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NATIONAL BUREAU OF STANDARDS
Lyman J. Briggs,
Director

NATIONAL BUREAU OF STANDARDS
HYDRAULIC LABORATORY BULLETIN
SERIES A

CURRENT HYDRAULIC LABORATORY RESEARCH IN THE UNITED STATES.

BULLETIN IV-2
JULY 1, 1936.

WASHINGTON

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DIRECTORY

United States Government Agencies.

CURRENT HYDRAULIC LABORATORY RESEARCH IN THE UNITED STATES.

Compiled by the National Bureau of Standards,
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Hydraulic Laboratory Bulletin, Series A.

Volume IV, Number 2. July 1, 1936.

INTRODUCTION.

The following list shows which issues of National Bureau of Standards Hydraulic Laboratory Bulletins, Series A and Series B are still available.

Series A. Current Hydraulic Laboratory Research in the United States.

Bulletin I-1, April 1, 1933. Out of print.
" I-2, July 1, 1933. " " "
" I-3, October 1, 1933.
" II-1, January 1, 1934. " " "
" II-2, July 1, 1934. " " "
" III-1, January 1, 1935. " " "
" III-2, July 1, 1935. " " "
" IV-1, January, 1936.

Series B.

Hydraulic Laboratories in the United States (1933).
Hydraulic Laboratories in the United States, 1st revision, 1935.

Since some of the laboratories reporting projects for inclusion in a given bulletin fail to respond to the notice sent out before the next bulletin is issued, it is necessary for us to decide in such cases whether projects reported by these laboratories shall be repeated in subsequent issues. It seems to be impossible to make any general rules for deciding such cases, so each case will be decided on its own merits. However, if a laboratory fails to respond to the notices for two consecutive issues of the bulletin, the projects which it had reported previously will be omitted thereafter.

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:

BALDWIN-SOUTHWARK CORPORATION.

(498)(a) EFFICIENCY AND HORSEPOWER TESTS - BOULDER DAM MODEL TURBINE.
(b) U. S. Reclamation Service.
(c) Research preparatory to final design and manufacture of turbines for Boulder Dam.
(d) Baldwin-Southwark Corp. Staff.
(e) K. W. Beattie, Research & Test Engineer.
(f) Determination of correct design of complete turbine, including spiral casing and draft tube to secure the best performance.
(g) An exact model was made of the turbine, draft tube and casing, and tested with alternative designs of casings and runners. Pitot tube traverses below the runner used in determining runner modifications.
(h) Tests near completion.
(j) Data secured used in design of main turbine parts.

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(499)(a) EFFICIENCY AND HORSEPOWER TESTS - PASSAMAQUODDY TIDAL POWER DEVELOPMENT.
(b) U. S. Engineers.
(c) Commercial research.
(d) Baldwin-Southwark Corp. Staff in collaboration with U. S. Engineers.
(e) K. W. Beattie, Research and Test Engineer.
(f) Determination of effect on turbine performance of variations in casing and draft tube design, with particular reference to variations affecting unit spacing and excavation.
(g) An existing high specific-speed turbine model is used. Model draft tubes and casing were built to permit modifications in width and depth, including changes in piers and insertion of a horizontal baffle in draft tube. Tests are made with each arrangement covering a wide range of operating conditions corresponding to variations in head at the Passamaquoddy Development from 5 ft to 25 ft.
(h) Experiments in progress.

UNIVERSITY OF CALIFORNIA. (and U. S. TIDAL MODEL LABORATORY.)

(16) (a) EVAPORATION BY FREE CONVECTION.
(c) Laboratory project.
(d) B. F. Sharpley and C. W. Quentel.
(e) Professor M. P. O'Brien.
(h) Experiments in progress. Report by Sharpley is being written.

....

(17) (a) TRANSPORTATION OF BED LOAD BY STREAMS.
(b) Corps of Engineers, U.S.A.
(d) Professor M. P. O'Brien.
(e) Professor M. P. O'Brien.
(g) Studies in tilting flume 3 ft wide and 18 inches deep.
(h) Brief summary in this Bulletin of results obtained with Columbia River sand.

....

(276) (a) DISCHARGE COEFFICIENTS OF SHARP-CRESTED WEIRS, IRREGULAR IN PLAN.
(c) Undergraduate thesis.
(d) Gray.
(e) Professor M. P. O'Brien.
(g) Continuation of laboratory tests.
(h) Report by Gray is being written.

....

(278) (a) CHARACTERISTICS OF DISC-FRICTION PUMPS.
(c) Laboratory project.
(d) R. G. Folsom and A. W. Everett.
(e) Professor M. P. O'Brien.
(f) To develop a theory of the performance of the turbulence type of pumps.
(g) Tests of Westco and Burke type of pumps.
(h) Project completed and brief summary is in this Bulletin.

....

(279) (a) SCOUR BELOW DAMS.
(c) Undergraduate thesis.
(d) N.E.Haavik and J. L. Hoffman.
(e) Professor M. P. O'Brien.
(g) Study of scour below scale models.
(h) Project completed and brief summary is in this Bulletin.

....

(280) (a) ORIFICES AND NOZZLES FOR MEASURING DISCHARGE AT END OF PIPE LINE.
(c) Laboratory project in cooperation with Fluid Meters Committee of A. S. M. E.
(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) Experiments are being continued for determining the effect of submergence.

....

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

....

(419) (a) DETERMINATION AND CORRELATION OF VIRTUAL MASS OF SHIP MODELS.
(c) Graduate thesis.
(d) J. P. Murphy.
(e) Professor M. P. O'Brien.
(g) Experiments with ship-model towing equipment.
(h) Experimental work in progress.

....

(420) (a) BROAD-CRESTED WEIRS.
(c) Undergraduate thesis.
(d) A. B. Davis and J. W. Sullivan.
(e) Professor M. P. O'Brien.
(f) Test of model laws.
(h) Project completed. Brief summary is in this bulletin.

....

(421) (a) SIMILARITY OF MODELS.
(c) Graduate thesis.
(d) Taylor.
(e) Professor M. P. O'Brien.
(h) Experiments in progress.

....

(422) (a) HYDRAULIC JUMP IN STANDARD IRRIGATION DROPS.
(c) Laboratory project.
(d) Stoker, Mautz & Shukle.
(e) Professor M. P. O'Brien.
(f) Determination of desirable length of depressed section.
(h) Project completed. Brief summary is in this Bulletin.

....

(423) (a) FLOOD WAVES.
(c) Graduate thesis.
(d) Matheson (Lieut.).
(e) Professor M. P. O'Brien.
(g) Investigation of waves in power canals by means of model channel.
(h) Experiments in progress.

....

(424) (a) IMPACT LOSS AT CONVERGENCE OF STREAMS.
(c) Cooperation with Special Committee on Hydraulic Research, American Society of Civil Engineers.
(d) O'Brien & Stoker.
(e) Professor M. P. O'Brien.
(f) To investigate the energy loss when open and confined streams intersect at various angles.
(h) Experimental work in progress.

....

(425) (a) MODEL STUDY OF WAVE ACTION ON BEACHES.
(c) Graduate thesis.
(d) Meyer. (Lieut.)
(e) Professor M. P. O'Brien.
(f) Investigation of the equilibrium profile of a beach as a function of the size of material, wave height and period.
(h) Project completed. Brief summary is in this Bulletin.

....

(426) (a) HYDRAULIC ROUGHNESS.
(c) Laboratory project.
(d) Folsom, Tripp, and Skoglund.
(e) Professor M. P. O'Brien.
(f) Investigation of methods to measure roughness.
(g) Experimental investigations in water channel with brass walls containing roughness and in air channel with wooden walls.
(h) Experimental work in progress on both channels.

....

(427) (a) FLOW OF WATER IN TIDAL CANALS AND ESTUARIES.
(c) Laboratory project.
(d) Arnold. (Lieut.)
(e) Professor M. P. O'Brien.
(g) Application of theory of E. I. Brown to field and laboratory measurements of estuary of Columbia River.
(h) Project completed. Brief summary is in this Bulletin.

....

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.
(f)
(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.

....

(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.

....

(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 $\underline{n}$ 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 $\underline{n}$ 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.

....

(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.

....

(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.

....

(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.

....

(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. See Bulletin III-2 for conclusions reached.

. . . .

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) Professor 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., 6-in., 8-in., 10-in., 12-in. and 24-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 and in Transactions, Volume 100, 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." At present practically all testing is finished and the complete results are being prepared for publication.
(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 1.5 fps.

. . . .

(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) Professor 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. Reed, 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 fps.

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 fps, which corresponds to a Reynolds number of about 46,600.

The loss of head, friction factor, Reynolds number relations 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 obtained.

....

(500) (a) MAGNITUDE AND FREQUENCY OF FLOODS ON ILLINOIS STREAMS.
(b) Engineering Experiment Station.
(c) Research.
(d) G. W. Pickels.
(e) G. W. Pickels. (Professor)
(g) Analysis of flood data collected by U.S.G.S.
(h) Completed by September, 1936.

....

(501)(a) SYNTHESIS OF THE HYDROGRAPH.
(b) University of Illinois.
(c) Graduate thesis (Doctor's degree)
(d) W. L. Huang.
(e) Professor G. W. Pickels.
(g) Extension of work of Sherman, Bernard and Horton.
(h) Will be completed in February, 1937.

....

(502)(a) PHYSICAL FACTORS AFFECTING THE HYDRAULIC PROPERTIES OF RAPID FILTER SAND.
(b) Graduate (Master's) Thesis.
(c) Laboratory investigation.
(d) H. H. Black and C. N. Stutz.
(e) Professor H. E. Babbitt.
(f) To study the hydraulic properties of filter sands.
(g) Completed.

....

(503)(a) PHYSICAL CONDITIONS AFFECTING THE FLOW OF WATER THROUGH NON-STRATIFIED SAND.
(b) Graduate (Master's) Thesis.
(c) Laboratory investigation.
(d) D. K. Harmeson and W. A. Hasfurther.
(e) Professor H. E. Babbitt.
(f) To study the hydraulic properties of filter sand in order to determine a method of measuring the effective size of sand and to check the common formulas for flow of water into wells.
(h) Completed.

....

(504)(a) MODEL OF SPILLWAYS ON WATER SUPPLY RESERVOIRS IN ILLINOIS
(b) Conducted for and in cooperation with the Illinois State Water Survey, Departments of Theoretical and Applied Mechanics and Civil Engineering, University of Illinois.
(c) Investigation of capacities, use as measuring devices and erosion problems.
(d) J. S. Gobble, R. T. Larson and J. J. Doland in cooperation with W. J. Putnam.
(e) Professor F. B. Seely.
(f) To establish rating curves for existing structures, study capacity requirements and suggest measures for reducing danger from undercutting.
(g) Construction and testing of models of five existing structures, one each at West Frankfort, Staunton, Carbondale, Centralia and Bloomington.
(h) West Frankfort model completed and about ready for test runs.

....

IOWA INSTITUTE OF HYDRAULIC RESEARCH.

(311)(a) TRANSPORTATION OF BOTTOM LOAD IN OPEN CHANNELS.
(c) Graduate thesis.
(d) F. T. Mavis and Te Yun Liu.
(e) Professor F. T. Mavis.
(f) Studies of capacity for traction.

....

(314)(a) Laboratory study of ground water profiles.
(c) Graduate thesis.
(d) F. T. Mavis and T. P. Tsui.
(e) Professor F. T. Mavis.
(i) Continuation of studies previously reported.

....

(316)(a) HYDROLOGIC STUDIES - RALSTON CREEK WATERSHED.
(c) Cooperative project - Iowa Institute of Hydraulic Research, U. S. Department of Agriculture, and U. S. Geological Survey.
(e) Professor F. T. Mavis.
(h) Continuous records since 1924 of precipitation, runoff, ground-water levels, and cover. Drainage area, 3 sq mi of rolling agricultural land near east city limits of Iowa City.

....

(317)(a) COOPERATIVE STREAM GAGING IN IOWA.
(c) Cooperative project - U. S. Geological Survey.
(d) R. G. Kasel, District Engineer, and staff.
(e) F. T. Mavis.
(h) Stream gaging stations are maintained cooperatively at stations on major watersheds in Iowa. Report on stream flow records in Iowa 1873-1932 was prepared cooperatively by U. S. Geological Survey, Iowa Institute of Hydraulic Research, and Iowa State Planning Board, and published by the Iowa State Planning Board.

....

(318)(a) HYDRAULICS OF SAND FILTERS.
(d) Prof. E. L. Waterman and graduate students.
(e) Professor F. T. Mavis.
(f) To study the hydraulic characteristics of filter sands in tubular sections of a filter.
(h) One series of tests was completed as a graduate thesis and the second series is in progress.

....

(451)(a) HYDRAULICS OF THE CURTIS BEND ON THE IOWA RIVER NEAR IOWA CITY.
(c) Graduate thesis.
(d) Prof. F. T. Mavis, Lieut. W. D. Smith, and Lieut. George W. Beeler.
(e) Professor F. T. Mavis.
(f) Correlation of field and laboratory data.
(h) Preliminary studies completed. Experiments to be continued.

....

(452)(a) COEFFICIENTS OF DISCHARGE FOR TAINTER GATES.
(c) Graduate thesis.
(d) Prof. J. W. Howe and Lieut. Hoy D. Davis.
(e) Professor F. T. Mavis.
(f) (1) To find the best definition of "head" under which the gate discharged.
(2) To find a simple method of computing the discharge under the gate.
(g) The gate extended across the full width of a rectangular channel. There were no side contractions, and the jet was fully supported by a horizontal floor. Gate openings were varied from 0.05 ft to 0.25 ft in height. The angles of lip with the horizontal varying from 58° to 72° and heads varying from 0.15 to 1.16 ft. The different angles were secured by raising the gate trunnions.
(h) About 120 tests were completed and the results analyzed. The head was defined as the distance from the pond level to the center of the opening. A marked relation was found between the height of the gate opening and the discharge coefficient. The coefficient decreased as the height of the opening became larger.
(i) The data obtained are not sufficient to draw general conclusions, and the experiments are to be continued.

....

(455)(a) FUNCTIONAL DESIGN OF FLOOD CONTROL RESERVOIRS.
(c) Graduate thesis.
(d) Prof. C. J. Posey and Fu-Te I.
(e) Professor F. T. Mavis.
(f) Analysis of flood routing problems.

....

(456)(a) THE HYDRAULIC JUMP IN ENCLOSED CONDUITS.
(c) Graduate thesis.
(d) Prof. E. W. Lane and C. E. Kindsvater.
(e) Professor F. T. Mavis.
(f) An experimental verification of the momentum theory as applied to the hydraulic jump in a pipe.
(g) A transparent 6 inch pipe is used. The jump is created by means of a concrete constriction.

....

(457)(a) THE TECHNIQUE OF THE PHOTOGRAPHIC DETERMINATION OF VELOCITIES OF WATER IN CLOSED CHANNELS.
(b) Institute of Hydraulic Research.
(c) Independent research.
(d) Dr. A. Lüksch, L. S. Hooper.
(e) Professor F. T. Mavis.
(f) To develop a technique for measuring velocities without introducing instruments into streams.
(g) Preliminary tests using different floating particles have been made and results have been compared with measured rates of flow.
(h) The technique as such has been found to be applicable for use in transparent models.

....

(505)(a) INVESTIGATION OF FLOW THROUGH EARTH DAMS.
(c) Graduate thesis.
(d) Prof. E. W. Lane and P. Charles Stein.
(e) Professor F. T. Mavis.
(f) To investigate the saturation of earth dams under various head water levels.
(g) A parallel-plates analogy is used as the experimental method.

....

(506)(a) STILLING POOLS FOR SPILLWAYS.
(b) Iowa Institute of Hydraulic Research.
(c) Experimental study, Institute project.
(d) F. T. Mavis, and P. Charles Stein.
(e) Professor F. T. Mavis.
(f) Investigation of erosion below model spillways and sluiceways.
(i) The work is a continuation of other studies previously reported.

....

(507)(a) THE CONVERSION OF KINETIC ENERGY INTO PRESSURE IN DIVERGENT CONDUITS.
(b) Am. Soc. C. E. Committee on Hydraulic Research.
(c) Independent research.
(d) Prof. F. T. Mavis and Dr. A. Luksch.
(e) Professor F. T. Mavis.
(f) To investigate the basic physical phenomena of flow in divergent conduits with particular reference to the energy conversion.

....

(508)(a) TESTS OF PROPORTIONAL FLOW WEIRS.
(b) Iowa Institute of Hydraulic Research.
(c) Independent experimental research.
(d) H. E. Howe and Edward Soucek.
(e) Professor F. T. Mavis.
(f) Determination of relation for discharge coefficients in terms of dimensions of weirs. Check on linear head-discharge relations.
(g) Gravimetric calibration of various sizes of weirs. Maximum operating discharge 3.4 cfs.
(h) Tests of 12 weirs of different sizes have been completed.
(i) The weirs which were tested are "Sutro Weirs" described in <u>Engineering News</u>, Vol. 72, No. 9, Aug. 27, 1914, p. 462.

....

(509)(a) FLOW OF WATER AROUND 6-INCH CELLULOID PIPE BENDS.
(b) Bureau of Agricultural Engineering, U. S. Department of Agriculture.
(c) Cooperative, government and Iowa Institute of Hydraulic Research.
(d) U. S. Department of Agriculture Staff.
(e) David L. Yarnell, Senior Engineer.

(f) To determine losses, changes in pressure, velocity and direction of current flowing through 6-inch pipe bends with various amounts of total curvature, on hyperbolic and elliptical-shaped bends, on an abrupt 90-degree elbow, as well as on a bend of circular cross-section with varying radius of curvature. The research included cases with uniform and other cases with non-uniform velocity distribution in the pipe approaching the bend.

(g) The investigation included tests on nine different bends. Pressure and velocity measurements taken at a great many points on the bends, as well as on the tangents, for velocities ranging from 2 to 14 fps. The practicability of using a bend as a flow meter was fully investigated.

(h) The research has been completed and the report now being edited for printing.

(i) The tests revealed many interesting facts which are here summarized very briefly:

1. All bends act as obstructions to flow, resulting in additional loss of head.
2. With uniform velocity distribution in the approach conduit to the bend, the velocities of the filaments along the inside wall of the bend are increased while those along the outside wall are reduced.
3. Using the standard 6-inch, 90-degree celluloid bend as a basis for comparison, and with uniform or normal velocity distribution in the approach conduit to the bend; the 45-degree bend gave a loss of head about 3/4 that on the 90-degree bend; the 180-degree bend with continuous curvature in one direction gave about 1 1/4 times that on the 90-degree bend; the 180-degree reversed curve bend about 2.1, the 270-degree bend about 2.7, and the 90-degree abrupt elbow about 7.8 times that on the 'standard' 6-inch, 90-degree celluloid bend.
4. For a given pipe bend, and quantity of flow, the head lost in the bend depends upon the velocity distribution in the approach tangent.
5. After a pipe bend has been calibrated, it may be used as a flow meter and discharges may be determined by merely measuring the difference in pressure between the inside and outside of the bend.
6. The losses in the pipe bends experimented upon appear to vary as the square of the velocity and not as the 2.25 power as suggested by some writers.

....

(510)(a) HYDRAULIC JUMP ON SLOPING APRONS.

(b) Bureau of Agricultural Engineering, U. S. Department of Agriculture.

(c) Cooperative, government and Iowa Institute of Hydraulic Research.

(d) U. S. Department of Agriculture Staff.

(e) David L. Yarnell, Senior Engineer.

