# Hydraulic Research in the United States

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Miscellaneous Publication 201

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Fluid Mechanics Laboratory, Mechanics Building, University of California

UNITED STATES DEPARTMENT OF COMMERCE • Charles Sawyer, *Secretary*
NATIONAL BUREAU OF STANDARDS • E. U. Condon, *Director*

# Hydraulic Research in the United States

Edited by Helen K. Middleton and Sonya W. Matchett

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# *Foreword*

"Hydraulic Research in the United States" has been issued in offset form by the National Bureau of Standards since January 1933, with the exception of the war years 1943 to 1946. Beginning with this issue, the information will be printed as a Bureau Miscellaneous Publication.

As heretofore, the information contained in this bulletin was compiled from reports by the various hydraulic and hydrologic laboratories in the United States and Canada. The cooperation of these agencies is greatly appreciated. Current and completed projects are reported under one general heading, grouped under the organization conducting the research. To conserve space it has been necessary to cut many reports, and it is hoped that this has been done without sacrifice of essential information.

Projects are numbered chronologically, and the number once assigned is repeated from year to year for identification purposes until a project is completed. A new numbering system was started in 1947, and numbers assigned to continuing projects prior to that date are now discontinued. Numbers commencing with 1052 refer to projects which are reported for the first time in this issue. All projects are in active state, unless otherwise noted under (f).

It is emphasized again that the National Bureau of Standards does not have in its files reports or detailed information regarding the research projects reported by other organizations. Such information may be obtained from the correspondent listed under (c) or immediately following the title of the organization reporting the work. It is of course understood that any laboratory submitting reports on work at their institution will be willing to supply detailed information to properly qualified inquirers upon request.

A similar bulletin, "Hydraulic Research", compiled and published by the International Association for Hydraulic Research, contains information on hydraulic research being conducted in foreign countries. This bulletin is edited by Prof. J. Th. Thijsse, Director of the Hydraulic Laboratory at the Technical University of Delft, Netherlands, and Secretary of the International Association for Hydraulic Research.

A bulletin entitled "Current Hydromechanics Research in the United States Related to Naval Architecture and Marine Engineering" is prepared by the Hydromechanics Subcommittee of the Technical and Research Committee of the Society of Naval Architects and Marine Engineers. Copies of this publication may be obtained by addressing the secretary of the subcommittee, Rear Admiral Herbert S. Howard, The Society of Naval Architects and Marine Engineers, 29 West 39 Street, New York 18, N. Y.

E. U. Condon, *Director.*

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Faculty of Applied Science, Kingston, Ontario
Prof. D. S. Ellis, Dean, Faculty of Applied Science

TORONTO, UNIVERSITY OF 157
Toronto 5, Canada
Prof. E. A. Allcut, Professor of Mechanical Engineering

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## Key to Projects

(a) Title of project.
(b) Project conducted for.
(c) Correspondent.
(d) Nature of project.
(e) Description.
(f) Present status.
(g) Results.
(h) Publications.

# HYDRAULIC RESEARCH IN THE UNITED STATES

THE BALDWIN-LIMA-HAMILTON CORPORATION, Hydraulic Turbine Laboratory.

(Formerly the Baldwin Locomotive Works, I. P. Morris Hydraulic Laboratory).

Inquiries concerning Projects Nos. 271, 798, 799, and 1052 to 1056, incl., should be addressed to Mr. H. J. Davis, Supervisor of Hydraulic Turbine Laboratory, Baldwin-Lima-Hamilton Corporation, Eddystone, Pa.

(271) ADJUSTABLE AND FIXED BLADE PROPELLER-TYPE HYDRAULIC TURBINE MODELS.

(b) Laboratory project.
(d) Experimental; applied research for design.
(e) To improve performance of present designs, and to extend the range of application of this type of turbine. Propeller runners of various designs in combination with modified turbine settings are being methodically tested in the 11-inch cavitation flume. Efficiency, output, cavitation, runaway speed, hydraulic thrust, and hydraulic blade torque are measured.
(g) Results provide data for improvement of existing design and information for designs which extend the present range of application, particularly with respect to head.

(798) INTERMEDIATE SPECIFIC-SPEED FRANCIS-TYPE HYDRAULIC TURBINE MODELS, GARRISON DAM.

(b) Department of the Army, Corps of Engineers, Garrison District.
(d) Experimental; applied research for design, and for acceptance of prototype units.
(e) Several homologous turbine models were tested in the 11-inch cavitation flume, complete cavitation data being obtained for all models.
(f) Completed.
(g) Results provided data needed to choose the turbine which, for this application, offered the most advantages. Guarantees were fulfilled by several designs, and the final choice was governed by a detailed study of model tests, particularly cavitation results.

(799) LOW SPECIFIC-SPEED FRANCIS-TYPE HYDRAULIC TURBINE MODELS, ROSS DAM.

(b) The city of Seattle, Washington.
(d) Experimental; applied research for design.
(e) As the head on this plant may be increased in the future, the turbine needed to be designed so as to operate efficiently with either the high or low head runner. Two specially designed runners in an homologous setting were tested in the 11-inch cavitation flume. In spite of the very low specific speed and correspondingly small values of the sigma breaks, it was found that cavitation measurements could be made after making necessary modifications to the existing cavitation flume. Such measurements were successfully made on both models over the complete range of operation.
(f) Completed.
(g) Results of test on the lower head model were incorporated in the final design of the prototype unit.

(1052) HIGH HEAD FIXED-BLADE PROPELLER TYPE HYDRAULIC TURBINE MODEL FOR CABINET GORGE PROJECT.

(b) Washington Water Power Company.
(d) Experimental; applied research for design.
(e) This turbine will be operated at a head higher than the usual range for propeller type turbines. Measurements of efficiency, output, cavitation, thrust, and runaway speed were made over a range of blade angles in the 11-inch cavitation flume.
(f) Completed.
(g) The model design was considered unusually successful, and results are being incorporated in the prototype unit.

(1053) CRITICAL SPEEDS OF TAIL-SHAFT AND PROPELLER ASSEMBLIES FOR SHIPS.

(b) Laboratory project.
(d) Experimental; applied research for design.
(e) Numerous tail-shaft failures suggested the possibility of critical speeds lower than the normally calculated first critical. It was considered that such a phenomena might be induced by variation in thrust produced by interference of the hull. To verify or disprove this hypothesis, a model shaft and propeller assembly was constructed, an air jet being used to impose a periodic eccentric thrust. The period of the jet thrust was varied from one per revolution to several multiples of a revolution.
(f) Completed.
(g) The results of these tests conclusively verify the hypothesis that critical vibration in a tail-shaft and propeller assembly may be induced at speeds lower than the normally calculated first critical by the action of an eccentric periodic thrust in an axial direction, this period being greater than one per revolution.

(1054) INTERMEDIATE HEAD KAPLAN-TYPE TURBINE MODEL FOR IMPERIAL VALLEY IRRIGATION DISTRICT, DROP NO. 2.

(b) Imperial Valley Irrigation District.
(d) Experimental; applied research for design.
(e) A completely homologous model has been manufactured and will be installed in the 11-inch cavitation flume.
(f) Model is about ready to install.

(1055) HIGH HEAD KAPLAN-TYPE TURBINE MODEL FOR BIG CLIFF PROJECT.

(b) Department of the Army, Corps of Engineers, Portland, Oregon District.
(d) Experimental; applied research for design.
(e) A completely homologous model is being manufactured and will be installed in the 11-inch cavitation flume.
(f) Model is in process of construction.

(1056) HIGH SPECIFIC-SPEED FRANCIS-TYPE HYDRAULIC TURBINE MODELS FOR SHERMAN ISLAND PROJECT.

(b) Eastern New York Power Corporation.
(d) Experimental; applied research for design.
(e) The problem is to furnish runners for an existing setting which can furnish efficiently an output 25% larger than developed at present.
(f) Models are in process of construction.

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POLYTECHNIC INSTITUTE OF BROOKLYN.

Inquiries concerning Projects Nos. 524, 800 to 802, incl., and 1057 should be addressed to Dr. Chilton A. Wright, Professor of Hydraulic and Sanitary Engineering, Polytechnic Institute of Brooklyn, 99 Livingston St., Brooklyn 2, N. Y.

(524) STUDY OF FLOW IN A STEEP CHUTE.

(f) Project completed. Thesis available on loan.

(800) INVESTIGATION OF A GENTILE PARTIAL POSITIVE DISPLACEMENT METER.

(f) Project completed. Thesis available on loan.

(801) STUDY OF FLOW IN A PARABOLIC WEIR.

(f) Project completed. Thesis available on loan.

(802) STUDY OF A 1-INCH GENTILE METER.

(f) Project discontinued.

(1057) INSTALLATION AND INVESTIGATION OF A FOUR-INCH TRANSPARENT CASE WATER TURBINE.

(b) Laboratory project.
(d) The turbine has been received. It will be installed for student use and its performance will be investigated by J. A. Clarke.

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CALIFORNIA INSTITUTE OF TECHNOLOGY.

(6) MECHANICS OF SUSPENDED LOAD TRANSPORTATION.

(b) Laboratory project.
(c) Dr. Vito A. Vanoni, Hydrodynamics Laboratories, California Institute of Technology, Pasadena 4, California.
(d) Experimental; basic research; for thesis (professional degree and doctoral).
(e) To investigate the internal mechanics of transportation of suspended load in flowing water; the effects of the material in suspension upon the velocity distribution of the flow; the distribution of sediment in open channel flow.
(g) Some experiments have been made and analyzed, but report is not yet completed.

(7) TRANSPORTATION OF BED MATERIAL LOAD.

(b) Laboratory project.
(c) Dr. Vito A. Vanoni, Hydrodynamics Laboratories, California Institute of Technology, Pasadena 4, California.
(d) Experimental; basic research; for thesis (professional degree and doctoral).
(e) To determine a general relationship between the rate of sediment movement by a stream and the hydraulic factors. The work is being carried out in flumes designed especially for sediment transportation studies.

(8) DENSITY CURRENTS.

(b) Laboratory project.
(c) Dr. Vito A. Vanoni, Hydrodynamics Laboratories, California Institute of Technology, Pasadena 4, California.
(d) Experimental; basic research; for thesis (professional degree and doctoral).
(e) An investigation of density currents resulting from suspensions of fine sediments in reservoirs to establish principles governing their behavior.

(11) PIPE AND WIRE REVETMENT FOR STREAM CONTROL.

(b) U. S. Department of Agriculture, Soil Conservation Service.
(c) Dr. Vito A. Vanoni, Hydrodynamics Laboratories, California Institute of Technology, Pasadena 4, California.
(d) Field investigation, experimental; applied research.
(e) To obtain information upon which to base improvements in the design of pipe and wire revetments for streams. The study includes field investigations and laboratory experiments.
(f) Completed.
(h) "Field and laboratory studies of a pervious fence used as a stream bank revetment", by John T. O'Brien. Report being published by the U. S. Department of Agriculture, Soil Conservation Service.

(15) STUDIES OF CAVITATION PHENOMENA.

(b) Bureau of Ordnance and Office of Naval Research, Department of the Navy.
(c) Dr. Robert T. Knapp, Hydrodynamics Laboratories, California Institute of Technology, Pasadena 4, Calif.
(d) Experimental; basic research.
(e) Visual and photographic observations are made on bodies of revolution and on other shapes with a view to obtaining a physical picture of the cavitation phenomena. This work is being done in a water tunnel with a 14-inch diameter working section and a maximum velocity of 100 fps. Observations are made with motion pictures taken at rates as high as 30,000 frames per second. In addition to studying the growth and collapse of individual bubbles, a study is also being made of the various kinds of cavitation that have been observed in experiments made in the past. The objective of the latter study is to relate the types of cavitation to the physical conditions under which they occur.

(16) HYDRODYNAMIC FORCES ON SUBMERGED BODIES.

(b) Bureau of Ordnance, Department of the Navy.
(c) Mr. J. P. O'Neill, Hydrodynamics Laboratories, California Institute of Technology, Pasadena 4, Calif.
(d) Experimental; basic research.
(e) Forces on bodies of different shapes and designs are measured in water tunnels, and the important steady state and damping force coefficients are thus obtained. These results are then used to predict the dynamic behavior through analysis. Then a body can be designed to have the desired dynamic behavior by selecting a shape with the appropriate values of these coefficients. A 14-inch diameter high-speed water tunnel with a maximum velocity of 100 fps, a free surface water tunnel with a working section of 20 inches by 20 inches, with a maximum velocity of about 30 fps, with controlled pressure, and a launching tank where bodies can be launched from the air into the water at high speeds and the paths in the air and in the water observed photographically, are available for this work. The pressure of the air over the water in the launching tank can be controlled and its effect on the behavior of bodies during water entry studied.

(279) FLOW IN ROTATING CHANNELS.

(b) Office of Naval Research, Department of the Navy.
(c) Dr. D. A. Morelli, Hydrodynamics Laboratories, California Institute of Technology, Pasadena 4, Calif.
(d) Experimental and theoretical.
(e) The purpose is to determine the nature of the flow in rotating channels and the mechanism of energy transfer from fluid to rotor or vice versa with a view to the development of design methods for hydraulic machinery. A special laboratory has been constructed which has a high degree of flexibility. It is possible to study the characteristics of individual elements of hydraulic machines to determine their influence on the whole machine. The test rotors are milled to a high degree of precision in the laboratory out of transparent material where necessary for photographic observation, or cast and machined units are used.
Pressure and velocity measurements are made with Pitot tubes or by photographic techniques. The latter have been developed extensively so that it is possible to observe the detailed flow in the impeller passage in two and three dimensions by high-speed motion pictures.
(f) Studies are in progress to correlate the design of vanes for two-dimensional impellers with the pressure distributions on the vanes at various flow rates. Studies of the details of the flow are being continued.
(h) "Measured performance of pump impellers." W. C. Osborne and D. A. Morelli, Preprint No. 50-A-90. Annual Meeting of A.S.M.E., Nov. 26-Dec. 1, 1950.
"Head and flow observations on a high efficiency centrifugal pump impeller." W. C. Osborne and D. A. Morelli. Trans. A.S.M.E., Vol. 72, 1950, pp. 999-1006.
"Evaluation of a two dimensional centrifugal pump impeller." John H. Beveridge and D. A. Morelli. Preprint No. 50-A-147. Annual Meeting of A.S.M.E., Nov. 26-Dec. 1, 1950.

(803) DYNAMICS OF CAVITATION BUBBLES.

(b) Office of Naval Research, Department of the Navy.
(c) Dr. Milton S. Plesset, Hydrodynamics Laboratories, California Institute of Technology, Pasadena 4, Calif.
(d) Theoretical, basic research.
(e) Analytical study of cavitating flow and boiling of liquids. Dynamic behavior of cavitation bubbles, scaling laws for cavitating flow. Theory of tensile strength of liquids.
(h) "Scaling laws for cavitating flow", by M. S. Plesset and F. R. Gilmore. (No copies of this report available).
"Stability of gas bubbles in liquid-gas solutions", by P. S. Epstein and M. S. Plesset, Journal of Chemical Physics, Vol. 18, No. 11, Nov. 1950, pp. 1505-1509.

(804) EXPERIMENTS ON AIR NUCLEI IN LIQUIDS AS THEY AFFECT CAVITATION.

(b) Bureau of Ordnance and Office of Naval Research, Department of the Navy.
(c) Dr. Robert T. Knapp, Hydrodynamics Laboratories, California Institute of Technology, Pasadena 4, Calif.
(d) Experimental; basic research.
(e) Cavitation and boiling experiments are being conducted with water which has been subjected to high pressure for known periods of time. The temperatures at which boiling starts are observed and the incipient cavitation parameter for a known shape is determined in a small water tunnel constructed specially for these studies. Observations are made visually and with high-speed motion pictures.
(g) A set of boiling experiments has been completed and a report of the results is being prepared.

(805) DYNAMICS OF PARTICULATE MATTER IN FLUID SUSPENSIONS.

(b) U. S. Air Forces.
(c) Dr. Vito A. Vanoni, Hydrodynamics Laboratories, California Institute of Technology, Pasadena 4, Calif.
(d) Experimental and theoretical; basic research.
(e) Studies are being made of the transportation of solid particles by turbulent flows. The experimental studies are being carried on in an existing water tunnel by means of observation of tracers whose density can be varied so that it is greater, equal to, or less than the water. A special water tunnel (low turbulence) with a working section 12 inches by 12 inches is being constructed for further experiments.
(g) Analytical studies are progressing and the new water tunnel is about 75% completed.
(h) "Theoretical considerations on turbulent diffusion and sedimentation", by Irving Michelson, Report N-71. Available on loan.

(806) HYDRODYNAMICS OF CENTRIFUGAL AND PROPELLER PUMPS, TURBINES, AND ALLIED FLOW PROBLEMS.

(b) Laboratory project.
(c) Dr. Robert T. Knapp, Hydrodynamics Laboratories, California Institute of Technology, Pasadena 4, Calif.
(d) Basic and precise research; thesis for M. E. degree.
(e) The Hydraulic Machinery Laboratory is designed for carrying out basic and precise research studies in the hydrodynamics of centrifugal and propeller pumps, turbines, and allied flow problems. Horizontal dynamometers up to 450 horsepower and a vertical one up to 30 horsepower are available with precision speed controls. Accurate instruments for measuring pressures, flow rates, speeds, and torques are provided. Special equipment for the study of cavitation has been developed.
(f) Full characteristics of axial and mixed flow deepwell pumps are being determined.
(g) Completed results which will permit visualization of the complete characteristics in function of specific speed will be available soon.

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(807) INVESTIGATION OF WAVES.

(b) Bureau of Yards and Docks, Department of the Navy.
(c) Dr. Robert T. Knapp, Hydrodynamics Laboratories, California Institute of Technology, Pasadena 4, Calif.
(d) Basic laboratory investigation.
(e) The behavior of waves in the presence of specified anomalies in the fluid regime or boundaries is the subject of both experimental and theoretical investigation. The types of anomalies investigated include: change of fluid density, change of fluid compressibility, fluid flow opposing the wave motion, and baffle-like discontinuities in the lower fluid boundary.
(f) Completed.
(g) Discontinuities consisting of small changes in density or compressibility of the fluid act as very weak reflectors of surface waves. Where this discontinuity is due to the presence of air bubbles in the fluid, the effect of density change is of much greater importance than compressibility change.
The change in wave length of surface waves in the presence of opposing surface currents may be accurately calculated by considering only the constancy of wave period in the undisturbed region and in the current.
(h) "Mobile breakwater investigations", by John H. Carr, available on loan.

(808) EXPERIMENTAL STUDIES FOR HARBOR DEVELOPMENT.

(b) Bureau of Yards and Docks, Department of the Navy.
(c) Mr. John H. Carr, Hydraulic Structures Laboratory, California Institute of Technology, Pasadena 4, Calif.
(d) Basic laboratory investigation.
(e) The penetration of wave energy into harbors, and the distribution of such energy within harbors will be investigated with the aim of determining some general principles of harbor design. The significance of reflection, refraction, and diffraction in these problems will be particularly investigated.
(g) Experimental verification has been obtained for the theoretical results of Morse and Rubenstein (Physical Review, 54, pp. 895-8, Dec. 1938), for the diffraction of waves by slits of dimensions comparable to a wave length.

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UNIVERSITY OF CALIFORNIA, College of Agriculture, Division of Irrigation.

(19) THE EFFECT OF THE DEPTH OF WATER TABLE UPON THE ABILITY OF PLANTS TO EXTRACT WATER.

(b) California Agricultural Experiment Station.
(c) Dr. Robert M. Hagan, Division of Irrigation, College of Agriculture, University of California, Davis, Calif.
(d) Field and laboratory investigation; basic and applied research.
(e) Studies conducted on behavior of plants grown on waterlogged soils and on soils with controlled water tables during crop season.
(g) Work will yield information of value in analyzing cropping problems associated with high water tables.

(20) MOVEMENT OF WATER THROUGH SOILS.

(b) California Agricultural Experiment Station.
(c) Dr. F. J. Veihmeyer, Division of Irrigation, College of Agriculture, University of California, Davis, Calif.
(d) Field and laboratory investigation; applied research.
(e) The ability of the soil to supply water to plants through capillary movement and the movement of water through soils is being studied under various conditions.
(g) Studies are continuing on fundamentals on plant-soil-water relationships.

(h) "Spread of apricot roots." A. H. Hendrickson and F. J. Veihmeyer, California Agriculture, 4 (7): 11, July, 1950.
"Soil moisture in relation to plant growth." F. J. Veihmeyer and A. H. Hendrickson, Ann. Review of Plant Physiol. 1: 285-304, 1950.
"How much water does a fruit tree need?" F. J. Veihmeyer and A. H. Hendrickson, Amer. Fruit Grower, 70 (6): 12, 36-37, 1950.

(21) STUDY OF HYDRAULICS OF SPRINKLING SYSTEMS.

(b) California Agricultural Experiment Station.
(c) Prof. C. N. Johnston, Division of Irrigation, College of Agriculture, University of California, Davis, Calif.
(d) Experimental; operation.
(e) Determination of the characteristics of jets and the distribution of water from sprinklers. Studies of evaporation from sprinkler jets to determine operation losses.
(g) Facilities available permit high speed photographs of sprinkler jets in order to record characteristics of these streams.
(h) "Sprinkling for irrigation." F. J. Veihmeyer, Your Farm, 7: 31-45, 1949.
"Sprinkling for irrigation." F. J. Veihmeyer, Amer. Fruit Grower, 69 (6): 10-11, 29, 35, 1949.

(22) STUDY OF THERMODYNAMICS OF SOIL MOISTURE.

(b) California Agricultural Experiment Station.
(c) Dr. Robert M. Hagan, Division of Irrigation, College of Agriculture, University of California, Davis, California.
(d) Field and laboratory; basic research.
(e) The ability of soil to supply water to plants, and methods of measuring free energy or potential of soil moisture are being studied.
(g) The effect of soluble material added to soils on the potentials of soil moisture is being studied. Results to date indicate that applications of materials within limits practical under commercial practice do not affect the permanent wilting percentage.
(h) "Irrigation experiments with apricots." A. H. Hendrickson and F. J. Veihmeyer, Amer. Soc. Hort. Sci., Proc. 55: 1-10, 1950.
"Responses of fruit trees and vines to soil moisture." F. J. Veihmeyer and A. H. Hendrickson, Amer. Soc. Hort. Sci., Proc. 55: 11-15, 1950.
"Essentials of irrigation and cultivation of orchards." F. J. Veihmeyer and A. H. Hendrickson, Calif. Agri. Ext. Circ. 50, Rev. 1950.

(23) HYDROLOGY OF IRRIGATION SUPPLIES IN CALIFORNIA.

(b) California Agricultural Experiment Station.
(c) Dr. F. J. Veihmeyer, Division of Irrigation, College of Agriculture, University of California, Davis, Calif.
(d) Experimental; applied research.
(e) Studies are being continued on the effects of denudation of watersheds upon the water regimen of typical grazing areas in California. Experimental watersheds and paired plots are located in various counties of California. Soil-moisture histories are obtained from plots from which the brush has been removed by denudation or burning and adjacent plots which are left with original vegetative cover. Laboratory studies of vegetable denudation have been initiated.
(g) Work will be continued for a number of years in connection with the removal of vegetation to permit growth of forage plants and its effect on runoff and erosion. To date, burning of brush has not accelerated erosion or runoff on the areas tested.
(h) "Soil moisture, runoff, erosion." F. J. Veihmeyer, Calif. Agriculture, 4 (10): 8-9, 13, 1950.

(24) MEASUREMENT OF IRRIGATION WATER AND IMPROVEMENT IN FARM IRRIGATION STRUCTURES.

(b) California Agricultural Experiment Station.
(c) Professor C. N. Johnston, Division of Irrigation, College of Agriculture, University of California, Davis, Calif.
(d) Experimental; design.
(e) Hydraulics of irrigation systems to better the design and efficiency of irrigation structures and equipment are being studied. Investigations are being conducted on concrete pipe to establish fitting coefficients for flow in concrete pipes with valves attached so that better design of these systems will result. Field studies are in progress to investigate drilling technique and casing production in deep wells when the quality of water has a corrosive effect. Prefabricated canal linings are being tested in small farm ditches. Calibration of gated concrete turnouts is being made.
(h) "Studies of pressure head losses in concrete risers and alfalfa valves". V. H. Scott, Agricultural Engin. 31 (6): 292, 294, 1950.

(25) PHYSICAL AND CHEMICAL FACTORS AFFECTING SOIL INFILTRATION RATES.

(b) California Agricultural Experiment Station.
(c) Dr. L. D. Doneen, Division of Irrigation, College of Agriculture, University of California, Davis, Calif.
(d) Field and laboratory; basic and applied research.
(e) Soil infiltration rates are being studied with particular reference to quality of water applied. Soil infiltration rates are being determined by various types of infiltrometers.
(g) Application of gypsum to irrigation water containing 50% or more sodium results in increased depth of penetration.
(h) "The use of gypsum in irrigation water". J. D. Actell and L. D. Doneen, Better Crops with Plant Food, 33: 16-18, 42-45, 1949.

UNIVERSITY OF CALIFORNIA, College of Agriculture, Division of Irrigation and Soils.

Inquiries concerning Projects Nos. 26, 27, 29, and 1058 should be addressed to Prof. M. R. Huberty, Chairman, Division of Irrigation and Soils, University of California, Los Angeles 24, Calif.

(26) DRAINAGE INVESTIGATIONS IN COACHELLA VALLEY, CALIFORNIA.

(b) Work cooperative between the Coachella Valley County Water District, Coachella, Calif., U. S. Regional Salinity and Rubidoux Laboratories, Riverside, Calif.; the U. S. Bureau of Reclamation, Boulder City, Nevada; and the California Agricultural Experiment Station, Los Angeles 24, Calif.
(d) Field investigations; applied research and design.
(e) The purpose is to develop and improve techniques for observing shallow ground water movement, for reclamation of saline soils, and for installation of drainage devices and systems.
(g) Results to date summarized in publication below.
(h) "Techniques for drainage investigations in Coachella Valley, California", J. S. Reger, A. F. Pillsbury, R. C. Reeve, and R. K. Petersen, Agric. Engr. (in press).

(27) HYDROLOGY OF IRRIGATION SUPPLIES IN CALIFORNIA.

(b) Laboratory project, coordinated with similar work by the Station under F. J. Veihmeyer, College of Agriculture, Davis, California. (Project 23, page 7).
(d) Field experiments; applied research.
(e) Purpose is to evaluate effects of watershed burning on runoff and erosion in southern California.
(g) Data for the past year scant because of light rainfall.

(29) FARM IRRIGATION STRUCTURES.

(b) Laboratory project, coordinated with similar work by the Station under F. J. Veihmeyer, College of Agriculture, Davis, Calif. (Project 24, page 8).
(d) Field and laboratory investigations; applied research and design.
(e) Improvement in the design and operating performance of irrigation distribution systems, control structures, and sprinkling systems.
(f) A continuing project, only one phase now active.
(g) Some investigations of the wetting expansion failure of plain concrete irrigation pipe have been completed. Investigations are underway on the operating characteristics of several types of pipe distribution systems.
(h) "Studies on the wetting-expansion failure of plain concrete irrigation pipe." A. F. Pillsbury and M. L. Hood. Tech. memo. of Division of Irrigation and Soils, University of California, Los Angeles 24, California (mimeo.) Copies available.
"Studies on the failure of plain concrete irrigation pipe systems." A. F. Pillsbury. Agric. Engineering (in press).
"What type concrete pipe irrigation distribution systems?" A. F. Pillsbury. Western Construction, Vol. 25, No. 9, September, 1950, pp. 90-92.

(1058) MOVEMENT OF WATER THROUGH SOILS.

(b) Laboratory project (Project 28 in Vol. 14); coordinated with similar work of the Station under F. J. Veihmeyer, College of Agriculture, Davis, Calif. (Project 20, page 6).
(d) Continuing field and laboratory studies; basic and applied research.
(e) Factors affecting both saturated and non-saturated flow of water into and through soils.
(g) Work on some field plots has been completed, and results are being summarized.
(h) "Effects of particle size and temperature on the permeability of sand to water." by A. F. Pillsbury. Soil Science (in press).

UNIVERSITY OF CALIFORNIA, College of Engineering, Fluid Mechanics Laboratory.

Inquiries concerning Projects Nos. 32, 35, 38, 39, 40, 41, 43, 46, 47, 280, 282, 526, 528, 529, 530, 810 to 813, incl., and 1059 to 1064, incl., should be addressed to Prof. J. W. Johnson, Department of Engineering, University of California, Berkeley 4, Calif.

(32) ENERGY LOSSES IN INTERSECTING STREAMS IN CLOSED CONDUITS.

(b) Laboratory project.
(d) Experimental for Master's thesis.
(e) Energy losses at the junction of pipes of various sizes, junction angles, and discharge ratios are being obtained experimentally, to be correlated for application in the design of flow circuits. Tests with water in converging flow in right-angle miter tees have been completed. These include a 6-inch by 6-inch welded tee, a 6-inch by 4-inch welded tee, and a 2-inch by 2-inch plastic tee. Data have also been obtained on the 2-inch by 2-inch plastic tee for diverging flow.
(g) A summary report, now being prepared, will include the results of (e) above and those available in the literature.

(35) OSCILLATORY WAVES.

(b) Laboratory projects.
(d) Experimental.
(e) To obtain experimental information on the details of oscillatory waves in shallow water, experiments are being conducted in a wave channel 60 feet long, 3 feet deep, and 1 foot wide. Wave velocity, period, length, height, mass transport, and orbital velocities through depth and length of channel will be measured and compared with theory. Change in wave characteristics will be studied when the waves pass over various types of bottom discontinuities and through various dampening devices.
(f) Two graduate theses in progress.

(38) STRUCTURES EXPOSED TO WAVE ACTION.

(b) Laboratory research, The California Company, Bureau of Yards and Docks, International Marine Platform Constructors.
(d) Experimental.
(e) To obtain experimental data for the design and location of such shore protection works as groins, jetties, piers, and bulkheads. Present work involves the measurement of forces exerted on model structural elements subjected to wave action.
(h) "The force exerted by surface waves on piles." J. R. Morison, M. P. O'Brien, J. W. Johnson, and S. A. Schaaf. Petroleum Transactions, AIME, Vol. 189, 1950, pp. 149-154.
"Moment distribution on a stepped caisson." J. R. Morison, Series 35-Issue 1, June 16, 1950.
"The forces exerted by waves on marine structures." J. R. Morison, Series 35-Issue 3, October 20, 1950.

(39) BEHAVIOR OF TWO-PHASE FLUIDS IN POROUS MEDIA.

(b) Laboratory project.
(d) Experimental and theoretical research; Ph. D. and M. S. thesis.
(e) To determine the nature and importance of the departure from equilibrium conditions for single and multiple component fluids which move through porous media under pressure gradients and which undergo a gradual phase change during the process. Single component fluids, including water, ammonia, and propane, are made to flow through uniformly packed, unidirectional, insulated sand columns. The fluids enter as a single liquid-phase but experience a phase change as lower pressures are encountered downstream. Measurements are made of pressure, temperature, and liquid saturation as a function of distance. The theoretical investigation is being based on reaction rate considerations.
(f) Work involving single component fluid has been completed. The above procedure is now being applied to the methane-crystal oil system. One M. S. thesis in progress.
(h) "Equilibrium considerations in two-phase flow of hydrocarbons through unconsolidated sand." J. A. Putnam and H. H. Aboul-Seoud. (In preparation).
"Steady flow of two-phase single component fluids through porous media." F. G. Miller, Presented before AIME Petroleum Branch, Los Angeles, October 1950 (proposed for publication in AIME Journal of Petr. Tech.).

(40) FLOW CHARACTERISTICS OF SOLIDS-GASEOUS MIXTURES IN A HORIZONTAL AND VERTICAL CONDUIT.

(b) Laboratory project. Supported in part by Research Corporation.
(d) Experimental; basic and applied research, design.
(e) The isothermal flow characteristics of a solids-gaseous mixture ($Al_2O_3$, $SiO_3$ catalyst, and air) are investigated in a 17 mm I. D. horizontal and vertical glass conduit for various air flow and solids flow rates. Pressure drops across test sections 2.0 feet in length are accurately measured for a series of air flow rates in which the solids to air ratio is varied from zero to 11.0 pounds of solids per pound of air. The solids (catalyst) are introduced into the flow system through a mixing nozzle fed by a slide valve controlled weighing tank, and have a size distribution varying from particles less than 10 microns to particles greater than 220 microns. Air velocities in the solids-free approach section vary from 50 fps to 150 fps.
(g) Experimental data being correlated on the metering of mixtures. Design of equipment underway for the study of the heat transfer characteristics of mixtures.

(41) PRESSURE DROP ACCOMPANYING TWO-PHASE, TWO-COMPONENT FLOW IN PIPES.

(b) Laboratory project.
(d) Theoretical and experimental; graduate theses.
(e) To determine the transition conditions under which the gas and/or liquid phases are flowing in viscous and/or turbulent motion or in slug flow for isothermal flow in horizontal and vertical pipes. Mixtures of air and various liquids are made to flow through vertical tubes. Pressure drop and fluid distribution with consideration of flow stability are determined for a range of liquid and gas rates which may be controlled separately.
(f) Some theoretical work is completed. Six graduate theses completed. Experimental and theoretical work still in progress.

(43) A PITOT TUBE STANDARD FOR FLOW MEASUREMENT.

(b) In cooperation with Turbine Pump Manufacturers Association.
(d) Experimental; applied research and development, M. S. thesis.
(e) The project is to design, construct, and calibrate a suitable Pitot tube for use with a standard code (to be developed) for application under a variety of field conditions.
(g) A test stand composed of different sizes of pipe between 4 inches and 10 inches has been installed and pressure gages are now being constructed in order that accurate pressure differentials may be determined rapidly. A series of velocity distributions have been obtained and the data analyzed in terms of free stream Pitot tube coefficients. No significant further work has been done.

(46) THE MEASUREMENT OF TURBULENT VELOCITY COMPONENTS BY THE METHOD OF ELECTROMAGNETIC INDUCTION.

(b) Laboratory project.
(d) Experimental and theoretical investigations; faculty research.
(e) To measure the components of turbulent velocity fluctuations in the axisymmetric flow of a liquid in a tube as a function of position and flow rate. Velocity fluctuations are measured by determining the potentials induced in water cutting transversely across a steady magnetic field. An electrical probe consisting of two closely spaced fine wires is arranged to traverse the pipe cross section in the fluctuating potential gradient. The electrical impulses of the probe are amplified and measured by means of a thermal milliammeter.

(47) GRAVITY WAVES AND RELATED PHENOMENA.

(b) Office of Naval Research and Bureau of Yards and Docks, Department of the Navy.
(d) Theoretical and laboratory investigation; basic research.
(e) To develop methods of forecasting wind waves and swell, surf conditions, and beach changes; measurement of wave characteristics; and make laboratory investigations to provide experimental checks and other information. A wave channel, model basin, and other facilities are used in the laboratory investigations.
(h) "Relationships between wind and waves, Abbotts Lagoon, California." J. W. Johnson, Trans. Amer. Geophys. Union, Vol. 31, No. 3, pp. 386-392, June 1950.
"Experimental study of surface waves in shoaling water." R. L. Wiegel, Trans. Amer. Geophys. Union, Vol. 31, No. 3, pp. 377-385, June 1950.
"The thermopile wave meter." J. D. Isaacs and R. L. Wiegel, Trans. Amer. Geophys. Union, Vol. 31, No. 5, pp. 711-716, October 1950.
"Southern swell observed at Oceanside,California." R. L. Wiegel and H. L. Kimberly, Trans. Amer. Geophys. Union, Vol. 31, No. 5, pp. 717-722, October 1950.
"Elements of wave theory", J. W. Johnson, Inst. on Coastal Engineering, October 1950.
"Wave recorders and data." Frank E. Snodgrass, Inst. on Coastal Engineering, October 1950.
"Estimating quantities of sediment supplied by streams to a coast." H. A. Einstein, Inst. on Coastal Engineering, October 1950.
"Design of piling." J. R. Morison, Inst. on Coastal Engineering, October 1950.
"Coastal sediment problems." J. W. Johnson, Engineering Hydraulics, 1st Ed., John Wiley & Sons, 1950, pp. 834-842.
"Engineering aspects of diffraction and refraction." J. W. Johnson, A. S. C. E. Annual Meeting, New York, January 1950.

(280) SEDIMENT TRANSPORT.

(b) Laboratory project.
(d) Experimental and theoretical; doctoral thesis.
(e) Determination of the transport characteristics in the transition sizes between bed load and wash load.

(282) EFFECT OF RATE OF FLOW ON RELATIVE PERMEABILITY IN MULTIPHASE FLOW IN POROUS MEDIA.

(b) Sponsored by American Petroleum Institute.
(d) Theoretical and experimental investigations. Graduate theses.
(e) To determine the effect of rate of flow on relative permeability over a wide range of pressure gradient when all other variables are controlled. The effects of hysteresis due to changing flow rate and saturation also are being investigated. Macroscopic behavior to be investigated from microscopic point of view. Mixtures of brine and hydrocarbon liquid are made to flow under steady flow conditions through artificially prepared consolidated cores. Phase saturations are determined by changes in X-ray absorption.
(h) "Determination of fluid saturation in porous media by ultrasonic transmission." E. G. Keller, O. J. M. Smith, and J. A. Putnam, AIME Journal of Petr. Tech. (in press). "A relative permeability study." S. M. Roberts, M. S. Thesis, June 1950.

(526) CALIBRATION OF THICK ASME NOZZLES.

(b) In cooperation with the ASME Fluid Meters Committee.
(d) Experimental.
(e) An experimental calibration of standard ASME nozzles with variable external dimensions for a series of downstream pressure taps. Standard ASME nozzles have been increased in their external dimensions so that a small clearance exists between the nozzle and pipe in which the nozzle is installed. Hydraulic grade lines are measured at several points downstream from the nozzle entrance for a series of different clearances between the nozzle and the pipe. Results are expressed in terms of the differential pressure across corner taps.
(f) Completed.
(g) Experimental data indicate little effect on nozzle discharge coefficients in the region upstream from the nozzle outlet. Downstream, a noticeable change in coefficients takes place.
(h) "Determination of ASME nozzle coefficients for variable external dimensions." R. G. Folsom, Trans. ASME, Vol. 72, pp. 651-654, July 1950.

(528) WAVES AND SURGES IN APRA HARBOR, GUAM, M. I.

(b) Bureau of Yards and Docks, Washington, D. C.
(d) Applied research and development.
(e) Waves and surges that exist, both inside and outside Apra Harbor, were measured by wave recorders and photographic methods and correlated with the atmospheric disturbances causing these phenomena.
(f) Completed.
(h) "Summary report on wave measurements on Apra Harbor, Guam, Marianas Islands." A. J. Chinn and E. W. Winkler, Series No. 26-Issue No. 3, August 1950.

(529) LITTORAL SEDIMENT FLOW ON A BEACH.

(b) Beach Erosion Board, Washington, D. C.
(d) Experimental research.
(e) On a model beach, the motion of sand is studied under wave action. Determination of the littoral drift as a function of direction, height, and period of waves. Development of devices measuring drift of water and sediment. Study of the influence of structures. such as groins. Supplementing the model studies is a field study of littoral transport at Santa Barbara. The procedure is to periodically measure the accumulation of sand in Santa Barbara Harbor and then relate the average transport of sand to measured wave characteristics.
(h) "Model study of sand transport along an infinitely long, straight beach." Thorndike Saville, Jr., Trans. Amer. Geophys. Union, Vol. 31, No. 4, August 1950.

(530) PARTICLE SEGREGATION ON DEGRADING SEDIMENT BEDS.

(b) Laboratory research and Corps of Engineers, Department of the Army.
(d) Basic research, experimental and theoretical.
(e) Study of the behavior of different particles in a moving sediment mixture. In a 1-foot wide flume, later probably in a wider channel, transport of mixtures is measured under conditions of scour and compared with existing theories.
(f) Completed.
(h) "The segregation of grain sizes in a degrading bed." A. S. Harrison, Report and Master Thesis, University of California, 1950.

(810) VERTICAL SHAFT PUMP SUCTION REQUIREMENTS.

(b) Peerless Pump Division of the Food Machinery Corporation.
(d) Experimental; applied research.
(e) An investigation on the quantity of air pumped by vortices formed in the suction bay of typical vertical shaft pump suction arrangements. Special equipment is installed in the discharge line from the pump in order to measure the quantity of air being pumped in terms of the quantity of water. Visual observations were made and recorded regarding vortex formation and size under different conditions of geometry and submergence.
(f) The testing has been completed and a report is in the process of being written.
(g) The results of the model and full scale test agree approximately. Both indicate possibilities of a 10 to 1 ratio in the quantity of air pumped over a relatively small range in changes in geometry. The report will be preliminary in nature but will provide some approximate limiting conditions suitable for good design procedures.

(811) STUDY OF DETACHED SHOCK WAVES.

(b) Laboratory study.
(d) Experimental; for graduate thesis.
(e) To study the behavior of detached shock waves by open-surface analogy and to check existing theories. The shock waves are obtained by towing wedges of different angles through still water.
(f) Completed.
(g) "A study of detached shock waves by the water channel-compressible gas-analogy." J. L. Hedgecock, Master of Science thesis, University of California, 1950.

(812) REVETMENT STUDY.

(b) Corps of Engineers, Department of the Army.
(d) Experimental.
(e) To find proper spacing of permeable revetment structures in river bends, especially the Salinas River, California.
(f) Completed.
(h) "Investigation of the fundamentals of the action of river training structures." H. A. Einstein, Inst. of Engr. Research, Series No. 31, July 1950.

(813) FLUID RESISTANCE IN ACCELERATED MOTION.

(b) Laboratory project.
(d) Experimental.
(e) The fluid resistance of bodies subjected to accelerated motion is being studied. Data have been obtained for flat circular disks moving through water with the plane of the disk perpendicular to the direction of motion. A drag coefficient has been developed in terms of a correlative modulus that includes the acceleration of the system. A continuation with other bodies is planned.
(h) "A correlating modulus for fluid resistance in accelerated motion." H. W. Iversen and R. Balent. Report No. He-116-314, June 1950. Wave Investigations Technical Report, Fluid Mechanics Laboratory, University of California, Berkeley. Office of Naval Research, U. S. Navy, Contract N7onr-29528.

(1059) HEAT TRANSFER AND PRESSURE DROP IN COOLING TOWERS.

(b) American Society of Heating and Ventilating Engineers; Laboratory research.
(d) Experimental and analytical.
(e) To determine the heat transfer from water in contact with air in a mechanical draft, packed cooling tower as a function of water rate, air rate, water temperature, and packing geometry.
To determine the pressure drop as a function of the above-mentioned variables.
(g) Several results have been obtained.
(h) "The internal performance of an induced draft packed cooling tower." N. W. Snyder, Heating, Piping and Air Conditioning, February 1949.
"The cooling of a freely falling water drop." N. W. Snyder, Ph. D. Thesis, 1947.
"The effect of packing variation on cooling tower performance." R. Erskine, Master's Thesis, 1949.
"The analytical prediction of cooling tower performance." E. Gallagher, Master's Thesis, 1949.
"Drop size distribution in a packed cooling tower." A. J. Okuno, Master's Thesis, 1949.
"Performance of a mechanically induced draft cooling packed tower." A. L. London, W. F. Mason, L. M. K. Boelter, Trans. ASME, 62, 41 (1940).
"Spray nozzle performance in a cooling tower." L. M. K. Boelter, S. Hori, J. Amer. Soc. Heat. and Vent. Engrs., May 1943.

(1060) MASS TRANSFER TO RISING BUBBLES AND ON BUBBLE PLATES.

(b) Laboratory research.
(d) Experimental and analytical.
(e) A study of diffusion to bubbles and mass of bubbles.
(g) Some equipment has been completed. No testing as yet.

(1061) STREAMFLOW DISTRIBUTION OF SELECTED PACIFIC COAST BASINS IN CALIFORNIA.

(b) Laboratory research.
(d) Basic research; analysis of available data.
(e) Development and analysis of flow-duration curves for representative drainage areas in order to relate shapes and slopes of the curves to known physical factors.
(g) Compilation of flow duration curves largely completed.

(1062) STUDY OF THE EFFECT OF ACCELERATION ON SHOCK WAVE FORMATION.

(b) Laboratory study.
(d) Experimental.
(e) A wedge is towed through still water at various velocities and accelerations. The resulting shock wave pattern is observed and analyzed.
(g) "An experimental investigation of transonic and accelerated supersonic flow by hydraulic analogy." E. V. Laitone, University of California, Department of Mechanical Engineering, Report Series No. 3, Issue No. 315, July 3, 1950.

(1063) FRICTIONAL EFFECT OF SMALL CROSS SILLS IN SEDIMENT CARRYING CHANNELS.

(b) U. S. Department of Agriculture, Soil Conservation Service.
(d) Experimental.
(e) The frictional effect of the structures is measured by comparison with the same channel without the structures at equal flow and sediment transport conditions.

(1064) SINGLE VORTEX IN A REAL FLUID.

(b) Yosemite Chemical Company, San Francisco.
(d) Experimental and analytical.
(e) The effect of friction on 8 single vortices is studied to devise methods of preventing their development in front of pump intakes.

UNIVERSITY OF CALIFORNIA, Department of Engineering, Los Angeles.

Inquiries concerning Projects Nos. 48, and 1065 to 1067, incl., should be addressed to Prof. L. M. K. Boelter, Department of Engineering, University of California, Los Angeles 24, California.

(48) FOG NOZZLE STUDIES.

(b) Forest Service, Department of Agriculture.
(d) Experimental.
(e) Evaluation of the hydraulic characteristics of several commercially available fire-fighting nozzles of the spray or fog type. Pressure-discharge characteristics, trajectories, and cross-sectional distribution of water in the spray were measured.
(f) Completed.
(g) The characteristics of ten nozzle types under a wide variety of conditions were determined.
(h) Unpublished report submitted to the Fire Control Equipment Development Center, U. S. Forest Service, Arcadia, California.

(1065) FIRE CONTROL RESEARCH.

(b) Forest Service, Department of Agriculture.
(d) Theoretical and experimental.
(e) Investigation into the effect of the discharge of spray nozzles on wood fires to determine how water, wetting agents, and various chemicals can best be applied in forest fire suppression.
(f) Completed.
(g) A very rough measure of the comparative suppression effectiveness of sprays of the various wetting agent solutions and water revealed little difference in their ability to quench the flames; however, rekindling always took place after the application of the water spray, but was practically eliminated after the application of the wetting agent spray.
(h) Two unpublished reports submitted to the California Forest and Range Experiment Station, Berkeley, California. Paper presented at annual meeting of the ASME, New York, Nov. 27-Dec. 1, 1950.

(1066) DROPLET DYNAMICS.

(b) Laboratory project.
(d) Theoretical and experimental.
(e) The mechanics of disintegration of a single small jet of water is under consideration.
(f) Equipment being assembled.

(1067) FLOW OF WATER IN TUBES AT EXTREMELY HIGH CONDITIONS OF PRESSURE TEMPERATURE AND HEAT FLUX.

(b) Atomic Energy Commission.
(d) Theoretical and experimental.
(e) The purpose is to study pressure drop, heat flux, and density in a circular stainless steel tube at extreme conditions of pressure, temperature, and heat flux.
(g) Data on pressure drop and densities have been obtained at heat fluxes up to 3,000,000 Btu per hr per sq ft at pressure up to 2500 psi, with and without surface boiling.
(h) Report to the Atomic Energy Commission in preparation, as are several papers for publication.

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UNIVERSITY OF SOUTHERN CALIFORNIA, Hydraulic Laboratory, School of Engineering.

(531) CREATION OF ARTIFICIAL RAIN TO STUDY RUNOFF FROM AIRPORT RUNWAYS.

(b) Laboratory project; in cooperation with Los Angeles District, Corps of Engineers.

(c) Dr. K. C. Reynolds, University of Southern California, Los Angeles 7, Calif.
(d) Experimental; for design and for M. S. theses.
(e) Tests are being conducted in a uniformly sloping channel 3 feet wide and 42 feet long. The prototype channels are located at the Santa Monica Airport, Santa Monica, Calif. The factors which affect the creation of artificial rain and which would influence runoff from airport runways are being investigated by analyzing the runoff hydrograph.
(f) Effect of rain distribution, droplet size, and wind on the runoff hydrograph are being investigated currently at the laboratory, and influence of rain distribution and droplet size at the Santa Monica Airport.
(h) Master's thesis in preparation by J. S. Guzman and A. A. Cohan on effect of rain distribution and droplet size on the runoff hydrograph, and by W. J. Moffitt on effect of wind on the runoff hydrograph.

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UNIVERSITY OF SOUTHERN CALIFORNIA, Research Foundation for Cross-Connection Control.

(49) RESEARCH FOUNDATION FOR CROSS-CONNECTION CONTROL.

(b) Laboratory project.
(c) Dr. Robert E. Vivian, Director; Dr. Kenneth C. Reynolds, Supervisor, Research Foundation for Cross-Connection Control, University of Southern California, Los Angeles 7, Calif.
(d) Experimental research and field investigations; basic research.
(e) To supplement and evaluate existing information on mechanical backflow prevention devices operating under constant line pressure, to perform laboratory acceptance tests on all pressure types of backflow prevention devices.
(f) A limited number of laboratory acceptance tests are being performed, particularly on backflow preventers 2 inches and larger.
(g) Four and a half years have been devoted to field and laboratory research.

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CARNEGIE INSTITUTE OF TECHNOLOGY, Department of Civil Engineering.

Inquiries concerning Projects Nos. 1068-1071 should be addressed to Prof. F. T. Mavis, Carnegie Institute of Technology, Pittsburgh 13, Pa.

(1068) MOVEMENT OF GRANULAR MATERIAL BY FLOWING WATER.

(b) Laboratory project.
(d) Experimental; for master's thesis.
(e) Tests of unigranular cohesionless beds located in a transparent channel indicate that "near-bottom" velocity, or some function of it, may be a satisfactory criterion of the beginning of bed movement.
(g) Work is being continued on a study of the effect of the "near-bottom" velocity gradient as well as the velocity.
(h) "Movement of granular material by flowing water, competent velocity and velocity gradient for sand." Gershon Kulin, Master's Thesis, Carnegie Institute of Technology, June, 1950.

(1069) HYDRAULICS OF SHORT SEMI-CIRCULAR CONDUITS.

(b) Laboratory project.
(d) Experimental; for master's thesis.
(e) A semi-circular conduit of transparent lucite was used to study the relationship between the hydraulic properties of short conduits and their cross-sectional shape. The experiments cover a range of conditions--part full and full; free and submerged. The data can be applied to conduits of any cross-section.
(f) Completed.

(g) The semi-circular shape was particularly adaptable to such studies since a rotation of the conduit provided a variety of differently oriented cross-sections which can be compared with a circular cross-section. Previous data on pipe flow can thus be utilized.
(h) "Hydraulics of short semi-circular conduits." Thomas E. Stelson, Master's Thesis, Carnegie Institute of Technology, June, 1950.

(1070) SUBMERGED WEIRS.

(b) Laboratory project.
(d) Experimental; for master's thesis.
(e) Models of broad-crested weirs, sills, and controls were tested free and submerged. Discharge was related to headwater and tailwater stages and to the profile of the control by methods previously developed for sharp-crested weirs.
(f) Suspended.
(h) "Submerged board-crested weirs of rectangular section." James B. Conyers, Master's Thesis, Carnegie Institute of Technology, June, 1950.

(1071) FLUID TURBULENCE.

(b) Laboratory project.
(d) Experimental; for doctor's thesis.
(e) Instantaneous velocity components along the coordinate axes are being measured and recorded on an oscillograph. The chart record is used to determine the magnitude of turbulence and its importance in engineering applications. The turbulence is now being studied in a hydraulic jump in a glass-sided flume.

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COLORADO A & M COLLEGE, Department of Civil Engineering.

Inquiries concerning Projects Nos. 52, 535 to 539, incl., 822 to 828, incl., and 1072 to 1075, incl., should be addressed to Prof. Maurice L. Albertson, Head of Fluid Mechanics Research, Department of Civil Engineering, Colorado A & M College, Fort Collins, Colorado.

(52) HYDRAULIC SAND SEPARATOR.

(b) Laboratory project.
(d) Experimental; applied research.
(e) The purpose is to obtain data valuable in the design of hydraulic models, and to supply a means of separating sand and gravel where a narrow size range is desired.
(g) An apparatus has been designed and built which classifies sand according to fall velocity by a continuous flotation process. The process is purely dynamic in that sand is introduced directly into the flow. A check for duplication of results indicates that duplications within plus or minus one percent are obtained. At present construction of a pilot apparatus is being completed to perform sand separation on a continuous basis of operation. Preliminary tests indicate satisfactory results.

(53) SAND TRAPS AND SLUICEWAYS.

(b) Soil Conservation Service, Colorado Agricultural Experiment Station.
(c) R. L. Parshall, Soil Conservation Service, Colorado A & M College, Fort Collins, Colo.
(d) Experimental; applied research.
(e) To develop design data for sand traps using vortex tubes, riffles, and deflectors alone, or in combination, and to perfect the design for sluiceways having a relatively flat grade which will effectively transport the bed load material from sand traps to a point of disposal.

(f) Model studies at Bellvue Laboratory summer 1947, riffle deflector-vortex tube, scale 1:10 to base final design of this type of sand trap for Consolidated Irrigation District, main canal, Selma, California. In operation since April, 1948. Final designs are now being prepared for the construction of a riffle deflector-vortex tube type of sand trap for the Belmonte Hydroelectric Project, Bogota, Columbia, S. A.
(g) Investigations, laboratory and field, various designs of sand traps, show that the vortex tube, operated under favorable conditions has been successful. Installations of the riffle deflector-vortex tube sand traps, large size, have been efficient in removing the bed load.
(h) Various progress reports have been issued on the subject of sand traps. Final report under preparation.

(55) SNOW COURSE MEASUREMENTS AND FORECAST ANALYSIS.

(b) Soil Conservation Service, Bureau of Reclamation, State Engineer of New Mexico, and State Engineer of Wyoming.
(c) H. Stockwell, Soil Conservation Service, Colorado A & M College, Fort Collins, Colo.
(d) Field investigation; applied research.
(e) Systematic measurements of depths and water content of snow at high elevations in Colorado mountain areas for the purpose of forecasting the runoff of the principal rivers of the state in the interest of irrigation, power, domestic supplies, and other uses.
(g) Snow measurement data are correlated with runoff. Once the relationship is established, the snow measurement data are used to predict the runoff for the coming season.
(h) For 1950, Colorado Agricultural Experiment Station, Miscellaneous Series Papers Nos. 452, 453, 454, 458, 459, 460, 462, 463, 464, 467. 468, and 469. These are the monthly Snow Survey reports for the Rio Grande, Colorado and Platte-Arkansas Drainage Basin.

(56) FRICTION LOSSES IN PIPES AND FITTINGS USED IN IRRIGATION PUMPING PLANTS.

(b) Soil Conservation Service, Division of Irrigation and Water Conservation; Colorado Agricultural Experiment Station.
(c) C. H. Rohwer, Soil Conservation Service, Colorado A & M College, Fort Collins, Colo.
(d) Experimental; applied research.
(e) Friction losses through suction pipe inlets, foot valves, gate valves, strainers, and check valves were measured for various discharges.
(f) Completed.
(g) Bell entrances and strainers reduce the head loss. Foot valves cause a material increase in the suction lift. The losses through gate valves are small except when less than one-half open. Check valves do not restrict flow materially under normal conditions.
(h) "Friction losses in selected valves and fittings for irrigation pumping plants." Tech. Bul. 41, Colorado A & M College, May, 1950.

(57) PHOTOGRAPHIC METHOD FOR MAKING SNOW SURVEYS.

(b) Laboratory project.
(c) Maxwell Parshall, Colorado A & M College, Fort Collins, Colo.
(d) Field investigation; applied research.
(e) Photographs of snow cover on a particular area of Cache la Poudre watershed are made. Area of snow cover is correlated with annual runoff.
(g) Fairly good correlation has been obtained.

(287) PERFORMANCE OF WELL SCREENS.

(b) Colorado Agricultural Experiment Station, Soil Conservation Service, and various well screen manufacturers.
(c) C. H. Rohwer, Soil Conservation Service, Colorado A & M College, Fort Collins, Colo.
(d) Experimental; applied research.

(e) (1) Measurement of loss of head in different types of well screens of various diameters and screen openings for the range of discharges per foot of length of screen suitable for each screen. (2) Determination of the size of opening in well screens, diameter of screen, thickness of gravel envelope, and size and graduation of sand or gravel for most effective control of flow of sands of different finenesses into the well with least loss of head, and to determine the size of openings in well screens and diameter of screen for most efficient operation in natural sands and gravels of a given classification. (3) Preparation of a report.
(g) Major loss in well screen occurs inside screen, the loss through perforations is small except at high velocities. The percentage of screen openings and the size of perforations are apparently not important unless the total area of the openings is small.

535) FLOW IN CHANNELS OF DEFINITE ROUGHNESS.

(b) Laboratory project.
(d) Experimental; for design and for masters' theses.
(e) To supply experimental data on the flow of water through a channel of definite roughness. An attempt is being made to use a type of roughness which can be easily reproduced and yet adequately serve as an index of roughness for flow in open channels. Tests are now under way in which natural gravel of various sizes from canals and rivers is used as the roughness. Further investigations include the determination of the sediment carrying capacity of channels with definite roughness.
(g) Tests have been completed using sheet metal baffle plates as a standard. From these data a single function has been established relating the Chezy resistance coefficient with the Reynolds number and the relative roughness.
(h) "Artificial roughness in open channels." A. R. Robinson, Master's Thesis, Colorado A & M College, November 1950.

