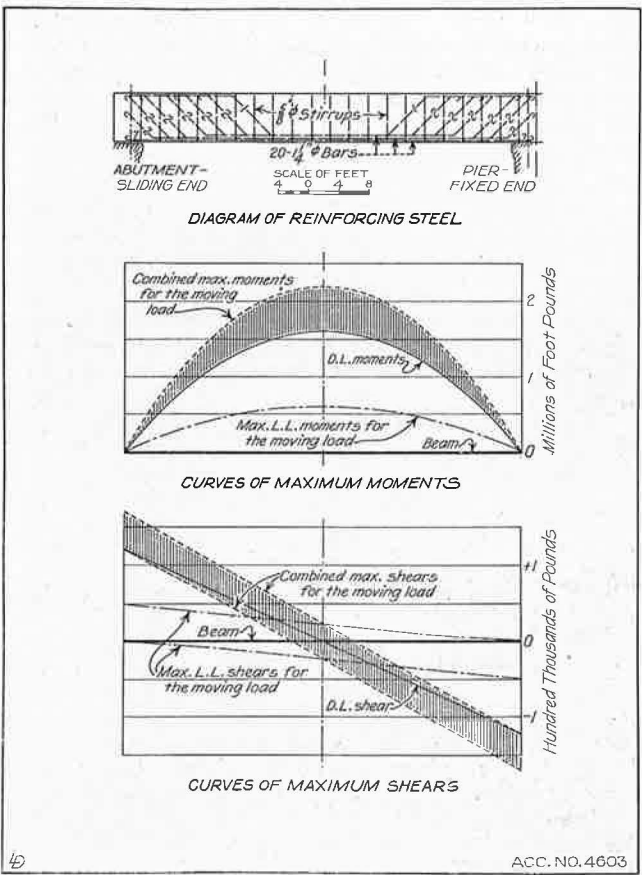


FIG. 358. THE SIMPLE GIRDER AT HUFFMAN. While much simpler than Fig. 357, the arrangement is the same.

from their school day physics. The theory of bending moments, by which the girders of these bridges are designed is an advanced step of this old principle. In the cantilever girder, if a force (the load in this case) acts upon a body (the girder) having a fixed axis of rotation (the pier), it tends to produce rotation about this axis. It is this tendency to rotate (to deflect the girder) that must be successfully resisted, in order to have the bridge stand up. For a single force the numerical amount of this rotating tendency at any point is measured by the product of the force multiplied by the perpendicular distance from the given axis of rotation to the force. This product is called the static moment. For several forces, the measure of this rotating tendency is the algebraic sum of the moments of all the forces. In a simple girder, that is, one with two supports, the section to be considered is taken as the center of moments; i. e. the axis of rotation. The bending moment is the algebraic sum of all the forces, which includes both the loads and the reactions on either side of the section. In the cases of the Taylorsville bridge, where the simple girder has a cantilever projection, the two examples given above are combined. Figures 357 and 358 are actual diagrams of the maximum and minimum bending moments in the two types of girders used on the Conservancy bridges, at any point in the girder, for the moving load and impact, plus the dead load.

Take the bending moment at any section through the girder. Divide it by the distance between the



FIG. 359. BRIDGE FORMS AT LOCKINGTON, SEPTEMBER 2, 1921.

The bolts used to fasten the footing stringers to the curved face of the weirs are clearly shown. To further strengthen the footings a second row of bolts was placed lower down, and bracing put between.

tension area (the steel) and the center of the compression area (the head of the T, in this case of the T beam), and the force acting on the steel and concrete is secured. Again divide this first quotient by the area of the steel, and the result is the unit stress in the steel,—divide by the area of the compression section, and the result is the unit stress in the concrete of the compression area. The Conservancy bridges are so designed that, under maximum load the tension in the steel is 14,000 pounds per square inch, and the compression in the concrete is 500 pounds per square inch. It can readily be appreciated that the design is a cut and try affair, as the dead load is the weight of the girder and the bridge itself. This weight of course, varies with the size of the bridge. A change in the proportions of the structure changes the loading on the girder, and consequently the stresses acting upon it.

Besides being pictures of the maximum and minimum moments, the diagrams show other interesting things. Fig. 357, is for the cantilever bridge at Taylorsville. Where the curves are below the zero line, re-enforcing steel is needed in the top of the girder; where it is above the line, steel is needed in the bottom of the girder. The diagram, therefore, shows that steel is needed both in the top and bottom of the girder for a portion of the length of the span of the simple girder. It is not difficult, while looking at the diagram, to visualize the stresses, and the shape of the structure necessary to meet them. It is also evident that the curve where the simple girders join the side walls of the outlet works (the abutments of the bridge) is for appearance only, and is not necessarily an addition to the strength of the bridge. Fig. 358 is the diagram for maxi-

mum conditions for Huffman. These girders have a constant depth, and the area of steel required in the bottom of the girder is in direct proportion to the ordinates of the diagram.

The vertical shear at any cross section of a girder is the algebraic sum of all the loads and reactions on either side of the section. Figures 357 and 358 are shear curves for the Taylorsville and Huffman bridges, and give both maximum and minimum shears. If the total shear at any cross section is divided by the area of the average section, the average shear per unit of area is secured. If this average vertical shear exceeds 40 pounds per square inch, re-enforcing is added. Experience and experimental data show that beams or girders never fail because of their vertical shear, but rather the failure cracks are due to the resultant of a combination of the vertical shearing stress with the horizontal shear, acting in a diagonal direction. Therefore, when the re-enforcing is added, it is either vertical or diagonal steel or both.

The girders at Taylorsville are fixed at the piers. Expansion and contraction movement is provided for by sliding plates at the abutments and by the open joint at the center of the structure. The latter is plainly visible in the picture on the cover. The other bridges are provided with sliding plates at either piers or abutments.

The floor slab is similar in all of the bridges. As shown in Fig. 354 the floor slab and curb overhang the girders which support them. This gives a simple span between the girders and two cantilever projections or brackets on the outside. The cantilever projection and the simple span balance each other, and therefore, the slab of the simple span need not be as thick and strong as would be necessary if the cantilever projections were not used. The simple span is designed as if the rear wheels of the 20 ton truck were distributed over 5 feet 9 inches in length, of the floor. The overhanging cantilever part of the floor is designed as if the same load were distributed over 2 feet in length of the floor.

The series of sketches shown in Fig. 360 illustrate the various steps leading up to the construction of the bridges. When the spillway weir was cast, a notch or seat was left to receive the bridge piers. These notches had horizontal bearing faces; if stepping was necessary, it was done by vertical and

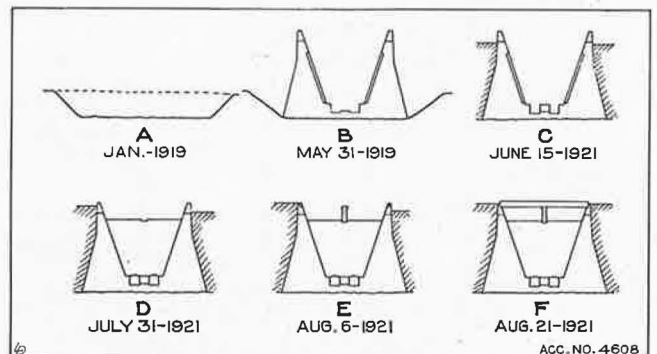


FIG. 360. THE SUCCESSIVE STEPS IN BUILDING THE LOCKINGTON OUTLET WORKS.

While the hydraulic fill was being placed the outlet was like a great trough through the dam, as shown by B, in order to take care of floods during the construction period.

horizontal steps. The forms for the entire structure were erected complete, except for the railings. The footings for the falsework were stringers fastened to the curved face of the weir by bolts previously cast in the weir. See Fig. 359. The concrete proportions were 1:2:4. The reinforcing was ovoid deformed bars, and was wired into position before concrete was poured. The gravel washing plants that were used in building the outlet structures were also used to prepare materials for the bridge work. The concrete was mixed and handled in bottom dump buckets. A steel derrick, mounted at Taylorsville and Huffman on one of the berms of the dam, and at Lockington and Englewood, on the floor of

the spillway, picked up the buckets full of concrete, and hoisted them up to the bridge. Each span, including the curbs, was made in one continuous pour. The Germantown bridge, being quite a distance from the dam, used a small mixer at one end of the bridge. The forms remained under the bridges for about three weeks after pouring.

The roadways of the bridges will be paved with a bituminous macadam material. There is danger, if the concrete surface of the floor slab were used as a wearing surface, that the concrete might wear down so as to expose the reinforcing, before repairs were made. The bituminous surface is more likely to be kept in repair.

Progress on the Work from November 1, 1921, to March 20, 1922

GERMANTOWN

Completed.

ENGLEWOOD

The last yard of material was pumped into the dam December 31, 1921, completing the embankment of 3,612,505 cubic yards. There remains to be done the removal of pumping equipment and railroads from the upstream slope of the dam; the construction of a surface drainage system; the erection of guard rails and the grading of the roadway on top of the dam; the dressing and seeding of the slopes of the dam; and the placing of 6,000 cubic yards of rip rap as a protection against wave wash on the upstream face.

The concrete floor, reducing the outlet conduits to their permanent size, was completed December 16.

The spillway bridge was finished in November and there remains to complete the spillway proper, only one block of concrete in the floor and a small amount of grading.

Work is in progress looking to the shifting of the Dayton-Covington and Piqua Traction line to its new location under the spillway bridge for the purpose of obviating a grade crossing where the road on top of the dam joins the Covington Pike.

The abutments for the Prairie Ford bridge were completed late in December and work suspended for the winter. A contract for the removal from its present location to the new abutments of the steel highway bridge has been awarded to Connell & Rohrer of Dayton, Ohio. Guard rails have been set wherever necessary along Road No. 7. The grading and gravelling of this road is complete with the exception of a small stretch east of the Prairie Ford bridge.

The grading of the cut-off road between Roads 4 and 5 near the east end of the dam is in progress.

During the winter a small force has been engaged in repairs to draglines, locomotives and other items of plant.

H S. R. McCurdy, Division Engineer.

March 20, 1922.

LOCKINGTON

Completed except for placing part of the guard rail across the top of the dam.

TAYLORSVILLE

The Taylorsville Dam was rapidly nearing completion at the time of the last report in the November, 1921 Bulletin. The hydraulic fill was finished on November 30. The concrete slope paving, and the concrete spillway bridge, were completed soon after the first of December. All of the equipment has been dismantled, and transferred to other features or put up for sale.

A small force of men has worked through the winter in placing the metal guard rail around the outlet works, the wooden guard rail on the road at Dugans Bridge and along the road over the dam, and in dismantling the equipment. The roads built by the District have been placed in good condition, and will be turned over to the county in the near future. A house is being prepared for the caretaker.

As soon as the frost is out of the ground the planting of the slopes of the dam will be completed, and the concrete catch basin for taking care of surface water from the top and slopes of the dam, will be placed. This work will complete the finishing touches on the dams. About one third of the camp has already been sold, and the remainder

will be disposed of by the first of June. The buildings are being removed from the premises.

O. N. Floyd, Division Engineer.

March 20, 1922.

HUFFMAN

The last of the hydraulic fill material passed through the pumps on December 6. The small section of the embankment south of the outlet works, built by teams in thin layers, compacted by rolling, was completed January 7, 1922, with material hauled from the main borrow pits by train. A gap at an elevation above the spillway has been left to permit the passage of construction trains. It will be closed at the very last.

The spillway bridge was started October 17, the concrete was placed in the north span on November 10, and in the south span November 15th. The last of the railing was poured December 27.

After the completion of the dam embankment, 6300 cubic yards of material, under the gravel washing plant, and which partly blocked the entrance channel to the conduits, was removed, and then a new channel was excavated for Mad River, just above the dam. This new channel eliminates a bad bend in the river, and also removes it to a safe distance from the upstream toe of the dam. The suitable part of the 25,000 cubic yards excavated from this channel, is being used in placing a clay blanket in the old river channel. Four thousand cubic yards of clay material previously dumped from trains along the west bank of the old channel, is also being used in the blanket.

Rock paving has been placed on the upstream face of the dam, over its entire length from the bottom up to elevation 807.5. This is the height to which the water in the basin would reach if a repetition of the 1898 flood should occur. A strip on the upstream face, from 25 to 50 feet wide, and along the side of the north wall of the outlet works has been paved with heavy rock, and a similar strip is now being paved along the south wall. This should be completed soon after April 1st.

Rock slope gutters have been built at intervals of 450 feet on both sides of the dam from the toe to the bottom. Runoff water from rains will be carried to these gutters in drainage ditches along the top of the dam and on the berms and thence down the gutters, without erosion of the slopes.

During the winter the slopes of the dam have been trimmed, a guard rail built around the outlet works, the spoil levees along the toes of the dam leveled off, and much of the equipment dismantled. A part of the camp has been sold. But little work remains to finish up the job.

C. C. Chambers, Division Engineer.

March 20, 1922.

DAYTON

All levee embankment on the right bank of the Miami has been completed except for a section about 300 feet long between Cincinnati Street and the Big Four Railroad. The left bank from Bayard Street (below Washington Street) to the Big Four Railroad, a distance of about 2 miles, remains to be completed. Two Bucyrus, Class 175, draglines and one Lidgerwood, Class K, dragline are now engaged on this work. The hauling of 120,000 cubic yards of excavation from the river channel near Washington Street in standard

dump cars has been completed. The track has been taken up and the railroad equipment removed from the job.

Since the date of the last report 3000 cubic yards of concrete have been placed in manholes, sewer extensions and monolithic slope revetment. The total concrete yardage placed to date is 33,000 cubic yards, making this work about 90% complete. Price Brothers Company has completed the laying of blocks for flexible slab revetment on Wolf Creek and on the Miami River between the Dayton View and Third Street bridges and is now laying blocks along the First Baptist Church retaining wall.

The Sunrise Avenue gravel plant was dismantled in January, and the equipment sold. It turned out a total of 120,500 cubic yards of sand and gravel. A commercial plant, is now in operation on Wolf Creek, near Summit Street. This is privately owned and operated, but it is under the supervision of the District for the purpose of preventing the drifting of sand and gravel into the improved channel in Dayton. Similar plants will soon be in operation on Mad River near Webster Street, and near Findlay Street.

Dragline D16-15 was engaged from December 1 to December 9 in lowering a 24 inch water main at Miller's Ford for the city. Dragline D-16-16 was used three days in February on lowering the 18 inch St. Francis Street sanitary sewer.

Total channel excavation up to March 1 amounted to 1,408,000 cubic yards. Levee embankment amounted to 550,000 cubic yards. The total yardage handled in accomplishing these quantities has been 3,540,000 cubic yards.

C. A. Bock, Division Engineer.

March 20, 1922.

HAMILTON

The electric dragline D16-18, completed its work at the south end of the improvement, crossed the river removing the trestle at Station 110, and moved upstream along the east bank to the north side of the Main Street bridge. Excavation was started at this point on January 3, the material being hauled into the north spoil bank which is located east of the B. & O. and adjoining the Ford Plant. The total of item 9, channel excavation, to March 1st was 1,444,000 cubic yards.

A Class 14 Bucyrus dragline on rollers, which was brought to Hamilton from Franklin, started excavation on the Four Mile Creek cut-off channel in the latter part of January. This channel gives Four Mile Creek an improved junction with the river and requires 100,000 cubic yards of excavation.

The Class 14 Bucyrus caterpillar dragline, after completing the track work on the east side of the river, crossed the river north of Black Street and excavated the filling material for the Black Street bridge. This material was loaded on 4 cubic yard dump cars and hauled to the bridge by 16 ton dinkeys. This machine is now building the levee on the west side north of Black Street and finishing the channel slopes.

The Marion Model 21, dragline is grading and shifting track on the north spoil bank.

A concrete wall has been completed from the northeast corner of the Champion Coated Paper Mill along the west bank to Old Black Street. Work has been started on the concrete wall on east bank between Dayton Street and Market Street.

The Black Street bridge has been filled with gravel and opened to traffic. A 16 inch water main and an 8 inch gas main have been laid across the bridge. The lamp posts have been set. The construction of sidewalks and pavement remains to be done. The cableway and other equipment has been dismantled.

The tract of land east of the Miami River, west of the B. & O. and north of Old River has been cleared of timber.

Seeding has been started on the levees completed last year.

C. H. Eiffert, Division Engineer.

March 20, 1922.

PIQUA

Since the last Bulletin was issued the big dragline stopped building levee at Station 60, and shifted forward to Station 81, and began to build levee southward. This gap was left in order to allow time enough for the Kuglieman property to be vacated, and to allow time enough for the plans for a new county bridge at Ash Street to mature. Just below Station 81 rock was encountered in the river bed. This necessitated the abandonment of the dragline work, and the machine is now moving back to complete the gap between Station 60 and 81.

The rock in the river bed has necessitated the purchase of borrow pits, and the building of the levee by teams or trucks. The levee below Station 88, as well as the Shawnee and West Side levees, will be let to contractors.

The grass planted on the completed portions of the levee last season is doing well, and little work will be necessary upon it, this year.

Albert Schroeder, Assistant Engineer.

March 20, 1922.

UPPER RIVER WORK

Troy.—The dragline, D-16-21, under the direction of Donald Jeffrey, completed the work covered by his contract on February 22, 1922, and it was then moved to the shop at Adams Street, where it is undergoing repairs. The work completed since our last report, consists of 9000 cubic yards of levee and channel work between Market Street and the B. & O.; about 9500 cubic yards of excavation below the B. & O.; the excavation of 4000 cubic yards from the channel below the Adams Street bridge; and considerable work near Adams Street for the gravel plant.

T. Daniels and Son completed their contract about December 15, 1921. Due to the wet weather, a part of their excavation at Adams Street had to be left until the coming season.

Price Brothers have nearly completed their work around piers "A, B and C" at Adams Street bridge. During their work at this bridge nine rises of the river have caused a total of 41 days delay outside of the extra work of cleaning up after each high water.

The work at Adams Street has progressed favorably during the winter months. Concreting only on good days, the north abutment and piers "E and F" have been completed, and pier "D" will be completed before April 1, as the footing has already been poured. The steel has also been placed on the east half of arch No. 7 and this will soon be poured. The work removing the fill on the old section of the bridge has been started. Part of this material will make the new south approach to the bridge and the balance will be hauled away.

Tippecanoe City.—The dragline D-16-4 completed its part of the levee and road embankment at Tippecanoe on March 9, 1922. The total levee and road embankment made by the dragline amounts to 167,000 cubic yards. Approximately 10,000 cubic yards are yet to be placed by teams, as this material was so wet at the time the dragline was working that it would not stand in the levee.

The canal interceptor was completed by Glen M. Wiley on December 16, 1921, except for the outlet chamber near Plum Street, which the District delayed until the Fourth Street sewer had tapped the county sewers at Plum Street.

The work on the Fourth Street sewer progressed until by the last of January 1200 feet of 66 inch sewer had been built. During the last two months, the connections at Plum Street with the two 24 inch county sewers have been made, and several manholes built. At present work is in progress on the curved section of the sewer at the outlet into Bull Run Ditch. As soon as this work is completed, a start will be made on the 51 inch sewer between Plum and Main Streets.

Wm. Oberer has completed the two concrete culverts where Bull Run Ditch crosses under North Second and North Third Streets. The ditch is also completed between Second and Third Streets and the excavation for the ditch between Third Street and the B. & O. is nearly complete. The levee between Second and Third Streets is about one half done. As soon as Mercer completes the Fourth Street sewer outlet, Oberer will complete the sewer headwall and the revetment in the ditch at the sewer outlet.

A. F. Griffin, Assistant Engineer.

March 20, 1922.

LOWER RIVER WORK

Miamisburg.—Since the last issue of the Bulletin in November, 1921, Price Brothers have completed the flood gate structures in the tail races of the Miamisburg Paper Company, the Ohio Paper Company, and Grove & Weber's mill. Only one of the five flood gate structures now remains to be finished, that is, the Miami & Erie canal job near the north corporation line. This is the largest of the five, comprising four 8 x 5 feet gates. Three of these gates are now in place and the concrete base for the fourth has been poured. Total concrete in flood gate structures placed to date is 925 cubic yards.

Franklin—The dragline work on the east side was completed December 14, 1921, and the machine was immediately dismantled and sent to Hamilton. Total yardage moved by this machine was about 100,000 cubic yards. The Miami Avenue wall was completed November 25, 1921, with the exception of 300 linear feet of concrete apron; the sheet piling for this has been driven and the concrete will be placed this season. Total concrete in the Miami Avenue wall is 2200 cubic yards exclusive of the apron. Five thousand cubic yards of fill was placed behind this wall adding 30 feet to the width of Miami Avenue for over a length of 500 feet. Various small jobs have been completed during the winter.

Middletown—Clearing of timber from the overflow areas through Middletown and above the Poastown Road bridge was commenced in February. There are 56 acres to be cleared. Three contracts were let and the work is now about 50% complete.

F. G. Blackwell, Assistant Engineer.

March 20, 1922.

RAILROAD RELOCATION

Big Four and Erie. Completed.

Baltimore and Ohio. Completed.

Ohio Electric. Completed. The work during the winter consisted of dismantling the old line.

Albert Larsen, Division Engineer.

March 20, 1922.

RIVER AND WEATHER CONDITIONS

November-December 1921. The total rainfall at Dayton for the months of November and December was 8.36 inches, which was 2.85 inches more than normal. On December 23, 2.07 inches of rain fell, causing a moderate rise in the rivers of the watershed and some impounding in the Germantown and Englewood retarding basins. Temperatures for these months were moderate, the highest 68 degrees, occurring on November 19, and the lowest 17 degrees on December 22. The mean temperature at the Dayton Weather Bureau for November was 44 degrees, and for December was 35 degrees. A maximum wind velocity of 48 miles per hour (for five minutes) occurred on November 18.

January 1-March 22, 1922. The total rainfall at Dayton for the period January 1 to March 22, 1922, was 6.66 inches, which is 1.55 inches less than normal. A rainfall of 1.85 inches (at Dayton) on March 14-15 caused a moderate rise in the rivers of the watershed and impounded water in the Englewood, Germantown and Lockington basins. The maximum stage at Dayton was 7 feet. Temperatures were moderate during the entire period, the lowest being 11 degrees on February 16, and the highest being 69 degrees on February 22. In general, the winter was mild with little snowfall.

C. S. Bennett, Assistant Engineer.

March 23, 1922.

The American Society of Civil Engineers to Hold Spring Meeting in Dayton

A meeting of the board of direction of the American Society of Civil Engineers will be held on Monday and Tuesday, April 3rd and 4th, at the Engineers Club in Dayton. This meeting will be followed by a meeting of the Society on the 5th, 6th, and 7th. While the annual conventions have been held during the summer months in different parts of the United States, this gathering will be the first technical meeting of the sort held outside of New York City. The selection of Dayton as the meeting place is in recognition of the Flood Prevention work, now rapidly drawing to a close.

On Wednesday, the 5th, the general topic "Flood Problems" will be discussed by the Society. The meeting will be opened by Chas. H. Paul, President of the Dayton Section. Mr. John R. Freeman, of New York, President of the Society, will preside. After an address of welcome by Col. E. A. Deeds, formal papers will be presented as follows:

"Flood Conditions in Canada," by J. G. Sullivan, President Engineering Institute of Canada;

"The Relation of the Federal Government to National Flood Problems," by Major General Lansing H. Beach, Chief of Engineers, United States Army;

"Flood Problems in China," by John R. Freeman, President, American Society of Civil Engineers;

"Methods of Flood Prevention in the Mississippi Valley," by J. A. Ockerson, Past-President, American Society of Civil Engineers, Member, Mississippi River Commission;

"Relation of Flood Problems to Power and Irrigation Development in the Rocky Mountain States," by A. P. Davis, Past-President, American Society of Civil Engineers, Director, United States Reclamation Service.

"Flood Prevention Methods on the Pacific Slope," by C. E. Grunsky, Vice President, American Society of Civil Engineers.

"Standing Waves in Rivers," by N. C. Grover, Chief Hydraulic Engineer, United States Geological Survey, Washington, D. C.

"Flood Problems of the Miami Valley and Their Solution," by Arthur E. Morgan, Former Chief Engineer, Miami Conservancy District, and Chas. H. Paul, Chief Engineer, Miami Conservancy District.

The formal papers will be discussed by the members of the Society.

Thursday, April 6th, will be devoted to an excursion to Englewood and Huffman Dams, travelling by special traction cars, and to an inspection of the National Cash Register works, where the party will be entertained at luncheon. In the evening a dinner will be given at the Miami Hotel, at which Col. Deeds will be the principal speaker.

An inspection of McCook Field, a trip over the channel improvement work in Dayton, and a visit to Middletown as the guests of the American Rolling Mills, will occupy Friday. Noon lunch will be served at the Rolling Mill, to be followed by an inspection of the big plant.

Headquarters will be at the Engineers Club. A registration of those in attendance will take place on Wednesday. Special arrangements will be made for the accommodation of engineers who wish to see special features of the flood prevention works not covered by the excursions.

Further Reduction In Personnel

Since the last Bulletin, some additional men in charge of particular portions of the work have left. The list includes George L. Albert, hydraulic engineer, H. W. Horne, assistant division engineer at Englewood, Ivan E. Houk, assistant engineer, and Superintendents H. M. Sherwood, Albert Armstrong, and G. E. Warburton. Dr. W. M. Smalley now gives only part of his time to the District work.

Protection from a 1913 Flood a Year Ahead of Time

Schedule Set at Start of Construction Period Exceeded.

The dams of the Miami Conservancy District are like a chain—their full ability to handle floods is not developed unless all of the links are completed, and in perfect working order. The critical flood season in the Miami Valley is in the spring of the year, although serious floods may occur during any period of the year. As the last of the five dams was not due to be finished until mid-summer of 1922, the 1923 flood season was to have been the first one in which full protection was assured. Actually, all of the dams were finished by December 31, 1921, and were ready to do their full part in flood protection during the critical season this year, a year ahead of time.

When bids were asked for the construction of the various sections of the work, in the fall of 1917, the following schedule was set for the five dams:

	Date set for completion
Germantown	Sept. 1, 1921
Englewood	June 1, 1923
Lockington	June 1, 1921
Taylorville	June 1, 1922
Huffman	June 1, 1922

Despite war conditions and many vexatious delays, Germantown Dam was finished on November 6, 1920, and everything moved out and the camp

sold by January, 1921, almost a year in advance of the date set by the schedule. Lockington did not go so well, but the final clean-up was made there in October, 1921.

The annoying delays in getting the railroads out of the way had seriously held back both the Taylorville and Huffman dams, so that they were actually behind schedule when the spring of 1921 came. Englewood had made good progress, far better, in fact, than had been anticipated. It was decided to use every effort to finish all three dams in 1921, and thus give the Miami Valley protection a year ahead of time.

The working season of 1921 was one of remarkable progress. Untoward things happened, of course, that generally cause trouble and delay, but nothing seemed to stop the work, and annoyances only caused the construction force to speed up to overcome them. By the end of the good weather season in the fall, the end was in sight. Taylorville was finished first, on November 30th, then Huffman, on December 6th, and then Englewood, on December 31st. The river improvements are in such an advanced state that the towns are safe against the recurrence of a 1913 flood. Protection against the "40 percent greater" flood will be an accomplished fact by the fall of 1922.



FIG. 361. THE RISING FLOOD, NINE YEARS AGO.

Protection against what this picture shows, is the significance of the completion of the last dam of the Miami Conservancy District on December 31, 1921, a year ahead of time. Taken on March 25, 1913 at Fourth and Ludlow Streets, Dayton, the view shows well the first overwhelming rush of water. Before night the elevation of the water reached the globes on the lamp posts.

Progress on Sales

As anticipated, the sale of equipment and second hand supplies has become an important item in the business of the Conservancy District. Despite stagnant business conditions, the volume of articles disposed of, and the prices obtained, have so far been very gratifying.

Up to the 28th of March, the total sales had reached \$576,500. Of this amount \$385,500 represents the proceeds of salvaging the railroad lines, \$107,000 represents the sale of equipment, repair parts, etc., and \$84,000 represents the sale of supplies and material which is that class of stuff ranging between toothpicks and Ford cars.

The major articles of equipment sold so far include two standard gauge locomotives, three narrow gauge locomotives, forty narrow gauge cars, two class 36 Marion draglines, one class 24 Bucyrus dragline, one class K Lidgerwood dragline, four gravel plants, two derricks and a spreader car. More equipment is being released as the various jobs are finished and closed down. A good start has been made on the sale of equipment, but the greater part remains to be sold.

Salt shakers, cook aprons, houses, rat traps, second hand Fords, mop sticks, old lumber and dishes continue to be the principal stock in trade for the miscellaneous sales. The market for this kind of stuff has been largely local. The stock of articles resulting from the closing down of the first jobs is well disposed of, but as other jobs are being finished right along, the sales stock is continually being replenished. A number of houses have been recently vacated at Taylorsville, and they are up for sale now. The spring market in houses has been good, and no difficulty is anticipated in disposing of these. They are to be wrecked and removed from the premises.

On the 29th of March, the entire Englewood village, land and buildings was put up at auction. A large and interested crowd assembled in the mess hall. The high bidders were Wm. Reitz and Wm. Foster, of Dayton, whose bid was \$27,000. The final sale is subject to the approval of the Conservancy Directors. If accepted, it will raise the total of the sales to date to \$603,500.



FIG. 362. THE HIGH WATER OF MARCH 15, 1922, AT HAMILTON.

A rainfall of two inches on March 14th, caused a storage of 36 feet in Germantown basin, 25 feet at Englewood, 15 feet at Lockington, 14 feet at Taylorsville, 11 feet at Huffman, and caused a 13 foot stage at Hamilton on the 15th. The operation of the improved channel is well illustrated. The view is looking upstream. The bridge in the lower right hand corner is the Columbia bridge. Then comes the steel railroad bridge, with the Main High Street bridge showing through the trusses. The new Black Street bridge can be dimly seen in the distance. The projection into the river between the Main High and Black Street structures is the river encroachment now being cleared away. Note the top of the concrete revetment just showing above the water.

THE MIAMI CONSERVANCY BULLETIN

JULY, 1922

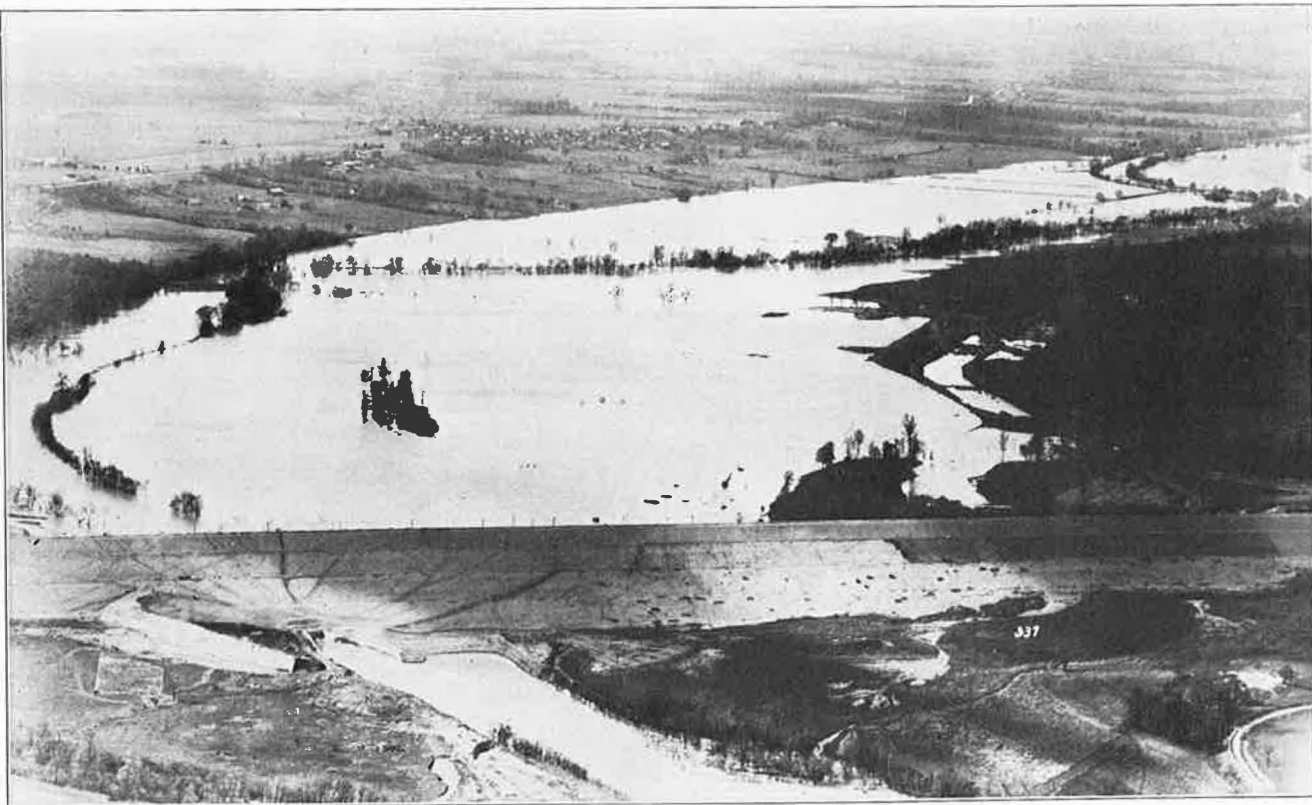


FIG. 363—ENGLEWOOD DAM AT WORK HOLDING BACK THE FLOOD OF APRIL 15, 1922
Photograph by Engineering Division U. S. Army Air Service



FIG. 364—BLACK STREET BRIDGE, HAMILTON, UNDER CONSTRUCTION AUGUST 8, 1921.