(f) To investigate the best methods of dissipating the energy in the high velocity water at the foot of such aprons and to develop the cheapest and most efficient method for accomplishing this.

(g) The experiments will be conducted in a flume 30 inches wide equipped with transparent walls. Many pressure and velocity measurements will be taken for various depths of approach water and tail water and for aprons having different slopes. Many lateral drainage ditches discharge through chutes into main ditches. Similar struc tures are used for irrigation systems in dropping the water from a high level to a low level. Water storage dam spillways discharge water down steep aprons. The failures of such structures are caused by the inefficient dissipation of the energy in the water at the foot of such structures.

(h) Investigation to be started in July.

(i) Progress reports will be made at various intervals.

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(511)(a) FLOW OF WATER AROUND 180-DEGREE BENDS OF SQUARE AND RECTANGULAR SECTION.

(b) Bureau of Agricultural Engineering, U. S. Department of Agriculture.

(c) Cooperative government and Iowa Institute of Hydraulic Research Project.

(d) U. S. Department of Agriculture staff.

(e) David L. Yarnell, Senior Engineer.

(f) To determine losses, changes in pressure, velocity and direction of current flowing around both open and closed bends of various curvatures.

(g) Investigation included measurements of pressure and velocity for various quantities of flow for channels, 10" x 10" with 5" inner radius, 5" wide x 10" deep with 5" inner radius, and 5" wide by 10" deep with 10" inner radius. Effect of non-uniform velocity of approach on losses investigated.

(h) Investigation completed and report now being printed.

(i) While the report gave much data on pressure and velocity distribution in the bend, information on losses obtained was not as complete as desired, because of the limited capacity of the laboratory at the time the tests were made. Annotated bibliographies on flow of water around bends accompanies report.

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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 unsatisfac tory in river navigation locks and to increase the efficiency of the hydraulic systems of such locks.

(g) A typical barge lock was constructed 1/15th 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) A preliminary report is in preparation.

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(213) (a) MISSISSIPPI RIVER, LOCK & 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) To design control works necessary to maintain a satisfactory navigation channel from the dam to the mouth of the Missouri river and to study the effect of spillway discharge on the river bed at piers of the railway and highway bridges about 800 ft below the dam.
(g) Movable bed models were built and tested; one with horizontal scale 1/250 and vertical scale 1/60, and the other with horizontal scale 1/400 and vertical scale 1/60.
(h) A final report covering these tests is in the last stages of preparation.
(i) Information concerning tests on this project may be had through the District Engineer, U. S. Engineer Office, St. Paul, Minnesota.

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(216)(a) MISSISSISSIPPI 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) backwater from the dam and adjoining sand dike (2) increase in channel velocities caused by the position of the sand dike (3) distribution of currents in the pool above the dam, (4) effectiveness of auxiliary spillways over the sand dike in reducing flood backwater (5) certain specific effects of a freshet which damaged the construction railway fill in April, 1934. In addition an investigation was made to determine whether a model of this type could be used to study silting.
(g) The tests were made in a fixed-bed model 1/500th full size in horizontal and 1/100 full size in vertical dimensions. Model water surface profiles were made to conform to open river profiles by roughening the main channel. Timber was simulated by scattered crushed rock. The "silt" found most satisfactory for use in the model was a commercial concrete admix (Barnsdall Admix). It was introduced at the intake to the model.
(h) Tests have been completed and the model dismantled.
(i) It was found that silt problems could be worked out successfully in a model such as this.

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(330)(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) To make a thorough study of all features of the hydraulic system for the 65 ft lift lock at Pickwick Landing, Tennessee.

(g) The side-culvert intakes and outlets, culvert control valves, emptying and filling ports, and the culverts themselves were set up as part of the lock model - which has been under investigation for some time. The scale ratio was made 1/30 for these tests because of the unusual size of the Pickwick lock.
(h) Project completed.
(i) Many improvements over first proposals were developed. Information may be had through District Engineer, U. S. Engineer Office, St. Paul, Minnesota.

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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 an arrangement for the spillways of this navigation dam which would cause least damage to a highway bridge approach fill below the structures. After a final arrangement for the spillways had been made the model was to be used further in studying methods of pool regulation and operation of the dam.
(g) Tests are being run on 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. The studies resulted in a major change in its design. A cast aluminum dam of the final design has been installed in the model.
(i) The general studies which are now being made are taken with particular attention to a comparison with measurements to be made in the prototype.

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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 and the results have been analyzed.

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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.
(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 are being carried out on a model of three roller gates 1/18 full size. Calibrations will be made for a full range of gate openings and stages in upper and lower pools.
(h) Tests are in progress.

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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.
(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 was provided for this study. Approximately 50 ft of sand bed 2 ft deep was provided to indicate relative effectiveness of expedients tested.
(h) All scheduled tests have been completed, but results have not been fully analyzed.

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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 covered: (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) Calibration of the gate is complete and the data are now being analyzed.

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(397)(a) WHITEWATER RIVER SILTING STUDY.
(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.
(g) A fixed bed model 1/100 full size in vertical and 1/600th full size in horizontal dimensions was constructed of portland cement concrete for this study. It simulated the Whitewater River valley for a distance of about 10 miles upstream from the confluence of the Whitewater and Mississippi Rivers, and the Mississippi River valley from a point above the town of Weaver to Minneiska, Minnesota. A 90° V-notch weir supplied water for Mississippi River flows and a small 30° V-notch measured flow in the Whitewater. "Silt" represented by Barnsdall (concrete) Admix, was introduced into the Whitewater inflow.
(h) Tests are complete.
(i) Very satisfactory checks have been obtained between model and prototype.

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(404)(a) MONONGAHELA RIVER, NEW DAM NO. 4.
(b) Corps of Engineers, U.S.A., Pittsburgh District.
(c) Institute Project.
(d) U. S. Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) To study the design of stilling basin; also to study in detail pressures over two shapes of ogee spillway.
(g) Sections of spillways and stilling basins were constructed 1/30th full size and set up in a glass-sided flume. Certain spillway sections were provided with piezometers on the center lines.
(h) Project completed.

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(445)(a) MISSISSIPPI RIVER, DAM NO. 26, COFFERDAMS.
(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) To determine the effect of channel restriction during construction upon protective works designed for the auxiliary lock and to measure the backwater caused by various cofferdams.
(g) A movable bed, distorted model of a short reach of river including the site of Dam No. 26 and bridges downstream from it was built for this study. Various expedients suggested to prevent scour at critical points around different cofferdams and the locks were tried out.
(h) Tests are complete.

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(446)(a) ROLLER GATE COEFFICIENT (STP)
(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 discharge coefficients for gates in Mississippi River Dams Nos. 5, 5A and 8.
(g) A model of a single roller gate and supporting piers has been constructed of aluminum castings to 1/38th the size of the prototype. The model with sill and stilling basin simulating Dam No. 8 is installed in a glass-walled flume. The sill and stilling basin may be replaced by other units to simulate dams 5 and 5A.
(h) Tests are in progress on model of Dam no. 8.

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(448)(a) WEEP HOLES.
(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 gradient required to "boil" the gravel in weep holes 4 and 10 in. in diameter and 1.5 and 4.0 ft deep.
(g) An apparatus was set up in which metal pipes representing..... the desired weep holes to full scale were installed and subjected to various heads of water. The gradients through the weep holes were measured by drops in water pressures between piezometers near the lower and near the upper ends. The rate of flow was measured over a V-notch weir.
(h) Tests are complete.

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(512)(a) ILLINOIS RIVER, PEORIA AND LA GRANGE DAMS.
(b) Corps of Engineers, U.S.A., Chicago District.
(c) Institute Project.
(d) U. S. Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) To determine the leakage through the wicket section of the dams for various heads and the discharge capacity and hydraulic characteristics of the butterfly valve section of the dams for various heads.
(g) A model of a part of the wicket section of the dams is being constructed 1/7th full size. The amount of water passing through the dam will be measured by a V-notch weir located upstream from the dam.
(h) Model under construction.

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(513)(a) SAND CONSOLIDATION STUDY.
(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 feasibility of using a sodium silicate-calcium chloride solution in the consolidation of foundation materials.
(g) This required a study of the strengths and proportions of chemicals to be used, the methods of injecting the solutions, and equipment required.
(h) Tests complete.

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(514)(a) TENNESSEE RIVER, GUNTERSVILLE LOCK HYDRAULIC SYSTEM.
(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) To make a thorough study of flow characteristics of the filling and emptying ports. The scale ratio of the model 1/20. By using this scale all parts of the Pickwick model, except the ports, could remain the same, since the design of the Guntersville lock was in direct conformity with the Pickwick lock.
(h) The filling and emptying ports have been satisfactorily designed, and studies will terminate upon completion of pressure investigations in the side culverts.
(i) Information concerning these tests may be had through the District Engineer, U. S. Engineer Office, St. Paul, Minnesota.

....

(515)(a) TENNESSEE RIVER, CHICKAMAUGA LOCK HYDRAULIC SYSTEM.
(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) To make a thorough study of the flow characteristics of the filling and emptying ports. These will be installed in the Guntersville lock model. Features other than the ports remain the same.
(h) Only preliminary studies have been made, using the Guntersville model.

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(516)(a) TENNESSEE RIVER, CHICKAMAUGA 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) To determine the effect, and to suggest corrective measures, if necessary, of the diversion of North Chickamauga Creek at the side of Chickamauga Lock upon the lower approach to the lock.
(h) Tests are complete.

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(517)(a) PILE FOUNDATIONS.
(b) Corps of Engineers, U.S.A., Upper Mississippi Valley Division.
(c) Institute Project.
(d) U. S. Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) Investigation of the transferability of results of test loadings, vertical and lateral, from small-scale to full-size piles, the effect of media, the effect of the water table in and percolation through the media on the supporting power of the piles, and to increase general knowledge of the mechanics of pile foundations.
(g) Model piles 1/6th, 1/12th, 1/18th and 1/24th sizes of standard wood piles of three different lengths, 35, 40 and 45 feet, will be driven and loaded in a fine, clear river sand of uniform grading contained in a concrete pit 6 by 10 by 8 ft deep. Vertical and horizontal loads will be applied and deflections measured on single piles, and later similar loads will be applied to groups of piles.
(h) The model piles have been constructed, the test pit is completed and filled with sand. The apparatus for loading and testing is under construction.
(i) Information concerning these tests may be had through the District Engineer, U. S. Engineer Office, St. Paul, Minnesota.

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(518)(a) MISSISSIPPI RIVER, DAM NO. 22.
(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 develop a satisfactory stilling basin for the submergible Tainter gates in this dam and to obtain pressures on the faces of a gate for various flows when submerged.
(g) A model of a single gate and half of each adjacent pier was built of aluminum, 1/28.87th full size and set up in a glass sided flume. The gate sill was cast in place in portland cement mortar and the stilling basin made of wood to permit easy alteration. Various heads and discharges have been passed through the model for two different types of stilling basins.
(h) Tests are complete, although they have not been analyzed by the staff. Photographs are available showing flow conditions and scour below the stilling basins.

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MASSACHUSETTS INSTITUTE OF TECHNOLOGY, DEPT. OF CIVIL & SANITARY ENGINEERING

(362)(a) MODEL OF CAPE COD CANAL AND APPROACHES.
(b) Col. 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 and high water profiles, velocities and other hydraulic features connected with design of enlarged canal.
(g) A distorted fixed bed model has been built of the Canal including the approach in Cape Cod Bay and both the present and proposed approaches in Buzzards Bay from Wings Neck. Scales: 1:600 and 1:60. Length of model 115 ft. The tides of the two bays are controlled by an electrically-controlled mechanism. Water-surface elevations are electrically determined by using the water surface as one plate of a condenser. Both electrical mechanisms good to 1/100 in. elevation.
(h) 170 ft by 25 ft trapezoidal section with known tides reproduced. Model checked nature. Sections 500 ft by 40 ft and 540 ft by 32 ft studied. Tests completed.

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(519)(a) EXPERIMENTAL STUDY OF BED LOAD TRANSPORTATION IN RIVER CHANNELS.
(b) River Hydraulic Laboratory, M.I.T.
(c) Graduate research for Master's degree.
(d) A. L. Jorissen.
(e) Professor K. C. Reynolds.
(f) To investigate effect of mechanical composition of sand on bed load movement.
(g) Wooden flume used 34 ft long, 24 in wide and 15 in deep with rails adjustable for slopes of 1:300, 1:600, 1:900. Two synthetic sand mixtures used.
(h) Research completed. Thesis report in preparation.

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(520)(a) INVESTIGATION OF DRAG OF FISH NETS.
(b) U. S. Bureau of Fisheries.
(c) Graduate research for Master's degree.
(d) G. W. Hines.
(e) Professor K. C. Reynolds.
(f) To determine drag of twine used for fish nets with various velocities of the water.
(g) Twine fastened to knife-edged pivoted rod. Water flows along glass channel and drag measured. Different loops studied. Ultimately will investigate drag of fish nets for various speeds of water.
(h) In progress.

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(521)(a) INVESTIGATION OF SHIP VIBRATION.
(b) Dept. of Naval Architecture, M.I.T.
(c) Graduate research for Master's degree.
(d) Lt. C.G.F.Prescott and Lt. A. C. Veasey.
(e) Commander H. E. Rossell, U.S.N.
(f) By model studies to determine fundamental facts about ship vibration.
(g) Several steel models of ships were subjected to vibration in attempt to find laws which will aid in overcoming vibration in future ship designs.
(h) Thesis completed, "Investigation of Vibrations in Ship Models". Research to be continued.

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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.
(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 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) Completed. Report published.

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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 and 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.
(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) Completed. Report published.

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(522)(a) SHORT CIRCUITING IN MIXING CHANNELS AND TANKS WITH STIRRING DEVICES.
(b) Sanitary Engineering Laboratory, M.I.T.
(c) Student research.
(d) Professor Thomas R. Camp and s tudents.
(e) Professor Thomas R. Camp.
(f) To determine relative efficiencies of different types of mixing tanks as measured by short circuiting.

(g) Measurement of short circuiting in models by means of salt and dyes.
(h) Bachelor's thesis submitted by A. H. Bagnulo and E. C. Knight, May, 1936, "A Study of Hydraulic Short Circuiting through Mixing Chambers". Other work to follow.

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(523)(a) HYDRAULICS OF LATERAL SPILLWAY CHANNELS.
(b) Sanitary Engineering Laboratory, M.I.T.
(c) Student research.
(d) Professor Thomas R. Camp and students.
(e) Professor Thomas R. Camp.
(f) To determine friction losses in lateral spillway channels.
(g) Experimental measurement of drop-down curve and comparison with theoretical curve.
(h) Bachelor's thesis submitted by J. H. Carr, Jr. and A. A. Thomas, May 21, 1936, "Hydraulics of Lateral Spillway Channels". Other work to follow.

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(524)(a) STUDIES OF CLARIFICATION BY SEDIMENTATION.
(b) Sanitary Engineering Laboratory, M.I.T.
(c) General scientific research.
(d) Professor T. R. Camp and assistants.
(e) Professor Thomas R. Camp.
(f) To determine influence of various factors affecting clarification.
(g) Studies of flow through small settling tanks. Correlation of clarification in settling tubes with removal in tanks.
(h) In progress.

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OHIO STATE UNIVERSITY.

(458)(a) CALIBRATION OF A VENTURI METER FOR A LARGE RANGE OF REYNOLDS NUMBERS.
(b) The Ohio State University Engineering Experiment Station.
(c) General engineering research.
(d) Professor S. R. Beitler.
(e) Professor S. R. Beitler.
(f) Further proof of the validity of the Reynolds Number theory to meters.
(g) A 1/2 x 3/4 inch Venturi is being calibrated with hot and cold water and with high accuracy head and quantity measurements to determine accurately the variation of coefficient with Reynolds number over a Reynolds number range of from 2,000 to 500,000.
(h) Test runs are in progress; they are expected to be completed in about six months.

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(525)(a) CALIBRATION OF PIPE ORIFICES WITH STEAM.
(b) Ohio State University Experiment Station in cooperation with the Bailey Meter Company.
(c) General engineering research.
(d) T. C. Barnes, S. R. Beitler.
(e) Professor S. R. Beitler.
(f) To give more positive demonstration of the fact that orifice coefficients determined with water can be used for the commercial measurement of steam.
(g) Two series of orifices, one in a 2 inch and one in a 3 inch line, are to be calibrated, using steam as the calibrating fluid. Tests will be run to cover the complete range of heads available. These orifices have already been calibrated with water so that direct comparisons may be made.
(h) Apparatus is at present being set up; testing will start about July 1 and should be finished about August 1.

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(526)(a) DETERMINATION OF DISCHARGE COEFFICIENTS OF FLOW NOZZLES.
(b) Ohio State University Engineering Experiment Station in cooperation with the Special Research Committee on Fluid Meters of the A.S.M.E.
(c) Cooperative research.
(d) and (e) Professor S. R. Beitler.
(f) To determine the discharge coefficients of flow nozzles in various sized pipes using steam as the metered fluid.
(g) This is a part of the work of the Special Research Committee on Fluid Meters of the A.S.M.E. which is being undertaken in order to standardize nozzles and to determine the coefficients accurately. For this purpose steam at several different pressures and temperatures and with a wide range of differential heads across the orifice will be used. The results are to be correlated with the results on other fluids made in other laboratories.
(h) Preliminary plans completed; test set up being erected, and tests will probably start in July.

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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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PRINCETON UNIVERSITY.

(462)(a) AN INVESTIGATION INTO THE NATURE OF CAVITATION.

(b) Graduate thesis.

(c) Laboratory research.

(d) Hugh J. Davis.

(e) Professor Lewis F. Moody.

(f) To determine the critical point at which cavitation originates in a closed conduit system, to measure the corresponding absolute pressure at the point where the cavitation occurs, to find whether the conditions satisfy the Thoma principle $\sigma H = H_b - H_s$, to investigate the effect of the separation of air contained in the water in a system under relatively low initial pressure, and to make visual observations of the flow at the cavitating point.

(g) The work utilized new apparatus installed under the supervision of Professor A. E. Sorenson. The apparatus is of similar form to that used in the experiments reported at the December 1935 meeting of the American Society of Mechanical Engineers, and also to that used by Professor W. S. Pardoe at the University of Pennsylvania, but is of larger size and of modified design, and is located on the second floor of the laboratory at a sufficient elevation above the sump to permit the use of low pressures. The apparatus comprises a Venturi meter of special design having a well-rounded, bell-mouth entrance, a glass throat of 2-1/2 inches inside diameter by a 3 inches length, and a tapering discharge section with all metal parts of brass with finished inner surfaces. It was found that with this design, cavitation started at the entrance to the glass section and progressed through it, so that its effects were clearly visible. Motion picture records were secured during the cavitation action. The apparatus is not intended for experiments on pitting or the effects of sustained cavitation.

(h) Accurate and interesting results were secured. It was found that the effects of air separation could be differentiated from the separation of condensable vapor, and that the critical point indicated by a point of discontinuity of the efficiency and discharge curves corresponded to the reaching of the vapor pressure of the water in accordance with the Thoma principle.

