STATE OF OHIO
THE MIAMI CONSERVANCY DISTRICT

History of the Miami Flood Control Project

by

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TECHNICAL REPORTS
Part II
DAYTON, OHIO
1918
FIG. I.-PANORAMIC VIEWS IN DAYTON. **UPPER VIEW SHOWS THE BUSINESS SECTION OF CITY DURING THE FLOOD OF MARCH, 1913, WHEN THE STAGE WAS ABOUT 27 FEET. LOWER VIEW SHOWS THE CITY IN MARCH, 1918, WHEN THE STAGE WAS ABOUT 5 FEET.**

DAYTON, OHIO

THE MIAMI CONSERVANCY DISTRICT

Board of Directors
EDWARD A. DEEDS, Dayton - Chairman
HENRY M. ALLEN, Troy
GORDON S. RENTSCHLER, Hamilton

EZRA M. KUHNS, Secretary
OREN BRITT BROWN, Attorney
JOHN A. McMAHON, Counsel
ARTHUR E. MORGAN, Chief Engineer
CHAS. H. PAUL, Ass't Chief Engineer
PREFATORY NOTE

This volume is the second of a series of Technical Reports issued in connection with the planning and execution of the notable system of flood protection works now being built in the Miami Valley.

The Miami Valley, which forms a part of the large interior plain of the central United States and comprises about 4,000 square miles of gently rolling topography in southwestern Ohio, is one of the leading industrial centers of the country. From the great flood of March, 1913, which destroyed in this valley alone over 360 lives and probably more than 100 million dollars’ worth of property, there resulted an energetic movement to prevent a recurrence of such a disaster. This movement developed gradually into a great cooperative enterprise for the protection of the entire valley by one comprehensive project. The Miami Conservancy District, established in June, 1915, under the newly enacted Conservancy Act of Ohio, became the agency for securing this protection. On account of the size and character of the undertaking, the plans of the district have been developed with more than usual care.

A Report of the Chief Engineer, submitting a plan for the protection of the district from flood damage, was printed March, 1916, in 3 volumes of about 200 pages each. Volume I contains a synopsis at the data on which the plan is based, a description of its development, and a statement of the plan in detail. Volume II contains a legal description of all lands affected by the plan. Volume III contains the contract forms, specifications, and estimates of quantities and cost.

After various slight modifications the report of the chief engineer was adopted by the board of directors as the Official Plan of the district, and was republished in May, 1916. This plan for flood protection contemplates the building of five earth dams across the valleys of the Miami River and its tributaries to form retarding basins, and the improvement of several miles of river channel within the half dozen largest cities of the valley. It is estimated that the dams will contain nearly 9,000,000 cubic yards of earth; that their outlet structures will contain nearly 200,000 cubic yards of concrete; that the river channel improvements will involve the excavation of nearly 5,000,000 cubic yards; and that the whole project will cost about 25,000,000 dollars.

In order to plan the project intelligently, many thorough investigations and researches had to be carried out, the results of which have proved of great value to the district and will also, it is believed, be of widespread use to the whole engineering profession. To make the results of these studies available to the residents of the state and to the technical world at large, it is planned to publish a series of Technical Reports containing all data of permanent value relating to the history, investigations, design, and construction of the flood prevention works.

The following reports, prepared by the engineering staff of the district, have been completed:
- Part I. The Miami Valley and the 1913 flood.
- Part II. History of the Miami flood control project.
- Part III. Theory of the hydraulic jump and backwater curves. Experimental investigation of the hydraulic jump as a means of dissipating energy.
- Part IV. Calculation of flow in open channels.
- Part V. Storm rainfall of eastern United States.

The following are in the course of preparation:
- Rainfall and runoff in the Miami Valley.
- Laws relating to flood prevention work.
- Flood prevention works in other localities.
- Earth dams.
- Selection of general type of improvement and design of retarding basin system.
- Construction of protection system.
- Contracts and specifications.

The aim in writing this particular volume, Part II of the Technical Reports, was to compile a complete and accurate history of the Miami flood control project from its inception in May, 1913, to the time when it was ready for beginning construction in September, 1917. It has been attempted not only to describe the engineering features, but also to outline the administrative and legal procedure involved in the development of the project. It is believed that this record will have considerable interest and usefulness for anyone connected with similar undertakings.

ARTHUR E. MORGAN,
Chief Engineer. Dayton, Ohio, March 1, 1918
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CHAPTER I - ORGANIZATION FOR FLOOD CONTROL

In March, 1913, unprecedented floods occurred on all the important rivers of Indiana and Ohio. In the Miami Valley many lives were lost and all the cities and towns suffered great damage. Out of the chaos of flood-wrecked homes and destroyed properties grew the demand that such a calamity must not be allowed again to visit the valley. This feeling crystalized into definite action in Piqua, Troy, Dayton, and Hamilton in connection with the organization and work of various relief committees.

FLOOD RELIEF ORGANIZATION

Naturally, the first emergency committees appointed in different parts of the valley were created for immediate relief work rather than for permanent protection. In Hamilton the Citizens' Relief Committee was organized to raise a fund for the immediate relief of flood sufferers. The administration of this fund was later given over to the Red Cross.

In Dayton, March 27, before the flood waters had left the city, Governor Cox appointed the Dayton Citizens' Relief Committee of the following five members:

John H. Patterson, President of the National Cash Register Company, Chairman.
John R. Flotron, President of the John Rouzer Company.
Edward Philips, Mayor of the City of Dayton.
Adam Schantz, President of the Dayton Breweries Company.
Frank T. Huffman, President of the Davis Sewing Machine Company.

It is difficult to conceive the extent of this committee's work, so complex and comprehensive did it become. The first and most important matter confronting the committee, as that of getting sufficient food into the city to take care of the destitute, and to establish the necessary stations for its distribution. A competent commissary organization was maintained in all parts of the city for about two months, practically the entire population of Dayton being fed for several days through this department, and large numbers for more than a month. Major T. L. Rhoads, Special Aide-de-camp of the President of the United States, arrived in Dayton within a few days after the flood to become the head of the Sanitation Department, and succeeded in preventing wide-spread epidemics throughout the city. H. E. Talbott, the committee's chief engineer, directed the great task of cleaning up the streets, see figures 2 and 3.

Dr. Edward T. Devine, special representative of the American Red Cross, had charge of the relief work in Dayton; he and his assistants did an excellent service in behalf of those left destitute by the ravages of the flood. Any who were in need of assistance were permitted to register, and a corps of assistants was kept busy investigating these cases. A great many businessmen were assisted by being given a small amount of money with which to re-open their places of business. The Dayton Bicycle Club took charge of removing the dead animals from the streets of the city, and through their untiring efforts more than a thousand dead horses were removed and the spread of disease prevented in a large measure. The Citizens' Relief Committee directly supervised all of the activities mentioned above; the raising and distribution of funds for relief purposes; and the receiving and distribution of all clothing and supplies sent into the city. Conferences were also held from time to time with the different banking institutions and building and loan associations in regard to the financial situation. Troy, Piqua, and other cities in the valley had similar relief committees. These were also largely for purposes of immediate relief and rehabilitation, and affected the general organization for flood control only in so far as they emphasized its need and gave it their moral support and cooperation.
FIG. 2. - CLEANING UP AFTER THE 1913 FLOOD, EAST FIRST STREET, DAYTON.
AGITATION FOR PERMANENT FLOOD PROTECTION

As the work of rehabilitation neared completion there developed in the various parts of the valley an agitation for permanent flood protection. The situation at Troy is indicated by the following letters:

Troy, Ohio, April 12, 1913.

Mr. John H. Patterson,
Dayton, Ohio.

Dear Sir;

Our citizens are very much worked up over the flood conditions and the liability for further serious trouble and at a meeting last night, in which steps were taken to immediately overcome the local difficulties so far as possible, it was decided to appoint a committee to meet with the citizens or committee of Dayton and other towns in the Miami Valley, looking to more permanent relief.

It is our desire and our expectation because of the leadership you have given not only in relief but looking to more active steps for betterment of future conditions, that the whole work will naturally head into your hands, and we, therefore, trust that you will approve the action we have taken.

Due notice of this committee and its appointment has been sent to the mayors of the several cities. We enclose a copy of the notice that has been sent out from which you will see that the suggestion is made that the call may be made by the Dayton Committee.

Yours very truly,

H. M. Allen,
A. G. Stouder, C. A. Geiger,
Committee., Troy, Ohio, April 12, 1913.

To The Honorable Mayor,
Hamilton, Ohio.

My Dear Sir;

At a meeting of the citizens of Troy last night as chairman of the meeting I was authorized to appoint a committee consisting of three of our citizens to act in conjunction with committees or citizens in the cities and towns of the Miami Valley looking to the immediate and active steps for the prevention of future disastrous floods.

The Troy Committee appointed by me consists of H. M. Allen, A. G. Stouder, and C. A. Geiger. This committee will be ready to cooperate with any of the cities and towns, and I suggest that a call for a general meeting be left to the committee that may be appointed at Dayton, Ohio.

Respectfully,

John McLain,
Mayor, City of Troy.

On April 18, 1913, the Ohio Legislature passed an emergency act which authorized the mayor of any city to appoint an emergency commission of not more than four members, for the purpose of expediting repair and reconstruction work necessitated by flood damage. Under this act the mayor of Hamilton appointed an emergency commission composed of:

S. M. Goodman, Hamilton Chas. Mason, Hamilton Ben. Harwitz, Middletown T. C. Simpson, Middletown

FIG. 4. - DEBRIS IN THE UNION STATION AT DAYTON. View taken shortly after the flood of March, 1913.
This commission, cooperating with the three commissioners of Butler County, engaged John W. Hill, a civil engineer of Cincinnati, to make surveys, plans, and estimates for flood control in the Miami Valley through Butler County. Mr. Hill reported under date of November 13, 1913, submitting an estimate for channel improvement, stating that "the cost of any improvements of the river channel which will prevent destructive effect from future great floods, even if limited to the cities of Hamilton and Middletown only, is very high in the light of the losses of property sustained last March." Hamilton soon realized the hopelessness of protecting itself except through the cooperation of the valley above. The Emergency Commission secured the construction of a temporary pontoon bridge, a suspension bridge, a pile bridge, and other temporary relief works in Hamilton, but for the purpose of securing permanent flood control the city allied itself with the movement being developed in Dayton for a comprehensive plan.

On April 20, Mr. Patterson called in Dayton a general meeting of citizens, at which there were present about 140 people. A committee of 20 was appointed to assist the Citizens' Relief Committee. On April 21 the total membership of the committee was increased to 30, and divided into the following committees:

Flood Prevention
John Patterson, Chairman
Walter Worman
Walter S. Kidder
Edward Hanley
H. E. Talbott
John Stoddard

Finance
Mayor Edward E. J. Barney
C. B. Clegg
J. H. Winters
T. Huffman
Chas. McKee
Philipps, Chairman

Public Improvement
Adam Schantz, Chairman
Edward A. Deeds
F. Cappel
T. P. Gaddis
J. E. Sauer
E. Canby

Sanitation
John R. Flotron, Chairman
L. Rauh
J. P. Breen
H. G. Carnell
Peter Kuntz
H. Burkhardt

* Edward A. Deeds later became vice-chairman of this committee, vacancies subsequently caused by the death of Edward W. Hanley and Walter Worman were filled by Adam Schantz and Frank T. Huffman.
William F. Bippus later became treasurer of this committee.

Traffic and public service
F. T. Huffman, Chairman
E. D. Grimes
E. B. Weston
E. L. Edwards
J. M. Switzer
A. J. Stevens

Each committee was vested with full power to consult competent authorities in their respective capacities. A few weeks later the following members were added to the Finance Committee:
John W. Aull
As the problems of immediate relief and rehabilitation diminished in importance and were gradually disposed of, the work of the Flood Prevention Committee assumed larger proportions. The dead and injured, the serious illnesses, the widespread destruction, and the general depreciation in real estate values that was already being felt, were powerful influences urging permanent protection. Public sentiment was aroused to the need for preventing the recurrence of flood disaster, and the committee keenly felt its responsibility. At a joint meeting of the Flood Prevention and Finance Committees on May 2, it was the general opinion that the Federal Government would not take immediate action to prevent the recurrence of flood disasters in the Miami Valley. It was believed that action would be hastened and confidence in the city stimulated should the citizens raise funds to commence immediate work. A resolution was adopted to raise a flood prevention fund.

On May 3 the Flood Prevention Committee passed a resolution as follows:

That it is the sense and best judgment of this committee that there be prompt and definite action to determine the cause of the inundation of the city of Dayton on March 25, 1913, and to apply the maximum of human knowledge and scientific skill with the necessary measure of financial resources to prevent the recurrence of a similar calamity.

That to enable this committee to take up the vast program of surveys, plans, specifications, condemnation, contracts, and construction incidental to and connected with the work of protection of life and property, to allay the fears and misgivings of the people, and to reinstate the beautiful city of Dayton as an attractive location for home life, happiness, and commercial prestige and success, there shall be provided a Flood Prevention Fund of $2,000,000.

That this flood prevention fund shall constitute a voluntary gift from the people of Dayton as a testimonial of devotion and patriotism to which all can subscribe with the assurance that it will be safeguarded, disbursed, and accounted for as a sacred trust.
end that the balance of funds necessary to complete this undertaking, through, above, and below the city of Dayton, may be appropriated in the regular legal way, and available in this serious work of protection and flood prevention.

The immediate results of this action of the Dayton Flood Prevention Committee were:

1. On May 5 the Morgan Engineering Company of Memphis, Tennessee, was employed by the Flood Prevention Committee to report on plans for flood prevention, and Arthur E. Morgan, president of the company, assumed personal charge of the investigations.

2. On recommendation of the Finance Committee, May 25 and 26 were designated as "Dayton Days", and plans were started for the campaign for funds.

3. Representatives of neighboring cities were invited to attend a meeting on May 15 to discuss the possibilities of cooperating for flood prevention in the Miami Valley. This meeting resulted in the organization of the Miami Valley Flood Prevention Association.

MIAMI VALLEY FLOOD PREVENTION ASSOCIATION

The meeting was held at the Dayton City Club, at which there were present representative citizens of Miami, Clark, Darke, Shelby, Logan, Warren, Butler, Greene, Montgomery, and Preble Counties. Edward A. Deeds presided at the meeting and stated as its purpose the furtherance of flood prevention measures by the cooperation of cities and counties in the Miami Valley. It was resolved:

That a committee consisting of five delegates from each county, to be selected by the flood relief committees in such counties, meet in at least ten days from this date, to form a permanent organization, to be present at an early meeting to be held in the city of Dayton at the call of the chairman of this meeting.

The association was formally organized on May 27 when John H. Patterson was chosen president, H. rvI. Allen of Troy, vice-president, and L. D. Upson, secretary. At a later meeting it was announced that the objects of this association shall be:

To secure through private or public aid a complete and coordinated survey of flood conditions within the Miami Valley with a view of preventing a recurrence of serious flood losses.

To formulate a single or several cooperative plans for the protection of the cities and lands in the Miami Valley from further flood destruction.

To secure the adoption of such coordinated plan or plans by the several county and city authorities upon whom the execution of flood prevention measures will devolve.

To endeavor to secure from the National Government such services of the army engineers, drainage bureau, geological survey, or other branches as will expedite and facilitate the preparation of cooperative flood protection plans.

To urge by all legitimate and expedient means the aid of the National Government and the State of Ohio in materializing such flood protection plans as may be prepared.

To urge some control either national or state of all streams navigable or unnavigable in order that plans for bridges and obstructions of all kinds shall be passed upon by a central authority.

To secure the cooperation of the railroads and other public utilities concerned, in preparing and carrying out flood protection measures, or other improvements contingent upon the alteration of roadbeds and bridges for flood protection purposes.

To maintain continued publicity for informing the citizens concerned of such steps as are being taken to further their protection, and the nation at large of the progress of the Miami Valley.

To secure funds for office and other expenses of the association.
Letters were sent to officials of the cities and counties, asking that all contracts involving flood protection work be delayed until cooperative action could be taken by the Flood Prevention Association. The results accomplished by this association were naturally of a very general character and its operations did not continue beyond its several meetings. It voted that all legal representatives of the counties and cities in the Miami Valley in all cases of flood protection recognize Mr. Morgan as consulting engineer for the valley to the end that the ultimate river improvements be a harmonious whole. The last meeting recorded is that of January 15, 1914.

This meeting was held largely for the purpose of explaining the proposed Conservancy Act of Ohio and enlisting the cooperation of those present to secure its passage. Among the speakers were Edward A. Deeds, O. B. Brown, John A. McMahon, Arthur E. Morgan, Joseph Wing, John 1. Millet', Honorable Warren Gard, George M. Verity, and Edward W. Hanley.

FLOOD PREVENTION FUND

Upon receiving instructions to secure funds with which to carry on the work, the Finance Committee immediately instituted a subscription campaign. Though the working time was very short, the campaign was planned and organized with the utmost care. A copy of the subscription blanks used is shown in figure 7, while a typical scene during the campaign is shown in figure 8.

FOR THE LOVE OF DAYTON - AND AS A TESTIMONIAL OF MY DEVOTION AND PATRIOTISM.

IN CONSIDERATION OF THE SUBSCRIPTION OF OTHERS FOR THE SAME PURPOSE, I HEREBY

SUBSCRIBE THE SUM OF

DOLLARS, ($ ________________ )

PAYABLE TO THE TREASURER OF THE FINANCE COMMITTEE OF THE CITIZENS' RELIEF COMMITTEE OF -DAYTON, OHIO. PAYABLE AS FOLLOWS,

5% on Jul. 1, 1913, 5% on Octob., 1. 1913, 15% on Aprill, 1914, 15% on Octob., I, 1914, 15% on April., l. 1915, 15%on Octob., l.1915, 15%on Aprill,1916, 15%on Octob., l. 1916, without int.,...

SAID MONEY IS TO BE USED FOR THE PURPOSE OF CARRYING OUT MEASURES FOR THE PREVENTION OF FLOOD IN THE CITY OF DAYTON, OHIO.

.DAYTON, OHIO.

1913.

&... signed.

Add...

FIG. 7.-SUBSCRIPTION CARD FOR FLOOD PREVENTION FUND.
On the 25th of May, after a monumental campaign of about ten days, the Finance Committee announced that subscriptions amounting to more than $2,000,000 had been received from a total of about 23,000 subscribers. Such results in a flood-wrecked city, where the burden of immediate relief to the homeless and destitute and the work of rehabilitation of the city were already taxing its resources, are a splendid tribute to the public spirit and earnestness of these men. In June the committee published a complete list of the subscribers to the flood prevention fund.

Great credit is due to the Finance Committee. This committee, under the Dayton Citizens' Relief Commission, remained in charge of the flood prevention fund, from which it has financed all work on plans for flood control, including the preliminary surveys and investigations of the Morgan Engineering Company; the employment of consulting engineers and legal assistance; the drafting of the Conservancy Act of Ohio, with all the subsequent expense of litigation, court proceedings, and defense of the law; the organization of the present Miami Conservancy District; and completion of surveys, plans, estimates, and appraisal work, under the administration of the district.

In the spring of 1918, after construction work had been begun by The Miami Conservancy District, the greater part of this fund was repaid to the subscribers. A small amount was retained as a safety reserve, as explained in the statement made by the Dayton Citizens' Relief Commission at that time, a portion of which follows:

Dayton, Ohio, April 1st, 1918.

TO SUBSCRIBERS TO THE FLOOD PREVENTION FUND:

Enclosed is a check to your order for amount of first refundment ordered paid contributors.

When this fund was subscribed in 1913 it was not known that any portion would be returned, as it was considered that the whole fund might be used for flood prevention works in Dayton; however, upon a scientific survey and study by eminent engineers it was found necessary to provide protection for the entire flood zone in the valley including Dayton, as the only proper method to afford permanent proper relief.

A large part of the fund was expended in engineering work and part of it for publicity of the engineering data and plan leading up to necessary legislation.

The wisdom of this policy is now evident, since under the Conservancy Act of Ohio a large portion of the expenditures covering the engineering data and settlement of proper claims has been repaid by The Miami Conservancy District, which sum, together with accruing interest on balances during the entire period, has made the final net expense approximately seven per cent of the net subscriptions.

This net expense, not being recoverable from the district, must be borne by fund, and should be borne by subscribers in proportion to the amount of their subscriptions called, rather than the amount of cash payments.

* * * * * * * * * *

It has been decided, therefore, that each subscriber should bear his share of the expense in exact proportion to the amount of his subscription.

This amount must, of course, be deducted from the actual payment, leaving a net amount due him.

The Committee retains a portion of the fund, amounting to approximately $325,000, as a safety reserve until The Miami Conservancy District has made the valley safe from flood. This fund will be placed at interest among competing banks and then finally distributed.
THE DAYTON CITIZENS’ RELIEF COMMISSION

In order that this two million dollar fund might be properly administered and the work for which it was intended successfully consumated, Mr. Patterson called a meeting of the Dayton Citizens’ Relief Committee June 14, 1913, at the Dayton City Club to consider the incorporation of the committee into The Dayton Citizens' Relief Commission. Judge O. B. Brown having been requested to devise a plan of incorporation was present and made his report. In accordance with his suggestion a committee, consisting of Edward W. Hanley, Walter S. Kidder, John W. Stoddard, and William F. Bippus, was appointed by the chairman to cooperate with Judge Brown in working out the details, and to consult with Honorable John A. McMahon. On June 25, 1913, The Dayton Citizens' Relief Commission was formally incorporated as successor to the various committees which were organized on April 21. The purposes of this corporation are set forth in the following articles of incorporation:

These Articles of Incorporation Of
The Dayton Citizens' Relief Commission WITNESSETH, That we, the undersigned, all of whom are citizens of the State of Ohio, desiring to form a corporation, not for profit, under the general corporation laws of said State, do hereby certify;
FIRST: The name of said corporation shall be THE DAYTON CITIZENS' RELIEF COMMISSION.
SECOND: Said corporation is to be located at Dayton, in Montgomery County, Ohio, and its principal business there transacted.
THIRD: Said corporation is formed:
(1) For the purpose of becoming the legal successor of the Dayton Citizens' Relief Committee, of which John H. Patterson is chairman, William F. Bippus, treasurer, L. D. Upson, secretary, and of which the other members are Frank T. Huffman, John R. Flotron, Edward Philipps, and Adam Schantz; and the legal successor of the Flood Prevention Committee, of said committee, consisting of John H. Patterson, chairman, Edward A. Deeds, Walter Worman, Edward V. Hanley, Walter S Kidder, John W. Stoddard and H. E. Talbott; and the legal successor of the Finance Committee of said committee, of which Edward Philipps is chairman, William F. Bippus is treasurer, and of which the other members are Torrence Huffman, Edward E. Burkhardt, John H. Winters, Thomas A. Ferneding, Eugene J. Barney, Charles J. McKee, George L. Marshall, A. M. Kittredge, Stanley Krohn, John W. Aull, Charles B. Clegg, and F. J. McCormick, Jr.; and the legal successor of the Executive Committee, of the Public Improvement Committee, of the Sanitation Committee, of the Traffic Committee, and of all other committees appointed by the said Dayton Citizens' Relief Committee or its officers; and to receive and hold the minutes, papers, books, and assets from said committees, or any other committees, acting under said Dayton Citizens' Relief Committee, and to carry out the purposes and objects of said committees; and the regulations of said corporation shall provide that there shall be a permanent Flood Prevention Committee, which shall consist in the first instance of the same persons above named who are now members of said committee, and shall also provide for a permanent Finance Committee, which in the first instance shall consist of the same members as are named in the above Finance Committee.

(2) For the purpose of raising, collecting, and administering a fund, called the Two Million Dollar Fund, for the prevention of floods in the city of Dayton, Ohio, and to become the legal successor of the Finance Committee of the Citizens' Relief Committee, of which William F. Bippus is the treasurer, and to take over, receipt for, and administer the fund called the Two Million Dollar Fund, which has now been collected or subscribed in excess of that amount, or may hereafter be collected or subscribed, payable to said treasurer, for the purpose of carrying out measures for the prevention of floods in the city of Dayton, Ohio.

IN WITNESS WHEREOF, We have hereunto set our hands this 23rd day of June, A. D., 1913.

Adam Schantz
Wm. F. Bippus
John W. Stoddard John W. Aull
Charles B. Clegg
H. G. Carmell
John R. Flotron
J. M. Switzer
Torrence Huffman
A. L. Light
A. J. Stevens
E. B. Weston

E. A. Deeds Edward W. Hanley H. E. Talbott
S. M. Krohn
John A. McGee John P. Breen
E. J. Barney
E. L. Philipps
A. M. Kittredge Walter Worman J. Edward Sauer
Frederick Cappel Thomas P. Gaddis L. D. Upson. C. W. King
E. Canby
E. L. Edwards

Regulations

ARTICLE I. Annual and Special Meetings of the Corporation.

The annual meetings of this corporation shall be held at 10:00 o'clock, a. m. on the first Monday in January of each year, the place of meeting to be designated by the president. And the trustees shall be elected by ballot at this Annual Meeting or at a special meeting called for that purpose in case no such annual meeting is held.

Special meetings of this corporation may be called by order of the trustees, or a majority thereof, at any time and by notice thereof signed by not less than ten members and mailed to each member at his last known address and by publication in two daily newspapers of the city of Dayton, not more than ten days nor less than five days prior to such called meeting.

ARTICLE II. Quorum.

It shall require fifteen members to constitute a quorum at the annual or special meetings of the corporation.

ARTICLE III. Trustees and Officers.

The number of trustees shall be thirty-nine, who shall have full power to conduct the affairs of said corporation in accordance with the purposes as set forth in the Articles of Incorporation, and to fill any vacancies occurring in said board from among the associate members as described in Article V; and shall elect by ballot a president, four vice-presidents, a secretary and such assistant or assistants as may be required,
and a treasurer and such assistant or assistants as may be required. The board and these officers shall serve for one year and until their successors are elected and qualified.

ARTICLE IV. Membership.

Any person subscribing or contributing any sum of money to the objects and purposes of this corporation and who has served upon the Dayton Citizens’ Relief Committee for the Flood of 1913, of which John H. Patterson was the Chairman, or was a member of the Executive Committee, or of the Flood Prevention Committee, or of the Finance Committee thereof, the Sanitation Committee, or the Traffic Committee, or the Public Improvement Committee; or any associate member elected to the Board of Trustees, shall become a member of this corporation by signing his name and agreeing to the articles of incorporation and these regulations.

ARTICLE V. Associate Members.

Any person contributing any sum of money to the objects and purposes of this corporation shall become an associate member. Associate members shall have the authority to meet; and advise with and suggest to the officers and trustees of the corporation any matters consistent with the purposes for which it is formed. Vacancies in the board of trustees shall be filled from the associate membership.

ARTICLE VI. Salaries.

The trustees and officers of this corporation shall serve without compensation.

ARTICLE VII. Committees.

There shall be two permanent committees:

1. The Flood Prevention Committee, which in the first instance shall consist of: John H. Patterson, Edward A. Deeds, Walter Vorman, Edward Hanley, Valter S. Kidder, John W. Stoddard, H. E. Talbott

Chairman

which committee shall have power and authority to make contracts with, or employ engineers, or engineering companies; to cooperate with any United States, state, county, or municipal authorities, and to solicit assistance from such authorities; to cooperate with any railroad company, person, corporation, or body, along the lines of flood prevention for the city of Dayton, with authority to propose and approve any plans to that end, and to authorize expenditures therefor.

2. The Finance Committee, which in the first instance shall consist of:

Edward Philipps, Chairman William F. Bippus, Treasurer Torrence Huffman
Edward E. Burkhart
*John H. Winters
Thomas A. Ferneding Eugene J. Barney

F. J. McCormick, Jr.

which committee shall have power and authority to audit all expenditures authorized by the Flood Prevention Committee, or of this corporate body; to raise funds and solicit subscriptions for the purposes of this corporation; and to cooperate with the Flood Prevention Committee in seeking further aid from the United States, state, county, and municipal authorities.

3. And such other committees as the board of trustees may determine. ARTICLE VIII. Expenditures.

No money shall be expended except by the authority of the Flood Prevention Committee and audited by the Finance Committee. All checks shall be signed by the treasurer, or his assistant, and countersigned by the president, or one of the vice-presidents, and by the secretary or his assistant.

ARTICLE IX. Proxies.

No proxies shall be allowed, either at the meetings of the corporation or at the meetings of the trustees.

ARTICLE X. Amendments.

These regulations may be amended, modified, or changed by the vote of a majority of the members at any annual meeting and upon roll-call, or at any special meeting called for that purpose, or by assent in writing of two thirds of the members.

*Mr. Winters asked to be relieved and his place was taken by Judge O. B. Brown.

MORGAN ENGINEERING COMPANY

At the request of the Flood Prevention Committee, Arthur E. Morgan, President of the Morgan Engineering Company, came to Dayton on May 5 to personally take charge of the investigations. The committee asked him to look over the entire situation, including all the valley north of Butler County. This county had already engaged an engineer to study its problem. The instructions to Mr. Morgan were, in brief: "the valley has suffered a calamity that must not be allowed to occur again. Find a way out." It was felt that the railroad and city bridges were chief causes of the disaster. There existed a tremendous determination to prevent floods, and a conviction that "dirt must be flying by fall." There
was also a desire to divert as much as possible of the expense to the Federal Government.

Edward A. Deeds, vice-chairman of the Flood Prevention Committee, in reviewing the situation created by the flood, before the conservancy court in October, 1916, said of the committee:

That committee was appointed to make a study of the flood situation and take whatever steps were necessary to prevent a recurrence of the disaster. I don't think anyone on the committee at that time had any appreciation of what was asked of it. We thought that we probably could get some local protection. In fact, we thought out some system of local protection in our small way at our first meeting. But we made a trip south, to Miamisburg and to the other cities. We went north, and we commenced to get a view of this thing in a bigger way; that there was a thing that affected the whole valley, and we saw immediately that we were not competent to handle that situation ourselves. We had had enough business experience in large matters to know that we should get assistance, and we immediately started out to locate some one who had had experience in the control of floods. Inquiry led us to the Morgan Engineering Company of Memphis.

At the first meeting Mr. Morgan indicated that the effect of local obstructions had probably been overestimated, and that the problem would not be so easily disposed of as had been supposed; that no plan of improvement should be adopted without a thorough analysis of the situation, that six months probably would pass before even a provisional solution could be offered, and probably a year before definite plans would be made; that federal aid might prove a will-o'-the-wisp and that if the people of the valley wanted flood control they should decide to get it and pay for it, for otherwise they might repeat the history of Pittsburgh and other cities which had waited many years in vain for help. He stated that the first thing to do was to find out definitely just what was needed.

The Morgan Engineering Company was formally engaged to develop plans to protect the entire valley north of Butler County. Mr. Morgan was to devote a definite part of his time to this work, with L. L. Hidinger, vice-president of the company, available for consultation and assistance in supervision. The company immediately opened an office in the City National Bank Building in Dayton. Field work was begun within two days after Mr. Morgan's arrival; and in two weeks about 50 engineers, recruited largely from flood prevention projects in the southern states, were at work in the field and office. This force was further increased in the course of a month. The general policy of developing the plans was explained to the Chief of Engineers of the United States Army and to the Secretary of War.

CONSULTING ENGINEERS

One of Mr. Morgan's first recommendations to the Flood Prevention Committee was that they secure the services of a board of consulting engineers, in order that this board might early become thoroughly acquainted with the situation and give the committee the benefit of its judgment and experience as the work progressed. The committee immediately adopted his suggestions that Professor Daniel W. Mead, consulting engineer of Madison, Wisconsin, and Professor Sherman M. Woodward, hydraulic engineer, of Iowa City, Iowa, be appointed, these two to select the third member of the board. Messrs. Mead and Woodward accepted the commission on May 5 and secured John W. Alvord, consulting engineer of Chicago, Ill., to act as the third member. General H. J. H. Chittenden was later called in as consulting engineer at various titles.

SUMMARY OF RESULTS

It would be difficult to summarize definitely the final results brought about by the various flood control and emergency committees in the valley, or to estimate the tremendous unifying effect of the flood itself. In Dayton a gratifying result of the flood and of the heroic work following, was the breaking up of life-long prejudices and factions, and the welding of the city into a fellowship of progress. Dayton's present form of commission-manager government, while under consideration before the flood, is due in large part to the reconstructive influences which followed. Each community in the valley made some effort to solve its flood problem independently, but these efforts only demonstrated the helplessness of the smaller cities to secure complete relief through local improvements, and emphasized the fact that the safety of the entire valley must be provided for under one plan. On November 28, 1913, a Butler County delegation met the Dayton Flood Prevention Committee in Dayton to discuss plans for the protection of the entire valley, and on December 9 the Butler County Emergency Commission arranged with the Dayton Flood Prevention Committee to include Butler County in plans for protection of the valley. The Flood Prevention Committee also conferred with the representative citizens of Piqua and other places.

The development of a successful policy and plans for flood control in the Miami Valley involved radical departures from timeworn methods, which created innumerable obstructions through ignorance and local prejudice.
All the momentum and stability that the combined efforts and cooperation of these groups of men could give were needed to guide the work safely through the many difficulties encountered. The chronology of the project, given in chapter IX, presents an example of steady, constructive progress that was attained only through investigation and preparation for every contingency. The progress made toward flood control in the valley is due largely to the members of the Flood Prevention Committee and to the people of Dayton who believed in them and gave them support. The committee was quick to see the various needs, to make accurate appraisals of situations, to define sound policies, and having outlined their program had the wisdom to see it consistently through to the end.
CHAPTER II. - PRELIMINARY REPORTS

This chapter is composed of extracts, arranged so far as practicable in chronological order, taken from various official reports dealing with the flood situation and the evolution of the flood protection plans during the first year following the inception of the work. The reports utilized include one prepared by a board of U. S. Army Engineers, a preliminary report and a later progress report of the Morgan Engineering Company, two reports from the regular consulting engineers of the project, two reports of the Dayton Flood Prevention Committee, a report of a special board of consulting engineers, and a report prepared by the attorneys and counsel employed on the project.

Some of these reports are given in full, but in order to save space others are given in part only. The portions omitted repeat matter given elsewhere, or deal with details unimportant to the general history of the project. Most of these reports have previously appeared somewhere in print.

EARLY REPORTS

Immediately following the flood of March, 1913, numerous reports were printed, describing the effects of the flood and suggesting various plans for future protection against such conditions. Many of these reports, though having the semblance of engineering data, were hastily prepared, were based on insufficient and inaccurate information, and contained estimates which were necessarily incomplete and therefore misleading. The public desire that actual construction be started at once operated to make such immature plans a real menace to the best solution of the problem for places which most needed protection. Passing mention is made of this only to indicate one of several sources of the opposition that developed rather to the working out of an effective plan for protecting the entire Miami Valley.

In marked contrast to such reports is that made to the Chief of Engineers, U. S. Army, on May 26, 1913, by the Board of Army Engineers composed of:

Lieut. Col. Francis R. Shunk
Lieut. Cot Henry Jervey
Maj. Charles S. Bromwell
Maj. John C. Oakes
Maj. FrederickW. Altstatter
Maj. Lewis H. Rand

The following quotations are taken from the report:

REPORT OF ARMY ENGINEER OFFICERS

3. Acting as it understood its instructions * * * *, the Board has endeavored to meet the wishes of the localities visited by giving them the benefit of its experience. It was found that in general immediate decisions were desired on matters the factors or which were so complicated that results could be expected only after thorough concentrated study, and that due to lack of data and time such decisions at this time are impossible.

5. * * * * * It would appear that the first requisite for the prevention of interference with interstate commerce and indeed for the protection of the railroads themselves should be the exercise by some central body of supreme control of bridges and their approaches. This control should extend to city and county bridges of which numbers were destroyed by the flood.

7. While the flood in many places was the worst on record, there is no reason why even worse ones may not be expected in future.

8. The Board finds that the damage caused by these floods may be divided into two well marked classes, those due to high water and those due to strong currents. Damages of the first class to some extent and those of the second class to a very large extent were caused by artificial contractions of the river channels and their adjacent flood plains. Building lines have been pushed forward into the streams, bridge abutments have been carried out beyond proper limits, piers so placed as to further choke the channels, and deck bridges with insufficient vertical clearance have been used instead of through bridges at proper elevations. On the flood plains, cities and towns have been so located as to act as dams, and railroad embankments have been carried from bluff to bluff. All these, by backing up the water above them, caused differences of level which developed currents of high velocity, in some cases sufficient to carry heavy bridge girders six or seven hundred feet. And these currents it was which caused the unusual damages of the late floods, such as destruction of houses and bridges, tearing up streets and loss of life. Mere high water, although bad enough, would not cause a catastrophe such as the late flood in the Miami Valley, but it is obvious that the height of the water in many cases was greatly increased by the artificial obstructions above mentioned.

9. The Board is at present not prepared to recommend means of preventing the occurrence of high stages in the rivers due to excessive rainfall.