The arches are in various stages of completion. The one in the foreground has the full set of forms for the arch and spandrel walls in place. On the next two the forms are only partly in place. On the fourth and fifth only the skeleton frame work supporting the completed arch remains in place. On the last arch visible, the work is so far along that the posts for the railing are set. The form work is described elsewhere in this Bulletin. The wires overhead and the tower in the background are a part of the cableway used to transport materials and to handle forms.

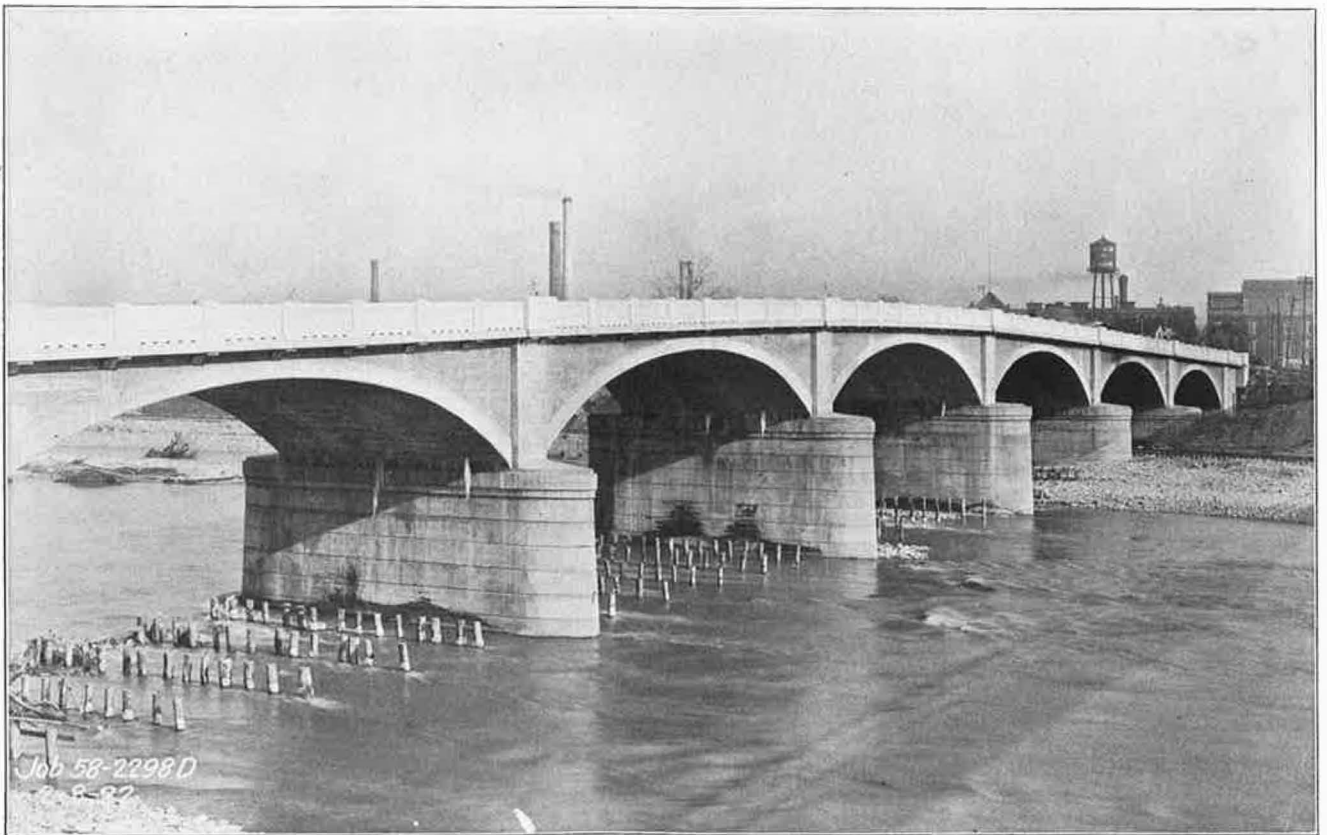


FIG. 365—THE FINISHED BLACK STREET BRIDGE, FEBRUARY 8, 1922.

The view is taken from the same position as Figure 364. The icicles on the under side of the arches mark the positions of the weep holes. The piling underneath has since been removed.

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THE MIAMI CONSERVANCY BULLETIN

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DAYTON, OHIO

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Subscription to the Bulletin is 50 cents for 12 issues. At news stands 5 cents per copy. Business letters should be sent to Office Engineer, Miami Conservancy District, Dayton, Ohio. Matter for publication should be sent to Bulletin Office, Miami Conservancy District, Dayton Ohio.

Death of John H. Patterson.

John H. Patterson, Dayton's foremost citizen, died on May 7th, 1922. His many achievements and benevolences need no recounting here. One of his most outstanding characteristics was his desire to help others. When disaster overwhelmed Dayton in 1913, his first thought was of what he might do to relieve the distress of the flood sufferers. He turned his whole energies, and devoted his entire organization and plant to relief work. Boats were built under his direction, meals were furnished, and the destitute were sheltered in the factory buildings. While the water was still on the streets, Mr. Patterson was appointed chairman of the Dayton Citizens' Relief Committee by Governor Cox. It is difficult to conceive the extent of this committee's work, so complex and comprehensive did it become. When the need for immediate relief became less acute, the problem of flood prevention was considered. The raising of the two million dollar flood prevention fund will long be remembered by the Miami Valley. Through it all the organizing ability, the vision and the understanding charity of John H. Patterson were inspirations as well as great material aids to Dayton.

Throughout the entire time since the flood prevention work started, his support of the work had been constant, and he kept in close touch with the progress of construction. Just a few days before he died, he was directing the preparation of an article on the benefits of the flood prevention works as shown by the high waters of last April.

A busy life has ended, but the impress of that useful life will long remain upon the community in which it was lived. Flood prevention owes a great debt to John H. Patterson.

Sales Progressing.

The selling of the equipment, materials and supplies for which the District has no further use is progressing in a most satisfactory manner. The total sales at the time this Bulletin went to press amounted to \$670,700. The camp houses have been going well, seventeen having been disposed of in one week. Less than ten remain unsold. So far, the sales have exceeded expectations. Much remains to be done. Every effort will be made to bring this phase of the Conservancy work to a prompt and satisfactory conclusion.

Public Confidence.

From the very inception of the Flood Prevention Work the interest of the people of the Miami Valley in it has been very keen. The intense interest aroused during the formation of the District resulted in the general public having an unusually complete knowledge of the fundamental principles of the flood control plan. The construction work has been closely followed by this well informed and critical public as no other public work has ever been. The extent of the public's confidence in the integrity of the work is in this case, more than in any other, a true measure of the success of the undertaking.

The storm of last April afforded an opportunity in a measure of determining the state of the public's mind towards the work. With reports of neighboring communities being flood-stricken reaching them, the citizens of the valley watched the storm without the old time alarm, and went in thousands to look at the basins at work. Above all, privately and through the press, they gave expression to their pride in the work, and to their confidence in the safety of the Miami Valley. Such expression of public approval was very gratifying to the employees of the Miami Conservancy District.

Flood Prevention Proves Its Worth

Miami Valley Saved From a Flood Scare on April 15, 1922.

"The heavy rain of Friday evening caused the Miami River, already swollen by the rain of Thursday night, to rise with great rapidity during the early hours of Saturday morning. During the morning the water reached the danger mark of 18 feet on the Main Street Bridge. Wild rumors of another 1913 flood spread rapidly. Many persons stayed up all night and watched the river. Others moved their belongings into the upper stories of their dwellings. Fortunately the rain ceased Saturday morning. A few hours more of storm, and the situation would have been indeed serious. As it was, water collected in the lower part of town, and damaged . . ."

The papers of Saturday, April 15th, would have carried some such story as the above if the old conditions had still prevailed. But there was no panic. The citizens viewed the storm with quiet confidence. Less than one hundred telephone calls about the river stage were received by the Conservancy office as compared with two thousand during the high water of 1920. Instead of going on a hysterical rampage, the Miami River behaved se-

dately and strictly according to plan. The stream was already well filled on Friday night from the effects of earlier rains. The stage increased slowly, but the sudden rush of water early in the morning, was held back by the dams, and the highest mark was only 9.6 feet, reached by 4:00 P. M. on Saturday. Several thousand people went out to see the dams in action. With their pages filled with stories of flood disasters elsewhere, the newspapers retold with evident elation the story of the Miami Conservancy District, and commented upon the accomplishment that has brought safety and security to the Miami Valley. While the flood did not nearly approach the capacity of the control system, it was in a way a test as it gave ocular proof of the ability of the flood control works to do what they were designed to accomplish.

A characteristic atmospheric disturbance passed over the Middle West during the first part of April. It was marked by cyclones and heavy rains. High flood stages were reported from the Mississippi, the Illinois, the Scioto, the Hocking, the Muskingum

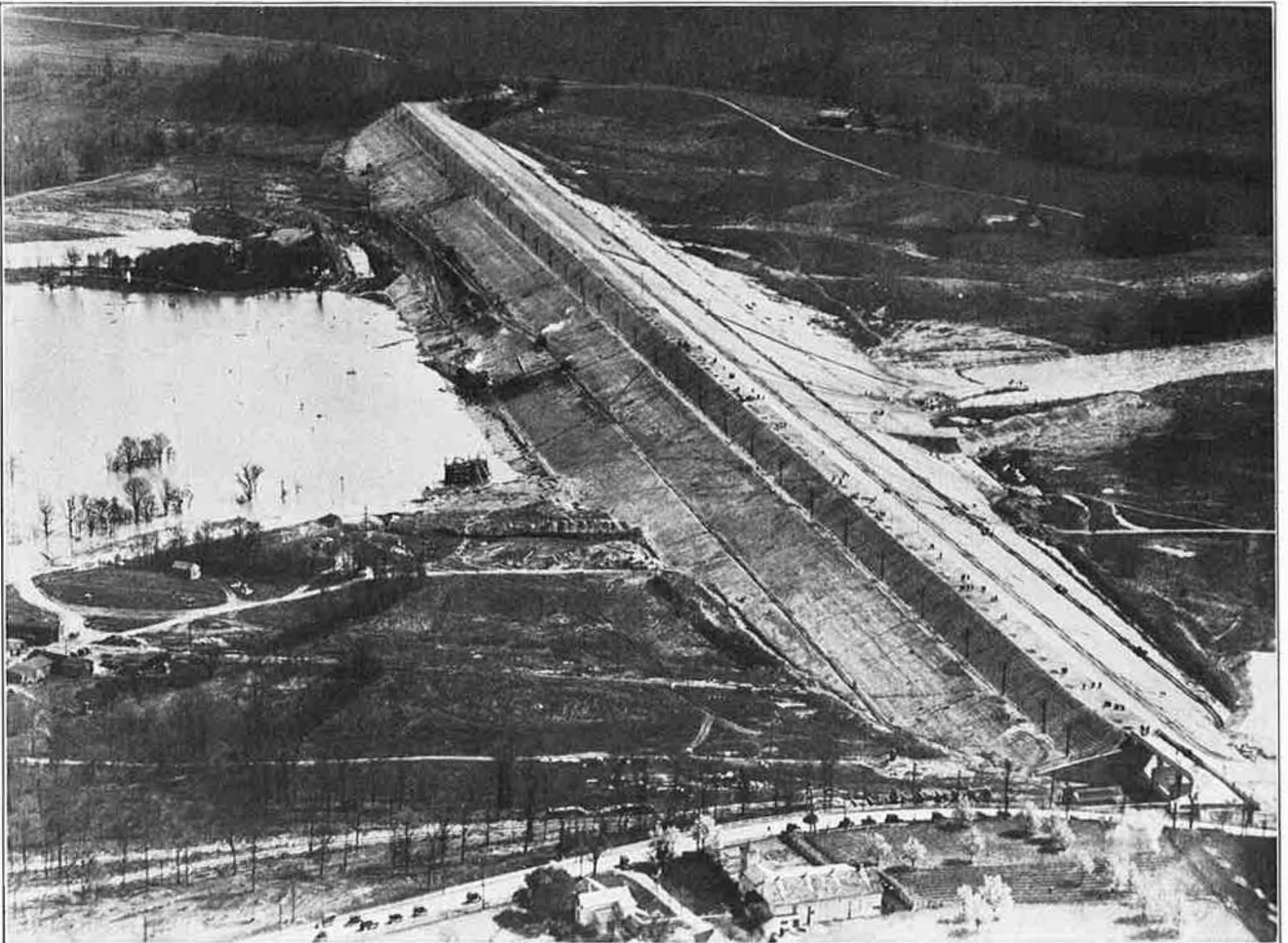


FIG. 366—THIRTY-SIX FEET OF WATER IN ENGLEWOOD BASIN, APRIL 15, 1922.

Photograph by Engineering Division, U. S. Army Air Service.

This picture was taken about the same time as Figure 363 with the aeroplane over the village of Englewood. The structure in the lower right hand corner is the spillway. The black object sticking up in the water close to the dam is the top of the gravel washer. The inlet to the conduits is just back of the gravel washer.

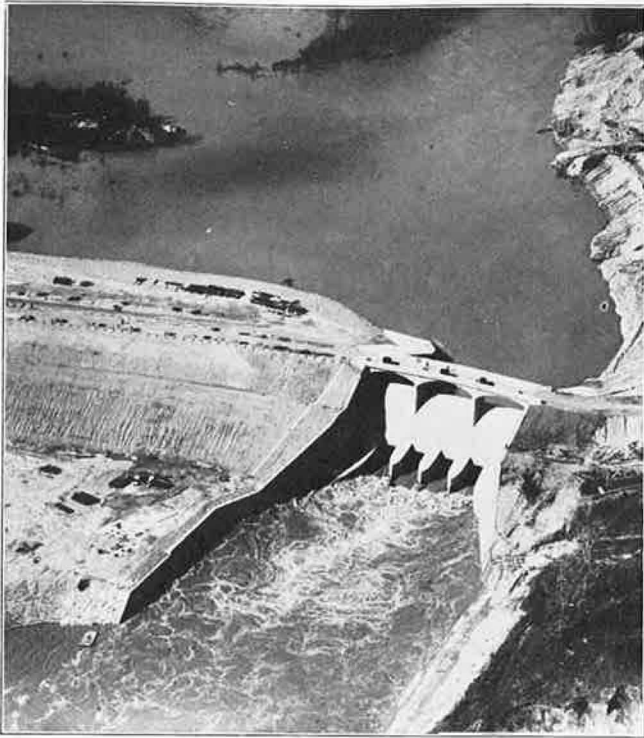


FIG. 367—TAYLORSVILLE CONDUITS
APRIL 15, 1922.

Photograph by Engineering Division, U. S. Army Air Service.

The view is taken looking upstream. The water was twenty feet deep over the floor of the conduits. The island in the background is the embankment of the Miami and Erie Canal. The marks that look like scratches on the face of the dam are small gulleys cut in the gravel slopes by the rain. The conduits at Tylorsville are the largest of the five. The graduation from the wild tumult of the hydraulic jump at the conduits to the quiet water at the lower end of the structure is clearly shown.

and many other rivers. Lives were lost, and many persons were made homeless. Trains were delayed, and wire communication interrupted.

Heavy showers and high winds were prevalent throughout the Miami Valley during the greater part of the first half of the month. Hamilton was visited by a destructive hail storm. A wind of cyclonic proportions swept up the east side of the Mad River Valley on the 10th, doing heavy damage to farm buildings. On Tuesday night, the 11th, very heavy showers occurred around Fort Loramie, Sidney and Lockington, and caused a general rise in the rivers. Heavy and general showers occurred at midnight on Thursday, and extended into the early morning hours on Friday. At a number of the weather stations over an inch and one half of rain fell within a few hours. This rain filled the streams, finished soaking up the ground, put some water in the lower parts of the retarding basins, and set the stage for the performance of Saturday.

Friday afternoon a severe rainstorm set in. For several hours the rain poured down in torrents, then lessened in severity and continued until late evening. This rain was general throughout the Valley, although "spotty." An inch and one half of rain fell in a short time in many places. Three and one half inches fell in the twenty-four hours

from Thursday midnight to Friday midnight over the greater part of the Valley.

The suddenness of the rain of Friday night, and the water-soaked condition of the ground caused a heavy and quick runoff. The streams above the dams acted just like the Miami Valley streams did in the past, and came up with a rush. The gauge at Pleasant Hill showed 13.2 feet in a few hours, which was a little over flood stage, and the one at Medway registered 9 feet or a foot above flood stage.

The rivers below the dams did not give their usual performance. Instead, they gave an excellent demonstration of the workings of the newly completed system. Dayton is close to three of the retarding basins and has a relatively small drainage area not influenced by the dams. Hamilton is further away, and has a large area, (about 800 square miles) not influenced by the dams. The other towns, except Troy and Piqua, of the Valley are, in position, in between these two towns. The lower part of Figure 368 shows the gauge readings at the Main St. bridge in Dayton. The gauge at this point has been maintained for a number of years. Zero does not mean the bottom of the river as it formerly did, as the improvement in the river has lowered the water level, so that normal low water is now below zero. Therefore, the present day heights cannot be directly compared with pre-conservancy readings. The upper part of Figure 368 shows the storage in the retarding basins. The rains in the upper part of the basin on the 11th are reflected by a long, broad hump in the lower or river stage curve, and there was enough water to cause a small increase in the storage in the basins. The abrupt hump in the river stage curve during the morning of the 14th came from the rains of Thursday night, which were especially severe in the immediate vicinity of Day-

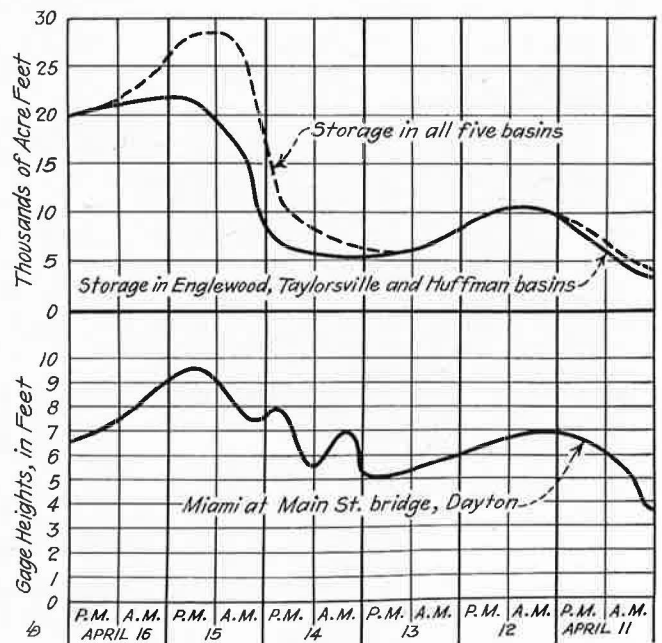


FIG. 368—DIAGRAM SHOWING BASIN STORAGE AND GAUGE HEIGHTS OF MIAMI AT DAYTON

ton, but not so heavy above the dams. The big rain of Friday started the main rise. The little hump just before midnight was caused by back-water from Wolf Creek's rampage, which was uncontrolled by retarding basins, plus the runoff from Dayton. As shown by the upper curves, the retarding basins were beginning to get to work, and consequently the curve of gauge heights in Dayton is a hump, rather than a peak. The smooth easy curve of the present day hydrograph is in marked contrast to the jagged peaks of the graphs of earlier days.

Under old conditions, a very pointed peak would have occurred Saturday morning. The old danger stage would have been reached, and perhaps passed a little. Under the conditions at this particular time, the three dams just above Dayton were the only ones that had much effect on the stage there. They were responsible for about one-half of the reduction in the stage. The other half of the reduction came from the channel improvement. The proportion of the reduction due to the dams would be greatly increased in a larger storm. The effect of the quicker "get-away" in the towns due to the improvements, and the change in the valley storage conditions, can only be determined after long observation of similar storms. As it was, a maximum discharge of 35,000 second feet occurred at 4:00 P. M. on the 15th. The maximum capacity of the improved channel at the Main Street bridge at Dayton is 110,800 second feet, with the water three feet below the top of the levees.

Another noteworthy improvement was in the smoothness with which the water flowed. In form-

er years, even at moderate stages, the waters of the Miami were wild and turbulent, the term "angry waters" best describing the stream in flood. During the flood of April, even though the velocity has been raised by the cleaning of the river, but little disturbance was to be seen, and the river went on its way very quietly. No damage was done to the works of the District in Dayton.

Hamilton has above it a large area not controlled by retarding basins. Much of this is to the west of and very close to the city. Consequently it has two peaks to its floods, one when the water from this uncontrolled area close at hand reaches the main river, just a few hours after it has fallen, and another later when the water from the upper valley gets down. In this particular flood, the first peak occurred at 5:00 A. M. on the 15th, with a gauge height of 15 feet, at the Main High bridge, and a discharge of 54,500 second feet. The retarding basins above Dayton, together with Germantown basin on Twin Creek, so reduced the second peak that it can hardly be determined. By Saturday noon the gauge was 14.7, on Sunday it rose to 13.7 after a fall, it was 10 feet on Monday, and 10.4 on Tuesday. Just as it was at Dayton, the effect of the basins was to cut down the peak flow and to prolong a moderately high stage of the river. No damage was done to the District's work. The maximum capacity of the improved river is 210,100 second feet to the free board line. It is interesting to note that the first peak is so much in excess of the second peak. It is only for very large floods that the second will be larger than the first.

The effect of the flood upon the towns in between

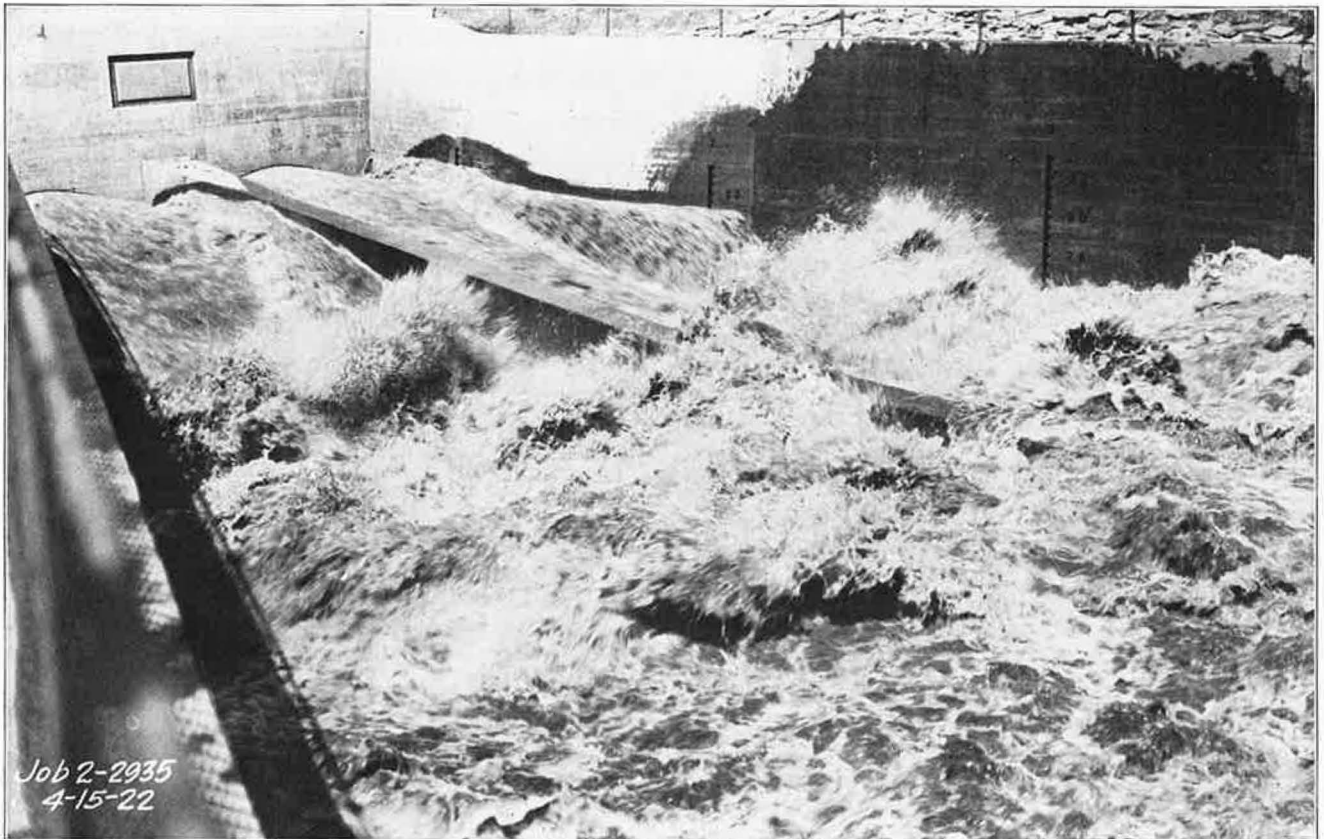


FIG. 369—THE ENGLEWOOD CONDUITS APRIL 15, 1922.

The picture gives only a meager idea of the tumult of the waters in the hydraulic jump. The wet places on the wall show how high the water leaped at times.

Dayton and Hamilton ranged between the two extremes. Troy and Piqua, affected only by Lockington basin, which does not have marked effect except during larger floods, received their benefit from the channel and levee improvement. The rain of Friday night was not so heavy above these towns as it was closer to Dayton, and on the Still-water drainage area.

Everything went according to plan at the dams. During the rainy period preceding the 15th the water passed through them unimpeded. A small amount of storage shows on Figure 368 because the high stage caused a considerable depth of water in the conduits, and consequently some storage, but in general the inflow equalled the outflow. The rains of the 11th caused some additional storage at Englewood, but the storage dropped back on the 14th. The heavy rain of Friday evening caused a rapid increase in the storage in a relatively few hours on Saturday morning, which decreased in rapidity later in the day until the maximum was reached.

	Max. Ht. Water abv. Conduit Floor, Ft.	Max. Storage Acre Ft.	Time	Max. Cap'ty. Basins to Spillway Acre Ft.
Germantown	39.9	8,600	6 AM-15	106,000
Englewood	36.9	18,500	5 AM-16	312,000
Lockington	22.6	2,275	4 AM-15	70,000
Taylorville	20.0	4,850	3 PM-15	186,000
Huffman	17.7	2,200	4:50 PM-15	167,000

The conduits ran full at Englewood, Germantown and Lockington. Although the elevation of the water in the basin at both Taylorville and Huffman was higher than the top of the conduits, they were not filled, as a marked contraction occurred at the entrance. At higher heads, they too, would be filled. It will be remembered by those who have followed the Conservancy work that some of the basins hold back a greater proportion of the water flowing into them than the others, and that Englewood, and then Germantown, hold back the largest proportion. Therefore, the storage at these two places was much more impressive than at the others. Backwater in Englewood basin reached nearly to West Milton, covering a number of roads not reached before. Marked whirlpools indicated the location of tunnel inlets. At the other three dams the storage, while not so extensive as at Englewood and Germantown, made large lakes, and covered areas not hitherto flooded. The effect of the storage can be seen by reference to Figure 368. There is no peak on the curve of gauge heights for Dayton, only a rounded hill with a long slope on the downhill side. The reason why the storage curve does not fall as rapidly as the gauge height curve is that Taylorville and Huffman with their large discharges emptied quickly and let the river stage fall. Englewood, with a small discharge and big storage retarded water for six days.

The dams behaved very well. No material physical damage was done. The slopes were cut slightly in places by the heavy rain, and some of the plantings were damaged, but the loss was trivial. Previous high waters had given opportunity to study the action of the hydraulic jump, and the studies and profiles made this time added nothing of interest to the information given on the hydraulic jump, in March 1921 Bulletin, save that this last performance confirmed the favorable results previously noted. Drift went through the conduits

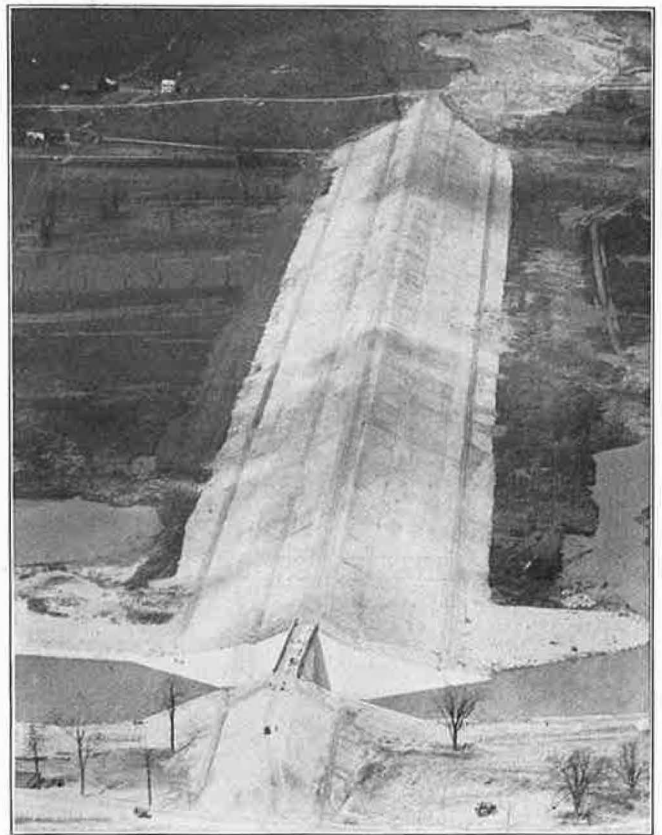


FIG. 370—HUFFMAN DAM, APRIL 12, 1922.
Photograph by Engineering Division, U. S. Army Air Service.
Very little water was being stored when this was taken.

cleanly and with dispatch. The iron railing at the inlet end of the tunnels at Germantown was torn away by the drift and the water. This result had been anticipated, and the railing built so it would go and not damage the concrete, but the twisted pipe gave emphatic evidence of the force that hit the railing.

The citizens of the Miami Valley were greatly interested in the working of the system. Germantown and Englewood were especially popular with sightseers, because of the high stage of the water in them, and because of their accessibility. Englewood, being along a paved highway, received the most attention. The crowd Saturday was very large. The sheriff took warning and on Sunday put deputies on the road to regulate traffic and keep it moving. Even with these men on duty, traffic became so dense that progress beyond a snail's pace was impossible, and the road was blocked several times.

One citizen stood a long time on the top of the Englewood Dam and looked at the lake above. Finally he said, "Well, I know that is a lake seven or eight miles long, and that it is pretty deep, and that there is lots of water in it, but it is not larger than a mud puddle compared with what the basin will hold." This fact of being big enough to handle anything that might come along, was the outstanding feature impressed upon everyone's mind by the high water of April 15th. But 32 percent of the Dayton channel capacity was used, 26 percent of Hamilton's, and only 4 percent of the basin capacity was utilized. It would take a much larger flood than that of last April to even approach the actual capacity of the system.

Black Street Bridge at Hamilton Completed

Methods That Were Somewhat Unusual Used in Constructing Important Structure.

The completion of the Black Street Bridge, on March 27, 1922, meant much to the City of Hamilton. The 1913 flood carried away the steel bridge at the foot of Old Black Street. A temporary bridge for pedestrians was erected on the piers of the old bridge, but for nine years all vehicular traffic in the north section of town had to go to the center of the town to cross the river. Besides the serious inconvenience this long detour has caused, a considerable retardation in the development of the north end of Hamilton has resulted. The construction of the new bridge has been very welcome.

