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NATIONAL BUREAU OF STANDARDS
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Director

NATIONAL BUREAU OF STANDARDS
HYDRAULIC LABORATORY BULLETIN
SERIES A

CURRENT HYDRAULIC LABORATORY RESEARCH IN THE UNITED STATES

BULLETIN V-2
July 1, 1937.

WASHINGTON

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DIRECTORY

CURRENT HYDRAULIC LABORATORY RESEARCH IN THE UNITED STATES

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Hydraulic Laboratory Bulletin, Series A.

Volume V, Number 2. July 1, 1937.

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 1, 1936,
" IV-2, July 1, 1936,
" V-1, January 1, 1937.

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

Attention is called to the means by which additional information regarding the projects reported in this bulletin may be secured. You will note by reference to the "key" below that item (e) is intended to list for each project the name of the person with whom correspondence should be had regarding it.

(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:

CURRENT PROJECTS IN HYDRAULIC LABORATORIES.

BALDWIN-SOUTHWARK CORPORATION.

(578) (a) EFFICIENCY AND HORSEPOWER TESTS - MODEL HYDRAULIC TURBINE WITH VARIOUS DRAFT TUBE DESIGNS.
(b) Baldwin-Southwark Corporation.
(c) Elbow draft tube design studies.
(d) Baldwin-Southwark Corporation staff.
(e) K. W. Beattie, Research & Test Engineer.
(f) Investigations for improving turbine performance through revised draft tube design.
(g) Modifications in the draft tube water passages of several draft tubes have been made, each arrangement being used in tests of the same propeller type turbine.
(h) Tests are in progress.
(i) Some modifications have resulted in improved turbine efficiencies.

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(579) (a) EFFICIENCY AND HORSEPOWER TESTS - MODEL PROPELLER TYPE HYDRAULIC TURBINE.
(b) Baldwin-Southwark Corporation.
(c) Tests of propeller type turbine runner.
(d) Baldwin-Southwark Corporation Staff.
(e) K. W. Beattie, Research & Test Engineer.
(f) Determination of improved design for runner blades.
(g) Blades of various shapes made and tested in complete turbine setting. Blades constructed of copper to facilitate alterations in shape.
(h) Tests in progress.

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CALIFORNIA INSTITUTE 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. How ll, 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) This project has been completed and a report rendered to the Los Angeles County Flood Control District. The results also embodied in Ph. D. degree thesis of Dr. Arthur T. Ippen are now on file in the library at the California Institute of Technology. An article is being prepared in the expectation of an early publication. A loan copy of the report to the Flood Control District is available to anyone interested.

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(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.

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(656) (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) On the basis of the results of Project (357) to investigate designs and methods of changing the direction of flow in open channels without excessive super-elevation under conditions of super-critical flow velocities.
(g) Two new precision flumes of more than 100 feet length have been constructed of brass; one of rectangular and one of

trapezoidal cross-section. The water supply has been increased to 7 cubic feet per second. Experiments are now in progress on flow around curves of fairly short radius. Types of construction are being investigated to afford the minimizing of the super-elevation in the curve and the elimination of the down-stream wave pattern.

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CALIFORNIA INSTITUTE OF TECHNOLOGY, COOPERATIVE LABORATORY, SOIL CONSERVATION SERVICE.

(657) (a) INVESTIGATION OF RELIABILITY OF SAND AND GRAVEL SAMPLE SPLITTERS AND SUGGESTED IMPROVEMENTS IN DESIGN.
(b) Section of Sedimentation Studies, Soil Conservation Service, U. S. Department of Agriculture.
(c) Cooperative research program with Soil Conservation Service.
(d) George H. Otto and assistants.
(e) Professor Robert T. Knapp, Vito A. Vanoni, Project Manager, George H. Otto.
(f) To determine the degree of reliability of the common laboratory sample splitter under normal conditions of use; to investigate causes of bias, if any are found to exist; and to attempt to eliminate them by changes of design.
(g) Extensive series of duplicate sample splitting on samples of known composition; analysis of results by statistical methods; detail study of operating technique to find sources of difficulty.
(h) Sufficient experimental data, analyses, and modification of design have been secured to warrant preparation of a report under the title "The Use of Statistical Methods in Effecting Improvements on a Jones Sample Splitter".

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(658) (a) THE USE OF PROBABILITY GRAPHS IN THE INTERPRETATION OF MECHANICAL ANALYSES OF SEDIMENTS.
(b) Section of Sedimentation Studies, Soil Conservation Service, U. S. Department of Agriculture.
(c) Cooperative research program with Soil Conservation Service.
(d) George H. Otto and assistants.
(e) Professor Robert T. Knapp, Vito A. Vanoni, Project Manager George H. Otto.
(f) The study is an attempt to find a rational basis for classifying or selecting sediments for use in the laboratory.
(h) A report is being prepared upon the results of this study to date.

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(659) (a) MECHANICS OF SUSPENDED LOAD TRANSPORTATION.
(b) Section of Sedimentation Studies, Soil Conservation Service, U. S. Department of Agriculture.
(c) Cooperative research program with Soil Conservation Service.
(d) Professor Robert T. Knapp, Vito A. Vanoni, H. F. Richards.
(e) Professor Robert T. Knapp, Vito A. Vanoni, H. F. Richards.
(f) To investigate the internal mechanics of transportation of a suspended load; the effects of the material in suspension upon the velocity distribution of the flow; the concentration gradient of the suspended material; etc.
(g) Closed circuit flume has been designed and constructed, capable of circulating mixtures of sediment and water at any rate of flow up to 5 cubic feet per second. The slope of the open channel portion can be adjusted to any desired value up to 1:60.
(h) Studies are still in the initial stages.

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(660) (a) DEVELOPMENT OF A HOT WIRE VELOCITY METER FOR USE IN WATER.
(b) Section of Sedimentation Studies, Soil Conservation Service, U. S. Department of Agriculture.
(c) Cooperative research program with Soil Conservation Service.
(d) Vito A. Vanoni, E. E. Simmons.
(e) Professor Robert T. Knapp, Vito A. Vanoni.
(f) To develop an instrument suitable for use in determining velocity distribution in flows carrying sediments.
(h) Considerable progress has been made in the application of alternating current to such a meter. Velocities up to several feet per second have been worked with encouraging results.

.....

(661) (a) THE DEVELOPMENT OF A GRAB SAMPLER FOR SUSPENDED LOAD.
(b) Section of Watershed Studies, Soil Conservation Service, U. S. Department of Agriculture.
(c) Cooperative research program of Soil Conservation Service.
(d) Vito A. Vanoni, J. Pat. O'Neill.
(e) Professor Robert T. Knapp, Vito A. Vanoni.
(f) The development of a sampler for suspended load for conditions in which the particles have fall velocities of appreciable magnitude.
(g) &
(h) In flows carrying large particles in suspension the local concentration of sediment is affected by disturbances in the flow. To be unbiased a sampler must therefore take an undisturbed sample. Various sampler designs have been studied under flow conditions in a glass wall flume using dye jets and other means to determine their effect on the flow. Preliminary designs of samplers have been made which appear to cause no measurable disturbance in the flow entering the sampler. The study is being continued.

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(662) (a) THE DEVELOPMENT OF A METHOD FOR MEASURING RATE OF FLOW IN STEEP CHANNELS CARRYING SUSPENDED LOAD.
(b) Section of Watershed Studies, Soil Conservation Service, U. S. Department of Agriculture.
(c) Cooperative research program of Soil Conservation Service.
(d) Professor Robert T. Knapp, Vito A. Vanoni, R. M. Oaks.
(e) Professor R. T. Knapp, Vito A. Vanoni.
(f) See (a).
(g) An attempt is being made to apply the results of Project No.357 to the measurement of rate of flow in cases where the approach velocity is above the critical by utilizing a slight change in direction as an indicator of rate.
(h) The preliminary studies have indicated that a further investigation is justified. This is now under way.

.....

(663) (a) MECHANICS OF SEDIMENT SUSPENSION.
(b) Section of Sedimentation Studies, Soil Conservation Service, U. S. Department of Agriculture.
(c) Cooperative research program with Soil Conservation Service.
(d) Dr. Hunter Rouse.
(e) Vito A. Vanoni, Project Manager, Robert T. Knapp, Hunter Rouse.
(f) Investigation of sediment suspension by fluid turbulence, eliminating from the problem both the translation of the fluid body as a whole and the variability of the mixing process with depth.
(g) Apparatus consists of glass jar 12" in diameter and 26" in height, containing lattice agitator capable of simple harmonic motion in the vertical direction. Agitator is driven by Transitorq having 1:10 speed variation, and is so constructed as to permit wide range of frequency and amplitude. Lattices are evenly spaced from top to bottom thus insuring uniform distribution of mixing, except in immediate neighborhood of boundaries. Sediment of known grading characteristics is introduced, and agitator is run at constant speed until equilibrium of suspension is obtained, whereupon samples are taken by pipette at various depths.
(h) Apparatus has been constructed and preliminary runs made.

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(664) (a) NOMOGRAM FOR THE SETTLING VELOCITY OF SPHERES.
(b) Section of Sedimentation Studies, Soil Conservation Service, U. S. Department of Agriculture.
(c) Cooperative research program with Soil Conservation Service.
(d) Dr. Hunter Rouse.
(e) Robert T. Knapp, Professor, Vito A. Vanoni, Project Manager, Hunter Rouse.
(f) Construction of line chart for use in sedimentation laboratories.
(g) Chart devised for any Reynolds number between 0.000001 and 100,000, permitting the determination of either velocity of fall or diameter of sphere for any fluid viscosity and any specific gravity difference; readings made with single setting of straightedge.

(h) Chart and descriptive paper submitted to Committee on Sedimentation, National Research Council, to be published in Annual Report in September of this year.

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GENERAL NOTE:

Several other projects are under investigation in the Cooperative laboratory in the Soil Conservation Service, although they are not far enough in advance to report as separate items. Apparatus is nearly completed for the investigation of the mixing of fluids of different densities, such as occurs in underflow of reservoirs, etc. Other equipment is nearing completion for the study of mechanics of erosion due to jets, and a large horizontal closed-circuit flume has been designed and partially completed for the purpose of investigating rate of wear in bed load materials.

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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 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) Investigation completed on two pumps and an article published in A.S.M.E. Transactions for November, 1936, under the title, "Experimental Determinations of the Flow Characteristics in the Volutes of Centrifugal Pumps", by R. C. Binder, LaFayette, Ind., and R. T. Knapp. Limited number of copies available for distribution.

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(356) (a) STUDY OF THE CHARACTERISTICS OF HIGH HEAD CENTRIFUGAL PUMPS.
(b) Metropolitan Water District of Southern California.
(c) Large-scale model study.
(d) and (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) Investigation completed with acceptance tests of contractor's model pumps. More detailed description of laboratory and facilities will be found in A.S.M.E. Transactions for November 1936, page 663, by R. T. Knapp, Pasadena, California, "The Hydraulic-Machinery Laboratory at the California Institute of Technology".

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(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 downstream conditions are being investigated at closely-spaced piezometer stations for a distance of about 100 pipe diameters.
(h) Investigation completed and report submitted. Not available for distribution but it is anticipated that an abridgement of it will be published.

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(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.
(h) Investigation completed and thesis being written by Mr. Watson.

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UNIVERSITY OF CALIFORNIA. (and U. S. tidal Model Laboratory.)

(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) Professor M. P. O'Brien and Dr. R. G. Folsom.
(e) Professor M. P. O'Brien.
(f) To standardize a set of orifice plates and nozzles for field measurement of pump discharge.
(h) Long-radius nozzle tests completed. Summary of results in preparation. Tests on ISA short-radius nozzles nearly completed.

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(281) (a) MODEL OF ESTUARY OF COLUMBIA RIVER.
(b) Corps of Engineers, U.S.A. North Pacific Division.
(d) Professor M. P. O'Brien.
(e) Professor M. P. O'Brien.
(f) To investigate channel improvements in the estuary of the Columbia River.
(g) Investigations were made with fixed bed models having horizontal scale of 1:3600 and vertical scale of 1:128. Tides and waves were reproduced.
(h) Final report available for loan.

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(419) (a) DETERMINATION AND CORRELATION OF VIRTUAL MASS OF SHIP MODELS AND SPECIAL SHAPES.
(c) Graduate thesis.
(d) J. P. Murphy.
(e) Professor M. P. O'Brien.
(h) Thesis completed and available for loan. Abstract in this issue.

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(420) (a) BROAD-CRESTED WEIRS.
(b) Undergraduate thesis.
(d) Joe and Thomson.
(e) Professor M. P. O'Brien.
(f) Comparison of models of broad-crested weirs with prototype and with models to larger scale.
(h) Thesis completed. Abstract in this issue.

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(421) (a) SIMILARITY OF MOVABLE-BED MODELS.
(c) Graduate thesis.
(d) E. H. Taylor.
(e) Professor M. P. O'Brien.
(h) Project completed. Thesis available for loan. Abstract in this issue.

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(423) (a) FLOOD WAVES.
(c) Graduate thesis.
(d) J. O. Killian (Lieut.)
(e) Professor M. P. O'Brien.
(g) Investigation of flood waves in power canals by means of model channel.
(h) Thesis completed. Abstract in this issue.

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(424) (a) INTERSECTING STREAMS.
(b) Cooperation with special committee on Hydraulic Research, A.S.C.E.
(d) Morgan and Horowitz, R. L. Stoker.
(e) Professor M. P. O'Brien.
(f) To investigate the energy loss and flow phenomena at the intersection of open and confined streams.
(h) Relationships between velocities and depths being studied for converging open channel flow. Completed. Abstract in this issue.
(i) New experiment station under construction.

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(425) (a) MODEL STUDY OF WAVE ACTION ON BEACHES.
(c) Graduate and undergraduate thesis.
(d) Lapsley (Lieut.), Lillivang and Brant.
(e) Professor M. P. O'Brien.
(f) Models of shore at Santa Barbara and Santa Monica will be compared with field surveys to test reliability of models.
(h) Thesis completed. Abstract in this issue.

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(631) (a) HOT-WIRE ANEMOMETER.
(c) Laboratory project.
(d) R. L. Stoker.
(e) Professor M. P. O'Brien.
(f) To develop an instrument of the hot-wire anemometer type for measuring water velocities.
(h) Tests in progress using 4-inch nozzle for calibration.

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(632) (a) FLOW AT THE CRITICAL DEPTH.
(c) Undergraduate thesis.
(d) R. L. Stoker and T. C. Royce.
(e) Professor M. P. O'Brien.
(f) To investigate the surface phenomenon for open channel flow at depths near the critical depth for various values of the normal depth.
(h) Thesis completed. Abstract in this issue.

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(634) (a) SAN DIMAS METERING FLUME.
(b) California Forest and Range Experiment Station.
(d) Wilm, Stoker, Bermel.
(e) Professor M. P. O'Brien.
(f) To continue work on development of a critical depth flume for metering debris-laden flows.
(g) Laboratory experiments on models.
(h) Preliminary tests on rectangular flume completed. Tests on trapezoidal flume in progress.

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(635) (a) CONTRACTION WORKS IN RIVERS.
(c) Master's Thesis.
(d) Park (Lieut.)
(e) Professor M. P. O'Brien.
(f) To study the increase in depth resulting from reduction of stream width and to correlate results with data on bed-transportation.
(h) Thesis completed.

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(665) (a) SUBMERGED SHARP-CRESTED WEIRS.
(c) Undergraduate thesis.
(d) A. L. Brosio.
(e) Professor M. P. O'Brien.
(f) To study the effect of submergence on sharp-crested, rectangular, suppressed weirs.
(h) Thesis completed. Abstract in this issue.

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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.

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(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 s tudy 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 mo.sture movement, are in use.
(h) In progress.

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(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 factors 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 distributionof 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.

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(666) (a) THERMODYNAMIC STUDIES OF EVAPORATION FROM FREE WATER, SOIL, AND PLANTS.
(b) California Agricultural Experiment Station.
(c) Experiment Station project, 1107.
(d) F. J. Veihmeyer and N. E. Edlefson.
(e) F. J. Veihmeyer.
(f) Evaporation, although playing as important a role as precipitation, especially in irrigated regions, has not been studied as carefully. This is chiefly due to the fact that measurement of precipitation is direct whereas measurement of evaporation has been more indirect. Although many investigators have worked on the problem, using more or less empirical methods, its status is far from satisfactory. Empirical methods yield results primarily of local importance. Of recent years, however, a number of investigators have made valuable contributions to the rational solution of the problem, especially with respect to evaporation from free-water surfaces. Less has been contributed, however, on the subject of losses from soils and plants. The problem is essentially one in thermodynamics and its solution calls for careful measurements of energy and temperature changes in various parts of the system concerned.
(g) Measurements will be made on the following: intensity of reception of solar energy; intensity of radiation to the sky; heat changes in the system; heat transfer to or from the air as sensible heat; conduction of heat into or out of the system.
(h) Field and laboratory studies in progress.

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(667) (a) HYDROLOGY OF IRRIGATION WATER SUPPLIES IN CALIFORNIA.
(b) California Agricultural Experiment Station.
(c) Experiment Station Project 1108.
(d) C. V. Civan, C. N. Johnston, J. E. Christiansen, F. J. Veihmeyer.
(e) F. J. Veihmeyer.
(f) The tremendous popular interest which has been aroused over conservation of water and soil resources is in large part based upon opinions advanced by extremists who have little substantiating data for their panaceas. Controversy between water-supply engineers, foresters, and those engaged in the production of live stock on ranges has reached the stage of emotion rather than logic. Watershed management is of vital importance to California agriculture. The results of some of the investigations of the Division of Irrigation Investigations and Practice, California Agricultural Experiment Station, notably those on evaporation of water from soils, transpiration, movement of water in the soil, and the factors that affect the water-holding capacity of soil have a direct bearing on some of the questions at issue. It is hoped that studies on typical watersheds of the State can be made by this Division because of its established program of basic research in soil-plant-water relations.

(g) Field and laboratory studies are being made.
(h) Experimental plots on a typical chamise covered area in Shasta County, California have been established. Measurements on the effect of vegetative cover on run-off and erosion have been made for one year. The work will be continued.

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CARNEGIE INSTITUTE OF TECHNOLOGY.

(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) See Bulletin IV-2, page 34.
(h) Model has been discontinued and work carried on under U.S.E.C.

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(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) See Bulletin IV-2, page 53.
(h) Model studies have been completed and report has been submitted to the U. S. E. C., Pittsburgh, Pennsylvania.

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(487) (a) CALLIPOLIS DAM ON THE OHIO RIVER.
(b) U. S. War Department.
(c) Laboratory investigations 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) See Bulletin IV-2, page 53.

(487) (h) Model studies have been completed and report has been submitted to the U.S.E.O., Huntington, West Virginia.

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(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) Model studies have been completed and report has been submitted to the U. S. E. O., Mobile, Alabama.

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(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) Tests have been completed for Tygart and Bluestone Dams and are being continued for Madden Dam.
(i) Reports have been submitted to the respective offices for the Tygart and Bluestone Tests.

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(490) (a) INVESTIGATION OF TRAVELING WAVES IN STEEP CHANNELS.
(b) Pure research. This is an authorized project of the American Society of Civil Engineer's Special Committee on Hydraulic Research. During the past year the project was 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 F. A. Morrison.
(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) See Bulletin IV-2, page 35.
(h) Work is still in progress.

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(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) Model studies have been completed and report has been submitted to U.S.E.O., Huntington, West Virginia.

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(544) (a) MODEL STUDIES OF 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) Model studies have been completed and report has been submitted to the U.S.E.O., Pittsburgh, Pennsylvania.

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(668) (a) MODEL STUDIES IN CONNECTION WITH THE PROPOSED TIONESTA CREEK, CROOKED CREEK, AND MAHONING CREEK FLOOD CONTROL DAMS.

(b) U. S. War Department.

(c) Laboratory investigation on a group of models.

(d) H. A. Thomas, E. P. Schuleen, W. J. Hopkins, and W. H. Knox.

(e) Professor H. A. Thomas.

(f)(g) Investigation includes the construction and testing of three models of the Tionesta Creek Dam at the present time as follows:

1. A 1:36 scale pyralin model of the intake tower, tunnel and outlet waves for the circular tunnel to study the flow conditions.
2. A 1:80 scale model of the saddle spillway to study the flow characteristics and scour conditions for various designs.
3. A 1:200 scale model showing the saddle spillway, tunnel and earth dam structure to study the scour conditions and general behavior of the various flow conditions.

(h) Tests on the first two models and construction of the third are being carried on at the present time.

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(669) (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) U. S. War Department.

(c) Laboratory investigation using a distorted scale model.

(d) Prof. H. A. Thomas, E. P. Schuleen, W. J. Hopkins, and W. H. Knox.

(e) Prof. H. A. Thomas.

(f) To obtain 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 Allebheny-Monongahela River Basin.

(g) This model is about 85 feet long by 6 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 metal fins, designed to duplicate the prototype rating curves. The flood wave from each tributary is introduced from an individual tank with a cam-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 are under way.
(i) The model channels are designed to satisfy the general differential equation for flood-wave movement, velocity-head and acceleration-head effect being included in the representation.

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CASE SCHOOL OF APPLIED SCIENCE.

(580) (a) HYDRAULIC MODEL STUDY OF SPILLWAY AND OUTLET WORKS, KEYSTONE DAM.
(b) The Central Nebraska Public Power & Irrigation District.
(c) To furnish data for design.
(d) Professor George E. Barnes and Staff, Mr. George N. Carter, Resident Engineer for the District.
(e) Professor George E. Barnes.
(f) To determine capacity and safety of the works.
(g) Model of Morning Glory Spillway modeled to a 1 to 40 scale. A Morning Glory Spillway 90 ft in diameter, gate controlled, with 28 1/2 ft diameter shaft and tunnel; control tower with cylinder gates and 20 ft outlet tunnel; two tunnels leading to a common stilling basin. Calibration of discharge capacity, determination of hydraulic gradients, performance of stilling basin.
(h) Study completed and report submitted.
(i) Bound report with description, analysis, charts, photographs, and drawings available for cost of reproduction ($7.00).

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(581) (a) DETERMINATION OF SCOUR ACCOMPANYING HIGH VELOCITIES IN BRULE CLAY.
(b) The Central Nebraska Public Power & Irrigation District.
(c) To determine data for design.
(d) Professor George E. Barnes and Staff, Mr. George N. Carter, Resident Engineer for the District.
(e) Professor George E. Barnes.
(f) To determine permissible velocities in stream bed of Brule Clay.
(g) Construction of model channel with natural clay and delivery of water at velocities expected in nature.
(h) Measurements completed.
(i) Results included in report on Hydraulic Model Studies for the Keystone Dam (see above).

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(582) (a) HYDRAULIC PERFORMANCE OF CANAL DROP.
(b) The Central Nebraska Public Power and Irrigation District.
(c) To furnish data for design.
(d) Professor George E. Barnes and Staff, and Mr. George N. Carter, Resident Engineer for the District.
(e) Professor George E. Barnes.
(f) To determine hydraulic performance.
(g) 1 to 40 scale model undistorted.
(h) Completed.
(i) Included in report on Hydraulic Model Studies for the Keystone Dam (see above).

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(670) (a) STUDY OF UPPER AND LOWER NAPPE AND DETERMINATION OF COEFFICIENT OF DISCHARGE, FOR A SHARP CRESTED WEIR, CIRCULAR IN PLAN.
(b) Thesis project.
(c) Laboratory Experiment.
(d) Robert B. duPont under the direction of Professor George E. Barnes.
(e) Professor George E. Barnes.
(f) To verify calculations by direct measurement.
(g) Twelve inch vertical shaft surmounted by circular sharp crested weir, centered in six ft diameter tank ten ft deep, carefully baffled upward flow, control of air pressure around the jet, point gages on upper and lower nappe.
(h) Equipment completely erected, measurements under way.
(i) None.

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(671) (a) COMPARISON OF HYDRAULIC JUMP FORMED WITH TAILWATER ALONE, AND TAILWATER IN COMBINATION WITH BAFFLE PIERS.
(b) Thesis project.
(c) Laboratory Experiment.
(d) Robert H. Gedney under the direction of Professor George E. Barnes.
(e) Professor George E. Barnes.
(f) To determine permissible reduction in tailwater depth by use of baffle piers to assist formation of hydraulic jump. Rectangular channel, level floor. Jet emerges under sluice gate. To determine velocity distribution below the jump and comparison of type, height, and spacing of baffle piers.
(g) See (f)
(h) Equipment erected and measurements under way.

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COLUMBIA UNIVERSITY.

(583) (a) DETERMINATION OF CHARACTERISTIC "FRICTION FACTOR -REYNOLDS NUMBER" GRAPHS FOR PITTED PIPE.
(c) Research.
(d) A. E. Matzke, Research Assistant, and others under direction of Prof. J. K. Finch.
(e) Prof. J. K. Finch, Department of Civil Engineering, Columbia University.
(f) The characteristic form of friction graph for smooth pipe and for pipe with a uniform quality of interior roughness (Nikuradse) have been established. Data are lacking, however, on the form of such graphs for pipe which deteriorates in carrying capacity through pitting. Proposed tests will begin with smooth pipe and will determine effect of artificial pitting of increasing amounts.
(g) Pipe 2 or 3 inches in diameter will be used, and experiments will be carried up to a Reynolds Number of one million or over.
(h) Funds are available. Plans now under way. Experiments will be made during Spring and Summer, beginning about April 15th.
(i)(No report furnished for this bulletin.)

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(584) (a) FLOW THROUGH GRANULAR MATERIALS.
(c) Research.
(d) N. V. Feodoroff under the direction of Prof. B. A. Bakhmeteff and Prof. J. K. Finch.
(e) Prof. B. A. Bakhmeteff and Prof. J. K. Finch, Department of Civil Engineering, Columbia University.
(f) The purpose of this investigation is a study of the application of the basic pipe resistance formula $h_f = f \frac{z}{d} \frac{v^2}{2g}$ to the case of flow through granular material. This involves a study of the behavior of f in the above expression as the Reynolds number varies. Does f in this case vary in a manner similar to the way it varies in the case of a pipe? Is there a "Poiseuille line" for laminar flow breaking off into a "Blasius line" or into one of "Nikuradse's lines " when turbulent flow is attained. What is the effect of variation of grain size and of mixtures of grain size on this phase of flow in granular materials? Is f a function of $\frac{C}{R^{(2-n)}}$? It is the purpose of this investigation to answer these questions.
(g) See (f) above. Water is permitted to flow at different velocities through a three inch pipe filled with lead shot varying in size from "Dust" to a size having a diameter of about 1/4 inch. Measurement of head lost per unit length, discharge, and temperature of water are made. This makes it possible to study the variation of f with a "synthetic" expression of the Reynolds Number type based on the physical features of the case. Experiments of this type will also be performed on sand and gravel.
(h) The experimental work is about 2/3 completed at present.
(i) (No report furnished forthis bulletin.)