10. Damages of the second class, due to high velocities, can in the opinion of the Board be almost entirely prevented by removing obstructions from the river channels and flood plains, by enlarging the channels where their natural dimensions are insufficient, by building levees where overflow of the whole flood plain is not desired and possibly by providing diversion channels. As an example of what may be done it is deemed proper to give an account of the plans tentatively worked out for Columbus, Ohio.

14. Columbus, Dayton, and Hamilton have provided for such surveys as are necessary for their own particular purposes, but so far as the
Board knows no comprehensive survey is being made that includes all of the information necessary for solving the problem of flood control of any stream in the Ohio River basin. Many partial surveys have been made, but very few complete surveys have been made including all the data necessary for the determination of all questions of river control. In the whole Ohio River basin only one survey has been made which includes topography of the flood plain and discharge measurements as well as the ordinary information relating to meanderings of the stream, and its varying depths. The Board recommends that in future whenever a survey by the United States is made to determine questions of navigability such survey shall include all data necessary to determine questions pertaining to regulation and uses of the stream.

15. As to its further operations, the Board is of opinion that, in accordance with its instructions, the whole subject of floods and their prevention should be fully investigated. * * * * *

FIG. 9.—PENNSYLVANIA RAILROAD BRIDGE AT PIQUA. View taken March 28, 1913, when the flood was subsiding. Note debris on the lower chords.

16. The Board has been much impressed in its examination by the evils of divided control of the water courses. The obstructions which have been placed along the various streams ought never to have been put there and their construction should have been prevented, but since the control of rivers is in the twilight zone between the spheres of Federal and State authority it developed that what was anybody's business was nobody's business and no effective authority has been exercised by anybody. These rivers are feeders of a navigable stream and have an important effect upon the regime of the Ohio River, and it is the opinion of the Board that the authority of the United States should be exercised to prevent encroachments upon them exactly as in the case of navigable streams. It is believed that this is the only method of control which promises good results in practice. The Board further urges that immediate steps be taken to exercise such authority since bridges and other structures are to be rebuilt at once and there is evident danger in several places that they may be rebuilt in an obstructive manner.

For the Board:

Francis R. Shunk,
Lt. Col., Corps of Engineers,
Senior Member, Board of Officers on River Floods.

It will be noted in the foregoing that the board was "not prepared to recommend means of preventing the occurrence of high stages in the rivers due to excessive rainfall", and that it offered no plans for the protection of any community in particular. It made a general analysis of the flood problem, and definite recommendations as to what steps should be taken to aid in its solution. The report placed particular emphasis on the need for more complete and comprehensive surveys and collection of engineering data to enable the making of definite plans and estimates. In urging proper control of streams and definite supervision over bridges the board indicated the necessity of cooperation between the various communities along a water course.

PRELIMINARY REPORT OF MORGAN ENGINEERING COMPANY

At the time of this report the examination of the Miami Valley was only fairly begun. As the Morgan Engineering Company proceeded with its various surveys, the collecting of data, and the making of preliminary
investigations, a plan was gradually evolved for the protection of the valley against floods. The early progress in the development of this plan is described in the following preliminary report of the Company under date of October 3, 1913:

Dayton, Ohio, October 3, 1913.

The Flood Prevention Committee of the Dayton Citizens' Relief Commission, Dayton, Ohio.

Gentlemen:

We wish to report the progress of the Miami flood prevention survey to date. You instructed us to make surveys and to prepare plans for the protection from floods of the city of Dayton, and also of the cities of Miamisburg, Troy, and Piqua, and all other towns in the watershed of the Miami River north of the south line of Montgomery County; and also to plan the reclamation of the agricultural lands in the valley of the Miami River and its tributaries. Our work has been in accordance with these instructions. It has been our aim to investigate every possible method of flood protection in order to be assured that no possibilities were overlooked. We have determined that a number of the suggested methods are entirely impracticable. Among these are projects for diverting the Miami and the Mad Rivers into the Little Miami; for diverting the Miami and the Stillwater Rivers to the west and north of the city, and for diverting the Miami and Mad Rivers to the east of the city, near Harshman.

The following projects are found to be feasible, though further investigation is necessary to determine fully their comparative merits and cost:

DIVERSION CHANNELS

First: Two storage reservoirs on the Stillwater River, with the diversion of Mad River through the city along or near the route of the old Miami and Erie Canal, and the improvement of the present channel to carry only the Miami River.

Second: Two storage reservoirs on Stillwater River, with the diversion of the Miami River from a point near the west end of Old River north of town, thence south to a point east of the Gas Works; and thence the diversion of both the Mad and Miami Rivers south along the old Miami & Erie Canal, crossing the present course of the Miami River above the Stewart Street bridge, and thence southwesterly two miles or more. In working out this plan, it may prove better to follow a route east of the canal where property is cheaper, as the Miami River can be diverted into the Mad River at any point between their present junction and the Erie Railroad bridge east of town.

Third: The diversion of the Mad River into the Miami and Stillwater north of town, and the diversion of all three streams from a point near the Steele Dam, southwesterly along the old Miami Boulevard into the river near the Dayton View bridge; thence following the present course of the river to the mouth of Wolf Creek and thence southwesterly to the southern limits of town, and for two miles or more beyond. As variations of this plan, it might be desirable to build reservoirs on Stillwater River, and it might be desirable instead of icaving the river at the mouth of Wolf Creek, to follow the river from the Dayton View bridge to the Washington Street bridge, and thence to make a diversion channel in a southwesterly direction.
IMPROVING THE PRESENT CHANNEL

Fourth: The improvement of the river channels throughout the city; removing all of the concrete bridges and replacing them with steel-truss bridges, with not more than two piers in the channel. It is practically impossible to confine an extreme flood to the present channel with the concrete bridges in their present condition.

Fifth: The improvement of the river channels leaving the concrete bridges in the channel, but deepening their foundations from 10 to 20 feet. While we believe this method of improvement is feasible, we have not yet completed plans for deepening the piers.

Sixth: Straightening the Miami River channel by rounding off some of the sharpest bends, and at the same time increasing its size. In such an improvement, a strip of land east and west from the north end of the Main Street bridge would be taken, as well as the point of land along the east end of the Dayton View bridge. It would also be necessary to take a strip of land along the east side of the river extending from the Main Street bridge past the Dayton View bridge toward the Third Street bridge. This would require the removal or modification of the concrete bridges.

Seventh: Raising the levees. In the plans heretofore mentioned, it is intended to keep the water line below the present tops of the levees. We are also determining the cost of raising the levees, improving the channel, and lifting the concrete bridges to higher elevations. While this method of improvement seems to be feasible, it would have the disadvantages that street grades approaching the bridges would be steeper; that the higher stage of the water during a flood would tend to be a menace to the city, and that higher levees would be a detriment to the adjoining property.

Of the foregoing plans, those for the improvement of the present river channel are the most difficult to deal with because of the bridges; of the tendency of the water to pile up at the outside of the bends in passing around the bends; of the necessity for paving the sides and part of the bottom of the channel with concrete to prevent the erosion which would result from high velocities, and especially the great loss of velocity at the bends in the river. * * * * *

If the bridge openings were left in their present condition, except for protection to the piers, the water level at the Herman Avenue bridge would be more than 10 feet higher than if there were no bridges to obstruct its flow. These few figures are given only to indicate the difficulties of the problems encountered in planning the improvement of the river channel. The present river channel, with the water flowing at the top of the levees, would carry less than half of the flood of last March.

STORAGE RESERVOIRS

Eighth: At the time we began our investigations, we did not believe that complete flood protection could be secured by storage reservoirs, and our investigation of this means of river control was carried out chiefly because it has been our policy to examine carefully every possible method of improvement.

We find upon examination that due to the alternate widening and narrowing of the valleys of the Miami, Mad, and Stillwater Rivers, they are peculiarly adapted to the construction of reservoirs. Many of these reservoir sites are made impossible by the locations of towns or railroads. We have investigated all of the more practicable sites over the watershed, and have determined upon six which fully meet the requirements.

We have not completed estimates for any other methods of improvements, but have progressed far enough to make reasonably certain that if all the interests which are affected bear their fair proportions of the cost, flood protection for the Miami Valley can be secured by a system of storage reservoirs more cheaply and more quickly than by any other method. We have outlined a system which will give complete relief from floods to the entire Miami Valley from near the headwaters of the Miami River to the Ohio River; to the Stillwater Valley from West Milton Wits outlet; and to the town of Osborn on the Mad River.
COST OF RESERVOIR SYSTEM

The biggest item of cost in the system of storage reservoirs would be the land taken. As the reservoirs would be empty during the crop-raising season of each year, and as the ponding of the water during floods would tend to prevent soil erosion, and would cause fertile mud to be deposited, the productive value of the lands within the reservoir would probably be increased. However, as it may be necessary to purchase a large part of these lands in securing right-of-way, we have included in our estimate of costs about half the total value of the lands below the water line during the most extreme floods; such as occurred last March. A large part of the lands in the reservoirs would not be covered once in 20 years.
We estimate that with two reservoirs on the Stillwater River, two on the Miami, one on Loramie Creek, and one on Mad River, the extreme flood flow at Dayton would be reduced to not more than one-fifth, and at Hamilton, near the mouth of the Miami, to about one-third of the greatest flow during the March flood.

A system of reservoirs, the sole object of which would be complete flood prevention in the Miami Valley, would cost about $12,000,000. It is possible that it complete detailed estimate will show a considerable less cost, but such a possibility cannot be counted upon at present. If the National Government should cooperate toward a more extensive system in order to store water to raise the low stages of the Ohio River and to further reduce floods in the Ohio Valley, the cost would be increased.

We are not sufficiently familiar with river conditions at Hamilton to state the capacity of the Miami at that place. We believe that the flood protection afforded by this system would be sufficient for all purposes in the Miami Valley. Should it appear, however, that the city of Hamilton should require further protection, it can be secured by the addition of another reservoir on Twin Creek, above Germantown. This would have the added advantage of protecting Germantown from a recurrence of the damage of last March, and also of protecting the agricultural lands along Twin Creek. The cost of this additional reservoir was not included in the above estimate, as we believe it will not be necessary. In this estimate for reservoirs we have considered only flood protection, and have not included parking or other improvements along the river in Dayton, or the cost of additional capacity of reservoirs for water power. In one instance, it may be profitable to go to additional expense to develop water power. This would result also in the formation of a permanent lake near Dayton.

In view of the fact that the city of Dayton, as well as all other cities in the Miami Valley, can secure protection most economically by cooperating in the construction of a system of storage reservoirs, we believe that it would be desirable for the committee at once to get in touch with the flood prevention committees in all parts of the valley to the end that such cooperation be secured. In the case of the small cities like Miamisburg, and in case of agricultural lands in the valley, this method would result in complete security at a moderate cost, whereas their condition is hopeless if they must rely on their own efforts for local protection.

In designing these reservoirs, it seems desirable not to adhere closely to engineering practice in the construction of dams. The interests involved are so great that it is desirable to plan dams of heavier and larger section than is usual. Our plans in this regard may be criticised by engineers as unduly large and expensive, but it seems necessary that there should be left no room for doubt as to the absolute and complete security of such a system.

To protect the entire valley by means of reservoirs would require about half as much time as to protect Dayton alone by local works. We estimate that two to three years would be necessary to complete the construction of a reservoir system, after the legal proceedings make construction possible.

We are continuing our work on other methods of protection, but in view of the great amount of work involved in making accurate comparisons it will be some months before a final report on all methods of protection can be submitted. Our investigations have gone far enough to indicate that the cost of protection to the city by local works will not be less than $7,000,000 nor more than $10,000,000.

Respectfully submitted,

MORGAN ENGINEERING COMPANY,
By Arthur E. Morgan.

As the feasibility of the plans outlined in the above report depends largely on the cooperation of the cities and towns in the valley, it was thought best to give full publicity to the possibilities even though the information at that time available was insufficient to permit a thorough cost analysis. Channel improvements would be purely local in effect and very costly. It would be difficult and expensive to secure the needed right-of-way through cities, and each improvement would tend to increase the difficulties of protecting other points in the valley below. These facts showed the advantages of a plan of reservoir control that would protect the entire valley. Effective cooperation of the various communities affected, for carrying out such a plan, was not possible under existing laws. It was evident that new legislation would be required, and the work of assembling data for the preparation of the bill for the state legislature, which had already been begun by Mr. Morgan, was given particular attention. The tentative conclusions outlined by the Morgan Engineering Company were substantially endorsed by the following reports of the board of consulting engineers.

REPORTS OF THE CONSULTING BOARD

Dayton, Ohio, October 25, 1913.

Morgan Engineering Co.,
Dayton, Ohio.

Gentlemen:

At the time of our previous visit to Dayton in connection with this work, a very limited, general examination led us to think that the most suitable works for the protection of Dayton would probably be found to be in the line of channel improvements rather than in reservoir construction, since under similar conditions elsewhere such has usually been found to be the case.

The investigations of your various field parties indicate that unusually favorable reservoir sites exist in this valley. From the data laid before us, this method of flood protection seems to be the most feasible of any method yet investigated, and therefore demands most careful consideration and investigation.

The amount of data at hand is so considerable as to render it impossible for us, without more study, to properly digest all the facts on which
our opinion on this project must be predicated; and still less to arrive at definite and final conclusions in regard to the practicability and cost of the tentative plans before us.

After the receipt of such specific and detailed information concerning these various reservoirs as is now available, and will become available as the surveys of your various field parties are completed, we will give this matter our early attention, and hope to furnish you definite opinions as early as possible. The importance of the stability and safe operation of reservoirs situated above the city of Dayton demands the most careful and complete study before a final decision is made.

We understand that all other practicable projects for local improvements, or local improvement in combination with more limited reservoirs than those now contemplated, will also be carried through the stage of preliminary design and estimate, in order that proper comparison may be made of all available methods of relief. We heartily endorse such comparative study, as we cannot express an opinion as to the relative merits of a reservoir system compared with other feasible systems of flood protection until the data furnished by such an investigation is available.

A reservoir system, if ultimately found as economical and efficient as seems reasonably apparent from our limited examination of the data now available, would at least materially reduce the necessity and expense for local betterments to all of the municipalities below such reservoirs, and would probably greatly reduce the cost of ultimate betterments to each of the municipalities benefited thereby.

It is evident, therefore, from the investigation made, that the prospects are so good for an economical reservoir system to constitute the chief, or at least a leading feature of the necessary betterments, and the effect of such a system of improvements is likely to be so important—not only to Dayton but to many other municipalities in the Miami Valley—that it now seems that some co-ordinate action between these municipalities is of the utmost importance.

We recommend, therefore, that immediate action be taken looking toward the formulation of suitable state legislation permitting coordinate action, both on the lines suggested and on such other lines as may be required by the conditions at other points within the state.

Respectfully submitted,

D. W. Mead,
J. W. Alvord,
S. M. Woodward, Consulting Board.

Dayton, Ohio, January 17, 1914.

The Flood Prevention Committee,
Dayton, Ohio.

Gentlemen:

As requested, we met in Dayton January 16 and 17, 1914, and have together reviewed the studies suggested by us and completed by the Morgan Engineering Company since our last meeting on October 25, 1913, as well as the data which has been sent us from time to time since then, and which we have individually considered prior to this meeting.

Much progress has been made during this interval in ascertaining the probable effect of a reservoir system under various conditions, and in securing further information as to channel improvement. Since our last meeting, the territory to be considered has been extended to include practically the entire Miami Valley, including the cities of Hamilton and Middletown. This will materially extend the work in hand, but will also simplify the general problem in many ways. Further data must be secured for the proper consideration of this additional territory, which will take some further time.

Regarding the questions before us, we report as follows:

Flood protection must usually consist of:

1. Channel improvement, including levees, to provide for the safe passage of floods; or
2. Reservoirs for the partial or entire retention or delay of flood waters until they can be safely and slowly released; or,
3. Such combination of channel improvements and flood reservoirs as the local conditions may render most practicable.

These methods of flood protection are not new, are based on thoroughly established engineering precedent, and are not solely a matter of theory.

We find that the cost of satisfactory flood protection to life and to the property interests of the Miami Valley by channel improvements alone will be so great as to render such improvements impracticable.

We find that the regulation of the Miami River and its tributaries for the protection of life and of the various public and private property interests from the ravages of flood can best be accomplished by the construction of suitable flood reservoirs, together with moderate channel improvements, where needed.

The construction of earth dams, and the impounding of water in reservoirs thus created, for the purpose of flood prevention is sound engineering practice:

1. When physical conditions make such reservoirs feasible.
2. When the structures are properly designed, constructed, and maintained.

We find the topographical and other physical conditions in the Miami Valley suitable for this purpose.

The proper design, construction, and maintenance of these structures is absolutely necessary for the safety of the lives and property lying below them. For this reason, we emphasize the necessity for the greatest caution in each step of the improvement, which must be considered solely on the basis of the welfare of the district, and must be entirely divorced from false economy or political expediency.

We find that the plans outlined by the Morgan Engineering Company for the location and construction of these structures are, in general, satisfactory.

As detailed plans are not yet prepared, we reserve the right to criticize such plans when completed, to demand any modification in such plans, and to insist upon such care in construction as may be found necessary for the safety of said structures.

Reservoirs are frequently used for the development of water power and for other purposes besides flood prevention. Such uses, however, are essentially antagonistic to the purposes for which these reservoirs are recommended in this valley. The use of these structures as "dry reservoirs" to impound flood water only during flood periods and to remain dry during other conditions of flow, adds so greatly to their safety and stability, that we strongly advise that they be utilized for flood prevention only and not for any other purpose.

Until surveys, plans, and estimates are more nearly completed, it is impossible to determine to what extent, if any, collateral channel improvements will be necessary at various points in the valley. We are convinced, however, that by combined action among the several municipalities and property interests, the system of reservoirs proposed will so greatly reduce the cost of necessary channel improvement as to make the total cost of adequate flood protection very materially lower to each separate interest.

No combined action of all of the interests needing flood protection in the Miami Valley is practicable under the present laws of Ohio. The bill now prepared for this purpose, known as the Conservancy Act of Ohio, seems to fully cover the needs of the situation so far as they can be ascertained at this time, and only by adequate legislation will the necessary combined flood protection works in the Miami Valley become practicable.

In general, the cost estimates of the Morgan Engineering Company seem reasonably sufficient, but the total cost of these improvements cannot be closely determined until detailed plans are made and finally adopted. Based on the general estimates so far made, our belief is that the total cost will be reasonable and much below the benefits resulting to the territory to be protected.

We find that the improvements thus far tentatively outlined, if properly installed, would have furnished satisfactory protection to the various municipalities from a considerably larger flood than that of March, 1913.

The system as outlined, with such modifications in detail as may be found essential, will give safety against flood and to the property interests in the valley against great floods, and we would advise that work be continued on the assumption that a reservoir system will constitute the dominant feature of the protection work, which will be supplemented by such moderate channel improvements as may be found necessary in each locality.

As previously stated, the safety of the works proposed is dependent on the care and thoroughness with which the physical facts are determined and with which adequate plans are matured to meet such physical conditions. No false idea of haste should be permitted to detract from the care
with which the preliminary work is done. We commend the thoroughness which has characterized the work to the present time, and urge that there be no relaxation of vigilance in securing the maximum safety and economy in the design, construction, and maintenance of these important works.

Respectfully,
D. W. Mead,
J. W. Alvord,
S. M. Woodward, Consulting Board.

ENGINEERING DATA

In the spring of 1914 the Morgan Engineering Company issued a volume containing over 100 pages of typewritten text accompanied by many blue-printed tables, diagrams, and computations, presenting the most complete collection of general information and engineering data relative to the undertaking that had been made up to that time. References were made to such pamphlets, bulletins, reports, maps, and other data as could not conveniently be included. While the volume was not presented as a formal report, it was available to anyone interested in the work. Its contents have been revised according to the later investigations and will be found in other volumes of the technical reports.

On the first page of the text the volume is stated to be a "general outline of the work already done and the principal data involved . . . . . . . together with a list of the most pertinent data available in the office. . . . . . . which may be seen on request." One immediate and important purpose it served was to aid in presenting the whole problem to a special board of consulting engineers. In reviewing this volume of data, the Engineering Record, in its issue of March 28, 1914, stated that the "hydraulic studies made by the Morgan Engineering Company have been both more extensive and intensive than any heretofore made in this country or abroad on a single project."

SPECIAL BOARD OF CONSULTING ENGINEERS

In March, 1914, a special board, consisting of eight members, was engaged to examine and report on the plans:

1.-As to the adequacy of the general plan proposed.
2.-As to whether other plans may be substituted to advantage.
3.-As to whether any modifications in the plans proposed may be made which will result in safer, more adequate, or more economical protection works.

The following extracts taken from the reports of the Dayton Flood Prevention Committee and the special board of consulting engineers explain the origin and the work, and state the findings, of this special board.

Report of the Dayton Flood Prevention Committee

To The Dayton Citizens' Relief Commission, Dayton, Ohio.

Gentlemen:

Your committee takes pleasure in presenting the complete report received from its special Board of Consulting Engineers. The eight engineers constituting the board were called in at a time when the plans that had been prepared by the engineering firm employed by this committee were at such a stage that a thorough investigation and an intelligent decision were possible. The stage in the proceedings toward securing flood protection for the Miami Valley was not so far advanced, however, but that material changes in the plans might be made without prohibitive loss or delay.

Feeling greatly its own responsibility in the matter and realizing that the issue at stake in the Miami Valley is too enormous to countenance other than the widest experience and 1110st conservative judgment, the committee deemed it, therefore, a most opportune time to have the intelligent opinion of a board of experts on the work proposed.

It is with renewed confidence that it presents this report, formulated only after the plans had been subjected to a critical analysis from the many different viewpoints of the individual members of the board.

Respectfully submitted,

Dayton Flood Prevention Committee.

Report of the Special Board of Consulting Engineers

Dayton, Ohio, March 26, 1914.

Committee,
Dayton, Ohio.

Gentlemen:

The special Board of Consulting Engineers, convened under your direction to consider plans for the prevention of flood damages in the Miami Valley, has the honor to submit the following report:

INTRODUCTORY

The flood of March, 1913, in the valley of the Great Miami River, was so destructive of life and property as thoroughly to arouse public sentiment to the necessity of preventing the recurrence of a similar disaster. Before the overflow had disappeared from the streets of Dayton, in which city the losses from the flood were greatest, a Citizens' Relief Committee was appointed by the Governor of the state, and this was later enlarged to a membership of about forty. A campaign for raising a fund of $2,000,000 was started, and was brought to a successful conclusion on May 27. For the proper administration of this fund, the Relief Committee was legally incorporated under the name of the Citizens' Relief Commission. The work of this organization has been mainly carried on by a committee, which is officially known as the Dayton Flood Prevention Committee, and is in close touch with the work of similar organizations throughout the valley. It is through the initiative of this committee that most of the measures thus far carried out have been accomplished.

Organization-The active agency for executing the purposes of the Flood Prevention Committee has been the Morgan Engineering Company, of Memphis, Tenn., which was retained for the work in May, 1913. Mr. Arthur E. Morgan, of this firm, has given the work his personal attention most of the time since, and has been advised therein by a consulting board, consisting of J. L. Alvord, of the engineering firm of Alvord and Burdick, Chicago, Daniel Mead, Professor of Hydraulic Engineering, University of Wisconsin, and S. VI. Woodward, Professor of Hydraulics, of the State University of Iowa, Iowa City, Iowa. Under this organization an immense amount of work has been accomplished, including surveys of nearly the entire flood plain of the main stream, surveys of seven reservoir sites on the main stream and tributaries, investigations, including estimates of cost, of the practicability of channel enlargement, and of flood control through the agency of reservoirs, and an exhaustive study of the storm of 1913 and researches as to other forms and the liability of the recurrence.

Conservancy Act-The most important single result accomplished to date is the passage by the Ohio State Legislature of the Conservancy Law of Ohio, designed to provide the legal machinery for carrying projects of flood protection into effect. The act was signed February 17, 1914, and on the following day the petition required by law, as a preliminary for the organization of districts there under, was duly filed with the Court of Common Pleas, of Montgomery County, asking for the formation of a Conservancy District for the control of floods in the Great Miami valley. The date for the hearing upon the petition required by the law was set for March 20, 1914.

Special Board of Consulting Engineers-To assist the petitioners in presenting their case at the hearing before the Common Pleas Court, as well as to pass upon the sufficiency of the plans of flood control so far developed, a special board of consulting engineers was summoned by the Flood Prevention Committee to meet in Dayton about ten days prior to the hearing, with the expectation that the members would remain throughout the hearing and give testimony before the court.

Examination of Local Data-The special board began its work by visiting all the more important points in the Miami drainage basin, which are in any way brought into this flood investigation. These trips included visits to the several reservoir sites proposed, inspection of flood effects in Dayton and Hamilton, and a general view of the valley from Hamilton to the headwaters of the main stream and some of its principal tributaries. During the progress of these examinations, and since, the mass of data assembled by the Morgan Engineering Company has been critically examined and further light sought on all doubtful points.

Reliability of Data-It may be stated at this point that careful investigation convinces the board of the general reliability of the data presented. The Morgan Engineering Company has prosecuted its difficult task with a degree of intelligence and honesty of purpose that gives confidence in the general accuracy of its work. The necessity of preparation on many details at an earlier period than was anticipated at this stage of the proceedings has led to some work which has not yet been carefully rechecked, and the detailed plans of the reservoir scheme cannot be completed for some time to come. These matters, however, all pertain to the official plan to be adopted after the district is organized. The board considers the data available at the present time sufficiently comprehensive to determine the question of the necessity and practicability of the proposed scheme of flood control and the advisability of forming a conservancy district for carrying it into effect.

**********REMEDIAL MEASURES

Intensity of Flood Flows to be Provided For-In considering plans for the prevention of future flood disasters in the Miami Valley, the question arises as to whether it will be sufficient to provide for a flood like that of 1913, or whether provision should be made for a still greater flood. So far as existing records go, there has never been in the valley an overflow equal to that of 1913. It is possible that the quantity of water which passed down in the flood of 1.805 was equal to that of 1913, but the bottoms being unobstructed by artificial works may have carried it without so great an overflow. The information available is not sufficient to decide this point. The flood of 1886, though a very great flood, was clearly of smaller magnitude than that of 1913. In studying the record of storms which have occurred in the Ohio basin, it appears that at least one storm—that of October, 1910, in eastern Missouri, western Kentucky, and southern Illinois—exceeded that of 1913 in intensity and the area of territory covered. If that storm had fallen upon the watershed of the Miami River it might possibly have produced a greater flood than that of 1913, though the season of the year would have been favorable to a considerable storage as ground water. The board considers it within the limits of probability that a flood as great as that of 1913, or even greater, may at any time occur in this valley, and recommends that protection works provide for a material factor of safety over the recent flood.
Sufficiency of Data

Before taking up the specific consideration of possible plans for relief, a brief statement may here be given of the sufficiency of the data furnished by the Morgan Engineering Company relating to flood flows and other elements of the general problem.

Surveys-The Morgan Engineering Company has made surveys of the Miami Valley from the Port Jefferson Reservoir to the Butler County line, and of the valleys of W01€ Creek, Mad River, Stillwater River, Loramie Creek, Twin Creek, and numerous small tributaries; these surveys covering the flooded areas and also, in more detail, the sites chosen for the detention basins. These surveys have been made by approved and customary methods and in a way to eliminate significant inaccuracies by frequent checks on a control line of U. S. Government bench marks, at intervals of from two to five miles, and by independent survey lines. We have examined, in considerable detail, these data and are of the opinion that they are reliable and dependable for the purpose intended.

Flood Measurements-The volumes of flood flow, during the flood of March 23 to 27, 1913, have been computed by carefully ascertaining the elevations of numerous well defined high water marks in various parts of the valley, and then determining the flow past any given point by
ascertaining, by well known and recognized formulae, the velocity corresponding to that slope through a cross section having the hydraulic properties there existing.

Several of the flows have been checked independently by calculating the flow through bridge openings, or contracted waterways. All estimates of flow have been checked by different computers and the close correspondence between the flows obtained by these two independent methods is a substantial check on their accuracy.

In this connection, we recommend that current meter gageings be continued for a long period at several points on the main stream and its tributaries until reliable rating curves are secured through all stages ordinarily reached by these streams.

Borings--Borings have been sunk at some of the dam sites, but not in such a way as to permit satisfactory samples of the subsoil to be collected. A method should be devised that will give samples of the subsoil as naturally occurring and a sufficient number of borings should be made to show the character of the soil, both at the dam sites and at the proposed borrow pits.

Capacities of Detention Basins--The capacities of the proposed detention basins have been calculated from the maps of the U. S. Geological Survey, checked, roughly, by actual cross sections of the valleys at intervals of about two miles; one of the basins has been completely surveyed, and checked closely with the estimated capacity determined as above. Further detailed surveys are in progress covering all of the basins.

. Meteorological Data--The data that has been collected and tabulated by the Morgan Engineering Company and presented to us for consideration are the most obtainable at this time. We consider it desirable that an adequate number of stations be maintained, and that several of these be equipped with automatic recording instruments.

POSSIBLE PLANS FOR RELIEF

Usual Measures of Flood Prevention--The board will no more than refer to those obvious measures of protection, such as flood warnings and police measures. designed to protect life and remove property from the path way of a flood when its occurrences seem imminent. These are not matters that fall within the province of the present investigation, although they are themselves of the very highest importance. The following discussion will be confined to such measures only as are necessary for the prevention of overflows from great floods. There are two general methods, distinct in principle from each other, by which the result can be accomplished.

The first is by the enlargement of channel cross sections by dredging, deepening, widening, and the removal of obstructions or the construction of levees. Enlargement by excavation will not be permanent, and it sometimes happens that the course of development on the banks of streams makes the efficient use of levees impracticable owing to the necessary changes of grades, bridges, etc., and the difficulty of handling sewage and the tributaries. These drawbacks may be of such magnitude as to compel a resort to the second method of flood control, namely, by works designed to restrain the flow of the streams for a period after the storm has fallen upon the watershed.

This the "reservoir" system of control of floods. It is not a new system, though comparatively few reservoirs have been built for the exclusive purpose of flood protection. In principle the system is ideal, because it means the detention, or holding back, of the excessive flow of the streams, and letting the waters out gradually. The great advantages of this method are frequently offset by the difficulty of filling suitable sites within reasonable cost. The necessity of flooding villages, farms, highways, and railroads may make the best of reservoir sites impracticable of utilization. It thus results that neither of the methods above outlined is of universal application. Each has its advantages, and each may be exclusively employed in a situation adapted to its use.

Channel Enlargement by Deepening and Widening--Coming to a specific consideration of the first method of control, namely, by channel enlargement, it may be stated that, in the problem here under consideration, it is the opinion of the board that this method is impracticable. Aside from its excessive cost, the method itself is defective. It is calling upon the river to maintain a channel of regular dimensions, while the nature and tendency of the stream are just the reverse. The Miami River, like all rivers, consists of a series of pools and bars. Remove the bars by excavation, and the river immediately sets at work to restore them. Excavate the channel below the mouths of the tributaries, and these streams immediately begin to cut back their beds until natural slopes are restored, pouring into the river during this process a large amount of channel-choking material. The size of the channel to carry safely a flood volume like that of 1913 would be many times its present cross section. ** ** While it would be physically possible to dig such a channel, it would not even then give permanent flood control. The high velocities of even a moderate flood might readily throw up barriers of gravel and rock, as was done in the recent flood, in which case the channel capacity would be greatly reduced, if not obliterated. The tendency would continually be toward a return to its original condition, and its maintenance would require constant work. It is practically certain that if the channel were once enlarged and then left to itself for a few years, it would not be in condition to do the work expected of it during time of flood.

The lining of the bed with concrete or stone would be an undertaking too great to deserve serious consideration. Then there is the cost of maintenance, which, though indeterminate in amount would surely be very great.
**Channel Enlargement by Levees**

As to the use of levees, the situation prohibits any extensive increase in their present height. It might be possible to raise the levees with a limited amount of widening of the river channel so that the stream would carry a flood like that of 1913, but they would have to be raised to such a height as to require a complete change of grade of railroads and cause steep gradients of approach at the several street crossings, together with a reconstruction of the bridges on the river. There would also be the problem of disposing of sewage during periods of high water, and of leveeing the tributaries back from the main stream to high ground. In cities where the banks of the river are already fully occupied and solidly built up on both sides, the necessary changes involved in a levee system make the cost of that system prohibitory.

While it is perhaps possible for an individual community to protect itself by means of channel improvement and levees, the initial cost and maintenance of such flood protection might far exceed the expense of protecting the entire Miami Valley by means of detention basins. Taking all into consideration, however, it is the conclusion of the board that channel enlargement, applied generally to the Miami River, is not a practical method of affording full protection from a flood like that of 1913 throughout the Miami Valley.

**Detention Basins**

The control of the Miami floods through any form of channel enlargement being thus accepted as impracticable, there remains the second principle of flood control to be considered, namely, that by use of detention basins. As already stated, this system of control is ideal, and were it not for the difficulty and expense of securing the necessary sites, it would undoubtedly find far wider application. It is the only method that promises general relief to the Miami Valley, and, unless it can be applied there, it will be necessary to accept the view that, although certain to occur, no adequate means of protection from future calamitous floods appears to be available.

**Sites Considered Eligible**

A sufficient number of practicable basin sites has been found in the Miami Valley and its tributaries. Two of these sites are on the main stream, namely, at Port Jefferson and Taylorsville; two on the principal eastern tributary-Mad River; one on the principal western tributary-Stillwater River; one on Loramie Creek, and one on Twin Creek.

**Earth Dam Construction**

The board favors the use of earth dams for making the detention basins, as those are best suited to the topographical and geological formations.

**Outlets Permanently Open**

The outlets of the basins will be permanently open and will be of such capacity that the ordinary flow will pass without any accumulation behind the dams; but in time of high water the surplus, after the discharge reaches a certain stage, will be detained in the basins, and the outflow will be regulated to an amount that can be safely carried away.

Safety

Inasmuch as a sense of insecurity is often felt by those who live in valleys below great dams, the board takes this occasion to express its opinion that these proposed dams will be made perfectly safe by following the established rules of engineering experience in their construction.

The System in Operation

The operation of the detention basin system has been worked out with considerable care and checked by several members of the board, both in its application to the flood of 1913 and, in an approximate manner, to one about twenty per cent greater.

The designs of the structures have not yet been fully worked out, and modifications will probably be necessary even to the extent of changes in location and height of spillway; but enough has been determined to show quite conclusively that the system admits of effective application on this watershed, and that it will furnish a satisfactory solution of the Miami flood problem. Before the official plan is adopted, in accordance with the terms of the Conservancy Act, all these details of construction, cost, and operation will be worked out with the greatest care.

**Supplemental Channel Improvement**

An examination of the Miami River shows that at certain points, even with the proposed basin control, there will be a deficiency in channel capacity to carry the outflow from the basins, together with the runoff from the unreservoired areas. It is believed to be thoroughly practicable to secure such required additional capacity, by means of channel enlargement and levees at selected points along most of the main stream and up the more important tributaries. No detailed information is at present available to permit of definite location or extent of such work, or designs and estimates of costs.

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The board is of the opinion:

1.-That floods as great as that of 1913, and even greater, are liable to occur at any time, and preventive measures should be carried out which will control floods about twenty per cent greater than that of 1913.

2.-That permanent flood protection for the Miami Valley by means of channel enlargement alone is impracticable.

3.-That detention basins, supplemented by limited channel improvement do offer a satisfactory solution of the problem.

4.-That the success of such a plan for flood control requires that the flooded area of the Miami Valley above the Whitewater River be considered as a unit.

5.-That works of the type suggested, properly designed, located, and constructed, will not only provide satisfactory and economical protection from floods, but they will be so massive and substantial as to fully justify confidence in their integrity and satisfy every reasonable question of stability.

Respectfully submitted,

REPORT OF DAYTON FLOOD PREVENTION COMMITTEE

A brief resume of the work done under the administration of the Dayton Flood Prevention Committee up to September, 1914, was given in a report by this committee dated September 23, 1914, here printed in full. It was accompanied by a report by their attorneys and counsel, also here given, and by a progress report by the Morgan Engineering Company. The engineering report is omitted, as its substance is presented elsewhere in detail.

To the Subscribers to the Flood Prevention Fund:

The Flood Prevention Committee takes this occasion to inform the subscribers to the Flood Prevention Fund of the progress which has been made to date towards securing safety for Dayton and the Miami Valley from a recurrence of disastrous floods.

ORGANIZATION

Upon the raising of the fund the first necessity was adequately to safeguard it, and to provide an organized method for vigorous prosecution of the flood prevention work. To this end The Dayton Citizens' Relief Commission was organized, its membership consisting of the subscribers to the fund, and its affairs placed in the hands of two committees. The Flood Prevention Committee, which was a continuation of the committee under whose direction a Flood Prevention Fund was subscribed, was to have charge of plans for flood prevention. The Finance Committee undertook the responsibility of auditing all accounts after these accounts had been passed upon by the Flood Prevention Committee. The funds collected have been placed on interest in Dayton banks, fully protected by suitable bonds.