The structure is a seven-span reinforced concrete arch bridge, 654 feet between abutments. Work was first started on May 22, 1920. As operations developed interested citizens noted a good many departures from the construction methods commonly in vogue in the Miami Valley, and questions have consequently been numerous. But there is nothing revolutionary about the bridge. The design is conservative and follows closely the accepted lines of present day practice. Similarly, the concrete was proportioned, mixed and handled in the most approved manner. But in the preparation of the foundations, in excavating for the footings

Nearly every contractor who has built bridges in the Miami Valley has had trouble in getting the pier footings placed. They have all used coffer-dams made of sheet piling and have almost always had trouble in working in the restricted spaces inside the coffer-dams, in keeping out the water, and in keeping men at work in the holes. At the Black Street bridge the District placed a dragline machine out in the river, dug a hole for each pier and piled up the dirt around the hole, so as to form a dike with its top above the water surface in the river. Then electrically-driven pumps were placed on the dike, and the water in the hole pumped out. Some water ran in through the gravel but the pumps were able to carry it away faster than it could run in. The longer the earth dikes stood, the less water came through their banks, as the burden of silt carried by the waters of the Miami served to stop up the voids in the gravel composing the dikes, and made them more watertight as time went on. Then the dragline with the leads and hammer of a pile driver suspended from the end of the boom, was so swung that the hammer was over the place where a pile was to be driven. The load cable of the dragline then pulled in and spotted a pile. The

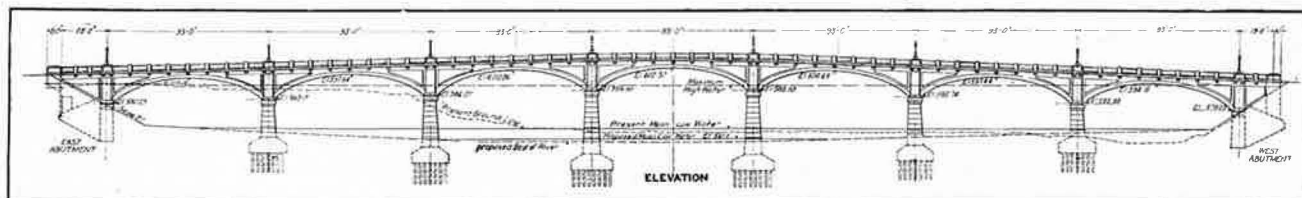


FIG. 371—ELEVATION OF BLACK STREET BRIDGE.

and driving the piling, in the long cableway for handling materials, and in the form work for the arches, methods were employed that were somewhat unusual.

The most common cause of failure in concrete bridges is poor foundations. No other feature is of more importance, and no other feature is more apt to be neglected. The Miami is a treacherous and shifting stream. A footing that might do very well in some streams, would prove inadequate to meet the high water conditions of southwestern Ohio. Therefore, the concrete footings for the Black Street bridge were placed sixteen feet beneath the river bed. In turn these footings rest on twenty-foot piles driven eighteen feet further down into the gravel, and with the top two feet imbedded in the concrete. The 150 piles under each pier are sufficient to carry the bridge, even with no support from the river bed material itself. The partial failure of the second pier of the Third Street bridge in Dayton on January 20, 1921, brought bridge foundations, particularly those of the Black Street bridge, then under construction, into sudden prominence. The February, 1921, Bulletin carried detailed accounts of the Black Street bridge footings, and compared them to various existing structures in the Valley.

leads were held in position at the bottom, by pushing them into the gravel, and were held at the top by the dragline boom. The pile was driven to the required depth by the hammer, the dragline was moved around and the operations repeated. When the piling was in place, forms for the concrete footings and piers were built, and the concrete placed. After the forms were removed, the hole around the foundation was filled by pulling the material in the dike down with the dragline. All of the work was in a broad, open cut, easy to work in and where there was no doubt about what was being done. It was anticipated that rises in the river would wash out the earth dikes once in a while, and in fact it happened twice. But there was nothing to wash out except the gravel and after the water receded the breach was filled in, the water pumped out and work resumed.

The process was so simple and different that it attracted much attention. The Bulletin ran a story in the February 1921 issue describing the methods used, and the Engineering News-Record of New York also carried stories about it. A good many letters of inquiry were received. This one is typical: "I am simply writing this letter to inquire if you know why it is you can excavate for piers in the Miami River, and not use any sheeting, when

everyone else seems to have trouble, even after using sheeting". The answer was that "the District had not built any bridge piers in the Miami River before, and was therefore not aware that excavation could not be made without sheeting, and for that reason the District was able to get along without it." The particular questioner who was so answered did not accept the answer as a joke and thought it inadequate, but after all it really does express the meat of the matter. Such a simple and obvious thing was not done before because every one did what the person before him had done. Then too, such large equipment as the District used is not always available to contractors.

There is really nothing novel in the use of a cableway with which to handle material and forms, as similar outfits have been often used on bridge work. But in the Miami Valley most contractors have been accustomed to using concrete towers on most bridge work, or cars on trestles and the simple and efficient cable carriage was a great source of interest to the citizens of Hamilton. As the construction plant has been described in detail in the February and March 1921 issues of the Bulletin, it will not be reviewed here. The complete success of the installation in accomplishing the ends desired, should be recorded.

The fourth feature of interest is a special construction of the arch forms. In a concrete bridge the weight of the concrete and the filling over the arches and the pavement, which is the so-called dead load, is large in proportion to the live load. The dead load is also a constant thing and is defi-

nite. Therefore, the thrust on the pier from the dead load of the arch on the left is balanced by an equal thrust from the arch on the right. The pier is designed, as far as overturning goes, only to meet the stresses from the live load. In some bridges the dead load is not equal on both sides of a pier. Then the pier and footing is designed to meet the unbalanced thrust due to the dead loads, as well as that due to the live loads. But all the arches are the same length in the Black Street bridge and the dead load thrusts on the piers are all equal. While the arch is being poured, the forms under it carry the weight. The substantial character of the Black Street forms can be seen by referring to Figure 364, the footings for the post being timber piles. The arches should be supported by the forms until all are poured, and the concrete set. If the supports underneath one of the arches were removed before all the spans were completed, the thrust against the piers might push them over, as there would not be any corresponding thrust in the opposite direction to offset the thrust from the unsupported arch.

Naturally, the arch forms in such a bridge as this require a great deal of lumber. The posts and bracing have a good salvage value, but the lagging has little value save as kindling, when the bridge is finished. A substantial saving in the amount of lumber used was secured at Black Street by the use of a semi-removable falsework. First, a skeleton structure was built up on the pile foundation, as shown by the sketch in Figure 373. Five bents of 11 posts each were used under each arch.

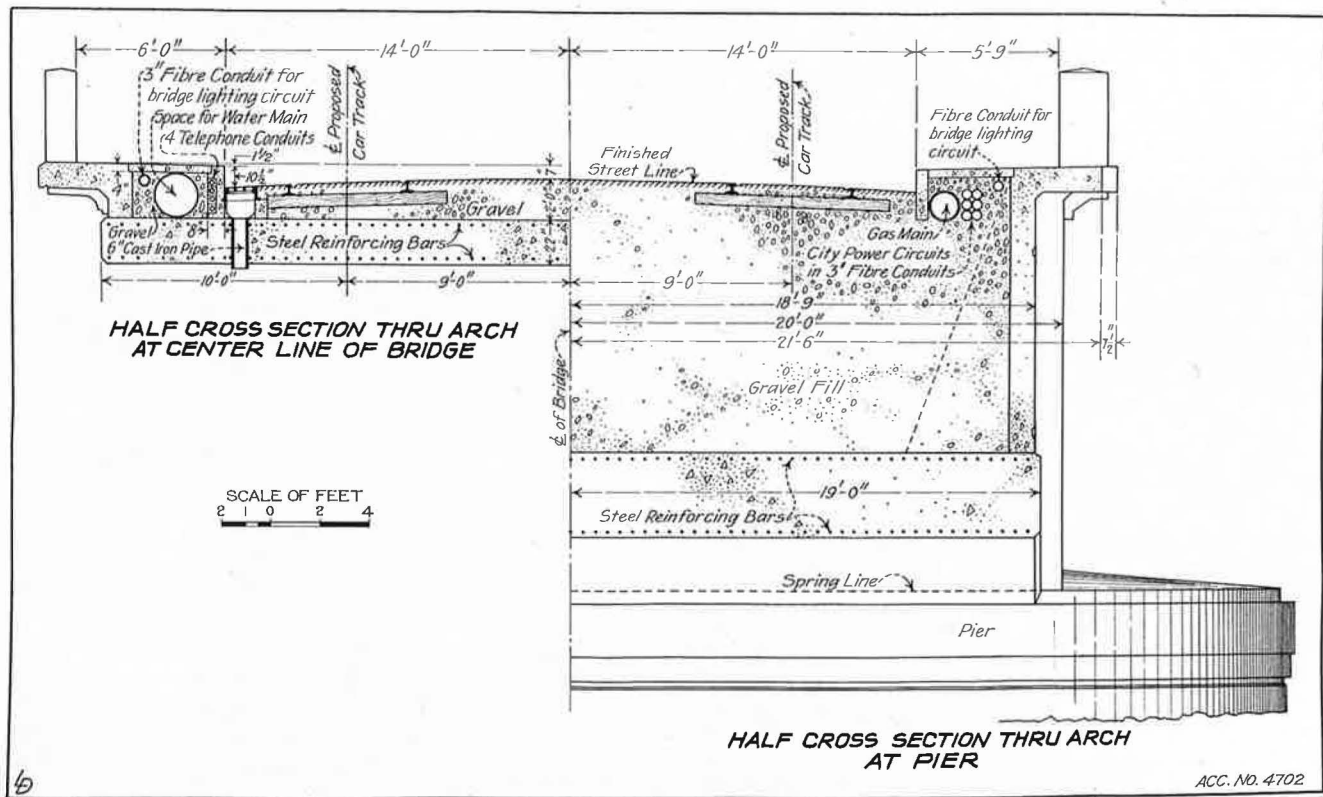


FIG. 372—DRAWING SHOWING SOME DETAILS AND DIMENSIONS OF THE BLACK STREET BRIDGE.

The tracks shown in the sketch will not be placed for the present. Extra steel in the arch is provided to carry the extra load of a street car. This can be seen in the section on the left.

These bents were placed on pile footings. At the level of the top of the piers a deck of longitudinal timbers was built, which helped brace the bents, and which also took the side thrust from the batter posts. A cap for each bent was run across the deck, both to carry the wedges for the vertical posts above, and to act as a heel for the batter posts. Then came the wedges, (to facilitate bringing the forms to the right level, and to make dismantling easy), then another cap, and then the eleven 8x8 vertical posts on each bent. This skeleton was thoroughly sway-braced. On top of the vertical posts was placed a strip of lagging, with bolts projecting upward that were gripped by the concrete after it was placed. This frame work composed the part of the falsework that remained in place throughout the work, and that carried the dead load until completion. It also afforded support for the forms for the spandrel walls and cantilever sidewalk. Full details are shown in Figure 373.

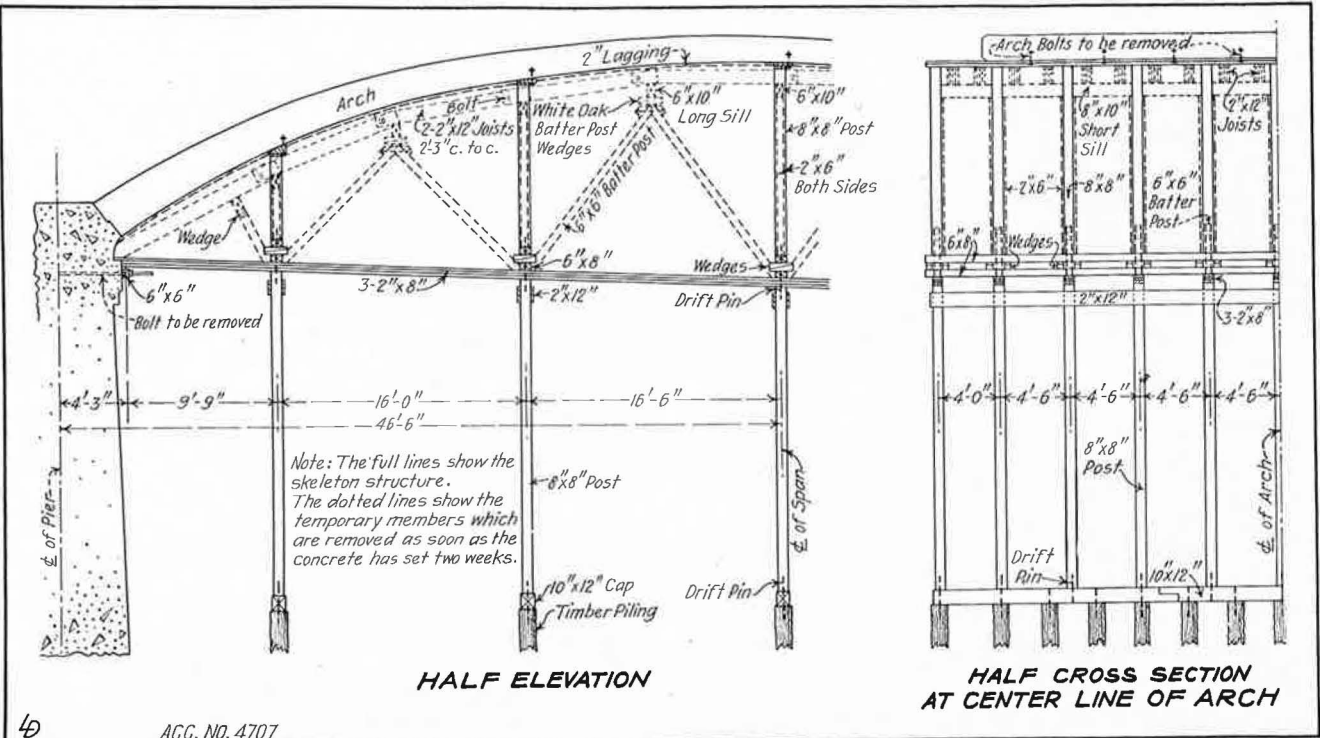
Further falsework was necessary to hold the lagging supporting the green concrete. A 2 inch by 6 inch strip of lumber was bolted to the side of each vertical post above the deck. Short caps went on top of the 2x6 strips, between the vertical posts, and these in turn carried the stringers supporting the lagging. The batter posts were independent of the vertical posts, and were supplied with wedges just beneath the cap. The stringers and lagging were cut and laid as the ordinary form work for structures of this kind.

After the arch ring had been poured, and the concrete had set, all the lagging except the strip on top of the vertical posts, the stringers, the batter posts, and the 2x6 strips, were removed, leaving the

arch supported by the skeleton falsework. This was done by taking out the bolts fastening the 2x6 strips to the vertical posts, and springing them out of plumb, and by loosening the wedges at the tops of the batter posts. With the pressure off of the lagging, it was easily removed. As the posts of the falsework had been carrying all of the load, in the first place, no additional load was placed upon them when the lagging was removed, and no settlement occurred. All of the lumber which was removed was used over again. But three sets of lagging, stringers, batter posts and strips were used for the entire bridge, instead of a full set for all seven spans. The forms as built required some special mill work, but the economy in lumber was so considerable that the net saving was about \$4,000. The plan was a complete success in every way.

Unusual care was taken in cutting the forms. Bolts were used as fastenings wherever possible. To insure accurate construction of the arch forms, the curves were laid out on a nearby tennis court. A framework was built of light lumber and laid down on the curves so located. Using stakes set at the centers, and proper radii, curves were marked on this framework, and the templates thus outlined were sawed out and used to mark the joists and side forms for the arches. Settlement allowances were made 0.04 feet at the center of the arch, and 0.08 feet midway between the center and the piers. The extraordinary care used in cutting out was reflected by the excellent fit secured, and the lack of alterations at the last minute.

Reference to Figure 372 will give the spacing and size of the reinforcing. The extra bars under the street car tracks should be noted. In placing the



HALF ELEVATION

HALF CROSS SECTION
AT CENTER LINE OF ARCH

FIG. 373—SKETCH ILLUSTRATING THE ARCH FORMS ON THE BLACK STREET BRIDGE.

The sway-bracing has all been omitted on the drawing. The stringers in some cases were cut from a single piece; in others, the curved part was spiked to a straight stringer. Not all of the wedges were oak; some were good quality pine.

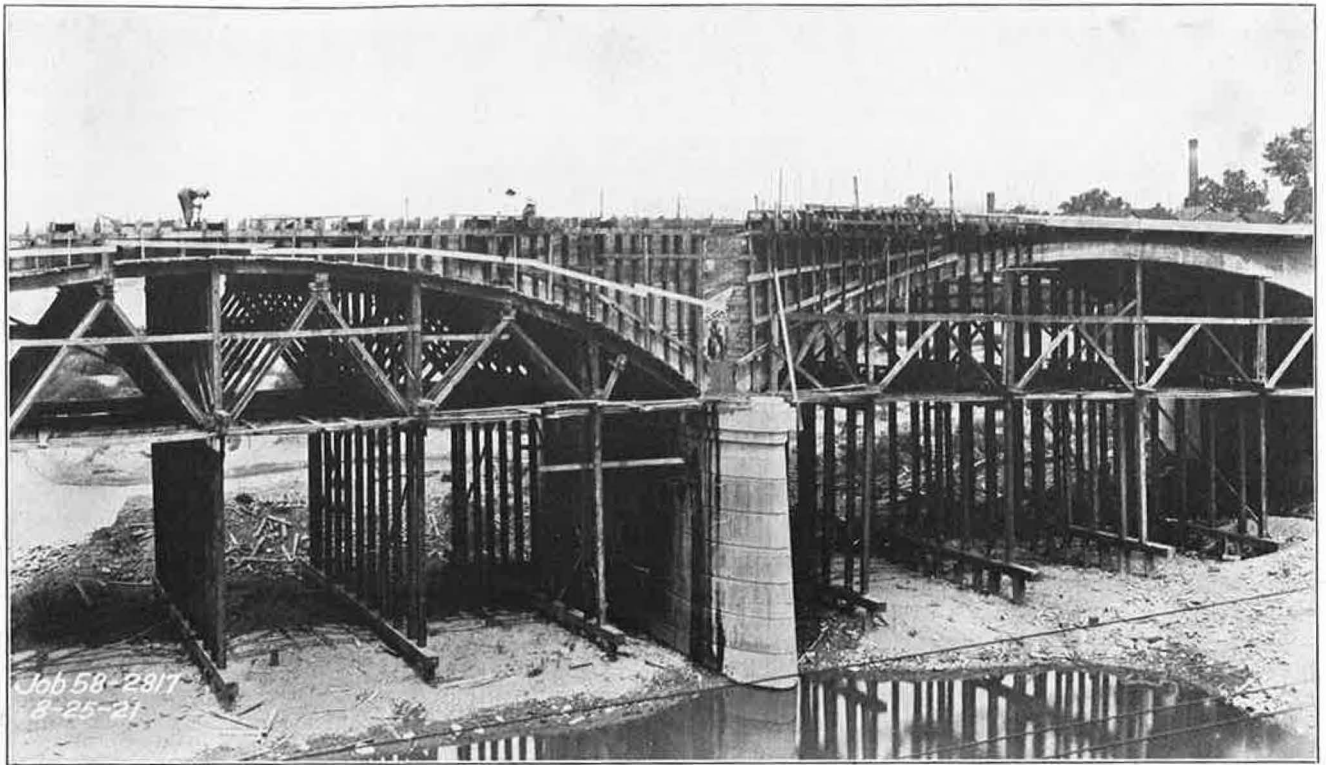


FIG. 374—BLACK STREET ARCH FORMS AS ACTUALLY BUILT, AUGUST 25, 1921.

The arch on the left has the full forms under it. The one on the right has only the skeleton forms supporting it.

steel, care was used in spacing accurately, and lacing bars of 3.8" steel pass above and below the transverse bars, forming a lattice work, and steel and concrete spacers were used to preserve the spacing.

The plant layout and the general method of handling the materials and concrete was described in the February 1921 Bulletin, in connection with the description of building the piers.

The same general methods were used throughout the construction of the bridge. Each arch was poured in three longitudinal rings of equal width, the middle one first, then the outside ones. Each ring was poured in one run. A hopper was set in the center of each arch, with a spout going in each direction down the slope of the arch. The batches were run alternately in both directions, so as to balance the loading on the forms. Back forms were used for a distance of 25 feet to 30 feet from the piers. To prevent rising of these top forms from the pressure of the semi-liquid concrete, $\frac{3}{4}$ inch rods were used to tie them down. The concrete mix in the arches was six bags of cement per cubic yard of concrete, which is nearly 1:2:4. The maximum size of the gravel used could be passed through a three-inch circular opening. Steel stubs and keys were placed in the arch concrete to connect with the reinforcement for the spandrel walls and counterforts.

The outstanding features of the spandrel walls are the use of counterforts, and the use of five expansion joints. The expansion joints split a counterfort into two parts, and extend directly through the spandrel walls, dividing each into four sections. The outside forms for the walls were built first, then the steel was placed and then the inside forms were set. The sections were poured alternately,

and each section was run continuously from the arch to the top of the sidewalk. The walls were finished with one inch of mortar colored with lamp black in the proportion of 2 pounds of lamp black to a barrel of cement. Only the outside half of the sidewalk is a part of the spandrel wall. The inside half of the sidewalk will not be laid until the bridge is paved. The reason for this form of construction was to provide a place for conduits for public service lines underneath the sidewalk at the outside of the bridge. Otherwise it would have been less expensive to build the entire sidewalk as a cantilever projection. The concrete aggregates used in this part of the work were washed and screened. The coarse aggregate passed through $1\frac{1}{2}$ inch circular openings, and the sand through $\frac{3}{16}$ inch by $\frac{3}{4}$ inch slots. Slightly more than seven bags of cement per cubic yard of concrete were used, the mix being from 1:1½:3 to 1:2:4. The expansion joints were filled with $\frac{1}{2}$ inch layer of asphalt and felt compound.

The pilasters over the piers were poured after the spandrel walls had been completed, and were separated from the latter by expansion joints. Fiber conduits were placed in the top of each pilaster to connect the lamp post on top of the pilaster, with the lighting circuit.

The posts for the railing were poured in place first, and after the forms had been removed the sections of rail were built between the posts. The railing is solid, in contrast to the various types of open railings in vogue in this vicinity. The scupper holes at the bottom are for the purpose of providing air circulation as a preventative of the usual dust and trash nuisance. Eight bags of cement per cubic yard of concrete were used, the mix being 1:1½:3. The tops of posts and railings were finished with a steel trowel, no mortar being used.

Steel templates were used to get a true line for the ridges on top of the railing.

Water proofing was applied to the tops of all arches, tops of piers, and to counterforts and to the backs of the spandrel walls below the top of the sidewalk. It consisted of a bituminous oil priming coat and three coats of asphalt applied in alternation with two layers of impregnated cotton fabric. The purpose of the water proofing is to prevent surface water, which finds its way down through the gravel fill, from soaking into the concrete. Weep holes are provided at the low points, the asphalt membrane carrying water to them. This work could only proceed in good weather, great care being necessary to insure a tight job. One month was required to water proof the entire bridge.

As soon as the water proofing was completed, the space over each pier and abutment was filled to a depth of 2 feet with oversize stone from the screening plant, to provide free drainage. This stone was carefully placed by hand around the drain pipes.

Then, with 4 yard dump cars running over a 36 inch gauge track, gravel and sand from the channel excavation was brought in to complete the filling. This filling is part of the dead load. As the arches and piers were designed upon the assumption that the dead load was all in place, it was necessary to distribute the fill in proportion to the finished depth over the entire bridge. To have completely filled one arch with the others empty, would have resulted in unbalanced loading. The filling was thoroughly saturated, and washed into place around posts and corners. Very little settlement is expected, but the paving will not be placed until even the minor settlement has ceased.

The tracks of the Hamilton Belt Railroad Company crossed the site of the west abutment of the new bridge. The railroad company objected to a shift in the track, so it was planned to carry the track on piling until the concreting was completed. When the time came to drive the piling, a greater penetration than 12 feet could not be secured, even with the use of iron protection shoes. A test pit dug by hand disclosed a layer of very compact gravel. It was not cemented, but was so graded that it had a small percentage of voids. The railroad company brought in a heavier hammer, and pounded the best part of a day on a high grade oak pile about 30 feet long, fitted with an iron shoe. A slow penetration was apparently secured, but on account of

the slow progress the railroad company agreed to the track shifting, and the work progressed again. When the oak pile was dug out in excavating for the abutment, the slow penetration was discovered to really be a pounding up of the pile, which is shown in Figure 375. The pile had hardly made a dent in the gravel.

The hazards of bridge building are well known. It is worth noting that the Black Street bridge proved to be an exception to the rule in respect to personal injuries. But one serious accident occurred, that of a broken leg from a fall. There were not many changes in the working force. The spirit and interest shown by the men was unusual.

Save in the depth and security of the foundations, there is nothing unusual in the design of the bridge. The best present-day methods were used in the calculations. The following tabulation shows the assumptions upon which the design was based. It should be noted that the maximum stresses are only about one-fourth of those that would break the materials.

Weight of concrete, 150 pounds per cubic foot.

Weight of earth fill, 115 pounds per cubic foot.

Live load on roadway, 200 pounds per square foot, or a concentrated load of one 20-ton truck.

Live load on line of proposed street car track, one 50-ton street car.

Live load on sidewalks, 100 pounds per square foot.

Maximum stresses in arches under maximum live and dead loads and temperature changes:

Steel 16000 pounds per square inch.

Concrete 635 pounds per square inch.

Maximum stresses in remainder of structure.

Steel 14000 pounds per square inch.

Concrete 500 pounds per square inch.

Maximum load on the piles, 30 tons, assuming the gravel to carry no direct stress.

The dimensions of the bridge are shown in the various illustrations. The following is a list of the principal quantities:

Excavation21992 cubic yards.

Backfilling7434 cubic yards.

Waterproofing36086 square feet.

Railing1393 lineal feet.

Concrete in piers.....6921 cubic yards.

Concrete in arches1988 cubic yards.

Concrete in spandrel walls693 cubic yards.

Timber piles.....15953 lineal feet.



FIG. 375—RESULT OF AN UNSUCCESSFUL ATTEMPT TO DRIVE AN OAK PILE THROUGH COMPACT GRAVEL AT BLACK STREET BRIDGE.

Progress on the Work From March 21, 1922 to June 26, 1922

GERMANTOWN

Completed.

ENGLEWOOD

Since the date of the last progress statement, March 20th, 1922, the work performed has consisted principally of the various minor items necessary for the completion of the finishing touches on the dam. Grading on the downstream slope is finished and the ground seeded to sweet clover. The upstream side is about 75% graded and partially planted with wild honeysuckle. The surface drainage system, comprising catch basins on top of the dam and on the berms and vitrified pipe down the slopes, is well under way. The guard rail on top of the dam is completed and is being painted. Riprap is being placed on the upstream side to elevation 825, the height to which a flood equal to that of 1898 would come. The stone for this is quarried at Ludlow Falls by forces of the District and transported to the dam by District trains. The Model "36" Marion dragline is moving along the toes of the dam, grading the top soil storage piles and smoothing up the scars incidental to construction operations.

The relocation of the Dayton Covington & Piqua traction at the spillway bridge, is completed, traffic being turned over the new line on June 23d. Filling the narrow gap between the spillway bridge and the Covington Pike, where the traction formerly ran, has been started, and will be completed in a few days.

The cut-off road between Roads 4 and 5, has been completed, guard rail erected and the road opened for traffic.

Under the contract with Connell & Rohrer for the removal of the Prairie Ford Bridge the structure has been dismantled, removed to the new location, and is being cleaned, painted and re-erected.

H. S. R. McCurdy, Division Engineer.

June 26, 1922.

LOCKINGTON

Completed.

TAYLORSVILLE

The principal items of work finished since the last report of March 20th are the guard rails on the main dam and on Road 12 leading from the east end of the dam to the National Road, the catch basins on the top and berms of the dam, the seeding and dressing of the slopes, and the removal of the old club house which stood partly in the toe of the dam and the filling of the cellar of this house.

The caretaker's house has been finished and about a mile of fence has been built around some pasture land for him. Fifty-three of the camp buildings and a number of garages have been sold and the most of these have been removed from the premises.

In a day or so all tools and equipment not needed by the caretaker will be turned in to the Salvage Department.

Taylorville Dam is finished.

O. N. Floyd, Division Engineer.

June 26, 1922.

HUFFMAN

At the time of the report in the April Bulletin, the major items of work had been finished. Since then the placing of a blanket in the old river channel above the dam has been completed. The necessary protection to the banks of the channel, has been made by riprapping the slopes with rock.

All the locomotives, cars and other hauling equipment have been shipped away from the job, and all construction tracks taken up except a short section connecting the storage yards below the south end of the dam with the Erie Railroad. After the two draglines had finished their work they were tracked across the river and up around the south end of the dam through a small gap that had been left in the dam where it ties into the Springfield Pike. This gap has since been filled.

Guard rails have been built along both sides of the top of the dam from the Valley Pike at the north end to the bridge over the spillway. Ditches have been made along the sides of the highway on top of the dam to carry the surface drainage to the rock gutters down the slopes. After the completion of the short section of guard rail between the spillway bridge and the Springfield Pike at the south end, and a little work on the road surface, this highway will be opened to the public.

Concrete paving has been placed on the slope of the

bank above the concrete wall on the north side of the hydraulic jump pool below the conduits. Various other sections of rock paving and riprap around the outlet works have all been completed.

Work has been started on clearing the river banks below the dam. All trees and underbrush that have a tendency to collect drift or retard the flow of the water are being cut out. This clearing work will be to a point about one-half mile below the dam.

With a few exceptions, all the buildings in camp have been sold and are being removed by the purchasers.

C. C. Chambers, Division Engineer.

June 26, 1922.

DAYTON

The principal work remaining to be done is the completion of channel excavation and levee building along the left bank of the Miami River. Early in July all of the levee upstream from Stewart Street will have been finished and the three big draglines, two Bucyrus, Class "175," and one Lidgerwood, Class "K," will be working on the section between Stewart Street and the plant of the Dayton Power and Light Company.

Price Brothers Company has nearly completed the required revetment work.

An agreement has been entered into with Frank Hill Smith, Inc., for the construction of miscellaneous concrete structure remaining to be built. This work includes sewers, crest walls, coping for the large river walls, steps on the levee slopes, etc. The work is now under way.

Leslie Wiley, working under contract agreement, is cleaning up material which could not be reached by the big draglines under and around the bridges.

Surfacing and seeding of levee slopes on the south bank of Mad River and on the west bank of the Miami River between Third Street and Dayton View Bridges has been done by John E. Freudenberger, under contract.

On the north bank of Mad River, west of Webster Street, a privately owned gravel plant is operating under supervision of the District. This is a "pit run" plant, no screening or washing apparatus having been installed. Another plant for screening and washing the product will soon be installed on the south bank of Mad River, just west of Findlay Street. These plants, as well as the plant already in operation on Wolf Creek, above Summit Street, excavate from the stream beds material which would otherwise drift into the improved channels farther downstream.

Total channel excavation, item 9, up to June 1st, amounted to 1,605,000 cubic yards. Levee embankment amounted to 623,900 cubic yards. To accomplish this work, the total yardage handled amounted to 3,913,000 cubic yards.

C. A. Bock, Division Engineer.

June 26, 1922.

HAMILTON

The electric dragline, D-16-18 has completed a cut from the Main Street bridge to the Black Street bridge along the east bank of the river. It has started south again and is removing the remaining excavation in the middle of the river.

The class 14, Bucyrus caterpillar dragline has finished the levee north of Two Mile Creek and the west channel bank from Two Mile Creek to Black Street. It is now finishing the bottom south of Black Street along the Champion Coated Paper Company's wall.

The class 14, Bucyrus dragline on rollers has completed the Four Mile Creek cut-off channel and is now excavating and driving piling for the east abutment of the dam which is to be built north of Old River and Two Mile Creek. This will be a concrete dam with a spillway section 800 ft. long, and will raise the low water level about 5 feet. Concreting has been started on the west abutment of the dam. The excavating for this abutment was made by the Class 14 caterpillar after completing the Two Mile Creek levee.

The Model 21, Marion dragline has prepared the east bank between High Street and Vine Street for the slope revetment and is now building the levee along the north side of the spoil bank east of the Ford plant.

The concrete walls along Monument Avenue and Front Street have been completed. The wall south of Two Mile Creek is about 75% complete.

Price Brothers are making good progress on the revetment on the east bank north of High Street.

The total amount of channel excavation, item 9, to June 1, was 1,661,000 cubic yards.

C. H. Eiffert, Division Engineer.

June 26, 1922.

PIQUA

The dragline is now filling the gap in the levee between the Decker Packing Company's plant and Station 60. This work was delayed because of high water early in the spring, and because the material used in the fill is hard to secure and handle. The Shawnee levee is being built by teams. Additional equipment is to be placed in this section of the work.