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(527)(a) GROUND WATER FLOW.
(b) Graduate thesis.
(c) Laboratory research, analysis and application of results.
(d) Lieut. William Whipple, Jr., U.S.A.
(e) Professor Lewis F. Moody.
(f) To apply an original method, proposed by the investigator, for plotting lines of flow and determining pressure gradients in the percolation through porous foundations of dams, through earth dams, and the flow of ground water.
(g) The method applies an electrical analogy and comprises the use of a model section in the form of a slab of wax and powdered graphite through which direct current is passed from suitable brass conductor strips forming the inlet and exit boundaries. The electrical potential at any point is measured by a stylus, a slide-wire bridge and galvanometer, forming in effect a calculating machine. The method was found to work out successfully and was applied to a number of typical problems, giving useful and important conclusions relating to uplift on concrete dams, seepage through earth dams and other problems. Empirical equations were developed for certain factors in the design of dams, and a new criterion was proposed for guarding against "piping".
(h) The applicability of the method was demonstrated in the fall of 1935 and many studies have been completed by its use. Results were compared with hydraulic experiments made by others, with satisfactory agreement.
(i) The method is believed to be useful and convenient, and the results of studies completed should be of particular interest to designers of dams.

....

(528)(a) THE SUBMERGED HYDRAULIC JUMP WITH SUDDEN VERTICAL ENLARGEMENT.
(b) Graduate thesis.
(c) Laboratory research and analysis.
(d) Lieut. James V. Hagan, U.S.A.
(e) Professor Lewis F. Moody.
(f) To apply the momentum principle to the flow of water in an open channel having a sudden drop in its bed, and to compare the theory with actual measurements in the laboratory.
(g) A glass-sided horizontal flume of 12 inch x 12 inch rectangular section was provided with a sluice gate giving either submerged or free discharge, and a raised horizontal floor forming a sudden vertical enlargement alternatively located at the sluice gate orifice or at a point down stream from the sluice. The discharge was measured by a calibrated Venturi meter. All tests were made under steady flow conditions. The work forms part of a series of investigations continued through the last few years on the effects of abrupt changes in section in open channels, various cases having been previously reported by Ostrand, Bulletin II-1, Project 138, p. 18; Ruestow, III-1, Project 139, p. 19; Kennedy, II-2, Project 237, p. 18, and Clark, IV-1, Project 459, p. 31.

(h) Agreement between observation and the theory, uncorrected for friction and velocity variation over the section, was found to be sufficiently close to warrant use in practice. Formulae and charts for ready solution were presented, and curves showing comparison with observation - Calling H the elevation of the water surface in the large pool in advance of the sluice gate, measured above the downstream horizontal bed; d_1 the vertical height of the orifice below the gate; d_s, the depth of water just downstream from the gate; d_2, the water depth a considerable distance downstream where the surface has become substantially horizontal and normal velocity distribution restored; and calling V_1 the velocity through the orifice; the relation between the variables was expressed in terms of the following non-dimensional ratios:

$$\frac{V_1^2}{2g\, d_1} = m; \quad \frac{d_s}{d_1} = \frac{H}{d_1} - \frac{V_1^2}{2gd_1} = n; \quad \frac{d_2}{d_1} = p;$$

giving the relation: $m = \dfrac{(p^2 - n^2)\, p}{4(p-1)}$. This is a cubic in p, and charts were presented for its convenient solution. For values of n greater than 2, the following approximation was given, accurate within 3% error,

$$p = n - \frac{2\, m}{n - 1.60}.$$

....

(529)(a) THE ROUND-CRESTED WEIR.

(b) Graduate thesis.

(c) Laboratory research.

(d) Capt. Warren N. Underwood, U.S.A.

(e) Prof. Lewis F. Moody.

(f) Investigation of a new form of crest proposed by the correspondent, in the effort to improve the characteristics of the weir as a measuring instrument. As stated in the paper: "As a means of measuring water, the sharp-crested weir possesses certain disadvantages. The principal one is that the underside of the nappe is unsupported. The amount of contraction there rests upon a delicate balance of dynamic forces. Slight changes in velocity due to minor disturbances in the flow near the crest, and differences in the distribution of velocities in the approach channel are likely to cause changes in the amount of contraction with resulting changes in the discharge." The new crest substitutes a quadrant of a transverse cylinder for the sharp crest, the section being a quarter circle. The object was to investigate the characteristics of such a weir from tests on a small model of one foot crest breadth.

(g) The flow was measured by a calibrated Venturi meter in series with the weir. Permissible range of head within the limit at which the nappe tends to part from the crest was determined; the effect of velocity of approach was investigated by varying the floor elevation of the approach channel; and a semi-empirical formula was developed for use with this weir, as follows:

$$Q = 4.015L \left(H + 0.80 \frac{Va^2}{2g}\right)^{3/2}$$

where $\frac{H}{R}$ is between 2.5 and 3.5. Here Q = discharge in cubic ft per sec ; L = crest length in feet; H = observed head on crest in feet; V_a = average velocity of approach in feet per second = Q divided by area of approach channel.

(h) It was concluded that "the round-crested weir would be a reliable means of measuring water when H/R is less than 3.5 if it is first carefully calibrated." (R is the radius of the crest in feet). It is hoped that this initial work may be followed by further investigation of the many factors involved, whenever there is opportunity to continue the development in this laboratory, and similar investigations elsewhere would be welcomed.

....

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 student 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 discharge rate through small circular orifices and triangular weirs.

(g) No change has been made since the last semi-annual report.

(h) The work has been confined entirely to computations involving: (1) discharge, velocity, and contraction coefficients of the orifices; (2) discharge coefficient of the triangular weirs; (3) Reynolds number; and (4) coefficient of surface tension.

(i) Computations so far completed on the orifices fail to indicate a definite relation between Reynolds number and the discharge coefficient. The value of the coefficient for a given ratio of head/diameter increases with temperate increase. Study is under way to determine the effects, if any, of the surface tension.

....

RENSSELAER POLYTECHNIC INSTITUTE.

(530) (a) AN INVESTIGATION OF FRICTIONAL LOSSES IN FITTINGS FOR SMALL COPPER PIPES.

(b) General scientific research.

(c) Undergraduate thesis.

(d) Louis Foster Camp, Jr.

(e) Professor Grant K. Palsgrove.

(f) To supplement the rather meager amount of published information relative to the smaller sizes of copper pipes.
(g) Water at varying velocities and temperatures was run through straight (commercial) copper pipe alone and straight pipe with fittings. Piezometer ring connections were used in head-reading setup. Copper pipes and fittings used were of the soldered joint type. Two sizes of pipe were tested, one inch and three-quarter inch, and five representative standard fittings were selected, namely, coupling, 90° Ell, 45° Ell, Tee, and Cross.
(h) Incomplete.

....

(531)(a) AN INVESTIGATION OF THE THEORY OF THE PITOT TUBE.
(b) General scientific research.
(c) Undergraduate thesis.
(d) James Francis McKenney.
(e) Professors Grant K. Palsgrove and William J. Moreland.
(f) To explain the transformation of kinetic energy of stream into potential energy in the region of the Pitot Tube entrance, thereby arriving at a rational explanation for the expression, $h = V^2/2g$.
(g) A closed water-circulating system consisting of sheet metal flume 3" x 6" x 3 ft long; transition pieces, reducing the size to that of a three-quarter inch aluminum pipe, at both entrance and exit of flume; two large-radius bends and straight 3/4" aluminum pipe sections connecting to a small circulating pump of centrifugal type. Two glass windows were placed at exit end of flume and an opening in cover at this point provided for placing of tube and other apparatus. Low velocity of flow in the region of critical velocity was used for most observations. A static pressure traverse was made just ahead of the tube, together with injection of jets of dye at various points, and their progress was observed both visually and photographically.
(h) Incomplete.

....

(532)(a) AN INVESTIGATION OF A PARSHALL FLUME.
(b) General scientific research.
(c) Undergraduate thesis.
(d) George E. Mussey.
(e) Professor Grant K. Palsgrove.
(f) Investigation of accuracy of a Parshall Venturi Flume for condition of free flow when indicated head is obtained from a diaphragm chamber.
(g) A rubber diaphragm was placed across bottom of flume at a point 2/3 length of converging section preceding the throat, and a water-tight chamber secured directly beneath diaphragm. This chamber was then connected through tubing to a piezometer tube containing graduations for determination of head during flow. A six-inch throat size only was used.
(h) Incomplete.

....

STANFORD UNIVERSITY.

(541)(a) EFFECT OF ANGLE OF ATTACK AND PROFILE OF TURBINE RUNNER BLADES ON CAVITATION.
(b) Stanford University.
(c) General scientific research.
(d) Professor V. C. Finch and assistants.
(e) Professor V. C. Finch.
(f) To correlate previous and current studies of the cavitation phenomenon in an investigation to determine in a quantitative way the effect of angle of attack and profile of runner blades on pitting by cavitation.
(g) Work has been carried forward in the production of cavitation in a two-dimensional venturi section having a throat of 3" x 3" and a downstream angle of flare of 10.5 degrees. A stethoscope has been used to determine the location of the most violent collapse.
(h) Violent cavitation has been produced with the addition of compressed air to the water, and the working section where the blade specimens are to be installed has been located.

....

(542)(a) CALIBRATION OF ORIFICES AT END OF PIPE LINE.
(b) Hydraulic Machinery Laboratory, Stanford University.
(c) Research for benefit of pump industry.
(d) Professors V. C. Finch and U. A. Patchett.
(e) Professor V. C. Finch.
(f) To calibrate a set of orifices for measuring the discharge at the end of a pipe line.
(g) Three orifices were installed at the end of a 6-inch pipe and were calibrated, discharging into the atmosphere, against a calibrated tank and other orifices which had been calibrated by weighing the discharge. The orifices were also calibrated discharging under water against a venturi meter which had been calibrated volumetrically, and against orifices which had been calibrated by weighing the discharge.
(h) Study completed.
(i) Report available for loan.

....

CARNEGIE INSTITUTE OF TECHNOLOGY.

(377)(a) MODEL STUDIES IN CONNECTION WITH THE RECONSTRUCTION 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 five 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 1:180 scale model of the entire main-channel structure to study the effects of currents on scour and navigation in the vicinity of the dam; (3) a 1:400 scale model of six miles of the river (including both the main and back-channel dams) to study the effect of the proposed structure on flood heights; and (4) a 1:15 scale model of a portion of one of the steel gates, to study pressure distributions on the faces of the gate when discharging water, and (5) a 1:15 scale model of a portion of one of the gates suspended on a lever system, to measure the total load on the hoisting mechanism.
(h) Tests on the first model have been completed. Tests on the other models are approaching completion.
(i) An unusual feature of the third model is the use of a micrometer hook gage for reading surface stages with extreme precision.

....

(487) (a) MODEL STUDIES IN CONNECTION WITH THE CONSTRUCTION OF THE NEW GALLIPOLIS DAM ON THE OHIO RIVER.
(b) U. S. War Department.
(c) Laboratory investigation on a fixed-bed 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 navigation on the Ohio River.
(g) Investigation includes the construction and testing of three models: (1) a 1:250 scale model showing several miles of the Ohio River, including old dam No. 26, and the new Gallipolis Dam, to study methods of controlling cross currents in the river near the upstream entrance of the locks; (2) a 1:48 scale model of two bays of the dam, to obtain rating curves for the roller-type gates at various openings; and (3) a 1:16 scale model of a portion of one of the steel gates to study pressure distribution on the gate when discharging water.
(h) Tests have been completed. Report is in preparation.

....

(488) (a) MODEL STUDIES ON THE SPILLWAY OF THE WARRIOR RIVER DAM AT TUSCALOOSA, ALABAMA.
(b) U. S. War Department.
(c) Laboratory investigation using glass-sided flume.
(d) E. P. Schuleen and H. A. Thomas.
(e) Professor H. A. Thomas.
(f) Investigation included studies to determine the best elevation, width and shape of the spillway apron at different sections of this dam. Model was constructed to 1:20 scale in a glass-sided flume.
(h) Tests have been completed. Report is in preparation.

....

(489)(a) MODEL STUDIES TO INVESTIGATE CAVITATION EFFECTS AT ENTRANCES OF OUTLET CONDUITS OF TYGART RIVER DAM AND OTHER HIGH DAMS.

(b) U. S. War Department.

(c) Laboratory investigation.

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

(e) Professor H. A. Thomas.

(f) Investigation includes the construction of apparatus suitable for making tests on model conduits under conditions such that the pressure of the atmosphere surrounding the model can be reduced in the model scale. Cavitation conditions in the model conduits are observed visually through a thick glass window, and are also studied by their erosion effects on the walls of the model conduits. Models of the conduits of the Tygart River Dam, of the Madden Dam and of the Bluestone Dam have been constructed and tested in this apparatus. The apparatus includes a special 8 inch centrifugal pump, air-tight tank with 8-inch piping, and a Nash vacuum pump. Model scales of about 1:15 can be used.

The primary purpose of the tests is to develop entrance designs for high-head conduit which will largely or wholly eliminate cavitation.

(h) The apparatus has been completed and a number of model conduits have been tested. This investigation has also included the construction of a 1:12 scale open model to study stream line paths and eddies in the conduit entrances of the Tygart River Dam and of the Madden Dam. This part of the work has been completed.

(i) The principle underlying the design of this apparatus is that, if a model is to give a true representation of cavitation effects, it is necessary to reduce the surrounding atmospheric pressure in the model scale. Under this condition the first vacuum formation at some point in the flowing stream occurs at corresponding heads in the prototype and model.

....

(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 student assistants.

(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-Monongahela River basin.

(g) This model is about 80 feet long by 2 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) Tests and calibrations of typical model channel, metal fins and control orifices completed. That portion of the model showing 60 miles of the Ohio River below Pittsburgh has been completed and tested experimentally. Experimental work temporarily suspended.

(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.

....

(490)(a) INVESTIGATION OF TRAVELING WAVES IN STEEP CHANNELS.

(b) Pure research. This is an authorized project of the American Society of Civil Engineers' Special Committee on Hydraulic Research. During the present year the project is being carried on in cooperation with the thesis work of Mr. R. F. Schnake, graduate student.

(c) Laboratory investigation and theoretical analysis, together with field investigation of traveling waves in steep channels connected with actual engineering structures.

(d) H. A. Thomas and R. F. Schnake.

(e) Professor H. A. Thomas.

(f) To investigate the fundamental hydraulic principles governing the formation and propagation of traveling waves and surges in channel of steep slope, and to correlate analytical findings with experimental results. To obtain data which will enable the designer of a steep channel to predict the probable maximum height and velocity of the traveling waves which may form in the channel under the given conditions.

(g) An experimental timber channel adjustable in length up to 40 feet and in slope up to about 70° has been constructed, together with apparatus for introducing traveling waves of various heights and amplitudes into the upper end of this channel. Velocities and profiles of these waves are being studied by photographic methods. Field studies on traveling waves in full-sized structures will involve the use of motion pictures. A glass-sided channel of adjustable slope and with moving-belt bed has also been constructed to hold the traveling waves stationary for observation and photographing.

(h) The experimental channels have been completed and numerous tests have been made. An extensive analytical investigation on the hydraulic theory of traveling waves in open channels has been carried on. A progress report on this research is to be presented at the October meeting of the American Society of Civil Engineering.

....

(543)(a) MODEL STUDIES IN CONNECTION WITH THE DESIGN OF THE BLUESTONE DAM, NEW RIVER, WEST VIRGINIA.

(b) U. S. War Department.

(c) Laboratory investigation on a group of models.

(d) F. H. Brockman and H. A. Thomas.

(e) Professor H. A. Thomas.

(f) and (g) Investigation includes the construction and testing of four models: (1) a 1:36 scale model showing two bays of the spillway, including crest gates, outlet conduits and stilling pool, to study the design of the crest profile, crest piers, spillway apron, conduit outlet deflectors, and stilling-pool dam; (2) a 1:160 scale model showing the entire dam, power house and adjacent river channel, to study cofferdam heights and to investigate river currents below the structure under various conditions of operation; (3) a 1:18 pyralin model of an outlet conduit and a longitudinal strip of the stilling pool, to study flow conditions in the conduits; and (4) a 1:15 scale model of a conduit entrance to study conditions with respect to the occurrence of cavitation.

(h) Active tests on all these models are now in progress.

....

(544)(a) MODEL STUDIES ON THE STILLING POOL OF THE TYGART RIVER DAM.

(b) U. S. War Department.

(c) Laboratory investigation.

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

(e) Professor H. A. Thomas.

(f) Supplementary investigation of current distribution in stilling pool.

(g) Construction and testing of a 1:80 scale model of a section of the spillway, outlet conduit and stilling pool, to supplement studies completed two years ago.

(h) Construction of model authorized. Work about to start.

....

CALIFORNIA INSTITUTE OF TECHNOLOGY, Hydraulic Machinery Laboratory.

(102)(a) INVESTIGATION OF VELOCITY DISTRIBUTION IN THE VOLUTE OF A CENTRIFUGAL PUMP IN THE NEIGHBORHOOD OF THE IMPELLER.

(b) Laboratory problem.

(c) Research for thesis for Ph. D. degree.

(d) R. C. Binder.

(e) Professor R. L. Daugherty or Professor Robert T. Knapp.

(f) The determination of the velocity value in the volute of a high-efficiency high-head centrifugal pump, including both average and instantaneous values in the region of the impeller discharge.

(g) A series of comprehensive surveys completely across the volute has been made at selected stations around the circumference of the impeller. Sufficient information has been obtained to determine the complete flow picture between the impeller and the volute at conditions of low, normal, and high discharge. By means of a precision dual-slide valve and special differential gage, instantaneous readings have been obtained to analyze the velocity distribution existing in the stream from a single impeller passage.

(h) Rather comprehensive investigations have been completed upon two different designs of pumps. The results have been presented and accepted as a thesis for the Ph. D. degree. It is anticipated that an abridgment of this work will soon be published in one of the technical periodicals.

....

(356)(a) STUDY OF THE CHARACTERISTICS OF HIGH HEAD CENTRIFUGAL PUMPS.
(b) Metropolitan Water District of Southern California.
(c) Large-scale model study.
(d) & (e)- Professors Th. von Karman, 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.
(f) To determine the normal and reverse flow operating characteristics and the cavitation limits of the model pumps submitted by the contractors for the pumping stations to be installed on the Colorado River Aqueduct.
(g) For a brief description of the special laboratory equipment used for this work, reference should be made to National Bureau of Standards Hydraulic Laboratory Bulletin Series B, October 1, 1935.
(h)&(i) This study began with the testing of five special pumps of varying types and specific speeds to determine the combination of qualities best suited for the various Aqueduct pumping plants. The results of this work were used to guide the preparation of the specifications for the purchase of pumping equipment. The next stage consisted in carrying out the acceptance tests of the model pumps which the specifications required that the manufacturers submit in order to qualify as bidders. This stage of work was completed early in the current year. At the present time the laboratory is engaged in investigating the performance of the larger-scale contrac tors' model submitted to fit the conditions of the individual stations. The bidders' models were constructed to a scale of 1:6.33 which results in pumps delivering about 5 cfs against a head of 450 ft. The contractors' pumps are on a model scale of 1:5.33, which gives a capacity of about 7 cfs against the same head.

....

(545)(a) THE VARIATION OF RESISTANCE TO FLOW WITH THE AMOUNT OF OPENING ON VALVES OF BOTH THE FOLLOWER RING GATE AND CIRCULAR PASSAGE PLUG TYPES.
(b) Metropolitan Water District of Southern California.
(c) Model study for use in analyzing the transient behavior of the Metropolitan Water District pumps, together with their pipe lines and control valves.
(d) Ralph M. Watson and Arthur T. Ippen.
(e) Professor Robert T. Knapp or Mr. R. M. Peabody.
(f) See (c).
(g) 6-inch valves of the desired types are being tested under carefully standardized conditions. Sufficient power is available to carry the Reynolds numbers, based upon the diameter of the valve, up to 3 to 4 million. The down-stream conditions are being investigated at closely-spaced piezometer stations for a distance of about 100 pipe diameters.