The Dayton Citizens' Relief Commission is organized under the laws of Ohio as "a corporation not for profit". Through its Flood Prevention Committee it has sought the cooperation of similar bodies in other parts of the flood-stricken districts of the valley.

TEMPORARY PROTECTION TO DAYTON

The first work undertaken by the Flood Prevention Committee was a survey of river conditions existing during May and June of last year, and the preparation of temporary plans for the protection of Dayton until such time as permanent works can be built. In cooperation with the city and county governments and various railroads, plans were prepared for the strengthening of the city's defenses against high water. Repairs and improvements according to these plans have been completed to a point where the city is now better prepared to resist high water than ever before in its history.

DETERMINATION OF VARIOUS METHODS

Very soon after the flood the city secured the services of the Morgan Engineering Company to make a complete examination of flood conditions in the valley and of the cause of the flood damage. They were instructed to make such surveys and investigations as were necessary to determine all possible methods of securing Dayton and the rest of the Miami Valley against a recurrence of the damage such as occurred from the flood of last year, and to recommend the best method of procedure.

A large force of engineers and surveyors was at once put into the field and many months of continuous work was done in determining the character and cost of all possible methods of flood prevention. The conclusions of the Morgan Engineering Company and their consulting engineers reporting on the various possible methods of improvement and recommending a system of reservoir control was presented to the committee last winter.

After further submitting the report to the regular board of consulting engineers for final consideration, it was adopted by the Flood Prevention Committee as representing the most desirable plan of protection. In order, however, to remove any possibility for doubt and to give the people of the valley full assurance that the plan had received mature consideration, the Flood Prevention Committee requested the Secretary of War and the Chief of Engineers of the United States Army to designate a Board of Army Engineers to make a further examination of these plans. Such an examination proved not feasible because of the legal limitations of the War Department. The committee then secured the services of a board consisting of distinguished engineers, several of whom had held positions of high responsibility as United States Army Engineers, and others of whom had been in responsible charge of some of the foremost engineering works of the country. This board, after a thorough and painstaking examination of the plans, approved the reservoir control method already presented to the committee, and reported further that, as compared with this method, a system of channel improvement for the Miami Valley as a whole would cost probably five times as much and would be less satisfactory.

On completion of the services by the Morgan Engineering Company for which they were originally secured, that of determining the best method for flood prevention for the valley, and after these conclusions had been verified by the consulting engineers, the Flood Prevention Committee decided to retain the services of the Morgan Engineering Company for the further work of preparing the detailed plan for flood prevention. All possible progress which is consistent with absolute thoroughness is being made in the preparation of these plans, with the hope that they will be completed by the time the progress of legal proceedings makes construction possible. A more detailed statement of the work being done by the Engineering Company is included in their report. * * * *

LEGISLATION

When it became apparent that the best results could be secured by the cooperation of various parts of the valley, your committee investigated the existing laws of the state to determine whether flood prevention works on a large scale could be carried out under the laws then on the statute books. It was found that great cooperative undertakings for flood prevention never had been contemplated by the law-makers of the state, and
that before construction could proceed new legislation would be necessary. The committee, therefore, addressed itself to the preparation of a bill which not only would make works of flood prevention possible in this valley, but would serve a similar purpose in all other parts of the state. Hearty cooperation in the preparation of the bill was offered by many other flood-stricken districts, and the law as finally drafted covers not only the conditions existing in the Miami Valley, but also provides legislative machinery for handling flood problems and other problems of water control in all parts of the state. A more detailed statement of the legal situation is made in the report of the attorneys of the committee. * * *

FIG. 1S.-SITE OF $10,000 HOME NEAR CLEVES, OHIO. View taken on the Barrows farm during the flood of March, 1913.

ORGANIZATION OF THE DISTRICT

Upon the enactment of the Conservancy Law, as the Flood Prevention Legislation has been entitled, immediate steps were taken toward carrying out its provisions by the organization of a conservancy district, including all lands in the Miami Valley damaged by floods.

LEGAL STATUS

Everything possible has been done to shorten the time during which the cities of the valley shall remain unprotected from floods, and considering the delays which can be and have been interposed by objectors before new legislation can become effective, the committee feels that very good progress has been made to date. The matter of the constitutionality of the conservancy act is now before the supreme court of the state. The case has been advanced and a decision should be reached by the end of the year.

ENGINEERING

The plans recommended by the Flood Prevention Committee for preventing floods in the Miami Valley consist of a system of seven storage reservoirs formed by the construction of dams, and a limited amount of channel improvement through the cities and perhaps through the farm lands. The design and construction of each one of these dams will be an important engineering undertaking in itself. When we consider the entire system, we have, from an engineering standpoint, one of the great undertakings of our time. Where so much is at stake the work must be done with a degree of thoroughness and safety that it is not ordinarily secured in engineering and constructions. The dams must be thicker and stronger, the spillways must be larger, and the tunnels more substantial than is usually secured in similar works.

The safety of engineering works depends not only upon the cost or the amount of material used in construction, but upon the thoroughness and care with which every detail is designed and every point of weakness eliminated. As the Flood Prevention Committee has kept in touch with the preparation of the plans, its members have become more and more deeply impressed with the fact that we have here a great engineering problem consisting of very many details. Each in itself justifying the most thorough preparation. The committee has taken upon itself the responsibility of seeing that there shall be no relaxation of determination to secure absolute thoroughness of preparation before construction begins.

The members of the committee realize the great amount of work on the part of the engineering force which this entails, and, if the committee errs, it will be upon the side of caution, insisting that no details shall be passed until the accuracy and thoroughness of their design are unquestionable. The works being planned are not to endure fifty or a hundred years, but must stand for all time as the security of this valley against a recurrence of the disaster of last year. Given thoroughness and integrity in design and in construction, the people of the Miami Valley can know that their protection is complete and sure.

THE COMING WINTER

As winter approaches, the committee is giving renewed attention to the system of flood warnings initiated by the United States Weather Bureau, and is having its engineers make another thorough examination of the conditions about the Miami River and its tributaries which would affect the safety of the city in time of flood. Any weak spots which are found in the present
system of flood protection will be immediately corrected.

COMPLETE REPORT TO FOLLOW

This brief statement of the situation to date is made in order that the subscribers to the Flood Prevention Fund and the people of the Miami Valley may know that there has been no relaxation in the effort to bring safety to the valley. A complete report is being prepared, and will be issued as soon as completed.

The committee wishes to thank the subscribers to the Flood Prevention Fund and the people of Dayton for their whole-hearted support up to the present time. The importance of the Flood Prevention Fund can be appreciated from the fact that work heretofore undertaken would have been impossible without such assistance, and it is, only through the existence of this fund that it has been possible to approach the matter in such a thorough-going manner as to secure ultimate and complete success. * * * *

In view of the disturbed financial situation caused by the European war, the existence of the Flood Prevention Fund will be particularly fortunate, as it will make possible the undertaking of construction without waiting for the settlement of financial conditions or the alternative of disposing of securities in a depressed market. The continued support of the subscribers to the fund is imperative if the final aim of gaining the security of the valley is to be quickly realized.

Respectfully submitted,

The Dayton Flood Prevention Committee.

REPORT OF ATTORNEYS AND COUNSEL

September 22, 1914.

To the Flood Prevention Committee.

Gentlemen:

The matter of preparing a proper bill to present to the legislature for protection against floods was submitted formally to counsel about the eighth of November, 1913. A tentative law was present'ed which had been prepared by Mr. Morgan, whose wide experience in the litigation, as well as the preparation of plans for controlling water, qualified him for this work.

Counsel, with this law as a basis, began the work of constructing a statute which they believed would accomplish protection, be fair to all parties, and be within the power of the legislature. They gave much time to the examination of the laws of other states, the decision of courts under them, and to the laws and decisions of our own courts. They were assisted by the criticism of Honorable John M. Dillon, of New York City, now deceased, and Judge Horace S. Oakley, of Chicago, experts in this line of work, and legal representatives of large bonding houses, to whom the bonds would probably be offered, and whose opinion would be of great value. On examination, both of these gentlemen gave their unqualified approval to the law as drafted and passed.

When the legislature met the law passed both houses, with some amendments, chiefly proposed by the objectors, which were accepted by the friends of the bill. Governor Cox gave it his approval February 17, 1914.

In order to lose no time the petition for the formation of a district was filed at once, viz: on February 18, 1914. Petitions were filed separately for 1,500 land owners, the cities of Dayton, Hamilton, and Middletown, the villages of Franklin and Miamisburg, and the counties of Montgomery, Butler, and Warren.

Notices were given under the statute of the pendency of the petitions, which were published at great length in each county in the proposed district.

On March 20, 1914, the full court convened. On the same day one of the leading objectors applied for a writ of prohibition in the court of appeals to prevent the court of common pleas from acting. This was heard and decided against the objectors. On March 21, after the decision of the court of appeals, the persons objecting to the formation of the district secured from the court of common pleas a delay to March 31.

The court met pursuant to adjournment on March 31. At this time counsel for the objectors moved for another delay, as one of the judges was unable to be present on account of illness. This was refused.

The case then proceeded. A large number of objectors appeared in the field. About 500 individuals, Shelby, Miami, and Greene Counties, by their county commissioners, and the cities and villages of Troy, Sidney, DeGraff, and Fort Laramie, by their attorneys, filed objections.

As proceedings in the courts of each county would probably be instituted, after the district was established, for the condemnation of property, and also in the settlement of the numerous assessments for benefits to be made under the law, it was deemed advisable to employ at once counsel in the chief counties interested so as to allow them to become familiar with the working and scope of the law, and accordingly the following were employed by the committee, with the approval of counsel:

John Galvin, of Cincinnati T. J. Cogan, of Cincinnati E. A. Belden, of Hamilton
B. F. Harwitz, of Middletown
P. H. Rue, of Franklin
Oscar Sheppard, of West Alexandria M. A. Broadstone, of Xenia
Keifer & Keifer, of Springfield
A. J. Hess, of Sidney.

They all appeared and rendered material assistance in the conservancy court, and in the court of appeals. They will be helpful in the settlement of matters hereafter out of court.

When the court met, on 1-1arch 31, the cause was fully argued at Memorial Hall, the arguments t::l!dng four days.
The judges were unable to agree upon the establishment of the district by a sufficient vote, viz: 6, the court on April 18 reporting it stood 5 for the district to 4 against.

Counsel for the petitioners thereupon suggested to the court, as a way out of the deadlock, that the petitions should be dismissed, so as to admit of an appeal at once. A majority of the court accepted this suggestion, and the entry of dismissal was made and the appeal taken on April 23, 1914.

Counsel for your committee had always been of the opinion that it was to the interest of the cause, and almost vital to it, that the questions involved, no matter how unimportant, should be passed upon by the supreme court, so as to insure the sale of bonds which would be offered to the public. Indeed, they had a plan arranged to get the questions into the supreme court, if the objectors did not take this case up.

The court of appeals acted with promptitude in hearing the case at once, as the law directs.

Objectors moved to dismiss the appeal for various technical reasons. These motions were heard and overruled on May 27, 1914. On June 3 the court, by a unanimous vote, finally decided and overruled the court of common pleas, ordered the judges to reinstate and hear the case, and proceed according to law.

Every substantial point arising properly at this time in the case was decided in favor of the petitioners.

Under the law and practice in ordinary cases they would be entitled to three months' time to prepare a brief, with two months' time thereafter for a reply by the petitioners, and one month more for a reply. The case under these rules would not be ready for submission to the supreme court until February 3, 1915. But the conservancy law makes any case arising under it a preferred one to be advanced on motion. As soon as the court met at Columbus, after the summer recess, viz: on Wednesday, September 16, 1914, we presented a motion to advance the case and to fix an early day for oral argument. The court has allowed the motion to advance, and announced, on Tuesday, September 22, in' open court, that the case would be heard on November 12, 1914.

In order not to delay the hearing, counsel have, spent the summer in the preparation of their brief, and announced in open court at Columbus that it was now ready and would be filed as soon as the brief for the objectors was filed.

Respectfully submitted,

BROWN & FRANK,
Attorneys.

J. A. McMAHON,
Counsel.

RESUME

The foregoing reports, though all of a preliminary character, afford a fair index to the development of the project. They show a gradual but steady progress from the preliminary investigations of the flood problem toward the working out of a definite plan for permanent protection of the Miami Valley. The studies and recommendations of the Morgan Engineering Company, the framing and passing of the conservancy act, the opinions of the regular board of consulting engineers, the compilation of engineering data and determination of the proposed plan, with its approval by the special board of consulting engineers, and the reports of the Dayton Flood Prevention Committee and their attorneys were all important steps and were all given wide publicity. It was felt that the best way to secure the much needed cooperation as well as to answer and, if possible, disarm opposition was to make the fullest information available to all interested parties.

The more important principal conclusions concerning flood control in the Miami Valley, established by the work outlined in these reports may be briefly summarized as follows:

1. Floods greater than that of 1913 may be expected to occur.
2. The cost to the smaller cities and towns for protecting themselves against such floods would be prohibitive.
3. The cost to the larger cities of providing any form of local protection against such floods would be excessive.
4. Permanent protection of the entire valley by means of channel improvement alone would be impracticable.
5. A properly constructed system of retarding basins supplemented by channel improvement would give effective control of floods.
6. Such control could be secured only through the united effort of the interests affected.
7. New legislation would be required to make possible such united effort.
CHAPTER III - THE CONSERVANCY ACT AND ORGANIZATION OF THE MIAMI CONSERVANCY DISTRICT

NEED FOR STATE LEGISLATION

It was discovered early in the flood prevention movement that Ohio had no adequate laws under which to carry out the proposed plans. The local flood problem at Troy presented a practical illustration of this. Parts of the city were frequently flooded by hill water from the west, and protection against this flooding would require the construction of levees, ditches, sewers, bridges, etc. The law for county ditches allowed the city to petition the county for the construction of ditches and to pay the part of the cost assessed against it. Levees, however, could not be built under this law, and the law providing for the construction of levees made no provision for the assessment of benefits against the city; neither did the ditch law provide for the construction of bridges or sewers. Ditches could be constructed under one act which had a certain range of provisions, levees could be constructed under another, channels could be cleaned under still another, etc. These laws had been conceived with particular problems and certain local requirements in mind and were entirely lacking in the broad, comprehensive provisions required for a great cooperative undertaking such as that proposed for protecting the Miami Valley from floods. They failed to provide the legal machinery for organizing the many interests needing flood protection into a unity of action. They provided no means for working out a comprehensive plan for the improvement, for safe-guarding individual and collective interests and rights, and for equitable distribution of the cost. Nor did they provide authority for enforcing the requirements of such an improvement.

The situation at Troy reflected in a way the imperative necessity for legislation which would make possible the construction of works for the control of floods; the regulation of streams for drainage, irrigation, and water power purposes; and the conservation of other public assets for the best uses of the people. It indicated definitely that the plans for the control of floods in the Miami Valley could not be carried out under the existing laws. The situation demanded action; cities, towns, and farm lands needed protection from destructive floods; the entire valley needed and wanted a protection that could be secured only by a cooperation of the various communities in the valley. It meant concerted action of parts of nine or ten different counties, and of a dozen or more cities and towns. Railroads and highways must be changed; bridges, dams, ditches, and levees constructed; sewers and streets readjusted. To do this, city and country lands must be acquired to provide right-of-way, damages must be paid where damage was incurred, and the cost must be equitably distributed among the many thousands of individual properties that would be benefited by the improvement. There was the additional consideration that similar problems were needing solution elsewhere in the state.

DRAFTING A NEW LAW

While the flood control plans were being developed, Mr. Morgan collected copies of existing drainage and flood control laws of various states and European countries, and assembled such other pertinent data as was available. The problem of preparing a law was approached from the engineer's point of view. Some of the requisites to be secured were:

1.-There must be wide freedom of action to carry out any type of improvement, and to do any reasonable thing which should be required by plans for flood control.
2.-Since the most efficient and effective agency in our country today, for getting things done, is the corporation, such improvements should be handled under corporate forms and management.

3.-There must be absence of politics.

4.-A flood control organization must have governmental powers such as right of eminent domain, police power, taxing power, etc.

5.-The law must harmonize with existing governmental machinery.

6.-It must make possible all methods of cooperation with corporations, cities, counties, with the home state or other states, and with the national government.

7.-It must be fair and not arbitrary.

8.-It should provide control over stream obstructions and over the ownership and use of water.

9.-It must be a general law, suitable to any situation, and so comprehensive that it will not need amendment to fit some other situation that may arise in some other part of the state.

All these needs, and many others, were covered in the bill that was written. American and European water control laws were carefully examined section by section to see whether some situation elsewhere had developed legal provisions which might apply in Ohio. In October, 1913, Mr. Morgan completed a tentative draft to form the basis of the proposed bill and submitted it to Judge Brown, attorney, and Mr. McMahon, legal counsel, with these comments:

In developing a flood prevention law, we must get our precedents and our legal forms from drainage laws. These first came into existence many years ago as provisions for the joint construction of drains affecting more than one person, and have gradually developed until in some states they provide for the construction of works costing millions of dollars and affecting hundreds of thousands of acres. The attitude of the courts toward these districts has gradually changed from being generally hostile 30 years ago to being generally favorable at present, and there is a large body of judicial decisions to which we can turn for our support if we follow generally the procedure which has grown up around cooperative drainage. The bill presented appears bulky and can doubtless be shortened to some extent by the elimination of processes which are provided for under the general law.

* * * * * * * * * *

Many of the provisions of this bill are taken from similar provisions in other state laws, and have in the main been passed upon by the supreme courts of those states. * * * * We have examined between 15 and 20 state drainage and reclamation laws in the preparation of this bill, and are most indebted to the laws of Missouri, Arkansas, Illinois, and Wisconsin.

The Missouri law, as a whole, is best worked out, but of the 12 drainage laws under which The Morgan Engineering Company is at present operating it is in some respects the most cumbersome.

This tentative draft will need modification in very many respects in order to fit it to the legal and administrative procedure of the State of Ohio.

Mr. McMahon spent several months in carefully examining every detail of the proposed law and in putting it in proper legal form. He considered the final draft to be one of the greatest achievements of his legal career. Realizing the importance of this work, the Flood Prevention Committee secured the assistance of Honorable John M. Dillon, of New York City, now deceased, and Judge Horace S. Oakley, of Chicago, whose long and intimate experience with the workings of special assessment laws in other states were of great value in this connection. After the legal problems had been worked out in conformity with the constitution, existing statutes, and court decisions, the bill was again critically examined from an engineering point of view. As finally drawn after many conferences between engineers and attorneys, it was not only in accord with generally accepted principles of financial and governmental administration, but it effectively safeguarded the rights of every person and every community affected by its operation, and it permitted the unhampered application of good engineering practice to all phases of the work. It was completed in time to be presented at a special session of the legislature which convened in January, 1914; was passed in the House by a vote of 87 to 18; in the Senate with only one opposing vote; and was signed by Governor Cox: on March 17, 1914.

FEATURES OF THE CONSERVANCY ACT

The conservancy act provides for the establishment of conservancy districts in Ohio, through petition of property owners to the court of common pleas of any county wholly or partly within the proposed district, for any or all of the following purposes:

(a) preventing floods;
(b) regulating stream channels by changing, widening, and deepening the same;
(c) reclaiming or filling wet and overflowed lands;
(d) providing for irrigation where it may be needed;
(e) regulating the flow of streams;  
(f) diverting, or in whole or in part eliminating water courses; and incident to such purposes and to enable their accomplishment, to straighten, widen, deepen, change, divert, or change the course or terminus of, any natural or artificial water course; to build reservoirs, canals, levees, walls, embankments, bridges, or dams; to maintain, operate and repair any of the construction herein named; and to do all other things necessary for the fulfillment of the purposes of this act.

Organization of a district is affected by a majority decision of a court consisting of one common pleas judge from each county having land in the district. Upon organization of a district the court becomes ipso facto the conservancy court of that district. This court appoints a board of three directors to manage the district, who in turn may employ engineers, attorneys, and other assistants as deemed necessary. In constructing and maintaining the works of a district, the board of directors is authorized to cooperate with the federal government, with the government of any other state, with public or private corporations, with other conservancy districts, or with private parties. A plan for the improvement is prepared, by the chief engineer and passed upon by the board of directors. After a formal hearing of objections by affected property owners the plan is subject to the approval of the court. An appraisal of all benefits and damages accruing to properties affected by the execution of the proposed plan is made by a board of three appraisers appointed by the conservancy court. Due notice of the filing with the court of the appraisal roll and of the hearing thereon shall be published to give the property owners affected opportunity for filing exceptions to any part or all of the appraisal. After a hearing, the court must formally act on the appraisal record. Bonds can then be issued and sold to finance the construction of the proposed improvement. Any owner has the right to appeal from his award of benefits or damages, and may have his case heard before a jury in the county in which his property is located. No property can be confiscated, damage must be paid where damage is sustained, and no property owner can be unjustly assessed.

The following list of successive steps shows the operation of the conservancy act from the time the petition for the organization of the district is filed until the construction of the works is begun.

1. Property owners file petition for organization of district. Property owners file bond to cover expenses.  
2. Court publishes notice of hearing on petition.  
3. Property owners file objections to organization of district. Court holds hearing and decides to organize or not to organize the district.  
4. Court appoints 3 directors and 3 appraisers.  
5. Directors employ secretary, attorney, engineers, etc., and prepare plans.  
6. Directors publish notice of hearing of plan.  
7.  
8. Property owners file objections to adoption of the plan.  
11. Court hears and passes on objections to Official Plan.  
12. Appraisers appraise benefits and damages.  
14. Court publishes notice of hearing on appraisals.  
15. Property owners file exceptions to appraisals.  
16. Court holds hearing and issues decree on appraisals.  
17. Property owners appeal on appraisals.  
18. Directors prepare and file Conservancy Assessment Record.  
19. Property owners have 30 days in which to pay assessments in full.  
20. Directors issue bonds and have works constructed.

A district may be financed from three separate funds which are provided for in the act:
1.-A preliminary fund, consisting of a tax levied upon the property in the district, not to exceed three-tenths of a mill on its assessed valuation.

2.-A bond fund, provided by the special assessment of benefits as approved by the court.

3.-A maintenance fund which is derived from a special assessment levied annually.

The preliminary fund is for defraying the cost of organization, surveys, and other expenses preliminary to the sale of bonds. The bond fund is for the construction cost of the proposed improvement. It is provided by an assessment levied on all real property against which benefits have been appraised. This assessment shall be levied on each property in proportion to the benefits appraised against that property. It shall not exceed the amount of benefits as approved by the court, and shall be only sufficient to pay for executing the plan. Any assessed property owner has the privilege of paying his assessment in full at any time within 30 days after the filing of the assessment roll in the office of the district. If not so paid, the assessment will be collected as an annual tax distributed over a period of years. The amount collected will go into a sinking fund to retire the bonds at maturity. This period shall not exceed 30 years. After the bonds have been sold the act does not permit an injunction against the collection of taxes for their payment or against constructing the works, as this would afford opportunities of obstruction and delay so great that little could be accomplished.

It will be noted throughout, however, that appeal to the courts is provided for every important step, thus fully protecting the rights of property owners.

**ORGANIZATION OF THE MIAMI CONSERVANCY DISTRICT**

On March 18, the day following the signing of the conservancy act by the Governor, the cities of Dayton, Hamilton, and Middletown, the villages of Franklin and Miamisburg, the counties of Montgomery, Butler, and Warren, and 1500 individual petitioners filed petitions for the establishment of the Miami Conservancy District. The proposed district included parts of 10 counties, consisting of the lowlands bordering the Miami River and its tributaries. A court consisting of the following 10 common pleas judges convened for the hearing on this petition in Memorial Hall in Dayton on March 20, 1914; and sat as a conservancy court under the new act.

Carroll C. Sprigg (presiding), Montgomery County
Hiram C. Mathers, Shelby County
J. M. Broderick, Logan County
Walter D. Jones, Miami County
F. M. Hagan, Clarke County
Charles H. Kyle, Greene County
Williard J. Wright, Warren County
A. C. Risinger, Preble County
Clarence vV. Murphy, Butler County
Otway J. Cosgrave, Hamilton County

An attendance of over 2,000 people gave evidence of the wide interest in the occasion. After hearing arguments for and against the organization of the district, the attorneys for the opposition entered an objection to the jurisdiction of the court and secured a continuance of the hearing to March 31. During the week of March 20-26 the special board of eight consulting engineers, mentioned in the preceding chapter, was retained to examine the plans for protecting the Miami Valley and to testify for the formation of the district. They did not appear before the court as expected on account of the long delay in the proceedings. When the court reconvened 01" March 31, Judge Broderick was absent on account of sickness. The opposition again raised questions of the jurisdiction of the court and questions of constitutionality.

The arguments of the objectors were stated briefly in general terms by their counsel as follows:

1.- The conservancy act confers legislative powers on the court.
2.-The act denies contestants the equal protection of the laws the petitioners have the privilege of appeal and the objectors do not.
3.- The conservancy act violates the principle of local self-government. It illegally delegates legislative power, including taxation, to others than those elected by, and answerable to, the people.

In reply to these arguments the counsel for the petitioners contended:
1.-That there is a true distinction between the delegation of power to make a law, which in values discretion as to what the law shall be, and the conferring of authority or discretion as to its execution, to be exercised under and in pursuance of the law. The functions of the conservancy court under the conservancy act are administrative and judicial.

2.- That it would have been competent for the legislature to have authorized the creation of a district without notice or hearing, because the mere creation of the district could not hurt anyone. When definite action is taken by such district as in the adoption and filing of a plan, or the assessing or taking of property, any objector has ample opportunity for presenting his objections in court for hearing and property owners are thus fully protected. An objector does not expect a hearing in court for instance before a railroad company is formed, to prevent its formation, because its line is located through a farm or house owned by the objector.

3.- That the organization of improvement districts is not a new idea. The formation of a district could not be equitably determined by popular vote in counties or municipalities, as in many cases only a fractional part of such counties or municipalities would be affected. Neither could it be determined by a vote of those residing in the district, since there would be no way in which the district boundary could be predetermined. Special assessment methods of obtaining funds for financing improvements have been repeatedly used in this country and upheld in the courts.

Further arguments in vindication of the conservancy act were presented in briefs by counsel for the petitioners from which is quoted the following:

As soon as the terrible flood of 1913 occurred, involving not only Columbus, Dayton, Hamilton, Zanesville, Middletown, but many other cities and villages, the necessity for a law was apparent. The question arose at once, how should protection be afforded?

It was questionable whether the State could enter upon the work in view of the provisions of Article VIII of the Constitution, especially as it would involve enormous expenditure for protection in special localities. A plan of taxation by county lines would not be entirely fair. The system of assessment upon those benefited seemed the best. That system was adopted, admitting, as it does, assessments upon entire corporate bodies. But a further step was important, How was the system to be in working order, bearing in mind that many counties might be required in one district?

The power could have been conferred upon the commissioners of the counties, as is done in the joint county ditch law. * * *

But a body of thirty men, representing different counties, different degrees of interest, governed by local prejudices, and ignorant of the law, would have been not only an unwieldy, but an impossible body.

The power might have been invested in cities with the power of, eminent domain. * * *

Such an arbitrary power would have been liable to abuse. Then conflicting schemes would have been put forward in the same district with
no reasonable method of harmonizing them. Such a plan would have led to interminable wrangling and ill-feeling, and numerous conflicting districts.

Then again the legislature might have authorized the formation of private corporations with powers extensive enough to accomplish the objects of the law. Many of the irrigation and water power schemes in the far west are handled by private corporations. Such a system would not have suited the public who are seeking protection alone; and there would have been an outcry against any plan that involved pecuniary profit to anyone.

Or the legislature might have provided for the formation of a district by a vote of the majority of those in the district. But the insuperable objection to such a plan is the fact that no definite boundaries to the district could be fixed. Thus if channel improvement was adopted, the persons and localities affected would be very different from those to be affected by a dry reservoir improvement. The expense of surveys for a comprehensive plan in advance would prohibit a plan. * * *

Finally the legislature might have provided for a state commission, with subordinate agencies in the flooded district, to carry out the purposes of the act. But that would have involved the state in expense, multiplied offices, and brought the great works that must be established within the baneful influence of political domination. * * *

* * * The bill was framed with a conscientious desire to protect the general public with as little sacrifice as was possible to those whose property would be taken, paying them liberally, or affording them every opportunity to have an award of the full value of everything taken from them by a friendly jury-all assessments for benefits upon any person or corporation to be finally submitted to the same test.

The hearing was concluded on April 3, when the court adjourned to prepare its decision. On April 18 the court voted 5 to 4 in overruling all the objections, but as a vote of 6 to 3 or a majority of the 10 judges was required for a decision to establish the district, the result was an entry of dismissal of the petition for the district.

The attorneys for the petitioners at once carried the case to the court of appeals which convened for the hearing in Dayton on May 7, 1914. The arguments were practically a repetition of those before the conservancy court. On May 27 the court of appeals announced a preliminary decision old the case was lawfully in the court of appeals, that the subject matter of the action was appealable and that the conservancy act was constitutional. On June 3 it announced a unanimous decision that the conservancy act was constitutional except for the preliminary tax for organization and preliminary expenses, which it held unconstitutional, and remanded the case to the conservancy court. The opinion against the preliminary tax did not affect the work in the Miami Valley, as the preliminary expenses were already being taken care of by the Dayton Flood Prevention fund. On May 14 the Flood Prevention Committee filed, for the petitioners, a petition in error in the court of appeals entitled "City of Dayton and others versus County of Miami and others". This was done to avoid any possible delay that might be caused by an adverse decision from the court of appeals.

On August 3 the objects filed a petition in error in the supreme court claiming the conservancy act to be unconstitutional and asking a reversal of the decision of the court of appeals. The questions considered were similar to those which had been argued in the lower courts. The decision of the supreme court on December 15 upheld the constitutionality of the conservancy act, but held that the case should have come into the court of appeals on error and not on appeal. At this juncture the wisdom of the petitioners in having filed the petition in error in the court of appeals was evident, as the case could now be taken up in the lower court without delay. On December 22 a motion, filed by the objects, to dismiss the petition in error was taken under advisement by the court of appeals and on January 18, 1915, the court of appeals upheld the right of the petitioners to a re-hearing of the case on the petition in error. On January 27 it issued a decision upholding the petition in error, and ordered the conservancy court to proceed with the hearing for the organization of the district in accordance with the provisions of the conservancy act. It held that the court erred in dismissing the petition instead of proceeding with the hearing of evidence in support of the petition. On February 18 the objects again took their case to the supreme court on error, claiming that the court of appeals erred in reversing the conservancy court's decision that the district could not be established. The supreme court was urged by the petitioners to give the case an early hearing on account of the delay being caused to flood control plans in various parts of the state. In the meantime a friendly suit was being prosecuted in Franklin County, where a district had already been organized under the conservancy act, to test the constitutionality of the preliminary tax clause. Other complications in the legal situation developed from time to time, and determined efforts were being made by the opposition to cripple the conservancy act by amendments presented to the legislature. Every opportunity was taken by the opposition to complicate the situation and delay the progress of the Flood Prevention Committee. On June 4, 1915, the supreme court sustained the conservancy act in its entirety.

On June 14 the petitioners for the district filed a petition, asking for the elimination of Logan County and a part of Shelby County from the original district. The engineering studies had developed the fact that the control afforded by the proposed Port Jefferson Retarding Basin in Logan County could be more economically secured by altering the plans for the other basins. The ten judges of the original conservancy court met again in Dayton on June 24. It
granted the petition to eliminate Logan County, which left the court comprised of nine judges.

FIG. 18.-MAP SHOWING THE MIAMI RIVER VALLEY. The territory embraced within the boundaries of the Miami Conservancy District is shown by the portion not cross hatched.
The court then proceeded with its hearing on the formation of the district. Evidence was submitted by the petitioners to establish the necessity for the proposed flood control work and that it would be conducive to the public health, safety, convenience, and welfare. The attorneys for the opposition attempted to complicate and confuse the issue by an extended cross questioning on the engineering details of the plans that were being prepared, particularly attacking the retarding basin feature. Counsel for the petitioners objected to the introduction of such testimony on the ground that the question before the court was that of the need for protection, and not a consideration of the details of any plan, as such considerations would be taken up at the time of the hearing on the plan itself. The court, however, overruled this objection, stating that the importance of the case warranted their being fully informed on all of its phases. Considerable engineering testimony was thereupon introduced in explanation of the plans so far as they had been determined. On June 28, 1915, after reviewing the testimony presented, the court, by a vote of 5 to 4, formally declared the establishment of the Miami Conservancy District, its boundaries to include lands in nine counties approximately as shown on the map in figure 18. The court appointed as directors: Edward A. Deeds of Dayton, Henry M. Allen of Troy, and Gordon S. Rentschler of Hamilton. These men had taken leading parts in the flood control movement, and their extended experience at the head of large business undertakings, and their active interest in public improvements made them peculiarly fitted for the appointment, which they accepted largely as a public duty. The directors appointed Ezra IV1'. Kuhns, of Dayton, as secretary.

In January, 1916, the district found a splendid home in the newly completed Conservancy Building in Dayton, see figure 19. The building was constructed by Mr. Deeds and presented to the district. It is a three-story structure, 45 feet by 90 feet, of fireproof construction throughout, the doors and window frames being of bronze and inside partitions of glass and steel. The exterior is of Bedford limestone. The entire administrative, appraisal, and engineering forces of the district were moved into these quarters. The building is conveniently located on Monument Avenue, overlooking the south bank of the Miami River, where it is not only an ornament to the city but will be a lasting monument to the great work of flood control in the valley and to the public spirited citizens who made this work possible.
COURT DECISIONS

The passage of the conservancy act, the attempted amendments, the establishment of the Miami Conservancy District, and the many legal proceedings attending these steps were so interdependent that a description of one involves a discussion of the others. While the legal proceedings apparently caused an unwarranted delay in the flood protection work, they ultimately resulted in expediting its progress. Every finding issued by the courts, which had any real importance or vital significance as to the practical application of the act, gave it unreserved support. The effect of these decisions, given by both the court of appeals and the supreme court, while not immediately apparent, was to give stability to the law and a gradually increasing momentum to the flood control movement that later pushed aside all obstacles to rapid progress. They established beyond doubt the constitutional validity of the conservancy act, they removed it from the suspicions and experimental atmosphere of an untried statute, and they gave it an unqualified recognition as a practicable, workable law. This weakened the opposition and gave a legal standing to the Miami Conservancy District that was later of inestimable value in the sale of its bonds and in establishing its financial security.
PROPOSED AMENDMENTS TO THE CONSERVANCY ACT

The conservancy act was drawn on broad lines with the intent to provide for any water control or conservation project or problem that might arise. Its proper understanding and application were therefore somewhat difficult for persons having in mind only one particular case with its peculiar local conditions. Thus, to one having a drainage problem in mind it was difficult to understand why the new act should provide for water power development, and this power development clause was immediately construed by opponents to the law as a menace. The appointment of the directors of a district by the court, the general power accorded the board of directors, and the methods of financing and general administration of an improvement, prescribed by the act were all challenged in attempts at amendment. The most persistent of these attempts originated with local opposition to the plans for the proposed Miami Valley improvement. They gained strength through the efforts of antagonistic lawyers, through a general misrepresentation of the plans and the law, and through partially successful efforts to make the matter a political issue.

Late in 1914 this opposition resulted in the drafting of proposed amendments which, if adopted, "could cripple the conservancy act and make it useless. The effects of the more important amendments proposed were to make it more difficult to initiate a petition; to eliminate any possible use of dams or reservoirs; to curtail the directors' power of condemnation; to provide for at least one elected director from each county affected by the district; to prevent removal of a judge by a charge of prejudice; and to include county commissioners as ex-officio members of the board of directors. The Quinlisk Bill was presented in the House on January 20, 1915, and on the following day a duplicate of this was introduced in the Senate as the Garver Bill. These bills were drawn to make radical changes in vital parts of the law and contained clauses, the constitutionality of which was very doubtful. Their passage would have effectively obstructed the plans of the Miami Conservancy District. Knowing this, the Dayton Flood Prevention Committee instituted a state-wide educational campaign to combat the erroneous information that was being published by opponents. It established an educational exhibit at Columbus for the purpose of explaining the conservancy act and in particular its application in the Miami Valley. Engineers of the committee displayed maps, diagrams, and models to illustrate the work contemplated in the Miami Valley, and explained the plans in detail to the legislators and to any others who were interested. Thirty-six leading citizens of the Miami Valley registered as lobbyists and devoted a large part of their time to this fight to preserve the law. "When it was learned that the opposition was passing a petition for popular support of the proposed amendments, the Flood Prevention Committee immediately circulated the following counter petition:

To the Honorable Members of the General Assembly of the State of Ohio:

We, the undersigned, residents of the City of Dayton and vicinity, most respectfully petition your honorable body to allow the Vonderheide Conservancy Act to remain on the statute books of Ohio for the present unchanged. It was drawn, after mature deliberation by some of the best legal talent of the country, in consultation with the best engineers of the world on questions of flood prevention. It aims to afford all feasible methods for protecting the lives and property, not only of this immediate vicinity, but of all sections of the state.

