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U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS
Lyman J. Briggs,
Director.



# CURRENT HYDRAULIC LABORATORY RESEARCH IN THE UNITED STATES.

BULLETIN NO. III-2
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WASHINGTON.

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DIRECTORY

CURRENT HYDRAULIC LABORATORY RESEARCH
IN THE UNITED STATES.

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Volume III, Number 2. July 1, 1935.

## INTRODUCTION.

The numerous requests that have been received for the various issues of this bulletin make it desirable to furnish the following list which includes all issues of the bulletin up to the present time.

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| Bulletin I-1, | April 1, 1933. | |
| " I-2, | July 1, 1933. | |
| " I-3, | October 1, 1933. | |
| " II-1, | January 1, 1934, | Out of print. |
| " II-2, | July 1, 1934. | " " " |
| " III-1, | January 1, 1935. | |

Description of hydraulic laboratories, July 1, 1933.

A number of foreign papers on hydraulic and hydrologic subjects have been received and are in the files of the Hydraulic Laboratory Section of the National Bureau of Standards. A list of these accessions, since January 1, 1935, is given in this bulletin. The papers will be loaned upon request.

A revision of the bulletin, "Hydraulic Laboratories in the United States", containing a description of the various hydraulic laboratories in this country, is planned for August, 1935. Information for inclusion in this revised bulletin will be accepted up to August 1, 1935. Please use the following form in preparing information:

1. Name of laboratory;
2. Year established;
3. Kinds of work for which the laboratory is especially fitted;
4. Head and quantity of water available for tests;
    (a) By gravity,
    (b) By pumping,
5. Principal pieces of equipment, with brief notes on size, capacity, precision or other features of interest;
6. Very unusual equipment, or facilities, if any;
7. Possibilities for work, for or by outside persons or companies, and terms therefor;
8. Distance from railroad station or siding;
9. Name and title of person in charge of laboratory;
10. Number of persons on regular staff;
11. Brief general description of laboratory;
12. Reference to published descriptions of laboratory.

It is not possible to include drawings in the bulletin.

Your attention is called to the fact that as a rule the Hydraulic Laboratory Section of the National Bureau of Standards does not have detailed information or copies of publications relating to the projects listed in these bulletins. For information always apply to the "Correspondent" whose name is listed under paragraph (e) for each project.

## CURRENT PROJECTS IN HYDRAULIC LABORATORIES.

(Key)

(a) Title of project:
(b) Project conducted for:
(c) Conducted as:
(d) Investigators:
(e) Correspondent:
(f) Purpose:
(g) Method and scope:
(h) Progress:
(i) Remarks:

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### BALDWIN-SOUTHWARK CORPORATION.

(351) (a) INVESTIGATION OF CURRENT METER BEHAVIOR IN TURBULENT FLOWING WATER.

(b) I. P. Morris Division, Baldwin-Southwark Corporation and S. Morgan Smith Company, jointly.

(c) Research.

(d) The work was conducted by the I. P. Morris Division of the Baldwin-Southwark Corporation under the direction of S.Logan Kerr, Research Engineer, with the co-operation of the S.Morgan Smith Company and the Safe Harbor Water Power Corporation.

(e) S. Logan Kerr, Baldwin-Southwark Corporation.

(f) Project conducted to investigate the effect of different degrees of turbulence on the behavior of the meter when compared to its still water rating.

(g) A 15" x 30" rectangular closed flume was used with two current meters under various degrees of turbulence with the flow measured by a calibrated weir. Pitot tube measurements were made in advance of the current meter measurements to establish the flow distribution. The pitot tube was rated under equivalent conditions of flow and checked against the discharge of the calibrated weir.

(h) Project completed and detail discussion presented in paper entitled "Research Investigation Current Meter Behavior in Turbulent Flowing Water" by S. Logan Kerr, A.S.M.E. Annual Meeting, December, 1933.

(i) General results of investigation indicate that for the conditions existing in the laboratory, the current meters showed a tendency to over-register by varying amounts, depending upon the turbulence present. It is recommended that further investigations be made under similar conditions to increase the amount of information available on the behavior of current meters in flowing water as compared to still water rating.

(352)(a) EFFICIENCY AND HORSEPOWER TESTS - BEAUHARNOIS MODEL TURBINE.
(b) Dominion Engineering Works, Ltd., Montreal.
(c) Commercial research.
(d) S. Logan Kerr, Research Engineer.
(e) S. Logan Kerr, Research Engineer.
(f) To investigate the effect of variation in runner and guide vane design in the 53,000 HP units for the Beauharnois Development.
(g) An exact scale model of the intake, casing, turbine and draft tube was made and various types of guide vanes, runners and other parts tested. The original series of tests were made in the flume of the Holyoke Water Power Co., Holyoke, Mass. and check tests were made in the same equipment in the Alden Hydraulic Laboratory, Worcester Polytechnic Institute. The second series of tests was made in the I. P. Morris laboratory at Eddystone, Pa. The second series comprised 40 or 50 complete tests with alterations made to runners and guide vanes to study the effect of these changes. Special paint tests were developed to show the flow characteristics on the turbine runner to obtain visual records of the effect of runner alterations.
(h) Final group of tests now in progress.
(i) Data secured on this investigation being used for the improved performance of the additional units to be installed in Beauharnois Development.

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(353)(a) IMPROVEMENT IN APPROACH CHANNEL FOR WEIR.
(b) I. P. Morris Division.
(c) General research.
(d) S. Logan Kerr, Research Engineer.
(e) S. Logan Kerr, Research Engineer.
(f) To improve the performance of the overall efficiency tests by elimination of variations in discharge characteristics.
(g) Standard propeller type turbine was installed in the flume and its characteristics established with the existing weir channel. The existing wooden racks were replaced by special corrugated racks and the loss in head measured. Float tests were made in the weir channel and check tests on turbine characteristics used as a basis for establishing the behavior of the weir.
(h) Completed.
(i) Results of investigation show that wooden racks in approach channel of the weir cause variations in weir discharge due to warping and distortion of the rack elements. The use of corrugated galvanized steel racks of special form produce the loss of head necessary to secure uniform distribution of flow and repeated tests indicate that the weir calibration remains constant within 0.1% with this equipment.

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(354)(a) EFFICIENCY AND HORSEPOWER TESTS - WHEELER DAM UNIT.
(b) Tennessee Valley Authority.
(c) Research preparatory to final design and manufacture and guarantee tests.
(d) S. Logan Kerr, Research Engineer.
(e) S. Logan Kerr, Research Engineer.
(f) Investigations to establish the design of the final propeller type unit to be installed at Wheeler Dam rated at 45,000 HP under 48' head at 85.6 RPM. The nature of this project requires that the highest efficiency be obtained and that the point of best efficiency occur at the correct discharge. The arrangement of the installation at Wheeler Dam makes it extremely difficult to conduct accurate performance tests in the field. The guarantee tests are, therefore, being conducted in the experimental laboratory to establish the performance of the main unit in the field.
(g) An exact model has been made of the complete hydraulic installation including intake, racks, piers, casing, turbine and draft tube. Complete characteristic curves for full range of gate openings, speed and head conditions were made on each model runner tested, blade setting of model runner adjusted to give correct characteristics.
(h) Tests are in progress.

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(355)(a) EFFICIENCY AND HORSEPOWER TESTS - FRANCIS TURBINE.
(b) Loup River Public Power District, Columbus Development.
(c) Research preparatory to final design and manufacture.
(d) S. Logan Kerr, Research Engineer.
(e) S. Logan Kerr, Research Engineer.
(f) Determination of correct design of complete turbine, draft tube to secure the best performance including the design and position of the baffle in the turbine draft tube.
(g) Exact model was made of the turbine and draft tube and tested as an open flume unit with various Francis Runner designs, and with different positions of the draft tube baffle.
(h) Tests in progress.

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CALIFORNIA INSTITUTE OF TECHNOLOGY.

(102)(a) INVESTIGATION OF VELOCITY DISTRIBUTION IN THE VOLUTE OF A CENTRIFUGAL PUMP IN THE NEIGHBORHOOD OF THE IMPELLER.
(b) Laboratory problem.
(c) General research for thesis for M.S. degree.
(d) R. C. Binder.
(e) Professor R. L. Daugherty, or Professor Robert T. Knapp.
(f) By a special instrument the magnitude and direction of the velocity of the water is measured at a number of points within the volute, thus supplying experimental information that has long been desired.

(g) The scope of this research has been enlarged to include the determination of the magnitude and direction of the instantaneous velocities as well as the average values. For this purpose a precision dual slide valve has been constructed which together with a phase shifting device permits of the measurement of the instantaneous values at any desired position of the impeller. To date the apparatus has been successfully operated over 2000 rpm.
(h) Continued. A preliminary report has been presented by Mr. R. C. Binder and information concerning it can be obtained from him or from Professor Knapp.

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(267)(a) A STUDY OF THE BALLONA CREEK OUTLET.
(b) The Los Angeles County Flood Control District.
(c) Model study to solve a particular problem.
(d) Professor Robert T. Knapp with Vito A. Vanoni and Warren E. Wilson as assistants.
(e) Professor Robert T. Knapp and Professor R. L. Daugherty.
(f) To determine the most advantageous construction of the new flood control channel of the Ballona Creek to discharge into the Pacific Ocean, together with the length and form of jetties if any prove necessary.
(g) Model is being constructed in the basin used for Project 100. The general technique is to be the same as for the older project. An automatic tide machine has been constructed to facilitate operations. Since the basin is too large to permit the use of a variable displacement plunger, the tides are produced by regulating inflow and outflow. A plunger type wave machine has also been constructed the full width of the model; i.e. 40 ft. and provided with mechanism for varying both the amplitude and the frequency of the waves. It is also possible to change the angle of the machine with the coast and thus produce waves of any desired degree of inclination.
(h) Has been completed and a report presented to the Los Angeles County Flood Control District.

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(356)(a) STUDY OF CHARACTERISTICS OF HIGH HEAD CENTRIFUGAL PUMPS.
(b) Metropolitan Water District of Southern California.
(c) Large scale model study.
(d) Professors Th. von Kármán, R. L. Daugherty, and Robert T. Knapp for the California Institute of Technology, Mr. R. M. Peabody for the Metropolitan Water District, plus staff of assistants.
(e) Same as (d)
(f) To determine the most advantageous types, speeds and operating conditions of the large centrifugal pumps to be used on the Colorado River Aqueduct.
(g) Details of laboratory equipment will be furnished for the revised edition of the bulletin, "Hydraulic Laboratories in the United States", which will be issued shortly by the National Bureau of Standards.
(h) Laboratory was placed in operation September, 1934. To date, five pumps of varying types and specific speeds have undergone exhaustive tests.

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(357)(a) INVESTIGATION OF HIGH VELOCITY FLOW AROUND BENDS IN OPEN CHANNELS.
(b) Los Angeles County Flood Control District.
(c) Cooperative study with Los Angeles County Flood Control District through C. H. Howell, Chief Engineer.
(d) Professor Robert T. Knapp, with Arthur Ippen and Warren E. Wilson, assistants.
(e) Professor Robert T. Knapp.
(f) To determine the most advantageous construction for curved channels with flow velocities above the critical, such as encountered in flood control channels from foothill areas.
(g) A special high velocity flume is being constructed for this work. Experiments will be conducted in channels of various cross sections and radii of curvature with grades up to 12% and rates of flow up to 5 cu. ft. per sec.
(h) Apparatus under construction. Experimental work will be under way in July.

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(358)(a) A STUDY OF SURGE WAVE PROPAGATION AND TRAVEL IN CHANNELS OF STEEP GRADIENT.
(b),(c),(d) and (e) Same as for Project (357).
(f) One type of steady flow in channels of steep gradient is as a series of surge waves. This may be the determining factor in the necessary free board on open channels. This experiment is for the purpose of further investigating conditions under which such flow takes place and the height and wave length of the waves produced.
(g) Equipment and apparatus used for Project 357 will be modified for this study. In this investigation it is planned to employ "slow motion" moving pictures as an aid to the study of the velocity and change of shape of the waves.
(h) Methods and apparatus are now being developed. Experimental work probably will be started in September.

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(359)(a) STUDY OF THE SPEED OF PROPAGATION OF FLOOD HYDROGRAPHS IN CHANNELS OF VARIOUS GRADIENTS.
(b),(c),(d) and (e) Same as for Project (357).
(f) A knowledge of the rate of travel of flood flows is necessary for the rational design of flood control systems. In some cases of high velocity channels further information would be valuable. This project is for the purpose of further investigation of this subject.
(g) Equipment and methods used in Project (358) will also be employed for this study, supplemented by auxiliary apparatus for the production of desired flood hydrographs.

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(360)(a) FUNDAMENTAL INVESTIGATIONS OF THE HYDRAULIC PHENOMENA INVOLVED IN SOIL EROSION.
(b)
(c) Cooperative research program with Soil Conservation Service, Mr. H. H. Bennett, Chief, U. S. Department of Agriculture.
(e) Professors Th. von Kármán and Robert T. Knapp.
(i) This program is just being initiated and therefore is not yet in the state where it can be separated into specific projects. The

following are some of the subjects to be included in the program:

(1) The influence of suspended load upon flow characteristics of streams.
(2) Variation of vertical distribution of suspended load.
(3) Bed load studies.
(4) Rate of wear of debris in relation to distance and velocity of stream transportation.
(5) Model studies of individual structures and erosion problems.
(6) Arroyo formation and abatement.

These will be outlined as individual projects in the next bulletin. The program will be under the direction of Dr. W. C. Lowdermilk and Mr. H. M. Eakin for the Soil Conservation Service and Professors Th. von Kármán and Robert T. Knapp for the California Institute of Technology.

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UNIVERSITY OF CALIFORNIA. College of Engineering and U.S. Tidal Model Laboratory.

(16) (a) EFFECT OF EVAPORATION FROM STANDARD PANS DUE TO CHARACTER OF SURFACE OF PAN.
(c) Laboratory project.
(d) Sharpley.
(e) Professor M. P. O'Brien.

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(17)(a) TRANSPORTATION OF BED LOAD BY STREAMS.
(c) Laboratory project.
(d) Lieut. Hoeffer.
(e) Professor M. P. O'Brien.
(g) Studies to be continued in a tilting flume 3 feet wide and 18 inches deep.
(h) Report is being written.

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(172)(a) HYDRAULIC JUMP.
(c) Laboratory project.
(d) Rindlaub.
(e) Professor J. N. LeConte.
(g) Experiments on the hydraulic jump in a sloping channel.
(h) Experimental work in progress.

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(269)(a) PROPELLER PUMPS.
(c) Laboratory project.
(d) Miller and Folsom.
(e) Professor M. P. O'Brien.
(h) Theory developed by O'Brien and Folsom is being extended to computation of characteristics of propeller fans.

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(273)(a) EFFECT OF VISCOSITY ON WEIR DISCHARGE.
(c) Laboratory project.
(d) Carson.
(e) Professor M.P.O'Brien.
(g) Tests will be made on triangular weirs using oils of different viscosities.
(h) Experimental work in progress.

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(274)(a) SURFACE PROFILES NEAR INLET TRANSITIONS.
(c) Undergraduate thesis.
(d) Douma and Tarr.
(e) Professor M. P. O'Brien.
(f) To analyze the draw-down curve at transition from canal to flume.
(g) Models of actual field installations will be constructed. Surface profiles and velocity distributions are to be carefully measured.
(h) Project completed; summary in this Bulletin.

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(275)(a) CAPILLARY RISE IN MANOMETERS.
(c) Laboratory project.
(d) Folsom.
(e) Professor M. P. O'Brien.
(g) Theoretical investigations and laboratory tests.
(h) Project completed; summary in this Bulletin.

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(276)(a) DISCHARGE COEFFICIENTS OF SHARP-CRESTED WEIRS, IRREGULAR IN PLAN.
(c) Undergraduate thesis.
(d) Gray.
(e) Professor M. P. O'Brien.
(g) Laboratory tests on weirs with straight, curved and broken crest traces to determine effect on coefficient of discharge.
(h) Thesis completed in May.
(i) Summary of Peters and Watters in this Bulletin.

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(277)(a) CONTRACTION WORKS IN RIVERS.
(c) Graduate thesis.
(d) Lieut. Jones.
(e) Professor M. P. O'Brien.
(f) To determine the effect of contractions in streams with movable bottoms on the scour and the surface slope.
(g) Laboratory tests.
(h) Project completed; summary in this bulletin.

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(278)(a) CHARACTERISTICS OF DISC-FRICTION PUMPS.
(c) Laboratory project.
(d) Folsom.
(e) Professor M. P. O'Brien.
(f) To develop a theory of the performance of the turbulence type of ~~pumps~~ pump.
(g) Tests of Westco and Burke type of pumps.
(h) Experimental work in progress.

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(279)(a) SCOUR BELOW DAMS.
(c) Graduate thesis.
(d) Lieut. Bengtson.
(e) Professor M. P. O'Brien.
(g) Study of scour below scale models of Moulton, Tisdale and Fremont weirs of Sacramento River flood control system.
(h) Project completed; summary in this Bulletin.

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(280)(a) ORIFICES FOR MEASURING DISCHARGE AT END OF PIPE LINE.
(c) Laboratory project.
(d) O'Brien and Folsom.
(e) Professor M. P. O'Brien.
(f) To standardize a set of orifice plates for field measurement of pump discharge. Design is a modification of the International Standard Orifice.
(h) First series of tests completed and partial report prepared.

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(281)(a) MODEL OF ESTUARY OF COLUMBIA RIVER.
(b) Corps of Engineers, U.S.A.
(d) M. P. O'Brien, B. D. Rindlaub.
(e) Lieut.B. D. Rindlaub.
(f) To investigate channel regulation in the Columbia River estuary.
(g) Investigations are being undertaken on movable and fixed bed models with horizontal scale of 1:3600 and vertical scales of 1:64 and 1:128. Tides and waves are being reproduced.
(h) Experimental work in progress.

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(282)(a) TRANSPORTATION OF SAND THROUGH PIPE LINES.
(b) Corps of Engineers, U.S.A.
(d) M. P. O'Brien, B. D. Rindlaub.
(e) Lieut. B. D. Rindlaub.
(f) To determine the relative power required to move five different river and harbor sands through dredge pipes.
(g) Laboratory tests made by pumping sand and water through 2-inch pipe.
(h) Tests completed and report is being written.

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(283)(a) FRICTION COEFFICIENT OF FLAT PLATES ON SAND UNDER WATER.
(b) Corps of Engineers, U.S.A.
(d) M. P. O'Brien, B. D. Rindlaub.
(e) Lieut. B. D. Rindlaub.
(f) To determine the coefficient of friction of flat metal surfaces resting on sandy bottoms. (Drag-head of a suction dredge).
(g) Laboratory tests.
(h) Project in progress.

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(372)(a) SAVONIUS ROTOR.
(c) Student experiment.
(d) Folsom, Everett, Mange and Stoker.
(e) Professor M. P. O'Brien.
(f) To compare the performance characteristics of straight-bladed rotors with the Savonius Rotor and the effect of shielding.
(g) Models were tested in an open water channel.
(h) Experimental work completed.
(i) Summary in this Bulletin.

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(373)(a) BANKI TURBINE.
(c) Student experiment.
(d) Professor M. P. O'Brien, Dawson and Rued.
(e) Professor M. P. O'Brien.

(f) To investigate the performance characteristics of the Banki turbine.
(h) Experimental work completed.
(i) A model Banki turbine 1 foot in diameter, 4 inches long and with 14 blades was tested. The maximum efficiency of the rotor was about 62%. The affinity relations were applied, and they checked quite well with the experimental results. The study also included considerations and suggestions with regard to design.

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(374)(a) HYDRAULIC RAM.
(c) Student experiment.
(d) Professor M. P. O'Brien, Soomil and Work.
(e) Professor M. P. O'Brien.
(f) To determine the performance characteristics of a Rife hydraulic ram, and to compare the results with the theory.
(h) First series of tests completed.

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(375)(a) SILTING OF LOG POND AT LONGVIEW, COLUMBIA RIVER.
(b) Weyerhaeuser Lumber Co.
(c) Commercial study.
(d) Professor M. P. O'Brien, Folsom, Everett and Stoker.
(e) Professor M. P. O'Brien.
(f) To investigate means of reducing silting.
(h) Experimental work under way.

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(376)(a) DISTRIBUTION OF SILT IN OPEN CHANNELS .
(c) Graduate thesis.
(d) J. E. Christiansen.
(e) Professor M. P. O'Brien.
(f) To compare the theory of distribution of silt in open channels with observed silt distribution from published data.
(h) Paper presented at 16th Ann. Meeting Am. Geoph. Union. Washington, April, 1935. Thesis available for loan from University of California.
(i) Summary in this Bulletin.

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CARNEGIE INSTITUTE OF TECHNOLOGY.

(243)(a) MODEL STUDY OF SPILLWAY ACTION AT PROPOSED DAM ON TYGART RIVER AT GRAFTON, W. VA.
(b) U. S. War Department.
(c) Laboratory investigation on a model dam.
(d) E. P. Schuleen and H. A. Thomas.
(e) Prof. H. A. Thomas.
(f) Improvement of design of structure for river regulation and flood control.
(g) Model studies of energy dissipation of discharge from flood gates, to obtain best design for deflecting apron at foot of this spillway and similar spillways.
(h) Tests are still in progress, and comprise detailed studies of the design of cushion pools and notched spillway aprons for dissipation of the energy of spillway and conduit discharge.

Since the publication of the previous report on these tests, a separate 1:24 scale model of three outlet conduits has been built to study the best design for metal-covered deflectors to spread the conduit discharge over the surface of the cushion pool.

(i) Height of free fall in prototype is 215 feet. Investigation includes study of the effects of large conduits discharging through dam near toe of spillway.

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(244)(a) MODEL STUDY TO DETERMINE METHODS OF CONTROLLING CURRENTS IN ALLEGHENY RIVER NEAR PROPOSED LOCK AND DAM NO. 9, NEAR EAST BRADY, PA.

(b) U.S.War Department.

(c) Laboratory investigation on a river model.

(d) E. P. Schuleen and H. A. Thomas.

(e) Prof. H. A. Thomas.