536) MODEL STUDIES FOR BHAKRA DAM.

(b) International Engineering Company, Inc.
(d) Experimental; applied research for design.
(e) To study the various hydraulic features and to: (1) determine the flow characteristics and relative desirability of various spillway designs and locations, (2) to determine the most desirable apron design and to study the action of the stilling pool during discharges of various spillways and outlets, (3) to calibrate the various spillways and outlets and determine the pressure distribution throughout the tunnel spillway, (4) to evaluate the erosion downstream from the stilling basin and the tunnel spillway outlet, (5) to determine the necessary height of training walls of the spillway and the stilling basin, and (6) to determine the proper height of the eyebrows over the river outlets on the spillway face.
(f) Completed.
(g) The results are given in the report to International Engineering Company.
(h) "Model studies for Bhakra Dam." M. L. Albertson, Colorado A & M College, Nov. 1949.

537) VORTEX TUBE SAND TRAPS.

(b) Laboratory project.
(d) Experimental; for design and for masters' theses.
(e) To obtain generalized data for design of the most efficient vortex tube as a sand trap in a canal.
(g) A tube placed at a 45-degree angle has been studied, and the relationship has been determined between the efficiency of the tube and such factors as the depth of flow, the discharge, the size of the bed material, the concentration of the bed material, and the relative elevation of the downstream lip of the tube. The resulting design curves permit the design of vortex tubes under prototype conditions for maximum efficiency.
(h) "Model studies for Bhakra Dam." M. L. Albertson, Colorado A & M College, August, 1950.

538) HYDRAULICS OF SPILLWAYS.

(b) Laboratory project.
(d) Experimental; for design and for masters' theses.

(e) To obtain generalized design information for spillways having the shape of the underside of the nappe from a sharp crested weir. Generalized tests are being made to determine the shape of the nappe with various negative pressures under it. Ultimately, the discharge coefficient and the pressure distribution will be obtained for all practical degrees of submergence and ambient pressures.
(g) Using laboratory data reported by other experimenters, and data obtained in this laboratory, dimensionless design curves have been developed which permit solving directly for the design head, the discharge, the height of the spillway, or the shape of the spillway crest. Further data have been obtained which show the effect of downstream submergence on the discharge and the pressure distribution over the spillway.
(h) "Direct solutions for spillway designs." Anand Harkauli, Special Report, Colorado A & M College, August 1948.
"Discharge coefficients and pressure distributions for spillways, Part 1." A. R. Robinson, Special Report, Colorado A & M College, June, 1950.

(539) STILLING WELLS FOR METER GATES.

(b) Armco Drainage & Metal Products, Inc.
(d) Experimental; applied research for design.
(e) To determine whether it is possible to simplify the design of the stilling wells and yet retain the accuracy and usefulness of the gate as a device for measuring flow.

(819) SURVEY OF GROUNDWATER RESOURCES IN REPUBLICAN RIVER DRAINAGE IN COLORADO.

(b) Section project.
(c) W. E. Code, Colorado A & M College, Fort Collins, Colo.
(d) Field investigation; applied research.
(e) Location of wells, flow measurements, compilation of well logs and watertable elevations.
(f) Project transferred to U. S. Geological Survey, Ground Water Division.
(g) All irrigation wells have been located and technical information recorded. Some foundation material for map has been assembled.

(820) THE STUDY OF SEEPAGE LOSSES FROM IRRIGATION CHANNELS.

(b) Soil Conservation Service, Bureau of Reclamation, Colorado Agricultural Experiment Station
(c) C. H. Rohwer, Soil Conservation Service.
(d) Experimental and field investigation; applied research.
(e) A study will be made of the factors influencing seepage from channels. It is hoped to perfect a method for making pre-investigations of seepage and interpreting the results for the purpose of measuring the seepage from existing canals, and predicting the seepage from proposed canals. Methods of measuring seepage will be evaluated to determine the limitations and advantages of each.
(h) "Seepage losses from irrigation channels." Tech. Bul. 38, Colorado Agricultural Experiment Station, 1948.

(821) GROUND WATER FLUCTUATIONS AND THEIR RELATION TO PUMPING.

(b) Laboratory project.
(c) W. E. Code, Colorado A & M College, Fort Collins, Colo.
(d) Field investigation; applied research.
(e) Measurements of water table elevation in 190 selected wells are made twice annually.
(g) It has been possible to determine from the data whether the ground-water supply in the various pumping areas is adequate for the demand imposed upon them. A definite lowering of the water table is occurring in the Kiowa, Bijou and Beaver Creek areas where pumping is the heaviest.
(h) Summary is prepared for inclusion in Geological Survey Water Supply Paper.

(822) DIFFUSION OF HEAT, VAPOR, AND MOMENTUM.

(b) Office of Naval Research, Colorado A & M College.
(d) Experimental; basic research.
(e) A controlled study in a wind tunnel of the fundamental principles describing the process of diffusion of vapor, heat, and momentum from various surfaces. Eventually it is intended to use the fundamental information to aid in determining evaporation from free surfaces, land areas with various soil and crop covers, and plant surfaces; and to heat and moisture losses from animals.
(h) "A comparative study of momentum transfer, heat transfer, and vapor transfer."
"Part 1, Forced convection, laminar case." C. S. Yih, ONR Report, Sept. 1950,
"Part II, Forced convection, turbulent case." C. S. Yih, ONR Report, in preparation.
"Part III, Free Convection." C. S. Yih, ONR Report, in preparation.
"Part IV, Dimensional analysis as a guide to experimentation." C. S. Yih, and M. L. Albertson, ONR Report, in preparation.
"Design and operating characteristics of a low-cost, low-velocity, wind tunnel." Jack E. Cermak and M. L. Albertson, ONR Report, in preparation.

(823) SCOUR IN A STILLING BASIN.

(b) Laboratory project.
(d) Experimental; for design and master's thesis.
(e) A laboratory study of the scour in a stilling basin as the energy in a jet of water is being dissipated. It is planned to use jets of various shapes and angles of attack on the stilling basin, and the position of the jet relative to the stilling basin.
(g) A study has been completed of the special problem of comparing the scour from a solid jet with that from a hollow jet valve. The jet was directed vertically downward at various velocities. Variables considered were the depth of the pool, the fall velocity of the erodable material and the size of the jet. Results showed that the depth and rate of scour depended upon the depth of water in the stilling basin and the size of the bed material. As expected, the larger the bed material, the smaller was the degree of scour. As the depth of the water in the stilling basin increased, the scour likewise increased to a maximum beyond which scour decreased as the depth increased.
(h) "Comparison of scour by hollow jets and solid jets of water." D. Dodiah, Master's Thesis, Colorado A & M College, Dec. 1949.

(824) HEAD LOSSES FROM BRIDGE PIERS.

(b) Laboratory project.
(d) Experimental; for design and for masters' theses.
(e) To determine the loss of head in open channels as a result of bridge piers obstructing the flow. The data of previous experimenters is being used, together with the laboratory data being taken in the range of variables previously not considered and yet of use in design work.
(h) "Effect of pier shape on backwater, total head loss, and water-surface profile." D. Q. Matejka, Master's Thesis, Colorado A & M College, July 1950.

(825) MODEL STUDIES FOR HIRAKUD DAM.

(b) International Engineering Company, Inc.
(d) Experimental; applied research for design.
(e) To evaluate the flow conditions through the hydraulic features of the structure, particularly through the sluiceways and the stilling basin.
(f) Completed.
(g) The test results are given in the report to International Engineering Company.
(h) "Hydraulic model studies for Hirakud Dam." M. L. Albertson, Jan. 1950.

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(826) MODEL STUDIES FOR RIHAND DAM.

(b) International Engineering Company, Inc.
(d) Experimental; applied research for design.
(e) To evaluate the hydraulic features of the structure, particularly the flow in the stilling basin and the effect of the airstep on the crest intended to entrain air to prevent cavitation and erosion of the spillway face and bucket.
(f) Completed.
(g) The test results are given in the report to International Engineering Company.
(h) "Hydraulic model studies for Rihand Dam." S. D. Resnick and M. L. Albertson, in preparation.

(827) AERATION OF SPILLWAYS.

(b) International Engineering Company, Inc.
(d) Experimental; applied research for design.
(e) To determine the general relationships which exist in connection with the air entrainmen and general aeration of the nappe flowing over a spillway crest. Conducted as a special and separate part of the model studies for Bhakra Dam.
(f) Inactive.
(g) The test results are given in the report to International Engineering Company.
(h) "Hydraulic model studies of air entrainment for Bhakra Dam." M. L. Albertson, March, 19

(828) INFLUENCE OF SHAPE OF THE FALL VELOCITY OF SAND GRAINS.

(b) Laboratory project.
(d) Experimental; for design and masters' theses.
(e) A controlled study of the fall velocity of various typical sands and gravel obtained fro a river bed, a wind-blown sand dune, and a rock crusher. The fall velocity was correlated with the shape of the particle and the Reynold's number of the flow. Special consideration was given to the problem of determining a shape factor of the particle which would be significant, and yet easily determined.
(g) Two masters' theses have been written and a third is in progress. A practical shape factor was determined and it correlated quite well considering the irregular and random shape of the particles involved.
(h) "Influence of shape on the fall velocity of sand grains." A. T. Corey, Master's Thesis, Colorado A & M College, Aug. 1949.
"A comparison of the sedimentation diameter and the sieve diameter for various types of natural sands." E. F. Serr, III, Master's Thesis, Colorado A & M College.

(1072) CALIBRATION OF ARMCO METERGATES.

(b) Armco Drainage and Metal Products, Inc.
(d) Experimental; applied research and for design.
(e) To determine calibration curves for the Armco Metergate. Sizes ranging from 8 to 48 in.
(f) Completed.
(h) Report in preparation.

(1073) SEDIMENTATION STUDY USING A TURBULENCE TANK.

(b) U. S. Bureau of Reclamation and Colorado A & M College.
(d) Experimental; basic research.
(e) A tank with glass sides is being built to determine more completely the effect of relatively uniform turbulence (created by a system of lattice structures similar to that used by Rouse), viscosity, fall velocity and gradation of sediment, and percolation upon the concentration gradient and amount of sediment in suspension.

(1074) HYDRAULICS OF STILLING BASINS.

(b) Laboratory project.
(d) Experimental; for design and masters' theses.

(e) To obtain generalized design information for stilling basins utilizing the hydraulic jump together with chute blocks, floor blocks, and sills.
(g) Generalized tests have been completed using cubical floor blocks to force the hydraulic jump having a length equal to 3 and 5 times the downstream depth when the tailwater elevation is either normal or below normal.
(h) "The effect of the size and spacing of floor blocks in the control of a hydraulic jump." Lloyd Weide, Master's Thesis, Colorado A & M College, in preparation.
"Direct solution for apron elevation." Maurice L. Albertson, Mimeographed Report, in preparation.

(1075) HYDRAULICS OF DROP STRUCTURES.

(b) Laboratory project.
(d) Experimental; for design and masters' theses.
(e) A series of fundamental experiments to obtain generalized design information for drop structures generally associated with irrigation and drainage canals.

(1076) INVESTIGATION OF THE ECONOMICS AND PRACTICABILITY OF SPRINKLER IRRIGATION IN COLORADO.

(b) Laboratory project.
(c) W. E. Code, Colorado A & M College, Fort Collins, Colo.
(d) Field investigation; applied research.
(e) Collection of data on the performance of sprinklers with respect to use of equipment, success as an irrigation method, effect on crops and cost.
(g) It has been found that many systems are poorly designed for a given situation and that in many cases savings in water are not as large as anticipated. Although many users raised satisfactory crops, others did not because of insufficient water application.
(h) "When to use sprinkler irrigation in Colorado." W. E. Code and A. S. Hamman. Colorado A & M College Extension Service. Bulletin 405-A, 1950.

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COLORADO UNIVERSITY, Hydraulics Laboratory, Department of Civil Engineering.

Inquiries concerning Projects Nos. 830, 831, and 1077 should be addressed to Professor Warren DeLapp, University of Colorado, Boulder, Colo.

(830) FLOW IN SHORT TUBES.

(b) Laboratory project.
(d) Experimental; basic research and masters' theses.
(e) Tests are being made on a 2-inch smooth pipe with a square-edged entrance to study boundary layer development and energy losses. Pipes of other sizes will be used later.

(831) SUPERCRITICAL VARIED FLOW IN OPEN CHANNELS.

(b) Laboratory project.
(d) Experimental; basic research and masters' theses.
(e) Surface profiles are being studied in a short rectangular channel, 10 inches wide, on a steep slope.

(1077) SPILLWAY CREST SHAPES.

(b) Laboratory project.
(d) Analytical; for design and masters' theses.
(e) Studies are being made of experimental data for various spillway crests and an effort being made to derive equations for these crests for design purposes.

COLUMBIA UNIVERSITY, Fluid Mechanics Laboratory, Department of Civil Engineering.

Inquiries concerning Projects Nos. 60, 61, 62, 289, 290, and 541 should be addressed to Prof. Boris A. Bakhmeteff, Fluid Mechanics Laboratory, Department of Civil Engineering, Columbia University, New York 27, N. Y.

(60) FLOW OF FLUIDS THROUGH GRANULAR (POROUS) MEDIA.

(b) Laboratory project.
(d) Theoretical and experimental; basic research.
(e) To establish rational generalized expressions for permeability of porous beds consisting of grains of uniform or mixed size. the present phase is dealing with flow of air through beds of lead shot, sand, and gravel. It is anticipated that the results will permit presentation of an integrated account of the phenomenon as a whole.

(61) ELECTROMAGNETIC VELOMETER.

(b) Laboratory project.
(d) Theoretical and experimental; basic research.
(e) To develop instrumentation and technique to record manifestations of turbulence in liquids as well as to measure detailed velocity distributions in boundary layers, separation zones, etc. Work at present is concentrated on developing a practical device for measuring very low spot velocities. The possibility of using electrostatically charged molecules for determining flow velocities is being explored.

(62) HYDRAULICS STRUCTURES.

(b) Laboratory project.
(d) Theoretical and experimental; basic research and for master's thesis.
(e) Apparatus in process of erection for study of (1) boundary layer regimen in intake reaches of open channels, (2) flow patterns over beds curved in the vertical plane.

(289) SEPARATION PATTERNS IN THEIR RELATION TO LOCAL "FORM RESISTANCES".

(b) Laboratory project.
(d) Experimental; master's thesis.
(e) A wide range of systematic experimental studies is planned with emphasis on the physical aspects of the phenomena. Research has been practically completed on the particular case of expansion in conduits.

(290) HYDRAULICS OF SHORT OUTLETS IN BODIES OF DAMS.

(b) Laboratory project.
(d) Experimental; master's thesis.
(e) To investigate the boundary layer regimen in outlet conduits.

(541) PATTERNS OF FLOW OVER WEIRS OF STANDARD OGEE FORMS.

(b) Laboratory project.
(d) Experimental; basic research and design.
(e) For the purpose of acquiring knowledge of the physical features of the flow phenomena and formulating a comprehensive basis for design, especially in regard to spillways in submerged conditions.
(f) The experimental work is nearing completion.

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UNIVERSITY OF CONNECTICUT, Hydraulic Research Laboratory, Department of Civil Engineering.

(1078) HYDROLOGIC FACTORS INFLUENCING RAINFALL-RUNOFF RELATIONSHIPS ON SMALL WATERSHEDS IN EASTERN CONNECTICUT.

(b) Laboratory project.
(c) Prof. K. C. Tippy, Box U-37, University of Connecticut, Storrs, Conn.
(d) Field investigation; applied research.
(e) Rain gages have been obtained and will be installed at various locations on the 4.5 square mile watershed of the Research Laboratory. Infiltrometers and lysimeters for the isolation and measurement of the factors affecting runoff are being devised.
(f) Just started, no test results.

(1079) STUDY OF WIND EFFECTS ON STRUCTURES.

(b) Laboratory project.
(c) Mr. A. L. Mirsky, Box U-37, University of Connecticut, Storrs, Conn.
(d) Experimental; applied research.
(e) A study of wind action and flow on the roofs of various types of buildings and structures is to be conducted in a small wind tunnel having an 8-inch by 8-inch throat and maximum wind speed of 150 fps.
(f) Small wind tunnel is complete. Work is progressing on smoke stream apparatus.

(1080) STUDY OF HYDRAULIC DESIGN OF CURB INLETS.

(b) Laboratory project; undertaken at request of State Highway Department.
(c) Prof. V. Scottron, Box U-37, University of Connecticut, Storrs, Conn.
(d) Experimental; for design.
(e) This project involves the hydraulic and structural design of the curb inlet type of catch basin, with particular reference to the hydraulic efficiency of the grate now used by the State Highway Department. A half-scale model of the inlet and approach surface is being constructed.
(f) Just started, no test results.

(1081) DESIGN OF A LOW-SPEED TWO-DIMENSIONAL WIND TUNNEL.

(b) Laboratory project.
(c) Mr. A. B. Barton, University of Connecticut, Storrs, Conn.
(d) Experimental; for master's thesis.
(e) A low-speed, two-dimensional wind tunnel, having a 24 inch by 3.25 inch throat is being built for flow demonstration purposes. Pressure patterns and lift and drag forces will be determined for a conventional air foil.
(f) Major structure of tunnel is complete. Work is continuing on auxiliary equipment.

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CORNELL UNIVERSITY, School of Civil Engineering.

(542) MOVEMENT OF SAND BED LOAD.

(b) Laboratory project.
(c) Prof. M. S. Priest, School of Civil Engineering, Cornell University, Ithaca, N. Y.
(d) Experimental; basic research for Ph. D. thesis.
(e) A study pertaining to the nature of sand bed load movement.
(f) Suspended.
(g) Studies of three sands have been completed and the flow conditions for each type of movement have been described graphically by a single equation.
(h) "Initial stages of bed load movement." T. A. Chen, Ph. D. Thesis, June 1949.
"Experimental study of bed load movement." A. F. El-Kashef, Ph. D. Thesis, Sept. 1950.

(1082) TRANSITIONS IN LAMINAR FLOW AT ENTRANCE TO PIPE.

(b) Laboratory project.
(c) Prof. M. Bogema, School of Civil Engineering, Cornell University, Ithaca, N. Y.
(d) Experimental; basic research for Ph. D. thesis.
(e) A study of the variation in velocity profile at entrance to pipe line to determine rate of boundary layer development and resulting energy losses.
(g) An equation representing the velocity distribution at all sections within the length of transition with an allowance for energy losses within the transition has been obtained and compared with profile obtained in 2-inch brass pipe.
(h) "Study of the zone of transition in laminar flow near the entrance to a smooth pipe." K. C. Asthana, Ph. D. Thesis, February 1951.

(1083) DESIGN OF CAVITATION EXPERIMENTAL EQUIPMENT.

(b) Laboratory project.
(c) Prof. M. Bogema, School of Civil Engineering, Cornell University, Ithaca, N. Y.
(d) Experimental; design for master's thesis.
(e) Collection of data on existing cavitation equipment and design of equipment for the Cornell Hydraulic Laboratory.

(1084) FLOW THROUGH 10-INCH DUPLEX STRAINER.

(b) J. A. Zurn Mfg. Co., Erie, Pa.
(c) Prof. M. Bogema, School of Civil Engineering, Cornell University, Ithaca, N. Y.
(d) Experimental; operation.
(e) Head loss coefficients determined for rates of flow from 700 to 3100 gpm for clean and partially clogged screens.
(f) Completed.

(1085) DIAPHRAM PUMP OPERATION.

(b) Ace Pump Co., Memphis, Tenn.
(c) Prof. M. Bogema, School of Civil Engineering, Cornell University, Ithaca, N. Y.
(d) Experimental; operation.
(e) Study to determine basic relations between speed of operation, cam radius, piston diameter, length and size of connecting pipe necessary to prevent water hammer.

(1086) GRAVITY WAVES IN SHALLOW WATER.

(b) Laboratory project.
(c) Prof. M. S. Priest, School of Civil Engineering, Cornell University, Ithaca, N. Y.
(d) Experimental; basic research for Ph. D. thesis.
(e) To study the change in character of gravity waves in water as the waves move from deep water into shallow water over a reef parallel to the direction of wave motion.
(f) Completed.
(g) A criterion for mimimum depth of water over the reef, for waves of different characteristics, has been established. Also a relationship between the height of waves in shallow water and in deep water, based on wave steepness and depth of water over the reef, has been found.
(h) "The passage of oscillatory waves over a reef." J. Amouzegar, Ph. D. Thesis, Cornell University, February 1951.

(1087) WAVE TANK STUDIES OF BEACH STABILITY RELATED TO VARIOUS WAVE CHARACTERISTICS.

(b) Office of Naval Research, Washington, D. C.
(c) Prof. D. J. Belcher, School of Civil Engineering, Cornell University, Ithaca, N. Y.
(d) Experimental; basic and applied research.
(e) To tie the changes in a beach condition, i.e. changes in its texture, its profile, and its firmness, to the characteristics of the waves acting on the beach and eventually to the prevailing weather conditions.

(g) New criteria for the effect of waves on beaches have been established. The importance of wave frequency and previous beach condition has been brought out.
(h) Progress reports by J. Amouzegar pending publication.

(1088) MODEL STUDIES OF THE DEVELOPMENT OF BEACH FORMS.

(b) Office of Naval Research, Washington, D. C.
(c) Prof. D. J. Belcher, School of Civil Engineering, Cornell University, Ithaca, N. Y.
(d) Experimental; applied research for master's thesis.
(e) To investigate the effect of waves on various types of beaches. Influence of grain size and beach form studied.
(f) Thesis for master's degree by G. J. Fallon, being completed.

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GEORGIA INSTITUTE OF TECHNOLOGY, School of Civil Engineering.

Inquiries concerning Projects Nos. 291, 841, and 1089 should be addressed to Prof. C. E. Kindsvater, School of Engineering, Georgia Institute of Technology, Atlanta, Ga.

(291) FLOW OF WATER OVER HIGHWAY EMBANKMENTS.

(b) Laboratory project.
(d) Experimental; basic research and design.
(e) Tests on a 1:6-scale model of a typical highway embankment section have been completed. Preliminary tests on a 1:12-scale model are underway. Tests are being conducted in a 15-inch wide flume. Variables include roughness and shape of crown, slope and height of embankment. Data include discharge calibration, water-surface profiles, and tail-water levels corresponding to (1) free flow, (2) incipient submergence, (3) lower limit of surface flow, (4) upper limit of plunging flow, and (5) submerged flow. Theoretical analyses for generalized application are continuing.
(f) Reactivated. (Suspended during 1949-50 academic year).

(841) SPILLWAY MODEL STUDIES, JACKSON'S BLUFF DAM.

(b) Florida Power Company, St. Petersburg, Fla.
(d) Experimental; for design.
(e) A 1:120-scale model of the spillway, adjacent abutments, and about 1,200 feet of river channel, with both fixed and movable beds, and a 1:30-scale sectional model of three bays of the spillway were constructed and tested. Principle objective was the design of an apron extension to relieve excessive erosion below the existing dam.
(f) Completed.
(h) Final report submitted to Florida Power Company.

(1089) SPILLWAY MODEL STUDIES, FURMAN SHOALS DAM.

(b) Georgia Power Company, Atlanta, Ga.
(d) Experimental; for design.
(e) A 1:120-scale comprehensive model and a 1:40-scale sectional model, both with fixed and movable beds, were constructed and tested. Objectives included design of the stilling basin and training walls, development of a gate-operating sequence, measurement of pressures and surface profiles over the face of the spillway, and calibration for free discharge.
(f) Completed.
(h) Final report submitted to Georgia Power Company.

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UNIVERSITY OF IDAHO, Engineering Experiment Station.

(547) STUDY OF PRINCIPLES, DEVELOPMENT, AND USE OF HIGH ALTITUDE PRECIPITATION GAGES.

(b) Laboratory project; in cooperation with United States Army Engineers, Weather Bureau, Forest Service, and Bureau of Reclamation.
(c) Prof. C. C. Warnick, College of Engineering, University of Idaho, Moscow, Idaho.
(d) Experimental; design and development.
(e) Tests conducted on movement of air around precipitation gages using a slow-speed wind tunnel. Information is being sought regarding proper design of windshields. Precipitation gages have been installed at Mullan Pass, Idaho and at the Priest River Experimental Forest to check the performance of various shield designs under actual operating conditions against performance observed in wind tunnel studies.
(g) Photographs obtained illustrating wind behavior with sawdust blowing around the gages, with and without windshields. Comparative catch tests made, using sawdust as a simulated snowstorm.
(h) "Wind studies on shielded snow gages." Presented at annual meeting of Western Snow Conference, April, 1949.

(548) METHODS OF EVALUATING SEEPAGE LOSSES IN IRRIGATION CANALS.

(b) Laboratory project; in cooperation with Geological Survey and Bureau of Reclamation.
(c) Prof. C. C. Warnick, College of Engineering, University of Idaho, Moscow, Idaho.
(d) Field investigation; applied research for development.
(e) Methods of measuring seepage losses are being studied using seepage meters, current meter and volumetric measurements of loss from pondage sections. Unlined and compacted earth canals are being studied near Post Falls, Idaho, to provide better means of evaluating seepage losses and to give data on the effectiveness of earth-lined canals.
(g) Three years of experimentation have been completed. Data being processed for a bulletin.

(842) THE PROBLEMS AND LIMITATIONS OF SPRINKLING AS A METHOD OF APPLYING IRRIGATION.

(b) Laboratory project; in cooperation with Soil Conservation Service and Bureau of Reclamation. This project carried on under Agricultural Engineering Experiment Station.
(c) Prof. M. C. Jensen, Agricultural Engineering Department, University of Idaho, Moscow, Idaho.
(d) Experimental and field investigation; design and operation.
(e) To develop a self-cleaning screen for sprinkler systems, and to determine hydraulic performance of current sprinkler system design. A cost study is also being made.
(g) A study has been made of cost of sprinkler irrigation, and tests have been completed in the laboratory and field on methods of screening irrigation water for sprinkler systems. A bulletin is being prepared on screening.
(h) "Screening water for sprinkler irrigation systems." B. E. Berry, Master's Thesis, University of Idaho, June, 1950.
"The cost of sprinkler irrigation in Idaho." B. L. Brooks, Master's Thesis, University of Idaho, June, 1950. (Available on loan).

(1090) AN ABSOLUTE VISCOMETER FOR NEWTONIAN FLUIDS.

(b) Laboratory project; sponsored in the Mechanical Engineering Department.
(c) Prof. N. F. Hindle, Mechanical Engineering Department, University of Idaho, Moscow, Idaho.
(d) Theoretical laboratory investigation; design and development for master's thesis.
(e) To develop and construct an instrument to measure absolute viscosity.
(g) Literature survey and assembly design is complete. Unit is being constructed.

(1091) A STUDY OF CANAL LININGS FOR CONTROLLING SEEPAGE LOSSES.

(b) Laboratory project; in cooperation with U. S. Bureau of Reclamation.
(c) Prof. C. C. Warnick, College of Engineering, University of Idaho, Moscow, Idaho.

(d) Field investigation; applied operational research.
(e) A study is being made of the effectiveness and permanency of different prefabricated linings by installing short test sections of lining in operating canals. Information is being obtained on seepage loss before and after being lined.
(g) Three test sections have been lined and data on seepage loss and ground water level fluctuations are being processed.

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ILLINOIS INSTITUTE OF TECHNOLOGY, Technology Center.

(1) FRICTIONAL RESISTANCE IN ROUGH PIPES.

(b) Laboratory project sponsored by the Office of Naval Research.
(c) Dr. V. L. Streeter, Illinois Institute of Technology, Technology Center, Chicago 16, Ill.
(d) Experimental; basic research.
(e) To investigate the frictional resistance coefficient "f" and the velocity distribution profile in artifically roughened pipes, at Raynolds numbers less than 50000. The region of transition from laminar to turbulent flow will be investigated to supplement previously obtained data for fully developed flow. The artificial roughnesses are helical grooves of square profile machined into 4.5-inch aluminum pipe at several spacings. Three different relative roughnesses will be investigated. Tests are planned to establish the velocity distribution in the wall region for smooth pipe flow.
(h) First issue of quarterly progress, "Frictional resistance in rough pipes."

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ILLINOIS STATE WATER SURVEY DIVISION.

Inquiries concerning Projects Nos. 556 to 561, incl., and 845 should be addressed to Dr. Max Suter, Head, Engineering Research Subdivision, Illinois State Water Survey Division, Box 232, Urbana, Illinois.

(551) RUNOFF FROM SMALL WATERSHEDS.

(b) Laboratory project, in cooperation with Geological Survey.
(c) Mr. W. J. Roberts, Illinois State Water Survey Division, Box 232, Urbana, Ill.
(d) Field investigation; applied research, design.
(e) Measurements are being made of watershed rainfall and stream flow, of stage, discharge over the spillway, and municipal pumpage on five small water supply reservoirs in Illinois.
(g) Twenty-one years of continuous measurements have been completed.

(552) SEDIMENTATION OF ILLINOIS RESERVOIRS.

(b) Laboratory project, in cooperation with Soil Conservation Service and Illinois Agricultural Experiment Station.
(c) Mr. J. B. Stall, Illinois State Water Survey Division, Box 232, Urbana, Ill.
(d) Field investigation; applied research.
(e) For design of water supply reservoirs, measurements of sediment accumulation have been made on sixteen lakes in Illinois. Sediment samples are being analyzed and complete surveys of watershed soil type, slopes, land use, and conservation practices are being made.
(g) Results at Lake Decatur, Decatur, Ill., showed correlation between rate of sedimentation in the reservoir and the land use on the watershed.

(553) RADAR-RAINFALL PROJECT.

(b) Laboratory project, in cooperation with the Pfister Hybrid Corn Co., El Paso, Ill.
(c) Mr. G. E. Stout, Illinois State Water Survey Division, Box 232, Urbana, Ill.

(d) Field investigation; basic research.
(e) A radar installation is being used to track rainclouds, showing extent of each rain area and movement. Rainfall data are collected over a concentrated network of 31 rain gages and correlated with the radar for quantitative rainfall measurement. Movies are being made of the PPI scope.
(g) Results indicate that radar will give an acuurate picture of rainfall extent. Radar was used for short period rainfall forecasts.

(555) EVAPORATION IN ILLINOIS.

(b) Laboratory project.
(c) Mr. W. J. Roberts, Illinois State Water Survey Division, Box 232, Urbana, Ill.
(d) Field investigation; applied research.
(e) Measurements are being made of evaporatoon at three Class A pan-type stations in northern central, and southern Illinois. Vapor pressure gradients are obtained at Four-Mile Crib in Lake Michigan and at Urbana.
(g) Measurements at Urbana were unreliable due to instrument failures. Equipment at Four-Mile Crib installed in August, 1950.

(556) PERMEABILITY OF GRADED SAND MIXTURES.

(b) Laboratory project.
(d) Experimental; basic research.
(e) The permeabilities of known mixtures of graded aand are measured to determine functional changes.
(f) Permeability tester was installed in Peoria Laboratory.

(557) TURBULENT FLOW THROUGH GRANULAR MEDIA.

(b) Laboratory project.
(d) Experimental; basic research.
(e) Critical flow is determined to define conditions under which turbulent flow occurs outside of well screens.
(f) Permeability tester installed.
(g) In flow through granular media, the Reynolds number cannot be calculated from ordinary formulas. By assuming a critical Reynolds number as existing at the determined critical flow conditions, the corresponding pore size can be calculated. This has been done in preliminary tests, but further work is needed to get a correlation with screen analysis.

(558) STUDY OF CAUSES AND PREVENTION OF SAND BOILS.

(b) Laboratory project.
(d) Field investigation; basic research.
(e) Sand boils occurring during floods in levied districts are mapped, classified, and sampled. Also sampled are river and nearby well waters.
(g) From chemical analyses and temperature measurements it was found that the water flowing in typical sand boils (those free from pipe connections towards the river) is different from the river water and similar to well water in neighboring wells. Such sand boils can be stopped from flowing by damming them up to a level that is below that of the river stage. They are not caused by leaks through the levee.

(559) ARTIFICIAL RECHARGE OF GROUND WATER.

(b) Laboratory project.
(d) Experimental laboratory and field investigation; basic research.
(e) Experimental field pit under construction.
(f) Suspended, waiting for completion of Peoria Laboratory.

(560) GROUND WATER INVESTIGATION IN THE PEORIA, ILLINOIS, DISTRICT.

(b) Laboratory project.
(d) Field investigation; basic research.

(e) To determine the ground water resources of the district, inventory of wells was made, including construction and logs of wells. Ground water levels are measured continuously, pumpage data collected, river stages and rainfall recorded, chemical analyses for changes in composition of ground water are made, areas of infiltration are determined, and all data are correlated with consideration of local ground conditions.
(g) The existence of a recession was proven to be due to overpumpage and high local concentration of pumpage. Remedial measures have been recommended.
(h) "Apparent changes in water storage during floods at Peoria, Ill." Max Suter, Trans. Amer. Geophys. Union, Vol. 28; 425. 1947.
"Groundwater in the Peoria Region." Bulletin 39, State Water Survey, 1950.

(561) GROUND WATER INVESTIGATION IN THE EAST ST. LOUIS AREA.

(b) Laboratory project.
(d) Field investigation; basic research.
(e) To determine the ground water resources of the district, inventory of wells was made, including construction and logs of wells. Ground water levels are measured continuously, pumpage data collected, river stages and rainfall recorded, chemical analyses for changes in composition of ground water are made, areas of infiltration are determined, and all data are correlated with consideration of local ground conditions.
(g) The existence of a recession was proven in locally overpumped areas.

(843) GROUND WATER RESOURCES IN JO DAVIESS, STEPHENSON, AND CARROLL COUNTIES.

(b) Laboratory project.
(c) H. F. Smith, Illinois State Water Survey Division, Box 232, Urbana, Ill.
(d) Field investigation; applied research.
(e) To determine ground water resources of the area, water level contours of the sandstone aquifers, transmissibility and storage coefficients of the aquifers, quantity of water available were obtained.
(g) Data indicate that piezometric surface conforms generally with topography, with a 500-foot drop in about 30 miles with no apparent withdrawal. The sandstone aquifers are overlain with 100 to 300 feet and more of impervious limestone.

(844) GROUND WATER RESOURCES IN CHAMPAIGN COUNTY.

(b) Laboratory project.
(c) H. F. Smith, Illinois State Water Survey Division, Box 232, Urbana, Ill.
(d) Field investigation; applied research.
(e) To determine ground water resources of the county, water level contours of two glacial aquifers. Pumping tests to determine transmissibility, rates of flow into heavily pumped areas.
(g) Data show little, if any, communication between two glacial aquifers. Withdrawal in heavily pumped area exceeds recharge by 30 percent.
(h) "Groundwater resources in Champaign County." Report of Investigation No. 6, State Water Survey, 1950.

(845) EXTENSION OF THEIS' NON-EQUILIBRIUM THEORY FOR VARIABLE FLOW.

(b) Office project.
(d) Theoretical; basic research.
(e) Development of formulas that could be used for conditions of variable flow.
(g) Formulas developed for most important types of variable flow, but the series obtained have not been calculated for wide ranges.

(1092) HYDROLOGIC CYCLE EVALUATION.

(b) Laboratory project; carried out in cooperation with the U. S. Geological Survey,
(c) G. E. Stout, Illinois State Water Survey, Box 232, Urbana, Ill.
(d) Field installation; applied research.

(e) 55 raingages, 3 stream-gaging stations, 5 groundwater level recorders are being maintained. Data will be used in analyzing storm rainfall, runoff relationships on small watersheds and effect of rainfall on the water table.
(g) Complete analysis of 3 years of storm rainfall data is being analyzed.

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UNIVERSITY OF ILLINOIS, Fluid Mechanics and Hydraulics Laboratory, Department of Theoretical and Applied Mechanics.

Inquiries concerning Projects Nos. 562 and 1093 should be addressed to Prof. F. B. Seely, Head, Department of Theoretical and Applied Mechanics, 214 Talbot Laboratory, University of Illinois, Urbana, Ill.

(562) AN EXPERIMENTAL AND ANALYTICAL STUDY OF LAMINAR FLOW AND THE CRITICAL VELOCITY IN OPEN CHANNELS.

(b) Laboratory project.
(d) Basic research and master's thesis.
(e) A lucite channel 6 inches in cross-section and 15 feet long and a glass-walled channel 18 inches wide, 26 inches deep, and 30 feet long have been used to study velocity distributions.
(f) Data are now being analyzed.

(1093) AN INVESTIGATION OF A NEW OPEN CHANNEL FORMULA BASED ON DIMENSIONAL ANALYSIS AND CORRELATION OF OPEN CHANNEL DATA WITH THAT OF CLOSED CONDUITS.

(b) Laboratory project.
(d) Experimental and analytical.
(e) Data have been collected on the flow of water in a 60-foot triangular, variable-slope flume. These data have been used to make a dimensionless graph and also a comparison with established pipe flow data. Several roughnesses as well as the smooth channel will be investigated.
(g) One master's thesis has been written with data from channel in smooth condition. A fair correlation with pipe flow was found.

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UNIVERSITY OF ILLINOIS, Hydraulic Engineering Laboratory, Department of Civil Engineering.

Inquiries concerning Projects Nos. 564, and 1094 to 1098, incl., should be addressed to Prof. J. J. Doland, Director of Hydraulic Engineering, University of Illinois, Urbana, Ill

(564) HYDROLOGY OF URBAN AREAS.

(b) Laboratory project; in cooperation with the Illinois Water Survey Division, and U. S. Geological Survey.
(d) Experimental; for design and masters' theses.
(e) Thirteen rain gages, one complete evaporation station including recording dew-point device, one radar station, and one recording stream gaging station are being installed for the determination of rainfall and runoff for an area comprising about seven square miles.

(1094) STUDY OF HIGHWAY INLET BOXES AND DISCHARGE PIPE SHAPES.

(b) Laboratory project, in cooperation with Illinois Division of Highways and Bureau of Public Roads.
(d) Experimental; basic research.
(e) Full scale tests of 2 by 4 foot, 2 by 3 foot, and 2 by 2 foot inlet boxes, 5 feet and 3 feet deep, are being tested with C. I. bell, square and, rounded discharge pipe shapes. Velocity of approach to inlet box is varied to simulate different approach gutter grades.

(1095) SCALE MODEL STUDIES OF INLET BOXES.

(b) Laboratory project, in cooperation with Illinois Division of Highways and Bureau of Public Roads.
(d) Experimental; applied research, field, design.
(e) Model tests of inlet boxes with the aim of utilizing kinetic energy of the falling jet to obtain higher discharges in connecting pipes. Temperature studies are being conducted to determine the desirability of catch basins as head reservoirs for winter grate operation.

(1096) FULL SCALE GUTTER TESTS.

(b) Laboratory project, in cooperation with Illinois Division of Highways and Bureau of Public Roads.
(d) Experimental; applied research.
(e) Determination of roughness coefficients for different degrees of surfacing on concrete gutters. Test section 120 feet long, adjustable slope, maximum Q = 5.5 cfs.

(1097) CORRECTION OF SCOUR BELOW TWO PIER HIGHWAY BRIDGE.

(b) Laboratory project, in cooperation with Illinois Division of Highways.
(d) Experimental; applied research.
(e) A 1:50 scale model of an overflow bridge on flood plain of the Wabash River has been constructed to determine the cause of excessive scour downstream from the bridge. Remedial dikes and topography changes will be tested to determine their suitability.

(1098) RESERVOIR MODEL.

(b) Laboratory project.
(d) Experimental; basic research.
(e) Model of unit width of triangular longitudinal section reservoir has been constructed with one entire side of lucite. Reservoir is 40 feet long, 4 feet deep at dam, and 11 inches wide. Studies on density currents are just beginning.

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IOWA INSTITUTE OF HYDRAULIC RESEARCH, State University of Iowa.

Inquiries concerning Projects should be addressed to the following, all at State University of Iowa, Iowa City, Iowa:
Nos. 66, 68, 299, 566, 1108, and 1110.....to Prof. J. W. Howe.
Nos. 69, 568, 850, and 1107.....to Mr. Emmett M. Laursen.
Nos. 72, 75, 79, 302, 853, 854, 1099, 1100, 1101, 1105.....to Dr. Hunter Rouse.
Nos. 81, 82, 298, 567, 1104.....to Dr. John S. McNown.

(66) HYDROLOGIC STUDIES, RALSTON CREEK WATERSHED.

(b) Cooperative project with Department of Agriculture and Geological Survey.
(d) Field investigation; applied research and masters' theses.
(e) Study being made of relation between rainfall and runoff over a small area. Discharge from a 3-square-mile area measured by Geological Survey; rainfall records at five automatic recording stations collected by Soil Conservation Service. Continuous records since 1924 of precipitation, runoff, ground-water levels, and vegetal cover.
(g) Yearly records available for examination at Iowa Institute of Hydraulic Research.
(h) Annual reports since 1924 available in files at Iowa Institute of Hydraulic Research.

(67) COOPERATIVE SURFACE-WATER INVESTIGATIONS IN IOWA.

(b) Cooperative project with Geological Survey.
(c) V. R. Bennion, Iowa Institute of Hydraulic Reserach, Iowa City, Iowa.

(d) Field investigation; collection of basic stream flow data.
(e) Stream-flow and sediment measuring stations maintained throughout Iowa cooperatively on a continuing basis. Records collected by standard methods of Geological Survey.
(g) Records of stream flow and sediment discharge computed yearly.
(h) Records contained in Water-Supply Papers of Geological Survey.

(68) HYDROLOGIC STUDIES, RAPID CREEK WATERSHED.

(b) Cooperative project with Department of Agriculture and Geological Survey.
(d) Field investigation; applied research and masters' theses.
(e) Study being made of relation between rainfall and runoff over a small area. Discharge from a 25-square-mile area measured by Geological Survey; rainfall records at four automatic recording stations collected by Weather Bureau. Continuous records since 1941 of precipitation, runoff, and ground-water levels.
(g) Rainfall records published in Weather Bureau Climatological Bulletins, and surface runoff and ground-water levels in Geological Survey Water-Supply Papers.

(69) RELATION OF SEDIMENT CHARACTERISTICS TO BED EROSION.

(b) Cooperative project with Office of Naval Research, Department of the Navy.
(d) Experimental; for doctor's thesis.
(e) To evaluate general relations between geometric and kinematic parameters of flow and mean size and grading of bed sediments for an arbitrary condition of scour. Experiments conducted in glass-walled flume 15 feet long, 3 feet deep, 1.5 feet wide with a two-dimensional horizontal jet. Selected geometrical proportions kept constant, the variables being the rate of flow, the mean diameter and standard deviation of the sediment, and time and depth of scour.

(72) ELECTRICAL ANALOGY OF THREE-DIMENSIONAL FLOW.

(b) Cooperative project with the Office of Naval Research, Department of the Navy.
(d) Experimental; basic research.
(e) Methods previously reported upon are being extended to the rapid exploration of pressure variation at rounded inlets of conduits having rectangular cross sections.
(h) "Application of the electrical analogy to hydrodynamics problems in three dimensions." P. G. Hubbard and S. C. Ling. State University of Iowa, 1950. (Presented at Jackson meeting of A.S.C.E., Hydraulics Division; in preparation for publication).

(73) MEASUREMENT OF TURBULENCE IN FLOWING WATER.

(b) Waterways Experiment Station, Corps of Engineers.
(c) Philip G. Hubbard, State University of Iowa, Iowa City, Iowa.
(d) Experimental development.
(e) To develop practical instruments for the field measurement of turbulence in flowing water. Instruments are planned to include a rigidly mounted unit for shallow water over a considerable velocity range, a unit to be suspended on a cable for deep water, and a tape recorder for evaluation of means and root-mean-squares of three velocity components.

(75) DIFFUSION OF SUBMERGED JETS.

(b) Cooperative project with the Office of Naval Research, Department of the Navy.
(d) Experimental; for graduate theses.
(e) To provide information on distribution of velocity and turbulence in two- and three-dimensional submerged jets. The velocity distribution in the air jet with unlimited boundary was originally studied as a function of longitudinal and lateral distribution, velocity of efflux and size of outlet, and results were reduced to dimensionless relationships. The distribution of turbulence is being studied in a similar manner. The investigation is being extended to the diffusion of flow under various related boundary conditions.
(h) "Characteristics of mean flow and turbulence at an abrupt two-dimensional expansion." Hsieh-Ching Hsu. Ph. D. Thesis, State University of Iowa, Feb. 1950. (Available on loan).

(79) CAVITATION.

(b) Cooperative project with the Office of Naval Research, Department of the Navy.
(d) Experimental and theoretical; basic research and graduate theses.
(e) Basic information on pressure distribution for systematically varied boundary conditions under various degrees of cavitation is being obtained in two variable-pressure water tunnels and a special cavitation tank. Measurements made of effect of variation of boundary form, Reynolds number, and degree of cavitation on the pressure distribution around the ellipsoidal, conical, and rounded head bodies of revolution at various angles of yaw; and disks, spheres, and ellipsoids. Tests conducted on pressure distribution and cavitation near a boundary discontinuity, such as a gate slot, to obtain data for a systematic series of slot dimensions and superelevations of the downstream edge of the slot. Studies being made on high-velocity submerged jets, using underwater noise as a criterion, to determine cavitation parameters, and tests to evaluate relations between cavitation index and temperature, relative velocity, and nozzle geometry. Effect of relative spacing on pressure distribution around a grid of equidistant cylinders mounted perpendicular to a steady, uniform, two-dimensional flow is being determined. Pressure distributions are being measured in the new water tunnel at Reynolds numbers above the boundary-layer critical, including various stages of cavitation.
(g) Bulletin prepared describing measurements on various head forms at zero angle of yaw. Studies of effects of yaw and of boundary discontinuities completed, and theses prepared.

(81) MATHEMATICAL ANALYSIS OF PRESSURE DISTRIBUTION.

(b) Office of Naval Research, Department of the Navy.
(d) Theoretical; basic research.
(e) Improved methods of applying irrotational-flow theory to problems of hydraulic design are being sought and used to obtain information on specific problems. Pressure distributions around faired boundary forms are obtained mathematically, neglecting viscous effects using both exact and approximate methods. Where possible, results are compared with experimental measurements in other studies. Study includes ellipsoidal and rounded-head forms with cylindrical afterbodies, two-dimensional wedge shapes, faired struts, and two-dimensional inlet sections. Ellipsoidal forms have been studied at various small angles of yaw. Modifications of the Kármán approximate source-sink method and others are used. Relaxation technique is being applied to boundary transitions, jet profiles, and the form of cavitation pockets. Approximate methods of determining the body profile for a given pressure or velocity distribution are being sought.
(g) Computations for wedge shapes of various angles and representative computations for several boundary forms have been completed. Relaxation method has been applied to problems of efflux and cavitation-pocket formation in axisymmetric flow. A relatively rapid method of approximation, depending on determination of sets of coefficients in Legendre Polynomials, has been devised for determining the body form for a given pressure distribution. Problems of divided flow have been analyzed as the two-dimensional counterpart of side-weir and manifold flow. The results of computations for axisymmetric head forms are compared with experiments in the reports listed under Project 79 on page 35.
(h) "Approximate analyses interrelating pressure distribution and axisymmetric body form." En-Yun-Hsu. Ph. D. Thesis, State University of Iowa, Feb. 1950. (Available on loan).

(82) HYDRAULICS OF MANIFOLDS.

(b) Laboratory project; sponsored by Committee on Hydraulic Research, Hydraulics Division, A.S.C.E.
(d) Experimental; for design and masters' theses.
(e) Divided and confluent flow have been studied in a 2-inch smooth brass pipe with a single right-angle lateral to determine effect of discharge and diameter ratios upon the changes in pressure at the junction. The effect of spacing in multiple-lateral manifolds and the pattern of flow and pressure variation in the immediate vicinity of the junction were studied.
(f) Completed.
(h) "Studies of multiple laterals in manifold flow." Adolfo Yanes. Master's Thesis, State University of Iowa, Feb. 1951. (Available on loan).

(298) FALL VELOCITY OF SEDIMENT.

(b) Laboratory project.
(d) Experimental; basic research and masters' theses.
(e) The effect of a cylindrical boundary and particle shape on the fall velocity of individual particles, and of concentration on rate of settlement of sediment are being investigated. Velocities of spheres, falling along axes of vertical cylinders of selected diameters and through fluids of different viscosities have been determined. Using stroboscopic timing and a thermostatically controlled bath, data have been obtained for sphere to cylinder diameters ranging from zero to unity, and for Reynolds numbers less than 1000. For larger values of R, drag force on a sphere fixed in a cylindrical conduit has been determined from measured pressure distributions and computations of surface drag. Approximate theoretical analyses agree well with experimental results within the Stokes' range. Fall velocities for a variety of regular shapes have been determined. Measurements are being made of the effect on fall velocity of particle concentration in uniformly dispersed suspensions of sediment, and for the effect of a vertical wall or the mutual effect of two identical particles displaced horizontally using clouds of uniform sediment.
(g) Study of cylindrical boundary effect and principal effects of shape are completed. Ratios of the principal axes are found to be significant shape parameters. The effects of sediment concentration on fall velocities are rather pronounced even for low concentrations. Representative results have been obtained concerning the effect of a plane vertical boundary and mutual interaction of two spheres. For uniform particles settling in a homogenous suspension, the results can be expressed by:

$$w_0 = w(1 + f\sqrt[3]{C}\ ),$$

where $w_0$ = actual fall velocity, $w$ = fall velocity for single particle, and $C$ = concentration in terms of submerged weight. It is believed that results can be extended to the case of graded particles settling in a stratified suspension.
(h) "Effect of shape of particles on their settling velocities - triaxial particles." Himansu Ranjan Pramanik. Master's Thesis, State University of Iowa, Feb. 1950. (Available on loan).
"Mutual influence of two freely falling spherical particles and the effects of a plane vertical boundary on a single spherical particle." Jagdish Raj Bammi. Master's Thesis, State University of Iowa, Aug. 1950. (Available on loan).
"Effect of a cylindrical boundary on the drag of spheres." John Terhune Newlin. Master's Thesis, State University of Iowa, Aug. 1950. (Available on loan).

(299) DETERMINATION OF PRESSURE DISTRIBUTION CAUSED BY FLOW OF AIR OVER A SERIES OF THREE-DIMENSIONAL BUILDING FORMS.

(b) In cooperation with Office of Naval Research, Department of the Navy.
(d) Experimental; applied research and masters' theses.
(e) To determine pressure distribution on simple three-dimensional building forms of various proportions, for winds of different orientations. Rectangular building models, with length-width ratios of 1, 2, and 4, height-width ratios of 1/2, 1, 3/2, and roof angles of 0°, 15°, and 30°, were tested in a low-velocity air tunnel with approaching wind directions of 0°, 45°, and 90°, and maximum air velocity of 35 fps. Models of hanger-type buildings having length-diameter ratios of 1/2, 1, 2, 4, and of flat walls having length-width ratios of 1/8, to 3/2 were also made. These studies completed; investigations now being made of effects of eaves and parapets.
(g) Contour maps of pressure distribution showed that positive pressures occurred on the windward walls only, while severe negative pressures were found near the upwind roof corner for quartering wind.

(302) SEDIMENT SIZE ANALYSIS BY MEANS OF PRESSURE DIFFERENTIALS IN STRATIFIED SUSPENSION.

(b) Laboratory project.
(d) Experimental; doctoral dissertation.

(e) To develop a technique for rapid size-frequency determination by measurement of pressure differentials during relative motion between sediment and suspending liquid. Sample is introduced at top of a water-filled tube containing a pervious piston which can be displaced along axis of tube. Piezometers at top of tube and just above piston permit differential pressure, and hence immersed weight of suspended sediment, to be recorded during traverse of tube by piston.
(f) Device previously developed by H. J. Skidmore now being extended by D. W. Appel to include electrical recording of pressure differential.

(566) EFFECT OF STORM LOCATION ON FORM OF UNIT HYDROGRAPH.

(b) Laboratory project.
(d) Analytical investigation; applied research for masters' theses.
(e) A study of the effect of runoff location on the form of the unit hydrograph for the Iowa River.
(f) Completed.
(h) "Influence of the location of storm runoff on shape of the unit hydrograph." Yu-Cheh Soong. Master's Thesis. State University of Iowa, Feb. 1950. (Available on loan).
"Mimimum expected yield from small watersheds, using synthetic meteorological years." C. E. Lewald. Master's Thesis. State University of Iowa, June 1950. (Available on loan).

(567) A STUDY OF FLOW OVER LATERAL SPILLWAYS.

(b) Laboratory project; partially supported by A.S.C.E. through J. Waldo Smith award.
(d) Experimental; applied research and masters' theses.
(e) Flow over a sharp-crested weir in one side of a rectangular channel is being studied as a function of the channel and weir dimensions, the channel depth, and the Froude number of the channel flow above the weir.
(g) A systematic investigation has been made of the variation of coefficient of discharge for the lateral weir as a function of the various geometrical ratios and the Froude number of the approaching flow. The discharge coefficient increased with increasing depth and crest length and decreased with increasing channel width. The variation of the coefficient with the Froude number was more complex, the direction of the trend depending upon other variables. For Froude numbers $(V/\sqrt{gy})$ greater than 0.7 an unstable hydraulic jump formed, causing considerable variation in the coefficient.
(h) "Experimental investigation of the discharge coefficient for a rectangular side weir." Carlos Acosta-Sierra. Master's Thesis, State University of Iowa, Feb. 1951. (Available on loan).

(568) SCOUR AT BRIDGE PIERS AND ABUTMENTS.

(b) Iowa State Highway Commission and Bureau of Public Roads.
(d) To investigate the effects of pier and abutment geometry, sediment properties, and stream-flow characteristics on the rate and pattern of scour, to provide safe design criteria.
(f) Initial phase, the study of pier and abutment geometry, and second phase, the study of the effect of stream-flow characteristics, is in progress. A related investigation, the development of a bridge pier and footing which will limit scour action by proper geometry of shape, is being carried on. Qualitative analyses are being performed in a 5-foot flume with movable sand bed on models of a single circular pier.
(g) Report No. 1: "Scour around bridge piers and abutments, effect of geometry of representative Iowa designs." Aug. 1950. (Request should be made of Iowa State Highway Commission, Ames, Iowa).
"Progress report on model studies of scour around bridge piers and abutments." Jan. 1951. (Request should be made of Highway Research Board, 2101 Constitution Avenue, Washington 25, D. C.

(850) MODEL STUDY OF SANTA CECILIA CANAL TRANSITIONS.

(b) Canadian-Brazilian Services, Ltd., Toronto, Canada.
(d) Experimental; applied research.

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(e) Model studies were made to determine head loss and scour downstream and to develop an economical design for two open-channel expansions in a canal system. One transition is from a non-pressure tunnel section to a trapezoidal section of canal in earth, minimum length of transition being required. The other is from rock cut to trapezoidal section in earth along a curve. Designs depending on guide vanes to expand the flow were found very satisfactory.
(f) Completed.
(g) Report submitted to Canadian-Brazilian Services, Ltd., Toronto, Canada. "Model studies aid in design of Paraiba Pirai diversion in Brazil." (Submitted for publication in Civil Engineering in 1951).

(851) A CONSTANT-TEMPERATURE HOT-WIRE ANEMOMETER FOR THE MEASUREMTNT OF TURBULENCE IN AIR.

(b) Laboratory project, and Office of Naval Research, Department of the Navy.
(c) Philip G. Hubbard, State University of Iowa, Iowa City, Iowa.
(d) Experimental; instrument design.
(e) The anemometer was designed to measure fundamental properties of turbulence in a low-velocity air tunnel, with special emphasis on simple operational techniques and high sensitivity at low frequencies. The aims were accomplished by utilizing carefully designed electronic control circuits and maintenance of the wire temperature at a constant level above that of the air stream.
(f) Completed.
(g) The instrument has been used to study turbulence behind screens and in a free jet and in boundary-layer studies.
(h) An AC-bridge hot-wire anemometer with constant temperature operation." P. L. Bernsten. Master's Thesis, State University of Iowa, Aug. 1950. (Available on loan).

(853) DESIGN OF HYDRAULICS LABORATORY EQUIPMENT.

(b) Central University of Venezuela, Caracas, Venezuela.
(d) Contract project.
(e) Design of modern equipment for student instruction in fluid mechanics and applied research in hydraulic engineering.
(f) Completed.

(854) BOUNDARY-LAYER DEVELOPMENT ON SMOOTH AND ROUGH SURFACES.

(b) Office of Naval Research, Department of the Navy.
(d) Experimental and theoretical; basic research and graduate theses.
(e) Preliminary experimental investigation of the drag of smooth and rough surfaces in the low-velocity air tunnel, including boundary-layer development, turbulence, and drag, has been completed. A similar study on artifically roughened surfaces is under way. Preliminary experiments have been made on surfaces roughened by symmetrical arrangements of cubes.
(g) "An exploratory investigation of boundary-layer development on smooth and rough surfaces." William Douglas Baines. Ph. D. Thesis, Aug. 1950. (Available on loan).

(1099) AIR ENTRAINMENT OF LIQUID JETS.

(b) Laboratory project.
(d) Experimental; basic research and master's thesis.
(e) The first phase involved the entrainment of air by vertical water jets of various diameters and efflux velocities.
(f) Dormant.
(g) The work described under (e) above has been completed.
(h) "Air entrainment of liquid jets." R. W. Shirley. Master's Thesis, State University of Iowa, Aug. 1950. (Available on loan).

(1100) BOUNDARY-LAYER DEVELOPMENT ON STEEP SLOPES.

(b) Waterways Experiment Station, Corps of Engineers.
(d) Experimental; basic research, for design and graduate theses.