The courts, from the lowest to the highest, are putting the stamp of their approval on the general policy outlined in that act as fast as the questions can be presented to them.

The unfaded memories of that awful disaster of 1913 and solicitude for our families and our homes, even more than the large property interest at stake, prompt us to urge upon you courageous action in defense of that measure which seems to promise relief for the situation.

A similar petition was passed for children's signature. These petitions, with over 89,000 names of residents of the Miami Valley appended were presented to a joint senate and house committee at a public hearing in the Capitol Building at Columbus on February 9, 1915. The spectacle at this hearing was one seldom equaled in the legislative halls of any state. Stereopticon and moving pictures of the 1913 flood were thrown on a huge screen, followed by illustrations of proposed flood prevention plans. These were described by Edward A. Deeds of the Flood Prevention Committee, who made a stirring plea that the conservancy act be left intact. His argument was supported by Gordon S. Rentschler who spoke for the citizens of Hamilton. Judge O. B. Brown of Dayton and Judge Horace Oakley presented legal reasons why the law should not be molested. General O. H. Ernst, U.S. Army retired, and Professor D. W. Mead, of Madison, Wisconsin, spoke briefly but to the point regarding the adequacy of the Miami Valley flood control plans from an engineering point of view. A touching appeal for flood protection was made by Mrs. J. A. Beery of Columbus, herself a sufferer in the 1913 flood. Defense of the proposed amendments was undertaken by A. J. Miller of Bellefontaine, Percy Taylor of Sidney, F. M. Sterret of Troy, Horace Stafford, and J. E. Bowman of Springfield. The debate continued until past midnight.

On February 10 the following statement came from the Flood Prevention Committee headquarters at Columbus:

To the Citizens of Dayton:

The Miami Valley Flood Prevention Committee wishes to take this early opportunity to express their deep appreciation for the splendid sup-
port that has been given them by the men, women, and children of Dayton.

This committee fully realizes that the future of the Miami Valley and the lives of its citizens depend upon the preservation of the conservancy law.

A modification of this beneficent law carries with it a responsibility for life and property which we believe the members of the general assembly will not care to assume when the question comes squarely before them for a decision.

Yours most sincerely,

E. A. Deeds, Chairman;

O. B. Brown, Secretary.

Newspapers, churches, chambers of commerce, and other institutions took up the fight, and except in a few cases where personal interest or local influence prevailed, gave energetic support to the preservation of the law. Engineering periodicals pointed out the folly of an amendment that would forever preclude the use of reservoirs as a means to flood protection, and of limiting the engineers to the use of only certain methods. The Governor and members of the legislature were deluged with letters, telegrams, and petitions asking that the law be preserved in every respect.

The efforts of the Flood Prevention Committee and of public spirited citizens, coupled with the tremendous public sentiment favoring the conservancy act, resulted in a decisive defeat of the proposed amendments. Two years later, in February, 1917, a further attempt was made to cripple the law by amendment, but by this time it had become so firmly established by the various courts that the movement was unfavorably received and was given very little consideration. The proposed amendment was presented as the Kious Bill, and was defeated in the legislature with practically no discussion.

OPERATION UNDER THE ACT

Shortly after the establishment of the Miami Conservancy District, in June, 1915, its board of directors appointed Arthur E. Morgan chief engineer, and instructed him to hasten the completion of the plans that had been developed for the Flood Prevention Committee under his direction. At his suggestion the district took over the entire part of the Morgan Engineering Company's organization employed on the Miami Valley flood prevention work, together with the equipment and supplies that were in use on the work. The district borrowed the necessary funds from the Dayton Citizens' Relief Commission, and the engineering work in preparation of the plans was continued without interruption. The formal organization of the district gave its engineers authority to enter lands for making surveys and test borings, which permitted the work to proceed unhampered. In some cases such entrance, previously, had been determinedly opposed by property owners.

In accordance with the law, the conservancy court appointed as appraisers of the district: Charles W. Kiser of Piqua, J. Edward Sauer of Dayton, and Samuel M. Goodman of Hamilton. A careful examination of the proposed plan and a field inspection of all the lands affected by the proposed improvement were immediately begun by the appraisers, in preparing for the assessment of benefits and damages, which must commence upon the adoption of the Official Plan by the court.

Step by step the requirements of the conservancy act were followed out by the district. In March, 1916, the chief engineer presented a comprehensive report consisting of three printed volumes of about 200 pages each and two large volumes of maps and plans. This report described in detail the proposed plan for the protection of the district from flood damage. It set forth the principal data on which the plan was based, explained the development of the plan, and gave a description of the proposed works and the property affected by their construction. It also presented contract forms and specifications, and estimates of quantities and cost of the proposed works. After a hearing of exceptions, consisting of conferences with representatives from different parts of the valley, this report, with a few minor revisions, was adopted by the board of directors as the Official Plan of the district and filed with the secretary as such on May 10, 1916. The approval of the Official Plan by the conservancy court on November 24, 1916, is described in detail in chapter VI. Following this approval the directors turned their attention particularly to matters relating to the appraisal work. A description of this work is given in chapter VII.
CHAPTER IV.-SURVEYS, STUDIES, AND INVESTIGATIONS

ASPECTS OF THE PROBLEM

The Morgan Engineering Company, having been engaged to investigate the flood situation and to prepare plans for flood control in the Miami Valley, began immediately to collect data and make surveys on a comprehensive scale. The work was prosecuted on the principle that no one method of flood control should be adopted until all possible methods had been thoroughly investigated. This program demanded an exhaustive analysis of every phase of the problem, and both field operations and office investigations were organized with that object in view. This chapter outlines the general surveys, studies, and investigations.

Mr. Morgan's first impression, which at the time was very generally shared, was that relief could be secured for Dayton by improving the river channel and by a partial reconstruction of some of the city bridges. Other methods of securing relief, such as a system of dams for the detention of flood waters, were investigated largely from a sense of duty in following out the program referred to. As the advantages of the use of dams became more apparent, however, it developed that the idea of channel improvement as a sole means of relief had become so strongly entrenched in the public mind in certain quarters as to form the basis of a determined opposition to the progress of the flood control project. This placed a burden of responsibility on the engineers which became greater as the surveys and studies gave a better understanding of the situation, and it was due largely to Mr. Morgan's insistence on developing every possible method of flood protection that the final solution resulted in a plan, the practicability and safety of which left no room for doubt as to its superiority. While its primary aim was the protection of all the principal towns and cities in the valley which had been damaged by the flood of 1913, it also afforded a large measure of protection to agricultural lands. It emphasized what had been recognized early in the course of the investigations, namely, the importance of dealing with the Miami River and its tributaries as a unit and working out the flood problems of the various communities in one harmonious plan. It will be evident from the foregoing that the engineering operations were not therefore confined to a consideration of the needs of Dayton alone, but were made to embrace the entire territory affected by the 1913 flood in the valleys of the Miami, Mad, and Stillwater Rivers.

EXISTING DATA

The first step was to collect and inventory such existing data as was available. This gave considerable immediate information and at the same time assisted in indicating what data was lacking and in outlining the work in hand. The following data was secured:

U. S. Geological Survey
- Topographic quadrangles, scale 1 inch equals 1 mile approximately, with contour intervals 10 feet and 20 feet, 15 in number.
- Topographic advance sheets, scale 1 inch equals 4000 feet, with contour intervals 10 feet and 20 feet, 2 in number.
- Map of Ohio, scale 1 inch equals 8 miles, approximately.
- Map of Indiana, scale 1 inch equals 8 miles, approximately.
- A list of government bench marks in and near the flood plains of the Miami River and its tributaries, except the Whitewater River, giving elevation, location, and description, compiled from Bulletins 411, 476, and 518. A few such bench marks were secured from the U. S. Coast and Geodetic Survey.
- Water Supply Paper 334, entitled The Ohio Valley Flood of March-April, 1913.

Ohio State Board of Health

U. S. Weather Bureau
- Monthly Weather Reviews, containing rainfall data.
- Bulletin Z, containing description of the 1913 floods in the Ohio and lower Mississippi River valleys and rainfall records.
- Gage heights and rainfall records, from office of Local Forecaster, H. F. Alps. Rainfall records were also...
obtained from the Dayton cooperative station, Mrs. Edith L. Boyer, observer.

City Maps and Data

Dayton. Atlas, scale 1 inch equals 200 feet; street maps, scale 1 inch equals 500 feet and 1 inch equals _ mile; and information relating to gas and water mains, sewers, pavements, and conduit lines, obtained from city engineer's office and public utility corporations.

Troy. Street map, scale 1 inch equals 200 feet.
Piqua. Map of city, scale 1 inch equals 200 feet, and street map, scale 1 inch equals 500 feet.
Franklin. Plat of townsite, scale 1 inch equals 500 feet. Hamilton. Street maps, scale 1 inch equals 200 feet, 1 inch equals 300 feet, and 1 inch equals 800 feet, and some bridge plans and cross sections of streams.

County Maps and Data

Maps of all Ohio counties in the Miami drainage area, scale 1 inch equals 1 mile, obtained from Ohio State Highway Commission, showing principal highways, streams, railroads, and political divisions.

Rand McNally highway maps of Eastern Indiana, Wall maps of Preble and Darke Counties, scale 1 inch equals ;/2 mile, approximately.

Atlases of Miami and Butler Counties, which contain also plats of the more important cities and towns.

Township maps of all townships in Miami County. Township maps were also later secured for Shelby, Greene, and Hamilton Counties; and section plats for Montgomery, Butler, and Clark Counties. These maps were used only in the compilation of property maps.

Highway plans and profiles, and some bridge plans, were obtained from the county engineers' offices.
Maps and profiles of drainage ditches were secured where available, many hundreds of them being obtained.

Railroads

Profiles, alignment and right-of-way maps, and bridge and culvert data were secured where available.

General Data

Photographs, showing flood damages and phenomena, were secured from various sources.

Descriptions of the Flood of March, 1913. Among these were a descriptive and illustrated pamphlet published in Dayton, entitled A Pictorial History of the Great Dayton Flood; a pamphlet published in Hamilton, entitled The Flood Disaster; a book of flood views published by the Pennsylvania Railroad, The History of the Flood of March, 1913; the May, 1913, Flood Edition, of the Bell Telephone News; and various personal experiences related by eye witnesses.

Miami & Erie Canal. Small scale map and condensed profile, and small scale maps of the Lewiston, Laramie, and Grand Reservoirs.

DATA REQUIRED

The task of collecting and examining all of this material, though in itself quite important, was but a small beginning in the systematic study of the problem. An idea of the scope of the work which confronted the engineers, is perhaps best obtained from the following brief outline taken from the written instructions issued by Mr. Morgan to the field and office forces at the commencement of the work.

Surveys
Paint highwater marks.
Run base lines entire length of valleys.
Locate and tie to U. S. Geological Survey bench marks. Take levels on highwater marks.
Locate flood lines of 1913 hood.
Meander river channels.
Obtain cross sections of the valley and of the river. Make topographic surveys of cities in flood plain. Obtain levee profiles.
Make soil boring surveys for channel improvements.

Hydraulic Investigations
Check highwater marks and secure additional ones. Measure bridge openings and secure highwater marks. Cross section the river flood plain.
Make discharge measurements.
Make determinations of Kutter's 11.
Secure evidence on velocity of flood flow.
Secure evidence concerning time of flood crests. Construct flood hydrographs.

Office Work
Prepare maps of the Miami drainage basin.
Compile rainfall records of previous great storms.
Plat rainfall contours on maps.
Trace map of Dayton to form base for topographic map. Plat field surveys, maps, cross sections, etc.
Compute valley storage capacity.
Trace county highway maps and show drainage ditches. Prepare maps for areas not covered by U. S. G. S. maps.

Develop plans and estimates for:
Protection at Dayton by
Channel improvement
Channel diversions
Reconstructing bridges
Temporary levee repairs and revetment
Division into Little Miami River
Division of Mad into Miami and Stillwater Rivers Diversion of Stillwater into Miami River
Division of Miami into Stillwater River
Protection at Piqua
Wolf Creek improvement
Protection at Troy
Investigate European methods of flood prevention. Investigate methods of assessing cost of such improvements.
Outline policy of keeping public informed.

General
Take photographs showing flood damages and effects.
Collect information from witnesses of the flood.
Secure data on flood damage.
Make valuation of real estate.
Make further search for pertinent maps and data.
Cooperate with U. S. Weather Bureau in establishing rainfall and river stations and developing a flood warning service.

HIGHWATER MARKS
The flood of March, 1913, left behind it an abundance of evidence as to the height reached by its muddy waters. It was realized that this evidence, when properly interpreted, would be of great value. It was therefore decided to locate and paint a number of the high water marks to preserve them for future reference. This was done in a methodical manner by a force of from eight to twelve men working about two weeks. Little difficulty was experienced in detecting the marks, the most satisfactory ones being found on trees, or on the inside walls of buildings. On many trees very definite marks could be found months after the flood, by peeling off the outer bark. The lodging of grass and root fibres in some cases so clearly defined the height reached by the flood that the heading up of the water on the upstream side of a tree could be measured.
Marks were painted at frequent intervals in the Miami, Mad, Stillwater, and Wolf Creek Valleys, and each was assigned a key number, and described in the field notes. Their elevations were obtained later by means of levels connecting with the U. S. Geological Survey bench marks, and the location and elevations were entered on the topographic maps described elsewhere in this report.

These highwater marks were very important as a source of information. With their aid it was possible to trace accurately the high water lines or so-called flood lines, and these in turn served to define the exact extent of the lands flooded. Taken in conjunction with the topographic maps, they showed the depths of flooding and so enabled the engineers to compute the amount of water stored in the valley at the height of the flood. They furnished the basic information necessary for the appraisal of benefits and damages to property accruing from the adopted plan of flood control. By indicating the slopes of water surfaces and river stages they were of prime value in computing the maximum discharge of the Miami River and of its principal tributaries. For the latter purpose a large number of additional high water marks were later established by a field party assigned to hydraulic investigations.

![FIG. 20.-BRIDGE SITE ON THE SPRINGBORO ROAD BELOW DAYTON. View taken in the summer of 1913.](image)

**FLOOD LINES AND RIVER MEANDERS**

While the high water marks were being painted field parties were organized for making flood line and river meander surveys. The object of these surveys was to determine accurately the locations of the flood lines with respect to topography and property lines, to map the bed and banks of the river channel, and to obtain such data as would enable a study of channel improvements to be made. This work was divided into four main sections, as follows, each of which was assigned to one field party:

- Miami Valley north from Dayton
- Stillwater Valley
- Mad River Valley and Wolf Creek
- Dayton and the Miami Valley south from Dayton

Each party was composed of 2 instrument men, one of whom acted as chief of party, and 4 to 6 rodmen. The instrument equipment consisted of a transit and a dumpy level on which was mounted a 4-inch compass. The procedure was to first run a base transit line up the valley along any railroad or highway whose location was such that the later surveys could be readily tied to the base line. Distances were read by stadia. 'Wherever practicable, the transit points were set near highway crossings, culverts, bridges, or buildings in such locations as could be readily described and identified.

Following the establishment of the base line, work was commenced locating the flood lines, one section of the party working on each side of the valley, but tying their work together at intervals. Distances were taken by stadia, the dumpy levels being provided with stadia wires for this purpose. The elevations of all the painted highwater marks were determined and the flood margin on each side of the valley was traced out. Stadia observations were
taken to show the general topography of the valley, location of houses, etc., and to locate the edge of the valley floor.

Bench marks were set at approximately half mile intervals and at crossings of any highway, railroad, or creek of importance. The work was tied to section and property corners, U. S. Geological Survey bench marks, railroad and highway crossings, and to the base line survey.

River meandering was also done by the level and compass method. The usual arrangement was for one section of the party to make the river survey proper, including cross sections of the channel, and for the other section to take cross sections of the valley. The river survey included the location of back channels, islands, bars, and accumulations of drift, and taking notes as to the condition of the channel. Cross sections of the latter were taken 1500 to 2000 feet apart, and at places where there were marked changes in width or depth. These were taken with hand level and tape, checking the distance across the channel by stadia. Valley cross sections were taken at approximately 2-mile intervals, by means of a level and compass line. These sections were begun at a flood line bench mark, were extended 50 to 75 feet in elevation above the flood line; then, running across the valley, were tied to the river meander survey, to the base transit line, to the flood line on the opposite side of the valley, and were again extended 50 to 75 feet in elevation above the flood line. Highways and railroads crossing the valley were located by a level and compass line, noting the size and character of embankments, bridges, culverts, etc., and also the extent to which they were damaged by the Bood.

In the cities the channel survey, particularly the topographic work, was executed in much greater detail. The first work of this kind was undertaken at Piqua, where prospective water works construction made it urgent to develop plans for flood control as quickly as possible. The work in Dayton included a stadia topographic survey of the river channel, cross sections of the channel, levels on street lines, filling in topography with hand level, and stadia topography in some of the outlying parts of the city which had not been previously mapped.

During the progress of the early surveys it was discovered that in some cases highway bridges were being reconstructed or replaced without adequate plans, or without regard for some of the lessons taught by the flood. A field examination was made of highway bridges and of the flood damages sustained by such structures, and recommendations were made for their repair and reconstruction and for the construction of temporary structures to provide emergency relief for river crossings. Numerous photographs, of which figures 20, 21, and 22 are typical, were secured showing the effects and damage of the flood at different places in the valley, and copies of such city maps and other local engineering data as was available were also obtained.
MEASUREMENTS OF THE 1913 FLOOD

No actual measurements of flood velocity had been made during the 1913 flood. Estimates of discharge obtained from different sources were found to be widely at variance, and even the observations as to time of passage of the crest of the flood at various places in the valley, obtained from apparently competent eye witnesses, were so conflicting that little dependence could be placed on them. The need for an accurate determination of flood flow was apparent at the outset and it was planned in such manner as to yield results of unquestioned reliability. The necessity for such a course was obvious in view of the importance of this data in connection with the design of adequate flood control works.

During the summer and fall of 1913, from two to eight months subsequent to the flood, a party was assigned to make detailed hydrographic surveys at selected places for determining the maximum rates of flood flow. This party moved from place to place working out each location separately, their individual surveys being later tied in to the general surveys. These hydrographic surveys consisted principally in measurements of valley and channel cross sections and of the surface slope of the flood, to be used in computing the discharge by stream flow formulas; and of measurements of cross section and water surface drop at places where bridges or other obstructions produced a considerable contraction in the cross section of the stream, to be used in determining the flood discharge by the contracted opening method. Surveys were made at a total of 23 places located as follows: 5 on the Miami River above Dayton, 4 on Stillwater River, 2 on Mad River, 2 on the Miami River below Dayton, and 10 on various small tributaries. The methods employed and the results obtained are described in detail in Part IV of the Technical Reports, entitled Calculation of Flow in Open Channels.

In collecting data for the slope-area calculations, high water lines were run along the edges of the valley and along the banks of the river; and typical cross sections 300 to 800 feet apart, depending upon the conditions at the particular location, were taken at right angles to the direction of flow. All available highwater marks were secured. Notes were taken concerning character of timber, conditions of the bottom of the valley and river, fences, levees, buildings, railroads, public roads, and any other natural or artificial conditions that might affect the flow of the stream. Besides noting these various features, probable values of roughness factor n in Kutter's formula were recorded for the overflow areas and main channel of each cross section. Before the final computations were made these values of the factor n were revised by Mr. Morgan and Mr. Woodward from their experience in the use of Kutter's formula. Careful effort was made to base the value of this factor upon the actual conditions as noted on the ground entirely independent of the consistency of the results obtained.

The surveys at the contracted openings consisted, for the most part, of detailed soundings and determinations of flood surface. Reliable highwater marks in sufficient number to determine the average slope above the drop-off, the drop-off curve itself, the lowest part of the trough, the standing wave, and the get-away slope, were secured. Soundings were taken along sections between upstream and downstream edges of abutments, along lines just above and just below the openings, and at enough points to locate the maximum scour, edges of holes, and general bottom of the river. Where surveys for slope-area calculations had not been made in the valley just above the contraction, a typical valley cross section, for use in estimating velocity of approach, was secured. Notes were recorded concerning the nature of the bottom, the condition of abutments, conditions above and below the opening, and any other features that might affect the flow.

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LOCAL SURVEYS FOR IMMEDIATE RELIEF

As the surveys progressed the city of Troy found that its flood problem was partly of a local character and might be remedied in a short time at no great expense. The city officials decided to undertake this work at once, and not wishing to burden the Dayton organization with it they independently engaged the Morgan Engineering Company to make plans for the improvement. This resulted in the construction during the winter of 1913-1914 of a ditch and levee along the north side of the city, which protected the west side of the city from the local hill runoff. This runoff had caused frequent damage in the west side during the storms of only moderate intensity, and the ditch and levee have protected this section against a number of freshets since its construction. The work was built by Miami County under the supervision of the county engineer. It was later made part of the main plan for flood control adopted by The Miami Conservancy District.

In the city of Hamilton there existed a similar local flood situation from which it was desired to secure immediate relief. Surveys and estimates for a levee construction to protect against ordinary floods were completed early in 1914. These were made by the Morgan Engineering Company in harmony with the main plan for flood control so far as this main plan could be developed at that time.

The protection recommended consisted essentially of a levee system along the north side of the city. This was constructed in the spring of 1914 by the Hamilton Flood Emergency Commission.

In Dayton there was an insistent demand that actual construction be started immediately to improve the river channels and strengthen the levees through the city. This demand was met by making a rapid survey of the channel condition as to bars, islands, brush, trees, and other obstructions that might be removed, see figure 23, and by determining where existing levees required strengthening. As soon as the necessary data was available, contracts were let for the removal of growths of brush and trees in the channel and the repairing and raising of the levees to a uniform grade. This work increased the effective channel capacity by about twenty per cent.
RESULTS OF EARLY SURVEYS
The flood line, river meander, and hydraulic surveys above described were completed in the late summer of 1913. The results were platted on maps, tables, and diagrams for office computations, and afforded the first authoritative data for use in the preliminary planning of various methods of flood control. They furnished definite data as to the flood flow during the 1913 flood, the height and time of the flood crest at various places, a comparison of this flood with previous floods, the area of city and country lands submerged, an approximate estimate of damage sustained, approximate flood velocities, volume of water stored in the flood plain of the valley, the general character and configuration of the watershed, and the improvements that had been built in the path of the flood. This permitted careful studies and comparisons of various plans to be made, the most important result of which was the establishment of the fact that the cost of any effective form of channel improvement alone would be excessive if not altogether prohibitive, and that a satisfactory solution would probably necessitate the cooperation of the entire valley. Another important result was the discovery that the valley contained several apparently excellent retarding basin sites. This caused the attention to become focused on retarding basin control as a means of flood reduction, and a little later led the Flood Prevention Committee to authorize the survey of possible sites. The tentative results of these early surveys was definitely outlined in the preliminary reports of the Morgan Engineering Company and of the consulting board, given in the preceding chapter.

TOPOGRAPHIC SURVEYS
Each of the various retarding basin sites offered several alternative locations for a dam. After selecting the basins which seemed to give the greatest promise as to efficient storage, reasonable cost of construction, and non-interference with railroads, towns, and other improvements in the valley, topographic surveys were made of the more favorable damsites at each of the basins in order to determine which seemed best, and to assist also in making preliminary estimates of cost of construction. This class of topography was taken by the stadia method in considerable detail, allowing the mapping of 1-foot contour intervals on flat ground, and 2 to 5-foot intervals on steep slopes. Thus fairly accurate projections could be made of the proposed structures, and also close comparisons of the alternative locations.

As the investigation of these sites progressed, the feasibility of retarding basin control became more apparent, and it was decided to make detailed topographic surveys of the more promising basins in order to make more accurate determinations of their relative efficiency and cost. The proposed Fayorsville Retarding Basin, on account of its large capacity and its location on the main stem above Dayton, seemed one of the most important of these locations and was the first to be surveyed. Following this the Englewood Retarding Basin on Stillwater River, the Huffman Basin on lower Mad River, the Upper Basin on the Mad River near Springfield, the Lockington Basin on Loramie Creek, the Germantown Basin on Twin Creek, and other sites were surveyed in a similar manner. The general method of making these
surveys was similar to that used for the early topographic work. The party consisted of an instrument man, a recorder, and three to five rodmen. The general procedure was to survey a belt on each side of the river and one around the margin of the basin. Any intervening gaps on the flat ground between these belts were then filled in. The aim of this work was to get the topography in sufficient detail to show 1-foot contour intervals on the flat ground and 2 to 5-foot intervals on the steep slopes. Notes were also taken to show the location of buildings, bridges, drainage ditches, railroads, highways, canals, and other topographic features. As the work in the retarding basins was completed similar surveys were made of the sections of valley between and below the basins so that eventually a complete topographic survey of the entire valley became available. The topographic surveys previously made in the valley by Butler County were made use of in this connection wherever the results were found to be in sufficient detail.

The general method of procedure for keeping notes and the data to be secured were practically the same for all of these surveys. Each chief of party was given a set of general instructions, which was supplemented by special instructions for his particular survey.

The surveys were plotted on maps as the notes became available. Maps of the dam sites were made on a scale of 200 feet to 1 inch and those of the retarding basins and flood plain of the valley on a scale of 500 feet to 1 inch. On these detailed maps were shown every item of information that was recorded in the field notes, the principal features being contour lines, highways, railroads, canals, drainage ditches, property lines, buildings, bridges, and embankments. In some cases the dimensions of streams or channels were indicated by showing the top width as the numerator and the bottom width as the denominator, respectively, of a fraction, followed by a unit indicating the depth. As the progress of the work permitted, these maps were transferred to tracing cloth so that blue prints could be made for detailed studies, computations, and estimates. The results of the surveys have thus been preserved in the form of original notes, detailed maps, and tracings. The detailed sheets were usually mounted on linen to make them more durable. The maps were made on 28 by 42-inch sheets.

RAILROADS AND HIGHWAYS

As the retarding basin plan of flood control began to take definite shape, and the relative merits of various combinations of basins, spillway elevations, and outlet capacities were being considered and compared, it became necessary to make detailed surveys for the relocation of highways, steam railroads, and electric lines. These surveys were at first of a preliminary character, but as the study narrowed down to a close comparison of the more feasible locations and combinations it required increasingly more detailed data to work with. The highway relocations were of a somewhat incidental nature, but the changes in the railroads and electric lines necessitated by the proposed retarding basin construction offered more serious problems. These changes involved a cost of several million dollars, and in many cases it was a very difficult question to decide just what degree of protection must be provided against slight flooding at very long intervals. Other problems were the balancing of slight variations in alignment to guard against cost of construction and operating expenses. In some cases the railroads wished to avail themselves of the opportunity offered by the proposed relocation to make some improvements in their lines. The studies for this purpose required accurate preliminary surveys, followed by a number of location surveys, and the making of a number of test borings at the Huffman damsite to determine the character of material in a proposed deep cut in that locality.

The surveys were made by the usual railroad survey method, taking hand level and tape topography from a preliminary transit line along which accurate levels had been taken. This topography was plotted on detail maps to a scale of 200 feet to 1 inch upon which were made various trial paper locations. Estimates were made on many different locations before the final location was adopted. The various railroad and electric line companies were kept fully informed concerning the surveys and were given access to all the maps, profiles, and other data developed from them.

At a later time it was found necessary to make additional surveys of the existing lines of steam and electric railroads to make an appraisal of benefits and damages to be assessed against these properties by reason of the construction of the proposed flood control work.

A complete field survey was also made to note the damage that had been caused to highways, railroads, and electric lines by the 1913 flood, particular attention being given to the damaged bridges. Data was also collected and classified showing the frequency and extent of flooding of railroads and highways in the past.
PROPERTY SURVEYS

Thousands of properties were to be affected by the construction of the proposed works and it was evident that an adequate description would be required for each in connection with the appraisal of benefits and damages. Many of the descriptions contained in the county records were found to be inadequate for this purpose and in many cases the maps and plats available were too old or incomplete to be of use. A property survey was therefore made covering practically the entire extent of country lands within the flood plain of the valley, and a considerable amount of similar work was done adjacent to the river channels through the cities and towns. The field notes were platted on maps, to a scale of 500 feet to 1 inch, which were checked against the records and maps found available in the court houses of the counties involved. These maps were made on sheets 28 by 42 inches in size, were traced as they were completed, and have been revised from time to time to show the transfers of property that have taken place since they were first made. The principal features shown are the property lines, roads, railroads, buildings, and streams. Certain flood lines were added later to aid in making the appraisal of benefits and damages. Chief among these lines are the highwater line of the 1913 flood, the highwater line of the 1898 flood, and the theoretical high water line of a flood equal in magnitude to that of 1913 but reduced by the proposed flood control works. In addition to these, there were shown on the maps of the retarding basins contour lines representing the computed water level for a flood about 40 per cent greater than that of 1913.

It is important to note that the work here described was initiated more than a year before the formal establishment of The Miami Conservancy District. There was no question, however, as to what was needed, for the conservancy act specifically provided for the manner in which any proposed improvement was to be paid for by special assessment. It also provided for compensating property holders whose property would have to be taken or damaged. It was evident at the outset that a vast amount of information was needed to meet these requirements, and the work of gathering this information was therefore started early to avoid unnecessary delay after the organization of the conservancy district should be affected. In doing this every effort was made to foresee the working out of the provisions of the act and prepare for this in advance. The wisdom of this course is apparent when it is realized that over 65,000 properties in the valley were affected by the plans.

LAND APPRAISALS

The manner in which the district would have to proceed to acquire ownership of, or flood easement over, land in the basins was of vital and immediate importance because an intelligent estimate of the cost of the several retarding basins could not be arrived at without an estimate of the cost of the land within the basins. The preliminary estimates were based on rather hurried and casual examination of the assessed valuations appearing on tax duplicate and on general information obtained from real estate dealers, farmers, and other sources. It was considered important to confirm these estimates in a more thorough manner and for this purpose an appraisement survey was made in October and November, 1914, of the lands and buildings within the proposed Englewood Retarding Basin situated on the Stillwater River.

A field inspection was made of all the properties lying within the proposed basin. using white print copies of the topographic maps on which to record observations and on which the property lines had been transferred from the property maps. Usually each property could be divided into two or more classes such as tillable, pasture, woodland, waste land, etc., for each of which a unit price per acre was determined. Field notes were made on the ground as to the nature of the soil, size, kind, and condition of improvements, local conditions likely to affect the value of the land, local information as to recent transfers, flood conditions, nearness to towns, and any other factors which, might have a bearing on the market value. This information was considered independently by each of the three men making the appraisal and each one made an independent notation as to his own appraisal of the present value of the property, based upon the information resulting from the inspection. These estimates were later tabulated and averaged in the office and compared with the assessed valuations.

This survey furnished a reliable check on the preliminary estimate of the value of the lands within the basins, and was helpful in indicating the probable time and cost involved in making the final appraisal. It also established a definite relation between the assessed valuation appearing on the tax duplicate and the probable present market value.

SUBSURFACE INVESTIGATIONS

The consideration of retarding basins as a possible means of reducing flood flow raised the question as to what types of dams would be best adapted for the various sites. The answer to this question being largely governed by the
character of the foundations, it became necessary to investigate the materials underlying the dam sites and ascertain if possible the depth to bed rock.

The first subsurface work undertaken was that of making wash borings and diamond drill core borings to assist in a preliminary survey for the location of the various damsites. This work was let by contract to Giles and Clark, of New York City, was begun in December, 1913, and was completed in June of the following year.

About 10,000 lineal feet of wash borings and 1500 feet of diamond drill borings were made at various sites, including 89 holes at the Taylorsville, 80 holes at the Englewood, 31 holes at the Huffman, 19 holes at the Port Jefferson, and 88 holes at the Germantown dam site. These holes were sunk to depths ranging from 4 to 170 feet. They were usually made along a line across the valley on the location of a tentative damsite, with a number of holes grouped around the probable spillway and outlet conduit locations. They were not sufficient in number to give exact data for design and plans, but gave general information as to the existence of rock, its depth from the surface, its character and that of the materials over lying it. This information aided materially in determining the most favorable locations for the dams, although in some cases the final choice could not be made until a more complete subsurface investigation had been made.

The final design and specifications for the structures, as well as their exact location on the ground, required a more definite knowledge of subsurface conditions. This was true not only for the dams but for structures to be built for flood protection at other places in the valley. For this purpose additional borings and test pits were made, and many samples of materials were secured for comparison, for testing, and for preservation as a permanent record of underground conditions. The area thus examined included dam sites, spillway and conduit locations, borrow pits, sites of channel improvements, and railroad and highway cuts and borrow pits.

The necessary boring equipment was purchased by the district, and the work was done by force account.

The total number of borings and holes sunk during these operations was as follows:

- At damsites and vicinity: 479
- At river banks and channel: 233
- At railroad relocations: 13
- At highway relocations: 105

These included wash borings, core borings, auger borings, and sand pump holes. More than 2000 samples secured during this work have been preserved and are still available for inspection, together with complete records giving the depth, location, and other data concerning each. A detailed description of the methods and appliances used and results obtained will appear in a later volume of this series.

The number of holes, their location and depth, and the amount of test pit work done was governed largely by the development of conditions as the work progressed. Some sites required relatively few borings to develop the nature of subsurface conditions sufficiently to meet the requirements of the work. At other places, as for instance where it was important to determine rock contours with considerable accuracy, holes were spaced at frequent intervals. Auger borings, wash borings, and test pits were used to investigate the borrow pit areas from which it was proposed to take material to build the dams. Levee sites and railroad and highway work were examined by wash, core, and auger borings, and by test pits, and all of these methods were applied to the foundations of proposed dams and their vicinity. The sand pump and test pits were used also to investigate the extent and nature of sand and gravel deposits available for concrete construction purposes. In addition to the boring and test pit work, a surface examination of various sites was made by Mr. August Foerste, a local geologist, who reported on geological features of interest in connection with the proposed works.

**RAINFALL AND RUNOFF RECORDS**

The necessity for securing records of rainfall and runoff was recognized at the time the first surveys were begun and within two weeks current meter measurements of discharge were being made at the most important locations. While there were several rainfall stations in the Miami Valley at that time, there were but three river gages, one at Piqua, one at Dayton, and one at Hamilton, AU on the Miami River. The work of establishing additional stations was begun, in cooperation with the U. S. Weather Bureau, almost immediately; and within a few months daily records of rainfall...
and river stages and periodical measurements of discharge were being secured at Sidney, Piqua, Tadmor, Dayton, and Hamilton, on the Miami River, at West Milton on the Stillwater River, at Springfield on Mad River, and at Germantown on Twin Creek, and daily records of rainfall were being secured at several additional stations distributed over the drainage area of the Miami River.

The number of stations was added to from time to time, as the work progressed, until, at the time construction began, records of river stages were being secured at 24 stations and records of rainfall at about 30. Automatic, recording, river gages, of the electric transmission type, were installed at Dayton and Hamilton, and a cable gaging station, for use in measuring discharges during large floods, see figure 24, was erected at Tadmor. Hourly readings of river stages, for use in plating hydrographs, were obtained during flood periods, at the greater number of the river stations. The records of the triple register maintained by the U. S. Weather Bureau in their local office at Dayton, furnished accurate data regarding rates of rainfall.

Current meter measurements of discharge at the various river stations, and also of the various canals and hydraulics in the cities and towns affected by the proposed improvements, were made at regular intervals. The total number of cross sections at which discharge measurements were made regularly was about sixty. A special effort was made to obtain current meter measurements at the river stations, during flood periods, so that accurate stream flow records could be computed. After a sufficient number of flood measurements had been made the records of daily stages and discharges were prepared. Some of the stream flow records have been published in the water supply papers of the U. S. Geological Survey, while the rainfall records and some of the river stages have been published by the U. S. Weather Bureau. These records furnished data for protecting the district in possible future litigation concerning stream flow or water supply conditions.

During periods of heavy rainfall special telephone or telegraph reports were made by the observers for use in flood warning work. These reports were received at the Conservancy Building, as well as at the Local Office of the U. S. Weather Bureau, and made it possible to calculate the probable rise in the rivers at the damsites and at the cities and towns in the valley below.

Detailed studies of the relation between rainfall and runoff were made, using the data secured at the gaging stations, particularly that secured during flood periods. As a practical aid in the study of this relation, a number of experimental plats were established on Moraine Farm, south of Dayton, where the exact amount of rainfall, runoff, and evaporation could be measured on varying slopes and with varying soil conditions, as well as the rapidity and degree of soil saturation caused by different rains. The results of these studies will be published in a later volume of the Technical Reports.
FLOW IN OPEN CHANNELS

The design of the retarding basins, as well as of the local channel improvements, was based to such a large extent on the principles of flow in open channels that it was deemed necessary to undertake extensive experiments and studies of the proper methods of calculating velocities, of the laws of scour and deposit, of the effect of curvature in alignment, of the nature of backwater curves, of the phenomenon known as the hydraulic jump, and of other conditions relating to the flow of streams.