(f) Improvement of river navigation.

(g) Investigation will study effect of various structures and dredging operation intended to control the direction and strength of the river currents in the vicinity of the proposed lock.

(h) Tests are still in progress and comprise studies of the directions and velocities of currents in the vicinity of the lock entrances, and of the effect of these currents on model barges entering the lock.

Since the publication of the previous report on these tests, separate larger-scale models of portions of this dam have been built to study the best design for the abutment and for the spillway apron.

(i) This is a fixed-bed model having a natural scale of 1:180.

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(284)(a) CONSTRUCTION OF A MODEL OF THE ALLEGHENY-MONONGAHELA-UPPER OHIO RIVER SYSTEM FOR USE AS AN INTEGRATING MACHINE FOR SOLVING PROBLEMS OF FLOOD-WAVE MOVEMENTS IN THIS RIVER SYSTEM.

(b) Carnegie Institute of Technology.

(c) Pure research.

(d) H. A. Thomas and J. W. Hackney, with the assistance of engineers furnished by the Works Division.

(e) Professor H. A. Thomas.

(f) To investigate the feasibility of obtaining accurate solutions of flood wave problems by using a special type of model channel as an integrating machine, and to apply this method to a study of various problems arising in connection with flood protection by proposed reservoirs in the Allegheny-Monangahela River basin.

(g) This model is about 80 feet long by 10 feet wide. It represents several hundred miles of the main river channels, all controlled tributaries below proposed reservoir sites, and numerous other tributaries. Vertical longitudinal and transverse scales are unequal. Profiles and cross sections are reproduced to scale, but curves are not reproduced. Hydraulic friction effect is produced by transverse metal fins, designed to duplicate the prototype rating curves. The flood wave from each tributary is introduced from an individual tank with a float-controlled orifice designed to reproduce the prototype hydrograph. Maximum flood stages of about 7 inches in the main model channels are read with precision on inclined gages.

(h) Preliminary tests and calibrations of typical sections of model channel and control orifices completed. Work just starting on construction of main model.
(i) The model channels are designed to satisfy the general differential equation for flood-wave movement, velocity-head and acceleration-head effects being included in the representation.

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(377)(a) MODEL STUDIES IN CONNECTION WITH THE RE-CONSTRUCTION OF THE EMSWORTH DAM ON THE OHIO RIVER 6 MILES BELOW PITTSBURGH.
(b) U. S. War Department.
(c) Laboratory investigation on a river model and on models of dam and gates.
(d) E. P. Schuleen and H. A. Thomas.
(e) Professor H. A. Thomas.
(f) Improvement of river navigation by raising the Pittsburgh pool to eliminate Monongahela Dam No. 1 and Allegheny Dam No. 1.
(g) Investigation includes the construction and testing of three models: (1) a 1:40 scale model of two bays of the dam to study the best hydraulic design for the piers, apron, and gates; (2) a model of the entire main-channel structure to study the effect of currents on scour and navigation in the vicinity of the dam; and (3) a 1:400 scale model of six miles of the river(including both main and back channel dams) to study the effect of the proposed structure on flood heights.
(h) The first model has been completed and tests on it are now in progress. The third model is now under construction.
(i) An unusual feature of the third model is the use of float gages to read surface stages with extreme precision.

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HARVARD UNIVERSITY.

(106)(a) HYDRAULICS OF FLOW OF WATER THROUGH SAND.
(b) Research in water supply and purification.
(c) Departmental research.
(d) G. M. Fair and L. P. Hatch.
(e) Professor G. M. Fair.
(f) Rational formulation of flow of clean water through clean sand and evaluation of factors controlling flow.
(g) Laboratory studies conducted on small-size tubes containing sand beds of different structure.
(h) Continuing research. Results being worked up for publication.

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UNIVERSITY OF ILLINOIS.

(300)(a) MEASURING THE FLOW THROUGH A PIPE LINE BY MEANS OF DIFFERENCE OF HEAD BETWEEN OUTSIDE AND INSIDE OF A BEND.
(b) Research.
(c) Laboratory problem.
(d) W. M. Lansford.
(e) M. L. Enger.
(f) To investigate the use of an elbow in a pipe line as a flow meter.

(h) Tests have been made on 2-in., 4-in., and 8-in. short turn elbows. A paper entitled "Use of an Elbow in a Pipe Line as a Means of Measuring the Flow of Water," by W. M. Lansford, was published in the April 1934 Bulletin of the Associated State Engineering Societies. Further results of this investigation are given by Mr. Lansford in his discussion, published in the November 1934 Proceedings of the American Society of Civil Engineers, of a paper by David L. Yarnell and Floyd A. Nagler entitled "Flow of Water Around Bends in Pipes." This investigation is being continued. Tests are being made on a 6-in. elbow having an 8 in. to 6 in. reducing section before and a 6-in. to 8 in. expanding section after the bend.

(i) The work was begun as a result of a suggestion made by the late Professor Nagler of the Iowa Institute of Hydraulic Research. The difference in head between the outside and inside of a given bend is a constant times the velocity head in the pipe for velocities exceeding about 1 ft. per sec.

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(301)(a) STUDY OF THE FLOW OF WATER IN A CIRCULAR GLASS PIPE BY THE USE OF MOTION PICTURES.

(b) Scientific research.

(c) Laboratory Project.

(d) Edgar E. Ambrosius, John C. Reed.

(e) M. L. Enger.

(f) To secure information relative to the characteristics of flow in circular conduits.

(g) Fine drops of an insoluble liquid (carbon tetrachloride and benzene) of the same density as water, in suspension in water flowing in a 1 3/4 inch circular glass pipe, are photographed by a motion picture camera as they move through a thin, broad field intensely illuminated from the two sides of the pipe.

(h) A paper entitled, "Study of the Flow of Water Through a Glass Pipe" by Edgar E. Ambrosius, John C. Redd, and Henry F. Irving, was presented before the 1934 Summer Meeting of the Aeronautic and Hydraulic Divisions, American Society of Mechanical Engineers, at Berkeley, California, and published by the George Reproduction Company, San Francisco, California.

This investigation is being continued with a more elaborate set-up and has some refinements not found on the old, such as maintaining constant head and a smooth belled entrance to the pipe in which the analysis is being made. The existing apparatus with its new and improved lighting equipment will permit the study of water velocities (using streak pictures) up to 4 ft per sec.

Using this set-up velocity profiles for both the laminar and turbulent flow regions have been determined. The average velocity as obtained from them checks within approximately 0.5 per cent of the average velocity determined from calculations by weighing the water discharged. The maximum velocity profile determined was for a velocity of approximately 4 ft. per sec. which corresponds to a Reynolds number of about 46,600.

The loss of head, friction factor, Reynolds number relation has also been determined for this particular pipe.

(i) The pipe is of sufficient length, 40 ft., made up of two 20 ft. sections, to insure a complete normal velocity distribution at low velocities. By the use of streak pictures (time exposures) it is anticipated that some information regarding mixing distances, and related phenomena encountered in turbulent flow may be ~~determined.~~ obtained.

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LOUISIANA STATE UNIVERSITY AND AGRICULTURAL AND MECHANICAL COLLEGE.

(23) (a) HYDROLOGICAL STUDY OF CITY PARK LAKE DRAINAGE AREA.
(b) Cooperative between the U. S. Geological Survey and the College of Engineering, Louisiana State University.
(c) General scientific research.
(d) Dr. Glen N. Cox and Assistants.
(e) Dr. Glen N. Cox.
(f) Study of rainfall, runoff and evaporation.
(g) The rainfall is measured in five standard cans and a Ferguson Weighing Recording Rain Gage, placed at various points over the 507 acre drainage area. The control is a concrete weir. An attempt will be made at arriving at the evaporation from the lake by knowing the amount of water that is being turned into the lake during dry periods and the amount that is being discharged.
(h) Records have been taken since April 1, 1933.

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(224)(a) FACTORS AFFECTING THE EVAPORATION FROM A LAND PAN.
(b) Cooperative between the U. S. Geological Survey and the College of Engineering, Louisiana State University.
(c) General scientific research.
(d) Dr. Glen N. Cox and assistants.
(e) Dr. Glen N. Cox.
(f) To determine the effect of the various meteorological factors on evaporation.
(g) Records of evaporation are taken on a standard U. S. Weather Bureau Land Pan, and meteorological data are obtained from a near-by station maintained by the Geology Department of the University.
(h) Records have been taken since June 1, 1933.

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(225)(a) COMPARISON OF EVAPORATION BETWEEN A LAND PAN AND A FLOATING PAN.
(b) Cooperative between the U. S. Geological Survey and the College of Engineering, Louisiana State University.
(c) General scientific research.
(d) Glen N. Cox and assistants.
(e) Dr. Glen N. Cox.
(f) Evident from title.
(g) A U. S. Geological Survey type floating pan is used, about which a barricade has been placed to reduce wave action. A recording thermometer and an anemometer have been installed so that a continuous record of lake temperatures and of wind movement may be obtained.
(h) Records have been taken since October, 1933.

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(226)(a) TILE AND OPEN DITCH DRAINAGE.
(b) Cooperative between the U. S. Department of Agriculture and the College of Engineering, Louisiana State University.
(c) General scientific research.
(d) B. O. Childs and Glen N. Cox.
(e) B. O. Childs, Houma, La., or Dr. Glen N. Cox.
(f) Study of rainfall, runoff, monthly water requirements of sugar cane, water-holding power, etc.
(g) Records of rainfall have been kept on a tiled and on an open ditch area for over four years. All runoff is pumped and measured. Water-table readings have been taken at a large number of places daily.
(h) Using the four year record, a paper has been prepared for the open ditch area which shows the water requirements of sugar cane, the amount of water needed to raise the ground water level, and the amount of water needed to wet surface material without producing any effect on ground water. This paper has not been published to date.

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MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

(321)(a) EXPERIMENTAL INVESTIGATION OF THE TRANSPORTATION OF SAND BY RUNNING WATER.
(b) River Hydraulic Laboratory, M. I. T.
(c) Graduate research for Master's degree.
(d) S. Chyn.
(e) Professor K. C. Reynolds.
(f) To determine the relationship between the transportation of the sandy bed of a miniature river and the grain size composition of the sand forming the bed.
(g) Synthetic sands of various sand modulus and mean grain diameter will be used.
(h) Tests are under way.

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(322)(a) EXPERIMENTAL DETERMINATION OF HYDRAULIC CHARACTERISTICS OF WATER CLOSET BOWLS.
(b) Massachusetts State Association of Master Plumbers and Sanitary Engineering Laboratory, M. I. T.
(c) Research for Benefit of Plumbing Industry.
(d) Professor Thomas R. Camp, E. C. Roche, R. B. Thompson, Gerald Putnam.
(e) Professor Thomas R. Camp.
(f) To develop method of "rating" water closet bowls which will show their minimum requirements as to total quantity and rate of supply for an adequate flush. The data given by such a rating will be useful to sanitary engineers and plumbers in selecting bowls and appropriate flushing devices, and to the manufacturers in improving the design of bowls and flushing devices.
(g) Rim and jet calibrated as orifices separately and operating together from which orifice constants are computed. Position of

water surface in bowl observed with steady siphon action and steady weir action for various rates of flow through bowl. Minimum rate of flow for steady siphon action observed. Time required for siphon to draw water surface to bottom of bowl observed for various constant rates of flush. From these data, rate of flush and amount of water for "safe economic flush" are established. Trial flushes are made from which rate curves of bowl discharge are measured.

(h) Experimental work completed. Report nearly completed.

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(323)(a) STUDY OF THEORY OF FILTRATION OF WATER THROUGH SAND.

(b) Sanitary Engineering Laboratory, M.I.T.

(c) Graduate research for Doctor's thesis.

(d) R. Eliassen.

(e) Professor Thomas R. Camp.

(f) To contribute to a rational theory for the time rate of "clogging" of sand filters.

(g) Sectional glass tube filter and one foot by two foot steel filter with plate glass side operated in parallel with large filters. At Providence (R.I.) Water Purification Plant. Observations of head loss and floc removal made at frequent intervals during run at small intervals of depth in filter. Observations of floc particle size and concentration also made at intervals during run at small intervals of depth. Data collected are analyzed in their relation to the Fair-Hatch sand flow formula in an effort to determine the manner in which the various factors vary during a run. Results show that removal is a maximum at the surface at the beginning of a run but decreases during the run to approach zero as the pores at the top of the bed approach saturation. At points below the surface the removal increases at the beginning of the run to a maximum value, then decreases to approach zero as the pores at these points approach saturation. The position of maximum removal thus moves downward into the bed during a run. Removal takes place throughout the depth of the bed all during a run, although it is very slight below a depth of 12" to 18".

(h) Thesis submitted May 1935. Title "An Experimental and Theoretical Investigation of the Clogging of a Rapid Sand Filter."

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(325)(a) STUDY OF SEEPAGE THROUGH EARTH DAMS ON PERVIOUS FOUNDATIONS.

(b) Soil Mechanics Laboratory, M.I.T.

(c) Graduate thesis.

(d) Lieutenants Besson, Kumpe, Lincoln, Powers, C.E., U.S.A.

(e) Professor Glennon Gilboy.

(f) To provide means for estimating seepage through and under earth dams for cases in which the permeability of dam and underground are of a comparable order of magnitude.

(g) Model studies in glass-sided flume, 2.5 feet high, 6 inches wide, 20 feet long. Observations on flow lines and discharge quantities. Correlation with mathematical analyses.

(h) Thesis submitted May 1935. Title,"Flow through Permeable Earth Dams on Permeable Foundations".

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(361)(a) EXPERIMENTAL AND THEORETICAL STUDY OF THE HYDRAULICS OF FLUSHING DEVICES FOR WATER CLOSET BOWLS.

(b) Massachusetts State Association of Master Plumbers and Sanitary Engineering Laboratory, M.I.T.

(c) Research for Plumbing Industry.

(d) Professor Thomas R. Camp, E. C. Roche, R. B. Thompson, J. B. Drisko, G. Putnam.

(e) Professor Thomas R. Camp.

(f) To develop method of calibrating flush valves and tanks which will show their discharge characteristics and pressure requirements. The data given by such a calibration will be useful in the selection and adjustment of a valve or tank to fit the requirements of a given water closet bowl, and should be useful to manufacturers in improving design.

(g) Hydraulic analysis of flush tanks is made. Flush valves are studied and classified, and a general hydraulic theory is developed for expressing pressure drop and rate of flush as a function of time during a flush. Individual flush valves are studied experimentally in an effort to evaluate the valve characteristics. Methods of adjusting flush valves to service conditions are described. A method of calibrating valves to facilitate selection and adjustment is recommended. Back-siphonage through flush valves and protective means are discussed.

(h) Experimental work completed. Report nearly completed.

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(362)(a) MODEL OF CAPE COD CANAL AND APPROACHES.

(b) Colonel John J. Kingman, District Engineer, U.S.Engineer Office, Boston.

(c) Research in connection with proposed widening program for Cape Cod Canal.

(d) Professor K. C. Reynolds and staff.

(e) Professor K. C. Reynolds.

(f) To determine mean low water profile and other hydraulic features connected with design of enlarged canal with 500-foot bottom width and 40-foot depth.

(g) A distorted fixed bed model is being built of the Canal including the approach in Cape Cod Bay and both the present and proposed approaches in Buzzard's Bay from Wings Neck. Horizontal scale 1:600, vertical scale 1:60, length of model 115 feet. The tides of the two bays will be controlled by an electrically-operated mechanism.

(h) Canal and Cape Cod Bay parts of model practically complete. Buzzards Bay under construction. Tide control mechanism under construction.

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(363)(a) MODEL STUDY OF PROPOSED MOORING BASIN FOR CAPE COD CANAL.

(b) Colonel John J. Kingman, District Engineer, U. S. Engineer Office, Boston, Mass.

(c) Research in connection with proposed widening program for Cape Cod Canal.

(d) Professor K. C. Reynolds, and staff.
(e) Professor K. C. Reynolds.
(f) To determine design of transition section between the proposed mooring basin, which is to be 2000 feet long and 300 feet wide, and the main canal. The shape of this section - whether a series of tangents or a circular arc - governs the extent of an eddy which would tend to cause deposition.
(g) Water passes over a measuring weir and enters the canal model which is to a scale of 1:150 and is about 40 feet long. The position of the eddy is determined by dye. Its length as well as width is governed by the shape of the connection.
(h) Model studies complete. Eddy reduced in length from about 2025 feet to 1500 feet. Eddy now is confined to water on side slope of basin. Report not yet written.

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MICHIGAN STATE COLLEGE, DEPARTMENT OF CIVIL ENGINEERING.

(364)(a) INVESTIGATION OF HEAD LOSSES IN SMALL FITTINGS.
(b) Student thesis.
(c) As per title above.
(d) C. F. Clark and J. C. Erkfitz.
(e) Correspondent: Frank R. Theroux.
(f) As per title.
(g) Method and scope: Combination of four fittings of various kinds as 90 degree ells, tees, etc. in 2 inch and 1 inch diameters. Velocities of 2 to 20 feet per second.
(h) Preliminary report as thesis by the authors completed June 1,1935.

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UNIVERSITY OF MINNESOTA.

(94)(a) TRANSPORTATION OF SEDIMENT.
(b) University of Minnesota Engineering Experiment Station.
(c) University hydraulics research project.
(d) Lorenz G. Straub and graduate assistants.
(e) Lorenz G. Straub.
(f) Investigations of transportation of bed sediment in alluvial rivers and the effect of contraction works on the river channel.
(g) Preliminary experiments were conducted in a wooden flume about 35 feet long, 12 inches wide, and 18 inches deep, sediment being added at the entrance to the flume and collected and weighed at the point of discharge. Water discharge was measured by means of a weir located at the entrance to the flume. Additional experiments are in progress using a specially designed steel tiltable flume about 60 feet long, 3 feet wide, and 15 inches deep. Sediments of various mechanical compositions are being used; some of the materials have been taken directly from the beds of midwestern rivers. Observations are made of the rate of sediment transportation for various flow conditions, the character of the riffle formations, the effect of channel contraction works on the regimen of the stream bottom, etc.

(h) Investigation in progress.
(i) Progress reports are contained in Transactions of the American Geophysical Union for 1932 and 1934, "Hydraulic and Sedimentary Characteristics of Rivers," and "Effect of Channel-Contraction Works upon Regimen of Movable Bed-Streams."

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(99)(a) LAWS OF HYDRAULIC SIMILITUDE.
(b) University of Minnesota Engineering Experiment Station.
(c) University hydraulics research project.
(d) Lorenz G. Straub and graduate assistants.
(e) Lorenz G. Straub.
(f) Investigations of the limitations of the laws of hydraulic similitude.
(g) In connection with various research projects of the hydraulics laboratory in which models are used, wherever possible studies are being made on models of several different scales. The results recorded are being generalized to develop numerical limitations of the various laws of hydraulic similitude.
(h) In progress.

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(190)(a) FLOW CONDITIONS IN OPEN CHANNEL.
(b) University of Minnesota Engineering Experiment Station.
(c) University hydraulics research project.
(e) Lorenz G. Straub.
(f) To determine conditions of laminar and turbulent flow in open channels.
(g) Flow conditions are observed in a small tiltable flume.
(h) Preliminary set of experiments completed; further studies are being undertaken with an improved type of apparatus.

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(327)(a) EXPERIMENTAL STUDY OF FLUSH VALVES FOR WATER-CLOSETS.
(b) Minnesota State Board of Health.
(c) Cooperative research project with Sanitary Division of Minnesota State Board of Health and the Hydraulics Department of the University.
(d) Lorenz G. Straub, H. A. Whittaker, Jack J. Handy.
(e) Lorenz G. Straub.
(f) Investigation of the suitability of various types of flush valves particularly with the view of determining possibilities of back-siphoning into fresh water lines.
(g) A standard water-closet bowl is so arranged that the discharge variation may be recorded graphically. The set-up permits using various types of flush valves. Wide variations in pressure are possible on the feed water line.
(h) In progress.

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(328)(a) EXPERIMENTAL STUDY OF SEDIMENTATION BASINS.
(b) University of Minnesota Engineering Experiment Station.
(c) Graduate research project.
(d) Alvin Anderson.
(e) Lorenz G. Straub.

(f) Determination of flow conditions in water works sedimentation reservoirs by means of models.

(g) Models of entrance and exit structures are built into a glass-sided channel in such a manner that flow conditions can be controlled. Finely divided solid material of low specific gravity is added to the water at the entrance to the model basin so that sedimentation and flow conditions can be observed.

(h) Preliminary experiments completed. Report in progress.

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(329)(a) STUDIES OF HYDRAULIC JUMP.

(b) University of Minnesota Engineering Experiment Station.

(c) Graduate research project.

(d) Harold Flinsch.

(e) Lorenz G. Straub.

(f) Experimental study of mechanical occurrences within hydraulic jump.

(g) A glass flume 20 inches wide and 27 inches deep is arranged to provide various conditions of shooting and streaming flow. Measurements are made of the velocities, pressures, etc., within the jump.

(h) Experiment is in progress.

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(365)(a) MODEL TESTS FOR EROSION.

(b) Northern States Power Company.

(c) Cooperative research with Northern States Power Company.

(d) George E. Loughland and Lorenz G. Straub.

(e) Professor Lorenz G. Straub.

(f) Investigation of erosion below taintor gates at St. Cloud, Minnesota, on the Mississippi River and experimental design for improvements of apron to reduce scour.

(g) Experiments conducted on small-scale wooden models built into glass flume.

(h) Experimental series completed. Revisions being made in actual structure.

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(366)(a) LABORATORY DESIGN AND ANALYSIS OF SPILLWAY CREST.

(b) Northern States Power Company.

(c) Cooperative research with Northern States Power Company.

(d) George E. Loughland and Lorenz G. Straub.

(e) Professor Lorenz G. Straub.

(f) Analysis by means of models of various proposed revisions and extensions of the spillway crest of a dam at Cedar Falls, Wisconsin.

(g) Studies consisted of determining the pressure distribution of models of the proposed and also the existing spillway crest. Studies were also made to determine a suitable design for the tumble bay of an added section of spillway.

(h) Laboratory studies have been completed.