....

(546)(a) INVESTIGATION OF THE EFFECT OF VARIATIONS IN INITIAL VELOCITY DISTRIBUTION UPON THE COEFFICIENTS OF A SERIES OF VENTURI TUBES.
(b) General laboratory research.
(d) Ralph M. Watson.
(e) Ralph M. Watson or Professor Robert T. Knapp.
(g) A series of carefully constructed Venturi meters is available in an installation in which they can be very precisely calibrated against a volumetric tank while in place. Provisions have been

made for the use of direction-finding Pitot tubes at various points in the approach section ahead of the meter.

....

CALIFORNIA INSITUTE OF TECHNOLOGY, Hydraulic Structures Laboratory.

(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 and Arthur T. Ippen.
(e) Professor Robert T. Knapp.
(f) To determine the behavior of flow around curves in open channels when the velocity is higher than the critical.
(g) A special flume of 100 ft in length was constructed so that gradients up to 12% for the entire length could be obtained. Experiments were performed for a series of typical curves and gradients.
(h) & (i) The initial division of this research has been completed and a report rendered to the Los Angeles County Flood Control District. As a result of the investigation, a new attack upon the analysis of such flow has been proposed which gives promise of permitting the treatment of many high-velocity open-channel phenomena which have not been satisfac torily analyzed to date. A brief report of the progress at that time was submitted at the January meeting of the American Geophysical Union and will appear in the 1936 Transactions. A more complete treatment, including the method of analysis, is now being prepared for publication.

....

(358) (a) A STUDY OF SURGE WAVE PROPAGATION AND TRAVEL IN CHANNELS OF STEEP GRADIENT.

AND

(359) (a) A STUDY OF THE SPEED OF PROPAGATION OF FLOOD HYDROGRAPHS IN CHANNELS OF VARIOUS GRADIENTS.

These two studies were contingent upon the completion of (357). The latter developed into a much more comprehensive investigation than was originally contemplated and therefore has delayed the work on Projects (358) and (359). However, the analytical treatment resulting from Project (357) furnishes a new and much more satisfactory foundation for the attack on these correlative subjects.

....

CALIFORNIA INSTITUTE OF TECHNOLOGY, Cooperative Laboratory, Soil Conservation Service.

(360) Research of the Cooperative Laboratory is still in too early a stage of development to warrant more than a preliminary survey at this time. Projects begun prior to completion of the new laboratory shelter, and major investigations to be undertaken as soon as the laboratory is complete (about July 30 of this year), are as follows:-

1. Cutting of pilot channels.
2. Energy dissipation in small spillways.
3. Energy dissipation by jets.
4. Improvement of existing sand and gravel sample splitters.
5. Tests on weight-frequency sampling theory.
6. Use of log-probability graphs in sedimentation studies.
7. Mechanics of suspended-load transportation.
8. Mechanics of wear in stream sediment.

The following details apply in general to all projects of the Cooperative Laboratory:-

(b) Division of Hydraulics and Sedimentation, Soil Conservation Service, U. S. Department of Agriculture, under direction of H. M. Eakin.
(c) Primarily scientific research; in addition, particular problems are studied for the other branches of the S.C.S.
(d) Various members of the permanent staff (10 men) of the Cooperative Laboratory.
(e) Professor Th. von Kármán, Professor Robert T. Knapp, Collaborators, or Vito A. Vanoni, Project Manager.
(f) to (i) The new one-story laboratory shelter 133 x 40 feet in size will house the suspended-load and wear flumes, and two glass-walled flumes, as well as a fineness laboratory for the physical analysis of sediment; photographic dark rooms; a work shop; and a field office. With a personnel trained in hydraulic, civil, and mechanical engineering and geology, fundamental research on the mechanics of stream-sediment transportation will be undertaken, emphasis being laid on the basic physical nature of the phenomena without losing sight of practical application to engineering work.

....

LOUISIANA STATE UNIVERSITY AND AGRICULTURAL AND MECHANICAL COLLEGE.

(28) (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.

....

(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 nearby station maintained by the Geology Department of the University.
(h) Records have been taken since June 1, 1933.

....

(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.

....

(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 Dr. 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 since October 1, 1930. 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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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; various types of rubber plates are also tested. 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. Typical specimens are analyzed micro-photographically.
(h) Sufficient information has been secured to select a material for prewelding of turbine blades combining corrosion resistance and machinability. Tests have demonstrated the influence of Brinell hardness, grain size, grain boundaries, grain shapes, impurities, inclusions, and strain hardening.

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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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UNITED STATES GOVERNMENT DEPARTMENTS.

ENGINEERS, CORPS OF, Eastport, Maine.

(468)(a) THE DETERMINATION OF DISCHARGE COEFFICIENTS FOR VENTURI AND OPEN-TYPE SLUICE GATES FOR THE PASSAMAQUODDY TIDAL POWER PROJECT.
(b) Corps of Engineers, U.S.A.
(c) To furnish data for design of the sluice gate structure for restoring the operating pool level following generating cycles.
(d) Alden Hydraulic Laboratory, Worcester Polytechnic Institute, Professor Charles M. Allen and staff.
(e) Captain Hugh J. Casey, C. E., U.S.A.
(f) To obtain rating curves for the discharge of both submerged Venturi and open-sluice type filling gates and to determine the most advantageous design of gate.
(g) Tests are conducted on 1/30 scale models, to determine the effectiveness of various features of design under the tidal conditions to be encountered during normal operation of the plant.
(h) Project completed.
(i) Information concerning tests on this project may be obtained from the District Engineer, U. S. Engineer Office, Eastport, Maine.

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(469)(a) MODEL TESTS ON THE NAVIGATION LOCK FOR THE PASSAMAQUODDY TIDAL POWER PROJECT.
(b) Corps of Engineers, U.S.A.
(c) To furnish data for the design of the navigation lock to be constructed at the entrance to the high-level operating pool.
(d) Alden Hydraulic Laboratory, Worcester Polytechnic Institute, Professor Charles M. Allen and staff.
(e) Captain Hugh J. Casey, C. E., U.S.A.
(f) To check the computed filling and emptying time, and measure hawser stresses on the vessel, to insure that there will be no objectionable degree of turbulence during lockage.
(g) Tests are conducted on 1/30 scale models for various representative lifts and various rates of filling-valve operation.
(h) Project completed.
(i) Information concerning tests on this project may be obtained from the District Engineer, U. S. Engineer Office, Eastport, Maine.

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(470)(a) MODEL TESTS ON ROCKFILL DAMS FOR THE PASSAMAQUODDY TIDAL POWER PROJECT.
(b) Corps of Engineers, U.S.A.
(c) To furnish data for the design of rockfill dams for isolating Cobscook Bay as a high-level operating pool.
(d) Alden Hydraulic Laboratory, Worcester Polytechnic Institute, Professor Charles M. Allen, and staff.
(e) Captain Hugh J. Casey, C. E., U.S.A.
(f) The full-scale prototype is to be constructed by dumping material directly into the tidal flow without employing auxiliary coffer-dams. The purpose of the model experiments is to determine the profile of cross-section and the size of stones required at various elevations to resist displacement by the overflow.
(g) Tests are conducted on 1/50 scale models for various representative stages of construction and using selected critical instantaneous values of pool and ocean tide, as determined by a comprehensive series of computations prepared in advance.
(h) Project completed.
(i) Information concerning tests on this project may be obtained from the District Engineer, U.S.Engineer Office, Eastport, Maine.

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ENGINEERS, CORPS OF, Zanesville, Ohio.

(561)(a) HYDRAULIC JUMP CURVES.
(b) Corps of Engineers, U.S.A.
(d) G. P. Schneider, W. E. Gay.
(e) The District Engineer, U.S.Engineer Office, Zanesville, O.
(f) To facilitate the solution of jump problems.
(g) Investigation comprises two parts: (1) A mathematical investigation of the form of curves to be used. (2) The construction of curves for a rectangular channel.
(h) Completed.
(i) Information concerning investigation may be obtained through the District Engineer, U.S.Engineer Office, Zanesville, O.

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GEOLOGICAL SURVEY, Water Resources Branch.

(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 Division 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, Nebr., during the summer of 1931 as a part of a cooperative investigation of the ground-water resources of the Platte River 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.

(i) The results of the pumping tests near Grand Island are published in United States Geological Survey Water-Supply Paper 679-A. The results of the other two tests are given in a report on the ground-water resources of the Platte Valley, which has been released to the public in manuscript form but has not yet been published.

....

(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 the study is to determine the effect of the size of intake openings of well screens on 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, Nebr. 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 observation 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; further work indefinitely postponed.

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(482)(a) THE CHANNEL-STORAGE METHOD OF MEASURING GROUND-WATER DISCHARGE.
(b) United States Geological Survey, Water Resources Branch.
(c) General scientific research.
(d) O. E. Meinzer, R. M. Leggette, R. C. Cady, V. C. Fishel.
(e) O. E. Meinzer, U. S. Geological Survey, Washington, D. C.
(f) The purpose of this project is to test the channel-storage method of determining ground-water runoff or effluent seepage.
(g) This investigation is being made on the upper part of the drainage basin of the Difficult Run, comprising an area of about one square mile, near Fairfax, Va. The theory of the investigation is essentially as follows: During periods in which there is no direct runoff from the surface, the ground-water runoff or effluent seepage from the basin above any point on the stream is equal to the total discharge of the stream past that point minus the decrease or plus the increase in channel storage. In the present investigation, the channel storage of the stream at different stages is determined by means of cross-section profiles and gage-height readings at 100-foot intervals. The data thus obtained are correlated with the rate of discharge at the master gaging station as determined by the usual stream-gaging methods. Subsequently the channel storage at any time is ascertained from the record of the automatic water-stage recorder at the master-gaging stations by means of a channel-storage rating table. The installations consist of a weir and water-stage recorder at the master gaging station, 134 subsidiary gaging stations for determining channel storage; a recording rain gage, and eight observation wells, of which three are equipped with automatic water-stage recorders. Automatic water-stage recorders are also installed on the stream in the vicinity of the observation wells and at a gaging station near the mouth of Difficult Run.
(h) The results of the investigation thus far were presented in a paper given at the meeting of the Section of Hydrology, American Geophysical Union, in April, 1936. The paper will be published in the 1936 Transactions of the American Geophysical Union. Investigation of the channel-storage method will be continued.

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(562)(a) INVESTIGATION OF CURRENT METER PERFORMANCE IN MEASUREMENTS OF VELOCITY OF WATER IN SHALLOW DEPTHS.
(b) United States Geological Survey, Water Resources Branch.
(c) Determination of empirical coefficients for field use and general scientific research.
(d) W. S. Eisenlohr, Jr., A. H. Frazier, H. F. Cox.
(e) C. H. Pierce, U. S. Geological Survey, Washington, D. C.
(f) To determine a series of coefficients for various channel conditions, velocities, and depths of water, to be applied as a correction factor to the measured discharge of a stream obtained by a current meter used under adverse conditions, such as very shallow water. Also incidental related problems including position of meter in vertical and type of meter.
(g) Current-meter measurements are being made in the 12-foot flume at the National Hydraulic Laboratory, National Bureau of Standards, Washington, D. C. These measurements are made in water which will be varied from 0.3 foot to 1.5 feet deep and flow with a mean velocity of from 0.1 to 1.5 fps. Several types of channel bed will be used, including smooth concrete, 3/4-inch gravel and

2-inch gravel. The discharge of the flume as measured by a weir, calibrated in place, will be divided by the discharge obtained by current meter measurement to obtain the correction coefficient. For each condition of flow several complete measurements are made, using different methods of measuring such as 0.6-depth, 0.2 and 0.8 depth methods and several others. Most of the work is being done with the Type A Price current meter, but other meters such as Pygmy meters of both cup and propeller type are being investigated.

(h) Work in smooth concrete channel for the greater depths completed. Bed of 3/4-inch gravel has been placed in flume and work in very shallow water is now in progress.

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U. S. BUREAU OF RECLAMATION.

(48) (a) HYDRAULIC MODEL EXPERIMENTS FOR THE DESIGN OF THE BOULDER DAM.

(b) (c) (d) (e) (f) (g) See Bulletin I-1, April 1, 1933.

(h) Earlier reports on this work (referred to in Bulletin I-3, October 1, 1933) were:

(1) "Hydraulic Capacity of the Diversion Tunnels of Hoover Dam", by B. W. Steele and S. P. Wing,

(2)(3) Technical Memorandums Nos. 333 and 347 by E. W. Lane.

A complete report of the hydraulic experiments for the Boulder Dam is in preparation and will appear in the near future as a part of the eleven-volume report covering all phases of the Boulder Canyon project. Some previously unreported data have been analyzed and all previous work will have been thoroughly reviewed and supplemented.

(i) All inquiries with regard to this work should be addressed to the Chief Engineer, U. S. Bureau of Reclamation, Denver, Colorado.

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(162) (a) STABLE CHANNELS FOR IRRIGATION CANALS.

(b) (c) (d) (e) (g) See Bulletin I-3, October 1, 1933.

(h) Reports available for loan:

"Canal Studies in Conjunction with the All-American Canal and a Study of Laguna Type Rock-Fill Weirs", by E. W. Lane and J. N. Bradley (Jan. 15, 1935).

"Existing Rock-Fill Weirs on Pervious Foundations", by R. K. Vierck, Technical Memorandum No. 490, November 12, 1935.

(i) The reports noted are the direct outgrowth of the studies undertaken as listed in Bulletin I-3, although the titles are somewhat misleading. All inquiries should be addressed to the Chief Engineer, U. S. Bureau of Reclamation, Denver, Colorado. See also the abstract of Technical Memorandum No. 490 under "Abstracts of Completed Projects".

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(193) (a) HYDRAULIC MODEL EXPERIMENTS FOR THE DESIGN OF THE NORRIS AND WHEELER DAMS, TENNESSEE RIVER.

(b)(c)(d)(e)(f)(g) See Bulletins II-1 and II-2, January and July, 1934, respectively.

(h) Tests completed. Following reports available for loan:

(1) "Protection Against Scour at the Toe of Norris and No. 3 Dams of the T.V.A.", by E. W. Lane, Technical Memorandum No. 359.
(2) "Progress Report on Hydraulic Model Studies of Norris and No. 3 Dams of the T.V.A.", by E. W. Lane, Technical Memorandum No. 366.
(3) "Hydraulic Model Studies for the Design of Draft Tubes for the Wheeler Dam", by G. J. Hornsby, Technical Memorandum No. 404.
(4) "Hydraulic Experiments for the Design of Norris Dam", by C. W. Thomas, Technical Memorandum No. 406.
(5) "Hydraulic Model Experiments for the Design of Wheeler Dam", by J. W. Ball, Technical Memorandum No. 407.
(6) "Hydraulic Model Studies for the Design of Draft Tubes for the Wheeler Dam", by G. J. Hornsby, Technical Memorandum No. 456.

(i) All inquiries should be addressed to the Chief Engineer, U. S. Bureau of Reclamation, Denver, Colorado.

....

(249)(a) HYDRAULIC MODEL EXPERIMENTS FOR THE DESIGN OF THE SPILLWAY OF THE HYRUM DAM.
(b) (c) (d) (e) (f) (g) See Bulletin III-2, July, 1935.
(h) Completed. Report available for loan:
"Hydraulic Model Studies for the Design of the Hyrum Spillway", by W. M. Borland and J. B. Drisko, Technical Memorandum No. 380.
(i) Inquiries should be addressed to Chief Engineer, U. S. Bureau of Reclamation, Denver, Colorado.

....

(250)(a) HYDRAULIC MODEL STUDIES FOR THE DESIGN OF THE SPILLWAY OF THE AGENCY VALLEY DAM.
(b) (c) (d) (e) (f) (g) See Bulletin III-2, July, 1935.
(h) Completed. Report available for loan:
"Hydraulic Model Studies for the Design of the Agency Valley Spillway", by J. B. Drisko, Technical Memorandum No. 506.
(i) Inquiries should be addressed to Chief Engineer, U.S.Bureau of Reclamation, Denver, Colorado.

....

(251)(a) HYDRAULIC MODEL EXPERIMENTS FOR THE DESIGN OF THE SPILLWAY OF THE PINE VIEW DAM.
(b) (c) (d) (e) (f) (g) See Bulletins II-2, III-1 and III-2, July, 1934, and January and July, 1935, respec tively.
(h) Completed. Report available for loan:
"Hydraulic Model Studies for the Design of the Pine View Spillway", by J. B. Drisko and W. M. Borland, Technical Memorandum No. 393.
(i) Inquiries should be addressed to Chief Engineer, U. S. Bureau of Reclamation, Denver, Colorado.

....

(338) (a) RYE PATCH DAM SPILLWAY TESTS.
(b) (c) (d) (e) (f) (g) See Bulletin III-2, July, 1935.
(h) Completed. Report available for loan:
"Hydraulic Experiments for the Design of the Rye Patch Spillway", by J. N. Bradley and J. B. Drisko, Technical Memorandum No. 411.
(i) Inquiries should be addressed to Chief Engineer, U. S. Bureau of Reclamation, Denver, Colorado.

....

(339) (a) MOON LAKE DAM SPILLWAY TESTS.
(b) (c) (d) (e) (f) (g) See Bulletin IV-1, January, 1936.
(h) Completed. Report available for loan:
"Hydraulic Model Studies for the Design of the Moon Lake Spillway", by J. N. Bradley and J. B. Drisko, Technical Memorandum No. 437.
(i) Inquiries should be addressed to Chief Engineer, U. S. Bureau of Reclamation, Denver, Colorado.

....

(340) (a) STUDY OF PERCOLATION THROUGH, AND STABILITY OF, EARTH DAMS UNDER A CHANGING HEAD.
(b) (c) (d) (e) (f) (g) See Bulletin III-2, July, 1935.
(h) Experiments abandoned after partial completion.
(i) Tests performed clearly demonstrated the "capillary siphon" effect as well as a drainage lag important in the design of the slopes. No report has been prepared. Inquiries should be addressed to Chief Engineer, U. S. Bureau of Reclamation, Denver, Colorado.

....

(382)(a) ISLAND PARK DAM SPILLWAY TESTS.
(b) (c) (d) (e) (f) (g) See Bulletin III-2, July, 1935.
(h) Completed. Report available for loan:
"Hydraulic Model Studies for the Design of the Island Park Spillway", by J. N. Bradley and J. B. Drisko, Technical Memorandum No. 478.
(i) Inquiries should be addressed to Chief Engineer, U. S. Bureau of Reclamation, Denver, Colorado.

....

(383)(a) TAYLOR PARK DAM SPILLWAY TESTS.
(b) (c) (d) (e) (f) (g) See Bulletin III-2, July, 1935.
(h) Completed. Report available for loan:
"Hydraulic Model Studies for the Design of the Taylor Spillway", by J. N. Bradley and J. B. Drisko, Technical Memorandum No. 474.
(i) Inquiries should be addressed to the Chief Engineer, U. S. Bureau of Reclamation, Denver, Colorado.

....

(547)(a) HYDRAULIC EXPERIMENTS FOR THE DESIGN OF THE GRAND COULEE DAM. (Formerly listed as Nos. 161, 194 and 248).
(b) U. S. Bureau of Reclamation.
(c) Both general scientific research and investigations for design and construction data.
(d) Begun under direction of E. W. Lane; continues under direction of J. E. Warnock.
(e) Chief Engineer, U. S. Bureau of Reclamation, Denver, Colorado.
(f) Determine spillway crest and stilling pool designs; determine safe diversion procedure during construction.