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(585) (a) THE HYDRAULIC JUMP IN A SLOPING CHANNEL.
(c) Research.
(d) A. E. Matzke, Research Assistant, under the direction of Prof. B. A. Bakhmeteff and Prof. J. K. Finch.
(e) Prof. B. A. Bakhmeteff and Prof. J. K. Finch, Department of Civil Engineering, Columbia University.
(f) Almost all of the work both theoretical and experimental, which has been done thus far on the hydraulic jump has dealt with a horizontal channel floor. This project includes a theoretical and experimental investigation of the hydraulic jump in channels of various slopes.
(g) See (f) above. The experimental work has been performed in the tilting flume of the Hydraulic Research Laboratory of the Department of Civil Engineering of Columbia University. The experiments have been done on floor slopes up to 0.07 in an attempt to cover the practical range of bottom flopes. Four series of experiments were run at various slopes, the kinetic flow factor remaining constant while the slope varied in each of the series. An attempt was also made to cover the practical range of kinetic flow factors.
(h) The work has been completed and will soon be ready for publication in a journal of one of the engineering societies.
(i) (No report furnished for the bulletin).

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(586) (a) A STUDY OF SUBMERGED FLOW.
(b) Research.
(c) A. E. Matzke under the direction of Prof. B. A. Bakhmeteff and Prof. J. K. Finch, Department of Civil Engineering, Columbia University.
(e) Prof. B. A. Bakhmeteff and Prof. J. K. Finch, Department of Civil Engineering, Columbia University.
(f) A systematic study of flow through submerged sluices, and over submerged weirs will be made in an attempt to clarify the understanding of these phenomena and to make them more applicable for practical use by engineers.
(g) Submerged flow will be produced and studied in the flume of the Hydraulic Research Laboratory of the Department of Civil Engineering. Pressures, surface profiles, and velocities will be measured. The definite scope of this project will depend to a great extent on the results obtained and the questions raised by the early experiments.
(h) Preliminary experiments of a broad crested weir and on a sluice gate have been made. Installation of apparatus for the systematic study of the sluice is practically completed, and experiments will be run in the very near future.
(i) (No report furnished for this bulletin.)

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CORNELL UNIVERSITY.

(587) (a) LARGE A.S.M.E. FLOW NOZZLES WITH WATER.
(b) National Bureau of Standards.
(c) Co-operative research.
(d) F. C. Morey, E. W. Schoder, A. N. Vanderlip.
(e) Professor E. W. Schoder.
(f) Finding of coefficients and loss of head.
(g) Alternately circulating an established gravity flow through the nozzle and measuring it volumetrically, using a weir as index of change; water column gages up to 12 ft head, mercury manometer (reservoir type) for higher heads. Three sizes: - 2¾ inch x 5.625 inch, 10.02 inch, 13.00 inch.
(h) The two smaller nozzles have been tested, and work is about to begin on the 2¾ inch x 13.00 inches.
(i) For the present it is assumed that the location of the downstream piezometer in the outer pipe wall just upstream from the tip of nozzle is a satisfactory tentative standard position.
(No report furnished for this bulletin.)

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(588) (a) SMALL WOODEN FLUME.
(b) Departmental investigation.
(c) General scientific research.
(d) E. W. Schoder, A. N. Vanderlip.
(e) Prof. E. W. Schoder or Mr. A. N. Vanderlip.
(f) Rreliminary to proposed checks on the classic data that lead to Kutter and Manning formulas.
(g) Volumetric measurements of discharge; water level and point or hook gages for slope and depth; micrometer calipers (under water) for widths. All these tentative.
(h) A fair start has been made with one slope.
(i) (No report furnished for this bulletin.)

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(589) (a) NORMAL DISTRIBUTION OF VELOCITIES FOR WATER IN BRASS PIPE.
(c) Graduate thesis.
(d) C. Y. Ling.
(e) Professor E. W. Schoder.
(f) To assist in finding nature of turbulent flow near wall.
(g) A 5-inch brass pipe, gravity flow, tiny hypodermic-needle Pitot tube, mean velocities up to 35 fps, are the main features.
(h) Work in progress.
(i) (No report furnished for this bulletin.)

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(590) (a) CHENANGO RIVER MODEL TEST.
(b) U. S. Corps of Engineers.
(c) Co-operative engineering research.
(d) U. S. Engineers and Cornell staff.
(e) Professor S. C. Hollister.

(f) To find effect of proposed improvements in river bed and in bridge piers in the lower Chenango at Binghamton, at which place the July 8, 1935, flood caused a depth of 24 ft and a discharge of over 80,000 cfs.
(g) Details of method and scope now under consideration.
(h) About 150 ft of the outdoor canal (16 ft wide and 10 ft deep) is being roofed over to house the model and permit work to proceed during the winter.
(i) (No report furnished for this bulletin.)

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(672) (a) FLOW NOZZLE RESEARCH.
(b) A.S.M.E. Fluid Meters Committee.
(c) Calibration of standard flow nozzles.
(d) Professors F. G. Switzer and W. C. Andrae.
(e) Professor F. G. Switzer.
(f) To secure coefficient data on standard nozzle as manufactured by different agencies and tested by different laboratories.
(g) Standard method of test as defined by Mr. H. S. Bean, in charge of all tests.
(h) Four nozzles for 3" pipe line completed. Additional sizes may be added to this series.
(i) This work was done in Mechanical Engineering Hydraulic Laboratory of Cornell University. A report of the results so far obtained is in the hands of Mr. H. S. Bean, National Bureau of Standards, to whom inquiry should be made for results.

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UNIVERSITY OF FLORIDA.

(591) (a) MODEL TEST OF A LABORATORY VENTURI FLUME.
(b) Graduate thesis.
(c) Laboratory research preliminary to design of full-scale structure for proposed new hydraulic laboratory for the University and Engineering Experiment Station.
(d) Robert M. Johnson.
(e) Professor Thomas M. Lowe.
(f) To determine the characteristics of Parshall's improved Venturi section in a narrow channel and its applicability as a form of weir for measuring the rate of flow through a rectangular laboratory flume.
(g) Wooden model of a portion of flume and Venturi section installed in laboratory and water circulated by a centrifugal pump. Orifice and Venturi meters in pump circuit used to measure rate of flow. Specially constructed gauges, piezometers, etc., were used to obtain the necessary hydraulic data.
(h) Study completed. Thesis will be placed in the University of Florida library February 1, 1937.
(i) Thesis also contains sectional views and floor plans of proposed hydraulic laboratory, and layout of experimental and instructional equipment.

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HARVARD UNIVERSITY.

(674) (a) SEEPAGE THROUGH DAMS.
(b) Soil Mechanics Laboratory, Graduate School of Engineering,
(c) Scientific research.
(d) A. Casagrande.
(e) Professor A. Casagrande.
(f) Part of a larger research project on stability of dams. Development of simple and yet reliable methods for determining the seepage characteristics through and beneath earth dams.
(g) Theoretical and experimental research. Comparison of existing methods and development of new methods.
(h) Practically completed.
(i) This investigation was conducted during the past three years. A comprehensive report will be published in the July, 1937, number of the Journal of the New England Water Works Association

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(675) (a) INVESTIGATION OF A NEW METHOD FOR DETERMINING THE COEFFICIENT OF PERMEABILITY OF THE SOIL IN THE GROUND.
(b) Soil Mechanics Laboratory, Graduate School of Engineering, Harvard University.
(c) Scientific research and graduate thesis.
(d) A. Casagrande and J. O. Osterberg.
(e) Professor A. Casagrande.
(f) Development of a new method for determining the permeability of undisturbed soil in its original position by means of observations on an individual test hole; also, the separate determination of the permeability parallel and perpendicular to the stratification.
(g) Theoretical and experimental research.
(h) Well under way.
(i) At the time this is written, the U. S. Engineer Office in Boston, under the direction of Captain Hugh H. Casey, is making plans to try out this method in the investigations of the foundation conditions of an earth dam.

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HORTON HYDRAULIC AND HYDROLOGIC LABORATORY.

(290) (a) VELOCITY DISTRIBUTION IN STREAM CHANNELS.
(b) Scientific research.
(c) Scientific research.
(d) Robert E. Horton, C. W. Force and Laboratory staff.
(e) Robert E. Horton.
(g) Investigation comprises two parts: (1) A mathematical investigation of the form of velocity curves in open channels called for by the Manning formula; (2) An analysis and study of several hundred vertical velocity curves obtained in natural river channels, with a view to comparing the actual and theoretical curves.
(h) Investigation nearly completed and publication expected within a few months. See abstract in Bulletin III-1.
(i) No report furnished for this bulletin.

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(291) (a) BACK-WATER BY THE MANNING FORMULA.
(b) Scientific research.
(c) Scientific research.
(d) Robert E. Horton and Laboratory staff.
(e) Robert E. Horton.
(f) Improvement in methods of analysis of problems of non-uniform flow.
(g) An integral of the backwater function in terms of the Manning formula has been obtained and tables of backwater 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, backwater 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.
(i) (No report furnished for this bulletin.)

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(292) (a) DISPERSION CURVES OF MANNING'S COEFFICIENT OF ROUGHNESS.
(b) Scientific research.
(c) Scientific research.
(d) Robert E. Horton and laboratory staff.
(e) Robert E. Horton.
(f) The purpose is to provide a means of presentation of experimental values of the coefficient of roughness n in such a manner that the percentage of cases in which the observed coefficient has been found to be greater or less than a given value can at once be determined, thus leading to a more direct and certain method of selection by judgment of values of the coefficient of roughness applicable to a given case.
(g) All available values of the coefficient n for certain particular types of channels have been collated and plotted in the form of frequency curves. The analysis does not, however, cover all types of channels and covers only a limited number of classes of pipe surface.
(h) Investigation completed but results not yet written up in form for publication.
(i) (No report furnished for this bulletin.)

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(293) (a) FLOOD WAVES SUBJECT TO FRICTION CONTROL.
(b) Scientific research.
(c) Scientific research.
(d) Robert E. Horton and laboratory staff.
(e) Robert E. Horton.
(f) To provide a basis for practical determination of the crest velocity and change of form of natural flood waves in large rivers.
(g) This research relates to the theoretical aspects of the subject. It is founded on an experimental investigation conducted some years ago at the same laboratory, using a slope table 120 feet in length, for the purpose of determining experimental forms of flood wave crests. The experimental research was conducted impart 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.
(i) (No report furnished for this bulletin.)

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(294) (a) RELATION OF CARRYING CAPACITY OF CAST IRON PIPE CONDUITS TO AGE IN SERVICE.
(b) Scientific research.
(c) Scientific research.
(d) Robert E. Horton.
(e) Robert E. Horton.
(f) Contribution to knowledge of the variation with age of the carrying capacity of water supply conduits and distribution mains.
(g) This investigation comprises mainly an analysis of continuous records covering five periods averaging one to three years each of variation in discharge coefficient with length of time in service since cleaning of a 24-inch water supply conduit at Utica, N. Y. It is shown that in this case the carrying capacity after cleaning decreases as an inverse exponential function of the time in service but does not approach zero as a limiting value. Causes of this are discussed and a comparison is made with other experimental data on the decrease in carrying capacity of pipe with age in service. (i)(No report furnished.)

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(385) (a) SURFACE RUNOFF PHENOMENA.
(b) Scientific research.
(c) Scientific research.
(d) Robert E. Horton and laboratory staff.
(e) Robert E. Horton.
(f) To determine (1) the law governing depth and velocity of overland or sheet flow under natural conditions; (2) to provide means of analyzing the hydrograph into its various component elements, including surface runoff; infiltration, accretion to soil moisture and ground-water flow; also to determine depth of surface detention during runoff; phenomena of surface runoff, amount of channel storage following surface runoff, and law governing depletion of channel storage.
(i) (No report furnished for this bulletin.)

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(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 the 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. (No report furnished for this bulletin.)

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UNIVERSITY OF ILLINOIS.

(301) (a) STUDY OF THE FLOW OF WATER IN A CIRCULAR GLASS PIPE BY THE USE OF MOTION PICTURES.
(b) Engineering Experiment Station. A cooperative investigation of the Departments of Theoretical and Applied Mechanics and Mechanical Engineering.
(c) Laboratory investigation.
(d) C. P. Kittredge, John C. Reed.
(e) Professor F. B. Seely.
(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 and 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.

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(500) (a) MAGNITUDE AND FREQUENCY OF FLOODS ON ILLINOIS STREAMS.
(b) Engineering Experiment Station.
(c) Research.
(d) G. W. Pickels.
(e) Professor G. W. Pickels.
(g) Analysis of flood data collected by U.S.G.S.
(h) To be published as Bulletin 296 of the Engineering Experiment Station, University of Illinois.

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(501) (a) SYNTHESIS OF THE HYDROGRAPH.
(b) College of Engineering.
(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) Thesis is completed and a copy is filed in University Library.

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(504) (a) MODEL OF SPILLWAYS ON WATER SUPPLY RESERVOIRS IN ILLINOIS.
(b) Engineering Experiment Station. A cooperative investigation with the Illinois State Water Survey and Departments of Theoretical and Applied Mechanics and Civil Engineering, University of Illinois.
(c) Investigation of capacities, use as measuring devices and erosion problems.
(d) C. O. Reinhardt, 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) Tests of West Frankfort model are completed and a report will probably be published.

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(626) (a) VELOCITY DISTRIBUTION IN PIPES AT HIGH REYNOLDS NUMBER.
(b) Graduate Thesis (Master's degree).
(d) L. D. Stoyke - W. M. Lansford.
(e) Professor F. B. Seely.
(g) A pitot tube is used to determine the velocity distribution in pipes of various diameters, 24 inches and less.
(h) Experiments in progress.

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(654) (a) A STUDY OF THE SATURATION LINE IN EARTH DAMS.
(b) College of Engineering.
(c) Graduate thesis (Doctor's degree).
(d) Chennan Li.
(e) Professor G. W. Pickels.
(g) Application of the Electric analogy using the electrolytic method.
(h) A copy of the thesis will be filed in the University Library, Feb. 1, 1938.

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(655) (a) THE DEVELOPMENT OF A MAGNETIC INSTRUMENT FOR MEASURING THE FLOW OF FLUIDS IN PIPES.
(b) Undergraduate thesis (Bachelor's degree).
(d) H. J. McSkimin - W. M. Lansford.
(e) F. B. Seely.
(g) A bar magnet is suspended from a plug in the top side of a non-magnetic pipe. The water flowing against the magnet deflects it, which in turn causes a magnetic needle outside the pipe to deflect a similar amount.
(h) Tests have been made using magnets of various shapes and sizes in three pipes of different diameters (3 in., 2 in., and 1 in. in diameter). A copy of the thesis is now on file in the University Library.

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IOWA INSTITUTE OF HYDRAULIC RESEARCH.

(311) (a) TRANSPORTATION OF BOTTOM LOAD IN OPEN CHANNELS.
(b) Mechanics and Hydraulics Department.
(c) Graduate Thesis.
(d) Prof. F. T. Mavis, T. Y. Liu and E. Soucek.
(e) Prof. F. T. Mavis.
(h) Laboratory studies of capacity for traction completed for four unigranular samples of Iowa River sand and for two mixtures. Completed. Report ready for publication.

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(314) (a) LABORATORY STUDY OF GROUND WATER PROFILES.
(b) Mechanics and Hydraulics Department.
(c) Graduate thesis.
(d) Prof. F. T. Mavis and T. P. Tsui.
(e) Prof. F. T. Mavis.
(h) Continuation of studies previously reported. Completed.

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(316) (a) HYDROLOGIC STUDIES - RALSTON CREEK WATERSHED.
(b) and (c) Cooperative project - Iowa Institute of Hydraulic Research, U. S. Department of Agriculture, and U. S. Geological Survey.
(e) E. W. Lane.
(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.
(i) Bulletin 9, University of Iowa Studies in Engineering by F. T. Mavis and Edward Soucek entitled "A Summary of Hydrologic Data, Ralston Creek Watershed, 1924-1935," published.

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(317) (a) COOPERATIVE STREAM GAGING IN IOWA.
(b) Iowa Institute of Hydraulic Research.
(c) Cooperative project - U. S. Geological Survey.
(d) R. G. Kasel, District Engineer, and staff.
(e) Prof. E. W. Lane.
(h) Stream gaging stations are maintained cooperatively, at stations on major watersheds in Iowa.

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

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(456) (a) THE HYDRAULIC JUMP IN ENCLOSED CONDUITS.
(b) Mechanics and Hydraulics Department.
(c) Graduate Student Thesis.
(d) Prof. E. W. Lane and C. E. Kindsvater.
(e) Prof. F. T. Mavis.
(f) To check the applicability of computations based on momentum relations to the hydraulic jump in enclosed conduits.
(h) Completed.

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(506) (a) THE EFFECT OF SCALE RATIO ON SCOUR BELOW MODEL STILLING POOLS.
(b) Mechanics and Hydraulics Department.
(c) Graduate College project and thesis.
(d) Prof. F. T. Mavis, Prof. E. W. Lane, and P. C. Stein.
(e) Prof. F. T. Mavis.
(f) To investigate similitude relations in model tests of scour below spillways.
(h) Completed.

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(507) (a) THE CONVERSION OF KINETIC INTO POTENTIAL ENERGY.
(b) Am. Soc. C. E. Committee on Hydraulic Research.
(c) Independent research.
(d) Prof. F. T. Mavis and E. R. Van Driest.
(e) Prof. F. T. Mavis.
(f) To investigate basic physical phenomena of flow in divergent conduits with particular reference to the conversion of energy.
(h) Preliminary studies of flow in a transparent expanding conduit have been completed.

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(592) (a) A STUDY OF SAND WAVES AND THEIR EFFECT ON HYDRAULIC ROUGHNESS.
(c) Independent research.
(d) Prof. E. W. Lane.
(e) Prof. E. W. Lane.
(f) To investigate the conditions giving rise to sand waves in large rivers and their effect on the hydraulic roughness of the river channels.

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(593) (a) A STUDY OF THE PERCOLATION UNDER EXISTING DAMS BY MEANS OF THE ELECTRIC ANALOGY.
(b) Mechanics and Hydraulics Department.
(c) Graduate thesis.
(d) Prof. E. W. Lane and K. W. Liu.
(e) Prof. F. T. Mavis.
(f) To investigate the hydraulic gradient theory of piping below masonry dams on earth foundations.

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(595) (a) A STUDY OF THE CARRYING CAPACITY OF RIVERS FOR SILT IN SUSPENSION.
(b) Mechanics and Hydraulics Department.
(c) Graduate thesis.
(d) Prof. E. W. Lane and G. H. Dunstan.
(e) Prof. F. T. Mavis.
(f) To derive quantitative relations for the silt carrying capacity of streams.

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(596) (a) MODEL STUDY OF RALSTON CREEK CONTROL.
(b) Mechanics and Hydraulics Department.
(c) Graduate thesis.
(d) Edward Soucek, J. S. McNown, and Prof. F. T. Mavis.
(e) Prof. F. T. Mavis.
(f) To compare rating curves for two models and prototype of existing control at Ralston Creek gaging station.

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(597) (a) CONTROL OF SILT DEPOSITS NEAR CONDENSER INTAKES OF A STEAM POWER PLANT.
(b) Iowa Institute of Hydraulic Research and Mechanics and Hydraulics Department.
(c) Graduate thesis.
(d) Edward Soucek, E. R. Van Driest, and Prof. F. T. Mavis.
(e) Prof. F. T. Mavis.
(f) To study methods of controlling deposits in pond and in condensers themselves.

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(598) (a) MODEL DRAFT TUBE STUDIES.
(b) Mechanics and Hydraulics Department.
(c) Graduate thesis.
(d) Prof. F. T. Mavis and H. H. Chang.
(e) Prof. F. T. Mavis.
(f) To study flow at constant head through model spreading tube with different cones and with different angularities of entering water.
(h) Completed.

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(599) (a) STUDY OF VACUUM FORMATIONS IN WATER SUPPLY SYSTEMS OF BUILDINGS.
(b) Iowa Institute of Hydraulic Research and National Association of Master Plumbers, Inc.
(c) Institute project.
(d) Dean F. M. Dawson and A. A. Kalinske.
(e) Prof. E. W. Lane.
(f) To investigate vacuum formations in practical installations and methods of preventing back-siphonage from submerged inlet fixtures.
(h) Two-inch water riser 4 stories high has been installed with interchangeable branch connections at each floor. Pressures and rates of water and air flow have been observed in preliminary investigations. Progress report due June 1937.

(i) Preliminary report rendered June 1937. Copies can be obtained from National Association of Master Plumbers, Inc., Edmonds Bldg., 917 Fifteenth Street, N. W., Washington, D. C.

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(600) (a) HYDRAULICS OF VERTICAL STACKS WITH CONNECTING DRAINS LAID AT DIFFERENT SLOPES.
(b) Iowa Institute of Hydraulic Research.
(c) Institute Project.
(d) A. A. Kalinske.
(e) Prof. E. W. Lane.
(g) Transparent sections in stack and connecting drain to facilitate observation of flow in conduit partially filled with water.
(h) Preliminary observations have been made. Quantitative tests to start soon.

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(601) (a) HYDRAULICS AND PNEUMATICS OF VERTICAL PIPES FLOWING PARTLY FULL.
(b) Iowa Institute of Hydraulic Research.
(c) Basis for further investigation of hydraulics and pneumatics of plumbing drainage systems.
(d) Dean F. M. Dawson and A. A. Kalinske.
(e) Prof. E. W. Lane.
(f) To determine minimum drain, stack, and vent sizes for plumbing installations and to study phenomena of non-uniform flow of water in circular conduits not directly open to the air.
(h) Experimental studies were completed by investigators (d) at the Hydraulics Laboratory of the University of Wisconsin. Report available in bulletin form.
(i) Results published as Bulletin No. 10, State University of Iowa Engineering Studies. Title: "Hydraulics and Pneumatics of Plumbing Drainage System."

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(602) (a) HYDRAULIC JUMP IN TRAPEZOIDAL CHANNELS.
(b) Mechanics and Hydraulics Department.
(c) Graduate thesis.
(d) Prof. C. J. Posey and P. S. Hsing.
(e) Prof. F. T. Mavis.
(f) To test limits of satisfactory jump action and agreement with the momentum theory over the range of commonly used shapes of trapezoidal channels with especial attention to scale effect.

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(603) (a) DETERMINATION OF SHAPE OF NAPPE AND COEFFICIENT OF DISCHARGE OF A VERTICAL SHARP-CRESTED WEIR, CIRCULAR IN PLAN, WITH
(b) Mechanics and Hydraulics Department. RADIALLY INWARD FLOW.
(c) Graduate thesis.
(d) Prof. J. W. Howe and C. S. Camp.
(e) Prof. F. T. Mavis.
(f) See title. Practical application to "morning glory" spillways.

(g) Experimental methods provided data from which empirical relations were developed. Arcs having radii of one, two and three feet were used. Thirty-two runs were made on the three weirs. All weirs had an approximate length of 1.5 ft and the angle of arc varied from 29° on the largest radius weir to 97° on the smallest radius. Radial guide walls extended both upstream and downstream from the weir. The weir crest was 3.5 feet above the approach floor. Positions of the nappe were determined along the radial center line of the arc.

It was found that with the coordinates of the nappe expressed in dimensionless values of x/H and y/H, where H was the head on the weir, practically identical profiles were obtained for runs in which the value of Head/Diameter was the same. Plots were made of x/H and y/H for values of H/D ranging from .02 to .25. No empirical relation between these variables was discovered. Within the range mentioned the high point of the under side of the nappe was located at

$$x/H = -0.40\ H/D + 0.26$$

$$y/H = -0.20\ H/D + 0.11$$

where the weir crest is at the center of coordinates.

All weirs had the same discharge relation: $Q = 3.28\ LH^{3/2}$ up to ratios of $H/D = .18$. Above this value a roller piled upon the top side of the nappe causing what might be called a submerged condition and the discharge was reduced. Above $H/D = .20$, the formula

$Q = 3.18\ LH^{3/2}$ is recommended.

(h) Completed for thesis requirement. Further search for relation between coordinates of nappe will be made.
(i) Work believed to be reliable.

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(604) (a) DETERMINATION OF COEFFICIE T OF DISCHARGE OF TAINTER GATE OVER HORIZONTAL SILL.
(b) Mechanics and Hydraulics Department.
(c) Graduate thesis.
(d) Prof. J. W. Howe and J. K. Peng.
(e) Prof. F. T. Mavis.
(f) See title.
(g) Method - experimental with analysis along empirical lines. A small tainter gate one foot wide and one foot in radius was mounted in a flume one foot wide.

Discharge under the gate was measured for a range of gate openings varying from 0.05 ft to 0.40 ft , a range of angles (lip with horizontal) varying from 56°-40' to 95°- 50', and a range of heads varying from 0.13 to 1.30 ft. Head was defined as the distance from the water surface to the center of the gate opening. This arbitrary definition was adopted because of the practical ease of computation on this basis, the difficulty of determin ing the elevation of the low point of the water surface below the gate, and the relative constancy of the coefficient of discharge. No submerged openings were tested. The coefficient of discharge was determined by the formula

$$C = \frac{Q}{A\sqrt{2g(H + VA^2/2y)}}$$

in which VA was velocity of approach (average) in the channel above the gate. The following conclusions were made:

The coefficient of discharge increases as the head increased, decreases as the angle of lip increases, decreases (generally) as the gate opening increases.