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(367)(a) EXPERIMENTAL ANALYSIS OF SOIL EROSION CONTROL PROJECTS.
(b) Agricultural Experiment Station, University of Minnesota.
(c) Cooperative project with Department of Agricultural Engineering, University of Minnesota.
(d) Harry B. Roe and Lorenz G. Straub.
(e) Professor Lorenz G. Straub.
(f) Experimental analysis of capacity and of flow conditions through a particular control structure by means of observations on a laboratory model.
(g) A model constructed of wood, glass, and plaster of Paris, containing the essential features of the layout, such as the culvert, dam, and approach channel, was provided in the laboratory. Observations were made of flow conditions and various rates of discharge.
(h) Preliminary laboratory experiments have been completed and changes are to be made in the actual structure.

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(368)(a) LABORATORY TESTS OF EROSION EFFECTS AROUND APRONS AT THE FOOT MASONRY DAMS.
(b) Department of Drainage and Waters, State of Minnesota.
(c) Cooperative project with Department of Drainage and Waters of the State of Minnesota and the Department of Agricultural Engineering of the University of Minnesota.
(d) H. B. Roe, Lorenz G. Straub, and members of staffs of Department of Agricultural Engineering and of Minnesota State Department.
(e) Professor Lorenz G. Straub.
(f) Experiments were made on a model of a typical soil saving dam with a view of determining means of reducing the erosion below the structure.
(g) The model was constructed of wood to a scale of 1 inch = 1 foot of the approach to the dam , the weir and dam itself, and the apron with side walls below the dam. This model inserted into a large channel arranged with gravel to determine the locations of the erosion. A large number of variations were made in the model to determine the most effective means of reducing erosion.
(h) Preliminary experiments completed. Report prepared.

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(369)(a) EXPERIMENTAL ANALYSIS OF COFFERDAM DESIGN.
(b) Mr. Lazarus White.
(c)
(d) Lorenz G. Straub and laboratory assistants.
(e) Professor Lorenz G. Straub.
(f) Experimental analysis of design for proposed cofferdam.
(g)
(h) In progress.

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NEW YORK UNIVERSITY.

(130)(a) DURATION CURVES OF STREAM FLOW.
(c) General scientific research and in connection with theses for Master's degrees.
(d) Thorndike Saville, graduate students, and assistants.
(e) Professor Thorndike Saville.

(f) To determine regional characteristics of stream flow and the applicability of statistical methods to its analysis.
(g) Construction of duration curves of weekly stream flow in terms of mean flow. Deviations of curves from one another as influenced by drainage area and regional characteristics and length of record. Construction of composite curve applicable to a region. Statistical analysis of curves and data.
(h) Study of five North Carolina streams completed and published: "An investigation of the flow duration curves of North Carolina streams," by Thorndike Saville and John D. Watson, Trans. American Geophysical Union, National Research Council, Washington, D. C., 1933, pp. 406-425. Studies in progress covering streams in New Jersey, New York, Tennessee and North Carolina.
(i) The investigation is intended to cover the entire country and the results will be presented in a series of papers dealing with different regions.

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(131)(a) ESTIMATING FLOOD FLOWS.
(b) General scientific research and in connection with theses for Master's degrees.
(d) Thorndike Saville, graduate students, and assistants on work relief.
(e) Professor Thorndike Saville.
(f)(g) To compare all the various methods which have been proposed by applying them to streams having long periods of flow, and to develop if found desirable, improved methods.
(h) Comparison of several methods to 57 year daily record of Tennessee River in Master's thesis (1933) by H. Thielhelm. Results indicate marked diversity. Subsequent studies indicate period of record has marked influence upon extrapolated values, and that estimates of extreme floods in terms of the mean flood differ for different stations on same streams even when same (30 year) period is used.

A report entitled, "A Study of Methods of Estimating Flood Flows Applied to the Tennessee River", has been circulated in mimeograph form by the U. S. Geological Survey in connection with its flood study being prosecuted under the auspices of the Mississippi Valley Committee and Water Resources Section of the National Resources Board. This manuscript will probably later be published with other material in a water supply paper dealing with floods.

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PACIFIC HYDROLOGIC LABORATORY.

(45) (a) RELATION OF PERMEABILITY OF GRANULAR MATERIALS TO PARTICLE SIZE.
(b) Water Conservation Committee, Irrigation Division, American Society of Civil Engineers.
(c) General scientific research.
(d) Charles H. Lee.
(e) Charles H. Lee, Consulting Engineer, 58 Sutter St., San Francisco.
(f) To provide a more accurate basis for preliminary classification of soil and earth materials as to permeability.

(g) Permeability coefficient of natural undisturbed material determined by means of permeameter. Also complete mechanical analysis of material made by means of hydrometer (Bouyoucos) method for which improvements have been developed. Mechanical analysis curves plotted by groups within fixed limits of permeability, data being obtained for as wide a variety of earthy materials as possible.

(h) Progress results incorporated in the following papers:

1. "The Interpretation of Water Levels in Wells and Test Holes", by Charles H. Lee, Transactions, American Geophysical Union, June 1934, Part II, pages 540-544.
2. "Selection of Materials for Rolled-Fill Earth Dams", by Charles H. Lee, Paper to be presented at meeting of Irrigation Division, American Society of Civil Engineers, at Los Angeles, California, July 3, 1935.

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(370)(a) EARTH DAM INVESTIGATIONS.

(b) 1. U.S.Indian Service.
2. Santa Clara Valley Water Conservation District.
3. California Water Service Company.

(c) Conducted as part of engineering research for design and selection of material for rolled-fill earth dams.

(d) Charles H. Lee.

(e) Charles H. Lee, Consulting Engineer, 58 Sutter St., San Francisco, California.

(f) Study of physical properties of soils as related to rolled-fill earth dam construction.

(g) Mechanical analysis by hydrometer method, shrinkage tests (Atterburg limits), microscope examination, specific gravity determinations, compaction tests, permeability of undisturbed compacted material, shear and compression tests.

(h) Completed.

(i) Partial results included in paper by Charles H. Lee to be presented at meeting Irrigation Division, American Society of Civil Engineers, at Los Angeles, California, July 3, 1935, entitled, "Selection of Materials for Rolled-Fill Earth Dams."

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PENNSYLVANIA STATE COLLEGE.

(137)(a) A STUDY OF VARIOUS TYPES AND KINDS OF STILLING DEVICES FOR USE IN CHANNELS OF APPROACH TO WEIRS AND FOR OTHER PURPOSES.

(b) The Pennsylvania State College.

(c) Research.

(d) Professors Elton D. Walker and H. K. Kistler.

(e) Either of above.

(f) The development of a standard stilling device, or possibly more than one device.

(g) Water is admitted to one end of a tank from a pipe, under such conditions as to produce a high velocity and considerable turbulence. The discharge is measured at the other end of the tank by means of a standard weir which has been calibrated.

Velocity measurements are made at a number of points in a cross section about four feet downstream from the inlet both with and without any stilling devices in place. When stilling devices are tested, they are inserted about two feet below the inlet. Each device is tested with a number of different velocities, average velocities being determined by means of the weir readings and the cross section of the channel. We seek to relate the relative effectiveness of the various stilling devices to the magnitude and distribution of velocities in the cross section.

(h) Data covering a large number of experiments are being tabulated and studied, and a progress report in the form of a bulletin is under preparation.

(g) Further investigation that may be suggested by the results found will be undertaken as soon as the current preliminary studies are completed.

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UNIVERSITY OF PENNSYLVANIA.

(371)(a) INVESTIGATION OF THE INFLUENCE OF INSTALLATION ON THE COEFFICIENTS OF VENTURI METERS.

(b) Will be presented to the A.S.M.E. Fluid Meters Committee.

(c) This is an investigation to determine the limiting installation conditions for Venturi meters of high and low ratio.

(d) W. S. Pardoe and a graduate class of three students.

(e) Professor W. S. Pardoe.

(f) Largely commercial.

(g) It involves at least twenty complete tests of each meter.

(h) About half done.

(i) Expect to complete report for the annual meeting of the A.S.M.E. next December.

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PENNSYLVANIA WATER & POWER COMPANY.

(228)(a) RESISTANCE OF WELDING MATERIALS TO CAVITATION- HIGH HEAD TESTS AT HOLTWOOD.

(b) Pennsylvania Water & Power Company and Safe Harbor Water Power Corporation.

(c) Commercial research.

(d) J. M. Mousson and Assistants.

(e) C. F. Merriam.

(f) Determination of resistance of various materials to pitting. Selection of best materials and method of application for repairs to turbines damaged by action of cavitation. Determination of most suitable material for new turbine installations.

(g) Exposure of test plates to cavitation formed by a special weir profile under a head of 1100 ft. Materials to be tested include welded, sprayed, cast, forged, and rolled plates of various steels, bronzes, and other alloys. Quantitative measurement of severity of damage is made by weighing specimens for amount of material lost. Correlation of results of these tests with analysis of chemical and physical properties.

(h) Sufficient information has been secured to select a material for prewelding of turbine blades combining corrosion resistance and machinability. Tests have indicated some correlation between Brinell hardness and resistance to pitting, although hardness alone is no infallible criterion.

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(229)(a) RESISTANCE OF MATERIALS TO CAVITATION, LOW HEAD TESTS AT SAFE HARBOR.
(b) Pennsylvania Water & Power Company and Safe Harbor Water Power Corporation.
(c) Commercial research.
(d) C.. F. Merriam and assistants.
(e) C. F. Merriam.
(f) Determination of resistance to pitting of various materials and protective coatings, and study of nature of pitting by microscopic examination of damage.
(g) Exposure of test plates to cavitation formed in a rectangular venturi passage. Materials tested include various steels, cast iron, copper, lead, aluminum, rubber and rubber paints, and other protective paints.
(h) Active work on this project has been suspended although apparatus is held in readiness for further work. Although experiments show that with head available the damaging action was not sufficiently severe to give greatly accelerated results, nevertheless it was possible to watch the progress of pitting and get a clearer idea of the way in which the destruction takes place.

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(230)(a) TURBINE MODEL TESTS.
(b) Safe Harbor Water Power Corporation.
(c) Commercial testing.
(d) L.M.Davis and assistants.
(e) C. F. Merriam.
(f) Determination of the effect of alteration of the shapes of blades for a Kaplan turbine and study of efficiency and cavitation characteristics of model runners.
(g) Efficiency and cavitation research on hydraulic turbines and commercial tests - Holtwood Hydraulic Laboratory.
(h) Much valuable information has been obtained. Practical methods of conducting cavitation tests have been developed and perfected. The laboratory is now being used for a number of commercial tests.

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(330)(a) EFFECT OF SEASONAL CHANGES IN RIVER WATER ON CORROSION OF SPECIMENS SUBJECTED TO CAVITATION.
(b) Pennsylvania Water & Power Company and the Safe Harbor Water Power Corporation.
(c) Commercial research.
(d) L. M. Davis and J. M. Mousson.
(e) C. F. Merriam.
(f) To determine whether there is greater danger of damage from cavitation in summer than in winter.

(g) Interspersed with test specimens under Project 228; specimens of standard analysis are tested weekly. Loss of weight is taken as a measure of extent of the damage. This is being correlated with river water temperature.

(h) This project has been completed. The results indicate a decrease in pitting with decreasing water temperature. The loss in weight for the rolled 18-8 chrome nickel steel specimens used for these tests was found to be proportional to the vapor pressure for the seasonal temperature range ($0^{\circ}$ - $26^{\circ}$C.) Tests with a recirculating system permitting artificial temperature control confirmed the results obtained from observations under the natural seasonal temperature variation.

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STEVENS INSTITUTE OF TECHNOLOGY.

(378)(a) THE STUDY OF THE FORCES ACTING ON SAILING YACHTS IN ACTUAL SAILING ATTITUDES.

(c) General scientific research.

(d) Professor Kenneth S. M. Davidson.

(e) Professor Kenneth S. M. Davidson.

(f) To determine the longitudinal resistance of sailing yachts heeled over and moving with leeway as they do under actual sailing conditions.

(g) Observations taken on board ships to determine relation between sail forces, speeds and heeled angles. Scale models are towed in the attitudes determined from the full size observations.

(h) Sufficient results have been obtained to show that the method is sound.

(i) The project involves the towing of yacht models heeled over and with sufficient leeway to give the lateral force necessary to balance the sail force. It further involves the measurement of lateral forces while the model is moving longitudinally.

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(379)(a) THE CALIBRATION OF A NOZZLE FOR FLUID FLOW MEASUREMENTS.

(b) Stevens Institute of Technology.

(c) Graduate thesis for advanced degree.

(d) Howard W. Emmons.

(e) Professor Richard F. Deimel.

(f) For the purpose of adding to the knowledge of the behavior of fluids flowing through nozzles.

(g) The method used was to measure the theoretical and actual flow of water, steam and air through a flow nozzle designed at Stevens Institute of Technology.

(h) Completed June 1, 1935.

(i) Completed thesis in Library of Stevens Institute of Technology.

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WEST VIRGINIA UNIVERSITY.

(50)(a) DISCHARGE THROUGH THIN PLATE ORIFICES IN PIPE LINES.
(b) West Virginia University.
(c) General scientific research.
(d) H. W. Speiden and Lewis V. Carpenter.
(e) Lewis V. Carpenter, College of Engineering, West Virginia University, Morgantown, W. Va.
(f) To study the coefficient of various sizes of circular thin plate orifices in pipe lines, with a view to the determination of the relations existing between the coefficients of large and small orifices by the principle of similarity.
(g) Series of 6 different sizes of circular orifices in a 2-inch pipe line. Pipe lines of smooth brass and wrought iron have been used. At the present time we have varied the distance up-stream and down-stream of the manometer connections, and are testing a specially designed manometer connection, expecting to find the best location of the taps to give the least interference.
(h) Work is still being continued on this project, and it is hoped to publish an article on it not later than January 1, 1936.

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UNITED STATES GOVERNMENT DEPARTMENTS.

BUREAU OF AGRICULTURAL ENGINEERING.

(192)(a) FLOW OF WATER IN IRRIGATION CHANNELS.
(b) Division of Irrigation, Bureau of Agricultural Engineering, U. S. Department of Agriculture.
(c) Conducted by Division of Irrigation with informal cooperation with U. S. Bureau of Reclamation, irrigation entérprises, hydro-electric companies and municipal water departments.
(d) Fred C. Scobey, Assistance as needed.
(e) Fred C. Scobey, Senior Irrigation Engineer, Division of Irrigation, Bureau of Agricultural Engineering, Berkeley, California.
(f) Revision, U.S.D.A. Bull. 194, "The Flow of Water in Irrigation Channels." (experimental determinations of the value of "n" for different kinds of channels and the preparation of estimation charts; originally published in 1915).
(g) Complete field tests are made in channels of all variations of surface that can be located under conditions where experimentation is feasible. They are made in all sizes of channel from small lateral ditches to the largest of canals.

The United States Bureau of Reclamation has agreed to allow access to its files of experimentation made along the lines laid down in our Bulletin 194 and ordered shortly after that publication appeared.
(h) In progress.
(i) See II-2 for parts of (g) and (h).

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(246)(a) SAND AND SILT REMOVAL INVESTIGATION, P.W.A. PROJECT NO. F.P.99.
(b) The Bureau of Agricultural Engineering, U. S. Department of Agriculture, and the Bureau of Reclamation, U. S. Department of the Interior.
(c) The investigations are being conducted cooperatively between the two above mentioned bureaus.
(d) R. L. Parshall, Senior Irrigation Engineer, Division of Irrigation, Bureau of Agricultural Engineering, in charge of the investigations; Carl Rohwer, Associate Irrigation Engineer, Division of Irrigation, Bureau of Agricultural Engineering, and E. W. Lane, Research Engineer, Bureau of Reclamation, as collaborators.
(f) The purpose of this work is to test the vortex and grating types of sand traps, previously investigated at the Bellvue hydraulic laboratory near Fort Collins, Colorado, with a view of applying these devices on an enlarged scale in the attempt to remove fine sand and silt from Colorado River water.
(h) In progress.
(i) See II-2 for (g) and part of (h).

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CORPS OF ENGINEERS, Portland District.

(259)(a) BONNEVILLE DAM, A NAVIGATION AND POWER PROJECT ON COLUMBIA RIVER.
(b) U. S. Engineer Corps, Portland District. Major C. F. Williams, District Engineer.
(c) A research problem to furnish data for design and subsequent operation of the Bonneville Project.
(d) J. C. Stevens, Consulting Engineer, A. J. Gilardi, Engineer in direct charge of river laboratory work, model studies of turbines under direction of Howard Cooper, C. I. Grimm, Head Engineer in charge of Bonneville Dam Project.
(e) District Engineer, U. S. Engineer Corps, Portland, Oregon.
(f) To make model studies to aid in the design, construction, and operation of the Bonneville Navigation and Power Project.
(g) An outdoor laboratory has been constructed at Government Moorings in the City of Portland. Water is pumped from Willamette River and circulated through the models. Models have been constructed as follows:
1. Locks for deep sea vessels.
2. Spillway section of Bonneville Dam for hydraulic effects.
3. Five miles of Columbia River, including Cascade Rapids, dam, locks, power house.
4. Draft tubes and scroll cases for turbines.
5. Coffer-dams in Columbia River.
6. Fishways.
7. Crest gates for cavitation effects.
(i) These model studies have been of great help in this work. Greater economy in design has resulted and much time in construction has been saved.

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GEOLOGICAL SURVEY.

(26)(a) PERMEABILITY TESTS CONDUCTED UNDER VERY LOW HYDRAULIC GRADIENTS.
(b) United States Geological Survey, Water Resources Branch.
(c) General scientific research.
(d) O. E. Meinzer, V. C. Fishel.
(e) O. E. Meinzer.
(f) The purpose of this experiment is to find out if there is a flow of liquids through porous material with hydraulic gradients as low as one foot per mile or less, and if there is a flow at such low gradients, to ascertain if it follows Darcy's law which states that the flow of water through a given porous material varies directly as the hydraulic gradient.
(g) The present investigation is conducted with a U-shaped non-discharging type of apparatus having a column of material two meters in length. An initial hydraulic gradient is established by adjusting the water levels so that the level in one column is slightly higher than in the other. Observations are then made on the rate of change of the water levels.
(h) The results obtained in these tests confirm Darcy's law for hydraulic gradients of one foot per mile and indicate that the law probably holds to at least half a foot per mile. There was a definite movement of water for gradients as low as 0.05 foot per mile. These results were presented in a paper at the fifteenth annual meeting of the American Geophysical Union and were published in the Transactions of the Union for 1934, Part 2, pp. 405-409. Further tests are in progress.

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(27)(a) THIEM'S METHOD FOR DETERMINING PERMEABILITY OF WATER-BEARING MATERIALS.
(b) The U. S. Geological Survey in cooperation with the Conservation and Survey Department of the University of Nebraska.
(c) General scientific research.
(d) L. K. Wenzel.
(e) L. K. Wenzel, U. S. Geological Survey, Washington, D. C.
(f) Pumping tests were conducted near Grand Island, Nebraska, during the summer of 1931 as a part of a cooperative investigation of the ground-water resources of the Platte Valley to determine the practicability of Thiem's method for determining permeability of water-bearing materials. Two additional pumping tests were made during 1933, one at Gothenburg and the other at Kearney, using a modified method of procedure that was determined by the test near Grand Island to give the most accurate results. See Bulletin II-1 for further details.
(l) The results of the pumping tests near Grand Island will be published by the United States Geological Survey as Contribution to the Hydrology of the United States and the results of the other two tests will be published ultimately in a report on the ground-water resources of the Platte Valley.

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(265)(a) STUDY OF THE SIZE OF INTAKE OPENINGS OF WELL SCREENS IN RELATION TO THE YIELD OF WELLS AND THE PERMEABILITY OF WATER-BEARING FORMATIONS.
(b) United States Geological Survey, Water Resources Branch.
(c) General scientific research.
(d) A. G. Fiedler, M. A. Pentz.
(e) A. G. Fiedler, U. S. Geological Survey, Washington, D. C.
(f) The purpose of this study is to determine the effect of the size of intake openings of well screens upon the yield of wells and also to determine the relationship between the yield of a well of a definite type to the permeability of the water-bearing formation.
(g) The permeability of the water-bearing formation will be determined by field pumping tests in accordance with the method suggested by Thiem as modified by L. K. Wenzel as the result of tests made in the Platte Valley, Nebraska. Laboratory tests of permeability will also be made. Wells finished with screens having different sizes of intake openings, but otherwise of identical construction, will be drilled in a selected area. The wells will be pumped at different rates and observations of the drawdown of the pumped well, and the lowering of the water-table in other observation wells will be made, and the relationship between yield, size of screen slot and permeability will be determined.
(h) Field work has been completed.

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BUREAU OF RECLAMATION.

(248)(a) SPILLWAY TESTS, GRAND COULEE DAM.
(b) U. S. Bureau of Reclamation.
(c) Routine laboratory study.
(d) Hydraulic Studies Section of U. S. Bureau of Reclamation.
(e) U. S. Bureau of Reclamation.
(f) Purpose: an aid to, and check on, the design of proposed structures.
(g) 1:184 model, testing completed.
1:120 full size model now being tested.
1:40 sectional model, testing under way.
1:15 sectional model at Montrose, Colorado, laboratory of Bureau of Reclamation.
(h) Tests under way.

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(249)(a) SPILLWAY TESTS, HYRUM DAM.
(b) U. S. Bureau of Reclamation.
(c) Routine laboratory study.
(d) Hydraulic Studies Section of U. S. Bureau of Reclamation.
(e) U. S. Bureau of Reclamation, Denver, Colorado.
(f) Purpose: an aid to, and check on, the design of proposed structures.
(g) Tests of 1:48 model of spillway chute and stilling pool.
(h) Studies completed.
(i) Report available for loan.

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(250)(a) SPILLWAY TESTS, AGENCY VALLEY DAM.
(b) U. S. Bureau of Reclamation.
(c) Routine Laboratory Study.
(d) Hydraulic Studies Section of U. S. Bureau of Reclamation.
(e) U. S. Bureau of Reclamation, Denver, Colorado.
(f) Purpose: an aid to, and check on, the design of proposed structures.
(g) Tests made of 1:30 model of entire spillway.
(h) Studies completed.
(i) Report not yet completed.