(g) Models of spillway crests tested at three scales; model of partially constructed dam at various stages and with alternate diversion sequences tested to determine best procedure for avoiding adverse "metabolism" in the river bed.
(h) Tests nearly completed. Report in preparation.
(i) The project as outlined represents an expansion and revision of the work listed in previous issues of this bulletin.

....

(548) (a) IMPERIAL DAM AND ALL-AMERICAN CANAL TESTS. (Formerly listed as Nos. 350, 380 and 381).
(b) (c) (d) (e) (f) (g) See Bulletin III-2, July, 1935.
(h) Partially completed - 1:40 model of the entire Imperial Dam is being tested at the Montrose Laboratory. Flow in the diverging or "influent" slots for the desilting works is being studied at the Denver laboratory.
(i) A complete report of this work will appear in the near future as a part of the eleven-volume report covering all phases of the Boulder Canyon project. Inquiries should be addressed to the Chief Engineer, U. S. Bureau of Reclamation, Denver, Colorado.

....

(549) (a) CABALLO DAM OUTLET WORKS AND SPILLWAY.
(b) International Boundary Commission.
(c) Routine laboratory study for design data.
(d) Hydraulic Laboratory Section of U. S. Bureau of Reclamation.
(e) Chief Engineer, U. S. Bureau of Reclamation, Denver, Colorado.
(f) Determination of best stilling pool and tunnel gate transition designs. Evolution of a satisfactory approach to the Venturi flume below the tunnel outlet.
(g) Models of spillway and outlet works. Pressures and discharge coefficients determined at the spillway crest and in the spillway stilling pool. Sills, pool dimensions established by trial.
(h) Tests nearing completion. Report will be available for loan.
(i) Principal features of this work are the clear demonstration of the inadequacy of the trapezoidal stilling pool and of the effectiveness of various factors in quieting the flow for entry into the Venturi flume.

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(550) (a) BULL LAKE OUTLET WORKS.
(b) U. S. Bureau of Reclamation.
(c) Routine laboratory study for design data.
(d) Hydraulic Laboratory Section of the U. S. Bureau of Reclamation.
(e) Chief Engineer, U. S. Bureau of Reclamation, Denver, Colorado.
(f) Determination of satisfactory tunnel gate transition section and of adequate air ducts to maintain gravity tunnel flow. Determination of stilling pool satisfactory for partial flows.
(g) Model tests. Transitions, stilling pool established by trial.
(h) Completed. Report in preparation.
(i) Novel feature of this work is a vertically curved hump in the floor of the open channel adjoining the outlet portals. Water issuing from the tunnels rises and spreads over this hump, descending again into a normal stilling pool in a well-distributed sheet.

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(551)(a) MORMAN FLATS SPILLWAY.
(b) Water Users Association, Salt River project.
(c) Routine laboratory study for design data.
(d) Hydraulic Laboratory Section of the U. S. Bureau of Reclamation.
(e) Chief Engineer, U. S. Bureau of Reclamation, Denver, Colorado.
(f) Determination of most economical method of increasing the spillway capacity of the existing Mormon Flats Dam.
(g) Model study.
(h) In progress.
(i) Several proposals studied include a cantilevered, inverted-dome overflow section, lowering the existing side-channel crest, deepening and widening the approach channel, substituting Stoney gates with a superelevated discharge chute, and rotating the existing gate piers with appropriate changes in the crest so that piers are parallel to the natural direction of approach - the "echeloned" spillway.

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(552)(a) HORSE MESA SPILLWAY.
(b) Water Users' Association, Salt River project.
(c) Routine laboratory study for design data.
(d) Hydraulic Laboratory Section, U. S. Bureau of Reclamation.
(e) Chief Engineer, U. S. Bureau of Reclamation.
(f) To develop adequate spillway capacities in limited side-channel areas.
(g) Model tests on the relative merits of echeloned gates, normal gates, and gates withdrawn upstream across the entrance to the side channel.
(h) In progress.

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(553)(a) ALAMOGORDO SPILLWAY.
(b) U. S. Bureau of Reclamation.
(c) Routine laboratory study for design data.
(d) Hydraulic Laboratory Section, U. S. Bureau of Reclamation.
(e) Chief Engineer, U. S. Bureau of Reclamation, Denver, Colorado.
(f) Development of satisfactory stilling pool. Check possibilities of cavitation in dentated steps.
(g) Model test.
(h) In progress.
(i) Pressure readings will be made on the sides of the dentated steps or diffusion sills.

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(554)(a) BARTLETT SPILLWAY.
(b) U. S. Bureau of Reclamation.
(c) Routine laboratory study for design data.
(d) Hydraulic Laboratory Section of U. S. Bureau of Reclamation.
(e) Chief Engineer, U. S. Bureau of Reclamation, Denver, Colorado.
(f) To check the performance of a superelevated spillway designed for free vortex velocity distribution.
(g) Model test. Measurements of crest coefficients, velocity, and depth distribution in channel.
(h) In progress.
(i) The spillway chute is curved in plan with a parabolic floor section convex upward and compensated for friction losses. The

designed section is exhibiting flow characteristics almost identical with those anticipated and is proving highly satisfactory.

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(555)(a) ROOSEVELT SPILLWAYS.
(b) Water Users Association, Salt River project.
(c) Routine laboratory study for design data.
(d) Hydraulic Laboratory Section, U. S. Bureau of Reclamation.
(e) Chief Engineer, U. S. Bureau of Reclamation, Denver, Colorado.
(f) To determine the discharge characteristics of modifications in the spillway crests and gate piers.
(g) Model tests.
(h) Completed. Report in preparation.

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(556)(a) STEWART MOUNTAIN SPILLWAY.
(b) Water Users Association, Salt River project.
(c) Routine laboratory study for design data.
(d) Hydraulic Laboratory Section, U. S. Bureau of Reclamation.
(e) Chief Engineer, U. S. Bureau of Reclamation, Denver, Colorado.
(f) To check the performance of a superelevated spillway designed for free vortex velocity distribution.
(g) Model tests. Measurement of crest coefficients, velocity and depth distribution in the channel.
(h) Completed. Report in preparation.

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(557)(a) CASPER-ALCOVA SPILLWAY AND OUTLET WORKS.
(b) U. S. Bureau of Reclamation.
(c) Routine laboratory tests for design data.
(d) Hydraulic Laboratory Section, U. S. Bureau of Reclamation.
(e) Chief Engineer, U. S. Bureau of Reclamation, Denver, Colorado.
(f) To determine satisfactory stilling pool conditions for the spillway and to establish the best setting of the needle valves in the outlet tunnels. To determine the adequacy of the collecting transition downstream from the needle valve jets.
(g) Model tests. Selection of best design by trial.
(h) Spillway tests completed. Report available for loan: "Hydraulic Model Experiments for the Design of the Alcova Spillway", by J. B. Drisko, Technical Memorandum No. 513. Outlet tests in progress.

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(558)(a) FRIANT OUTLET WORKS.
(b) U. S. Bureau of Reclamation.
(c) Routine laboratory study for design data.
(d) Hydraulic Laboratory Section, U. S. Bureau of Reclamation.
(e) Chief Engineer, U. S. Bureau of Reclamation, Denver, Colorado.
(f) To establish the best setting of the needle valves and the proper design of the stilling pool.
(g) Model test.
(h) Model under construction.

....

(559)(a) FRESNO (MONTANA) DAM SPILLWAY.
(b) U. S. Bureau of Reclamation.
(c) Routine laboratory study for design data.
(d) Hydraulic Laboratory Section, U. S. Bureau of Reclamation.
(e) Chief Engineer, U. S. Bureau of Reclamation, Denver, Colorado.
(f) To evolve satisfactory stilling pool design.
(g) Model test. Observation of hydraulic jump and extent of erosion.
(h) Model under design.

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(560)(a) NEEDLE VALVE AND RING-FOLLOWER AND CYLINDER-FOLLOWER GATE CHARACTERISTICS.
(b) U. S. Bureau of Reclamation.
(c) General laboratory study for design data.
(d) Hydraulic Laboratory Section, U. S. Bureau of Reclamation.
(e) Chief Engineer, U. S. Bureau of Reclamation, Denver, Colorado.
(f) To ascertain the operating characteristics of the mechanism noted; to test improvements in the shapes of ports and gate seats.
(g) A five-inch needle valve preceded by six-inch ring-follower and cylinder-follower gates is used. Pressures are measured at critical points, and total pull on gate leaves determined with weighing balances.
(h) In progress.
(i) Of conspicuous importance are the already observed effect on the needle valve flow produced by partial gate openings in the feeder line and the closing or uplift forces acting on the gate leaf at partial openings as a result of converging or diverging flow beneath the edge of the leaf.

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NATIONAL BUREAU OF STANDARDS. (National Hydraulic Laboratory).

(42) (a) INVESTIGATION OF THE PHYSICS OF PLUMBING SYSTEMS.
(c) General research.
(d) R. B. Hunter, G. E. Golden.
(e) The Director, National Bureau of Standards.
(f) To obtain data on which to base logical estimates of the capacities of drain pipes, vertical and sloping, in plumbing systems and to make a study of safety requirements with special reference to back-siphonage and to venting.
(g) It is proposed to collect and to correlate as far as possible existing data on these subjects and to make such supplementary experiments as may be necessary to meet the purposes of the investigation.
(h) Apparatus for testing in connection with the study of back-siphonage has been installed, and it is expected that experiments will be started at an early date. The tower used in previous studies of flow in vertical and sloping pipes has been reconditioned and is ready for use.

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(43) (a) INVESTIGATION OF PIPE BENDS.
(b) U. S. Bureau of Reclamation.
(c) General research.
(d) K. H. Beij, G. H. Keulegan.
(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 smooth and rough pipe bends; on sizes up to 20 inch diameter if funds permit; on bends of various central angles and on miter bends and cast fittings.
(h) Papers on tests on 3/8-inch brass tubing with bends having central angles varying from 5 to 180 degrees, and on tests on 4-inch steel pipe with 90 degree bends of radii varying from 6 inches to 7 feet are being prepared for publication. It has been found impossible to procure commercially copper coils of the dimensions desired for tests. A special joint with piezometer connections for use on one-inch lead pipe has been designed and constructed, and attempts to bend coils with this pipe are being made in the laboratory.

....

(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) Completed.
(i) A summary of the results of the investigation was presented before the Section of Hydrology, at the annual meeting of the American Geophysical Union, April 30, 1936.

The results of the investigation will also be published in the Journal of Research, National Bureau of Standards, Vol. 17, No. 2, August, 1936.

....

(171)(a) INVESTIGATION OF THE PRESSURE VARIATIONS ON 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, F. C. Morey.
(e) The Director, National 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) Tests have been started, but improvements to the set-up are being made as the need arises and time permits.

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

....

(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, G. C. Conners.

(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 being made on various divisors, both with clear and with muddy water, to determine the effectiveness of the divisor in splitting off a definite percentage of the water and soil passing it. All old types, modifications of the old types and some divisors of new design are being studied.

(h) Work has been completed on most of the older types of divisors. Various new forms have been developed and are being tested.

....

(341) (a) STUDY OF MEASURING FLUMES.

(b) Soil Conservation Service, U. S. Department of Agriculture.

(c) Data for calibration and design.

(d) H. L. Cook, J. B. Drisko, L. L. DeFabritis.

(e) Chief, Soil Conservation Service.

(f) The development and calibration of more suitable measuring flumes for the measurement of rates of runoff from experimental areas.

(g) Consideration is being given to all types, ranging from the straight-sided, free overfall to modified venturi flumes. Tests are being made on meters which appear to be capable of maintaining their ratings under service conditions and which are so designed that small rates of flow may be accurately determined.

(h) Three flumes of different design have been tested with clear water.

....

(342) (a) STUDIES OF ARTIFICIAL CONTROLS FOR STREAM-FLOW MEASUREMENTS.

(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, H. N. Eaton (National Bureau of Standards).
W. S. Eisenlohr, Jr. (Geological Survey).
(e) The Director, National Bureau of Standards.
(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-scale sections have been tested in the 12 ft wide flume with flows ranging from 0.1 to 30 cfs. The tests included calibrations under free overfall conditions and with various degrees of submergence, also a study of the effect of the filling up of the channel above the control.
(h) Work is continuing on the report of this investigation. A glass-walled flume 18 inches wide and 30 inches high is being constructed for continuing this study on small-scale models of the controls.

....

(343) (a) ROUGHNESS IN PIPES.
(b) National Hydraulic Laboratory.
(c) General research.
(d) K. H. Beij, G. H. Keulegan, H. N. Eaton.
(e) The Director, National Bureau of Standards.
(f) Study of hydraulic roughness in pipes.
(g) Correlations of friction losses with surface of pipes.
(h) A "Glossary of Terms" has been completed and a chapter on "Laboratory Tests on Small Closed Conduits" is being prepared for the first report of the Committee for Research on Hydraulic Friction. (See section of this bulletin, "Hydraulic Research Committees".) It is expected that some experimental work will be done in the near future in connection with the study of pipe bends, Project 43.
(i) This investigation is carried on in connection with other projects as opportunity offers.

....

(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 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 case at various depths inside the well screen and at the same depths outside the screen in contact with the sand bed.
(h) Data previously taken have been correlated and studied.
(i) Owing to the economic unfeasibility of overcoming difficulties with dissolved air as reported in Bulletin IV-1, this study has been abandoned.

....

(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 (National Bureau of Standards). C. A. Betts and F. L. Brown (U. S. Forest Service).
(e) The Director, National Bureau of Standards.
(f) To test spillway flashboard pins to failure under pressure due to static and overflowing water and also in a mechanical testing machine. The results are to be compared with values used in design.
(g) In addition to the tests described in Bulletin IV-1, a series of mechanical tests was made by the Engineering Mechanics Section of the National Bureau of Standards. Duplicate specimens of 3/4 in., 1 in., 1-1/4 in., 1-1/2 in., 2 in., 2-1/2 in., and 3 in. standard galvanized steel pipe 36 inches long were supported in a testing machine by means of the same pipe sockets utilized in the hydraulic tests. The pipes were tested to failure as horizontal cantilevers with one end fixed, and the deflection of the free end was measured.
(h) The mechanical tests have been completed, and a thorough analysis is being made of the results of both the mechanical and the hydraulic tests.
(i) A brief description of the tests and the results used for field design are given in Engineering News-Record, Vol. 116, No. 18, April 30, 1936, (pp 627-628) "Controlling Flashboard Drop by Collapsing Pipe Supports", by C. A. Betts.

....

(496)(a) DETERMINATION OF DISCHARGE COEFFICIENTS OF FLOW NOZZLES: COOPERATIVE RESEARCH PROJECT SPONSORED BY THE SPECIAL RESEARCH COMMITTEE ON FLUID METERS OF THE A.S.M.E.
(b) Factors for use in commercial measurements of fluids.
(c) Cooperative research.
(d) H. S. Bean, F. C. Morey.
(e) The Director, National Bureau of Standards.
(f) To determine discharge coefficients for a consistent series of "Long Radius" flow nozzles, so that similarly-made nozzles may be used without the need of individual calibrations in the commercial metering of fluids and in power plant tests.
(g) Water from a constant-head tank will be discharged through the flow nozzle into either a weighing or a volumetric tank for a measured interval of time. Readings of the differential pressures between 1, 2 or 3 pairs of pressure taps will be taken, from which the "calculated" rate of flow will be computed. The pressure tap locations that will be used are: in the corner of the nozzle flange and pipe wall, one pipe diameter upstream and in the nozzle throat, one pipe diameter upstream and opposite the nozzle throat. In some cases complete studies of the variations of pressure on both sides of the nozzle will be made. The rates of flow will be varied over as wide a range as can be obtained.

(h) Work has recently been actively resumed in the measurement of nozzle coefficients for I.S.A. and Long-Radius Nozzles (A.S.M.E. Fluid Meters Committee). Efforts have been made to reduce errors in determining rates of flow by the installation of a Photoelectric Timer, consisting of a photoelectric relay, chronograph, and a high grade ship's chronometer. A target on the diverter operates the relay, which makes a record on the chronograph tape. The chronometer supplies half-second signals to the time pen. The speed of the chronometer tape may be varied, making possible time observations with probable error of ± .05 second. Improvements in the diverter have also been made, making possible very sudden diversion of the flow.

Low rates of flow are now being measured with the aid of a weighing tank of about 1000-pound capacity, while the higher rates are measured with a volumetric tank of 200 cubic foot capacity. Some difficulty has been experienced in correlating the results.

....

(497)(a) METHODS FOR SAMPLING AND ANALYZING SOIL-WATER MIXTURES.
(b) Soil Conservation Service, U. S. Department of Agriculture.
(d) H. L. Cook, J. O. Laws, S. R. Kline.
(e) Chief, Soil Conservation Service.
(f) Determination of best methods of sampling and analysis from the standpoints of accuracy and efficiency.
(g) The methods that are now in general use and others that may suggest themselves will be used on synthetic mixtures of various concentrations of soils.
(h) Preliminary tests of the so-called "wt-vol" method of analysis and of a method based on the submerged weight of the sample.

....

(563)(a) AGING TESTS ON PIPES.
(b) U. S. Treasury Department.
(c) Cooperative project with the Division of Metallurgy, National Bureau of Standards.
(d) K. H. Beij, G. H. Keulegan.
(e) The Director, National Bureau of Standards.
(f) To determine the effects of long-continued service on the hydraulic friction of pipes.
(g) Specimens of 1-1/4-inch pipes of 9 different materials will be installed in a cold-water line in constant service at the National Bureau of Standards. Specimens of 3/4-inch pipes of 7 different materials will similarly be installed in a hot water line. It is planned to determine the hydraulic resistance coefficients of these specimens at intervals over a period of 20 years.
(h) The resistance coefficients of the test specimens will be compared with those of standard lengths of smooth brass pipe. A permanent set-up for testing has been installed. The test specimens have been prepared and preliminary tests made. The specimens have been installed in the service lines. The next tests on the specimens will be made in June, 1937.

....

(564)(a) CURRENTS THROUGH LAKES AND RESERVOIRS.
(b) U. S. Geological Survey.
(c) General research.
(d) B. H. Monish.
(e) The Director, National Bureau of Standards.
(f) To determine the laws controlling certain currents in lakes and reservoirs.
(g) Under certain conditions a silt-laden stream flowing into a lake or large reservoir will flow through and under the water in that reservoir without dispersing, mixing or depositing the silt. An explanation of this action is sought, together with a means of preventing or controlling and utilizing it.
(h) A preliminary search of literature on the subject is being made, and a tentative experimental program laid out.
(i) While designed as fundamental research, these tests will apply especially to the reservoir behind Elephant Butte Dam and to Lake Mead,. the Boulder Dam reservoir.

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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 inactive at present.
(i) See list of publications, U. S. Waterways ExperimentStation.

....

(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.

....

(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 ft high, of various materials and placed in various ways, kept full; measurements taken.
(h) First phases of experimental work complete. Study inactive at present.

....

(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. Materials of low specific gravity being investigated.
(i) Results of initial tests are contained in Paper 17. Results of tests of coarse materials are contained in Technical Memorandum 69-1. Report on results of tests upon synthetic sands and initial tests upon materials of low specific gravity being prepared.

....

(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, 8, U.S. Waterways Experiment Station. Report on most recent study is to be found in Technical Memorandum No. 29-8.

....