(e) Tests are being conducted in a sloping flume below a spillway crest to determine the velocity distribution and boundary-layer thickness as a function of distance from the crest, discharge rate, angle of slope, and bottom roughness, to develop a means of predicting the location of the zone at which the turbulent boundary layer intersects the water surface and air entrainment begins.

(1101) MOVEMENT OF SEDIMENT IN HIGHWAY DRAINAGE SYSTEMS.

(b) Bureau of Public Roads.
(d) Experimental; for basic research and graduate theses.
(e) A study of the movement of sediment in pipes, including the pattern of sand transport and the accompanying hydraulic energy losses; and a study of the effects of the geometry of sand traps on their efficiency in sediment removal.

(1102) HISTORY OF HYDRAULICS.

(b) Laboratory project.
(c) Simon Ince, State University of Iowa, Iowa City, Iowa.
(d) Library research; for doctor's degree.
(e) To trace the historical development of the important theories of hydraulics, covering the fundamental ideas of the science, the critical periods of development, and the contributions of personalities of major importance.

(1103) PRESSURE DISTRIBUTION ON THE DOWNSTREAM FACE OF A SUBMERGED SPILLWAY.

(b) Laboratory project.
(c) Prof. Ake Alin, State University of Iowa, Iowa City, Iowa.
(d) Experimental; basic research and master's thesis.
(e) Studies were made to determine the pressures along the downstream face of a submerged spillway face for various degrees of submergence, to obtain data to assist in evaluating the water force along the downstream face. The data are useful in the study of stability of low submerged dams. Discharge coefficients for various degrees of submergence were also evaluated.
(f) Completed.
(h) "Pressure distribution on the downstream face of a submerged weir." Michael Bar Shany. Master's Thesis. State University of Iowa, June 1950. (Available on loan).

(1104) ACCELERATED MOTION OF A SPHERE.

(b) Laboratory project.
(d) Experimental; basic research and doctor's thesis.
(e) Force components on an oscillating sphere in a fluid were studied experimentally. Components were separated into inertial effective force and dissipative shear force. The apparatus closely approximated simple harmonic motion of the sphere and the data were analyzed on the assumption that the motion was exactly simple harmonic. Results were applied to the allied problem of a stationary sphere in an oscillating fluid. Experimental results were compared with analytical; and with earlier work in Germany. The data are extended to present a simple analysis of the diffusion characteristics of suspended sediment in water. Study is to be extended to include other shapes and to obtain more detailed information concerning the unsteady pattern of flow around submerged bodies.
(f) Suspended temporarily.
(h) "Accelerated motion of a sphere." M. R. Carstens. Doctoral Thesis. State University of Iowa, June 1950. (Available on loan).

(1105) DRAG COEFFICIENTS OF MULTIPLE PLATES AS A FUNCTION OF SOLIDITY RATIO.

(b) Laboratory project.
(d) Experimental; for master's thesis.

(e) Systematic measurements were made in a low-velocity wind tunnel of drag on (1) four symmetrically arranged squares of variable spacing, starting with a single large square; (2) concentric rings of varying width, spacing and number; and (3) overlapped square-meshed lattices of various bar-mesh ratios, starting with a single square ring. The drag was expressed as a coefficient and related to the solidity ratio, (ratio of closed area to total area enclosed by peripheral outline).
(f) Completed.
(g) (1) For any given number of multiple plates as spacing varies from zero to infinity the drag coefficient varies from that of a solid plate to that of a series of independent plates; (2) for any given width-mesh ratio the greater the number of plates the larger the drag coefficient; and (3) for a given solidity ratio the greater the number of plates the greater the drag coefficient.
(h) "Drag coefficients of multiple plates as a function of solidity ratio." Tien-To Siao. Master's Thesis, State University of Iowa, Aug. 1950. (Available on loan).

(1106) A DIRECT OPTICAL METHOD FOR MEASURING FLUID VELOCITIES IN LAMINAR FLOW.

(b) Laboratory project.
(c) Prof. C. J. Posey, State University of Iowa, Iowa City, Iowa.
(d) Experimental; basic research and master's thesis.
(e) A method and the apparatus for direct optical determination of the fluid velocity in any filament of steady, uniform, laminar flow in an open channel were developed. The method is no way disturbs the flow, except for the negligible effect of minute particles of aluminum in suspension. Velocities were determined by comparing the movement of images on a ground glass with a moving belt whose speed was precisely controlled over a continuous range by a variable oscillator and synchronous motor.
(f) Completed.
(h) "A direct optical method for measuring fluid velocities in laminar flow." Ellis B. Pickett. Master's Thesis. State University of Iowa, Aug. 1950. (Available on loan).

(1107) TRANSPORTATION OF SEDIMENT AS SUSPENDED AND TOTAL LOAD.

(b) Office of Naval Research, U. S. Navy Department.
(d) Experimental; basic research.
(e) To determine the suspended and total load as a function of hydraulic and sediment parameters. A recirculating flume 3 feet wide, 15 inches deep, 100 feet long, and of variable slope has been constructed (see Project 569, 1950). Distribution of sediment, and total load will be measured. Effect of sediment transport on velocity distribution, energy loss, and other hydraulic characteristics will also be evaluated.

(1108) RELATION OF WATERSHED CHARACTERISTICS TO THE FORM OF THE UNIT HYDROGRAPH.

(b) Laboratory project.
(d) Analytical investigation; basic research, for master's thesis.
(e) A study is being made of the relation of watershed characteristics of stream basins in Illinois and unit hydrographs for those basins, recently developed by the Geological Survey in cooperation with the State of Illinois.

(1109) A STUDY OF MEANDERS.

(b) Field project.
(c) Prof. C. J. Posey, State University of Iowa, Iowa City, Iowa.
(d) Field investigation; applied research for master's thesis.
(e) A study of the various aspects of the meandering behavior of streams, including field measurements and qualitative observations. Numerical relations between discharge, bed material, and slope of the streams were attempted. A device for measuring the length of the meanders by traverses along the frozen stream was developed.
(f) Completed.
(h) "A study of meanders." Cezar Nuguid. Master's Thesis, State University of Iowa, Aug. 1950. (Available on loan).

(1110) MINIMUM EXPECTED YIELD FROM SMALL WATERSHEDS, USING SYNTHETIC METEOROLOGICAL YEARS.

(b) Laboratory project.
(d) Experimental and field research; for master's thesis.
(e) A system is proposed for constructing a synthetic meteorological period by applying the theory of repeated trials to observed monthly meteorological data. The method permits anticipation of critical dry periods for a desired design frequency. A device is also proposed for avoiding the difficulty involved in estimating monthly groundwater storage.
(f) Completed.
(h) "Minimum expected yield from small watersheds, using synthetic meteorological years." C. E. Lewald. Master's Thesis. State University of Iowa, June 1950. (Available on loan).

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THE JOHNS HOPKINS UNIVERSITY, Institute of Coöperative Research.

Inquiries concerning Projects Nos. 855, 856, and 1111 should be addressed to Dr. John C. Geyer, The Johns Hopkins University, Baltimore 18, Md.

(855) HYDRAULIC BEHAVIOR OF STORM SEWER INLETS.

(b) Baltimore City, Baltimore County, and the Maryland State Roads Commission.
(d) Experimental; basic research and design.
(e) Model tests of curb, gutter, and combination inlets of various designs for inflow changes with street dimensions of grade, crown and roughness. The design of the inlet itself, of the inlet depression, and of deflectors at the inlet are all under study.
(g) Tests on curb inlets, with and without depressions, and on combination curb and gutter inlets of simple design without depression have been completed and rating formulas derived. Several patterns of gutter grates have been compared for efficiency in accepting flow and, with each pattern installed in turn in a typical curb and gutter inlet, rating curves for all patterns have been prepared. The use of inlet models having a reduced scale on the order of 1:5 has been validated by field tests.
(h) Reports submitted to Journal of Sewage and Industrial Wastes for publication early in 1951. "Hydraulic behavior of storm drain inlets, Part I- Flow into gutter inlets in a straight gutter without depression." Wen Hsiung Li, John C. Geyer and George S. Benton. "Hydraulic behavior of storm drain inlets, Part II- Flow into curb-opening inlets." Wen Hsiung Li, Knut K. Sorteberg and John C. Geyer.

(856) HYDROLOGY OF STORM DRAINAGE SYSTEMS IN URBAN AREAS.

(b) Baltimore City, Baltimore County, and the Maryland State Roads Commission.
(d) Field investigation; basic research and design.
(e) Study of rainfall and runoff as affected by types and patterns of ground surface, length and degree of slope, shape of watershed, pattern of drainage ways.
(g) Eleven recording rain gages are in operation to provide information on the temporal and geographic pattern of storms. One area of about 20 acres has been selected for intensive study. The runoff from the whole area is being gaged and also that from a 0.5 acre paved area within the whole.

(1111) DEVELOPMENT OF A FLOW GAGE FOR STORM SEWER DISCHARGES.

(b) Baltimore City, Baltimore County, and the Maryland State Roads Commission.
(d) Experimental; applied research.
(e) The development of gages for measuring both depth and velocity of the debris-laden, shooting flow commonly found in storm sewers. The search is for a method generally adaptable to existing storm sewers that does not require extensive alterations of the sewer channel.

(g) Methods attempted to date are; (1) an adaptation of the salt dilution method, (2) an air-purged line in which air pressure indicates the static head of the flow. Both are unsatisfactory: (1) requires too extensive instrumentation for automatic operation; (2) is only a partial solution in that velocity is not measured. A model channel is being constructed where other devices will be tested.

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LEHIGH UNIVERSITY, Fritz Engineering Laboratory.

Inquiries concerning Projects Nos. 90, 573, and 1112 to 1115, incl., should be addressed to Prof. M. B. McPherson, Department of Civil Engineering and Mechanics, Lehigh University, Bethlehem, Pa.

(90) STUDIES OF PRESSURE VARIATIONS CAUSED BY BOUNDARY MISALIGNMENT IN THEIR RELATION TO CAVITATION IN HYDRAULIC STRUCTURES.

(b) A.S.C.E. Subcommittee on Cavitation and the Lehigh Institute of Research.
(d) Experimental; basic research; master's thesis.
(e) Determination of pressure variation as a function of approach velocity and head, and magnitude of misalignment. Study of pressure distribution along one surface of both a rectangular open channel and a closed conduit in which a transverse step of variable height has been placed. An attempt will be made to define misalignment tolerances for hydraulic structures.
(g) Open channel study nearly completed; closed conduit study initiated. Within the scope of the open channel study, extent of cavitation-inducive velocities have been defined.
(n) "Open Channel Study." Progress report to A.S.C.E. Subcommittee on Cavitation, Aug. 1950.

(573) MODEL STUDY OF THE LITTLE PINE CREEK, PENNSYLVANIA, DAM OUTLET STRUCTURE.

(b) Laboratory project; major portion sponsored by Gannett, Fleming, Corddry and Carpenter, Inc. consultants.
(d) Experimental; design.
(e) Determination of stage-discharge relationships under varying conditions, evaluation of conduit transition loss. Drop-inlet type, with orifice at top, trash rack mounted over orifice.
(f) Completed.
(g) "Design of dam outlet trash-rack verified by model tests." M. B. McPherson. Civil Engineering. Aug. 1950.

(1112) MODEL STUDY OF THE HILLS CREEK DAM, PENNSYLVANIA, CHUTE SPILLWAY.

(b) Laboratory project; major portion sponsored by F. H. Dechant, Consulting Engineer.
(d) Experimental; applied research; master's thesis.
(e) 1:24 scale model of a short spillway chute having a 45° direction change; supercritical flow. Alternate designs being investigated.

(1113) A STUDY OF SHARP-CRESTED CIRCULAR WEIRS.

(b) Laboratory project.
(d) Experimental; undergraduate thesis.
(e) Study of the effects of variations in head, approach depths and diameter. Weirs are circular in plan, radial in approach.

(1114) MODEL STUDY OF FALL RIVER DAM, KANSAS, SPILLWAY.

(b) Laboratory project; graduate problem.
(d) Experimental; undergraduate instruction.
(e) 1:100 scale including approach area, apron, tailwater area and tainter gates. Experimental proving of Corps of Engineers Design.

(f) Nearing completion.
(h) Graduate student report will be available on loan.

(1115) INEXPENSIVE DEMONSTRATION FLUID POLARISCOPE.

(b) Laboratory project.
(d) Development.
(e) An effective familiar teaching aid, reduced to a minimum of cost.
(f) Completed.
(h) "An inexpensive demonstration fluid polariscope." M. B. McPherson and R. E. Nece. Unpublished, available on request. Publication of a summary is pending.

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LOUISIANA STATE UNIVERSITY AND A & M COLLEGE, School of Hydraulic Engineering.

(857) DETERMINATION OF DISCHARGE COEFFICIENTS FOR SECTOR GATES.

(b) Laboratory project.
(c) Prof. Dwight L. Glasscock, Louisiana State University and A & M College, Baton Rouge 3, La.
(d) Experimental; applied research for master's thesis.
(e) 1:50 scale models of gates having radii of 36, 38, and 40 feet were constructed. Tests to be made to determine discharge rates at various gate openings and differential heads.
(f) Inactive.
(g) Preliminary results obtained.
(h) "A study of discharge coefficients for vertical sector gates." Richard McLemore. Master's Thesis, Louisiana State University and A & M College, Aug. 1950. (Available on interlibrary loan).

(858) STUDY OF SUBMERGED BROAD CREST WEIR DISCHARGE CHARACTERISTICS.

(b) Laboratory project.
(c) Prof. Dwight L. Glasscock, Louisiana State University and A & M College, Baton Rouge 3, La.
(d) Experimental; applied research for master's thesis.
(e) Tests will be conducted on ogee weirs and various broad-crested weirs to determine the effect of submergence on discharge.
(g) Preliminary results obtained.
(h) "A study of the discharge characteristics of submerged weirs." James R. Marable. Master's Thesis. Louisiana State University and A & M College. Aug. 1950. (Available on interlibrary loan).

(859) STUDY OF FLARING DOWNSTREAM END OF CULVERTS UPON DISCHARGE.

(b) Laboratory project.
(c) Prof. Dwight L. Glasscock, Louisiana State University and A & M College, Baton Rouge 3, La.
(d) Experimental; applied research for master's thesis.
(e) Tests will be made of scale models without flaring for verification and comparison. Models will then be flared and changes in discharge observed.
(g) Preliminary results obtained.
(h) "Study of flaring outlet end of culvert to increase rate of discharge." L. E. Venegas. Master's Thesis, Louisiana State University and A & M College, Aug. 1950. (Available on interlibrary loan).

(860) THE EFFECT OF CHLORIDE CONTENT OF WATER ON FLOW THROUGH SAND.

(b) Laboratory project; in cooperation with the Geological Survey.
(c) Mr. George M. Slaughter, Louisiana State University and A & M College, Baton Rouge 3, La.
(d) Experimental; applied research for master's thesis.
(e) Tests will be conducted in a permeameter, having sand media. Tests will range from distilled water through sea water.

(g) Preliminary study completed.
(h) "A study of the effect of chloride content on the flow of water through porous media." W. E. Edens. Master's Thesis, Louisiana State University and A & M College, Aug. 1950. (Available on interlibrary loan).

(861) THE DERIVATION OF SYNTHETIC UNIT HYDROGRAPHS FOR THE STREAMS OF LOUISIANA.

(b) Laboratory project in cooperation with the U. S. Geological Survey and Department of Public Works, State of Louisiana.
(c) Mr. George M. Slaughter, Louisiana State University and A & M Coleege, Baton Rouge 3, La.
(d) Theoretical and experimental; applied research for master's thesis.
(e) Unit hydrographs were derived from existing data. These and the drainage basin characteristics were compared and used to derive coefficients for the construction of synthetic unit hydrographs.
(f) Master unitgraph derived for Louisiana streams.
(g) Completed.
(h) "Synthetic unitgraph for streams of Louisiana." P. C. Stottlemyer. Master's Thesis, Louisiana State University and A & M College. Aug. 1950. (Available on interlibrary loan).

(862) ANALYSIS OF THE RELATION OF TURBULENCE AND VELOCITY PROFILES TO DISTRIBUTION OF SEDIMENT.

(b) Laboratory project.
(c) Mr. George M. Slaughter, Louisiana State University and A & M College, Baton Rouge 3, La.
(d) Theoretical; applied research for master's thesis.
(e) Review of literature on fluid turbulence and a comprehensive bibliography on transportation of sediment. An attempt was made to collect and correlate a major portion of existing data on this subject into one paper. No additional basic data were obtained.
(f) Completed.
(h) "A theory of the transportation of suspended sediment in a flowing stream." J. W. Flanagan. Master's Thesis, Louisiana State University and A & M College Aug. 1950. (Available on interlibrary loan).

(867) STUDY OF EFFECT OF FLOATING BREAKWATERS ON WAVE ACTION.

(b) Laboratory project.
(c) Dr. V. Merkys, Louisiana State University and A & M College, Baton Rouge 3, La.
(d) Theoretical and experimental; basic research.
(e) An investigation of floating breakwaters of varying dimensions and roughness to determine maximum dissipation of the wave amplitude with a minimum of detrimental effects upon the dissipating breakwaters. The floating breakwaters were tested in a 40 foot by 3 foot wave tank.
(f) Completed.
(h) "An analysis of the theory and application of the floating breakwater." H. E. Kleinpeter. Master's Thesis, Louisiana State University and A & M College. Aug. 1950. (Available on interlibrary loan).

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UNIVERSITY OF MARYLAND, Glenn L. Martin College of Engineering and Aeronautical Sciences.

(1116) NEW DESIGN OF CREST-STAGE GAGE.

(b) Geological Survey, Water Resources Branch, College Park District.
(c) Mr. F. F. Le Fever, District Engineer, Geological Survey, University of Maryland, College Park, Maryland.
(d) Experimental; for design and operation.
(e) Crest-stage inlet performance was studied in a slightly sloping, 30 foot long concrete flume, 20 inches wide by 18 inches deep with velocities up to 8 fps to determine if the new crest-stage gage has a tendency to produce a pile-up effect on the water level within the pipe which is opposed by the customary draw-down effect from the open-bottom vertical inlets.

(f) Completed.
(g) A new crest-stage gage has been developed using a smaller pipe and substituting an aluminum measuring rod for the usual destructible wooden stick, for easier operation, reduced maintenance, and better accuracy.
(h) Final report under preparation.

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

Inquiries concerning Projects Nos. 306 to 309, incl., 311, 577 to 580, incl., and 869 should be addressed to Dr. A. T. Ippen, Department of Civil and Sanitary Engineering, Massachusetts Institute of Technology, Cambridge 39, Mass.

(306) SCOUR AROUND BRIDGE PIERS.

(b) Laboratory project.
(d) Experimental; graduate research.
(e) Qualitative study of scour patterns for various geometric arrangements of pile groups. Quantitative comparison of scour for single piles under various conditions of uniform sediment sizes. Plastic sediments in various colors and sizes are used to trace history of scour.
(g) Systematic studies for various pile groups have been completed. A series of scour measurements with different bed materials and flow conditions are available which, however, need further extension with respect to grain size and hydraulic conditions. General conclusions are not possible so far.
(h) "Scour around bridge piers." W. J. Love. M. S. Thesis, June 1950.
"Scour around bridge piers." K. P. Devenis. M. S. Thesis, Sept. 1950.

(307) STABILITY OF FLOW STRATIFIED DUE TO DENSITY DIFFERENCES.

(b) Laboratory project; initially sponsored by Committee on Hydraulic Research, Hydraulics Division, A.S.C.E.
(d) Theoretical and experimental; graduate research.
(e) Theoretical analysis of instability at interface of density flow. Laboratory studies of criteria for mixing.
(g) Comprehensive analysis of density flows on basis of gravity and inertia forces was compiled. Experimental study of underflow in reservoirs at equilibrium of gravity and viscous forces was carried out in a glass-walled tank. Velocity distributions in reservoir and density currents were determined. Critical state of flow beyond which mixing occurs was determined for a large range of characteristic parameters. Shape of initial surge and its celerity were measured. Work to be continued with a wider reservoir to reduce wall effects.
(h) "Initial characteristics of density current flow." E. P. Braucher. M. S. Thesis. Sept. 1950.

(308) SUPERCRITICAL FLOW IN OPEN CHANNEL CONTRACTIONS.

(b) Laboratory project.
(d) Theoretical and experimental; graduate research.
(e) Theoretical analysis of standing wave patterns for supercritical flow in open channel contractions. Experimental measurements to verify analytical results were made for straight wall construction.
(f) Completed.
(g) Basic tests for a limited range of Froude numbers in high velocity channel have verified essentially the theoretical analysis.

(309) CHARACTERISTICS OF OSCILLATORY WAVES.

(b) Laboratory project; initially sponsored by the Committee on Hydraulic Research, Hydraulics Division, A.S.C.E.
(d) Experimental; basic and graduate research.
(e) Systematic investigation of forms and propagation of oscillatory waves. Development of techniques to record instantaneously wave forms, internal velocities, and pressures during passage of a wave.
(g) A lucite wave tank of 18 inches by 12 inches cross-section has been built with a tilting device. Experimental techniques to photograph particle motion within a wave have been developed.

(311) HYDRAULIC ANALOGY TO SUPERSONIC FLOW OF GASES.

(b) U. S. Air Forces.
(d) Experimental; basic research.
(e) To provide experimental evidence for a wide range of Froude numbers as to the extent to which hydraulic shock waves conform to the theoretical analogy to supersonic flow of gases. Typical experiments on airfoils involving shock waves and expansion zones for water are to be compared to known experimental results for air.
(g) A high velocity flume of 40 feet long and 4 feet wide has been constructed. It can be tilted up to slopes of 10 percent. 30 feet of the bottom consists of glass. Extensive measurements for a wide range of conditions have been completed and analyzed. Experimental lift, drag, and moment coefficients for two airfoils have been shown to agree with theoretical values obtained for air and water.
(h) "Studies on the validity of the hydraulic analogy to supersonic flow." Parts I and II. A. T. Ippen and D. R. F. Harleman. Air Force Tech. Report No. 5985, May 1950.
"Studies on the validity of the hydraulic analogy to supersonic flow." D. R. F. Harleman. Sc. D. Thesis. Jan. 1950.
Part III of comprehensive report in preparation.

(577) CHARACTERISTICS OF SOLITARY WAVES.

(b) Laboratory project; also sponsored by the Office of Naval Research.
(d) Experimental; graduate research.
(e) Experimental investigation of solitary wave characteristics for comparison with various mathematical theories. Forms and velocity of propagation of solitary waves are to be determined. Internal velocities and pressures are recorded instantaneously and related to wave form and relative wave height.
(g) A series of measurements of wave celerity and wave form have been made, and the results analyzed.
(h) "Experimental study of the characteristics of solitary waves." S. C. Stephan Jr. M. S. Thesis. Jan. 1950.

(578) DEVELOPMENT OF METHODS AND INSTRUMENTS TO DETERMINE THE CHARACTERISTICS OF TURBULENT MOTION IN WATER.

(b) Laboratory project; sponsored by Engineering Foundation and by Office of Naval Research.
(d) Experimental; development of instrumentation.
(e) Theoretical and experimental study of various instruments and methods to record instantaneous values of velocity and pressure in a turbulent flow.
(g) A thorough analysis of all possible methods to measure and record instantaneous velocities and pressures has been completed. Experimental attempts to adapt hot-wire or electromagnetic probes for this purpose have been abandoned due to the multitude of inherent difficulties. A combination of Pitot tube and electric capacitance pressure cell is now employed to obtain the distribution of root mean square velocity fluctuations in a turbulent stream and to determine the growth of turbulent boundary layers.
(h) "Capacitance type pressure gage for turbulence measurements." H. G. Farmer Jr. M. S. Thesi Sept. 1950.

579) INVESTIGATION OF FLUID FRICTION AND CAVITATION PHENOMENA IN UNSTEADY MOTION.

(b) Office of Naval Research, Department of the Navy.
(d) Experimental; basic research.
(e) The influence of unsteady flow patterns on submerged bodies is to be explored in a specially developed water tunnel. The flow in the working section is to be adjusted so that desired accelerations can be maintained for a short length of time and total resistance and pressure distributions determined.
(g) A pilot model of the water tunnel has been constructed, and special flow control mechanisms for water and air have been completed. The development of the electronic instrumentat .on for automatic control of velocities and accelerations is under way. A test section for the measurement of wall friction under unsteady flow conditions has been installed.

(580) FUNDAMENTAL RESEARCH ON METHODS OF AIR DISPERSION IN THE ACTIVATED SLUDGE PROCESS.

(b) Public Health Service.
(d) Experimental; basic research.
(e) The experimental apparatus with specially designed diffusers producing a uniform supply of small diameter air bubbles has been constructed. An instrument to record continuously the oxygen content of the water based on the principle of the mercury electrode method has been developed. Actual tests of oxygen transfer from uniformly distributed bubbles of constant frequency and diameter are now underway in a 6-inch lucite column.
(h) "The continuous measurement of oxygen concentration in aeration processes." R. S. Yoseph. M. S. Thesis. June 1950.

(869) TRANSIENT STABILITY OF A NON-LINEAR SYSTEM USING ELECTRONIC ANALOG COMPUTATIONAL METHODS.

(b) Laboratory project; sponsored by the Research Corporation, N. Y.
(d) Theoretical and experimental study by electronic analog.
(e) The initial investigations employing the electronic analog computer are carried on considering the effects of the reservoir-tank-conduit system alone on the transition stability of hydro units. Subsequent investigations are to include other variables.
(g) The feasibility of attacking non-linear problems of transient performance and operating stability of hydro-power plants has been demonstrated, and preliminary phases of the work have already been completed.
(h) "Electrical analogies and electronic computers for surge and water-hammer problems." H. M. Paynter. Paper submitted to A.S.C.E. Hydraulics Division meeting. Jackson, Miss. Nov. 1950.

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MASSACHUSETTS INSTITUTE OF TECHNOLOGY, Department of Mechanical Engineering.

(312) EFFECT OF SUDDENLY APPLIED LIQUID PRESSURE IN DEFORMING A METAL SURFACE.

(b) National Advisory Committee for Aeronautics.
(c) Prof. B. G. Rightmire, Massachusetts Institute of Technology, Cambridge 39, Massachusetts.
(d) Experimental; basic research for thesis.
(e) Repeated pressure applied very suddenly by a liquid to a metal surface produces damage similar to that caused by cavitation. It is proposed to determine how sudden the application of repeated pressure must be to cause damage, and the character of the damage. Various liquids and specimen materials will be used.
(g) Pressure waves of 1000 psi amplitude building up at a rate of 100 psi per micro-second have been found to deform an aluminum or copper surface after 100,000 applications. Depth of deformation is about 0.001 inch. Means of controlling steepness and amplitude independently have been developed.
(h) "Effect of liquid impact on a copper single crystal." W. B. Giles. Master's Thesis. Massachusetts Institute of Technology, Sept. 1950.
"Effect of liquid impact on polycrystalline copper." R. J. Vannelli. Master's Thesis, Massachusetts Institute of Technology. Sept. 1950.

(878) FLOW THROUGH TWO ORIFICES IN SERIES.

(b) Laboratory project.
(c) Prof. W. M. Rohsenow, Massachusetts Institute of Technology, Cambridge 39, Mass.
(d) Experimental; applied research; master's thesis.
(e) The flow characteristics of two orifices in series were investigated using water. Under certain conditions a pressure rise across the second orifice is experienced. A double orifice can be devised which will have the same measuring head as a single orifice but will have greater pressure recovery.
(f) Completed.
(g) Upstream orifice coefficient is not affected appreciably by the presence of the downstream orifice. Maximum recovery appears to result when the downstream orifice is placed at the vena contracta of the upstream orifice and has approximately the diameter of the vena contracta. Pressure recovery of 65% was obtained with upstream orifice diameter 0.60 pipe diameter, downstream orifice = 0.55 pipe diameter, and spacing = 0.25 pipe diameter.
(h) To be submitted to A.S.M.E. for publication.
"Flow through two orifices in series." C. H. Fink and S. R. Pollis. S. M. Thesis, June 1950.

(880) RECOVERY FACTORS AND HEAT TRANSFER TO AIR FLOWING AT SUPERSONIC VELOCITIES IN A TUBE.

(b) Office of Naval Research, Department of the Navy.
(c) Prof. J. Kaye, Massachusetts Institute of Technology, Cambridge 39, Mass.
(d) Experimental and analytical; basic research, for M. S. and D. Sc. theses.
(e) To obtain reliable data for heat transfer from a wall to a fluid moving at supersonic velocities and to determine recovery factors for the same mean stream conditions. The coefficients of friction for supersonic flow in a tube are also measured.
(h) "Measurements of friction coefficients, recovery factors, and heat transfer coefficients for supersonic flow of air in a pipe." Joseph Kaye, Joseph H. Keenan, William H. McAdams. Heat Transfer and Fluid Mechanics Institute, Berkeley, Calif. June 1949.

(881) EFFECT OF REYNOLDS NUMBER ON INTERPRETATION OF PITOT TUBE READINGS.

(b) Laboratory project.
(c) Mr. A. H. Shapiro, Massachusetts Institute of Technology, Cambridge 39, Mass.
(d) Experimental and analytical; basic and applied research.
(e) Impact tubes are calibrated at very low Reynolds numbers, the ratio of pressure rise to free-stream velocity head being plotted as a function of Reynolds Number.
(g) At very low Reynolds numbers, the pressure rise at the impact hole has been found to be as much as twenty times greater than would be indicated by Bernoulli's theorem for frictionless flow.
(h) "The effect of Reynolds number on impact tube calibration." H. A. Gerdes, D. M. Brooks, and J. F. Kalina. Master's Thesis, 1950.

(882) MIXING OF COAXIAL GAS JETS.

(b) Bureau of Ordnance, Department of the Navy.
(c) Mr. A. H. Shapiro, Massachusetts Institute of Technology, Cambridge 39, Mass.
(d) Experimental.
(e) The effects of density ratio and velocity ratio on the momentum, mass, and temperature transfer of two coaxial gas jets were measured.
(f) Completed.
(g) The turbulent Prandtl and Schmidt numbers were both found to be 0.7.
(h) "An optical investigation of the mixing of two concentric gas streams." R. J. Nickerson. Master's Thesis. 1949.
"Turbulent mixing of coaxial gas jets." Fred Landis. Doctor's Thesis. 1950.

(1117) SUPERSONIC VORTEX-SOURCE FLOW.

(b) Laboratory project.
(c) Mr. F. Giraud, Massachusetts Institute of Technology, Cambridge 39, Mass.
(d) Theoretical and experimental.
(e) Experimental investigation of the behavior of vortex flow, viscosity effect, and diffusion efficiency.
(g) A theoretical method to compute flow problems, blading and passages. Evidence of a deceleration from supersonic to subsonic without shock. Check of some theoretical aspect of the theories developed.
(h) To be published soon:
"Determination of solutions of the hydrodynamical equations as one initial value problem."

(1118) RESEARCH ON CASCADES OF AIRFOILS.

(b) General Electric Company and Westinghouse Electric Corporation.
(c) Prof. E. S. Taylor, Massachusetts Institute of Technology, Cambridge 39, Mass.
(d) Experimental and theoretical.
(e) The primary object is to study the requirements for producing flow in a finite cascade equivalent to that for an "infinite" cascade. A simple low speed ($M = 0.15$) cascade tunnel has been built, to furnish experimental data to check and aid theoretical analysis.
(f) Experimental work on an airfoil designed to have a prescribed pressure distribution has begun. Laminar separation of the airfoil at the Reynold's numbers involved has made it necessary to study this phenomena experimentally.
(g) Results so far are inconclusive.

(1119) THREE-DIMENSIONAL ROTATIONAL FLOW IN BENDS.

(b) Office of Naval Research, Department of the Navy.
(c) Mr. Hans Eichenberger, Rm. 31-278, Massachusetts Institute of Technology, Cambridge 39, Mass.
(d) Theoretical and experimental.
(e) Includes a theoretical study of the flow of a fluid with an initial velocity gradient around pipe bends. Some experimental work has been initiated on water in a bent rectangular duct in order to study the behavior by means of dye.

(1120) BOUNDARY LAYER IN A ROTATING PIPE.

(b) National Advisory Committee for Aeronautics.
(c) Prof. W. R. Hawthorne, Rm. 31-267, Massachusetts Institute of Technology, Cambridge 39, Mass.
(d) Theoretical and experimental.
(e) Theoretical and experimental study of the frictional effects in the helical motion of fluid in a pipe. Joint undertaking with Prof. C. C. Lin in Mathematics Department. Plans for construction of experimental apparatus are under way.

(1121) CONSTRUCTION OF PROFILES WITH SPECIFIED PRESSURE DISTRIBUTIONS BY RELAXATION METHODS.

(b) National Advisory Committee for Aeronautics.
(c) Mr. John Stanitz, National Advisory Committee for Aeronautics Laboratories, Cleveland, O.

(1122) BASIC LEAKAGE STUDY.

(b) Laboratory project.
(c) Mr. J. L. Shearer, Massachusetts Institute of Technology, Cambridge 39, Mass.
(d) Experimental investigation; basic research.
(e) Investigation of laminar and turbulent flow in capillary passages with stationary and moving boundaries.
(h) "Basic leakage study, design and construction of apparatus." Don Erickson. S. B. Thesis. June 1950.
"Basic leakage study, preliminary experimental investigation." P. Fischetti. S. M. Thesis. Sept. 1950.

UNIVERSITY OF MICHIGAN, Lake Hydraulics Laboratory.

(1123) TESTS ON HARBOR MODELS.

(b) Waterways Experiment Station, Corps of Engineers.
(c) Prof. E. F. Brater, 320 West Engineering Building, Ann Arbor, Mich.
(d) Experimental; applied research.
(e) To determine the best harbor arrangement to provide refuge for small draft vessels at Harrisville, Michigan. Tests are being conducted on an undistorted fixed bed model, scale ratio 1:75.
(g) It is expected that a report will be available in April 1951.

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UNIVERSITY OF MICHIGAN, Experimental Naval Tank.

Inquiries concerning Projects Nos. 585, and 1124 to 1129, incl., should be addressed to Prof. L. A. Baier, 326 West Engineering Building, University of Michigan, Ann Arbor, Mich.

(585) RESISTANCE OF BARGE TOWS.

(b) Department of the Army, Corps of Engineers.
(d) Experimental; design.
(e) Tests are made in the naval tank to determine resistance of several formations of certain barge types relative to non-restricted straight channels and to selected channels restricted in width and depth. Each run will consist of movement of one model formation, at one draft and one depth of water for a given channel condition through a range of velocities sufficient to define a curve of functions of resistance versus velocity.
(f) Tests 75% completed.

(1124) BARGE DESIGN AND FLOTILLA ARRANGEMENTS.

(b) Ingalls Shipbuilding Corporation.
(d) Experimental; design.
(e) Tests are being conducted for the development of barge forms and arrangements of flotillas for improvement in river operation.
(f) Tests 90% completed.

(1125) SKEG DESIGN.

(b) Ingalls Shipbuilding Corporation.
(c) Prof. Harry Benford, 326 West Engineering Building, University of Michigan, Ann Arbor, Mich.
(d) Experimental; design.
(e) Tests are being conducted to develop the most efficient shape and position of skegs for the purpose of correcting yawing of towed barges.
(f) Tests 75% completed.

(1126) SMALL COMMERCIAL HULL DESIGN.

(b) General Motors Corporation.
(d) Experimental; design.
(e) Resistance and power tests are being conducted with a view to developing efficient hull forms for small power diesel engines.

(1127) TRANSOM IMMERSION ON HIGH-SPEED MOTORBOATS.

(b) Laboratory project.
(d) Research; design.
(e) Tests are being conducted to determine the most efficient transom immersion for various high speed hull forms.
(f) Tests 85% completed.

(1128) COMMERCIAL VESSELS, 150 to 250 FEET IN LENGTH.

(b) Fairbanks, Morse and Company.
(d) Experimental; design.
(e) A large family of hull forms is being tested in order to provide design data for the future design of commercial vessels, 150 to 250 feet in length.
(f) Tests 10% completed.

(1129) BARGE DESIGN AND FLOTILLA ARRANGEMENTS.

(b) St. Louis Shipbuilding and Steel Company.
(d) Experimental; design.
(e) Barge tests are being conducted to determine the most efficient end rakes and flotilla arrangements for various operating requirements.

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MISSISSIPPI STATE COLLEGE, Engineering and Industrial Research Station.

Inquiries concerning Projects Nos. 4, 5, and 891 should be addressed to Dr. Harold Flinsch, Box 365, State College, Miss.

(4) DEVELOPMENT OF SURFACE WAVES BY WIND.

(b) Laboratory project.
(d) Theoretical and experimental research.
(e) Research on the theories of surface wave origin and growth, on measurements in the laboratory and in nature, and on the comparative results of theory and measurement.
(g) A paper on the proposed theoretical approach of the project is in preparation. New experimental equipment has been acquired.
(h) "An experimental investigation of wind-generated surface waves." H. v. N. Flinsch. Ph. D. Thesis, University of Minnesota, May 1946.

(5) SHIP STABILITY AND ROLLING PERIOD.

(b) Laboratory project.
(d) Theoretical and experimental research.
(e) Exact and approximate formulas determining certain characteristics of ships, such as rolling period, metacentric height, etc., are compared with the results of experiments on ship models.
(g) Preliminary experiments have been performed on a basic model, and some of the results assembled in a brief report.

(891) A STUDY OF HEATED FLOW.

(b) Laboratory project.
(d) Theoretical and experimental research.
(e) The effect of heating on the flow characteristics of various fluids is to be studied.
(g) Experimental apparatus is being designed and will be constructed in the near future.

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MISSOURI SCHOOL OF MINES AND METALLURGY, Department of Civil Engineering.

(116) FLOW THROUGH SMALL LOW HEAD SIPHONS.

(b) Laboratory project.
(c) Prof. J. B. Butler, Missouri School of Mines and Metallurgy, Rolla, Mo.
(d) Experimental; for student demonstration.

(e) Tests have been made on siphons of various materials, noting discharge, friction loss, and peak suctions.
(f) Temporarily discontinued.

(117) STUDY OF SUCTION IN TUBES AND SMALL HYDRAULIC APPLIANCES ESPECIALLY AS LIMITED OR AFFECTED BY ADHESION AND COHESION OF WATER.

(b) Laboratory project.
(c) Prof. J. B. Butler, Missouri School of Mines and Metallurgy, Rolla, Mo.
(d) Experimental; for student demonstration.
(e) Tests have been made on several small suction devices noting effect of adhesion and cohesion of water.
(f) Temporarily discontinued.

(317) VELOCITY STUDIES IN A VERTICAL PIPE FLOWING FULL.

(b) Laboratory project.
(c) Prof. V. A. C. Gebecker, Missouri School of Mines and Metallurgy, Rolla, Mo.
(d) Experimental; basic research for master's thesis.
(e) Tests were conducted on vertical flow in 1/2 inch hard-drawn copper pipe to investigate flow with pipe flowing full with gravity assisting in line pressure.
(g) Completed.
(h) Further studies using definite pipe diameters in pipes of other materials are contemplated.

(318) FLOW THROUGH PIPE TRANSITIONS.

(b) Laboratory project.
(c) Prof. V. A. C. Gevecker, Missouri School of Mines and Metallurgy, Rolla, Mo.
(d) Experimental; basic research.
(e) Tests on various shaped transitions were made, noting discharge and friction loss.
(f) Suspended.

(319) WEIR STUDIES.

(b) Laboratory project.
(c) Prof. E. W. Carlton, Missouri School of Mines and Metallurgy, Rolla, Mo.
(d) Experimental; basic research for master's thesis.
(e) Tests on rectangular weirs were made to determine effect of velocity of approach on the relation between crest depth and critical depth of an imaginary open channel having same dimensions as the weir opening.
(g) Study produced a simple, accurate, and quick solution for plotting of M function. Relationship between the M function and the critical depth is logarithmic. This greatly simplifies determination of critical flow where the critical depth is known or vice versa. A relationship exists between M function of channels of same shape but different dimensions. The velocity of approach does not affect the relationship between physical depth and crest depth.

(586) FLUID FLOW IN PIPES.

(b) Laboratory project.
(c) Prof. J. B. Butler, Missouri School of Mines and Metallurgy, Rolla, Mo.
(d) Library research; basic research for master's thesis.
(e) A study of the various formulas for solution of problems on fluid flow in pipes is being made. A correlation of the categories of roughness recommended by Prof. E. W. Schoder of Cornell University for use in the "exact type" exponential formula with the relative roughness curves of Nikuradse used in determining the Reynolds number--friction factor relationship is being undertaken.
(g) A selected bibliography has been assembled.

(587) CROSS-SECTIONAL STREAM VELOCITY IN PIPES.

(b) Laboratory project.
(c) Mr. James J. Trace, Missouri School of Mines and Metallurgy, Rolla, Mo.
(d) Experimental; basic research.
(e) For studying velocity distributions in pipes, data are obtained by a Pitot tube for a wide range of velocity heads. The equation for the velocity profile is determined for each overall velocity head and then compared with equations for other velocity heads. The parameters of the equations are also compared.

(588) SMALL AUGER TYPE TURBINES OPERATING OVER A LARGE RANGE OF HEADS.

(b) Laboratory project.
(c) Mr. James J. Trace, Missouri School of Mines and Metallurgy, Rolla, Mo.
(d) Experimental; basic research.
(e) Using a 6-inch Auger type runner designed for a 12-foot head and having adjustable blades, the efficiency, specific speed, and horsepower output are being studied for each head and setting of the blades. The application of small water turbines in the local streams around Rolla is being studied which necessitates a knowledge of the practicability of using one model of a water turbine for all installations for small output.

(1130) EFFECT OF FLUID INTRODUCTION ON VENTURI TUBE CHARACTERISTICS.

(b) Laboratory project.
(c) Mr. James J. Trace, Missouri School of Mines and Metallurgy, Rolla, Mo.
(d) Experimental; basic research.
(e) Study of liquid and gas flow in Venturi tubes with the introduction of fluid at the negative pressure point. Operating characteristics are determined for this condition, using a 2-inch Venturi tube for water with the introduction of water. The characteristics of a 6-inch Venturi tube with air as the medium are being obtained.

(1131) FLOOD CONTROL WITH RETARDING-BASIN TYPE RESERVOIRS.

(b) Laboratory project.
(c) Prof. E. W. Carlton, Missouri School of Mines and Metallurgy, Rolla, Mo.
(d) Library research; for master's thesis.
(e) Studies of retarding-basin type reservoirs for flood control in the Meramec Basin of Mo.
(f) Completed; report written.

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NEWPORT NEWS SHIPBUILDING AND DRY DOCK COMPANY.

Inquiries concerning Projects Nos. 123, 124, 896, 898, 901, and 1132 to 1137, incl., should be addressed to C. H. Hancock, Hydraulic Laboratory, Newport News Shipbuilding and Dry Dock Company, Newport News, Va.

(123) HYDRAULIC TURBINE TESTS.

(b) Laboratory project.
(d) Experimental; for design data.
(e) Scale model turbines, using either Francis or propeller type runners, are tested for power and efficiency at various speeds.
(f) As required.

(124) METER CALIBRATION TESTS.

(b) Laboratory project.
(d) Experimental; to establish calibration curve for determining correction factors for various rates of flow.

(e) Meters are tested at various heads and rates of flow by the weighing tank method. Time is recorded electrically by chronograph.
(f) As required.

(896) VANE MOMENT TESTS ON ADJUSTABLE BLADE RUNNERS.

(b) Laboratory project.
(d) Experimental; for design data.
(e) Tests are to determine vane moment diagrams. The turbine load is applied by an electrical dynamometer and the gate openings are controlled by a governor. The blades adjust automatically and the blade moment is measured by a spring dynamometer.
(f) As required.

(898) SHIP MODEL DECELERATION TEST.

(b) Laboratory project.
(d) Experimental; for design data.
(e) The decelerating resistance of a ship model was measured at several rates of deceleration, and the model results compared with the ship results. A study was made of the resistance of a ship undergoing deceleration.
(f) Completed.
(h) "The backing power of geared-turbine drive vessels." E. F. Hewins, H. J. Chase, and A. L. Ruiz. Society of Naval Architects and Marine Engineers, Nov. 9, 1950.

(901) SHIP MODEL RESISTANCE TESTS.

(b) Laboratory project.
(d) Experimental; for design data.
(e) Scale ship models are towed in the 56-foot model basin to determine the effective horsepower, bare hull, required by the ship. Because of their small size, several models may be towed in a short period of time thus allowing much preliminary work to be done on the choice of lines. The final lines are checked at the David Taylor Model Basin. To eliminate a large portion of this preliminary testing, a schedule of systematic models was arranged in which the beam-draft ratio, the displacement-length ratio, and the prismatic coefficient are varied over a wide range. Towing of this set of models is continuing and when completed will provide design data for a standard offset series covering a wide range.

(1132) HYDRAULIC PUMP TESTS.

(b) Laboratory project.
(d) Experimental; for design data.
(e) Scale model pumps, centrifugal and propeller types, are tested at constant speeds for head developed, power consumption, and efficiency at various rates of discharge. Cavitation tests are sometimes conducted by lowering the suction head to a point where the developed head and efficiency break down.
(f) As required.
(h) "Model tests of granby pumps." B. L. VanderBoegh. Trans. A.S.M.E. July 1947. Vol. 69, No. 5.

(1133) CAVITATION TESTS OF HYDRAULIC TURBINE MODELS.

(b) Laboratory project.
(d) Experimental; for design data.
(e) Scale model turbines are tested on cavitation stand to determine sigma at which cavitation starts. Available suction head on cavitation stand is 28 ft.
(f) As required.

(1134) CAVITATION TESTS ON MODEL SHIP PROPELLERS.

(b) Laboratory project.
(d) Experimental; for design data.
(e) A water tunnel with a 48-inch test section is under construction. An electric dynamometer is being designed to measure the propeller torque and thrust. Propellers up to 8-inch will be tested and a suction head approaching 33 feet will be available.

(1135) PERFORMANCE TESTS ON WATER CIRCULATING SYSTEMS FOR SHIPS.

(b) Bureau of Ships, Department of the Navy.
(d) Experimental.
(e) A 1:6 scale model of a ship condenser is being tested to determine scoop performance and condenser efficiency.

(1136) WAVE TESTS ON SHIP MODELS.

(b) Laboratory project.
(d) Experimental; for design data.
(e) Ship models are tested in the 56-foot model basin with scaled waves to determine the speed reduction in waves for the pull required for various still water speeds. Pitching periods and angles are determined from light trace photographs.
(f) As required.

(1137) IMPACT TEST ON SHIP MODELS.

(b) Office of Naval Research, Department of the Navy.
(d) Experimental.
(e) Ship models are tested in waves in the model towing tank to determine the impact and slamming forces on ships with light draft, encountered in heavy seas.

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NEW YORK UNIVERSITY, Department of Chemical Engineering.

Inquiries concerning Projects Nos. 590 and 1138 should be addressed to Prof. John Happel, Department of Chemical Engineering, New York University, New York 53, N. Y.

(590) PRESSURE DROP DUE TO FLUID FLOW THROUGH ASSEMBLAGES OF SPHERES.

(b) Laboratory project.
(d) Experimental and theoretical; for two doctoral theses.
(e) Rigid assemblages of uniform smooth spheres of various fractional void volumes (47.6%-100%) are being constructed, and the effect on pressure drop of passing a viscous liquid through these assemblages is being measured. Subsequently the effect of particle size graduation and roughness on pressure drop will be determined. A theoretical approach to the effect of fractional void volume on pressure drop is also being attempted.

(1138) EFFECT OF VARIATION OF SOLID TO FLUID DENSITY RATIO ON FLUIDIZATION CHARACTERISTICS.

(b) Laboratory project.
(d) Experimental; for one doctoral and one master's thesis.
(e) Screened particles of very light solid substances will be fluidized in a 2-inch glass tube and the fluidization characteristics observed. The primary objective will be the determination of the optimum ratio of solid to gas density for smooth fluidization.
(f) Equipment constructed.

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NEW YORK UNIVERSITY, Fluid Mechanics Laboratory.

(592) THE BOUNDARY LAYER AND RELATED PHENOMENON OF OPEN SURFACE FLOW IN A HORIZONTAL FLUME.

(b) Laboratory project.
(c) Mr. A. H. Griswold, Fluid Mechanics Laboratory, New York University, New York 53, N. Y.
(d) Experimental; master's thesis.
(e) Center velocity profiles were taken at eleven sections along a smooth horizontal flume, 3 feet wide and 36 feet long. The boundary layer development was studied.
(f) Completed.
(g) Both the Kármán semi-empirical law and the exponential law for the velocity distribution were verified by this investigation. The development of the boundary layer as a function of Reynolds number followed reasonably well that predicted by Kármán. The intersection of the boundary layer and the surface of flow takes place 120 inlet depths downstream from the inlet section. The ratio of the exit depth to the critical depth of flow had an average value of 0.702 and should therefore make the exit depth useful in computing the discharge.

(1139) COLLAPSE OF CAVITY IN COMPRESSIBLE FLUID.

(b) Laboratory project.
(c) Mr. S. S. Wulc, Department of Engineering Mechanics, New York University, New York 53, N. Y.
(d) Theoretical; basic research.
(e) Analytical determination of pressures involved in collapse of spherical cavity in compressible liquids, assuming that the cavity remains spherical during the collapse.

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UNIVERSITY OF NORTH CAROLINA, North Carolina State College of Agriculture and Engineering.

(593) DYNAMIC SIMILARITY OF SMALL HYDRAULIC MODELS.

(b) Laboratory project.
(c) Prof. N. W. Conner, Department of Mechanical Engineering, North Carolina State College, Raleigh, N. C.
(d) Theoretical; basic research.
(e) To make a theoretical study of dynamic similarity of small hydraulic models and at large scale ratios.
(g) One phase of the experimental work has been completed. Additional tests are now in progress.
(h) Results will be published by the Department of Engineering Research of the North Carolina State College.

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NORTHWESTERN UNIVERSITY, The Technological Institute.

(127) RELIEF FROM WATER HAMMER BY MECHANICAL-PNEUMATIC SURGE SUPPRESSORS.

(b) Laboratory project.
(c) Prof. L. H. Kessler, Northwestern Technological Institute, Evanston, Ill.
(d) Experimental; for design.
(e) To determine extent to which surge pressures in pipe lines may be relieved by a preloaded, gas-filled, compression chamber in which the gas is separated from the liquid in the pipes by a stainless steel bellows.
(g) Present work has shown this type of unit to be free from fatigue failure and capable of protecting pipe systems from severe shock. Field tests are now being conducted on pipe lines in oil fields, distilleries, fuel supply lines for railroads, and test stations for jet engines. An improved pressure-time recorder of mechanical rather than electronic type has been built and is now in use.

(h) "Mechanical-pneumatic 'Shokstops' and accumulators--their place in relief from liquid hammer." L. H. Kessler and M. B. Gamet. Fifth National Conference on Industrial Hydraulics, Oct. 27, 1950. Chicago, Ill.
"Water hammer--its cause and cure, including researches at Northwestern University." L. H. Kessler. Annual Meeting, American Society of Sanitary Engineering, Oct. 1950. San Antonio, Texas.

(326) CAVITATION DAMAGES UNDER CONTROLLED CONDITIONS.

(b) Laboratory project.
(c) Prof. W. S. Hamilton, Northwestern Technological Institute, Evanston, Ill.
(d) Experimental; basic research, for theses' and staff papers.
(e) The pressure in a vertical column of liquid is caused to fluctuate by a motor-operated piston and bellows arrangement, thereby forming and releasing a cavity at the top of the column. The amount of damage to various materials will be related to size of cavity, static load, dissolved air content, and proximity of material to point of cavity collapse.
(f) Pits have been caused in brass, lucite, and mortar. An elastic-tube strain gage is being constructed for pressure measurements. Testing of a large number of mortar samples is under way.

(903) THE FORCES EXERTED BY WAVES ON A SLOPING PLANE.

(b) Laboratory project.
(c) Prof. W. S. Hamilton, Northwestern Technological Institute, Evanston, Ill.
(d) Experimental; applied research, for staff paper.
(e) A plane surface approximately 2 feet by 10 feet is supported in a wave tank with the long edge in the still water surface. The slope of the plane is adjustable, and the supporting members contain strain gages to permit recording the variation of force with time. Waves are generated so that they travel with the crest parallel to the long edge of the rectangular surface and break as they run up on it. Forces have been determined for various values of slope and sizes of waves, and the effectiveness of the surface in causing the waves to break has been evaluated.
(f) Completed.
(g) Forces measured were comparable to a static head on the board equal to the wave height. A surface having a slope of about 0.15 effectively destroyed the energy of waves having lengths up to 10 feet.
(h) "Forces exerted by waves on a sloping board." W. S. Hamilton, Trans. Amer. Geophys. Union, P. 849. Dec. 1950.

(904) BULK MODULUS OF PETROLEUM PRODUCTS, INCLUDING CRUDE OILS AND GASOLINE.

(b) Laboratory project.
(c) Prof. L. H. Kessler, Northwestern Technological Institute, Evanston, Ill.
(d) Experimental; basic research, for design.
(e) Tests have been conducted on three crude oils, one gasoline, and on distilled water at temperatures from 60° F. to 130° F. and at pressures ranging from 0 to 1500 psig. Further tests will be made on other oils and gasolines, tap water, and a variety of chemicals. Specific gravities and viscosities will be determined over the ranges of temperature and pressure indicated above.
(g) Tests indicate high modulus with low temperature and rapidly increasing modulus at low pressures after which a leveling off takes place with nearly constant modulus above 1000 psig.
(h) "New method for bulk-modulus determinations." S. Logan Kerr, L. H. Kessler, and M. B. Gamet. Trans. A.S.M.E., Nov. 1950.

(905) THE LIQUID-SOLID CYCLONE.

(b) Laboratory project.
(c) Prof. D. A. Dahlstrom, Northwestern Technological Institute, Evanston, Ill.
(d) Experimental and field investigations; basic and applied research, for design and operation.

(e) Application of centrifugal fields as obtained in the liquid-solid cyclone to the rapid classification, beneficiation, separation, and desliming of coal and minerals below the 100 mesh size.
(g) Experimental and field investigations on theory and operation of the liquid-solid cyclone have been completed, making it possible to design equipment for any capacity and efficiency desired. Present investigations have indicated that it is easily possible to deslime minerals and coal of minus 200 refuse, and design and operation methods have been published.
(h) "High-speed classifications and desliming with the liquid-solid cyclone." D. A. Dahlstrom, to be published soon in Mining Engineering and Mining Trans. A.I.M.E.

(906) SEPARATION OF FINE-SIZED CLOSE GRAVITY SOLIDS BY CENTRIFUGAL FORCE AS OBTAINED IN THE LIQUID-SOLID CYCLONE.

(b) Laboratory project.
(c) Prof. D. A. Dahlstrom, Northwestern Technological Institute, Evanston, Ill.
(d) Theoretical and experimental; basic and applied research for design and operation.
(e) Separation of close gravity solids by liquids and the application of centrifugal fields as obtained in the liquid-solid cyclone is being investigated.
(g) Economical separation and recovery of materials differing by as little as 0.01 in specific gravity and as small as 100 mesh in size have been obtained. A small pilot plant has been constructed, which can be used on any material to obtain necessary design data. Methods for predicting industrial design and operation have been advanced.
(h) "Close gravity solids-solids separation with heavy liquids and the liquid-solid cyclone." J. J. Moder, Ph. D. Thesis. Northwestern Technological Institute, Aug. 1950.

(1140) HYDROLOGY OF UNDERGROUND WATER SUPPLIES AND DETERMINATION OF HYDRAULIC CHARACTERISTICS OF SOME SHALLOW AND ARTESIAN WELLS IN NORTHERN COOK COUNTY AND SOUTHERN LAKE COUNTY, ILL.

(b) Laboratory and field project.
(c) Prof. L. H. Kessler, Northwestern Technological Institute, Evanston, Ill.
(d) Experimental; for design.
(e) All available information is being obtained from the State Geological Survey and local well drillers. Test wells are being drilled in glacial drift at various locations above the Niagara Cuesta, and one artesian well will be under way soon to determine geologic formations and changes therein, radius of curves of influence, and other hydraulic characteristics of wells in this area. Special attention will be given to sanitary significance of the quality of water obtained from the various aquifers such as hardness, chlorides, iron and sulphur.

(1141) HIGH SPEED SEPARATION OF CLOSE SPECIFIC GRAVITY LIQUIDS IN THE CYCLONE.

(b) Laboratory project.
(c) Prof. D. A. Dahlstrom, Northwestern Technological Institute, Evanston, Ill.
(d) Theoretical and experimental; basic and applied research for design and operation.
(e) Rapid separation of close specific gravity liquids by use of centrifugal fields as obtained in the cyclone is being investigated. Preliminary tests indicate that recoveries of over 90% of each liquid can be obtained in a two-phase system in separate streams. Design and operating variables are primarily nozzle diameter, operating pressure, volume distribution between overflow and underflow, and specific gravity difference between the two phases. Theoretical studies are now being performed so that accurate predictions of recoveries and design can be made. Eventual applications will be made to liquid-liquid extraction.

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UNIVERSITY OF NOTRE DAME, Department of Engineering Mechanics.

Inquiries concerning Projects Nos. 907, 909, and 1142 should be addressed to Dr. K. E. Schoenherr, College of Engineering, University of Notre Dame, Notre Dame, Ind.

(907) THREE-DIMENSIONAL INVESTIGATION OF THE STABILITY OF TOWED MARINE SHIPS.