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(251)(a) SPILLWAY TESTS, PINEVIEW DAM.
(b) U. S. Bureau of Reclamation.
(c) Routine laboratory study.
(d) Hydraulic Studies Section of U. S. Bureau of Reclamation.
(e) U. S. Bureau of Reclamation, Denver, Colorado.
(f) Purpose: an aid to, and check on, the design of proposed structures.
(g) Tests made of 1:30 model of entire spillway.
(h) Studies finished.
(i) Report available for loan.

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(338)(a) RYE PATCH DAM SPILLWAY TESTS.
(b) U. S. Bureau of Reclamation.
(c) Routine laboratory study.
(d) Hydraulic Studies Section of U. S. Bureau of Reclamation.
(e) U. S. Bureau of Reclamation, Denver, Colorado.
(f) Purpose: an aid to, and check on, the design of proposed structures.
(g) 1:50 scale model tested at all flows.
(h) Studies complete.
(i) Report available for loan.

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(339)(a) MOON LAKE DAM SPILLWAY TESTS.
(b) U. S. Bureau of Reclamation.
(c) Routine laboratory study.
(d) Hydraulic Studies Section of U. S. Bureau of Reclamation.
(e) U. S. Bureau of Reclamation, Denver, Colorado.
(f) Purpose: an aid to, and check on, the design of proposed structures.
(g) 1:40 model tested under various conditions.
(h) Studies complete.
(i) Report available for loan.

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(340)(a) STUDY OF PERCOLATION THROUGH, AND STABILITY OF, EARTH DAMS UNDER A CHANGING HEAD.
(b) U. S. Bureau of Reclamation.
(c) Routine laboratory study.
(d) Hydraulic Studies Section of U. S. Bureau of Reclamation.
(e) U. S. Bureau of Reclamation, Denver, Colorado.
(f) Purpose: an aid to, and check on, the design of proposed structures.

(g) Arbitrary models tested in a glass-faced flume, under a varying water head.
(h) Work under way.

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(350)(a) IMPERIAL DAM SPILLWAY MODEL TESTS.
(b) U. S. Bureau of Reclamation.
(c) Routine laboratory study.
(d) Hydraulic Studies Section of U. S. Bureau of Reclamation.
(e) U. S. Bureau of Reclamation, Denver, Colorado.
(f) Purpose: an aid to, and check on, the design of proposed structures.
(g) 1:30 model of a section of the dam tested for prevention of scour.
(h) Tests under way.

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(380)(a) IMPERIAL DAM SLUICEWAY MODEL TESTS.
(b) U. S. Bureau of Reclamation.
(c) Routine Laboratory Study.
(d) Hydraulic Studies Section of U. S. Bureau of Reclamation.
(e) U. S. Bureau of Reclamation, Denver, Colorado.
(f) Purpose: an aid to, and check on, the design of proposed structures.
(g) 1:40 model of the sluices tested for prevention of scour and comparison of alternate designs.
(h) Tests completed.
(i) Report not yet completed.

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(381)(a) IMPERIAL DAM AND ALL-AMERICAN CANAL INTAKE MODEL TESTS.
(b) U. S. Bureau of Reclamation.
(c) Routine laboratory study.
(d) Hydraulic Studies Section of U. S. Bureau of Reclamation.
(e) U. S. Bureau of Reclamation, Denver, Colorado.
(f) Purpose: an aid to, and check on, the design of proposed structures.
(g) A 1:40 model of the entire Imperial Dam, including the intake works to the All-American Canal and all appurtenant works, and several thousand feet of the Colorado River, is being tested at the Montrose laboratory.
(h) Testing under way.

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(382)(a) ISLAND PARK DAM SPILLWAY TESTS.
(b) U. S. Bureau of Reclamation.
(c) Routine laboratory study.
(d) Hydraulic Studies Section of U. S. Bureau of Reclamation.
(e) U. S. Bureau of Reclamation, Denver, Colorado.
(f) Purpose: an aid to, and check on, the design of proposed structures.
(g) 1:30 model of spillway, chute, and tunnel tested for performance and satisfactory operation.
(h) Studies completed.
(i) Report available for loan.

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(383)(a) TAYLOR PARK DAM SPILLWAY TESTS.
(b) U. S. Bureau of Reclamation.
(c) Routine Laboratory Study.
(d) Hydraulic Studies Section of U. S. Bureau of Reclamation.
(e) U. S. Bureau of Reclamation, Denver, Colorado.
(f) Purpose: an aid to, and check on, the design of proposed structures.
(g) 1:50 model of spillway and chute tested for satisfactory operation and improvement of design.
(h) Studies completed.
(i) Report pending.

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NATIONAL BUREAU OF STANDARDS.

(43)(a) INVESTIGATION OF PIPE BENDS.
(b) U. S. Bureau of Reclamation.
(c) General research.
(d) K. H. Beij, G. H. Keulegan, G. E. Golden.
(e) The Director, National Bureau of Standards.
(f) To obtain the general laws of head loss in pipe bends; to correlate, insofar as possible, all available results of previous investigations; to obtain practicable formulas for use of engineers; and to extend the results to include flow of other fluids, such as oils, steam, etc.
(g) Laboratory tests will be made on pipe of various materials and various degrees of roughness; on sizes up to 20 inch diameter if funds permit; on bends of various central angles and on miter bends and cast fittings. Transparent pipes and bends will be used to investigate the nature of flow.
(h) Tests on a line of 4-inch steel tubing with 90 degree bends of radii varying from 6 inches to 16 feet are in progress. Seven bends of a total of nine have been tested. Tests have been completed on bends of 3/8 inch brass tubing of central angles varying from 5 to 180 degrees and constant arc length of 2 meters. The results are being prepared for publication. Tests have been made on one elbow and one tee in a line of 1 inch copper tubing. A progress report has been submitted to the Bureau of Reclamation.

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(129)(a) TRANSPORTATION OF SEDIMENT, COLORADO RIVER.
(b) U. S. Bureau of Reclamation.
(c) General research.
(d) C. A. Wright, B. H. Monish.
(e) The Director, National Bureau of Standards.
(f) To determine the relative scouring action on a bed of fine sand of clear water and of water containing a considerable amount of fine silt and clay.
(g) Experiments have been conducted with the apparatus described in Bulletin II-2 by the methods described in Bulletin III-1.
(h) It was found that 1% of ordinary sodium carbonate was very effective in dispersing the kaolin used to simulate the clay and silt, and, by using this material, it was found possible

to increase the concentration of clay in the water to 3%. A number of experiments were carried out, using asphalt sand for the bed material, followed by a few experiments in which Colorado River sand was used as the bed material. In these last experiments, Virginia clay was added to the kaolin in the water. Finally a few runs were made with Colorado River sand and with clear water.

(i) It was found that, in order to start the asphalt sand moving, a 40% higher mean velocity was required when the water contained considerable clay than when it was clear. However, when the mean velocity had been increased sufficiently to produce a substantial rate of scour, (say 10 lb per foot width of bed per hour), the mean velocity required to move the sand at a given rate was only about 30% greater for the clay-laden water than for the clear water. In the case of the fine Colorado River sand, (average diameter 110 microns), the velocity necessary to scour the sand appeared to be only about 10% greater with the clay-laden water than for the clear water for the same depths. The final report on this investigation is now being prepared.

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(171)(a) INVESTIGATION OF THE PRESSURE VARIATION IN THE UPSTREAM AND DOWNSTREAM SIDES OF AN ORIFICE PLATE.

(b) Scientific Data, National Bureau of Standards.

(c) National Bureau of Standards research.

(d) H. S. Bean, E. Buckingham, C. D. Shepard.

(e) The Director, U. S. Bureau of Standards.

(f) To obtain more complete data than is now at hand on the variations of pressure in the vicinity of an orifice plate, which will assist in better correlation of orifice coefficient data.

(g) Water from a constant head tank will be discharged through the orifice section of the line into either a weighing or calibrated tank. Simultaneous readings will be made of the pressure at 48 pressure openings extending from the orifice plate face to about 4 pipe diameters upstream and 10 pipe diameters downstream. It is planned to vary the ratio of orifice to pipe diameter from about 0.05 to over 0.8, and to vary the Reynolds number over at least 1 to 10 range for each orifice.

(h) Set-up in progress of erection.

(i) It is possible the same set-up will be used later for similar tests using air in place of water.

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(195)(a) LAWS OF SEDIMENT TRANSPORTATION.

(b) Proposed by U. S. Corps of Engineers and U. S. Bureau of Reclamation.

(c) General research.

(d) C. A. Wright, B. H. Monish.

(e) The Director, National Bureau of Standards.

(f) Study of the laws of transportation of bed load by flowing water.

(g) The following studies are planned: validity of Du Boys' law of tractive force as a criterion for the movement of bed load, taking account of the wall effect and the vertical velocity distribution curve; relation of bed load movement to mean and bottom velocities of water; critical tractive force for spheres of different sizes and specific gravities, for sand grains of uniform size, for various sand mixtures and different degrees of sharpness; effect on critical tractive force of fine silt or clay particles mixed with the sand; comparison of values of critical tractive force as determined by different criteria; tests of Kramer's sand uniformity factor; range of tractive force over which various sand mixtures are suitable for use in models, roughness coefficient for flume with sand bed; with non-movement of sand and with various degrees of sand movement and riffling.

(h) In connection with the experiments conducted for Project 129, a study was made of the vertical velocity distribution in the water at the upstream end of the approach to the sand bed.

(i) It was found that the bed velocity (0.01 ft above the bed) was about 83% of the mean velocity in the vertical section. However, no general relation could be found between the bed velocity and the amount of sand scoured. Because of the fact that no sand was fed in at the upper end of the flume, the progressive changes in slope of the water surface were too great to permit a study of the relation between tractive force and the scour produced.

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(196)(a) MODES OF TRANSPORTATION OF SAND BY FLOWING WATER.
(b) Proposed by the U. S. Geological Survey.
(c) General research.
(d) C. A. Wright, B. H. Monish.
(e) The Director, National Bureau of Standards.
(f) Study of the various modes of transportation of bed and suspended load by flowing water.
(g) Study of the formation, dimensions and motion of riffles and traveling banks under different conditions; quantity of bed load as related to depth, slope, velocity, etc.; velocity of travel of uniform sand grains and sand mixtures using colored grains; mechanism of suspension and laws of suspended load.
(i) Experiments in the flume used for Project 129 indicate that the critical mean velocity at which riffles are formed in a bed of asphalt sand increases from 1.00 fps for clear water to 1.40 fps when the water contains finely divided kaolin. For a bed of Colorado River sand, the corresponding mean velocities are 0.82 fps and 0.92 fps. Microphotographs showed the sand grains to be well rounded and the kaolin particles to be discs with rounded edges.

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(258)(a) STUDY OF DIVISORS FOR SOIL EROSION INVESTIGATIONS.
(b) Soil Conservation Service, U. S. Department of Agriculture.
(c) Data for calibration and design.
(d) H. L. Cook, D. A. Parsons.
(e) Chief, Soil Conservation Service.
(f) Calibration of divisors now in use; study of relative accuracy of various types; development of new divisors.
(g) Calibrations are made with both clear and silt-bearing water. Every known type of divisor, including many new types, is being investigated.
(h) Most of the older types of divisors have been investigated. Various new forms have been developed and are being tested. In conjunction with this investigation, a calibration has been made of the Lowdermilk tipping bucket gage for measuring runoff.

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(341)(a) STUDY OF MEASURING FLUMES OF THE VENTURI TYPE.
(b) Soil Conservation Service, U. S. Department of Agriculture.
(c) Data for calibration and design.
(d) H. L. Cook, D. A. Parsons.
(e) Chief, Soil Conservation Service.
(f) The development of improved devices for measuring the rate of runoff from plots used in the study of soil erosion.
(g) Tests are to be made of venturi-type flumes and control meters in an effort (1) to develop flumes with which more precise measurements of small flows may be obtained, and (2) to devise throat sections that will promote self-cleaning of the flumes,
(h) This investigation has been temporarily postponed. Tests will probably commence within the next three months.

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(342)(a) STUDIES OF ARTIFICIAL CONTROLS FOR STREAM-FLOW MEASUREMENT.
(b) U. S. Geological Survey, Water Resources Branch.
(c) Cooperative project with U. S. Geological Survey for comparative performance tests and general scientific research.
(d) R. B. Hunter and C. W. Elliot (National Bureau of Standards) W. S. Eisenlohr, Jr., (Geological Survey).
(e) C. H. Pierce, U. S. Geological Survey, Washington, D. C.
(f) To study the relative merits of the various designs of several district offices of the Survey, with a view to standardizing on a few selected types.
(g) Full size models are being tested in the 12-foot flume with flows ranging from 0.1 to 30 second-feet. Nine or more controls are to be tested including V-notch and trapezoidal-notch weir crest plates and various forms of concrete notches, inclined crests, and horizontal crests. Tests include calibration with free fall and submerged conditions and study of the effects of filling the channel above the control.
(h) The tests on nine full-scale controls and on modifications of three of these have been completed. The tests will be continued on three of the control weirs with full scale cross-sections in a 30-inch wide flume to study effects at higher heads than are obtainable in the 12-foot wide flume.

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(343)(a) ROUGHNESS IN PIPES.
(b) National Hydraulic Laboratory.
(c) General research.
(d) K. H. Beij, G. E. Golden.
(e) The Director, National Bureau of Standards.
(f) Study of hydraulic roughness in pipes.
(g) Correlation of friction losses with surface of pipes.
(h) Data have been obtained on a 4-inch galvanized iron pipe line, about 65 feet long, with screwed couplings. Chapters on "Glossary of Terms" and "Laboratory Tests on Small Closed Conduits" for the first report of the Committee for Research on Hydraulic Friction are being prepared. See pages 77 and 78 of Bulletin III-1 for information as to this committee.
(i) This investigation is carried on in connection with other projects as opportunity offers.

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(344)(a) EFFICIENCY OF WELL SCREENS.
(b) U. S. Geological Survey.
(c) General research.
(d) R. B. Hunter, B. H. Monish (National Bureau of Standards), and A. G. Fiedler (Geological Survey).
(e) A. G. Fiedler, U. S. Geological Survey.
(f) To determine the losses through well screens of a certain type.
(g) Tests of the efficiency of certain types of well screens previously tested in the field (See Project 265) at flows varying from 10 to 100 gallons per minute:(a) in clear water, and (b) in contact with a sand bed, pressure measurements being made in each test at various depths inside the well-screen and at the same depths outside the screen in contact with the sand bed. It is expected that these data will aid in correlating and interpreting the results of the field tests made by using Thiem's method.
(h) The apparatus is assembled and preliminary tests have been made on one screen.

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(345)(a) BIBLIOGRAPHY ON DRAFT TUBES.
(b) Tennessee Valley Authority.
(d) G. H. Keulegan, H. N. Eaton, E. Buckingham.
(e) Carl A. Bock, Asst. Chief Engineer, Tennessee Valley Authority, Knoxville, Tennessee,or the Director, National Bureau of Standards.
(f) To make a study of the literature on the subject of draft tubes for large water wheels published during the last twenty years and to prepare a report which will include an annotated bibliography.
(h) Abstracts of a large number of articles on the subject of draft tubes and diffusers have been prepared, and the report has been completed.
(i) A limited number of copies of the report and one copy of the abstracts are available for loan. After criticisms of the report have been received from engineers who are familiar with the subject of draft tubes, the report may be rewritten and published.

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(384)(a) TESTS OF SPILLWAY FLASHBOARD PINS.
(b) U. S. Forest Service.
(c) Cooperative project with the U. S. Forest Service for testing field designs under simulated field conditions in the laboratory.
(d) C. A. Wright and C. W. Elliot (National Bureau of Standards) C.A.Betts (U.S.Forest Service).
(e) The Director, National Bureau of Standards.
(f) To test spillway flashboard pins to failure under static water pressure and to compare the results with the values used in design.
(g) A five-panel length of flashboard sections will be built

diagonally in the 12-foot flume. The necessary static head to produce failure of the pins will be obtained by building rigidly-fixed flashboards above the collapsible sections, so that a 4-foot head of water can be provided above the crest of the collapsible flashboards.

(h) Plans for the tests have been completed, but construction will not be started for several weeks.

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HORTON HYDRAULIC AND HYDROLOGIC LABORATORY.

(290)(a) VELOCITY DISTRIBUTION IN STREAM CHANNELS.

(b) Scientific research.

(c) Scientific research.

(d) Robert E. Horton, C. W. Force and Laboratory staff.

(e) Robert E. Horton.

(g) Investigation comprises two parts: (1) A mathematical investigation of the form of velocity curves in open channels called for by the Manning formula; (2) An analysis and study of several hundred vertical velocity curves obtained in natural river channels, with a view to comparing the actual and theoretical curves.

(h) Investigation nearly completed and publication expected within a few months. See abstract in Bulletin III-1.

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(291)(a) BACK-WATER BY THE MANNING FORMULA.

(b) Scientific research.

(c) Scientific research.

(d) Robert E. Horton and Laboratory staff.

(e) Robert E. Horton.

(f) Improvement in methods of analysis of problems of non-uniform flow.

(g) An integral of the back-water function in terms of the Manning formula has been obtained and tables of back-water functions have been computed therefrom for rectangular channels. It is believed that the method has important advantages because of the fact that where, as is ordinarily the case, back-water calculations are based on the Chezy formula, with a constant coefficient, serious errors are involved when the depth varies because the coefficient is itself a function of the depth.

(h) Investigation completed but results not yet written up in form for publication.

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(292)(a) DISPERSION CURVES OF MANNING'S COEFFICIENT OF ROUGHNESS.

(b) Scientific research.

(c) Scientific research.

(d) Robert E. Horton and Laboratory staff.

(e) Robert E. Horton.

(f) The purpose is to provide a means of presentation of experimental values of the coefficient of roughness n in such a manner that the percentage of cases in which the observed coefficient has been found to be greater or less than a given value can at once be determined, thus leading to a more direct and certain method of selection by judgment of values of the coefficient of roughness applicable to a given case.

(g) All available values of the coefficient n for certain particular types of channels have been collated and plotted in the form of frequency curves. The analysis does not, however, cover all types of channels and covers only a limited number of classes of pipe surface.

(h) Investigation completed but results not yet written up in form for publication.

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(293)(a) FLOOD WAVES SUBJECT TO FRICTION CONTROL.

(b) Scientific research.

(c) Scientific research.

(d) Robert E. Horton and laboratory staff.

(e) Robert E. Horton.

(f) To provide a basis for practical determination of the crest velocity and change of form of natural flood waves in large rivers.

(g) This research relates to the theoretical aspects of the subject. It is founded on an experimental investigation conducted some years ago at the same laboratory, using a slope table 120 feet in length, for the purpose of determining experimental forms of flood wave crests. The experimental research was conducted in part for the Sanitary District of Chicago. The present research relates mainly to the analysis of the results and is predicated on the idea that the movement of a flood wave in rivers is not, on the one hand amenable purely to momentum control, like waves in still water; neither is it, on the other hand, subject solely to friction control, as in the case of non-uniform flow in channels.

(h) Experimental investigation completed; theoretical investigation in progress. Suggestions are desired from other laboratories interested in this same problem.
See Abstract in Bulletin III-1.

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(294)(a) RELATION OF CARRYING CAPACITY OF CAST IRON PIPE CONDUITS TO AGE IN SERVICE.

(b) Scientific research.

(c) Scientific research.

(d) Robert E. Horton.

(e) Robert E. Horton.

(f) Contribution to knowledge of the variation with age of the carrying capacity of water supply conduits and distribution mains.

(g) This investigation comprises mainly an analysis of continuous records covering five periods averaging one to three years each of variation in discharge coefficient with length of time in service since cleaning of a 24-inch water supply conduit at Utica, N.Y. It is shown that in this case the carrying capacity after cleaning decreases as an inverse exponential function of the time in service but does not approach zero as a limiting value. Causes of this are discussed and a comparison is made with other experimental data on the decrease in carrying capacity of pipe with age in service.

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(385)(a) SURFACE RUNOFF PHENOMENA.

(b) Scientific research.

(c) Scientific research.

(d) Robert E. Horton and laboratory staff.

(e) Robert E. Horton.

(f) To determine (1) the law governing depth and velocity of overland or sheet flow under natural conditions; (2) to provide a means of analyzing the hydrograph into its various component elements, including surface runoff, infiltration, accretion to soil moisture and ground-water flow; also to determine depth of surface detention during runoff, phenomena of surface runoff, amount of channel storage following surface runoff, and law governing depletion of channel storage.

(i) Part I of this investigation - developing a new method of determining the velocity and depth of sheet flow directly from a runoff hydrograph and rain intensity graph, has been published as Publ. 101, Horton Hydrological Laboratory, - Edwards Bros., Inc., Ann Arbor, Mich., pubr., price 75¢. Copies of this publication will be sent to hydraulic laboratories in exchange for their publications if desired. Part II, nearing completion, gives applications of the method of hydrograph analysis and develops the subject analytically. Part II will also contain full discussion of the factors which control direct surface runoff, and it is shown that these factors are: rain intensity and duration, aerial rainfall distribution on the drainage basin, infiltration capacity, initial detention in minor depressions on the ground surface, slope of the surface, roughness of the ground surface, and length of overland flow.

In Part II the discussion of the character of overland flow - whether turbulent, laminar or mixed - is continued, and it is shown that overland flow from natural drainage basins generally follows approximately the law $q = K\delta^M$, where K varies for different drainage basins and varies to some extent with different rainfall intensities on the same drainage basin. The exponent M is approximately 2.0, indicating that sheet flow or direct surface runoff is usually mainly turbulent but partly laminar. The value of the exponent M is, however, affected by variation in depth of sheet flow or surface detention, and this effect is discussed.

(386)(a) WIND VELOCITY NEAR THE GROUND.

(b) Scientific research.

(c) Scientific research.

(d) Robert E. Horton and laboratory staff.

(e) Robert E. Horton.

(f) Scientific research.