The levee west of the Miami River is nearly completed, and a steam shovel and cars will soon be at work on the Water Street levee.

The raising of the Rossville bridge has been completed. Some work remains to be done at the approaches.

Albert Schroeder, Assistant Engineer.

June 26, 1922.

UPPER RIVER WORK

Troy—The dragline D-16-21, after undergoing repairs, started work again in the middle of May, and is busy cleaning out the channel in the vicinity and under the Adams Street Bridge. Under each arch the channel is being excavated below grade to a depth of from $2\frac{1}{2}$ to 4 feet. This excavation will receive the material in the old arches when they are torn down. The dragline work will be completed about August.

The work of strengthening the piers of the Adams Street bridge has been completed by Price Brothers, and the work of reconstructing the bridge, which is being done by the forces of the District, is making very good progress. All of the piers, except the tops of A, B and C have been poured; both abutments and the three north arches are complete. The forms for the spandrel walls and sidewalks for the three north arches are well under way, and the falsework completed for arches 1, 2, 3 and 4. Except for Arch No. 2 the arch steel has all been placed.

Price Brothers have been driving piling along the right bank of the river for revetment, which is to be placed as soon as the men and equipment are released from the bridge work at Piqua.

The Coleman wall, and some cleaning up work at and near the Market Street Bridge, has been completed.

Tippecanoe City—Since the report in the April Bulletin, I. C. Mercer and Sons have completed the Fourth Street sewer as far as South Street. So far, 1240 feet of 66-inch, 1210 feet of 51-inch, and 650 feet of 42-inch concrete sewer has been laid. There still remains 1000 feet of 36-inch sewer and about 80 feet of tile at the upper end to be placed. August 1st should see the end of this section of the work.

The Bull Run Ditch being built under contract by Wm. Oberer is near completion. The only work remaining to be done is the finishing of the slopes, and the Ritter Street culvert. The same contractor has also placed the earth fill for the raising of Main Street between First Street and the Miami and Erie Canal, and hauled about 1000 cubic yards of material into the main levee to make the connection with the Main Street wall.

The District forces removed and cleaned 44000 bricks from Main Street, and have completed the street work where North Second Street crosses the levee. Walls in connection with the raising of Main Street have been completed and work is now under way on the wall south of Main Street.

J. Connelly's team outfit started work completing the levee from Station 41 to the power house, on June 12th. This is the section the dragline had to leave because of sliding banks.

A. F. Griffin, Assistant Engineer.

June 26, 1922.

LOWER RIVER WORK

West Carrollton—Completed.

Miamisburg—Since the report dated March 20 Price Brothers have completed the flood gate structure in the Miami and Erie canal near the north corporation line. The five flood gate jobs in Miamisburg are now complete. Total concrete in these jobs is 1000 cubic yards.

On the sixth of May Price Brothers started driving steel sheet piling for the revetment which will be placed along the east bank of the river from a point just above the end of Lock Street downstream 900 feet. The depth of the river in this location made it necessary to drive sheet piling from 8 feet to 15 feet in length. This work was completed June 6. In constructing a two-to-one slope from the water surface upon which to place the revetment it was necessary to move about 1500 yards of material. Price Brothers did this with their small dragline. The grading is done and concreting will soon be started.

Franklin—No further work has been done since the report in the April Bulletin.

Middletown—Price Brothers started the flood gate job in the Miami and Erie canal on Tytus Avenue, April 1st, and completed this work the last of May. There are 213 cubic yards of concrete in this structure which carries four 4 x 5 gates.

Timber clearing along the overflow areas of the river channel in Middletown has been completed, and the clearing above the Poastown Road bridge is nearly finished.

F. G. Blackwell, Assistant Engineer.

June 26, 1922.

RAILROAD RELOCATION

Big Four and Erie—Completed.

Baltimore and Ohio—Completed.

Ohio Electric—Completed.

RIVER AND WEATHER CONDITIONS

The total rainfall at Dayton for the period since the report in the April Bulletin was 11.87 inches. Of this amount 5.38 inches was precipitated in April and 4.16 inches in May. The April rainfall was 2.48 inches more than normal for this month. On April 13-14 a heavy storm occurred and 3.11 inches of rain fell in Dayton in the 24 hour period. This storm was general over the Miami Valley and caused a considerable rise in the streams and impounded water in all of the District basins. Details of this storm and its results are related elsewhere in this issue. On June 8, a very heavy local storm caused a rainfall of 2.50 inches in one and three-quarters hours at the Lockington Dam. There were 10 clear days and 11 on which more than 0.01 inch of rain fell, while May had 12 clear days and 17 on which rain fell. However, the total rainfall in May was only 0.28 inch more than normal for this month.

Temperatures during the period were moderate and not far from normal. The lowest temperature was recorded on March 23 and was 32 degrees while the highest temperature during the period was 92 degrees, which was reached on June 16. The mean temperature for March was 44 degrees; for April was 54 degrees; and for May was 66 degrees.

Wind velocities were not unusual, the maximum (for five minutes) being 52 miles per hour on April 11.

C. S. Bennett, Field Engineer.

June 26, 1922.

Meeting of the American Society of Civil Engineers a Success

With flood prevention as the topic for discussion, the American Society of Civil Engineers held its spring meeting in Dayton, on April 5th, 6th and 7th. With the nearly completed flood prevention works before them, a number of distinguished engineers discussed the Miami Valley's solution of the flood problem, and presented papers on similar problems that exist elsewhere. Inspection trips to two dams and over a portion of the river improvements were made. The Engineering Division of the Air Ser-

vice at McCook Field, the National Cash Register Company, and the American Rolling Mills at Middletown, entertained the society. These were all the inspection trips that could be included in the two days allotted, and the greater part of the District's work, and other industries that were anxious to entertain the visitors, could not be seen.

The Engineering News-Record in commenting editorially upon the meeting, said, "In the record of gratifying success made by the American Society

of Civil Engineers in its Dayton meeting there lies far more than an isolated fact in the society's career. The meeting marks an epoch in the life of this great professional body. Long tied up in rather rigid and routinized practices, the society broke away from these and for the first time held a regular meeting away from headquarters. It took the meeting to the members out in the field. The response was a surprisingly large attendance and an intense interest During the current season the last work will be done on the Miami Conservancy District construction. The Dayton meeting was a fitting and quietly impressive valedictory, as was remarked by the most energetic and resourceful promoter of the project. So quickly has the work run along during the four-year construction period that it has attracted far less notice than it deserves. As a detail, it progressed to completion without incident or accident. One of its greatest distinctions, however, is that virtually every element of the work embodies new methods, research discovery, or development of better practice, to a degree that makes this one enterprise a splendid model. As it has been a great school for the chosen group of engineers who were engaged in it, so it will long be a school for all concerned with hydraulic engineering in any phase, and flood-protection in particular."

The meeting was preceded by a meeting of the Board of Direction of the Society, on the 3rd and 4th. The Board was entertained at dinner on Monday night by the Dayton section of the Society, and on Tuesday night by the Dayton Engineers Club. On Wednesday noon, the Dayton Chamber of Commerce held a luncheon in honor of the visiting engineers, at which John R. Freeman, President of the American Society of Civil Engineers, and J. G. Sullivan, President, Engineering Institute of Canada, were speakers.

On Wednesday, the 5th, the technical meeting started with the registration of the 350 visiting en-

gineers. Sessions were held morning, afternoon and evening. Led by President Freeman, the subjects of the papers and discussions ranged from flood-stricken China, to the lowlands of the Mississippi, and to sand and tidal waves. Cloud bursts on small areas were discussed by a number of speakers. During the evening session Mr. A. E. Morgan, former Chief Engineer, and Mr. Chas. H. Paul, present Chief Engineer, told of the work of The Miami Conservancy District.

Thursday and Friday were given over to inspection trips. In arranging these, the endeavor was to show to the visitors features that were of interest to engineers, and would exhibit characteristic products of the Miami Valley. Flood protection, cash registers, airplanes, and Armco iron were the products selected as exhibits. The Engineering Division of the Air Service opened McCook Field to the visitors, took them over the wonderful plant, staged exhibition flights by many types of planes, put on an aerial circus in front of the Engineers Club during the noon hour on Wednesday, and another while the engineers were at the Englewood Dam. The National Cash Register Company entertained the visitors to dinner at their plant, took them over the great factory, gave their shop lecture, and took them to the roof of the office building for a birdseye view of the lower end of the Miami River improvement. The American Rolling Mills took the party to Middletown on a special train, served luncheon, and took them through their East Mill, where Armco iron is made, and furnished a special train to return.

Two typical dams, Englewood and Huffman, and the Dayton River improvements were shown. The two dams were virtually completed, but at Dayton an opportunity was given to see some of the work under way. As Colonel Deeds said at the banquet at the Miami Hotel, the visit of such a distinguished group of men was the best ending to the work that could be made.

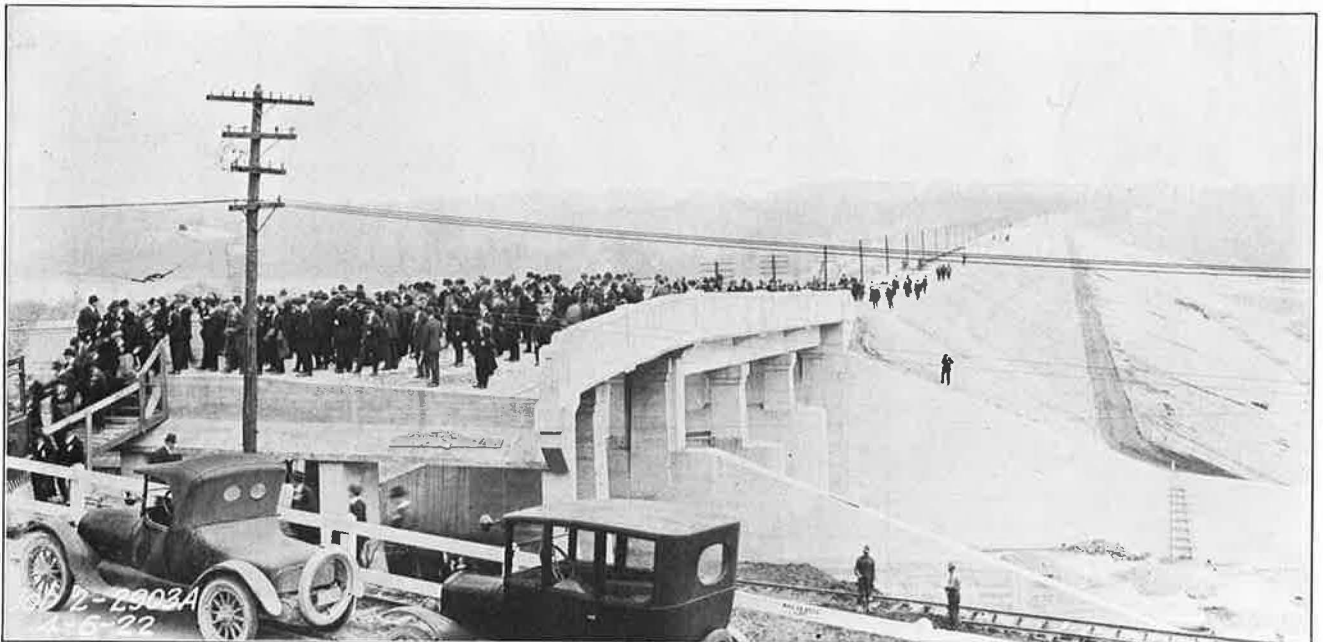


FIG. 376—MEMBERS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS AT ENGLEWOOD DAM, APRIL 6, 1922.

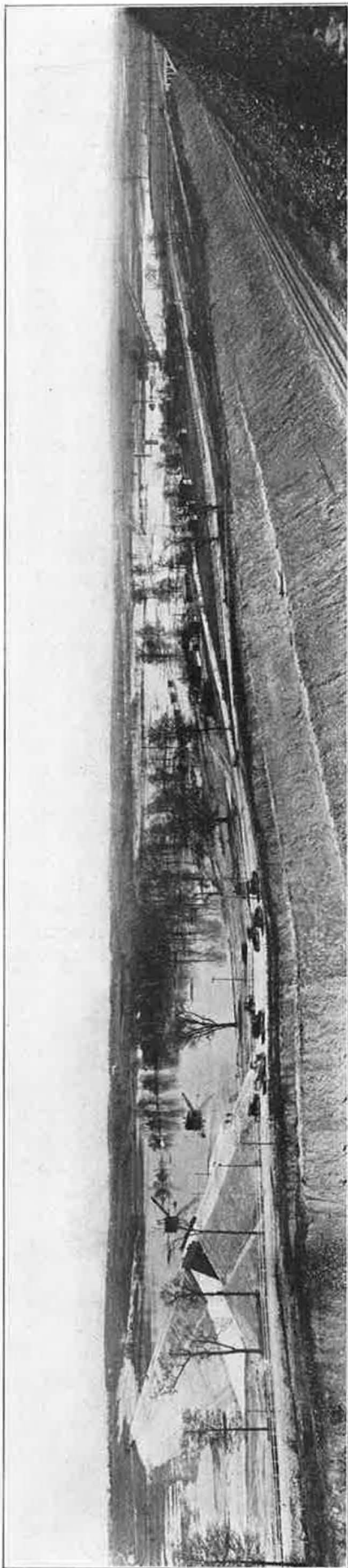


FIG. 377—PANORAMIC VIEW OF HUFFMAN BASIN ON APRIL 15, 1922.

The water in the basin was nearly 18 feet deep over the floor of the conduit tunnels. This was the first considerable storage that had occurred in this basin. The water was backed up over the lower end of the old Springfield Pike for the first time. The new location of the Springfield Pike

can be seen just below the edge of the railroad cut. It crosses the cut on the arch bridge seen at the extreme right of the picture. The railroad tracks in the right foreground are those of the Erie and Big Four. The Ohio Electric tracks are between the cut and the Springfield Pike.

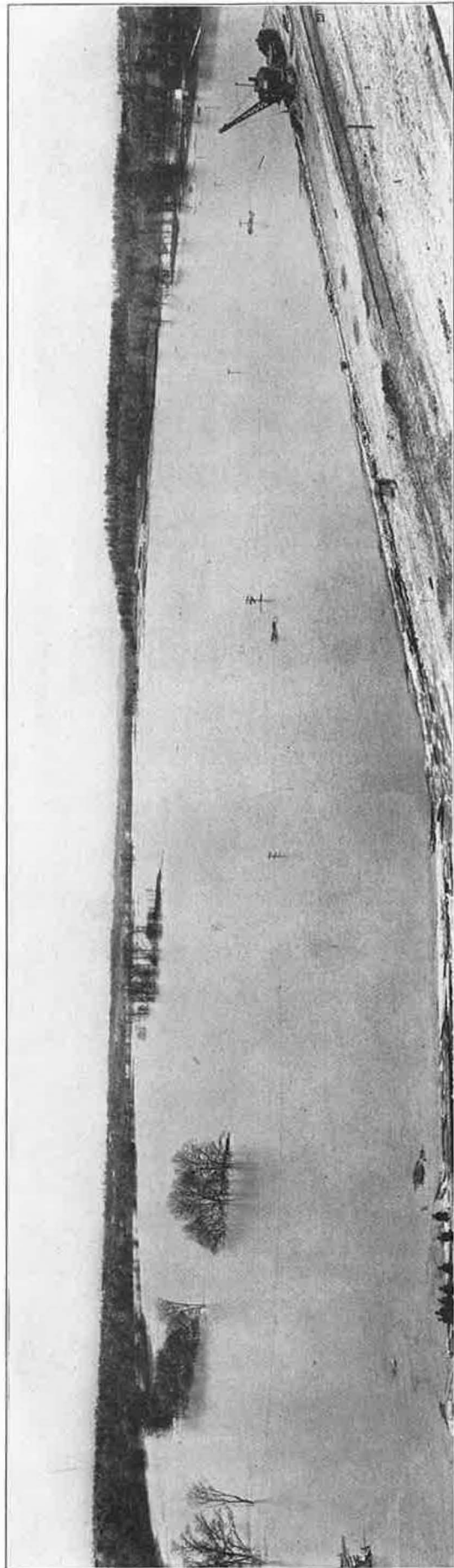


FIG. 378—VIEW LOOKING UPSTREAM FROM THE SIDE OF THE ENGLEWOOD DAM, APRIL 15, 1922

This shows conditions similar to those shown in the cover picture. The water is about 36 feet deep over the floor of the conduits. Nearly a foot more of storage was secured before the crest was reached. The whirlpool in the lower left hand corner marks the entrance to the conduits.

THE MIAMI CONSERVANCY BULLETIN

DECEMBER, 1922



FIG. 379—VIEW OF THE IMPROVED RIVER CHANNEL IN DAYTON. LOOKING UPSTREAM FROM
NEAR MILLER'S FORD, NOVEMBER 23, 1922.

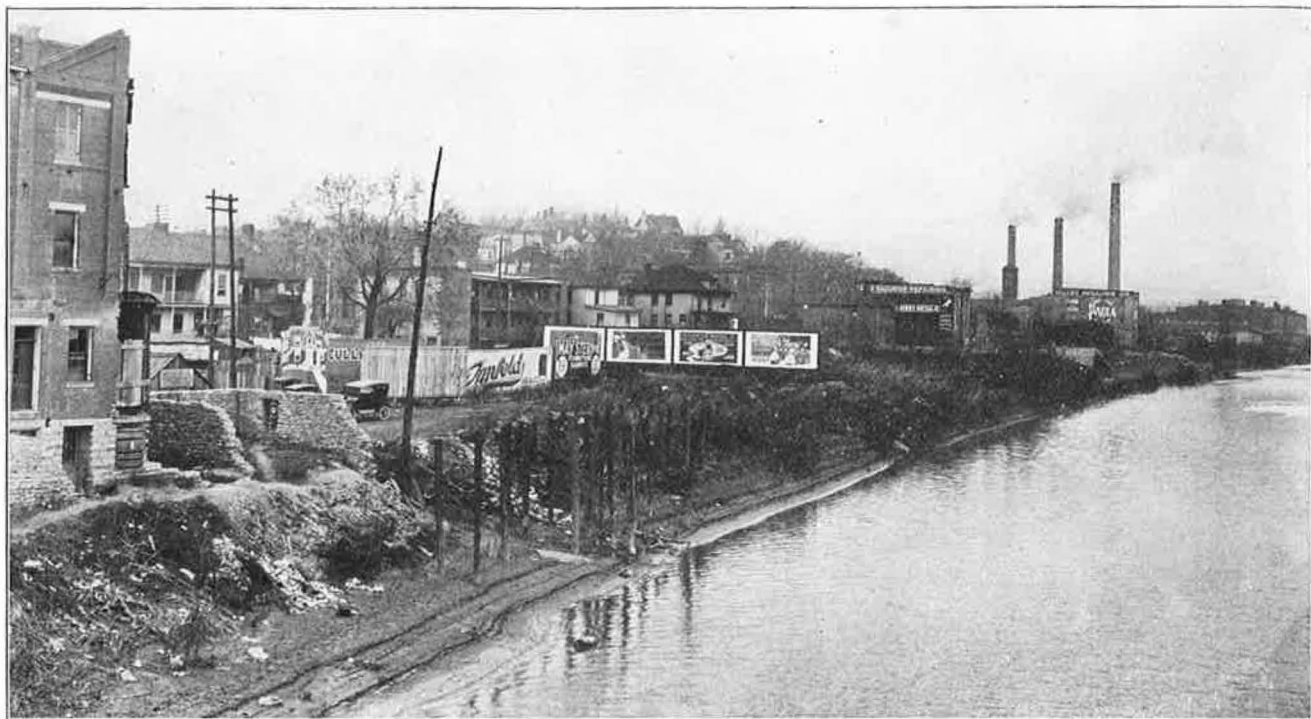


FIG. 380—THE WEST BANK OF THE MIAMI AT HAMILTON, LOOKING UPSTREAM FROM THE MAIN-HIGH BRIDGE, MARCH 1, 1918.

The three-story building and the old stone foundation shown in the left of the picture were in the way of the proposed levee, and obstructed the waterway of the Main-High bridge. The river bank above the foundation contained piling, old foundations, trash, projecting sewers, and was covered with a heavy growth of willows. The portion of the city to the west was subject to overflow from high river stages as there was no levee at this point. The river bank was unsightly, and was insanitary as well.

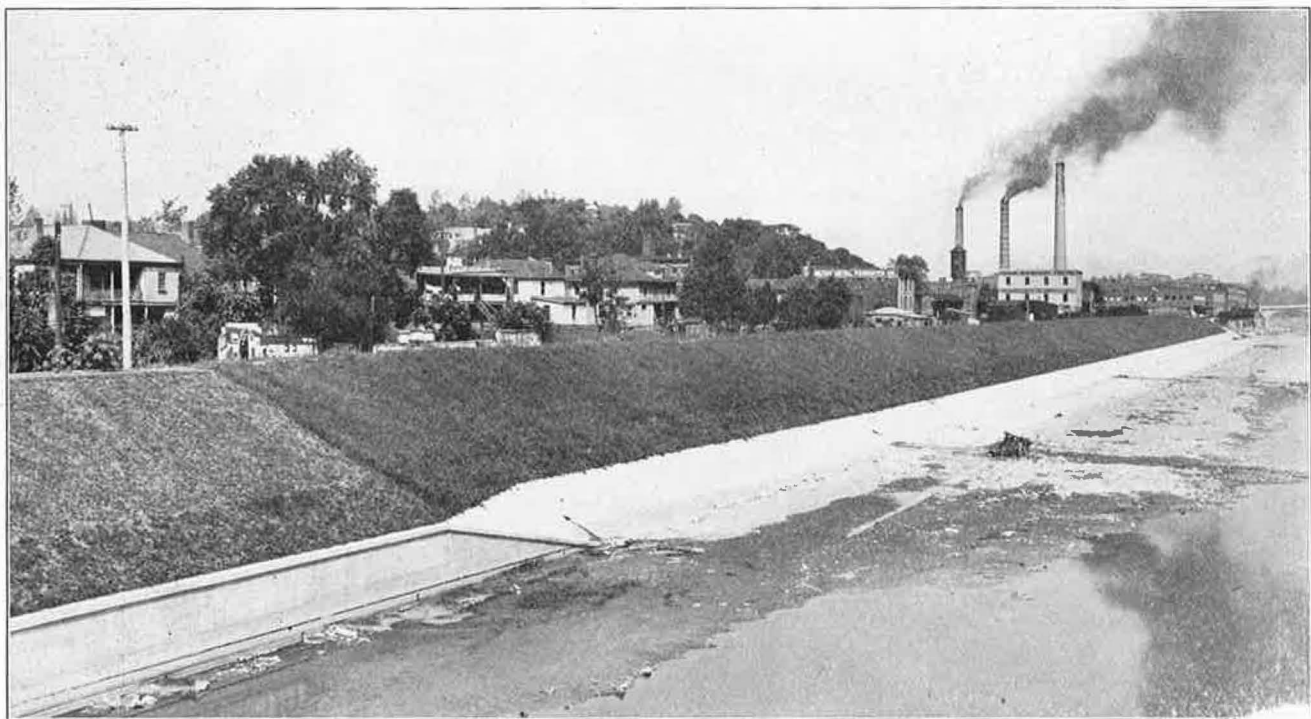


FIG. 381—THE WEST BANK OF THE MIAMI AT HAMILTON, LOOKING UPSTREAM FROM THE MAIN-HIGH BRIDGE, TAKEN SEPTEMBER 23, 1922.

This view shows the same territory as Fig. 380. The three-story building and the old foundation have been removed and the river widened somewhat. The river channel has also been deepened and cleared of bars along the shore. The piling, old foundations, trash and other obstructions have been taken out. A substantial earthen levee has been built to protect the west side of Hamilton. The wide white band along the base of the levee is the concrete revetment. At the foot of the revetment is a flexible mat made up of concrete blocks, woven together by galvanized cables. The portion of the levee above the revetment has been sown to grass, and good growth has resulted. The wall shown in the lower left hand corner is the beginning of the transition from the river section to the bridge opening. The clean banks and grassy slopes of the new levees have been a great civic improvement for Hamilton.

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THE MIAMI CONSERVANCY BULLETIN

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The Bulletin is 5 cents per copy. Business letters should be sent to the Office Engineer, The Miami Conservancy District, Dayton, Ohio.

The Finishing Touches.

The five dams of the flood prevention works were virtually completed last winter, and the condition of the work in the cities was such that the valley was safe against a repetition of the 1913 flood. Another season's work was necessary before the cities were fully prepared for the forty percent greater flood than 1913, for which the works were designed. Today the system, save for a few finishing touches, is completed. The finishing touches take time, but by spring they, too, will be finished, and the Miami Conservancy will be on a maintenance basis.

Salvage and Sales.

Since the last Bulletin was published, nearly all of the units of the Conservancy work still under way at that time have been completed, and the equipment and left-over materials and supplies have become available for sale. The Conservancy shops have been busy overhauling the equipment and putting it in condition to be placed on the market. Excellent progress has been made in the actual selling. Total sales passed the \$800,000 mark early in December. This progress has been made in the face of the usual fall in activity in the construction field.

The Conservancy District purchased good machinery. The size of the job made it economical to maintain a first class repair shop manned by a crew of expert repairmen. The equipment received a repair and overhauling service that was unusually thorough. Parts that failed under the stress of service were reinforced when replaced. As a result the

equipment offered for sale is sturdy, is in excellent operating condition, and is none the worse for the hard service given it while building the Flood Prevention Works.

For the same reason that the District could maintain repair shops, it was able to secure the services of competent men to plan equipment layouts. The District is giving to prospective buyers an advisory service in planning their plants. Customers are being encouraged to avail themselves of this service, and to look over the District's stock before reaching a final decision on what they wish to buy.

A Maintenance Engineer Appointed

Mr. C. H. Eiffert was appointed Maintenance Engineer of The Miami Conservancy District on December 1, 1922. He has been with the District for seven years. For the past five years he has been Division Engineer in charge of the river improvement work at Hamilton. Before that he was engaged on the preparation of plans and specifications for various features of the project. He is a graduate of Cornell College, Iowa, and a member of the American Society of Civil Engineers.

The creation of the office of Maintenance Engineer marks a definite step in the change of the Conservancy organization from a construction to a maintenance basis. The flood control works are now practically completed, and have been ready to handle floods for the last year or more. The upkeep and maintenance of the various features of the project are of principal importance from now on, and the Maintenance Engineer will be directly responsible to the Chief Engineer's office for that feature of the District's operations.

Local Improvement in Dayton Finished.

Everything Ready to Handle Safely a Forty Percent Greater Flood Than That of 1913.

On September 21st, the two big draglines, one working downstream, the other working upstream, met on the left bank of the Miami between Stewart Street and Miller's Ford, and completed the excavation on the Dayton Division. While the usual cleaning up operations remain to be done, the flood protection works themselves are completed.

In future years, when the heavy spring rains come, and the streams of the valley give their annual performance, the Miami through Dayton will not act as it has in the past. Instead of the angry, tumbling waters that have been so characteristic of high waters in the old days, the river will move swiftly and smoothly on its way. Only during extremely large floods will the water approach the tops of the levees. The high stages will last longer than before, as the waters held back by the dams will flow off gradually after the rains cease. As the water in the river rises, gates in the sewers and other openings will be closed, so that water will not back through the openings to flood the lower parts of town. Surface water that collects in low places back of the levees will be pumped off by means of electrically driven pumps kept ready at all times for this emergency. Dayton is ready for any flood that may come along.

The more spectacular features connected with the construction of the dams have caused many persons to overlook, to some extent, the importance of the river improvement works in the cities. The works of the District are like a chain, and are dependent upon each other for strength and safety. The dams hold back the water that cannot be taken care of by the river channels through the cities. To a certain extent, channel improvement in all of the towns was feasible and economical. Much capacity could be

gained by removing bars and islands and by deepening, widening or straightening the channel. At Dayton, however, the numerous concrete bridges, and the valuable property adjacent to the river, placed a very definite limit to channel enlargement.

The problem of keeping the river channels free from bars is an important one. The sands and gravels composing the bed of the Miami are constantly shifting. Even moderate high waters carry with them a surprising amount of material. The cause of bars forming is a decrease in the velocity of the stream. A wide place, a log, a change from a steep slope to a less steep slope, growth of willows, will any of them cause a check in the velocity of the water and cause the water to drop its burden of gravel to form a bar. Once started, the bar aggravates conditions, and increases the volume of the deposits.

Therefore, the purpose of the channel improvement in Dayton has been to produce as large a channel as could be made within the limits imposed, uniform in size, and on uniform grades. It was necessary to actually narrow up the old channel in certain places to prevent decrease in velocity, and at others to remove houses and the old levees in order to make room for the enlarged channel. As the improvements in most cases will result in increased velocities of flow, it was necessary to protect the levees in certain places by revetment. All of the many operations in Dayton were incident to the carrying out of this simple plan.

The flood of 1913 produced a maximum flow in the Miami River at the Main Street bridge in Dayton of about 250,000 cubic feet per second—about three and one-half times the capacity of the old



FIG. 382—LOOKING UPSTREAM AT THE JUNCTION OF THE MAD AND MIAMI RIVERS, DAYTON, SEPTEMBER 15, 1922.

The Mad is on the right, the Miami on the left. The bridge in the background is the one at Webster Street. The white streaks on the levees are revetments protecting the base of the levees against scour. Eventually the reclaimed land between the two rivers, and the open space in the right of the picture, will become city parks.

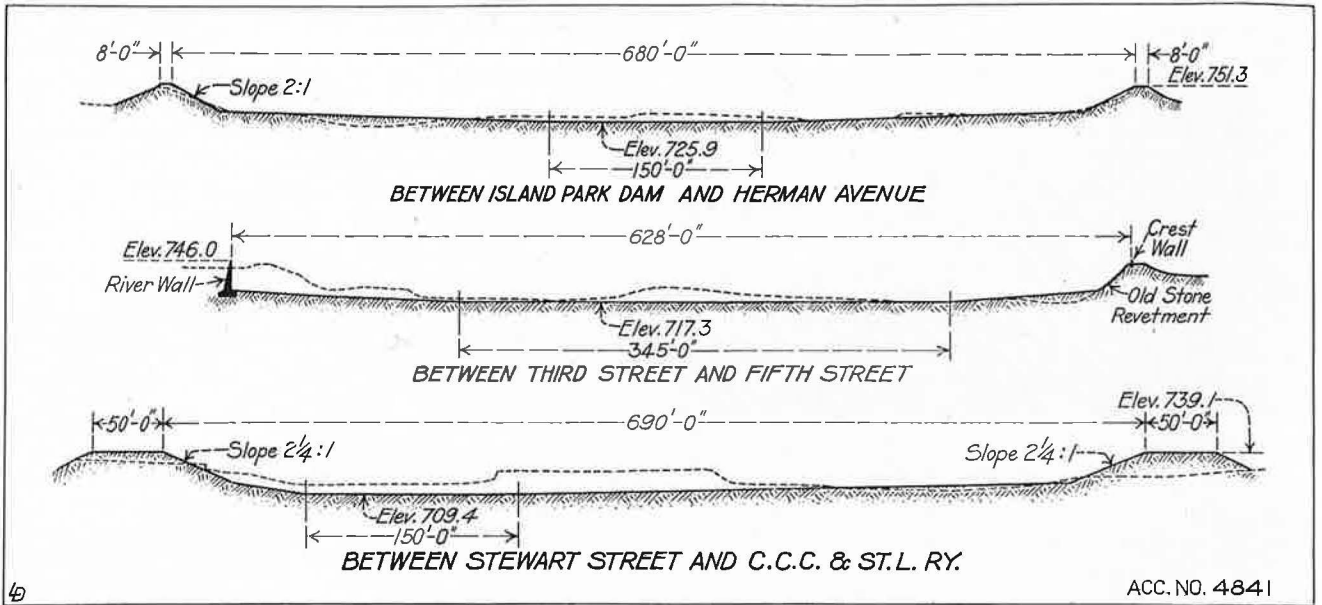


FIG. 383—THREE CROSS-SECTIONS OF THE RIVER CHANNEL THROUGH DAYTON. The solid lines represent the improved waterway. The dotted lines show conditions as they were before the Conservancy work started.

channel. The new channel is designed, in conjunction with the retarding basins, to take care of a forty percent larger flood than that of 1913. If a flood that size should occur, the basins will let only enough water pass to produce a flow of 75,000 second feet in the Miami above Mad River, 110,000 second feet at Main Street, and 120,000 second feet below the mouth of Wolf Creek, and the water will only reach the freeboard line, three feet below the tops of the levees. A flood a great deal larger than forty percent greater than 1913 would have to occur before the levees would be overtopped. Figure 383 shows the dimensions of the channel at various points.