(b) Office of Naval Research, Department of the Navy.
(d) Basic theoretical analysis.
(e) Research to establish conditions necessary for the dynamic stability of a ship towed by a hawser. The effect of the location of the point of attachment of the hawser and of rough water are being considered.
(g) Conditions for stability of a ship moving in a sea at rest have been found. It is planned to introduce special types of rough water effects into the equations of motion.
(h) The two-dimensional study of stability was presented in "The dynamic stability on course of towed ships", Society of Naval Architects and Marine Engineers, 1950 Spring Meeting.

(909) AUTOMATIC REGULATION OF DIVING AND RISING OF SUBMARINES.

(b) Laboratory project.
(d) Basic theoretical research.
(e) An analysis of the motion caused by the use of various types of automatic controlling devices which actuate the stern elevator and which depend upon the characteristics of the state of the moving submarine. The directional stability of a submarine fitted with various types of controlling devices is also being studied.
(g) Since non-linear differential equations of motion are involved, only one solution has been completed. Calculations have been started for the solutions of other motions resulting from other types of controlling devices.

(1142) THEORY OF WAVE RESISTANCE.

(b) Laboratory project.
(d) Basic theoretical research.
(e) The theory of wave resistance is being studied and extended to provide a better correlation with experimental results at low and moderate speeds.
(g) A theory has been formulated and calculations have been made which predict the thick boundary layer or viscous wake near the stern. It predicts the extensions to the actual outline of the ship. Surface distribution of sources and sinks have been compared with the point source and sink distribution.

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OHIO STATE UNIVERSITY, Robinson Laboratory.

Inquiries concerning Projects Nos. 598, 910, 1143, and 1144 should be addressed to Prof. S. R. Beitler, Robinson Laboratory, Ohio State University, Columbus 10, Ohio.

(597) ELIMINATION OF PULSATION ERROR IN FLUID METERS.

(b) Laboratory project; sponsored by American Gas Association, and American Society of Mechanical Engineers.
(c) Mr. D. J. Masson, Robinson Laboratory, The Ohio State University, Columbus 10, Ohio.
(d) Experimental; applied research.
(e) The flow of air from a two-stage reciprocating compressor, equipped with a pulsation eliminator, is being measured by two orifices in series. A sonic block is set up between the orifices so that pulsating flow is measured by the first and non-pulsating flow is measured by the second orifice. The secondary elements consist of standard flow meters. The difference in the rate of flow measured by each orifice is a measure of the error due to pulsation. The "pulsameter" is also being used to check its reliability in predicting pulsation errors over one percent.
(f) Inactive.
(g) Results indicate that effective dampeners can be designed to operate over a limited range.

(598) COEFFICIENTS OF DISCHARGE FOR ECCENTRIC AND SEGMENTAL ORIFICES.

(b) American Society of Mechanical Engineers and American Gas Association.
(d) Experimental; applied research.
(e) Coefficients of discharge are being obtained for eccentric and segmental orifices in 4-inch, 6-inch, 10-inch, and 14-inch pipe lines. It is desired to publish curves from which coefficients for commercial use may be chosen for a large range of Reynolds numbers, diameter ratios, and pipe sizes.
(f) Work has been completed on all but a portion of the 14-inch line orifices and are being analyzed.
(g) Tentative results are being disseminated.

(910) CALIBRATION OF ORIFICES, VENTURIS, AND FLOW NOZZLES.

(b) Manufacturers and users of flow meters.
(d) Experimental; calibration for use.
(e) Many primary metering elements for flow measurement are being calibrated individually for accurate measurements.
(g) Results indicate that published data on orifices and nozzles are satisfactory, but that material for venturi tubes is not complete.

(1143) STUDY OF SUDDEN EXPANSION IN PIPE LINES.

(b) Laboratory project.
(d) Experimental; basic research for masters' theses.
(e) A study of pressure and velocity changes with flow through sudden enlargements for both compressible and incompressible fluids.
(f) Theoretical analysis has been completed.
(h) Three theses prepared, available for reproduction.

(1144) A STUDY OF FLOW IN BENDS AND ELBOWS IN SMALL PIPE LINE.

(b) Laboratory project.
(d) Experimental; basic research.
(e) A study of the variation of pressure and velocity around bends of different radius in smooth tubes of 1-1/2 inch in diameter and less.
(f) The apparatus is constructed and experimental work started.

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OREGON STATE COLLEGE, Department of Civil Engineering.

(918) RELATION BETWEEN RAINFALL AND RUNOFF FROM SMALL WATERSHED IN WESTERN OREGON.

(b) Field investigation.
(c) Mr. Ronald McReary, Oregon State College, Corvallis, Ore.
(d) Watershed partly farmed, partly forested, in Willamette Valley. Automatic recording gage for runoff; automatic recording raingages for precipitation, all on loan from Weather Bureau or Geological Survey.

(1145) MODEL STUDY OF SIPHON SPILLWAY OF MALAD RIVER HYDRAULIC POWER PLANT, IDAHO.

(b) Laboratory project.
(c) Mr. Roy S. Shoemaker, Oregon State College, Corvallis, Ore.
(d) Experimental; for correction of prototype and for master's thesis.
(e) Tests being made on large scale model to find means for correcting faulty operation of prototype.

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ELTON WATER WHEEL COMPANY.

(1146) HEAD EFFECT ON IMPULSE TURBINE MODEL TESTING.

(b) Laboratory project, sponsored by Mountain Laboratory Group.
(c) Mr. P. B. Dawson, Jr. Pelton Water Wheel Company, San Francisco 10, Calif.
(d) Experimental; applied research.
(e) To establish model law for testing impulse turbines under various operating pressures, tests are being made under heads between 100 and 2000 feet. The effect of housing size and shape is under study.
(g) Initial tests have been completed.

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PENNSYLVANIA STATE COLLEGE, Hydraulics Laboratory.

Inquiries concerning Projects Nos. 330, 1147, 1148, and 1149 should be addressed to Dr. Andre L. Jorissen, Pennsylvania State College, State College, Pa.

(131) SHAVER CREEK HYDROLOGIC STUDY.

(b) Cooperative with Weather Bureau, Forest Service, and Geological Survey.
(c) Prof. C. J. Smith, Pennsylvania State College, State College, Pa.
(d) Field investigation; applied research.
(e) Long term study of the hydrologic action of a mountain watershed. Runoff is measured by a calibrated stream control, rainfall with three recording rain gages, evaporation from a standard pan, and ground water level by a recording float gage.

(330) STUDY OF LIQUID TURBULENCE.

(b) Laboratory project, supported by Research Corporation.
(d) Experimental; basic research; doctor's thesis.
(e) It is planned to study the frictional resistance of rough surfaces having a regular sine wave form. Preliminary studies are made in a fluid polariscope in an attempt to correlate the flow pattern with the occurrence of turbulence.
(g) An improved polariscope has been assembled and used for preliminary studies. Roughness patterns generated by sine waves of equal amplitudes and varying wave lengths are built and are being investigated in a rectangular closed channel.
(h) "Liquid turbulence research project, Progress Report No. 1." V. L. Dutton. Sept. 1949.

(1147) VENTURI TUBE RESEARCH.

(b) Laboratory project, sponsored by Builders-Providence, Inc.
(d) Experimental; applied research; master's thesis.
(e) Comprehensive study of Venturi tube characteristics to obtain information for standardization. The objective is to develop improved types of Venturi tubes.

(1148) MODEL STUDY OF THE FLOW CONDITIONS IN THE LYMAN RUN DAM SPILLWAY.

(b) Chaster Engineers, Pittsburgh, Pa. for General State Authority and the Department of Forests and Waters of the Commonwealth of Pennsylvania.
(d) Experimental; design and operation.
(e) Model study of the flow conditions in a curved spillway channel 450 feet long, tapering from 125 feet to 80 feet in width and having a slope ranging from 5 to 20 percent. Flow range between 0 and 25,000 cfs. Model scale 1:48.
(f) Completed.
(g) Tests proved the inadequacy of a first design to carry the maximum rate of flow. A revised design was more satisfactory and yielded information to be used by the designer in determining the height of the lateral walls of the channel. Hydraulic jump occurrences were studied.

(1149) MODEL STUDY OF FLOW CHARACTERISTICS IN AN ELECTROSTATIC PRECIPITATOR DETARRER.

(b) Koppers Research Program of the Engineering Experiment Station, Pennsylvania State College.
(d) Experimental; design and operation.
(e) Model study of the flow conditions in a Koppers electrostatic precipitator to determine the flow conditions existing in the original design, to devise means of obtaining uniform flow conditions if such conditions do not exist.
(f) Suspended.
(g) Qualitative studies on a two-dimensional model using water as a fluid were completed. The flow conditions in the model, as originally designed, were very unsatisfactory. Simple means could be found to improve these conditions. It was recommended that the investigation be extended to a three-dimensional model of large dimensions on which quantitative information could be obtained.

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PENNSYLVANIA STATE COLLEGE, Ordnance Research Laboratory.

Inquiries concerning Projects Nos. 129, 328, 1150, 1151, and 1152, should be addressed to Dr. J. M. Robertson, Ordnance Research Laboratory, P. O. Box 30, State College, Pa; and concerning Projects Nos. 605, 920, and 921 to Dr. Donald Ross at the same address.

(129) WATER TUNNEL FLOW STUDIES.

(b) Cooperative with Hydraulic Laboratory.
(d) Experimental; applied research, for design.
(e) Water tunnel components, of one-eighth prototype diameter, were studied in an experimental tunnel which did not include a model pump. A single pass system produced velocities up to 50 fps in the 6-inch working section. Various nozzle contours, working section lengths, angles of diffuser, and one vaned turn combination were studied. Experimental results were integrated with theoretical methods to develop means for predicting prototype flow conditions.
(f) Tests completed; reports in progress.
(g) The studies led to the establishment of design specifications for the 48-inch tunnel.
(h) "Shear stress in a turbulent boundary layer." Donald Ross and J. M. Robertson, Journal Applied Physics, Vol. 21, No. 6, 557-561, June 1950.
"A superposition analysis of the turbulent boundary layer in an adverse pressure gradient Donald Ross and J. M. Robertson. Presented at 1950 Heat Transfer and Fluid Mechanics Institute.

(328) FLOW PAST SLOTS IN SURFACES.

(b) Cooperative with Hydraulics Laboratory.
(d) Experimental; applied research.
(e) Studies were made on the pressure and flow conditions near slots in surfaces, as affected by relative boundary layer thickness and contour of slot corners.
(g) The boundary layer thickness, slot width in direction of flow, and rounding of downstream edge were found to govern the magnitude of the pressure dip following the slot.

(605) FUNDAMENTALS OF SURFACE CAVITATION.

(b) Cooperative with Department of Mineral Technology.
(d) Experimental; basic research.
(e) A laboratory-size eggbeater apparatus is used in which the noise inception point and noise output is to be correlated with the chemical composition and nature of the liquid and the surface of the propeller.
(f) Suspended; preliminary report in progress.
(g) Effects of air content and electric charge on cavitation inception were investigated for one simple propeller shape.

(920) ELECTROMAGNETIC ANALOGY FOR PROPELLERS.

(b) Laboratory project.
(d) Experimental; applied research.
(e) The analogy between the velocity fields of vortices and the magnetic fields of current carrying wires is used to obtain the induced velocities for propellers and to study wide blade effects.
(g) Initial tests indicate agreement with theoretical calculations within the accuracy of the electrical equipment.

(921) PROPELLERS FOR OPERATION IN SYMMETRIC WAKES.

(b) Bureau of Ordnance, Department of the Navy.
(d) Theoretical and experimental; applied research.
(e) The problem is the design of optimum-efficiency and cavitation-free propellers for operation behind bodies of revolution. It is being attacked through consideration of the physics of propeller action. Design methods resulting from the theory will be tested by experiments in the 48-inch water tunnel.
(g) A new theoretical design method for optimum propellers operating in radially varying velocity fields has been developed. Several propeller designs await testing in the 48-inch water tunnel.

(1150) HYDRODYNAMIC PERFORMANCE OF 48-INCH WATER TUNNEL.

(b) Laboratory project.
(d) Experimental; applied research.
(e) Velocity distributions and pressures are being measured in all portions of 48-inch water tunnel at velocities up to 80 fps. Results will be correlated with the experimental studies made on smaller scale under Project 129.

(1151) DESIGN AND CONSTRUCTION OF 12-INCH WATER TUNNEL.

(b) Laboratory project.
(d) Design.
(e) Tunnel is planned for general supplementary research; interchangeable working sections are being designed, one closed of 12-inch diameter; one rectangular closed; maximum design velocity 70 fps.
(f) Construction will start in a few months.

(1152) DESIGN AND CONSTRUCTION OF 48-INCH AIR TUNNEL.

(b) Laboratory project.
(d) Design.
(e) Closed circuit tunnel planned for supplementary research; working section 48-inch octagon, 15 feet long, maximum design velocity 200 fps.
(f) Construction will start in a few months.

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UNIVERSITY OF PENNSYLVANIA, Department of Civil Engineering.

(922) EFFECT OF INSTALLATION ON THE COEFFICIENT OF AN 8 INCH x 6 INCH BETH-FLO TUBE.

(b) Laboratory project.
(c) Prof. W. S. Pardoe, University of Pennsylvania, Philadelphia 4, Pa.
(d) Experimental.
(e) Eleven different set-ups gave errors as much as minus 12 percent and plus 10 percent.
(f) Completed.
(g) Placed after a short radius 90 degree bend, lowered the coefficient 12 percent. Placed after an artifically roughened pipe raised the coefficient 10 percent.
(h) Trans. A.S.M.E. Vol. 72, No. 8, Nov. 1950, p. 1103.

(1153) EFFECT OF IMPERFECTIONS OF THROAT VENTS ON COEFFICIENTS OF VENTURI METERS.

(b) Laboratory project.
(c) Prof. W. S. Pardoe, University of Pennsylvania, Philadelphia 4, Pa.
(d) Experimental; applied research.
(e) Tests on 8-inch by 4-inch Venturi meter with throat vent imperfections such as drilling burrs (inside and outside), depressed vents, filleted vents, and with varying number and size of vents.
(g) Tests and number and size of vents completed; should be at least four of maximum size of 1/4 inch diameter.

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PENNSYLVANIA WATER & POWER COMPANY.

Inquiries concerning Projects Nos. 1154 to 1158, incl., should be addressed to Mr. S. K. Waldorf, 405 Fulton Bank Building, Lancaster, Pa.

(1154) MEASUREMENT OF WATER VELOCITIES WITH ULTRASONICS.

(b) Laboratory project.
(d) Experimental; applied research.
(e) The purpose is to develop an improved method of measuring large quantities of water, particularly the discharge of large hydroelectric units having short intake conduits with large rectangular cross-sections. An ultrasonic transducer rod is placed at each of two parallel opposite walls of the rectangular duct in which water velocity is to be measured. The transducers are displaced from each other along the principal axis of flow. The phase angle between the transmitted and received ultrasonic signals is a measure of the water velocity.
(g) Water velocities up to six feet per second have been measured with an error of one percent and less, in a rectangular duct five inches by nine inches.
(h) "Ultrasonic method for measuring water velocity." W. B. Hess, R. C. Swengel, S. K. Waldorf. AIEE Miscellaneous Paper 50-214, 7 pages. (Obtainable upon request to Company). Digests of above paper: "Measuring water velocity by an ultrasonic method." W. B. Hess, R. C. Swengel, and S. K. Waldorf, Electrical Engineering, Vol. 69, No. 11, p. 983, Nov. 1950. "Water velocity." Mechanical Engineering, Vol. 72, No. 11, p. 911, Nov. 1950.

(1155) CORRELATION OF ANNUAL TREE GROWTH WITH PRECIPITATION AND RIVER FLOW.

(b) Laboratory project.
(d) Field investigation; applied research.
(e) Cross-sections of trees from Juniata River drainage area above Huntingdon, Pa. are being measured for correlation with flow records at Huntingdon, and precipitation and temperature records at several other stations.

(1156) INDUCING FRACTURE LINES IN RESERVOIR SHEET ICE WITH AIR BUBBLES.

(b) Laboratory project.
(d) Field investigation; applied research.
(e) An experimental 2000-foot length of pipe with holes at intervals for discharging compressed air, is laid on the reservoir bottom. It is expected that the warmer water caused to rise with the bubbles will produce a zone of weakness in the reservoir sheet ice. If successful, a system of such pipes will facilitate the break-up of the sheet ice and reduce the possibility of ice jams.
(g) Limited experience is encouraging, but not conclusive.

(1157) SEDIMENTATION IN SAFE HARBOR RESERVOIR.

(b) Laboratory project.
(d) Field investigation; applied research.
(e) With a U.S. D-43 sampler, the amount of suspended sediment in the Susquehanna River is measured at the head of the Safe Harbor Reservoir. The suspended sediment in the discharge of the reservoir is measured by special means applicable to turbulent water at the station discharge and dam overflow. The rate of silting in the reservoir is measured periodically by fathometer soundings.

(1158) FOREWARNING OF FRAZIL ICE FORMATION.

(b) Laboratory project.
(d) Experimental; applied research.
(e) By means of a resistance thermometer and strip chart recorder, the temperature of the Susquehanna River is measured within 0.001° C. at Safe Harbor and Holtwood. It appears there is a correlation betwsen the formation of frazil ice on hydroelectric station equipment and the rate of cooling of the water to the freezing point.

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PRINCETON UNIVERSITY, School of Engineering.

(609) THE LOCATION AND EFFECTS OF THE COLLAPSE OF THE SUBMERGED WAVE BEHIND RIGHT VERTICAL SEMI-SUBMERGED CYLINDERS OF FINITE LENGTH.

(b) Princeton University Committee for Fundamental Research.
(c) Prof. A. Donald Hay, School of Engineering, Princeton University, Princeton, N. J.
(d) Experimental; basic research.
(e) An analysis of the experiments will establish a theory to explain the alteration of flow pattern about semi-submerged cylinders of finite length. The location and magnitude of the break in the curve of resistance versus speed will be located by formulas.

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RENSSELAER POLYTECHNIC INSTITUTE, Hydraulic Laboratory.

(610) THE WATER TABLE.

(b) Laboratory project.
(c) Prof. Harold A. Wilson, Rensselaer Polytechnic Institute, Troy, N. Y.
(d) Experimental; basic and applied research.
(e) The apparatus consists of a flat plate of glass, 4 feet wide and 5 feet long, with a small broad-crested weir at one end and sump tanks at both ends. The purpose is to make visual the flow of water as affected by different phenomena and to correlate this flow with air flow as a means of amplifying air flow design and computations. A Mach number of the water of about 7 has been obtained.
(g) Work has progressed on velocity profiles to the extent that the quantity of flow from the integrated velocity curve checks the flow obtained from calibrated orifice meter within one percent consistently. Also, the total momentum as determined from the velocity profile upstream from a plane shock, applied to the downstream side, will check the measured shock depth within one percent.

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ROCKY MOUNTAIN HYDRAULIC LABORATORY.

(332) TESTS OF SCOUR AROUND BRIDGE PIERS.

(b) Laboratory, in cooperation with Bureau of Public Roads.
(c) Prof. C. J. Posey, Engineering Building, State University of Iowa, Iowa City, Iowa.
(d) Experimental; development.
(e) To determine design requirements for flexible mats to protect piers from scour.
(f) Continuation of tests is planned for summer of 1951.
(g) Mats must be porous, flexible, yet prevent upward movement of material driven by underflow between stagnation zone and low pressure areas.
(h) "Flexible mats may reduce scour at piers of small bridges." David W. Appel, Engineering News-Record, Vol. 144, No. 21, p. 43, May 25, 1950. Presentation of report on 1950 tests scheduled at Highway Research Board Meeting, Washington, D. C. Jan. 9, 1951.

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ST. ANTHONY FALLS HYDRAULIC LABORATORY, University of Minnesota.

Inquiries concerning Projects Nos. 98, 100, 104, 108, 333, 336, 339, 611, 612, 615, 616, 924, 925, and 1159 to 1166, incl., should be addressed to Dr. Lorenz G. Straub, Director, St. Anthony Falls Hydraulic Laboratory, Hennepin Island, Minneapolis 14, Minn.

Inquiries concerning Projects Nos. 111, 112, 114, 620, 621, 931, 932, 1167, and 1168, which are being conducted in cooperation with the Soil Conservation Service, should be addressed to Mr. Fred W. Blaisdell, Project Supervisor, U. S. Soil Conservation Service, St. Anthony Falls Hydraulic Laboratory, Hennepin Island, Minneapolis 14, Minn.

Inquiries concerning Projects Nos. 194, 412, 413, 982 to 985, incl., and 1206 which are being conducted in cooperation with the Corps of Engineers, should be addressed to the District Engineer, Corps of Engineers, Department of the Army, St. Paul District, St. Paul, Minn. (These projects are listed on pages 107 and 108.

(98) FLOW OF SUSPENDED SOLIDS IN PIPES.

(b) Cooperative with Standard Oil Company of Indiana.
(d) Experimental and analytical; for doctor's thesis.
(e) A study of effect of suspended matter characteristics on head loss, solids distribution, and velocity distribution of flow of suspended solids in pipes. Measurements include head loss, velocity, and solids distribution of fine sediment suspended in water flowing in a 2-inch copper pipe by means of a Pitot-like sampler.

(100) AIR ENTRAINMENT RESEARCH.

(b) Office of Naval Research, Department of the Navy.
(d) Theoretical and experimental; basic and applied research.
(e) A new channel 18 inches wide, 50 feet long, adjustable to all slopes from horizontal to vertical, is in use. The inlet section is designed to jet a uniform stream of water at the terminal velocity for the set slope and discharge. Still uncompleted is the pump installation for complete testing at the highest angles. Electrical measurements of air concentration and velocity in small filaments of the flow have been perfected. Photographic flash units of high light intensity and short duration have been developed, and photographs are being used to augment the data obtained from velocity and air concentration traverses. The analysis of the flow is being developed with the experimental results as a guide.
(h) "An electrical method for measuring air concentration in flowing air-water mixtures." O. P. Lamb and J. M. Killen. St. Anthony Falls Hydraulic Laboratory Technical Paper No. 2, Series B. March 1950.

(104) FLOW DIVERSION RESEARCH.

(b) Office of Naval Research, Department of the Navy.
(d) Theoretical and experimental; basic and applied research and design.
(e) Work, begun with measurement of pressure and velocity distributions in radius elbows, was then extended to miter elbows with guide vanes. In guide vane studies scale effects and end effects evidenced by secondary currents and associated pressure losses, are investigated.
(g) Experiments confirm analytical research showing that many scale effects and end effects in guide vane cascades can be eliminated by removing cause of secondary currents; namely, the vorticity in the flow approaching the guide vanes, occurring mainly in the boundary layers.

(108) LARGE SCALE CULVERT STUDIES.

(b) Elk River Concrete Products Co., and American Concrete Pipe Association.
(d) Experimental; applied research.
(e) Pipe friction and entrance losses were determined for various shapes, sizes, and kinds of commercial culvert pipes, for flush and re-entrant type entrances, and for various discharges. Each pipe was 192 feet long and was tested under both full and part-full flow conditions.
(f) Completed.
(g) Data obtained and analyzed for 36-inch, 24-inch, and 18-inch corrugated circular pipes, corrugated pipe arches, and concrete pipes.
(h) "Hydraulic data comparison of concrete and corrugated metal culvert pipes." L. G. Straub and H. M. Morris. St. Anthony Falls Hydraulic Laboratory Technical Paper No. 3, Series B. July 1950.
"Hydraulic tests on concrete culvert pipes." L. G. Struab and H. M. Morris. St. Anthony Falls Hydraulic Laboratory Technical Paper No. 4, Series B. July 1950.
"Hydraulic tests on corrugated metal culvert pipes." L. G. Straub and H. M. Morris. St. Anthony Falls Hydraulic Laboratory Technical Paper No. 5, Series B. July 1950.

(333) RAMAPADASAGAR DAM.

(b) Government of Madras, India.
(d) Experimental; for design.
(e) A movable-bed, distorted model horizontal scale ratio 250:1, vertical scale ratio 100:1 is being used to study scour patterns and water surface levels consequent to constructing cofferdams that greatly restrict the flow.
(f) Suspended experimental work on first construction stage completed; preliminary report prepared.

(336) FLOW OF AIR-WATER MIXTURE IN A VERTICAL PIPE.

(b) Laboratory project.
(d) Experimental; master's thesis.
(e) The special case of fully mixed concurrent flows of air and water is being studied in a 26-foot vertical testing section of 1 1/8-inch Lucite tubing.
(f) Suspended.

(339) CHARACTERISTICS OF A SILT-LADEN DENSITY CURRENT.

(b) Laboratory project.
(d) Theoretical and experimental; for doctor's thesis.
(e) An attempt is being made to establish a criterion for the stability of two superposed streams of homogeneous fluids having slightly different densities and a relative motion. Tests have been made to show the characteristics of density currents being formed in various ways.

(611) FLOW AROUND A SPHERE UNDER CONDITIONS OF VELOCITY GRADIENT.

(b) Laboratory project.
(d) Analytical and experimental; doctor's thesis.
(e) The objective is to determine the pressure distribution on a sphere at various velocity gradients and Reynolds numbers, and to establish the relationship between lift and drag under these flow conditions. It is anticipated that results will be applicable to problems of sediment transportation.

(612) SIMILARITY IN SCOUR BELOW A SPILLWAY.

(b) Laboratory project.
(d) Experimental; for master's thesis.
(e) Three geometrically similar spillway models and three coarse sediments of similar size distribution and different mean grain size were used. All practical combinations of model and sediment were tested under several conditions of tailwater elevation and discharge to relate the variables concerned so that behavior of bed material under similar conditions at concentrated scour might be predicted.
(f) Completed.
(g) Dimensionless plats were presented showing the logarithmic relation between scour and the variables of discharge, time, model scale, and terminal fall velocity of sediment. Tailwater depth determines whether scour shall be local and deep or if it shall continue downstream from toe of the spillway.
(h) "Similarity in scour below a spillway." C. O. Johnson, Master's Thesis. University of Minnesota. April 1950. (Available for interlibrary loan).
"A review of scour below a spillway and its prevention." A. Rodionov, Master's Thesis. University of Minnesota. June 1949. (Available for interlibrary loan).

(615) CAPILLARY FLOW THROUGH EARTH DAMS.

(b) Laboratory project, also sponsored by the Committee on Hydraulic Research, Hydraulics Division, A.S.C.E.
(d) Experimental; for master's thesis.
(e) Tests are to be conducted in a channel with a plate glass front. A dam of brass has been installed in the channel with a capillary gap between the dam and the plate glass to study the effect of the capillary rise on the velocity distribution and quantity of discharge through the dam.
(f) Testing is temporarily dormant.

(616) FLOW THROUGH GRANULAR MEDIA.

(b) Laboratory project.
(d) Experimental and theoretical; for master's thesis.
(e) Tests are to be made to determine head loss resulting from flow through uniform-sized media of varying shapes. Dimensionless numbers have been developed through consideration of the forces and dimensions involved. Tests are to be made in order to determine the relationship between these dimensionless numbers. An attempt will be made to determine the effect of particle shape and surface area on flow conditions.

(924) FREE-JET WATER TUNNEL STUDIES.

(b) Office of Naval Research, Department of the Navy.
(d) Experimental; applied research and design.
(e) A pilot model free-jet installation has been completed and a developmental testing program is being carried out to determine the effect of various design parameters on the surface texture and the external configuration of the jet by means of high speed photography. An attempt will be made to make quantitative studies of the overall dimensions of steady state cavitation bubbles and velocity distributions in the free-jet on this small scale.

(925) EXPERIMENTAL STUDY OF A GRAVITY FLOW, CYLINDRICAL SEDIMENTATION TANK.

(b) Laboratory project.
(d) Experimental; master's thesis.
(e) An analysis was made of the flow-through time, short circuiting, and efficiency of a cylindrical, downward flow, gravity-type sedimentation tank with an inside collector cone for the removal of the water. Various cones were tested and various-sized spherical beads were used as sediment.
(f) Completed.
(g) For particles in the Stokes law range, the efficiency of sedimentation varied directly with the ratio of settling velocity of the particle to velocity of flow. Data for the preparation of glass beads into small size ranges through the use of an Infrasizer and an extensive microscopic analysis of these ranges is given in tabular and graphical form.
(h) "Model study of the efficiency of a radial, gravity flow sedimentation tank." J. E. Fant, Master's Thesis, University of Minnesota. June 1950. (Available for interlibrary loan).

(1159) MISSISSIPPI RIVER REVETMENT STUDIES.

(b) Waterways Experiment Station and Mississippi River Commission.
(d) Experimental; applied research.
(e) Studies on the behavior of full-scale articulated concrete revetment are being made in the laboratory's main testing channel. Turbulence patterns and mean velocities comparable to those observed in the lower Mississippi are being reproduced over the revetment laid on a sand bed of the same composition as the lower Mississippi bottom and banks. Measurements of pressure fluctuations above and below the revetment blocks as well as differential pressures across the blocks are being made by electronic methods; pressure gradients are being measured in the sand stratum below the blocks.

(1160) EFFECT OF TUBE VIBRATIONS ON PRESSURE DROP OF FLOW IN TUBES.

(b) Office of Naval Research, Department of the Navy.
(d) Theoretical and experimental; basic and applied research.
(e) This project arose in connection with the possibility that external tubing vibrations were producing excessive pressure drop or excessive phase lag in pressure in high pressure aircraft hydraulic lines. An experimental apparatus has been established to pump oil through tubing at pressures up to 3000 psi over a range of Reynolds numbers (based on tube diameter) from 1000 to 20,000 and to vibrate the tubing externally at various frequencies. As a conclusion from research by others, it is believed the vibrations contemplated will produce early transition in the tube when flow is in the lower Reynolds number range; it is still to be determined whether vibration will have any effect on already turbulent flow.
(g) First measurements indicate no appreciable effect of vibrations on steady, turbulent flow.

(1161) ENTRANCE LOSSES IN MODEL CULVERT.

(b) Laboratory project.
(d) Experimental research for master's degree.
(e) Measurements of head loss at the entrance to a circular pipe were made to determine effect of Reynolds number, head over crown, shape of entrance lip, and width of approach channels on entrance coefficients. A 4-inch Lucite pipe was used.
(f) Completed.
(g) The form of entrance lip was found to be the most important factor. There was some variation with Reynolds number, and width of approach. Very little effect was attributable to head over crown.
(h) "Entrance losses in short circular conduits." E. E. Chapus. Master's Thesis, University of Minnesota. Nov. 1949. (Available on interlibrary loan).

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(1162) STANDING SURFACE WAVES IN AN OPEN CHANNEL WITH A WAVY BOTTOM.

(b) Laboratory project.
(d) Experimental and theoretical; for master's thesis.
(e) Verification of hydrodynamical equations giving the amplitude of surface waves. The equations were derived for irrotational flow, and are to be tested for turbulent flow in a 6-inch wide glass-sided channel.

(1163) THE STUDY OF FLOW AT AN INTERFACE.

(b) Laboratory project.
(d) Experimental and theoretical; basic research.
(e) Experiments are to be conducted in a 6-inch channel with an immediate object to study the interfacial instability and to clarify flow conditions before and after mixing and to determine the characteristics of a flow of liquid with the density varying with depth and some facts in connection with bed-load movement, boundary-layer effect, shallow water-wave, etc. Photographic method will be employed to record flow patterns. Analytical and relaxational approaches will be carried in parallel with an attempt to solve some simple cases of incompressible flow with variable density.

(1164) CHARACTERISTICS OF SEDIMENT WAVES FORMED ON THE BED BY FLOWING WATER.

(b) Laboratory project.
(d) Theoretical; for doctor's thesis.
(e) A theoretical analysis of the development and propagation of sediment waves was made in order to relate wave length and wave shape to the properties of the flow.
(f) Completed.
(g) A theoretical relationship between wave length and the Froude number of the flow was found to agree with experimental data. Conditions for the propagation of dunes of two profile shapes were established and criteria set up for the smooth phase of sediment movement.
(h) "A study of waves formed by flowing water in the sediment composing the bed of an open channel." A. G. Anderson. Doctor's Thesis, University of Minnesota. April 1950. (Available on interlibrary loan).

(1165) RIPPLE FORMATION AND ITS RELATION TO BED-LOAD MOVEMENT.

(b) Laboratory project.
(d) Theoretical and experimental; for doctor's thesis.
(e) A basic research to investigate the phenomenon of bed-load movement of an alluvial stream. Analytical study on the items of mechanics, characteristics of ripple formation and its relation to bed-load movement will be conducted first. Later on, experimental work will be carried out in order to verify certain analytical results.

(1166) MODEL STUDY OF SPILLWAY OF GUAYABO DAM, EL SALVADOR.

(b) Harza Engineering Company, Chicago, Ill.
(d) Experimental; for design.
(e) Tests upon a 1:75 model of the spillway were made to analyze the flow pattern and erosion characteristics and to establish the hydraulic design of the spillway.
(f) Completed.
(g) A bucket type spillway with sloping training walls was found to be the most effective for preventing serious scour.

(111) DROP INLET CULVERT WITH PIPE CONDUIT.

(b) Division of Drainage and Water Control, Soil Conservation Service, in cooperation with Minnesota Agricultural Experiment Station and St. Anthony Falls Hydraulic Laboratory.
(d) Experimental; applied research.
(e) Tests have been made on three different sizes of Lucite pipe set on slopes ranging from 2.5 to 30 percent to verify the similarity relationship. Information on discharges, pressures, and flow conditions has been obtained. Future studies will be on the effect of different types of inlets on the flow conditions.

(g) Pipe drop inlet culverts laid on deep slopes will flow completely full even though the outlet discharges freely. Entrained air did not invalidate the Froude model law.
(h) "Hydraulics of drop-inlet pipe-conduit spillways." Fred W. Blaisdell. Department of Agriculture, Soil Conservation Service, 66 pp., Dec. 1949. (Available on loan.)

(112) DROP SPILLWAY WITH BOX INLET.

(b) Division of Drainage and Water Control, Soil Conservation Service, in cooperation with Minnesota Agricultural Experiment Station and St. Anthony Falls Hydraulic Laboratory.
(d) Experimental; for design.
(e) Experiments are made on 6-inch wide models to determine the effect of different lengths of box, heights of drop, approach channel widths, dike locations, submergences, etc., on the head-discharge curve.

(114) DIVERGING TRANSITION FOR SUPERCRITICAL VELOCITIES.

(b) Division of Drainage and Water Control, Soil Conservation Service, in cooperation with Minnesota Agricultural Experiment Station and St. Anthony Falls Hydraulic Laboratory.
(d) Experimental; for design and master's thesis.
(e) Surface contours are determined for different Froude numbers, shapes of entering stream, sidewall flares, bed slope, bed friction, etc.
(f) Suspended.

(620) FLOW IN TRAPEZOIDAL OPEN CHANNEL JUNCTIONS AT SUPERCRITICAL VELOCITY.

(b) Soil Conservation Service, Regions 2 and 3, Department of the Navy.
(d) Experimental; for design.
(e) Models of paved trapezoidal open channel junctions were studied to discover a satisfactory form of junction when flow in one or both of the joining channels was at supercritical velocity. The channels are used to drain storm water from Whiting Field and are laid on slopes as steep as 10 percent.
(f) Completed.
(g) Several different methods for joining streams flowing at supercritical velocities were studied. Five types of junction are recommended for use under as many different conditions of topography and flow.
(h) "Hydraulic model studies for Whiting Field naval air station: Part V, Studies of open-channel junctions." Charles E. Bowers. Project Report No. 24, St. Anthony Falls Hydraulic Laboratory, 61 pp., Jan. 1950. (Copies may be obtained from Project Supervisor, Soil Conservation Service, St. Anthony Falls Hydraulic Laboratory, Hennepin Island, Minneapolis 14, Minn.

(621) JUNCTION OF DRAINAGE PIPES AND PAVED CHANNELS.

(b) Soil Conservation Service, Regions 2 and 3, Department of the Navy.
(d) Experimental; for design.
(e) Models of the structures used at the head end of trapezoidal open channels flowing at supercritical velocities were constructed with several pipes of different sizes entering at various angles.
(f) Completed.
(g) Modification of several original designs was required to prevent cross waves in the downstream channel. Measured drop-down curves in the model channel where the slope was distorted showed good agreement with the computed curves for the prototype channel.
(h) "Hydraulic model studies for Whiting Field naval air station: Part III, Pipe-ditch transition structures." Fred W. Blaisdell and Charles A. Donnelly. Project Report No. 23, St. Anthony Falls Hydraulic Laboratory, 50 pp., Jan. 1950. (Copies may be obtained from Project Supervisor, Soil Conservation Service, St. Anthony Falls Hydraulic Laboratory, Hennepin Island, Minneapolis 14, Minn.

(931) DETENTION STORAGE STRUCTURE.

(b) Soil Conservation Service, Regions 2 and 3, Department of the Navy.
(d) Experimental; for design.

(e) A box inlet drop spillway with a rectangular orifice in the headwall was studied to determine its capacity. This structure is to be used for the detention storage of storm runoff and the subsequent release of the stored water through an uncontrolled orifice.
(f) Completed.
(g) It was necessary to increase the size of the orifice to enable it to pass the design flow.
(h) "Hydraulic model studies for Whiting Field naval air station: Part IV, Detention-type box inlet drop spillway." Fred W. Blaisdell and Charles A. Donnelly. Project Report No. 23, St. Anthony Falls Hydraulic Laboratory, 50 pp., Jan. 1950. (Copies may be obtained from Project Supervisor, Soil Conservation Service, St. Anthony Falls Hydraulic Laboratory, Hennepin Island, Minneapolis 14, Minn.

(932) STRAIGHT DROP SPILLWAY.

(b) Soil Conservation Service, Regions 2 and 3, Department of the Navy.
(d) Experimental; for design.
(e) Tests were made to determine flow conditions through a straight drop spillway located at the end of a horizontal curve in the approach ditch and to study reasons for the failure of outlets already in use at Whiting Field.
(f) Completed.
(g) The structure was moved downstream to achieve better flow conditions and the upstream channel was paved near the structure to eliminate scour at the ends of the weir notch. A new stilling basin was developed after obtaining unsatisfactory results from two standard types of basins, including the type now in use at Whiting Field.
(h) "Hydraulic model studies for Whiting Field naval air station: Part I, Straight drop spillway." Fred W. Blaisdell and Charles A. Donnelly. Project Report No. 23, St. Anthony Falls Hydraulic Laboratory, 50 pp., Jan. 1950. (Copies may be obtained from Project Supervisor, Soil Conservation Service, St. Anthony Falls Hydraulic Laboratory, Hennepin Island, Minneapolis 14, Minn.

(1167) CANTILEVERED DITCH OUTLET.

(b) Soil Conservation Service, Regions 2 and 3, Department of the Navy.
(d) Experimental; for design.
(e) In order to avoid excavation in a sandy delta having a high water table, it was desired to construct the outlet above the level of the delta and support it on piling. The model tests were made to develop a satisfactory type of outlet structure.
(f) Completed.
(g) A bucket outlet was not satisfactory because of large and strong side whirls. The recommended outlet dissipates much of the energy in an incomplete hydraulic jump and the water is then dropped almost vertically onto the sand delta from a U-shaped cantilevered weir.
(h) "Hydraulic model studies for Whiting Field naval air station; Part II, Cantilevered ditch outlet." Fred W. Blaisdell and Charles A. Donnelly. Project Report No. 23, St. Anthony Falls Hydraulic Laboratory, 50 pp., Jan. 1950. (Copies may be obtained from Project Supervisor, Soil Conservation Service, St. Anthony Falls Hydraulic Laboratory, Hennepin Island, Minneapolie 14, Minn.

(1168) A STUDY OF CANTILEVERED OUTLETS.

(b) Division of Drainage and Water Control, Soil Conservation Service, in cooperation with Minnesota Agricultural Experiment Station and St. Anthony Falls Hydraulic Laboratory.
(d) Experimental; applied research.
(e) Pipe outlet conduits for small spillways are frequently cantilevered beyond the tow of the earth dam. Attempts will be made to determine quantitatively the size of the scour hole to be expected under various field conditions.

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S. MORGAN SMITH COMPANY,

Inquiries concerning Projects Nos. 934, 1169, and 1170 should be addressed to Mr. R. Sahle, Supervisor S. Morgan Smith Company Laboratory, York, Pa.

(934) ADJUSTABLE BLADE PROPELLER TYPE TURBINE MODEL. EFFICIENCY AND HORSEPOWER TESTS.

(b) District Engineer, Portland District, Portland, Ore.
(d) Experimental; applied research.
(e) Model tests were conducted on a complete 12-inch model turbine with plate steel elbow draft tube and semi-spiral case. A wall provided with adjustable gates was installed downstream from the discharge end of the draft tube.
(f) Completed.
(g) Results show the effect on the performance of the prototype Kaplan unit caused by raising the tailwater elevation by means of gates a sufficient amount to provide a water supply for the fishway.

(1169) FRANCIS TYPE TURBINE TEST MODEL. EFFICIENCY TEST.

(b) Laboratory project.
(d) Experimental; applied research.
(e) A 21-1/4-inch model turbine with complete wheel case and elbow draft tube was tested. The new design of runner of a low specific speed type was tested over a large range of speed and head.
(f) Completed.
(g) Results were used to determine performance and design of prototype units.

(1170) ADJUSTABLE BLADE AXIAL FLOW PUMP.

(b) Laboratory project.
(d) Experimental; applied research.
(e) A standard design axial flow pump was tested under specially designed intake and discharge conditions.
(f) Completed.
(g) Results show that the performance of a standard design pump can be greatly changed by these special conditions.

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SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS.

(895) THE COMPILATION OF DATA ON SHIP RESISTANCE.

(b) Office of Naval Research, Department of the Navy.
(c) Mr. W. N. Landers, Secretary, The Society of Naval Architects and Marine Engineers, 29 West 39th St., New York 18, N. Y.
(d) The compilation of the data on ship resistance presently available at the various model basins and in designing offices, and the presentation of these data in a readily usable form.
(e) A critical study and correlation of existing data on the resistances of ship hull models which have been tested. An analysis of these data to determine systematically the influence of differences of hull form on resistance and to establish the fundamentals of the subject.
(f) A standard form entitled "Model Resistance Data" has been developed to record model data and test results. Another form entitled "Expanded Resistance Data" has been prepared for the expansion of the model test results to ship size. Explanatory notes defining the various dimensions, ratios, and coefficients used on the data sheets have been compiled. Model resistance and expanded resistance data sheets covering 86 models have been completed. It is expected ultimately to complete sheets for a total of 100 models. Estimated time of completion, 1951.

(h) "Model resistance and expanded resistance data sheets with explanatory notes for models 1-40." $4.00 per set to members of The Society of Naval Architects and Marine Engineers $5.00 per set to non-members.
"Model resistance and expanded resistance data sheets for models 41-60." $4.00 per set to members of The Society of Naval Architects and Marine Engineers, $5.00 per set to non-members.

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STANFORD UNIVERSITY, Hydraulic Laboratory.

Inquiries concerning Projects Nos. 624, 626, 627, 628, and 1171 should be addressed to Prof. John K. Vennard, Stanford University, Stanford, Calif.

(624) STUDY OF A PHASE OF THE CAVITATION PROBLEM.

(b) Office of Naval Research, Department of the Navy.
(d) Experimental; basic research.
(e) Collapse of cavities in a conical space simulating a solid angle of a sphere. Small hole at apex of cone plugged by end of impact rod on which SR4 strain gages are mounted.
(f) Completed and final report submitted to O.N.R.
(g) Impact pressures of very short duration but of large magnitude (up to 450,000 psi) measured. Good check on available theory obtained and cavitation collapse pressures concluded to be even higher than those measured.

(626) EFFECT OF POROSITY ON PERMEABILITY.

(b) Laboratory project.
(d) Experimental; doctoral thesis.
(e) Permeability tests were made on randomly packed and systematically packed media over a wide range of porosities using a variable head permeameter.
(f) Completed.
(g) The Blake-Kozeny-Hatch relationship was confirmed.
(h) "The effect of porosity on permeability in the case of laminar flow through granular media." Joseph B. Franzini. Ph. D. Thesis, Stanford University, 1950.

(627) STUDY OF TURBULENT BOUNDARY LAYERS.

(b) Laboratory project.
(d) Experimental; engineer thesis.
(e) Pressure drops and velocity profiles downstream from sharp and bell mouth entrances in smooth pipes of various diameters.

(628) EFFECT OF SHAPE OF PARTICLE ON SETTLING VELOCITY.

(b) Laboratory project.
(d) Experimental; basic research.
(e) Measurement of fall velocity of particles of regular geometric shape in the turbulent range. Correlation of results with fall velocities of spheres.
(f) Inactive.

(1171) STUDY OF MANIFOLD PORTS.

(b) Laboratory project.
(d) Experimental; engineer thesis.
(e) Measurement and interpretation of pressure variation near outlet parts in manifold pipes and obtaining hydraulic coefficients for various flow geometries.

(1172) PERMEAMETER WALL EFFECT.

(b) Laboratory project.
(c) Mr. Joseph B. Franzini, Stanford University, Hydraulic Laboratory, Stanford, Calif.
(d) Experimental; basic research.
(e) Permeability tests are to be conducted on Ottawa 20-30 sand using variable head permeameters of different sizes.
(f) Preliminary work on the packing of particles in cylindrical containers is in progress.

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STEVENS INSTITUTE OF TECHNOLOGY, Experimental Towing Tank.

MISCELLANEOUS PROJECTS.

The Experimental Towing Tank carries out an extensive research program of a classified nature for the Bureau of Ships, Bureau of Ordnance, and the Bureau of Aeronautics, Department of the Navy. A large number of projects involving commercial vessels of many different designs for private clients are also undertaken for the determination of effective horsepower, the resistance, directional stability of barges, the determination of shaft horsepower for river towboats and comparable vessels, resistances under sailing conditions of sailing yachts, and the hydrodynamic characteristics of flying boats and seaplane floats.

(340) PLANING SURFACES (Project CC839).

(b) Office of Naval Research, Department of the Navy.
(c) Prof. B. V. Korvin-Kroukovsky, Experimental Towing Tank, Stevens Institute of Technology, 711 Hudson St., Hoboken, N. J.
(d) Experimental and basic.
(e) To investigate the fundamental factors affecting the performance of planing surfaces for application to seaplanes and planing type surface craft, and to investigate the wave shape formed in the wake of such surfaces.
(g) Investigations will extend from elementary planing surfaces of several deadrises through warped surfaces, surfaces with the steps of Vee plan form, and the combinations of the forebody and the afterbody planing in its wake.
(h) "Lift of planing surfaces." B. V. Korvin-Kroukovsky. Reader's Forum Section, Journal of Aeronautical Sciences. Sept. 1950.
In preparation:
"Wetted length and center of pressure of vee-step planing surfaces." Daniel Savitsky. ETT Report No. 378.
"Trim, drag, and wetted area of seaplane in two-step planing." B. V. Korvin-Kroukovsky and Daniel Savitsky.

(940) DETERMINATION OF WAKE FRACTION AND THRUST DEDUCTION OF A TOWBOAT WITH AND WITHOUT A BARGE FLEET (Project T1250).

(b) Laboratory project.
(c) Mr. Randolph Ashton, Experimental Towing Tank, Stevens Institute of Technology, 711 Hudson St., Hoboken, N. J.
(d) Experimental and developmental.
(e) Self-propelled and towing tests have been made of a towboat with and without a barge fleet, at comparable propeller revolutions, under varying conditions of draft and water depth.

(1173) THE DEVELOPMENT OF A TEST TECHNIQUE FOR THE DETERMINATION OF SHIP MODEL RESISTANCE IN WAVES (Project T1198).

(b) Laboratory project.
(c) Mr. Randolph Ashton, Experimental Towing Tank, Stevens Institute of Technology, 711 Hudson St., Hoboken, N. J.

(d) Experimental and developmental.
(e) Resistance tests in waves of commercial vessel models so that the models are about as free as possible to respond to the oncoming waves--in particular, to surge fore and aft.
(g) Method developed termed the "gravity-weight method", with extremely little friction in the system and no towbar, springs, or dashpot damping.

(1174) WAKE FRACTION STUDY (Project T1306).

(b) Laboratory project.
(c) Mr. Allan B. Murray, Experimental Towing Tank, Stevens Institute of Technology, 711 Hudson St., Hoboken, N. J.
(d) Experimental and developmental.
(e) Self-propelled tests of a twin-screw hopper dredge model to compare the wake-fraction and thrust-deduction coefficients with two pairs of propellers--each pair having the same diameter but differing in other respects.

(1175) RUDDER FORCE AND TORQUE MEASUREMENTS DURING TURNING (Project 1345).

(b) Maritime Administration.
(c) Mr. John B. Drisko, Experimental Towing Tank, Stevens Institute of Technology, 711 Hudson St., Hoboken, N. J.
(d) Design research.
(e) To measure turning diameters, rudder stock torque, and lateral rudder force of a proposed ship design, for three alternate rudder designs.
(f) Tests completed.

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UNIVERSITY OF TENNESSEE.

(944) HYDRAULIC FRICTION.

(b) Engineering Experiment Station, University of Tennessee.
(c) Dr. G. H. Hickox, Engineering Experiment Station, University of Tennessee, Knoxville 16, Tenn.
(d) Experimental; basic research.
(e) A long term investigation is under way to determine friction coefficients in the transition range between smooth and rough turbulent flow. The purpose of the study is to define more completely the relationship between character of roughness of pipe surface and the shape of the transition curve. Tests are being made in a four inch lucite pipe which is roughened as desired by the insertion of sleeves with appropriate roughness characteristics.
(g) Tests on a smooth pipe indicated good agreement with the results of other experimenters. Tests on surfaces roughened with small depressions indicate an increasing friction coefficient with an increase in the number of depressions. The difference in friction coefficients increases with increasing Reynolds number.

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TEXAS ENGINEERING EXPERIMENT STATION, A & M College of Texas.

(1176) SOME FACTORS AFFECTING THE EFFICIENT USE OF IRRIGATION WATER IN TEXAS.

(b) Laboratory project.
(c) Mr. E. L. Harrington, Dept. of Civil Engineering, A & M College of Texas, College Station, Texas.
(d) Theoretical and field investigation; for doctor's thesis.

(e) A map showing mean annual rainfall during the growing season has been prepared for Texas. An attempt is being made to determine the probability of an adequate amount of water being obtained, due to rainfall, in certain localities. Useful soil moisture constants including apparent density, moisture holding capacity, and wilting percentage, will be determined for fifteen representative Texas soils.
(g) Study of soil moisture constants has been completed.

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UNIVERSITY OF TEXAS, Department of Civil Engineering.

Inquiries concerning Projects Nos. 637, 947, and 948 should be addressed to Prof. Carl W. Morgan, Department of Civil Engineering, University of Texas, Austin, Texas.

(637) DESIGN OF A GLASS-WALLED TILTING FLUME.

(b) Laboratory project.
(d) Experimental; for design.
(e) The glass-walled portion of the flume is 1 foot wide with a depth of 4 feet for the first six feet of length and a depth of 2 feet for the remaining 18 feet of length. The slope is readily adjustable to positive or negative values.
(f) Completed. Operation satisfactory.
(h) "Glass-walled flume provides flexibility in University of Texas laboratory." Walter L. Moore. Civil Engineering, March 1950.

(947) FACTORS AFFECTING THE BLOW OUT HEAD FOR A CUT OFF WALL IN A PERMEABLE MATERIAL.

(b) Abraham Strieff, Fargo Engineering Co., Austin, Texas.
(d) Experimental; basic research.
(e) To make preliminary observations of the blow out process under a vertical cut off wall in sand and thus check the contention that factors other than the critical exit gradient are significant.
(f) Temporarily inactive.
(g) Indications show that other factors are significant; results are not conclusive.

(948) DIFFUSION OF A TWO DIMENSIONAL SUBMERGED JET.

(b) Laboratory project.
(d) Experimental; M. S. Thesis.
(e) An experimental study of the diffusion of a water jet to determine the influence of a free surface and solid boundaries.
(g) Detailed measurements of mean flow characteristics have been made for a hydraulic jump occurring at a step-down in the channel floor. A range of relative step sizes has been covered from zero to four times the depth of the entering flow with the Froude number of the entering flow varied between 2 and 8.

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UTAH STATE AGRICULTURAL COLLEGE, Engineering Experiment Station.

Inquiries concerning Projects Nos. 949 to 952, incl., should be addressed to Dr. J. E. Christiansen, Engineering Experiment Station, Utah State Agricultural College, Logan, Utah.

(949) MODIFIED VENTURI SECTION FOR MEASURING FLOW IN OPEN CHANNELS (Project 14).

(b) Cooperative with Geological Survey, Armco Drainage and Metal Products Company, and Douglas Fir Plywood Association. Field studies conducted at outdoor cooperative (Soil Conservation Service, Utah State Agricultural College) Irrigation Research Laboratory.

(d) Experimental and field investigation; applied research and development, masters' theses.
(e) To develop a satisfactory water measuring device for open channels on very flat gradients.
(f) Nearing completion.

(950) AN INVESTIGATION OF FRICTION LOSSES IN ALUMINUM TUBING AND COUPLINGS (Project 18).

(b) Cooperative with Aluminum Company of America.
(d) Experimental; applied research and master's thesis.
(e) To determine friction loss in aluminum tubing and losses at commercial couplings. Additional studies to be made on tubing with deflection angles at couplings.
(f) Reactivated in January 1951.

(951) AN ANALYSIS OF A SMALL HYDRO-ELECTRIC POWER PLANT (Project 21).

(b) Laboratory project.
(d) Experimental; applied research and master's thesis.
(e) Purpose is to construct and test a small hydro-electric power plant and auxillary apparatus for determining characteristics of a representative impulse turbine which is to be used for hydraulic laboratory exercises.
(f) Completed.
(h) "A study of a small hydro-electric power plant." Lloyd E. Myers, Jr. Master's Thesis. (Available on loan).

(952) A STUDY OF THE HYDRAULIC PROPERTIES OF CENTRIFUGAL CONCRETE PIPE (Project 22).

(b) Cooperative with City of Logan, Utah and Utah-Idaho Concrete Pipe Company.
(d) Experimental and field investigation; applied research and master's thesis.
(e) To determine actual friction loss factor for a newly constructed water supply line consisting of 36-inch and 24-inch concrete pipe approximately 16,000 feet long.
(f) Completed.
(g) Coefficients of friction for centrifugal ooncrete pipe, 24-inch and 36-inch diameters, are comparable to coefficients given for smoother types of pipe. Losses at bends of the type used were negligible.
(h) "Hydraulic properties of centrifugal concrete pipe." Boyd L. Christensen. Master's Thesis.

(1177) REVISION OF BULLETIN NO. 2 "WATER MEASUREMENT" (Project 20).

(c) Prof. Eldon M. Stock, Civil Engineering Department, Utah State Agricultural College, Logan, Utah.
(d) Applied research; preparation of bulletin.
(e) "Water Measurement" explains and simplifies common methods and devices used to measure irrigation water to aid farmers, ditchriders and others, who are interested in the measurement of irrigation water. Provides by means of graphs and tables, simple solutions to water measurement problems.
(f) Manuscript complete.

(1178) A STUDY OF THE FACTORS AFFECTING PERMEABILITY OF SOILS TO WATER (Project 23).

(b) Cooperative with Agricultural Experiment Station, Utah State Agricultural College.
(d) Experimental and theoretical; basic research, for doctor's thesis.
(e) A careful study of the validity of the equation $k = cwd^2e^3/\mu(1 + e)$ for the permeability of granular materials. Ottawa sands were prepared by sieving to obtain grains of as nearly uniform size as possible. Permeability tests are being conducted with different densities of packing.

(1179) MEASUREMENT OF PERMEABILITY OF SATURATED SOILS BELOW THE WATER TABLE (Project 24).

(b) Cooperative with Agricultural Experiment Station.
(d) Experimental and theoretical; applied research for doctor's thesis.
(e) To determine factors affecting the Kirkham method of measuring permeability of saturated soils below the water table for various boundary conditions.
(f) Experimental work completed.

STATE COLLEGE OF WASHINGTON, Division of Industrial Research.

(641) THE HYDRAULICS OF SPRINKLER IRRIGATION SYSTEMS.

(b) Laboratory project.
(c) Prof. C. L. Barker, Department of Civil Engineering, State College of Washington, Pullman, Wash.
(d) Theoretical; for design.
(e) Using the experimental results of J. R. Barton, "A study of diverging flow in pipe lines", University of Iowa, August 1946, an analytical study was made, taking the results from a single branch and working out the discharge ratios for multiple branches. The variables considered were the coefficient of discharge of the sprinkler or branch, diameter ratios, number of branches, and head loss coefficients between branches, and their values were selected to include the ranges ordinarily found in sprinkler irrigation systems. The results are mainly presented as a graphical solution whereby can be determined the discharge ratio of any branch in the line to the discharge of the downstream branch knowing the parameters listed. The solution includes also the summation of discharge ratios up to and including any branch from the downstream branch.
(f) Completed.

(1180) PRESSURE GENERATION IN PIPES FROM THE RELEASE OF AIR.

(b) Cooperative with Concrete Products Association of Washington.
(c) Mr. J. A. Roberson, Division of Industrial Research, Washington State College, Pullman, Wash.
(d) Experimental and field investigation; applied research.
(e) The purpose is to study the action of air and water when air is released from vents or inlets in gravity water pipe systems. Hydraulic model studies are being made.
(g) Studies indicate that dynamic pressure generation is potentially present in pipelines that have release of air from vents or inlets.

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UNIVERSITY OF WASHINGTON, Department of Civil Engineering.

Inquiries concerning Projects Nos. 363, 642, 643, and 644 should be addressed to Prof. C. W. Harris, Hydraulics Laboratory, Department of Civil Engineering, University of Washington, Seattle 5, Wash.

(363) INTERNAL PRESSURES IN TURBULENT FLOW IN PIPES.