(g) Records of wind velocity 1 foot above ground at about sixty stations in the United States have been compared with measured wind velocities at nearby U.S.Weather Bureau stations at various heights up to 200 feet above ground and these results compared with existing formulas of Stevenson, Hellman and others and with their experimental data.

(i) Comparison is also made between the law governing wind velocity distribution and that of water in a wide stream channel for turbulent flow conditions. Consideration is also given to the conditions under which air flow over the ground surface is laminar, and the conclusions are reached:

1. That a different law of velocity distribution in natural wind currents above the ground surface pertains for turbulent and laminar flow.
2. That the existence of turbulence depends in a large measure on the difference between air and ground surface temperature.
3. That turbulence frequently exists over land surfaces at times when the air flow over adjacent large water bodies is laminar.
4. Some evidence is offered indicating that a sufficient depression of surface temperature of soil or water below the temperature of the adjacent air may inhibit not only convective turbulence but may also inhibit frictional turbulence.
5. It is also pointed out that there is a difference between the flow of air and the flow of water over a plane surface under natural conditions because of the fact that in the flow of water only frictional turbulence is ordinarily involved, whereas in the flow of air, convective turbulence usually predominates, if it is present, but frictional turbulence also exists, and the laws of velocity distribution in relation to distance from the surface are probably different for frictional and convective turbulence.
6. Application of the results to the theory of evaporation from broad water surfaces is considered and it is suggested that a different formula or set of laws governs evaporation according as the air flow is laminar or turbulent. It is shown that these facts apparently account for the abnormally low evaporation loss from some large lakes, such as Lake Superior, and for other anomalies of evaporation phenomena.

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PURDUE UNIVERSITY.

(47)(a) FLOW OF FLUIDS THROUGH CIRCULAR ORIFICES AND TRIANGULAR WEIRS.
(b) Purdue Engineering Experiment Station.
(c) General scientific research.
(d) F. W. Greve and Graduate Assistant.
(e) Professor F. W. Greve, School of Civil Engineering, West Lafayette, Indiana.
(f) To determine experimentally the effects of density, surface tension, temperature, and viscosity upon the rate of discharge through small circular orifices and triangular weirs.
(g) and (h) The capacity of the enlarged testing plant is approximately 1800 gals. The liquids used to date have been water and soap solutions of 0.03%, 0.06%, and 0.10% concentration, passing through circular orifices of 0.5, 1.0, 1.5 and 2.0-in. diameters, and 30, 60 and 90-degree triangular weirs. Fourteen tests were made on each opening at temperatures of approximately 80, 100, 120, and 140°F. Photographs were made of the jets issuing from the several orifices in order to study the vena contracta. The physical properties of the various liquids were determined in the chemistry laboratory.
(i) The investigation was enlarged since the last report to include triangular notches. The tests will be continued in the fall with dextrose solutions.

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IOWA INSTITUTE OF HYDRAULIC RESEARCH.

(107)(a) HYDRAULIC TEST ON MODEL OF MISSISSIPPI RIVER BELOW KEOKUK DAM.
(b) Corps of Engineers, U.S.A., Rock Island District.
(c) Institute projects.
(d) U. S. Engineer, Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) and (g) See Bulletin III-1.
(h) Project completed.
(i) Information concerning tests on this project may be had through the District Engineer, U. S. Engineer Office, St. Paul, Minnesota. The model was a general fixed-bed model used to determine backwater caused by the dam, current conditions at the locks and water-surface profiles after the structure was in place.

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(108)(a) MISSISSIPPI RIVER, LOCK AND DAM NO. 4, GENERAL MODEL.
(b) Corps of Engineers, U.S.A., St. Paul District.
(c) Institute project.
(d) U.S.Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) and (g) See Bulletin III-1.
(h) Project completed.
(i) See project 107 (i).

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(109)(a) STUDY TO IMPROVE HYDRAULIC SYSTEM OF NAVIGATION LOCKS, GENERAL MODEL.
(b) Corps of Engineers, U.S.A.
(c) Institute project and graduate thesis.
(d) U. S. Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) To eliminate as many as possible of the features now found to be unsatisfactory in river navigation locks and to increase the efficiency of the hydraulic systems of such locks.
(g) A typical barge lock was constructed 1/15 full size and has subsequently been altered to fit requirements developed by the tests. The model reproduces the complete hydraulic system of a lock.
(h) Improvements in lock chamber port shape have increased the rate of filling and emptying without occasioning turbulence in the lock. Tests have indicated changes necessary to prevent entrapment of air in the lock-wall culverts. Analysis is now being made of the flow conditions at the culvert outlets.
(i) It has been found that tainter gates used for control valves in the culverts are more satisfactory when faced downstream.

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(159)(a) TAINTER GATE COEFFICIENTS.
(c) Graduate thesis.
(e) Professor F. T. Mavis and Prof. J. W. Howe.
(f) To determine discharge coefficients for model installations.
(h) Tests to be resumed.

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(208)(a) A STUDY OF VORTEX MOTION.
(c) Graduate thesis.
(d) D. F. Djang.
(e) Prof. F. T. Mavis.
(f) To determine the effect of vortices on the sediment carrying power of streams.
(g) Problem approached from both mathematical and experimental standpoints.
(h) Project completed. (i) Abstract in this Bulletin.

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(211)(a) RELATION OF TAIL RACE FLOOR TO BOTTOM OF DRAFT TUBES.
(c) Graduate thesis.
(d) Andreas Luksch.
(e) Prof. F. T. Mavis.
(f) To determine the effect of location of tail race floor upon draft tube efficiency with and without spiral flow.
(h) Project completed.
(i) Abstract in this Bulletin.

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(212)(a) HYDRAULIC STUDY OF MODEL OF LOCK AND DAM NO. 26, MISSISSIPPI RIVER AT ALTON, ILLINOIS. (Site 8300 feet upstream from R.R. bridge.)
(b) U. S. Engineer Department.
(c) Institute project.
(d) U. S. Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) and (g) See Bulletin II-1.
(h) Project completed.

(i) Information concerning tests on this project may be had through the District Engineer, U. S. Engineer Office, St. Paul, Minnesota. The model was a general movable-bed model used to determine backwater caused by the dam, current conditions at the locks and water-surface profiles after the structure was in place.

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(213)(a) MISSISSIPPI RIVER, DAM NO. 26, GENERAL MODEL.
(b) Corps of Engineers, U.S.A., St. Louis District.
(c) Institute project.
(d) U. S. Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) and (g) See Bulletin III-1.
(h) Project completed.
(i) Information concerning tests on this project may be had through the District Engineer, U.S.Engineer Office, St. Paul, Minnesota. The model was a general movable-bed model used to determine backwater caused by the dam, current conditions at the locks and water-surface profiles after the structure was in place.

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(215)(a) MISSISSIPPI RIVER, DAM NO. 20, STILLING BASIN DESIGN.
(b) Corps of Engineers, U.S.A., Rock Island District.
(c) Institute project.
(d) U.S.Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) and (g) See Bulletin III-1.
(h) Project completed. The general criteria for stilling basin dimensions were determined.
(i) Information concerning tests on this project may be obtained through the District engineer, U. S. Engineer Office, St. Paul, Minnesota. The model consisted of a single gate and accessory structures set up in a glass-sided flume.

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(216)(a) MISSIPPI RIVER, LOCK & DAM, NO. 5.
(b) Corps of Engineers, U.S.A., St. Paul District.
(c) Institute project.
(d) U. S. Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) To determine (1) possible erosion of sand dam adjacent to spillways, (2) currents at the locks, (3) backwater caused by the dam, (4) the effectiveness of auxiliary spillways over the sand dam in reducing flood backwater, (5) certain specific effects of a freshet which damaged the construction railway in April, 1934, (6) possible erosion of a railway fill along the right bank of the river, and (7) the feasibility of using models for the study of silting.
(g) Tests are being made in a distorted fixed-bed model 1/500 full size in horizontal and 1/100 full size in vertical dimensions.
(h) That part of the investigation suggested by par. (f), parts (1) to (6), inclusive, is complete. The silting studies are in progress.

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(217)(a) THE EFFECT OF TRANSFACIAL VELOCITY ON DISCHARGE COEFFICIENTS OF ORIFICES AND SHORT TUBES.
(b) Corps of Engineers, U.S.A.
(c) Institute project.
(d) U. S. Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) To determine the effect on orifice and short tube discharge of flow past one face of the orifice or end of the tube. The ultimate purpose is to establish coefficients for lock port discharge.
(g) The apparatus consists of a rectangular, galvanized iron pipe 6 in. by 8 in. in cross section, 30 ft. long, with a 4 ft. mid-section of pyralin. Standard orifices or short tubes of varying dimensions can be inserted in the side of the pyralin section of the pipe so as to discharge into a tank wherein depths may be varied. Velocities in the 6-in. by 8-in. pipe may be varied from 0 to 9 ft./sec. Orifices or tubes may be submerged from 0 to 3.5 ft. Equipment is provided to measure the hydraulic gradient and velocity in the pipe, submergence of orifice, and discharge in either direction through the orifice.
(h) Calibrations have been made of a number of port shapes and of a standard 2-in. orifice with flow from the pipe into the tank representing the lock chamber. Some of the model ports have also been calibrated with flow passing from the tank into the pipe.
(i) The most efficient port yet tested has a "venturi" shape with the throat section near the pipe (lock culvert) end of the port. From the throat, the sides and top of the port expand into the lock chamber. Top and side at the junction with the culvert are rounded on a large radius. The corners at the lock chamber end are rounded on a small radius.

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(218)(a) MISSISSIPPI RIVER LOCK & DAM NO. 4, STILLING BASIN MODEL.
(b) Corps of Engineers, U.S.A., St. Paul District.
(c) Institute project.
(d) U.S.Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) and (g) See Bulletin III-1.
(h) Project completed. Designs for roller and tainter gate basins were studied; tests on double-leaf, vertical-lift gates were made.
(i) See Project 215(i)

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(220)(a) HYDROSTATIC PRESSURES ON ROLLER GATES.
(b) Corps of Engineers, U.S.A.
(c) Institute project.
(d) U.S.Engineer Department Staff aided by Rock Island District Office.
(e) Martin E. Nelson, Associate Engineer.
(f) To determine distribution of hydrostatic pressure on model

and full size roller gates under various conditions of operation.

(g) Tests were made on a model gate 1/22.53th full size in which the heads on piezometers spaced around the gate were measured. An investigation of pressure distribution on submergible roller gates and their sills has been made in a 1/20th size model. Piezometers have been installed around gate No. 9, Dam No. 15, at Rock Island, Mississippi River upon which prototype measurements will be made.

(h) Tests on the model gate are completed. Three of a continuing series of tests have been made at Dam No. 15.

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(221)(a) TESTS ON SAND DAMS.

(b) Corps of Engineers, U.S.A., St. Paul District.

(c) Institute project.

(d) U.S.Engineer Department Staff.

(e) Martin E. Nelson, Associate Engineer.

(f) To design crests which will carry flood flows over sand dams and to study seepage through the dams under various amounts of submergence.

(g) Tests on a 1/5 size model have been made in a glass flume. A 1/2 size model, embodying the results of tests on the small model, will be built and tested in a 10-ft. concrete canal.

(h) Tests on the 1/5 size model are complete.

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(305)(a) AN ANALYTICAL AND EXPERIMENTAL STUDY OF THE FLOW OF WATER THROUGH SANDS.

(c) Graduate theses.

(d) E. F. Wilsey and C. C. Wang.

(e) Prof. F. T. Mavis.

(f) Additional experiments on uni-granular sands and mixtures.

(h) Project completed.

(i) Abstract in this bulletin.

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(306)(a) DISCHARGE COEFFICIENTS FOR SUBMERGED MODEL SPILLWAYS.

(e) Prof. F. T. Mavis.

(h) Preliminary tests completed.

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(307)(a) STABILITY OF EMBANKMENTS IN WATER.

(c) Graduate thesis.

(d) Prof. A. F. Meyer and F. R. Hoehl.

(e) Prof. F. T. Mavis.

(f) To investigate load-settlement relations for model embankments under different saturation conditions.

(h) First study complete.

(i) This study by Lt. F. R. Hoehl dealt with the settlement of various loads placed on small model embankments having various degrees of saturation. The loads were applied over an area 12 in. by 3 1/4 in. to sand embankments 4 in. wide on top with side slope 1 1/2 to 1, 2 to 1, and 2 1/2 to 1. Load-settlement curves were prepared for each of several series of tests in which the moisture content of the embankment was varied.

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(309)(a) A STUDY OF THE FORMATION OF VORTICES ABOVE OUTLETS.
(c) Graduate thesis.
(d) Prof. C. J. Posey and graduate students.
(e) Prof. F. T. Mavis.
(f) To study the similarity of vortices.

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(310)(a) STILLING POOLS FOR SPILLWAYS.
(c) Graduate thesis.
(d) C. W. Kinney.
(e) Prof. F. T. Mavis.
(f) Compilation and analysis of data from model tests. Additional tests in progress.
(h) Preliminary study complete.
(i) A thesis by C. W. Kinney reports experiments conducted to investigate the use of the hydraulic jump as a means of preventing erosion below model spillways. In the experiments the hydraulic jump was formed on a smooth apron below an under-shot gate. A sill of rectangular cross section was fastened to the lower end of the apron. The opening beneath the under-shot gate, the quantity of discharge, the length of apron and the height of sill were varied and observations were made of the erosion of the sand below the apron. The studies are to be carried further on both a larger and a smaller scale of apparatus.

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(311)(a) TRANSPORTATION OF BOTTOM LOAD IN OPEN CHANNELS.
(c) Graduate thesis.
(d) Te Yun Liu.
(e) Prof. F. T. Mavis.
(f) Studies of capacity for traction.
(i) Progress report in this bulletin.

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(312)(a) A LABORATORY INVESTIGATION OF OVERFLOW SECTIONS WITH SAND CORE.
(c) Graduate thesis.
(d) Prof. A. F. Meyer and H. J. Skidmore.
(e) Prof. F. T. Mavis.
(f) Model study of certain proposed paving and stabilizing structures.
(h) Project complete.
(i) Abstract in this Bulletin.

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(313)(a) THE SOLUTION OF CERTAIN TWO-DIMENSIONAL FLOW PROBLEMS BY MEANS OF AN ELECTRICAL ANALOGY.
(c) Graduate thesis.
(d) H. F. Sykes.
(e) Prof. F. T. Mavis.
(f) The third of a series of theses dealing with the applications and limitations of the electrical analogy. Intended to complete certain aspects of a program of study begun in 1928.
(h) Project completed.
(i) Abstract in this Bulletin.

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(314)(a) LABORATORY STUDY OF GROUND WATER PROFILES.
(c) Graduate thesis.
(d) T. P. Tsui.
(e) Prof. F. T. Mavis.
(h) Preliminary study complete. Investigation being continued.
(i) Progress report in this bulletin.

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(315)(a) ANALYSIS OF PRECIPITATION AND FLOOD RECORDS FOR IOWA.
(b) Iowa State Planning Board.
(c) Cooperative project, - R. H. Matson, coordinator.
(d) F. T. Mavis, Edward Soucek and Staff.
(e) Prof. F. T. Mavis.
(h) Frequency-intensity studies for precipitation virtually completed to date. Duration tables for flow and flood studies completed.

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(316)(a) HYDROLOGIC STUDIES - RALSTON CREEK WATERSHED.
(c) Cooperative project, - Bureau of Agricultural Engineering, U. S. Dept. of Agriculture, and U. S. Geological Survey.
(d) D. L. Yarnell, R. G. Kasel, and C. W. Kinney.
(e) Prof. F. T. Mavis.
(h) Continuous records, since 1924, of precipitation, run-off, ground water levels, and cover. Drainage area of 3 sq. mi. of rolling agricultural land near east city limits of Iowa City.

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(317)(a) COOPERATIVE STREAM GAGING IN IOWA.
(c) Cooperative project - U. S. Geological Survey.
(d) R. G. Kasel and staff.
(e) Prof. F. T. Mavis.
(h) Stream gaging stations are maintained cooperatively at stations on major watersheds in Iowa. Report on surface water resources of Iowa is being prepared.

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(318)(a) HYDRAULICS OF SAND FILTERS.
(c) Graduate theses.
(d) Prof. E. L. Waterman, R. J. Schliekelman and G. C. Ahrens.
(e) Prof. F. T. Mavis.
(f) To study the hydraulic characteristics of filter sands in tubular sections of a filter.
(h) Preliminary tests completed. Studies to be continued.

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(319)(a) TENNESSEE RIVER, PICKWICK DAM.
(b) Corps of Engineers, U.S.A., Nashville District.
(c) Institute project.
(d) U.S.Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) and (g) See Bulletin III-1.
(h) Project completed.
(i) See Project 107 (i).

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(320)(a) TENNESSEE RIVER, PICKWICK LOCK HYDRAULIC SYSTEM, GENERAL MODEL.
(b) Corps of Engineers, U.S.A., Nashville District.

(c) Institute project.
(d) U. S. Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) and (g) See Bulletin III-1.
(h) Project completed.
(i) In this model were set up and tested all features of the hydraulic system for the 65-ft. lift lock at Pickwick Landing. Many improvements over first proposals were developed. Information may be had through District Engineer, U.S.Engineer Office, St.Paul, Minn.

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(387)(a) KANAWHA RIVER, WINFIELD DAM, GENERAL MODEL.
(b) Corps of Engineers, U.S.A. Huntington District.
(c) Institute project.
(d) U.S.Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) To determine (1) swell head caused by project structures, with and without backwater from the Ohio River, (2) the effects in the lower lock approach of operation of the power-house, roller gates, and flap-crest gates, (3) effectiveness of ports in the upper guard wall in eliminating the draw around the nose of the wall.
(g) Tests are being made in a fixed bed model 1/125 full size. The model covers a 7800-ft. reach of river with the project structures at about the mid-point.
(h) A part of the information listed in par. (f) has been obtained for the condition of no backwater from the Ohio River.

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(388)(a) KANAWHA RIVER, WINFIELD DAM, STILLING BASIN MODEL.
(b) Corps of Engineers, U.S.A., Huntington District.
(c) Institute Project.
(d) U. S. Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) To supply the following information:(1) best shape and dimensions of sill for a standard-type roller gate; (2) best shape and dimensions of sill for a flap-type roller gate for over and under discharge; (3) dimensions and arrangement of a stilling basin for the dam; and (4) shape and size of roller gate pier noses and tails.
(g) A model of one roller gate and its supporting piers was constructed 1/46.12th full size in a glass-sided flume.
(h) Observations of relative scour in a sand bed below the model provided information leading to design of the stilling basin. Observations of flow lines and pressure measurements made on the gate sill provided data for a tentative sill shape.
(i) Pressure distribution tests will be run on sectional models of the roller gate sills built to one or more scales different from that already used.

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(389)(a) MISSISSIPPI RIVER, DAM NO. 7, ONALASKA SPILLWAY.
(b) Corps of Engineers, U.S.A., St. Paul District.
(c) Institute project.

(d) U. S. Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) To investigate the effectiveness of a stilling basin designed for this combination overfall and culvert spillway and to develop improvements, if indicated.
(g) The model consists of a section of stilling basin and spillway 1 ft. long built 1/20th full size. It is set up in a small, glass-sided flume.
(h) Improvements have been worked out which improve the stilling basin action, and increase the hydraulic efficiency of the culvert spillway.

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(390)(a) MISSISSIPPI RIVER, LOCK & DAM NO. 11.
(b) Corps of Engineers, U.S.A., Rock Island District.
(c) Institute project.
(d) U. S. Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) To provide information on a layout for the spillways of this navigation dam which would cause least damage to a highway bridge approach fill below the structures.
(g) Tests are run in a distorted model with a fixed bed, except for a reach directly below the model dam which is movable bed. Horizontal dimensions are 1/200th full size and vertical dimensions are 1/80th full size.
(h) Final arrangement of the spillway has been fixed. A model dam is now under construction which will exactly simulate the prototype.
(i) Tests will be run for comparison with measurements to be made later in the prototype.

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(391)(a) OGEE SPILLWAY TESTS.
(b) Corps of Engineers, U.S.A., Rock Island District.
(c) Institute project.
(d) Martin E. Nelson, Associate Engineer.
(f) To calibrate overfall spillways, shaped in accordance with designs used on Upper Mississippi River dams, under extremes of submergence.
(h) The project has not yet been started.

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(392)(a) PERCOLATION THROUGH FOUNDATION MATERIALS.
(b) Corps of Engineers, U.S.A., St. Paul District.
(c) Institute project.
(d) U. S. Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) To determine the resistance to percolation and quickening of foundation sands from the sites of Mississippi River Dams No. 5 and 7.
(g) Testing procedure was approximately the same as that ascribed to Terzaghi by Harza in an article "Uplift and Seepage under Dams," Proc. A.S.C.E., Sept., 1934. The apparatus was of local design, consisting primarily of a transparent cylinder 18 in. in diameter, containing the sample undergoing test, and an

arrangement so that flow could be passed upward or downward under different heads.

(h) Tests on the sands as received and with overloads of gravel are complete.

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(393)(a) ROLLER GATE COEFFICIENTS.

(b) Corps of Engineers, U.S.A., Rock Island District.

(c) Institute project.

(d) U.S.Engineer Department Staff augmented by personnel from Rock Island District.

(e) Martin E. Nelson, Associate Engineer.

(f) To determine discharge coefficients for an 80 by 20-ft. roller gate and to determine quantitatively the effect of end contraction caused by pier noses.

(g) Investigations will be carried out on a model of three roller gates 1/18th full size. Calibrations will be made for a full range of gate openings and stages in upper and lower pools.

(h) Tests have not been started.

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(394)(a) ROLLER GATE STILLING BASINS.

(b) Corps of Engineers, U.S.A., Rock Island District.

(c) Institute project.

(d) U.S.Engineer Department Staff augmented by personnel from Rock Island District.

(e) Martin E. Nelson, Associate Engineer.

(f) To obtain a stilling basin adequate to protect the river bed from the large discharges required to pass ice under the roller gates of Upper Mississippi River dams built on erodible foundations. Also to design an apron for a submergible gate which will accomplish the same purpose.

(g) A model of three 80 by 20 ft. roller gates 1/18th full size is provided for this study. Approximately 50 ft. of sand bed 2 ft. deep is provided to indicate relative effectiveness of expedients tested.