The old river channel of the Miami was very crooked in the first place, and in comparatively recent times occupied land now occupied by the buildings of Dayton. Past attempts at control have confined the river within definite limits, but the river bed still is very winding through the city. The new alignment follows the old channel very nearly, takes advantage of the old improvements, and is composed of long, easy, smooth curves, and some short straight stretches. The levees are parallel to each other, very nearly. At constricted places, where the value of the property adjacent to the river was very high, and at the bridges, where a change in the shape of the river channel was necessary, concrete walls were used instead of levees. The distance in elevation between the bottom of the new river bed and the tops of the levees is about twenty-eight feet. The bridge openings, with their piers and arches, offer some obstruction to the flow of the stream, and some head or elevation is necessary to overcome the resistance. Thus at high stages, the water on the upper side of the bridges will be a foot or so higher than on the lower side. In building the levees, advantage was taken of this and the tops of the levees below the bridges are a foot or so lower than the levees above. When the river is running full, water crowds to the outside of the curves, so

the levees on the outside of the curves are made a little bit higher than those on the inside. The low water channel is on the outside of the curves, also. The natural tendency of a stream is to crowd outward on the curves, and the artificial bed will be more stable if the deepest part is placed where nature would place it.

During low water the stream will occupy the low water channel. A moderate stage of water will put the river over the gently sloping beaches and against the levees. At flood stages the waters will try to eat into the banks of the levees on the outside of the curves. To give the water something too hard to cut, the outside of all curves has been protected by concrete revetment. At the most exposed places the lower portion of the steep levee slope is covered by a solid reinforced concrete slab similar to a side-

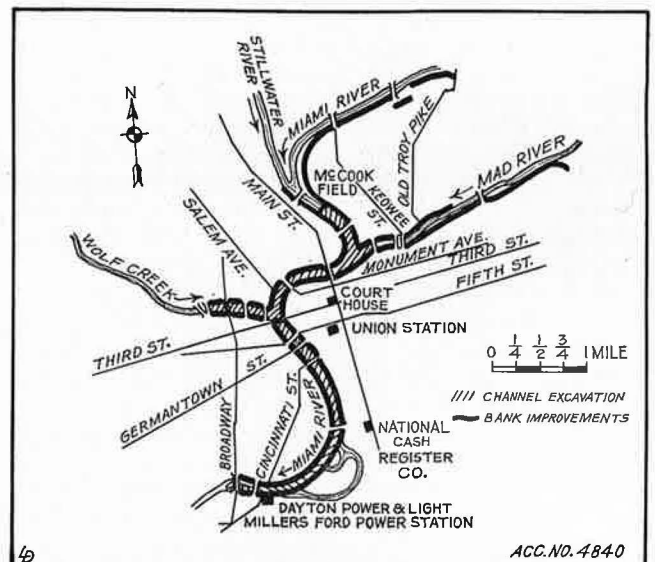


FIG. 384—SKETCH SHOWING THE COURSES OF THE MIAMI, MAD AND STILLWATER RIVERS AND WOLF CREEK THROUGH DAYTON.



FIG. 385—BEFORE AND AFTER PICTURES OF THE LEFT BANK OF THE MIAMI RIVER BELOW THIRD STREET, DAYTON.

The views were taken looking downstream from the Third Street Bridge. The projecting point, covered with a tangled mass of vegetation, shown in the upper picture, is typical of a number of similar obstructions to the river flow that existed before the Conservancy work was started. The lower view shows the completed improvement. The high value of the real estate involved made it cheaper to build a wall than to buy enough right-of-way for a levee.

walk tilted up on edge. This does not reach to the top of the levee, as floods so large that the water would come above the top of the revetment will be so infrequent that a good sod is sufficient to protect the upper part of the levee. The beach at the toe of the levee is protected by a flexible concrete mat made up of concrete blocks, twelve inches wide, twenty-four inches long, and five inches thick, each one pierced by two holes and strung together on galvanized wire cable. This phase of the work was described in detail in the November, 1920, Bulletin.

The work in Dayton naturally divided itself into three parts, each quite different in character, and requiring different equipment. The first of these in importance was the channel excavation and levee building. The excavating machine used was the dragline. The greater part of the work was done with the two largest draglines on the District's work, the class 175 Bucyrus. So well are they proportioned that only by getting them beside some familiar object can their size be appreciated. The machines weigh 225 tons, the booms are 125 and 135 feet long, the buckets hold three and one-half to four and one-half cubic yards, and the reach in a 180-degree turn is 250 to 270 feet. The motive power is electricity. The two big machines were reinforced

by two smaller ones, a class 91½ Bucyrus steam machine and a class K Lidgerwood electric. These machines did the odd jobs that the big machines did not have time for, or were too large to do. The Lidgerwood also did all of the work below the Miller's Ford transmission lines and finished nearly two thousand feet of levee above that point.

From the Island Park Dam to the mouth of Wolf Creek only a small amount of the material that was removed from the channel was needed to enlarge the levees. So valuable was the property adjacent to the work that at only a few points could sufficient waste land be secured on which to dump the surplus material. This made it necessary to transport the material from the excavating machines to the dumping grounds. On this particular stretch of river it was considered cheaper to use floating equipment, and to provide slack water, a temporary dam was built across the Miami at Wolf Creek, giving a ten-foot depth of water in the improved river above. One of the big dragline machines was mounted on a scow. The excavated material was loaded onto other scows by this machine, and the loaded scows were pushed by the steamer, "Dorothy Jean," to the spoil banks where they were unloaded by another machine. This operation was a familiar one to all Daytonians, and was fully described in the May, 1919, Bulletin and pictorially shown in various other Bulletins. An area on the west bank of the Miami just below the Herman Avenue bridge and a triangular area at the junction of the Mad and the Miami, and an area at the mouth of Wolf Creek, were reclaimed with the excavated material, and in time will become city parks.

The levees were built up in various ways. A great deal of care was taken to preserve the old trees growing on the levees. The trees were so large and dense in some cases that the draglines could not swing their booms over the levees, and teams or cars had to be used to bring in the earth. The levees were dressed with good soil, planted to grass, and carefully tended so that a good growth of sod has been produced. This growth will keep the rains from washing gullies into the fills.

The temporary dam at the mouth of Wolf Creek performed the duty expected of it very well. Considerable thought was given to the problem of removing it, but the Miami saved all that trouble when one stormy night the river washed the dam away, just a short time after the work above it had been finished.

From Wolf Creek to Fifth Street scowing was continued by excavating a channel sufficiently deep for floating scows. From Fifth Street to a point about 700 feet below Washington Street, nearly all of the surplus channel excavation had to be hauled out to low areas on the right bank near Stewart Street. Standard gauge locomotives hauling air dump cars were used, as it was not practicable to use the floating equipment on this stretch of river.

From below Stewart Street to the railroad bridge just below Cincinnati Street, the improved channel runs for some 8000 feet through the lowland ordinarily subject to overflow from every rise in the river, and consequently not occupied by many buildings. More than 1,000,000 cubic yards of material

were taken out of this section of the work. The general plan that was followed was to start the dragline down the center of the river, excavate the material, and deposit it in a windrow as far over towards the river bank as the machine would reach. Then the same machine, or one following right behind it, would pick up the material again, swing around in a half circle, and deposit it again in another windrow still closer to the bank. It was cheaper to make three throws with the machine than to load and transport the earth, although it was usually necessary to make only one or two throws to get the material into final position. The first earth formed the levee, and the surplus was put back of the levee, so that in some places the width of the

had to be lowered to get them below the new river bed and one entirely new main was laid. This lowering proved to be an annoying job, but an interesting one. The Bulletin has described some of the operations in the December, 1918, issue. Subsequent lowerings were carried out in much the same way. Each one was an adventure in a way, for the river had a perverse habit of coming up at critical moments, and threatening to wash out the work.

The various walls and revetments comprise the group of jobs next in importance to the excavation in the channel. Forty-one walls, ranging in size from the South Robert Boulevard river wall, 1036 feet long and 25 feet high, including the foundation, to the little one at the central fire station, but 44 feet long and five feet high, were built. Figure 386 is a good illustration of these. The Bulletin has said a good deal about this phase of the work in the November, 1920, March, 1920, and March, 1921, numbers, and a detailed account of the work is not necessary here. As far as possible old walls were worked into the new scheme, by extending and raising them. The proximity of buildings in some cases proved to be a complication that required the most careful work to prevent damage to the abutting property. By the use of sliding forms, and by careful planning of plant, the work which ordinarily would prove to be exasperatingly slow and expensive, was so standardized that it moved forward rapidly and economically.

The novel features of the revetment attracted so much attention that articles about it appeared in the November, June, and January, 1920, and the August, 1919, Bulletins. Little can be added save that 7765 cubic yards of the slab, and 2954 cubic yards of the flexible revetment were placed in Dayton.

The odd job group is the third section of the work. Each item deserves a story in itself. When the existing state of affairs was disturbed in Dayton, all kinds of things bobbed up. Sewer outlets had to be lengthened. Flood gates had to be installed on pipe lines through the levees. The new levee changed drainage conditions in some localities, and the rain washed gravel into Mrs. Murphy's cellar, and that also had to be taken care of. Street grades had to be rectified, and sewer manholes changed. Some of these items could be definitely anticipated, others could not be except in a general way. Taken altogether, the odd jobs form a work of no mean size and importance.

Construction machinery makes considerable noise, especially during hot, still summer nights, when sleep comes slowly. Some families had concrete plants at their back doors for a time. Mufflers were used, and other devices employed to reduce annoyance from this source, but the work was a nuisance to many people especially during the night shift. The patience of the citizens who were within hearing distance of the river was remarkable. Every one seemed to realize the necessity of the work, and nearly every one helped by not complaining. Noise now is a thing of the past, and when spring comes the grass will cover the new levees, and cover the scars made by the work. Dayton is secure against the flood danger.

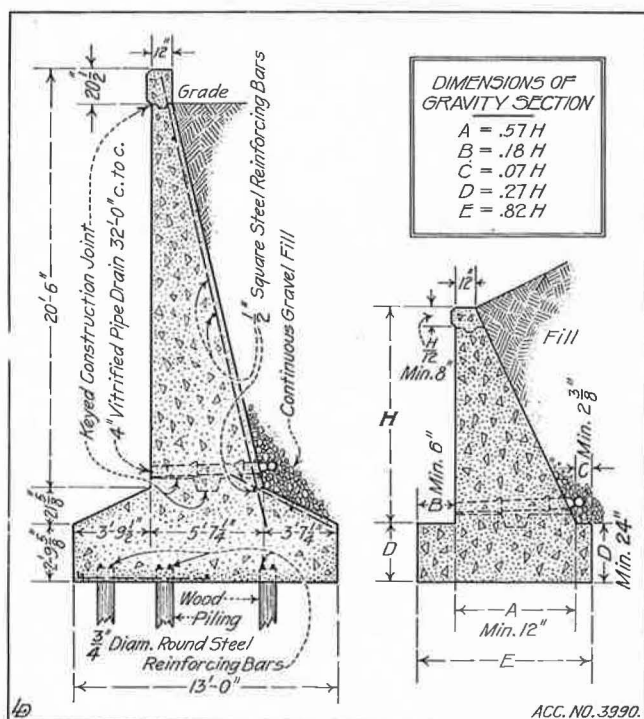


FIG. 386—CROSS-SECTIONS OF TYPICAL RETAINING WALLS BUILT IN DAYTON.

fill is wider than at others. At some time in the future a boulevard will run down on one or both sides of the river, and this territory, once an eyesore to the town, will be transformed into a far different sort of a district than it is now.

In cleaning out the river, more than 2,000,000 cubic yards were excavated, and either placed in the levees, dropped into deep holes in the river or placed in the spoilbanks. Of the 2,000,000 cubic yards, 723,000 cubic yards were used to enlarge the levees and in addition 129,000 cubic yards were taken from borrow pits for the same purpose. To accomplish all this work, the draglines traveled up and down and across the river, a total distance of over thirty-three miles. Some special work at cleaning out under the bridges was necessary. On Wolf Creek it was possible to build much of the levee with the small dragline. At other points sections of levee were built with teams.

The Miami River is crossed by a number of water and gas mains and sewers. In thirteen cases these

Adams Street Bridge at Troy Completed

The Success of the Novel Undertaking Can Now Be Recorded.

The unusual feature of constructing a new concrete bridge on top of a similar structure already in place, using the old bridge to support the forms for the new, was present in the reconstruction of the Adams Street Bridge at Troy. The work has just been completed, and the success of the novel undertaking can now be recorded.

The Official Plan of the District originally provided at Troy for a deep water channel for the Miami River, following the old river closely, and using the bridges as they then stood. Very large floods were to have been taken care of by making the levee on the north side of the river low enough so that a large flood would overtop the banks, and flow over the low ground to the north.

composed of twelve-foot piling, but some of the piling proved to be only three feet long. The waterway under the bridge was wholly inadequate for the new plan.

The first idea would be to wreck such a bridge and build another. To remove a concrete bridge, especially the piers, is a big job and an expensive one. The District calculated that it would be cheaper to reinforce the old piers and use them to carry the new bridge and to use the old arches to carry the falsework for the new, and to add extra arches at one end, than to build an entirely new bridge. The obvious expedient of building a new bridge on a different site and digging a hole and blowing the old bridge into it, was barred because it was neces-

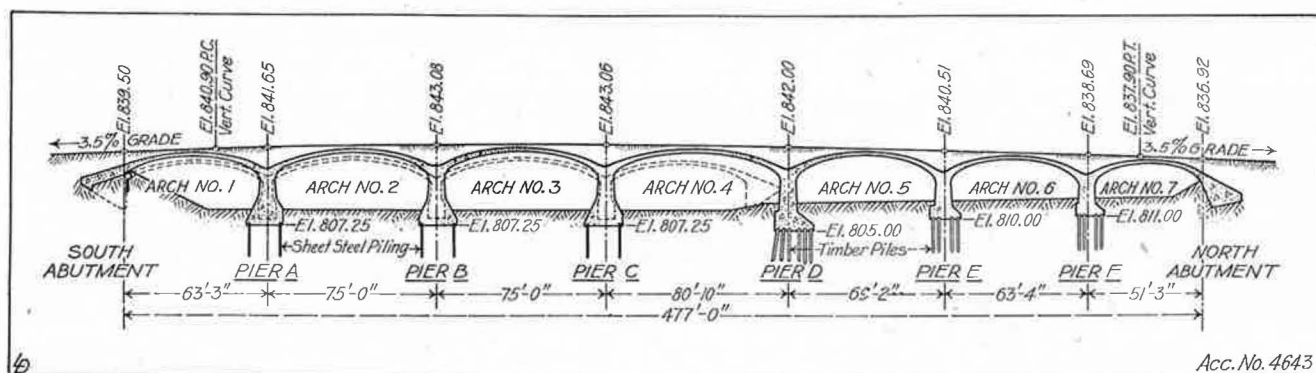


FIG. 387—ELEVATION OF THE RECONSTRUCTED ADAMS STREET BRIDGE, TROY.

The position of the old arches and the outline of the piers before they were enlarged, is shown by the dotted lines. The reconstructed bridge is shown by the solid lines. The enlargement of the old piers, and the protective sheet piling around them, should be especially noted.

But as the time to build the works drew near, the Miami County people decided that a much more desirable plan for the future beautification of Troy would be to confine the flood channel within definite limits, lengthen the bridges to accommodate the enlarged river, and fill in and beautify the remainder of the overflow area. Leaving out the reconstruction of the two river bridges, the cost of the new plan did not greatly exceed the Official Plan. Miami County agreed to pay for lengthening the two bridges if the new plan was adopted. When the change was approved by the Conservancy Court, the County entered into an agreement for the District to do the bridge reconstruction work for the County.

The Market Street Bridge had two steel trusses and by adding another span, sufficient waterway was secured. This work was mentioned in the May, 1921, issue of the Bulletin.

The Adams Street Bridge reconstruction was more of a problem. The old bridge was built in 1913, and consisted of four reinforced concrete arches. See Figure 387. The outward appearance of the structure was good, but the pier footings were inadequate and some of the concrete was in bad condition. The footings were so narrow that they could not take care of the unbalanced forces from the new arches with a sufficient margin for safety. They were also set practically on top of the river bed, and were placed on a foundation supposed to be

sary to use the old site. The cost of securing the necessary property for the approaches to a new site was prohibitive.

Some very definite advantages were to be had by following this rather novel plan of utilizing the old bridge. The danger of floods washing out the timber falsework was done away with, as a clear waterway always remained under the bridge. Less timber was necessary in building the forms. No additional right-of-way was necessary. Considerable saving in

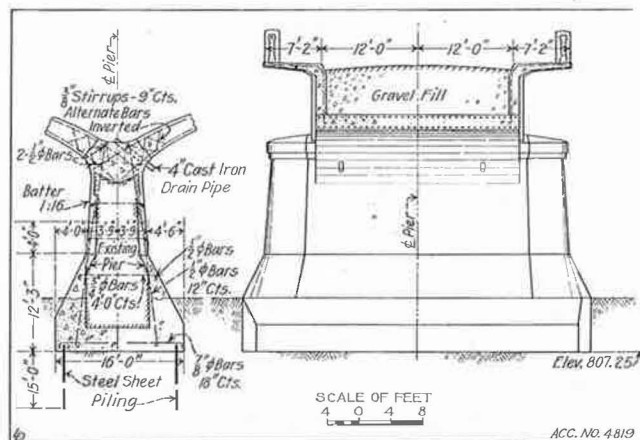


FIG. 388—SKETCH ILLUSTRATING THE ENLARGEMENT OF THE BRIDGE PIERS ON THE ADAMS STREET BRIDGE, TROY.

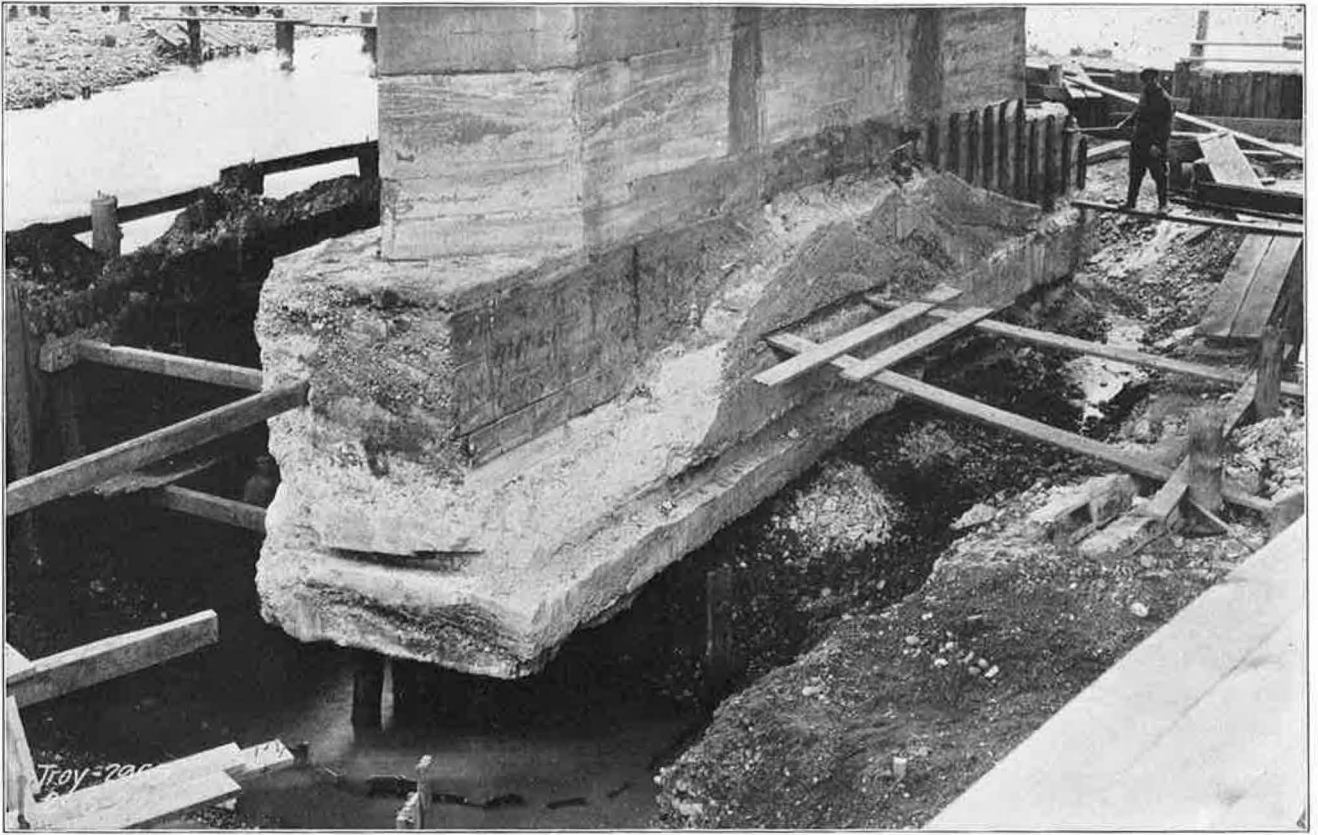


FIG. 389—A PIER OF THE ADAMS STREET BRIDGE READY FOR UNDERPINNING, FEBRUARY 6, 1922.

A coffer dam had been built, the gravel removed from around the pier, and the excavation made underneath the first third of the footing. The wooden piling underneath the old footing should be noted. The top of the line of protective sheet steel piling can be seen sticking out of the water in the bottom of the pit. Concrete was packed underneath the old footing, and the entire pier was encased in a jacket of concrete.

the volume of concrete was secured. The disadvantages were principally in the trouble of reinforcing and underpinning the old piers, and in the adventuring into the unknown which this novel plan necessitated. Without precedent to go by, the greatest of care and thought was necessary to insure the success of each step in the work.

The design of the new bridge was simple. The irregular length of the spans of the old bridge governed the length of the three comparatively short spans that were added at the north end, as the principle was adhered to of having the center span the longest, and having the spans decrease somewhat uniformly towards the ends. The deep water channel through the Troy follows the old river channel and runs under the old bridge. The entire bridge is designed to carry a concentrated live load of one twenty-ton truck, with fourteen tons on the rear wheels and six tons on the front wheels. The sidewalks are designed to carry a live load of 100 pounds per square foot. The materials will receive a maximum stress under total dead and live loads of 500 pounds per square inch for the concrete, and 14,000 pounds per square inch for the steel. These stresses are about one-quarter of stresses that would break the materials. A variation of eighty degrees in temperature was considered a maximum. With the maximum temperature stress added to the maximum loading, the concrete would be stressed to 735 pounds per square inch, and the steel to 16,000 pounds per square inch, which are well within the limits of safety.

The deep water channel was under the old bridge, and therefore the building of the extension on the north end of the old bridge was carried on in the dry. Concrete sills were used to carry the posts for the falsework. The superstructure and forms commonly used for the piers, arches, and abutment of concrete bridges, were used for these three arches. No unexpected contingencies came up and no unusual construction methods were employed.

The spandrel walls, sidewalks, fill and paving were a considerable part of the dead load on the old bridge. They were removed before much work was done, in order that as little load as possible would be on the piers while they were being enlarged. It was necessary to remove these carefully and to unload all arches simultaneously and uniformly. Otherwise, unbalanced forces might have pushed over one of the piers. Most of the work was done by hand. Small shots of dynamite were used in breaking up the concrete wherever possible in order to lighten the hand work.

The first job in reconstructing the old bridge, was to enlarge and deepen the footings. The rebuilt footings are almost twice as wide as the old ones, and extend about three feet deeper into the river bed. A coffer dam of earth was thrown up around the pier, the water was pumped out, and the material around the footing excavated by hand. Taking one-third of the length of the old footing at one time, the excavation was carried three feet below the bottom of the old footing, and then underneath. It was then that the condition of some of the old wooden

piles was disclosed. Sheet steel piling fifteen feet long was driven one foot inside of the line of the new footing and projecting up one foot into the footing. Concrete was packed into the space underneath the old footing, and around the old piles out past the line of the sheet piling. When the concrete was set, the next third was dug out, and the operation repeated. Figure 389 illustrates the procedure.

When the underpinning was all completed, holes were drilled through the old piers and the tie-rods placed through them. Then a jacket of concrete was placed entirely around the old piers, the network of steel in the jacket being held in place by the tie-rods.

The reconstruction work on the piers and the south abutment did not turn out to be as difficult as was anticipated, although high water stopped the work a number of times. The difficulty of driving sheet piling in the restricted space under the bridge was overcome by the use of a small, compact steam hammer.

The north abutment had to be replaced by a new pier immediately north of it. See Figure 390. As the excavation for the new pier removed the bearing from behind the old abutment, some means of supplying a temporary support until the old bridge was taken down, was necessary. Figure 390 shows how this was accomplished. The heavy timbers, wedged against concrete footings, were placed in line with the direction of the force against the abutment and braced to prevent buckling. Then the excavating was done, and when the pier was poured, the concrete was boxed around the timbers. The holes so left were filled in after the completion of the bridge permitted the removal of the brace for the old abutment.

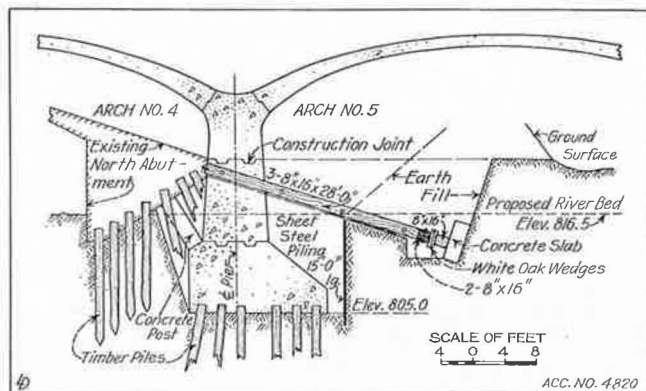


FIG. 390—SKETCH SHOWING CONSTRUCTION OF NEW PIER BEHIND THE OLD ABUTMENT OF THE ADAMS STREET BRIDGE.

When all of the upper part of the old bridge save the arches was removed and the piers had been reconstructed, the forms for the new arches were built on top of the old bridge. The only difference from the forms ordinarily used on such work was in the posts. Instead of the long bents resting on piles or sills in the river bed, the posts were short, and rested on top of the old concrete arches, leaving an unobstructed waterway.

As the posts carrying the arch forms for the new spans on the north end rested on the ground, these arches could be poured in the usual way. But on the part of the new bridge that rested on the old, a



FIG. 391—ADAMS STREET BRIDGE, AUGUST 21, '22.

Both the old and the new arches are in position. The forms were being removed from the new arch when this picture was taken.

different method was necessary. To have poured each new arch complete would have caused an unbalanced loading on the piers that could have been dangerous. So each arch was poured in three longitudinal sections, one section being poured on all of the arches, and then another, and finally the third. By proceeding in this manner, the unbalanced thrust on the piers did not exceed a safe figure.

When the new arch rings had set, the most ticklish part of the job, the removal of the old arches, remained to be done. Underneath the bridge a trench was dug, deep enough so that the old concrete falling into it would all be below the grade of the improved channel. Then one-inch holes were drilled through the old arches seven feet apart longitudinally and three feet apart laterally, and corresponding holes were cast into the new arches above. The holes were placed so that they would be ready for a certain contingency. Due to the same difficulty about having too large an unbalanced thrust on the piers, the old arches had to either all come down at once, or else be removed uniformly. To have one old arch all removed with the others still standing might spell disaster. The practical difficulty of so managing affairs that all of the arches would let go and fall at the same moment was so great that this method was not seriously considered. So the piecemeal method was the one decided upon. The holes mentioned above were so arranged that bolts could be run through them, taken up a bit, and the lower arches suspended from the upper ones, in case that during the operations hereafter described, the old arches showed any sign of failure. If this had happened, the suspended weight would have been very nearly equal on each side of each pier. The wrecking of the old arches was much easier than had been expected. Scaffolding was suspended from the upper arches by means of rods run through the holes mentioned above, and workmen using sledges, small charges of dynamite and chisels, began taking out little bites from all of the arches, working at about the same rate on all of them.

The net-work of reinforcing steel held the old concrete together very well, and the steady nibbling reduced each arch to a very narrow rib, without any necessity arising of suspending any of the old struc-

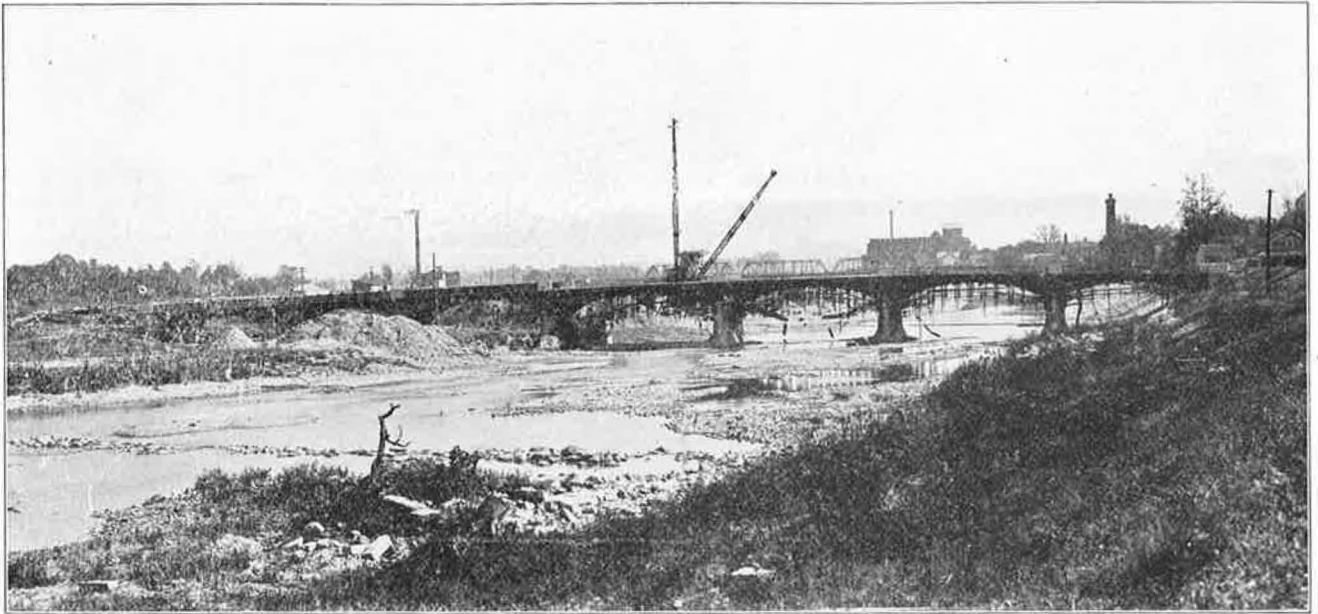


FIG. 392—ADAMS STREET BRIDGE, OCTOBER 14, 1922.

The old arches have been removed, but some of the old reinforcing steel with chunks of concrete clinging to it can be seen under the 3rd arch from the right. The rods hanging down from the underneath side of the new arches were used to carry the scaffolding that supported the wrecking crews. If the necessity had occurred the old arches would have been carried by these same rods during the wrecking process.

ture from the new. These last narrow ribs were cut and dropped without incident.

As soon as the success of the wrecking operations was assured, the new spandrel walls and sidewalks were started. The spandrel walls are built without brackets or batter. The sidewalks are cantilevered out without brackets. No unusual features were developed on either of these two items.

The construction plant was not elaborate. A derrick dug the gravel needed in addition to that already piled up on the site by the dragline. A portable gravel-washing and screening plant prepared the material for use. The aggregates were loaded into the Smith one-yard mixer by gravity, and the concrete was transported to the work in side-dump

concrete cars that ran over a narrow-gauge track, up over the levee, and across the river on top of the forms. It was not necessary to hoist any of the concrete into position. A gasoline locomotive did the hauling.

The contractor who had the special work of reinforcing the old piers used a very simple layout. Part of the time he had his mixer on top of the old bridge, and chuted the concrete down. The remainder of the time he brought in the concrete on a light trestle with a deck but a few feet above the water surface.

The job is now completed with the exception of backfilling and cleaning up. Within a few weeks the new bridge will be open to traffic.

Progress on the Work From June 27, 1922, to December 5, 1922

GERMANTOWN

Completed.

ENGLEWOOD

The rip-rap placing, which was in progress at the time of the last progress report, has been completed. The road over the top of the dam has been thrown open to traffic. The construction equipment has all been removed, the railroad track has been torn up and the job cleaned up. Englewood dam is entirely completed.