Roughness factor experiments, consisting of measurements of surface slope, discharge, and cross section, for use in comparing velocity formulas, were begun in the summer of 1913 and have been continued up to the present time. Measurements
were made at selected locations on the Miami River at Tadmor, Dayton, and Hamilton, on the Miami and Erie Canal in Dayton, and on the Ohio River at Cincinnati. There were also available for the studies, measurements made by the Morgan Engineering Company of Memphis, Tennessee, on large drainage canals in northeastern Arkansas, on the Bogne Phalia River in Mississippi, and on the St. Francis River in Arkansas. The total range in discharge of these various streams, during the intervals ill which the observations were made, was from about 100 to 53,000 second feet; the range in hydraulic radius was from about 1.5 to about 21 feet; and the range in velocity was from about 0.5 to about 6 feet per second. In addition to the above investigations a careful study was made of all the data that has been collected on the Mississippi River and its tributaries by the Mississippi River Commission during the past 35 years; and roughness factors were calculated for the channel above New Orleans from the gagings and surveys made by that Commission during the floods of 1912 and 1913, when the discharge varied from about 935,000 to about 1,300,000 second feet. In these series of gagings the hydraulic radius varied from about 55 to about 61.5 feet; and the mean velocity, from about 5 to about 6.3 feet per second.

Studies of the European and American literature dealing with the flow of water in open channels were also begun in the summer of 1913 and have been continued to the present time. The various engineering periodicals, the transactions of the scientific and technical societies, the reports of government bureaus, and the publications of private engineers were all carefully examined. Exhaustive studies were made of the work of recent investigators, such as Siedek, Groeger, Lindboe, Hermanek. Barnes, Schmeer and others, as well as of the classical works of Humphreys and Abbot, Ganguillet and Kutter, and Darcy and Bazin. Comparisons of all of the more important formulas for computing the mean velocity in open channels were made, using the experimental data obtained in connection with the Miami Valley flood prevention studies. Examinations were also made of the applicability of these various equations to the computation of the flood discharges of March, 1913. These studies were probably more extended than any that have ever been undertaken on this subject.

The search of the literature was extended so as to include discussions of the backwater conditions produced at bridges, of the computation of discharge from measurements of the drop in the water surface and the minimum area of cross section at places where the normal area of flow space is appreciably contracted by some obstruction such as a railroad or highway fill, of the conditions under which scour and deposit occur, of the effect of curvature on friction losses, of the nature of backwater curves, of the hydraulic jump, and of other conditions affecting the flow of water.

Valuable data regarding loss of head due to curvature and laws of scour and deposit were obtained in connection with the measurements of the 1913 flood and the roughness factor experiments.

The studies of backwater curves and the hydraulic jump are fully described in Part III of the Technical Report and the greater part of the other investigations of the principles of flow in open channels are given in Part IV.

FLOODS AND RAINFALL

One of the first problems in planning flood control works for the valley was to determine the size of the greatest flood against which protection would be required. The lack of data regarding rates of flood discharge and flood frequency necessitated exhaustive studies not only of great floods but also of the great storms that cause them. These investigations included the maximum rates of discharge that occurred in the Miami Valley in March, 1913, discussed in the preceding pages; the occurrence and size of past floods in the Miami Valley; the maximum rates of discharge and frequency of floods that have occurred elsewhere in the United States and also in foreign countries; the rainfall during the storm of March, 1913; the occurrence of great storms in eastern United States, their rainfall distribution and intensity; rainfall in Europe; and various other conditions relating to rainfall and floods. The studies of the past floods in the Miami Valley and of floods in other parts of the United States and in Europe were based on published data. The various engineering periodicals, the transactions of the scientific and technical societies, the reports of government bureaus, and the publications of private engineers and of engineering corporations, were all thoroughly searched.

It was found that the maximum rates of runoff that occurred in the Miami Valley during the flood of March, 1913, were about the same as those that occurred in the Scioto and Olentangy Valleys during the same storm; and that they were greater than any that had occurred in the Miami Valley during the preceding century. In fact, for streams in the eastern part of the United States of similar size, no records of runoff were found which were as great as those of the 1913 flood. However, the examination of European flood control literature showed that such rates of runoff, although not frequent, have occurred in certain parts of Europe. In parts of France and Germany where the topography, permeability of surface, annual rainfall, and character of storms

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are comparable with those of southwestern Ohio, records of flood rates practically as great have been noted; while in mountainous regions with steep slopes and impermeable coverings even greater rates have occurred.

The examination of European stream flow records covering long periods of time, such as the 900-year record of the Danube at Vienna, the 300-year record of the Seine at Paris, and the 2300-year record of the Tiber at Rome, showed that the average maximum flood of a hundred years is not greatly exceeded by the maximum flood of one or two thousand years.

Additional data regarding flood runoff is given in Part IV of the Technical Report, Calculation of Flow in Open Channels, chapter III, and in Part V of the Technical Report, Storm Rainfall of Eastern United States, chapter XI.

In order to determine the frequency and intensity of storms that have caused great floods in the past, an examination was undertaken of all existing rainfall records of the United States. First the Weather Bureau records at Dayton and Columbus were investigated and later a squad of men was sent to the city of Washington to examine all of the existing government records. The data abstracted included all the most intense rainfalls recorded up to December 31, 1914. The tabulation consists of 4300 sheets and required nearly a year to complete; but the results afford probably the most complete summary of great storms ever compiled.

Fairly complete rainfall records in the United States extend back to 1892. The Weather Bureau was officially organized in 1891, taking over all the meteorological work previously carried on by the signal service of the War Department. During the following year the number of observing stations was greatly increased. Prior to this time the number of stations maintained by the government was not sufficient in some sections of the country to insure that every great storm would be included in a search of this kind.

From the tabulation of rainfall records covering the entire eastern half of the United States, maps and diagrams were made of all the greatest storms since 1892. These show the relative duration, frequency, and intensity of the storms and also give a ready comparison of their seasonal and geographic distribution. It was found that although heavy storms frequently move up the Ohio Valley, the latitude of the Miami Valley and its distance from the Atlantic Ocean and the Gulf of Mexico preclude the possibility of rainfalls as great as those that occur in southern states. Of the 33 great storms which were given special study, 12 occurred in the upper Mississippi Valley. Of these, the few that materially exceeded the storm of March, 1913, occurred during the summer and fall months when the runoff is a much smaller part of the rainfall than it is in the winter and early spring. Most of the heaviest storms occurred farther south than Ohio. The studies indicate that, for the Miami Valley, the storm of March, 1913, was unusual as to duration, intensity of rainfall, and extent of territory covered; and that it never will be greatly exceeded in this locality.

As a result of the investigations of floods and rainfall it was decided to plan the flood control works large enough to control a runoff about 40 per cent greater than that of March, 1913, and to make the dams and appurtenances large enough to safely withstand floods from two to three times as great.

The result of the studies of storm rainfall have been published as Part V of the Technical Report, Storm Rainfall in Eastern United States.

FLOOD CONTROL METHODS

In attacking the flood problem of the Miami Valley every possible method was given consideration and was investigated until it was either definitely proved to be impracticable or inadequate, or was shown to be a possible method of solution. Those plans which then seemed feasible were worked out in sufficient detail to demonstrate conclusively which would give the best results. Among those investigated were a plan of channel improvement only; a system of numerous small reservoirs and check dams; diversion channels and cutoff channels; diversion of the flood flow of the Miami River northward through Loramie Creek to Lake Erie, combined with a power development; various combinations of retarding basins; and channel improvement supplemented by retarding basins. The river and flood control literature of this country and Europe was searched for suggestions and aid in the proper solution of the problem. Particular study was made of flood control systems in operation elsewhere, and every source of information on the subject was exhausted before the final plan was adopted.

In developing the retarding basin system of flood control careful study was given to the design of earth dams, particularly as to seepage, stability, methods of construction, and conditions which might cause their failure. The causes of failure of over two hundred dams were fully investigated, about half of which were constructed of earth. This number included all the most important dams, built under engineering supervision, the failures of which were described in engineering literature. The number of human lives that would be lost should one of the dams in the Miami Valley fail, would be so great that nothing but an
absolutely safe design could be considered.

The wisdom of these extensive preliminary investigations was amply proved by the results. During the early stages of the surveys it was believed, by the engineers as well as by residents of the valley, that channel improvement offered the only practicable solution for the flood problem, and that reservoir control was entirely impracticable. The exact reverse proved to be true, and if a system of control by channel improvement alone had been attempted, the results would have been entirely inadequate, and might have culminated in a disastrous failure.

HEIGHT OF DAMS AND SIZE OF CONDUITS

The determination of the most economical height of dam and size of conduit for each of the retarding basins involved extensive studies of the action of the basins during typical floods with different lengths of dams and sizes of conduits; of the effect of the backwater on villages, railroads, traction lines, and other utilities; of the effect of channel improvements in the cities below; and of the relative cost of the two methods of securing protection. In considering this problem it was necessary not only that each dam be studied by itself but also that its action in combination with the other basins, and with the local channel improvements, be studied, until all parts were coordinated into the most effective and most economical system.

The effect of each basin, and of the system as a whole, on all the large floods of the past 25 years, was studied under several conditions of design, to ascertain the degree of control obtained on floods of varying size. The depth, duration, and season of flooding on lands within the retarding basins, during the past 25 years, were thoroughly investigated, and were compared with the conditions that would have existed if the basins had been constructed. The interference of the backwater in the basins with villages, railroads, traction lines, and other utilities were also studied in detail and compared with the conditions that have existed in the past. The maximum heights that would be reached in the different basins during a flood 40 per cent greater than that of March, 1913, were calculated, as were also the maximum discharges of the basins, for such a flood, the resulting stages in the valleys below, and the stages that would exist if the basins were not constructed. As a test of the stability of the dams, the action of the individual basins was investigated for a flood twice as great as that of 1913.

An exhaustive study was made of the effect of valley storage on the flood flow of the 1913 flood. This data proved to be of great value in showing the relative efficiency of the combined channel improvement and retarding basin system, as compared with a system of channel improvement alone. It also gave a comparison of the area of land actually flooded in 1913 with the area that would be submerged in the retarding basins during a recurrence of such a flood.

CONDUIT OUTLET EXPERIMENTS

One of the most difficult problems of the retarding basin plan was the proper design of conduit outlets, for handling the tremendous discharge at high velocities which will occur during floods. The dams forming the retarding basins were planned to have permanently open outlet tunnels or conduits through their bases at the level of the river channel. These conduits are not provided with gates or any other apparatus requiring manipulation, being of such size as to permit no more water to pass through than can be safely carried in the channels through the cities and towns below. It was found that the maximum depth of water to be stored in some of the basins during extreme floods would give discharge velocities of over 50 feet per second through the conduits. While there was ample precedent for handling such high velocities in concrete conduits, the safe discharge of the water into earth lined channels, for such conditions, had not been satisfactorily worked out. Since this was an essential feature of the retarding basin principle of flood control, it was decided to make extensive experiments and tests for developing a satisfactory method of reducing the high velocity and dissipating the energy of the water before its entrance into the unprotected channel, where it might otherwise produce dangerous erosion. For this purpose, an experimental plant consisting of a model outlet conduit and channel was constructed at Moraine Farm. This model was one-sixteenth of the actual size of the structures as proposed for the dams. Water was pumped through the model by an electric driven centrifugal pump delivering through a pressure tank so arranged that various velocities could be obtained at will. A large number of experiments and tests were conducted with this apparatus, extending over a period of twelve months. Various forms of outlet channels, baffle piers, drop off devices, and stilling pools were used.

The most important conclusion reached by these experiments is that for large structures the hydraulic jump is the most practicable method of securing the desired elimination of energy. Its certainty to occur is demonstrated by observations below high spillway dams, and the manner of securing it at conduits mouths is established by these
experiments. Its use is economical and safe, and, since it is governed by a known theoretic law, its position is capable of fairly definite calculation. To secure a stable and uniform jump, the water entering it should be in the form of a sheet of uniform thickness and velocity across the channel. This condition can be secured in the channel below a conduit by providing a smooth and gradual expansion in the sides of the channel, so shaped as to insure continuous contact between the spreading water and the sides. The sides should be tangent to the conduit walls and should not be concave toward the water until the jump is passed. The bottom of the channel should be gradually depressed below the outlet, so that at the point where the jump is desired, there shall be sufficient depth of tail water to produce it. The results of this work and their application to the design of the outlet conduits and channels are described in Part III of the Technical Reports.

DESIGN OF CONDUITS

The design of the conduits through the dams was complicated by the fact that they might be subjected to many very different conditions of loading.

When the design was started it was decided not to use any steel upon which reliance was to be placed for permanency, on account of the uncertainty of its lasting properties under the conditions here obtaining. While it is a simple matter to design a conduit without reinforcement for one known condition of loading, or to design one with reinforcement for a variety of conditions of loading, it is a very difficult and complicated problem to design one with a variety of conditions of loading, and make it safe for all, without the use of reinforcement.

A systematic and exhaustive series of investigations for the design of these conduits was therefore begun a very short time after the decision to use the retarding basin method of flood control was reached. These studies extended over a period of about two and one-half years, investigations being made for every possible condition of loading as well as for stresses due to temperature changes. The total number of investigations made as the design of the project developed, and as changes were made from time to time, was almost two hundred. A great many of these were made upon sections of conduits that were discarded because of radical changes in size due to modification in the general design of the project.

CONSTRUCTION MATERIALS AND METHODS

The policy of the thorough investigation of every problem that presented itself was consistently continued in the investigations of construction materials and methods. The samples of sand and gravel taken from sources of supply near the sites of the proposed works, in the subsurface investigations, were tested as to their suitability for use in concrete, in a laboratory equipped for this purpose in the Conservancy Building. Tests were also made of the permeability of concrete, and the solubility in concrete of various kinds of stone available for use. Since the works were being planned to last for all time, the life and permanent stability of the materials of construction were matters of vital importance. Researches of engineering literature were made on such subjects as the preservation of steel and iron in concrete under water, temperature stresses in massive concrete structures, and allowable loadings on foundations. The character of foundation footings of large buildings in Dayton, and the amount of settlement occurring during and after their construction, were investigated. Various forms of channel paving were carefully studied before the flexible concrete block form of revetment was finally adopted.

As the plans neared completion, studies were made of construction methods and equipment adapted to the work. As examples of the problems encountered, there may be mentioned that of stream control at the dams during their construction, and that of protecting, against sudden high water, the excavating machinery to be used in the channels at Dayton and Hamilton.
FIELD INSPECTIONS

The effects of floods were studied in various ways. Eroded fields, such as that shown in figure 25, as well as fields buried by deposits of sand and gravel, such as that shown in figure 26, were examined in different parts of the valley. The damage to roads, bridges, and railroads was inspected and inventoried. A study was made of the deposition of silt by flood waters, the rate of such deposit, and its value as a fertilizer. The failure of the Stony River dam in West Virginia, on January 15, 1914, was fully investigated on the ground, as was also the destructive flood at Erie, Pennsylvania, in August, 1915. The channel improvement that had been constructed at Kansas City was inspected. Complete reports and photographic records covering these investigations were compiled for ready reference.

After it had developed that a system of retarding basins combined with channel improvement would be used, one of the engineers made an extensive trip through the western states, visiting many large earth dams that were under construction or in operation. The principal purpose of this trip was to investigate the hydraulic fill method of earth dam construction, but it furnished also much valuable information on other points, such as the stability of earth dams, details of construction, and construction plant. An inspection trip was made through Ontario and Quebec to observe methods and difficulties of handling ice at the intakes, spillways, and sluice ways of various dams and power plants, as well as the action of high velocities in conduits. When the Island Park dam was built by the City of Dayton, a system of pipes was installed in such a manner that observations could be made on the upward pressure of water under the dam. In making tests of earth pressure and the time required for compacting earth under water the cooperation of the United States Office of Public Roads and Rural Engineering was secured to carry out an extensive program of experiments directly in line with the information desired.
FIG. 26.-GRAVEL DEPOSIT MADE DURING THE 1913 FLOOD.

FIG. 27.-MIAMI & ERIE CANAL AQUEDUCT OVER MAD RIVER. View taken before the 1913 flood.
In Dayton a levee patrol organization was maintained by the engineers of the district in conjunction with the city department of public service. The purpose of this was to be ready for emergency work in repairing or strengthening the levees in case of dangerous floods occurring before the flood control works were completed. In time of flood an engineer was stationed at the Conservancy Building at all times to reply to telephone requests for information.

Surveys and field inspections were made to determine the physical status of the Idiami and Erie Canal and of the existing Laramie and Lewiston Reservoirs in the upper part of the valley. The inspection of these reservoirs was made with a view to determining in what way their operation might affect the proposed plan, and whether they needed any repairs or improvements to insure their future safety and that of the proposed works. The Miami and Erie Canal aqueduct over Mad River in Dayton, as it existed before the 1913 flood, is shown in figure 27.

Some surveys were made at industrial plants, factories, and other properties which were especially affected by the proposed construction, and much other work was done in connection with various researches and investigations to develop certain phases of the problem or to supplement the data available. Special surveys and field inspections were also required in many cases to furnish more detailed data for use in appraising the benefits and damages.

**FINAL DETAIL SURVEYS AND PLANS**

While many of the above described surveys were made in great detail, their purpose was largely for determining the main features of the plan and not for working out the details of design. As the main features took definite form it became necessary to cover certain parts of the ground a second time in order to secure more exact data for use in the final studies and detailed designs, and for use also in the preparation of contract and working drawings, specifications; and estimates. The subsurface investigation is an illustration of this in that the first borings were made to aid in a choice of various feasible damsites, while the later borings were made to determine the specific location, size, shape, and other features of individual structures such as retaining walls, levees, conduits, spillways, etc., and to give more exact data for plans, specifications, and estimates.

The detailed surveys of the damsites were begun in February, 1916. A true meridian was established at each site. Systems of coordinates which had previously been established for referencing the borings and test pits were tied to these meridians and the courses properly corrected. True bearings were used on the new work, all of which was tied to either existing or new coordinate points. Permanent hubs consisting of iron pipes about 20 feet long were placed at important points and referenced where possible in such a manner that they could readily be found by one not familiar with the surveys.

All railroads, roads, telephone, telegraph, and fence lines, houses, barns, canals, streams, pipe lines, and other features were carefully located; and areas of rock outcrop were described in the notes. Probable favorable locations for sand or gravel pits and quarries were indicated. Outlines of cultivated land, pasture land, marsh land, woodland, etc., were determined roughly. Elevations on which to base the topography were established with a wye level or transit. Cross sections of the river channel were taken not further than 100 feet apart over the damsite and from entrance to outlet of spillways and conduits. All topography on this work was taken with a leveling instrument and tape and not by stadia, and was plotted to scale in the field.

For areas covered by the conduit and spillway structures, sections for locating the contours were taken at frequent intervals so that the topography could be plotted accurately on the field sheets to a scale of 40 feet to 1 inch. The remainder of the topography, which included the entire damsite and borrow pit areas, was mapped on a scale of 100 feet to 1 inch and in such detail that no further surveys would be necessary for planning and locating the construction plant on the ground. Any physical features of the site that might be of use in drawing up designs and estimates were carefully noted and described. An outline of the area to be covered at each dam site was furnished the chief of party before the survey was begun.

Similar surveys were made for the local protection plans in cities and towns. This work covered three important items; namely, cross sectioning river channels, detail surveys of areas occupied by or adjacent to the proposed improvement, and staking out the improvement itself. Its purpose may be stated as the collection of data for making final designs and contract drawings, for the description of right-of-way required, for the determination of contract quantities and character of materials, for the location of spoil areas and determination of overhaul, for the establishment of bench marks and reference points, and for determining the space available for placing and moving construction equipment. The surveys were so planned as to involve a
minimum duplication of previous work.

The field work was done in such a manner as to permit accurate plotting of notes to a scale of 50 feet to 1 inch. It included the location and description of street and property lines, buildings, retaining walls, bridge abutments, sidewalks, pavements, railroad tracks, hydraulics, sewers, manholes, water gates, and other structures within the affected area. Cross sections were taken of the river bank at intervals of 50 feet except where irregularity of the ground required intermediate sections. Cross sections of river channels at bridges with description of bridge structures were secured in each city. Permanent bench marks, according with standard design, were established at such locations as to be readily available for construction purposes.

The final definite location and design of the dams made it possible to determine the necessary relocation of railroads, electric lines, and highways. As the relocation plans developed, conferences were held with the railroad officials, the plans explained to them, and all the data that had been accumulated made available to them. In this way agreements as to the proposed construction were arrived at. The final lines, which were staked out on the ground, were shown on topographic maps on a scale of 200 feet to 1 inch. At Huffman Hill, opposite the Huffman damsite, where the new location for the Erie and Big Four Railroads required a 100-foot cut, core borings were made to determine the nature of the materials. On account of questions of right-of-way it was found necessary to make certain property surveys along the new lines. Right-of-way maps were then prepared on a scale of 200 feet to 1 inch. All final railroad maps were made on sheets 21 by 42 inches. Complete profiles, plans, and estimates were prepared for the construction work.

The highway relocations were first tentatively laid out on the original 500 feet to 1 inch topographic maps. A closer topographic survey was then made by taking topography from a preliminary transit line along the proposed location, showing 1-foot contour intervals, on a scale of 100 feet to 1 inch. Some borings were made to develop the character of material in the proposed borrow pits, to determine the amount and character of rock excavation, and to develop foundation conditions at proposed bridge sites. A paper projection was then made and the final locations staked out on the ground, tying in property lines and section corners. Property maps were then prepared, profiles drawn, descriptions written of the right-of-way required, and the estimates of cost revised. Specifications for road construction, including plans for small structures, were made to conform with those of the State Highway Commission. The maps were made sheets 21 by 28 inches.

The various surveys and investigations occasioned a great deal of drafting, computation, and miscellaneous office work. All maps, plans, computations, notes, and other data have been carefully classified and indexed so as to be readily available at any time.

**ENGINEERING ORGANIZATION**

The engineering office established by the Morgan Engineering Company in the City National Bank Building in Dayton was maintained throughout the preliminary surveys and investigations. O. N. Floyd, engaged on the project from the beginning, had charge of the preliminary surveys and kept in close touch with all the engineering details. I. E. Houk directed the hydraulic surveys and computations. K. C. Grant made investigations and translations of European literature. G. C. Cummin began the investigation of rainfall records. P. D. Fuqua had charge of much of the topographic field work. C. H. Shea as chief draftsman had charge of all maps, plans, and field notes. C. A. Bock was in charge of the office administration. Professor S. IVT. Woodward acted as consulting engineer on the various features of the work.

In June, 1915, the Miami Conservancy District took over the entire part of the Morgan Engineering Company's organization employed on the Miami Valley flood protection work, appointing Mr. Morgan chief engineer. During the year preceding this the engineering force had been materially increased in order to hasten the completion of the plans. From this time up to the beginning of the construction period the engineering force comprised about 18 assistant engineers, 13 computers, 22 draftsmen, 3 chiefs of party, 4 instrument men, 12 rodmen and chairmen, and 5 clerks and stenographers. J. H. Kimball had charge of the final development of plans for channel improvements in the various cities and towns and assisted in working out specifications. O. N. Floyd directed much of the field work and had general supervision of plans for railroad relocations and changes affecting other public utilities. E. N. Floyd worked out plans for railroad relocations, channel improvements, and made a search of the literature on earth dams. C. C. Chambers had charge of all field parties. H. S. R. McCurdy directed the subsurface investigations and testing of materials and assisted in working out specifications. A. B. Mayhew made studies of the balancing of the retarding basins and of a system of numerous small basins, and planned highway relocations. K. C. Grant worked out plans for an alternative system 0.£ channel improvement and made studies of the action of the retarding basins. S. M. Woodward acted as consulting engineer on the various features of design and conducted a large part of the technical
studies. G. 1-1. Matthes had charge of several portions of the work, such as the study of rainfall data, and the determination of benefits to city lots. B. M. Jones worked out various hydraulic problems, including general methods for determining spillway capacities, and conditions governing valley storage. J. E. Houkhad charge of the hydrographic work and the experiments and studies on flow in open channels. R. M. Riegel made experimental investigations of the hydraulic jump and assisted on design of structures. C. H. Eiffert made field inspections for channel improvements and assisted in their design. Walter M. Smith had charge of the design of outlet conduits and spillways. C. H. Shea had charge of the drafting force and all maps, plans, and field notes. C. A. Bock had charge of the office administration and assisted the chief engineer in outlining and coordinating the engineering investigations. In December, 1915, Charles H. Paul was engaged as construction engineer and later was appointed assistant chief engineer. He worked out a large part of the specifications and has had general supervision of the plans for the dams. Mr. Morgan, as chief engineer, directed the work from its inception.
CHAPTER V.-THE OFFICIAL PLAN

This chapter describes briefly the various successive steps in the process of preparing and adopting the official plan for the flood protection works of the district. It covers the collection of data, design of the works, formulation and presentation of the plan, the adoption of the plan by the board of directors after public hearings, and finally the formal approval of the plan by the conservancy court at the conclusion of a hearing lasting seven weeks.

RESULTS OF INVESTIGATIONS

The greatest flood that has occurred in the Miami Valley, of which we have any knowledge, is that of March, 1913. The magnitude and frequency of probable future floods must be judged not only from the record of past occurrences in this valley, but also from what has occurred in neighboring territory subject to similar weather conditions. From a comprehensive study of rainfall records and great storms it appeared that storms of greater intensity than that of 1913 have occurred in southern Illinois and in Iowa. Their occurrence in Ohio must therefore be looked upon as possible.

The preliminary investigations showed that uncontrolled floods smaller than that of 1913, even those discharging only half as much water, would cause very great damage. The first question to be decided, therefore, was against how great a flood should the valley be protected. An improvement might be planned for controlling a lesser flood, such as might occur perhaps once in twenty-five years, with works that would prove inadequate for larger floods; or the works might be made adequate to protect the valley against floods as great as that of 1913; or they might be made adequate under all possible flood conditions. The plan to be adopted would necessarily depend upon the cost of different degrees of protection, upon the values to be protected, and upon the damage that would occur whenever works designed for partial protection should fail. After numerous comparisons of plans and estimates of costs had been made and analyzed it became apparent that protection should be provided against the greatest possible flood. This applied to the entire Miami Valley with the exception of localities where minor damage from moderate overflow on low lying lands would not justify the cost of the necessary local protection. The rainfall and flood investigations resulted in a decision to provide protection against floods about forty per cent greater than the flood of 1913.

When the investigation of the flood control problems was undertaken in May, 1915, it was assumed that relief was to be found by means of local channel improvements; and for several months attention was centered principally on this type of improvement. In the meantime, however, all methods of flood control within the range of possibility were being carefully considered. Plans for relief by each method were prepared to a point where it could be determined definitely whether that particular method was or was not feasible.

Among the plans investigated were: the diversion of the rivers into other streams or into new channels; the construction of numerous small retarding basins; the construction of a few large retarding basins; the construction of storage reservoirs which would serve flood prevention and other purposes; the enlarging of the river channels; and the local protection of the cities by a variety of methods. Very few of the possibilities investigated proved to be at all practicable. It was found possible at moderate expense to divert the water of Mad River into the Little Miami; but as this would simply have transferred the flood problem to another part of the state the plan was abandoned. The relief of the Miami Valley as a whole by channel improvement alone was found to be so excessively expensive to construct and so difficult to maintain as to be entirely out of the question. Local channel improvement was found to be possible for some cities, but entirely impossible for others. Bypasses for carrying flood water around the cities were found to be too expensive to warrant consideration. A system of many small retarding basins was found to be wholly impracticable, because it is only where they can be tilled to a considerable depth that retarding basins become economical.

It would be possible to build a dam across the Miami River just above Piqua, and to divert all of the flow into Loramie Creek Valley, through an artificial channel to Grand Reservoir, and thence to Lake Erie. This would naturally resolve itself into a power development, the regulated flow of the river being used at Piqua. However, the value of the power would not warrant the extra cost, which would be considerable on account of the many complications involved.

The construction of reservoirs for combined flood prevention and power purposes was not found to be feasible in any part of the Miami Valley. Power development and flood control can be provided for at the same time only by
creating storage space additional to that necessary for holding Boood water, since space used for storing water for power production cannot at the same time be kept empty and thus available for storing water in time of flood. In Europe such combination: of power, storage, and flood prevention reservoirs have frequently worked out to ad vantage, but in the Miami Valley the loss due to permanently submerging the large areas of valuable agricultural land would be greater than would be justi-fied by the resulting benefits. Under the retarding basin system these lands will continue to be cultivated, and will increase in fer-tility.

FIG. 28.—LOOKING EAST ON THIRD STREET, DAYTON.
View taken when the 1913 flood waters were highest. Note trolley pole extending above water from street car which is entirely submerged.

While some of the researches and investigations made were merely incidental in the development of the plan, the final results would not have been complete or even possible without them. As the investigations proceeded, and as data became available from the surveys throughout the district, it became obvious that no one method of improvement taken by itself would best solve the problem. The best solution was found to be a system of retarding basins supplemented by local channel improvements, the improvement by each method being carried to a point where further protection could be more economically secured by another method. The final balance between the different elements of the plan was reached only after many estimates and comparisons; the plan adopted being one of many combinations that had been worked out in great detail.

DESCRIPTION OF THE PLAN
Just as numerous comparisons were made in determining the general features of the plan, so the same course was followed in finally determining the details. For instance, in most cases there were numerous possible locations for the dams to form the retarding basins. One location might be most favorable so far as the location of the dam itself was concerned, while another would show more favorable conditions for the location of conduit or spillway. Again, the apparent balance of economy as seen from the surface might be entirely upset by soil borings indicating unfavorable conditions in the underlying rock, and in the end all these conditions might be set aside by the impracticability of securing enough earth in that particular location for building the dam at reasonable cost.

With a dam finally located there would be several possible spillway or conduit locations to choose from; the best was determined by successive elimination of the less favorable, as were the larger features. Over the entire project, both with regard to retarding basins and to channel improvements, this policy of comparison and elimination was
followed.
The detailed study at times disclosed difficulties which indicated the necessity for additional expense in order to insure complete safety in the final plan, or disclosed the possibility of additional safe-guards. At other times opportunities were found by taking advantage of favorable conditions to reduce the cost. Not until the final selections of details had been made and the items summed up, could a definite and accurate statement of the total cost be made.

REPORT OF THE CHIEF ENGINEER

A complete plan for the effective control of floods in the Miami Valley was submitted to the directors of the district by the chief engineer early in 1916, with the following letter of transmittal:

February 29, 1916.

To The Board of Directors of The Miami Conservancy District.

Gentlemen:

Following the organization of The Miami Conservancy District by order of the court on the 28th of June, 1915, the appointment of your board on the 28th of June, 1915, as the board of directors of the district, and the appointment dated the 7th of July, 1915, of the undersigned as chief engineer of the district, with instructions to prepare a plan for the protection of the district from floods; he proceeded to prepare such a plan, which is herewith presented for your consideration, with the recommendation that it be adopted as the Official Plan of The Miami Conservancy District, as provided for in Section 12 of the Conservancy Act of Ohio. In the preparation of the plan, your engineers have supplemented and completed the data secured and the work done by The Morgan Engineering Company under the direction of The Dayton Flood Prevention Committee. In the presentation of this plan, it has seemed advisable to outline in brief the data on which the plan is based, and a statement of the processes and methods employed in determining its various features.

When this plan is carried into effect the Miami Valley, in our opinion, will be permanently protected from serious damage by flood. In its necessity for flood prevention, the valley is not unique. Wherever, along the rivers of this country, industrial and agricultural development reaches a high stage, the protection of these interests from damage by uncontrolled flood waters becomes necessary, and must be secured before permanent prosperity is established.

The immediate cause for the movement for flood protection and the organization of The Miami Conservancy District, was the great flood of 1913. Here, as elsewhere, the movement for protection has awaited until it should receive the impetus given by a single great disaster, though the necessity for protection from many smaller storms, and rarely from larger ones, always has been present, and will continue to be present until protection is secured. As the development of the valley progresses from year to year, the extent of the interests requiring protection from floods grows continually greater.

In the preparation of the plan a considerable amount of original engineering investigation has been carried on by the engineering force. The completeness of these investigations and accuracy of the final results are due in a large measure to the faithful and persistent efforts of various members of the force, and to the advice and counsel of the consulting engineers of the district. Reports on the investigations, and acknowledgments of the services which have made them successful are out of place in an official plan, but will be covered at a later date in a separate report. Other engineering organizations have been generous in supplying, without charge, data necessary on this work, and it would seem well to reciprocate by making the results of these investigations generally available.

Respectfully submitted,

ARTHUR E. MORGAN,
Chief Engineer.

This report was presented in three printed volumes and two volumes of photographic reproductions of drawings. It included: first, a selection of some of the most pertinent and important facts from the great volume of technical and engineering data which had been accumulated in the course of the preparation of the plan; second, a statement of the more important principles governing the development of the plan; third, a detailed description of the plan itself; fourth, a listed description of the property affected; fifth, forms to be used in advertising the work before letting contracts, forms of contract and bond, and specifications for the work; sixth, estimates of quantities and costs; and seventh, a set of about 400 drawings, including plans of the work to be done, and topographic and property maps of the district.

Over three thousand copies of the report were printed and distributed. This was in keeping with the policy, early established, of giving the people of the valley full information at all times. Practically every newspaper in the valley published a description of the plan so illustrated as to bring it to the attention of all readers. It was described by the leading engineering periodicals of the country in a manner calculated to draw out the criticism and comment of engineers interested in flood control problems. A special effort was made to supply copies of the report to those who were known to be opposing the plans, to give them the benefit of all the information available. In some cases this served to correct misunderstandings regarding the plans and to remove distrust of the motives actuating the advocates of the flood protection plans.
In brief, the plan provided for a system of five retarding basins, supplemented by channel improvement through the cities. The retarding basins were to be formed by earth dams built across the valleys of the Miami, Mad, and Stillwater Rivers, and on Twin and Loramie Creeks. The highest dam, that at Englewood, was to be 120 feet above the valley, and the lowest, the Huffman Dam, was to be 65 feet high. For the construction of all the dams, a total of about 9,000,000 cubic yards of earth and about 190,000 cubic yards of concrete would be necessary. Each dam was to have, in its base, permanently open outlets through which the ordinary flow of the river and the flow during ordinary freshets would pass unimpeded. The conduits were to be so proportioned that no more water could pass through them than could be carried safely in the improved channels through the cities below. During large floods the water which could not pass through the outlet conduits would be held temporarily in the basins above the dams. In this manner, the larger part of the runoff during a flood like that of 1913, which lasted about four days, would be distributed over a period of about two weeks and its flood height would be correspondingly reduced. The local flood control works at the various cities were to consist of widening and deepening the channels, correcting sharp bends, raising and lengthening bridges, protecting the sides and bottoms of channels with concrete at critical points, and building levees.

The channel improvement work would involve about 5,000,000 cubic yards of excavation and 90,000 cubic yards of concrete.
During the 1913 flood about 1,415,000 acre feet of water fell upon the drainage areas above the proposed dams. The total capacity of the retarding basins to the spillway level would be 840,000 acre feet, or 60 per cent of the total rainfall of the 1913 flood. During the beginning of a flood, and again during its ending when the flow is still large but not greater than the channels will carry, all the flow would pass through the openings in the dams and none would be stored. This would leave the whole of the storage capacity of the basins available for detaining the excess flow of the flood passing down the valley. Assuming, for the moment, that during a flood like that of 1913 all the rainfall would run off and none would be stored in the soil to run off slowly, there would remain 575,000 acre feet, or 40 per cent of the rainfall, to pass through the conduits. The conduits were planned of such size, however, that considerably more than this would pass through them during this interval, leaving a smaller part to be stored in the basins, and in such a flood the water consequently would not rise to the spillway level. The river channels would be filled approximately to their full capacity during the entire time of the flood, and it would be only the peak of the flood, the part that the rivers cannot carry, which would be temporarily held back in the retarding basins. By improving the river channels through the cities the rate at which the water could be allowed to pass through the conduits would be increased and the amount that must be held back in the basins would be decreased, the economic balance being at the point which secures the desired control at the lowest cost.

In general, the greatest rate of flow through the cities below the retarding basins in case of a storm like that of 1913 would be approximately half as great as the uncontrolled flow in 1913, the remainder being cared for by retarding basin control.

The work was so planned that construction could proceed simultaneously on all of the channel improvements and dams.

**PUBLIC HEARINGS ON PLAN AND ITS ADOPTION** The following notice was published in each of two newspapers of different political affiliations and of general circulation in each of the counties having lands in the district, on March 2, 9, and 16, 1916:

Notice is hereby given by the Board of Directors of The Miami Conservancy District that a plan for the improvements for which The Miami Conservancy District was created has been completed, and that all persons interested therein may inspect the same at the office of said Board in The Miami Conservancy building at the southwest corner of Monument Avenue and Jefferson Street, Dayton, Ohio.