An empirical formula (modified Horton) was proposed

$$C = \left[\frac{1.8\ N - 1}{(1.8 + \theta/22)\ N - (\theta/66)^3}\right]^{.428}$$

in which N - ratio D/W = U.S. depth/gate opening.

θ = angle of lip (with horizontal) in degrees.

A nomographic solution of this formula was given. Two empirical nomographs prepared directly from the original data were also presented. All of the formulas and diagrams given agreed with the original data to within 3 per cent.

(h) Work completed.

(i) Believed to be a reliable piece of work. Some disagreement as to the effect of gate opening upon discharge and some doubt in writer's mind as to desirability of applying results on small gate openings to large scale prototypes.

(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) Prof. E. W. Lane.
(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, as well as on the tangents, for velocities ranging fro 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 is in press, being printed as Technical Bulletin No. 577 of U. S. Department of Agriculture.

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(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) Prof. E. W. Lane.
(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 are being conducted in a flume 30 in wide equipped with transparent walls. Many pressure and velocity measurements are being taken for various quantities of flow and various depth of approach water and tail water and for aprons having different slopes. Many lateral drainage ditches discharge through chutes into main ditches. Similar structures are used for irrigation systems in dropping the water from a high level to a low level. Water storage dam spillways discharge 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) The contemplated experiments have been completed and the report is in course of preparation.
(i) The theory of the hydraulic jump on sloping aprons has been developed. When the discharge, upstream and downstream depths are increased by the model ratio law, it appears from the limited number of tests so far made that the lengths of the roller and the jump also increase in the same ratio. A progress report on the investigation is now under way.

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(108) (a) MISSISSIPPI RIVER, LOCK & DAM NO. 4, ALMA, WIS.
(b) Corps of Engineers, U. S. Army, St. Paul District.
(c) Institute project.
(d) U. S. Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) To determine water loads on a proposed double-leaf vertical-lift gate, the self-cleaning characteristics of sills for submergible gates, dimensions for stilling basins, backwater caused by the dam, and current conditions at critical points on the dam and in the navigation channel.
(g) Water loads were computed from pressures on piezometers in a large-size model. Stilling basin studies were made in sectional models. A fixed-bed river model was tested for backwater and navigation data.
(h) Tests are complete. A final report is in preparation.

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(109) (a) STUDY TO IMPROVE HYDRAULIC SYSTEM OF NAVIGATION LOCKS, GENERAL MODEL.
(b) Corps of Engineers, U. S. Army.
(c) Institute project and graduate thesis.
(d) U. S. Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) To eliminate as many as possible of the features now found to be unsatisfactory in river navigation locks and to increase the efficiency of the hydraulic systems of such locks.
(g) A typical barge lock was constructed 1/15th prototype size and was subsequently altered to conform to changes indicated by tests.
(h) A final report is in preparation.

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(313) (a) MISSISSIPPI RIVER, LOCK & DAM NO. 26, ALTON, ILL., GENERAL.
(b) Corps of Engineers, U. S. Army, St. Louis District.
(c) Institute project.
(d) U. S. Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) To study changes in river regimen caused by the project structures at each of two sites, to design means of preventing erosion around bridge piers immediately downstream from one site, to determine the best composition for the dam and backwater caused by it during and after construction, and to design adequate stilling basins.
(g) Tests were run in two distorted, movable-bed river models to study site conditions and training works. A large-size sectional model of 8 Tainter gates was used to design bridge pier protection. A single Tainter gate was simulated for stilling basin studies.
(h) The final report has been completed.

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(320) (a) TENNESSEE RIVER, PICKWICK LOCK HYDRAULIC SYSTEM.
(b) Corps of Engineers, U. S. Army, Nashville District.
(c) Institute project.
(d) U. S. Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) To develop an efficient hydraulic design for the lock filling and emptying system.
(g) Studies were made in a model of the entire lock to design culvert intakes, port sizes, a transition from intakes to main culverts, a culvert venting system, and culvert discharge ports. An auxiliary, single-port apparatus was used to calibrate model, filling and emptying ports under a full range of operating conditions.
(h) A final report has been completed.

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(390) (a) MISSISSIPPI RIVER, LOCK & DAM NO. 11, DUBUQUE , IOWA.
(b) Corps of Engineers, U. S. Army, Rock Island District.
(c) Institute project.
(d) U. S. Engineer Department Staff and Rock Island District personnel.
(e) Martin E. Nelson, Associate Engineer.
(f) To provide information on a layout for the dam spillways which would cause least damage to the highway bridge approach fill and to investigate the scour caused by various gate operation procedures.
(g) A part fixed-bed, part movable-bed model with the spillway made of wood was studied for spillway locations. Later, the roller and Tainter gates and stilling basins were made of metal to exactly simulate the prototype dam, ground coal was introduced as bed material, and scour tests were run.
(h) Tests are in progress.

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(393) (a) ROLLER GATE COEFFICIENTS (RI)
(b) Corps of Engineers, U. S. Army, Rock Island District.
(c) Institute project.
(d) U. S. Engineer Department Staff and Rock Island District personnel.
(e) Martin E. Nelson, Associate Engineer.
(f) To determine coefficients of discharge for roller gates operating singly and in groups under typical upper Mississippi River conditions.
(g) One series of tests was made in a model 1/18th prototype size in which three, complete roller gates were represented. Later, tests were made in a precise model of a section of roller gate 1/14th prototype size.
(h) A final report is in preparation.
(i) It has been found impracticable to express the test results in terms of general coefficients of discharge. Curves have been prepared which show the relationships between gate-opening, discharge, and upper and lower pool stages for the sill shapes tested.

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(395) (a) SUBMERGIBLE TAINTER GATE.
(b) Corps of Engineers, U. S. Army, Rock Island District.
(c) Institute project.
(d) U. S. Engineer Department Staff and Rock Island District personnel.
(e) Martin E. Nelson, Associate Engineer.
(f) To determine whether or not a submergible Tainter gate was feasible and to determine discharge coefficients for gates of various radii.
(g) Tests were made on a model of a single gate and appurtenant structures. A variety of sill shapes as well as gate radii were investigated through a wide range of upper and lower pool stages.
(h) Data are now being analyzed.

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(445) (a) MISSISSIPPI RIVER, LOCK & DAM NO. 26, ALTON, ILL., COFFERDAMS.
(b) Corps of Engineers, U. S. Army, 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 upon protective works designed for the auxiliary lock, and to measure backwaters caused by the 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 were tested at critical points around different cofferdams and the locks.
(h) A final report has been completed.

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(446) (a) ROLLER GATE COEFFICIENTS (St.P.)
(b) Corps of Engineers, U. S. Army, 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 as constructed in Mississippi River Dams No. 5, 5A, and B.
(g) Tests were made on single, submergible roller gates set up to simulate each dam on a scale of 1/38. Models were accurately machined from aluminum castings.
(h) A final report has been completed.

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(447) (a) TAINTER GATE COEFFICIENTS.
(b) Corps of Engineers, U. S. Army, 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 as constructed in Mississippi River Dams No. 5, 5A, and B.
(g) Machined, cast aluminum models 1/17.2 times as large as prototype gates were made for this study. Tests were made to cover the range in upper and lower pools, gate openings, and discharges expected at each dam.
(h) Tests are in progress.

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(448) (a) WEEP HOLES.
(b) Corps of Engineers, U. S. Army, St. Paul District.
(c) Institute project.
(d) U. S. Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) To determine the conditions under which gravel will be discharged from weep holes in lock floors and stilling basins.
(g) An apparatus was set up in which metal pipes represented full-size, cylindrical weep holes 6 and 10 in. in diameter, each diameter 1½ and 4 ft long. Increasing discharges were passed through two gradings of gravel in each set up until gravel was discharged from the pipes. Conical weep holes have now been built for further tests.

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(512) (a) ILLINOIS RIVER, PEORIA - LA GRANGE DAMS.
(b) Corps of Engineers, U. S. Army, 1st Chicago District.
(c) Institute project.
(d) U. S. Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) To determine (1) the discharge between wickets when raised, (2) the discharge through and characteristics of butterfly valves as designed for the Peoria and for the La Grange Dams, (3) current conditions on and scour below the stilling basin under various operating conditions.
(g) A 1/7th scale model was set up with a Peoria valve at one end and the La Grange valves at the other end of a line of wickets. Tests were run through a complete range of upper and lower pools and discharges.
(h) A final report has been prepared.

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(514) (a) TENNESSEE RIVER, GUNTERSVILLE LOCK HYDRAULIC SYSTEM.
(b) Corps of Engineers, U. S. Army, Nashville District.
(c) Institute project.
(d) U. S. Engineer Department.
(e) Martin E. Nelson, Associate Engineer.
(f) To study the arrangement and design of filling and emptying ports for the Guntersville Lock.
(g) A model of the entire hydraulic system for this lock was tested.
(h) A final report is in preparation.

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(517) (a) PILE FOUNDATION TESTS.
(b) Corps of Engineers, U. S. Army, Upper Mississippi Valley Division.
(c) Institute project.
(d) U. S. Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) To solve, by tests on scale models, problems of load capacities of pile groups as compared with single piles, loads to be applied both vertically and horizontally.
(g) Model piles 1/6th, 1/12th, 1/18th, and 1/24th as large as round wood piles 1 ft in diameter at the butt and 35, 40, and 45 ft long will be driven in a fine, clean river sand of uniform grading and subjected to loads until failure occurs. The sand bed is arranged so that different rates of seepage may be maintained through it.
(h) Tests are just getting under way.

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(607) (a) CHANOINE WICKET CALIBRATION.
(b) Corps of Engineers, U.S.Army, Ohio River Division.
(c) Institute project and graduate thesis.
(d) U. S. Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) To establish rating curves for discharge through and over wicket dams under the varying conditions which obtain in the Ohio River.
(g) A line of model wickets, 1/7th prototype size, was set up in a 10-ft canal for initial tests. Later, wickets were also tested in a 2.5-ft flume. Discharges under various conditions of upper and lower pools were measured with wicket spaces equivalent to 1 in., 3 in., and 5 in. and with different numbers of wickets down. A 1/14th size model has been set up in the 10-ft canal for additional tests.
(h) Tests are in progress.

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(608) (a) MISSISSIPPI RIVER, LOCK & DAM NO. 3, RED WING, MINN.
(b) Corps of Engineers, U. S. Army, St. Paul District.
(c) Institute project.
(d) U. S. Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) To develop suitable protection against erosion in the upper lock approach and immediately downstream from the locks while river flow is passed through the locks during construction.
(g) Tests were run in a distorted, movable-bed model of the dam and lock site.
(h) A final report has been prepared.

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(609) (a) TENNESSEE RIVER, WATTS BAR LOCK HYDRAULIC SYSTEM.
(b) Corps of Engineers, U.S.Army, Nashville District.
(c) Institute project.
(d) U. S. Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) To determine lock filling and emptying characteristics for a lift of 71 ft.
(g) Tests were made in a model which was 1/20th as large as the prototype. Filling and emptying curves were established for various methods of valve operation.
(h) A final report is in preparation.

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(651) (a) TENNESSEE RIVER, GENERAL JOE WHEELER LOCK.
(b) Corps of Engineers, U.S.Army, Nashville District.
(c) Institute project.
(d) U.S.Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) To determine the similarity of the model to the prototype and to prepare curves showing the rate of rise and filling and emptying periods under normal lift.
(g) A model was set up to exactly simulate the Joe Wheeler Lock on a scale of 1/20.
(h) Tests are in progress.

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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.

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

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

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MASSACHUSETTS INSTITUTE OF TECHNOLOGY, Department of Civil and Sanitary Engineering.

(29) (a) MODEL STUDY OF WAVE ACTION ON SEA WALLS.
(b) River Hydraulic Laboratory, M.I.T.
(c) Graduate research for Doctor's degree.
(d) Professor K. C. Reynolds.
(e) Professor K. C. Reynolds.
(f) To experimentally study the reliability of models for determining wave action on sea walls.
(g) A plunger at one end of a wave tank 20 ft long and 6 ft wide created waves which ran the length of the tank and struck a vertical sea wall. Three models (scales 1 to 15, 1 to 30, and 1 to 45) of the same wall were used. The rate of movement of the beach in front of the wall as carried over the wall was determined as a continuous mass curve. Froude's model law was found to be applicable to converting the rate of beach movement from model to nature.
(h) Doctor of Science thesis submitted by Prof. Reynolds in May, 1937, "An Experimental Investigation of the Reliability of Models for Determining Wave Action on Sea Walls."

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(652)(a) MODEL OF CAPE COD CANAL AND APPROACHES.
(b) River Hydraulic Laboratory, M.I.T.
(c) Graduate research for Master's degree.
(d) Lts. J.S.B.Dick, E.B.Dowming, J.McCormack, Jr., and O.J. Pickard of Corps of Engineers.
(e) Professor K. C. Reynolds.
(f) To determine coefficient of roughness of Cape Cod Canal model and study effect of dikes in Buzzards Bay on velocities and water surface profiles of the canal.
(g) A distorted fixed bed model of the canal and approaches (formerly used for researches for Corps of Engineers - see Bulletin V-1, project 362) was used. Horizontal scale 1:600, vertical scale 1 to 60, time scale 1 to 77.5. Certain dikes are to be built in Buzzards' Bay to eliminate serious cross eddies. Their location and best construction procedure was examined.
(h) Tests completed. Master's thesis submitted to May,1937, "Experimental Determination of Velocity Functions in Cross Section of Cape Cod Canal Model with and without Dikes".

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(653)(a) THE BEHAVIOR OF TWO-LIQUID DIFFERENTIAL GAUGES.
(b) River Hydraulic Laboratory, M.I.T.
(c) Graduate research for Master's degree.
(d) Lts. James F. Stroker and James E. Walsh.
(e) Professor George E. Russell.
(f) To investigate the behavior of differential gauges using various combinations of liquids.
(g) Actual difference in level of water in two separate tanks was measured by point gauges and compared with computed difference obtained by deflections of the differential gauge. Mercury, kerosens, chlorobenzene (C_6H_5Cl) and mixtures were used.
(h) Master of Science thesis submitted in May,1937,"Behavior of Two-Liquid Differential Gauges".

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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) Cavitation is produced by high acceleration of material by means of magnetostriction vibrator.
(h) Progress reports:
J. C. Hunsaker, Mech. Eng., April 1935. Vol. 57, No. 4.
J. C. Hunsaker, Trans. A.S.M.E., October 1935, Vol. 57, No.7.
E. W. Spannhake, Thesis, Mass. Inst. of Tech. Library, "Theoretical investigation of the periodic nature of cavitation".
Schumb, Peters, Millikan, Metals & Alloys, May 1937.
S. Logan Kerr, Trans. A.S.M.E., July 1937.

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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.

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(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.
M.A.Thesis - J. Bicknell July 1936.

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(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.
Annual Reports to the N.A.C.A. Dec. 1936.

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UNIVERSITY OF MINNESOTA.

(94) (a) TRANSPORTATION OF SEDIMENT.
(b) University of Minnesota Engineering Experiment Station.
(c) University hydraulics research project.
(d) Lorenz G. Straub and graduate assistants.
(e) 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.

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

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(190) (a) FLOW CONDITIONS IN OPEN CHANNEL.
(b) University of Minnesota Engineering Experiment Station.
(c) University hydraulics research project.
(e) 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.

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(327) (a) EXPERIMENTAL STUDY OF FLUSH VALVES FOR WATER-CLOSETS.
(b) Minnesota State Board of Health.
(c) Cooperative research project with Sanitary Division of Minnesota State Board of Health and the Hydraulics Department of the University.
(d) Lorenz G. Straub, H. A. Whittaker, Jack J. Handy.
(e) 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.

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(676) (a) FRICTION LOSS IN PLUMBING SYSTEM PIPE LINES.
(b) Minnesota State Board of Health.
(c) Cooperative research project with the Sanitary Division of the Minnesota State Board of Health and the Hydraulics Department of the University of Minnesota.
(d) Lorenz G. Straub and Jack J. Handy.
(e) Lorenz G. Straub.
(f) Determination of influence of various types of connections and nature of workmanship upon efficiency of plumbing pipe lines, in order to set up minimum requirements for the state plumbing code.
(g) Pipe lines are constructed under idealized conditions in the laboratory in such a manner that flow conditions can be observed, head losses and discharges measured.
(h) Experimental apparatus is being installed.

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(677) (a) SEDIMENTATION AT THE CONFLUENCE OF RIVERS.
(b) In cooperation with Special Committee on Hydraulic Research of the American Society of Civil Engineers.
(d) Lorenz G. Straub and Sigurd H. Anderson.
(e) Lorenz G. Straub.
(f) Laboratory experimental investigation of equilibrium conditions at points of confluence of rivers.

(g) Idealized conditions of the confluence of rivers are to be reproduced in the laboratory by means of channels through which sediment is transported by water under control conditions. The transportation characteristics of the sediments used are previously determined by means of a specially constructed tiltable channel designed for this purpose.
(h) Apparatus has been set up and preliminary experiments started.

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(678) (a) STUDY OF WIND-GENERATED WAVES.
(b) University of Minnesota Engineering Experiment Station.
(d) Harold Flinsch.
(e) Lorenz G. Straub.
(g) A glass tunnel 20 inches wide, 27 inches deep, and about 40 feet long is filled with water to different depths and an air current passed over the water surface. Observations are made of the wave formations for different velocities of the air current.
(h) Apparatus has been assembled and experiments are in progress.

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(679) (a) STABILITY OF SAND DAMS.
(b) Cooperative experiments with the Committee on Seepage and Erosion, American Society of Civil Engineers.
(d) Hibbert Hill and Lorenz G. Straub.
(e) Lorenz G. Straub.
(f) To study the stability of downstream slopes of sand dams.
(g) Laboratory experiments.
(h) Plans for experimental set-up under way.

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NEW YORK UNIVERSITY.

(130) (a) DURATION CURVES OF STREAM FLOW.
(c) General scientific research and in connection with theses for Master's degrees.
(d) Thorndike Saville, graduate students, and assistants.
(e) Professor Thorndike Saville.
(f) To determine regional characteristics of stream flow and the applicability of statistical methods to its analysis.
(g) Construction of duration curves of weekly stream flow in terms of mean flow. Deviations of curves from one another as influenced by drainage area and regional characteristics and length of record. Construction of composite curve applicable to a region. Statistical analysis of curves and data.
(h) Study of five North Carolina streams completed and published: "An investigation of the flow duration curves of North Carolina streams", by Thorndike Saville and John D. Watson, Trans. American Geophysical Union, National Research Council, Washington, D.C., 1933, pp. 406-425. Studies in progress covering streams in New Jersey, New York, Tennessee and North Caroline.

(i) The investigation is intended to cover the entire country, and the results will be presented in a series of papers dealing with different regions.

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(131) (a) ESTIMATING FLOOD FLOWS.
(b) General scientific research and in connection with theses for Master's degrees.
(d) Thorndike Saville, graduate students, and assistants.
(e) Professor Thorndike Saville.
(f) (g) To compare all the various methods which have been proposed by applying them to streams having long records of flow, and to develop if found desirable, improved methods.
(h) Comparison of several methods to 57 year daily record of Tennessee River in Master's thesis (1933) by H. Thielhelm. Results indicate marked diversity. Subsequent studies indicate period of record has marked influence upon extrapolated values, and that estimates of extreme floods in terms of the mean flood differ for different stations on same streams even when same (30 year) period is used.
Progress report entitled: "A Study of Methods of Estimating Flood Flows Applied to the Tennessee River," U. S. Geological Survey Water-Supply Paper 771, 1936, pages 398-420.

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(680) (a) HYDRAULICS OF SUB-SURFACE FILTER WASHING.
(b) New York University, Division of Sanitary Engineering.
(c) Experimental investigation on the effect of submerged nozzles on the upward expansion of sand from underwashing.
(d) Graduate students under Professor Lewis V. Carpenter.
(e) Professor Lewis V. Carpenter, Professor of Sanitary Engineering.
(f) To obtain basic hydraulic data to make the proper calculations for filter washing when applying part of the wash water from submerged nozzles.
(g) Construct a filter of 9 sq ft area with an "aloxite" underdrain and a system of vertical nozzles for washing the filter downward at the same time that the upward wash is in progress. It is proposed to vary the angle of the nozzles as well as the spacing and study the losses of head with various portions of the wash water being applied through the nozzles. The sand expansion will be used as an index to determine the best results for each head and varying quantity.
(h) Apparatus has been built and some tests have been made.
(i) Preliminary report should be available about January 1, 1938.

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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 $\frac{1}{2}$ x $\frac{3}{4}$ inch Venturi is being calibrated with hot and cold water and with high accuracy head and quantity coefficient with Reynolds number over a Reynolds number range of from 2,000 to 500,000.
(h) Taking of data temporarily stopped in order to analyze results available.

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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) Experimental work completed, apparatus and results being checked by other investigators.

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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) Data on I.S.A. nozzles in 3 inch pipe for steam and water practically completed. Both rough and smooth pipe have been used, and results show effect of pipe roughness and coefficient of these results. Long radius nozzles have been calibrated in 3 inch standard extra heavy pipes and are now being calibrated with steam.

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(636) (a) STUDY OF THE EFFECT OF PULSATIONS ON ORIFICE METERS.
(b) Ohio State University.
(c) Student thesis.
(d) J. H. Eagle and W. A. Daberko.
(e) Professor S. R. Beitler.
(f) To determine the effect of pulsating flow on orifice meters and to attempt to design the practical pulsation eliminator.
(g) Two orifice meters in series are to be connected to the discharge of a reciprocating compressor. One of these will operate on pulsationless flow and the other with full pulsation. The quantity flowing, static pressure and speed of pulsation will be varied and the effect of the meter indication determined. An attempt will then be made to design and build a practical piece of apparatus which will eliminate this effect.
(h) Taking of data completed. Report in process of preparation.

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THE UNIVERSITY OF OKLAHOMA.

(617) (a) DETERMINATION OF DISCHARGE COEFFICIENTS FOR FLOW NOZZLES AND SQUARE-EDGED ORIFICES WHEN METERING OIL. 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 project sponsored by the Special Research Committee on Fluid Meters of the A.S.M.E.
(d) Professor M. M. Ambrosius and Mr. Isaac Lovelady.
(e) Professor W. H. Carson, Head, Department of Mechanical Engineering.
(f) Determine discharge coefficients for flow nozzles and square-edged orifices at low Reynolds numbers as encountered when metering oils.
(g) Set-up includes meter runs of 2, 3, and 4-inch pipe. May be supplied with oil from heat-exchanger which is thermostatically controlled. From the meter runs the oil is discharged to weighing tanks.
(h) Work about 2/3 completed.
(i) (No report furnished for this bulletin.)

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OREGON STATE COLLEGE.

(681) (a) FLOW AROUND BENDS IN OPEN CHANNELS.
(b) Committee on Hydraulic Research, Am. Soc. C. E., J. C. Stevens, Chm., Portland, Oregon.
(c) A research project on phenomena of flow of water around bends in open channels.
(d) C. A. Mockmore, Fred Merryfield, Frank Lucas, Oregon State College, Corvallis, Oregon.
(e) C. A. Mockmore, 962 Van Buren Street, Corvallis, Oregon.
(g) An open channel 18 inches wide and 10 inches deep, with several bend sections of 30-inch central radius have been designed to permit varying flow conditions. The bends are of pyralin, to assist in obtaining motion pictures. Varying channel slopes and varying ratios of depth to width of channels are easily obtainable.
(h) The channel is now complete, and the taking of data under varying conditions of flow has started.
(i) Preliminary data shows that, with a constant rate of flow and with varying ratios of channel depth D to width W, there is a ratio of D/W at which the stream velocities on the inside and outside of the bend are approximately equal, and that for a rise in D/W, the maximum stream velocity occurs on the inside of the bend, while for a lowering of D/W, the maximum stream velocity occurs on the outside of the bend.

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(682) (a) STUDY OF A RECTANGULAR SHARP-CRESTED WEIR FOR WIDE VARIATION OF L/H RATIO.
(b) Oregon State College.
(c) Undergraduate Thesis for prize offered by Portland, Oregon, Section of Am. Soc. C. E.
(d) W. H. Edwards, F. Merryfield, C. A. Mockmore.
(e) C. A. Mockmore, Oregon State College, Corvallis, Oregon.
(f) The purpose of the experiment was to make a study of the determination of discharge through a narrow rectangular, sharp-edge, contracted weir notch for large variations of head.
(g) The weir notch was 4 inches wide and suitable for heads as high as 30 inches. Numerous readings were taken for different heads on the weir and the results plotted and compared to well-known weir formulae, such as the Hamilton-Smith, Smith-Walker, Hegley, Frese, Barnes, Cone, King, and Francis formulae. The Kinzer formula, $Q = 0.4342\ LH\ (2gH)^{\frac{1}{2}}$, approached the actual flow data more closely than any other compared formula.
(h) The results of the experiment have been embodied in a report (May, 1937), which may be borrowed from the Department of Civil Engineering, Oregon State College.

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(683) (a) A STUDY OF THE HORIZONTAL CIRCULAR WEIR.
(b) Oregon State College.
(c) Undergraduate Thesis for prize offered by Portland, Oregon, Section of Am. Soc. C. E.
(d) Wm. J. Dorner, F. Merryfield, C. A. Mockmore.
(e) C. A. Mockmore, Oregon State College, Corvallis, Oregon.
(f) The purpose of the experiment was to study the flow of water over sharp-crested, horizontal circular weirs, such as may be used for overflow pipes.
(g) Sharp-crested weirs were made on the ends of $2\frac{1}{2}$, 3, 4, and 6-inch pipes. The head was varied so that it exceeded the pipe diameters.
(h) The study indicates that there are primarily two types of flow over such weirs: (1) where the water spilling down the waste pipe permits air to pass through the pipe, and (2) where the water spilling over the weir closes the waste pipe. In changing from open to closed flow a very material increase in head occurs without any increase in flow.
(i) The results of the experiment are embodied in a report which may be borrowed from the Department of Civil Engineering, Oregon State College.

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(684) (a) A STUDY OF GATING PROPELLER WATER TURBINES.
(b) Oregon State College.
(c) Graduate Thesis for Advanced Degree.
(d) Grant A. Robley.
(e) C. A. Mockmore, Fred Merryfield.
(f) The purpose of the experiment is to investigate a new method of gating a propeller turbine by changing its effective diameter and hence its capacity to deliver power as opposed to the use of wicket gates or other means of gating.
(h) A 10 horsepower turbine with a 7-inch runner has been designed, built and tested in the laboratory. Work is in progress now on the effect of changing the diameter of the hub of the runner.