LOCKINGTON

Completed.

TAYLORSVILLE

Completed.

HUFFMAN

Completed.

DAYTON

The Dayton Channel improvement work has been completed.

The first of the three big machines to finish was the Lidgerwood, Class "K", D-16-8, which did its last work on the left levee, about 1,000 feet upstream from the Miller's Ford power plant, on August 26th. On September 21, the two Bucyrus, Class 175 draglines, D-16-15 and D-16-16 completed their work. They had been working toward each other on top of the left levee and met about 1,500 feet downstream from Stewart Street. After that date D-16-15 worked until October 28, under a special agree-

ment with the National Cash Register Company, leveling down a pile of surplus material on their property.

There still remained some channel work around the bridges, for which a contract had been let. The contract was forfeited and, on August 25, the District took over the work. The last dragline work was done on November 15th.

At the mouth of Wolf Creek a concrete barrier has been constructed, to maintain the required difference in grade between the creek and the Miami River and to check the drifting of gravel into the river.

A third maintenance gravel plant has been installed. It is located on the south bank of Mad River west of Findlay Street.

Total channel excavation, Item 9, amounted to 2,025,000 cu. yds. Levee embankment amounted to 852,500 cu. yds. The total yardage handled in accomplishing this work was approximately 4,500,000 cubic yards. The total amount of concrete placed was 36,000 cu. yds.

C. A. BOCK, Division Engineer.

December 5, 1922.

HAMILTON

The electric dragline, D-16-18, made the outside cut on the east side of the river, between the Black Street bridge and the High-Main Street bridge, during the months of July and August. This machine moved south on the High-Main Street bridge September 1, and removed 146,000 cubic yards accretion between the High-Main Street bridge and

the Columbia bridge that had formed in the previously finished channel. The electric machine then moved under the High-Main Street bridge and started to working northward on the east side taking out the last cut, including the railroad fill, and at present is opposite the south end of the Black-Clawson wall. All of this material is being placed in the north spoilbank.

The Class 14 Bucyrus caterpillar dragline excavated the material from in front of the Champion Coated Paper Company's intake in the early part of July; then moved downstream and began grading the bottom near the west side, above the High-Main Street bridge, passing the material eastward to be loaded on cars by the electric dragline. This machine then moved to the damsite north of Two-Mile Creek, and excavated the bottom for the west half of the dam, and handled both the steel sheetpiling and the wood piling from this portion of the dam. It then moved downstream, passing under the Black Street bridge, and excavated a deep-water channel in front of the Champion paper mill. This channel has a bottom width of 40 feet, with 4 to 1 side slopes, and a depth of about seven feet below the bottom of the improved main channel. This machine then moved above the Black Street bridge and excavated in the middle of the river, passing the material eastward, nearer to the railroad track; after this it moved to the east end of the dam for a day or so, and then moved to the west end of the dam, where it is preparing the slope below the dam.

The Class 14 Bucyrus dragline, mounted on rollers, excavated for the footings, built the cofferdam, and drove the piling for the east half of the dam. It then moved down to the north end of the Black-Clawson wall and made the cut next to the bank up to Old River, grading the slope and bottom for revetment, and loading the waste material on cars. This machine then moved to the east end of the dam and graded the slope and bottom for revetment between the end of the east abutment and Old River. It is now excavating below the dam, near the east bank, piling up the material to be loaded on cars and hauled out later.

The Model 21 Marion dragline completed the levee east of the Ford plant. It then built the railroad fill in the river from High-Main Street bridge to Columbia bridge. It was then moved above the Black Street bridge where it built the top part of the river slope along the concrete wall on the east bank; then following the storm of Sept. 3, it was again moved below High-Main Street bridge to rebuild the track that was wrecked by the flood. This machine was then moved to the south spoilbank where it did some grading, and then built the east and west levee across the spoilbank. It is now grading the roadway approaches to the south spoilbank.

Four spur-dikes have been built into the river from the east bank downstream from the Lindenwald power house, as a protection to the caving bank at that point. Further downstream, the vertical earth bank was sluiced down to a 2 to 1 slope, on which a bank protection of brush and stone spalls was placed.

Price Brothers Company have completed the revetment on the west bank, and their work on the east bank is now nearing completion. This work will be completed in December unless cold weather prevents the placing of concrete.

The sidewalks and curbs have been completed on Black Street bridge, and the bridge and approaches have been paved. The east approach was paved with brick by the District, and the bridge proper and west approach were paved with asphalt by the Andrews Asphalt Paving Company. The bridge will be opened to traffic December 11th. The brick paving was grouted November 27th.

The dam, previously referred to, was completed November 3d. It is a concrete overfall dam, 801 feet long, and from seven to nine feet high above its foundation. It raises the ordinary low water level about five feet. The dam rests on a porous foundation. A continuous row of steel sheetpiling was placed at the end of the upstream apron of the dam and a row of 15-foot hardwood piles, on three foot centers was driven near the end of the downstream apron. The dam is located at the upper end of the improvement, and its function is to prevent the accumulation of gravel in the improved channel.

The total amount of channel excavation, Item 9, to November 30th, 1922, was 2,002,985 cubic yards. About 150,000 cubic yards remain to be excavated, of which 125,000 cubic yards will be Item 9.

The concrete walls have all been completed.

The excavation work was delayed about a week by the storm of Sept. 3d, and the construction of the dam was delayed two weeks.

R. B. McWHORTER, Division Engineer.
December 5, 1922.

PIQUA

The Shawnee levee, started with teams, is being completed with a steam dragline and cars. It is now so nearly completed that the finishing touches should be all done by Christmas. The Grant Street levee has been held up by litigation, and still remains to be done.

The last of the walls, the one at Water Street, and the last of the revetment are both so nearly completed that they too will be out of the way by Christmas. Sewer outlet valves are now being placed. Some cleaning up work and some seeding and sodding work on the levees, remains to be done.

ALBERT SCHROEDER, Assistant Engineer.
December 5, 1922.

UPPER RIVER WORK.

Troy—The dragline D-16-21 completed its work about November 15th, and was then taken to Piqua. The remaining channel excavation is now being done by J. Conley's team outfit and a small Eric shovel. Except for the material to be used for backfill on the Adams Street bridge the channel excavation will be completed by December 15th.

The last pouring of concrete for the Adams Street bridge occurred on November 21st, and the water-proofing of the bridge is now well under way, leaving only the backfilling to be done. The sidewalks and curbs on the south approach have been completed and the pavement will soon be laid. The embankment for the north approach is being placed by Conley.

The revetment work has been completed and only 200 ft. of parapet wall remains to be poured. This should be completed in two weeks.

Tippecanoe City—At Tippecanoe, the sewer work has been completed except for one overflow chamber, now under construction, and the pumping station at the south end of the system. Bull Run Ditch is completed and also the Ritter Street culvert as well as revetment work at the sharp curves.

The District forces have completed the walls north and south of Main Street and the paving of Main Street between First Street and the M. & E. Canal where the street had to be raised. The main levee was completed about September 25th, and then Conley placed the embankment for the Power House switch. The ties and rails for the switch are on the ground ready to be laid. At present the District forces are starting a tunnel under the levee for the 14 inch suction main. This tunnel is planned to be about 4 ft. x 6 ft. and 80 ft. long.

Price Brothers were given the contracts for building the substructure at the Water & Electric Light Plant, and the suction and discharge mains. So far about 800 ft. of 12 inch discharge main has been laid on First Street and the concrete in the pump pit has been brought above the ground level, and the foundations for the Power House walls poured.

A. F. GRIFFIN, Division Engineer.
December 5, 1922.

LOWER RIVER WORK

West Carrollton—Completed (except for the placing of several flood gates).

Miamisburg—Since the report dated June 26, 1922, the line of protection around the village has been completed. The Finke Engineering Company completed the levee north of Sycamore Creek by filling the gaps over the tail-race structure of the Ohio Paper Company and the Miamisburg Paper Company. The Price Brothers Company was awarded the contract for, and have just about completed the construction of retaining walls north and south of Sycamore Creek and the widening of Main Street Bridge. Mr. Robert Rowan was awarded the contract and has completed the placing of a fill east of retaining wall between Sycamore Street and Sycamore Creek. The 900 feet of monolithic slope revetment has been completed. The Crumley, Jones & Crumley Company of Cincinnati have been awarded the contract for the construction of the high level storm sewer in Third Street and have a portion of it completed. The District forces have started on the construction of flood gate chambers on sewers crossing under levee, and are making good progress.

Franklin—Since the report dated June 26 the line of protection around the village has been completed, the last stretch of levee east of Front Street at south end, and terminating in high ground, having been placed. All re-ventment work on both sides of river has been completed by Price Brothers Company. The District's forces started and have about completed the construction of flood gate chambers in sewers crossing under levee.

Middletown—The Price Brothers Company have completed the flood gate structure in the Miami and Erie Canal at Tytus Avenue. The clearing of timber in the overflow area of river channel has also been completed. The District's forces have started on the construction of flood gate chambers on sewers crossing under levee.

F. G. BLACKWELL, Division Engineer.
December 12, 1922.

RAILROAD RELOCATION.

Big Four and Erie—Completed
Baltimore and Ohio—Completed.
Ohio Electric—Completed.

RIVER AND WEATHER CONDITIONS.

The most striking feature of the weather conditions since the date of the last Bulletin was the unusual period of dry weather during the late summer and fall. Stages of the river at Dayton were below the zero of the gauge all during the months of September, October and November, the lowest stage being -1.9 feet. Rainfall for October was 1.10 inches and for November 1.79 inches, the total deficiency from normal for the two months being 2.40 inches. On September 3 a very heavy local storm occurred over a portion of the valley just northwest of Hamilton, resulting in a rise of the Miami River at Hamilton of 10.8 feet in a few hours. The maximum recorded rainfall during this storm was 6.3 inches at Oxford.

Temperatures since the last report were mild. Unusually warm weather prevailed during the fall months of October and November, and the lowest temperature recorded to the date of this report was 23 degrees on November 26.

C. S. BENNETT, Field Engineer.
December 12, 1922.

Maintenance Organization.

The completion of the five dams of the Conservancy District, and the near approach of the completion of the river improvements has drawn attention to the problem of maintenance. The important thing now is to keep the system up to one hundred percent efficiency, ready for the supreme test whenever it may come.

To this end maintenance forces are being organized. A maintenance engineer has recently been selected, as note elsewhere in this Bulletin. And caretakers have been appointed to take care of the dams and river improvements. The works have been built for all time, and are as enduring as engineering skill can achieve with reasonable expense. But as time goes on any structure, however massive or secure, will show slight defects or deteriorations, and must be maintained to keep it up to the highest point of efficiency.

Careful, systematic maintenance is not an expensive process. But unsystematic or haphazard maintenance might prove to be literally and figuratively very costly. Deteriorations often start in such a small way that they can hardly be recognized as such in the beginning, and they often grow so gradually that their enlargement is hardly noticeable until a bad condition is created. The rain may wash gullies in the dams and levees. Flood gates or sewer outlets must be kept oiled and clean. The river channels must be watched to prevent the formation of bars and other obstructions. As long as the rivers continue to flow they will persist in carrying gravel and silt, and bars will form in

certain places, in spite of the efforts that have been made to build a channel that will be nearly self maintaining. Careful study must be made of the bar-forming tendencies of the river, in order to devise the best and most economical method of keeping the channel clean. It is quite difficult, however, even under the most rigid inspection, to always detect changes in the channels and levees, unless careful records are kept, and measurements taken. A detailed inspection, done regularly by competent men whether changes are suspected or not, backed up with written records, and adequately supervised by some one competent to interpret what is found, is the first requisite. The second is to correct the defects in a workman-like manner.

Careful organization of the inspection work is therefore very necessary. The personnel must be made up of men who will go over the ground time after time, and who will see every change and every new development. They must have the most careful direction, as adequate planning is necessary in order that every part of the work may be covered.

Organization will be of even more importance during times of high water. Floods large enough to really test the flood prevention works will be relatively infrequent. When they do come they will give little warning. Every man connected with the levee patrol or other maintenance work must know what to do, as little opportunity will be given for instructions when the hour comes. Some men must see that the flood gates on the sewers are closed, others must patrol the levees and dams to observe the action of the water, and to watch for untoward incidents. Hydrographic measurements must be made of the streams, and much other information must be secured. One of the most important things will be the collecting of information on the behavior of the system under stress, as that information will be the basis on which the future maintenance policy will be based. During the construction period a levee patrol has been maintained, using the engineers employed on the construction organization. With the departure of these men, a new organization for that purpose must be developed.

An Additional Volume of the Technical Reports Now Ready.

An additional volume of the technical reports of The Miami Conservancy District is now ready for distribution. It is entitled Part IX, The Accounting and Cost Keeping System of the Department of Engineering and Construction, by F. L. Cavis, Chief Accountant of the District. It consists of 112 pages, 6 x 9 inches, and 31 illustrations, and is bound in paper covers. The price is 75 cents postpaid. The size and unique character of the enterprise, and the fact that it was public work, and carried out by the District's own forces, necessitated the development of an unusually complete accounting system. A construction organization, put together to do a big job, has to have a workable accounting system, ready made for it, and cannot wait on time and growth to rectify mistakes. This report presents an accounting system that has had unworkable features taken out of it under the pressure of actual operations.

The Concrete Overflow Dam at Hamilton

Barrier to Prevent Gravel Drifting Down Into the Improved Channel, Constructed Above Old River.

A concrete overflow dam built across the Miami River at the upper end of the river improvement at Hamilton has been a feature of the construction work this fall. The purpose of the barrier is to prevent gravel from drifting down into the improved channel through the city, there to form bars that would be expensive to remove. As long as rivers continue to flow, they will carry along with them, silt and gravel, especially at times of high water. The heavy gravels and sands, which are most troublesome of all the materials carried along by the water, travel on the bottom of the stream. A depression in the bed, plus a slight check in the velocity of the stream, will cause the materials to drop into the depression and stay there until the pit is filled. This dam will check the velocity of the Miami, and the basin above will form the pit in which the gravel and sand will drop. A sand and gravel plant will excavate the deposited material, screen it, and sell it for building material, and thus put a bad habit of the Miami River to beneficial use.

Reference to Figure 394, which is a cross-section of the highest section, will give the principal dimensions. The dam is built on a pervious foundation. The central part is an ogee weir, and is a gravity section,—that is, it will stand up against the tendency of the water back of it to overturn it, without reinforcing steel. The broad aprons give it added stability, especially against the tendency of the water to push it downstream. The wide base also forces the water percolating through the pervious foundation under the dam and creeping along the lower side of the concrete to travel a considerable distance between the upper and lower toes. Head,

which is nothing more than potential energy, is used up in forcing the water through the voids in the gravel. The longer the distance, the more head is used. Much of the destructive energy of the water is thus used up in friction, and the velocity of the percolating water is cut down so much that the material under the dam is not displaced or washed away. The cut off walls and the sheet piling at the upper toe help in this by adding to the distance the creeping water has to travel, and by giving some right angle turns to the direction of the creep. They also help anchor the dam in place. The wooden piles at the lower toe also serve as an anchor to the dam and to the flexible mat and in case of a washout at the toe, will hold up the apron. The wide flexible mat of concrete blocks, (see Figure 395) at the lower toe, is a protection for the toe of the dam against the scouring action of the water as it falls over the dam, and shoots with high velocity over the smooth concrete apron.

The abutments, built against the natural banks of the stream, vary in thickness from 36 inches at the bottom to 12 inches at the top. The east abutment is on a 2 to 1 slope, and the west one is a 3 to 1 slope. Both abutments are supported by toe walls 3 feet thick, which in turn are supported by a row of wooden piles 3 feet apart. The foundation material is sand and gravel, similar to the material under the main dam.

The aprons are re-inforced with $\frac{3}{4}$ inch iron bars, laid 18 inches apart, and running up and down stream. The upper apron caps the tight wall of sheet steel piling, the lower apron caps the wooden piling. The cables for the flexible mat are anchored into



FIG. 393—GENERAL VIEW OF THE BARRIER DAM AT HAMILTON, SEPTEMBER 23, 1922.

The first section had been completed, and the river turned through the five gaps, when this view was taken. The coffer dam around the remainder of the dam had been built, and the water pumped out. The dragline in the foreground was engaged in driving piling, with the leads and hammer of the pile driver suspended from the end of the boom. The trestle carried the narrow gauge track used in the transportation of the concrete from the mixer to the forms.

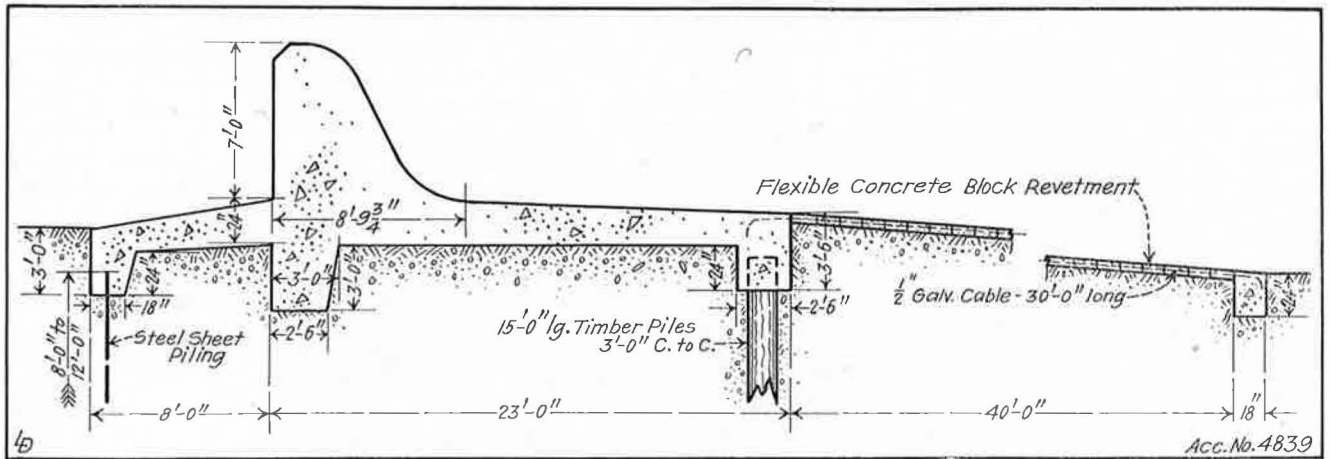


FIG. 394—CROSS-SECTION OF THE BARRIER DAM AT HAMILTON.

the toe of the downstream apron. The concrete block mat is composed of the same kind of blocks that are used to protect the toes of the levees, and is laid in a similar manner.

Some of the methods used in building the Black Street Bridge were employed to advantage. A drag-line excavated one-half of the foundation, threw up an earth dyke around the excavation, and did the pile driving just like similar work was done at Black Street. An eight-inch centrifugal pump unwatered the pit, and had to run less than one half the time to keep the water down. A wooden trestle was built just above and two feet higher than the upstream crest of the dam. (See Figure 393). Narrow gauge track was laid, and concrete cars were handled over it by gasoline locomotives. The concrete mixing plant was on the bank. The foundation and the aprons were poured ahead of the spillway section, with joints every 30 feet, to provide for

expansion and contraction. Beginning at the east end 90 feet of the spillway section was run in three 30 foot sections. Then alternate sections 30 feet long were poured, leaving gaps 24 feet long between, until five gaps were formed.

Then the coffer dam was cleared away, and the river was turned through the five gaps. Then the foundation for the remainder of the dam was dug, a dyke thrown up around it, the water pumped out, and the concreting operations repeated, save that no further gaps were left out.

When the last half was completed, the coffer dams were cleaned up. The dam was now completed save for the five gaps. These were closed one at a time. A small timber coffer dam on the upstream side shut off the water until the section could be filled with concrete.

When the last section was reached the water was very low in the river, as the Ford Plant was



FIG. 395—THE FIRST SECTION OF THE BARRIER DAM AT HAMILTON, AUGUST 22, 1922.

The coffer dam was still in position. The five gaps in the spillway section were used to carry the river while the remainder of the dam was under construction. The trestle carried the track used in transporting concrete from the mixer to the forms.

using nearly all of it. After the opening was closed by the timber bulkhead it took 60 hours for the water to rise to the top of the dam. This allowed sufficient time for completing the forms, pouring the concrete and removing the forms. On this last section a hand pump was used to remove the water between the forms and the timber bulkhead, until the concrete had been poured and had set up.

An average day's work was 100 cubic yards. On the abutments and on the end walls for the flexible mat a small mixer and wheelbarrows were used. Work was started June 1, 1922 and was completed November 9th. There are about 3,000 cubic yards of concrete, and 16,000 blocks in the structure.

Besides the utilitarian features of the dam, a fine body of water has been formed, extending up to the railroad bridge. Several handsome groves of trees are on the banks, and raw material exists for a pleasure ground that will mean much to Hamilton.

Unusual Storm Occurs in September.

During the early morning hours of Sunday, September 3, a very unusual storm occurred over a portion of the valley just north and west of Hamilton. The recorded rainfall at Hamilton was 4.2 inches, at Oxford 6.3, at Eaton 2 inches, at Dayton 1.6, and at Cincinnati 1.6. Practically all of the rain fell between 1:30 and 7:00 A. M., and it is the opinion of most of the observers that a large portion of it fell within a two-hour period. The severe rainfall was practically all on the west side of the river at and above Hamilton, and on the east side of the river apparently there was no place where the rainfall was of unusually high intensity.

This storm was the cause of a sudden and destructive flood in the small streams in the western part of Butler County, and the southern part of Preble County, and produced a stage of 12.9 feet in the Miami River, at Hamilton. Approximately 25 County bridges were washed out on the various small streams in the region affected. Two Mile Creek and Four Mile Creek, coming into the Miami just above Hamilton, were very badly swollen. Four Mile Creek cut into its banks severely at Coke Otto, undermined a portion of the traction line and highway near the highway bridge, and overflowed considerable land in and around Coke Otto. About 20 or 30 families were driven from their homes.

At Two Mile Creek the North "B" Street bridge was wrecked by the undermining of the south abutment, which had been in bad shape for some time. This put the traction line out of business and necessitated the hurried construction of a temporary bridge by the C. & D. Traction Company.

Despite the unexpectedness of the rise, but little damage was done to the District property. The work was delayed four or five days by the washing out of the railroad track in the river bottom. The concrete barrier dam at Hamilton was under construction at the time of this flood and fears were had of its safety under such a head of water while it was in an incomplete state. When the waters receded, it was found that the only damage done was in the displacement of part of the timbers on the temporary trestle. The trestle was tied together with cable, so none of the material was washed away.

Conservancy Men Widely Scattered.

Recently while motoring through a magnificent pine forest, in southern California, and at an altitude of 9,000 feet, Mr. G. H. Matthes, formerly Assistant Engineer with the District, ran across A. F. McCarthy, formerly Chief Steward for the District. McCarthy was as hearty and genial as ever. He is feeding 2000 men, located in four camps, all situated high in the Sierras, and remote from towns. This winter, 1,000 men, engaged in driving a tunnel 13½ miles long, will be snowed in for seven months, with only a dog sled as communication with the outside world. McCarthy has the job of feeding these men so well that they will remain contented. This fall he has been busy getting in the supplies necessary to serve some six hundred thousand meals this winter. If anything is forgotten, the men will do without these articles, as nothing can be brought over the trail during the winter months. The work is being done by the Southern California Edison Company.

Mr. Matthes attended the American Society of Civil Engineers meeting in California, where he read a paper, and then he spent a month visiting engineering work on the coast before returning to Chattanooga, Tennessee, where he is engaged in an investigation and survey of the Tennessee River for the Government.

Lieutenant A. A. Ort of the U. S. Navy visited the work of the District in November. He was formerly Assistant Engineer with the District. He is now in Haiti, struggling with administration problems in that negro republic.

O. N. Floyd, formerly division engineer at Taylorsville, is in Texas, where he is Assistant Chief Engineer on the Wichita Falls work. T. C. Shuler, formerly at Huffman, is with him.

Barton M. Jones, former Division Engineer at Lockington, is now resident engineer on the flood prevention work at Pueblo, Colorado. With him are W. J. Smith and Ray Hahs, former Conservancy men.

A. L. Pauls, former Division Engineer at Germantown, is near Ishpeming, Michigan, where he is building a concrete dam.

P. W. McGinnis, formerly at Huffman, is in California helping build a dam in the mountains. L. E. Paul, formerly Field Clerk at Huffman, is working on the Ohio River dams.

Mr. Chas. H. Paul to Receive the Norman Medal.

Mr. Chas. H. Paul, chief engineer for The Miami Conservancy District, will receive the Norman medal at the annual meeting of the American Society of Civil Engineers on January 17, 1923. The Norman medal was instituted and endowed in 1872. It is awarded annually for a paper contributed to the Society during the year which shall be judged worthy of special commendation as a contribution to engineering science. The paper for which the award has been made to Mr. Paul is entitled "Core Studies in the Hydraulic Fill Dams of The Miami Conservancy District."

The presentation will be made on the first of a three day session of the Society, to be held in New York. Distinguished engineers from all over the United States will attend.

THE MIAMI CONSERVANCY BULLETIN

DECEMBER, 1923

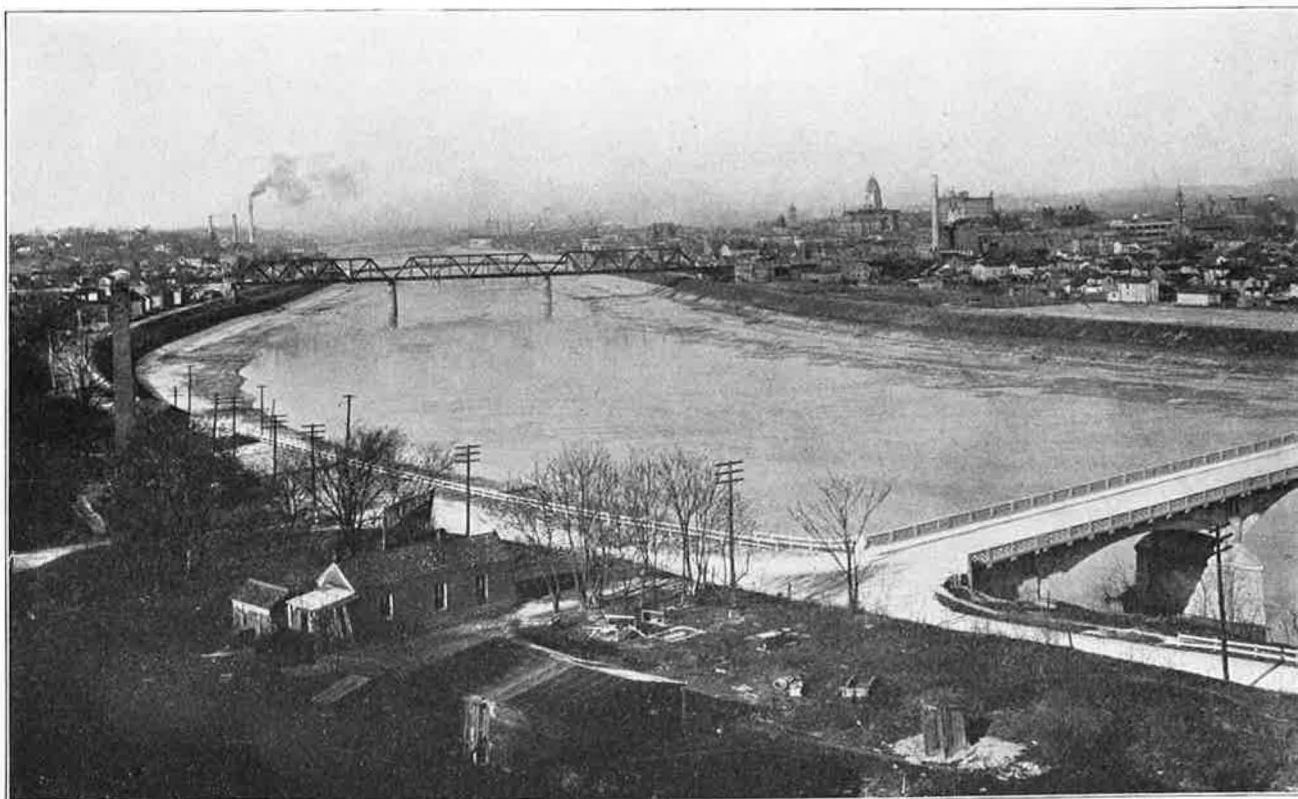


FIG. 395.—VIEW OF THE COMPLETED RIVER CHANNEL AT HAMILTON LOOKING UP-
STREAM FROM HILL SOUTHWEST OF COLUMBIA BRIDGE.



FIG. 397.—THE EAST BANK OF THE MIAMI AT HAMILTON NORTH OF MAIN ST. LOOKING UP-STREAM FROM MAIN-HIGH BRIDGE. APRIL 1, 1918.

Practically all of the buildings shown in this picture were removed in order that the river channel might be widened and that necessary space for the levee and walls be made.



FIG. 398.—THE EAST BANK OF THE MIAMI AT HAMILTON NORTH OF MAIN ST. LOOKING UP-STREAM FROM MAIN-HIGH BRIDGE. APRIL 19, 1923.

This view shows the same section of river front as Fig. 397 above, after all construction work had been completed. The easterly end of the new Black St. bridge appears at the extreme left of the picture. The concrete revetment extends to within four feet of the top of the levee. Flexible block revetment was laid at the foot of the concrete on the slopes.

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THE MIAMI CONSERVANCY BULLETIN

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DAYTON, OHIO

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Number 5

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Final Issue of the Bulletin

This is the concluding issue of the Bulletin. All details of the construction of the District's works for the protection of the Miami Valley from floods have been completed. The District is now on a maintenance basis. Throughout the period of construction this little publication has appeared at more or less regular intervals, its object being to acquaint the public with the work being done by the District and to point out in some detail (in a popular manner) some of the outstanding features of the project. Progress of each of the units of the entire system has been chronicled in the preceding issues, and the purpose of this number is to present a final report on the construction activities of the District. It is hoped that the aim of the Bulletin has been attained; that its readers have gained from its pages a clear, intelligible picture of the manner in which the works have been constructed.

Final Volume of Technical Reports

Part X of the technical reports of The Miami Conservancy District is now in preparation and it is expected that this report will be available for distribution within a few months. It is entitled "Construction Plant and Methods as Used on The Miami Conservancy Project," and is being written by Chas. H. Paul, Chief Engineer of the District. This, the final volume of the series, should be of more than usual interest to both engineers and contractors, especially to those engaged in the class of work on which equipment such as was used on this project can be adapted. It deals with plant and methods on a large scale enterprise, where the various units were widely separated and where the selection of plant for each separate job became a problem in itself.

A separate chapter will be given to the discussion of the dragline excavator as this type of equipment in various sizes was used so extensively on this work.

This report will contain a list of the plant used on each important feature of this large flood control project, together with a description and cost of each item of equipment. Methods and results will be discussed under the various classifications of work, such as rock and earth excavation, concrete, hydraulic fill, transportation, etc., and cost data under various headings will be set down and analyzed.

Concrete Tablets at the Dams

In order that the five dams of The Miami Conservancy District might be properly identified by visitors and tourists large concrete tablets have been erected at suitable locations at each dam.

These tablets are about ten feet square and are supported at each side by massive concrete posts. The inscriptions on each tablet were formed by the use of specially prepared metal letter patterns. Concrete forming the tablets was poured with the forms in a horizontal position, the letter patterns having been placed in the forms first. Special treatment and very careful handling of materials were necessary in order to secure a clean job, as it was quite difficult to pull the letter patterns out of the concrete without chipping the edges.

After the concrete was set the tablets were raised to a vertical position and set in place. The supporting posts were then cast. The final touch was given by filling the letters with black paint. On each tablet is the name of the dam and its length, height, and thickness at the base, also the date of completion. (See page 79.)

Review of the Work at Hamilton

Local Improvement at Southern End of the District Completed in 1923.

The pouring of the last slab of slope revetment on October 10, 1923, marked the end of the construction period at Hamilton. This work was started in the spring of 1918 and required altogether a period of more than five years.

The project at Hamilton consisted mainly of widening and deepening the channel; building levees, retaining walls, and slope revetment. It included also the construction of the Black Street bridge, the Twomile dam, Buckeye Street sewer, Wood Street sewer and Front Street sewer. In addition to and in connection with these larger divisions of the project there were a great number of minor items among which are: the extending or adjusting of about thirty sewer outlets, building 24 gate chambers, public service relocations and adjustments, removal of buildings, etc.