(b) Laboratory project.
(d) Experimental; basic research.
(e) To determine relation of boundary pressure to the internal pressures in pipes flowing with high turbulence (especially in turbulence caused by sudden enlargement). A special piezometer tube has been designed to measure the pressure at any point within a 12-inch pipe.
(f) Suspended.
(g) Results to date are not conclusive. Further study desirable.

(642) A STUDY OF THE VALIDITY OF THE USE OF THE HYDRAULIC RADIUS AS A MEANS OF CORRELATING THE RELATIONSHIPS OF FLOW IN CONDUITS OF DIFFERENT SHAPES.

(b) Laboratory project.
(d) Experimental; basic research.
(e) A series of tests to determine the relationships of the flow functions to the hydraulic radius in channels of different shapes. The project is intended to correlate the work done on closed conduits of various shapes and that done on pipes. It is tributary to Project No. 644.
(g) Results are in form of initial data only.

(643) EFFECT OF TYPE OF FLOW AND SIZE OF PIEZOMETER OPENING ON PIEZOMETER READINGS.

(b) Laboratory project.
(d) Experimental; basic research.
(e) By varying the degree of turbulence and by introducing controlled amounts of spiral flow to determine the effect on piezometer readings as an indication of pressure within a pipe; and by varying the size of piezometer openings to determine the effect of this size on the accuracy of measurement.
(f) Suspended.
(g) Results indicate definite effects of type of flow and size of piezometer opening on piezometer readings. Further work necessary for quantitative analysis.

(644) FLOW IN PIPES AND CHANNELS.

(b) Laboratory project.
(d) Experimental; basic research.
(e) To establish a means conforming to modern concepts of flow identifying pipe and channel surfaces in relation to their resistance to passage of water, and to introduce a practical formula for applying a specific roughness coefficient, once found, to any size pipe or channel.
(f) Suspended pending completion of several tributary investigations.
(g) Definite concepts of the relations between the types of flow in pipes, and of the relation of the resistance to flow of water in pipes to specific roughness, have been developed.

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UNIVERSITY OF WISCONSIN, Hydraulic Laboratory.

Inquiries concerning Projects Nos. 366, 955, 956, 957, 958, and 1181 should be addressed to Prof. J. R. Villemonte, Hydraulic Laboratory, University of Wisconsin, Madison 6, Wis.

(366) HEAD LOSSES IN FLOW OF LIQUIDS IN PIPES.

(b) Cooperative with Mueller Brass Co., Port Huron, Mich.
(d) Experimental; for B. S. thesis.
(e) Head loss measurements are being made on straight copper and galvanized iron standard pipe of various sizes.
(f) Completed.
(g) Studies of relations pertaining to friction factor, relative roughness, and Reynolds number based on empirical data have been completed for copper pipes 1/2, 1 and 2 inches in diameter.
(h) "Energy losses in copper pipes." D. H. Ferrell and R. C. Kolf. B. S. Thesis. June 1950. (Available on loan).

(368) DEVELOPMENT OF A FLOOD FORECASTING PROCEDURE FOR THE WISCONSIN RIVER.

(b) Laboratory project.
(c) Dr. Arno T. Lenz, Hydraulic Laboratory, University of Wisconsin, Madison 6, Wis.
(d) Experimental; for M. S. thesis.
(e) Fundamental studies in rainfall-runoff relations are being made to estimate runoff values to be used in flood forecasting by the unit-hydrograph method.
(f) Six M. S. theses have been completed.

(646) BEHAVIOR OF OIL-WATER SEPARATORS.

(b) American Petroleum Institute.
(c) Dr. G. A. Rohlich, Hydraulic Laboratory, University of Wisconsin, Madison 6, Wis.
(d) Experimental and theoretical; basic research.

(e) Determination of hydraulic characteristics of separating tanks. This is accomplished by dosing the influent with sodium phosphate and making chemical tests at regular intervals to indicate the phosphorous concentration in the effluent. Retention studies using wax spheres of 200 microns diameter are being used to evaluate performance of influent and effluent baffles.
(g) Vertical slot influent baffle with 3 to 7 percent net area gives best flow characteristics.
(h) "Laboratory experiments on the behavior of gravity separators." Dr. G. A. Rohlich and Dr. A. C. Ingersoll. Proc. Fifth Industrial Waste Conference, Purdue University Bulletin, Series No. 72, 1950.

(955) EFFECT OF SUBMERGENCE ON DISCHARGE OF PARSHALL FLUMES.

(b) Laboratory project.
(d) Experimental; for M. S. thesis.
(e) Submergence tests are being run with various conditions of submergence on a standard 6-inch Parshall flume.
(f) Completed.
(g) Analysis has been based on application of superposition principle and provides a simple, accurate submerged discharge equation.
(h) "Effect of submergence on discharge of a 6-inch Parshall flume." V. N. Gunaji. M. S. Thesis. June 1950. (Available on loan).

(956) HEAD LOSSES IN FLOW OF LIQUIDS IN PIPES UNDER HIGH LINE PRESSURES.

(b) Cooperative with Ladish Co., Cudahy, Wis.
(d) Experimental; for master's and doctoral theses.
(e) A circulating system of 2-inch seamless steel pipe with oil flowing will contain a 20-foot section in which energy losses will be measured by latest type strain gages. Line pressures will be varied from 100 to 2000 psi and show the effect of high line pressure on the friction factor for both laminar and turbulent flow.
(g) The test apparatus, equipment, instrumentation and appurtenences thereto are now complete, and partial data on the 2-inch pipe have been taken.
(h) "Energy loss in liquid flow in straight pipes under high pressures." M. S. Thesis. June 1950. (Available on loan).

(957) THE THERMODYNAMICS OF LIQUIDS.

(b) Laboratory project.
(d) Experimental; for doctoral, master's and bachelor theses.
(e) The effect of temperature (50-120° F) and pressure (0-2200 psig) on the compressibility, density, and viscosity of liquids will be observed by use of newly designed precision equipment.

(958) HEAD LOSSES IN FLOW OF LIQUIDS IN WELDING PIPE FITTINGS.

(b) Cooperative with Ladish Co., Cudahy, Wis.
(d) Experimental; for master's and bachelor theses.
(e) Head losses over and above those in straight pipe of same centerline length will be observed for a wide variety of welded pipe fittings, including one and two gore miter turns. Most fittings will be 4 inches in diameter.

(959) HYDROLOGIC INVESTIGATION OF LAKE MENDOTA DRAINAGE BASIN.

(b) Part of a larger project entitled "Origin and quantities of algal fertilizers tributary to Lake Mendota." Cooperative study sponsored by University of Wisconsin, Madison 6, Wis.
(c) Dr. A. T. Lenz, Hydraulic Laboratory, University of Wisconsin, Madison 6, Wis.
(d) Field investigation; applied research for M. S. thesis.
(e) Eleven stream gaging stations have been installed to measure tributary inflow to Lake Mendota and Yahara River outflow. Fourteen new recording rain gages will be installed to correlate rainfall and runoff. Chemical and temperature measurements are being taken as part of the larger project.
(g) One M. S. thesis and three B. S. theses completed.

(960) WATER TREATMENT STUDIES.

(b) Infilco.
(c) Dr. G. A. Rohlich, Hydraulic Laboratory, University of Wisconsin, Madison 6, Wis.
(d) Experimental; applied research for M. S. thesis.
(e) Comparison of results secured by operation of accelerator and conventional water treatment methods. Bacteriological studies under way at present.
(g) Two M. S. theses completed.

(1181) VORTEX FLOW FROM HORIZONTAL THIN-PLATE ORIFICES.

(b) Cooperative with Mr. J. C. Stevens, Portland, Ore.
(d) Theoretical and experimental; for doctoral and master's theses.
(e) Existing fundamental considerations will be studied and extended to apply to this problem. An experimental apparatus will be constructed to observe (1) the pressure, velocity and depth relations for a free-flow vortex with initial radial approach, (2) the effects of initial tangential approach and (3) the effects of boundary proximity.

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WORCESTER POLYTECHNIC INSTITUTE, Alden Hydraulic Laboratory.

Inquiries concerning Projects Nos. 649, 961, 963, 964, 965, and 1182 to 1185, incl., should be addressed to Prof. L. J. Hooper, Alden Hydraulic Laboratory, Worcester Polytechnic Institute, Worcester 2, Mass.

(649) GOOSE POND SPILLWAY TEST.

(b) Granite State Electric Co. (New England Power Assn.).
(d) Experimental; for design.
(e) The purpose is to increase economically the spillway capacity of an existing structure. A 1:16 scale model was constructed and some tests were made.
(f) Inactive. Work will be continued.

(961) VALVE TESTS.

(b) Chapman Valve Co.
(d) Experimental; for design.
(e) Head loss measurements for various discharges were made on a 24-inch disc type check valve. Closure time and pressure changes were determined photographically for various flows up to 45 cfs.
(f) Inactive. Work will be continued.

(963) CALIBRATION OF KENNISON FLOW NOZZLES.

(b) Builders-Providence, Inc.
(d) Experimental.
(e) Two 30-inch flow meters were calibrated to maximum discharge of 20 cfs and discharge and operating characteristics were determined.
(f) Completed.

(964) MEASUREMENT OF TURBULENCE.

(b) Office of Naval Research, Department of the Navy.
(d) Experimental; for design.
(e) The purpose is to determine the feasibility of measuring turbulence in water using diffusion of salt solution. The integrating circuit design and construction have been completed. Work is continuing on electrode design and test.

(965) HOLYOKE INTAKE DESIGN.

(b) Jackson and Moreland.
(d) Experimental.
(e) A 1:50 model was constructed of the proposed power house intake and fore-bay arrangement. Tests were made to determine loss of head, stability of flow conditions, effect of flood flows on fore-bay and ice diversion.
(f) Completed.

(1182) CALIBRATION OF DISC TYPE METERS.

(b) Hersey Meter Co.
(d) Experimental.
(e) Several 8 and 6-inch compound flow meters were calibrated. Head loss measurements were also made.
(f) Completed.

(1183) FISHWAY AND TAILRACE DESIGN.

(b) Fish and Wildlife Service.
(d) Experimental.
(e) A 1:16 model of the proposed tailrace at Holyoke was constructed with proposed fishway (ladder) arrangements. Tests were made to determine means of guiding fish to best passages.

(1184) C. J. STRIKE POWER DEVELOPMENT.

(b) Ebasco Services, Inc.
(d) Experimental; for design.
(e) A 1:40 model of the proposed spillway and apron are being constructed to study the hydraulic jump formation and to study spillway performance for various gate operations.

(1185) SALT VELOCITY TESTS.

(b) Laboratory project.
(d) Experimental; applied research.
(e) Tests were made to determine the performance of the salt velocity method at low velocities. The settling rate of salt solutions in quiet water was determined and the effect of varying the quantity and specific gravity was determined for actual flow tests.
(h) "Low velocity studies of salt velocity method." L. J. Hooper and L. C. Neale. A.S.M.E. Sept. 1950.

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U. S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, California Forest and Range Experiment Station.

Inquiries concerning Projects Nos. 261 and 1186 should be addressed to Dr. Stephen N. Wyckoff, California Forest and Range Experiment Station, P. O. Box 245, Berkeley 1, Cali

(261) WATERSHED MANAGEMENT RESEARCH, CALIFORNIA.

(b) Laboratory project.
(d) Experimental; field investigation; basic and applied research.
(e) Purposes are: (1) to study the disposition of rainfall as influenced by watershed conditions, including vegetation, soils, geology, and topography; and (2) to develop methods of watershed management, including the treatment of areas denuded by fire, to assure maximum yield of usable water, and satisfactory regulation of flood runoff and erosion. Major work center is the San Dimas Experimental Forest. Rainfall, runoff, and erosion are measured on two main drainage areas, on ten large and seven small watersheds within these areas, and on eighteen experimental plots. Twenty-six large lysimeters furnish comparisons of the use of water by various species of shrubs, and one species of pine. Climatic data are obtained from several meteorological stations. Studies of runoff and erosion as influenced by fire and the revegetation of large burns are in progres
(g) "Disposition of Annual Rainfall in Two Mountain Areas in California." P. B. Rowe and E. A. Colman. Manuscript submitted to Department of Agriculture for publication as a technical bulletin. A study of interception of rainfall by second growth ponderosa pine showed that approximately 12 percent of each year's rainfall is lost by interception. Interception of snow was of the same magnitude as that of rain.
(h) "Rainfall interception by chaparral in California." E. L. Hamilton and P. B. Rowe. Sacramento, Calif. Department of Agriculture, Forest Service, in cooperation with California Department of Natural Resources, Division of Forestry.
"Hydrologic problems of brushland management." E. A. Colman. Mimeographed.
"Effect of weed competition upon survival of planted pine and chaparral seedlings." J. S. Horton, California Forest and Range Experiment Station Research Note No. 72.
"Trees and shrubs for erosion control in southern California mountains." J. S. Horton. Sacramento, California. Department of Agriculture, Forest Service, in cooperation with California Department of Natural Resources, Division of Forestry.
"Use of the helicopter for sowing mustard seed in burned areas of southern California." C. H. Gleason and D. G. MacBean. Jour. Forestry 47(3): 192-195. March 1949.

(1186) FLOOD CONTROL SURVEY RESEARCH, CALIFORNIA AND WESTERN OREGON.

(b) Laboratory project.
(d) Experimental; field investigations; statistical studies in applied research.
(e) To furnish a physical base for evaluation of flood control measures as they affect flood and sediment damages. Emphasis is on the determination of the influence of "land use" on frequency of flood peaks, annual and seasonal yields of water, and sediment productior from whole watersheds.
(g) After segregation of the effects on flood size of eleven meteorological and watershed variables, analysis of covariance showed an inverse relation between a specially defined forest cover variable and the peak discharges from watersheds of the Willamette Basin, Oregon. Results of similar completed studies in southern California gave an inverse relation of the peak discharges from watersheds and sedimentation of reservoirs to forest cover density, with the peak discharges varying as the -0.852 power and the sedimentation as the -1.974 power of the cover density.
(h) "Does burning increase surface runoff?" H. W. Anderson. Jour. Forestry 47(1): 54-57, 1949.
"Influence of some watershed variables on a major flood." H. W. Anderson and H. K. Trobitz. Jour. Forestry 47(5): 347-356, 1949.
"Flood frequencies and sedimentation from forest watersheds." H. W. Anderson. Trans. Amer. Geophys. Union 30(4): 567-584, 1949 and 31(4): 621-623, 1950.

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U. S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, Northeastern Forest Experiment Station.

Inquiries concerning Projects Nos. 656, 966, 967, 1187, and 1188 should be addressed to Dr. V. L. Harper, Northeastern Forest Experiment Station, 102 Motors Avenue, Upper Darby, Pa.

(656) FOREST INFLUENCES INVESTIGATION (WATERSHED MANAGEMENT).

(b) Cooperative with the Pennsylvania Department of Forests and Waters.
(d) Field investigation; basic and applied research.
(e) Studies have been started on the Delaware-Lehigh Experimental Forest, Monroe County, Pa., to determine the water economy for a watershed covered with scrub oak. Afterwards, the cover will be converted by planting and fire protection to a commerciably valuable type, and the effect on water relations will be measured. Installations have been established to evaluate all components of a water balance equation for the watershed.
(h) A progress report covering the two hydrologic years 1948-49 and 1949-50 will be published in the near future.

(966) FOREST INFLUENCES INVESTIGATION (WATERSHED MANAGEMENT).

(b) Laboratory project.
(d) Field investigation; basic and applied research.
(e) Studies have been started on the Pocono Experimental Forest, Wayne County, Pa., to determine effects of forest management practices and logging operations upon the quantity and quality of water yielded by a small watershed.

(967) STUDY OF THE EFFECT OF SOIL AND COVER CONDITIONS ON SOIL MOISTURE RELATIONSHIPS.

(b) Laboratory project.
(d) Field investigation; applied research.
(e) Soil cores were obtained under different conditions of soil, cover, and use on the Allegheny watershed. Tests were made on about 1,000 cores to determine percolation rate, detention storage capacity, retention storage capacity, volume weight, and organic content, for use in flood control surveys to permit more accurate estimates of the increase in infiltration and water storage resulting from a program of land management.
(g) Analysis of percolation rates and storage capacities showed that land cover and use primarily affect the upper soil horizons. In the lower horizons the principal factors affecting soil moisture values are texture and drainage. Within the forest, grazing resulted in a greatly reduced rate of water movement and amount of detention storage throughout the A horizon. The effect of cover and use was greatest in the A horizon and gradually diminished throughout the B horizon. In the C horizon no significant difference between soil moisture values were detected for differing conditions of cover and use.
(h) A Station Technical Paper will be released soon.

(1187) FROST STUDIES IN THE NORTHEASTERN UNITED STATES.

(b) Laboratory project.
(d) Field investigation; applied research.
(e) A continuation of the work listed under Projects Nos. 374 and 375 in Volume 14 of this bulletin. To determine the effect of land use and condition upon type and depth of frost formation. Periodic observations of frost type and depth, snow depth, and water content are made upon a large number of plots in New England, New York, and northern Pennsylvania, selected to sample a variety of land uses and conditions within certain land use classes. Observations were made on 120 plots during the winter 1947-48. During the winters of 1948-49 and 1949-50 observations were made upon only a few plots in eastern Pennsylvania and little information was gained due to the mildness of the winters. A new and sidely expanded system of plots is being established for observations during the winter 1950-51.

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(1188) FOREST INFLUENCES INVESTIGATION (WATERSHED MANAGEMENT).

(b) Laboratory project.
(d) Field investigation; basic and applied research.
(e) Studies have been started on the Fernow Experimental Forest, Tucker County, W. Va., to determine the effect of different levels of cutting practices and different logging practices upon water quantity and quality. Five watersheds will be maintained in an undisturbed condition for a preliminary period for standardization. Then treatment will be applied to four of the watersheds, and the various elements relating to the water economy of the watersheds evaluated.

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U. S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, Northern Rocky Mountain Forest and Range Experiment Station.

(968) FOREST INFLUENCES INVESTIGATIONS.

(b) Laboratory project.
(c) Dr. George M. Jemison, Northern Rocky Mountain Forest and Range Experiment Station, Missoula, Mont.
(d) Field investigation; applied research.
(e) To develop a detailed hydrological analysis for a small timbered watershed. Also to determine effect of forest cover and other site factors on accumulation of snowfall, rate of snow melt, and movement of snow-melt water. Work under way at Priest River Experimental Forest, Idaho.

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U. S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, Pacific Northwest Forest and Range Experiment Station.

(969) EFFECT OF LOGGING AND OTHER FOREST OPERATIONS ON STREAM FLOW.

(b) Laboratory project.
(c) Dr. J. A. Hall, PNWF&RES, 423 U. S. Court House, Portland 5, Ore.
(d) Field investigation; basic research.
(e) 1. Three small study watersheds have been selected in Blue River Experimental Forest, and stream gages are being installed. No logging will be done on study areas during a six-year calibration period.
2. A series of watersheds on the Wenatchee National Forest have been selected to determine changes in stream flow following logging in ponderosa pine forest. Installation of stream gages is planned for next year. There will be a six-year calibration period for the stream gages. Effects of grazing and of road construction on runoff and water quality will be studied.
3. A group of small watersheds on the Starkey Experimental Range have been selected to determine effects of grazing on stream flow and sedimentation.
4. Hydrologic analysis of several watersheds in western Oregon and western Washington to determine relation of land use and cover conditions to stream flow and sedimentation. Using a statistical approach, forest cover type and density, topography, soil characteristics, precipitation, etc. are evaluated with respect to flood peaks.
5. Soil sampling and measurement of depth, texture, percolation rate, detention and retention storage capacity, and volume/weight of soils is carried on as part of the hydrologic analysis. Studies now confined to the Oregon coast and Washington west of the Cascades will be extended to cover eastern Washington and Oregon next year. Relation of forest soil percolation rate and storage capacity to age of forest cover; and relation of cover and soil type to extent of soil freezing, with regard to the effects of freezing on percolation rate are also studied.

(g) A sharp increase in percolation rate and detention storage capacity over the first fifteen years after logging and burning was observed in the coast range soils in Oregon. The soil freezing observations showed that soils under dense forest cover remained unfrozen, that soils under open pine forest showed discontinuous permeable frost, that soils of open brush and grass lands showed as much as seven inches of impermeable frost carrying over into the spring snowmelt period, and that one inch of impermeable "concrete" frost was sufficient to prevent infiltration and cause runoff from melting snow. Incidental observations also showed that intensity of cutting in the Douglas-fir forest had a decided effect on snow accumulation and melting.

(h) "Statistical control on hydrologic forecasting." H. G. Wilm, PNWF&RES Research Note No. 61, Jan. 1950.
"Some references on watershed management." W. E. Bullard, PNWF&RES Research Note No. 63, March 1950.
"Some observations on soil freezing in forest and range lands of the Pacific Northwest." C. E. Hale, PNWF&RES Research Note No. 66, July 1950. (Available through the Director, Pacific Northwest Forest and Range Experiment Station, 423 U. S. Court House, Portland 5, Oregon).

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U. S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, Rocky Mountain Forest and Range Experiment Station.

Inquiries concerning Projects Nos. 376, 377, 378, and 379 should be addressed to Dr. L. D. Love, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo.

(376) FOREST INFLUENCES RESEARCH, MANITOU EXPERIMENTAL FOREST.

(b) Laboratory project.
(d) Field investigation; applied research.
(e) Studies of the influence of grazing, timber cutting, and revegetation of depleted watershed lands upon water supplies and more particularly upon erosion and sedimentation, to solve problems in watershed management for the forest- and range-covered watershed lands of the Rocky Mountain Front Range.
(g) An increase in surface runoff from bunchgrass ranges as grazing pressure was intensified was found from natural precipitation on permanently established plots and from artifically applied rainfall on infiltration plots. Erosion on permanent plots continued at normal rates under moderate grazing but doubled when grazing was heavy. Removal of litter from stands of young ponderosa pine more than doubled runoff and increased soil erosion 72 times in the first year of treatment. After eight seasons of needlefall accumulation, the treated plots are again reacting similarly to those untreated. Two watersheds, burned to encourage aspen growth, showed an immediate increase in erosion, while watersheds cleared without subsequent burning remained unchanged in erosion rates because litter was undisturbed. Infiltration tests on a 4,800-acre drainage showed (1) highly absorptive soils under aspen and on north slopes in the spruce-Douglas fir type; (2) relatively low rainfall absorption and high runoff rates from mixed brush and bunchgrass cover on steep south slopes.
(h) "Report of the committee on evaporation and transpiration." Trans. Amer. Geophys. Union 31(5): 792. Oct. 1950.

(377) FOREST INFLUENCES RESEARCH, FRASER EXPERIMENTAL FOREST.

(b) Laboratory project.
(d) Field investigation; applied research.
(e) To determine influence of lodgepole pine and spruce-fir forests and of cutting of this timber upon factors associated with the yield of water, largely from stored snow. The aim is to solve problems in watershed management for forested watersheds of the Continental Divide zone of the Central Rockies.

(f) First phase of experiments in mature lodgepole pine completed in 1944. Studies of thinning in immature lodgepole pine completed in 1949. Second phase involving logging of a 710-acre experimental watershed has been well started with construction of access road and debris catchment basin, surveying of channels, and installations for study of physical factors affecting snow-melt and water yield.
(g) Reduction in density of the forest canopy through partial clearing of timber has resulted in 15 to 30 percent increase in precipitation reaching the soil. This increase is all, or in part, an addition to ground water, since the sum of evaporation and transpiration losses from the soil are not increased by the timber cutting.
(h) "A day's contribution to the snow-melt hydrograph." F. A. Bertle and E. G. Dunford. Proc. Western Snow Conference, 60-64, April, 1950.

(378) FOREST INFLUENCES RESEARCH, WESTERN COLORADO.

(b) Laboratory project.
(d) Field investigation; applied research.
(e) Range and watershed problems in the Upper Colorado River basin have been analyzed and a report prepared. Both short- and long-term experiments being conducted to determine effect of forest and range vegetation on water yields, erosion, and sedimentation. Stream flow records (not including winters) obtained since fall of 1947 from three high-altitude forested watersheds. Largest watershed is being commercially logged to evaluate effect on water flow. An infiltrometer is being used to determine the effect of vegetation and soil type and amount of organic materials on infiltration and erosion rates of soils. About 400 sample plots have been tested since 1948 in sagebrush, pinyon-juniper, grassland, and aspen vegetation. Small grazing and reseeding experiments have been established.
(g) Preliminary results from small forested watersheds show that logging over one-half of the timbered area has not altered the water quality. Erosion has been negligible and no sediment nor bed-load has reached the gaging station. Infiltration tests on grazing lands have shown that the most critical rangelands in Western Colorado are in pinyon-juniper vegetation. Production of herbage is extremely low, infiltration rates are low and soil erosion rates high. Rangelands in sagebrush are also in critical condition. Exclusion of cattle from heavily grazed lands increases moisture-absorption rates up to elevenfold and reduces erosion rates as much as thirtyfold. Gophers cause increase in water-absorption rates where cattle grazing is heavy, but a decrease when cattle are excluded.
(h) "A simple volume-weight sampler and procedure." E. J. Dortignac. Soil Science 69(2): 95-105. Feb. 1950.

(379) TRAPEZOIDAL FLUMES FOR OPEN-CHANNEL FLOW.

(b) Laboratory project.
(d) Experimental; design.
(e) Study to work out the design for an improved gaging station for use in mountain stream channels which will not become clogged with bed load material, silt, ice, and snow, or other obstructions, and will provide an accurate stage-discharge relation over a wide range of discharges. Scale models of trapezoidal flumes of various dimensions were tested.
(f) Completed.
(g) An apparently satisfactory flume shape has been obtained which awaits field testing.
(h) "A trapezoidal flume for gaging mountain streams." B. C. Goodell. Station Paper No. 2. Rocky Mountain Forest and Range Experiment Station (Mult.) 18 pp. illus. June 1950.

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U. S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, Southeastern Forest Experiment Station.

(380) FOREST INFLUENCES INVESTIGATIONS - WATER RESOURCE AND WATERSHED MANAGEMENT RESEARCH.

(b) Laboratory project.
(c) Dr. I. T. Haig, Southeastern Forest Experiment Station, U. S. Forest Service, P. O. Box 252, Asheville, N. C.

(d) Field investigation; basic and applied research.
(e) To determine the effect of vegetation on the phases of the hydrologic cycle; the effect of land use management practices on water yield and water quality; to develop standards and methods of watershed management so as to derive the greatest benefit from the land and water resources in the southeastern United States. Most of the experiments and data collections are carried out on the 5500-acre Coweeta Hydrologic Laboratory located in the zone of maximum precipitation in the eastern United States (Nantahala Range of the Southern Appalachian Mountains). Within this area are approximately 35 individual watersheds which are either being treated experimentally or being used as control checks. The John C. Calhoun Experimental Forest near Union, South Carolina, has been established and is doing basic research on how piedmont soils influence water resources and plant growth. Research projects include determination of effects of (1) permanent complete removal of all major vegetation; (2) temporary complete removal of all major vegetation; (3) removal of riparian vegetation; (4) removal of laurel and rhododendron shrub vegetation; (5) local logging practices; (6) mountain agriculture; (7) woodland grazing; (8) forest fires on water yield and quality; (9) improved techniques for removing wood products and retaining high quality water values on mountain watersheds.
(g) Investigations on woodland grazing have demonstrated that changes in soil due to trampling are reflected in reduced infiltration, permeability and total porosity, increases to storm peaks and stream turbidities; reduction in the amount of browsable vegetation is reflected in number and height of plants; reduced diameter growth of forest trees also occurs. Records of stream flow from the mountain farm watershed demonstrated that grazed pastures are one of the major flood source areas in the southern Appalachian Mountains. Annual erosion amounts up to 0.5 cu yd per lineal foot of poorly built logging roads were observed and were associated with increased turbidities and reduced water values. Clearing of mountain watersheds for agriculture raises the stream temperature and causes the trout to leave.
(h) "Land use and trout streams." Geoffrey E. Greene. Jour. of Soil and Water Conservation. 5(3): 125-126. July 1950.
"Hydrologic characteristics of South Carolina piedmont forest soils." Marvin D. Hoover. Soil Science Society of America Proc. (1949) 14: 353-358, 1950.

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. S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE, Southwestern Forest and Range Experiment tation.

(657) FOREST INFLUENCES INVESTIGATIONS AND WATERSHED MANAGEMENT.

(b) Laboratory project.
(c) Dr. Raymond Price, Southwestern Forest and Range Experiment Station, Box 951, Tucson, Ariz.
(d) Experimental; basic and applied research.
(e) To determine the influence of types and densities of vegetation on stream flow, water uses, water losses, and erosion and sediment yield, at Sierra Ancha Experimental Forest, a 13,255-acre area in the Salt River watershed. Additional experimental watersheds and plots in representative areas throughout the Salt River watershed.
(g) Soils with the best surface protection, including rock and litter, showed the smallest erosion losses. Evapo-transpiration loss of water from drained slopes is largely that retained by the soil. Vegetation or evaporation from bare soil can more than use all the summer precipitation in the Southwest. Consumptive use by forest and range vegetation depends on the amount and distribution of rainfall, climate, topography, and storage capacity of soils as well as the type of vegetation and the degree to which its use overlaps the period of water surplus.
(h) "Consumptive use of water by forest and range vegetation." L. R. Rich. April 1950 meeting, Irrigation Division, A.S.C.E. (Mimeo.)

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U. S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, Division of Irrigation and Water Conservation.

(53) SAND TRAPS AND SLUICEWAYS.

(b) Cooperative with Colorado Agricultural Experiment Station. See Project 53, page 17.

(151) LINING OF IRRIGATION CANALS AND DITCHES.

(b) See Project 151, page 92.

(287) PERFORMANCE TESTS OF WELL SCREENS.

(b) Cooperative with Colorado Agricultural Experiment Station. See Project 287, page 18.

(386) DETERMINATION OF THE CHARACTERISTICS OF THE SUSPENDED SILT LOAD OF TEXAS STREAMS.

(b) Laboratory project.
(c) Dean W. Bloodgood, Soil Conservation Service, 302 West 15th Street, Austin, Texas.
(d) Experimental; basic and applied research.
(e) (1) To determine the relationship between the suspended silt load and the discharge of Texas streams; (2) to establish criteria for planning surface reservoir storage based on suspended silt to be handled; (3) to determine the characteristics of silt deposited in reservoirs for use in evaluation of the life of a given reservoir: (4) to secure data necessary to determine the effect of silt load on the cost of preparing water for domestic and industrial use; and (5) to determine the relationship between silt load and the management of the tributary watersheds.

(387) HYDROLOGY OF SNOW AND STREAM FLOW IN RELATION TO IRRIGATION IN THE NORTHWEST.

(b) Laboratory project.
(c) Mr. Robert A. Work, Soil Conservation Service, P. O. Box 1149, Medford, Ore.
(d) Experimental; basic research.
(e) (1) To develop from snow surveys and related data advance knowledge of the amount and distribution of the water supply available for each stream basin each season for agricultural use; and (2) to determine the factors which influence amount and distribution of water supplied to irrigated areas. Characteristics of stream flow and ground waters in principal stream basins are being studied in relation to occurrence, distribution, utilization, and efficiency of use.
(g) Research projects are being conducted in several states in cooperation with State Agricultural Experiment Stations to determine methods of developing and applying general forecasting principles to local conditions.

(388) EVALUATION OF FACTORS AFFECTING WATER YIELDS FROM HIGH WATERSHEDS IN UTAH.

(b) Laboratory project.
(c) Mr. Gregory L. Pearson, Soil Conservation Service, College Hill, Box D, Logan, Utah.
(d) Experimental; basic research.
(e) (1) To determine the effect of deviation from normal of late fall and early spring precipitation on the established snowcover--runoff relationship for Utah streams; (2) to determine the effect of temperature and other climatic factors upon the quantity and distribution of runoff from Utah's snow-fed streams; (3) to determine the effect of various meteorological phenomena on the distribution and extent of the "snow blanket" for particular storms with special reference to established snow courses. At present data are being gathered at two mountain installations.

(389) STORAGE OF WATER UNDERGROUND FOR IRRIGATION IN CALIFORNIA.

(b) Laboratory project.
(c) Mr. Albert T. Michelsen, Soil Conservation Service, 222 P. O. Bldg., Berkeley, Calif.
(d) Experimental; basic research.

(e) To determine the factors affecting the percolation rate on water-spreading areas, and to devise ways and means to increase the percolation rate. In some soils the percolation rate decreases during spreading, and the objectives are to determine the cause of the decrease and to find practical methods of maintaining the high initial rates. Field tests are being made on test ponds and strips.
(h) "Report to cooperation on water spreading investigations in San Joaquin Valley, California." Dean C. Muckel (1949) Mimeographed.

(390) IMPERIAL VALLEY DRAINAGE INVESTIGATIONS.

(b) Laboratory project.
(c) Mr. George B. Bradshaw, Soil Conservation Service, P. O. Box 158, Imperial, Calif.
(d) Experimental; applied research.
(e) (1) To continue broadening the drainage criteria on the farm-area basis by investigating pumping from deep, pervious strata to determine the effect on lowering the water table under various stratified conditions, particularly where the aquifer is overlain with heavy soils; (2) to make a study of present drainage problem in relation to irrigation systems and irrigation practices within and adjacent to the area so that when the East Mesa lands are opened up to irrigation some basis for differentiating between local and Mesa contributions to the ground water problem may be available; and (3) to study irrigation methods in relation to leaching to develop irrigation practices that will provide for necessary leaching with minimum contributions to the ground water problem.

(391) SAN FERNANDO VALLEY DRAINAGE INVESTIGATIONS.

(b) Laboratory project.
(c) Mr. William W. Donnan, Soil Conservation Service, 1059 Post Office and Courthouse, Los Angeles, Calif.
(d) Experimental; applied research.
(e) To obtain basic physical data necessary to design an adequate drainage system to control the ground water in San Fernando Valley Soil Conservation District, and to develop methods and techniques that might be applied to the solution of similar problems in other areas.

(393) IRRIGATION AND SOIL LOSS CHARACTERISTICS OF CONTOUR AND DOWNSLOPE IRRIGATION.

(b) Soil Conservation Service and Washington Agricultural Experiment Station.
(c) Mr. Stephen J. Mech, Soil Conservation Service, P. O. Box 590, Prosser, Wash.
(d) Experimental; applied research.
(e) Study of irrigation and erosion characteristics of different size irrigation streams as influenced by furrow grade, crop and crop sequence, tillage, and soil moisture.
(h) "Infiltration and its relation to soil and water conservation under irrigation." Stephen J. Mech. Northwest Science (Vol. 24, No. 3, pp. 120-125. August, 1950.)

(658) INFILTRATION OF WATER INTO AND PERMEABILITY OF SOILS IN AN IRRIGATED AREA OF THE SOUTHWEST

(b) Laboratory project.
(c) Mr. Karl Harris, Soil Conservation Service, Room 24, Post Office Bldg., Phoenix, Ariz.
(d) Experimental; applied research.
(e) Test plots with various types of crops are given different irrigation treatments to determine the rate of growth, the amount yielded, and the moisture level of the soil. Plots have been set up to study the effect of various types of organic matter on the soil structure and water penetration.

(1189) METHODS OF CONTROL AND DISTRIBUTION OF WATER.

(b) Laboratory project.
(c) Dr. George D. Clyde, Soil Conservation Service, College Hill Box D., Logan, Utah.
(d) Experimental, field and laboratory; basic and applied research.
(e) Not only existing but proposed and new methods are being tested to determine their feasibility and applicability for the control and distribution of irrigated water.

(1190) DISTRIBUTION OF WATER FROM PERFORATED PIPE.

(b) Utah Agricultural Experiment Station, Bureau of Plant Industry, and W. R. Ames Company.
(c) Dr. Vaughn E. Hansen, Soil Conservation Service, College Hill, Box 70, Logan, Utah.
(d) Experimental; applied research.
(e) The effect of wind on the distribution pattern from perforated pipe is being studied, to provide design data and to determine the limitations of this type of distribution for irrigation purposes.

(1191) DETERMINATION OF THE DISCHARGE FROM HORIZONTAL PIPE BY THE COORDINATE METHOD.

(b) Cooperative with Utah Engineering Experiment Station and Irrigation Department, Utah State Agricultural College.
(c) Dr. Vaughn E. Hansen, Soil Conservation Service, College Hill, Box 70, Logan, Utah.
(d) Experimental and theoretical; applied research, master's thesis.
(e) To determine the coefficient of discharge for the flow from a horizontal pipe as determined by the coordinate method. This coefficient has been assumed to be one which is definitely not the case in the majority of problems encountered in the field. The tests are being conducted so that the method may be applied with confidence to the measurement of water.

(1192) FLOW THROUGH FLEXIBLE NON-ELASTIC PIPE.

(b) Cooperative with Utah Agricultural Experiment Station and Irrigation Department of the Utah State Agricultural College.
(c) Dr. Vaughn E. Hansen, Soil Conservation Service, College Hill, Box 70, Logan, Utah.
(d) Experimental and theoretical; applied research, master's thesis.
(e) A light-weight, flexible, non-elastic pipe has recently been developed to convey water. As very little is known regarding the hydraulic properties of this material they are being studied.

(1193) SPRINKLING AS A METHOD OF ADAPTING WATER TO IRRIGATION FARM LANDS.

(b) Laboratory project.
(c) Mr. Claude Pair, Soil Conservation Service, 413 Federal Building, P. O. Box 835, Boise, Idaho.
(d) Experimental; applied research.
(e) (1) To obtain more precise information for the design, layout, installation, and operation of sprinkler irrigation systems in various type soils, slopes, and crops under various weather conditions; (2) to determine the effect of sprinkling upon various soils and crops; (3) to determine the economic limitations on the use of sprinkler irrigation systems; (4) to assist in the development and testing of better sprinkler equipment, and more efficient operating procedures; (5) the study of fertilizer application through sprinkler irrigation; and (6) to make available to the public the latest information obtained on results of work that has been done, what is being done, and who is doing work on sprinkler irrigation problems.

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U. S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, Irrigation Research Laboratory.

(151) LINING OF IRRIGATION CANALS AND DITCHES.

(b) Laboratory project; Soil Conservation Service, Utah State Agricultural College, and Bureau of Reclamation cooperating.
(c) Dr. C. W. Lauritzen, Soil Conservation Service, Box 179, College Hill, Logan, Utah.
(d) Experimental; basic and applied research.
(e) Linings for irrigation canals and ditches are being tested to develop more effective and lower cost methods of reducing conveyance losses in irrigation systems. The investigation includes: (1) evaluation of the physical properties of canal lining materials; (2) model testing of linings in an outdoor laboratory; and (3) field testing at selected sites to determine relative durability under varying subgrade and climatic conditions.

U. S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, North Appalachian Experimental Watershed; Blacklands Experimental Watershed; and Central Great Plains Experimental Watershed.

(150) HYDROLOGIC EXPERIMENT STATIONS.

(b) Soil Conservation Service, Department of Agriculture, and State Agricultural Experiment Stations of Ohio, Texas, and Nebraska.
(c) Dr. Lewis A. Jones, Division of Drainage and Water Control, Soil Conservation Service, Washington 25, D. C.
(d) Experimental; for design and general information in planning farms for soil and water conservation.
(e) Rainfall and runoff are measured on watersheds ranging from 1 to 5,000 acres. In addition to rainfall and runoff measurements, studies are made on small Government-operated areas of evapo-transpiration, moisture storage, moisture transmission through the soil, and percolation of water to the ground-water table. The purpose is to determine the hydrologic effect of physiography, tillage, and ground surface conditions, vegetal covers, and soils and geology, and the effect of conservation farming on runoff and erosion, as well as the characteristics of flood runoff from agricultural watersheds.
(h) "Hydrology of surface supplies to runoff." L. Schiff. Soil Conservation Service Tech. Pub. 90 (publication pending).
"Hydrology of rates and amounts of surface runoff from single and mixed cover watersheds." L. Schiff, Soil Conservation Service Tech. Pub. (publication pending).
"Rates and amounts of runoff for the Blacklands of Texas." Ralph W. Baird and William D. Potter, U. S. Dept. Agri. Tech. Bul. No. 1022, July 1950.

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U. S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, Research Branch.

(394) A STUDY OF THE EFFECTS OF LAND-USE AND FARMING PRACTICES ON RUNOFF FROM SMALL WATERSHEDS.

(b) Cooperative with Purdue University, Agricultural Experiment Station.
(c) Dr. R. B. Hickok, Agricultural Engineering Building, Purdue University, Lafayette, Ind.
(d) Experimental; for design information.
(e) To study the effects of types of land-use and cultural practices as a means of reducing rates and amounts of surface runoff, for soil and moisture conservation and upstream flood control. Continuous time-rate records of rainfall and runoff are collected for 20 small watersheds. Twelve watersheds are used in the rotation crop experiments. Determinations are made of the seasonal amounts and periodic high rates of runoff under a present typical farming system and under a conservation system. The results are intended to be applicable for soil conditions, the climate, and a type of agriculture generally representative of a large part of the eastern section of the corn belt.
(g) Analysis of runoff rate data for critical storms and seasonal runoff totals for several years indicate important correlations with the type of soil management (conservation vs. prevailing practices), crop, and specific soil conditions. More extensive data are needed for quantitative estimating of the expectancies of runoff rates and amounts within entirely practical fiducial limits.

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U. S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, St. Anthony Falls Hydraulic Laboratory.

Reports on projects conducted by the Soil Conservation Service at the St. Anthony Falls Hydraulic Laboratory are listed under St. Anthony Falls Hydraulic Laboratory, University of Minnesota, Minneapolis, Minn., Projects Nos. 111, 112, 114, 620, 621, 931, 932, 1167, and 1168. Inquiries should be addressed to Fred W. Blaisdell, U. S. Soil Conservation Service, St. Anthony Falls Hydraulic Laboratory, Hennepin Island, Minneapolis 14, Minn.

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U. S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, Stillwater Outdoor Hydraulic Laboratory.

(152) (153) THE HYDRAULICS AND STABILITY OF CONSERVATION CHANNELS.

(b) Soil Conservation Service, Department of Agriculture, and Oklahoma Agricultural Experiment Station.
(c) Dr. Lewis A. Jones, Soil Conservation Service, Washington 25, D. C.
(d) Experimental; for design.
(e) Measured flows up to 150 cfs are passed through outdoor test channels of various cross-sections up to 40 feet in width with slopes up to 10 percent. Measurements of hydraulic elements and scour rates are made for flows of different velocities and for various channel linings. The purpose is to obtain (1) effects of linings, vegetal and non-vegetal, on the water carrying capacity and other hydraulic characteristics of channels used in soil and water conservation operations; and (2) protective characteristics of various types of linings, vegetal and non-vegetal.

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U. S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, Sub-Tropical Experiment Station.

(395) CONSERVATION OF THE MARL LANDS OF THE HOMESTEAD AREA.

(b) Soil Conservation Service in cooperation with the Sub-Tropical Experiment Station of the University of Florida, and Dade County Division of Water Control.
(c) Mr. M. H. Gallatin, Sub-Tropical Experiment Station, Route 2, Box 508, Homestead, Fla.
(d) Experimental field investigations; basic research.
(e) Periodic sampling of lands adjoining canals in the Miami and Homestead areas with and without chloride barriers to study the effectiveness of these structures in control of the intrusion of chlorides; effect of pumping from deep rock ditches on the intrusion of chlorides on agricultural lands; effectiveness of diking to protect low-lying lands from tidal inundation. Determining the tolerance of crops to chlorides as they are affected not only by high concentration but also by cultural and tillage methods.
(g) Present data indicates that removal of water from areas where ditches penetrate underlying permeable rock removes the fresh water head and allows the chloride front to move into these areas. Some data available on the tolerance of crops to chlorides.

(396) WATER CONTROL ON THE DEEP MARL LANDS IN SOUTH FLORIDA.

(b) Soil Conservation Service in cooperation with the Sub-Tropical Experiment Station of the University of Florida.
(c) Mr. M. H. Gallatin, Sub-Tropical Experiment Station, Route 2, Box 508, Homestead, Fla.
(d) Experimental; field investigation; design and operation.
(e) The experiment covers 50 acres of deep marl. Records are kept of all water removed, cost of removal, seepage into ditches, infiltration capacity, effect of slough and pot holes on removal of water, effectiveness of bedding and size of beds to facilitate faster removal of surface water, and on tillage methods, sub-soiling and mole drainage as it affects removal of water; time of plowing and disking with relation to surrounding undrained land.

(397) WATER CONSERVATION AND IRRIGATION STUDIES ON THE ROCKDALE SOILS OF THE HOMESTEAD AREA.

(b) Soil Conservation Service in cooperation with the Sub-Tropical Experiment Station of the University of Florida.
(c) Mr. M. H. Gallatin, Sub-Tropical Experiment Station, Route 2, Box 508, Homestead, Fla.
(d) Experimental; field investigation.
(e) To determine cycle, rates of application, and types of irrigation systems best suited to this area. Observations are made of (1) distribution and pattern of various types of irrigation systems in use; (2) effect of elevation of water table on irrigation cycle; (3) rates of application and their effect on the leaching of plant nutrients; (4) rate of application, moisture studies on limes and avocados to determine the irrigation cycle; (5) the responsiveness of the water table to rainfall; and (6) the water table as affected by ground water conditions as they exist in the Everglades.

(g) Data to date show definite correlation between water table and irrigation cycle. Rates of application are governed by maturity of grove, amount of organic matter, types of material and depth of scarification.

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U. S. DEPARTMENT OF AGRICULTURE, U. S. Regional Salinity and Rubidoux Laboratories.

(1194) PRINCIPLES UNDERLYING THE FLOW INTO AND THROUGH SOILS.

(b) Laboratory project.
(c) Mr. Ronald C. Reeve, P. O. Box 672, Riverside, Calif.
(d) Experimental; basic research.
(e) To investigate the factors that influence the flow of water into and through soils.

(1195) CHARACTERISTICS OF FLOW THROUGH WELL CASINGS.

(b) Laboratory project.
(c) Mr. Ronald C. Reeve, P. O. Box 672, Riverside, Calif.
(d) Experimental; applied research, for design.
(e) To determine the loss of head through various well casings and screens in combination with various gravel packs.

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U. S. DEPARTMENT OF THE ARMY, OFFICE OF THE CHIEF OF ENGINEERS, Beach Erosion Board.

Inquiries concerning Projects Nos. 181, 184, 185, 399, 660, 661, 663, 664, and 970 to 977, incl., should be addressed to The President, Beach Erosion Board, 5201 Little Falls Road, N. W. Washington 16, D. C.

(181) EQUILIBRIUM PROFILE OF BEACHES.

(b) Laboratory project.
(d) Experimental; basic research.
(e) To evaluate the effect of wave form, initial beach slope, and sand grain size in determining the equilibrium profile of beaches. Tests have been made with an original beach slope of 1:15, 1:30 and a combination of 1:10 and 1:20, wave period of 1.3, 1.75, 2.2, 2.75, and 3.3 seconds; wave height of about 0.4 feet; and sand sizes 0.21, 0.56, 0.90, and 3.44 mm, median diameter. The tests are continued until the rate of change of the shape of the beach is very slight, usually 100 hours.
(h) Quarterly Summary, Waterways Experiment Station.

(184) STUDY OF MODEL SCALE EFFECTS.

(b) Laboratory project.
(d) Experimental; basic research.
(e) To determine the laws of model similarity governing the action of waves on movable sand beaches. Conditions of wave height, wave period, beach slope and grain size of sand are adjusted to various scales in an attempt to simulate the results of the tests obtained in the large wave tank for project 181, "Equilibrium Profile of Beaches."
(h) Quarterly Summary, Waterways Experiment Station.

(185) STEEL SHEET PILING INVESTIGATION.

(b) Laboratory project.
(d) Field investigation; applied research.

(e) To determine the probable life of steel sheet piling as used in maritime structures, to evaluate the causes of deterioration, and to determine practical methods of extending the probable life. Thickness measurements of representative steel sheet piling samples in maritime structures located along the east coast were made in 1936, 1940, and 1946. When available, data on salinity, pH, water temperature and pollution were also compiled.
(f) Suspended.
(h) "Deterioration of steel sheet pile groins at Palm Beach, Florida." Culbertson W. Ross. Corrosion, Vol. 5, No. 10, Oct. 1949.

(399) DEVELOPMENT AND CONSTRUCTION OF SIX-FOOT WAVE TANK.

(b) Laboratory project.
(d) Experimental; design.
(e) To obtain data for use in the design of, to design, and to construct a wave tank for the study of the effect of waves 6 feet high and 300 feet long. Various types of wave generating mechanisms, the power required by the generator to form the waves, and the action of the waves on a beach which is placed at an angle to the axis of the tank have been studied in a 1:12 scale model. The large wave tank will be 635 feet long, 15 feet wide, and 20 feet deep. Generation of waves is to be accomplished by a pusher-type wave generator.
(f) The wave tank is completed. The design of the wave-generating machinery has been complete and a contract for its construction is scheduled.
(h) Quarterly Summary, Waterways Experiment Station.

(660) OBSERVED WAVE CHARACTERISTICS.

(b) Laboratory project; additional research by New York University.
(d) Field investigation; basic research.
(e) To secure a more thorough knowledge of the characteristics of ocean waves in comparison to the uniform wave trains generally studied in the laboratory. Several electrical recording wave gages have been installed in coastal waters and an extensive series of wave records are being analyzed by methods of significant heights and periods. The validity of wave refraction diagrams by present methods as applied to areas with gently shelving bottom topography such as encountered on the Atlantic and Gulf coasts are being studied. Further research for the Board has been undertaken by New York University to develop wave forecasting methods applicable to the Atlantic coast.
(f) Six wave gages are in operation, three on the Atlantic and three on the Pacific coast.
(h) Quarterly Summary, Waterways Experiment Station.

(661) LITTORAL DRIFT STUDY AT HYPERION, SANTA MONICA BAY, AND SUNSET BEACH, ANAHEIM BAY, CALIF.

(b) Laboratory project.
(d) Field investigation; basic research.
(e) A study of the relation between movement of beach material and natural forces such as waves, tides, and littoral currents. Fourteen million cubic yards of sand have been placed on Hyperion Beach, Santa Monica Bay, and one million cubic yards have been placed on Sunset Beach, Anaheim Bay, Calif. Rate of movement of this material from the placement areas is being studied by frequent hydrographic surveys. Intensity and direction of the waves are being recorded.
(f) Field work completed.
(h) Quarterly Summary, Waterways Experiment Station.

(663) SAND MOVEMENT AND WAVE STUDY, LONG BRANCH, NEW JERSEY.

(b) Laboratory project.
(d) Field investigation; basic research.
(e) To determine if sand placed in deep water will be moved onto the beach by wave action. Six hundred thousand cubic yards of sand have been placed in 38 feet of water at Long Branch, N. J. Movement of sand is being studied by frequent hydrographic surveys. Wave intensity and direction is being recorded for comparison with any sand movement. An effort is being made to measure the amount of sand moving along the bottom and the amount thrown into suspension by the waves.

(f) Completed.
(h) Technical Memorandum No. 17, "Test of nourishment of the shore by offshore deposition of sand."

(664) DEVELOPMENT OF SUSPENDED SAND SAMPLER.

(b) Laboratory project.
(d) Experimental; development.
(e) To develop an apparatus which can be used to determine the amount of sand in suspension in the water near beaches on which waves are breaking. Laboratory tests have been made with a pump-type sampler with various sized sand and various velocities of stream flow past the nozzle. Several field tests have been made and a satisfactory pier-mounted pump-type apparatus has been developed. Apparatus will be used in the sand movement study at Mission Bay, Calif.
(f) Completed. Sampler is in operational use at Crystal Pier, Mission Bay, Calif.
(h) Quarterly Summary, Waterways Experiment Station.

(970) STUDY OF THE EFFECTS OF JETTY CONSTRUCTION AT MISSION BAY, CALIFORNIA, ON THE MOVEMENT OF LITTORAL DRIFT.

(b) Laboratory project.
(d) Field investigation; basic research.
(e) To observe the effects of construction of the two jetties at Mission Bay, Calif. upon the littoral drift of sand past the inlet with a view of determining the changes in regime associated with jetty construction. Movement of the beach material is to be correlated with natural forces.
(h) Quarterly Summary, Waterways Experiment Station.

(971) COMPARATIVE STUDY OF PERMEABLE AND IMPERMEABLE GROINS.

(b) Laboratory project by and at University of California.
(d) Experimental; basic research.
(e) To determine relative efficiency of permeable groins and impermeable groins in retaining and trapping sand on a beach. Groins are installed along a model beach, singly, in sets of three, and in groups of ten. Observations are made on the progressive changes occurring along the beach and tests are continued until equilibrium conditions for the littoral transport is reached.
(h) Quarterly Summary, Waterways Experiment Station.

(972) STRUCTURAL DESIGN OF SHORE STRUCTURES.

(b) Laboratory project.
(d) Experimental; basic research.
(e) To prepare a handbook on the design of shore structures. Field and model tests on the wave pressures caused by breaking waves which act on structures will be made in order to fill such gaps in our present knowledge of these forces not covered by other current investigations. Pressure measuring equipment has been procured and small-scale tests are under way.
(h) Quarterly Summary, Waterways Experiment Station.

(973) CONSTRUCTION OF COAST MODEL BASIN.

(b) Laboratory project.
(d) Experimental; basic research.
(e) The coast model test basin is under construction. The basin will be 300 feet by 150 feet in plan and 3 feet deep. Provisions will be made for simulating tides, waves, littoral currents and movable sand beaches. The basin will be used to study beach problems involving waves, tides and littoral drift.
(g) The wave tank has been completed. The specifications for the wave generators have been completed and a contract for their construction is scheduled.
(h) Quarterly Summary, Waterways Experiment Station.

(974) SURVEY METHODS - SHALLOW WATER SOUNDINGS.

(b) Laboratory project.
(d) Experimental; applied research.
(e) To develop improvements in shallow water hydrographic survey methods from a review of present methods and the introduction of new techniques. New instruments to aid in survey boat positioning are being reviewed for possible application to the needs of the Corps of Engineers.
(h) Quarterly Summary, Waterways Experiment Station.

(975) METHODS OF BY-PASSING SAND PAST INLETS.

(b) Laboratory project.
(d) Field investigation; applied research.
(e) To study methods and requirements for pumping sand past inlets and to determine the applicability of the methods in stabilization of beaches adjacent to inlets. Estimates of the cost of pumping sand past selected inlets have been prepared for evaluation of the problem. Field observations of beach changes have been conducted in a step toward defining the sand by-passing problem.
(h) Quarterly Summary, Waterways Experiment Station.

(976) ESTABLISHMENT OF CRITERIA FOR CONSTRUCTION OF ARTIFICIAL BEACHES.

(b) Laboratory project.
(d) Experimental; basic research.
(e) To evaluate the several factors controlling the ultimate configuration and distribution of material artifically placed for the purpose of restoring or improving beaches. Field investigations of artifically-placed fills are being made. In the laboratory, small-scale tank studies of material artifically on beaches will be made.
(h) Quarterly Summary, Waterways Experiment Station.

(977) DEVELOPMENT OF WAVE HEIGHT AND WAVE DIRECTION GAGES.

(b) Laboratory project.
(d) Experimental; development.
(e) To develop wave height and wave direction gages for use in securing accurate records of waves. A satisfactory step-resistance wave gage of the surface-mounted type for measuring the height and period characteristics of water surface variations attributable to wave motion was developed and tested in the laboratory and field. Auxiliary equipment which allows the gages to be operated on a 7-day unattended basis was developed and three gages of this type are presently in operation. Wave direction gages, operated on the Rayleigh disk principle, have been tested in the field with unsatisfactory results. Laboratory tests of a wave direction gage which utilizes two wave-height gages operating concurrently have been made. Results of these trials warrant further tests of such an instrument and plans are underway.
(h) "The Rayleigh disk as a wave direction indicator." Beach Erosion Board Technical Memorandum No. 18.
Quarterly Summary, Waterways Experiment Station.

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U. S. DEPARTMENT OF THE ARMY, CORPS OF ENGINEERS, Bonneville Hydraulic Laboratory.

Inquiries concerning Projects Nos. 189, 190, 191, 192, 401 to 410, incl., 665, 666, 667, 978, 979, and 1196 to 1202, incl., should be addressed to Mr. R. B. Cochrane, Office of the District Engineer, Portland District, 628 Pittock Block, Portland, Ore.

(189) GENERAL MODEL STUDY OF McNARY DAM, COLUMBIA RIVER, UMATILLA, OREGON.

(b) Department of the Army, Corps of Engineers, Walla Walla District, Walla Walla, Wash.
(d) Experimental; for design.

(e) A fixed-bed 1:100-scale, undistorted model reproduces a 3.7 mile reach of the Columbia River, at the site of McNary Dam. After verification of the natural river features, the powerhouse, spillway, navigation lock, and fishway structures were installed. The tests were made to determine the best arrangements of spillway dam, powerhouse, fishways, and lock structure and to study certain problems with regard to fishway approaches and cofferdam construction.
(f) Tests are nearing completion.
(g) Basic tests indicated that realignment of the structure would be necessary. Tests of a revised design showed satisfactory improvements with changes in alignment. Cofferdam studies indicated satisfactory flow conditions for the various steps or arrangements during construction of the project structures. Facilities were developed to permit fish migration through the structures during all stages of construction. Studies to determine the most economical alignment of the tailrace excavation are nearing completion.
(h) Preliminary reports have been issued on the various tests completed to date.

(190) MODEL STUDY OF McNARY DAM SPILLWAY, COLUMBIA RIVER, UMATILLA, OREGON.