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(685) (a) STUDY OF THE BANKI WATER TURBINE.
(b) Oregon State College.
(c) General research.
(d) C. A. Mockmore, Fred Merryfield.
(e) C. A. Mockmore, Oregon State College.
(f) To study the Banki Water Turbine under operating conditions.
(g) A 3 horsepower Banki Water Turbine was designed, built and tested in the Oregon State College hydraulics laboratory.
(h) This turbine was installed (1934) at a small power site in the Coast Range Mountains, where it has been subjected to varying flow and weather conditions.

(i) A translation of Professor Donat Banki's original article on this turbine together with a report on the building and testing of the 3 horsepower turbine at the Oregon State College is being submitted to the Special Committee on Hydraulic Research of the Am. Soc. C. E.

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PENNSYLVANIA STATE COLLEGE.

(137) (a) A STUDY OF VARIOUS TYPES AND KINDS OF STILLING DEVICES FOR USE IN CHANNELS OF APPROACH TO WEIRS AND FOR OTHER PURPOSES.
(b) The Pennsylvania State College.
(c) Research.
(d) Professors Elton D. Walker and H. K. Kistler.
(e) Either of above.
(f) The development of a standard stilling device, or possibly more than one device.
(g) Water is admitted to one end of a tank from a pipe, under such conditions as to produce a high velocity and considerable turbulence. The discharge is measured at the other end of the tank by means of a standard weir which has been calibrated. Velocity measurements are made at a number of points in a cross section about four feet downstream from the inlet both with and without any stilling devices in place. When stilling devices are tested, they are inserted about two feet below the inlet. Each device is tested with a number of different velocities, average velocities being determined by means of the weir readings and the cross section of the channel. We seek to relate the relative effectiveness of the various stilling devices to the magnitude and distribution of velocities in the cross section.
(h) Data covering a large number of experiments are being tabulated and studied, and a progress report in the form of a bulletin is under preparation.
(g) Further investigation that may be suggested by the results found will be undertaken as soon as the current preliminary studies are completed.

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UNIVERSITY OF PENNSYLVANIA.

(371) (a) THE EFFECT OF INSTALLATION ON THE COEFFICIENTS OF VENTURIMETERS.
(b) For general information and for manufacturers of Venturimeters.
(c) Three meters of various ratios were placed in different types of flow and following the combinations of elbows, the effect on the coefficient being noted.
(d) To fix limits of installation.
(e) and (f) See (d).
(g) Described in article.
(h) Completed.
(i) These tests were described in the November issue of the Transactions of the A.S.M.E. 1936. (No report furnished for this bulletin.)

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(611) (a) THE BEHAVIOR OF INWARD PROJECTING TUBES.
(b) For my own information.
(h) Not yet published.
(i) (No report furnished for this bulletin.)

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(612) (a) THE VARIATION OF COEFFICIENTS OF VENTURI METERS WITH RATIO DIAMETERS.
(b) General information and the meter manufacturing companies.
(f) To establish the law of such variation.
(h) Is not complete and may never be published.
(i) (No report furnished for this bulletin.)

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(613) (a) THE EFFECT OF VARIATION OF ANGLE OF UPSTREAM CONE ON THE COEFFICIENTS OF VENTURI METERS.
(b) To be used in discussion of Dr. Knapp's paper on the laboratory of the California Institute of Technology before the A.S.M.E. December 2, 1936.
(h) This will be finished in the near future and will be submitted as a discussion of the above paper.
(i) (No report furnished for this bulletin.)

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PRINCETON UNIVERSITY.

(686) (a) RESULTS OF CAVITATION RESEARCH AT PRINCETON UNIVERSITY.
(b) Research.
(c) Continuation of experimental program previously reported.
(d) Professor A. E. Sorenson.
(e) Professor L. F. Moody.
(f) Investigation of the hydraulic conditions in a Venturi form of apparatus equipped with a glass throat as affected by the approach to the critical point of cavitation. The scope excludes the investigation of pitting and the consequences of cavitation, but is directed to the effect on flow conditions of the cavitation coefficient sigma. The work and conclusions will be reported at the Cavitation Session at Cornell University, June 26, 1937, under the joint auspices of the Applied Mechanics and Hydraulics Divisions of the American Society of Mechanical Engineers.

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(687) (a) EFFECT OF DOWN-STREAM CONDITIONS ON THE COEFFICIENTS OF A ROUNDED NOZZLE.
(b) Thesis for advanced degree.
(c) Experimental research.
(d) Lieut. Edward M. Parker, U.S.A.
(e) Professor L. F. Moody, Princeton University.
(f) (g) Comparison of results with free discharge, submerged discharge and discharge through conical diffusers of various angles of divergence. Also, comparison of results using throat piezometers and downstream pressures.

(h) Work to be completed by June 22.
(i) Will be more completely reported in next issue.

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(688) (a) EFFECT OF BLADE-PITCH ANGLE ON CURRENT METER CHARACTERISTICS.
(b) Thesis for advanced degree.
(c) Experimental research.
(d) Lieut. Lawrence Joseph Lincoln, U. S. A.
(e) Professor L. F. Moody, Princeton University.
(f) and (g) Still water ratings at various angles of obliquity of the meter axis to the direction of motion, carried out on a new form of current meter having pivoted blades on the same principle as a Kaplan turbine.
Tests were run to determine the over or under registering characteristics of the meter when used in turbulent flow at various pitch angles of the blades.
(h) Work to be completed by June 22, 1937.
(i) Opposite characteristics as regards under and over registry were found for pitch angles above and below about 20° pitch. At an angle of between 19 and 20° the meter was found to be practically cosine true, that is, at this pitch angle it correctly resolved the velocity component.
Complete report will follow in next issue.

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(689) (a) EFFECT OF GUIDE RINGS ON THE CHARACTERISTICS OF A PROPELLER TYPE CURRENT METER.
(b) Thesis for advanced degree.
(c) Experimental research.
(d) Lieut. John R. Parker, U.S.A.
(e) Professor L. F. Moody.
(f) and (g) To investigate the effect of the attachment of various guide rings surrounding the propeller, on the oblique flow characteristics. Guide rings were placed in various positions to determine whether the performance could be brought closer to the desired cosine registration. The same meter was used as has been described above for the investigation of Lieut. Lincoln.
(h) Work to be completed by June 22, 1937.
(i) Complete report in next issue.
Results show this method to be less satisfactory than by the method investigated by Lieut. Lincoln above. Improvements can be obtained, however, within limited ranges, making the method applicable to existing meters in some cases.

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(690) (a) FLOW IN AN OPEN CHANNEL WITH DOWNWARDLY SLOPING FLOOR.
(b) Thesis for advanced degree.
(c) Experimental research.
(d) Lieut. Alfred D. Starbird.
(e) Professor L. F. Moody.
(f) and (g). The 12" glass flume, described in previous reports, was utilized and was equipped with a floor sloping at various angles. The floor sloped downward in passing down stream in order to give a gradually diverging section. Various depths of flow and various quantities were used covering conditions when a hydraulic jump is formed, when no jump is formed and when there is a hydraulic drop. Curves were constructed to show the relation of upstream and downstream depths and efficiency of deceleration and loss of velocity head.
(h) Work not yet completed.
(i) Will be more completely reported in next issue.

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PURDUE UNIVERSITY.

(47) (a) FLOW OF FLUIDS THROUGH CIRCULAR ORIFICES AND TRIANGULAR WEIRS.
(b) Purdue Engineering Experiment Station.
(c) General scientific research.
(d) F. W. Greve and assistants.
(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) Check tests have been run with the head measured by a point gage placed within the approach channel. In previous trials, the head was determined with a piezometer and hook gage located exterior to the channel, correction being made for difference of water temperature in the channel and in the piezometer.

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UNIVERSITY OF ROCHESTER.

(691) (a) STUDY OF FLOW THROUGH VALVES.
(b) Experimental Engineering Research.
(c) Cooperative study with Taylor Instrument Companies.
(d) J. L. Hill, Jr., Alfred Maurer.
(e) Assistant Professor J. L. Hill, Jr.
(f) To determine the characteristics of double-seated V port valves at various lifts and varying head differentials.
(g) Preliminary work will include tests on 1", 1¼", 1½", 2", 2½", and 3" valves. Valves are set between straight runs of same size pipe, 70 diameters upstream and 30 diameters downstream. Pressure drop across valve measured from 5 diameters upstream to 21 diameters down stream. Corrections made for pipe friction. Head pressure maintained constant by Taylor Fulscope Regulator.

.....(h). Investigations in progress.....

S. MORGAN SMITH COMPANY.

(692) (a) HEAD LOSS, OPERATING TORQUE AND BEARING PRESSURE ON ROTO-VALVE.
(b) Metropolitan Water District of Southern California, Colorado River Aqueduct.
(c) Research.
(d) R. Sahle and testing crew for S. Morgan Smith Company.
(e) Engineering Department, George A. Jessop, Chief Engineer.
(f) To determine the head loss, bearing pressure and the maximum operating torque of a model Roto-valve with a tapered waterway at various plug angles. The valve was tested with both normal and reverse flow conditions.
(g) A model Roto-valve with a tapered plug was placed in a test pipe line connected to a head tank 110 ft high, in which the required head on the valve was maintained. Water was supplied to the head tank by means of centrifugal pumps. The quantity of water passing through the valve was measured by a calibrated Venturi meter. Piezometers were placed around the test pipe some distance upstream, as well as downstream, from the valve plug. The force required to operate the valve was measured with a scale beam and levers. The bearing pressures were taken by means of a floating bearing connected to a pressure piston connected to a pressure pump and pressure gauge. The tests were made with the flow in both directions.
The valve plug was set at various angles and the quantity of flow was changed through it. Differential pressure head, bearing pressure and the required torque to open, close, seat and unseat the valve was determined. Vacuum readings were taken on the downstream side of the plug in partly opened positions. The intensity and extent of the vacuum and its effect on the operation and discharge of the valve was determined.
The same procedure was carried out with a valve having a straight waterway.
(h) Tests are completed.
(i) The information obtained is used to properly design and select Roto-valves and their control mechanisms.

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STEVENS INSTITUTE OF TECHNOLOGY.

(378) (a) THE STUDY OF THE FORCES ACTING ON SAILING YACHTS IN ACTUAL SAILING ATTITUDES.
(b) Experimental Towing Tank, Stevens Institute of Technology.
(c) General scientific research.
(d) Professor Kenneth S. M. Davidson.
(e) Professor Kenneth S. M. Davidson.

(f) To determine the longitudinal resistance of sailing yachts heeled over and moving with leeway as they do under actual sailing conditions.
(g) Observations taken on board ships to determine relation between sail forces, speeds and heel angles. Scale models are towed in the attitudes determined from the full-size observations.
(h) Completed.
(i) Reported in a paper published in Volume 44(1936) of the Transactions of the Society of Naval Architects and Marine Engineers. See abstract in this bulletin.

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(638) (a) TOWING A SPHERE UNDER WATER.
(b) Stevens Institute of Technology.
(c) General scientific research.
(d) Frederick W. S. Locke, Jr.
(e) Professor Kenneth S. M. Davidson.
(f) To determine the critical Reynolds Number for a sphere submerged in water and to investigate the effect on the critical Reynolds Number of surface roughness and time between successive test runs.
(g) Sphere was towed under water in the Experimental Towing Tank.
(h) Test work completed.
(i) Reported in undergraduate thesis on file in library of Experimental Towing Tank, Stevens Institute of Technology.

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(693) (a) INVESTIGATION OF THE EFFECT OF SCALE ON THE RESISTANCES OF SMALL MODELS OF SEAPLANE FLOATS.
(b) Experimental Towing Tank, Stevens Institute of Technology.
(c) General scientific research.
(d) Lyman Middleditch, John O'Boyle, and Burrell Parkhurst.
(e) Professor Kenneth S. M. Davidson.
(f) To determine a method of predicting the hull resistances of seaplane floats from tests of small models.
(g) The method is, in general, to correlate the resistances of a series of geometrically similar models by systematic adjustment of wetted area. Test runs are made at various speeds and trim angles. An upward vertical force is applied to the model to reproduce the wing lift of the full-size seaplane at different speeds.
(h) Tests of smallest model completed.

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THE UNIVERSITY OF TEXAS.

(615) (a) PRESSURE DROP IN NON-ISOTHERMAL FLOW OF LIQUIDS IN BRASS TUBES.
(c) Pure research.
(d) Professor B. E. Short.
(e) Professor B. E. Short.
(f) To check pressure drop data that were obtained for flow around tubes in baffled tube bundles with the liquid being cooled and to determine the possible effect of the Prandtl group on the friction factor.
(g) Pressure drop measurements are being made for different flow rates during both heating and cooling of the liquid. Wide range of flow rates being used and different kinds of liquids being used.
(h) Apparatus has been constructed and a few preliminary tests made with a slight variation in apparatus subsequently made.
(i) (No report furnished for this bulletin.)

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THE TULANE UNIVERSITY OF LOUISIANA.

(463) (a) INVESTIGATION OF HYDRAULIC LOSSES AT PIPE ENTRANCES.
(b) Graduate thesis.
(c) Laboratory research.
(d) John K. Mayer.
(e) Prof. W. B. Gregory.
(f) To determine the variation of the entrance coefficient with (1) Reynolds Number and the wall thickness of the pipe for square-edged cylindric intakes, and (2) with cone length, cone angle, wall roughness and Reynolds number for conical intakes.
(g) Intakes were made of 3/4" and 4" brass pipe and had piezometer connections placed at several points along their length for determining the static pressure by means of a manometer. Entrances were modified by varying the wall thickness for the cylindric intakes and by varying the cone length and angle of truncation for the conical intakes. Runs were made at various velocities for each intake, the entrance coefficient determined and plotted against Reynolds Number. The apparatus used covered a range of Reynolds Number from 10,000 to 700,000.
(h) Study completed. Thesis in the Tulane University library.
(i) The results have been correlated so that the entrance coefficient may be accurately determined for any given set of conditions. Some of the more important conclusions drawn from the results of the study are;
For square-edged Cylindric Entrances:
(1) Pipes of any wall thickness seem to have a common entrance coefficient of 0.25 at a Reynolds Number of 2,000. (2) The entrance coefficient increases from this point as a fractional power of R up to a value of R of about 80,000, beyond which point the rate of increase is much lower.

(3) The entrance coefficient is also dependent upon the ratio of wall thickness to internal diameter for ratios of less than about 0.06; the coefficient increasing and approaching unity as the t/d ratio approaches zero.
For 19° Conical Entrances;
(1) The entrance coefficient is independent of Reynolds Number, except for long cones in which case there is a slight increase as R increases. (2) Truncating the cone at an angle of other than 90° with the cone axis increases the entrance loss considerably and produces less stable flow conditions. (3) A mathematical analysis of the loss in intakes of varying section showed that the losses in conical intakes depends primarily upon the ratio of cone entrance diameter to pipe diameter, if the transition loss at the junction of the cone and pipe is neglected. Cone length and angle have very little effect. The entrance loss decreases rapidly as the cone entrance is enlarged from pipe diameter to three pipe diameters, but beyond this point the change is very slow. Experimental results compared favorably with the computed loss.

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UNION COLLEGE.

(694) (a) AN INVESTIGATION OF FLOW THROUGH NARROW RECTANGULAR SLOTS AND EXTREMELY SMALL RECTANGULAR WEIRS.
(b) General scientific research.
(c) General research.
(d) Professor Robert Abbett.
(e) Professor Robert Abbett.
(f) Investigation of flow characteristics of very narrow rectangular slots and weirs in the effort to determine their efficiency as measuring instruments for small rates of flow. Also an effort is being made to explain the variations in behavior between such small weirs and those having longer crest lengths.
(g) Routine tests have been made on weirs from 1/8 inch to 48 inches in width for heads varying from zero to 12 inches.
(h) Results so far obtained indicate that weirs less than 2 inches wide follow one law of flow, weirs having crest lengths greater than 8 inches follow a different law and that weirs between 2 inches and 8 inches in width lie in a transitory region in which each weir behaves according to its own individual law. Rectangular weirs less than two inches in width seem to have some advantages for measuring small quantities of water since errors in measuring the head have a less pronounced effect than in the case of the triangular weir.

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(695) (a) AN INVESTIGATION OF SPLASH PHENOMENA.
(b) General scientific research.
(c) General research.
(d) Professor Robert Abbett.
(e) Professor Robert Abbett.
(f) To explain the transformation of energy involved in splash caused by falling bodies in water.
(g) Splash patterns have been obtained for falling spheres, and round, square and rectangular plates. Patterns are extremely sensitive to changes in body roughness and fluid viscosity. Experiments are incomplete.

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STATE COLLEGE OF WASHINGTON.

(628) (a) RESISTANCE OF SPECIALLY DESIGNED BENDS FOR 6-INCH PIPE.
(b) (c) Private research in cooperation with Engineering Experiment Station.
(d) E. R. Fosdick.
(e) Professor J. G. Woodburn.
(f) To determine loss of head due to specially-designed 90-degree bends in 6-inch pipe, as compared to loss due to standard cast iron bend.
(g) Piezometers on bend and in approach and discharge pipes were used to measure the loss of head. Discharge was measured over 90-degree V-notch weir.
(h) Tests completed, paper being prepared.
(i) (No report furnished for this bulletin.)

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(629) (a) EFFECT OF LOW ARCH SKEW BRIDGES ON WATER STAGES IN RECTANGULAR FLOOD CHANNELS.
(b) (c) Model studies to supplement computations of channel capacities for Walla Walla Flood Control District.
(d) (e) Prof. F. G. Woodburn.
(f) (g) Models on scale of 1 to 40 of arch skew bridges were inserted into rectangular flume in which water was flowing at velocity and depth proportional to computed velocity and depth in Mill Creek, Walla Walla. Depths of flow after insertion of bridge models were measured and found to agree closely with depths computed by contracted-area method. Changes from shooting to streaming velocity, occurrence of waves at certain stages, and probable location of channel bed erosion were also demonstrated.
(h) Results were incorporated in report to Flood Control District and will be compared with field measurements at first high water.
(i) (No report furnished for this bulletin.)

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(630) (a) STUDIES OF FLOW IN SMALL RECTANGULAR FLUMES.
(b) (c) General departmental research.
(d) Glen Gage and Alex. Hutchison, seniors; and other students.
(e) Professor J. G. Woodburn.
(f) This work is a continuing project with several purposes and phases.
1. Determination of coefficients of retardation and study of their variation with depth of flow.
2. Relation of center surface velocity, as shown by floats, to average velocity in cross-section.
3. Study of critical depth and hydraulic jump in relation to slopes to be avoided because of wavy water surface.
4. Effect of reverse bends on slope of water surface and on deposition of sand.
(g) A wooden flume 30 ft long, 15 in. wide and 10 in. deep was used for preliminary studies. This flume has been replaced by a concrete flume 25 ft long, 10 in. wide, and 10 in. deep. The slope of the flume is adjustable up to 0.01. Flows up to 1 cfs can be provided, with measurement by Venturi Meter.
(h) Studies now in progress.
(i) (No report furnished for this bulletin.)

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UNIVERSITY OF WASHINGTON.

(637) (a) DESIGN AND CONSTRUCTION OF A DIRECTIONAL CURRENT METER.
(c) Laboratory project.
(d) William Morton.
(e) Professor C. L. Utterback.
(f) Investigation of River and Ocean Currents.
(i) (No report furnished for this bulletin.)

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WEST VIRGINIA UNIVERSITY.

(696) (a) EFFICIENCY OF SEDIMENTATION BASINS.
(b) Undergraduate thesis.
(c) Model study of sedimentation basin of Morgantown Water Co. Filtration Plant.
(d) E. R. Benford.
(e) H. W. Speiden, Dept. of Civil Engineering.
(f) To study the methods of determining efficiency of sedimentation basins.
(g) Studied distribution of chlorides in effluents of prototype and model basins. Also the effect of a different baffle arrangement in the model.
(h) Complete.
(i) A copy of the thesis is available for loan at the University Library.
Little or no correlation was found between results on the model and the full sized basins, which may have been due in part to the construction of the model. The flowing-through period as determined by the centroid vertical of the chloride curve was frequently more than the theoretical period.

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WORCESTER POLYTECHNIC INSTITUTE - ALDEN HYDRAULIC LABORATORY.

(647) (a) STUDY OF ELECTRODES FOR SALT VELOCITY METHOD.
(b) Alden Hydraulic Laboratory.
(c) Laboratory research concerning special conditions.
(d) Leslie J. Hooper.
(e) Prof. C. M. Allen.
(f) To determine the distribution of current flow in the field of an electrode for special test conditions.
(g) An A. C. Wheatstone bridge circuit is used to determine the potential field and the flow patt ern about an electrode located in a bath representing the pipe or conduit cross-section.
(h) Apparatus constructed and tests in progress.

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(648) (a) REPRESENTATIVE AMERICAN HYDRAULIC LABORATORIES.
(b) Freeman Scholarship of Boston Society of Civil Engineers and Alden Hydraulic Laboratory of Worcester Polytechnic Institute.
(c) Inspection of about 50 laboratories in the United States and Canada.
(d) Leslie J. Hooper.
(e) Prof. C. M. Allen.
(f) To become acquainted with the present hydraulic laboratory practice in the United States and Canada.
(h) Draft of final report prepared.
(i) Report to be published in the "Journal" of the Boston Society of Civil Engineers.

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(649) (a) PITOT TUBE INVESTIGATIONS, STUDY OF IMPACT ORIFICE OF PITOT TUBES.
(b) Alden Hydraulic Laboratory.
(c) General research.
(d) C. W. Hubbard.
(e) C. M. Allen.
(f) To determine the cause of and evaluate systematic errors in pitot tube measurements, both in smooth and turbulent water.
(g) 1. Calibration of a reference pitot tube on rotating 80 ft boom located on quiet pond. Pitot impact balanced against centrifugal force in radial pipe, allowing error of impact orifice to be measured directly with sensitive U-tube.
2. Study of angularity of turbulent flow in 12" and 40" pipes to determine average angle and its probable effect on impact tip. Tests made with light vane indicator so connected electrically with chronograph that the percent of time the flow angle is less than or greater than some arbitrary angle could be measured. The results when plotted on probability paper indicated values of mean angle.

3. Study of the error in the impact orifice reading caused by presence of supporting rod behind it. Apparatus so arranged that change in distance of rod from tip can be made without changing flow or removing instrument from pipe. This allows direct measurement of change in impact reading with change in position of rod along axis of pipe.
4. Study of effect of supporting rod on reading of wall piezometers. Apparatus so arranged that dummy rod can be rotated about and moved along axis of pipe and its effect on a wall piezometer measured accurately.

(h) 1. Calibration of reference impact tip on rotating boom completed. Coefficient found to be unity with variations in individual runs about 0.1%.
2. Angularity of flow tests partially completed in 12" and 40" pipes.
3. Studies of effect of supporting rod on impact orifice started. Apparatus constructed, but too few results obtained to draw conclusions.
4. Studies of effect of supporting rod on wall piezometers started. Apparatus constructed but insufficient data obtained to draw conclusions.

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(650) (a) HARTFORD MODEL TEST, MODEL TEST OF SPILLWAY CHANNEL.
(b) The Water Bureau, Hartford, Conn.
(c) Commercial research.
(d) Prof. C. M. Allen and C. W. Hubbard.
(e) Prof. C. M. Allen.
(f) To check the office design and make such modifications that the overflow from the spillway of the Barkhamsted Reservoir will flow satisfactorily to the lower level below the dam.
(g) Method was to construct a model of the proposed spillway and channel one-thirtieth full scale. Suitable water supply was available through eight and four inch pipes. Flow measured by model spillway which had been calibrated in previous tests. Model constructed of quick-setting concrete with wood templates to speed up testing. Three changes in design of channel cross-section required before maximum flow which was below critical depth would pass satisfactorily through lower bridge opening.
(h) Completed.
(i) Important feature of designing transition section in channel with steep slope is to lay out transition in planes parallel to channel bottom, not with level contour lines.

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BUREAU OF AGRICULTURAL ENGINEERING, U. S. DEPT. OF AGRICULTURE.

(510) (a) HYDRAULIC JUMP ON SLOPING APRONS. (See also report by Iowa Institute of Hydraulic Research.)
(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. (Deceased since this report was submitted.)
(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 of accomplishing this.
(g) The experiments are being conducted in a flume 30 inches wide equipped with transparent walls. Many pressure and velocity measurements are being taken for various quantities of flow and 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 structures 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) Investigations are now being made.
(i) The theory of the hydraulic jump on sloping aprons has been developed. When the discharge, upstream and downstream depths are increased by the model ratio law, it appears from the limited number of tests so far made that the lengths of the roller and the jump also increase in the same ratio. A progress report on the investigation is now under way.
(No report furnished for this bulletin.)

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U. S. GOVERNMENT LABORATORIES.

CORPS OF ENGINEERS, BONNEVILLE HYDRAULIC LABORATORY.

(567) (a) MODEL STUDIES OF THE BONNEVILLE PROJECT ON THE COLUMBIA RIVER.
(b) United States Engineer Department, Second Portland District, Lieut. Colonel C. F. Williams, District Engineer; Major A. E. McKennott, Chief Engineer; Claude I. Grimm, Head Engineer, Division Office.
(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.

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

(e) United States District Engineer, Second Portland District, Portland, Oregon.

(f) 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 and cavitation prevention, best method of gate operation in the completed dam for cavitation prevention, 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 tailwater and to the sea. Other problems which have been investigated included the navigation lock which will handle seagoing vessels and will have the highest single lift in the world.

(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; however, pure city water is used for the pump models. Seven principal models have been built and operated up to date; other models are under construction at the present time.

The lock model, the spillway model and spillway flume, the gate model, the power house diffusion chamber model, the large river model, together with the description of the experimental work carried out to date have been described in Bulletin IV-1, of this series. (See pages 44 and 45). Additional experiments have been carried out in the spillway flume lately, for further study of the fishway problems.