All objections to said plan will there be heard on Monday, the 10th day of April, 1916, beginning at 10 o'clock a.m. and continuing from day to day until said hearing is completed. The law provides that all objections to said plan shall be in writing and filed with the Secretary of said
Board at his office not more than ten (10) days after the last publication of said notice. The last publication of this notice will be Thursday, March 16, 1916. The office of the Secretary is in the saiq Miami Conservancy building.

After said hearing the Board will adopt a plan as the OFFICIAL PLAN of said District.


Dated March 1, 1916.

In accordance with this notice the board of directors held meetings in the conservancy building, giving opportunity to all those interested to hear and be heard. The general plan was described and the engineers of the district explained in detail the various parts of the plan, its manner of operation, and the affect it would have on any particular property or properties.

At the first of these meetings the board, after consulting the convenience of the various objectors, arranged a schedule, assigning a definite date for hearing the objections from each locality. This served to expedite the hearings, to save time for the objectors, and to give them opportunity of hearing any part or all of the proceedings. Objections from the same locality were grouped together as nearly as possible.

A total of twenty-three objections had been filed with the secretary and were heard and considered at these meetings. Some objections were made by certain cities and towns in the valley against particular features of the proposed work; a few individuals and corporations asked for slight modifications; and a few individuals protested against the entire plan. The railroads entered objections largely in order not to waive their right to be heard.

In some cases a thorough explanation of the plan entirely set aside the objections. In other cases it was found that modification of some minor, detail could be made without difficulty to satisfy the wishes of a property owner with respect to his property. Objections to the entire plan or to large features of it were carefully considered, and every effort was made to determine in detail whether such features could be materially altered, and to explain the situation if they could not.

There had been statements to the effect that Piqua did not desire flood protection as provided by the plans of the district. In order to bring the issue squarely before the citizens, the directors arranged a special meeting with them during the heating of objections. A large delegation of the leading business men of the city attended this meeting, at which the plans were explained in detail and questions answered concerning them. This delegation passed a resolution giving complete indorsement of the plans.

There was some dissatisfaction in Tippecanoe City concerning the district's plans for local protection at that place. Efforts to come to an agreement with the village council having failed, the directors suggested that the council name any competent engineer to investigate the proposed plans and report independently as to their acceptability from the standpoint of the village, the district to pay the entire cost of the investigation. The suggestion was followed, with the result that a hydraulic engineer of the council's, choosing reported a general approval of the plans in so far as they affected Tippecanoe City. A few minor modifications were suggested in the local improvements as prescribed by the plans. These were incorporated in the plan recommended by the chief engineer.

During the hearing certain dates were set aside for discussing the plans with delegations of citizens from Troy, Franklin, and Middletown. These conferences and hearings resulted in certain minor adjustments of the plans, principally in details of the local protection of the various cities and villages, being approved by the chief engineer and adopted by the board. The report of the chief engineer, incorporating these modifications, was formally adopted on May 10, 1916, as the Official Plan of the District, in the following resolution:

RESOLVED, That the Plan reported by the Chief Engineer and filed with this Board on February 29, 1916, together with certain modifications, alterations, additions, corrections, and amendments, this day approved and agreed upon, be hereby adopted as the Official Plan, and the Secretary is hereby instructed to identify the same by causing an entry to be made upon a copy thereof now before this Board under his hand and the seal of this District, which copy contains the completed statement, outline, and description of the Official Plan of The Miami Conservancy District, appearing in three printed volumes and two books of exhibits, also be it

RESOLVED, That the said Official Plan remain on file with the Secretary for the purpose of inspection and reference, and such other uses as may be ordered from time to time.

On October 3, 1916, the conservancy court convened in Memorial Hall in Dayton, for a public hearing on the objections to the official plan. The court was composed of the following judges:

Carroll C. Sprigg (presiding), Montgomery County A. C. Risinger, Preble County
C. H. Kyle, Greene County
F. W. Geiger, Clark County
C. W. Murphy, Butler County
W. D. Jones, Miami County

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H. C. Mathers, Shelby County
W. J. Wright, Warren County
O. J. Cosgrave, Hamilton County

The district was represented by John A. McMahon, counsel, of Dayton, Chen B. Brown, attorney, of Dayton, and E. J. B. Schubring, examining attorney, of Madison, Wisconsin, assisted by other attorneys from various cities and towns of the valley. For the objectors appeared a number of local attorneys, while certain non-objectors wishing to preserve their rights to be heard, were also represented. There were also present the chief engineer of the district with his principal assistant engineers and a number of engineers from various parts of the country, called in to give expert testimony in the case.

The court arranged a schedule of procedure which could be followed to the best advantage of all concerned. The list of objectors was first read by the clerk, and a record made stating by whom each was to be represented. The official plan was then formally brought before the court, and a statement made by Attorney Schubring describing the general features of the plan. Following this, a statement of the objections was made by Attorney P. R. Taylor. The court then took a recess of three days to inspect the locations for the proposed protective works in company with the chief engineer of the district, and the engineer of the opponents of the plan.

The court reconvened on October 10, when attorneys for the opposition asked to be allowed to call Chief Engineer Arthur E. Morgan as an adversary witness for cross-examination. After some deliberation the court granted this request. For five consecutive days Mr. Morgan replied to a continuous cross-examination. His testimony was commented on in the Dayton Daily News as follows:

""" His cross-examination had not more than started before it was apparent to everyone that he had a grasp of the subject clearly beyond anything that was to be expected. This impression was made more and more certain as the trial proceeded. No possible plan that could have any application however remote to the problem in this valley had been overlooked. No line of research had been abandoned until its particular bearing on the main problem had been definitely determined. The opposition had other plans for flood protection to suggest. They had spent much time and money in investigating and working out these plans. But they found during the course of this hearing that the conservancy district had made so much more careful study of these same opposition plans, and thorough investigation of their application to conditions here, that there was no comparison as regards the reliability of results. During the five days that Mr. Morgan was on the stand there was no request for information made, either by the opposition attorneys or by members of the court, that was not met with instant response. The most unexpected subjects were brought up. The most obscure criticisms were introduced. The promptness and thoroughness of the answer was always more surprising and unexpected than the question itself. """ Mr. Morgan's discussion of the theory of rainfall and of his research on that subject held the attention of the court and spectators for more than two hours at one session. It showed such careful study of that one subject and such logical conclusions as to future conditions to be expected in the Miami Valley that even one of the opposition attorneys took occasion to express his admiration of the achievement in his closing argument.

Mr. Morgan gave an outline of the plan itself, of the manner of its operation, and of the methods to be used in constructing the proposed works. His testimony fills over 600 typewritten pages.

Following this the objectors called various local witnesses to substantiate their claims. The only engineer witness presenting evidence in support of the objectors was John W. Hill, consulting engineer of Cincinnati. He had been employed by the counties of Miami, Shelby, and Clark to make plans and estimates to provide for flood relief by means of a system of channel improvement and also to verify the estimates given in the official plan. Against this testimony the district placed the testimony of Chief Engineer Morgan, of four of his assistants, and of five other engineers of national reputation, all of whom testified as to the adequacy, safety, and reasonable cost of the official plan.
In refuting the objectors' contention that the Miami is a navigable stream, and therefore under direct control of the Federal Government, counsel McMahon called to the stand Judge Dennis Dwyer, an early settler of Dayton. The spectacle of this pioneer of the valley, 87 years old, being questioned on the witness stand as to the history of the river by another resident of nearly the same age was one of the most impressive incidents of the hearing.

Edward A. Deeds, president of the board of directors, occupied the witness stand for over a day. He gave a good idea of some of the larger complexities and difficulties met by the Flood Prevention Committee, reviewed the history of the project, and gave a description of events leading to the adoption of the plan. In closing, he declared that a failure to provide flood protection would mean the end of business and industrial growth in the valley and in this way might be a worse calamity than the 1913 flood itself. His testimony was a vital factor in bringing out the consistency of the work and the adequacy of the plan.

The hearing was concluded on November 24, 1916, having continued for a period of seven weeks. The testimony fills over 3,000 typewritten pages, large parts of which are very interesting and instructive.

SUMMARY OF TESTIMONY

The arguments against the plan may be classed according to their general character as: first, those opposing retarding basins, dwelling on the hazard of the dams and on the damage that might be caused to lands and properties in or near the basins; second, those contending for changes of certain details, capable of being investigated with the idea of possible adjustment; third, those purely visionary; and fourth, those based on legal technicalities. The last were overruled by the court for later consideration in order to proceed with the hearing of the objections to the plan itself. The second and third class of arguments were answered by a detailed explanation of the plan.

Gradually the opposition fell back on the general argument that, regardless of how safely the dams might be planned, there would still remain danger of some one of them at some time failing. In this connection they contended that ice and drift would block the conduits, that the high velocities in the conduits would be dangerous, and that large earth dams were not customarily built above important cities. They contended also that the dams as planned were unnecessarily large and that the degree of protection planned was larger than warranted. Thus they contended on the one hand that the works were unsafe and inadequate and on the other that they were larger than required. It was also claimed that sewers would be rendered useless by backwater, that the best farm lands in the state would be destroyed, and that malaria and other diseases would result from the water retarded in the basins. By the testimony of John W. Hill, the opposition undertook to show that a system of channel improvement was practicable and preferable to the system given in the official plan, that the estimated cost for the proposed construction was low, and that dams may not be safe. In support of this they presented Mr. Hill's 150-page printed report attacking the plan of the district.
In reply to these arguments the engineers of the district presented the results of their studies, supported by their personal experience and by photographs and illustrations. Added to their testimony was that of T. W. Jaycox, consulting engineer of Denver, with extended experience in the construction of earth dams in the west; of F. J. Fischer, construction engineer of the Los Angeles Water Supply Commission; of Brigadier General Wm. H. Bixby, former Chief of Engineers, U. S. Army; of Daniel V. Mead, hydraulic engineer of Madison, Wisconsin; and of Brigadier General H. IVI. Chittenden of Seattle, Washington, also former Chief of Engineers. U. S. Army. These engineers expressed unqualified approval of the official plan. General Chittenden stated on the stand that this plan had been worked out under the best engineering skill available, that it had the unqualified approval of the best engineers in the country, that no other plan was practicable for the valley, and that a refusal of the plan presented would make the protection of the valley against flood disasters practically impossible.

A masterly summary of the argument replying to the objections was presented in the final rebuttal by Attorney Schubring. His keen insight into engineering matters enabled him to make a remarkably clear and convincing interpretation of the relative value of the contentions presented before the court. In concluding he presented the issue forcibly to the court and pointed out that the plan had been worked out under the best engineering skill available, that it had the unqualified approval of the best engineers in the country, that no other plan was practicable for the valley, and that a refusal of the plan presented would make the protection of the valley against flood disasters practically impossible.

REPORT OF FLOOD BOARD OF ARMY ENGINEERS During the course of the hearing frequent reference was made by opposing counsel to the attitude of government engineers, endeavoring to show that these engineers were opposed to the use of retarding basins for flood control purposes. Allusions to a forthcoming report of the Ohio Valley Flood Board of Army Engineers, intimating that this report was being purposely held back because it disapproved the official plan, led the directors of the district to secure permission from the War Department to receive an advance copy of this report, not for publication but for examination by the court. A reading of the report silenced the arguments of the objectors as nothing else could, since it in no way took exception to the official plan. It stated concerning the question of navigability of the Miami River that there could be no future navigation in a commercial sense without radical improvements. It condemned partial protection by means of inadequate levees, stating that such embankments should be removed from valleys subjected to great floods except where they form part of a comprehensive plan for flood protection; or, when for other reasons, it is evident that their presence is not a source of danger.

Referring to conditions at Dayton the report states:

It is probable that the best protection for Dayton under existing conditions would be dams, one each on the Stillwater, Upper Miami, and Mad Rivers, just above Dayton, so designed as to reduce the maximum standard storm discharge at Dayton to an amount which can be economically and safely cared for by improvement of the Dayton channel, which is probably not less than 100,000 second feet.

The adequacy of the plan is briefly commented on in the following quotations:

Adequacy of the Plans-It was felt by those concerned that a project involving such a large sum, in order to justify the expenditure, should furnish as complete protection as possible. Realizing this, the conservancy district has based the reservoir capacities and channel improvements upon a standard storm greater in intensity than that of 1913. The standard storm was adopted after an
exhaustive search covering the records of all storms east of the Rocky Mountains so far as the U. S. Weather Bureau files record them. * * *

* * * * * * * * *

Spillways-In order that the dams shall not be overtopped their safety is secured by means of spillways which are adequate to care for a storm far in excess of the standard storm.

* * * * * * * * *

The reservoirs proposed above Dayton are well located to secure the maximum benefit for that city. They are sufficiently near to control all but 70 square miles of the entire drainage area above Dayton. This 70 miles is not believed to be extensive enough to cause any danger to Dayton due to severe local storms.

* * *

******** * * While the plan does not include the entire valley it aims to provide protection for all places where such protection is most urgently needed so far as can be economically justified. * * *

DECISION AND OPINION OF COURT

On November 24 the conservancy court formally approved the official plan and issued the following statement of its findings:

1. The Court is of the opinion that the question raised as to the constitutionality of the law by reason of the decisions in the cases of Baumann v. Dayton in the 66 O. S., and Commissioners v. Gates in the 83 O. S. is not now properly before the Court for the reason that it does not appear that any assessment has been made against any specific piece of property and that therefore no one is in a position to complain; and for the same reason other questions as to the constitutionality of the act on account of the method provided for raising of funds is not now before the Court. To this finding, Judge Mathers dissents.

2. The Court is of the opinion that the Miami River is not a navigable stream in law or fact.

3. The Court is of the opinion that any obstruction that may occur from the adoption of the plan to the public use or navigation of the Miami and Erie Canal is authorized by the contract between the Conservancy Board and the state officials as provided for in the Conservancy Act.

4. As to the objection that no construction shall be made under the authority of the Act which will cause the flooding of any village or city unless the Board shall have acquired and paid for the right to use the land affected for such purpose and shall have paid all damages incident thereto, the court is of the opinion that such provision of the law does not prevent the adoption of the Official Plan.

5. The Court is of the opinion that channel improvement alone for the entire Conservancy District is not feasible or practicable and is prohibitive in cost and would not adequately protect the District from flood waters. Judge Mathers dissents from the proposition that channel improvement alone would not adequately protect against floods.

6. The Court is of the opinion that the combination of dams and dry detention-basins together with channel improvement is the only practical and efficient method of protecting the Miami Valley from the results of destructive floods.

7. The Court is of the opinion that earthen dams with concrete conduits and spillways as provided for in the Official Plan are safe and will be of sufficient strength to sustain at all time any burden that may be placed upon them by impounded water. Judges Jones and Mathers and Kyle do not fully concur in the foregoing but find that a preponderance of the evidence shows that the dams as provided will be reasonably safe.

8. The Court is of the opinion that it would not be feasible to reduce the height of the Huffman dam or its spillway. To this Judges Kyle and Geiger dissent.

9. The Court is of the opinion that the Lockington Dam should not be eliminated from the Official Plan. To this Judges Jones, Mathers, and Geiger dissent.

10. The Court is of the opinion that the objections filed to the Official Plan as proposed by the Board of Directors of The Conservancy District should be overruled; that the work proposed in said plans is necessary, and that the same will be conducive to and conserve the public health, safety, convenience, and welfare of The Miami Conservancy District, and the Court, therefore adopts the said Official Plan. To the judgment of the Court adopting the Official Plan, Judges Jones and Mathers dissent by reason of the finding made by the Court in the ninth syllabus hereof refusing to eliminate the Lockington Dam; otherwise concurring with the majority of the court.
CHAPTER VI.-APPRaisal OF BENEFITS AND DAMAGES

PURPOSE AND SCOPE

The conservancy act provides that improvements constructed under it shall be paid for by special assessments against the properties benefited. It requires the board of appraisers of a district to appraise the benefits of every kind, to all real property affected, which will result from the execution of the official plan, the damages sustained by such property, and the value of the land and other property necessary to be taken by the district. The appraisers are required also to appraise the benefits and damages, if any, accruing to counties, townships, cities, villages, and other public corporations.

The total benefits in a district must be greater than the estimated cost of the proposed improvement; otherwise, according to the law, the work cannot be undertaken, and the district may be disorganized. The appraisal of benefits serves a purpose similar to the appraisement for state and county taxes. A tax appraisement furnishes the basis for levying taxes so that each owner of property will pay his right proportion. In the same way, the appraisal of benefits of a conservancy district gives a basis for dividing the cost of the proposed improvement in a fair way among the owners. Upon completion of the appraisal of benefits and damages, the cost of the improvement, including damages to be paid, is assessed against the properties affected, in proportion to the benefits appraised against them.

The total benefits as appraised by the board of appraisers of the Miami Conservancy District amounted to almost three times the estimated cost of the protection, so that each owner was assessed an amount equivalent to about one-third of the appraised benefit to his property. Any property to be taken or damaged by the district had to be bought and paid for in fun before any construction affecting it could be commenced.

The plan of the district affected many thousands of tracts of country lands and city properties, as well as property belonging to various municipalities, public utilities, and other interests. Some of the lands were needed to provide right-of-way on which to locate the works of the district, some lands within the retarding basins were to be subjected to varying degrees of future flooding, some were to be given complete protection against future floods, while others were to receive only partial protection. Some of the properties had suffered only slightly from past floods, while others had suffered greatly. The 1913 flood in certain cases swept away entire buildings and washed out the lots on which they had stood. Thus the affected area included properties which had been rendered almost worthless and properties of great value, a fair comparison of whose values was not always given by the assessed valuations on the tax duplicate. During the 1913 flood the physical loss to property in the district by flood and fire was estimated at about $65,000,000 to private and public property, and about $5,000,000 to utilities. Coupled with this was the general depreciation of property values, the loss of labor, earning, and the time required for replacements. It was the duty of the appraisers to estimate for each property the benefit or damage which would result from the construction of the proposed works, and to specify it in dollars and cents. This appraisal of benefits and damages presented a problem of many complications and of large proportions.
GENERAL METHODS

The appraisers of the district, J. Edward Sauer, president of the Teutonia National Bank of Dayton; Charles W. Kiser, former county treasurer of Miami County, Ohio; and Samuel M. Goodman, manufacturer and director of the American Rolling Mills Company, Middletown, Ohio, were appointed in August, 1915. They immediately began a study of the proposed plans of the district, a field inspection of the properties affected. They held conferences with the engineers of the district in order to become familiar with the Official Plan and the various details and features that would affect the properties involved. They personally inspected the lands in the district to get first hand knowledge of each individual farm, and of conditions and values in general. Continued investigations and frequent inspection trips gave them very accurate knowledge of the relative conditions and values prevailing in all portions of the district. The engineer most
familiar with a particular local situation often accompanied the appraisers to explain in detail how various properties were affected.

Supplementing their study of the plans and their field inspections, the appraisers held conferences with real estate men and property owners to confirm their judgement as to property values and the value of flood protection. The engineering department of the district furnished maps, tables, and diagrams showing: the location of properties; the frequency and extent of past flooding; the degree of protection provided; and the depth, duration, season, and frequency of flooding that would have occurred within the basins had they been in operation during previous years.

Under the supervision of Logan ‘N. Marshall, chief tax and appraisal agent, a force of office clerks, stenographers, and field inspectors was organized to carry on the detail work connected with the appraisals. John E. Feight of Dayton was employed as chief assistant to Mr. Marshall, and Robert Kennedy was given supervision of the work in Hamilton and Butler Counties.

A complete, accurate record of all properties that would be benefited or damaged was needed for the appraisal. This was compiled in suitable form, on sheets printed for the special purpose of collecting and classifying the data on which the appraisals were to be based. A separate sheet was used for each piece of property. The information collected on these forms included such items as location, size, description, character, and ownership of tracts and lots; the number, kind, size, use, and condition of buildings; the appraised value of the property as recorded in the tax duplicate and its value as appraised by the district; and also the degree of protection provided. The listing of properties was done in the office. Details of description were entered by inspectors on the ground, while the information as to degree of protection provided was supplied by the engineering department. The appraisers examined the sheets as they were completed and made further inspections in the field to verify and check the data. With this preparation and information they were able to establish an equitable basis for their appraisements. The main work naturally became divided into two branches, that for determining damages and that for determining benefits.

METHODS OF DETERMINING DAMAGES
The land in the basins subjected to flooding on account of the dams constitutes the major part of the damaged property in the district. It was found that the owners of some of this land preferred to sell, while others wished to retain their land and to sell to the district an easement for the increased future flooding. To meet this situation an appraisal was made of the market value of each property before the construction of the proposed works, of the value of the flood easement, and of any further damages that would be sustained as a result of any part of the construction. In determining damages or easements to be allowed, the main factors considered were:

a. Value of the property before being affected by the proposed works.

b. Frequency, duration, depth, and season of flooding which might be caused by the proposed works, as compared with the original flooding conditions.

It was the aim of the district to give first consideration to the wishes of the owner in deciding whether a tract of land should be purchased by the district, or whether a flood easement should be taken; and in otherwise adjusting the ownership and control. Important factors in this connection were the regulations, required for controlling the location of buildings in the basins, and the problem of providing suitable home sites for tracts in the lower portions of the basins which at times might be subjected to deep flooding. On recommendation of the engineers; building limits were fixed in each basin at from five to ten feet below the proposed spillway elevation; and sufficient high land adjacent to the basins was purchased for necessary home sites. Such low lands as were purchased by the district. were provided with suitable means of ingress and egress, and with building sites on high ground.

The amounts paid for properties needed for right-of-way purposes were based on the original value of the property, the size of the portion taken, damages sustained in the removal of buildings, etc., and the effect on the remainder of the property.

In the case of railroads damaged by being required to relocate their lines on account of the basin, complete plans and estimates of cost for- the changes were worked out by the district. Independent detailed estimates of the damages and benefits accruing to the railroads by reason of such changes were made by the district and by the railroad companies. These estimates agreed so closely that after adjustment of differences they were used as the basis for the final appraisal.

METHODS OF DETERMINING BENEFITS
The amount of benefits that would accrue to a particular property from the execution of the Official Plan depended, in the main, upon the following considerations:

a. Value of the property  
b. Degree of protection needed  
c. Degree of protection provided

Properties benefited were considered as either special or general cases. Special cases were those that needed individual consideration. These included county and township highways, municipal properties, and public utilities, such as railroads, light and power plants, etc. The general cases were those that could be classified into groups to which uniform rules or principles of appraisal were applicable. The latter were of two kinds, city lots and country lands. Each of these kinds was further subdivided into classes according to the depth of past flooding, degree of protection provided, nature of use of property, and other important factors, such as danger from swift currents, the liability to be surrounded by deep flooding, etc. The benefit to all properties falling into anyone of these classes was determined by a set of factors or considerations applicable to that class, modified where necessary by fixed rules of application.

Benefits to City Lots

The determination of benefits to properties in the cities was perhaps the most difficult part of the appraisers' task. Each lot had to be considered with reference to its value, location, elevation, degree of past flooding, and degree of protection provided. The actual benefit to a property is the difference in its value before and after the construction of the improvement. It was found, however, that the market values then existing did not represent the actual value without protection. The very fact that plans for protection had been completed and that this appraisal of benefits was being made, kept real estate values almost up to the level that would have resulted from the securing of actual protection. If it had developed that protection were impossible, property values would have dropped much below the existing level. This depreciation represents a large part of the benefit derived from the improvement. The remainder of the benefit is the further increase in existing values directly due to the improvement. The increased value with protection was found to be much nearer existing market values, than was the value without protection, and it was therefore decided to first appraise the values with protection. These were determined from an examination of the information collected and recorded on the printed forms, from consultations with the inspectors, and from a general viewing of the properties.

Having appraised the value with protection it was next necessary to determine what part of such value represented the benefit derived from protection; or, in other words, the amount that this value would depreciate if protection were not secured. For this purpose the engineering department prepared maps of the cities, towns, and villages, upon which were outlined zones or areas showing depth of past flooding, and areas receiving equal degrees of protection as provided by the plan. After a careful examination of these zones, and after conferences with representative real estate and other business men, a schedule of percentages was assigned, indicating the amount of benefit derived in each zone. For instance, it was decided that the benefit to property in those zones having the greatest need for protection which were deeply flooded in 1913 and which were provided complete relief by the plan, was about 30 per cent of its value, based upon its having such protection. Such properties were considered as having the maximum or 100 per cent benefit factor. Zones having less imperative need of protection were assigned benefit factors ranging from 100 per cent down, depending upon the depth of past flooding and the degree of protection provided. Thus, a property situated in a zone to which the 50 percent benefit factor applied was assessed 50 per cent of the maximum benefit rate of 30 per cent, or 15 per cent of its appraised value, protected. If the appraised value of this property, protected, were $5,000 the resulting benefits would be $750.

Special Cases of Benefits and Damages

The special cases, for both benefits and damages, were given careful individual study by the appraisers, and in some cases special valuations of the properties were made. Conferences were held with the owners of property and whenever possible agreements were reached in regard to the benefits or damages to be awarded. The treatment of special cases is particularly well illustrated by the agreements made with the railroads. They were given all the engineering data accumulated by the district bearing on their respective cases. The engineers of the railroad companies then made studies of the various situations. They frequently arrived at practically the same conclusions as regards cost of construction, benefits, and damages that had been reached by the engineers of the district.
APPRAISAL RECORD

The appraisal record was made in triplicate and bound in book form. It gave a list of the owners of all property affected, a legal description, of each piece of property, together with the appraised benefit to be derived from flood protection. Where property was to be damaged, or subjected to greater flooding than before, the amounts appraised for the damage, or for an easement, were given.

The amount to be paid for land to be purchased was stated as appraised. In cases where either a title to the property or a flood easement would serve the purposes of the district an amount was stated for each alternative. The amounts
involved in options or contracts which had already been secured by the district were not shown, the documents themselves being presented to the court.

On May 9, 1917, complete copies of the record were filed with the conservancy court, and with the secretary of the district. At the same time there was filed with the clerk of each county, that part of the record covering properties in that county.

Legal notice was given by publication on May 10, 17, and 24, that the appraisal record had been filed and that any exceptions thereto must be filed with the clerk of the conservancy court in Dayton on or before June 4, 1917.

It was explained in the newspapers of the valley, and to many property owners in person, that the appraisal record should not be confused with the assessment of tax which would be levied after the appraisal record had been approved by the conservancy court. The total cost of the works, with ten per cent added for contingencies as required by the law, was estimated at $27,778,000, or about 36 per cent of the total benefits. This cost is distributed as follows: Real estate purchases and easements $7,150,000
Construction cost of flood control works $12,145,000
Public service relocations and damages $3,550,000
Administration and general expense $1,900,000
Taxes and special assessments during construction period $200,000

Total $24,945,000

The district published in various papers the table given on the following page, as an example for determining assessments, assuming that the levy would be 36 per cent of the benefit.

After the final correction of the appraisal record as explained on the subsequent pages, it covered a total of about 65,000 pieces of property, of which 60,000 were appraised for benefits and 5,000 for damages. These properties belonged to about 40,000 owners. The total 1916 grand tax duplicate value of properties assessed for benefits, including cities, villages, and counties assessed as units, is $1,194,816,600. The work of the appraisers was a large undertaking. It was begun in the summer of 1915 and completed two years later. At times as many as 200 employees, including field inspectors, clerks, and stenographers, were engaged on the work.

How to Determine Flood Assessment

<table>
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<tr>
<th>TOTAL BENEFIT</th>
<th>ASSESSMENT</th>
<th>ANNUAL ASSESSMENT</th>
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<tbody>
<tr>
<td>1/11th figure may be paid 1/11 cash obtained from the within 30 days after appraisal roll for tiling of assessment each piece of property affected (1) roll (2)</td>
<td>If paid in installments of 5% 30-yea</td>
<td>1/11st 4 year's interest paid the principal (a)</td>
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900.00 800.00 700.00 600.00 500.00 400.00 300.00 200.00 100.00 90.00 80.00 70.00 60.00 50.00 40.00 30.00 20.00 10.00

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/ $25.02
22.52 20.02 17.51 15.01 12.51 10.01 7.51 5.00 2.50 2.25 2.00 1.75 1.50 1.25 1.00 0.75 0.50 0.25
-LS18.00
16.20 14.40 12.60 10.80 9.00 7.20 5.40 3.60 1.80 1.62 1.44 1.26 1.08 0.90 0.72 0.54 0.36 0.18

$360.00 324.00 288.00 252.00 216.00 180.00 144.00 108.00 72.00 36.00 32.40 28.80 25.20 21.60 18.00 14.40 10.80 7.20 3.60

HEARING ON EXCEPTIONS

On June 18, 1917, the conservancy court convened at Memorial 1-1 all in Dayton, for hearing the exceptions and
objections to the appraisal record. About 2000 exceptions had been filed. The court first arranged a schedule of dates for hearing the exceptions, grouping the exceptors by counties, cities, and towns, both for benefits and damages. The exceptions were then taken up in turn, each case being given a hearing by the court when the property owner appeared in person or when he could present a witness other than his lawyer.

The last hearing of exceptions was held July 17, and the final entry on exceptions and decrees of the court confirming the appraisal record, consisting of 54 printed pages, was signed by each of the 9 judges July 30, 1917. After stating that certain exceptions could not be considered because they "were not filed within the time prescribed by law, and that certain others had been withdrawn, the entry continues:

The court further finds that upon said hearing the following exceptions and objections were referred back to the Board of Appraisers for reconsideration, viz:

* * * * * * * *

and that thereafter the said Board of Appraisers duly made and filed herein their report as to each and all of said exceptions and objections so referred back to them with recommendations that the appraisal roll be modified and amended in certain respects; and that thereupon the objectors whose objections and exceptions had so been referred back to said Board of Appraisers requested leave of the court to refile their objections and exceptions to the report of the Board of Appraisers as so modified and amended; and that leave was granted and the said exceptions are now authorized to be filed and are filed to said roll as so proposed to be modified and amended. The court now upon consideration adjudges and directs that said appraisal roll be and the same is hereby directed to be modified and amended as recommended by said Board of Appraisers, and the same is so amended as follows:

Thereupon the Board of Appraisers made report to the court that certain errors and mistakes had occurred in preparing and transcribing the appraisal roll, and asked leave of the court to amend and modify the said appraisal roll to correct said errors and amendments; and the court now upon consideration finds that said errors and mistakes occurred as reported by said Board and that same should be corrected and the appraisal roll amended and modified by said Board of Appraisers, and the same is now ordered to be done and said corrections are now made as follows, viz:

* * * * * * * *

**And thereupon the court having heard and determined all of the exceptions filed, and amended exceptions allowed to be filed, said exceptions and amended exceptions to all appraisals for benefits are now overruled; to which ruling of the court each of said exceptors now excepts.

And the court now approves and confirms said appraisers’ report and said appraisal roll as modified and amended in so far as the appraisals for benefits are concerned as to all property involved, including the appraisals for benefits against all cities, villages and counties so appraised by said report and in said appraisal 1911 as amended and modified.

The court coming on further to consider the said report of said appraisers and the appraisal roll as to appraisals for land taken and damaged, the court finds that a number of settlements between the district and the owners of property to be taken or to be damaged have been made and contracts entered into, it is therefore ordered, adjudged and decreed that in all cases where contracts are or may hereafter be entered into by the district and the property owners such contracts shall and do supersede the appraisals of the appraisal 1911 as to terms and time of payments and all other respects; and that as to the property concerning which such settlements were made it is not necessary to ‘make any further findings.

The court further finds that as to the property to be taken or damaged that the appraisal of the value of said land to be taken and appraisals for damages as reported by said Board of Appraisers contained in said appraisal roll as modified and amended shall be and the same are hereby approved and confirmed and the exceptions of all exceptors thereto filed herein are now overruled; to which overruling the said exceptors now further except.

The owners of the land to be taken, with the book, page and index numbers of same as same appears upon the appraisal rolls filed herein, to which reference is hereby made for a description of the property, are as follows:

* * * * * * * *

The court finds that as to all of said land last above enumerated to be taken by this proceeding and concerning which no contracts have been made with the owners, that said The Miami Conservancy District is a public corporation created by the laws of Ohio with full power to acquire by this proceeding such lands and easements and property as may be necessary for the purposes of the district and the execution of the Official Plan thereof; that the said lands so above enumerated are necessary for the purposes of the said The Miami Conservancy District and for the carrying into execution of the said Official Plan, and that the said district, by its proper officers, has been unable to agree with the respective owners of said property as to the purchase price of the same or as to the rights to be taken therein. And the court does therefore find and adjudge that the said District is entitled to appropriate said property and the rights therein to its uses and purposes, and that upon the payment of the amounts of the appraisals of said land or easements to be taken and the damages said The Miami Conservancy Dis- trict shall be entitled to take possession of and hold said land or easement as it may elect in writing, with all the rights and interests thereto belonging; and appropriating for the uses and purposes and to the extent for which the said appropriations were made.

When the directors elect to appropriate the easement, such appropriation shall confer upon the district the right to erect all its works according to the official plan as it now stands, and all its details, without any obligation to respond in damages or otherwise for any further injury that may be done directly or indirectly by the erection, operation or continuance of any of the said works.

And the court having approved said appraisal roll orders the said District, through its directors, to exercise its election as to whether it will take the easement in the properties appropriated, but not contracted for, or the fee simple, and to file such election in this court on or before the 5th day of August, A. D. 1917. No cases of condemnation shall be brought by the directors, where appeals have been perfected, until after such
election has been filed by the district.

The cause coming on further to be heard upon the said appraisal roll and upon the evidence as to the amount of said appraisal 1911 and the estimated cost of constructing the improvements contemplated in and by the said official plan of said The Miami Conservancy District, the court finds that the estimated cost of constructing said improvement contemplated in and by said official plan as reported in said official plan is the sum of $23,500,000.00, and that the sum of the uncontested and accepted appraisals for benefits is more than $70,000,000.00 and the court now approves and confirms said appraisers' report as modified and amended herein and hereby and all the appraisals thereof and therein.

All of the exceptors who have heretofore filed their exceptions herein again now except to each and every part of this finding and decree.

And the clerk of this court is hereby ordered to transmit to the clerk of The Miami Conservancy District a certified copy of this decree and of all the appraisals confirmed and as confirmed by the court, except those parts from which appeals have been perfected but not determined, such copy not to be transmitted until after ten days from the entering of this order, the time allowed by law for said appeals to be perfected.

It further being made to appear to the court that all the property formerly of The Cincinnati, Hamilton & Dayton Railway Company and Judson Harmon, and Rufus B. Smith, Receivers thereof, situate within the district other than the line Dayton to Delphos, has been acquired and is now owned by The Toledo and Cincinnati Railroad Company, and that said The Toledo and Cincinnati Railroad Company and The Miami Conservancy District have reached and entered into an agreement whereby the report of the Appraisers has, by mutual agreement, been modified, it is ordered that the objectors of said The Cincinnati, Hamilton and Dayton Railway Company and Judson Harmon and Rufus B. Smith its Receivers, so far as said objections relate to the portion of the property of said railway so purchased and acquired by The Toledo and Cincinnati Railroad Company, are settled and adjusted by said agreement and that said objections so far as they relate to that portion of said property not so acquired, namely so far as they relate to that portion of the railroad between Dayton, Ohio, and Delphos, Ohio, be and they are overruled, to which they especially except.
In case any person or corporation wishes to appeal from this order to the court of the county in which the land is situated, the court now fixes the bond for each and every such person or corporation at the sum of Two Hundred ($200) Dollars to be conditioned according to law, such bond to be given to The Miami Conservancy District.

When such appeals have been perfected The Miami Conservancy District and its Directors are ordered to begin proceedings as provided in Section 34 of the act to ascertain the compensation, and damages to be paid for land taken or damaged and to appraise benefits, unless the parties agree in cases of condemnation in the meantime.

And thereupon this court adjourned to meet according to call of the presiding judge.

C. H. KYLE, J.
CLARENCE MURPHY, J. WALTERD. JONES, J. FRANK W. GEIGER, J.
E. T. SNEDIKER, J. WILLARD JUREY WRIGHT, J. OTWAY J. COSGRAVE, J.
J. D. BARNES, J.
A. C. RISINGER, J.

In accordance with the order of the court, the board of directors filed a list of the properties appropriated, but not already contracted for, stating in each case whether it elected to take easement or fee simple. These properties, for the most part, comprised lands in the basins, where the frequency, depth, and duration of flooding were the main factors in deciding the election. Wherever possible, the owner's preference was given first consideration. The list of election was prepared by the engineers and approved by the directors.

About 600 exceptors appealed from the order of the conservancy court and filed bonds for taking their cases to the court of the county in which the land was situated. A great many of these, however, reached agreements with the directors so that the entire amount of benefits involved in unsettled cases was reduced to less than two per cent of the total benefits.