(h) Tests on the standard type roller are complete. The investigation involving a roller gate submergible to a depth of 8 ft. is under way.

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(395)(a) SUBMERGIBLE TAINTER GATE.

(b) Corps of Engineers, U.S.A., Rock Island District.

(c) Institute project.

(d) U.S. Engineer Department Staff.

(e) Martin E. Nelson, Associate Engineer.

(f) To determine whether or not a gate of this type was feasible.

(g) A model of a 60 by 20-ft tainter gate, submergible to a depth of 8 ft, and appurtenant structures have been built 1/28.87th full size in a glass-sided flume. The investigation will cover: (1) water loads on the gate, (2) characteristics of flow over and under the gate, (3) discharge capacity of the gate, and (4) stilling basin design.

(h) Testing has just been started.

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(396)(a) VORTEX TESTS.
(b) Corps of Engineers, U.S.A., St. Paul District.
(c) Institute project.
(d) U.S.Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) To investigate the starting head for orifices of various shapes and dimensions in the sides and in the bottoms of containers.
(h) This project has not been started.

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(397)(a) WHITEWATER RIVER, SILTING STUDIES.
(b) Corps of Engineers, U.S.A., St. Paul District.
(c) Institute project.
(d) U. S. Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) To investigate the effect upon deposition of silt at certain critical sections of the Whitewater River when it becomes affected by backwater from Mississippi River Dam No. 5.
(h) This project has not been started.

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(398)(a) KANAWHA RIVER, MARMET LOCK & DAM.
(b) Corps of Engineers, U.S.A.
(c) Institute project.
(d) U. S. Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) To determine backwater, current conditions, surface profiles, etc.
(g) General model with fixed bed.
(h) Project completed.
(i) Information concerning these tests may be had through the District Engineer, U.S.Engineer Office, St. Paul, Minnesota.

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(399)(a) KISKIMINITAS RIVER, LOCK AND DAM NO. 2.
(b) Corps of Engineers, U.S.A.
(c) Institute project.
(d) U.S.Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) To determine backwater, current conditions, surface profiles, etc.
(g) General model with fixed bed.
(h) Project completed.
(i) Information concerning these tests may be had through the District Engineer, U.S.Engineer Office, St. Paul, Minnesota.

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(400)(a) MISSISSIPPI RIVER, LOCK AND DAM NO. 2.
(b) Corps of Engineers, U.S.A.
(c) Institute project.
(d) U. S. Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) To determine backwater, current conditions, surface profiles, etc.
(g) General model with fixed bed.
(h) Project completed.
(i) Information concerning these tests may be had through the

District Engineer, U.S.Engineer Office, St. Paul, Minnesota. The following paper has been published: "Laboratory tests on Hydraulic Models of the Hastings Dam," by Martin E. Nelson, Bulletin 2, University of Iowa Studies in Engineering, July 1, 1932.

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(401)(a) MISSISSIPPI RIVER,LOCK AND DAM NO. 15.
(b) Corps of Engineers, U.S.A.
(c) Institute project.
(d) U. S. Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) To determine backwater, current conditions, surface profiles,etc.
(g) General model with fixed bed.
(h) Project completed.
(i) Information concerning these tests may be had through the District Engineer, U. S. Engineer Office, St. Paul, Minnesota.

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(402)(a) OHIO RIVER, MONTGOMERY ISLAND LOCK & DAM.
(b) Corps of Engineers, U.S.A.
(c) Institute project.
(d) U. S. Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) To determine backwater, current conditions, surface profiles,etc.
(g) General model with fixed bed.
(h) Project completed.
(i) Information concerning these tests may be had through the District Engineer, U.S.Engineer Office, St. Paul, Minnesota.

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(403)(a) KANAWHA RIVER, MARMET LOCK AND DAM.
(b),(c),(d),(e),(g),(h) and (i), see Project No. 398.
(f) Study of the design of stilling basin, including dimensions and arrangement of baffle piers, end sill and apron.

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(404)(a) MONONGAHELA RIVER, NEW DAM NO. 4.
(b) Corps of Engineers, U.S.A.
(c) Institute project.
(d) U. S. Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) Study of the design of stilling basin, also a detailed study of pressures over two shapes of ogee spillway.
(g) General model with fixed bed.
(h) Project completed.
(i) Information concerning these tests may be had through the District Engineer, U.S.Engineer Office, St. Paul, Minnesota.

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(405)(a) HYDRAULIC INSTRUMENTS.
(b) Corps of Engineers, U.S.A.
(c) Institute project.
(d) U. S. Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) Development of various hydraulic instruments for use in investigations.

(h) Satisfactory propeller-type current meters with 1-in. wheels have been developed and used for some time. A Bentzel-type meter has been constructed with a rubber float which gives promise of being self-compensating for variation in water temperature. (This project is continuous.)

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(406)(a) CLINCH RIVER, NORRIS DAM.

(b) Corps of Engineers, U.S.A.

(c) Institute project.

(d) U. S. Engineer Department Staff.

(e) Martin E. Nelson, Associate Engineer.

(f) This model was built to devise tunnels to carry river flow through the base of the Norris Dam at certain stages of the construction period.

(h) Project completed.

(i) Information concerning these tests may be had through the District Engineer, U. S. Engineer Office, St. Paul, Minnesota.

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(407)(a) HYDRAULIC SYSTEM FOR OHIO RIVER BEARTRAP GATES.

(b) Corps of Engineers, U.S.A.

(c) Institute project.

(d) U. S. Engineer Department Staff.

(e) Martin E. Nelson, Associate Engineer.

(f) Tests were run on a 1/10th size model of a typical beartrap gate to devise a method of flushing silt from the pressure chamber.

(h) Project completed.

(i) Information concerning these tests may be had through the District Engineer, U.S.Engineer Office, St. Paul, Minnesota.

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(408)(a) STUDY OF FLOW OVER SAND DIKES.

(b) Corps of Engineers, U.S.A.

(c) Institute project.

(d) Karl Jetter.

(e) Martin E. Nelson, Associate Engineer.

(h) Project completed.

(i) Results given in thesis for M. S. degree, "Tests on Sand Dikes Protected against Erosion by Overflowing Water", by Karl Jetter, State University of Iowa, August, 1931.

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STANFORD UNIVERSITY.

(337)(a) HYDRAULIC MODEL EXPERIMENTS FOR THE DESIGN OF SPILLWAY FOR SAN FRANCISQUITO RESERVOIR, SAN MATEO COUNTY, CALIFORNIA.

(b) Stanford University.

(c) A laboratory investigation of physical works being designed for early future construction.

(d) J. G. Rawhauser.

(e) Comptroller's Office, Stanford University, California.

(f) To develop form and dimensions of chute type spillway of adequate capacity, affording the greatest economy of construction at the site available.

(g) Model of spillway with ogee lip and chute type waste channel constructed on scale of 1:50, tested with various forms weir ends and converging channel walls.
(h) Experimental work completed and report written.
(i) The spillway model on a scale of 1:50 was built to represent a spillway lip 300 feet long with an ogee section 5 feet high and a waste channel with 1 1/2:1 slopes contracting gradually by smooth curves from the full bottom width of 300 feet at the weir lip to a bottom width of 40 feet in the steepest portion of the chute at a distance of 350 feet from the lip. By the use of modeling clay applied inside the original model construction four additional shapes of end contraction and side wall curvature were developed.

Upon each of the five forms thus made available a series of from 16 to 22 tests was run with a range of discharge from 2,000 to 20,000 c.f.s. The discharge formula for each form was derived and close study made of the positions of standing waves in the channel with particular reference to the required height of side walls.

A report of sixteen pages prepared by Mr. Rawhauser summarizes the results of these investigations with photographs of models under test and diagrams of discharge formula derivation, is available in the files of the Comptroller at Stanford University. Details of all test data and calculations are also on file for reference.

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U. S. GOVERNMENT DEPARTMENTS (continued).

U. S. WATERWAYS EXPERIMENT STATION.

(51)(a) SUSPENDED LOAD INVESTIGATIONS.
(b) Mississippi River and Tributaries.
(c) All experiments are prosecuted to the end of aiding in the development of plans for flood control, harbor improvement, navigation, etc. All have a direct practical application to the work of the Corps of Engineers, U. S. Army, in its administration of the Rivers and Harbors of the Nation. The U. S. Waterways Experiment Station holds as an unvarying principle the maintenance of the closest contact with the field in all experimental work. This contact is kept both by Station personnel visiting the prototype and by engineers from the field visiting the Station while any particular model study is in progress.
(d) All experiments are conducted at the U. S. Waterways Experiment Station by personnel of the Station under the direction of Lieut. Francis H. Falkner, Director of the Station.
(e) The Director, U.S.Waterways Experiment Station.
(f) Study of suspended load carried by the Mississippi River, its tributaries, and the Atchafalaya River - silting of reservoirs -

study of the behavior of different sediment traps. Design of new traps.
(g) Field and laboratory investigations, analyses of samples, compilation of curves, comparison of results obtained from different traps.
(h) Studies for 1930-31 reported on, other studies still in progress.
(i) See list of publications, U.S.Waterways Experiment Station. *

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(52)(a) SOIL INVESTIGATIONS.
(b) Navigable Waterways, U.S.A.
(c) (d) and (e) See (51).
(f) Study physical properties of soils, especially as they pertain to levee construction.
(g) Mechanical Analyses, Atterburg Limits, permeability tests, microscopic examinations, specific gravity determinations, shear and compression tests of samples undisturbed and otherwise, obtained under the supervision of the Station. Study of subsidences by use of pre-set plates established throughout the compressible strata at critical points for measuring the progress of consolidation in the strata. Checking observed results against anticipated settlement determined from study of undisturbed samples of foundation material.
(h) Studies in progress continually.

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(59)(a) LEVEE SEEPAGE.
(b) Mississippi River Commission.
(c) (d) and (e) See (51).
(f) Study and observe hydraulic gradient and flow lines in levees and models of levees of standard sections of various materials placed by various methods.
(g) Loop of levees, standard section, 10 feet high, of various materials and placed in various ways, kept full; measurements taken.
(h) First phases of experimental work complete. Study presently inactive.

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(74)(a) TRACTIVE FORCE.
(b) Mississippi River Commission.
(c) (d) and (e) See (51).
(f) To determine relation between physical properties of bed-load materials and tractive force required to move them. Also to determine laws governing rate of bed load movement.
(g) Tests in special tilting flume checked by special runs in models.
(h) Initial phases of experimental work complete. Tests are being continued, using artificial mixtures, in glass-sided flume. Range of sizes to be extended to include small gravels.

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* See Bulletin II-2, pages 46-47.

(i) Results of initial tests ate contained in Paper 17. Results of tests of coarse materials are contained in Technical Memorandum 69-1.

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(77)(a) ISLAND NO. 35, MISSISSIPPI RIVER.
(b) Mississippi River Commission.
(c) (d) and (e) See (51).
(f) Develop methods of improving navigation conditions.
(g) Movable bed model of river from Mile 181.4 to 204.0, below Cairo. Model scales are 1:600 horizontal and 1:150 vertical.
(h) Original experiment and additional studies completed. Model temporarily inactive.
(i) Reports of original experiment included in Technical Memoranda Nos. 29, 29-2, 3, 4, 5, 6, 7, U. S. Waterways Experiment Station. Report on most recent study being prepared as Technical Memorandum No. 29-8.

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(91)(a) MISSISSIPPI RIVER MODEL NO. 4 - INCLUDING THE MISSISSIPPI RIVER FROM MILE 560 TO MILE 655 BELOW CAIRO.
(b) Mississippi River Commission.
(c) (d) and (e) See (51).
(f) Miscellaneous problems involving flood control and channel stabilation between the limits specified in (a). Reaches studies: Millikens Bend, King's Point, Racetrack Towhead, Diamond Point Cut-off, Buckridge Crossing, and Yucatan Point Cut-off.
(g) Model scales:1 to 1000 horizontal and 1 to 100 vertical; movable bed. For most recent tests the movable bed was fixed.
(h) Model intermittently active.
(i) Results of these studies are described in Technical Memoranda Nos. 34, 34-2, 38-1, 47-1, 47-2, 47-3, 47-4, 47-5, 58-1, 58-2, 58-3, U. S. Waterways Experiment Station. Technical Memorandum No. 72-1 describes the results of a channel capacity study made with model bed fixed.

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(92)(a) MISSISSIPPI RIVER MODEL NO. 5 - INCLUDING THE MISSISSIPPI RIVER FROM MILE 650 TO MILE 762.5 BELOW CAIRO.
(b) Mississippi River Commission.
(c) (d) and (e) See (51).
(f) Miscellaneous problems involving flood control and channel stabilization within the limits specified in (a). Reaches studied: Dondurant Towhead, Waterproof Cut-off, Rifle Point, Coppen Point Cut-off, Natchez Island, Esperance Point - Morville Landing, Glasscock Point Cut-off.
(g) Model scales: 1 to 1000 horizontal and 1 to 100 vertical; movable bed.
(h) In progress.
(i) Results of these studies are described in Technical Memoranda Nos. 32-1, 32-2, 32-3, 32-4, 42-1, 42-2, 42-3, 42-4, 42-5, 60-1, U. S. Waterways Experiment Station.

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(152)(a) ROBINSON CRUSOE ISLAND, MISSISSIPPI RIVER.
(b) District Engineer, Memphis, Tennessee.
(c)(d) and (e) See (51).
(f) Study of proposed regulating works.
(g) Movable bed model from Mile 208.1 to Mile 250.9 below Cairo.
(h) Experiment completed.
(i) Report included in Technical Memoranda Nos. 44-1, 2, 3, 4 and 5, U. S. Waterways Experiment Station.

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(153)(a) ARTICULATED CONCRETE MATTRESS STUDY.
(b) U.S. District Engineer, Memphis, Tennessee.
(c) (d) and (e) See (51).
(f) Relative protection afforded banks by two types of articulated concrete mattress.
(g) Installation of full size mattress units on the banks of the creek from which Station water supply is derived. Observations of erosion from floods will be made.
(h) In progress.

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(163)(a) MISSISSIPPI RIVER MODEL NO. 1, INCLUDING THE MISSISSIPPI RIVER FROM MILE 390 TO MILE 810 BELOW CAIRO, THE RED RIVER FROM ITS MOUTH TO MILE 33 ABOVE BARBRE LANDING, AND THE ATCHAFALAYA RIVER FROM ITS HEAD TO MILE 35 BELOW BARBRE LANDING.
(b) Mississippi River Commission.
(c) (d) and (e) See (51).
(f) Miscellaneous problems affecting water surface elevations within the limits specified in (a). Problems studied: Ten proposed cut-offs, Leland and Tarpley Neck Cut-offs, Brunswick Levee Extensions, Natchez Levee Set-back, and Enlargement of the Atchafalaya River.
(g) Model scales 1 to 2400 horizontal and 1 to 120 vertical; fixed bed.
(h) Present series of tests completed. Model temporarily inactive.
(i) Results of several studies are described in Technical Memoranda Nos. 25, 25-A, 25-B, 25-C, 25-D, 34, 34-2, 50-1, 50-2, U. S. Waterways Experiment Station.

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(165)(a) MISSISSIPPI RIVER BED MATERIAL SURVEY.
(b) Mississippi River Commission.
(c) (d) and (e) See (51).
(f) To determine characteristics of material composing the bed of the Mississippi River and its principal tributaries.
(g) Samples taken from bed of Mississippi River at about one-mile intervals from Cairo to Gulf of Mexico, and from beds of Ohio, Old, Red, Black and Atchafalaya Rivers, and the Atchafalaya Basin. Supplementary samples later taken from Arkansas, White, Ouachita, Yazoo, St. Francis, Ohio, Tennessee, Cumberland, Wabash, Missouri, and Illinois Rivers. Special trap used for procuring samples. Mechanical and hydrometer analysis, specific gravity test, and microscopic examination were made of each sample. Petrographic study is being made.

(h) Analysis of samples from Mississippi, Ohio, Atchafalaya, Red, Black, and Old Rivers completed and tabulated. Analyses of other tributary samples completed and being tabulated. Petrographic study in progress.
(i) Paper 17 includes results of analyses of Mississippi, Ohio, Atchafalaya, Red and Old River samples.

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(166)(a) U. S. INTRACOASTAL WATERWAYS CROSSING WITH BRAZOS RIVER DIVERSION CHANNEL, NEAR FREEPORT, TEXAS.
(b) U. S. District Engineer, Galveston, Texas.
(c) (d) and (e) See (51).
(f) Study to eliminate shoaling in canal caused by waters of Brazos River.
(g) Scale 1 to 200 horizontal and 1 to 45 vertical. A silt-laden discharge of water and bed material added to the stream were used in simulating flow in Brazos River Diversion Channel. Various improvement plans were tested.
(h) Completed.
(i) Results of experiment are in Technical Memorandum No. 54-1, U. S. Waterways Experiment Station.

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(168)(a) HEAD OF PASSES, MISSISSIPPI RIVER.
(b) U. S. District Engineer, 1st N.O.District, New Orleans, La.
(c) (d) and (e) See (51).
(f) Determine methods of improving navigation conditions at Head of Passes.
(g) Movable bed model extending from 8 miles above to 6 miles below Head of Passes. Model scales 1:600 horizontal and 1:150 vertical.
(h) Original studies completed. Additional studies requested by Board of Review of Proposed Plans for Improvement of Southwest Pass are now in progress.
(i) Reports on original studies included in Technical Memoranda Nos. 46-1, 2, 3, 4, U. S. Waterways Experiment Station.

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(169)(a) SOUTHWEST PASS, MISSISSIPPI RIVER.
(b) District Engineer, 1st New Orleans District, New Orleans, La.
(c) (d) and (e) See (51).
(f) Determine methods of improving channel conditions in Southwest Pass.
(g) Movable bed model from Mile 8.8 below Head of Passes to Gulf of Mexico. Model scales: 1:1000 horizontal and 1:125 vertical.
(h) Experiment completed.
(i) Report included in Technical Memoranda Nos. 45-1, 2, 3, 4, 5, 6, U. S. Waterways Experiment Station.

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(170)(a) MISSISSIPPI RIVER MODEL NO. 2, INCLUDING THE MISSISSIPPI RIVER FROM MILE 370 TO MILE 445 BELOW CAIRO, 60 MILES OF THE ARKANSAS RIVER, AND 16 MILES OF THE WHITE RIVER.
(b) Mississippi River Commission.
(c) (d) and (e) See (51).
(f) Determine effects of separating mouths of Arkansas and White Rivers; also effects of cut-offs on these rivers upstream from mouth, and miscellaneous problems for channel stabilization and navigation.

(g) Model scales 1 to 1000 and 1 to 100; fixed bed.
(h) Temporarily inactive.
(i) Partial results of this study are described in Technical Memorandum No. 51-1.

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(198)(a) FITLER BEND, MISSISSIPPI RIVER.
(b) Mississippi River Commission.
(c) (d) and (e) See (51).
(f) Study for improvement of navigation and miscellaneous hydraulic problems.
(g) Model scales 1 to 500 and 1 to 150; movable bed.
(h) Temporarily inactive.
(i) Results to date of this study are described in Technical Memorandum No. 56-1.

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(199)(a) ARANSAS PASS, GULF OF MEXICO.
(b) The Division Engineer, Gulf of Mexico Division.
(c) (d) and (e) See (51).
(f) To determine best improvement for navigation channel through pass.
(g) Tidal study. Scale of model, 1 to 500 horizontal and 1 to 100 vertical. A reversible flow of water simulating tidal action, and a movable bed, is used to test proposed improvement works.
(h) Completed.
(i) Results described in Technical Memorandum No. 67-1.

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(200)(a) FORT CHARTRES, MISSISSIPPI RIVER.
(b) District Engineer, St. Louis, Missouri.
(c) (d) and (e) See (51).
(f) Develop dike system to improve depths over crossings in vicinity of Ste. Genevieve.
(g) Movable bed model from Mile 137 to Mile 112 above Cairo. Model scales: 1:1000 horizontal and 1:125 vertical.
(h) Completed.
(i) This experiment supplemented previous study of the river between Miles 137 and 120 above Cairo. (See (83) Report No. I-3, Oct.1, 1933). This study is reported in Technical Memoranda Nos. 49-1, 2, 3, and 4, U. S. Waterways Experiment Station.

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(253)(a) CAT ISLAND, MISSISSIPPI RIVER.
(b) U. S. District Engineer, Memphis, Tennessee.
(c) (d) and (e) See (51).
(f) Study of proposed regulating works.
(g) Movable bed model from Mile 241.2 to Mile 275.0 below Cairo. Model Scales: 1:1000 horizontal and 1:125 vertical.
(h) Experiment in progress.
(i) Partial report included in Technical Memorandum No. 63-1, U.S. Waterways Experiment Station.

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(254)(a) SAVANNAH RIVER, GEORGIA.
(b) U. S. District Engineer, Savannah, Ga.
(c) (d) and (e) See (51).
(f) Determine methods of improving navigation conditions in Savannah River.
(g) Movable bed model from Mile 188 to Mile 178.5 above Savannah. Model scales: 1:200 horizontal and 1:30 vertical.
(h) Experiment completed.
(i) Report included in Technical Memoranda Nos. 57-1, 2, U.S. Waterways Experiment Station.

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(255)(a) CONEY ISLAND DIKE MODEL.
(b) District Engineer, Cincinnati, Ohio.
(c) (d) and (e) See (51).
(f) Determine method of improving the navigability of the Ohio River in the vicinity of Dam No. 36.
(g) Model scales: 1 to 250 horizontal and 1 to 60 vertical; fixed bed.
(h) Completed.
(i) Results of experiments are included in Technical Memoranda Nos. 64-1 and 64-2, U. S. Waterways Experiment Station.

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(256)(a) MISSISSIPPI RIVER MODEL NO. 3 - INCLUDING THE MISSISSIPPI RIVER FROM MILE 486 TO MILE 531 BELOW CAIRO.
(b) Mississippi River Commission.
(c) (d) and (e) See (51).
(f) Miscellaneous problems involving the river within the limits specified in (a). Reaches studied: Walker Bend - American Cut-off, Worthington Point Cut-off, Kentucky Bend, and Cracraft Chute.
(g) Model scales 1 to 1000 horizontal and 1 to 100 vertical; movable bed
(i) Results of studies are described in Technical Memoranda Nos. 59-1 and 74-1, U. S. Waterways Experiment Station.
(h) Completed.