The river model was used during the first half of 1937 to study a temporary fish ladder at the center of the dam. The gate model was used to determine cavitation due to small inaccuracies in construction of the spillway crest. The 1:36 spillway model was used to determine the discharge curve and discharge coefficients for the final design of the spillway dam.

(h) The Bonneville Hydraulic Laboratory has been in operation for about 3 years. The original experimental program has been completed, but a considerable volume of additional experimental work has developed later. However, the remainder of this work is scheduled to be discontinued.

(i) No detailed reports have been published to date. A few brief articles have appeared in technical periodicals. Information concerning details of the experimental work may be obtained from the District Engineer, U. S. Engineers Office, Second Portland District, Portland, Oregon.

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(621) (a) COLUMBIA RIVER NEAR THREEMILE RAPIDS.
(b) (c) (d) (e) See Project (567) above.
(f) To determine the most satisfactory and the most economical method of improving the stretch of the Columbia River located near The Dalles at the head of the future Bonneville reservoir. This section is approximately 4 miles long and includes Threemile Rapids proper; the flow is extremely turbulent and dangerous, and numerous river boats have been lost or damaged. The purpose of the work is to bring about safer navigation conditions.
(g) A model approximately 70 ft long and 35 ft wide representing about 2 miles of the Columbia River, including Threemile Rapids proper, has been built on a scale of 1:100.
(h) Numerous experiments under natural conditions and with the completed Bonneville Project have been carried out for various flows. The necessary improvements have been determined, and bids will be called on the basis of the experimental work.
(i) A detailed report will be submitted in the near future.

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(624) (a) INVESTIGATION OF 28-INCH DREDGE PUMP.
(b) (c) (d) (e) See Project 567 above.
(f) To analyze the flow conditions and possible wear reduction of the Fort Peck Type.
(g) A 1:6 scale model made out of pyralin and aluminum has been constructed and installed with a new pipeline and tank layout. The model is driven by means of a 15 HP Diehl Dynamometer. A stroboscope and a method of taking stroboscopic motion pictures synchronized with the dynamometer has been developed.
(h) Studies of the operation of the existing design have been completed. An extremely interesting reel of motion pictures including stroboscopic studies of flow conditions within the impeller has been issued. Some tests have been started for the purpose of improving the design to reduce wear.
(i) A detailed report of the work completed was issued in June, 1937.

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(625) (a) STUDIES OF BEDLOAD MOVEMENT.
(b) (c) (d) (e) See Project 567 above.
(f) To extend the range of the existing information concerning the tractive capacity of water for bedload material similar to that found in the bed of the Columbia River.
(g) A flume 6 ft wide, 5 ft deep and approximately 125 ft long has been designed and is now completed. It has a maximum water supply of over 50 cfs: It is provided with a motor-driven sandfeed, weighing apparatus to determine the rate of bedload movement, and mechanical means for returning the sand to the sandfeed.
(h) Experimental work has not been started as yet.

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FOREST SERVICE, UNITED STATES DEPARTMENT OF AGRICULTURE.

California Forest and Range Experiment Station.

(716) (a) WATERSHED MANAGEMENT.
(b) Federal, state and other agencies responsible for the management of watersheds and production of water supplies.
(c) Comprehensive investigation of hydrology, erosion and related studies in mountainous watersheds of California, including laboratory studies at selected field stations and at Berkeley headquarters.
(d) C. J. Kraebel, senior silviculturist in charge of Forest Influences Division of the Experiment Station; J. D. Sinclair, silviculturist in charge San Dimas Experimental Forest; and staff of 24, including foresters, engineers, geologists, botanists and other technicians.
(e) E. I. Kotok, Station Director.
(f) Investigation of the influence of rainfall, (rate, amount, direction and related factors), physiography, vegetative cover and watershed denudation or other treatment upon total water yield and rates of run-off and erosion.
(g) Hydrologic measurements in watersheds of various sizes from 0.06 to 14.1 square miles, under normally vegetated conditions, denuded by fire, or treated otherwise; study of surface run-off and erosion from plots; lysimeter experiments to determine transpiration requirements and effect on percolation rates of various types of vegetation; and studies of meteorological factors, vegetation, geology, and zoology of the watershed areas.

Major work center is San Dimas Experimental Forest, a 17,000-acre tract embracing the entire watersheds of San Dimas and Big Dalton Creeks in Angeles National Forest, 30 miles east of Los Angeles. Research equipment includes; 375 standard and 15 intensity rain gages, 114 lysimeters, 6 climatic stations, 17 concrete stream-gaging stations with flumes, weirs, and recording apparatus, 9 Forest Service dams and 2 large County Flood Control dams for storage and measurement of eroded material from watersheds, 22 small plots for studying surface runoff and erosion, and all necessary administrative improvements such as roads, trails, headquarters buildings (including laboratory), and telephone system.

In Kings River drainage of the southern Sierra Nevada, studies similar to the San Dimas, but on a smaller scale, are now in the construction stage. The Big Creek Unit (elevation 1000 to 2500 feet) comprises small watersheds in woodland-grass type; Teakettle Creek Unit (elevation 6000 to 8000 feet) has three 500-acre watersheds in conifer forest type with precipitation largely in form of snow. Research equipment includes: 4 climatic stations, 95 rain gages, 8 stream-gaging and erosion measuring stations, and the necessary roads, trails and field headquarters buildings.

(h) Collection of records was begun upon completion of each research installation so that from one to three seasons' data have now accumulated. Numerous office progress reports have been completed. Two manuscripts on raingage distribution and precipitation measurement in mountain areas have been prepared for publication. Other papers on plot results, streamflow data, vegetation and animal surveys and other subjects are in preparation.

(i) Investigations expected to continue 30 to 50 years, aiming at the development of methods of watershed management to provide, for any given area, the maximum yield of useful water compatible with satisfactory control of erosion and runoff. Results will be published occasionally as warranted.

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(717) (a) DEVELOPMENT AND RATING OF FLUMES FOR MEASURING DEBRIS-LADEN STREAMFLOW.

(b) San Dimas Experimental Forest.

(c) Experiment Station hydraulics research project.

(d) Dr. H. G. Wilm, associate silviculturist and members San Dimas technical staff.

(e) Director, California Forest and Range Experiment Station, Berkeley, California.

(f) To develop a method of measuring debris-laden streamflow.

(g) Full-scale rating of flumes of several designs with clear water, including study of modifications of the Parshall flume. Measurement of the influence of bedloads on accuracy of these flumes.

Equipment: timber flume structure 235 feet long, 16 feet wide to a control weir and 12 feet wide below, and 6 feet deep; installed below sluice-gates of San Dimas (Los Angeles County) Flood Control Dam and using water from this reservoir in controlled quantities from 0.1 second-foot up to 235 second-feet. The control weir may be set up as a 16-foot suppressed weir or as a 3, 5, or 8-foot contracted weir, by installation of bulkheads and blades on the suppressed weir. Flumes under investigation are installed, 2 at a time in tandem, in the 12-foot flume below the control weir. Water depths over the weir and in the flumes are measured with point gages.

(h) The Parshall flume has been found to function satisfactorily under conditions for which it was designed, viz. with clear or moderately silt-laden flows; bedloads such as occur in high flows from disturbed watersheds cause serious errors in flow measurement. A new type of flume has been designed to function as a broad-crested weir in which water stages are measured downstream of the "critical" section; a "Scobey" cylinder-quadrant transition is employed in place of a bottom contraction. This flume has measured flows containing bed-loads with satisfactory accuracy.

(i) Further work is now under way to perfect the design of this flume, both by model studies in cooperation with the University of California (see below) and by full-scale studies in the San Dimas flume laboratory. Paper accepted for publication in Proceedings American Society of Civil Engineers.

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(718) (a) MODEL STUDIES TO PERFECT THE DESIGN OF THE "SAN DIMAS" FLUME FOR MEASURING DEBRIS-LADEN FLOWS.
(b) Forest Service Experiment Stations and other agencies measuring loaded streamflow.
(c) Hydraulic research project conducted in cooperation with the University of California.
(d) K. J. Bermel, R. L. Stoker and Dr. H. G. Wilm under direction of Professor M. P. O'Brien and C. J. Kraebel.
(e) Director, California Forest and Range Experiment Station, Berkeley, California.
(f) Stated under "a".
(g) Laboratory study of models, using small flumes of various cross-sections and floor slopes, with several types of entrance transitions. Equipment includes an 18 x 24-inch metal and wood flume, handling flows up to 2 second-feet, using venturi meters for measurement of flows.
(h) Models of rectangular and trapezoidal sections completed and 96 runs made. Joint publication planned upon completion of tests.

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U. S. GEOLOGICAL SURVEY.

(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, A. D. Ash,
(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, type of meter, and operation of meter near a vertical wall.
(g) Current-meter measurements are being made in the 12-foot flume at the National Hydraulic Laboratory, National Byreau of Standards, Washington, D. C. These measurements are made in water which will be varied from 0.3 feet 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 coarse gravel.

The discharge of the flume as measured by a weir or Venturi meter, 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) The experimental work in the various channel conditions of smooth concrete, 3/4 inch gravel, and coarse gravel has been completed and the computations and interpretations of the results obtained by the current-meter measurements are now being made.

(i) As the results of this investigation are expected to be used in the interpretation of current-meter measurements of natural streams where the width of channel is, in most cases, much greater than the width of the flume in the laboratory, special efforts are being made to eliminate uncertainties in regard to the manner in which the current meter is affected by conditions other than the flowing water and the flume bed.

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(618) (a) A NEW METHOD OF DETERMINING THE PERMEABILITY, SPECIFIC YIELD, AND ELASTICITY OF WATER-BEARING MATERIALS.

(b) United States Geological Survey, Water Resources Branch.

(c) General Scientific Research.

(d) C. V. Theis, assisted by T. W. Robinson and H. A. Waite.

(e) C. V. Theis, 309 Federal Building, Albuquerque, New Mexico.

(f) The purpose of this study is to establish the relation of the lowering of the piezometric surface and its recovery, to the rate and duration of discharge of a well that is supplied from ground-water storage. It is hoped that this study will lead to the development of a new practical method of determining permeability and specific yield.

(g) A paper published in the 1935 Transactions of the American Geophysical Union, pages 519-524, investigates in part the nature and consequence of a mathematical theory that considers the motion of ground water before equilibrium is reached and as a consequence involves time as a variable. An equation is derived showing the relationship between the period and rate of discharge of the well, and the drawdown, permeability and specific yield. A corollary equation gives the relation of the above factors to the rate of recovery of the water level in a pumped well, and makes it possible to compute the permeability of the aquifer from observations of the rate of recovery.

(h) Observations have been made on a number of artesian and water-table wells in the San Luis Valley, Colorado, and in the Mimbres Valley, N. Mex.

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(619) (a) A COMPARATIVE INVESTIGATION OF SEVERAL METHODS OF DETERMINING PERMEABILITY OF WATER-BEARING MATERIALS.
(b) United States Geological Survey, Water Resources Branch.
(c) General scientific research.
(d) R. M. Leggette, assisted by C. E. Jacob and M. L. Brashears, Jr.
(e) R. M. Leggette, 226 Post Office Building, Jamaica, L.I., New York.
(f) A comparative investigation of several methods of determining permeability of water-bearing materials.
(g) The investigation is being made in Croton Valley near Ossining, New York. Several observation wells have been constructed and water-level measurements are being regularly made as a preliminary to the tests.

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(620) (a) INVESTIGATION OF THE EFFECT OF REFORESTATION ON STREAMFLOW.
(c) Cooperative between the U. S. Geological Survey and the New York State Department of Conservation.
(d) Arthur W. Harrington and assistants.
(e) Arthur W. Harrington, District Engineer, Water Resources Branch, U. S. Geological Survey, Albany, N. Y.
(g) Complete hydrologic studies will be made of several reforested and non-reforested areas over a long period of time.
(h) Project is still in its preliminary stage, but continuous records of precipitation, runoff, ground-water elevations, temperature and humidity are being collected on three small reforested areas in Central New York.
(i) (No report furnished for this bulletin.)

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(697) (a) STUDY OF INTAKES FOR GAGE WELLS.
(b) United States Geological Survey, Water Resources Branch.
(c) Tests of intakes of various forms in different velocities of flowing water, needed for intake design and for hydraulic research.
(d) W. S. Eisenlohr, Jr.
(e) C. H. Pierce, U. S. Geological Survey, Washington, D. C.
(f) To ascertain the essential factors relating to the design of intakes and to perfect a design that will maintain the water surface in the gage well at the same height above gage datum as the water surface in the river at the outer end of the intake pipe.
(g) Tests will be made of 1/8-scale models in the 20-inch flume at the National Hydraulic Laboratory, National Bureau of Standards, Washington, D. C. Subsequent tests of a few full-size models will be made in the 12-foot flume for comparison with results obtained with the 1/8-scale models.

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U.S.DEPARTMENT OF THE INTERIOR, National Park Service.

(698) (a) SUB-SURFACE FLOW INVESTIGATION.
(b) The National Park Service.
(c) Study of character of flow through soil with respect to both its rate as affecting storage losses and its effect upon the competency of structures and embankments.
(d) Branch of Engineering, National Park Service.
(e) Oliver G. Taylor, Chief Engineer, National Park Service, E. F. Preece, Asst. Chief Engineer, Director of Engineering Laboratory.
(f) For the design of dams, embankments, and foundations.
(g) Model studies by means of flume and soil mechanics apparatus.
(h) Comparative series of tests to determine effectiveness of various design elements partially completed. Preparations being made to determine character of flow to drain lines, particularly with respect to drainage systems for relatively flat areas, for slopes and pressure relief drains in connection with earth and masonry dams.
(i) There are no provisions for publishing the data which are collected, but, within the limits of stenographic help, they are available to anyone interested at any time.

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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 this Bulletin for April 1933.
(h) Completed. Reports in preparation. See also this bulletin for January, 1937, in regard to partial reports.

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(399) (a) MOON LAKE DAM SPILLWAY AND OUTLET WORKS.
(b) (c) (d) (e) (f) (g) See this bulletin for January, 1936.
(h) Completed. Reports in progress. See also this bulletin for January, 1937, in regard to partial reports.

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(547) (a) HYDRAULIC EXPERIMENTS FOR THE DESIGN OF THE GRAND COULEE DAM.
(b) (c) (d) (e) (f) See this bulletin for January 1, 1937.
(g) Models of spillway bucket tested at three scales; model of partially constructed dam at various stages and with alternate diversion sequences to determine the best procedure for avoiding adverse erosion of the river bed. The sluice entrance tests were made at a specially constructed orifice aperture in a pressure tank. Accurate jet contraction measurements and velocity traverses have been made. Testing of the sluiceways is practically completed.
(h) All tests completed except those on sluiceway. Reports are in preparation. Also see paper "Experiments Aid in Design at Grand Coulee", by J. E. Warnock in Civil Engineering, November, 1936.

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(548) (a) IMPERIAL DAM AND ALL-AMERICAN CANAL TESTS.
(b) (c) (d) (e) (f) (g) See this bulletin for January 1, 1937.
(h) Studies of the models of the headworks conducted at the Montrose laboratory, and work on the "influent slots" for the desilting works have been completed. Testing has also been completed on the New River inverted siphon crossing and wasteway, Pilot Knob Wasteway, and the canal drops Nos. 1 and 4. Testing is now in progress on the following All-American Canal structures: Siphon Turnout, canal drops 2 and 3, an automatic radial gate to be used on All-American Canal structures, and on a 1:6 model of an ejector to be installed in the bucket of the Imperial Dam for evacuating the seepage water from within the dam. Available for loan, "Preliminary Report on Model Studies of Influent Slots in All-American Canal Desilting Works" by F. R. Cline. See also abstract in this bulletin. Other reports are in preparation. (i) Work concerned primarily with testing of gate structures and stilling pools.

(549) (a) CABALLO DAM OUTLET WORKS AND SPILLWAY.
(b) (c) (d) (e) (f) (g) See this bulletin for July, 1936.
(h) Report in preparation.

(550) (a) BULL LAKE OUTLET WORKS.
(b) (c) (d) (e) (f) (g) See this bulletin for July, 1936.
(h) Completed Report "Hydraulic Model Experiments for the Design of the Bull Lake Outlet Works" by J. M. Buswell and D. C. Weed should be on file at the Denver Public Library by August, 1937. See also abstract in this bulletin.

(551) (a) MORMON FLAT SPILLWAY.
(b) (c) (d) (e) (f) (g) See this bulletin for July, 1936.
(h) Completed report in preparation.

(552) (a) HORSE MESA SPILLWAY.
(b) (c) (d) (e) (f) (g) See this bulletin for July, 1936.
(h) Completed. Report in preparation.

(553) (a) ALAMOGORDO SPILLWAY.
(b) (c) (d) (e) (f) (g) See this bulletin for July, 1936.
(h) Completed. Report in preparation.

(554) (a) BARTLETT SPILLWAY.
(b) (c) (d) (e) (f) (g) See this bulletin for July, 1936.
(h) Completed. Report in preparation.

(555) (a) ROOSEVELT SPILLWAYS.
(b) (c) (d) (e) (f) (g) See this bulletin for July, 1936.
(h) Completed. Report in preparation.

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(556) (a) STEWART MOUNTAIN SPILLWAY.
(b) (c) (d) (e) (f) (g) See this bulletin for July, 1936.
(h) Completed. Report in preparation.

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(558) (a) FRIANT OUTLET WORKS.
(b) (c) (d) (e) (f) (g) See this bulletin for July, 1936.
(h) Kern County Canal tests completed. Report in preparation. Tests on Madera Canal Outlets contemplated in the near future.

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(559) (a) FRESNO DAM SPILLWAY (Montana)
(b) (c) (d) (e) (f) (g) See this bulletin for July, 1936.
(h) Testing in progress.

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(560) (a) NEEDLE VALVE AND RING-FOLLOWER AND CYLINDER-FOLLOWER GATE CHARACTERISTICS.
(b) (c) (d) (e) (f) (g) See this bulletin for July, 1936.
(h) Completed. Report "Tests on Model Gate Outlets" by N. Noonan and G. J. Hornsby on file in the Denver Public Library. See also Abstract in this bulletin.

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(571) (a) GIBSON SPILLWAY.
(b) (c) (d) (e) (f) (g) See this bulletin for January, 1937.
(h) Completed. Report in preparation.

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(572) (a) UNITY DAM SPILLWAY.
(b) (c) (d) (e) (f) (g) See this bulletin for January, 1937.
(h) Completed. Report in preparation.

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(699) (a) MARSHALL FORD DAM SPILLWAY.
(b) Colorado River, Texas.
(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 designs of overfall section, Sluiceways and stilling pool.
(h) Testing in progress.

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(700) (a) PARKER DAM.
(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 test large stoney gates for vibration.
(g) Model test. One gate was constructed to scale in weight and dimension and observations taken for the various conditions under which it will be required to operate.
(h) Tests completed on original model. Further tests under consideration. Available for loan "Progress Report on Parker Dam Gate Tests - Vibration Studies", Dr. V. L. Streeter. See also "Abstracts of Completed Projects" at the end of this bulletin.

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(701) (a) GRASSY LAKE 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 develop satisfactory stilling pool design and approaches.
(g) Model test. Observation of hydraulic jump and extent of erosion.
(h) Completed. Report in preparation.

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(702) (a) SEMINOE DAM OUTLET WORKS.
(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 eliminate negative pressures in the sluiceways and to evolve a satisfactory stilling pool for dissipation of the energy from the outlet needle valves.
(g) Model tests. Piezometers are used in developing the shape of sluiceway entrances. The stilling pool is being designed from observation of the hydraulic jump and comparison of erosion effects.
(h) Testing in progress.

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(703) (a) VALLECITO DAM SPILLWAY.
(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 check hydraulic design of gate section, chute and stilling pool.
(g) Model tests. Observation of flow.
(h) Testing in progress.

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(704) (a) BOCA DAM SPILLWAY.
(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 check the hydraulic design of the gate section, chute and stilling pool.
(g) Model tests. Observation of flow throughout structure.
(h) Tests completed. Report in preparation.
(i) A new type of sill which appears to have some constructional and hydraulic advantages over the Rehbock sill was developed.

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NATIONAL BUREAU OF STANDARDS, National Hydraulic Laboratory.

(42) (a) INVESTIGATION OF THE PHYSICS OF PLUMBING SYSTEMS.
(b) National Bureau of Standards.
(c) General research.
(d) R. B. Hunter, G. E. Golden, L. O. Olsen.
(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 venting.
(g) It is proposed to collect and correlate as far as possible existing data on these subjects and to make such supplementary experiments as may be necessary to meet the purpose of the investigation.
(h) A paper giving the results of the study of back-siphonage in plumbing systems has been prepared and will be published at an early date, probably in the Journal of Research, National Bureau of Standards.
Experimental work on the capacities of plumbing drains is now in progress.

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(43) (a) INVESTIGATION OF PIPE BENDS.
(b) National Bureau of Standards.
(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 are planned on smooth and rough pipe bends of various diameters and central angles; and on miter bends and cast fittings.

(h) A paper on tests of 4-inch steel pipe with 90 degree bends of radii varying from 6 inches to 7 feet is being prepared.

Apparatus and materials are being assembled and installation will begin shortly, of a set-up for tests on 1-inch pipe coils of one to ten or twelve turns and radii up to about 4 feet, for tests on bends of very long radii of pipe up to 2 inches in diameter, and tests of fittings such as elbows and tees of sizes up to 2 inch.

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(171) (a) INVESTIGATION OF THE PRESSURE VARIATIONS ON THE UPSTREAM AND DOWNSTREAM SIDES OF AN ORIFICE PLATE OR FLOW NOZZLE.
(b) Scientific data, National Bureau of Standards.
(c) National Bureau of Standards research.
(d) H. S. Bean, F. C. Morey, W. G. Wagner.
(e) The Director, National Bureau of Standards.
(f) To obtain more complete data than are now at hand on the variations of pressure in the vicinity of an orifice plate or flow nozzle, which will assist in better correlation of orifice coefficient data, and the selection of the suitable pressure tap locations for use with flow nozzles.
(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 completed on 3 flow nozzles in 4-inch pipe.
(i) It is possible the same set-up will be used later for similar tests using air in place of water. Work on this project is now being carried on in conjunction with project (496).

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(258) (a) STUDY OF DIVISORS FOR SOIL EROSION INVESTIGATIONS.
(b) Soil Conservation Service, U. S. Department of Agriculture.
(c) Data for calibration and design.
(d) H. L. Cook, D. A. Parsons, F. W. Blaisdell, 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 all of the old types of divisors that have been in extensive use or that appeared to have the desired qualifications. Thus far, the Geib multislot divisors have given the best results. Plans and specifications for these have been prepared.
(i) Further work will be confined principally to the development of divisors having greater capacities than those previously studied.

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(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, D. A. Parsons, 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) A considerable number of flumes of different design have been built and tested with clear water. Plans have been made for several types to be constructed and used in field trials.

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(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) 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) Experimental work has been completed, and the report is being written.

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(343) (a) FRICTION LOSSES IN STRAIGHT PIPES.
(b) National Bureau of Standards.
(c) General research.
(d) K. H. Beij, G. H. Koulegan.
(e) The Director, National Bureau of Standards.
(f) Study of hydraulic roughness in pipes.
(g) Correlation of friction losses with surface characteristics of pipes.
(h) A critical review of previous work has been completed, and the results are being prepared for publication.
(i) This investigation is carried on in connection with other projects as the opportunity offers.

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(384) (a) TESTS OF SPILLWAY FLASHBOARD PINS.
(b) U. S. Forest Service.
(c) Cooperative project with the U. S. Forest Service for testing field designs under simulated field conditions in the laboratory.
(d) C. A. Wright (National Bureau of Standards). C. A. Betts (U.S.Forest Service.)
(e) The Director, National Bureau of Standards.
(f) To test spillway flashboard pins to failure under pressure due to static and overflowing water and also in a mechanical testing machine. The results are to be compared with values used in the 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) A comprehensive report upon the results of the investigation has been completed and is available for loan.
(i) A more general paper including the laboratory results, as well as methods of field construction and tests in service, is being prepared for submission to the American Society of Civil Engineers for publication in the Proceedings.

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(496) (a) DETERMINATION OF DISCHARGE COEFFICIENTS OF FLOW NOZZLES: Cooperative research sponsored by A.S.M.E. Special Research Committee on Fluid Meters.
(b) Factors for use in commercial measurement of fluids.

(c) Cooperative research sponsored by A.S.M.E. Special Research Committee on Fluid Meters, with cooperation of the National Bureau of Standards, University of California (Project 280), Ohio State University (Project 536), University of Oklahoma (Project 617), Cornell University (Project 587), Massachusetts Institute of Technology.
(d) H. S. Bean, F. C. Morey, W. G. Wagner.
(e) The Director, National Bureau of Standards.
(f) To determine discharge coefficients for "long-radius" flow nozzles; to determine the most satisfactory location for pressure holes; to check, compare and correlate American (U.S.) and European designs and practices.
(g) Tests are being made on nozzles in 2, 3, 4, 8, and 16-inch pipes, with oil, water, steam and air. Each nozzle used in this project is to be tested with two or more fluids in two or more of the laboratories listed.
(h) Test program about 1/3 completed.
(i) Program will require two or three years to complete.

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(497) (a) METHODS FOR SAMPLING AND ANALYZING SOIL-WATER MIXTURES.
(b) Soil Conservation Service, U. S. Department of Agriculture.
(d) H. L. Cook, D. A. Parsons, J. O. Laws, S. R. Kline, E. P. Deatrick.
(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 use and others that may suggest themselves will be used on synthetic mixtures of various concentrations of soils.
(h) Tests have been made of several sample splitters of the Uhland-Woodruff type to aid in the design of a useful instrument. A promising column sampler has been built but not yet thoroughly tested. Methods of analysis were given further study.

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(564) (a) DENSITY CURRENTS. (Title formerly "Currents in lakes and reservoirs".)
(b) National Bureau of Standards.
(c) General research.
(d) B. H. Monish, G. H. Keulegan, H. N. Eaton.
(e) The Director, National Bureau of Standards.
(f) To determine the laws governing and permitting the movement of a current of fluid relative to a body of fluid of different density.
(g) A current of clear water in a rectangular glass-walled closed channel is caused to flow over a salt solution of greater density situated in a depression in the floor of the channel. Relative velocity, velocity distribution and turbulence are indicated by the use of dyes and observed through the glass walls. Samples of fluids for density determinations are siphoned off by a tube inserted through the top of the channel.