(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 stabilization between the limits specified in (a). Reaches studied: Millikens Bend, King's Point, Racetrack Towhead, Diamond Point Cut-off, Buckridge Crossing, and Yucatan Point Cut-off. Most recent study made on Delta Point Reach.

(g) Modelscales: 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, 72-1, U. S. Waterways Experiment Station. Technical Memorandum No. 88-1 contains results of most recent study.

....

(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: Bondurant Towhead, Waterproof Cut-off, Rifle Point, Cowpen 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) Model intermittently active.

(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, 82-1, 82-2, Waterways Experiment Station.

....

(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) Work suspended.

....

(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, Island 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.

....

(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 River. 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) Analyses of samples from Mississippi, Ohio, Atchafalaya, Red, Black, and Old Rivers completed and tabulated. Analyses of other tributary samples completed. Petrographic study completed.

(i) Paper 17 includes results of analyses of Mississippi, Ohio, Atchafalaya, Red, and Old River samples; petrographic report being prepared.

....

(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 used in simulating flow in Brazos River Diversion Channel. Various improvement plans are being tested.

(h) Completed.

(i) Results of experiment are in Technical Memorandum No. 54-1, Waterways Experiment Station.

....

(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 to 600 horizontal and 1 to 150 vertical.
(h) Completed.
(i) Reports on studies included in Technical Memoranda Nos. 46-1, -2, -3, -4, -5, -6, -7, -8, U. S. Waterways Experiment Station.

....

(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) Model temporarily inactive.
(i) Results of this study are described in Technical Memorandum No. 51-1.

....

(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.

....

(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 to 1000 horizontal and 1 to 125 vertical.
(h) Inactive.
(i) Report included in Technical Memorandum No. 63-1, U. S. Waterways Experiment Station.

....

(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.
(h) Model intermittently inactive.
(i) Results of studies are described in Technical Memoranda Nos. 59-1 and 74-1, U. S. Waterways Experiment Station.

....

(257) (a) DIRECTIVE ENERGY STUDY.
(b) Mississippi River Commission.
(c) (d) and (e) See (51).
(f) Experiments to determine relations between length of tangent, length of pool, total length, slope, and bed material of rivers.
(g) Outdoor flume, 50 ft x 15 ft with movable bed, being used.
(h) Model temporarily inactive.
(i) Results of experiments to date are included in Technical Memoranda Nos. 61-1, -2, -3, and -4, U. S. Waterways Experiment Station.

....

(409) (a) STUDIES OF PIPE LINE MIXERS.
(b) The 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 being made in 4-inch observation pipe.
(h) Initial tests completed. Design recommended to Memphis District for field tests.
(i) Field tests completed. Report on laboratory tests and field tests being prepared.

....

(414) (a) MODEL STUDY TO DETERMINE EFFICACY OF SUB-LEVEES AND THEIR EFFECT IN CONTROLLING THROUGH AND UNDER SEEPAGE FOR MAIN LINE LEVEES.
(b) The 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) Flume tests of models, permeability tests and mechanical analyses.
(h) Tests completed; report in preparation.

....

(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 HELENA, ARKANSAS TO THE GULF OF MEXICO.
(b) Mississippi River Commission.
(c) (d) and (e) See (51).
(f) Miscellaneous flood control problems on the lower Mississippi River.
(g) Model scales, 1 to 2000 horizontal and 1 to 100 vertical; fixed bed.
(h) In progress.
(i) Result of studies to date are contained in Technical Memorandum 92-1. Technical Memorandum 92-2 and 92-3 are being prepared.

....

(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) Model: scales of 1 to 800 horizontal and 1 to 80 vertical, fixed bed. Tidal flow is to be simulated. Various proposed plans for eliminating shoaling to be tested.
(h) Model in adjustment stage.

....

(471) (a) CHESAPEAKE AND DELAWARE CANAL MODEL.
(b) The District Engineer, U. S. Engineer Office, Philadelphia, Pennsylvania.
(c) (d) and (e) See (51).
(f) To study methods of eliminating shoaling in the Delaware River entrance to the Chesapeake and Delaware Canal.
(g) Model scales of 1 to 800, horizontal, and 1 to 80 vertical. Movable bed. Tidal flow simulated. Various proposed plans for eliminating shoaling tested.
(h) Completed.
(i) Results of tests are to be found in Technical Memorandum No. 93-1, U. S. Waterways Experiment Station. Additional details of the technique developed for operation of the tide reproduction mechanism are to be found in Technical Memorandum 93-2.

....

(472) (a) BALLONA CREEK OUTLET MODEL.
(b) The District Engineer, U. S. Engineer Office, Los Angeles, California.
(c) (d) and (e) See (51).
(f) Maintenance of flood channel at outlet into ocean.
(g) Model scales, 1 to 100 horizontal, and 1 to 50 vertical. Movable bed. Tidal flow, wave action and creek floods to be reproduced.
(h) Adjustment of model in progress.

....

(473) (a) MARACAIBO OUTER BAR MODEL.
(b) Standard Shipping Company, New York, N. Y.
(c) Investigation of progressive westward movement of the outer bar with view to ascertain any probable future development.
(d) See (51).
(e) See (51).
(f) To study outer bar action at entrance of Lake of Maracaibo, Venezuela.
(g) Scale of model 1 to 300, horizontal, 1 to 50 vertical. Tidal flow and wave action to be reproduced. Movable bed.
(h) Adjustment of model in progress.

....

(477) (a) PHYSICAL AND CHEMICAL TESTS OF SOIL AND ROCK FROM SITE OF CONCHAS DAM, NEAR TUCUMCARI, NEW MEXICO.
(b) The District Engineer, U. S. Engineer Office, Tucumcari, New Mexico.
(c) (d) and (e) See (51).
(f) The determination of the suitability and action of the material represented by the samples for dam construction and the foundation of a contemplated earthen or rock-fill dam.
(g) Classification tests, mechanical analyses and Atterburg Limits. Chemical analyses and determination of percent of water-soluble constituents on a weight basis of entire specimen. Detailed tests for design purposes, shear, consolidation, permeability, absolute specific gravity and water content for undisturbed and remolded samples of soil, also permeability and durability tests of rock samples.
(h) Tests completed.
(i) Consolidated report in preparation.

....

(479) (a) MEMPHIS DEPOT STUDY, MISSISSIPPI RIVER, MILE 226 TO MILE 234 BELOW CAIRO.
(b) The District Engineer, U. S. Engineer Office, West Memphis, Arkansas.
(c) (d) and (e) See (51).
(f) Determine method of improvement of navigational channel to the Memphis Engineer Supply and Repair Depot.
(g) Model scales, 1 to 450 horizontal and 1 to 150 vertical. Movable bed.
(h) In progress.
(i) Results described in Technical Memorandum 89-1, U.S. Waterways Experiment Station.

....

(480) (a) GALVESTON HARBOR MODEL.
(b) The District Engineer, U. S. Engineer District, Galveston, Texas.
(c) (d) and (e) See (51).
(f) Feasibility of model study being investigated.

....

(481) (a) ABSECON INLET MODEL.
(b) The District Engineer, U. S. Engineer Office, Philadelphia, Pa.
(c) (d) and (e) See (51).
(f) Study to determine means of eliminating shoaling in navigation inlet.
(g) Design suspended awaiting field data.

....

(533) (a) INVESTIGATION OF PARTIAL FAILURE OF MURRY DAM, ARDMORE, OKLA.
(b) Works Progress Administration, Ardmore, Okla.
(c) (d) and (e) See (51).
(f) To determine the cause of failure and perform tests of soils for redesign and reconstruction.
(g) Classification tests, mechanical analyses, water contents, and Atterburg limits. Detailed tests for design purposes, shear, consolidation and permeability.
(h) Field investigation and laboratory tests in progress.

....

(534) (a) CONCHAS DAM STILLING BASIN.
(b) The District Engineer, U. S. Engineer Office, Tucumcari, New Mexico.
(c) (d) and (e) See (51).
(f) To determine an economical stilling basin design for the Conchas Dam Project.
(g) Model scale, 1 to 50. Entire spillway section and stilling basin reproduced. Satisfactory basin determined by observation of stilling basin action, by scour patterns below the dam and by velocity measurements. Observations recorded by moving pictures and still photographs. Two distinct types of basins were studied: the roller and eddy type basin and the hydraulic jump basin.
(h) Tests completed. Report being prepared.

....

(535) (a) CHAIN OF ROCKS, MISSISSIPPI RIVER.
(b) The District Engineer, U. S. Engineer Office, St. Louis, Mo.
(c) (d) and (e) See (51).
(f) Study for improvement of navigation and miscellaneous hydraulic problems.
(g) Model scales, 1 to 600 horizontal and 1 to 125 vertical. Movable bed. Mississippi River from Mile 183.0 to Mile 202.8 and Missouri River from Mile 0.0 to Mile 8.0.
(h) Adjustment of model in progress.

....

(536) (a) PRYORS ISLAND REACH.
(b) The District Engineer, U. S. Engineer Office, Louisville, Kentucky.
(c) (d) and (e) See (51).
(f) Study for improvement of navigation and channel stabilization.
(g) Model scales, 1 to 600 horizontal and 1 to 150 vertical. Movable bed. Ohio River from Mile 899 to Mile 919.
(h) Model in construction stage.

....

(537) (a) KANSAS CITYS FLOOD CONTROL MODEL.
(b) The Division Engineer, Missouri River Division, Kansas City, Missouri.
(c) (d) and (e) See (51).
(f) Study of proposed plans for flood control at the Kansas Citys.
(g) Model scales, 1 to 800 horizontal and 1 to 100 vertical; fixed bed.
(h) In progress.

....

(538) (a) DOGTOOTH BEND.
(b) The District Engineer, U. S. Engineer Office, St. Louis, Mo.
(c) (d) and (e) See (51).
(f) To determine means for improving navigation.
(g) Not determined.
(h) In preliminary design stage.

....

(539) (a) SWIFT SURE TOWHEAD.
(b) The District Engineer, U. S. Engineer Office, St. Louis, Mo.
(c) (d) and (e) See (51).
(f) To determine means for improving navigation.
(g) Not determined.
(h) In preliminary design stage.

....

(540) (a) GRAND TOWER.
(b) The District Engineer, U. S. Engineer Office, St. Louis, Mo.
(c) (d) and (e) See (51).
(f) To determine means for improving navigation.
(g) Not determined.
(h) In preliminary design stage.

....

UNIVERSITY OF CALIFORNIA, College of Agriculture, Davis, California.

(270) (a) THE EFFECT OF DEPTH TO WATER TABLE UPON THE LOSS OF WATER FROM THE SOIL SURFACE. (Part of project on principles of soil moisture in relation to irrigation.)
(b) California Agricultural Experiment Station.
(c) Experiment Station project.
(d) M. R. Huberty and F. J. Veihmeyer.
(e) Professor F. J. Veihmeyer.
(f) This study is part of a larger project to determine losses of water through plant transpiration and surface evaporation.
(g) Twenty-five tanks holding more than one ton of soil, equipped with Mariott constant water-level regulating devices, are being used. The amount of water evaporated is determined volumetrically and gravimetrically. The investigations have been under way for several years. The experiments have been conducted in such a way that a statistical analysis of the results of evaporation from the surface of the soils with the water table a constant distance below the surface can be obtained.
(h) The experiments will be continued for several additional years.

....

(271) (a) MOVEMENT OF MOISTURE THROUGH SOILS. (Part of project on principles of soil moisture in relation to irrigation.)
(b) California Agriculture Experiment Station.
(c) Experiment Station project.
(d) N. E. Edlefson and F. J. Veihmeyer.
(e) Professor F. J. Veihmeyer.
(f) This study is part of a general project to study movement of water in soils, both under saturated and unsaturated conditions. It also involved the movement of water to roots of plants, the energy relations involved by extraction of water by plants and the factors affecting availability of water to plants.
(g) Extensive equipment of plant containers with suitable arrangements for determining water use ranging from small cans to tanks containing over one ton of soil are being used. In addition, numerous field plots with permanently rooted and annual plants, together with a specially equipped laboratory for the study of different phases of soil moisture movement, are in use.
(h) In progress.

....

(272) (a) CHARACTERISTICS OF SPRINKLERS AND SPRINKLER SYSTEMS FOR IRRIGATION. (Part of larger project on farm irrigation structures and systems.)
(b) California Agricultural Experiment Station.
(c) Experimental Station Project.
(d) J. E. Christianson.
(e) Professor F. J. Veihmeyer.
(f) Determination of f ctors affecting uniformity of distribution, evaporation losses, and frictional losses in pipe lines with multiple outlets.
(g) Approximately 100 tests have been made on sprinklers of different makes and types to determine the distribution of water under varying conditions. Water is caught in a large number of cans (rain gages) and evaporation losses estimated from average depth caught as compared with water discharged. Effect of wind, pressure, speed of rotation of sprinkler, temperature, humidity, and various combinations of nozzles on performance of sprinklers studied. A large number of tests have been made on portable sprinkler pipe with sprinklers spaced at definite intervals to determine net pressure losses.
(h) In progress.

....

(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) Professor 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 ft 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 ft long, 3 ft 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) Progress report prepared; investigations being continued.

....

(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) Professor 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.

....

(190) (a) FLOW CONDITIONS IN OPEN CHANNEL.
(b) University of Minnesota Engineering Experiment Station.
(c) University hydraulics research project.
(d)
(e) Professor 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 report has been prepared; further studies are being undertaken with an improved type of apparatus.

....

(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) Professor 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.

....

(328)(a) EXPERIMENTAL STUDY OF SEDIMENTATION BASINS.
(b) University of Minnesota Engineering Experiment Station.
(c) Graduate research project.
(d) Alvin Anderson.
(e) Professor 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; abstract of report presented in Civil Engineering, Vol. 6, No. 5, pp. 321-323.

....

(329)(a) STUDIES OF HYDRAULIC JUMP.
(b) University of Minnesota Engineering Experiment Station.
(c) Graduate research project.
(d) Harold Flinsch.
(e) Professor 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) Report prepared.

....

(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 tainter 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) Laboratory experimental series completed; revisions made in actual structure; field observations are being made as a result of model results.

....

(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.

....

(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; report has been prepared.

....

(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) Experimental work has been completed; report prepared.

S. MORGAN SMITH COMPANY.

(565)(a) FIXED BLADE PROPELLER TURBINE EFFICIENCY & HORSE POWER TESTS.
(b) U. S. Engineer Office, Eastport, Maine, Passamaquoddy Power Dev.
(c) Research.
(d) R. Sahle, J. D. Scoville and testing crew for S. Morgan Smith Co., Mr. R. Allan for the U. S. Engineer Office.
(e) Engineering Department, George A. Jessop, Chief Engineer.
(f) To determind the most economical unit spacing, width of scroll casing and depth and width of draft tube, considering horsepower capacity, efficiency and first cost of structure and equipment. To test a number of modifications to the water passages to secure data on the effect of capacity and efficiency.
(g) Three different unit spacings and two depths of draft tube were investigated, involving three model scrolls and four model draft tubes, one tube requiring substantially less depth of excavation.

Ten tests were made in all; six were required to determine the most desirable overall dimension and four to settle the advantages of minor but important modifications. The alternative designs tested included different elevations of scroll case roof, contraction of width near the intake, number of piers and the shape of the draft tube. The intake losses were also measured. A standard design fixed blade runner with wicket gate casing was used but selected to discharge the proper quantity of water to secure a true relationship with the large size units. The object of the tests was to determine the relative results of the various turbine settings and not to secure data on the best type of design of runner and gate casing.

All the tests were conducted over an unusually large range of speed to cover the required proportional speed as determined by the field head conditions. Thus efficiency and power gains and losses can be determined at any required head in the range from 5 to 23 ft. The capacity and efficiency at the low heads is of unusual importance in this development.

The power was measured by an Alden absorption dynamometer and precision beam scale, the head by differential float gauges, and the water by weir.
(h) Tests are completed.
(i) The data obtained is of a preliminary nature but will decide the unit spacing as well as the best draft tube and casing design for the conditions.

....

(566)(a) HYDRAULIC THRUST ON KAPLAN TURBINES.
(b) S. Morgan Smith Co.
(c) Research.
(d) R. Sahle and testing crew for the S. Morgan Smith Co.
(e) Engineering Dept., G. A. Jessop, Chief Engineer.

(f) To determine the thrust on a Kaplan runner at various blade angles, speeds and gate openings.

(g) Investigations were carried out in an open flume setting with a standard design wheel case having movable gates and an elbow draft tube. The total weight of all moving parts as well as the stationary brake was determined by lifting the weight off the thrust bearing on beams placed across two accurately balanced Fairbank platform scales. The tests were conducted under ten feet head. When this head was acting on the blades, the two scales were balanced and the hydraulic thrust determined. Numerous tests were made at different blade angles, speeds and gate openings to obtain the necessary data needed on Kaplan turbines.

(h) Tests 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.

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CORPS OF ENGINEERS. BONNEVILLE HYDRAULIC LABORATORY.

(567)(a) MODEL STUDIES OF THE BONNEVILLE PROJECT ON THE COLUMBIA RIVER, AND OTHERS.

(b) United States Engineer Department, Portland District No.2, Lieut. Colonel C. F. Williams, District Engineer, Claude I. Grimm, Chief Engineer.

(c) A research program to check the hydraulic designs, to furnish data and assist in visualizing the problems connected with design, construction, and future operation of the Bonneville Project, and others.

(d) A. J. Gilardi, Resident Engineer in charge of the laboratory, J. C. Stevens, Consulting Engineer on model studies.

(e) United States District Engineer, Portland District, No. 2, Portland, Oregon.

(f) 1. To determine the best design of cofferdams and methods of placement of cribs for all stages of construction, handling of navigation, most favorable cross section of the spillway dam for scour prevention, best method of gate operation in the completed dam for handling flood waters, passing debris and ice, backwater effect and its reduction by means of channel improvements, & best layout of fish ladders and other provisions for getting mature fish into the upper pool and small fish down to tail-water and to the sea. Other problems which have been investigated included the navigation lock which will handle sea-going vessels and will have the highest single lift in the world.

2. To determine a satisfactory cross section for scour prevention and the best layout of the structures for the Mill Creek Diversion Dam for the Walla Walla Flood Control Project.

3. To determine design improvements, possible wear reduction and other studies of the 18" pump for the new Pacific Type Light-Draft Hopper Dredge.

(g) An outdoor laboratory covering an area of about 2 acres has been built at the Government Moorings near Linnton Station, Portland, Oregon. Water is pumped from the Willamette River and circulated through the various models. Seven principal models have been built and operated up to date; other models are under construction at the present time.

1. The lock model, the spillway model and spillway flume, the gate model, the power house diffusion chamber model, and the large river model have been described in preceding Bulletin IV-1, of this series. (See pages 44 and 45.)

2. The river model has been used very extensively during the first half of 1936 for studies and demonstrations of the second step or Washington shore cofferdam for a large variety of possible combinations; the best method of placement of the cribs and closure was used for construction in the field. This model was also used recently for studying several possible methods of closing the breach in the upstream shore fill caused by the spring floods; the method involving a trestle connecting the Washington shore with the cribs was adopted and the size and quantity of rocks required to stay in place in the swift water were determined and used for construction.

3. Model for the Mill Creek Diversion Spillway for the Walla Walla Flood Control Project. This model was built on a scale of 1:8 and installed in the existing spillway flume. Numerous experiments were made and a cross section developed which reduced the scour of the gravel foundation to a minimum.