(b) Department of the Army, Corps of Engineers, Walla Walla District, Walla Walla, Wash.
(d) Experimental; for design.
(e) A 1:36 scale model reproduces three complete 50-foot-wide bays of the spillway section. Various designs of ogee spillway, piers, gates, and stilling basins have been investigated to provide the most effective and satisfactory design for control of flow and dissipation of energy. Problems pertaining to fishladders were also studied.
(f) Tests completed.
(g) Several shapes of piers, arrangements of stilling basins, and types of radial and vertical lift gates were tested. Based on these tests a pier with an elliptically-shaped nose, split vertical lift gates, and stilling basin with two rows of baffle piers have been adopted.
(h) Seventeen preliminary reports have been issued. Final report is being prepared.

(191) MODEL STUDY OF McNARY DAM NAVIGATION LOCK, COLUMBIA RIVER, UMATILLA, OREGON.

(b) Department of the Army, Corps of Engineers, Walla Walla District, Walla Walla, Wash.
(d) Experimental; for design.
(e) The 1:25 model reproduces a section of the forebay, the lock chamber, and the lower lock approach channel. The purpose is to obtain comparable test data on several types of lock filling and emptying systems to permit selection of the most satisfactory hydraulic system for the designed lock.
(f) Tests completed.
(g) A lock with a bottom lateral filling and emptying system controlled by streamlined reversed tainter gates opening at a non-uniform rate was adopted on the basis of the tests. A correlation between model and prototype lock culvert pressures will be obtained from piezometers embedded in the concrete structure at McNary Dam.
(h) Five preliminary reports have been issued. Final report is being prepared.

(192) MODEL STUDY OF DORENA SPILLWAY, ROW RIVER, OREGON.

(b) Department of the Army, Corps of Engineers, Portland District, Portland, Ore.
(d) Experimental; for design.
(e) The 1:50 model reproduces a portion of the forebay and earth-filled dam, gravity-type spillway, stilling basin, the five sluiceways, and a portion of the tailbay. Hydraulic characteristics of the spillway and stilling basin as designed were studied.
(f) Tests completed.
(g) Results indicated that with the stilling basin sloped 1 on 21.5, with a broadcrested sill, and with conventional rectangular-faced baffles, a satisfactory hydraulic jump formed for all discharges up to and including the design flood of 97,500 cfs.
(h) Four preliminary reports have been issued. Final report is being prepared.

(401) MODEL STUDY OF McNARY DAM FISHLADDER, COLUMBIA RIVER, UMATILLA, OREGON.

(b) Department of the Army, Corps of Engineers, Walla Walla District, Walla Walla, Wash.
(d) Experimental; for design.

(e) The 1:16 model reproduced a section of the fishladder, including a 180-degree bend, 13 bays upstream, and 7 bays downstream. Subsequently the upper leg was revised to include three of the tilting weirs which will maintain satisfactory flow conditions in the horizontal section between the fixed-type weirs and the automatic regulating gates upstream. Flow conditions were studied for various widths, slopes, head on the weirs, and for submerged orifices of different shapes, sizes, and locations to determine the effects on flow conditions within individual pools between the weirs.
(f) Tests completed.
(g) A fishladder 30 feet wide, with bottom slope of 1 on 20, with spacing between weirs of 20 feet and with 2 orifices per weir was selected for final construction.
(h) Seven preliminary reports have been issued. Final report is being prepared.

(402) MODEL STUDY OF McNARY FISHLADDER DIFFUSER, COLUMBIA RIVER, UMATILLA, OREGON.

(b) Department of the Army, Corps of Engineers, Walla Walla District, Walla Walla, Wash.
(d) Experimental; for design.
(e) The 1:10 model reproduced a 3-bay section of the 30-foot-wide fishladder. The center bay contained a diffuser consisting of an 8-foot-deep chamber beneath the normal floor of the ladder. The auxiliary water was extruded through the baffles within the chamber into the flow passing downstream through the ladder proper. This study was made to determine the best arrangement of introducing auxiliary water into the fishladder under proposed tailwater and general operating conditions.
(f) Tests completed.
(g) Tests of a revised design showed that a stepped floor in the fishladder under the diffuser was the most satisfactory in distributing auxiliary water laterally in the diffuser pool.
(h) A preliminary report has been issued. Final report is being prepared.

(403) MODEL STUDY OF LOOKOUT POINT SPILLWAY, MIDDLE FORK, WILLAMETTE RIVER, OREGON.

(b) Department of the Army, Corps of Engineers, Portland District, Portland, Ore.
(d) Experimental; for design.
(e) The 1:72 fixed-bed model reproduces section of the prototype forebay, a section of the earth fill, a gravity spillway having 5 tainter gate-controlled bays, four tainter gate-controlled flood regulating sluices, and a stilling basin. Tests are being made to study the performance of the spillway, the flood regulating sluices, and both baffles and non-baffled stilling basins to determine the most satisfactory type.
(f) Tests completed.
(g) The under-designed spillway crest (design head equals 75 percent of maximum head) satisfactorily passed the project design flood of 245,000 cfs. Satisfactory flow conditions were obtained with the non-baffled stilling basin designed for 175,000 cfs.
(h) Six preliminary reports have been issued. Final report is being prepared.

(404) MODEL STUDY OF LOOKOUT POINT TUNNEL, MIDDLE FORK, WILLAMETTE RIVER, OREGON.

(b) Department of the Army, Corps of Engineers, Portland District, Portland, Ore.
(d) Experimental; for design.
(e) The 1:25 model includes a portion of the forebay, the intake tower containing the tunnel entrances, the flood-control power tunnels; Howell-Bunger valves of machined brass; and a portion of the tailbay area. Tests have been made to study the hydraulic characteristics of the power and flood control tunnels, including discharge capacities, pressures, and velocities as affected by alignment, slopes of entrances, and type and location of control valves.
(f) Tests completed.
(g) Satisfactory dissipation of energy can be achieved from the outlet tunnel by discharging through hooded Howell-Bunger valves or tilted tainter valves installed in a six lateral outlet manifold. Conduits through the gravity type spillway have been adopted in place of the design which was tested.
(h) Four preliminary reports have been issued and the final report is being compiled.

(405) GENERAL MODEL STUDY OF ICE HARBOR DAM, SNAKE RIVER (OREGON, WASHINGTON, AND IDAHO).

(b) Department of the Army, Corps of Engineers, Walla Walla District, Walla Walla, Wash.
(d) Experimental; for design.
(e) The 1:100, undistorted, fixed bed model reproduces the river from mile 8.3 to mile 11.0. Proposed structures include the spillway with fourteen 40-foot bays equipped with vertical lift gates, the powerhouse with five turbine generator units, a single-lift navigation lock, and two fishways. The most satisfactory layout of the structures with regard to navigation, power generation, and passage of fish will be determined.
(f) Inactive.
(g) Verification tests of the natural river conditions have been completed. A study of flow conditions with the cofferdam of the first construction phase installed indicates that a temporary fishladder is desirable to aid the migration of fish.
(h) Two preliminary reports have been issued.

(406) MODEL STUDY OF ICE HARBOR DAM SPILLWAY, SNAKE RIVER (OREGON, WASHINGTON, AND IDAHO).

(b) Department of the Army, Corps of Engineers, Walla Walla District, Walla Walla, Wash.
(d) Experimental; for design.
(e) The 1:32 model will consist of a 3-bay section of the spillway dam. Investigation will be made of proposed designs of the spillway, apron, baffles, and gates. Improvements, where necessary, will be made to determine the most effective design for dissipation of energy and control of flow.
(f) Inactive.

(407) MODEL STUDY OF ICE HARBOR DAM NAVIGATION LOCK, SNAKE RIVER (OREGON, WASHINGTON, AND IDAHO).

(b) Department of the Army, Corps of Engineers, Walla Walla District, Walla Walla, Wash.
(d) Experimental; for design.
(e) A bottom-lateral filling and emptying system for a lock will be investigated first in a 1:25 model including the entire lock chamber and culvert system, and a portion of the approach and exit channels. Filling and emptying characteristics will be observed and hawser forces and changes in water-surface elevations will be recorded electrically from a central control panel. The purpose is to develop satisfactory hydraulic filling and emptying systems for a navigation lock with a head of 100 feet for Ice Harbor.
(f) Inactive.

(408) GENERAL MODEL STUDY OF CHIEF JOSEPH DAM, COLUMBIA RIVER, WASHINGTON.

(b) Department of the Army, Corps of Engineers, Seattle District, Seattle, Wash.
(d) Experimental; for design.
(e) The 1:80 fixed bed model was enlarged to include a 2.5-mile reach of the river upstream. Reproduced are the revised 19-bay spillway, 20-unit powerhouse, and a powerhouse intake channel excavated to accomodate the ultimate development of 27 generator units. This study is to determine the most economical and effective arrangements of spillway dam and powerhouse, to determine the forebay and tailbay flow conditions with various operating conditions, and to obtain a satisfactory program of cofferdam construction.
(g) Testing of the powerhouse approach channel, verification of the model river bed, and studies of the first three phases of cofferdam construction and river diversion have been made. Additional tests are in progress to determine the effects of stilling basin training walls and to further improve the alignment of the powerhouse approach channel.
(h) Thirteen progress reports have been issued.

(409) MODEL STUDY OF CHIEF JOSEPH DAM SPILLWAY, COLUMBIA RIVER, WASHINGTON.

(b) Department of the Army, Corps of Engineers, Seattle District, Seattle, Wash.
(d) Experimental; for design.
(e) The 1:33 sectional model consists of three bays of the tainter gate-controlled spillway dam. The purpose is to determine the most effective and economical stilling basin design, to check the performance of the spillway abutments, and to obtain crest rating curves and pressures.

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(g) Several shapes of spillway piers with trunnion arm supports and training walls downstream arrangements of stilling basins, and types of baffle piers have been tested. Based on these tests a spillway pier with an elliptical-shaped nose, revised stilling basin, and streamlined baffle piers have been recommended for adoption.
(h) Thirteen progress reports and four preliminary reports have been issued.

(410) MODEL STUDY OF CHIEF JOSEPH DAM PENSTOCK, COLUMBIA RIVER, WASHINGTON.

(b) Department of the Army, Corps of Engineers, Seattle District, Seattle, Wash.
(d) Experimental; for design.
(e) The 1:25 model reproduces a section of the powerhouse forebay, one penstock complete from entrance through turbine scroll case, and the entrances of the adjacent penstocks on either side. The purpose is to study the effects of non-uniform flow conditions at the penstock entrance (as determined from Chief Joseph General Model) on velocity distribution at the entrance to the scroll case.
(f) Construction of the model has been resumed after results of the general model study indicated the necessity for a larger-scale model.

(665) MODEL STUDY OF McNARY SPILLWAY GATE, COLUMBIA RIVER, UMATILLA, OREGON.

(b) Department of the Army, Corps of Engineers, Walla Walla District, Walla Walla, Wash.
(d) Experimental; for design.
(e) The 1:10 model includes a single spillway bay complete with split vertical gate. Pressures underneath the gate, in the gate slots, and in the spillway crest were measured with pressure cells for several gate operations and discharges.
(f) Tests completed.
(g) Recent tests indicated that the occurrence of vibrations and nappe oscillations during flow through small openings of a gate placed in upstream slots may have been induced by normal vibrations of the adjacent Bonneville powerhouse. With the gate in the normal downstream slot position, satisfactory performance was obtained for all flows and gate arrangements.
(h) Four preliminary reports have been issued. Final report is being prepared.

(666) MODEL STUDY OF McNARY NAVIGATION LOCK TAINTER VALVES, COLUMBIA RIVER, UMATILLA, OREGON.

(b) Department of the Army, Corps of Engineers, Walla Walla District, Walla Walla, Wash.
(d) Experimental; for design.
(e) A 1:20 sectional model was constructed for a detailed study of the reverse tainter valve. Studies have been completed of a valve in which all structural features were simulated. Comparisons were made of various shapes of the trunnion arms and of the lip on the bottom edge of the valve.
(f) Tests completed.
(g) A pressure study on a valve and in a culvert section immediately above and below the valve has been completed. A valve shape has been determined which minimizes the valve loading and vibrational tendencies during lock operation.
(h) Five preliminary reports have been issued. Final report is being prepared.

(667) MODEL STUDY OF McNARY WASHINGTON SHORE FISHLADDER DIFFUSER, COLUMBIA RIVER, UMATILLA, OREGON.

(b) Department of the Army, Corps of Engineers, Walla Walla District, Walla Walla, Wash.
(d) Experimental; for design.
(e) The 1:16 model reproduces the complete diffusion chambers and the auxiliary water supply system in the lower end of the fishladder. Pressures were observed in critical sections of the water supply systems to the diffusion chambers to determine the hydraulic grade lines and to locate low pressure areas which might be detrimental to the prototype structure.
(g) Tests indicate that the valves controlling the flow to the diffusion chambers should be fully open or fully closed for flows throughout the lower range of tailwaters. High negative pressures occurred in the lines downstream from the valves with partial valve openings. The valves were submerged during high tailwater stages and danger from negative pressures was eliminated.
(h) One preliminary report has been issued. Final report is being prepared.

(978) MODEL STUDY OF LOOKOUT POINT CONDUIT, MIDDLE FORK, WILLAMETTE RIVER, OREGON.

(b) Department of the Army, Corps of Engineers, Portland District, Portland, Ore.
(d) Experimental; for design.
(e) The 1:19.2 model consists of an outlet conduit, including a bell-mouth entrance and an intake conduit, a tainter valve, and an expanding outlet conduit section downstream from the valve. Tests were made to determine whether open-channel flow will exist in the conduit outlet with all operating conditions and to obtain capacity curves and pressures.
(f) Tests completed.
(g) Tests of a revised design indicated that open channel flow and satisfactory pressures would obtain for all operating conditions up to and including the design head of 200 feet.
(h) A preliminary report has been issued. Final report is being prepared.

(979) MODEL STUDY OF LUCKY PEAK OUTLET TUNNEL, BOISE RIVER, IDAHO.

(b) Department of the Army, Corps of Engineers, Walla Walla District, Walla Walla, Wash.
(d) Experimental; for design.
(e) The 1:28.75 model will include a section of 23-foot diameter tunnel, a six-branch manifold outlet with vertical slide control valves, the stilling basin, and a reach of the river downstream. The purpose is to determine the hydraulic characteristics of the manifold including the action of the slide valves, particularly when submerged, and the effect on the river bed downstream.
(g) Preliminary studies, using a sectional model of one branch of the manifold, indicated that improved velocity distribution and pressures and construction economies would result from a revised plan which reduced the number of manifold outlets and replaced Howell-Bunger valves with vertical slide valves.
(h) Four progress reports have been issued.

(1196) MODEL STUDY OF DETROIT DAM FLOOD-CONTROL CONDUITS, NORTH SANTIAM RIVER, OREGON.

(b) Department of the Army, Corps of Engineers, Portland District, Portland, Ore.
(d) Experimental; for design.
(e) The 1:20-scale sectional model includes a forebay and upstream face of the dam, the bell-mouth conduit intake and a section of the conduit upstream from the gate housing, the gate section, including both emergency and operating slide gates, and the rectangular section of conduit between the gate housing and the downstream face of the spillway. The purpose is to determine whether open-channel flow will exist in the conduit outlet with unvented operating conditions and to obtain capacity curves and pressures. The conduits must be capable of safe operation under a maximum emergency head of 309 feet.
(f) Inactive.
(g) Tests revealed that flow conditions and pressures would be satisfactory if the vertical and horizontal dimensions of the conduit downstream from the gate housing were increased sufficiently to insure open-channel flow.
(h) One preliminary report has been issued.

(1197) MODEL STUDY OF CHIEF JOSEPH DAM DIVERSION SLUICES, COLUMBIA RIVER, WASHINGTON.

(b) Department of the Army, Corps of Engineers, Seattle District, Seattle, Wash.
(d) Experimental; for design.
(e) The 1:30 model reproduces the upstream and downstream faces of the dam and a pair of the twenty-four ungated sluices which will carry normal river flows through the uncompleted spillway dam. The purpose is to compare the model results with the computed rating curve, especially where the flow changed from open-channel to full-culvert flow with rising and falling pools.
(f) Inactive. Tests have been completed, and results will be incorporated in the Final Report on General Model Study of Chief Joseph Dam.
(g) Tests revealed that the change from open-channel to full-culvert flow occurred at the same pool elevation for rising and falling river flows. The sluices appeared to provide less than the computed capacity.
(h) One preliminary report has been issued.

(1198) MODEL STUDY OF FRICTION LOSSES IN CORRUGATED METAL PIPE (CW-828).

(b) Office, Chief of Engineers, U. S. Army, Washington, D. C.
(d) Experimental; applied research.
(e) Tests will be conducted to determine values of Manning's "n" for corrugated metal pipe of 3-, 5-, and 7-ft diameters. Provisions will be made to measure velocities, discharges and pressures within the test section.

(1199) MODEL STUDY OF RUBBER SEAL TESTER.

(b) Department of the Army, Corps of Engineers, Portland District, Portland, Ore.
(d) Experimental; for design.
(e) The 1:1 apparatus consists of a horizontal fixed plate upon which is mounted a frame of the seal to be tested and a companion plate which is made to run back and forth under pressure across the rubber seal frame while under water to simulate prototype action of a rubber seal in service. The speed of the rubbing action can be varied, and the pressure exerted against the rubber seal can be raised to 250 psi.
(f) Tests have been discontinued.
(g) Results have been expressed as a family of curves showing friction coefficients of the J-rubber seals against a steel plate for various periods of operation at pressures of from 100 to 250 psi.
(h) Two progress reports have been issued.

(1200) MODEL STUDY OF FINGERLING TESTS FOR McNARY DAM, COLUMBIA RIVER, UMATILLA, OREGON.

(b) Department of the Army, Corps of Engineers, Walla Walla District, Walla Walla, Wash.
(d) Experimental; applied research for design.
(e) The purpose is to study the effect of actual design conditions on downstream salmon migrants as they pass through the auxiliary water supply system of the powerhouse fish collection channel. The 1:1 model was capable of reproducing both structural and velocity conditions in the supply system as the water is drawn from the supply conduit and extruded into individual diffusion chambers.
(f) Tests completed.
(g) The upper limit of the tests was controlled by the maximum velocity obtainable in the model. The tests demonstrated that velocities approaching 25 fps impinging on a wall two feet from the mouth of a conduit will not significantly affect fingerling salmon.
(h) One preliminary report has been issued.

(1201) SECTIONAL MODEL STUDY OF COFFERDAM CLOSURE, McNARY DAM, COLUMBIA RIVER, UMATILLA, OREGON.

(b) Department of the Army, Corps of Engineers, Walla Walla District, Walla Walla, Wash.
(d) Experimental; for design.
(e) The 1:24 sectional model represents the central portion of a fill to be placed across a natural river channel between cells of the upstream cofferdam. The purpose is to determine whether the fill, composed of pre-cast concrete tetrahedron-shaped blocks weighing from 8 to 12 tons each and 3- to 5-ton boulders, can be placed in the high-velocity flow under conditions predicted by test results of the closure in the 1:100-scale McNary General Model.
(f) Tests completed; progress reports being prepared.
(g) Results indicate that closure can be assured during low-water periods only. A 50,000-cfs rise of the river would make closure very difficult and would necessitate anchoring a series of "tets" together across the fill to act as a buffer and key for successive blocks

(1202) MODEL STUDY OF COFFERDAM CLOSURE, McNARY DAM, COLUMBIA RIVER, UMATILLA, OREGON.

(b) Department of the Army, Corps of Engineers, Walla Walla District, Walla Walla, Wash.
(d) Experimental; applied research.

(e) A 1:24 model, constructed at the project site, reproduces the natural topography for a 1400-foot reach of the river, the junior cofferdam, and eleven cells of the main cofferdam adjacent to a river channel which must be filled before construction of the final cofferdam cells can proceed. The fill will be placed by dropping a large number of 8-ton concrete blocks precast in tetrahedron form and 3- to 5-ton boulders. As each of the blocks and boulders is dropped, a similar block or boulder, reduced to model scale, will be dropped at the same relative point in the model. With discharge and water-surface elevations adjusted in the model to coincide with those in the river, it is intended that the model will show the effectiveness of the various construction steps.

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U. S. DEPARTMENT OF THE ARMY, CORPS OF ENGINEERS, Fort Peck District.

(668) HYDRAULIC MODEL OF FORT PECK TUNNEL OUTLET AREA, FORT PECK DAM, FORT PECK, MONTANA.

(b) Laboratory project.
(c) District Engineer, Fort Peck District, Corps of Engineers, Fort Peck, Mont.
(d) Experimental; for design.
(e) The 1:73.5 model reproduces the three high velocity discharge tunnel outlets, the power house outlets, the concrete apron for these outlets, and a reach of river channel downstream of sufficient length properly to reproduce the tailwater. The tailwater on the apron is shallow, and the outlet structures as constructed do not properly spread the flow, so that there are concentrations of flow over the end of the apron which cause excessive erosion along the right bank and the adjacent channel bed. The project is to develop a satisfactory method for reducing this erosion and to determine the best structures for accomplishing this purpose.
(f) Completed.
(g) Tests indicate that satisfactory conditions will be obtained through increasing the spread of flow by the use of training walls extending downstream from the tunnel outlets, and baffle piers on the apron located in a single row upstream from and approximately parallel to the edge of the apron, against which the flow will impinge, thereby reducing velocity and serving to redistribute the flow.

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U. S. DEPARTMENT OF THE ARMY, CORPS OF ENGINEERS, Little Rock District.

(669) TEST OF TAINTER GATE FOR CONTROL OF CONDUIT FLOW.

(b) Department of the Army, Office, Chief of Engineers.
(c) District Engineer, Little Rock District, Corps of Engineers, Little Rock, Ark.
(d) Experimental; design and operation.
(e) A tainter gate was constructed and installed at Norfolk Dam at the downstream end of an existing conduit. Tests were made to determine downpull, vibration, air intake volume, and measurement of pressures on the face of the gate and in the conduit. Different types of rubber seals are being used during the tests.
(f) Tests have been completed on the gate leaf and on hydraulic and pneumatic rubber seals. An additional eccentric trunnion-type tainter gate will also be tested.
(g) Results indicate that the tainter gate operated in a satisfactory manner. The hydraulic seals tested are not considered adequate. However, the pneumatic seals are considered satisfactory.

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U. S. DEPARTMENT OF THE ARMY, CORPS OF ENGINEERS, Los Angeles District.

Inquiries concerning Projects Nos. 980, 981, 1203, 1204, and 1205 should be addressed to District Engineer, Los Angeles District, P. O. Box 5180 Metropolitan Station, Los Angeles 55, Calif.

(980) MODEL STUDY OF WHITTIER NARROWS FLOOD-CONTROL BASIN.

(b) Laboratory project.
(d) Experimental; for design.
(e) Earth dam with gated outlets and spillway. Three models are being used: A 1:24 model of the outlet works for tests on the operation of the four radial sluice gates; a 1:42 model of a half plan of the spillway for tests on the operation of the nine tainter gates; a 1:60 general model of the flood-control basin for tests on the over-all operation of the project.
(f) Tests on the 1:42 model are completed. Tests on the 1:60 model are in progress.
(g) A plan of derrick stone protection against scour at the downstream end of the spillway chute was developed in lieu of a stilling basin.

(981) MODEL STUDY OF THE CONFLUENCE OF TUJUNGA WASH AND PACOIMA WASH CHANNELS.

(b) Laboratory project.
(d) Experimental; for design.
(e) Tests were conducted in a 1:30 model of the confluence to determine the best means of joining the two streams in which velocities were supercritical.
(f) Completed. Preparation of report is in progress.
(g) A 1000 foot transition following the confluence was necessary to reduce the waves to a satisfactory minimum.

(1203) MODEL STUDY OF LOS ANGELES RIVER CHANNEL IMPROVEMENT, RIO HONDO TO PACIFIC OCEAN.

(b) Laboratory project.
(d) Experimental; for design.
(e) From Rio Hondo to Spring Street the improvement proposed is a paved trapezoidal channel. Normal velocity would be supercritical (25 fps) but numerous bridges would produce Class "B" flow and attendant hydraulic jumps upstream of the bridges. From Spring Street to Pacific Ocean the channel will be trapezoidal, the side slopes will be paved, the bottom unpaved, and the velocity subcritical (12 fps). A 1:50 model will be used to study flow conditions at confluences, at bridges, and at the junction of the paved and unpaved channels. The tests will be accomplished in stages.

(1204) AIRFIELD SURFACE DRAINAGE INVESTIGATION.

(b) Chief of Engineers, Department of the Army, Washington 25, D. C.
(d) Experimental; applied research.
(e) Paved, turfed, mulched, and bare test sections simulating portions of a landing strip or parking apron have been constructed to obtain basic data for analysis of rainfall-runoff relationships for various types of surfaces, cover conditions, and slopes. Natural and simulated rainfall will be studied. Special control devices and recorders are being used to obtain the data.

(1205) MEASUREMENT OF HIGH-VELOCITY FLOW.

(b) Laboratory project.
(d) Experimental; for design.
(e) Equipment is being designed to measure high-velocity flood flows in large concrete channels in which the maximum depth and velocity would be 10 feet and 60 feet per second, respectively. Drag coefficients will be determined for best shape of strut to support a pitot tube in the high-velocity flow. It is anticipated that the tests will be conducted at the David Taylor Model Basin.

. S. DEPARTMENT OF THE ARMY, CORPS OF ENGINEERS, St. Paul District.

In cooperation with St. Anthony Falls Hydraulic Laboratory.

Inquiries concerning Projects Nos. 412, 413, 982 to 985 incl., and 1206 should be addressed to the District Engineer, Corps of Engineers, St. Paul District, 1217 U. S. Post Office and Custom House, St. Paul 1, Minn.

(194) A STUDY OF METHODS USED IN THE MEASUREMENT AND ANALYSIS OF SEDIMENT LOADS IN STREAMS.

(b) Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation.
(d) Experimental; for design.
(e) Designs for point-integrating and depth-integrating sediment samplers and laboratory apparatus have been developed, and the mechanical features and streamlining of both types of samplers have been improved to provide better operating characteristics and greater stability over a wider range of stream sampling conditions. Sampler designs for depth-integrating include a light weight sampler (operated by hand), a medium, and a heavy sampler (300 lb) for use in deep and fast streams.
(g) Samplers already developed are available in quantity to meet the needs of the Federal cooperating agencies. Construction drawings for the 300-lb sampler have been prepared. A bottom-withdrawal tube and a visual accumulation tube are being used in the study to develop an improved method of determining particle size gradations of fluvial sediment.
(h) "Measurement and analysis of suspended sediment loads in streams." M. E. Nelson and P. C. Benedict. Proc. A.S.C.E. Vol. 76, Separate No. 31, Sept. 1950.

(412) ST. ANTHONY FALLS LOCKS.

(b) St. Paul District, Corps of Engineers.
(d) Experimental; for design.
(e) The complete hydraulic systems of the upper lock and the lower lock are being studied in 1:22.4 models. The lower lock is to have a single culvert and chamber laterals, and the upper lock a culvert in each wall and a system of chamber laterals alternating from the two culverts.
(g) Some revisions in the hydraulic system of the lower lock tending to simplify prototype construction were tested before dismantling the model of the lower lock. The model of the upper lock is being built.

(413) STUDY OF BALDHILL DAM, SHEYENNE RIVER, NORTH DAKOTA.

(b) St. Paul District, Corps of Engineers.
(d) Experimental; for design.
(e) A 1:51 half model of the spillway was constructed to check the prototype design. The model simulated the approach section, spillway, tainter crest gates, and stilling basin. A movable sand bed was provided downstream.
(f) Completed.
(g) Realignment of training walls and revisions in the stilling basin studied in the model were included in the final design. Data from the prototype structure operating under flood conditions in the spring of 1950 were obtained and compared with equivalent model data.
(h) "Laboratory tests on hydraulic model of Baldhill Dam, Sheyenne River, North Dakota." Hydraulic Laboratory Report 55, Sept. 1950. (Available for sale).

(982) SPILLWAY FOR ORWELL DAM, OTTERTAIL RIVER, MINNESOTA.

(b) St. Paul District, Corps of Engineers.
(d) Experimental; for design.
(e) A 1:25 model is being tested to check the adequacy of the proposed spillway and stilling basin. It includes the spillway and crest gate, stilling basin, and approach areas.

(983) MISSISSIPPI RIVER CHANNEL IMPROVEMENT AT SMITH AVENUE BRIDGE, ST. PAUL, MINNESOTA.

(b) St. Paul District, Corps of Engineers.
(d) Experimental; for corrective measures and operation.
(e) The model, with scales of 1:100 horizontally and 1:25 vertically, simulated a reach of the river channel. Tests were conducted to determine means of eliminating a sand bar deposited in the navigation channel immediately downstream from the bridge during the spring floods.
(f) Tests completed; final report being prepared.
(g) The study indicated that during floods eddies adjacent to the bridge piers eroded the channel bed material. This material was deposited as a bar in the navigation channel downstream. The model indicated that the navigation channel could be stabilized by depositing rock in the area subjected to scour.

(984) CORALVILLE RESERVOIR SPILLWAY AND OUTLET STRUCTURE.

(b) Rock Island District, Corps of Engineers.
(d) Experimental; for design.
(e) The complete outlet conduit was tested at a scale of 1:36 to check the performance of the intake, conduit, and stilling basin. A 1:100 general model simulated a 5,400-foot reach of river including the earth-filled dam with outlet conduit near one end and spillway at the other. In this model, spillway discharges up to 240,000 cfs were studie
(f) Tests completed.
(g) Tests established the design of the stilling basin for the outlet conduit, the alignment of training walls, and lay-out of approach area for the spillway, and indicated the current conditions in the channel downstream from the dam.

(985) FILLING AND EMPTYING SYSTEMS FOR HIGH-LIFT LOCKS (CW-820).

(b) Chief of Engineers, Corps of Engineers, Washington, D. C.
(d) Experimental; applied research.
(e) To develop adequate criteria for the design of filling and emptying systems for high-lift locks. Tests will be conducted in prototype locks, in model locks for definite projects, and in a general lock model at a scale of 3:100.
(g) Tests are being conducted in the general lock model on a mono-culvert system to obtain comparisons of operating characteristics of chamber laterals having streamlined and square-edged port entrances.

(1206) CONDUIT GATE STRUCTURES AND TRANSITIONS (CW-805).

(b) Chief of Engineers, Corps of Engineers, Washington, D. C.
(d) Experimental; applied research.
(e) A general model study will be made to establish gate operating procedures for multiple gate conduits and design criteria for transition sections between conduit outlets and single and multiple control gates. The model includes a complete outlet conduit with upper pool reservoir, multiple control gates in conduit intake, and a stilling basin.
(f) A testing program has been prepared.

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U. S. DEPARTMENT OF THE ARMY, CORPS OF ENGINEERS, Waterways Experiment Station.

Inquiries concerning Projects Nos. 211, 213, 218, 219, 221, 226, 230, 234, 236, 237, 243 257, 417, 419, 420, 425, 426, 672 to 679 incl., 682, 683, 986 to 1004 incl., and 1207 to 1213 incl., should be addressed to The Director, Waterways Experiment Station, Corps of Engineers, P. O. Box 631, Vicksburg, Miss.

(211) MODEL STUDIES OF OUTLET WORKS, SPILLWAY AND STILLING BASIN, GARRISON DAM, MISSOURI RIVER, NORTH DAKOTA.

(b) The District Engineer, Garrison District, Corps of Engineers, Bismarck, N. D.
(d) Experimental; for design.
(e) A 1:100 model of the spillway and a 1:41.6 model of one bay of the spillway were used to determine the hydraulic performance of the approach channel, crest, chute, stilling basin and pilot channel and to correct unsafe conditions. To examine the performance of the power conduits, and the flood-control conduits including intake structure and transition, of the stilling basins under diversion and reservoir operation conditions, and to devise corrections for any unsafe conditions, two models are being employed: a 1:50 model of the power conduits, and a 1:25 model of one of the 22-foot flood-control conduits. The 26-foot tunnel was also tested in this model. Of special interest is the use of a tainter gate for control of conduit flow. Incidental models were tested in a vacuum tank to determine the cavitation characteristics of the emergency slide gate slots in the flood-control conduits and the articulated tunnel joints.
(g) A stilling basin was developed for the flood control and power conduits that gave satisfactory flow conditions during both diversion and reservoir operation of the conduits.

(213) MODEL STUDY OF CONTROL STRUCTURE, MORGANZA FLOODWAY, LOUISIANA.

(b) The District Engineer, New Orleans District, Corps of Engineers, New Orleans, La.
(d) Experimental; for design.
(e) The control structure will consist of a broadcrested weir and a stilling basin. Discharge coefficients, head-discharge relationships, stilling-basin design, and effect of crest shape on hydraulic efficiency were determined in a 1:20 model. A 1:30 model was used to test various weir shapes.
(f) Testing completed; preparation of final report in progress.
(g) A simplified weir control increased flow capacity for submerged conditions.

(218) CONDUIT INTAKE MODEL TESTS.

(b) Office, Chief of Engineers, Department of the Army, Washington, D. C.
(d) Experimental; applied research.
(e) Small-scale models are being used for a general study of the hydraulic characteristics of entrance curves for (a) rectangular conduits in which the entrance is flared in four directions, and (b) a gated tunnel having a rectangular entrance and floor at same elevation as approach channel (entrance flared in three directions).
(g) Initial tests with the conduit flared in four directions indicated the desirability of an elliptical entrance curve conforming to the equation $(X^2/D^2) + (Y^2/1/3\ D^2) = 1$ where D equals the corresponding dimensions of the conduit. Similar results were obtained for a rectangular conduit entrance constructed to the equation $(X^2/D^2) + (Y^2/1/5\ D^2) = 1$. Additional tests were made using the same basic equation and varying the length of curve.

(219) SLIDE GATE MODEL TESTS.

(b) The Chief of Engineers, Department of the Army, Washington, D. C.
(d) Experimental; applied research.
(e) A general study by model and prototype tests to determine (a) the best shape of gate lip to reduce downward hydraulic pull on the gates and vibration tendencies during opening or closing; and (b) to determine the optimum shape for gate slots to eliminate or reduce cavitation tendencies. A 1:6 model reproduces the gate slots, the slide gate, a portion of the conduit upstream and downstream from the gate section, and the air vent. A 1:10 gate with a 45° lip is designed to fit the 1:6-scale gate slots for study of effect of conduit height on pressure conditions on the gate lip. Some of the tests are being conducted in a vacuum tank to determine the point of incipient cavitation.
(g) Tests conducted with a gate slot 2.5 feet or 1 foot deep and 4, 3, or 2 feet wide and the downstream edge tapered 1 inch in 12 inches revealed very little difference in pressure conditions along the downstream edge.

(221) ANALYSIS OF HYDRAULIC EXPERIMENTAL DATA (MODEL AND PROTOTYPE) AND DEVELOPMENT OF DESIGN CRITERIA (formerly entitled "ANALYSIS OF RESULTS OF MODEL TESTS AND PROTOTYPE OBSERVATIONS").

(b) The Chief of Engineers, Department of the Army, Washington, D. C.
(d) Experimental and field investigations; for design.
(e) Analysis of prototype observations and results of model tests, with the ultimate objective of furnishing accurate design data, and thus effecting economies and efficiency in future design work. The investigation includes hydraulic structures, open channels, harbors, and tidal estuaries. Equipment for obtaining data from prototype structures is kept in readiness so that observations may be made as opportunity permits. Analysis of model and prototype data is in progress.
(g) A review of model and prototype results was published during March 1950 on the breakwater location, Alameda Naval Air Station. Work is in progress on analysis of model and field data on Ballona Creek Outlet, California.

(226) POTAMOLOGY INVESTIGATIONS.

(b) The President, Mississippi River Commission, Corps of Engineers, Vicksburg, Miss.
(d) Experimental and field investigation; applied research.
(e) Model studies are being conducted to (1) provide means of predicting future changes in meandering of the Mississippi River and the need for bank protection, (2) study revetment stability, (3) study and develop methods of channel stabilization by means other than the use of revetment, and (4) develop and test comprehensive plans for improvement of specific troublesome reaches of the Mississippi River. A study to determine the erodibility characteristics of various natural and synthetic erodible materials is being conducted in two small flumes. Experiments to adapt these erodible materials for use in modeled bends of unstable reaches of the Mississippi River are being made in a large flume in which the Concordia-Scrubgrass Bend reach of the Mississippi River presently is reproduced to scales of 1:100 vertically and 1:400 horizontally. Revetment and other possible methods of channel stabilization are being investigated on a 1:60 model of a Mississippi River bend contained in another large flume. Investigations in the field include (1) soil surveys to determine the nature, characteristics, and physical properties of the banks of the Mississippi River to permit recognition of soil factors affecting bank stability, (2) hydrographic and hydraulic surveys to provide information in specific revetted reaches to permit recognition of hydraulic and hydrographic factors affecting revetment stability, and (3) surveys to determine the magnitude and extent of turbulence forces engendered at the bed of the Mississippi River and their effects on revetment stability. The soils phase of the investigation is conducted with the usual field sampling equipment plus special sampling equipment recently developed. Laboratory tests on the field samples are performed with special equipment in addition to ordinary laboratory equipment. The magnitudes and frequencies of the forces of turbulence engendered at the bed of the Mississippi River have been measured by means of a pressure cell installed in a cast-iron disk 5 feet in diameter and 3 inches thick with horizontal and vertical stabilizers.
(g) Pressure fluctuations on the surface of the disk used to measure the forces of turbulence in the river were found to be as high as 0.3 psi in one second or less.

(230) MODEL STUDY OF FLOOD CONTROL, CUMBERLAND, MARYLAND.

(b) The District Engineer, Washington District, Corps of Engineers, Washington, D. C.
(d) Experimental; for design.
(e) Purpose is to study and develop proposed plans for the protection of Cumberland from floods, using a 1:16, undistorted, fixed-bed model.
(f) Tests are at present suspended.

(234) MODEL STUDY OF MEMPHIS HARBOR, MISSISSIPPI RIVER, MEMPHIS, TENNESSEE.

(b) The District Engineer, Memphis District, Corps of Engineers, Memphis, Tenn.
(d) Experimental; for design.

(e) Effects of proposed closure of Tennessee Chute on flood heights and channel configurations were studied in a model of combination movable-bed and fixed-bed type, with scales of 1:600 horizontal, and 1:150 vertical.
(f) Completed.
(g) "Memphis Harbor, Mississippi River; model investigation." Waterways Experiment Station Technical Memo. No. 2-320. 1950. (Available on loan).

(236) MISSISSIPPI BASIN MODEL.

(b) Office, Chief of Engineers, Department of the Army, Washington, D. C.
(d) Experimental; for design.
(e) Plans provide for a model of the Mississippi River watershed including the Ohio, Missouri, White, Arkansas, and Red Rivers and their principal tributaries. Initial construction has been limited to the Missouri River from Sioux City to the mouth, the Arkansas River from Blackburn Dam Site to Pine Bluff, the Upper Mississippi River from Hannibal to Tiptonville, and the Ohio River and tributaries from above Pittsburgh to Wheeling. Coordination of releases from reservoirs, effect of reservoir operation on flood stages, routing of project and other floods, levee grades, stage predictions, and effect of floodways on stage reduction will be studied. Model scales are 1:2000 horizontal, and 1:100 vertical. Portions of the Missouri, Upper Mississippi, and Arkansas Rivers are in operation.

(237) MISSISSIPPI RIVER FLOOD-CONTROL MODEL.

(b) The President, Mississippi River Commission, Corps of Engineers, Vicksburg, Miss.
(d) Experimental; for design.
(e) The fixed-bed model, with scales of 1:2000 horizontal, and 1:100 vertical reproduces the main channel of the Mississippi River from Helena, Ark., to Donaldsonville, La.; the entire Atchafalaya Basin, including Morganza and West Atchafalaya Floodways, to the Gulf of Mexico; and the backwater areas of the Arkansas, White, Yazoo, Ouachita, and Red Rivers. Operational plans for the Red River backwater area control structure were studied to determine the most efficient and effective plan to provide flood protection in the Red-Ouachita backwater area consistent with safety of the Mississippi River main-line levees and to obtain data on flow characteristics of flood waters diverted into the backwater area through the control structure. The Mississippi River channel area and the various floodway areas of the model are currently being rebuilt to 1947-1950 surveys.

(243) MODEL STUDY OF SALT WATER INTRUSION, CALCASIEU RIVER, LOUISIANA.

(b) The District Engineer, New Orleans District, Corps of Engineers, New Orleans, La.
(d) Experimental; for design.
(e) Effects of deepening the ship channel on the intrusion of salt water into the Calcasieu River and the passage of salt water eastward through the Intracoastal Waterway from the Calcasieu River to the Mermentau River basin were determined by a fixed-bed tidal model with scales of 1:1000 horizontal, and 1:50 vertical. Salt water was introduced into the ocean water supply system, and fresh water at the upper end of the model.
(f) Completed.
(g) Proposed channel deepening would cause general increases in salinity in Calcasieu River and the Intracoastal Waterway particularly during net eastward flows in the latter; however, during period of net westward or reversing tidal flow in the Intracoastal Waterway channel, channel deepening would have negligible effect on salinity intrusion therein.
(h) "Salt water intrusion, Calcasieu River, Louisiana and connecting waterways; model investigation." Waterways Experiment Station Technical Memo. No. 2-310. April 1950. (Available for sale or loan).

(257) MODEL STUDY OF STABILITY OF RUBBLE-MOUND BREAKWATERS.

(b) The Chief, Bureau of Yards and Docks, Department of the Navy, Washington, D. C.
(d) Experimental; for design.

(e) Various types of rubble-mound breakwaters in progressive stages of construction are tested to determine the stability and displacement of material under wave action. The linear scale ratio is 1:45. The breakwater material is sized in accordance with specifications established by hypothetical prototype breakwaters.
(g) Design wave heights (largest wave which does not damage breakwater) have been determined for rubble breakwaters with slopes from 1:1 to 1:3 constructed of 2.8-specific gravity cap rock simulating 13-1/2-ton to 27-ton cap rock in prototype. Data obtained were used to determine the coefficient K' in Iribarren's formula. Although the coefficient varies considerably with breakwater slope and wave steepness, the equation and coefficients proposed by Iribarren are useful in rubble-mound breakwater design. More data will be necessary before rubble breakwaters can be designed with known safety factors.

(417) MODEL STUDY OF ALGIERS LOCK, INTRACOASTAL WATERWAY, NEW ORLEANS, LOUISIANA.

(b) The District Engineer, New Orleans District, Corps of Engineers, New Orleans, La.
(d) Experimental; for design.
(e) The feasibility of filling the lock through the sector gates and gate recesses, thus eliminating a culvert system, was studied in a 1:20 model. Forces developed on the sector gates during operation were also investigated.
(f) Testing completed; preparation of final report in progress.
(g) Tests revealed that it is feasible to fill a lock chamber through sector gates in a reasonable time. A revised design of gate lip was developed to reduce hydraulic forces on the gates.

(419) SLIDE GATE TESTS, NORFOLK DAM, ARKANSAS.

(b) The District Engineer, Little Rock District, Corps of Engineers, Little Rock, Ark.
(d) Experimental; for design.
(e) The most desirable shape of the bottom of the gate to minimize vibration, negative pressures, and disturbance of flow and the downpull on the gate leaf and the amount of air drawn through air vents, for four types of gates, were determined in a 1:6 model. Gates with 60-degree and 45-degree lips were designed for further study of the effect of conduit height on pressure conditions on the gate lip.
(f) Testing completed; preparation of final report in progress.
(g) On the four types of gate lip shapes tested, that with the seal connected to the upstream face at angles of 45 degrees and 60 degrees provided best results. The Norfolk type and square-edged lip resulted in low pressures at small gate openings while at large openings flow parted from the lip. The height of the conduit had no apparent effect on pressures on the gate lip. These results were substantiated in field tests made at Norfolk Dam.
(h) Results will be incorporated in the comprehensive report on the model and prototype study of slide gates for Norfolk Dam.

(420) MODEL STUDY OF CONDUITS AND HOWELL-BUNGER VALVES, NARROWS DAM, LITTLE MISSOURI RIVER, ARKANSAS.

(b) The District Engineer, Vicksburg District, Corps of Engineers, Vicksburg, Miss.
(d) Experimental; for design.
(e) Tests in a 1:16 model were used to determine discharge coefficients of the Howell-Bunger valves, and to study stilling-basin action below the valves with special emphasis on pressures at the end sill.
(f) Final report in preparation.
(g) Tests demonstrated the need for some type of hood over the valves to prevent flow from being projected onto the access road along the right side of the stilling basin. Hoods having semicircular tops supported by vertical walls from the basin floor gave satisfactory results. It was necessary to replace the sloping end sill of the original design by a vertical-faced end sill to maintain a cushion of water in the stilling basin. Pressures on the end sill were not of serious proportions. Tests made to obtain information on the coefficient of discharge for the combination of the valves and the contraction immediately above the valves, resulted in a coefficient of about 0.87.

(425) COMPREHENSIVE MODEL STUDY, DELAWARE RIVER, PENNSYLVANIA.

(b) The District Engineer, Philadelphia District, Corps of Engineers, Philadelphia, Pa.
(d) Experimental; for design.
(e) Model is being used to develop and test plans for reduction of shoaling in several ranges of the navigation channel. The model is of the fixed-bed, silt-injection type, with scale ratios of 1:1000 horizontally, and 1:100 vertically. Tides and tidal currents are reproduced by automatic tide-control machines. Observed prototype salinities are reproduced in the Delaware Bay portion of the model, and provisions made for the injection of silt, and for measuring silt deposits.
(g) Tests of the Mantua Creek Anchorage indicated that enlargement of the anchorage to proposed dimensions would increase appreciably the rate of shoaling therein; also, that proposed appurtenant spoil area disposal dikes would have but little effect on the rate of shoaling in the enlarged anchorage.

(426) MODEL STUDIES OF EAST BRANCH DAM, CLARION RIVER BASIN, PENNSYLVANIA.

(b) The District Engineer, Pittsburgh District, Corps of Engineers, Pittsburgh, Pa.
(d) Experimental; for design.
(e) Tests were conducted to investigate the adequacy of the side-channel spillway, longitudinal channel, dispersal bucket, and elements of the outlet works, and to study hydraulic forces acting on the control gates by determination of gate lip pressures. Three models were involved: (1) a 1:50 model of the spillway; (2) a 1:25 model of the outlet works; and (3) a 1:12 model of one of the control gates for the outlet tunnel.
(f) Preparation of final report in progress.
(g) A satisfactory transition in the outlet structure was developed and the training wall in the stilling basin shortened 40 feet. The spillway was modified to improve the design.

(672) MODEL STUDIES OF LYNNHAVEN BAY AND INLET, VIRGINIA.

(b) The District Engineer, Nrofolk District, Corps of Engineers, Norfolk, Va.
(d) Experimental; for design.
(e) Tests were conducted to develop the most efficient design of inlet and interior channels to provide the desired volume of tidal flow into and out of Lynnhaven Bay and to determine the effectiveness of jetties in preventing reshoaling of the inlet channel and the effects of jetties on the beaches adjacent to the inlet. Two tidal models were used: (1) a fixed-bed model, reproducing all Lynnhaven Bay and Inlet and a portion of Chesapeake Bay to scales of 1:800 horizontal, and 1:80 vertical; and (2) a movable-bed type, reproducing Lynnhaven Inlet and adjacent beaches, and off-shore areas to about the -25-foot contour of depth in Cheasapeake Bay, with scales of 1:400 horizontal, and 1:80 vertical.
(f) Testing completed; final report being prepared.
(g) Tests indicate that a single jetty on the east side of Lynnhaven Inlet would be almost as effective as twin jetties in preventing reshoaling of the entrance channel.

(673) GENERAL SPILLWAY MODEL TESTS.

(b) The Chief of Engineers, Department of the Army, Washington, D. C.
(d) Experimental; applied research.
(e) Tests on a 1:40 section model are used to study hydraulic characteristics of the standard spillway shape, including the effect of crest piers and gates, and to establish general rules for design of roller-type energy dissipators. The drop from spillway crest to bucket will be varied to study the effect of nappe thickness.
(g) Tests to obtain discharge and pressure data for various approach elevation conditions indicated that if height of weir were equal to or greater than the head, coefficient and pressure data were in the same range for the same crest shape. Tests of two pier shapes were begun.

(674) MODEL STUDIES OF FORT RANDALL DAM, MISSOURI RIVER, SOUTH DAKOTA.

(b) The District Engineer, Omaha District, Corps of Engineers, Omaha, Nebraska.
(d) Experimental; for design.
(e) A 1:100 comprehensive model was used to determine effects on velocities of depth and curvature of the approach channel; to investigate flow over the spillway, and develop a good stilling-basin design; and to study flow conditions in the exit area. A 1:50 outlet stilling-basin model was used to develop a stilling basin below the power conduits which will dissipate satisfactorily the energy of diversion flow, and which can be used to simplify construction of the powerhouse; to verify the design of the flood-control conduits stilling basin to insure satisfactory operation under present-day tailwater ratings and through various lower stages to ultimate retrogression; and to determine the limit of required tailrace paving and necessity for protective bank works by study of currents and wave action. A 1:25 intake and flood-control conduits model was used to determine the character of flow for various reservoir levels; measure loss coefficients of the intake structure; investigate pressures in the transition section; and to determine the effects of partial gate operation upon downpull and oscillation of the gates and upon air requirements.
(f) Testing completed on all models except the 1:100 comprehensive.
(g) An outlet stilling basin was developed that gave the desired flow characteristics for all operating conditions. A further analysis of the design requirements based on model tests and investigations indicated that one spillway gate could be eliminated.

(675) MODEL STUDY OF FLOOD CONTROL TUNNEL, BLAKELY MOUNTAIN DAM, OUACHITA RIVER, ARKANSAS.

(b) The District Engineer, Vicksburg District, Corps of Engineers, Vicksburg, Miss.
(d) Experimental; for design.
(e) Tests on a 1:25 model were used to analyze the hydraulic characteristics of all elements of the tunnel and to correct unsatisfactory conditions. Special consideration was given to flow conditions through the drop immediately below the control structure.
(f) Preparation of final report in progress.
(g) The hydraulic performance of the structure was studied and a gate operating schedule developed to eliminate an unstable hydraulic jump in the tunnel.

(676) MODEL STUDIES OF JIM WOODRUFF DAM, APALACHICOLA RIVER, FLORIDA.

(b) The District Engineer, Mobile District, Corps of Engineers, Mobile, Ala.
(d) Experimental; for design.
(e) Tests were used to investigate the hydraulic performance of the spillway and lock structure as originally designed, and to effect necessary revisions. Particular attention was given to currents at the upstream and downstream lock approaches and flow through the draw span some 0.7 mile below the structure, and the determination of submergence coefficients for the spillways. Four models were involved: (1) a 1:100 comprehensive model; (2) a 1:38.4 section model of one full gate bay plus adjacent half gate bays of the controlled portion of the spillway; (3) a 1:30 section model of a 30-foot portion of the uncontrolled spillway; and (4) a 1:30 section model of a 30-foot portion of the overflow dike.
(f) Testing completed; preparation of final report in progress.
(g) The spillway design was modified in shape and the stilling basin shortened. The lock walls were decreased in length and the depth of approach channel increased. A flip bucket was added to the overflow dike section.

(677) MODEL STUDY OF PHILPOTT DAM, SMITH RIVER, VIRGINIA.

(b) The District Engineer, Norfolk District, Corps of Engineers, Norfolk, Va.
(d) Experimental; for design.
(e) Tests in a 1:40 model were used to analyze the hydraulic characteristics of the spillway and stilling basin, and flood-control conduits, and to correct any undesirable conditions.
(f) Completed.
(g) Final approved plans involved the use of a horizontal type energy dissipator for dissipation of low and intermediate flows. At high discharges spray action will result.

(h) "Spillway for Philpott Dam, Smith River, Virginia; model investigation." Waterways Experiment Station Technical Memo. No. 2-321. 1950. (Available for sale and loan).

(678) CHARLESTON HARBOR MODEL STUDY.

(b) The District Engineer, Charleston District, Corps of Engineers, Charleston, S. C.
(d) Experimental; for design.
(e) Tests are made to determine whether channel realignment, the provision of channel control works, or other remedial measures will be effective in reducing the present heavy rate of shoaling in certain reaches of the navigation channels. The fixed-bed model has scales of 1:800 horizontally, and 1:80 vertically. Shoaling studies are made by injecting finely-ground gilsonite into the model channels. A field study to obtain data for use in the model tests is being conducted by the Charleston District.
(g) At least one improvement plan tested to date has indicated appreciable reduction in shoaling at six of eight major shoal areas.

(679) RARITAN RIVER MODEL STUDY.

(b) The District Engineer, New York District, Corps of Engineers, New York, N. Y.
(d) Experimental; for design.
(e) Tests are to determine some means for minimizing the excessive rate of shoaling in the south channel. The fixed-bed model has scales of 1:600 horizontally, and 1:100 vertically. Shoaling studies are made by injecting finely-ground gilsonite into the model channels.
(f) Original tests completed; tests of three modifications of the best improvement plan in progress.
(g) Results indicate that two of the proposed improvement plans would reduce shoaling in the problem area by approximately 50 percent.

(682) HYDRAULIC CAPACITY OF MEANDERING CHANNELS IN STRAIGHT FLOODWAYS.

(b) Office, Chief of Engineers, Department of the Army, Washington, D. C.
(d) Experimental; applied research.
(e) A general study of meandering channels in straight floodways. Model tests are used to study effects of radius of curvature of bends; sinuosity of channel; depth of overbank flow; roughness of overbank; water-surface slope; and ratio of overbank area to channel area. Scales are proportionate to average conditions in nature so that the data obtained can be applied to natural problems.

(683) MODEL STUDIES OF FLOW CONDITIONS IN PUMPING PLANT SUMP AND SURGES IN SEWERS.

(b) The District Engineer, Louisville District, Corps of Engineers, Louisville, Ky.
(d) Experimental; for design.
(e) A general study of surges in a sewer system due to sudden arrest of flow at the pumping plant and effect of surcharging the sewer upon the concentration time for flow to the pumping plant, and a study of flow conditions in the transition and sump of the subject pumping plant. For study of flow conditions in the pumping plant, a 1:16 model was used. For study of surges and concentration time, a 1:32 general model was used.
(f) Testing completed; preparation of final report in progress.
(g) The surge model verified the initial computations of the surges occurring in the sewer and provided sufficient basic data for the computations of all surges. The pumping plant model demonstrated the original design to be inadequate; a design that had the required discharge capacity was developed.

(986) MODEL TESTS OF CHEATHAM DAM, CUMBERLAND RIVER, TENNESSEE.

(b) The District Engineer, Nashville District, Corps of Engineers, Nashville, Tenn.
(d) Experimental; for design.
(e) Tests of a 1:12 model were conducted to determine the relative force required to raise a wicket under various operating conditions and to determine the optimum angle for the face of the wicket, the guard sill, and the strut. A 1:36 model is being used to determine the most advantageous shape for the submergible tainter gate and the aeration required; the forces acting on the gate; and flow conditions for various tailwater elevations.

(g) Uplift forces acting on the upstream emergency dam were eliminated by use of a wicket gate with a curved upstream face. A design has been developed for the submergible tainter gate that eliminates the tendency of the gate to oscillate under certain operating conditions.

(987) MODEL STUDY OF CHANNEL IMPROVEMENTS, FARM CREEK, ILLINOIS.

(b) The District Engineer, Chicago District, Corps of Engineers, Chicago, Ill.
(d) Experimental; for design.
(e) The proposed plans for flood control within East Peoria have been studied on a 1:60, fixed-bed model.
(f) Testing completed; preparation of final report in progress.

(988) MODEL STUDY OF SPILLWAY, GENEGANTSLET DAM, NEW YORK.

(b) The District Engineer, Baltimore District, Corps of Engineers, Baltimore, Md.
(d) Experimental; for design.
(e) Model tests of the spillway were conducted in a 1:36 model to study flow conditions in the curved approach to the spillway, over the spillway crest, and in the converging chute.
(f) Testing completed; preparation of final report in progress.
(g) Two designs were developed that gave the desired flow conditions, one design employing two weirs and the other requiring only one weir.

(989) MODEL STUDY OF MISSISSIPPI RIVER, VICINITY OF GREENVILLE BRIDGE, GREENVILLE, MISSISSIPPI.

(b) The District Engineer, Vicksburg District, Corps of Engineers, Vicksburg, Miss.
(d) Experimental; for design.
(e) The original fixed-bed model has been converted into a movable-bed model using crushed coal for bed material. Tests are used to study flow conditions existing in the Mississippi River in the vicinity of the Greenville Bridge, Greenville, Miss., and to develop plans for the improvement of the reach.
(g) Fixed-bed tests indicated that a realignment of the channel would improve flow conditions in the vicinity of Greenville Bridge.

(990) MODEL STUDY OF LOCK CULVERT VALVE, PEARL RIVER LOCKS, PEARL RIVER, LOUISIANA.

(b) The District Engineer, Mobile District, Corps of Engineers, Mobile, Ala.
(d) Experimental; for design.
(e) Tests on a 1:8 model were conducted to determine hydraulic forces acting on and vibrational characteristics of the butterfly valves.
(f) Completed.
(g) Deflectors of suitable design attached to the butterfly valves reduced the operating torque by more than 100 percent for a headwater-tailwater differential of 28.0 feet.
(h) "Study of butterfly valves for Pearl River Locks; model investigation." Waterways Experiment Station Technical Memo. No. 2-313. June 1950. (Available on loan).

(991) MODEL STUDY OF OUTLET WORKS, TEXARKANA DAM, TEXAS.

(b) The District Engineer, New Orleans District, Corps of Engineers, New Orleans, La.
(d) Experimental; for design.
(e) Tests were conducted on a 1:25 model of the conduits, stilling basin, and portion of the outlet channel to develop an economical and safe stilling basin for the conduits.
(f) Testing completed; preparation of final report in progress.
(g) A stilling basin design was developed which eliminated the undesirable flow condition existing in the original design.