(h) Tests were made using both dissociating and non-dissociating salts to form solutions whose densities ranged from 1.02 to 1.08. A definite relation was found to exist between the density of the water, the difference in density of the two liquids, the kinematic viscosity and the velocity of flow when mixing began to take place. The apparatus is being rebuilt, and a second apparatus geometrically similar, but one-half size, is being constructed as an aid in determining scale effect.

A progress report is being prepared, copies of which will be available for loan.

(i) See report of National Research Council Interdivisional Committee on Density Currents, in this bulletin.

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(616) (a) FLOW IN OPEN CHANNELS.
(b) National Bureau of Standards.
(c) General research.
(d) G. H. Keulegan.
(e) The Director, National Bureau of Standards.
(f) To investigate the phenomena of open channel flow in the light of modern concepts of turbulent flow. This will involve a study of the dependence of the hydraulic friction factor on the cross-section of the channel and on the roughness of its surfaces, the apparent friction of the free surface and the depression of the filament of maximum velocity.
(g) The first step has been to review critically Bazin's work in open channels. This has involved a study of the utility of von Kármán's velocity distribution law when applied to wavy and to rough surfaces. Future aspects of the investigation will include an experimental investigation of flow in channels having triangular cross-sections with included angles ranging from 22.5° to 135° and with different roughness characteristics. The friction characteristics of the rough surfaces will be determined by means of tests in closed channels having the same surface.
(h) The investigation of Bazin's data has given a positive result, in the sense that it has established the significance and limitation of the hydraulic radius, the equivalent sand roughness for some of the surfaces used, a rational basis for Manning's formula and the relation existing between the relative equivalent sand roughness and Manning's "n". A paper giving the results of this study is in process of preparation.

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(705) (a) MODEL STUDIES, SAVAGE RIVER DAM.
(b) The District Engineer, U. S. Engineer Office, Washington, D.C.
(c) Study of performance of side-channel spillway around a proposed earth dam.
(d) C. A. Wright, for the National Bureau of Standards, E. P. Fortson, E. P. Tippetts, and B. W. Steele, for the U. S. Engineer Office.
(e) The District Engineer, U. S. Engineer Office, Washington, D.C.

(f) To determine special features of the design, such as spillway coefficient, capacity of side channels, characteristics of flow in upper and lower parts of steep spillway channel, and scouring at toe of earth dam.

(g) An undistorted model to a scale of 1 to 60 has been constructed. The approach topography was made of cement mortar in a sheet iron tank, and the spillway crest was machined out of paraffin supported by cement mortar in a steel angle. The spillway channel was constructed of sheet metal alongside the tank to a slope of 5 percent at the crest and 20 per cent below. The upper channel is 50 feet wide at the bottom, 40 feet below, with side walls sloping at 1/4 to 1. A shallow bucket was provided at the lower end of the channel, and the channel was curved into the river bed below the toe of the earth dam. The water was supplied by a pump and measured with a venturi meter. Hook and point gages were used for measuring the headwater level and channel profiles respectively. The tailwater was set by a needle gate, and scour in the sand bed measured by a special point gage. The sand bed was placed in a shallow tank and extended about 800 feet down-stream from the dam.

(h) Observations were made of the effect of the position of the crest with respect to the spillway channel axis, crests designed for 70,000 and for 60,000 cfs, various changes in shape of spill-way channel and the effect of various tailwater elevations. Water surface profiles were taken at 100 foot stations along the channel for discharges of 25,000, 50,000, and 70,000 cfs. Spillway coefficients were determined for field discharges ranging from 10,000 to 80,000 cfs.

(i) The tests served to determine essential features of the design which had to be completed by a certain date.

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(706) (a) STUDY OF CONTROLS FOR THE MEASUREMENT OF RUN-OFF FROM SMALL WATERSHEDS.

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

(c) Development and calibration under various channel and flow conditions.

(d) D. B. Krimgold, A. N. Huff.

(e) Chief, Soil Conservation Service.

(f) Development and calibration of dependable controls for the measurement of flows from small agricultural areas.

(g) Models are being rated for various up-stream and down-stream conditions.

(h) Several one-tenth scale models have been tested in the horizontal position. One has also been tried in an inclined position.

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(707) (a) DEVELOPMENT OF ARTIFICIAL RAINFALL APPARATUS.
(b) Soil Conservation Service, U. S. Department of Agriculture.
(d) H. L. Cook, V. J. Palmer, V. D. Young, D. A. Parsons.
(e) Chief, Soil Conservation Service.
(f) Development and study of the methods of use of an apparatus for the production of artificial rain of uniform distribution and controllable intensity.
(g) A comprehensive study of the past work in this field will be made. Some of the old devices and new ones will be built and tested. A study of spray nozzle discharges and distribution patterns will be made.
(h) A portable rain apparatus similar to one previously used has been constructed and distribution tests begun.

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TENNESSEE VALLEY AUTHORITY.

(494) (a) PICKWICK LANDING DAM, SPILLWAY DESIGN.
(b) Tennessee Valley Authority.
(c) Investigation of stilling basin and shape of crest for Pickwick Landing Dam.
(d) Laboratory staff under direction of G. H. Hickox.
(e) A. S. Fry, Head Engineer, Tennessee Valley Authority, Knoxville, Tennessee.
(f) To determine a satisfactory and economical design of apron below the dam in order to dissipate energy, and to determine the best shape of spillway crest.
(g) Tests made on models built to three different scales. Action of stilling basin for 1:50 and 1:25 sectional models observed through glass panels in side of flume. Results checked on 1:100 model of entire dam. Discharge coefficients, pressures on face of spillway, and on spillway gate piers for various combinations of gate operation were carefully measured on a 1:25 model. Supplementary studies were also made to determine the size of air passages necessary for satisfactory aeration of the nappe.
(h) Tests completed.
(i) Report in progress.

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(495) (a) PICKWICK LANDING DAM, COFFERDAMS.
(b) Tennessee Valley Authority.
(c) Investigation of effect of cofferdamming and construction operations on river regimen.
(d) Laboratory staff under direction of G. H. Hickox.
(e) A. S. Fry, Head Engineer, Tennessee Valley Authority, Knoxville, Tennessee.
(f) To determine the effect of proposed cofferdams and dredging operations during construction on river stages, navigation, and scour; to determine the allowable constriction of the river channel by cofferdams in each of the various stages of construction.

(g) A model of 9000 feet of the Tennessee River including the dam site was built to a scale of 1:100. 3800 feet of the channel at the site was formed in fine sand in order to investigate scouring conditions. Scale models of all proposed construction features such as coffordams, lock, power house, and spillways were put in place to simulate various proposed phases of construction, and the effects on the river were observed in order to determine the best sequence of operations.
(h) Tests completed.
(i) Report in progress.

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(573) (a) GUNTERSVILLE LOCK, NAVIGATION STUDIES.
(b) Tennessee Valley Authority and Corps of Engineers, U. S. Army.
(c) Investigation of navigation conditions at entrance to Guntersville Lock.
(d) Laboratory staff under direction of G. H. Hickox.
(e) A. S. Fry, Head Engineer, Tennessee Valley Authority, Knoxville, Tennessee.
(f) To determine the proper location of lock, and length and angle of guide walls to give good navigation conditions in the neighborhood of the lock.
(g) Tests were made on a model built to a scale of 1:150. About one and one-half miles of river channel are included. Navigation conditions were studied by observation of the river currents and by operation of model barges through the lock. Conditions during construction were studied, as well as the final design.
(h) Tests completed.
(i) Report in progress.

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(574) (a) HIWASSEE DAM, SPILLWAY DESIGN.
(b) Tennessee Valley Authority.
(c) Investigation of stilling basin and spillway discharge coefficients for Hiwassee Dam.
(d) Laboratory staff under direction of G. H. Hickox.
(e) A. S. Fry, Head Engineer, Tennessee Valley Authority, Knoxville, Tennessee.
(f) To determine the most satisfactory and economical design of stilling basin at the toe of the dam, and to measure spillway discharge coefficients.
(g) Tests were made on a 1:55 scale model placed behind a glass panel to allow visual observation of erosion in the bed below the stilling basin.
(h) Tests completed.
(i) Report in progress.

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(575) (a) SWAN LAKE MODEL EXPERIMENT.
(b) Tennessee Valley Authority.
(c) Study of effect of closing a small bridge in a long embankment crossing a wide river valley.
(d) Laboratory staff under direction of G. H. Hickox.
(e) A. S. Fry, Head Engineer, Tennessee Valley Authority, Knoxville, Tennessee.
(f) To investigate the direction and velocity of currents along the embankment of the Southern Railway due to closing the bridge across Swan Lake, near Decatur, Alabama.
(g) A model of the flood plain and river channel of the Tennessee River near Decatur, Alabama, was built to scales of 1:400 horizontal and 1 to 100 vertical. After verification, it was operated with the proposed changes in the railway embankment. The magnitude and direction of the resulting currents were recorded, as well as the changes in water surface elevation.
(h) Tests completed.
(i) Report in progress.

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(576) (a) UPPER CHICKAMAUGA POOL, NAVIGATION EXPERIMENT.
(b) Tennessee Valley Authority and Corps of Engineers, U. S. Army.
(c) Investigation of navigation conditions in the upper reach of the Chickamauga pool as influenced by the proposed Watts Bar Lock and dam.
(d) Laboratory staff under direction of G. H. Hickox.
(e) A. S. Fry, Head Engineer, Tennessee Valley Authority, Knoxville, Tennessee.
(f) To determine the best location of lock and arrangement of guide and guard walls, also the best method of operating spillway gates, with relation to navigation through the lock.
(g) Tests were made on a 1:150 scale model. About one-half mile of channel above the dam and one mile below were included. Velocities and directions of currents were observed visually and recorded photographically. Model barges were operated in the vicinity of the lock and their motion recorded by motion pictures.
(h) Tests completed.
(i) Report in files of Tennessee Valley Authority.

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(577) (a) HEAD INCREASER FOR POWER HOUSE.
(b) Tennessee Valley Authority.
(c) Investigation of a combined spillway and power house unit whose object is increasing the effective head on the turbines by a reduction of tailwater depth over the draft tubes. This is to be accomplished by the formation of a hydraulic jump, using the spillway discharge.
(d) Laboratory staff under the direction of G. H. Hickox.
(e) A. S. Fry, Head Engineer, Tennessee Valley Authority, Knoxville, Tennessee.

(f) To determine the possibility of the proposed unit for installation at dams on the Tennessee River.
(g) Tests are being made on a 1:50 scale model. Provision is made for changing the proportions and dimensions of the spillway sluices, draft tube, and tailrace. Transparent sections permit visual observation of flow conditions.
(h) Tests are under way.

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(708) (a) GUNTERSVILLE DAM SPILLWAY DESIGN.
(b) Tennessee Valley Authority.
(c) Investigation of stilling basin for Guntersville Dam.
(d) Laboratory staff under direction of G. H. Hickox.
(e) A. S. Fry, Head Engineer, Tennessee Valley Authority, Knoxville, Tennessee.
(f) To determine a satisfactory and economical design of apron below the dam for dissipation of energy and prevention of bed erosion.
(g) Tests are being made on a L;25 scale model of 3 spillway gates. Action of the stilling basin may be observed through glass panels in side of flume.
(h) Tests under way.

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(709) (a) CHICKAMAUGA DAM, SPILLWAY DESIGN.
(b) Tennessee Valley Authority.
(c) Investigation of stilling basin for Chickamauga Dam.
(d) Laboratory staff, under direction of G. H. Hickox.
(e) A. S. Fry, Head Engineer, Tennessee Valley Authority, Knoxville, Tennessee.
(f) To determine a satisfactory and economical design of apron below the dam for dissipation of energy and prevention of bed erosion.
(g) Tests are being made on a 1:25 scale model of 3 spillway gates. Action of the stilling basin may be observed through glass panels in side of flume.
(h) Tests under way.

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(710) (a) CHICKAMAUGA DAM, COFFERDAM.
(b) Tennessee Valley Authority.
(c) Investigation of effect of cofferdamming and construction operations on river regimen.
(d) Laboratory staff under direction of G. H. Hickox.
(e) A. S. Fry, Head Engineer, Tennessee Valley Authority, Knoxville, Tennessee.
(f) To determine the effect of proposed cofferdams and dredging operations during construction on river stages, velocities, and scour; to determine the allowable constriction of the river channel by cofferdams in the various stages of construction.
(g) A model of about 2 miles of the Tennessee River at the site of Chickamauga Dam was formed infine sand at a scale of 1:110 in order to investigate scouring conditions. The bed was paved with concrete to measure velocities and backwater effects. Scale models of proposed construction features such as cofferdams, locks, and spillways, were installed to simulate various phases of construction.
(h) Tests under way.

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U. S. WATERWAYS EXPERIMENT STATION

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

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(59) (a) LEVEE SEEPAGE.
(b) Mississippi River Commission.
(c), (d) and (e) See (52).
(f) Study and observe hydraulic gradient and flow lines in levees and models of levees of standard sections of various materials placed by various methods.
(g) Loop of levees, standard section, 10 feet high, of various materials and placed in various ways, kept full; measurements taken.
(h) Study inactive at present.

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(91) (a) MISSISSIPPI RIVER MODEL NO. 4 - INCLUDING THE MISSISSIPPI RIVER FROM MILE 560 TO MILE 655 BELOW CAIRO.
(b) Mississippi River Commission.
(c) (d) and (e) See (52).
(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) Model scales: 1 to 1,000 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.

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(92) (a) MISSISSIPPI RIVER MODEL NO. 5 - INCLUDING THE MISSISSIPPI RIVER FROM MILE 650 TO MILE 762.5 BELOW CAIRO.
(b) Mississippi River Commission.
(c) (d) and (e) See (52).
(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 1,000 horizontal and 1 to 100 vertical; movable bed.
(h) Model temporarily inactive.
(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.

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(153) (a) ARTICULATED CONCRETE MATTRESS STUDY.
(b) U. S. District Engineer, Memphis, Tennessee.
(c) (d) and (e) See (52).
(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.

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(163) (a) MISSISSIPPI RIVER MODEL NO. 1, INCLUDING THE MISSISSIPPI RIVER FROM MILE 390 TO MILE 810 BELOW CAIRO, THE RED RIVER FROM ITS MOUTH TO MILE 33 ABOVE BARBRE LANDING, AND THE ATCHAFALAYA RIVER FROM ITS HEAD TO MILE 35 BELOW BARBRE LANDING.
(b) Mississippi River Commission.
(c) (d) and (e) See (52).
(f) Miscellaneous problems affecting water surface elevations within the limits specified in (a). Problems studied: Ten proposed Cut-offs, Leland and Tarpley Neck Cut-offs, Brunswick levee Extensions, Natchez Levee Set-back, and Enlargement of the Atchafalaya River.
(g) Model scales 1 to 2,400 horizontal and 1 to 120 vertical; fixed bed.
(h) Model temporarily inactive.
(i) Results of several studies are described in Technical Memoranda Nos. 25, 25-A, 25-B, 25-C, 25-D, 34, 34-2, 50-1, 50-2, U. S. Waterways Experiment Station.

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(168) (a) HEAD OF PASSES, MISSISSIPPI RIVER.
(b) U. S. District Engineer, 1st N. O. District, New Orleans, La.
(c) (d) and (e) See (52).
(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) Report is contained in Technical Memoranda Nos. 46-1, 2, 3, 4, 5, 6, 7, 8, 46-S1 and S2.

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(170) (a) MISSISSIPPI RIVER MODEL NO. 2, INCLUDING THE MISSISSIPPI RIVER FROM MILE 370 TO MILE 445 BELOW CAIRO, 60 MILES OF THE ARKANSAS RIVER, AND 16 MILES OF THE WHITE RIVER.
(b) Mississippi River Commission.
(c) (d) and (e) See (52).
(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 1,000 and 1 to 100; fixed bed.
(h) Model temporarily inactive.
(i) Results of this study are described in Technical Memorandum No. 51-1.

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(198) (a) FITLER BEND, MISSISSIPPI RIVER.
(b) Mississippi River Commission.
(c) (d) and (e) See (52).
(f) Study for improvement of navigation and miscellaneous hydraulic problems.
(g) Model scales 1 to 500 and 1 to 150; movable bed.
(h) Temporarily inactive.
(i) Results to date of this study are described in Technical Memorandum No.56-1.

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(253) (a) CAT ISLAND, MISSISSIPPI RIVER.
(b) U. S. District Engineer, Memphis, Tennessee.
(c) (d) and (e) See (52).
(f) Study of proposed regulating works.
(g) Movable bed model from Mile 241.2 to Mile 275.0 below Cairo. Model scales 1 to 1,000 horizontal and 1 to 125 vertical.
(h) Completed.
(i) Report included in Technical Memorandum No. 63-1, U. S. Waterways Experiment Station.

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(256) (a) MISSISSIPPI RIVER MODEL NO. 3 - INCLUDING THE MISSISSIPPI RIVER FROM MILE 486 TO MILE 531 BELOW CAIRO.
(b) Mississippi River Commission.
(c) (d) and (e) See (52).
(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 1,000 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.

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(257) (a) DIRECTIVE ENERGY STUDY.
(b) Mississippi River Commission.
(c) (d) and (e) See (52).
(f) Experiments to determine relations between length of tangent, length of pool, total length, slope, and bed material of rivers.
(g) Outdoor flume, 50 feet x 15 feet with movable bed, being used.
(h) Model temporarily inactive.
(i) Results of experiments to date are included in Technical Memoranda Nos. 61-1, -2, -3, -4, U. S. Waterways Experiment Station.

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(409) (a) STUDIES OF PIPE LINE MIXERS.
(b) The District Engineer, U. S. Engineer Office, Memphis, Tenn.
(c) (d) and (e) See (52).
(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) Completed.
(i) Report in Technical Memoranda Nos. 115-1 and 115-2.

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(414) (a) MODEL STUDY TO DETERMINE EFFICACY OF SUB-LEVEES AND THEIR EFFECT IN CONTROLLING THROUGH AND UNDER SEEPAGE FOR MAIN LINE LEVEES.
(b) The District Engineer, U. S. Engineer Office, Memphis, Tennessee.
(c) (d) and (e) See (52).
(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.
(i) Report in Technical Memorandum 101-1.

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(415) (a) MISSISSIPPI RIVER MODEL -HELENA, ARKANSAS TO DONALDSONVILLE, LOUISIANA, INCLUDING THE MISSISSIPPI RIVER FROM MILE 298 TO MILE 900 BELOW CAIRO, AND ESSENTIAL PORTIONS OF ALLUVIAL VALLEY FROM HELENA, ARKANSAS TO THE GULF OF MEXICO.
(b) Mississippi River Commission.
(c) (d) and (e) See (52).
(f) Miscellaneous flood control problems on the lower Mississippi River.
(g) Model scales, 1 to 2,000 horizontal and 1 to 100 vertical; fixed bed.
(h) In progress.
(i) Result of studies to date are contained in Technical Memoranda 92-1* 92-3, 92-4, 92-5, and 92-6 and in letters to the President, Mississippi River Commission.

* Also 92-2.

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(417) (a) MARE ISLAND STRAIT, SAN FRANCISCO BAY, CALIFORNIA.
(b) U. S. District Engineer, San Francisco, California.
(c) (d) and (e) See (52).
(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) Completed.
(i) Report on study is contained in Technical Memorandum No. 81-1.

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(471) (a) CHESAPEAKE AND DELAWARE CANAL MODEL.
(b) The District Engineer, U. S. Engineer Office, Philadelphia, Pennsylvania.
(c) (d) and (e) See (52).
(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) Temporarily inactive.
(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.

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(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 (52).
(e) See (52).
(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) Verification of model in progress.

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(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 (52).
(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) Temporarily inactive.
(i) Results described in Technical Memorandum 89-1, and Technical Memorandum 89-2, U. S. Waterways Experiment Station.

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(480) (a) GALVESTON HARBOR MODEL.
(b) The District Engineer, U. S. Engineer District, Galveston, Texas.
(c) (d) and (e) See (52).
(f) Feasibility of model study being investigated.

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(481) (a) ABSECON INLET MODEL.
(b) The District Engineer, U. S. Engineer Office, Philadelphia, Pa.
(c) (d) and (e) See (52).
(f) Study to determine means of eliminating shoaling in navigation inlet.
(g) Design suspended awaiting field data.

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(535) (a) CHAIN OF ROCKS, MISSISSIPPI RIVER.
(b) The District Engineer, U. S. Engineer Office, St. Louis, Mo.
(c) (d) and (e) See (52).
(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) Verification of model in progress.

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(536) (a) PRYORS ISLAND REACH.
(b) The District Engineer, U. S. Engineer Office, Louisville, Ky.
(c) (d) and (e) See (52).
(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) Tests of proposed plans are in progress.

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(537) (a) KANSAS CITY'S FLOOD CONTROL MODEL.
(b) The Division Engineer, Missouri River Division, Kansas City, Missouri.
(c) (d) and (e) See (52).
(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) Completed.
(i) Report in Technical Memorandum 102-1.

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(538) (a) DOGTOOTH BEND - INCLUDING THE MISSISSIPPI RIVER FROM MILE 32.7 ABOVE CAIRO TO MILE 4 BELOW CAIRO.
(b) The District Engineer, U. S. Engineer Office, St. Louis, Mo.
(c) (d) and (e) See (52).
(f) To determine means for improving navigation.
(g) Model scales, 1 to 600 horizontal and 1 to 100 vertical; movable bed.
(h) Verification of model in progress.

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(539) (a) SWIFT SURE TOWHEAD - INCLUDING THE MISSISSIPPI RIVER FROM MILE 51.2 TO 67.3 ABOVE CAIRO.
(b) The District Engineer, U. S. Engineer Office, St. Louis, Mo.
(c) (d) and (e) See (52).
(f) To determine means for improving navigation.
(g) Model scales, 1 to 600 horizontal and 1 to 120 vertical; movable bed.
(h) Verification of model in progress.

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(540) (a) GRAND TOWER - INCLUDING THE MISSISSIPPI RIVER FROM MILE 72.9 TO MILE 84 BELOW CAIRO.
(b) The District Engineer, U. S. Engineer Office, St. Louis, Missouri.
(c) (d) and (e) See (52).
(f) To determine means for improving navigation.
(g) Model scales, 1 to 600 horizontal and 1 to 150 vertical; movable bed.
(h) Tests are in progress.

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(568) (a) EAST RIVER, NEW YORK HARBOR.
(b) The District Engineer, First New York District, U. S. Engineer Office, New York, N. Y.
(c) (d) and (e) See (52).
(f) To study tidal currents in the East River.
(g) Model scales, 1 to 480 horizontal and 1 to 80 vertical; fixed bed.
(h) Tests are in progress.

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(569) (a) POSSUM KINGDOM DAM SPILLWAY AND STILLING BASIN.
(b) The District Engineer, U. S. Engineer Office, Mineral Wells, Texas.
(c) (d) and (e) See (52).
(f) To calibrate the spillway, and to determine an economical stilling basin design.
(g) Model scale, 1 to 70. Typical spillway study.
(h) Completed.
(i) Report in Technical Memoranda Nos. 111-1 and 111-2.

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(570) (a) SOILS SURVEY YERBA BUENA SHOAL, SAN FRANCISCO HARBOR.
(b) The District Engineer, U. S. Engineer Office, San Francisco, California.
(c) (d) and (e) See (52).
(f) To determine cause of subsidence, and investigate soil foundation.
(g) Classification tests, mechanical analysis, water contents, Atterberg Limits, and shear and consolidation tests.
(h) Completed.
(i) Report in Technical Memorandum No. 116-1.

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(640) (a) STUDY OF HYDRAULIC CONDITIONS CAUSED BY LOCK AND DAM NO. 6, MISSISSIPPI RIVER.
(b) The District Engineer, U. S. Engineer Office, St. Paul, Minnesota.
(c) (d) and (e) See (52).
(f) To determine the backwater effect and the change in silting characteristics in the tributary streams, resulting from the operation of Lock and Dam No. 6, Upper Mississippi River, in particular, the study concerning Big Trout Creek and the drainage system which discharges in the Mississippi through the C.M. St. P. & P. Railroad Bridge No. L. 52.
(g) Model scale: 1 to 200 horizontal and 1 to 50 vertical, fixed bed.
(h) Completed.
(i) Report contained in Technical Memorandum No. 121-1.

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(641) (a) SEDIMENT SURVEY OF MAYERSVILLE RANGE, MISSISSIPPI RIVER.
(b) The Mississippi River Commission, Lower Mississippi Valley Division.
(c) (d) and (e) See (52).
(f) To obtain field data on the relative amount of material moving in suspension at high and low stage of the Mississippi River.
(g) Samples were collected in the field and later analyzed for sediment content.
(h) Completed.
(i) Report contained in Technical Memorandum No. 122-1.

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(642) (a) ANALYSIS OF SEDIMENT AND SAND SAMPLES, CALCASIEU PASS, LOUISIANA.
(b) Beach Erosion Board, First New Orleans District, New Orleans, Louisiana.
(c) (d) and (e) See (52).
(f) To analyze sand and water samples of Calcasieu Pass, Louisiana.
(g) Analyze samples as received.
(h) Completed.
(i) Report contained in Technical Memorandum No. 119-1.

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(643) (a) MODEL STUDY OF PLANS FOR CHANNEL IMPROVEMENT IN THE OHIO RIVER AT MANCHESTER ISLANDS.
(b) The District Engineer, U. S. Engineer Office, Cincinnati, Ohio.
(c) (d) and (e) See (52).
(f) To aid in determining the most feasible method for effective permanent improvement in the channel by Manchester Islands.
(g) Model scales; 1 to 300 horizontal and 1 to 80 vertical, movable bed.
(h) Construction of model complete. Verification in progress.