The condition of the channel before improvement was largely as the flood of 1913 had left it. The capacity within the banks was less than 100,000 second feet. Deep holes had been scoured in places and bars formed in others. The banks were irregular and overgrown with brush. The remains of three truss bridges were in the river below their respective sites and added to the obstructions. The channel had been encroached upon by manufacturers and residents along the banks by the erection of buildings and by the dumping of cinders and other waste. Figure 397 shows the condition of the east bank above the Main Street bridge before work was begun. Figure 398 is taken from the same point after the completion of the work.

The narrowest point in the channel was opposite the Sterling Paper Company. The 1913 flood at this point reached an elevation of 607. A similar flood in the improved channel, retarded by the dams, would reach elevation 588.5, a difference of 18.5 feet.

The damage done by the 1913 flood was proportionately greater at Hamilton than at any other city

in the District. The maximum discharge was 352,000 second feet as compared with 252,000 at Dayton and 70,000 at Piqua. The flow provided for in the new channel is 200,000 second feet. With the retarding basins in action it will require a flood 40% greater than that of 1913 to produce this flow.

In designing the new channel it was planned to widen, deepen and straighten the existing one. Levees were added to give additional capacity. Revetment was required here to a greater extent than elsewhere in the District on account of the higher velocities, the maximum being about 13.5 feet per second.

At the upper end the improvement terminates at a dam just above Two Mile Creek and Old River. At this point the channel has a bottom width of 800 feet. It narrows down to 620 feet at about Station 9. The width remains constant to Station 15 from which point it is reduced to 540 feet at the north end of the Champion Coated Paper Company's mill. At the south end of the paper mill the width is further reduced to 520 feet. It holds this width to Station 47 from which point it is reduced to 501 feet at the Main Street bridge. South of the bridge the channel widens gradually to 620 feet in a distance of 1000 feet, this width being maintained to the south end of the improvement 8500 feet below the Main Street bridge. From Station 10 to Station 60 the slope of the channel is 0.08 per cent. Below Station 60 it is 0.05 per cent.

Heavy retaining walls were required at both ends of the Main Street bridge and along the Black-Clawson Foundry. Smaller walls were used as substitutes for levees where space was too restricted to permit the use of the latter.

A cut-off channel to straighten the course of Four-mile Creek was dug about 1½ miles north of the city.

The principal quantities involved in the work at

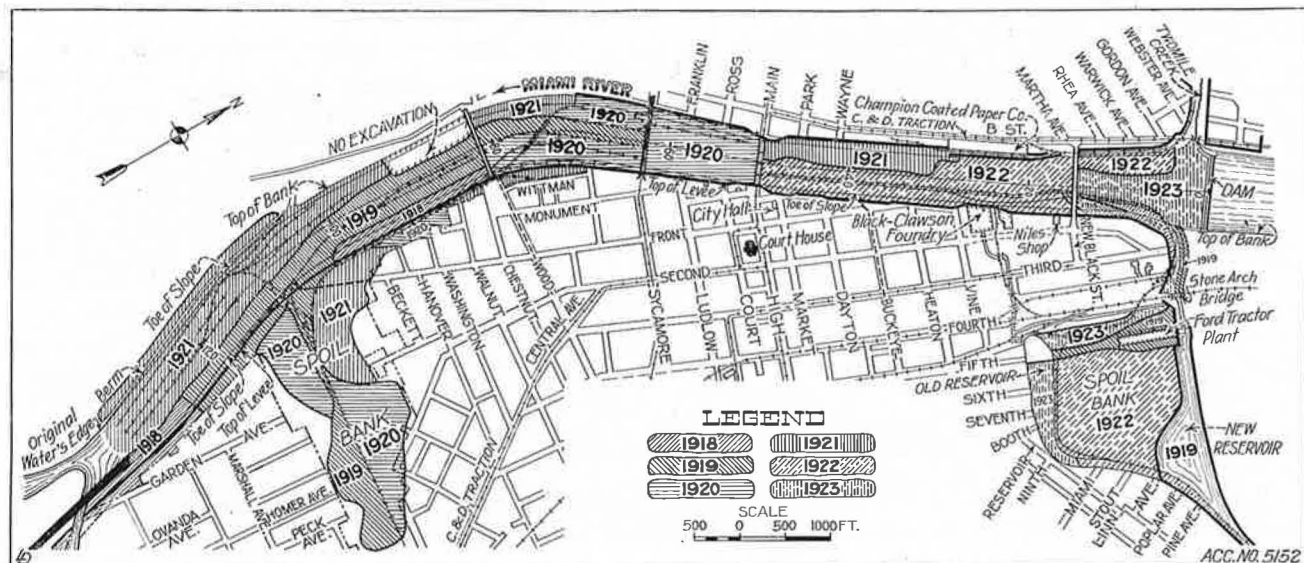
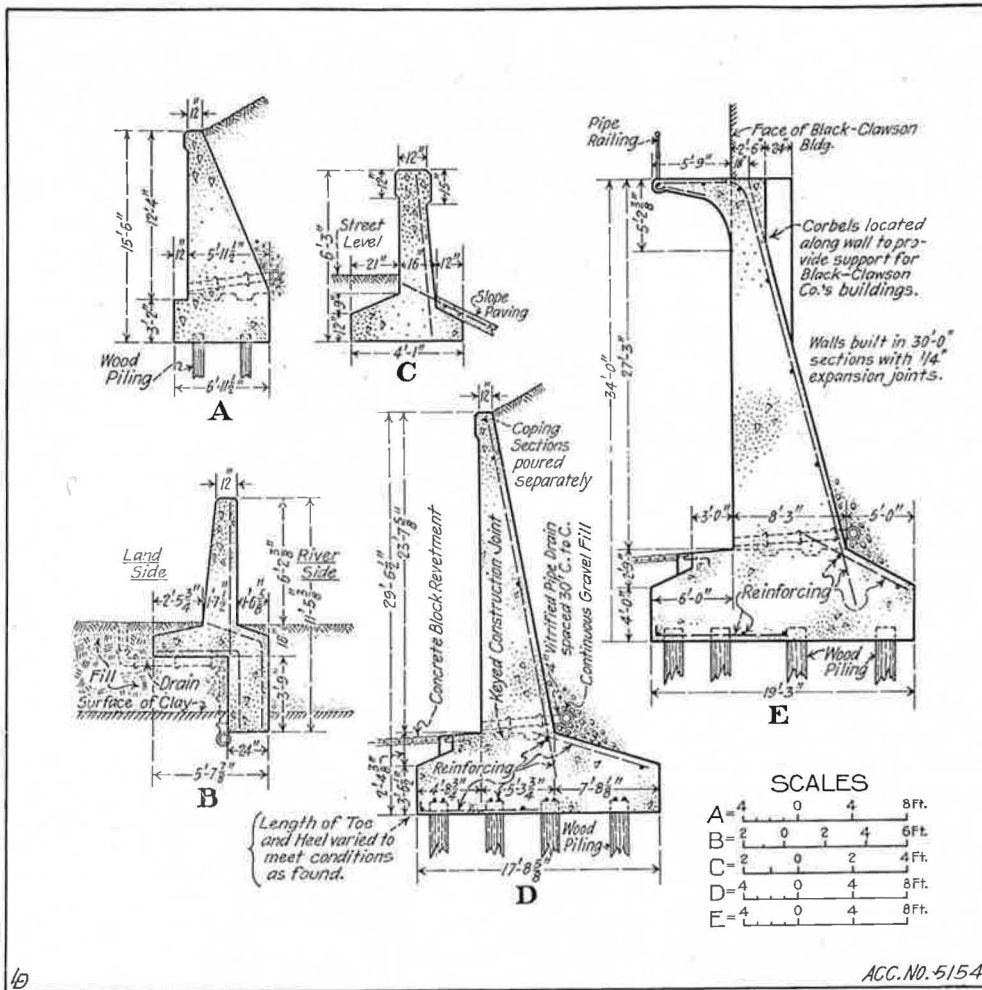


FIG. 399.—PLAT SHOWING THE EXTENT OF THE WORK AT HAMILTON.

The shaded portion indicates where the work was done and progress by seasons of the channel excavation and levee construction is shown. The total length of improved channel is about 2½ miles. Levees or walls were constructed on the east bank of the river from the old river just below the dam to a point about 8500 feet below Columbia bridge.



Hamilton were:—

Excavation, all classes.....2,314,000 c. y.
 Levee embankment 379,000 c. y.
 Concrete 32,000 c. y.

Excavation

There was a large surplus of excavation which could not be placed in levees so that it was necessary to secure spoil banks for this material. These were two in number as shown on the map. The channel excavation naturally divided itself into two sections, that above the Main Street bridge being taken into the north spoil bank and that below into the south spoil bank.

The equipment used for handling excavation consisted of:—

- 1—Class 24 Bucyrus electric dragline.
- 1—Class 14 Bucyrus electric dragline, caterpillar type.
- 1—Class 14 Bucyrus electric dragline on skids and rollers.
- 1—Model 21 Marion dragline, caterpillar type.
- 3 to 5—40 to 50-ton locomotives.
- 30—12-yard Western air dump cars.
- 1—Spreader car.
- 3 to 4 miles—Standard gauge track, 60 to 85 lb. rail and accessories.

The Class 24 Bucyrus was used for most of the channel excavation, being assisted by the two Class 14 machines. The Class 14 on caterpillars was used

principally to build levees, track embankments, excavate for bridge piers and retaining walls, drive piling for piers and retaining walls, excavate and drive piling for Twomile dam and dig minor channels. The Class 14 on rollers was used to dig the Fourmile Creek cut-off and to assist on channel excavation. The Model 21 Marion was used to build minor track embankments and small levees, to shift track, unload coal, load topsoil on wagons, clean out under bridges and build roadways and approaches. It was also used as a crane in repairing and dismantling the larger machines. This machine was purchased in time of labor shortage, primarily to shift track but so many other uses were found for it that it was used very little for its intended purpose.

A steam shovel and narrow gauge outfit were used in removing 56,000 cubic yards under contract on the east bank north of Black Street.

A local shop was maintained thruout the work and most repair work was done on the job. Major repairs, however, such as rebuilding dragline buckets, rewinding motors, etc., were made at the District's shop in Dayton.

Connections were made with the B. & O. railroad tracks at South Hamilton, through the Niles Tool Works yard and near North Third Street. Coal, cement and other construction materials, as well as the District's cars and locomotives, were brought to the work over three tracks. All supplies for the Black Street bridge were delivered directly

to the bridge by rail through the Niles yard.

To enter the north spoil bank it was necessary to build an underpass under the B. & O. Railroad. Arrangements were made with the railroad company to drive the piling and build the trestle at the District's expense after which the District's forces made the required excavation. After the work was completed the District backfilled the underpass after which the trestle timbers were removed by the railroad company.

Excavation was started at the lower end of the proposed improvement and progressed upstream. A small channel was first dug around Riley's Island to lower the water through the city thus facilitating the work. The excavation by years as well as the fill in spoil banks is shown on the map Fig. 399.

The excavation was so planned that as a rule the equipment was kept on the higher ground at the sides of the channel during the high water season, the work near the stream bed being done during dry weather. This was not always possible because high water sometimes occurred very unexpectedly as on September 3, 1922, when the rise came so suddenly during the night that the Class 24 dragline had to be abandoned in the middle of the river immediately below the Main Street bridge. At this time the river tracks were badly damaged and the dragline undermined and tilted to one side, but no serious damage resulted to the machine.

When working in the stream with a dragline it was nearly always possible to have a connection with one of the banks so that the machine could move to a safe position in a few hours.

As stated above, one reason for starting the work at the lower end was to have a lower water level through the city. Another reason was the necessity for coordinating the work of excavation with that of the removal of a number of factory buildings on the east bank north of Main Street bridge and also with the construction of Black Street bridge. These jobs required from two to three years and the excavation could not be undertaken until they were practically completed.

The track layout for the excavation is also shown in Figure 399. As the work south of Main Street bridge was being completed, tracks were being laid to the north spoil bank so that the hauling equipment was in readiness when the dragline started work north of Main Street. South of Main Street two trestles were required to make the material on the west side accessible. The decks of these trestles were cabled together and the cable anchored at one bank to prevent their being swept away by high water. North of Main Street bridge no trestles were necessary, most of the material on the west side being placed in the levee, and the remainder cast over to where it could be reached by the dragline from the east side.

Revetment

The methods of laying flexible concrete block revetment as well as monolithic slope revetment were described in detail in previous bulletins. The methods used at Hamilton were similar, with the exception that where the revetment extended high on the banks the upper slabs were poured from the top of the slope. Pouring from the bottom with a dump bucket running on a boom was a more satisfactory method where it could be used. This was true for the reason that it was necessary to use a mix dry

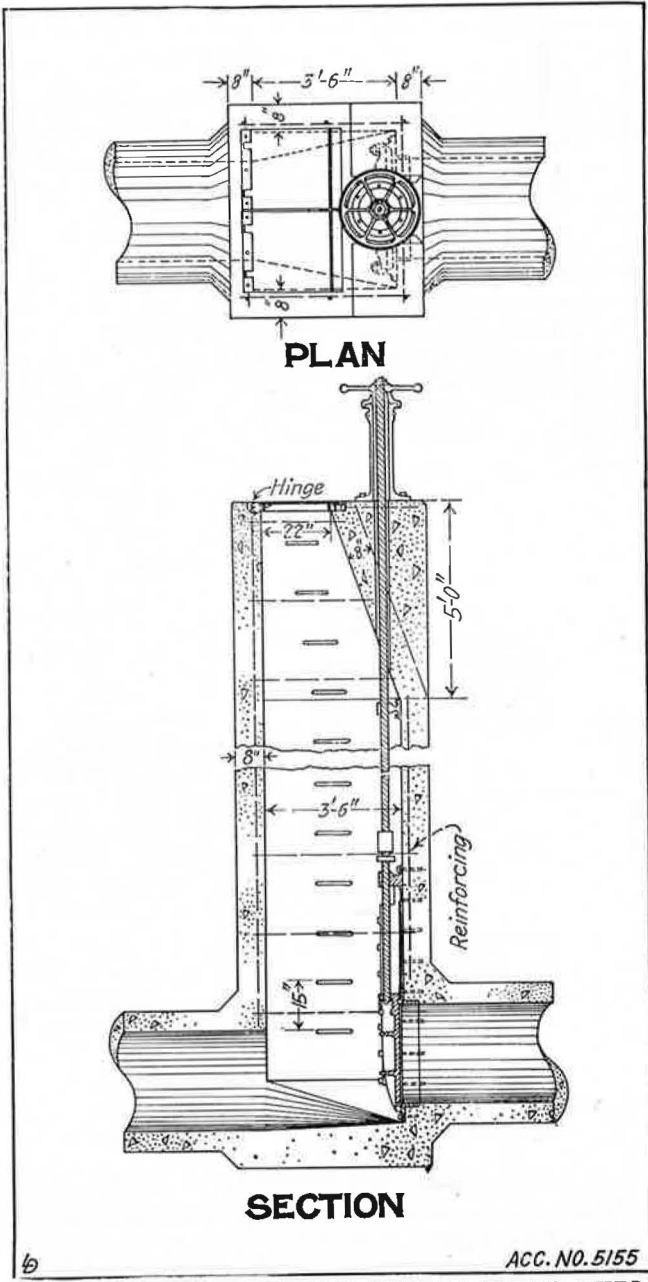


FIG. 401.—CROSS SECTION AND PLAN OF TYPICAL SLUICE GATE CHAMBER.

The gate is operated by turning the hand wheel at the top enough to stay in place on a 2:1 slope. The proper mix for this purpose was a little too dry to run well in a chute.

On the east side of the channel north of the Main Street bridge the revetment reaches to within four feet of the top of the levee and extends to the mouth of Old River. South of the bridge it extends to the railroad bridge and reaches an elevation 14 feet above the toe of slope. On the west side the top of the slope revetment is 6 feet above the toe of slope and extends from Twomile Creek to the Columbia bridge. Flexible block revetment was used within the same limits as the slope revetment, the width varying from 20 to 35 feet.

All of the revetment work was done by Price Brothers Company, of Dayton, under a cost-plus-variable-fee contract which proved very satisfactory to both parties. Materials were furnished by the District, the contract covering labor only.

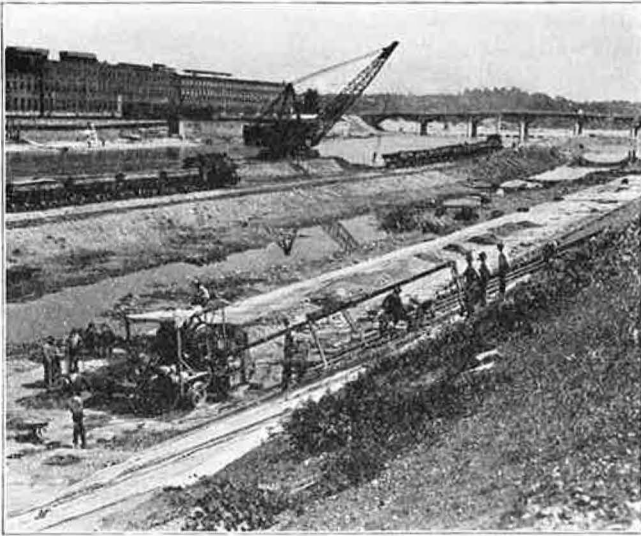


FIG. 402.—CONSTRUCTION ACTIVITIES AT HAMILTON.

In the foreground is the concrete mixer pouring slope revetment two slabs high, each slab being 13.5-ft. on the slope. In the center is a dragline loading cars. At the right is the Black St. bridge.

The first season's work on revetment was done in 1920, the section on the east side below Main Street being laid at that time. During 1921 revetment was laid on the west side from Columbia bridge to the Champion Coated Paper Company's mill. The remainder of the revetment on the west side and west of that on the east side north of Main Street bridge was laid in 1922, a small amount of work being left over at the extreme north end on the east side. A small section on the east bank south of Main Street bridge had been previously omitted on account of the District's shop projecting over the bank. This was completed in the fall of 1923 as soon as the shop had been removed.

It was not practicable to work on the revetment during the high water season as lower parts of the slopes were often submerged.

At the west end of the Main Street bridge the revetment reaches a lower elevation than at any other point, this elevation being below low water level. The Marion Model 21 dragline was used to build an earth cofferdam around this section and the site was unwatered by a centrifugal pump with 4" discharge. This work was done by the District's forces, the contractor handling only the revetment.

Walls

Five types of retaining walls were used. Figure 400-A is the plain gravity type which was used for retaining earth fills up to a height of 12 feet. Figure 400-B shows a type of wall used in place of a levee when space was limited. It is reinforced against water pressure and has a cut-off going down through the gravel to clay. No coping was used in this case as the wall is in a location where the additional expense for the sake of appearance was not warranted. Drains are provided under this wall to prevent upward pressure on the base. The third class of wall, Figure 400-C, was used along N. Monument Avenue where a levee would have taken up too much of the street. As it is in a conspicuous location and can be seen from both sides, a coping is provided on each side. The river side of this wall is connected by reinforcing to the slope revetment

which at this point reaches the base of the wall. The river walls at the Main Street bridge and the wing walls at the Black-Clawson foundry are of the type shown in Figure 400-D. This is known as the semi-reinforced type. The flexible block revetment is fastened to these walls by steel hooks spaced 1 foot apart and placed during the pouring of the wall. The Black-Clawson wall is shown in Figure 400-E. It is of the semi-reinforced type but differs from the other river walls in that it supports a cantilever side walk and carries the west wall of the Black-Clawson foundry buildings. During the construction of this wall the west portions of the buildings were removed and temporary wooden ends placed east of the excavation. After the completion of the work the west wall of the buildings was rebuilt of brick on top of the river wall.

For the larger walls excavation was made by a Class 14 Bucyrus dragline where there was room for open excavation. Where sheeting had to be resorted to a stiff-leg derrick with clam-shell was used. For the Black-Clawson wall this derrick was mounted on railroad trucks which ran on a track alongside of and parallel to the excavation.

Pile driving for the foundation of the larger walls was done with leads hung from the derrick or dragline boom, steam for the hammer being supplied by the derrick or dragline boiler.

Concrete was mixed in a $\frac{1}{2}$ yard Smith mixer and wherever possible was chuted directly into place. Where this could not be done it was placed with bottom dumping buckets handled by the derrick.

Sectional wooden forms of two-inch material were used. Forms on the larger walls were held together by $\frac{3}{4}$ -inch rods secured by Universal form clamps and covered with tin tubes to facilitate their removal.

A number of sewer outlets had to be extended or rebuilt to make them conform to the revised alignment of the banks. These ranged in size from small pipes to 5 foot circular concrete sewers. In most cases they were adjusted so as to discharge on the concrete revetment. On the 36" sanitary sewer at South Ave. a submerged outlet was constructed extending about 100 ft. into the river.

All sewers which have street or surface openings below the high water level are provided with gates, the smaller ones being of the automatic or flap-gate type while the larger ones are sluice gates operated by hand wheels or wrenches. The sluice gates are in most cases placed in gate chambers built in the levees. A detail of one of these is shown in Figure 401.

The construction of the Black Street bridge, the relocation of hydraulic canal, the Buckeye Street, Wood Street and Front Street sewers, the conduits under the B. & O. bridge at Old River and the Two-mile Dam were major parts of the work, all of which have been described in detail in previous issues of the Bulletin.

The cost of the work at Hamilton, not including property rights, was \$2,645,000.

Index for Volumes 3 and 4

An index for Volumes 3 and 4 of the Bulletin is now available. This covers all issues from August 1920 to December 1923, both inclusive. A copy of this index will be mailed free to any readers who desire it. A limited supply of the index for Volumes 1 and 2 is also available for distribution.

Progress of Sales of Equipment

Remarkable Demand for Construction Plant Used on District Work.

Total sales of equipment, supplies and buildings, including salvage from the public service relocations, have reached the impressive sum of nearly one and a half million dollars. Despite the fact that 1923 was a somewhat quiet year in the construction field, over \$600,000 has been realized by the District on sales of equipment and supplies. Dragline excavators were the largest single pieces of equipment used on the job. These machines are very expensive and it might be supposed that in a slow construction period the demand for equipment of this class would be quite limited. Yet eleven draglines were disposed of between January and November, 1923, at a total return of \$195,000. The entire remaining supply of dump cars, 98 in all, was sold this year, bringing in \$97,920, or nearly \$1000 each. Locomotives of various types brought \$98,000; fourteen locomotives were sold in eleven days early in the year. Pumps and motors sold to the amount of \$32,300, and dredge pipe, \$14,000.

The items mentioned above had a total sale value of \$407,300, which leaves about \$193,000 as the amount realized from the sale of miscellaneous small supplies and equipment during the year. In this class are small tools, hotel and restaurant equipment, plumbing supplies, hardware and builders supplies, boiler and engine parts, electrical supplies, drills, motor trucks, concrete machinery, transformers, derricks, engineering equipment, office furniture and miscellaneous merchandise.

None of this material was given away; neither was it priced at an unreasonable figure. Every item, even such small ones as bolts, nails, buckets, coat hooks, was counted, classified and priced in accordance with the fair retail market value of the goods. In fixing the prices original prices were obtained and compared with present-day prices as secured from retail merchants, jobbers, or manufacturers, the depreciation from age was considered, and a fair price finally established. All prices on equipment were reviewed and approved by the Chief Engineer before they were finally set. All selling was done from these fixed prices. Most of the small supplies and equipment were sold at the District's warehouse in North Dayton.

In order to properly bring before the public the class and quantity of goods offered for sale resort was made to advertising. Supplies, automobiles and trucks, and small equipment were advertised in the local newspapers. Larger and specialized equipment was brought to the attention of contractors and engineers through the medium of the technical press; such publications as Engineering News-Record and Electrical World. Some equipment was sold through authorized equipment dealers at specified commissions ranging from 3% to 10% of list price. However the amount sold through these dealers was a very small portion of the total volume of sales. At intervals sales catalogs were printed, listing quantity, kind and prices of all equipment and supplies ready for disposal. These lists were mailed to a selected list of prospective purchasers. Whenever inquiries were received by mail regarding material for sale they were followed up until the sales were made or it became evident that none could be made.

Equipment was sold for shipment to all parts of the United States. One shipment, which included three dragline excavators, filled 28 freight cars and freight charges alone on this equipment amounted to \$35,000. The W. E. Callahan Construction Company, of Dallas, Texas, which has the contract for a large reclamation project in the Sacramento Valley in California, was the purchaser of this outfit. Another large sale was made to the Ambursen Construction Company, of New York. This company is engaged in the construction of a dam in Arkansas, and it took \$80,000 worth of used Conservancy equipment to this job. The Carterville Fuel Company, Herrin, Illinois, bought a dragline and other equipment for use in its strip mine. East, west, north and south the sturdy equipment which handled the work here is being sent for duty in other fields. Twenty-five carloads were shipped in the first two weeks of July.

The District operated its own shop during the entire construction period. Here repairs and renewals were made to equipment by men who were fully competent and acquainted by experience with the types of machines on which they worked. As part of the plant was released due to gradual completion of various units of the job, the plant used on the completed units was immediately inspected and repaired, either in the field or at the central shop. The plan was to make every machine whole in every respect, and ready to be put to work the day it was unpacked by the purchaser. This policy has been followed since the completion of the job and until every piece of equipment worth selling has been completely overhauled and repaired the shop forces will be busy. The wisdom of this policy has been demonstrated. Equipment has been bought and paid for by contractors a thousand miles away who have not seen their purchases until they unloaded them from the cars at their destination. Not a machine has come back. Exceedingly few complaints have been heard, and all of these have been satisfactorily adjusted.

Another feature that appealed to prospective customers was the fact that they were given the benefit of the knowledge and experience of the District's staff of engineers and construction men in planning their needs. Due to the fact that numerous odds and ends of construction work remained uncompleted until the 1923 season, many of the men familiar with the equipment were on the job until late in the year. These men were at all times ready and willing to consult with a prospective customer regarding the best and most economical type of plant to do his job. If it developed that the District did not have the particular type of equipment best suited to a certain job no attempt was made to sell the customer and he was frankly advised to look elsewhere.

There is now in preparation a new sales catalog which will list all the supplies and equipment remaining. It is expected that by the middle of 1924 the "house cleaning" will be completed and in consequence the construction cost of the job will have been reduced by some two million dollars.

The Conservancy Lands

How the Farm Lands in the Retarding Basins Were Rearranged.

By S. Graham Smith, Farm Manager

The real estate end of the Conservancy work has not been altogether an insignificant item, as the District purchased a little over 33,000 acres of farm land and hundreds of parcels of town property. This might all be roughly divided into four classes:

- A. Real estate bought for channel improvement and local protection in and about the cities of the valley.
- B. Lands purchased for the necessary relocation of railways and highways.
- C. For the erection of the dams—including the land on which they were built, the ground used for borrow-pits and that immediately adjacent.
- D. Lands in the retention basins on which the District required the right to flood, to police and remove drift if thought advisable and to control the elevation of buildings.

Certain parcels, of course, would be included in part in all three classes B, C, and D, in that parts were required for the reasons given under the different heads. The necessity for the purchase of lands of classes A, B, and C, is easily understood; the situation in regard to class D land possibly should have further explanation.

Each farm located in a proposed retention basin was a problem which had to be considered individually, depending to what extent, or degree, it might be affected by backwater from the retarding dam at times of floods.

Some were so low, in relation to the dam, that annual, and at times, deep flooding was certain, not only on the fields but over the buildings—and possibly containing no high land to which the farmstead might be moved. Others were so situated that the buildings and almost all of the farm were entirely out of the basin, leaving affected but a small, unimportant area, perhaps a little ravine, practically worthless anyway and even this part so high that backwater would not be expected once in 200 years; and between these extremes all in regular gradation. In the case of farms which contained land high enough and otherwise suitable for building sites, and which sites would not be needed for building locations for other land not so provided, the owners were offered two propositions; either to sell to the District a flood easement, for a stated sum, or to sell the land outright; the flood easement to include the right to subject the land to backwater flooding, to police, etc., and to control the elevation of all buildings.

There are above the dams about 55,000 acres in farms, parts or all of which could be affected by backwater, and of this total the District bought the fee in some 30,000 acres and flood easements on the balance of 25,000.

It must be understood that there are not actually 55,000 acres which could be submerged by backwater, but approximately this area in affected farms. Only small parts of some of these are within the basins and these parts, as explained above, in many cases will not be overflowed unless there should be a flood forty per cent larger than that of 1913. The total area actually subject to overflow in a maximum flood is 35,600 acres. Even the fields in the lower parts of the basins, subject to deep and relatively

frequent flooding, are not materially changed as to their use, as very few floods occur during the growing season and even alfalfa and wheat have been subjected to submergence by backwater for many days in winter and early spring with benefit to both the growing crops and the soil. Floods of medium magnitude, which would be considered very small compared with the great one of 1913, are of rare occurrence when considered as a factor affecting the use of the basin lands for agriculture. The flood of March 1898 which, with the exception of that of 1913, was the largest in the last 57 years, would have covered little over a quarter of the lands in the basins had the dams been in operation.

Out of the land purchased, new farms have been laid out where necessary and buildings moved to high sites. The rearranged farms are being sold, subject to flood easements, and up to the present about one-half of these Class D lands have been sold.

The creation of the retention basins affected practically two towns only, Tippecanoe City in Miami County, a small part of which was in the Taylorsville basin, and Osborn in Greene County in the Huffman basin. The situation at Tippecanoe was taken care of by levee protection for the more important and valuable properties affected, and the purchase and removal of houses from those which were not worth the cost of protection. The town of Osborn, however, was entirely within the Huffman basin, the site being from five to fifteen feet below the spillway level of the Huffman dam. As all railroads, two steam and one electric, were relocated a distance of a mile and a half from the old locations passing through this town, the place would have lost most of its reason for being anyway, so that the cost of protection would have exceeded the value protected. The District bought all the realty in the town.

Near a new station planned for the two relocated steam roads, and also close to the new location of the electric line, was a nice, level piece of farm land belonging to the District which was quite suitable for a town site. It was planned to take this into the Osborn corporation, move the town over and maintain the corporate existence and to a large extent the original "personnel" of the village.

The new site, with a connecting strip to make it contiguous, was then annexed to Osborn, a local, private corporation was organized and capitalized sufficiently for the project. This corporation purchased from the District the land comprising the new site and the buildings in the old town, contracted the moving and relocation of the houses and has been selling and moving to such an extent that now the old town is almost all on its new location and the properties back in the hands of private owners. In addition to the frame buildings moved over from the old town site, many new buildings have been erected; dwellings, stores, a bank, a grain elevator, and municipal water plant. What was an unbroken field of grain a few years ago, now is a going town, served by three railroads with their sidings, switch tower and stations, streets curbed and electrically lighted, water system and everything needed for the comfort and convenience of the

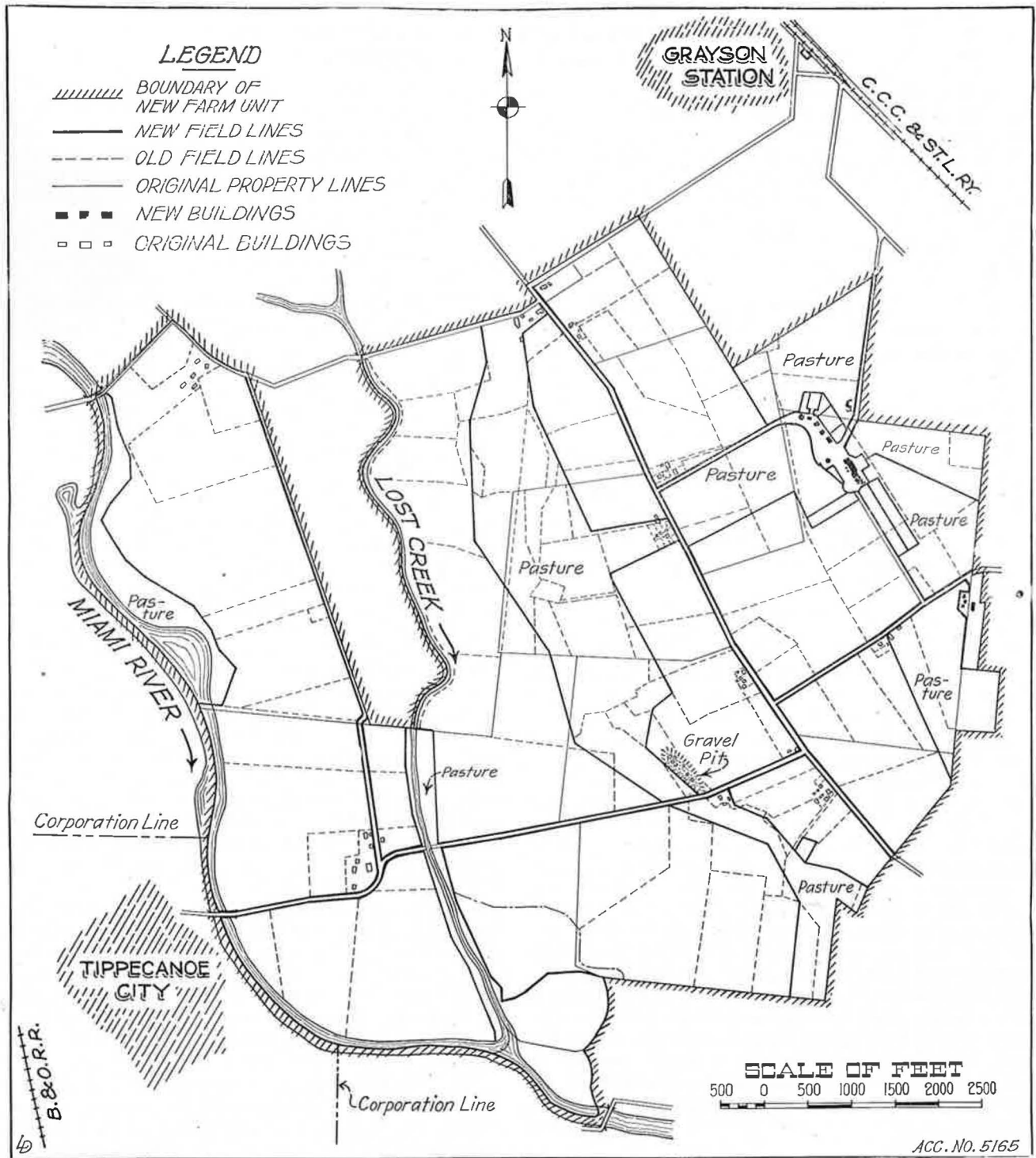


FIGURE 403.—MAP OF TRACT NORTHEAST OF TIPPECANOE CITY IN MIAMI COUNTY, KNOWN AS TAYLORSVILLE OPERATING UNIT NO. 1.

citizens and their economic and political life.