(992) MODEL STUDIES OF PINE FLAT DAM, KINGS RIVER, CALIFORNIA.

(b) The District Engineer, Sacramento District, Corps of Engineers, Sacramento, Calif.
(d) Experimental; for design.

(e) Tests were used to investigate the hydraulic performance of the spillway, spillway bucket and conduits and to effect revisions demonstrated to be desirable; particular attention was given the performance of the flip bucket and flow conditions from the conduits. Four models were involved in the study: (1) a 1:60 comprehensive model; (2) a 1:40 section model of the spillway crest; (3) a 1:18 model of the conduit outlet portal; and (4) a 1:18 model of one of the conduits in the upper tier.
(f) Testing completed; preparation of the report in progress.
(g) The adequacy of the flip bucket to deflect flow was confirmed. Alterations to the alignment of the upper tier of sluices and to the outlet portal of the lower tier of sluices improved flow conditions.

(993) CAVITATION RESEARCH.

(b) Chief of Engineers, Department of the Army, Washington, D. C.
(d) Experimental; applied research.
(e) Cavitation characteristics of such structures as baffle piers, steps in stilling basin, spillway gate slots, offset joints, etc. and pressures in horizontal bends are being studied on models installed in a vacuum tank. Models tested to date have been generally of three types: (1) offsets into flow; (2) offsets away from flow; and (3) gate slots. All shapes have been tested in the floor of a conduit 0.500 foot high by 0.283 foot wide. Conduit roof was terminated 0.667 foot upstream of the test shape, resulting in open channel flow over the shape. The depth of water was used to determine $h_o$ in the expression $K_i = (h_o - h_v) / (V_o^2 / 2g)$.

(994) EFFECT OF MODEL DISTORTION.

(b) Chief of Engineers, Department of the Army, Washington, D. C.
(d) Experimental; applied research.
(e) A general study is being made to determine the effects of model distortion on velocity distribution, bed movement, and other hydraulic conditions in a triangular flume with 2-foot sidewalls connected at the bottom by a continuous hinge, permitting variation of the central angle. The slope is also adjustable.

(995) SIMULATION OF AIR ENTRAINMENT IN MODELS INVOLVING HIGH VELOCITY FLOW.

(b) Chief of Engineers, Department of the Army, Washington, D. C.
(d) Experimental; applied research.
(e) This investigation comprises a series of studies to determine: (1) the spread of the boundary layer in accelerating flow; (2) the effect of air entrainment on stilling basin performance; and, (3) the relationship between air demand in a model and prototype sluice.

(996) USE OF AIR INSTEAD OF WATER IN MODEL TESTING.

(b) Chief of Engineers, Department of the Army, Washington, D. C.
(d) Experimental; applied research.
(e) A general study is to be made analytically and by model tests to determine the accuracy of model tests of closed conduits using air instead of water as the model fluid.
(f) The testing apparatus is being designed.

(997) SLUICE OUTLET MODEL TESTS.

(b) Chief of Engineers, Department of the Army, Washington, D. C.
(d) Experimental; applied research.
(e) Tests will be conducted on various types of sluice outlet portals to determine the relative effectiveness of each type. These tests will involve sluice outlets with flared sidewalls and with tetrahedral floor deflector blocks.

(998) STUDY OF WAVE FORCE ON BREAKWATERS.

(b) Office, Chief of Engineers, Department of the Army, Washington, D. C.
(d) Experimental; applied research.

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(e) A general investigation of wave phenomena and resulting forces is being conducted to develop formulas, supported by experimental data, from which wave pressures on impervious surfaces, vertical and inclined, can be determined.
(f) Calibration of instruments and equipment has been begun.

(999) STABILITY OF RUBBLE-MOUND BREAKWATERS.

(b) Office, Chief of Engineers, Department of the Army, Washington, D. C.
(d) Experimental; applied research.
(e) Rubble-mound structures will be studied to determine size of cap rock and slope of mound necessary to withstand action of waves and to develop formulas, supported by experimental data, from which the action of waves on rubble structures can be determined. Test data will be presented in dimensionless form, therefore no model scale, as such, will be utilized.
(f) The test program is being developed.

(1000) ROUGHNESS STANDARDS FOR HYDRAULIC MODELS.

(b) Office, Chief of Engineers, Department of the Army, Washington, D. C.
(d) Experimental; applied research.
(e) A general study of roughness standards for models was conducted to evaluate the resistance of definite types of roughness in terms of Manning's "n" and other parameters, so that much of the trial-and-error process of adjusting the surface roughness of river models can be eliminated.
(f) Testing completed; preparation of final report in progress.
(g) Curves prepared from test data were used to determine the channel roughness for the portions of the Mississippi Basin Model now in operation. With the exception of a few reaches, only minor adjustments were necessary to obtain the correct water surface profile.

(1001) SCALE EFFECTS ON SPILLWAY DISCHARGE COEFFICIENTS.

(b) Office, Chief of Engineers, Department of the Army, Washington, D. C.
(d) Experimental; applied research.
(e) Tests are conducted on existing spillway models to determine the effect of the size of a model on spillway discharge coefficients.
(g) Tests to determine effect of surface tension on discharge coefficients of spillways revealed no appreciable effect in small-scale spillway models.

(1002) SCALE EFFECTS IN HARBOR MODELS.

(b) Office, Chief of Engineers, Department of the Army, Washington, D. C.
(d) Experimental; applied research.
(e) Tests will be conducted to determine effects of various model scales and distortion on wave characteristics in a harbor.
(f) Initiation of tests awaiting development of testing program.

(1003) STUDY OF HARBOR DESIGN.

(b) Office, Chief of Engineers, Department of the Army, Washington, D. C.
(d) Experimental; applied research.
(e) Tests will be conducted of typical harbors to establish general criteria for designing harbors and harbor works to obtain optimum protection from wave action.
(f) Review of literature, preparatory to outlining testing program, is in progress.

(1004) INSTRUMENTATION.

(b) Office, Chief of Engineers, Department of the Army, Washington, D. C.
(d) Experimental; development.

(e) Various types of instruments for use in hydraulic models are being developed to make such measurements as those of wave heights, dynamic fluid pressures, gate vibration and downpull, and low velocity flow. An investigation was made of the use of electrical analyzers in determining the characteristics of wave forms. Development of an improved tidal mechanism has been initiated.
(g) Development of a salinity (conductivity) recorder for model use was completed.

(1207) MODEL STUDY OF SLUICE COASTER GATE.

(b) Office, Chief of Engineers, Department of the Army, Washington, D. C.
(d) Experimental; applied research.
(e) A general study of relative merits of various gate lip shapes, seals and recesses is being conducted. The investigation includes determination of downpull effects of changes in gate-lip shape, length and slope of seals, size and shape of the recess in the face of the dam, and need for an air vent in the entrance. The 1:20 model of the gate is being tested in combination with a typical sluice which includes a slide gate, standard entrance curves conforming to the elliptical equation $(x^2/D^2) + (y^2/(D/3)^2) = 1$, and a removable constriction at downstream end of sluice.

(1208) MODEL STUDY OF PORT WASHINGTON HARBOR, WISCONSIN.

(b) The District Engineer, Milwaukee District, Corps of Engineers, Milwaukee, Wisconsin.
(d) Experimental; for design.
(e) A 1:100 fixed-bed model was used to determine the best plan for providing adequate protection from wave action. Tests included extension of the north breakwater, a companion south detached breakwater, rubble added to lakeside of present caisson breakwaters, and rubble wave absorbers installed at ends of inner harbor basins.
(f) Testing completed; preparation of final report in progress.
(g) A plan involving partial realignment of the north breakwater extension and elimination of the proposed detached breakwater section, with a wave absorber in the west slip and one at the junction of the north and west slips, will provide adequate protection against storms from all critical directions. However, a rubble back slope will be required along the north caisson breakwater to eliminate effects of overtopping during storms from the northeast.

(1209) MODEL STUDY OF BELTON DAM, LEON RIVER, TEXAS.

(b) The District Engineer, Fort Worth District, Corps of Engineers, Fort Worth, Texas.
(d) Experimental; for design.
(e) Tests are being conducted on a 1:100 comprehensive model to determine the effect of spillway discharges on the earth dam; the best shape of the spillway excavation; proper alignment of approach walls; height of walls downstream from the control section; and to study overall flow in the exit area.

(1210) MODEL STUDY OF GRAYS HARBOR, WASHINGTON.

(b) The District Engineer, Seattle District, Corps of Engineers, Seattle, Washington.
(d) Experimental; for design.
(e) A fixed-bed model, with scales of 1:800 horizontally and 1:80 vertically, is being used to develop a comprehensive plan to protect the existing south jetty from the undermining effects of tidal currents, and to protect Point Chehalis from erosion by current and wave action. Upon completion of this part of the investigation a portion of the model will be converted to a movable-bed type to determine scour and shoal tendencies of the selected plan. Plans for reduction of shoaling in the navigation channel will also be studied.
(g) Hydraulic adjustment of the model has been accomplished.

(1211) MODEL STUDIES OF HOOSIC RIVER, ADAMS AND NORTH ADAMS, MASSACHUSETTS.

(b) The District Engineer, New York District, Corps of Engineers, New York, N. Y.
(d) Experimental; for design.

(e) A 1:30 model and 1:20 model are being used to verify the hydraulic design for improvement of the channels of the North and South Branches of Hoosic River in North Adams, Mass., and of the main channel in Adams, Mass., and to determine whether changes should be made for safety, increased efficiency, or economy.
(g) The stilling basin as designed for the North Adams section was found unsatisfactory and a basin was developed that produced the desired flow conditions. The design and location of the stilling basin in the main channel at Adams were verified.

(1212) MODEL STUDY OF OUTLET WORKS, OAHE DAM, MISSOURI RIVER, SOUTH DAKOTA.

(b) The District Engineer, Omaha District, Corps of Engineers, Omaha, Neb.
(d) Experimental; for design.
(e) A 1:60 model is being used to investigate the performance of the outlet works, effect revisions demonstrated to be desirable, and to observe flow conditions in the discharge and pilot channels.

(1213) PROTOTYPE ANALYSIS (HYDRAULIC).

(b) The Chief of Engineers, Department of the Army, Washington, D. C.
(d) Field investigations; for design.
(e) Procurement and analysis of prototype observations with the ultimate objective of developing design criteria. A tabulation of all prototype data presently available, prototype facilities available for obtaining additional data, and recommendations as to the data to be obtained is now being prepared. Some field data, consisting chiefly of photographs, have been collected.

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U. S. DEPARTMENT OF COMMERCE, BUREAU OF PUBLIC ROADS.

(568) SCOUR AT BRIDGE PIERS AND ABUTMENTS.

(b) Cooperative with Iowa Institute of Hydraulic Research. See page 37.

(1094) STUDY OF HIGHWAY INLET BOXES AND DISCHARGE PIPE SHAPES.

(b) Cooperative with University of Illinois, Hydraulic Engineering Laboratory. See page 32.

(1095) SCALE MODEL STUDIES OF INLET BOXES.

(b) Cooperative with University of Illinois, Hydraulic Engineering Laboratory. See page 33.

(1096) FULL SCALE GUTTER TESTS.

(b) Cooperative with University of Illinois, Hydraulic Engineering Laboratory. See page 33.

(1101) MOVEMENT OF SEDIMENT IN HIGHWAY DRAINAGE SYSTEMS.

(b) Cooperative with Iowa Institute of Hydraulic Research. See page 39.

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U. S. DEPARTMENT OF COMMERCE, NATIONAL BUREAU OF STANDARDS, National Hydraulic Laboratory.

Inquiries concerning Projects Nos. 154, 159, 160, 166, 432, 433, 1005, 1006, 1007, and 1214 to 1217, incl., should be addressed to the Chief, National Hydraulic Laboratory, National Bureau of Standards, Washington 25, D. C.

(154) AGING TESTS OF PIPES.

(b) Treasury Department.
(d) Experimental; for design and operation.
(e) Data have been obtained on the effect of 14 years of service on the hydraulic characteristics of small pipes of different materials.
(f) Final report being prepared.

(159) MODEL LAWS FOR DENSITY CURRENTS.

(b) Waterways Experiment Station, Corps of Engineers, Department of the Army.
(d) Theoretical and experimental; basic and applied research.
(e) The immediate purpose is to determine model laws for models involving the motion of stratified liquids. The two major problems are (1) the motion of a heavy liquid initially confined in a "lock" when released into a long channel containing a stationary lighter liquid, and (2) the motion of a heavy liquid from a "sea" into a long channel with either still or flowing lighter liquid.

(160) EFFECT OF STORM WINDS ON LAKE LEVELS.

(b) Laboratory project.
(d) Theoretical; basic research.
(e) To determine frictional forces of wind on lake surfaces and set-up.

(166) WET VENTING, STACK VENTING, AND SELF-SIPHONAGE OF PLUMBING FIXTURES.

(b) Housing and Home Finance Agency.
(d) Experimental; applied research.
(e) One two-story and two one-story house drainage systems were erected to investigate the stack and wet venting of plumbing fixtures and the self-siphonage of fixture traps. The drainage systems were constructed of transparent plastic pipe and fittings so that motion pictures of the flow could be obtained and the phenomena could be observed visually.
(f) Completed.
(h) National Bureau of Standards, Building Materials and Structures Report BMS119, "Wet venting of plumbing fixtures." John L. French, Herbert N. Eaton, and Robert S. Wyly. 1950.
Special Report on "Maximum permissible unvented lengths of fixture drains." June 1, 1950.

(432) FROST CLOSURE OF THE ROOF VENTS OF PLUMBING DRAINAGE SYSTEMS.

(b) Laboratory project.
(d) Experimental and theoretical; applied research.
(e) Data have been obtained from the field and from laboratory tests, and theoretical studies have been made to provide information for code-writing authorities.
(f) Preparation of report in progress.

(433) CAPACITIES OF PLUMBING STACKS.

(b) Housing and Home Finance Agency.
(d) Experimental; applied research.
(e) To determine the capacities of plumbing stacks in buildings, a vertical stack about 60 feet high has been tested to determine flow and pressure conditions at points where horizontal branches join the stack; terminal velocities; and the distribution of water and air over the cross-section.
(g) A theoretical analysis, supplemented by experimental data, has made it possible to compute the backpressures on the horizontal drains at intermediate floors of a multi-story building when the rate and velocity of flow from the higher floors and the rate of flow from the horizontal branch in question are known. The analysis has been applied to a 3-inch stack with the horizontal drains connected to the stack with sanitary and with long-turn T-Y stack fittings.

(h) First Progress Report, "Capacities of plumbing stacks and horizontal branches." May 31, 1949.
Second Progress Report, "Capacities of plumbing stacks and horizontal branches." May 15, 1950.

(685) ORIFICE METERS.

(b) Cooperative with American Gas Association; American Society of Mechanical Engineers; and Bureau of Ships, Department of the Navy.
(c) Mr. Howard Bean, National Bureau of Standards, Washington 25, D. C.
(d) Experimental; applied research.
(e) To obtain information on installation requirements of orifices, flow nozzles, and venturi tubes, with special reference to (1) using shorter meter runs than now recommended; (2) the effects of globe and plug valves preceding an orifice; and (3) possible development of a field method of evaluating pipe roughness.
(h) NBTL- Interim Report No. 1. "Determination of the minimum length of straight pipe required between various pipe fittings and the orifice plate." Jan. 1950.
NBTL- Interim Report No. 2. "Progress on experimental evaluation of expansion factors." March 1950.
NBTL- Interim Report No. 3. "Progress on globe valve, expansion bend, and combination of valve and bend series."
(Reports available from Naval Boiler and Turbine Laboratory, Philadelphia Naval Base, Philadelphia 12, Pa).

(1005) STANDARDS FOR HOUSE SEWER PIPE.

(b) Housing and Home Finance Agency.
(d) Experimental and theoretical; applied research.
(e) The purposes are (1) to provide a nationally recognized specification of standard performance for pipes of various materials when used as house sewers and house drains; and (2) to establish standards of performance for both automatic and non-automatic food-waste-disposal units and the effect of these units on the building drainage system. Under (1) data will be gathered regarding leakage at joints, suitability of joints, resistance of joints to leakage when deflected, root penetration, moisture absorption, crushing strength, flexural strength, and resistance to the action of chemicals.
(h) First Progress Report, "Performance requirements for domestic house sewer connections and septic-tank-to-field connections." March 2, 1950.
Progress Report, "Operating characteristics of food-waste-disposal units." Dec. 29, 1950.

(1006) WIND GENERATED WAVES AND SET-UP.

(b) Laboratory project.
(d) Theoretical and experimental; basic and applied research.
(e) To determine (1) relations between wind force, fetch, depth, and wave characteristics for wind-generated waves in shallow water, and (2) relations between wind force, fetch, depth, length, wave characteristics, and set-up.
(h) "Wind tides in small closed channels." Garbis H. Keulegan. J. of Research, National Bureau of Standards, RP 2207, May 1950.

(1007) ABSORPTION AND REFLECTION OF WAVE ENERGY BY POROUS BARRIERS.

(b) Laboratory project.
(d) Experimental and theoretical; basic research.
(e) Reflection and transmission of solitary waves at vertical barriers composed of glass spheres were studied experimentally only.

(1214) PHYSICS OF FLOW IN PLUMBING SYSTEMS.

(b) Laboratory project.
(d) Theoretical and experimental; applied research.
(e) Preparation of papers giving results of plumbing research, and routine tests on plumbing fixtures, flushing devices, and joint compounds and fixture setting compounds.

(h) "Self-siphonage of fixture traps." John L. French and Herbert N. Eaton. National Bureau of Standards Building Materials and Structures Series. In press.
"Those government researchers." Herbert N. Eaton, Plumbing and Heating Business, Nov. 1950.

(1215) INVESTIGATION OF CONVENTIONAL PLUMBING SYSTEMS.

(b) Housing and Home Finance Agency.
(d) Experimental; applied research.
(e) (1) Test four single-story drainage systems with 2-inch soil stacks and 2 and 3-inch building drains complete with sink, lavatory, water closet, bathtub, food-waste-disposal unit, and in one case with laundry tray and floor drain to determine whether this size of stack can be used satisfactorily in one and two-story, single-family residences; (2) investigate the effect of fouling of fixture drains on the self-siphonage of fixture traps; (3) determine the rate of evaporation of trap seals under various conditions; (4) report on previous studies of rate of transmission of gases through trap seals; and (5) determine flow rates from customarily used fixtures in private dwellings.
(h) "The nature of fixture unit ratings as used to denote the loading characteristics of plumbing fixtures." Herbert N. Eaton and John L. French. Housing Research Paper No. 15, Housing and Home Finance Agency. In press.

(1216) RESEARCH ON PLUMBING SYSTEMS.

(b) The McPherson Foundation for Sanitary Research.
(c) Mr. Monroe M. Werner, National Bureau of Standards, Washington 25, D. C.
(d) Experimental; applied research.
(e) To study: (1) standardization of plumbing systems for trailer coaches; (2) persistence of contamination in water closet bowls; and (3) capacities of vents in plumbing drainage systems.

(1217) OPEN CHANNELS WITH UNIFORMLY DISTRIBUTED INFLOW.

(b) Laboratory project.
(d) Experimental; basic and applied research.
(e) To determine surface curves, velocity distributions, and friction laws for channels in which the inflow is uniformly distributed along the length of the channel.

(1218) TIDAL FLOW IN ENTRANCES TO RIVERS AND LAGOONS.

(b) Beach Erosion Board.
(d) Theoretical; applied research.
(e) Review of existing mathematical relations in light of their adequacy for engineering uses, and development of new relations for conditions not adequately covered.

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U. S. DEPARTMENT OF COMMERCE, WEATHER BUREAU.

Inquiries concerning Projects Nos. 1010 to 1015, incl., should be addressed to Mr. Merrill Bernard, Climatological and Hydrologic Service, U. S. Weather Bureau, Washington 25, D. C.

(1010) ELECTRONIC FLOOD ROUTING MACHINE.

(b) Laboratory project.
(d) Experimental; applied research.
(e) A basic circuit for an electronic analog computer to solve flood wave problems has been developed, and usefulness of the computer is being studied.
(g) Basic analog circuit generally satisfactory. Experiments continuing to determine possibilities of other circuits.

(1011) SHORT RANGE SNOW-MELT FORECASTING.

(b) Laboratory project.
(d) Experimental; applied research.
(e) To develop relations between streamflow resulting from melting snow and appropriate meteorological parameters. A statistical approach is being attempted.
(g) A reasonably adequate procedure has been established and is being refined and tested.

(1012) AUTOMATIC RADIO REPORTING RAIN GAGE.

(b) Laboratory project.
(d) Field test.
(e) A simple telemetering device has been constructed for use with standard recording rain gage. Necessary radio components have been assembled and the equipment will be installed for field test.

(1013) PRESSURE ACTUATED RIVER GAGE.

(b) Laboratory project.
(d) Field test.
(e) A remote indicating and recording gage constructed under contract has been satisfactorily tested for accuracy in laboratory and has been installed under field conditions for service tests.

(1014) UTILIZATION OF SOIL MOISTURE DATA IN FORECASTING STREAMFLOW.

(b) Laboratory project.
(d) Field investigation.
(e) Standard electrical resistance soil moisture and temperature equipment is being installed in selected areas. Statistical tests will be utilized to determine whether data can be used to improve forecasts of runoff from rainfall.

(1015) MEASUREMENT OF EVAPORATION.

(b) Laboratory project.
(d) Theoretical and field investigation; basic and applied research.
(e) To design a pan evaporation index station and for estimating evaporation from lakes and ground surfaces.
(g) A satisfactory correlation between pan evaporation and meteorological parameters has been demonstrated. Design of the station is well along. Studies of suitable instruments continue.

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U. S. DEPARTMENT OF THE INTERIOR, GEOLOGICAL SURVEY.

(169) UNSATURATED FLOW OF WATER IN RELATION TO GROUND-WATER RECHARGE.

(b) Laboratory project.
(c) Mr. W. O. Smith, U. S. Geological Survey, Washington 25, D. C.
(d) Experimental and theoretical; basic research.
(e) Mechanics of nonsaturated flow of water in porous bodies.
(f) Preliminary paper in progress.
(g) Certain definite relations between discharge and time have been found for uniform sand. The results appear to be independent of the grain radius.

(194) A STUDY OF METHODS USED IN THE MEASUREMENT AND ANALYSIS OF SEDIMENT LOADS IN STREAMS.

(b) Cooperative. See Project 194, page 107.

(436) SEDIMENTATION STUDIES IN INLAND WATERS.

(b) Laboratory project.
(c) Mr. W. O. Smith, U. S. Geological Survey, Washington 25, D. C.
(d) Field investigation; experimental and theoretical; applied research.
(e) (1) To investigate factors governing the deposition and distribution of bottom sediments; (2) determine their physical properties; and (3) develop accurate techniques to determine storage and ascertain what factors govern changes in storage. Extensive studies for Lake Mead, the storage reservoir behind Hoover Dam, have begun.
(f) Report in preparation.

(437) STAGE-DISCHARGE RELATIONS UNDER BACKWATER CONDITIONS.

(b) Laboratory project.
(c) Mr. W. D. Mitchell, U. S. Geological Survey, Champaign, Ill.
(d) Experimental; applied research.
(e) Analyses are being made of backwater data to test and develop methods for obtaining discharge ratings for rivers under conditions of changing backwater for use in stream gaging practice.
(g) Preliminary results indicate that present methods of preparing backwater ratings are in need of revision.
(h) Progress report on file.

(439) EFFECT OF REFORESTATION ON STREAM FLOW.

(b) Laboratory project.
(c) Mr. A. W. Harrington, U. S. Geological Survey, Albany, N. Y.
(d) Field investigation; basic research.
(e) To study effect on stream flow of growing trees on abandoned farm land. Observations of stream flow, precipitation, ground-water levels, and evaporation at three small reforested drainage basins and adjacent controls were begun in 1935.
(h) Progress reports on file show very little effect to date.

(445) SMALL RESERVOIRS IN ARID REGIONS.

(b) Laboratory project.
(c) Mr. H. V. Peterson, U. S. Geological Survey, Salt Lake City, Utah.
(d) Field investigation; applied research.
(e) To determine runoff, evaporation, seepage, and sedimentation in arid regions. Readings are being obtained on staff gages installed on a number of representative stock-watering reservoirs in western states.
(g) Progress reports on file.

(447) THERMO-TRANSFER AND ELECTRO-TRANSFER PHENOMENA IN SOILS AND SEDIMENTS AND THEIR RELATION TO GROUND-WATER RECHARGE.

(b) Laboratory project.
(c) Mr. W. O. Smith, U. S. Geological Survey, Washington 25, D. C.
(d) Experimental and theoretical; basic research.
(e) Relation of the phenomena to flow of liquids in porous bodies.

(450) ELECTROLYTIC POTENTIAL MODELS FOR SOLUTION OF PROBLEMS IN GROUND-WATER HYDRAULICS.

(b) Laboratory project.
(c) Mr. W. O. Smith, U. S. Geological Survey, Washington 25, D. C.
(d) Experimental and theoretical; applied research.
(e) Development of electrolytic potential techniques for model studies.

(690) DISCHARGE THROUGH MULTIPLE OPENINGS.

(b) Laboratory project.
(c) Mr. Tate Dalrymple, U. S. Geological Survey, Washington 25, D. C.
(d) Field investigation; applied research.
(e) Crest-stage gages are installed on upstream and downstream sides of all openings of selected bridge and valley crossings, so that study can be made of the drop through each opening and of the transverse water-surface profiles. Current-meter measurements made during the floods will be used to study relationships of discharge through each opening to the total discharge, the drop, and the conveyance.

(691) COMPUTING PEAK DISCHARGES BY INDIRECT METHODS.

(b) Laboratory project.
(c) Mr. Tate Dalrymple, U. S. Geological Survey, Washington 25, D. C.
(d) Field investigation; applied research.
(e) Establishment of maximum stage gages on slope-reaches or suitable contracted openings, computing flood discharges and comparing with measured discharge; to test adequacy of slope-area method of computing flood discharge.

(1016) INTERPRETATION OF ELECTRIC LOGS.

(b) Laboratory project.
(c) Mr. Paul H. Jones, U. S. Geological Survey, Baton Rouge, La.
(d) Experimental and theoretical; basic research.
(e) Tests are being made of various combinations of rocks and water, and physical and chemical properties are being correlated similar to the results of electric logs. Theoretical studies are being made to correlate the various factors. It is hoped that definite relationships can be established between results of electric logs, the permeability of the rocks, and the quality of the water.
(h) Report in preparation.

(1219) ELECTRICAL LOGGING INSTRUMENTS FOR GROUND-WATER WELLS.

(b) Cooperative with State of Tennessee, State of Maryland.
(c) Mr. R. M. Richardson, U. S. Geological Survey, Memphis, Tenn.
(d) Development.
(e) Development, test, and design of instruments for measuring and recording self potential, resistivity, and temperature in ground-water wells.

(1220) RELATION OF GROUND WATER TO STREAM FLOW.

(b) Laboratory project.
(c) Mr. S. L. Schoff, U. S. Geological Survey, Washington 25, D. C.
(d) Field investigation.
(e) Network of 23 observation wells in basin of Pond Creek, Okla., begun in March 1948. Water level data are to be correlated with low-water stream flow.

(1221) STEADY STATE ELECTRIC FLOW NET MODELS.

(b) Laboratory project.
(c) Mr. R. R. Bennett, U. S. Geological Survey, Washington 25, D. C.
(d) Experimental.
(e) Preparation of electrical flow net models using coloidal carbon. Boundary conditions simulate those commonly found in nature. Object is to catalogue various types of nets for future reference.

(1222) INFILTRATION AND EVAPO-TRANSPIRATION STUDY.

(b) Laboratory project.
(c) Mr. W. C. Rasmussen, U. S. Geological Survey, Washington 25, D. C.

(d) Field investigation.
(e) Weekly measurement of wells, rain gages, soil moisture, runoff and pond storage in two drainage basins near Salisbury, Md., to measure all factors in hydrologic cycle to determine infiltration, evapo-transpiration and specific yield.

(1223) EVALUATION OF HYDROLOGIC CYCLE.

(b) Laboratory project.
(c) Mr. D. S. Wallace, U. S. Geological Survey, Washington 25, D. C.
(d) Field investigation.
(e) Establishment of gaging station and network of observation wells on headwaters of Hudson Creek, Louisa Co., Va., for correlation of water levels and stream flow.

(1224) INDUCED INFILTRATION OF RIVER WATER.

(b) Laboratory project.
(c) Mr. M. I. Rorabaugh, U. S. Geological Survey, Louisville, Ky.
(d) Applied research.
(e) Analysis of records of Renney collector to determine effects of stage and temperature of river on quantity and temperature of yield.

(1225) STORM WATER INFILTRATION IN GROUND-WATER RECHARGE BASINS.

(b) Cooperative with Nassau County, L. I.
(c) Mr. M. L. Brashears, Jr., U. S. Geological Survey, Mineola, L. I.
(d) Field investigation.
(e) Observations are made of precipitation, evaporation, ground-water levels and storm water inflow into artificial recharge basins, to determine rate of infiltration and amount of storm water available for ground-water recharge when collected in recharge basins, and to evaluate effectiveness of these basins.

(1226) EVAPORATION FROM LAKES.

(b) Cooperative with Bureau of Reclamation, Navy Electronic Laboratory, Weather Bureau.
(c) Mr. R. W. Davenport, U. S. Geological Survey, Washington 25, D. C.
(d) Field investigation.
(e) Evaporation by mass transfer and energy budget principles to be tested at Lake Hefner, Okla., in relation to evaporation computed from water budget, to develop techniques for determining evaporation from reservoir using meteorologic and limnologic data.

(1227) STOCK-WATER RESERVOIR STUDIES.

(b) Cooperative with Bureau of Reclamation.
(c) Mr. R. C. Culler, U. S. Geological Survey, Salt Lake City, Utah.
(d) Field investigation.
(e) Development of techniques for determination of effects of stock-water reservoirs on water supply. Detailed surveys made of number, capacity and performance of reservoirs in the Cheyenne River Basin in Wyoming, will be analyzed to determine evaporation, transpiration, and seepage losses and their effect on flow of Cheyenne River.

(1228) RIVER BASIN SEDIMENTATION STUDIES.

(b) Cooperative with Bureau of Land Management, Forest Service.
(c) Mr. N. J. King, U. S. Geological Survey, Salt Lake City, Utah.
(d) Field investigation.
(e) To determkne effect of geology, soils, topography, and vegetative cover on erosion and to appraise the effect of various types of land trestment on erosion abatement. San Rafael Basin, Colorado Basin, Utah, has been established as a pilot sediment study area.
(f) Preliminary reports in preparation.

(1229) GLACIER RUNOFF.

(b) Laboratory project.
(c) Mr. C. S. Heidel, U. S. Geological Survey, Helena, Mont.
(d) Field investigation.
(e) Study of recession and accretion of Grinnel Glacier, Mont. Glacier mapped annually for some years, storage rain gage and stream gaging station installed in 1949.

(1230) EFFECT OF LOGGING ON STREAM FLOW.

(b) Cities of Tacoma and Seattle.
(c) Mr. F. M. Veatch, U. S. Geological Survey, Tacoma, Wash.
(d) Field investigation.
(e) Operation of seven gaging stations on small streams in areas where logging operations are scheduled in several years. There are control basins where no timber will be cut.

(1231) CATHODIC PROTECTION OF BURIED PIPE AGAINST CORROSION.

(b) Laboratory project.
(c) Mr. R. P. Smith, U. S. Geological Survey, Baton Rouge, La.
(d) Field investigation.
(e) Magnesium anodes are to be installed at several gaging stations where corrosion of pipe wells or intake pipes has required frequent replacement. Anodes and pipes are to be inspected annually to determine rate of loss of magnesium and to observe extent of corrosion.

(1232) VELOCITY VANE.

(b) University Florida Engineering Experiment Station.
(c) Mr. N. D. Bourke, University of Florida, Gainesville, Fla.
(d) Laboratory and field investigation.
(e) Development of a vane to measure direction and rate of water movement in drainage canals in southern Florida. Field model now under test.

(1233) MAGNITUDE AND FREQUENCY OF FLOODS.

(b) Cooperative with several stete agencies.
(c) Mr. Tate Dalrymple, U. S. Geological Survey, Washington 25, D. C.
(d) Applied research.
(e) Analyses of flood records to determine magnitude and frequency of flood discharge at gaging stations, and at supplementary network of crest-stage gages on small streams, to determine techniques for establishing flood discharges on ungaged streams.

(1234) INVESTIGATION OF APPARATUS FOR MEASURING BED LOAD.

(b) Laboratory project.
(c) Mr. P. C. Benedict, U. S. Geological Survey, Lincoln, Neb.
(d) Field investigation; theoretical studies.
(e) Construction of apparatus for measuring bed load, consisting of concrete flume with baffles to induce turbulence, thereby throwing entire sediment load into suspension. Comparison of sediment concentrations at upstream side of flume with those measured at downstream side of flume.
(h) "Construction of an apparatus for the measurement of bedload in Middle Loup River at Dunning, Nebraska." R. E. Oltman and R. B. Vice, Geological Survey, Water Resources Bulletin, Nov. 1949.

(1235) INVESTIGATIONS OF FLUVIAL SEDIMENTS FOR DETERMINING BED LOAD.

(b) Laboratory project.
(c) Mr. P. C. Benedict, U. S. Geological Survey, Lincoln, Neb.
(d) Field investigations; theoretical studies.

(e) Comparison of sediment concentrations at a naturally contracted section on Niobrara River near Cody, Nebraska with those measured at regular gaging station 1/4-mile upstream.
(h) Progress Report, "Investigations of fluvial sediments of the Niobrara River near Cody, Nebraska." Eugene F. Serr III. Geological Survey 67, May 1950.

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U. S. DEPARTMENT OF THE INTERIOR, BUREAU OF RECLAMATION.

Inquiries concerning Projects Nos. 460, 461, 462, 463, 698, 704, 705, 1021 to 1026, incl., 1028, 1029, 1030, 1032, 1033, 1034, and 1236 to 1267, incl., should be addressed to the Chief Engineer, Bureau of Reclamation, Denver Federal Center, Denver, Colorado.

(460) HEART BUTTE DAM SPILLWAY AND OUTLET WORKS.

(b) Laboratory project.
(d) Experimental; for design.
(e) A 1:21.5 model was used to study critical features of the uncontrolled morning-glory spillway combined with outlet gates and tunnel, particularly the prevention of serious vortices and cavitation erosion in the spillway throat and transition.
(f) Completed.
(h) Report being prepared.

(461) BOYSEN DAM SPILLWAY.

(b) Laboratory project.
(d) Experimental; for design.
(e) A 1:60 model was used for the crest discharge calibration, chute, and stilling basin studies of a preliminary design.
(f) Completed.
(g) Adequacy and efficiency of the hydraulic design as modified by exigencies of construction conditions were determined.
(h) Report No. Hyd-212, "Hydraulic model studies of Boysen Dam spillway." G. L. Beichley.

(462) BOYSEN DAM OUTLET WORKS.

(b) Laboratory project.
(d) Experimental; for design.
(e) A 1:16 model was used to conduct the studies of the discharge of two hollow-jet valves into a stilling pool.
(f) Completed.
(g) Directing the valves downward at an angle into a relative deep pool, together with special shaping of the basin walls, developed an effective outlet works.
(h) Report No. Hyd-283, "Hydraulic model studies of the outlet works--Boysen Dam--Missouri River Basin Project." E. J. Rusho.

(463) DAVIS DAM SPILLWAY.

(b) Laboratory project.
(d) Experimental; for design.
(e) A 1:72 model was used in the investigation of roller buckets, sloping aprons, and stilling basins to determine the most effective and economical design of the spillway, the possible retrogression of streambed in the future being taken into consideration. The diversion scheme for construction purposes was tested.
(f) Completed.
(g) Type and proportions of spillway stilling device were determined; rectangular-type stilling basin proved most feasible for the receding tail water which could be expected.
(h) Report being prepared.

(698) SPRING CREEK DAM OUTLET WORKS.

(b) Laboratory project.
(d) Experimental; for design.
(e) A 1:7.43 model was used to study the applicability of a jet-flow regulating gate in controlling medium-head normal flow discharging into the elbow of the combination spillway and outlet works. Aeration was the principal subject.
(f) Completed.
(g) Four 8-inch air intake openings, two on either side, one near the top of and one near the bottom of the rectangular outlet tunnel, provided adequate aeration. The outlet tunnel was curved downward to follow the path of a free jet propelled by the normal water-surface head.
(h) Report being prepared.

(704) CEDAR BLUFF DAM SPILLWAY.

(b) Laboratory project.
(d) Experimental; for design.
(e) A 1:48 model was used to determine the hydraulic characteristics of an uncontrolled spillway crest, a short tube for outlet of normal flow, and the attendant stilling basin.
(f) Completed.
(g) Short-tube outlets through crest section were developed that did not have large negative pressures. Spillway crest had negative pressures on downstream side to increase the coefficient of discharge.
(h) Report being prepared.

(705) HUNGRY HORSE DAM SPILLWAY.

(b) Laboratory project.
(d) Experimental; for design.
(e) A 1:36 model of a morning-glory-type spillway is being tested to develop satisfactory hydraulic characteristics of critical features such as the crest, elbows, tunnels, and stilling basins.
(g) The principal problems have been the determination of a satisfactory crest shape and aeration to prevent cavitation erosion. A basic hydraulic investigation project is set up utilizing a circular, sharp-crested weir to determine the coordinates of the nappe of a morning-glory-type spillway discharge from basic data.

(1021) KEYHOLE DAM SPILLWAY.

(b) Laboratory project.
(d) Experimental; for design.
(e) Tests were made on a 1:24 model of an uncontrolled spillway for the earth dam to arrive at the proper proportions of the gate crest, the long incline chute, and the ski-jump bucket discharging into the riverbed downstream.
(f) Completed.
(g) A satisfactory spillway crest, chute and ski-jump bucket, that will throw the trajectory far enough downstream to prevent the undermining of the spillway structure, have been developed.
(h) Report No. 271, "Hydraulic model studies of Keyhole Dam spillway." G. L. Beichley.

(1022) KEYHOLE DAM OUTLET WORKS.

(b) Laboratory project.
(d) Experimental; for design.
(e) A 1:20 model of the outlet works, consisting of two rectangular slide gates discharging into a horseshoe tunnel which in turn discharges into a rectangular stilling basin, was investigated for hydraulic performance.
(f) Completed.

(g) A ridge down the center of the invert of the tunnel will be required to straighten out the flow which discharges into the stilling basin. A schedule of operation of the gates is being prepared.
(h) Report being prepared.

(1023) FALCON DAM SPILLWAY.

(b) International Boundary and Water Commission.
(d) Experimental; for design.
(e) A 1:130 model of the Falcon Dam on the Rio Grande was tested to determine the hydraulic performance of the spillway and the spillway channel leading to the river, together with the effect of small and large floods on the river channel below the dam, and the effect of floods on the powerhouses, both on the United States side and the Mexican side.
(f) Completed.
(g) Spur-type walls were added below the stilling basin to prevent erosion; the shape of the pier separating the spillway and intake was changed to reduce draw-down, and the training walls were raised to prevent overtopping.
(h) Report Hyd-276, "Hydraulic model studies of Falcon Dam." A. S. Reinhart. July 1950. (Available on loan.)

(1024) FALCON DAM, UNITED STATES OUTLET WORKS.

(b) International Boundary and Water Commission.
(d) Experimental; for design.
(e) A 1:24 model of the stilling basin and two hollow-jet valves discharging at an angle of about 30° downward into the pool, has given good hydraulic performance. Proportions of the stilling basin were developed for the most economic use.
(f) Completed.
(g) It was found possible to remove a center wall in the stilling basin. Other dimensions of the basin were selected on a basis of hydraulic performance.
(h) Report No. Hyd-276, "Hydraulic model studies of Falcon Dam." A. S. Reinhart. July 1950. (Available on loan.)

(1025) FALCON DAM, MEXICAN OUTLET WORKS.

(b) International Boundary and Water Commission.
(d) Experimental; for design.
(e) A 1:30 model of the outlet works, consisting of two 3-inch hollow-jet valves discharging on an inclined position downward into a stilling basin, was investigated for hydraulic performance. A companion project to the Falcon Dam, United States outlet works study that was made on a slightly different scale.
(f) Completed.
(g) Dimensions of the stilling basin that performed best hydraulically were obtained.
(h) Report Hyd-276, "Hydraulic model studies of Falcon Dam." A. S. Reinhart, July 1950. (Available on loan.)

(1026) SHADEHILL DAM SPILLWAY.

(b) Laboratory project.
(d) Experimental; for design.
(e) A 1:20.73 model of a morning-glory-type spillway for the Shadehill earth dam was investigated for hydraulic performance.
(f) Completed.
(g) The morning-glory spillway was enlarged to increase the discharge. No low pressures existed in the structure and air was not supplied to the crest. Piers were used on the crest to reduce vortices.
(h) Report being prepared.

(1028) HYDRAULIC PERFORMANCE TESTS ON IRRIGATION WATER METERING DEVICES.

(b) Laboratory project.
(d) Experimental; for design.
(e) Studies of metering devices proposed for use in canal turnouts and in irrigation pipe line distribution systems to determine their hydraulic characteristics for design purposes. Among those being investigated are four sizes of meter gates, four sizes of Fresno venturi meters, and two sizes of a modified venturi-type meter used by the Consolidated Irrigation District of California. Principal points of study are the coefficients of discharge, pressure losses, adaptability of the devices for a wide range of application in open channel as well as closed conduit distribution systems.

(1029) TIETON DAM SPILLWAY.

(b) Laboratory project.
(d) Experimental; for rehabilitation.
(e) A 1:42 model was used in the design for the rehabilitation of a side-channel spillway to study diversion of high-velocity spillway discharge through a relatively short radius bend into the riverbed.
(f) Completed.
(g) The left wall of the spillway channel was warped from a 1/2:1 slope to vertical and the vertical wall was extended and curved to deflect the flow toward the river channel.
(h) Report being prepared.

(1030) OCHOCO DAM SPILLWAY.

(b) Laboratory project.
(d) Experimental; for rehabilitation.
(e) A 1:36 model was used to develop a method of diverting high-velocity spillway discharge through an angle of approximately 15° and away from the toe of the chute to protect a hillside from erosion and the chute from being undermined.
(f) Completed.
(g) Diversion of discharge was accomplished by the use of curved deflector piers at the end of the chute.
(h) Report being prepared.

(1032) TECOLOTE TUNNEL.

(b) Laboratory project.
(d) Experimental; for design.
(e) A satisfactory means of dissipating the energy from the high-velocity jet from the water-regulating valve located in the tunnel was accomplished using a 1:10 model.
(f) Completed.
(g) The phototype design, instead of the conventional stilling basin, will incorporate two baffles in the tunnel and a valve discharge guide with a tube valve discharging submerged.
(h) Report No. Hyd-287, "Hydraulic model studies of methods to dissipate the high-velocity jet from the regulating valve in Tecolote Tunnel--Santa Barbara Project, California." L. R. Thompson.

(1033) ANCHOR DAM SPILLWAY.

(b) Laboratory project.
(d) Experimental; for design.
(e) A 1:30 model was used to determine hydraulic characteristics of an overfall spillway for the concrete arch dam and the erosive action in the river channel and to determine the best bucket profile.
(f) Completed.
(g) Recommended design included a 5-percent vacuum crest with a 6.67-foot corbel, a maximum spillway slope of 0.37, a parabolic bucket with wide drain slots at the exit, and training walls which converge to make the bucket 70 feet wide at the exit.
(h) Report No. Hyd-289, "Hydraulic model studies of the spillway and outlet works of Anchor Dam--Owl Creek Unit--Missouri River Basin Project." W. P. Simmons, Jr.

(1034) EROSION TESTS ON EARTH SAMPLES TAKEN FROM PROPOSED SITES OF EMERGENCY SPILLWAYS.

(b) Laboratory project.
(d) Experimental; for design.
(e) To determine the erosion resistance of various earth material samples when subjected to moderate water velocities, using a laboratory rig capable of producing velocities of from 1 to 16 feet per second.
(g) Results vary and are given in a separate report on each project.
(h) Reports available on loan are:
Report No. Hyd-265, "Erosion tests on Narrows Dam site Foundation Sample No. 9B-1040 taken from Test Pit No. 3 at an elevation of 4373.7 feet--Emergency spillway--Narrows Dam--Missouri River Basin Project." Dec. 1949.
Report No. Hyd-266, "Erosion tests on earth Samples No. 14G-571, 658, and 661, representing various strata through which the proposed unlined emergency spillway channel will pass-Cannonball Dam site--Elgin Axis--Missouri River Basin Project." Dec. 1949.
Report No. Hyd-269, "Erosion tests on earth Samples No. 13P-94, 96, and 97, taken at elevation 3542.0 from two suggested sites for an auxiliary spillway--Moorhead Dam--Missouri River Basin Project." Dec. 1949.
Report No. Hyd-272, "Erosion tests on an earth sample taken at elevation 4065.3 on the spillway centerline 70 feet downstream from the end of the proposed spillway--Keyhole Dam--Missouri River Basin Project." Feb. 1950.
(All reports written by W. P. Simmons, Jr.)

(1236) WILLOW CREEK DAM EMERGENCY SPILLWAY.

(b) Experimental; for design.
(e) A 1:15 model was used to check the performance of the U-shape side channel spillway, for crest discharge calibration; and to determine the usefulness of a deflector bucket at end of the concrete spillway channel.
(f) Completed.
(g) The floor of the U-shape side channel spillway was lowered slightly at the upstream end of the channel and made to slope uniformly to reduce construction cost without loss of spillway capacity due to submergence. The deflector bucket at downstream end of channel was abandoned due to insufficient velocity for it to be of benefit in throwing the flow away from the structure.
(h) Report being prepared.

(1237) OLYMPUS DAM SPILLWAY.

(b) Laboratory project.
(d) Experimental; for design.
(e) A 1:36 model was used for discharge calibration and to study the flow through the stilling basin.
(f) Completed.
(g) An intermediate training wall which was to provide a stilling basin for small discharges through the left hand bay of the spillway was found to be unnecessary as small discharges could be passed through the center bay into the full-size stilling basin.
(h) Report being prepared.

(1238) MEDICINE CREEK OUTLET WORKS.

(b) Laboratory project.
(d) Experimental; for design.
(e) A 1:12 model was used to develop a satisfactory stilling basin and to check the performance of a modified type of slide gate.
(f) Completed.
(g) The downstream gate frame was modified to permit aeration of the jet and the proportions of the stilling basin and transition were determined.
(h) Report No. Hyd-273, "Hydraulic model studies of the outlet works, Medicine Creek Dam." W. E. Wagner.

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(1239) CIRCULAR WEIR STUDIES.

(b) Laboratory project.
(d) Experimental; basic research and for design.
(e) A circular sharp-crested weir is used to determine the under and upper nappe of the jet with varying heads, different velocities of approach and varying degrees of vacuum under the nappe.
(g) Shapes of upper and under nappe of jet with vacuums from 0 to 40 percent of head and negligible velocity of approach have been determined.

(1240) SOLDIER CANYON OUTLET WORKS.

(b) Laboratory project.
(d) Experimental; for design.
(e) A 1:4.67 and 1:6 model were used to study the discharge of a butterfly valve and a commercial pivot valve into a stilling pool.
(f) Completed.
(g) A hood, which served to confine the spray from the pivot valve and direct the flow into the stilling pool, was developed.
(h) Report being prepared.

(1241) WELLTON-MOHAWK CANAL STRUCTURES.

(b) Laboratory project.
(d) Experimental; for design.
(e) Three models, a 1:24 and two 1:12, were used to develop an adequate hydraulic jump and system of baffle piers for lowering the canal flow from the stilling pool to a degrading channel.
(f) Completed.
(g) A hydraulic jump was the most economical means of dissipating the energy of the jet, followed by staggered rows of baffle piers for lowering the flow to the degrading channel. As channel degrades, more baffle piers are uncovered, or, if necessary, the 2.1 slope and baffle piers may be extended.
(h) Report being prepared.

(1242) TIBER DAM SPILLWAY.

(b) Laboratory project.
(d) Experimental; for design.
(e) A 1:48 scale model of the spillway was built to study hydraulic performance and aid in obtaining a satisfactory design.
(f) Completed.
(g) Training walls were realigned and a crown added to the spillway chute floor to secure better flow distribution in the stilling basin.
(h) Report being prepared.

(1243) RECTANGULAR SEMIBELLMOUTH ENTRANCE STUDIES.

(b) Laboratory project.
(d) Experimental; for development.
(e) Piezometric pressures on the roof of a rectangular semibellmouth entrance are being studied to determine what shape will best prevent negative pressures. Five entrances have been tested to date, using air as a fluid.

(1244) WILLOW CREEK DAM SPILLWAY AND OUTLET WORKS.

(b) Laboratory project.
(d) Experimental; for design.
(e) A 1:16 model of the combined spillway and outlet works is being used to determine flow patterns in the conduit, erosion in the riprapped stilling basin, and to develop a canal turnout in the ski-jump bucket to provide a required minimum discharge for all flows through the main conduit.

1245) DISCHARGE MEASURING SYSTEM FOR ALVA B. ADAMS TUNNEL.

(b) Laboratory project.
(d) Experimental; for operation.
(e) A 1:10 scale hydraulic model of the tunnel near the entrance portal was used to develop a satisfactory discharge measuring system.
(f) Completed.
(g) The curve weir developed provided an accurate means of measuring the discharge and had a low energy loss at the maximum discharge. Flow conditions immediately downstream of the gates were greatly improved.
(h) Report being prepared.

1246) CACHUMA DAM SPILLWAY.

(b) Laboratory project.
(d) Experimental; for design.
(e) A 1:60 scale hydraulic model of the spillway was used to study the performance of the proposed design.
(g) The right approach area was modified to improve the flow distribution. Chute walls were moved and a crown incorporated in a section of the chute floor, resulting in a better flow distribution in the stilling basin and a decrease in the amount of concrete required.

1247) RUBBER GATE SEAL DEVELOPMENT FOR HIGH HEAD STRUCTURAL STEEL GATES.

(b) Laboratory project.
(d) Experimental; for design.
(e) To develop an improved rubber gate seal for high head gates to replace the unsatisfactory "music note" shape seal, using a rig capable of testing a 12-inch length of full-size seals at heads to 200 feet.
(g) A double stem type of rubber seal is superior to the "music note" seal.

1248) HIGH VELOCITY TURNOUTS.

(b) Laboratory project.
(d) Experimental; for design.
(e) To verify by laboratory tests the formulae used in a general design procedure for vertical stilling wells, both square and circular in section.

1249) FISH SCREENS.

(b) Laboratory projects.
(d) Experimental; for design.
(e) To determine loss in head for proposed perforated 16-gage steel-plate fish screen compared with head loss for a standard 5-mesh, 19-gage wire screen.
(f) Completed.
(g) The loss in head through the perforated screen is several times higher than the loss through the standard screen at vertical and 45° screen positions.
(h) Report No. Hyd-274, "Fish screen head loss-Perforated 16-gage steel plate (5/32-inch holes staggered on 7/32-inch centers) versus 5-mesh, 19-gage galvanized wire--Tracy Pumping Plant Intake--Central Valley Project." Wiley J. Karrh, March 1950. (Available on loan.)

1250) PROTECTIVE HOOD FOR FLAP VALVES OF CANAL UNDERDRAIN SYSTEMS.

(b) Laboratory project.
(d) Experimental; for design.
(e) To develop a concrete protective hood for flap valves of canal underdrain systems which will provide impact protection, prevent sediment deposition against the flap valve, and prevent malfunctioning of the valve flap due to biological growth.
(f) Completed.

(g) A protective hood was developed in the laboratory but no substantiating data are available from field installations.
(h) Report No. Hyd-270, "A study of hydraulic characteristics of an unreinforced concrete protective hood for canal lining underdrain flap valves of the Wellton-Mohawk Canal--Gila Project, Arizona." J. C. Schuster. Jan. 1950. (Available on loan.)

(1251) PRESSURE REGULATOR--GRAND COULEE DAM POWER PLANT TRANSFORMER COOLING WATER.

(b) Laboratory project.
(d) Experimental; for modification of existing equipment.
(e) Pressure-regulating valves to reduce the penstock head to the working pressures of the transformers for cooling at the Grand Coulee Power Plant require excessive maintenance. A study was made to eliminate the pressure-regulating valves by substituting thin plate orifices and a plug valve in the pipe line.
(f) Completed.
(g) Substitution can be made provided the back pressure is maintained above the critical pressure which produces cavitation in the system.
(h) Report being prepared.

(1252) CAVITATION-FREE OPERATION OF REGULATING GATES.

(b) Laboratory project.
(d) Experimental; for design.
(e) A general study to develop design criteria for cavitation-free operation of regulating gates in closed conduit irrigation distribution systems.
(g) A method of computing the required back pressure to prevent cavitation was obtained by use of parameters which were affected by a flow pattern change due to cavitation and which indicated system efficiency.
(h) Report being prepared.

(1253) TRENTON DAM SPILLWAY.

(b) Laboratory project.
(d) Experimental; for design.
(e) A 1:54 model was used to investigate the over-all hydraulic characteristics of the spillway including entrance to overflow section, spillway chute, stilling basin, and erosion downstream of the basin.
(g) Principal development is a cantilevered wing wall, which forms the upstream extension of the training wall on either side of the crest, to minimize the troublesome flow contraction which causes a nonuniform flow distribution through overflow section. This wall extension reaches farther upstream at the top than at the bottom, the leading edge being undercut toward the spillway crest.
(h) Report being prepared.

(1254) VIBRATION--KEECHELUS DAM OUTLET WORKS TOWER.

(b) Laboratory project.
(d) Experimental; for field operation.
(e) A 1:15 model was used to investigate a serious vibration of the field structure. The results are to be used in rehabilitating the existing tower.
(g) Three possible causes of vibration have been determined; vibration of the cylinder gates controlling flow from the tower, negative pressures occurring at entrance to the discharge conduit, and extreme turbulence within the outlet works tower. The latter is believed to be the principal cause and the investigation is proceeding toward reducing this turbulence.
(h) Report being prepared.

(1255) PALISADES DAM RECTANGULAR REGULATING GATES.

(b) Laboratory project.
(d) Experimental; for design.

(e) A 1:19 model was used to develop a rectangular, downstream seal, regulating slide gate suitable for use at heads up to 240 feet and capable of discharging a smooth, even stream into closed or open conduit or on a spillway. Particular attention was directed to the gate slots using a 1:2 sectional model.
(g) A gate was developed which discharged the desired smooth stream at a discharge coefficient of 0.95 when full open. A slot design was obtained which, when the gate discharges into the atmosphere at a 240 head, produces pressures no lower than minus 1 foot of water.
(h) Report being prepared.

1256) TRENTON DAM CANAL OUTLET WORKS.

(b) Laboratory project.
(d) Experimental; for design.
(e) A 1:12 model was used to determine the feasibility of the modified high-pressure slide gate for regulating under submerged conditions and to determine the effectiveness of the side entry, vertical stilling well in dissipating the destructive energy of the released water.
(g) The modified slide gate can be safely used submerged at the conditions encountered, and the stilling well, with a properly designed baffle, dissipates the destructive energy of the water.
(h) Report being prepared.

1257) SURGING-IRRIGATION WATER DISTRIBUTION SYSTEM.

(b) Laboratory project.
(d) Field investigation; for operation.
(e) To determine the cause and remedy of water surface surging in open stands--to be specifically applied to the Coachella Distribution System, California.
(g) Air carried into the system where the water falls from a weir into the downstream side of a pipe stand is a primary cause of the surging. Airtight lids for the stands vented to limit negative pressures within the stand to certain limits, stop or greatly reduce the surging. Pipe line vents, regulating gates, and circular weirs were much less effective than the lids. Studies are in progress to determine, for various heights of fall of the nappe, the depth of water cushion required to allow entrained air to separate from the water.

(1258) PALISADES DAM DIVERSION SCHEME--OUTLET WORKS AND SPILLWAY.

(b) Laboratory project.
(d) Experimental; for design.
(e) To develop a stilling basin suitable for the diversion scheme, a spillway design, and to study the over-all flow characteristics of the combined units of powerhouse, outlet works, and spillway.

(1259) FLATIRON STILLING BASIN--POWER AND PUMPING PLANT--COLORADO-BIG THOMPSON PROJECT.

(b) Laboratory project.
(d) Experimental; for design.
(e) To develop a stilling basin for the pump turbine bypass valve in the Flatiron Powerhouse.
(g) Preliminary tests show a submerged tube valve is much preferred to a nonsubmerged hollow-jet valve.

(1260) SUPERIOR-COURTLAND DIVERSION DAM, HEADWORKS AND SLUICEWAY STRUCTURES.

(b) Laboratory project.
(d) Experimental; for design.
(e) Tests on a 1:15 model of headworks and sluiceway structures were made to improve sediment-excluding characteristics.
(f) Completed.

(g) Large reduction in sediment load drawn into the canal is obtained by use of guide walls.
(h) Report No. Hyd-275, "Hydraulic model studies of Superior-Courtland Diversion Dam, Headworks and Sluiceway Structures--Progress Report No. 1 on General Studies of Headworks and Sluiceway Structures." O. S. Hanson. March 1950. (Available on loan.)

(1261) REPUBLIC DIVERSION DAM, HEADWORKS AND SLUICEWAY STRUCTURES.