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(644) (a) MODEL STUDY OF SPILLWAY FOR SARDIS DAM, NEAR SARDIS, MISSISSIPPI.
(b) The District Engineer, U. S. Engineer, Vicksburg, Mississippi.
(c) (d) and (e) See (52).
(f) To determine the hydraulic performance of the proposed structure, with especial reference to the capacity and hydraulic safety of the works as designed.
(g) The spillway, fixed bed; the channel, movable bed. Scale of model: 1 to 36.
(h) Desig nof model in progress.

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(645) (a) MODEL STUDY OF OUTLET STRUCTURES FOR SARDIS DAM, NEAR SARDIS, MISSISSIPPI.
(b) The District Engineer, U. S. Engineer Office, Vicksburg, Miss.
(c) (d) and (e) See (52).
(f) To examine the hydraulic performance of the proposed works, with special reference to hydraulic safety at maximum discharge and optimum performance at medium discharge.
(g) The channel and stilling basin, fixed bed; the channel leading from stilling basin, movable bed. Model scale: 1 to 25.
(h) Construction of model in progress.

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(646) (a) SOILS TESTS, PROPOSED SHIP CHANNEL, LAKE CHARLES, LOUISIANA.
(b) The District Engineer, U. S. Engineer Office, First New Orleans District New Orleans, Louisiana.
(c) (d) and (e) See (52).
(f) To analyze sand and water samples of the Proposed Ship Channel, Lake Charles, Louisiana.
(g) Analyze samples as received.
(h) Completed.
(i) Report contained in Technical Memorandum No. 124-1.

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HYDRAULIC RESEARCH IN CANADA.

ECOLE POLYTECHNIQUE DE MONTREAL.

(639) (a) HYDRAULIC MODEL STUDIES OF DIFFERENT SPILLWAY PROFILES.
(b) Hydraulic Laboratory, Ecole Polytechnique de Montréal.
(c) General scientific research.
(d) Professor Raymond Boucher.
(e) Professor Raymond Boucher.
(f) To establish a comparison between the discharge capacities of different spillway designs.
(g) Studies are made on concrete models of existing and recommended spillway profiles. Pressure distribution on spillway crests determined. Coefficients of discharge are determined for various heads up to the designed head. The effect of gate piers of various designs is also investigated.
(h) Experimental work in progress.

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(673) (a) CALIBRATION OF A SHARP-CRESTED TRIANGULAR WEIR.
(b) Division of Sanitary Engineering, Ministry of Health of the Province of Quebec.
(c) Cooperative investigation.
(d) R. Boucher, L. Fontaine and G. Bourbonnais.
(e) Professor Raymond Boucher.
(f) To determine the discharge curve of 90° sharp-crested triangular weir made of wood. To determine the variation of the coefficient of discharge, particularly at low heads when the nappe is clinging to the front face of the weir.
(h) Experimental work completed. Report in preparation.

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HYDRAULIC RESEARCH IN FRANCE.

(711) (a) STUDY OF THE PROPAGATION OF AN ARTIFICIAL WAVE ON THE RHONE.
(b) Compagnie Nationale du Rhone.
(c) Study at full scale.
(d) Collaboration between the "Société des Forces Motrices Rhone & Jura" and the "Compagnie Nationale du Rhone.
(e) M. Pierre Delattre.
(f) Study of waves which will be produced by the operation of the Genissiat hydro-electric plant on the Rhone.
(g) The test was accomplished by rapidly filling the reservoir of the Pougny-Chancy dam. The filling of the reservoir affected a volume of more than two million cubic meters and was accomplished in 4 hours, 35 minutes. At the time of closing the gates, the flow of the Rhone was 480 cubic meters per second.

During the first hour of filling, the flow was reduced to 100 cubic meters per second. There was produced a negative wave, the duration and volume of which was measured at several stations downstream:

Station	Distance to Pougny-Chancy km	Duration of the wave hours	Volume of the wave - millions of cubic meters
Pougny-Chancy	0	4^h 25'	3.2
Pont de Pougny	2.223	5^h	2.2
La Frontiere	3.826	5^h	-
Pont Carnot	8.870	5^h 15'	2.2
Pyrimont	30.510	7^h 15'	2.0
Chanez	57.053	8^h 30'	1.3
Pont de Cordon	91.097	9^h	-
Le Sault	127.209	12^h	1.3
Loyettes	159.122	12^h	-

(h) Analogous studies were made on negative waves produced by filling the Coulouvreniere dam.

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(712) (a) GENISSIAT DAM ON THE RHONE.
(b) Compagnie Nationale du Rhone.
(c) Tests on model.
(d) Mm. Henry, Connet and Bayard.
(e) M. Delattre.
(f) Determination of the characteristics of two tunnels, each capable of discharging 650 cubic meters per second to the free air.
(g) Several models of straight tunnels have been tested, and a complete model of the two tunnels, all on a scale of 1:100.
(h) Tests on 1:100 scale completed - tests on 1:40 scale in progress at the laboratory of the firms Neyret-Beylier and Piccard-Pictet in Grenoble.

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(713) (a) STUDY OF THE NON-PERMANENT REGIME IN A RECTANGULAR CHANNEL OF CONSTANT SLOPE.
(b) Compagnie Nationale de Rhone.
(c) Theoretical study.
(d) M. Henry.
(e) M. Henry.
(f) Study of waves which will be produced by operation of the Genissiat hydro-electric plant on the Rhone.

Note - Much information furnished on the above projects has been omitted on account of lack of space. The complete project descriptions, with translation, are on file at the Hydraulic Laboratory, National Bureau of Standards.

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COMPLETED PROJECTS - ABSTRACTS.

UNIVERSITY OF CALIFORNIA.

(419) VIRTUAL MASS OF SHIP MODELS AND ELLIPSOIDS OF REVOLUTION.
Investigator: J. P. Murphy.
Master's thesis.

Using a falling weight towing mechanism, the apparent increase in mass of an immersed body during acceleration was determined for ship models and for ellipsoids of revolution. Conclusions reached as a result of this work were:

1. The virtual mass is a function of the shape and displacement and can be estimated from theoretical considerations with an accuracy sufficient for most purposes.

2. The virtual mass of a ship model is approximately equal to the virtual mass of an ellipsoid of revolution of the same fineness ratio.

3. The virtual mass of an ellipsoid of revolution is independent of the draught and is a function of the fineness ratio only.

4. The virtual mass is independent of the acceleration within the limits of these tests.

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(420) SIMILARITY OF BROAD-CRESTED WEIRS.
Investigators: George C. Thomson and Alvin K. Joe.
Undergraduate thesis.

Models of dams tested at Cornell University by U. S. Board of Engineers on Deep Waterways (Water Supply Paper No. 200) were tested with and without submergence discharge. The shapes used were Series 10, 16 and 19, and the height in all cases was three inches. Three, six and twelve-inch models of the Lower Dam on the Devils River (Special Flood Report, Flood of September and October 1932, International Portion of the Rio Grande, International Boundary Commission) were also tested with and without submergence. Water surface profiles were obtained for selected conditions of discharge and submergence.

Within the range of the original Cornell experiments, the three-inch models agreed with the larger models within an accuracy of ± 5 percent, and the three models of the Lower Dam on the Devils River were in somewhat better agreement among themselves, indicating that the results should apply to the prototype.

The submergence tests showed that, for the particular shapes tested, the effect of submergence measurable but small (less than 5% for most of the models) up to a 60 percent submergence ratio.

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(421) SIMILARITY OF MOVABLE-BED MODELS.
Investigator: E. H. Taylor.
Master's thesis.

Flumes six and twelve inches wide and fitted with three arrangements of baffles were tested with bed materials of similar size distribution but differing in median diameter by a factor of 2. The walls and baffles were vertical so that at each depth of flow the flow system was a distorted model of every other depth. Two questions were considered, namely:

1. Will the configuration of the model stream bed after identical runs be exactly the same?

2. What restrictions should be placed on the transference of results from models to prototypes?

The first question was studied by making three as nearly as possible identical runs for each condition. About 200 soundings were made after each run and represented by error-frequency curves. The results showed that reproducibility (duplication of same conditions) is best with arrangements giving a high degree of turbulence.

Comparison of distorted and undistorted models of the same flow system showed that the agreement was markedly better with complete similarity in overall dimensions and median sand size.

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(423) FLOOD WAVES.
Investigator: J. O. Killian.
Master's thesis.

The rate of discharge at the upper end of the Neches Canal in Texas was to vary from 2000 second-feet during 15 hours of each day to 400 second-feet during 9 hours. The practical problem was to determine whether a wave of this amplitude would travel undamped through the entire 70 miles of the canal. The model canal was 50 feet in length, 1.5 feet wide at the bottom and 3 inches deep. Friction was simulated by screens placed transverse to the flow.

The model was distorted in length, width, depth and slope in addition to the type of frictional resistance. The duration of the discharge cycle and the friction coefficient were varied through a wide range at constant bottom slope. The water surface elevation was observed simultaneously at eight stations during thirty runs, some of which were repetitions.

The entire set of data was correlated on the basis of dimensionless ratios representing the rate of damping and the effective wave length. Since only one slope was used, the results are not general but the work will be continued with other slopes and discharge cycles.

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(434) INTERSECTING STREAMS.
Investigators: C. Horowitz and J. R. Morgan.
Undergraduate thesis.

The water surface profile near the junction of two open channels was investigated in model channels 10 inches deep and 4 inches wide. Six arrangements of the converging channels and a range of discharge ratios were included. The resulting data were correlated on the basis of dimensionless groups. For most of the arrangements, the flow conditions could be predicted from the momentum equations as usually applied, but this was not possible under conditions such that the velocity distribution was markedly non-uniform.

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(425) MODEL STUDY OF WAVE ACTION ON BEACHES.
Investigators: W. W. Lopsley, R. W. Brant, and O. J. Lillevang
Undergraduate and Master's theses.

Models of the shoreline and breakwaters at Santa Barbara and Santa Monica, California, were constructed for the purpose of establishing the reliability of small models for the study of beach erosion problems. At both of these localities construction of breakwaters produced radical changes in the shoreline. The model scales were: Santa Barbara, horizontal 750, vertical, 100; Santa Monica, horizontal 700, vertical, 140. The range of tide and the height and length of the waves were reproduced in accordance with the vertical scale ratio, while the littoral drift was supplied on the windward shore as rapidly as it was transported away.

The experiments showed that these models were too small and too greatly distorted to reproduce details of the shoreline, but the large scale changes, such as the area of accumulation around the Santa Barbara breakwater, agreed closely with surveys.

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(633) FLOW AT THE CRITICAL DEPTH.
Investi ator: T. C. Royce.
Undergraduate thesis.

In a glass-sided flume, 25 feet long and six inches wide, flows were set up with the normal depth slightly less than, equal to, and slightly greater than the critical depth. Under normal flume conditions, the water surface was smooth but relatively large undulations could be produced by slight variations in roughness or by small bottom obstructions and these undulations then continued for some distance. The friction coefficients obtained from these tests did not indicate any change in losses at or below the critical depth.

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(665) SUBMERGED SHARP-CRESTED WEIRS.
Investigator: A. L. Brosio.
Undergraduate thesis.

Sharp-crested, rectangular, suppressed weirs, 0.734 feet and 0.401 feet in height, were first calibrated with complete aeration and then subjected to different submergences. It was found that over an intermediate range of percentage submergence that the nappe might either flow along the surface with large surface waves or plunge below the surface with little disturbance. These possible flow conditions have been observed by other experimenters. The data were found to follow the equation

$$Q = 2/3 \sqrt{2g} \; M \; C_o \; L \; H^{1.5}$$

$$M = k \left(\frac{D}{H}\right)^{0.120} - 1.30$$

Here C_o is the coefficient for free, fully-aerated discharge, and k has a value of 2.29 for surface flow and 2.31 for sub-surface flow.

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UNIVERSITY OF MINNESOTA.

(328) STUDY OF SEDIMENTATION BASINS.

A model was made of an actual sedimentation basin which had been investigated to determine the relation of the flow-through time to the theoretical detention. Studies were made of the distribution of flow through the basin by introducing dye at the entrance and taking photographs in series at different time intervals. Details of the direction and velocity of flow were observed by direct observation; however, the complete photographic record gave a method of comparison between various speeds of model operation, and permitted some analysis of the effect of this speed upon the nature of the currents. In the experimental analysis the question arises immediately as to whether the model should be operated in accordance with the Reynolds Model Law, the Froude Model Law, or some other fixed relation.

In this case the relation of the efficiency to Reynolds' number was determined for various speeds of operation. It was found for Reynolds numbers greater than about 200 (using the hydraulic radius as the linear dimension in the number), the model could be operated at any of a large range of velocities without affecting the efficiency - that is, neither Reynolds Model Law nor Froude's Model Law had to be adhered to; inertia being the governing factor. These results were borne out by experiments on the prototype, the linear dimension of which was 7.25 times that of the model.

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(369) EXPERIMENTAL ANALYSIS OF COFFERDAM DESIGN. (Experiments in cooperation with Committee on Soils and Foundations, American Society of Civil Engineers).

Experiments were made on a model of a cofferdam contemplated for use in connection with the construction of a spillway on a river canalization project. Two fundamentally different types of experiments were performed with different set-ups; one a partial model constructed in a glass flume consisting of a longitudinal section of the cofferdam, the other a full model including several thousand feet of river channel. Numerous observations were made for various river discharges and various types of cofferdams. Conditions of erosion were observed both inside and outside of the cofferdam. Flow conditions were recorded, also head losses through the structure.

The following summarized statements are pertinent:

1. It appears to be practicable to construct a cofferdam using a single line of sheet piling with a supporting embankment on the inside without the structure being seriously endangered by flood stages of the river.

2. The originally proposed arrangement (one in which the upstream line of sheet piling was inclined in plane downstream to the shore) was not conducive to good flow conditions within the cofferdam during flood stages. The studies indicated that erosion was likely to take place because of the transverse currents developed within the cofferdam. Furthermore, with this arrangement serious scour was indicated to occur at the upstream river-side corners of the structure.

3. Limited stream line entrance was shown not to improve flow conditions as regards the danger to erosion either on the inside or the outside of the cofferdam.

4. Apparently the ideal condition of stream-lined structure is approached by beginning the upstream line of sheet piling at right angles to the shore and making a sweeping long radius curve to the downstream line of sheet piling.

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STEVENS INSTITUTE OF TECHNOLOGY.

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

This investigation is reported in a paper entitled, "Some Experimental Studies of the Sailing Yacht", by Kenneth S. M. Davidson, published in Volume 44 (1936) of the Transactions of the Society of Naval Architects and Marine Engineers.

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The paper deals with the development of experimental and analytical means of investigating problems of sailing yacht hull design, and with the particular questions arising in the application of models to this work.

It emphasizes, first, that comparatively small models are inevitable because of the high displacement-length and maximum speed-length ratios of sailing yachts, and discusses the reliability of such models when turbulence is satisfactorily induced.

It then shows for a very clearly-defined case, that the relative overall performances of two particular boats, under sail, were not reflected by the usual curves of upright hull resistance - a fact which strongly sugges ted the importance of heeled resistances.

The necessity of considering the heeling force when investigating the additional resistance caused by heel, and the reasoning underlying a reproduction of the complete force system of a full-size boat, in model size, are discussed in detail.

The test technique devised for measuring resistances with heel and leeway is described.

A method of determining close-hauled speeds as functions of the true wind speed, by combining the heeled resistances predicted from model tests run at the correct kinetic stabilities, with aerodynamic coefficients for the sails derived from sailing tests of full-size boats, is applied to the well-defined case previously mentioned, and is shown to produce an answer in agreement with the observed facts.

The sail force coefficients and the "aerodynamic" characteristics of the hull are considered.

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BUREAU OF RECLAMATION

(548) ALL-AMERICAN CANAL - "INFLUENT SLOT".

The so-called "influent slots" of the All-American canal desilting works are the narrow vertical openings uniformly spaced in the vertical concrete side walls of the "influent" or intake channels, through which the silt-laden waters are to be diverted into the adjacent settling basins. The water of the influent channels is to move with a velocity of about seven feet per second and must be delivered around 60- and 120- degree bends into the still water of the settling basins with a minimum disturbance and loss of energy. The purpose of these experiments was to test various streamlined slot sections with the intention of determining the most satisfactory plan.

A model of a single slot with appropriate sections of the approach and of the settling basin was constructed, full scale in plan, but abbreviated in depth and covered to permit the use of pressures which would correspond to those existing slightly below the surface in the prototype. Seventeen different shapes were tested, their relative efficiencies being judged on a basis of velocity head converted to pressure head, and upon the appearance of the flow.

The shapes tested were principally of the 120° turn, and most of them gave good results. Those tried were divided into three classes, depending on whether the turn was made before or after widening the shape, or simultaneously. In general, the greatest efficiency was obtained by making the turn with a rather short radius and slightly converging side walls. After completing the turn, the walls diverged to give the widening of the slot and the consequent decrease of velocity which had been required.

The recommended designs fell into this classification, and gave excellent velocity head recovery. The flow also appeared more than satisfactory. Several other shapes gave almost equally acceptable results, however. The report compares the various shapes tested in a tabulation of velocity head recoveries. Flow conditions for all shapes are shown by a series of sketches, also.

Available for loan, "Preliminary Report on Model Studies of Influent Slots in All-American Canal Desilting Works" by F. R. Cline.

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(550) HYDRAULIC MODEL EXPERIMENTS FOR THE DESIGN OF THE OUTLET WORKS AND SPILLWAY OF THE BULL LAKE DAM.

The Bull Lake Dam is located on Bull Lake Creek, a tributary of the Wind River, about 40 miles northwest of Riverton, Wyoming. It is an earth-fill dam equipped with a spillway and a twin tunnel outlet works for by-passing water during construction and for regulation of irrigation flow.

The report covers the model experiments for the design of the outlet works and spillway. The stilling pool of the outlet works consists of a "hydraulic hump" incorporating a dentated step and a Rehbock sill. This operated satisfactorily for unbalanced flow from the two tunnels, with no appreciable erosion of the riprapped river bed. The stilling pool for the spillway had a Rehbock sill at its downstream end and produced satisfactory flow for all operating conditions.

Report, "Hydraulic Model Experiments for the Design of the Bull Lake Outlet Works and Spillway" by J. M. Buswell and D. C. Weed should be on file at the Denver Public Library by August, 1937. No Technical Memorandum number has yet been assigned.

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(560) NEEDLE VALVE AND RING-FOLLOWER AND CYLINDER-FOLLOWER GATE CHARACTERISTICS.

The original purpose of this series of tests was to make a qualitative study of the performance of gates located at the faces of dams or in penstocks and sluices. It was later deemed necessary to make a series of quantitative tests to determine hoist requirements and pressures exerted on gates due to hydrodynamic conditions. This information was especially desirable in connection with tractor gates, ring-follower gates, and cylinder-follower gates.

The general design of a gate hoist provides for sufficient capacity to close or open the gate under full operating head. The usual method of computing the required force to operate a gate, that is, necessary hoist capacity, is to sum up the frictional resistances of the gate plus the weight of the moving parts for lifting the gate, and minus that weight for lowering the gate. The weight of the moving parts in water is equal to the "dead" weight of those parts minus the effect of buoyancy or uplift of the water. The frictional resistance varies for the different types of gates. In sliding gates this force is equal to from 0.3 to 0.75, depending on the material in the leaf and seat, of the water load on the leaf. In the case of fixed wheel gates the frictional resistance is equal to the axle friction plus the rolling friction of the wheel, plus a resistance due to the seals. If roller trains are used in place of wheels, the axle friction is eliminated but a link friction must be added.

The force of friction plus or minus the weight of the gate must be considered in every hoist design. There are also hydraulic forces present which may increase the load on the hoist to a point where the above design, even with the customary factor of safety, is no longer safe. This force is caused by the unbalanced water pressures above and below a lead when it is in a throttling position. The water passing below a flat bottom leaf exerts no pressure and may even create a partial vacuum on the under side of the leaf. As there is a pressure above the leaf (water pressure if the leaf is submerged or atmospheric pressure if it has a free water surface), the downward force is equal to the difference of the pressures above and below the gate in lb per sq in. multiplied by the area of the bottom of the leaf in square inches. By changing the shape of the bottom of the gate or of the approach, a pressure may be built up on the bottom of the leaf which will partially or completely eliminate the unbalanced condition. If the leaf is in a housing in the line, the pressure above the leaf, that is the pressure in the upper housing, can be controlled by careful selection of clearances between the leaf and housing, both on the upstream and downstream sides. Ring-follower gates are special cases and have additional forces caused by water passing through the follower-ring which is attached to and is a part of the leaf. The measured values obtained from the model experiments were used in the subsequent preparation of designs.

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(715) PARKER DAM GATE STUDIES.

A model of part of the Parker Dam including one of the five Stoney gates and the corresponding crest was constructed to a scale of 1:30. The purpose of the study was to insure that no harmful vibrations would be set up by the flow of water beneath the gate. The prototype gate (fifty feet wide and fifty feet high) is designed to comprise horizontal girders covered with a 9/16-inch upstream skin plate. The model gate was made from a 5/8-inch plate machined to 1/4-inch leaving ribs 3/8 inch high and 1/5 inch thick spaced similarly by the girders in the prototype. With this design the natural period of the model gate was 1/ $\sqrt{30}$ times that of the prototype as required for hydraulic similitude. Any hydraulic oscillations which might cause the prototype to vibrate would produce similar effects in the model. No such vibrations could be detected in the model at any head or gate opening.

Available for loan, "Progress Report on Parker Dam Gate Tests - Vibration Studies", by V. L. Streeter.

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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, Miss.

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HYDRAULIC RESEARCH COMMITTEES.

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

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

Members

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

During the past year by action of the Executive Committee of the Section of Hydrology, the Committee on Dynamics of Streams has been assigned an additional field of study which is closely related to its present activities, namely, the study of "Land Forms", as related to hydrology, geology, and dynamics of streams. The Committee has continued to concern itself with problems related to the flow of water in rivers and smaller streams, the forces which the water exerts, the work which it does in erosion, transportation, deposition, and the relation between the streams and the channels they occupy. It is also concerned with the dynamics of rain- and surface-waters in soil erosion.

A number of papers have been published by members of the Committee and others which have been solicited. Most of these appear in the Transactions of the American Geophysical Union, published by the National Research Council. The annual report of the Committee for 1937 presents an extensive review of literature on dynamics of streams appearing during the past two years both in this country and abroad. This report covers such topics as varied flow phenomena, flood wave, velocity distribution in rivers, soil erosion, sediment transportation, turbulence, river regulation, river estuaries, and the like.

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

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

(No report furnished for this issue of the bulletin.)

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

Chairman: J. C. Stevens,
Spalding Bldg.,
Portland, Oregon.

Members.

Chilton A. Wright, Secretary,
Herbert D. Vogel,
Clarence E. Bardsley,
E. W. Lane,
Lorenz G. Straub.

Cooperating Members:

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

This committee was appointed in April, 1934. Its main objective is to encourage hydraulic research by agencies and individuals having the facilities and personnel for such work. In furtherance of this objective the following definite problems are now the subjects of research by directors of hydraulic laboratories:

"Traveling Waves on Steep Slopes", by Professor Harold Thomas, Carnegie Institute of Technology.

"Curves in Open Channels", by Professor C. A. Mockmore, Oregon State College.

"Phenomena of Intersecting Streams", by Professor M. P. O'Brien, University of California.

"The Conversion of Kinetic to Potential Energy", by Professor F. T. Mavis, University of Iowa.

"Sedimentation at the Confluence of Rivers", by Professor L. G. Straub, University of Minnesota.

To define and determine fundamental physical phenomena involved in the problems is the primary object. To further this work the Committee is receiving appropriations from Engineering Foundation.

In addition to the above research program the Committee has under way: (1) the preparation of a manual for hydraulic laboratory practice; (2) the adoption of a set of standard letter symbols for hydraulic laboratory work to be followed later by a glossary of terms; (3) the making of English abstracts of important papers on hydraulics published in other languages.

Committee for Research on Hydraulic Friction, Division of Engineering and Industrial Research, National Research Council.

Chairman: Th. von Kármán,
Daniel Guggenheim Aeronautical Laboratory,
California Institute of Technology,
Pasadena, California.

Members of the Committee have recently published two works on friction and turbulence as follows:

B. A. Bakhmeteff - The Mechanics of Turbulent Flow.
Princeton University Press, 1936.

Th. von Kármán - The Fundamentals of the Statistical Theory of Turbulence.
Journal of the Aeronautical Sciences.
February 1937.

The Monograph by Professor Bakhmeteff covers in part the first objective of the Committee, namely a summary of the present status of our knowledge of hydraulic friction. Professor von Karman's paper appears to open up a new field for investigation and may fundamentally alter present concepts of turbulent flow.

A preliminary outline of an investigation of turbulence in the atmosphere has been prepared but has not been adopted by the Committee nor approved by the sponsoring agency. This program includes detailed and continued measurements of velocity, temperature, pressure and humidity to a distance of several hundred feet over a water surface and should provide basic information on the structure of turbulence.

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National Research Council Interdivisional Committee on Density Currents.

At the recommendation of the Subcommittee on Hydrodynamics of the Committee on Borderland Fields between Geology, Chemistry and Physics, National Research Council (See Bulletin V-1, January 1, 1937, page 102) the formation of the above-named committee has been authorized and is sponsored by the Division of Geology and Geography, Physics, and Engineering of the Council. While the Committee is still in process of organization, its membership as of June 1, 1937, is as follows:

Chairman: Herbert N. Eaton, Chief Hydraulic Laboratory Section, National Bureau of Standards, Washington, D. C.

Reginald A. Daly, Dept. of Geology and Geography, Harvard University, Cambridge, Mass.