The total benefits as approved by the conservancy court amounted to more than $77,000,000. Their distribution is shown in the following table:

<table>
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<tr>
<th>Miami County</th>
<th>Piqua</th>
<th>Troy</th>
<th>Montgomery County</th>
<th>Miamisburg</th>
<th>Germantown</th>
<th>West Carrollton</th>
<th>Dayton</th>
<th>Warren County</th>
<th>Franklin</th>
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<th>Hamilton</th>
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<th>Cleves</th>
<th>Shelby County</th>
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ASSSESSMENTS

Since 36 per cent of the benefits was sufficient to cover the estimated cost of the improvement, each property was assessed 36 per cent of its appraised benefit, and the assessment roll was made up from these figures. During September the district published official notices of the assessments as follows:

COURT OF COMMON PLEAS Of Montgomery County, Ohio No. 36847 In the Matter of THE MIAMI CONSERVANCY DISTRICT Notice to Property Owners to Pay Assessments.

To all persons and Public Corporations Interested, Public Notice is hereby given:

(1) That on the first (1st) day of September, 1917, the Board of Directors of The Miami Conservancy District duly levied an assessment upon all the property in said District, upon which benefits have been appraised, in the aggregate sum of Twenty-seven Million, Eight Hundred Four Thousand Dollars and Sixty-four Cents ($27,804,480.64), and the said levy has been extended upon the Assessment Record as to each and every item therein, and that said Assessment Duplicate is now on file in the office of the District in the City of Dayton, Montgomery County, Ohio, and is now in course of collection by the Treasurer of said District at its office, southwest corner of Monument Avenue and Jefferson Street, in the City of Dayton, Ohio.

(2) A copy of that part of said Assessment Record as it affects the benefited lands in Montgomery County, Ohio, including the city of Dayton and villages of Germantown, Miamisburg, and West Carrollton, and the townships of Butler, German, Harrison, Jefferson, Mad River, Miami, Randolph, Van Buren, and Wayne, is on file in the office of the Auditor of Montgomery County at the Court House in the City of Dayton, Ohio.

(3) That the entire assessment so levied against each and every parcel of land may be paid at any time on, or prior to, the Fifth (5th) day of October, 1917.

(4) That as soon after the Fifth (5th) day of October, 1917 as conveniently may be, the Board of Directors of said District will divide the unpaid portion of said assessments into convenient installments, and will issue bonds bearing interest not exceeding six (6%) per cent per annum in anticipation of the collection of the several installments together with interest, pursuant to the Conservancy Act of the State of Ohio.

THE MIAMI CONSERVANCY DISTRICT E. A. Deeds, President Ezra M. Kuhns, Secretary

Notices were also published in local papers advising that the district would receive payment in cash of any assessments, at temporary offices opened for the purpose. A total of about $760,000 was thus collected. The following is typical of the notices published regarding the establishment of temporary offices.

PUBLIC NOTICE

For the convenience of property owners in Piqua and Washington Township, the Miami Conservancy District will have representatives in the Orr-Flesh Building, Piqua, Ohio, who will be prepared to furnish information with reference to assessments, and who are authorized as deputy collectors to receive payments of assessments and issue proper receipts. Any persons finding it more convenient to pay at the above sub-offices than at the offices at Dayton, Ohio, will be privileged to do so.

The office will be opened on Monday, September 10, and persons can be accommodated throughout the collecting period at any time from 9 a.m. to 4 p.m. except Saturdays, when the office will close at 12 o'clock.

THE MIAMI CONSERVANCY DISTRICT By Ezra M. Kuhns, Secretary.

CONSERVANCY BONDS

Soon after the approval of the appraisal record by the conservancy court, negotiations were begun by the board of directors for selling bonds to furnish the remainder of the construction fund not provided by the cash payments. Conditions for financing a large new undertaking at the time were most unpromising. With the government asking help from all banking institutions to aid in financing military operations, with the universal conservation of resources of every kind, and with the tendency towards postponing all new undertakings in order to devote the entire energies of the country to the prosecution of the war, it seemed difficult to get capitalists interested in the Miami Valley project. The directors were thoroughly alive to the necessity of the flood control works. They knew that the future of the valley with all its varied industries depended on the speedy and timely construction of these works. During the progress of the war Dayton had become a busy center in the manufacture of munitions and military equipment and supplies. A number of the largest factories in the Miami Valley devoted the most of their plants to government work. Moraine City, a new factory city in the outskirts of Dayton, was given over entirely to the production of airplanes. The National Cash Register Co., Dayton Metal
Products Co., Barney & Smith Car Works, Recording & Computing Machines Co., American Rolling Mills Co., Troy Wagon Works, Platt Iron Works, and the Dayton Engineering Laboratories Co. were all handling government work. It was of direct importance to the federal government, therefore, that these industries of the valley be made safe from floods.

FIG. 15.-FLOOD CONDITIONS IN THE DELCO PLANT, DAYTON.
View taken shortly after the flood of March, 1913.

In presenting the project to officials of the National City Company of New York City, Mr. Deeds, President of the Board of Directors of The Miami Conservancy District, and now Colonel in the U. S. Army, stated in part:

* * * A broad, successful plan for the preservation of the lives and property in our valley has been worked out. No engineering project with which I am familiar has been more thoroughly planned,

Our legislative matters are now in perfect shape. The plan itself has been approved; the bonds have been authorized; the assessment roll has been recorded in the different counties and assessments made against property; contracts of purchase have been made for the lands to be taken and should not be permitted to lapse; contracts have been advertised and the public have been promised that operations would begin this fall. The lives of thousands of people may depend entirely on our promptness in this matter. I do not believe any body of men with the facts before them can assume the awful responsibility for the least delay.

The National City Company indicated that it would underwrite the bond issue if the United States Secretary of the Treasury offered no objection to the project being financed at this time. Colonel Deeds immediately placed the entire situation before Mr. Mc.Indoo, who replied as follows:

December 6, 1917.
Dear Sir:

I received your letter of November 30, in which you advise me concerning the flood control project for the Miami Valley and ask my permission to proceed with the necessary financing to complete the undertaking. You call attention to the fact that the flood of March, 1913, destroyed four hundred lives, left forty bereft of reason, and caused a property loss approximating one hundred million dollars, and that the loss of life would probably have been thousands had the flood occurred later in the morning after the families had become separated for the day; that under the direction of a Flood Prevention Committee, supported by a fund of two million dollars voluntarily subscribed by the citizens of Dayton, a complete survey was made of the entire watershed and a plan for flood control determined upon and approved by an independent board; that the Conservancy Law of Ohio was framed and the Miami Conservancy District organized thereunder, and that the administration is under a board of directors appointed by the court; that the district comprises parts of nine counties in the watershed, and the municipalities of Hamilton, Middletown, Germantown, Franklin, Miamisburg, Carrollton, Dayton, Tippecanoe, Troy, and Piqua; that under the supervision of a board of appraisers appointed by the court, after two years' work, the appraisal roll has been prepared, approved by the court, and transmitted to the tax officials; that the total of the appraised benefits is $77,234,668, and the total bond issue authorized is $25,000,000, of which $15,000,000 is required for the first year and $5,000,000 each in the second and third years; that land contracts and contracts for rights-of-way amounting in all to $8,000,000 become due between December 15 and April 1 and must be paid; that some contracts are let and trained organizations for each branch of the work are waiting for instructions to proceed; that the entire valley is unprotected, because any attempt at protection except in a comprehensive way would have been futile; that the Miami Valley, from Hamilton to Piqua, is carrying its full share of the war industrial load, including ship engines, machine tools, munitions, steel, airplanes, clothing and blankets; and that delay would extend into another flood season which might mean disaster.

Both from what you tell me and from my general knowledge of the situation, I am of the opinion that the preservation of human life and the public welfare are concerned in this conservancy project, and that I ought not to offer any objection to its prompt completion.

Permit me to express my appreciation of your patriotic action in consulting me concerning this matter and requesting my opinion before attempting to finance this work at this time. Of course, I have no power or duty in the premises, but in view of the financial situation as affected by the government's operations, which should have preference at all times during this war, I feel grateful for the opportunity you give me of passing on this matter.

It is my hope that others charged with similar responsibilities in respect to the financing of enterprises, both public and private, will make it their practice to consult with the Secretary of the Treasury before undertaking any new financing or, indeed, before making commitments or expenditures which would require to be financed by borrowings. It is only by subordinating local and personal interests to the public welfare, and by enforcing the most rigid economy in matters of public and private enterprise, as well as in matters of personal expenditure, that the United States can hope to bear its part of the financial burden of the war and to release sufficient labor and materials for war purposes without depletion of our resources.

Cordially yours,

W. G. McAdoo,
Secretary.

After an inspection of the Miami Valley and a study of its resources and its industrial activities, the National City Company, the Guarantee Trust Company, and Harris, Forbes & Company, all of New York City, contracted to underwrite the entire bond issue of the district, amounting to $24,340,490.

The bonds are to be retired in 30 years and to bear 5 per cent interest. While their rate is slightly higher than the directors had hoped for, the district is fortunate under the existing conditions to be able to finance its work without delay. Of the total issue, $15,000,000 were placed on the market early in December, 1917, to provide funds for immediate purchase of equipment and beginning of construction. The entire amount offered at this time was sold in less than a week.
CHAPTER VII.-PREPARATION FOR CONSTRUCTION

ADVERTISEMENTS

On September 15, 1917, the greater part of the proposed construction was advertised for bids. The local channel improvements proposed for some of the smaller cities in the valley were not advertised at that time as the work involved was not of great magnitude. The following quotations, taken from the printed advertisements, describe the work advertised and the manner in which the proposals were to be submitted:

Dayton, Ohio, September 15, 1917.

Sealed proposals will be received at the office of the Secretary, Board of Directors, The Miami Conservancy District, Dayton, Ohio, until 2 o'clock P. M. November 15, 1917, for the construction of dams and appurtenances as follows:

Contract No. 1.-Germantown Dam and appurtenances, including Road No.1, involving approximately the following principal quantities: Excavation, 200,000 cu. yds.; embankment, 850,000 cu. yds.; concrete, 20,000 cu. yds.; paving and riprap, 1,000 cu. yds.; iron and steel, 120 tons.

Contract No. 2.-Englewood Dam and appurtenances, including Road No.3, Road No.4, and Road No.5, involving approximately the following principal quantities: Excavation, 375,000 cu. yds.; embankment, 3,500,000 cu. yds.; concrete, 38,000 cu. yds.; paving, and rip rap, 2,000 cu. yds.; iron and steel, 180 tons.

Contract No. 3.-Lockington Dam and appurtenances, including Road No.8 and Road No.9, involving approximately the following principal quantities: Excavation, 200,000 cu. yds.; embankment, 1,000,000 cu. yds.; concrete, 37,000 cu. yds.; paving and riprap, 1,000 cu. yds.; iron and steel, 50 tons.

Contract No. 4.-Taylorsville Dam and appurtenances, including Road No.12 and Road No.13, involving approximately the following principal quantities: Excavation, 750,000 cu. yds.; embankment, 1,100,000 cu. yds.; concrete, 57,000 cu. yds.; paving and riprap, 5,000 cu. yds.; iron and steel, 400 tons.

Contract No. 5.-Huffman Dam and appurtenances, including Road No. 16 to Station 60+50, and Road No. 17, involving approximately the following principal quantities: Excavation, 300,000 cu. yds.; embankment, 1,400,000 cu. yds.; concrete, 45,000 cu. yds.; paving and riprap, 1,500 cu. yds.; iron and steel, 400 tons.

**********Contract No. 41.-Improvement of Miami River at Dayton, above Island Park, involving approximately the following principal quantities: Levee embankment, 65,000 cu. yds.

Contract No. 42.-Improvement of Miami River at Dayton, Island Park to W ashington Street, involving approximately the following principal quantities: Channel excavation, 850,000 cu. yds.; concrete in retaining walls and revetment, 25,000 cu. yds.; levee embankment, 80,000 cu. yds.

Contract No. 43.-Improvement of Miami River at Dayton, Washington Street to Stewart Street, involving approximately the following principal quantities: Channel excavation, 465,000 cu. yds.; levee embankment, 205,000 cu. yds.; concrete in retaining walls and revetment, 3,500 cu. yds.

Contract No. 44.-Improvement of Miami River at Dayton, Stewart Street to Broadway, involving approximately the following principal quantities: Channel excavation, 1,000,000 cu. yds.; levee embankment, 655,000 cu. yds.; concrete in revetment, 2,000 cu. yds.

Contract No. 45.-Improvement of Mad River at Dayton, involving approximately the following principal quantities: Channel excavation, 20,000 cu. yds.; levee embankment, 35,000 cu. yds.; concrete in retaining walls and revetment, 1,500 cu. yds.

Contract No. 46.-Improvement of Wolf Creek at Dayton, involving approximately the following principal quantities: Channel excavation, 80,000 cu. yds.; levee embankment, 25,000 cu. yds.; concrete in revetment, 1,400 cu. yds.

Contract No. 47.-Improvement of Miami River at Hamilton, involving approximately the following principal quantities: Channel excavation, 1,900,000 cu. yds.; concrete in retaining walls and revetment, 27,000 cu. yds.; reinforcing steel, 550,000 lb.

* * * *

Proposals must be on the blank forms furnished by the Board, and must be accompanied by a certified check for not less than 5 per cent of the aggregate amount of the bid, figured on the basis of the estimated quantities and the unit prices bid, but which in no case need exceed $50,000; such check to be drawn to the order of the Treasurer of The Miami Conservancy District, as a guarantee that the bidder, if awarded a contract, will, within 10 days after the contract is delivered to him for that purpose, execute the same, and furnish surety bond for the faithful performance of the contract in the sum of 40 per cent of the contract price; said contract and bond to be on the standard forms which have been adopted by the Board.

Any bidder, to whom an award has been made, shall fall to execute the contract or to furnish satisfactory bond within the time hereinbefore specified, or as extended by the Board, the award shall thereupon become void, in which case the proceeds of the certified check shall become the property of the District, and the contract may be awarded to the next lowest or best bidder; and such next lowest or best bidder shall thereupon assume the contract, as if he were the party to whom the award was first made.
Each bidder must, in his proposal, present satisfactory evidence that he has been engaged in constructing works of the general character covered by his proposal, and that he is fully prepared, and has the necessary capital, to begin the work promptly, and to conduct it as required by the contract and specifications. Proposals not containing such evidence will not be recognized as bids.

The right is reserved to reject any or all bids, and to waive any technical defects, as the interests of the District may require.

Drawings, specifications, proposal blanks, and other information may be obtained on application to the Chief Engineer, The Miami Conservancy District, Dayton, Ohio, at whose office drawings, boring samples, and other data may be inspected.

EZRA M. KUHNS,
Secretary.

PROPOSALS RECEIVED
Proposals were received on November 15 from the following construction companies:

United Dredging Company of Seattle, Wash.
Mc Williams Northern Dredging Co. of Chicago, Ill.
M. e. Connors & Company of Chicago, Ill.
Winston & Company of Richmond, Va.

Parsons Construction Company of Binghamton, N. Y. Hunkin-Conkey Company of Cleveland presented unconditioned proposals on two dams, but these were received after the bids had been opened and read, and so were not considered. The prices named in their bids were much higher than the engineer's estimates.

All proposals, except the bids received on two contracts, were informal and were conditioned on prices of labor and materials, on the attitude of the national government toward construction work, or on other possible developments. Some of the proposals contained unit prices not differing appreciably from the estimates of the district, but the conditions attached were such as to make the final price indefinite. The qualifying provisions of the proposals included the effect of war conditions on ability to secure labor, material, and equipment, and also covered possible increase in prices. One of the proposals required that the district take over the entire equipment used on the work, after its completion. A careful analysis of the proposals indicated that practically all of the bidders had gone so far in their attempt to protect themselves against possible contingencies, that the district could gain nothing by awarding the work to them. A number of informal proposals offered to do the work on a cost plus a percentage basis; but these, too, while assuring a generous profit to the contractor, left the burden of every risk with the district. Some of the contractors already had the greater part of their equipment and organization engaged on large government contracts and it was felt that their undertaking the work would not materially facilitate its construction.
WORK TO BE DONE BY FORCE ACCOUNT

At a meeting of the board of directors on December 3, 1917, all proposals were rejected except that of the McWilliams Northern Dredging Company on Contract 41. With the exception of this contract it was decided that it would be better for the district to do the work by force account.

The proper construction of the flood control works involved two great essentials. First, and above everything else, was the necessity of having the work done in the very best possible manner, so that there could never be the slightest doubt as to its safety or effectiveness. Second, there was the necessity of having it done in the quickest and cheapest manner consistent with perfect work. It was felt that the engineers who were responsible for the quality of the work should not be burdened with the task of buying and installing equipment and with the construction man's job of prosecuting the work. With this in mind the directors, on recommendation of the chief engineer, secured the services of Mr. C. H. Locher, an experienced contractor, for assembling the necessary equipment and supervising the entire construction.

As soon as it was decided that the work should be done by the forces of the district, preparations were started for beginning construction. Tentative construction programs were outlined for the various contracts by Mr. Locher, with the aid of the engineers and the purchase of equipment begun. The first actual construction work on channel improvement under the supervision of the district was the raising of the levees opposite Island Park dam, in the city of Dayton, which was begun November 27, 1916. The first construction in connection with the dams was begun November 15, 1917, in the removal of the tracks of the Ohio Electric Railway from the Huffman Basin to make way for the building of the Huffman Dam.
CHAPTER VIII—OPPOSITION to THE FLOOD PROTECTION PROJECT

If an historian, in writing of any great public development, should state that it was initiated and brought to completion without serious objection, we should know his record to be untrue, because it would be contrary to universal experience. Not only does every great public project of an engineering nature meet with objection, but, if we compare the objections and opposition met with on a hundred great public undertakings, we may observe as great a similarity of symptoms as a doctor observes in as many cases of typhoid fever. We shall see that the obstructions put in the paths of such improvements are but the natural and normal reactions of certain human traits.

An engineer makes a mistake if he undertakes a great project without having appraised all of the factors involved as closely as may be practicable. As the objections and opposition that will be encountered will be not the least of his difficulties, it behooves him to consider them in advance, determining insofar as it is possible: what objections are well taken and should, therefore, be eliminated by modifications in his plans; how he may reduce other objections to a minimum; and whether there are any which are too formidable and deeply rooted to be overcome, and which, therefore, will require changes in his plans that, from a purely engineering point of view, would be undesirable or unnecessary. It is because a record of the objections and obstructions met with in one case may serve to forewarn and to inform persons who may undertake similar future projects that this chapter is written.

NATURE OF THE OPPOSITION

We make a serious mistake when we assume that opposition to a new public project commonly proceeds from wrong motives. The average successful man has been buffeted about a great deal before he has made a secure place for himself. When finally he has paid for and developed a farm, or has established himself after years of effort in business or in professional practice, he naturally looks with fear and suspicion on any large public undertaking which, so far as he knows, may take away the secure position he has gained, and may require him to begin life anew, or to submit himself to heavy burdens of taxation. Moreover, he is justified by experience in believing that public money is not always well spent, and that private interest may be back of public projects- His natural attitude, therefore, is one of aloofness or suspicion until his mind shall be made clear as to the merits of the undertaking.

In many respects the fulfillment of the Conservancy District plans meant a change in point of view and in habits of thought. People had been in the habit of seeing public works carried out through the medium of city and county government. When they were asked to consider themselves as parts of a conservancy district, consisting of a ribbon of land a hundred and fifty miles long, their idea of political units was disturbed. They were told that the county was the natural political unit for flood prevention purposes, and that their rights of home rule were being violated. Patriotism was declared to refer to county boundaries, and no more potent appeal was made than that which bade people to have no dealings with the foreigners from over the county line.

FIG. 38.—LIFE BOAT BEING LAUNCHED IN DAYTON.

Several of these boats were brought from lake ports during the 1913 flood, for use in relief work.
In case of a complicated project like that of the Miami Conservancy District, which requires the best efforts of trained and experienced engineers for its solution, the average man finds it impossible to give the time and study necessary to master the questions involved. In the end he must rest his support or opposition upon his confidence or lack of confidence in the integrity and capacity of the men who have the project in hand. In a locality like the Miami Conservancy District the attitude of most people is that they sincerely desire to find the right solution to the problem. In every such group of people, however, as is proved by the history of public improvements in every part of the world, there is a small number of people who are willing to exploit to their own advantage the ignorance, prejudice, lack of information, and other characteristics of their neighbors. In the Miami Conservancy District, therefore, the problem of the Dayton Flood Prevention Committee and of the board of directors of the district has been so to conduct themselves that at all times they should deserve and possess the unlimited confidence of the people of the Miami Valley, The method of the opposition has been to strive by every means, including false reports, rumors, fears, imputations of dishonesty or incompetence, and ridicule, to undermine this confidence,

By its nature the lawyer's profession gives the best opportunity for understanding the weaknesses of human nature, and how these weaknesses may be exploited to serve any desired' purpose; and, moreover, the lawyer's profession makes this exploitation immediately profitable. In any part of the United States, when a great public project is undertaken, while most attorneys will confine their opposition to the protection of their clients and of the public from injustice, a few will be found who systematically use their knowledge of human, nature to promote fear, suspicion, distrust, hatred, and conflict of interest. These few attorneys usually are supported by men of other callings who lack only the skill and experience necessary to make themselves equally troublesome. These men, and others who are sincerely opposed to the project, finding their immediate aims to be identical, commonly unite their forces; while, similarly, among those favoring the project, there will generally be found some men of doubtful motive, who hope by their adherence to gain some personal advantage, and who, in fact, do not increase the confidence of the public in the undertaking.

The flood control movement in the Miami Valley had a tremendous and widespread support following the great flood of 1913. About 23,000 persons contributed to the Dayton Flood Prevention Fund, and the same urgency that prompted their contribution naturally made them keenly impatient for the "dirt to fly." They did not fully realize the difficulties and the proportions of the undertaking. While the real problems of future protection were being worked out step by step by the engineers, attorneys, and law makers, the passing months toned down the memories of the great flood disaster' and public interest waned. Not more than two months had elapsed before there were signs of impatience, and adverse criticism began to add its burden to the already heavy responsibilities of the Flood Prevention Committee. Many persons without engineering understanding of the situation proposed ridiculously impossible solutions, claiming for them almost immediate results, and the local newspapers, lacking facilities for determining the truth 'of matters involving technical considerations, often published misleading items that tended to agitate the public mind and promote the feeling that work was being delayed unnecessarily. Now and then, when information of real interest was given to the papers, it was often so misinterpreted by reporters unfamiliar with the engineering terms, that it had a detrimental effect on public opinion. Local prejudice and personal interests cropped out here and there and added their quota of hindrance. The public nature of the project offered numerous opportunities for opposition and obstruction, the origin and character of even the chief causes being so varied as almost to preclude satisfactory analysis or classification.

**HISTORY OF THE OPPOSITION**

During the first summer after the flood all the important communities in the Miami Valley were discussing and investigating measures for flood protection. The matter of financing extensive improvements 'received nearly as much attention as deciding upon the nature of the improvements. Although various communications: to the newspapers manifested some impatience because so much' time was passing without seeing the "dirt begin to fly"' in general" during this first season, survey's, investigations, and discussions proceeded amicably enough until a little after the Dayton Flood Prevention Committee in October decided in favor of the retarding basin plan. An essential element of this plan was the cooperation of all the communities affected in the valley in carrying it into execution. During October, November, December, and January the general features of the plan were explained at public meetings in all the cities of the valley. The cities below Dayton joined in the movement rather readily, for it had become sufficiently obvious that in most cases they were powerless to secure any efficient local flood protection working alone. Hamilton was a conspicuous example of this. She had gone to large expense in employing
engineering services to plan local flood protection only to find that the expense of such protection would be entirely prohibitive. The situation was quite otherwise in the cities above Dayton. Situated as they are where the streams are much smaller, local protection was not in some cases entirely impracticable, at least not obviously so, and hence these cities did not join heartily in a common undertaking as did the cities lower down the valley. But probably a more potent factor in preventing ready acquiescence in the adoption of the retarding basin plan was the fact that the construction of the proposed dams and retarding basins would cause extensive disturbances to property ownership, high ways, and railroads in their immediate neighborhood. The announcement of the proposed retarding basin plan was rather sudden and unexpected, the extent of the necessary local readjustments of property ownership and lines of communication was quite unknown, but was probably somewhat exaggerated in the first description of the plans, and hence it was probably only natural that in the communities in the immediate proximity to the proposed dams, there was a widespread flare of resentment at what seemed to them as an unnecessary and unwarranted disturbance of their situation. These people entirely unaccustomed to the idea of flood protection by means of retarding basins, and not at all convinced of the necessity of this plan, were easily prejudiced against it. To the sponsors of the retarding basin plan, to whom its discovery as a possible and feasible method of protection had seemed a most fortunate event, this sudden manifestation of opposing and seemingly unreasoning prejudice was a great surprise. Perhaps it was a strategic error to state so definitely as was done the exact locations of the proposed retarding basin dams and their great dimensions. Possibly if the general idea of amelioration of floods by temporary storage had been first presented, while investigations of the large number of possible damsites was being thoroughly carried out so that the most feasible might be selected, the opposition to the retarding basin plan might have been largely forestalled. However that may be, within a few weeks after the retarding basin plan was publicly announced on October 4, 1913, a most violent opposition to the whole plan was in evidence in Troy, Pi qua, Sidney, West Milton, Osborn, and Springfield, all located above Dayton on the Miami, Stillwater, and Mad Rivers. Although public meetings were held for the purpose of explaining the proposed flood protection plan, it was difficult in these cities to secure even a respectful hearing.

FIG. 39.-FLOOD VIEW IN NORTH DAYTON.
Looking southeast from house on east side of Daniel Street, in March, 1913, when the flood was near its crest.

In January the Ohio Conservancy Law was introduced in the special session of the legislature. Opposition to the flood protection plan took then the form of objections to the passage of this law. Local newspapers in Sidney, Pi qua, and Troy took up the fight eagerly and published all sorts of reckless statements, sometimes with cleverly worded qualifications, of which the following samples will show the general character:

The startling fact remains—that in the last twenty-five years more than a hundred good, strong, solid concrete, and earthen dams have broken by water pressure.

Reservoirs to be death traps above the cities and towns of this valley.

Statistics compiled are all against impounding or dry reservoirs for the Miami Valley.

... The Morgan Engineering Company paid $2,000,000 by the city of Dayton and $2,200 by the city of Troy have reached their
conclusions.

The Johnstown dam couldn't break either. It was the last word in flood prevention.

It is well known that had our rivers been cleared out and not been encroached upon there would have been no such flood as the one which visited us last March.

An taxpayers of this county, no matter how far they reside from Hood peril, would have to pay for the alleged improvement. The outlying small towns would have to be taxed and every farmer bear his burden.

Dayton is willing to ruin more than one farm in her eagerness to help herself. She is ready to taxride the people of Troy for her own benefit. It is i with her merely a question of selfishness. Let her build up her own town t before she seeks to despoil others of their savings.

If you don't want Dayton to take your land and your money for her own benefit, begin now to fight the proposition.

It is estimated that 38,000 acres of land would be flooded by the Lockington and Port Jefferson dams.

Indications are not wanting that there will be self-appointed vigilance committees who intend to see to it that if the reservoirs are built that they will not remain in existence long after a flood comes. A feeling of contempt and scorn is rising against all the persons who have taken a forward position in support of the Morgan plans of this county. It is certain that no jury could be secured in Miami County to convict a man of blowing up the dam.

The law is an outrage. Governor Cox and his bunch of Dayton henchmen put it across on the people of the valley, despite the protests of this end of the valley. It provides that a board of directors, to be appointed by the Dayton courts, shall have charge of the flood prevention work. The power vested in this board is unlimited. They can do as they please. They can raze buildings, condemn land, and heap indignities upon the heads of the taxpayers of this community without reserve.

Taxpayers of Shelby County. You are going to be held up and robbed of your birthright in about such a way as Esau was robbed of his. You are to be lined up against the fence and your pockets are going to be turned inside out and you will have nothing to say about it.

On February 20, 1914, at a public mass meeting in Troy, called by the county commissioners of Miami County to consider the recently enacted Conservancy Act; numerous speeches were made urging opposition to the enforcement of the law, after which long resolutions were adopted from which the following are extracts:

The Conservancy Act of Ohio authorizes the creation of conservancy districts for the alleged purpose of preventing disastrous floods. The three commissioners to be appointed under the provisions of this act are clothed with the right of eminent domain; the right to enter our lands and homes without our consent; to subvert the authority of the sheriff and constables; to take from our county commissioners any right they now have under the law to provide roads and bridges and superintend the same; the powers of unlimited taxation.

The Miami and Stillwater Rivers, the property of the people, are to be obstructed by dams, among the most enormous in size in the history of the world, with a hydraulic power behind them, sufficient to produce enough electric power to propel for the present and prospective use of every manufacturing industry in Dayton, Miamisburg, Middletown, and Hamilton, for which purpose all the indications point they were primarily designed, instead of for alleged flood protection.

It stores millions of tons of water high over the tallest steeples of Sidney, Piqua, Troy, and Tippec canoe City; depreciates all values in these cities, and forever stops their growth on account of the terror it will create.

The resolutions further urged the county commissioners to oppose in every way possible the enforcement of the law.

Similar meetings were subsequently held in Piqua and Sidney to discuss methods of fighting the organization of the Miami Conservancy District. Although not all of the speakers at these meetings were opposed to the law, the majority were agitators and politicians who indulged in much intemperate language. Contributions were solicited and plans were made for collecting contributions from all parts of Logan, Shelby, and Miami Counties. It was noticeable that many of the most outspoken opponents of the flood prevention plans were persons who had no property affected in any way by the plans.

In order to increase the weight of the opposition and to enlarge the area from which funds might be solicited, misleading statements like the following were freely published in the newspapers:

Some persons seem to think because they are not within the limit of the land covered by water, under the Conservancy Act of Ohio there would be no expense to them on account of the dams. They are very much mistaken.

Assessments would be made against all the land from which water flows into the Miami river and tributary streams. The estimated cost of this proposed work is not less than $17,000,000. Shelby County land owners will be compelled to pay their share which is estimated at not less than $200,000, and it might amount to $800,000, unless this proceeding is defeated in the suit brought to accomplish it in Montgomery county courts. Persons have been appointed in every township to solicit funds to pay for the employ of eminent attorneys in the suit, and every person

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should feel it a duty to contribute to the pay of the necessary expense of defeating the proceedings, the hearing of which is fixed for March 20 at Dayton.

The anti-reservoir campaign is to be waged not only in the cities and big towns and villages of the county, but is to be carried into the school districts. Three such meetings have been arranged as follows: Monday evening, March 9, at Frederick, where four school districts converge. Rigs will meet persons from Troy who intend attending at Ginghamsburg.

Tuesday, March 10, at Coppock's school house. Persons desiring to attend from Troy take 5:30 car and get off at Evanston.
Wednesday evening, March 11, at Paddy's school house in northwest corner of Monroe township on National Road.

It has been decided to collect a fund of $5,000 by popular subscription to fight the reservoir scheme. The money will be used to employ constitutional lawyers in case Prosecutor O'Donnell does not ask the Commissioners to appropriate money for this purpose. Each taxing district in the county has been assessed its rightful share of the amount. The amount assessed against Troy and Concord township is $597.15. The names of those who contribute are to be published.

Upon the matter of the employment of a constitutional lawyer to oppose the act, four of the counties, Miami, Shelby, Logan, and Greene agreed to take such action.

The opposition to the conservancy law has grown very formidable and is arranging to secure the best possible legal talent to represent it before the court. Signatures to protests are being secured and an effort is being made to raise a large sum of money.

At a meeting of the representatives of the boards of county commissioners of Shelby, Clark, Logan, Greene, and Montgomery Counties at Troy with the Miami County board, it was decided to employ the law firm of Huyt, Dustin, Kelly, Andrews & McKeon. of Cleveland to represent the counties opposed to the conservancy law and the Morgan plan of flood prevention at the hearing on the petition before the joint common pleas court at Dayton on March 20.

FIG. 40.--FLOOD VIEW IN NORTHEAST PIQUA. Taken March 26, 1913, when the flood waters were slowly receding.

Miami, Logan, Shelby, and Greene Counties will bear the expense of the attorney's fees, which are not to exceed $5,000, no matter if the case goes to the supreme court of the nation.

Under the resolutions passed by the great mass meeting, an executive committee was formed, composed of one man from each taxation district in the county, with full power to do all things necessary to defeat the operation of the Conservancy Act of Ohio in the proposed district. The committee is circulating the following paper in Miami and several of the townships have raised their allotment as set forth.

"Anti-Reservoir Executive Committee, Pioua, Ohio, March 3, 1914.

At a meeting of this committee, composed of one member from each taxing district of Miami county, this day held in the council room of the city of Pioua, Ohio, it was unanimously resolved that the sum of 85,000.00 would be required for office expenses, stenographic work, printing, postage, and attorney's fees, with which to successfully fight the most monstrous law in history-the Conservancy Act of Ohio; and that each taxing district of Miami county should be requested to furnish that part of the whole amount as the tax duplicate of such district is
The following table shows the apportionment to the tax duplicate of the entire county. Under this appointment the following amounts would be furnished:

<table>
<thead>
<tr>
<th>District</th>
<th>Amt. of Dup.</th>
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<tbody>
<tr>
<td>Bethel Tp.</td>
<td>$2,722,320</td>
</tr>
<tr>
<td>Elizabeth Tp.</td>
<td>2,393,030</td>
</tr>
<tr>
<td>Lost Creek Tp. and Cass Town</td>
<td>2,286,306</td>
</tr>
<tr>
<td>Brown Tp. and Fletcher</td>
<td>3,100,000</td>
</tr>
<tr>
<td>Staunton Tp.</td>
<td>2,492,850</td>
</tr>
<tr>
<td>Spring Creek Tp.</td>
<td>2,644,550</td>
</tr>
<tr>
<td>Monroe Tp. and Tippecanoe</td>
<td>5,122,900</td>
</tr>
<tr>
<td>Concord Tp. and Troy</td>
<td>12,249,600</td>
</tr>
<tr>
<td>Washington Tp. and Pi qua</td>
<td>18,819,510</td>
</tr>
<tr>
<td>Union Tp. and Milton and others</td>
<td>6,017,730</td>
</tr>
<tr>
<td>Newton Tp. and Pleasant Hill</td>
<td>4,108,650</td>
</tr>
<tr>
<td>Newberry Tp. Covington and Bradford</td>
<td>6,310,360</td>
</tr>
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Proportion

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<th>Proportion</th>
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<tr>
<td>$199.39</td>
<td>$157.46 $227.04</td>
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<tr>
<td>$182.59</td>
<td>$175.26 $209.32</td>
</tr>
<tr>
<td>$227.04</td>
<td>$167.46 $200.93</td>
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<td>$440.77</td>
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<tr>
<td>$300.93</td>
<td>$462.19</td>
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</table>

$68,267,860

$5000.00

"The undersigned hereby agree to pay the sum set opposite our names to John A. McCurdy, Treasurer of the Anti-Reservoir Executive Committee of Miami County, Ohio, with the understanding that a report of all expenses incurred shall be made by publication at the close of the work, and if any part of the general fund remain unexpended, each subscriber shall have a proportionate per cent of the same refunded to him or them.

*Anti-Reservoir Executive Committee of Miami County.* Troy, Ohio, March 4, 1914.

"We, the undersigned citizens of Miami County, respectfully remonstrate against the formation of the proposed Miami Valley Conservancy District under the Conservancy Act of Ohio, on plans which involve the building of dams across our rivers and the impounding of enormous bodies of water over our heads; the submergence of much of our richest lands; the consequent danger from back water in high flood time to the water and sewer systems of some of our cities; and earnestly represent our entire faith in flood protection through channel improvement."

This preceding remonstrance has been signed by 95 per cent of the voters in each of the school districts in the various townships of the county and so far as the villages and cities have been canvassed these figures maintain. There has never been in the history of the county such an overwhelming sentiment on one side of a proposition submitted to the judgment of the people.

The Troy city council voted $500 to employ Attorney Robert Black of Cincinnati to aid City Solicitor G. T. Thomas in his fight against the measure and to represent the city at Friday's hearing.

It might perhaps be well to intimate that the school house campaign described above as extending throughout Miami and Shelby counties was inspired chiefly for the purpose of raising money; and that the newspaper publications and speakers at the meetings who tried to stir up the people by telling them that they would all be subject to a heavy tax for the purpose of paying for the proposed works, were either speaking in ignorance of the law or with a deliberate intention to deceive. They could scarcely have been ignorant of the law as a long explanation of the law had been printed in many papers numerous times, and its provisions had been explained at numerous meetings.

The following quotations, taken from a statement prepared by one of the active opponents of the work at about this time, are especially interesting examples and are illustrative of the methods adopted by the promoters of the opposition.