Figure 403 illustrates the necessity for the purchase by the District of much of the land which for the purpose of this article is called Class D. While this case is exceptional in that this new unit, or farm, is the largest in the whole project, it shows why it was not possible in many cases for the individual farm owners to sell flood easements and retain their farms.

Contained within this tract are about 1400 acres, made up of twelve farms purchased by the District

from twelve separate owners. There are on the whole 1400-acre tract but two locations high enough for buildings—a rather small knoll near the middle of the east line and a gravelly ridge some 2000 feet northwest of this knoll. On the small elevation first mentioned has been relocated a medium sized set of farm buildings; a dwelling, barn, crib, hog-house and small outbuildings, but on the larger ridge is the main farmstead for this unit.

Both of these elevations were on the same farm. As eleven of the original farms contained no ground

high enough for building sites, one can readily see how it would have been impossible for the owners of these eleven properties to have adjusted the matter on any other basis than an outright sale. And without the purchase of the twelfth farm, having the two sites, no suitable farmstead could have been provided for the others.

Now—while this new farm unit is, of necessity, larger than the average farm, and the buildings are farther from some of the fields than were the original buildings on the smaller farms, considered only as an industrial plant for producing grain, hay, live stock or milk, the net costs of production will be less than before the change. The new main farmstead is located much nearer a shipping point (Grayson Station), with elevator and stock loading pens, than the average of the twelve original farms. It includes four dwellings which, as they are reasonably close together, are provided with hard and soft running water, modern plumbing and electric lights and power, all water supplied from one central plant. As these residences are, in all ways, much more desirable than the average farm house, the farm labor situation is much improved. There is a bank barn with over 15,000 square feet of mow floor, and an equal area of well lighted basement for live stock. This is connected, by an inclosed passage, with a modern granary supplying storage for 32,000 bushels of ear corn and about 13,000 bushels of small grain—all grain put in by modern dump and power elevator and withdrawn by gravity through bottoms of cribs and bins right into wagon, truck or feed carrier. On the south side of granary, and close enough to spout the feed into feed-room, is an up-to-date farrowing house for hogs, well drained, sunny and convenient. This farmstead has also a large, bank machinery storage with basement work shop equipped with forge, power grinders, saw, etc. All buildings supplied with running water. The cost of installation and maintenance of these conveniences and the same labor saving equipment on twelve separate farms would have been thought prohibitive.

The twelve original farms were divided into eighty-one cultivated fields of an average size of 11.2 acres. The new farm has only twelve fields of an average of 85 acres each. The average length of the original fields was 884 feet; the new fields average 2762 feet long. In all cultural operations, plowing, disking, harrowing, rolling, planting, cultivating and harvesting, one must turn at the end of the field, of course. This lost motion of turning is reduced in the new field lay-out to less than one-third of what it was in the old. It requires less labor per acre for all field operations and less labor per bushel after the grain is brought in; also less labor per head of live stock than on the original farms. On this new farm, as on the others of the District's where the buildings have been located on the highest side, the stable and yard manure is produced near the land that needs it the most; the more distant fields being first-bottom are better able to produce good crops without manure.

The overflow feature is negligible on this farm as the lowest field will probably not have backwater from the dam oftener than once in ten years. The abandoned sites of the old farm buildings should expect backwater only once in fifty to eighty years.

The soil however is naturally of a superior type, level and rich. It has been kept up in quality and is being constantly improved, but one could not depend upon the silt deposit from backwater overflow to maintain fertility as on some of the other lands in the District.

As already explained, the large farm above described is used here as an illustration of the necessity for the purchase and rearrangement of much of the farm land, and is an extreme case as to size. Most of the farms as rearranged which have been sold, and which are still for sale, are only of medium area, and in regard to probability of backwater overflow vary from those of which some fields will have almost annual overflow to those of which no part will probably be affected by backwater once in a lifetime. The low, first bottom land forming the flood plain of the streams was subject to overflow before construction of the dams, and was always in some danger of damage by either scour or gravel deposit caused by currents of high velocity. The first bottom land which lies not too far above the dams is forever protected from rapid currents and while overflow will be deeper and hence cover larger areas and in some cases continue for slightly longer periods, the frequency is not necessarily materially increased. In the case of the bottom lands in the basins which lie quite well up stream from the dams conditions will not be changed by the dams except at times of big floods when, of course, currents will be checked as soon as the backwater reaches them.

The overflow matter is working out just about as it was forecast before completion of the dams. There has been no backwater so far during the corn growing season and silt deposit has been at least as much as was expected. There has been received but one complaint from a purchaser of one of the District's farms on account of backwater overflow and this was that he was not getting as much as he had hoped for.

The fact that most of the farm land already disposed of has been sold back to local farmers, much of it to members of the same families from whom the land was bought, and that there is no hesitation on the part of insurance companies, banks and building and loan associations to loan money on Conservancy land, is the best of evidence that the net effect of the retarding dams is, at least, not injurious.

While, as above stated, about one half of the Class D land has been sold, the District still has something like 15,000 acres for sale. This land is divided into farms of from 75 acres to 1400 acres and at the present time blocks of contiguous farms could be sold up to 6000 acres—and these containing the best land in the best part of the Miami Valley.

River Conditions in 1923

From a meteorological standpoint the year 1923 was one of few extremes, except perhaps with respect to rainfall. Up to December 1st the accumulated deficiency in rainfall amounted to 6.40 inches; the late summer and fall months were unusually dry. However, the year ended with a total rainfall for the 12 month period that was nearly up to normal, as December was a very wet month. According to Weather Bureau records at Dayton 6.84

(Concluded on Page 80.)

Finishing Touches Made in 1923

Review of Construction Work Done to Wind Up the Big Job.

While the dams were completed by the end of the 1922 season and most of the local protection work in the towns was done, there remained numerous small jobs and finishing touches which could not be handled until the big work was out of the way. The construction forces got busy on these early in 1923 and at the time this is being written it can be truly said that the construction of the works of the District is entirely finished. This is said with considerable satisfaction for it is a well known but ever surprising fact that finishing a job after the hard part has been successfully accomplished always takes longer than was anticipated.

Work done at Piqua this year consisted in finishing the levee on the right side of the river below the Shawnee bridge; in cleaning up the grounds and removing the buildings north of the Rossville Bridge and east of Main Street; and in completing the surface dressing and grassing of the levee slopes. Property line survey work was also completed.

At Troy the track elevation and levee construction along the Troy and Piqua branch of the B. & O. Railroad at Morgan Ditch was started during the summer and completed in the early fall. This work completed the levee system in Troy. The roadway on the Adams Street bridge and the approaches were paved; concrete was used for the bridge pavement. The city of Troy constructed a low concrete dam across the river just below the B. & O. Railroad bridge. This was done with the permission of and according to plans approved by the District.

The principal item of construction at Tippecanoe City in 1923 was the completion of the new water pumping and electric power plant. A new building to house the plant was erected just inside the levee and north of Plum Street. Part of the pumping equipment from the old plant east of the canal was removed to the new building and some new plant units were installed. This work took considerable time and it was not until early in December that

the new plant was in full operation. At the east end of Broadway, near the levee, a small sewage pumping station was constructed. The pumps and motor are housed in a neat brick and concrete structure. This plant will be used during high water to keep sewage from backing up when the flood gates are closed.

The only construction work undertaken at Dayton was the removal of the gravel bar in the Miami River at the mouth of Wolf Creek. This work had been held in abeyance pending the completion of a concrete barrier near the mouth of Wolf Creek. The purpose of this barrier is to check the drifting of gravel into the river and also to maintain the difference in grade between the creek channel and the river bed.

All work in the towns of West Carrollton, Miamisburg, Franklin and Middletown was completed by the end of 1922, except the construction of the Third Street sewer in Miamisburg and a few flood gates at Miamisburg and Middletown. This work was done early in 1923.

At the beginning of the year more work remained to be done at Hamilton than at any of the other towns. A considerable quantity of channel excavation near the upper end of the job was completed early in the year. The levee along Twomile Creek was finished and necessary paving and sidewalks laid where B Street crosses the levee. The temporary underpass at the B. & O. Railroad bridge was filled in and the tracks removed. All concrete revetment work on the east side of the river at the upper end was finished up, along with the revetment at the end of the barrier dam north of Twomile Creek. Necessary repairs were made to the concrete apron of this dam. The shop and office buildings on Monument Street were removed and the levee and revetment at this point finished. The balance of the top soil was placed on the levee slopes and the slopes were seeded. All flood gate structures were finished and the gates were set.

Maintenance of the Flood Prevention Works

Outline of Work Necessary to Keep System Ready for Next Flood.

By C. H. Eiffert, Maintenance Engineer

The maintenance problem consists in keeping in perfect working condition a system which may not function to its full capacity during the next 100 years. A flood of the size requiring control is likely to occur not oftener than once or twice in a lifetime. However no one can foretell the time at which such a flood or a greater one will occur, therefore the protecting system must be ready for it at all times.

The dams and other works built by the District are of great stability, nevertheless, constant weathering and deterioration are taking place. Frost action loosens the surface material on the slopes of dams and levees and rain water washes gullies, small at first, but if not repaired, increasing in size, until they become a menace. Persons walking up and down the slopes in the cities cause more damage than one would think, ground hogs make holes in levees and small boys dig caves in the banks.

Residents adjoining the District's property have a tendency not only to dump garbage, tin cans and other refuse on the slopes, but to encroach by building fences, sheds and other structures on the District's land.

To attend to such matters caretakers have been appointed at all dams and at cities where the District has built levees or made channel improvements. These men are in effect, custodians of the District's property. With necessary help the caretakers in the cities cut weeds, clear out brush, inspect levees, channels, sewer outlets, flood gates and revetment. They also read gauges, report accidents and look after the sale of gravel. At the dams their duties are less numerous but no less important. They must inspect the dams and outlet structures daily and the reservation weekly. They cut weeds, repair washes in the slopes, grade the roads over the dams and keep drains and gutters open. They also read the gauges, report accidents, etc. The

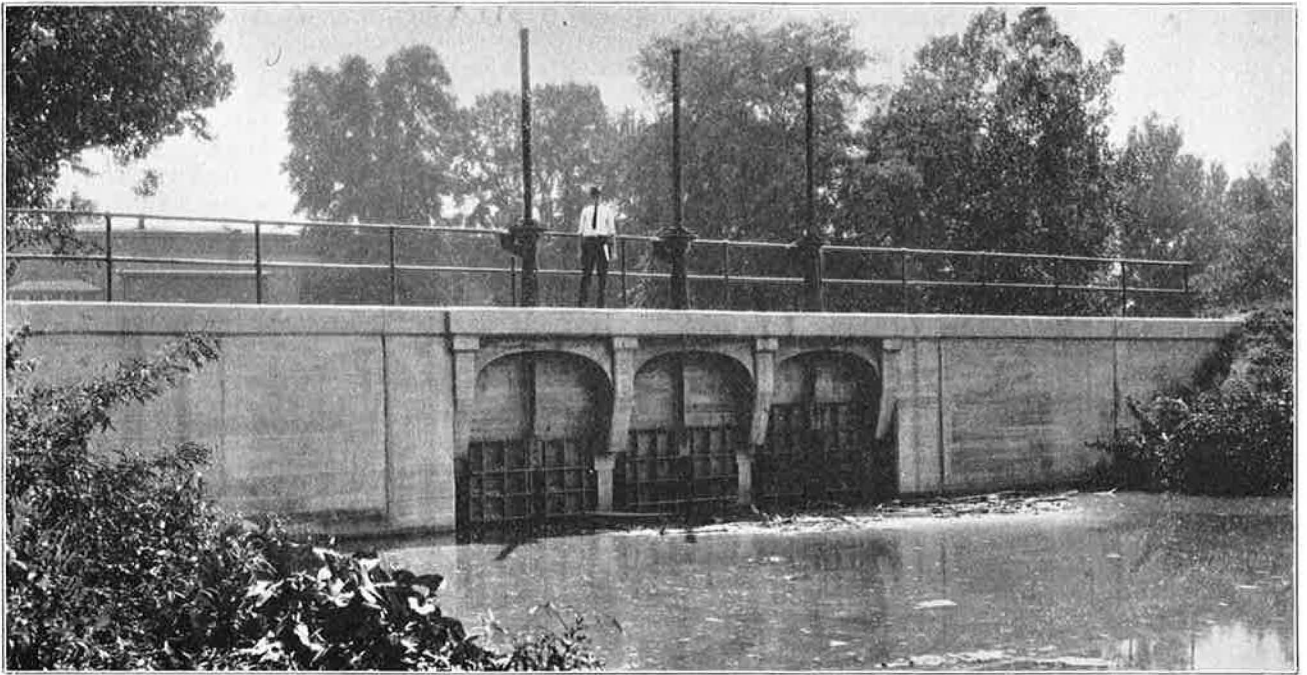


FIG. 404.—FLOOD GATES AT FRANKLIN.

These gates are in the head race of The American Writing Paper Co. They are each 6-ft. by 7-ft. The gate structure is in the line of the levee and is built into the levee at each end.

caretakers at the dams are furnished with houses and land for farming purposes as all of their time is not required on District work, but they must be near at hand, subject to call at any time. Caretakers in the cities spend all of their time on District work.

One of the duties of the caretakers in the cities will be to maintain and operate flood gates. These gates have been placed in sewers and canals to prevent water from backing into the cities in times of flood. They vary in size from 6 inch flap gates to 96 inch sluice gates.

A set of large sluice gates in the head-race of the American Writing Paper Company at Franklin is shown in Figure 404. A cross section of a typical gate chamber, such as were built on most of the larger sewers, is shown in Figure 401.

There are about 220 gates in all, 150 of them being sluice gates. The flap gates are of course automatic in their action and require only to be painted occasionally and to be kept free from obstructions. The sluice gates must be closed by hand at the proper time. A list of gates has been provided for each caretaker showing the gauge heights at which they must be closed. During high water the gauges must be watched rather closely so that the gates will be closed at the proper time. As it may not be necessary to close some of the gates for years, they will not be in usable condition unless they are tested at frequent intervals and are kept properly lubricated and painted.

To prevent erosion and scouring, the levees throughout the towns were seeded during the construction period with red-top blue grass, timothy, sweet clover, alfalfa and other grasses, those kinds being used that were thought to be best adapted for the special soil and slope conditions in each par-

ticular case. Satisfactory results were obtained, yet there are numerous places where a good stand was not secured due to unfavorable weather and soil conditions and such places have been and will be reseeded until a good growth is obtained on all the levees. The intention is to eventually have a blue grass sod on all the slopes. At the present time however some of the gravelly soils are not adapted to blue grass and will have to be built up by the use of sweet clover and alfalfa. Some of the levee slopes were covered with top-soil and the results obtained appear to justify the additional expense.

All levees must be patrolled and carefully inspected during high water to detect any seepage, scouring or other signs of weakness. The caretakers also form the nucleus of an emergency force for flood fighting and repair work.

On the slopes of the dams, which consist mostly of gravel, experiments were made with many different varieties of vegetation. Some of the grasses used were brome grass, timothy, red top, Canada blue grass, Kentucky blue grass, sweet clover, Japan clover, wild bunch grass and others. These were planted in various combinations with or without nurse crops and at different seasons. There were also plantings of honeysuckle vines, roses, horse tail ferns, Boston ivy, sumach and St. John's wort. On the Germantown dam which was first to be completed, more than 40 different plots were laid out and planted. The results were closely observed and applied in later plantings. Up to the present time sweet clover and alfalfa have proven to be the best cover for the gravel slopes that can be obtained quickly. Honeysuckle has done very well where planted with a shovelful of top soil to each plant but has not yet made a dense cover such as is required to entirely prevent erosion. All of

the dams now have a fairly good stand of sweet clover with a mixture of alfalfa, timothy and other grasses in various proportions. It is believed that in the course of a few years the soil will be enriched sufficiently so that a sod may be obtained.

The gravel roadways over the dams have become county roads. It is however necessary for the District to keep the gutters and drains open, for clogged drains would cause the gutters to overflow and wash gullies in the slopes. It is probable that the roads over two or more of the dams will be paved by the counties in the near future. This will eliminate some of the maintenance work as in connection with the county paving the gutters will be paved by the District.

Another and important function of the maintenance organization is to make an intensive study of floods as they occur and obtain accurate measurements of discharges in outlet conduits and improved channels. In this way it will be possible to check the design of the system. The floods against which the protection works are of the greatest benefits are the large floods which occur at greater intervals of time and of course the data on such floods is of proportionately greater importance. Not knowing when such floods will come, the maintenance organization must be ready at all times to meet any emergency. This is much more difficult than if such an emergency occurred, say once each year.

At all of the dams and four of the cities rain gauges have been established, some of them in cooperation with the U. S. Weather Bureau. The rainfall is measured daily by the caretakers. By means of the rainfall and stream measurements reliable runoff data will be secured.

At Taylorsville and Englewood the reservations in connection with the dams are wooded and of such a nature that many fine camp sites exist. The roads passing these reserves make them easily accessible for tourists and campers. A patrolman has been appointed at each of these reserves for the summer months. His duties are to cut weeds and brush, dispose of fallen trees, and to clean up and supervise camping grounds. The other dams are not so favorably located for camping purposes. Persons who wish to camp more than one day on these reserves are required to obtain a written permit from the Chief Engineer.

One of the most difficult problems will be to keep the channels at Dayton and Hamilton in good condition. The deepening of the channel below its original bed has created a tendency for gravel and sand to be deposited in this depression. This tendency has been offset somewhat by improving the alignment of the channels. However the smaller streams, such as Mad River and Wolf Creek at Dayton, and Fourmile and Twomile Creeks at Hamilton, are known to bring down large amounts of gravel. To prevent as much of this material as possible from lodging in the improved channel, gravel plants have been located above the improvements on Wolf Creek and Mad River. These plants excavate gravel from the stream bed making a depression into which gravel will settle as it drifts downstream. Two small dams have been built on Wolf Creek to check the movement of gravel. At

Hamilton a dam was built across the river at the upper end of the improvement. Above this dam is located the plant of the Hamilton Gravel Company which removed 31,500 cubic yards from the river during 1922. The Wolf Creek plant excavated 36,500 cubic yards during 1922. If it is considered that this amount of gravel might have to be removed annually from the improved channel it will be seen that a large expense is eliminated. A small revenue is derived from these plants by the District to compensate for the necessary inspection and control.

In spite of the fact that these gravel plants will remove large quantities, bars will form in the improved channels. These must be dealt with as they occur. In some cases where the gravel is of good quality and may be reached by teams it can be sold by the caretakers. In other cases the District may have to pay for having it removed when the proper time comes.

The formation of gravel bars and deposition of silt must be closely watched. Grass and weeds growing on the river bottom catch a surprising amount of silt, especially on the inside of curves. These deposits form so gradually that it is difficult to detect them by ordinary observation and cross sections must be taken to observe them accurately.

Willows and other brush must be removed from the channel and if possible their growth should be prevented. At present they are being either pulled up or cut with scythes and axes. Several experiments have been made with the purpose in view of exterminating the willows but so far with only slight success. If left to grow they would soon form a dense jungle over the entire river bottom. This would cause the deposition of large quantities of gravel and silt, forming bars, the removal of which would be very costly.

All of the lands in the retarding basins, except the permanent reserves, will eventually be in the hands of private owners, the District having flood easements and building restrictions on these lands. With a few exceptions no new buildings are permitted lower than 5 feet below spillway level, and old buildings are not allowed lower than ten feet below spillway. It will be the duty of the maintenance organization to make annually, a systematic inspection of all of these farms to see that the restrictions are complied with.

As stated above the principal difficulty lies in keeping tuned up for a flood which may not occur in several decades. At present the inhabitants of the valley still have vivid memories of the 1913 flood. Some of the men employed on the maintenance work have such memories and realize the importance of keeping flood protection works fit for maximum service. All of the men in the maintenance organization were employed on the works when they were under construction. These men have personal knowledge of the work and are familiar with conditions that need watching. In time, however, not only will they be replaced by others, but the Administration will change, flood dangers will be forgotten and the utmost vigilance on the part of those in charge will be necessary to keep the system always in readiness for a maximum flood.

Record of Conservancy Work in Drawings and Photographs

Complete History of the Construction Work in Picture and Plan.

It is very essential in planning and executing a construction project to make, prior to commencing the work, the necessary designs and working drawings. It is just as important to leave, when the work has been completed, a record showing how the structures were actually built. Changes of a major or minor nature are often made during construction, especially if the project involves the erection of structures of an unusual nature which are not standardized as to design.

On the Miami Conservancy project a large force of engineers and draftsmen were kept busy many months preparing and checking the plans for the construction of the works. Several thousand drawings were made and a considerable number of these were "working drawings", that is drawings which were taken to the field for use in laying out the work.

In order to have a record of all the structures of the District as actually built, the tracings of the working drawings were all carefully checked since the completion of the work and all revisions were noted on them in colored ink. After each drawing was checked and corrected it was labelled "Record Drawing," signed by the Chief Engineer, and filed away. There are over 400 of these record drawings; they constitute a complete and exact record of the manner in which all of the structures built by the District were made.

The value of a photographic record of the work was realized in the early stages of the project. Many pictures were taken which were of great assistance to the engineers in making the preliminary studies and final designs and plans. When construction work was started in 1918 it was found advisable to secure the services of an expert photographer, and throughout the construction period photographs were taken at all stages of the work.

The pictorial record is valuable from several as-

pects. In many cases, especially in the towns in the District, the improvement work was carried on through very valuable territory and the question of damage to adjoining properties was a real one. Wherever any structures were close enough to the proposed improvement to be affected by it, photographs were made showing conditions existent before any work was started. Then, in case damage claims were filed after the work was under way, evidence was available as to the original situation. This record has saved the District from the payment of unjust damage claims in several instances. In one case it was claimed that cracks had developed in the walls of a certain building close to a new retaining wall after the construction of the wall, showing that the new construction was responsible for settlement of the building. However, photographs taken of this building prior to the construction of the wall showed that the cracks existed at that time.

Photographs were made of structures which were, upon completion, to be partly or wholly hidden from view. These pictures furnish an indisputable record of the construction of these works.

Numerous pictures were taken from "strategic" points to show the progress of the work. A series of pictures were made from the same point at various stages of the work to show the gradual transition from original conditions to the final stage.

Photographs of equipment taken under working conditions have frequently been of material assistance in selling various parts of the construction plant.

In all some 4,000 negatives were made, all of the uniform size of seven by eleven inches. These negatives have been numbered and indexed for ready reference. A file copy of prints was prepared in the form of books, each containing all the photographs of a particular feature or unit of the project.

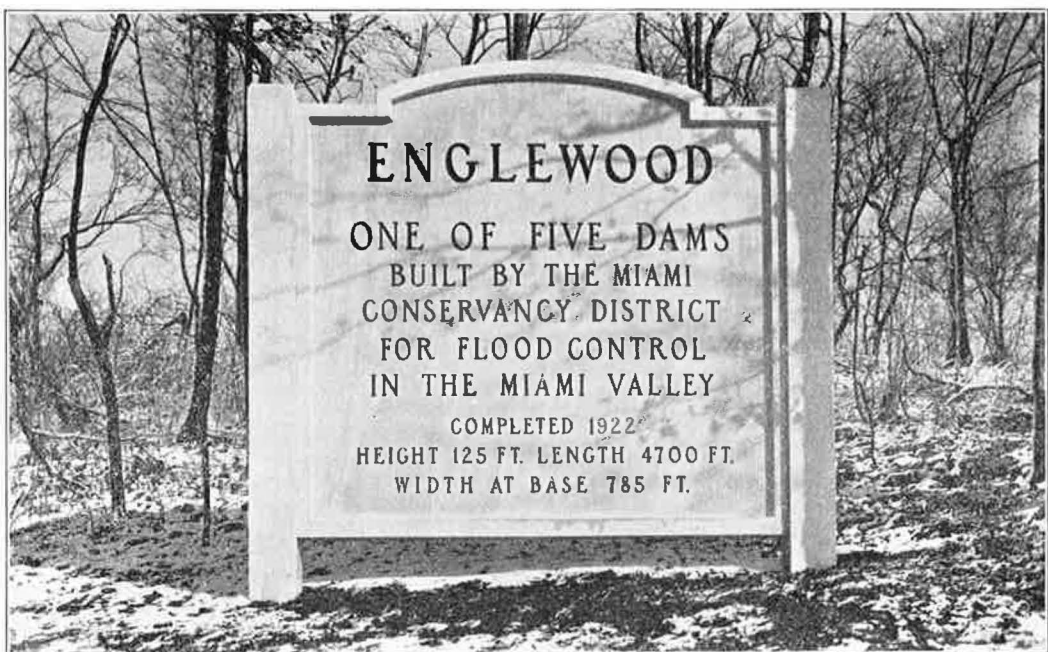


FIG. 405.—CONCRETE TABLET AT ENGLEWOOD DAM.

A similar tablet has been erected at each of the dams in a place easily seen by those who pass along the roads.
(See page 67 for further explanation.)

Engineering and Construction Personnel During the Construction Period

The list below includes the names of the men who were in responsible charge of the construction of the works of the District during the construction period, which extended from early in 1918 to late 1923. Some of these men served for only short periods, others were on the job from start to finish. It should be understood that this list does not include all engineering and construction employees; to attempt such a tabulation would take much more space than is available in this Bulletin. However, every one who was associated with the project, whether his name appears here or not, may feel that he has had a part in the creation of the largest purely flood control project in the country and has contributed his share in making the Miami Valley safe from disasters such as occurred in 1913.

General Engineering and Construction

Chief Engineer.—Arthur E. Morgan; Charles H. Paul.
Asst. Chief Engineer.—Charles H. Paul; J. H. Kimball.
Construction Engineer.—Charles H. Paul; J. H. Kimball.
Construction Manager.—Charles H. Locher.
Designing Engineer.—Walter M. Smith; R. M. Riegel.
Hydraulic Engineer.—G. L. Albert.
Office Engineer.—G. H. Matthes; C. N. Phillips; C. S. Bennett.
Field Engineer.—C. N. Phillips; J. F. Burkin; S. K. Young; C. S. Bennett.
Mechanical Engineer.—A. S. Robinson.
Engineer (Hydraulic Design and Data).—S. M. Woodward; G. H. Matthes.
Hydrographer and Flood Warning.—I. E. Houk.
Asst. Engineer (on Local Improvements).—E. C. Foust; W. M. Caye.
Master Mechanic.—Wm. McIntosh.
Chief Electrician.—Frank Harvey.
Engineer (Equipment and Salvage).—I. R. Bailey.
Chief Accountant.—O. K. Welker; F. L. Cavis; H. I. Lowman.
Purchasing Agent.—Fowler H. Smith.
Traffic Man.—W. T. Stockman.

Germantown Dam

Division Engineer.—A. B. Mayhew (died May 12, 1918); A. L. Pauls.
Asst. Div. Engr.—C. O. Shively.
Asst. Engr.—J. S. Bowman; A. Philpott.
Superintendent.—Albert Armstrong.

Englewood Dam

Division Engineer.—H. S. R. McCurdy.
Asst. Div. Engr.—H. W. Horne.
Asst. Engr.—J. L. Southworth; Kirby Jones; Myron Cornish; C. W. Howe.
Superintendent.—Richard Byers.
Asst. Supt.—R. L. Clark; Wm. Harrington.

Lockington Dam

Division Engineer.—Barton M. Jones.
Asst. Div. Engr.—C. H. Shea.
Asst. Engr.—W. J. Smith, Jr.; J. J. Loehr; W. R. Mounts; C. L. Zull.
Superintendent.—John Bolton; G. E. Warburton; W. D. Rogers (concrete).

Taylorville Dam

Division Engineer.—O. N. Floyd.
Asst. Div. Engr.—V. P. Odoni; H. L. Freund.

Asst. Engr.—B. H. Petty; H. R. Daubenspeck; W. J. Smith, Jr.; C. O. Shively.
Superintendent.—H. M. Sherwood.
Asst. Supt.—D. C. Hager; Atolfo Claroni; W. D. Rogers (concrete).

Huffman Dam

Division Engineer.—C. C. Chambers.
Asst. Div. Engr.—I. E. Goodner (to Dec. 1918).
Asst. Engr.—J. S. Gena; C. L. Zull; J. W. Cullen.
Superintendent.—Verne Clawson.
Asst. Supt.—J. R. Cook; P. W. McGinnis.

Dayton

Division Engineer.—C. A. Bock.
Asst. Div. Engr.—E. L. Chandler.
Asst. Engr.—R. B. Clement; H. L. Rogers; C. W. Ullom; J. E. Everhardt; E. J. Ries; Kirby Jones; W. L. Sylvester; C. L. Zull; F. G. Blackwell.
Superintendent.—H. A. Hanson.
Asst. Supt.—V. H. Tucker; S. U. Stine.

Hamilton

Division Engineer.—C. H. Eiffert.
Asst. Div. Engr.—R. B. McWhorter.
Asst. Engr.—J. E. Faist; G. W. Schrader; C. H. Schwartz; J. S. Gena.
Superintendent.—W. T. Rains; Wm. Roush (concrete); F. C. Williams (sewers).
Asst. Supt.—J. D. Allen.

Railroad Relocations

Division Engineer.—E. N. Floyd; Albert Larsen.
Asst. Engr.—W. D. Kramer; O. Froseth; W. E. Duckett; W. R. Yount; C. W. Howe; J. K. Cochran; L. F. Wilcock; S. Rice.
Superintendent.—F. H. Sprague (concrete); Leslie Wiley (concrete).

Piqua

Asst. Engineer.—Albert Schroeder.
Superintendent.—Thos. Nagle.

Troy and Tipp City

Division Engr.—A. F. Griffin.
Asst. Engr.—G. N. Burrell (concrete); E. J. Ries; E. W. Lane.
Superintendent.—W. D. Rogers (on Adams St. Bridge); Robt. Reynolds.

Miamisburg, Franklin, Middletown, W. Carrollton

Division Engineer.—F. G. Blackwell.
Asst. Engr.—W. L. Sylvester; G. N. Burrell; J. P. Keckler.
Superintendent.—Albert Armstrong.

River Conditions in 1923

(Continued from Page 75.)

inches of rain fell in December; this is 4.22 inches more than the normal amount for this month. December rains furnished the highest river stage of the year, the gage at Dayton recording 8.30 feet on the 14th. No high water was experienced in the spring; the highest stage at Dayton was 6.90 feet, on May 17th. It should be remembered in this connection that the river gage at Dayton was lowered 2.73 feet in December, 1922, so that a stage of 6.90 feet represents a stage of only 4.17 feet under the old conditions. It was necessary to lower the gage because in the dry season the stages fell below the zero of the gage. The lowest recorded stage of the river at Dayton for 1923 was 0.48 feet on August 24th. It is probable that the river fell still lower in October and November, but some temporary construction work in the river channel several hundred feet below the Main Street bridge so affected the stage that it was not possible to get accurate readings during those months.