M. M. Ellis, In charge Interior Fisheries Investigations, U. S. Bureau of Fisheries, Columbia, Mo.

N. C. Grover, Chief Hydraulic Engineer, In charge, Water Resources Branch, U. S. Geological Survey, Washington, D. C.

P. V. Hodges, Associate Engineer, Bureau of Indian Affairs, 8th and Figueroa Bldg., Los Angeles, California.

C. S. Howard, Chemist, Water Resources Branch, U. S. Geological Survey, Washington, D. C.

C. Juday, Limnologist, Geological and Natural History Survey, The University of Wisconsin, Madison, Wisconsin.
Robert T. Knapp, Associate Professor of Hydraulic Engineering, California Institute of Technology, Pasadena, California.
W. C. Lowdermilk, Chief, Division of Research, Soil Conservation Service, Washington, D. C.
(Alternate)
G. C. Dobson, Head of Sedimentation Investigations Section, Soil Conservation Service, Washington, D. C.
Heinrich Peters, Assistant Professor of Aeronautical Engineering, Massachusetts Institute of Technology, Cambridge, Mass.
Francis P. Shepard, Assistant Professor of Geology, University of Illinois, Urbana, Illinois.
C. S. Scofield, Agriculturist, in charge Division of Western Irrigation, U. S. Bureau of Plant Industry, Washington, D. C.
W. A. Snow, Resident Member, Board of Engineers for Rivers and Harbors, U. S. Corps of Engineers, Washington, D. C.
H. U. Sverdrup, Director, Scripps Institution of Oceanography, La Jolla, California.
C. P. Vetter, Engineer, U. S. Bureau of Reclamation, Customhouse, Denver, Colorado.

The broad objective of the committee is to investigate through theoretical studies, laboratory experiments, and field observations the nature and occurrence of density currents, which may be defined tentatively as follows: A "density current" is the movement, without loss of identity by mixing at the bounding surfaces, of a stream of fluid under, through, or over a body of fluid, the density of which differs from that of the current, the density difference being a function of the differences in temperature, salt content, and/or silt content of the two bodies of fluid.

Density currents occur in reservoirs, lakes, rivers, oceans and in the atmosphere. Various individuals and organizations have made observations on these currents during recent years, but there seems to have been no general recognition of the fact that the phenomena observed are only different aspects of density currents.

The first undertaking of the committee was to organize a program of field observations on the flow of silty water through reservoirs. To this end, meetings were held on June 14 and 15 at Washington, D. C., and cooperative programs were drawn up for observations at Elephant Butte Reservoir and Lake Mead. The following subcommittees were appointed to assume responsibility for these two programs.

Members of Subcommittee on Elephant Butte Reservoir.

Chairman - C. S. Scofield, Chief of Division of Western Irrigation Agriculture, U. S. Bureau of Plant Industry, Washington, D. C.
M. M. Ellis, In charge Interior Fisheries Investigations, U. S. Bureau of Fisheries, Columbia, Missouri.
L. R. Fiock, Project Superintendent, Rio Grande Project, Bureau of Reclamation, El Paso, Texas.
(Alternate)
W. F. Resch, Associate Hydraulic Engineer, Rio Grande Project, U. S. Bureau of Reclamation, El Paso, Texas.
C. S. Howard, Chemist, Water Resources Branch, U. S. Geological Survey, Washington, D. C.
B. H. Monish, Hydraulic Laboratory Section, National Bureau of Standards, Washington, D. C.
(Soil Conservation Service representative to be announced later.)

Members of Subcommittee on Lake Mead Project.

Chairman - C. P. Vetter, Engineer, U. S. Bureau of Reclamation, Customhouse, Denver, Colorado.
M. M. Ellis, In charge, Interior Fisheries Investigations, U. S. Bureau of Fisheries, Columbia, Missouri.
C. S. Howard, Chemist, Water Resources Branch, U. S. Geological Survey, Washington, D. C.

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Special Research Committee on Fluid Meters, American Society of Mechanical Engineers.

Chairman - R. J. S. Pigott, Gulf Research and Development Corporation, Pittsburgh, Pa.

Members

H. S. Bean,
S. R. Beitler,
R. K. Blanchard,
J. R. Carlton, (Sec.)
W. W. Frymoyer,
Louis Gess,
A. J. Kerr,
T. H. Kerr,
M. P. O'Brien,
William S. Pardoe,
Ed S. Smith, Jr.,
R. E. Sprenkle,
Edward C. M. Stahl,
T. R. Weymouth
M. J. Zucrow.

Subcommittee on Flow Nozzle Research.

Chairman - H. S. Bean, National Bureau of Standards, Washington, D.C.
Members - S. R. Beitler, J. R. Carlton, R. J. S. Pigott, R. E. Sprenkle, E. C. M. Stahl.

Subcommittee on "Influence of Installation" -

H. S. Bean,
J. R. Carlton, Chairman,
W. W. Frymoyer,
R. E. Sprenkle,
E. C. M. Stahl,
T. R. Weymouth

Subcommittee on "Description of Meters"

S. R. Beitler
R. K. Blanchard,
R. E. Sprenkle, Chairman,
E. C. M. Stahl.

Subcommittee on "Revision of Part I".

H. S. Bean, Chairman,
W. W. Frymoyer,
Louis Gess,
W. S. Pardoe,
Ed S. Smith, Jr.,
R. E. Sprenkle,
E. C. M. Stahl,
T. R. Weymouth.

Subcommittee on "Oil Measurement in Tulas Area".

H. S. Bean,
A. J. Kerr,
R. J. S. Pigott,
R. E. Sprenkle.

Subcommittee on "Joint A.G.A. - A. S. M. E. Committee".

H. S. Bean,
J. R. Carlton (alternate)
T. H. Kerr, Chairman,
R. J. S. Pigott,
Chas. C. Reed (alternate)
R. E. Sprenkle,
Archer E. Young.

Subcommittee on "Bibliography".

J. R. Carlton, Chairman,
Ed S. Smith, Jr.

Subcommittee on Fund Raising.

Chairman - E. C. M. Stahl, Brooklyn Edison Co., 380 Pearl St., Brooklyn, N. Y.

Members - R. K. Blanchard, W. A. Carter, Paul Diserens, L. K. Spink.

For statement regarding aims and program of this committee see Bulletin V-1, pages 99 and 100.

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

(Available for loan.)

Argentine Republic.

Republic Reglamento para la Construcción y Funcionamento de las Obras Domiciliarias de Desagüe y Provision de Agua de la Ciudad de Buenas Aires. (Rules for the construction and operation of domestic installations for the drainage and water supply of the city of Buenos Aires.) Effective as of December 1, 1915. In Spanish.
Publication of the Obras Sanitarias de la Nacion, 1915.

Reglemento para la Construcción y Functionamento de las Obras Domiciliarias de Desagüe y Agua en las Ciudades de Provincias. (Rules for the construction and operation of domestic installations for drainage and water supply in the cities of the Provinces. Publication of the Ministry of Public Works of the Argentine Republic, 1920. In Spanish.

Reglamentacion Complementaria sobre Desagües Pluriales de las Fincas Urbanas. (Supplementary regulations for the storm water drainage of urban lands of the City of Buenos Aires). In Spanish.
Publication of the Obras Sanitarias de la Nacion, 1930.

Canada.

Department of Mines and Resources, Dominion Water and Power Bureau, Water Resources Paper No. 72, Surface Water Supply of Canada, Pacific Drainage. Climatic Years 1930-31 and 1931-32

Surface Water Supply of Canada. Arctic and Western Hudson Bay Drainage in Alberta, Saskatchewan, Manitoba and Western Ontario, Canada. Department of Mines and Resources, Water Resources Paper No. 75. Climatic years 1933-34 and 1934-35.

Surface Water Supply of Canada. Atlantic drainage, New Brunswick, Nova Scotia, Prince Edward Island. Canada, Department of Mines and Resources. Water Resources Paper No. 77, Climatic years 1932-33 and 1933-34.

China.

The Central Hydraulic Research Institute of the National Economic Council at Nanking. Publication by the National Economic Council at Nanking, China, 1937. In English.

China. (Cont'd)

Report on model tests of the course of the Huai River to the sea. Yang Chuang dam with lock. Model test No. 1. Published by the Central Hydraulic Engineering Laboratory, National Economic Council of China, 1936. In Chinese.

Foundation ceremony at the establishment of the Central Hydraulic Engineering Laboratory, National Economic Council of China, 1936. In Chinese. Kong Hsiang Hsi.

Czechoslovakia.

Model tests with a spillway and sluice gate of an earth dam on the Rožnov. Bečva River, Czechoslovakia.
K. Kostka.
Report of the Hydraulic Laboratory of the Polytechnic College at Brünn. Reprint from Technicky Obzor, Vol. LXXII, Nos. 1, 2, 1937. In Czech with English summary.

Hungary.

Hydraulic Proceedings of the Water Board of the Royal Hungarian Ministry of Agriculture, Vol. XVIII, No. 3, July-September, 1936. In Hungarian with English summaries.

1. A. Rohringer. The future of waterways in Hungary, p. 19.
2. J. Lisadorfer. Types of dams employed in the canalization of the Main and Neckar Rivers.
3. A. Trummer and W. László'ffy. Planned utilization of water resources in Hungary.
4. T. Boros. Meteorological factors determining the necessity for irrigation in Hungary.

Italy.

Il Lago Tana e le sui Possibilità di Sfruttamento. (Lake Tana and the possibility of exploiting it.) In Italian.
G. De Marchi.
N. 18 dei "Problemi del Giorno" dell'Istituto per gli Studi di Politica Internazionale, Milan, 1936.

Sul Regime Idraulico del Lago Tana. (On the hydraulic regime of Lake Tana). In Italian.
E. Gentilini.
Reprint from "Annali dei Lavori Pubblici", Fasc. V. 1936.

Italy. (Cont'd)

Dispositivo per la Misura della Portata dei Canali con minime Perdite di Quota. (Means for the measurement of the discharge of a channel with minimum loss of head). In Italian.
G. de Marchi.
Reprint from L'Energia Elettrica, Fasc. 1, Vol. XIII, 1936.

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B. Gentilini. In Italian.
Memorie e Studi dell'Istitute di Idraulica e Costruzioni Idrauliche del Regio Politecnico di Milano, No. 18, 1936.

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M. Marchetti. In Italian.
Memorie e Studi dell' Istituto di Idraulica e Costruzioni Idrauliche del R. Istituto Superiore d'Ingegneria di Milano, No. 22, 1936.

Il Lago Tana e le sui Possibilita di Sfruttamento. (Lake Tana and the possibility of its exploitation).
G. de Marchi. In Italian.
Memorie e Studi dell' Istituto di Idraulica e Costruzioni Idrauliche del R. Istituto Superiore d'Ingegneria di Milano, No. 19, 1936.

Determinazione dei Coefficienti di Scabrezza per il Canale di Turbigo. (Determination of the coefficient of roughness for the Turbigo Canal.)
F. Bay. In Italian.
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Esperienze sulla contrazione delle vene liquide. (Experiments on the contraction of liquid jets.)
G. de Marchi. In Italian.
Reprint from the "Annali dei Lavori Pubblici, 1925, Fasc. VIII.

Equazione di forma di uno strammazo dedotta dalla sua equazione di Portato. (Equation for the form of a weir deduced from the equation of flow.)
G. di Ricco. In Italian.
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S. Kolupaila, Kaunas, 1937.
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Sweden.

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(On the mean velocity of water in partly-filled pipe lines.
In Swedish.
Erik Lindquist.
Reprint from Teknisk Tidsrift, Vol. 56, 1926.

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In Swedish.
Erik Lindquist.
Reprint from Teknisk Tidscrift, Vol. 3, March, 1930.

En metod för ekonomisk dimensionering av trycktuber. (A method for determining the economic dimensions of pressure pipe lines. In Swedish.
S. Tham.
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Om inverkan av vattnets strömart och ytspänning vid flodbyggnadstekniska modellförsök. (On the effect of the nature of flow and surface tension of water in technical river-hydraulic model tests. In Swedish. Reprint.

Om sektioner bestämmande för avrinningen genom ett vattendrag. (On critical sections - natural control sections -) for flow in a water course.
Erik Lindquist.
Reprint. In Swedish.

Switzerland.

Der Geschiebebetrieb als Wahrscheinlichkeitsproblem.
(The transportation of sediment as a problem in probability.)
H. A. Einstein. In German.
Zur Kinematik der Geschiebebewegung. (On the kinematics of the movement of sediment.)
G. Polya. In German.
Mitteilung der Versuchsanstalt für Wasserbau an der Eidg. Techn. Hochschule in Zurich.

U. S. S. R.

Transactions of the Scientific Research Institute of Hydrotechnics, Leningrad, Vol. XIX, 1936.
In Russian with English summaries.

1. N. N. Pavlovsky. Principles of the hydromechanical method of solution of the problem of free percolation flow from open channels, pp 5 and 24.
2. N. T. Meleshenko. Analysis of groundwater flow under structures equipped with drainage holes. pp. 25 and 48.
3. N. N. Pavlovsky. Free percolation into infinite half-space from open channels, which can be represented on the w-plane by half circles. pp. 49 and 80.
4. M. D. Chertoussov. Determination of maximum elevation of water surface in head races of hydro-electric plants during shut-downs. pp. 81 and 103.
5. I. B. Egiazaroff. Investigations of wave motion in long pools. A review of reports presented at the XVIth International Navigation Congress and of the work carried out at the Hydroelectric Laboratory. pp. 105 and 135.
6. V. A. Gavrilenko. Distribution of averaged velocities in turbulent uniform flow. pp. 139 and 174.
7. N. N. Pavlovsky. Upon distribution of velocities in turbulent flow of liquids. pp. 177 and 207.
8. S. V. Isbash. Hydraulics of cofferdam cribs. pp.208 and 240.
9. V. E. Domansky. Damming of river channels by rockfill without use of lateral spillways during construction. pp. 241 and 250.
10. A. V. Znamensky. Main results of investigations concerning cementation of soils. pp. 261 and 271.
11. V. I. Chernogradsky. Computation of stability of earth dams. pp. 273 and 284.
12. a. A. A. Uginchus. Design of non-silting channels. In Russian. p. 285.
12. b. P. D. Evdokimov. Note on shape of canal cross-sections. In Russian. p. 294.
13. c. M. A. Dementiev. New method for experimental determination of boundary layer in streams. In Russian. p. 300.
12. d. N. M. Viatskikh. Some elements of further development of the method of electrical analogy. In Russian. p. 304.
13. e. M. Z. Abramov. Apparatus for measuring hydrodynamical pressures at any point of a stream. In Russian. p. 311.

TRANSLATIONS.

BUREAU OF RECLAMATION.

The following translations have been prepared at the Bureau of Reclamation since the previous list given in Bulletin V-1, January 1937. Inquiries should be addressed to the Chief Engineer, U. S. Bureau of Reclamation, Denver, Colorado.

Steinbrenner, W.	Der zeitliche Verlauf einer Grundwasserabsenkung (The Rate of lowering of the Watertable). Translated by E. F. Wilsey from Wasserwirtschaft und Technik, Vol. 4, 1937, p. 27.
Weinig, F.	Entwurf von Saugrohrkrummern mit Hilfe der achsensymmetrischen Potentialströmung (Design of Curved Draft Tubes by Means of Axially Symmetrical Potential Flow). Translated by E. F. Wilsey, from Forschung auf dem Gebiete des Ingenieurwesens, Vol. 8, 1937, p. 47.
Vitols, A.	Beitrag zur Frage des vacuumlosen Dammprofiles (Vacuumless Dam Profiles). Translated by E. F. Wilsey from Wasserkraft und Wasserwirtschaft, Vol. 31, 1936, p. 207.
Rehbock, T.	Verfahren zur Bestimmung des Brückenstaues bei rein strömenden Wasserdurchfluss (Method for Determining the Backwater Height Due to Bridge Piers with Pure Streaming Flow). Translated by D. P. Barnes and E. F. Wilsey, from "Aus dem, Flussbaulaboratorium der Technischen Hochschule zu Karlsruhe", 1932.
Keutner, C.	Die Regelung kleinerer Wasserläufe durch Errichtung von Gefällstufen. (The Regulation of Small Streams by the Construction of Drops) Translated by E. F. Wilsey from Die Bautechnik, Vol. 15, 1937, p. 173.
Naterman and Mohlmann	Neue Wege fur Abflussberechnungen in offener Gerinnen und die Erfahrungen bei ihrer erstmaligen Anwendung. (A New Method of Computing the Discharge in Open Channels). Translated by I.B.Hosig from Die Bautechnik, Vol. 14, 1936, p. 798.
Schoklitsch, A.	Stauraumverlandung und Kolkabwehr. (Prevention of Scour and Energy Dissipation). Translated by E. F. Wilsey from the book of that title published by Julius Springer, Berlin, 1935, pages 78 to 173.

Smetana, Jan — Experimentální Studie Vodního Skoku Vzdutého. (Experimental Study of the Submerged or Expanded Hydraulic Jump). Translated by A. D. Kalal from Bulletin No. 13 of the T. G. Masaryk Hydrologic and Hydrotechnical Institute at Prague, 1934.

Smetana, Jan — Dva Příkladi Užití Rationelní Teorie Padjezů. (Two applications of Rational Theory to Stilling Pool Design). Translated by A. D. Kalal from Bulletin No. 14 of the T. G. Masaryk Hydrologic and Hydrotechnical Institute at Prague, 1935.

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NEW YORK UNIVERSITY.

The following translation has been made at New York University, College of Engineering, under WPA Project 158-1624 and under the direction of Dean Thorndike Saville.

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NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS.

Schlichting, H. — Experimental Investigation of the Problem of Surface Roughness. Ingenieur-Archiv, Vol. VII, No. 1, Feb., 1936. Translation published as Technical Memorandum No. 823, N.A.C.A., April 1937.

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The following translations have been made at the University of Minnesota. Inquiries should be addressed to Professor Lorenz G. Straub, University of Minnesota.

Vitaskikh, N. M. — Some Elements of Further Development of the Method of Electrical Analogy. Transactions of the Scientific Research Institute of Hydrotechnics, Vol. XIX, 1936, pages 304-311. (Russian).

Abramov, M. Z. — Apparatus for Measuring Hydrodynamical Pressures at Any Point of Stream. Transactions of the Scientific Research Institute of Hydrotechnics, Vol. XIX, 1936, pages 311-317. (Russian).

Uginchus, A. A. — On Computation of Nonsilting Canals. Transactions of the Scientific Research Institute of Hydrotechnics, Vol. XIX, 1936, pages 285-294. (Russian).

Demontiev, M. A. — New Method for Experimental Determination of the Width of Boundary Layer in Streams. Transactions of the Scientific Research Institute of Hydrotechnics, Vol. XIX, 1936, pages 300-303 (Russian).

Evdokimov, P. D. — Notes on Shape of Canal Cross-Section. Transactions of the Scientific Research Institute of Hydrotechnics, Vol. XIX, 1936, pages 285-294 (Russian).

Preobragensky, N. A.
Saveliev, S. F. — Experimental Investigation of Settling Basin at Kamskir Hydroelectric Plant. Transactions of the Scientific Research Institute of Hydrotechnics, Vol. X, pages 105-128. (Russian).

Ehrenberger, R. — Experiments about the Velocity of Water in Full Drain Pipings. Reprint from Wasserwirtschaft und Technik, Vol. 5, 1936, No. 35-36. (German).

Meleshenko, N. T. — Groundwater Flow Under Flat-Bottomed Structure Resting on Porous Soil Underlain by Inclined Watertight Strata. Transactions of the Scientific Research Institute of Hydrotechnics. Vol. 18, (Russian).

Burkov, A. F. — Results of Field Investigations of Silting in Upper Pool and Structures of Dzoraghet Hydroelectric Plant and Their Comparison with Model Experiments in Hydroelectric Lab. Transactions of the Scientific Research Institute of Hydrotechnics, Vol. 18, 1936, pages 183-201. (Russian).

Sigwart, K. — Measurements of the Viscosity of Water and Water Vapor up to the Critical Field. VDI, Vol. 80, No. 39, Sept. 26, 1936, pages 1202-03. (German).

Heller
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Levy, I. I. — Hydraulic Design of Sluice Openings. Transactions of the Scientific Research Institute of Hydrotechnics, Vol. XV, 1935, pages 99, 145. (Russian).

Richter, H. — Pressure Loss in the Smooth, Straight Circular Pipe. from VDI, Vol. 76, No. 52, pages 1269-74, Dec. 24, 1932. (German).

Shamov, G. I. — Brief Information Regarding the Results of Laboratory Tests of Silt Samplers. Transactions of the Scientific Research Institute of Hydrotechnics, Vol. XVI, November, 1936, pages 218-220. (Russian).

Keutner, — The Water Movement in Seepy Soil-Layers. Die Bautechnik, 1933, Heft 22 u. 24. (German)

Prokofieva, U. F.
Novotorzev, V. I. — Theoretical Principles of Designing Transit Stream Flows. Transactions of the Scientific Research Institute of Hydrotechnics, Vol. XVII, 1935, pages 130-145. (Russian.)

Goncharov, V. N. — Flow Round a Cube Fixed to Bottom of Flume. Transactions of the Scientific Research Institute of Hydrotechnics, Vol. XVII, 1935, pages 77-111. (Russian).

Gavrilenko, V. A. — Transportation of Bedload. Transactions of the Scientific Research Institute of Hydrotechnics, Vol. XVII, 1935, pages 113-127. (Russian).

Burkov, A. T. — Silt at Zemo-Avchal Hydroelectric Plant on the Kurva River. Transactions of the Scientific Research Institute, Vol. XI, 1934, pages 96-136. (Russian).

Isbash, S. V. — Influence of Scale in Laboratory Tests of Hydrotechnical Structures. Transactions of the Scientific Research Institute, Vol. XI, 1934, pages 43-72. (Russian).

Chertousov, M. D. — Conditions of flow in lower pool of hydraulic structures and stilling basin designs. Transactions of the Scientific Research Institute of Hydrotechnics, Vol. XIII, 1934, pages 68-77. (Russian).

Aravin, V. I. — Non-uniform Flow in Channels with Geometrically similar Cross-Sections. Transactions of the Scientific Research Institute of Hydrotechnics, Vol. XII, 1935, pages 55-69. (Russian).

R. Ehrenberger — The Problem of Characterization of River Detritus. (Special Reprint from Die Wasserwirtschaft, 1931, (German).

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Korolev, A. A. — Projection of Transition Spheres on Canals. Transactions of the Scientific Research Institute of Hydrotechnics. Vol. XV, 1936, pages 143-156. (Russian).

Robin, P.M. — Design of Stilling Basins. Transactions of the Scientific Research Institute of Hydrotechnics Vol. XIII, 1934, pages 70-123. (Russian)

Mostkov, M. A. — Graphical Hydraulics of Variable Flow. Transactions of the Scientific Research Institute of Hydrotechnics, Vol. IX, 1933, pages 51-79. (Russian).

Grunmach, Leo — Experimental Determination of the Surface Tension of Liquids and of Smelted Metals by the Measurement of the Wave Length of the Capillary Waves Produced on Them. Annalen der Physick and Chemie, Fourth Series, Vol. 3, 1900, pages 660-661. (German).

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Ehrenberger, R. — Model Experiments Concerning a Mud-Removal Installation of the Water-Reservoir Gross Arl II. Reprint from Wasserwirtschaft und Technik, Vol. 2, 1935, No. 11-12 (German).

Timonoff, V. E. — Outdoor Hydrotechnical Laboratories and Their Importance for Summer and Winter Investigations of Rivers. Transactions of the Scientific Research Institute of Hydrotechnics, Vol. 14, 1934, pages 81-188. (Russian).

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Wankel, Richard — Hydromechanics of the Pressure Pipe Conduits. Pamphlet published in 1919 by R. Oldenbourg. (German).

Burgers, I.M.
Velikanov, M. A. — Study of Correlation of Velocity's Pulsation in Various Points of a Stream. Transactions of the Scientific Research Institute of Hydrotechnics, Vol. 12,1934, pages 24-29. (Russian)

Aravin, V. I. — Streamflow of Constant Depth in an Open Channel with a Curvilinear Longitudinal Profile of Bottom. Transactions of the Scientific Research Institute of Hydrotechnics, Vol. X, pages 60-68. (Russian).

Ehrenberger, R. Detritus Measurements in Rivers by Means of Collecting Instruments and Model Experiments with the Latter. Special Reprint from Die Wasserwirtschaft, No. 33 and 36, 1932. (German).

Chugaev, R. R. Approximate Methods for Computation of General Stability of Earth Dams. Transactions of the Scientific Research Institute of Hydrotechnics, Vol. XVIII, 1936, pages 203-216. (Russian).

Trifonov, E. K. Experimental Investigation of Positive Wave Propagation along Dry Bottom. Transactions, Scientific Research Institute of Hydrotechnics, Vol. X, 1933, pages 169-182. (Russian).

Aravin, V. I. Flow of Water in Channels with Curvilinear Longitudinal Profile of Bottom. Transactions of the Scientific Research Institute of Hydrotechnics, Vol. IX, 1933, pages 31-51. (Russian).

Chertoussov, M. D. Some Considerations Regarding the Length of Hydraulic Jump. Transactions, Scientific Research Institute of Hydrotechnics, Vol. XVII, 1935, pages 67-77, (Russian).

Shamov, G. I. Analysis of Existing Formulas for Bottom Silt Flow. Transactions of the Scientific Research Institute of Hydrotechnics, Vol. IX, 1933, pages 193-226. (Russian.)

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NATIONAL BUREAU OF STANDARDS (National Hydraulic Laboratory.)

The following translation has been made:

Hégly, V. M. — Note sur L'Écoulement de l'Eau dans un Canal à Profil Complexe. (Flow in Earthen Channels of Compound Cross-section.)
Annales des Ponts et Chaussées, Vol. 106, No. 5, May 1936, pp. 445-528.
Abridged translation by Chilton A. Wright in cooperation with the Special Committee for Hydraulic Research of the American Society of Civil Engineers.

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INTERNATIONAL ASSOCIATION FOR HYDRAULIC STRUCTURES RESEARCH

The Association plans to hold its first meetings in Berlin on August 30 and 31, 1937. The first business will be to adopt permanent Articles of Association and to elect officers. Following this, a program of papers on "distorted models" and "bottomload and silt" will be presented.

The Association plans also to start issuing -- possibly semi-annually -- a bulletin on current hydraulic research in Europe. The form will be quite similar to that used in the bulletins now appearing in the United States and the U.S.S.R. Projects will be reported in English, French, or German. Research in the United States and in the U.S.S.R. will not be reported in the new bulletin, but will continue to be reported as at present.

For further information about the Association, see this Bulletin, IV-1, January 1, 1936, page 92.

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Materials for earth dams, levees, etc.

Meters, orifices, etc.

Model tests - coasts, harbors, etc.

Model tests - Dams, gates, spillways, locks, etc.

Weirs.