I shall endeavor to show that the entire course, from the beginning to the present moment, of the Dayton flood committee and the Morgan Engineering Company, in securing the enactment of the Conservancy Law of Ohio, and their conduct since its passage has been flagrantly marked by continuous acts of insincerity; that the lives of the leaders of the movement have been lives of insincerity, openly arrayed against the interests of the common people; that no statement made by them, except proven by scientific data, is entitled to respect or credence; that no cause, in the nature of things, can be righteous, that is conducted without true honor or dignity and that the vital question of popular government is assailed by this act.

The opinion of Judge Dillon of New York, about how near to the quick, the people has been shorn of their constitutional rights, gave the Dayton committee a much larger concern than their professed interest in the health, safety, welfare, and convenience of the people.

To whisper anything that might reflect upon the pre-eminent standing of Mr. Morgan as an engineer would almost seem profanation and yet nearly all the work of last year, under his charge in this valley, was performed by young men, without a week of former practice in the field, fresh from college, and using the ordinary transit, acknowledged by all engineers to be inaccurate under some conditions.
The people of the upper Miami Valley have as great cause for rebellion and resistance, as our ancestors had for their resistance of the Stamp Act. Caesar had his Brutus; Charles the First had his Cromwell, George the Third his Washington and the Patterson crowd may profit by their example.

Let not the people fear! There is a mighty God of Israel who is on the side of the people of the upper Miami valley who will put it into the hearts of ou; chosen judges that this offense shall not be committed; that the principles for which our ancestors fought and suffered and for which !1.1any of us fought and suffered from '61 to '65 are. still alive in the hearts of the people.

The attempts of the opposition to cripple the conservancy law by securing the passage of radical amendments have been discussed in chapter III, see page 76. These amendments were introduced into the state legislature early in the year 1915. They were drawn so as to make it more difficult to initiate a petition; to eliminate any possible use of dams or reservoirs; to curtail the director's power of condemnation; to provide for at least one elected director from each county affected by the district; to prevent removal of a judge by a charge of prejudice; and to include the county commissioners as ex-officio members of the board of directors. However, their primary purpose was to obstruct the operations of the Miami Conservancy District and to make it impossible to build retarding basins in the upper Miami Valley. The amendments introduced in the House never came to a vote while those introduced in the Senate were defeated by a vote of 23 to 8.

Failing in their efforts to secure help from the state legislature the opposition's next move was to petition for the establishment of a district to include all lands draining into the Miami River, in 13 counties, three counties near the headwater of the river being added to those already involved in the Miami Conservancy District petition in the hope that their judges would be opposed to the retarding basin plan and would furnish the votes required to prevent its approval by the conservancy court. Failing in this attempt, also, no further steps of importance were taken by the opposition until late in the year 1916, when the hearing on the Official Plan was begun by the conservancy court. This hearing was described by the late General Chittenden in the Engineering News of November 9, 1916, in an article entitled The Battle over the Miami Flood Prevention Plans. In discussing the reasons for the opposition General Chittenden says:

Nothing so mystifies an onlooker at the hearing, even one who has kept in close touch with the history of the case, as to try to discover the real basis of opposition to the conservancy plans. That opposition has been strenuous and resourceful from the beginning, but just what it is based on is difficult to say. In Mr. Taylor's opening address, following Mr. Schubring, he professed to disclose the grounds of the opposition, but except for a single reference to the public health of the community the sole ground presented was the lack of safety in the dams. There was no dissent from the proposition that something should be done. "We all want to get together," said Mr. Taylor, "and see what is the best thing to be done for the district."

Even cost was not the matter "of prime importance," but safety, and Mr. Taylor continued:

"The fundamental proposition is this, as we see it. Is the plan of protection by retarding basins safe and feasible, or is it not? Now, that is absolutely the crux of the whole situation. Anything else is practically surplusage. Of course, there are questions of local flood protection that ought to be heard and will be heard, but the thing we want to get at" is this one matter: everything hangs upon that: Are the dams safe?"

Elaborating this idea, the whole system of retarding basins was attacked in general and in detail as essentially unsound and creating an ever present menace to the inhabitants in the valleys below.

Unfortunately this line of attack lacks the essential elements of sincerity. Those who are mainly using it live above the dams, except some few below the small basin at Lockington. No complaint worth considering has come from below the main dams. There is no pronounced distrust of their safety there, where if anywhere it must exist. If is therefore impossible to accept this argument as the real reason. It is effective, it strikes a popular chord, it plays upon public fears and is a useful instrument in accomplishing the real purpose. Yet what the real purpose of the opposition is and what is the motive back of it are nowhere definitely disclosed.

The writer is convinced in his own mind that it is the desire to escape the burdens of an assessment district, which some fear will be out of proportion to the benefits. Indirectly this idea has cropped out in numerous places. Then there is, or has been, a feeling that the scheme is for the benefit of Dayton, Hamilton, and other towns and that the outlying districts will be taxed for their benefit. Finally, the very fact of opposition has gained a certain vogue, enters more or less into local politics, serves to sustain much legal practice, and thus its continuance derives an importance in certain directions which is not to be lightly estimated.

Such is a general view of the situation as nearly as the writer has analyzed it. He has not been able to lay his finger on what he can term a single valid objection. There may be such; but if so they have been covered up under the plausible 'appeal of safety, which, as already stated, lacks the simplest element of sincerity.

Only one engineer testified for the opposition. He had been engaged by the counties of Miami, Shelby, and Clark to make a report on the cost of securing flood prevention by channel improvement and also on the cost of the plan adopted by the Miami Conservancy District. His report was offered as evidence and his own testimony was in elucidation of this report. Speaking of
this General Chittenden says:

Concerning both report and testimony, the most charitable commentary that can be made is, that they were unfortunate, whether from a professional point of view or as a contribution to the cause of the opposition. It is true that Mr. Hill's time and resources, as he repeatedly urged, were very limited, and it was not to be expected that he could offset in wealth of detail the elaborate work of the district itself. But the report was not merely weak in this respect; it disclosed a willingness to adjust data to suit the exigencies of the case, and this feature was so manifest as to deprive the report of all claim to public confidence.

The following paragraph taken from the closing comments made by General Chittenden in the above mentioned article 'is pertinent:

Viewing the case as a whole, it well illustrates what the writer has often remarked: The greatest obstacles that the promoters of public work have to overcome are not those of nature, but of man. Nature is sometimes a stubborn adversary, but she always acts in the open, without subterfuge or indirection. But human ignorance, prejudice and self-interest are handicaps of a different character. Ignorance is least important, because it may yield to instruction. Prejudice—that is, prejudgment of a case and then sticking to it regardless of facts—is immeasurably worse. But selfinterest is the most insuperable obstacle of all. Public measures are judged by their effect on the private pocket-book, and the rarest phenomenon in the world is a willingness to subordinate personal interest to the public welfare.

After the Official Plan was approved by the conservancy court, no further opposition of importance was met with. Although a great many exceptions to the assessments were filed after appraisers had submitted their report, the total amount of property involved was not great and they did not in any way hold up the progress toward construction.

METHOD OF MEETING THE OPPOSITION

The intrinsic merit of a great project is not in itself sufficient to assure the success of that project. Many of our most useful and widely beneficial public works have been brought to a successful completion only through persistent and painstaking promotion and education. Such educational work is needed to assist the public in an understanding of the merits of a project, not merely to obtain passive permission but to stimulate live public support and active cooperation in the work. To successfully overcome impatience, prejudice, and ignorance of the plans, to combat misrepresentation, to harmonize conflicting interests into united effort, and to gain the whole and confident support of the people in the Miami Valley flood control project, was perhaps one of the most difficult tasks presented by the undertaking.

Flood protection is fundamentally a work of the people and its progress and successful accomplishment depend in a large measure on public support. This is particularly true in the case of large projects which involve many interests and affect many properties, as where a number of cities and towns and counties must be reckoned with. The present day tendency to publish and circulate such news and opinions as are readily available makes it imperative that reliable information regarding a project be disseminated to forestall the spreading of erroneous ideas and misrepresentations.

Being a work of the people it was recognized at the outset that the only just course would be to keep the people fully informed on every phase and development of the project, and it was this policy that proved to be the best weapon against all efforts to obstruct the work. Every important step was publicly announced and its significance explained. The plans were often exhibited and explained in detail in public places, and were kept open for public inspection at all times. They naturally involved many considerations of a technical character and to have these understood by the general public was by no means an easy matter. There were even cases where the feeling of opposition had become so bitter that persons made no examination whatsoever of the 'plans, but attacked them without knowing their purport.
Soon after the flood prevention surveys were begun it was decided to institute a campaign of education through the medium of the newspapers. This was conducted by a graduate civil engineer having previous newspaper experience. The first article presented in this way outlined the necessity for the preliminary surveys. In another article, the work of the field parties was described and illustrated with photographs taken in the field. Other articles followed, pointing out the importance of preserving and recording high water marks, the necessity for determining the amount of flood flow, the effect of bridges on channel capacities, the purpose of these articles being to keep the public informed as to how and why things were being done, and so to prevent as, much as possible the development of opposition. Other flood problems and projects were described. A four-page newspaper supplement, entitled Flood Prevention in the Miami Valley, was prepared and issued by the Flood Prevention Committee in March, 1914, and distributed throughout the valley by thirty or more local newspapers. Each paper was supplied, without cost, with as many copies as it required, printed with its own heading. This supplement set forth a full though concise statement of facts without comment or argument. It gave briefly some of the results of the rainfall studies, outlined the necessity for flood control law and briefly described the law and the flood control plans that were being prepared. It was very effective in presenting to the general public a clear exposition of the main factors of the problem.

A matter much more difficult to deal with than the accidental misrepresentations occasionally made in the friendly papers were the persistent and bitter attacks of a few of the country papers in the valley. Curiously enough this antagonism appeared in parts of the valley least affected by the proposed plan, the most violent tirades in fact coming from unaffected communities. Articles that were sensational, misleading, and abusive were printed in papers having little or no logical interest in the matter. The unreasoning character and ridiculous falsity of their statements may be illustrated by the following typical quotations:

The Dayton flood prevention committee had through the connivance of the newspapers, prevented the Morgan plans from becoming known to the citizens generally.

The possibilities of this flood bill are startling. If they do not expect to make use of the power clause, what is it in there for?

A gentleman who says he has seen the real Morgan estimates, which are not given out to the public, declares that nearly 30 reservoirs are to be built in Miami County.

Do you know that every foot of land that drains into the Miami River can be taxed by this Act?

The directors of flood districts are to be paid $10,000 per year.

Government experts are against the dry reservoir plan.

Government engineers who were on the job before the Morgan people, say it would take a reservoir as big as Lake Erie to handle the water which swept through this valley last spring.
It was difficult to meet such willful misrepresentation. At first, attempts were made to reply to such statements, but it was found almost impossible to do this without aggravating the opposition to more bitter attacks. The best policy proved to be to ignore the willful misrepresentation but to give careful consideration to all conscientious opposition.

Numerous methods other than newspaper work were employed to disseminate correct information regarding the plans and the law. Public meetings were held in all the cities and towns affected, illustrated lectures being given to explain the plan in detail. Several large papier mache models of the proposed Germantown dam were made and exhibited in various cities. Persons who opposed the plans were urged to examine them, and every facility was offered for such inspection at the engineering office where an engineer was always available to explain them. The information bureau established at Columbus in January, 1915, to combat the proposed amendments to the conservancy act, was especially equipped for educational work of this kind. To counteract misleading statements attacking the law, circulated by the opposition, a 45-page booklet entitled The Truth about the Conservancy Law of Ohio was hurriedly but carefully prepared, and thousands of copies were distributed to those interested. This gave an explanation of the conservancy act and the effect thereon of the proposed amendments. Nearly 10,000 copies of the conservancy act giving the complete text, were distributed by the Flood Prevention Committee during the first three years after its passage. In September, 1914, the Committee published a printed report setting forth the legal, financial, and engineering status of the work, and sent out over 20,000 copies of this pamphlet to residents of the valley. Many other reports and pamphlets were published and freely distributed. The engineering journals were kept fully informed as to the engineering features.

The conscientious efforts to keep complete and exact information before the people gradually became appreciated throughout the valley and overcame such opposition as rested on misunderstanding or misinterpretation of the law or the plans. The policy of fair dealing adopted by the Flood Prevention Committee and by the directors and their engineers, finally won over all but the most unreasoning element of the opposition. Some of the most bitter antagonism, because of its unreasoning and offensive character, in the end proved of real benefit to the project.
CHAPTER IX.-CHRONOLOGY


Nov. 24, 1916, approval of the Official Plan.
July 30, 1917, approval of the appraisal record.
Sept. 15, 1917, advertisement forbids.
Dec. 10, 1917, sale of bonds.

A detailed chronology of events is given in the following pages:

CHRONOLOGY OF EVENTS DURING YEAR 1913

March 23-27—Disastrous floods in the Miami Valley.

March 27—Dayton Citizens' Relief Committee of five members appointed by Governor Hines M. Cox. Citizens' Relief Committee of Hamilton organized to raise funds for relief of flood sufferers.

April 15—Emergency Act passed by state legislature authorizing the mayor of any city to appoint an emergency commission. Emergency commission appointed at Hamilton, consisting of the following: S. M. Goodman, Hamilton; Chas. Mason, Hamilton; Ben Harwit, Middletown, and T. C. Simpson, Jiddletown.

April 21—Dayton Citizens' Relief Committee enlarged to thirty members, and following committees appointed:

Flood Prevention, generally known as the Dayton Flood Prevention Committee.
Finance.
Public Improvement.
Sanitation.
Traffic and Public Service.

Emergency Commission of Hamilton, cooperating with county commissioners of Butler County, engaged John W. Hill of Cincinnati to investigate the flood control problem in Butler County.

May 2—Dayton Flood Prevention and Finance Committee adopted resolution to raise $2,000,000 fund for flood control work.


May 10—Dayton invited other Miami Valley cities to cooperate in flood control work.

May 13—Surveys begun by Morgan Engineering Company.

May 15—Miami Valley Flood Prevention Association, representing five counties, organized at Dayton.

May 25—Raising of $2,000,000 voluntary fund by citizens of Dayton, completed.

May 29—Daniel W. Mead, of Madison, Wis., John W. Alvord, of Chicago, Ill., and Sherman M. Woodward, of Iowa City, Iowa, consulting engineers, held first meeting in Dayton.


August 7—Morgan Engineering Company and city engineer presented report to city council of Dayton, recommending repair and strengthening of levees, and removing of trees and brush from the river channel within the city for temporary protection of Dayton.

October 3—Morgan Engineering Company submitted preliminary report on various plans for flood control.

October 4—Public informed that Morgan Engineering Company recommended protection of Miami Valley by means of retarding basins combined with channel improvement and that legislation be enacted providing for the organization of conservancy districts.

October 20—2S—Consulting engineers met in Dayton.

October 25—Consulting engineers approved recommendation of Morgan Engineering Company regarding necessary legislation and recommended that additional study be given to methods of flood control before finally adopting a definite plan for the Miami Valley.

November 8—Dayton Flood Prevention Committee authorized drafting of conservancy bill.

November 13—John W. Hill submitted report to the county commissioners and Emergency Commission of Butler County, on flood conditions in Butler County.

November 28—Butler County delegation met Dayton Flood Prevention Committee at Dayton and examined plans for protection of entire valley.

December 9—Butler County Emergency Commission arranged with Dayton Flood Prevention Committee to include Butler County in plans for protection of Miami Valley from floods. Mass meeting at Hamilton addressed by E. A. Deeds, Arthur E. Morgan, and others.

December 19—Dayton Flood Prevention Committee visited Piqua and conferred with representative citizens on flood prevention plans.

CHRONOLOGY OF EVENTS DURING YEAR 1914

January 8—Conservancy bill reported to Dayton Flood Prevention Committee.
January 7—Mass meetings held at Troy and Piqua to explain flood control plans and conservancy bill.
January 10—Conservancy bill submitted to Governor Cox and Attorney General Hogan."

January 10—Greater Dayton Association held membership meeting at Memorial Hall. Arthur E. Morgan explained flood control plans with slides.

January 13—Mass Meeting held at Sidney to explain flood control plans and conservancy bill.

January 15—Miami Valley Flood Prevention Association and Dayton Citizens' Relief Commission held meeting and approved conservancy bill.

January 17—Consulting engineers held meeting in Dayton and made report approving plan of Morgan Engineering Company for retarding basins supplemented by channel improvements at cities.

January 19—Conservancy bill, House Bill No. 19, introduced in state legislature by Representative Victor Vonderheide, of Dayton.

January 20—Hearing on conservancy bill at Columbus before Judiciary Committee of House. Judge Horace S. Oakley, of Chicago, and others, spoke for the bill.

January 21—Judiciary Committee of House reported out conservancy bill, with recommendation for passage, but without emergency section.

January 21—Mass meeting held at Troy to explain conservancy bill and flood control plans.

January 22—House of representatives passed conservancy bill, 88 to 18. Emergency section defeated. Representative Quinlisk, of Shelby County, sought, unsuccessfully, to have construction of reservoirs eliminated. Several amendments were adopted: (1) Contract shall not be let to other than lowest bidder unless, upon a hearing before the Court, an order be obtained therefor. (Sec. 16); (2) Giving State the power to regulate rates for power, light, etc.; (j) Conservancy court shall consist of one common pleas judge from each county in a conservancy district.

January 23—Conservancy bill introduced in the Senate and referred to the Committee on Public Works.

January 24—Chamber of Commerce, Youngstown, Ohio, held meeting at which conservancy bill was explained.

January 25—Senate Committee on Public Works held hearing on conservancy bill.

February 2—Senate Committee on Public Works voted to recommend conservancy bill for passage.

February 2—Mass meeting held at Lebanon to explain flood control plans and conservancy bill.

February 3—Conservancy bill reported out by Senate Committee on Public Works.

February 4—Senate passed and amended conservancy bill, 29 to 1. Emergency section added in senate.

February 5—Senate amendments to conservancy bill concurred in by house of representatives. Emergency section defeated in house of representatives.

February 6—Emergency section reconsidered and passed by house of representatives, 85 to 16.

February 10—Conservancy bill signed by Governor James M. Cox and filed with Secretary of State.

February 13—Business Men's League in Franklin held meeting at which conservancy bill and flood control plans were explained.

February 17—Conservancy bill, signed by Governor James M. Cox and filed with Secretary of State.

February 20—Hearing on conservancy bill at Columbus before Judiciary Committee of House. Judge Horace S. Oakley, of Chicago, and others, spoke for the bill.

February 24—Conservancy court convened at Dayton. Judge Broderick of Logan County took over as presiding judge.

March 1—Special Board of Consulting Engineers made trip over reservoir sites by automobile from Piqua to Dayton.

March 3—Court of appeals decided conservancy act was constitutional, except in the preliminary tax clause.

March 4—Conservancy meeting held at Tippecanoe City to explain conservancy act and flood prevention plans.

March 5—Flood prevention supplement, entitled Facing Forward, issued by newspapers of valley.

March 9—Special Board of Consulting Engineers engaged.

March 15—Special Board of Consulting Engineers made trip over reservoir sites from Piqua to Dayton.

March 20—Conservancy court convened at Dayton to hear petition for establishment of Miami Conservancy District. Court composed of one common pleas judge from each county.

March 21—Court of appeals dismissed writ of prohibition, and ordered conservancy court to proceed. Conservancy court proceeded with hearing in Memorial Hall. Constitutional questions raised by counsel for opposition, and court adjourned to March 31.

March 31—Conservancy court convened at Dayton. Judge Broderick of Logan County took over as presiding judge. Decided to proceed with 9 judges.

Arguments heard on constitutionality of conservancy act for 3 days.

April 3—Conservancy court adjourned to consider case.

April 16—Conservancy court met for further hearing of case. Logan County judge still absent.

April 18—Conservancy court decided 5 to 4 in favor of constitutionality of conservancy act. Petition dismissed, as majority of 10 judges was necessary.

April 23—Petitioners filed bonds for appeal.

April 25—Court of appeals met and fixed May 7 for hearing.

May 7—Court of appeals met to hear arguments on appeal.

May 8—Court of appeals adjourned after hearing argument on constitutional questions.

May 14—Petition-in-error, entitled, City of Dayton and Others vs. County of Miami and Others, No. 65, filed in court of appeals.

May 27—Court of appeals decided case was appealable.
July 20—Delegation of objectors to Miami Conservancy District and conservancy act from upper Miami Valley interviewed Governor Cox, and urged him to bring matter before special session of legislature. Request not granted.

August 3—Petition-in-error, entitled, Snyder et al. vs. Deeds et al., Case 14,696, filed in supreme court by objectors.

August 7—Motion made by defendants to advance error case filed in supreme court August 3, 1914.

August 17-0. N. Floyd began a five weeks' trip to the Pacific Coast to examine methods of constructing earth dams.

September 16—Motion of defendants to advance case in supreme court sustained. November 2 set as time for briefs and final oral argument.

September 23—Dayton Flood Prevention Committee issued report to subscribers to Flood Prevention Fund.

November 12—Supreme court heard arguments on petition-in-error.

See August 3 and 7, and September 16.

December IS—Supreme court declared conservancy act constitutional and a proper emergency law; but found Sec. 6 unconstitutional, and reversed case 011 that account because it had not come up on error instead of appeal.

December 22—Court of appeals took under advisement a motion to dismiss petitions-in-error, see May 14, after hearing arguments.

**CHRONOLOGY OF EVENTS DURING YEAR 1915**

January 18—Court of appeals, sitting in Columbus, upheld right of petitioners for district to seek review of case on a petition-in-error.

January 20—House Bill No. 116, amending conservancy act, introduced in state legislature by Representative Quinlisk of Shelby County.

January 21—Senate Bill No. 38, amending conservancy act, introduced by Senator Garver of Miami County. Quinlisk Bill read second time by title and referred to Committee on Conservation of Natural Resources.

January 22—Court of appeals, sitting in Dayton, heard arguments on petition-in-error.

January 25—Garver Bill read second time and referred to Committee on Drainage and Irrigation.

January 27—Court of appeals upheld petition-in-error, and ordered conservancy court to proceed with hearing. Defendants in error ordered to pay the costs.

January 28—Dayton Flood Prevention Committee established headquarters at Hartman Hotel, Columbus, to combat proposed amendments to conservancy act.

January 28—Dayton Flood Prevention Committee explained situation to newspaper men in Columbus, with stereopticon views to illustrate plans.

February 2—Joint committee of legislature held meeting in Senate Chamber to hear proponents of Garver-Quinlisk Bills.

February 3—Joint committee of legislature held meeting in house of representatives to hear opponents of Garver-Quinlisk Bills.

February 9—Public hearing of both sides on Garver-Quinlisk Bills held in house of representatives before joint committee. E. A. Deeds and others spoke in support of the conservancy act. Large delegations from the Miami Valley presented petitions, urging preservation of law.

February 10—Petition against Garver-Quinlisk Bills presented to house of representatives, signed by Charles G. Wilson and 2,889 citizens of Dayton and vicinity. Similar petition presented signed by Peter G. Thompson and 16,400 citizens of Butler County.

February 13—Friendly suit filed in supreme court by Prosecuting Attorney R. P. Duncan, of Franklin County, to test constitutionality of preliminary tax clause of conservancy act.

February 18—Petitions-in-error filed in supreme court by objectors to proposed District; No. 14,834, County of Miami et al. vs. City of Dayton et al.

February 24—House Committee on Conservation held hearing on Quinlisk Bill.

March 1—Senator Garver made bitter speech in senate against conservancy act and the campaign to preserve it.

March 2—Senator Lloyd moved that Senate Bill No. 38, Garver Bill, be taken from Committee on Drainage and Irrigation, complaining of dilatory tactics of the committee. Upon motion of Senator McDermott, further consideration of Senator Lloyd's motion postponed until 2:00 p. m. next day;.

March 3—Senator Lloyd withdrew motion to take Garver Bill from committee by agreement; and Senator White, Chairman of Committee, reported out Garver Bill with recommendation for passage. On motion of Senator Garver, rules suspended, and bill made special order for March 10, at 2 p. m.

March 10—Senate Bill No. 38, upon motion of Senator Garver, its author, indefinitely postponed.

March 13—Counsel for Dayton Flood Prevention Committee filed motion to advance Case No. 14,834 in supreme court, see February 18.

March 17—House Committee on Conservation held meeting. Representative Quinlisk offered substitute for his original bill, to amend conservancy act only as to election of directors and option to take easement or fee. Quinlisk's motion to report his substitute out was lost. Representative Stokes moved for new hearing March 23. Motion carried.

March 18—Supreme court advanced case, see Feb. 18, after hearing argument by counsel for Dayton Flood Prevention Committee. Court ordered all briefs in by April 24, on account of illness of John A. McMahon. Case set for oral argument May 28.

March 22—Attorney General E. C. Turner gave opinion to legislature that emergency laws must receive a two-thirds vote of all members.

March 23—House Committee on Conservation held hearing on amendments to conservancy act.

March 25—Court of common pleas of Lucas County rendered opinion that conservancy act was valid and properly passed.

March 26—Directors of Franklin County Conservancy District and Dayton Flood Prevention Committee, through Prosecuting Attorney R. P. Duncan, of Franklin County, asked supreme court to amend the pending quo warranto proceedings to include the question of the validity of the conservancy act.

April 5—House Committee on Conservation reported out Quinlisk's original bill, without recommendation. Report agreed to, bill ordered engrossed, and read third time in regular order. This bill never came to a vote in the house of representatives.

April 6—Senate Bill No. 262 introduced by Senator Garver and read first time. It proposed to amend the conservancy act by having one director elected from that part of each county, within the district; and by giving property owners option to say whether they would sell easement or fee.

April 6—Senate Bill No. 262 read second time. Referred to Committee on Judiciary. Motion to refer to Committee on Drainage and Irrigation
April 7—Opponents to proposed district filed petition at Troy for formation of Western Ohio Conservancy District which included all lands draining into the Miami River in 13 counties.

April 13-Senate Bill No. 262 reported back from Judiciary Committee without recommendation. Ordered engrossed and read third time in regular order. On motion Senator Garver made special order for 2:30 p.m. April 21.

April 17-Petition for organization of Western Ohio Conservancy District advertised in Troy Record. Hearing set for June 1, 1915, but later postponed to June 22, to await supreme court decision.

April 21-Senate Bill No. 262 came up at 4:56 p.m. Read for third time. Bill lost 23 to 8. Motion to reconsider tabled.

May 28—Case involving the validity of the conservancy act submitted to supreme court without oral argument, see March 26.

June 4—Supreme court declared conservancy act constitutional and a proper emergency measure. Entire law upheld, except Sec. 6 as to appeal.

June 11—Dayton Flood Prevention Committee made a public report of progress to the Dayton Citizens' Relief Commission.

June 14—Petitioners for Miami Conservancy District filed petition in Dayton asking for elimination of Logan County and part of Shelby County from original district.

June 22—Common Pleas Judges from 13 counties included in Western Ohio Conservancy District convened in Troy, heard arguments and dismissed petition.

June 22—Counsel for opponents of Miami Conservancy District at once filed motion at Dayton to add Champaign, Auglaize, and Darke Counties to Miami Conservancy District.

June 24—Conservancy Court of 10 judges met in Dayton. Motion to extend boundary overruled. Elimination of Logan County allowed, and Logan County judge ceased to be member of court. Hearing concluded on afternoon of June 25, court adjourned to June 28.


July 7—Directors of district appointed Ezra M. Kuhns, secretary; Oren B. Brown, attorney; John A. McMahon, counsel, and Arthur E. Morgan, chief engineer of The Miami Conservancy District.

July 7—E. A. Deeds announced that he would donate permanent home for the office of the district.

July 24—Professor Daniel IV. Mead appointed acting chief engineer on account of illness of Arthur E. Morgan.

August 4—Board of appraisers appointed by conservancy court as follows: J. Edward Sauer, Samuel M. Goodman, and Charles W. Kiser.

August 6—Public informed that Upper Mad Reservoir would be omitted, Huffman Dam raised, and Village of Osborn bought outright by the district.

August 7—Contract let for constructing of Conservancy Building.

August 10—Petition-in-error filed, Case No. 115, County of Miami et al. vs. Edward Deeds et al. questioning legality of eliminating Logan County.

August 12—Ground broken for Conservancy Building.

August 30—General H. M. Chittenden arrived in Dayton to go over flood control plans.

September 25—Arthur E. Morgan returned to work after long illness.

December 18—Motion filed by directors of the district in court of appeals to dismiss error proceedings taken by objectors to establishment of district, see August 10, 1915.

December 20—Court of appeals, meeting in Dayton, heard arguments on motion of directors to dismiss the error proceedings taken by the objectors to the establishment of the district, Judges Ferneding, Alread, and Kunkle on bench, see December 18, 1915.

March 13—Mass meeting held at Tippecanoe City to discuss plans of the district. John W. Hill employed as engineer.

March 18—Mass meeting held at Tippecanoe City at which resolutions were adopted objecting to plans of the district.

March 17—Middletown City Commission appointed a citizens' committee of seven men to investigate plans of the district as follows: G. M. Verity, D. Eppelsheimer, Harry Duane, C. T. Thompson, Robert Kaser, V. C. Hatfield, and B. F. Harwitz.

March 12—Mass meeting held at Tippecanoe City at which V. L. Silvey spoke in opposition to the plans of the district.

March 20—Piqua City Council adopted resolution objecting to plans of the district.

March 21—Troy City Council defeated resolution objecting to plans of the district.

March 23—Miami County Commissioners adopted resolutions objecting to plans of the district.

March 25—Shelby County Commissioners filed objections against the plans of the district.

March 29—Petition-in-error, Case No. 115, argued before 5th Circuit Court of Appeals, and submitted. Judges Shields, Powell and Houck on bench, see August 10, 1915.

April 8—Mass meeting held at Piqua by anti-conservancy citizens. Attendance small.

April 10—Formal hearing to consider objections to the proposed flood control plan begun at Conservancy Building by the directors.

April 13—Mass meeting held at Piqua by anti-conservancy citizens. Dr. Gainor Jennings of West Milton presided. John W. Hill, engineer; Mayor E. M. Bell, Percy R. Taylor, Dr. Van S. Deaton, Martin Quinlisk, Frank M. Sterrett, and others spoke.

April 13—Tippecanoe City delegation heard by the directors.

April 17—Piqua delegation of over thirty business men endorsed the proposed flood control plan after discussing matter for a large part of the day with the directors.
CHRONOLOGY OF EVENTS DURING YEAR 1916

January 1-Conservancy Building opened for inspection.

January 2-Miami River reached 14-foot stage at Dayton.

January 7-District offices moved from City National Bank Building into Conservancy Building.

January 21-Court of appeals overruled motion of directors to dismiss error proceedings taken by objectors to establishment of district, see December 18 and 20, 1915.

January 31-Miami River reached 14.8-foot stage at Dayton.

February 2-Miami River reached 14-foot stage at Dayton.


February 17-Professor Louis Mitchell, of Syracuse University, reported to Mayor and Council of Tippecanoe City on plans of the district affecting Tippecanoe City. Only minor changes were recommended.

February 23—Court of appeals granted request of objectors to Miami Conservancy District for transfer of error proceedings to judges of another district for determination. Case assigned to Fifth District Court, Judges Shields, Powell, and Houck.


February 29-Delegation of about sixty citizens from Franklin, including village and township officials, came to Dayton to examine flood control plans. Officials of the district explained the proposed work.

February 29-Directors of the district entertained newspaper men of Miami Valley at Miami Hotel, Dayton, and explained chief engineer's plan and arrangements for publication.

March 1-Filing of completed plan advertised in newspapers of all counties in the district.

March 2-Report of chief engineer fully described in newspapers of the valley.

July 17-Prosecuting attorneys of Miami, Shelby and Clark Counties, and more than 500 objectors, filed motion with supreme court to set aside the decision of the court of appeals, see April 29, 1916.

July 20-Rainfall at Hamilton was 2.95 inches in an hour.

August 16-John W. Hill submitted report to the Commissioners of Miami, Shelby, and Clark Counties on Flood Protection in the Great Miami Valley.

September 29-Chief Justice Nichols of the supreme court held hearing in Dayton on affidavit charging Judge Mathers of Shelby County with prejudice and bias. Judge Mathers was permitted to remain on the conservancy court.

October 3-Conservancy court began hearing on objections to official plan.

October 4-6-Conservancy court, in special session, postponed the hearing on the objections to the official plan from June 19 to October 3, 1916.

October 30-The Ohio Valley Flood Board, composed of a Board of Officers of the Corps of Engineers of the U. S. Army, submitted to the Chief of Engineers, U. S. Army, a Report on Preliminary Examination of Miami River, Ohio. This report was submitted by the Chief of Engineers to the Secretary of War and by him transmitted to Congress.

November 24-Conservancy court approved official plan by almost unanimous vote.

November 25-Rip-Rap Sub-District organized.

November 28-Application filed application with the County Clerk for rehearing on the official plan.

November 28-Supreme court refused to review the decision of the court of appeals, thereby approving the elimination of Logan County from the district, see April 29 and July 17, 1916.

November 28-Opposition filed application with the County Clerk for rehearing the official plan.

CHRONOLOGY OF EVENTS DURING YEAR 1917

January 11-Motion for rehearing official plan overruled by conservancy court, see November 28, 1916.

February 21-Citizens of Hamilton, through their Chamber of Commerce, gave large testimonial dinner in honor of the citizens of Dayton as an expression of appreciation of the services of the Dayton Flood Prevention Committee.

March-Bills introduced before the house of representatives with the purpose of repealing or seriously modifying the conservancy act failed to receive favorable action.

May 9-Appraisal roll filed with the conservancy court and in the county offices of each county in the district.

June 13-Louis N. 01'1' filed suit in the United States District Court against the directors of the district to enjoin them from borrowing money on warrants and from levying assessments upon his real estate near Piqua.

June 14-Judge Hollister, of the United States District Court at Cincinnati, refused to grant temporary injunction to Louis N. Orr.

June 18-Conservancy court convened to consider appraisal roll. Personnel of court: Judge C. H. Kyle, Greene County, presiding; Clarence Murphy, Butler County; Walter D. Jones, Miami County; Frank W. Geiger, Clark County; E. T. Snediker. Montgomery County; Willard Jurey, Wright, Warren County; Otway J. Cosgrave, Hamilton County; J. D. Barnes, Shelby County; and A. C. Risinger, Preble County. A docket was arranged for hearing objections by counties.

July 19-Court of appeals, Judges Powell, Kunkle, and Alread, affirmed decision of conservancy court on official plan on error proceedings instituted by 1. C. Koehne.

July 30-Conservancy court filed final entry on exceptions and decree approving appraisal roll.
August 10—United States District Court, Judges Warrington, Cochran, and Hollister, upheld constitutionality of Conservancy Act of the State of Ohio and denied application of Louis N. Orr for injunction to prevent assessments.

September 1—Directors of the district levied assessment on property in the district, amounting to $27,804,480.64, and advised property owners, by advertising, that assessments could be paid before October 5, 1917, thereby saving interest charges. Assessment duplicate was placed on file at the office of the district and the parts for the various counties were filed at the respective county offices.

September 13—District began advertising in the leading engineering and contracting journals that bids would be received on November 15, 1917, on twelve contracts, covering the five dams and the channel improvement work in Dayton and Hamilton, amounting to about $10,000,000.

October 9—Brigadier General Hiram M. Chittenden, consulting engineer for the District, died at Seattle, Washington.

November 4—Contract for construction work on temporary relocation of Ohio Electric Railway at Huffman damsite awarded to M. C. Connors and Company of Chicago. Construction began a few days after award was made.

November 15—Bids, on the unit price basis, on the twelve contracts covering the five dams and channel improvements at Dayton and Hamilton, received. Practically all of the bids were conditioned and in every case exceeded the engineer's estimate due to war conditions.

December 3—Contract 41, Miami River channel improvements above Island Park dam, Dayton, awarded to Williams Northern Dredging Company of Chicago. All other bids rejected by the directors.

December 7—Directors decide to handle construction work, except Contract 41, by force account.

December 8—Secretary of Treasury Wm. G. McAdoo stated that he could see no reason for objecting to the bond issue of the district.

December 3—National City Company of New York City and other companies underwrite $15,000,000 bonds.

December 10—Conservancy bonds for the amount of $15,000,000 placed on the market.

December 18—Case 15,779, Supreme Court, Ira Chase Koehne vs. The Miami Conservancy District. Motion to dispose with printing record overruled and case dismissed.

December 21—Case 20,348, Miami Common Pleas Court, Jos. S. Blevins, Plaintiff, vs. The Miami Conservancy District, et al., defendants. Demurrer to petition sustained. Decision rendered holding that the conservancy law is valid law, under the decision of the supreme court, and that it was, for any person to question its validity in the courts of this state.

CHRONOLOGY OF EVENTS DURING YEAR 1918

February 19—Case 15,686, Ira Chase Koehne vs. City of Dayton, SuCourt. Court held that the Great Miami River is not a navigable river. Supreme Court sustained the motion of the district to adhe case of On Ys. Allen, et al, and assigned same for October 8, ently changing the date to October 14, for oral argument.