4. Model of the entire Mill Creek Diversion Dam. This model included the spillway, embankment, and intake headworks. It was built on a horizontal scale of 1:100 and had a deformation of 1:4. The purpose of this model was to study the currents above the dam, near the intake and near the earth embankment, transportation of floating debris, etc. A layout was developed which gave entirely satisfactory results.

5. Dredge pump model. A 1:4 scale model has been built entirely out of pyralin, so as to obtain complete transparency. The model was originally provided with a variable-speed drive, which was replaced later by a dynamometer drive. Various methods of illumination have been provided, including a high-power stroboscope for a study of the flow in the interior of the impeller while rotating at full speed. Velocity and pressure measurements, as well as numerous other studies, have also been carried out; very interesting and valuable results have been obtained. The experimental work is continuing at the present time.

(h) The Bonneville Hydraulic Laboratory has been in operation for about 3-1/2 years; the work is still in progress at the present time as described above. (See paragraphs g1, g2 and g5.)

(i) No detail reports have been published todate. Information concerning details of this experimental project may be obtained from the District Engineer, U. S. Engineer Office, Second Portland District, Portland, Oregon.

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MASSACHUSETTS INSTITUTE OF TECHNOLOGY, HYDRAULIC MACHINERY LABORATORY.

(36)(a) EXPERIMENTAL INVESTIGATION OF THE CAVITATION PHENOMENON.
(b) Massachusetts Institute of Technology.
(c) General research.
(d) H. Peters - B. G. Rightmire.
(e) Professor H. Peters.
(f) 1. Study of properties of the liquid which influence the severity of cavitation damage.
2. Study of the periodic nature of cavitation.
(g) for (f)(1) An aluminum sample is vibrated in various liquids at various temperatures with an approximate frequency of 8000 cycles/sec and amplitude of about 0.01 mm. The loss of weight is used as a measure for the severity.
for (f)(2) Experimental work in a Venturi passage and theoretical work.
(h) Progress reports;
J. C. Hunsaker, Mechanical Engineering, April, 1935. Volume 57, No.4.
J. C. Hunsaker, A.S.M.E. October, 1935, Volume 57, No. 7.
E. W. Spannhake, Thesis, Mass. Institute of Technology Library, "Theoretical Investigation of the Periodic Nature of Cavitation".

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(483)(a) I. INVESTIGATION OF ROTARY FLOW IN PIPE LINES.
II. INFLUENCE OF ROTATION UPON ORIFICE AND NOZZLE COEFFICIENTS.
(b) Massachusetts Institute of Technology.
(c) General study.
(d) Students.
(e) Professor H. Peters.
(h) In progress.
I. Thesis, 1934.
II. Thesis, 1935.

....

(484)(a) STUDY OF MIXING BETWEEN A JET OF FLUID OF VARIOUS DENSITIES AND A STILL FLUID.
(b) Massachusetts Institute of Technology.
(c) General study.
(d) J. Bicknell - H. Peters.
(e) Professor H. Peters.
(f) Study of turbulent mixing.
(g) Progress report at the annual meeting of the Institute of the Aeronautical Sciences, January, 1936.

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(485)(a) STUDY OF FLOW THROUGH RECTANGULAR CHANNELS.
(b) Massachusetts Institute of Technology.
(c) General study.
(d) Students.
(e) Professor H. Peters.
(f) Determination of frictional factors.
(g) Pressure measurements and velocity distribution.
(h) Just started.

....

(486)(a) STUDY OF THE BOUNDARY LAYER ON SURFACES WITH PRESSURE GRADIENT.
(b) Massachusetts Institute of Technology and the National Advisory Committee for Aeronautics.
(d) H. Peters - J. Bicknell.
(e) H. Peters.
(f) Study of friction and of separation of laminar and turbulent flow.
(g) Airflow through a 2-dimensional Venturi passage.
(h) Just started.

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PACIFIC HYDROLOGIC LABORATORY.

(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, "Selecting Materials for Rolled Fill Earth Dams", presented at a meeting of the Irrigation Div., A.S.C.E. in Los Angeles, Cal., July 4, 1935. Summary in Civ.Eng., Sept., 1935, p.556, with comments by letter in Oct. and Nov. issues of Civ.Eng. 1935.

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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.

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THE TULANE UNIVERSITY OF LOUISIANA.

(463)(a) INVESTIGATION OF HYDRAULIC LOSSES AT PIPE ENTRANCES.
(c) Graduate research.
(d) J. K. Mayer.
(e) Professor W. B. Gregory.
(f) To determine the relationship between the entrance loss coefficient ($h'_e = K_e V^2/2g$) and Reynolds number R_e for various types of pipe entrances; viz., square-edged cylindrical pipes of various wall thickness, cone entrances of various lengths and angles, and bell-shaped entrances.
(g) Investigations were first carried out on model intakes made of 3/4 inch brass pipe having piezometer rings attached at various distances from the entrance and connected to a manometer for determining the pressures. Water was drawn through the intake by means of a centrifugal pump and discharged into a weighing tank in order to determine the rate of flow. The static head of water over the entrance was measured with a hook gage. Runs were made on each intake at various velocities within the limits of the apparatus. Work is now being done on a 4 inch brass pipe drawing water from the laboratory storage channels and discharging into a calibrated 60° V-notch weir.
(h) See Bulletin IV-1 for summary of results.

....

(464)(a) TESTING OF MODEL SCREW AND CENTRIFUGAL PUMPS.
(b)
(c) Graduate research.
(d) W. P. Wallace and A. P. Texada, Jr.
(e) Professor W. B. Gregory.
(f) To carefully determine the charac teristics of a 9 inch Wood screw pump and a 3 inch Wood trash pump under various conditions.
(g) The screw pump is a model of the 14 foot Wood screw pumps used in the drainage of New Orleans and was built by the New Orleans Sewerage and Water Board under the personal supervision of Mr. A. B. Wood. The pump is driven by a 9-speed induction motor mounted as a power dynamometer and discharges into a calibrated 60° V-notch weir. Heads are determined by manometers and altitude gages.

The trash pump is also driven by a motor mounted as a power dynamometer and discharges into the same V-notch weir.

(h) Installation of the screw pump has just been completed and only preliminary tests made to date.

Tests of the trash pump have proved quite satisfactory, showing a maximum pump efficiency of 60 percent at 202 gpm against a head of 21 ft when running at 1170 rpm.

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WEST VIRGINIA UNIVERSITY.

(50) (a) DISCHARGE THROUGH THIN PLATE ORIFICES IN PIPE LINES.

(b) Thesis for M.S.C.E. degree.

(c) General scientific research.

(d) A. E. McCaskey and H. W. Speiden.

(e) Professor H. W. Speiden, Dept. of Civil Engineering, West Virginia University, Morgantown, W. Va.

(f) To study the coefficients of various sizes of circular orifices in thin plates 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) A series of orifices has been tested in 2 inch pipes of brass and wrought iron. The effect of pressure measurements at various points on the pipes has been studied. The present work is on a 4 inch pipe of wrought iron with orifice and piezometer dimensions similar to those in the earlier work.

(h) Experimental work is practically completed on this phase of the work and the thesis will be published in January, 1936.

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COMPLETED PROJECTS - ABSTRACTS.

California, University of

(17) TRANSPORTATION OF BED LOAD BY STREAMS.

Curves showing results are included in paper by M. P. O'Brien in Transactions of American Geophysical Union, 1936.

Conditions at start of sand motion and rate of transportation were correlated as a function of $\frac{V}{R^{1/3}}$ where V is the average velocity and R is the hydraulic radius.

Report available for loan.

(278) CHARACTERISTICS OF DISC-FRICTION PUMPS.

The object of the investigation was to develop a theory of operation of the disc-friction or turbulence pump. The analysis was based on experimental studies of two commercial pumps of this type, viz., a Burke and a Westco pump.

The theory proposed is based upon the assumption that a slug of fluid passing from inlet to discharge in the raceway is given a number of impacts by the blades of the impeller. The number of impacts, depends upon the speed of the impeller, the mean velocity of the fluid, and the blade spacing. It was found that the performance of a geometrically similar pump could be predicted over a speed range of at least 44% by the theory for the two pumps investigated.

(This thesis by A. W. Everett is available for loan.)

(279) SCOUR BELOW DAMS.

This investigation was a continuation of the work by Lieut. T. F. Bengtson. Three models of the Plattsburg Dam to scales of 1:12, 1:24 and 1:48 were tested for scour with two sets of sands having median diameters very nearly in proportion to the linear scales. Experiments were also conducted for other materials, including powdered coal.

The conclusion drawn was that the criterion developed by Butcher and Atkinson (Minutes of the Proceedings of the Institute of Civil Engineers, Volume 235, Part 1, 1932-33.) gives the characteristics of the material which will show similarity of scour under dynamically similar hydraulic conditions. This criterion is $b_d \, b_{s-1} = b_\ell$ where b_d is the ratio of median diameters in prototype in model, b_ℓ is the linear scale ratio of an undistorted model and b_{s-1} is the ratio of the quantity s-1, where s is the specific gravity of the material. (Thesis by N.E.Haavik and J.L.Hoffman available for loan.)

(420) BROAD-CRESTED WEIRS.

The purpose of the study was to make a comparison between discharge coefficients obtained with three-inch high model weirs with those obtained by the U. S. Board of Engineers on Deep Waterways on the prototype at Cornell University. (Water Supply and Irrigation Paper No.200.)

Models corresponding to Series 7, 12, 14, 17, 19, and Chambly Dam of 18-inch crest length were tested. The coefficients of each model defined a smooth curve, but deviated as much as 10% in certain instances from the prototype results. (Thesis by A.B. Davis and J.W. Sullivan available for loan.)

(422) HYDRAULIC JUMP IN STANDARD IRRIGATION DROPS.

Experiments were made with approximately a 1:10 scale-ratio model of the U. S. Bureau of Reclamation Irrigation Drop No. 40-D-2074. The purpose of the study was to investigate the occurrence and properties of the jump phenomenon and to particularly note the effect of length of the depressed basin.

Water surface profiles and velocity measurements were made for different rates of flow, downstream depths and lengths of the depressed section. A normal hydraulic jump rarely occurred in the model and, for proper reduction of velocity in the down-stream channel, the experiments indicated that the depressed section should be increased about 50% over that specified. (Thesis by F. F. Mautz and R.J. Shukle available for loan.)

(425) MODEL STUDY OF WAVE ACTION ON BEACHES.

The study involved an investigation of the model laws applicable to a model study of wave action on beaches and finding a relation between wave characteristics and the resulting slope of the beach.

The apparatus consisted of a 20 ft x 12 ft x 2-1/2 ft tank and a machine for generating waves of various heights, lengths and frequencies. Beaches of sand of different median diameters were placed in the tank, and the heights, lengths and frequency of waves were recorded. Data were also recorded which gave an experimental check as to velocity of wave, variation of axes of orbits of water particles and shape of wave.

With regard to the model laws, the results showed that geometrical similarity must exist; that the length, velocity and time scales must be chosen in accordance with Froude's Criterion; and that the lower limit of wave length and velocity must be above that imposed by the effect of surface tension.

An analysis of the experimental results led to the equation:

$$\tan\ i = k\,(h/l)^n,$$

where i = slope of beach at stillwater line,
h = height of wave,
l = length of wave,
and k and n are functions of the median diameter of the sand and perhaps other characteristics of the sand.

It was found for the following median diameters of sand:

dia = 0.472 mm	dia = 0.368 mm
k = 0.0359	k = 0.487
n = -0.313	n = -0.303

(Thesis by Lieut. R. D. Meyer available for loan.)

(437) FLOW OF WATER IN TIDAL CANALS AND ESTUARIES.

The object of the study was to compare the reflected wave theory of Colonel E. I. Brown ("Flow of Water in Tidal Canals", Trans. A.S.C.E., 1932, pp. 749-834) with experimental data observed in a small channel 3 inches wide, 9 inches deep and 192 feet long.

Owing to lack of space, the channel was built in a loop and had several 45 degree bends. The channel mouth connected to the tidal basin of the Columbia River Model at the U. S. Tidal Model Laboratory. A 3-inch pipe line from a constant head tank furnished the fluvial discharge at the upstream end of the channel.

Water-surface elevations were measured by point gages at stations approximately 16 feet apart and at time intervals of 5 seconds throughout the 140.3 second tidal cycle. Velocities were obtained from float measurements of 0.5 foot travel at each station. The experiments involved different distances of propagated tide by blocking off a portion of the channel, also with channel horizontal and sloping, and with and without fluvial discharge.

Fairly good agreement was found between the theory and experiment.

(Thesis by Lieut. R. R. Arnold available for loan.)

U. S. BUREAU OF RECLAMATION.

(162) EXISTING ROCK-FILL WEIRS ON PERVIOUS FOUNDATIONS.

In connection with the design of the Imperial Dam for the diversion of the waters of the Colorado River into the All-American Canal which will irrigate the Imperial Valley of Southern California, the possibility of using a rock-fill weir was considered. The Laguna Dam, which is of this type and is located five miles below the site of the Imperial Dam, has been in successful operation for several years. The report was drawn up from available data on rock-fill weirs.

Rock-fill weirs have been used extensively for a long time; some of those in India are over 1500 years old. This type of structure is fundamentally a diversion dam and is used primarily on rivers having pervious and easily erodible beds. It is adapted only to low flat streams.

The report covers the Okhla, Madaya, Dehri, Beswada, Brahmini, Jobra, Adimapalli, Rupar, Godaveri, Mon, Sangam, and Nellore weirs in India, the Rossetta and Damietta weirs in Egypt, the Huang Pi weir built recently in China, and gives a more detailed account on the Laguna Weir in the United States.

The weirs are separated into two classes, those with a rubble facing and those with a paved surface. A table of comparative data on the several weirs is included. The water plane beneath the downstream face of Laguna Weir, a table listing flood conditions at this structure, and a sieve analysis of the bed material of Colorado River are also given.

Factors are discussed which effect the stability of this type of structure and which should be considered in the design. Much of the theory with regard to underseepage and to hydrostatic uplift pressures which was used in the design of these existing works has been disproved in recent years. Much more work along these lines in the way of experiment and the testing of actual dams is to be desired.

Technical Memorandum No. 490, by R. K. Vierck available for loan.

U. S. WATERWAYS EXPERIMENT STATION.

Technical Memoranda and Research Memoranda have been prepared for all completed studies, and for all completed phases of any study now listed as "In progress". Loan copies of these papers may be obtained by writing to the Director, U. S. Waterways Experiment Station, Vicksburg, Mississippi.

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National Bureau of Standards (National Hydraulic Laboratory).

The following translation has been made at the National Bureau of Standards (National Hydraulic Laboratory).

Hégly, V. M. "Note sur la répartition des vitesses dans un canal à profile complexe. Expériences exécutés au laboratoire du Saulcy, à Metz. (Notes on the distribution of velocities in a canal of compound cross-section. Experiments made at Saulcy, near Metz, France.) Comptes Rendus des Travaux de la Société Hydrotechnique de France, June 30, 1932. Paris, Report No. 51, Société Hydrotechnique de France, Sept. 23, 1933. Translation by Chilton A. Wright. Available for loan after Aug. 1, 1936.

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Available for loan.

Egypt.

Civil Engineering Society Year-book, Egyptian University, Faculty of Engineering, Cairo, 1936.

Contents:

1. High floods and how to protect Lower Egypt, by H. E. Osman Moharram. Resumé in English.

2. Tunnelling under cities and rivers, by Ch. Andreae. In English.

3. The Nile, by H. E. Hurst. Summary in English.

4. Aerial topography, by Imam Shaban. In Arabic.

5. Irrigation and drainage of the oases, by Hassan Mohammed. In Arabic.
6. Irrigation works in the Sudan, by Hussein Hefny. Resume' in English.

Italy.

G. de Marchi and M. Marchetti.	Ricerche Sperimentali sui Sifoni Autolivellatori. Memorie e Studi dell'Istituto d'Idraulica e Costruzioni Idrauliche del' R. Istituto Superiore d'Ingegneria di Milano, Nos. 3, 4, 1935.
G. Gentilini.	Sull' Equazione del Movimento uniforme delle Corrente Liquide. Raggio Medio e Forma della Sezione attraverso le Constatazione Sperimentali. Memorie e Studi dell'Istituto d'Idraulica e Costruzioni Idrauliche del' R. Istituto Superiore d'Ingegneria di Milano, No. 12, 1935.
M. Marchetti.	I Boccagli e i Diaframmi Normalizzati inseriti nelle Condotte Forzate, Risultati di Esperienze Relative a Bassi Numeri di Reynolds. Memorie e Studi dell' Istituto d'Idraulica e Costruzioni Idrauliche del' R. Istituto Superiore d'Ingegneria di Milano, No. 13, 1935.

Alessandro Veronese. Ricerche sul comportamento idraulico dei sifoni di derivazione. (Researches on hydraulic behavior of diversion (or intake) siphons over embankments.)
Comitato per l'Ingegneria del Consiglio Nazionale delle Ricerche Centro di Ricerche Idrauliche nel R. Istituto Superiore di Ingegneria di Padova. Printed by Società Cooperative Tipografica, Padova, 1935.

Vittorio Pisa. Metodi chimico e chimico-elettrico per la misura della portate. (Chemical and electro-chemical methods for the measurement of discharge.)
Comitato per l'Ingegneria del Consiglio Nazionale delle Ricerche centro di Ricerche Idrauliche nel R. Istituto superiore de Ingegneria di Padova. Printed by Carlo Ferrai, Venice, Oct. 10, 1935.

E. Scimemi & E. Indri. Esperienze sulla formazione della barra nel porto Lagunare di Lido (Venezia). Experiments on the formation of bars in the swampy port of Lido. (Venice)). Laboratorio di Idraulica nel R. Istituto Sup. di Ingegneria, Luglio 1 - 1935 XIII. Italy.

Germany.

J. Einwachter. Wasserwalzen und Energieumwandlung (Rollers and the transformation of energy.) Reprint from Wasserwirtschaft und Technik, 1935, Hefte 29, 30.

G. Weinblum and W. Block. Stereophotogrammetrische Wellenmessungen bei der Hochsee-Messfahrt 1934 des Motorschiffes, "San Francisco". (Measurement of waves by stereophotography on the experimental voyage of the motorship, "San Francisco", on the high seas in 1934). Mitteilungen der Preussischen Versuchsanstalt für Wasserbau und Schiffbau, Heft 23, Berlin, 1936.

G. Weinblum, Berlin. Widerstandsuntersuchungen an Schiffen. (Investigations on the resistance of ships.) Reprint from Zeitschrift für ang. Math. - u. Mech., Band 15, Heft 6, December, 1935.

G. Weinblum. A. Untersuchungen über scharfe Schiffsformen. (Investigations of sharp ship forms).
B. Theorie der Wulstschiffe. (Theory of ships with bulged bows.) Mitt. der Preus. Versuchsanstalt für Wasserbau und Schiffbau, Heft 25, Berlin, 1936.

Hungary.

Hydraulic Proceedings of the Royal Hungarian Ministry for Agriculture, Vol. XVII, No. 3, 1935, with English summaries.

Hydraulic Proceedings of the Water Board of the Royal Hungarian Ministry of Agriculture, Vol. 17, No. 4, 1935, October-December. In Hungarian with English summaries.

1. J. Dieter. The granary of the duty-free harbour of Budapest.
2. J. Bertok. Regulation of the water level of Lake Balaton and the sluice at Siofok.
3. I. Pap. Water regulation in the environs of the city of Szeged and the establishment of the fish-pond at Feherto.
4. A. Vajda Problems of hydraulic engineering in Russia.
5. L. Aujezsky. Factors determining the condition of precipitation.
6. W. Laszloffy. Measuring the discharge in open chnals by profile contraction.