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(257)(a) DIRECTIONAL ENERGY STUDY.
(b) Mississippi River Commission.
(c) (d) and (e) See (51).
(f) Experiments to determine relationsbetween length of tangent, length of pool, total length, slope, and bed material of rivers,
(g) Outdoor flume, 50 feet x 15 feet with movable bed, being used.
(h) In progress.

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(409)(a) STUDIES OF PIPE LINE MIXERS.
(b) U. S. District Engineer, U. S. Engineer Office, Memphis, Tenn.
(c) (d) and (e) See (51).
(f) To study the effect of rifles in dredge discharge pipes on the percentage of solids that can be pumped without increasing the power of the dredge. Size, pitch, and spacing of rifles will be studied, and the efficiency of various designs compared with the efficiency of the smooth discharge pipe.
(g) Tests will be made in 4-inch and 2-inch observation pipes.
(h) Apparatus being constructed.

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(410)(a) BROWN LAKE SPILLWAY MODEL.
(b) Mississippi River Commission.
(c) (d) and (e) See (51).

(f) To determine the head-discharge relation for the spillway crest, and to determine means of eliminating scour below the apron of the spillway.
(g) Model scale 1:20, undistorted.
(h) Head-discharge study completed. Study of scour elimination in progress.

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(411)(a) INVESTIGATION OF FOUNDATIONS OF THREE LEVEES IN VICKSBURG ENGINEER DISTRICT TO DETERMINE THEIR RELATIVE STABILITY IN SHEAR.
(b) U. S. District Engineer, U. S. Engineer Office, Zanesville, Ohio.
(c) (d) and (e) See (51).
(f) To determine whether the ultimate shearing strength of the plastic material in the foundations of three specific units could be predicted. Two of the foundations failed and the remaining one has been satisfactory.
(g) Mechanical analyses, shear tests (Direct and Squeeze Methods) consolidation tests, specific gravity, water content and Atterberg Limits.
(h) Completed.
(i) Report rendered to the District Engineer, U. S. Engineer Office, Zanesville, Ohio.

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(412)(a) INVESTIGATION OF EXISTING AND EXTENSION OF LEVEES IN CLEAR CREEK DRAINAGE AND LEVEE DISTRICT, UNION COUNTY, ILLINOIS.
(b) U.S.District Engineer, U. S. Engineer Office, St. Louis, Mo.
(c)(d) and (e) See (51).
(f) The determination of the strength of the foundation material underlying the present levee and its ability to satisfactorily support the enlargement of this levee. Also to design the sections of the present levee so as not to exceed the strength of its foundation.
(g) Mechanical analyses, shear tests (Direct and Squeeze Method) Consolidation tests, specific gravity, water content and Atterberg Limits.
(h) Completed.
(i) Report rendered to District Engineer, U. S. Engineer Office, St. Louis, Missouri.

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(413)(a) THE DESIGN OF AN AUXILIARY DAM AT THE U. S. WATERWAYS EXPERIMENT STATION BASED ON THE STRENGTH OF SOIL AVAILABLE.
(b) The Director, U. S. Waterways Experiment Station, Vicksburg, Miss.
(c) (d) and (e) See (51).
(f) To determine the safe side slopes, using a factor of safety of 1.5.
(g) Mechanical analyses, shear tests by direct method, specific gravity, and water content.
(h) Completed.
(i) Report rendered to the Director, U. S. Waterways Experiment Station, Vicksburg, Mississippi.

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(414)(a) MODEL STUDY TO DETERMINE EFFICACY OF SUB-LEVEES AND THEIR EFFECT IN CONTROLLING THROUGH AND UNDER SEEPAGE FOR MAIN LINE LEVEES.
(b) U. S. District Engineer, U. S. Engineer Office, Memphis, Tenn.
(c) (d) and (e) See (51).
(f) To determine, by means of flow nets developed from models, the relative quantities of seepage, etc.
(g) Permeability tests, mechanical analyses.
(h) Tests in progress.

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(415)(a) MISSISSIPPI RIVER MODEL - HELENA, ARKANSAS TO DONALDSONVILLE, LOUISIANA, INCLUDING THE MISSISSIPPI RIVER FROM MILE 298 TO MILE 900 BELOW CAIRO, AND ESSENTIAL PORTIONS OF ALLUVIAL VALLEY FROM* ARKANSAS TO THE GULF OF MEXICO.
(b) Mississippi River Commission.
(c) (d) and (e) See (51).
(f) Miscellaneous problems regarding water surface elevations within the limits as specified.
(g) Model scales 1 to 2000 horizontal and 1 to 100 vertical; fixed bed.
(h) Model in construction stage.

........................* Insert "Helena".................................

(416)(a) PORT WASHINGTON, WISCONSIN, LAKE MICHIGAN.
(b) U. S. District Engineer, Milwaukee, Wisconsin.
(c) (d) and (e) See (51).
(f) Study to determine best breakwater system for harbor.
(g) Scale of model 1 to 50, undistorted, fixed bed. A plunger apparatus is used to produce waves. Various proposed breakwater plans are tested.
(h) In progress.

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(417)(a) MARE ISLAND STRAIT, SAN FRANCISCO BAY, CALIFORNIA.
(b) U. S. District Engineer, San Francisco, California.
(c) (d) and (e) See (51).
(f) Study to determine means of eliminating shoaling in navigation channel.
(g) In process of design.

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## CURRENT HYDRAULIC RESEARCH IN FOREIGN COUNTRIES.

GREAT BRITAIN.
UNIVERSITY OF LONDON.

(418)(a) ATOMISATION OF JETS.
(b) Ph. D. thesis.
(c) Scientific research.
(d) H. P. Spratt.
(e) Dr. S. J. Davies.
(f) To find out what fundamental factors are involved in the atomisation of fluid jets, and how these determine the size

and distribution of the resultant droplets.

(g) Jets collected in a movable scoop with fine screw motion, and fluid distribution plotted experimentally by differential method.

(h) A comprehensive series of experimental jet measurements have already been made by this method; the plotted results so far confirm theoretical expectations based on mathematical analysis of the problem.

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PROGRESS REPORTS ON UNCOMPLETED PROJECTS.

IOWA INSTITUTE OF HYDRAULIC RESEARCH.

(311) TRANSPORTATION OF BOTTOM LOAD IN OPEN CHANNELS.

A master's thesis by Te Yun Liu, prepared jointly with A. N. Carter, presents the results of an effort to determine for a limited range of materials the traction load, namely the weight of material transported in a given time, as a function of the bottom velocity, size, shape, and specific gravity of the materials.

The tests were conducted in a glass walled flume 15 ft. long, 1 ft. wide, and 2 ft. deep. The sand bed 1 ft. long and 1 ft. wide was maintained at the level of a false floor during each of the tests conducted. Four uni-granular materials were tested; crushed limestone 5.5 mm in diameter and crushed limestone 2.8 mm in diameter each having a specific gravity of 2.69; coarse river sand 2.9 mm. in diameter with a specific gravity of 2.64; and a finer sand 1.4 mm in diameter with a specific gravity of 2.58. An analysis of the data obtained for loads varying from 0 to about 50 lbs. per ft. per hr. for these particular materials and tests indicated that the traction load varied approximately with the 15th power of the bottom velocity. No general conclusions were drawn on the basis of these tests.

(314) LABORATORY STUDIES OF GROUND WATER PROFILES.

Tests conducted by Tsung-pei Tsui had as their objective the investigation of ground-water profiles in a sand-filled trough 18 ft. long, 34 in. deep, and 12ft. wide. Depths of water at the inlet and outlet ends of the trough were varied along with the quantity of flow, and the overall permeability coefficient $k$ in the formula

$$Q = \frac{k}{2L}(h_1^2 - h_2^2)$$

was found, in which $Q$ is the discharge in cubic feet per day, $L$ is the length of trough, $h_1$ and $h_2$ are the depths of water at the inlet and the outlet ends of the trough respectively. The coefficient $k$ for the sand used was found to be 220 ± 20 ft. per day.

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## COMPLETED PROJECTS.

### 1. ABSTRACTS.

### UNIVERSITY OF CALIFORNIA, COLLEGE OF ENGINEERING.

(274) SURFACE PROFILES NEAR INLET TRANSITIONS.

(This thesis by J.H.Douma and E.A.Tarr is available for loan.)

The purpose of the investigation was to determine what factors contribute to holding the water surface above the normal depth at flume entrances.

The section of the canal used was 1 foot wide at the bottom with 1:1 sloping sides and a depth of 6 inches; the flume had a 10 inch diameter semi-circular section, and the transition from the canal to the flume was a 7 inch radius quadrant wing-wall with necessary concrete fillets to provide a rounded entrance to the flume.

Measurements of depths and velocities were taken both longitudinally and transversely to the channel during different rates of flow for various slopes corresponding to normal flume depths greater than, less than, and equal to the critical flume depths.

The theory employed for determining the theoretical surface curve was: (1) Differential equation of the surface curve as derived by Bakhmeteff and others, (2) specific energy curve method, (3) Q-curve method, and (4) energy curve solution as presented in Mr. F. C. Scobey's thesis "Flow of Water in Constricted Lengths of Channels".

Even when friction and impact losses were neglected, computations showed that only about 78% of the theoretical drop in water surface occurred in creating the higher flume velocity. The report indicates and offers the following explanations: (1) As the water surface begins to drop, vertical accelerations become appreciable which results in a reduction of the pressure on the bottom of the channel very similar to free outfall. In effect, pressure energy is given over to kinetic energy, and the higher flume velocity is created without the expected surface drop. (2) If the transition does not accelerate the flow sufficiently, then, in order that continuity be maintained, the water flowing near the bottom of the canal will assume a higher level upon entering the flume, and this results in an upward thrust that tends to prevent the water surface from dropping to the normal level.

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(275) MANOMETER ERRORS DUE TO CAPILLARITY.

(This report by R. G. Folsom is available upon request.)

The investigation was undertaken to provide the data required for the selection of manometer tube sizes when making measurements within a given limit of error. The material was collected from published reports of mathematical and experimental researches, with the addition of some approximate tests.

Attempts were made to measure the capillary rise under conditions similar to normal engineering usage. Levels were determined with a cathetometer reading to 0.0001 inch for a series of different diameter commercial glass tubes. Capillary rise with dirty water and tap water in contact with air and mercury was investigated.

The study showed that the simplified formulas of the type given by Gibson and Marks for the capillary rise in small tubes cannot be applied for diameters greater than about 0.1 inch. Approximate equations for water-air and mercury-water in glass tubes are given, and the tests indicate these values to be valid for normal engineering conditions. The data provide a basis for the selection of manometer tube size for measurements within an allowable error. Likewise, they indicate the error to be expected with a U-tube when the tube diameters differ.

References: (1) Gibson: Hydraulics and its Applications.
(2) Marks Mechanical Engineers' Handbook.
(3) Lord Rayleigh: Proc. Royal Soc. London. Vol. 92, pp. 184-95.
(4) Sugden: Journal Chem. Soc., Vol. 119, 1921, p. 1483.
(5) Eagle and Wilson: Civil Engineering, Vol. 4, No. 1, 1934, pp. 30-32.

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(276) DISCHARGE COEFFICIENTS OF SHARP-CRESTED WEIRS IRREGULAR IN PLAN.

(This thesis by W. R. Peters and F. F. Watters is available for loan.)

The purpose of the investigation is to determine the discharge coefficients of such weirs, and the relation they bear to the better-known standar type.

Seven different plan forms have been investigated: A standard weir, normal to the direction of flow; weirs at an angle to the normal of 30°, 45° and 60°; "V" shaped weir with 90° vertex angle, placed with vertex first upstream and then downstream; and a "2-foot set-down" type weir of three feet crest length. The weirs were placed across a rectangular channel one foot wide, and the crest height of the weirs above the channel bottom was 9 inches.

The coefficients were defined by the equation: $Q = CLH^{3/2}$, where L is the crest length.

The standard weir had the largest discharge coefficient, but the smallest discharge per channel width. The "2 foot set-down" weir gave the greatest discharge per channel width, but had the smallest discharge coefficient over practically the whole head range considered.

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(277) CONTRACTION IN OPEN CHANNELS.

(This thesis by Lieut. C. R. Jones is available for loan.)

The object of the research was to check various formulas that have been proposed for giving the relationship between depth and breadth in a stream with erosible bed.

A channel, 25 feet long and 0.5 feet wide, with glass sides and a wooden bottom covered with several inches of sand, was used. Near the center of the channel, for a length of about 8 feet, the width was contracted to 78% and 58% of the normal width. The rate of flowwas maintained constant until the bed profile reached equilibrium. Depths and surface elevations were read periodically. Sands of 0.25 mm and 0.095 mm mean diameters were used.

The theory used was: (1) Chezy and Manning equation adaptations, and (2) O'Brien's and Straub's modified form of du Boys' equations.

There was found to be a wide scattering of computed widths and depths when hydraulic radius was used, and the agreement with measured widths and depths was only fair. However, when the depth was used in place of the hydraulic radius, the computed and measured values agreed well. (As the bed was much rougher than the walls, most of the fluid friction undoubtedly originated at the bed surface.) Of the formulas used, the Manning adaptation gave the best results.

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(279) SCOUR BELOW DAMS.

(This thesis by Lieut. T. F. Bengtson is available for loan.)

The purpose of the study was (1) to check the hydraulic design with regard to scour of the Tisdale and Fremont Weirs of the Sacramento River Flood Control System, the Keokuk Dam on the Upper Mississippi River, the initial design of the Bonneville Dam on the Columbia River, and (2) to determine the effect of bed-material on the scour. Models of the above structures were tested in a channel with a glass observation section. Tests were made to determine the rate of flow corresponding to the worst scour for various bed-materials.

In correlating the amount of scour and bed-material, the maximum scour for each material was plotted against (S - 1) L, where S represents the specific gravity of the material and L its mean diameter. The study indicated that size and distribution of size of the material had a marked influence upon the amount of scour, and that it would seem advisable in model scour tests of hydraulic structures to use material identical in character with that in the prototype and reduced in size according to the model scale.

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(372) SAVONIUS ROTOR.

The performance of two straight bladed rotors, with 6 and 3 blades respectively, was compared with a 2 bladed S-rotor. Each of the three rotors was 8 inches long with a 3 1/2 inch diameter. The rotors were tested with an without shields in a 1-foot wide open channel with water velocities up to 2 feet per second. Five different shields, varying from a quadrant of a cylindrical surface to a fairly streamlined wedge, were placed immediately upstream from the rotors.

The efficiency was defined by the ratio of the measured power output to the power flux of the water flowing through a projected area equal to that of the rotor. With no shield the maximum efficiency attained by the S-rotor was about 25% and occurred at a ratio of peripheral velocity to stream velocity of about 0.9. Under similar conditions, the three-bladed rotor had an efficiency of about 13% at a velocity ratio of about 0.7. * The output of the particular 6-bladed rotor tested was negligible, but could probably have been improved by reducing the blade width.

*Shielding the rotors increased their maximum output to about 40%.

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(376) DISTRIBUTION OF SILT IN OPEN CHANNELS.

The thesis presents a discussion of the theory of silt distribution as advanced by Schmidt (W. Schmidt. Die Massenaustausch in freien Luft und verwandte Erscheinungen, H. Grand, Hamburg, 1925.) and reviewed by O'Brien (M.P.O'Brien. Am. Geoph. Union Trans. 14th Meeting (1933) 487-491.) and compares the theory with the observed silt distribution from published data.

The theory of turbulent flow and the conception of the "austausch coefficient" or mechanical viscosity is briefly discussed. Expression for the austausch coefficient in terms of the hydraulic elements of the stream are derived.

The settling velocity of silt in water is discussed, and figures are presented showing relations between settling velocity, coefficient of resistance, Reynolds number, and particle diameter. That Stokes law does not apply for the entire range of silt particle sizes is shown. The effect of shape of particle and chemical composition of water on sedimentation is discussed.

An approximate method of integrating the differential equation for silt distribution as given by O'Brien is explained. From published data, principally from Fortier and Blaney (Fortier, S. and H. F. Blaney, 1928. Silt in the Colorado River and its relation to irrigation, U. S. Dept. Agr. Tech. Bul. 67:1-94.), comparisons of the observed and theoretical silt distribution are made. The theoretical distribution is based on the austausch coefficient calculated from the vertical velocity curves.

Although the theory agrees very well with the data analyzed, the practical applications are sufficiently important to justify additional studies. For this purpose better data are needed. Laboratory studies are suggested.

Paper presented at 16th Ann. Meeting Am. Geoph. Union. Washington, April 1935.
(Thesis available for loan from University of California, Hydraulic Laboratory, Berkeley.)

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## IOWA INSTITUTE OF HYDRAULIC RESEARCH.

(208) A STUDY OF VORTEX MOTION. The object of this study by G. F. Djang was to investigate analytically and experimentally the drift distance of a body falling freely in a stream which may possess any degree of turbulence. For mathematical simplicity, the theoretical investigation was limited to the cases (1) that the resitance is proportional to the first power of the velocity, and (2) that the resistance is proportional to the second power of the velocity.

Small balls and paper disks were dropped into streams of water in which there were different degrees of turbulence and the drift distance and time of fall were observed. In general there was satisfactory agreement between mathematical deductions and the experimental data.

The following conclusions were drawn: (1) for a given velocity distribution, the mathematical expressions for the drift distance are of the same form whether the resistance varies with the first or second power of the velocity; (2) a working formula is proposed

$$x = U\left(t - \frac{2n}{np}\right)$$

in which $x$ is the drift distance, $t$ is the time of fall, $U$ is the mean velocity of the stream, and $n$ and $p$ are constants involving the mass and density of the body and the nature of the fluid; and (3) the effect of turbulence on drift distance and time of fall can be treated advantageously by means of the Brownian movement method.

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(211) RELATION OF TAIL RACE FLOOR TO BOTTOM OF DRAFT TUBES.

"The hydrodynamics of spreading draft tubes". A dissertation by Andreas Luksch presents a critical digest of theories and tests of spreading draft tubes by Prasil, White, Moody, Kaplan, and Spannhake, and tests conducted on a small metal draft tube and on its counterpart in clear glass. The objects of the experiments were (1) to determine for a model draft tube the discharge under constant head as a function of the distance of the draft tube outlet from the tail-race floor; (2) to determine the effect of vertical components of flow on the relation between the discharge under constant head and the distance of the draft tube from the tail-race floor; (3) to observe and to study the stream paths in a glass model draft tube; and (4) to apply an electrical analogy and a graphical method to the analysis of the flow through a spreading tube.

The following conclusions were drawn from the tests: (1) For axial flow the discharge under constant head is a maximum if the distance of the draft tube outlet from the tail-race floor is about 1/4 d, where d is the throat diameter of the draft tube; for greater distances the discharge decreases rapidly; for free discharge it is only about 70 per cent of the maximum. (2) For rotational flow the discharge is independent of the distance of the draft tube outlet above the floor if the distance is greater than about 1/4 d. (3) Axial flow conditionscan exist in actual water turbine operation and therefore a bell-shaped draft tube should be located at the position of maximum discharge for axial flow. (4) Observations of the glass model indicated that for axial entrance conditions the flow does not fill the divergent part of the tube unless the distance of the outlet is about 1/4 d above the tail-race floor; in that position the floor has the effect of forcing the flow to follow the walls of the draft tube. (5) For rotational flow a vortex forms close to the axis and most of the discharge through the tube takes place near the side walls. For distances greater than about 1/4 d, the location of the tail-race floor does not affect the vortex motion and it has no effect on the flow through the draft tube under conditions of non-axial entrance.

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(305) AN ANALYTICAL AND EXPERIMENTAL STUDY OF THE FLOW OF WATER THROUGH SANDS.

"Experimental and analytical study of the permeability of sand."

The object of this dissertation by E. F. Wilsey was to determine by experiment the effect of temperature, porosity, shape and size of the sand grains on the flow of water through sand within the limits of Darcy's Law.

Two empirical formulas were devised as follows:

For Iowa River sand (an angular sand)
$$\underline{k} = 0.814 \frac{u_{60}}{u_t}\left(\frac{p}{40}\right)^6 d^2$$

For Ottawa sand (a rounded sand)
$$k = 1.24 \frac{u_{60}}{u_t}\left(\frac{p}{40}\right)^5 d^2$$

where k is the permeability in cm. per sec., $u_{60}$ and $u_t$ are the absolute viscosities at 60° and t°F., respectively; p is the per cent porosity; and d is that diameter such that 10 per cent of the material is of smaller grains.

The following conclusions were drawn from this investigation: (1) The rate of flow of water through sand is inversely proportional to the absolute viscosity of the water. (2) The permeability of Iowa River sand varies as the sixth power of the porosity and that of Ottawa sand as the fifth power. The exponent appears to depend on the shape of the sand particles. (3) For a given porosity of 40 per cent, the permeability of the Ottawa sand was 50 per cent greater than that of the Iowa River sand, the diameters of the grains ranging from 0.63 to 0.93 mm. in both samples. (4) The permeability of uni-granular sands is proportional to the square of the average diameter of the sand grains. (5) The "effective size" as defined by Slichter was found to be approximately that size such that 31 per cent of the material is of smaller grains. (6) Other factors remaining unchanged the permeability of graded sands is proportional to the square of the 10 per cent effective size as defined by Hazen. (7) The upper limit of Darcy's Law was reached when the apparent velocity through Iowa River sand was approximately 0.029 centimeter per second, the porosity being about 40 per cent. (8) In order to correlate the data of various experimenters, a standard apparatus and a standard sand must be adopted.

Parallel studies were carried on by C. C. Wang using a small permeameter designed by Prof. A. F. Meyer for determining the permeability of sandstones. These investigations are to be carried further using a wider variety of shapes and gradations of sands.

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(310) STILLING POOLS FOR SPILLWAYS.

A thesis by C. W. Kinney reports experiments conducted to investigate the use of the hydraulic jump as a means of preventing erosion below model spillways. In the experiments the hydraulic jump was formed on a smooth apron below an under-shot gate. A sill of rectangular cross section was fastened to the lower end of the apron. The opening beneath the under-shot gate, the quantity of discharge, the length of apron and the height of sill were varied and observations were made of the erosion of the sand below the apron. The studies are to be carried further on both a larger and a smaller scale of apparatus.

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(312) A LABORATORY INVESTIGATION OF OVERFLOW SECTIONS WITH SAND CORE.

A thesis by Lt. H. J. Skidmore reported the results of tests conducted under the supervision of Martin E. Nelson for the U. S. Engineer Office in St. Paul, Major D. F. Johns, District Engineer. The object of the tests was to investigate the feasibility of constructing overflow sections of sand paved with an articulated mattress of concrete. The models were constructed to one-fifth scale representing a sand-fill embankment 40 ft. wide with an upstream slope 1 on 3, and a downstream slope 1 on 5 1/2. Four models were tested: No. 1 having a crest sloping 1 in. in 10 ft. in the direction of flow; No. 2 having a slope of 3 in. in 10 ft. in the direction of flow; No. 3 and 4 having an ogee curb 0.4 ft. high and 0.97 ft. wide at the base of the model.

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(313) THE SOLUTION OF CERTAIN TWO-DIMENSIONAL FLOW PROBLEMS BY MEANS OF AN ELECTRICAL ANALOGY.

This study by Lt. H. F. Sykes, Jr., is the third of a series of investigations into the use of an electrical analogy in the solution of certain problems in hydrodynamics. The thesis presents the mathematical interpretation of the analogy and explains briefly by illustrative examples approaches to the solution of hydrodynamics problems (1) by the assumption of a functional relationship, (2) by the method of Schwarz-Christoffel, (3) by the velocity method (conformal mapping), (4) by graphical solution, and (5) by the electrical analogy.

The electrical analogy is applied to the solution of (1) the flow over an infinitely long cylinder resting on a horizontal plane, (2) the flow in a channel of uniform depth whose width changes abruptly from w to 1/2 w, (3) the electrostatic flux lines and equipotential lines for an electrostatic machine for producing pure tones, (4) the surfaces normal to the flow lines through a spreading draft tube assuming a perfect liquid, and (5) the pressure distribution on the upstream face of a spillway dam.

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( ) TRANSPORTATION OF DETRITUS BY FLOWING WATER.

University of Iowa Studies in Engineering, Bulletin 5, by F. T. Mavis, Chitty Ho, and Yun Cheng Tu, presents a critical digest of representative investigations into the problems of transportation of detritus. Tests were conducted in the laboratory to determine the competent velocities at which grains of sand, fine gravel, Haydite, and crushed limestone commenced to move along the bed of a rectangular open channel 30 in. wide. Under conditions of competence, velocities were measured as near as 5/16 in. to the sand bed and competent bottom velocities were estimated on the basis of velocity-depth curves. The mean apparent specific gravities of materials tested were 1.83, 2.60 and 2.64. The following formula was found to be in substantial agreement with the tests on uni-granular materials conducted by Ho and Tu:

$$V_o = 1/2\, d^{4/9}(s - 1)^{1/2}$$

in which $V_o$ is the competent bottom velocity, in ft. per sec., at which grains of material begin to move across their bed, d is the mean diameter of grain, in mm., and s is the apparent specific gravity of the grains.

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REFERENCES.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

(323) STUDY OF THEORY OF FILTRATION OF WATER THROUGH SAND.
"An experimental and theoretical investigation of the clogging of a rapid sand filter"; thesis, May, 1935.

(325) STUDY OF SEEPAGE THROUGH EARTH DAMS ON PERVIOUS FOUNDATIONS.
"Flow through permeable earth dams on permeable foundations"; thesis, May, 1935.

MICHIGAN STATE COLLEGE.

(364) INVESTIGATION OF HEAD LOSSES IN SMALL FITTINGS.
Thesis, June, 1935.

PACIFIC HYDROLOGIC LABORATORY.

(45) RELATION OF PERMEABILITY OF GRANULAR MATERIALS TO PARTICLE SIZE.
"The interpretation of water levels in wells and test holes", by Charles H. Lee, Transactions of the American Geophysical Union, June, 1934, Part II, pages 540-544.

STEVENS INSTITUTE OF TECHNOLOGY.

(397) THE CALIBRATION OF A NOZZLE FOR FLUID FLOW MEASUREMENTS.
Thesis, June, 1935, in library of Stevens Institute of Technology.

U. S. GEOLOGICAL SURVEY.

(26) PERMEABILITY TESTS CONDUCTED UNDER VERY LOW HYDRAULIC GRADIENTS.
"Tests of permeability with low hydraulic gradients", by O. E. Meinzer, and V. C. Fishel, Transactions of the American Geophysical Union, June, 1934, Part II, pages 405-409.

U. S. BUREAU OF RECLAMATION.

(249) SPILLWAY TESTS, HYRUM DAM.
Report available for loan.

(251) SPILLWAY TESTS, PINEVIEW DAM.
Report available for loan.

(338) Rye Patch Dam Spillway Tests.
Report available for loan.

(339) MOON LAKE DAM SPILLWAY TESTS.
Report available for loan.

(382) ISLAND PARK DAM SPILLWAY TESTS.
Report available for loan.

NATIONAL BUREAU OF STANDARDS.

(345) BIBLIOGRAPHY ON DRAFT TUBES.
Report available for loan.

HORTON HYDROLOGICAL LABORATORY.

(385) SURFACE RUNOFF PHENOMENA.
"Surface runoff phenomena; Part I -- Analysis of the hydrograph", by Robert E. Horton. Publication No. 101, Horton Hydrological Laboratory, February 1, 1935, 72 pages. Publishers: Edwards Brothers, Inc., Ann Arbor, Michigan, price $0.75.

IOWA INSTITUTE OF HYDRAULIC RESEARCH.

(400) MISSISSIPPI RIVER, LOCK AND DAM NO. 2.
"Laboratory tests on hydraulic models of the Hastings Dam", by Martin E. Nelson, Bulletin No. 2, University of Iowa Studies in Engineering, July 1, 1932.

(408) STUDY OF FLOW OVER SAND DIKES.
"Tests on sand dikes protected against erosion by overflowing water", thesis by Karl Jetter, State University of Iowa, August, 1931.

STANFORD UNIVERSITY.

(337) HYDRAULIC MODEL EXPERIMENTS FOR THE DESIGN OF SPILLWAY FOR SAN FRANCISQUITO RESERVOIR, SAN MATEO COUNTY, CALIFORNIA.
Report available in files of Comptroller, Stanford University.

U. S. WATERWAYS EXPERIMENT STATION.

(77) ISLAND NO. 35, MISSISSIPPI RIVER.
U. S. W. E. S. Technical Memoranda Nos. 29, 29-2, 3, 4, 5, 6, 7. 29-8 in preparation.

(91) MISSISSIPPI RIVER MODEL NO. 4.
U. S. W. E. S. Technical Memoranda Nos. 34, 34-2, 38-1, 47-1, 2, 3, 4 and 5, 58-1, 58-2, 72-1.

(92) MISSISSIPPI RIVER MODEL NO. 5.
U. S. W. E. S. Technical Memoranda Nos. 32-1, 2, 3 and 4, 42-1, 2, 3, 4 and 5, 60-1.

(152) ROBINSON CRUSOE ISLAND, MISSISSIPPI RIVER.
U. S. W. E. S. Technical Memoranda Nos. 44-1, 2, 3, 4 and 5.

(163) MISSISSIPPI RIVER MODEL NO. 1.
U. S. W. E. S. Technical Memoranda Nos. 25, 25 A, B, C and D, 34, 34-2, 50-1 and 2.

(165) MISSISSIPPI RIVER BED MATERIAL SURVEY.
U. S. W. E. S. Paper 17.

(166) U. S. INTRACOASTAL WATERWAYS CROSSING WITH BRAZOS RIVER DIVERSION CHANNEL.
U. S. W. E. S. Technical Memorandum No. 54-1.

(168) HEAD OF PASSES, MISSISSIPPI RIVER.
U. S. W. E. S. Technical Memoranda Nos. 46-1, 2, 3 and 4.

(169) SOUTHWEST PASS, MISSISSIPPI RIVER.
U. S. W. E. S. Technical Memoranda Nos. 45-1, 2, 3, 4, 5 and 6.

(170) MISSISSIPPI RIVER MODEL NO. 2.
U.S.W.E.S. Technical Memorandum No. 51-1.

(198) FITLER BEND, MISSISSIPPI RIVER.
U.S.W.E.S. Technical Memorandum No. 56-1.

(199) ARANSAS PASS, GULF OF MEXICO.
U.S.W.E.S. Technical Memorandum No. 67-1.

(200) Fort Chartres, Mississippi River.
U. S. W. E. S. Technical Memoranda Nos. 49-1, 2, 3 and 4.

(253) CAT ISLAND, MISSISSIPPI RIVER.
U. S. W. E. S. Technical Memorandum No. 63-1.

(254) SAVANNAH RIVER, GEORGIA.
U. S. W. E. S. Technical Memoranda 57-1 and 2.

(255) CONEY ISLAND DIKE MODEL.
U. S. W. E. S. Technical Memoranda Nos. 64-1 and 2.

(256) MISSISSIPPI RIVER MODEL No. 3.
U.S.W.E.S. Technical Memoranda Nos. 59-1 and 74-1.

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## TRANSLATIONS.

The following translations have been made by Professor M. P. O'Brien, University of California.

Schiller, "Super-Critical Discharge of Compressible Fluids" from Forschung, May-June 1933.

Nemenyi, "About the Application of the Darcy Law and its Limitations" from Wasserkraft and Wasserwirtschaft, July 1934.

Muelhofer, "Measurements of Suspended Sediment and Bedload on the River Inn" from Wasserkraft und Wasserwirtschaft, Feb. 1933.

Schoklitsch, "Movement and Transport of Bedload" from Wasserkraft und Wasserwirtschaft, Feb. 1934.

Forthmann, "About Turbulent Diffusion of Flow Lines" from Ingenieur Archiv., Feb. 1934.

Leroux, Deullin, "Determination of the Coefficient of the flow of Nozzles and Submerged Orifices" from Annales des Mines ou Resueil, Vol. IV, Part II, 1933.

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## FOREIGN PAMPHLETS RECEIVED BY THE NATIONAL BUREAU OF STANDARDS AND IN FILES OF NATIONAL HYDRAULIC LABORATORY.

### AUSTRIA.

F. Schaffernak.
Untersuchung über die Wasser- und Geschiebebewegung bei freien Werkseinfängen (Investigation of the motion of water and sediment at open intakes). Mitt. des Hydrologischen Institutes an der Technischen Hochschule in Wien, 5. Folge, 1930.

R. Dachler.

(1) Ueber Sickerwasserströmungen in geschichteten Material (Concerning percolation through stratified material).

(2) Der Sickervorgang in Dammböschungen (The process of percolation through dam sections).

(3) Ueber die Versickerung aus Kanälen (Concerning seepage from canals).

Mitt. des Hydrologischen Institutes an der Technischen Hochschule in Wien, 7, Folge, Reprint from "Die Wasserwirtschaft", 1933, Nos. 2, 4 and 9.

F. Schaffernak and R. Dachler.

Versuchstechnische Lösung von Grundwasserproblemen (Experimental solution of ground water problems) Mitt. des Hydrologischen Institutes an der Technischen Hochschule in Wien, 6. Folge. Reprint from "Die Wasserwirtschaft", 1931, Nos. 1 and 3.

F. Schaffernak and R. Dachler.

Das Widerstandsgesetz für die Wasserströmung durch Kies(The law of resistance for the flow of water through gravel).

R. Dachler

Ueber den Strömungsvorgang bei Hangquellen (On the flow process involved in bank seepage.)

Mitt. des Hydrologischen Institutes an der Technischen Hochschule in Wien, 9. Folge. Reprint from "Die Wasserwirtschaft", 1934, Nos. 15 and 5 -- 6.

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FRANCE.

M. Hégly.

Sur la propagation d'une onde solitaire dans un canal réduit, à section trapézoidale (On the propagation of a solitary wave in a model channel of trapezoidal cross-section). Reprint from Comptes Rendus, Vol. 199, October 29, 1934.

GERMANY.

G. Kempf.

Ueber den Einfluss von Strombrückenpfeilern auf die Leistung und Wirtschaftlichkeit der Schiffahrt (On the effect of bridge piers in streams on the power requirements and economics of transportation). Reprint from Werft-Reederei-Hafen, Vol. XV, Nos. 18 and 19, 1934.

J. M. Mousson.

Wassermessungen in einem Grosskraftwerk (The measurement of flow in a large power plant). Reprint from Zeitschrift des Verein deutscher Ingenieure, Vol. 78, No. 46, 1934.

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*Also F. Schaffernak.

Erforschung der physikalischen Gesetz, nach welchen die Durchsickerung des Wassers durch eine Talsperre oder durch den Untergrund stattfindet (Investigation of the physical law according to which water percolates through a dam or through the sub-soil). Mitt. des Hydrologischen Institutes an der Technischen Hochschule in Wien, 8. Folge. Reprint from "Die Wasserwirtschaft", 1933,No.30.

Seifert and Antsberg.
Einfluss des Messfahrzeugs auf die Umlaufwerte von Messflügeln auf tiefem und flachem Wasser (Effect of the supporting ship on the calibration constants of current meters in deep and shallow water). Mitt. der Preussischen Versuchsanstalt für Wasserbau und Schiffbau, Berlin, Heft 18, 1935.

ITALY.

G. de Marchi and F. Contessini.
Temperature, contrazioni e dilatazioni longitudinali, e pressioni interstiziali in una grande diga massiccia (Temperatures, longitudinal contraction and expansion and interstitial pressures in a large solid dam). Part I, Temperature del massiccio murario (Temperatures in the solid wall), by F. Contessini. Part II, Contrazioni e dilatazioni longitudinali (Longitudinal contraction and expansion), by G. de Marchi and F. Contessini. Memorie e Studi dell'Istituto di Idraulica e Costruzioni Idrauliche del Istuto Superiore d'Ingegneria di Milano, Nos. 8 and 9, 1934.

JAPAN.

F. Numachi.
Formation of rust which shows the configuration of stream lines. Reprint from the Technology Reports of the Tohoku Imperial University, Vol. XI, No. 3, 1934.

F. Numachi.
Ueber zylindrische Staurohre zur Messung von Geschwindigkeit, Richtung und statischem Druck von Wasserströmung (On cylindrical impact tubes for the measurement of velocity, direction and static pressure in the flow of water). Reprint from the Technology Reports of the Tohoku Imperial University, Vol. XI, No. 3, 1934.

LATVIA.

A. Vitols.
Une solution possible du problème concernant l'écoulement des eaux pluviales d'un plan incliné (A possible solution of the problem of the flow of rain water down an inclined plane). IIème Conférence Baltique d'hydrologie et d'hydrométrie, Tallinn, Juin, 1928.

A. Vitols.
Essai de morphologie des courants d'eau dans le sol mobile (On the morphology of stream beds in erodible soil). IVème Conférence Hydrologique des Etats Baltiques, Leningrad, September, 1933.

A. Vitols.

De quelques éléments morphologiques des cours d'eau naturels dans le sol mobile (On some morphological elements of natural water courses in erodible beds). Latvijas Universitates Raksti, Mechanikas Fakultates Serija, Vol. I, No. 4.

A. Vitols.

Condition essentielle à suivre pour s'assurer des valeurs les plus exactes du coefficient de rugosité (Essential condition to follow in order to assure the most exact value of the coefficient of roughness). Latvijas Universitates Raksti, Mechanikas Fakultates Serija, Vol. I, No. 3.

A. Vitols.

Matériaux concernant la construction d'une station hydroélectrique sur le fleuve Daugava en Lettonie (Material relating to the construction of a hydroelectric plant on the Daugava River in Latvia). Latvijas Universitates Raksti, Mechanikas Fakultates Serija, Vol. I, No. 7.

A. Vitols.

Essai de projet d'amélioration d'un cours d'eaunaturel (on a plan for improving a natural water course). Latvijas Universitates Raksti, Mechanikas Fakultates Serija, Vol. I, No. 5.

## RUSSIA.

Transactions of the Scientific Research Institute of Hydrotechnics, Leningrad, Vol. 13, 1934. (In Russian, English abstracts).

Contents:

1. M. A. Velikanov, Principle of similitude in turbulent flow.
2. G. N. Maslov, Theory of elasticity applied to the study of temperature stresses and deformations in concrete blocks.
3. M. D. Chertousov, Conditions of flow in lower pool of hydraulic structures and stilling basin design.
4. P. M. Bobin, Design of stilling basins.
5. P. D. Evdokimov, Design of core walls in earth dams.
6. A. F. Burkov, Regimen of silt at Dzorageth Hydroelectric plant.
7. A. M. Estifeev, Ice troubles at the Volkhov hydroelectric plant. in 1928-1932.

Transactions of the Scientific Research Institute of Hydrotechnics, Leningrad, Vol. 14, 1934. (In Russian, English abstracts for titles 2 -- 8).

Contents:

2. N. N. Davidenkov, Determination of hydrostatic - pressure ratio for loessial soils.
3. V. Chernogradsky, Laboratory and field investigations of soils for earth-fill dams.
4. A. B. Dobrowolski, On the theories of water congealation and more especially on the formation of anchor-ice and frazil.
5. V. E. Timonoff, Outdoor hydrotechnical laboratories and their importance for summer and winter investigations of rivers.
7. R. N. Davidenkov, Stability study of motion of fine-grained sand through the pores of coarser material.
8. L. I. Kozlova, Experimental study of motion of fine-grained sand through the pores of coarser material.
9. A. Whithols, On a raft floating in a canal.

W. Timonoff.

Maximal-ausnutzung der Flüss und der Wasserverkehr (Maximum utilization of rivers and water transportation). IV Hydrologische Konferenz der Baltischen Staaten, Leningrad, September, 1933.

## HYDRAULIC RESEARCH COMMITTEES.

COMMITTEE ON DYNAMICS OF STREAMS, SECTION OF HYDROLOGY, AMERICAN GEOPHYSICAL UNION.

Functions of Committee.

This committee is concerned with the laws of flow of water in rivers and smaller streams, the forces which the water exerts, the work which it does in erosion, transportation, and deposition, and the relations between the streams and the channels that they occupy. The work of the Committee touches on the field of sedimentation, the field of oceanography in regard to processes at the mouths and in the tidal reaches of streams that discharge directly into the ocean, and the field of chemistry of natural waters in regard to the encroachment of salt water in tidal streams.

The Committee on Dynamics of Streams was organized as one of the permanent research committees of the Section of Hydrology of the American Geophysical Union in the spring of 1932. It periodically makes surveys of the research work that is in progress in its field in this country and abroad, and through its members keeps in touch with work being done in the field of dynamics of streams with a view of encouraging research work on this subject.

A report is prepared annually by the Committee and presented at the regular spring meeting of the American Geophysical Union. These reports in the past have been published in the Transactions of the Union, National Research Council.

Members of Committee.

Lorenz G. Straub, Chairman.

K. Hilding Beij.
H. H. Bennett.
R. W. Davenport.
John B. Drisko.
Henry M. Eakin.
H. V. Geib.
C. S. Howard.
E. W. Lane.
L. M. Lawson.
W. C. Lowdermilk.
Gerard H. Matthes.
George W. Musgrave.
Martin E. Nelson.
Morrough P. O'Brien.
R. L. Parshall.
G. W. Pickels.
C. E. Ramser.
Wm. W. Rubey.
Fred C. Scobey.
Roy N. Towl.
A. C. Trowbridge.
Herbert D. Vogel.
N. E. Winters.
H. H. Wheaton.

The following sub-committees have been organized:

1. Bibliography, Chairman: M. P. O'Brien.
2. Nomenclature, " Gerard H. Matthes.
3. Dynamic action of rain in surface runoff and soil erosion. Chairman: H. H. Bennett.

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TRANSPORTATION SUB-COMMITTEE OF THE PETROLEUM DIVISION OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

W. G. Heltzel, Chairman.

This committee has been making some studies of the flow of oils in operating pipe lines. The work is being done through the efforts of the individual pipe line companies.

The first objective in the committee's program is the verification of the Stanton-Pannell coefficient curve for the flow of oil in actual pipe lines. Tests have been conducted over a period of several months, and considerable data have been obtained for 8 and 10-inch pipe lines varying in length from 35 to 40 miles. The 8 inch line was built with screw couplings, but the 10-inch line was welded. Viscosities of the oil were determined each day, and the pressure gages were checked and calibrated. The volumes of oil pumped through the lines were measured volumetrically. Pressure losses in manifolds and junctions were excluded by measuring the pressures at suitable points.

The data obtained substantiate the Stanton-Pannell curve for Reynolds numbers between 15,000 and 55,000. The committee hopes to be able to obtain coefficients at Reynolds numbers above 55,000 by making tests on fluids being delivered through short lines at high velocities. It also plans to obtain data over a range of Reynolds numbers that include the critical region.

(Note: The above information was taken from a letter dated May 23, 1935, from Mr. William G. Heltzel.)

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UNIVERSITY OF CALIFORNIA, College of Agriculture.

The following projects reported in Bulletin III-1 are being continued:

(270) THE EFFECT OF DEPTH TO WATER TABLE UPON THE LOSS OF WATER FROM THE SOIL SURFACE.

(271) MOVEMENT OF MOISTURE THROUGH SOILS.

(272) CHARACTERISTICS OF SPRINKLERS AND SPRINKLER SYSTEMS FOR IRRIGATION.

## INDEX TO PROJECTS.

Hydraulics - General.



Hydrology.

Machinery - Hydraulic. Page.



Materials for Earth Dams, Levees, etc.



Meters, Orifices, etc.



Model Tests - Coasts, Harbors, etc.



Model Tests - Dams, Gates, Spillways, etc.

Model tests - Miscellaneous. Page



Model tests - Streams.



Plumbing.



Sediment - Transportation, Erosion, Settling, Analysis, etc......

Similitude.



Waves.



Weirs.



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