Japan.

A. Miyadzu. Path and stability of a local vortex moving round a corner. In English. Philosophical Magazine, Series 7, Vol. XIX, March, 1935.

A. Miyadzu. On the divergent and convergent flows of a viscous fluid, compared with those of a perfect fluid. In English. Technology reports of the Tohoku Imperial University, Vol. XI, No. 4, 1935.

F. Numachi. Versuche über Flügelprofile bei Kreisgitteranordnung (1 Mitteilung) (Investigation of the profile of ring gate vanes for turbines). In German. Technology reports of the Tohoku Imperial University, Vol. XII, No. 1, 1936.

Russia.

Bulletins of the U.S.S.R. Commission for the Exchange of Hydraulic Laboratory Research Results, as follows:

Bulletin No. 5, "Exchange of Hydrotechnical Research Results, Scientific Research Work in 1934", Leningrad, 1935. In Russian.

Bulletin No. 6, 1935. In Russian. Translation of "Current Hydraulic Laboratory Research in the United States", Vol. II, 1934.

Bulletin No. 7, Exchange of Hydrotechnical Research Results-Scientific Research Work in 1934, Leningrad, 1936. In English. Contains list of investigations in progress in the U. S. S. R. in 1934.

Bulletin No. 8, 1935. In Russian. "Die Preussische Versuchsanstalt für Wasserbau und Schiffbau in Berlin".

Transactions of the Scientific Research Institute of Hydrotechnics, Leningrad, Vol. XVII, 1935. In Russian: all with English summaries, except "Short Notes."

1. I. V. Egiazarov. Unsteady wave motion in long pools.
2. S. V. Isbash. Construction of dams and other structures by dumping stones into flowing water. Design and practice..
3. M. D. Chertoussov. Some considerations regarding the length of the hydraulic jump.
4. V. N. Goncharov. Flow around a cube fixed to the bottom of a flume.
5. V. A. Gavrilenko. Transportation of bed load.
6. U. F. Prokofieva and V. I. Novotorzev. Theoretical principles of designing transit stream flows (transitions).
7. I. I. Weiz. Some considerations upon steady slowly-varied flow of liquids in regularly shaped non-prismatic channels.
8. P. I. Glujgue. Investigations of concrete in structures.
9. V. V. Kind. Action of weak solutions of sulphates (similar to natural waters containing sulphates) upon various types of cements.
10. S. G. Gutmann. On kinematics of two-dimensional flow.
11. V. E. Timonoff. International Navigation Congress at Brussels in 1935.
12. Short notes.
    (a) M. D. Chertoussov. Determination of depth of water cushion.
    (b) G. K. Lotter. Considerations regarding the over-cooling of water in connection with turbulent flow in open channels.
    (c) T. N. Pouzirevskaya. New design of lifts proposed by Prof. N. P. Pouzirevskaya for Volga-Baltic Sea project.
    (d) I. D. Zaporogets. Determination of chemical activity of acid hydraulic mixtures by accelerated method.

Transactions of the Institute of Hydrotechnics and Land Reclamation, Moscow. Vols. XI, XII, XIII, XIV and XV, 1935. In Russian.

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V. M. Apollosov. Use of Machinery by Dalverzin Construction Trust for Irrigation Development of Dalverzin Steppe. Part I, 1933. In Russian. Middle-Asia Scientific Research Institute of Irrigation, Tashkent.

S. Batoorin. Concerning the Composition of Cadastral Surveys of Irrigation Systems, 1933.. In Russian. Middle-Asia Scientific Research Institute of Irrigation, Tashkent.

S. Batoorin. Cadastral Control Surveys of Irrigation Systems, 1935. In Russian. Middle-Asia Scientific Research Institute of Irrigation, Tashkent.

Prof. J. B. Egiazaroff. Regulation of the water level in the reaches of canalized rivers and regulation of the flow below the last lock dam according to whether the water power is or is not used. XVIth International Congress of Navigation, Brussels, 1935. 1st Section, 2nd Question.

REFERENCES TO PUBLICATIONS.

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Transactions of the American Geophysical Union, Part II, Reports and Papers of the Section of Hydrology and the Western Interstate Snow-Survey Conference, published by the National Research Council of the National Academy of Sciences, Washington, D. C., August, 1936. Approximately 350 pages.

Copies of this publication may be purchased at the price of $2.00 (postpaid) from the General Secretary, American Geophysical Union, 5241 Broad Branch Road, N. W., Washington, D. C. Checks should be made payable to the "American Geophysical Union".

Contents:

Appendix C. The Horton method for determination of infiltration rates. L. K. Sherman.
Appendix D. Consistency tests of long-term runoff records in the upper Mississippi basin suggested by study of U. S. Geological Survey Water Supply Paper No. 772, W. J. Parsons.
Appendix E. Comments on data of intensity and frequency of rainfall. M. Bernard.

6. Physics of Soil Moisture. F. J. Veihmeyer, Chairman.
7. Underground Water. D. G. Thompson, Chairman.
   Appendix A. Research on limestone caverns. A. C. Swinnerton.
   Appendix B. Geologic work of the Tennessee Valley Authority on limestone caves. E. C. Eckel.
   Appendix C. Geologic investigations at Mammoth Cave, Kentucky. E. R. Pohl.
8. Dynamics of streams. L. G. Straub, Chairman.
9. Chemistry of Natural Waters. C. S. Howard, Chairman.

Symposium on ground water.

Introduction: some problems relating to fluctuation of ground-water head. D. G. Thompson.
Long-time records of ground-water levels on Long Island, New York. R. M. Leggette.
Maximum ground-water levels. R. E. Horton.
Fluctuations in ground water at Woodgate, New York. E. S. Cullings.
Long-term record of water-level fluctuations at Plainfield, New Jersey. H. T. Critchlow and H. C. Barksdale.
Decline of artesian head in west-central South Dakota. T. W. Robinson.
The relation of the drought of 1934 to ground-water supplies in the James and Sheyenne River basins of North Dakota and South Dakota. A. N. Sayre.
The recovery of the ground-water level in Nebraska in 1935. L. K. Wenzel.
An interpretation of graphs of water-table fluctuations at four wells in southern California. F. C. Ebert.
Fluctuations of ground-water levels in Utah. G. H. Taylor.
The underground-water index: its relation to surface runoff. C. M. Saville.
Review of the work of W. J. McGee on ground-water levels. O. E. Meinzer.

Papers.

The seepage of water through porous media under the action of gravity. M. Muskat.
Historical development of ideas regarding the origin of springs and ground water. M. N. Baker and R. E. Horton.
Several methods of studying fluctuations of ground-water level. L. K. Wenzel.
The effect of distant earthquakes on the water level in wells. F. B. Blanchard and P. Byerly.
Natural stream-channel storage. R. E. Horton.

The channel-storage method of determining effluent seepage.
O. E. Meinzer, R. C. Cady, R. M. Leggette and V. C. Fishel.
Flow-duration characteristics of Illinois streams. J. H. Morgan.
Evaporation computed by the energy-equation method. R. E. and R. W. Kennedy.
Notes on the transportation of silt by streams. M. P. O'Brien.
The twin problem of erosion and flood control. H. M. Eakin.
Experimental study of the scour of a sandy river bed by clear and by muddy water. C. A. Wright.
Fluvial morphology in terms of slope, abrasion and bed load. S. Shulits.

(Papers also by N. C. Grover, C. S. Howard, S. K. Love and W. D. Collins. See p.102)

WESTERN INTERSTATE SNOW-SURVEY CONFERENCE (Joint meeting with Section of Hydrology).

Status of coordination and standardization of snow-surveying. J. C. Marr.
Precipitation surveys for anticipating water supplies. H. K. Burton and J. C. Alter.
The effect of soil absorption on snow-survey forecasting of stream flow. H. P. Boardman.
Calculation of normals for use with snow-survey data. C. H. Lee.
Lamoille Creek Basin normals: a case in which extension of normals by comparison with precipitation data proved more valuable than by comparison with another stream. C. Elges.
Extension of normals by precipitation data and by comparison with another stream. G. L. Parker.
Soil absorption and its effect on stream-flow forecasts in Utah. G. D. Clyde.
The Adirondack snow survey. E. S. Cullings.
Appendix A - Instructions to observers.
Improvement in snow-survey apparatus. J. E. Church.
Questionnaire and answers on snow-survey equipment and methods. J. E. Jones.
Historical and administrative. J. E. Church.

Pacific Coast Meeting of the Section of Hydrology.

January 31 and February 1, 1936.

Reports and papers.

Symposium on contribution to ground-water supplies.
General review. H. F. Blaney.
Water-conservation project in Santa Clara County. F. H. Tibbetts.
Water-spreading as practiced by the Santa Clara Water-Conservation District, Ventura County, California. V. M. Freeman.
Some factors affecting the rate of percolation on water-spreading areas. D. C. Muckel, Jr.
Remarks on water spreading. A. L. Sonderegger.
Percolation from surface streams. R. A. Hill and H. D. Whitman, Jr.
Movements of ground water. O. E. Meinzer.
General discussion. H. Conkling.

Basic hydrologic data. D. M. Baker.
Problems of long-range weather-forecasting for the Pacific Coast. G. F. McEwen.
The relationship between tree growths and stream runoff in the Truckee River Basin, California-Nevada. G. Hardman.
Experiment in correlation of tree-growth rings and precipitation cycles. W. E. Davis and A. W. Sampson.
The diurnal fluctuation in the ground water and flow of the Santa Ana River and its meaning. H. C. Troxell.
Comparison in flows of certain Southern California streams with that of the Colorado River. J.B. Lippincott.
Evaporation from water surfaces: Status of present knowledge and need for further investigations. N. W. Cummings.
Discussion. A. A. Young.
Underflow at Whittier Narrows, San Gabriel River Valley, Los Angeles County, California. J. C. Kimble.
Changes in the composition of ground waters resultant to anaerobic sulfate decomposition and the attendant precipitation of calcium and magnesium. F. M. Eaton.
A study of high-velocity flow in curved channels of rectangular cross-section. A. T. Ippen and R. T. Knapp.
A "closed-circuit" flume for suspended-load studies. R. M. Oaks and R. T. Knapp.
Experiments with critical-depth flumes for measurement of flow in debris-laden streams. H. G. Wilm, J. S. Cotton and H. C. Storey, Jr.
Hydrologic aspects of the San Dimas Experimental Forest. C. J. Kraebel and J. D. Sinclair.
Some considerations on the behavior of rock debris and silt particles in streams and reservoirs. G. H. Otten and V. A. Vanoni.

HYDRAULIC RESEARCH COMMITTEES.

Committee on Dynamics of Streams, Section of Hydrology, American Geophysical Union.

Chairman: Professor Lorenz G. Straub,
University of Minnesota,
Minneapolis, Minnesota.

No report. See Bulletin III-2, page 79; also Trans. American Geophysical Union, Part II, Sixteenth Annual Meeting, 1935, page 443, and Seventeenth Annual Meeting, 1936, Part II.

Transportation Subcommittee of the Petroleum Division of the American Society of Mechanical Engineers.

Chairman: W. G. Heltzel,
Stanolind Pipe Line Company,
Philcade Building,
Tulsa, Oklahoma.

See Bulletin III-2, page 79. Committee temporarily inactive. Work to be resumed.

Committee for Research on Hydraulic Friction, Division of Engineering and Industrial Research, National Research Council. See Bulletin IV-1, page 98.

The Committee has adopted a program for the preparation of its first report and the individual members are working on their assignments.

Some changes in the membership of the Committee have been recommended because of changes in the affiliation of the members. The Committee has been notified that Mr. Jacob E. Warnock has been appointed as a member representing the Bureau of Reclamation and that Lieutenant F. H. Falkner has been appointed as a representative of the Corps of Engineers.

As part of the work of this Committee, a glossary of terms has been prepared by the National Bureau of Standards and sent to Committee members for criticism. Action on the glossary is to be deferred until the first draft of the report has been prepared. However, the Committee plans to prepare a list of symbols on the basis of those suggested in the glossary and this list will be sent to the members for reference in preparation of the different sections of the first report.

The first report of the Committee will consist of a presentation of the present status of turbulence research applied to the problem of fluid friction and a number of chapters collecting available experimental data on friction in model and full scale open and closed conduits are being prepared. The main objec tive of this report is to point out those particular problems which require further experimental clarification. It is believed that by cooperation with the Committee for coordination of research in industry and university, it will be possible to direct the attention of several institutions interested in hydraulics to these problems in order to complete the information on channels and pipes of constant section. The Committee will then turn its attention to other aspects of the turbulence problem.

Th. von Kármán, Chairman.

Committee on Absorption and Transpiration, Section of Hydrology, American Geophysical Union.

Chairman: Charles H. Lee,
58 Sutter St.,
San Francisco, California.

No report. See Bulletin IV-1; also Trans. American Geophysical Union, Part II, Sixteenth Annual Meeting, 1935, page 392, and Seventeenth Annual Meeting, 1936, Part II.

Special Committee on Hydraulic Research, American Society of Civil Engineers.

This committee was appointed in April, 1934. It has four major objectives as follows;

1. Research Problems. In this field two lines of endeavor are being followed. One is to supply problems for hydraulic research to students and others suited to the investigator's ability and facilities, and to act in an advisory capacity regarding it. The second line is to induce a few directors of laboratories to undertake pure research looking to the solution of a definite fundamental problem in hydraulics. Those who accept such assignments are appointed co-operating members of the committee. Four such appointments have been made and five such research problems are in progress as follows - one by a member:

a) Conversion of Kinetic to Potential Energy, F. T. Mavis, Assoc. M. Am. Soc. C. E, Associate Director in Charge of Hydraulic Laboratory, University of Iowa, Iowa City, Iowa.

b) Phenomena of Intersecting Streams, M. P. O'Brien, M. Am. Soc. C. E. Associate Professor of Mechanical Engineering, University of California, Berkeley, California.

c) Curves in Open Channels, C. A. Mockmore, M. Am. Soc. C. E. Head of Civil Engineering, Oregon State College, Corvallis, Oregon.

d) Traveling Waves on Steep Slopes, Harold A. Thomas, M. Am. Soc. C.E. Professor of Civil Engineering, Carnegie Institute of Technology, Pittsburgh, Pa.

e) Sedimentation at the Confluence of Rivers, Lorenz G. Straub, Assoc. M. Am. Soc. C. E., Professor of Hydraulics, University of Minnesota, Minneapolis, Minnesota.

2. Letter Symbols for Model Studies.

A set of such symbols has been adopted by the committee and will soon appear in published form for criticism and suggestions.

3. Conformity of Model to Prototype.

All information obtainable is being gathered to show conformity of structures to model behavior. In some cases structures are tested after having been constructed; in other cases provisions are being made in new structures for testing after completion.

4. Manual of Laboratory Practice.

The committee is preparing a brief manual of standard procedure in construction and operation of models.

The personnel of the committee follows:

J. C. Stevens, Chairman
Clarence E. Bardsley
E. W. Lane
L. G. Straub
Chilton A. Wright
Herbert D. Vogel.

Cooperating members:

M. P. O'Brien
Harold A. Thomas
C. A. Mockmore
F. T. Mavis

HYDRAULIC LABORATORIES IN INDIA.

(Information furnished by Professor F. N. Mowdawalla, Bangalore).

1. Hydraulic Testing Station, Poona, (Special Irrigation Division, Research Circle).
2. Irrigation Model Tes ting Station, Karachi, (Public Works Department of the Government of Bombay).
3. College of Engineering, Roorkee (United Provinces).
4. College of Engineering, Bangalore.
5. College of Engineering, Madras.
6. College of Engineering, Hyderabad, (Deccan).
7. Special Irrigation Research Circle, Lahore (Public Works Department of the Government of the Punjab).

Titles of Section of Hydrology papers brought forward from page 98 -
U.S.Geological Survey records of suspended and dissolved matter in surface waters. N. C. Grover.
Suspended matter in the Colorado River, 1925 - 1935. C. S. Howard.
Suspended matter in several small streams. S. K. Love.
Dissolved mineral matter in surface waters. W. D. Collins.

INDEX TO PROJECTS.

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Flow - Through soils, granular materials, etc.

Hydraulics - General.

Model Tests - Miscellaneous.

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Model Tests - streams.

Plumbing.

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

VI-6/INHU

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Date

The National Bureau of Standards,
Washington, D. C.

Subject: Hydraulic Laboratory Bulletin, Series A.

Gentlemen:

Hydraulic research which falls within the scope of your bulletin, "Current Hydraulic Laboratory Research in the United States", is being performed at

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It is suggested that you send your next notice of a forthcoming issue of the bulletin to __________________________

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in order that opportunity may be given to report this work if it is desired.

____
(Signature)

____
(Address)

____

VI-6/INHU

Date

The National Bureau of Standards,
Washington, D. C.

Subject: Hydraulic Laboratory Bulletin,
Series A.

Gentlemen:

Bulletin IV-2 in the series entitled, "Current Hydraulic Laboratory Research in the United States", has been received.

July 1, 1936.

ADDENDUM TO

NATIONAL BUREAU OF STANDARDS
HYDRAULIC LABORATORY BULLETIN
SERIES B

HYDRAULIC LABORATORIES IN THE UNITED STATES
First revision, October 1, 1935.

YALE UNIVERSITY, Department of Civil Engineering,
New Haven, Connecticut.

(a) Yale University, Hydraulic Laboratory.
(b) Established 1892.
(c) Laboratory especially fitted for accurate work on relatively small flows.
(d) Head and quantity of water available for tests:
 (1) Gravity: 45 gpm (0.10 cfs) at 95 ft head (city supply).
 (2) Pumping: 600 gpm (1.3 cfs) at 60 ft head.

(e) Principal equipment:

2 inch diameter connection to New Haven water supply, concrete storage tank of 8 x 12 x 4 = 384 cu ft capacity;

5-inch Gould centrifugal pump, driven by compound-wound, DC motor having speed variation from 400 to 800 rpm, pump capacity 600 gpm at 60 ft head;

5-inch and 2-inch circulating pipe system, steel pressure-regulating tank 3 ft in diameter and 10 ft high (by closing tank overflow outlets and pumping against air cushion, high heads may be obtained);

A steel weir flume with variable weirs, 22" x 24" x 24'-0";

Measuring tanks on platform scales.

Miscellaneous Equipment includes weirs, Venturi meters, displacement meters, pretometer, hook gauges, 12-inch water wheel, rams, current meters, numerous gauges for reading small quantities.

(f) Unusual equipment: Working model of rowing tanks channel in the Payne Whitney Gymnasium for study of wave action at different velocities of water.
(g) Possibilities for work for or by outside persons or companies: It is not customary to perform routine tests. Research work may be done within the limits of capacity of the laboratory.
(h) Railroad siding.
(i) Head of Laboratory: R. H. Suttie, Associate Professor of Civil Engineering.
(j) Two persons on regular staff.
(k) General description: Laboratory is situated in the basement of Winchester Hall, 15 Prospect Street, New Haven, Conn. Rooms 30 x 18 ft and 30 x 52 ft. It is used primarily for undergraduate instruction. Facilities are suitable, however, for accurate research work on relatively small flows and moderate heads.

Besides the hydraulic facilities described above, there are pumps, weirs, measuring tanks, meters, orifices, etc. in the Mason Lab. of Mech. Eng., used in connection with courses in Mechanical Engineering.