(b) Laboratory project.
(d) Experimental; for design.
(e) Tests on a 1:15 model of headworks and sluiceway structures were used to improve sediment-excluding characteristics. A continuation of the work begun under Superior-Courtland Diversion Dam studies.
(g) Guide walls were found less effective than on previous studies due to lower discharges and velocities. A headworks incorporating vortex tube desanding apparatus is now being tested.

(1262) SHEEP CREEK DIVERSION SEDIMENTATION BASIN.

(b) Laboratory project.
(d) Experimental; for design.
(e) Tests on a 1:9 model of a sedimentation basin are being conducted to determine the modifications required to improve the efficiency of the basin. Tests will also be made on prototype structure to determine additional data on model-prototype relationships for movable bed models.

(1263) FORT LARAMIE CANAL SEDIMENTATION BASIN.

(b) Laboratory project.
(d) Experimental; for design.
(e) A 1:120 model of sedimentation basin was tested to check the design of modifications to be made on existing basin to improve the sluicing characteristics.
(f) Completed.
(g) Location and alignment of the guide wall was determined to improve flow distributuion through basin during sluicing operations.
(h) Report being prepared.

(1264) VORTEX TUBE.

(b) Laboratory project.
(d) Experimental; for design.
(e) A program of general testing to obtain additional information for design criteria for a vortex tube desanding apparatus. A horizontal vane with a gradually expanding cross section is used to increase the velocity over the vortex tube to obtain better action in canals having low water velocities.

(1265) STABLE CHANNEL SHAPES.

(b) Laboratory project.
(d) Theoretical; for design.
(e) An analytical and theoretical study to obtain data for the design of nonscouring and nonsilting canals in erodible material. A theoretical study is being made to find a channel shape giving equal force on particles on channel bottom and sides. An analytical study is being made of existing data on critical tractive forces for various materials and velocity distribution in various shaped channels.
(h) Reports available on loan are: Report No. Hyd-292, "The stable channel problem for coarse material." R. E. Glover, March 1949.
Report No. Hyd-293, "Principle of design of stable channels in erodible materials." E. W. Lane. Feb. 1950.
Report No. Hyd-294, "Proposed program of studies to develop methods of design of stable channels in erodible material. E. W. Lane. Jan. 1950.
Report No. Hyd-295, "Critical tractive forces on channel side slopes." A. C. Carter. May 1950.

Report No. Hyd-296, "Critical tractive forces which start movement of sediment in a channel." A. C. Carter. May 1950.
Report No. Hyd-299, "Angle of repose of noncohesive material." A. C. Carter. Oct. 1950.

(1266) DEVELOPMENT OF THE SALT VELOCITY METHOD OF WATER MEASUREMENT.

(b) Laboratory project.
(d) Experimental; development.
(e) Proposed developments include an electrically controlled volumetric injection apparatus for field test use, electrodes practical for field tests which will produce results of the desired accuracy, and a correlation between the original electrical conductivity of the water and the quantity and density of brine needed to produce the required increase in conductivity for detection by a low potential circuit (from 3 to 15 volts) containing a balanced bridge. A study of brine cloud behavior for varying brine density and varying Reynold's number will be made to aid in electrode design.

(1267) ANALOG COMPUTER MODEL OF SACRAMENTO-SAN JOAQUIN DELTA.

(b) Laboratory project.
(d) Experimental; for design and operation.
(e) To expedite computations of tidal flow distribution in the complex array of channels forming the Delta.
(f) Completed.
(g) Location, size, and capacity of a proposed artificial channel were established and the possibilities of tidal pumping were evaluated.
(h) Paper presented at meeting of Hydraulic Division; ASCE, Jackson Miss. Nov. 1 to 3, 1950. (Available on loan.)

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U. S. DEPARTMENT OF THE NAVY, DAVID TAYLOR MODEL BASIN.

Inquiries concerning Projects Nos. 178, 467, 468, 470, 709, 710, 711, and 1268 should be addressed to The Director, David Taylor Model Basin, Department of the Navy, Washington 7, D. C.

(178) VORTEX-EXCITED VIBRATIONS OF CIRCULAR CYLINDERS.

(b) Laboratory project.
(d) Experimental and theoretical; basic research.
(e) To obtain correlations of drag, side force, and vortex configurations of vibrating cylinders, including the effect of forced vibrations on the resulting vortex formation. The experiments will be conducted in a special miniature model basin in which continuous force measurements will be recorded of the free and forced oscillations of the cylinders.
(f) The construction of the miniature model basin is about three-fourths complete.

(467) MEASUREMENT OF TURBULENCE IN WATER.

(b) Laboratory project.
(d) Experimental and theoretical; basic research.
(e) To investigate experimental and theoretical methods of describing turbulence in water. The first phases have been primarily concerned with the development of experimental methods for measuring the turbulence parameters. A hot-wire instrument has been developed, which in exploratory tests gave excellent results in measurement of turbulence behind grids. A dye diffusion method has also been used with success in checking hot-wire measurements. Attempts to measure turbulence by the electro-magnetic methods and by photographing neutrally-buoyant oil-base particles injected into the stream have been discontinued. At present work is in progress to perfect the hot-wire technique to permit the measurement of velocity correlations and the intensity of turbulence in water.

(h) "Progress report on research in frictional resistance." TMB Report 726, Sept. 1950, which includes:
"Recent progress in hot-wire measurement of turbulence in water." M. S. Macovsky and W. L. Stracke. --- "Model basin turbulence." M. S. Macovsky and J. P. Breslin. --- "The development of a turbulence indicator for liquids utilizing magnetic induction." A. Borden.
TMB Report 743, Nov. 1950.

(468) FRICTIONAL RESISTANCE RESEARCH.

(b) Laboratory project.
(d) Experimental and theoretical; basic research.
(e) An extensive program to find more precise information about frictional resistance of ship models, with particular emphasis on the boundary layer about hydrodynamic forms and means for stimulating turbulence. Instrumentation has been developed for detecting transition, for measuring the intensity of turbulence and for measuring boundary-layer thickness. The following special studies will be made: a study of the boundary layer flow on flat plates under various conditions of stimulation, with and without artificially imposed pressure gradients; a study of the effect curvature on frictional resistance; experimental and theoretical studies of the effect of pressure gradients on bodies of revolution on the boundary layer flow and frictional resistance; study of the effect of transverse curvature on frictional resistance; theoretical and experimental research on methods for characterizing hydraulic roughness of surfaces and for measuring the frictional resistance of such surfaces. Also short program to measure the resistance of various types of paints for ship hulls.
(g) The hot-wire anemometer is being used successfully for measuring boundary-layer thickness and transition to turbulent flow on flat plates and on ship models.
(h) "Effects of turbulence stimulators on the boundary layer and resistance of a ship model as detected by hot wires." John P. Breslin and Morris S. Macovsky, TMB Report 724, Aug. 1950.
"Progress report on research in frictional resistance." TMB Report 726, Sept. 1950, which includes:
"Notes on studies of the resistance of hydraulically-rough surfaces." P. Eisenberg --- "A review of the theory of the frictional resistance of a smooth flat plate with turbulent boundary layer." L. Landweber --- "Effect of transverse curvature on frictional resistance." W. M. Ellsworth. --- "Boundary layer and drag of bodies of revolution." P. S. Granville. --- "Effects of turbulence stimulation on the boundary layer and resistance of a ship model as detected by hot wires." J. P. Breslin and M. S. Macovsky. --- "Experimentation to develop suitable methods for stimulating turbulent flow about ship models." R. B. Couch and W. B. Hinterthan. --- "On the acoustic stimulation of turbulence." M. St. Denis.

(470) ELECTROLYTIC TANK.

(b) Laboratory project.
(d) Experimental; applied research.
(e) An electrolytic tank has been built for studying the flow and pressure distribution about two and three-dimensional hydrodynamic forms using the method of electric analogy.
(g) Velocity distributions about cylinders and bodies of revolution have been measured with an accuracy within 2 percent. The method is being extended to probe about three dimensional bodies with only a single plane of symmetry.

(709) THEORY OF WAVE RESISTANCE.

(b) Laboratory project.
(d) Theoretical and experimental; basic research.
(e) A synopsis has been written on the application of theory to the calculation of wave resistance. Notwithstanding serious limitations of the theory, its application to practical problems is promising.

Calculations are being made to give general information about the wave resistance of submerged bodies of revolution moving near a free surface. The work is based on the theory developed by T. H. Havelock. The forms considered are ellipsoids, Rankins ovals, and a simple family of streamline bodies.

(h) "Analysis of wave resistance." George P. Weinblum. TMB Report No. 710, Sept. 1950.

(710) TEST OF MAIN INJECTION SCOOPS AND OVERBOARD DISCHARGES.

(b) Bureau of Ships, Department of the Navy.
(d) Experimental; for design.
(e) Model tests to improve designs for greater efficiency. Measurements will be made of the flow, the velocity head, and the drag for different boundary layer conditions. Attempts will be made to scale the boundary layer on the model to simulate the velocity distribution along the keel of the ship. Plans are being made for a systematic study of different designs. Preliminary two-dimensional studies will be made of entrance and ejection forms in a bentonite channel.
(g) "Comments and calculations on the problem of the condenser scoop." W. Spannhake. TMB Report to be published soon.
"Progress Report: Research on main injection scoops and overboard discharges." J. P. Breslin. TMB Report to be published soon.

(711) CAVITATION RESEARCH.

(b) Laboratory project.
(d) Experimental and theoretical; basic research.
(e) To investigate cavitation as affected by air content and quality of the water. Second phase is concerned with the steady state cavity formed behind a bluff obstacle in a stream. The shape of the bubble, the pressure gradients and temperatures within the bubble, and drag of various shapes in a cavity have been measured. The work will include two- and three-dimensional cavity studies, questions of history of flow, and pressures developed at collapse.
(f) First phase has been completed.
(h) "Critical pressures for the inception of cavitation in a large-scale Numachi nozzle as influenced by the air content of the water." S. F. Crump. TMB Report to be published soon.
"On the mechanism and prevention of cavitation." Phillip Eisenberg, TMB Report 712, July 1950.

(1268) STUDIES OF INTERACTION OF FINS AND BODY.

(b) Laboratory project.
(d) Theoretical; basic research.
(e) A theoretical investigation of the boundary layer flow in the juncture between body and fins to determine causes of adverse effects and to suggest methods of alleviation. May be supplemented by appropriate experimental studies.

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U. S. DEPARTMENT OF THE NAVY, NAVAL BOILER AND TURBINE LABORATORY.

(1037) ORIFICE METER INSTALLATION.

(b) Cooperative with American Gas Association and American Society of Mechanical Engineers.
(c) Attn. Code 760, Director, Naval Boiler and Turbine Laboratory, Philadelphia Naval Base, Philadelphia 12, Pa.
(d) Experimental; applied research.
(e) Tests conducted with orifice metering section in 4-inch steam line with globe valve, expansion bend, and combination of valve and bend at various distances preceding the orifice, at various orifice ratios, to determine minimum length of straight pipe required before the orifice.

U. S. DEPARTMENT OF THE NAVY, NAVAL ENGINEERING EXPERIMENT STATION.

(472) CONDENSER TUBE ALLOYS: SEA WATER CORROSION AND EROSION.

(b) Bureau of Ships.
(c) The Director, Naval Engineering Experiment Station, Bureau of Ships, Department of the Navy, Washington 25, D. C.
(d) Experimental; for design.
(e) To determine the corrosion-erosion resistance of condenser tube alloys in sea water. Five experimental condensers, each containing 20 tubes, are under test at the Marine Test Site, Kure Beach, N. C. Twelve alloys are being studied.
(h) The first test report, C-3428, should be available early in 1951.

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U. S. DEPARTMENT OF THE NAVY, NAVAL ORDNANCE LABORATORY.

(713) PRESSURE FIELD SURROUNDING HIGH-VELOCITY SPHERES IN WATER.

(b) Office of Naval Research and Bureau of Ordnance, Department of the Navy.
(c) Dr. J. Howard McMillen, Naval Ordnance Laboratory, White Oak, Silver Spring 19, Md.
(d) Experimental and theoretical; basic research.
(e) Measurement of the pressure field surrounding a sphere traveling at a speed 0.2 that of sound was made shadow-graphically and compared with a single point source model of flow.
(f) Discontinued.
(g) Pressure measurements agree well with the point source model ahead of the sphere but the agreement is poor at the sides and to the rear.

(714) ENTRY OF HYPER-VELOCITY SPHERES INTO WATER.

(b) Office of Naval Research and Bureau of Ordnance, Department of the Navy.
(c) Dr. J. Howard McMillen, Naval Ordnance Laboratory, White Oak, Silver Spring 19, Md.
(d) Experimental; basic research.
(e) Shadowgrams are being taken of 1/8-inch steel spheres entering and traversing water at velocities of about 7000 ft/sec. Refraction of the light rays and their relationship to the impact pressure and shock wave is being investigated.
(g) A bright flash of light is observed upon water impact by supersonic spheres. The light is of less than one microsecond duration and originates in the surface impact region of smaller diameter than the sphere.

(715) WATER-ENTRY CAVITY FORMATION.

(b) Office of Naval Research and Bureau of Ordnance, Department of the Navy.
(c) Dr. Albert May, Naval Ordnance Laboratory, White Oak, Silver Spring 19, Md.
(d) Experimental; basic and applied research.
(e) An investigation of the size, shape, and development of the cavity when objects enter water in velocity range below 200 fps. Mostly, spheres and cylinders are being used, and emphasis has been on vertical entry.
(f) Being terminated.
(g) Virtual mass is very small during entry cavity phase. Tests of effect of confining walls on cavity formation show effect when cavity diameter is about 1/5 or more of the width of the tank.
(h) "The virtual mass of a sphere entering water vertically." Albert May and Miss J. C. Woodhull, J. of Applied Physics. Dec. 1950.

(716) SCALING LAWS OF WATER ENTRY.

(b) Office of Naval Research and Bureau of Ordnance, Department of the Navy.
(c) Dr. Albert May, Naval Ordnance Laboratory, White Oak, Silver Spring 19, Md.

(d) Experimental; basic and applied research.
(e) To determine scale relations of surface closure, deep closure, size and shape of the cavity and trajectory relating to water entry. Parameters being varied are velocity, model size, pressure and density of the atmosphere above the water, surface condition and specific gravity of missile. Entry velocities range from 15 to 250 fps. Most of the work has been with spheres at vertical entry.
(f) Being terminated.
(g) Surface condition of the missile is important at speeds of 20 fps and less. Froude scaling plus theoretically-indicated scaling of the gas is in fair agreement with the scale relations found, but there are deviations as yet not understood.

(717) DRAG COEFFICIENTS OF SPHERES AND CYLINDERS AT WATER ENTRY.

(b) Office of Naval Research and Bureau of Ordnance, Department of the Navy.
(c) Dr. Albert May, Naval Ordnance Laboratory, White Oak, Silver Spring 19, Md.
(d) Experimental; basic research.
(e) Determination of drag coefficient while a cavity is attached, and its dependence on the state of the cavity, and the velocity of the body.
(f) Being terminated.

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S. DEPARTMENT OF THE NAVY, NAVAL ORDNANCE TEST STATION.

Inquiries concerning Projects Nos. 1269, 1270, and 1271 should be addressed to Dr. E. P. Cooper, U. S. Naval Ordnance Test Station, 3202 E. Foothill Blvd., Pasadena 8, Calif.

1269) ESTABLISHMENT OF FLOW PATTERNS AROUND BODIES ENTERING WATER.

(b) Office of Naval Research.
(d) Experimental and theoretical; basic research.
(e) Study of transient phenomena relating to establishment of flow patterns around solid bodies entering water from the air, covering theoretical pressure-time relations, effects of atmospheric pressure on cavity closure, of gravity on cavity closure, of viscosity of air and of water (or other liquid) on cavity closure, boundary layer effects and surface cleanness, and development of photographic techniques for laboratory study of models.
(g) (1) Theoretical pressure distributions and drag coefficients for various shaped bodies were compared with results obtained experimentally and excellent agreement was found. A theoretical investigation of the compression shock due to the impact of an axially symmetric body on a plane water surface was made, utilizing the theory of weak waves.
(2) An iterative procedure for the study of pressure and velocity distribution for the case of the water entry of a flat plate was developed and partially completed on NOTS I.B.N. automatic calculating machines. Difficulties were encountered and a new method was devised. Work is continuing at the Institute for Numerical Analysis (INA) of the Bureau of Standards at the University of California, Los Angeles.
(3) Experimental studies of the influence of atmospheric pressure on cavity closure. Data are being analyzed to determine validity of previous indications that large cavities and longer delay in surface sealing occurred at higher atmospheric pressures, contrary to results expected from the Bernoulli effect.
(4) A shadowgraph photographic technique has been developed for use in studying splashes at water entry.
(h) "Photographic studies of splash in vertical and oblique water entry of spheres." Frank G. White. Naval Ordnance Test Station, NAVORD Report 1228, April 1950.

1270) CAVITY SHAPE IN STEADY-STATE FLOW.

(b) Office of Naval Research.
(d) Theoretical; basic research.

(e) Although fairly reliable estimates of the drag of axially symmetric bodies in steady-state cavitating flow can be obtained from the two-dimensional Wagner and Riabouchinsky models, little is known about the actual shape of the cavity. A method has been developed for determining cavity shape as a perturbation from the uniform flow over a prolate ellipsoid. The principal objection to such a method is the large amount of numerical work required.
Therefore, a second method has been developed which correlates the time history of an expanding cylindrical bubble to the steady-state cavity behind an axially symmetric nose shape in terms of elliptic integrals. Since these integrals are already tabulated, the computation becomes simple.
(g) Cavity shapes for flat plates and various cones were calculated by the elliptic integral method, and they agree closely with experimental data.

(1271) CAVITY DRAG.

(b) Office of Naval Research.
(d) Theoretical; basic research.
(e) The complications of the Wagner re-entrant jet theory for computing the drag of symmetric wedges indicated the desirability of developing a simpler method. The Riabouchinsky image theory has been modified to serve this purpose.
(f) Completed.
(g) The results obtained foom the theories of Riabouchinsky and Wagner were found to be in agreement within an error of only 0.16 percent.

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U. S. DEPARTMENT OF THE NAVY, OFFICE OF NAVAL RESEARCH.

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The following projects not listed elsewhere in this Bulletin are also being sponsored:

INCOMPRESSIBLE FLOWS WITH FREE SURFACES (at Brown University)

FLUID MECHANICS AND RELATED MATHEMATICAL STUDIES (at Institute for Mathematics and Mechanics, New York University).

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TENNESSEE VALLEY AUTHORITY, Hydraulic Data Branch.

Inquiries concerning all TVA Projects should be addressed to Mr. Albert S. Fry, Hydraulic Data Branch, Tennessee Valley Authority, Knoxville, Tenn.

Unless otherwise noted work is being done for Tennessee Valley Authority, Hydraulic Laboratory Section.

(723) FONTANA DAM, SPILLWAY MODEL STUDIES.

(d) Experimental; for design.
(e) Tests on 1:100 and 1:51 models were made to develop spillway structures that would dissipate the energy of flood overflows without damage to the dam or adjacent structures.
(f) Tests completed; final report in preparation.
(g) A spillway utilizing two diversion tunnels used during construction was developed with buckets to spread the discharge. A small emergency spillway was also developed.
(h) Summary of results in Appendix C, Technical Report No. 12, "The Fontana Project." TVA, Treasurer's Office, Knoxville, 1949.

(724) FONTANA DAM, LOW-LEVEL OUTLET, HOWELL-BUNGER VALVE MODEL STUDIES.

(d) Experimental; for design.
(e) Tests on a 1:42.35 model were made to develop a structure that would safely and efficiently dissipate part of the energy in the Howell-Bunger valve discharge.
(f) Tests completed; final report in preparation.
(g) Structures were developed which gave satisfactory flow cnnditions in the 15-foot diameter tunnel below the valve area. These structures were designed to keep to a minimum the air required when the valve is discharging.
(h) Summary of results in Appendix C, Technical Report No. 12, "The Fontana Project." TVA, Treasurer's Office, Knoxville, 1949.

(725) FONTANA DAM, LOW LEVEL OUTLET, OUTLET STRUCTURE MODEL STUDIES.

(d) Experimental; for design.
(e) Tests on a 1:100 model were made to develop a structure that would perform satisfactorily under all operating conditions.

(f) Tests completed; final report in preparation.
(g) A comparatively simple outlet structure was developed.
(h) Summary of results in Appendix C, Technical Report No. 12, "The Fontana Project." TVA, Treasurer's Office, Knoxville, 1949.

(726) FONTANA DAM, CAVITATION STUDIES.

(d) Experimental; for design.
(e) To develop specifications for permissible variation in tunnel alignment so as to prevent cavitation damage to the walls of the Fontana spillway tunnels.
(f) Tests completed; final report in preparation.
(h) Summary of results in Appendix C, Technical Report No. 12, "The Fontana Project." TVA, Treasurer's Office, Knoxville, 1949.

(727) HALES BAR DAM, SPILLWAY MODEL STUDIES.

(d) Experimental; for design.
(e) Tests were made on a 1:34.76 model of the spillway to develop a modification of the existing apron to prevent erosion and assist in reconstruction of the dam.
(f) Tests completed; final report in preparation.

(1038) HALES BAR DAM, SPILLWAY APPROACH STUDIES.

(d) Experimental; for design.
(e) Tests are made on a 1:65 model to determine effect of the remains of cofferdam structures upstream of the spillway on the spillway discharge and to determine amount of the obstructions which should be removed.

(1039) CHANNEL STUDIES BELOW HALES BAR DAM.

(d) Experimental; for design.
(e) Tests are conducted on a 1:65 model to study effect of channel alignment on spillway discharge and navigation conditions, and effect of lock location and spillway gate operation on navigation conditions.

(1272) HALES BAR DAM, POWERHOUSE INTAKES STUDIES.

(d) Experimental; for design.
(e) Tests were made on a 1:65 model to determine design for intakes and guide structures to provide good velocity distribution.
(f) Tests completed; report in preparation.
(g) An upstream guide wall and special pier noses at the intakes were required.

(1273) HALES BAR DAM, MISCELLANEOUS STRUCTURES STUDIES.

(d) Experimental; for design.
(e) Tests were made on a 1:65 model to determine location of trash boom and head-water gage intake for a new powerhouse.
(f) Tests completed; report in preparation.

(728) SOUTH HOLSTON AND WATAUGA DAMS, SPILLWAY MODEL STUDIES.

(d) Experimental; for design.
(e) Tests on 1:100 and 1:51 models were made to develop a morning-glory spillway to handle flood overflows.
(f) Tests completed; report in preparation.
(g) Proper location of piers on crest were determined, and a deflectorin the vertical shaft to deflect flow to outside of bend at bottom was developed.

(730) SOUTH HOLSTON DAM, SPILLWAY OUTLET MODEL STUDIES.

(d) Experimental; for design.
(e) Tests on a 1:51 model were made to develop an outlet structure to dissipate the energy from the morning-glory spillway and the Howell-Bunger valve sluiceway without damage to the tunnel or outlet structures.
(f) Tests completed; report in preparation.
(g) A spillway outlet and stilling basin were developed.

(731) SOUTH HOLSTON DAM, SURGE TANK MODEL STUDY.

(d) Experimental; for design.
(e) A 1:50 model of the penstock and surge chamber was used to determine (a) the orifice size and characteristic shape to produce favorable pressure and water surface elevation changes for the best governor operation; (b) the maximum and minimum water surface elevations to be expected in the surge chamber; and (c) the operational characteristics of the selected design.
(f) Tests completed; report in preparation.
(g) With the proper orifice between the riser and the surge chamber as satisfactory results can be obtained as with the differential riser type of surge tank.

(732) WATAUGA DAM, BED LOAD STUDY.

(d) Experimental; for design.
(e) A fixed-bed 1:70 model of the river near the powerhouse was tested to determine whether bed load moved by the spillway discharge would be deposited in the powerhouse tailrace, and, if so, how it could be prevented.
(f) Tests completed; report in preparation.
(g) A small wall located along the upstream edge of the tailrace channel was found sufficient to keep the bed load from depositing in the draft tubes and the tailrace.

(1274) BOONE DAM, SPILLWAY MODEL STUDIES.

(d) Experimental; for design.
(e) Tests are made on a 1:50 model to determine spillway bucket shape and training walls required.
(g) Erosion tests have shown that a bucket-type apron can be made to operate satisfactorily.

(735) TURBINE DISCHARGE RATINGS.

(d) Field tests; applied research.
(e) Measurements of turbine discharges are being made to rectify discrepancies and increase accuracies in reported discharges. On tributary rivers current meter measurements are made below the dams. On the main river discharges are determined for individual units by making velocity traverses in the turbine intakes.
(g) Equipment for turbine discharge measurements has been tested and method found to be sound.

(736) APALACHIA DAM, SPILLWAY RATING.

(d) Experimental; operation.
(e) Model tests, checked by field measurements, are to be used in determining the discharge ratings for all anticipated operating conditions. Discharge tables for operating purposes will be prepared.
(f) Model studies completed.

(738) CHEROKEE DAM, SPILLWAY RATING.

(d) Experimental; operation.

(e) Model tests, checked by field measurements, are to be used in determining the spillway discharge ratings for all anticipated operating conditions. Discharge tables for operating purposes will be prepared.
(f) Model studies completed.

(739) CHEROKEE DAM, SLUICE RATING.

(d) Field investigation; operation.
(e) Measurement of discharges and differential pressures in the sluices, supplemented by model test data, will be used to establish the discharge ratings for the eight sluices. Tables of discharge for any gate opening at any headwater elevation within the operating range are to be prepared.

(741) DOUGLAS DAM, SPILLWAY RATING.

(d) Experimental; operation.
(e) Model tests, checked by field measurements, are to be used in determining the spillway discharge ratings for all anticipated operating conditions. Discharge tables for operating purposes will be prepared.
(f) Model studies completed.

(742) DOUGLAS DAM, SLUICE RATING.

(d) Field investigation; operation.
(e) Measurement of discharges and differential pressures in the sluices, supplemented by model test data, will be used to establish the discharge ratings for the eight sluices. Tables of discharge for any gate opening at any headwater elevation within the operating range are to be prepared.

(743) FONTANA DAM, LOW-LEVEL OUTLET RATING.

(d) Field investigation; operation.
(e) Field measurements of discharges and pressures in the Howell-Bunger control valve were used to compile discharge-valve opening data within the expected operating range.
(f) Tests completed; final report in preparation.
(h) Summary of results in Appendix C, Technical Report No. 12, "The Fontana Project." TVA, Treasurer's Office, Knoxville, 1949.

(744) FONTANA DAM, LOW-LEVEL OUTLET, AIR DEMAND STUDIES.

(d) Field investigation; operation.
(e) Measurements of air demanded by the 84-inch Howell-Bunger valve were made through its entire range of openings and heads.
(f) Tests completed; final report in preparation.
(g) The results, when plotted as air demand versus water discharge, gave a family of curves varying with head but of unpredictable shape. A constant ratio of air to water exists at each valve opening position.
(h) Summary of results in Appendix C, Technical Report No. 12, "The Fontana Project." TVA, Treasurer's Office, Knoxville, 1949.

(745) FONTANA DAM, SLUICE RATING.

(d) Field investigation; operation.
(e) Field measurement of discharges and differential pressures in the sluices, supplemented by model test data, will be used to establish the discharge ratings for the six sluices. Tables of discharge for any gate opening at any headwater elevation within the operating range are to be prepared.

(746) FORT LOUDOUN DAM, SPILLWAY RATING.

(d) Experimental and field investigation; operation.

(e) Model tests, checked by field measurements, are to be used in determining the discharge ratings for all anticipated operating conditions. Discharge tables for operating purposes will be prepared.
(f) Model studies completed.

(748) HALES BAR DAM, SPILLWAY RATING.

(d) Experimental and field investigation; operation.
(e) Model tests, checked by field measurements, are to be used in determining the discharge ratings for all anticipated operating conditions. Discharge tables for operating purposes will be prepared.
(f) Model studies completed; preliminary rating tables issued.

(753) OCOEE NO. 3 DAM, SPILLWAY RATING.

(d) Experimental and field investigation; operation.
(e) Model tests, checked by field measurements, are to be used in determining the discharge ratings for all anticipated operating conditions. Discharge tables for operating purposes will be prepared.
(f) Model studies completed.

(755) WATTS BAR DAM, SPILLWAY RATING.

(d) Experimental; operation.
(e) Model tests, checked by field measurements, are to be used in determining the discharge ratings for all anticipated operating conditions. Discharge tables for operating purposes will be prepared.
(f) Model studies completed.

1275) WATAUGA DAM, SLUICE RATING.

(d) Field investigation; operation.
(e) Measurements of discharges and pressures on the two Howell-Bunger valves were used to prepare a preliminary table of discharge for any valve opening or head in the expected operating range.

1276) WATAUGA DAM, SLUICE AIR DEMAND AND VIBRATION STUDIES.

(d) Field investigation; operation.
(e) Measurements of air demanded by the Howell-Bunger valves were made, and effect of air pressure pulsations in producing structure vibrations was determined.

(758) CHEROKEE DAM, PROTOTYPE CHECK TESTS.

(d) Field investigation; applied research.
(e) Measurements of pressure in sluices are being obtained to be compared with the pressures measured during the model tests.

(759) DOUGLAS DAM, PROTOTYPE CHECK TESTS.

(d) Field investigation; applied research.
(e) Measurements of pressures in sluices are being obtained to be compared with the pressures measured during the model tests.

(760) FONTANA DAM, PROTOTYPE CHECK TESTS.

(d) Field investigation; applied research.
(e) Plaster surface impressions of carefully located sections are taken after each extended period of tunnel operation to obtain evidence of damage. Entire tunnel is examined for erosion, cavitation damage, or structural failure.
(f) Inspections made in Sept. 1946, Oct. 1949, and May 1950.

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(761) KENTUCKY DAM, PROTOTYPE CHECK TESTS.

(d) Field investigation; applied research.
(e) Measurements are made of lateral pressures on the face of the spillway piers and on the submerged baffle piers on the spillway apron to be compared with the results of the model tests.

(1277) WATAUGA DAM, PROTOTYPE CHECK TESTS.

(d) Field investigation; applied research.
(e) Outlet tunnel surfaces are inspected after completion and after extended periods of operation to determine erosion, cavitation damage, or structural failure.
(f) Initial inspection in Dec. 1949.

(762) SOUTH HOLSTON DAM, PROTOTYPE CHECK TESTS.

(d) Field investigation; applied research.
(e) An electrical pressure cell has been installed in the penstock to obtain pressure data during turbine operation to be compared with data obtained from the model tests. The relative accuracy of the surge tank model can thus be determined.

(763) HIWASSEE DAM, PROTOTYPE CHECK TESTS.

(d) Field investigation; applied research.
(e) Measurements of pressure in sluices are being obtained for comparison with pressures measured in model tests.

(1278) NORRIS DAM, PROTOTYPE CHECK TESTS.

(d) Field investigation; applied research.
(e) Sluice tunnels inspected for erosion, cavitation damage, and structural failure, and to determine effectiveness of previous remedial design change.
(f) Report written.
(g) Only minor erosion and cavitation damage existed.

(1279) WHEELER DAM, PROTOTYPE CHECK TESTS.

(d) Field investigation; applied research.
(e) Measurements were made to determine effect of obstructions in the tailrace channel on turbine operation.

(774) RADIO GAGES FOR REPORTING RAINFALL AND RIVER STAGES.

(d) Experimental; development.
(e) To effect a practical and economical method for obtaining and rapidly reporting hydraulic data from relatively inaccessible locations. Mechanical devices were developed for translating rainfall depths and stream stages into electrical impulses which are broadcast by short-wave radio transmitters for reception in a central office.
(g) The gages have provided prompt reports when other forms of communication have been disrupted, and from localities where other forms of communication or observer are unavailable.

(1041) DEVELOPMENT OF PRESSURE AND DIFFERENTIAL PRESSURE RECORDER.

(d) Experimental; development and operation.
(e) To develop an accurate recorder.
(g) An instrument has been developed which records accurately on an 11-inch strip chart. The unique feature is that the instrument can be set to record any range of pressure or differential pressure within the total range of the pressure pickup. By selective switching the scale position and range can be set to any predetermined values.

(1280) TAPE RECORDING STREAM GAGE.

(d) Experimental; development and operation.
(e) A traffic counter was modified, and tested, to print water stages to nearest 1/100 foot at hourly intervals.
(f) Test completed.
(g) Modified design was satisfactory.

(1281) DEVELOPMENT OF LOW-VELOCITY MEASUREMENT INSTRUMENT.

(b) Cooperative with American Society of Engineering Education and University of Tennessee.
(d) Experimental; applied research for master's thesis.
(e) An instrument using a mechano-electric transducer with indicating circuits has been designed.

(1282) HOWELL-BUNGER VALVE DISCHARGE COEFFICIENT.

(d) Field investigation; applied research.
(e) Tests made to determine discharge, pressure at base of valve, and dimensions of valves, and all available data analyzed to determine coefficient based on net flow area through body of valve.
(f) Report in preparation.
(g) Coefficient is about 0.9 at maximum discharge and increases slightly with size. Maximum discharge does not occur at maximum opening.

(1283) WIND VELOCITY AND AIR TEMPERATURE MEASUREMENTS AT STEAM PLANT LOCATIONS.

(d) Field investigation; design and operation.
(e) To obtain information for use in studies of air pollution and its control. Observations being made at Johnsonville and Widows Creek Steam Plants.

Hydro-Meteorological Section, in collaboration with Field Investigations Section.

(764) DETERMINATION OF SEDIMENT CARRIED IN SUSPENSION BY TENNESSEE RIVER AND TRIBUTARIES.

(d) Field investigation; basic research.
(e) To provide data for estimating effective life of storage reservoirs, and loss of soil from the land. Samples of water were collected periodically at stream gaging stations in the watershed, analyzed to determine the sediment content, and correlated with river discharge to determine the suspended sediment load at each station.
(f) Field work completed; report in preparation.

(766) GROUND WATER INVESTIGATIONS.

(d) Field investigation; basic research.
(e) Hydrologic study to determine effect of filling of reservoirs upon adjacent water table. Records of water levels in observation wells are compared with rainfall and river stages for periods before and after reservoir filling.
(f) Observations discontinued.
(g) Preliminary reports prepared for internal use; conditions found to be normal at all sites studied.

(767) RESERVOIR RIM INVESTIGATIONS.

(d) Field investigation; basic research.
(e) To determine the leakage, through rims of new reservoirs, and to check conditions for other reservoirs. Ground water levels are observed and post-impoundage levels compared with pre-impoundage records; stream flow from rim areas is measured to determine whether any increase has occurred after creation of a reservoir.
(g) Preliminary report prepared for internal use. No serious leakage conditions have been found.

(769) RESERVOIR AND STREAM TEMPERATURES.

(d) Field investigation; basic research.
(e) Study of water utilization and water movement as concerns industrial plant locations and stream pollution. Variations in temperature from surface to bottom in reservoirs throughout the year are determined by soundings, and by continuous recording gages in natural streams.

(770) INVESTIGATION OF WINDS AND WAVE HEIGHTS.

(d) Field investigation; basic research.
(e) To obtain data on occurrence of waves of various heights as concerns navigation on TVA lakes and develop relation of wave height to wind for design purposes. Three recording stations were installed.
(f) Observations discontinued.
(g) Records analyzed; special requests answered by reference to available data.

(771) GALLERY DRAINAGE IN LARGE DAMS.

(d) Field investigation; design.
(e) Weirs are placed in main galleries and drainage measured as check on tightness and stability.
(g) Reports prepared annually for internal use.

(783) WHITE AND RICHLAND CREEKS--DETERMINATION OF ROUGHNESS COEFFICIENT.

(d) Field investigation; basic research.
(e) Determinations being made in several river reaches of known discharge to extend knowledge of relation between roughness coefficient and physical characteristics of rivers.

(786) WATER TRAVEL IN NATURAL STREAMS.

(d) Field investigation; applied research.
(e) Sanitary and chemical changes in water during passage downstream are determined. A given mass of water is identified by electrical conductivity or chemical titration.

(787) MOVEMENT OF WATER THROUGH LARGE RESERVOIRS.

(d) Field investigation; applied research.
(e) Because of slow water travel, samples are collected by traverse through lake.
(g) Water entering a reservoir does not intermix with the rest of the reservoir, but remains as a density current as a result of the difference in temperature between the inflowing water and that in the reservoir. During certain seasons of the year, in Watts Bar Reservoir the cold water released from Norris Reservoir passes upstream along the bottom of the Emory River arm of the former reservoir.

Field Investigations Section.

(772) FLOOD INVESTIGATIONS, TENNESSEE RIVER AND TRIBUTARIES.

(d) Field investigations; basic research.
(e) Survey to obtain data for hydraulic studies and for planning flood-control projects. High-water marks are set and observations made as floods occur; field search is made for high-water marks of past floods. Data are collected on rainfall, runoff, and damages incurred by floods.

(773) INVESTIGATIONS OF SPRINGS AND RUNS BELOW DAMS.

(d) Field investigation; design and operation.

(e) Hydrologic investigation related to construction activities. Flows from springs and in small streams below dam sites are measured before and after construction of dams to determine leakage. Observation weirs are observed regularly and the records are analyzed to account for current rainfall.
(g) Records have shown no appreciable leakage through any dam which has been constructed to date.

(775) BACKWATER EFFECT OF RESERVOIRS ON SMALL TRIBUTARIES.

(d) Field investigation; operation.
(e) On small tributaries automatic crest markers were located to record crest elevations reached by tributary floods. Profiles obtained before filling a reservoir are compared with those for similar discharges after filling to obtain backwater effect.

Hydraulics Investigations Section in collaboration with Field Investigations Section.

(733) HENDERSON COUNTY WEIR CALIBRATION.

(d) Experimental; design.
(e) Studies were made on a 1:5 model of a modified Columbus deep-notch weir with upstream silting basin.
(f) Tests completed; preliminary report prepared.
(g) Ratings for various amounts of silting were determined and a modified silting basin developed.

(734) WHITE CREEK SUSPENDED SEDIMENT SAMPLER.

(d) Experimental; for design.
(e) Full-scale studies were made to develop a continuous sampler which would collect 1/100,000 of any discharge between 0.7 and 244 cfs.
(f) Report in preparation.
(g) Sampler developed retains 1/105,000 part of total stream discharge.

(765) EVAPORATION IN THE TENNESSEE BASIN.

(d) Field investigation; applied research.
(e) To provide data for estimating reservoir losses and derive a general rule, applicable to the Basin, permitting computation of evaporation from pans at six locations in Basin together with standard meteorological readings.
(h) Monthly records in "Precipitation in Tennessee River Basin."

(768) PRECIPITATION IN TENNESSEE RIVER BASIN.

(d) Field investigation; basic research.
(e) A comprehensive study of rainfall and other weather phenomena for purposes of water dispatching and improvements in water control; storm studies as related to maximum precipitation, rainfall-runoff, spillway design and operation, etc.
(h) Monthly bulletin, "Precipitation in Tennessee River Basin." Also annual summary.

(1042) WIND VELOCITIES AND DIRECTIONS--WHITETOP MOUNTAIN.

(b) Cooperative with U. S. Weather Bureau and Radio Station WOPI, Bristol, Tenn.
(d) Field investigation; basic research.
(e) In connection with possible wind-power installations, a wind travel and direction recorder has been installed on a radio tower 150 feet above ground and 40 feet above the treetops at the mountain summit, elevation 5600.
(h) Monthly abstracts in "Precipitation in Tennessee River Basin."

Hydraulic Investigations Section.

(777) RUNOFF-SILT INVESTIGATIONS ON SMALL WATERSHEDS.

(d) Field investigation; basic and applied research.
(e) To evaluate hydrologically existing or changed land-use practices or management. Data are obtained on rainfall, runoff, and soil loss, and in some instances include ground-water levels and soil moisture.

(778) EFFECT OF ALTITUDE UPON RAINFALL.

(d) Field investigation; basic research.
(e) At four locations, rainfall data have been or are being collected. The stations are arranged in series at varying elevations, up one side of a ridge and down the other, so that exposure as well as altitude will be reflected in the result.

(779) MAXIMUM POSSIBLE PRECIPITATION IN TENNESSEE VALLEY.

(b) Cooperative with U. S. Weather Bureau.
(d) Theoretical; applied research.
(e) Hydrometeorological analysis of large storms with upward adjustments of controlling factors to maximum limits as applied to the Tennessee Valley and subdivisions.
(g) Results to be published as one of current series of hydrometeorological reports by the U. S. Weather Bureau and cooperating agencies.

(780) MONTHLY EVALUATION OF GROUND-WATER STORAGE.

(d) Theoretical; operation.
(e) By analysis of current records of stream discharge, the volumes of runoff in ground-water and channel storage are determined for use in operation of multi-purpose reservoirs.
(g) Results reported monthly within the organization.

(782) SNOWFALL IN GREAT SMOKY MOUNTAINS.

(b) Cooperative with U. S. Weather Bureau and National Parks Service.
(d) Field investigation; basic research.
(e) Daily observations of snowfall, its water equivalent, temperature, and relative humidity at altitudes from 1400 to 6300 feet.
(h) Processed data available through cooperating agencies.

(1284) RESERVOIR SEDIMENT DENSITY SAMPLER.

(b) Cooperative with Federal Inter-Agency River Basin Committee, Subcommittee on Sedimentation.
(e) Experimental; applied research, design, operation, development.
(e) A device is being developed for making in-place density measurements of deposited reservoir sediment. Principle is that shielding of a radioisotope varies with mass between source and metering point.

Special Investigations Unit.

(785) SEDIMENTATION OF EXISTING RESERVOIRS.

(d) Field investigation; basic research.
(e) Selected ranges in reservoirs are probed and sounded, volumetric samples are collected and analyzed, quantity and distribution of sediment are computed to determine deposition by stream, probable life of reservoir, effect of sediment storage on navigation channels and sedimentation of downstream reservoirs, and probable sedimentation in future reservoirs.

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UNIVERSITY OF BRITISH COLUMBIA, Hydraulic Laboratory.

(1043) LOSS OF HEAD THROUGH FISH SCREENS.

(b) Experiments conducted by International Pacific Salmon Fisheries Commission.
(c) Mr. Milo C. Bell, Dominion Building, New Westminster, B. C., Canada.
(d) Basic research; design.
(e) Tests were conducted on screens of different mesh sizes and gage with different angles of attack with the water.
(f) Completed.
(g) Techniques of underwater photography to determine behavior of fish migrants at turbine intakes were studied.
(h) Report being prepared.

(1044) FRASER RIVER MODEL.

(b) Cooperative with Department of Public Works, Canada and National Research Council of Canada.
(c) Mr. J. H. Parkin, National Research Council, Ottawa, Canada.
(d) Experimental; to assist in problems of river regulation and control.
(e) An erodible-bed tidal model to study methods of maintaining stable navigational channels with a minimum of dredging and river regulation. Horizontal scale, 1:600; vertical scale, 1:70.
(h) Progress and technical reports submitted periodically to the sponsors.

(1285) MODEL STUDIES OF PROPOSED FISHWAY DESIGN.

(b) Experiments conducted by Dominion Department of Fisheries.
(c) Mr. C. H. Clay, 402 W. Pender St., Vancouver, B. C., Canada.
(d) Experimental; design.
(e) Tests on a 1:20 model of a proposed design to determine flow patterns, velocities, energy dissipation, and general suitability.
(f) Completed.
(h) Report prepared by Dominion Department of Fisheries.

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ECÒLE POLYTECHNIQUE DE MONTREAL, Hydraulics Laboratory.

(266) HYDRAULIC MODEL STUDIES OF DIFFERENT SPILLWAY PROFILES.

(b) Laboratory project.
(c) Prof. Raymond Boucher, Ecole Polytechnique, Montreal 18, Canada.
(d) Experimental; applied research.
(e) To establish a comparison between the discharge capacities of different spillway designs, studies are made on concrete models of existing and recommended spillway profiles. Pressure distribution on spillway faces, coefficients of discharge, and the effect of gate piers of various design are determined.

(268) CALIBRATION TESTS OF A SHARP-CRESTED PARABOLIC WEIR.

(b) Laboratory project.
(c) Prof. Raymond Boucher, Ecole Polytechnique, Montreal 18, Canada.
(d) Experimental; applied research.
(e) To obtain head-discharge relations for weir of 3 cfs capacity, and influence of viscosity.

(791) NEW METHOD OF UTILIZING THE WATER HAMMER FOR THE DETECTION OF LEAKS IN PIPES.

(b) Laboratory project.
(c) Prof. Andre Leclerc, Ecole Polytechnique de Montreal, Montreal 18, Canada.

(d) Experimental; applied research.
(e) To develop a very sensitive recorder for pressure waves in pipes to be used for the location of leaks in distribution systems. The sensing element is made of a cylinder tapped to the pipe. The wire wound around the cylinder acts as a strain gage in the measurement of the pressure variation produced in the pipe by water hammer. A cathode-ray oscillograph is now being developed to register the deformations of that cylindrical strain gage.

(1045) MODEL STUDY OF SPILLWAY AND FLOOD CHANNELS FOR TRENCHE DEVELOPMENT, SAINT-MAURICE RIVER, QUEBEC, CANADA.

(b) The Shawinigan Engineering Company Limited, Montreal.
(c) Prof. Raymond Boucher, Ecole Polytechnique, Montreal 18, Canada.
(d) Experimental; for design.
(e) Tests were conducted on a 1:75 model to determine the hydraulic performance of the original design of the spillways and the curved flood channels separated by gravity walls. Tests revealed: (1) that the longest wall could be removed without affecting the flow conditions in the flood channels; (2) that the form of the remaining walls should be modified to a rectangular shape; (3) that the profile of two of the flood channels would give better flow conditions if slightly modified. Height of the walls separating the curved flood channels was determined. The spillways were also calibrated.
(f) Completed.

(1046) MODEL STUDY OF THE ICE CONDITIONS ON THE SAINT-FRANCIS RIVER AT BROMPTONVILLE, QUEBEC, CANADA.

(b) The Foundation Company of Canada Limited, Montreal.
(c) Mr. J. M. Thomas, The Foundation Company of Canada Limited, Montreal 25, Canada.
(d) Experimental; applied research.
(e) Tests of a fixed bed, 1:100 model were conducted to investigate the causes of ice jams on the Saint-Francis River at Bromptonville.
(f) Completed.

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NATIONAL RESEARCH COUNCIL, Division of Mechanical Engineering.

Inquiries concerning Projects Nos. 792, 1047, 1286, 1287, and 1288 should be addressed to The Director, Division of Mechanical Engineering, National Research Council, Ottawa, Canada.

(792) DIVERSION OF LOGS FROM A POWER PLANT INTAKE.

(b) Laboratory project.
(d) Experimental; for design.
(e) Study on a 1:25 model of a power plant having the entrance to the forebay adjacent to the entrance of a log chute. Designs of guide booms, racks, and troughs have been studied to guide the logs to the chute when the plant is operating at full load.
(f) Suspended.
(g) A floating trough to carry the logs across the entrance to the forebay appears to offer the best solution.

(1047) FORCES ON LOGS IN A FLOWING STREAM.

(b) Laboratory project.
(d) Experimental; applied research.
(e) To obtain information on the mechanism of log jam formation a study of the forces acting on a single log floating on the surface of moving waters has been undertaken. The study will be continued to investigate the behavior of groups of logs.
(h) Preliminary results in Report MH-22, "Model studies of hydrodynamic forces on floating logs." A. E. Fee.

(1286) MODEL STUDIES OF DAM ON THE TOBIQUE RIVER.

(b) New Brunswick Resources Development Board.
(d) Experimental; for design.
(e) A 1:50 model of a proposed dam, spillway, and fish ladder is being studied to obtain data for the design of the spillways and entrance to the fish ladders.

(1287) MODEL STUDIES OF SPILLWAY FOR DAM ON THE MAYO RIVER.

(b) Department of Resources and Development.
(d) Experimental; for design.
(e) 1:50 models of two alternative designs of spillway and channel suitable for an earth-filled dam are being studied to determine the capacity, turbulence, and height of side walls for maximum flow.

(1288) MODEL STUDIES OF TYPICAL SMALL FISHING CRAFT.

(b) Laboratory project.
(d) Experimental; development.
(e) A series of models of fishing craft, typical of those used on the west coast, is being studied to obtain design data and to improve the form of the hulls.

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QUEEN'S UNIVERSITY, Faculty of Applied Science.

(1048) TIDAL MODEL OF STRAIT OF CANSO.

(b) Board of Engineers on Crossing of the Strait of Canso.
(c) Prof. D. S. Ellis, Queen's University, Kingston, Ontario, Canada.
(d) Experimental; applied research.
(e) A model, with scales of 1:4800 horizontal and 1:360 vertical, is being tested to determine the effect on tidal currents of a causeway across the Strait.

(1289) WATER-HAMMER RESURGES IN PIPE LINES.

(b) Laboratory project.
(c) Prof. F. M. Wood, Queen's University, Kingston, Ontario, Canada.
(d) Experimental; applied research.
(e) Resurges in a pipe line under constant head where water column breaks and pressures drop to absolute zero are being studied.

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UNIVERSITY OF TORONTO, Department of Mechanical Engineering.

(1289) DISCHARGE CHARACTERISTICS OF WEIR-TYPE SPILLWAYS.

(b) Laboratory project.
(c) Prof. L. E. Jones, University of Toronto, Toronto 5, Canada.
(d) Experimental; applied research and for master's thesis.
(e) A continuation of earlier tests on model spillways with various pier spacings and proportions with a view to systematizing discharge characteristics for such spillways.

(1290) THE INVESTIGATION OF LOSSES THROUGH BUTTERFLY VALVES AND CONDUIT BENDS BY MEANS OF MODELS USING AIR FLOW.

(b) Canadian Brazilian Services Limited.
(c) Prof. G. Ross Lord, University of Toronto, Toronto 5, Canada.

(d) Experimental; design.
(e) Discharge coefficients were obtained for two valve shapes for Reynolds numbers from $10^5$ to $1.2 \quad 10^6$.
(f) Completed.
(g) Reported to sponsor.

(1291) MODEL STUDY OF FLOW CONDITIONS BEFORE A POWER PLANT INTAKE STRUCTURE.

(b) Canadian Brazilian Services Limited.
(c) Prof. G. Ross Lord, University of Toronto, Toronto 5, Canada.
(d) Experimental; for design.
(e) Tests of a 1:78 model of the junction between a trapezoidal open channel and a horseshoe-shaped tunnel driven in rock were carried out to investigate the approach flow conditions and determine the intake losses.
(f) Completed.
(g) Reported to sponsor.

(1292) DISCHARGE OF A RELIEF VALVE AT HIGH VELOCITY UNDER WATER.

(b) Canadian Brazilian Services Limited.
(c) Prof. G. Ross Lord, University of Toronto, Toronto 5, Canada.
(d) Experimental; for design.
(e) The relief valve is being studied by means of a model to determine the best location of the valve and study its operation when discharging into the tailrace channel at high velocity.

(1293) THE FLOW OF SOLIDS SUSPENDED IN LIQUIDS IN PIPES.

(b) Laboratory project.
(c) Prof. G. Ross Lord, University of Toronto, Toronto 5, Canada.
(d) Experimental; applied research and for master's thesis.
(e) Tests are being conducted with various solids suspended in water.

(1294) HYDRAULIC ANALYSIS OF MIXTURE DISTRIBUTION IN THE COMBUSTION CHAMBER OF A GAS TURBINE.

(b) Laboratory project.
(c) Prof. E. A. Allcut, University of Toronto, Toronto 5, Canada.
(d) Experimental; applied research and for master's thesis.
(e) Tests are to be conducted with transparent models of gas turbine combustion chambers, using water as the flow medium.

(1295) THE DESIGN OF EXPANDERS FOR PIPE EXITS.

(b) Laboratory project.
(c) Prof. G. Ross Lord, University of Toronto, Toronto 5, Canada.
(d) Experimental; applied research and for master's thesis.
(e) The purpose is to develop an efficient expansion device which will effectively reduce the effluent velocity when pipes discharge into tanks or experimental channels.

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The foreign publications which have been received by the agencies listed below are available on loan, unless otherwise indicated.

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Direct inquiries to The Director, Waterways Experiment Station, Corps of Engineers, P. O. Box 631, Vicksburg, Miss.

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Section 2. Ocean navigation:

Question 1: Regularization of natural and artificial estuaries, including estuaries of small dimensions, tideless or otherwise.
Communication 1: Protective works adopted to limit erosion along the open coast; how they work. Reference to model experiments.
Communication 4: Penetration of waves and swells into harbors; means of predicting them and limiting their action. Reference to model experiments.

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U. S. DEPARTMENT OF COMMERCE, NATIONAL BUREAU OF STANDARDS, National Hydraulic Laboratory.

Direct inquiries to the Chief, National Hydraulic Laboratory, National Bureau of Standards, Washington 25, D. C.

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U. S. DEPARTMENT OF THE INTERIOR, BUREAU OF RECLAMATION.

Direct inquiries to the Chief Engineer, Bureau of Reclamation, Denver Federal Center, Denver, Colo.

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CHILE

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SPAIN

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U. S. DEPARTMENT OF THE NAVY, OFFICE OF NAVAL RESEARCH.

A catalogue of all foreign publications received is available in the Technical Information Division, Naval Research Laboratory, Washington 25, D. C.

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Direct inquiries to The Director, Waterways Experiment Station, Corps of Engineers, P. O. Box 631, Vicksburg, Miss.

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U. S. DEPARTMENT OF THE INTERIOR, BUREAU OF RECLAMATION.

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A catalog of translations made by this Office is available in the Technical Information Division, Naval Research Laboratory, Washington 25, D. C.

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ADVISORY COMMITTEE ON BASIC RESEARCH IN UNDERWATER BALLISTICS, Office of Naval Research, Department of the Navy.

Chairman, Garrett Birkhoff, Harvard University, Cambridge, Mass.

Purpose: (a) To plan an effective hydrodynamics research program; (b) to aid the coordination of research and development; and (c) to arrange meetings of larger groups in order to discuss recent developments; (d) to edit and arrange for publication of reports; (e) to encourage publication of papers; (f) to encourage visits to laboratories and research facilities; and (g) to keep the program alive and thereby attract qualified experts to the field

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BUREAU OF ORDNANCE COMMITTEE ON HYDROBALLISTICS, Bureau of Ordnance, Department of the Navy.

Chairman, J. M. Robertson, Ordnance Research Laboratory, P. O. Box 30, State College, Pa.

Purpose: This committee is being organized to advise the Bureau of Ordnance on basic and foundational research in hydroballistics.

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COMMITTEE ON TIDAL HYDRAULICS, Department of the Army, Corps of Engineers,

Chairman, Clarence F. Wicker, District Engineer's Office, Philadelphia, Pa.

Purpose: (a) To evaluate the present state of knowledge of tidal phenomena of interest to the Corps of Engineers; (b) to recommend program of study, investigation and research designed to provide the knowledge necessary to arrive at adequate solutions for the engineering problems associated with such tidal phenomena; and (c) to exercise technical supervisio of the prosecution of the recommended programs.

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COMMITTEE ON SURFACE DRAINAGE, Highway Research Board, National Research Council.

Chairman, Carl F. Izzard, Bureau of Public Roads, Washington 25, D. C.

Purpose: To coordinate research in hydraulics and hydrology as applicable to highway engineering.

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RESEARCH COMMITTEES OF THE SECTION OF HYDROLOGY, American Geophysical Union.

CHEMISTRY OF NATURAL WATERS.

Chairman, W. W. Hastings, Geological Survey, Washington 25, D. C.

DYNAMICS OF STREAMS.

Chairman, J. W. Johnson, 244 Hesse Hall, University of California, Berkeley 4, Calif.

EVAPORATION AND TRANSPIRATION.

Chairman, A. Russell Croft, 2525 Madison Ave., Ogden, Utah.

GLACIERS.

Chairman, William O. Field, Jr., American Geographical Society, Broadway at 15th Street, New York, N. Y.

GROUND WATER.

Chairman, Joseph F. Poland, Geological Survey, 2520 Marconi Ave., Sacramento 15, Calif.

INFILTRATION.

Chairman, Lloyd L. Harrold, 1527 Denman Ave., Coshocton, Ohio.

LAKES.

Chairman, Jack L. Hough, Department of Geology, University of Illinois, Urbana, Ill.

LAND EROSION.

Chairman, Harold V. Peterson, 502 Federal Building, Salt Lake City 1, Utah.

PHYSICS OF SOIL MOISTURE.

Chairman, Geoffrey B. Bodman, Division of Soils, University of California, Berkeley 4, Calif.

PRECIPITATION.

Chairman, William C. Ackerman, Tennessee Valley Authority, Knoxville, Tenn.

RUNOFF.

Chairman, Carl F. Izzard, Bureau of Public Roads, Washington 25, D. C.

SNOW.

Chairman, Walter U. Garstka, Bureau of Reclamation, Federal Center, Denver, Colo.

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COMMITTEE ON MOISTURE CONSERVATION, American Society of Agricultural Engineers.

Chairman, R. R. Poynor, Farm Practice Research, International Harvester Company, 180 North Michigan Ave., Chicago 1, Ill.

Purpose: To assist in programs on research and application; to assist in coordinating and interpreting information; and to encourage research.

Sub-committee on Research and Program Guidance for Moisture Conservation, L. L. Harrold, Chairman.
Sub-committee on Machinery for Creating Surface and Soil Conditions Receptive to Moisture Conservation, G. E. Ryerson, Chairman.
Sub-committee on Earth Structures for Moisture Conservation, A. J. Wojta, Chairman.

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COMMITTEE ON RURAL WATER SUPPLIES, American Society of Agricultural Engineers.

Chairman, Earl L. Arnold, Applications and Loans Division, Rural Electrification Administration, Washington 25, D. C.

Purpose: To make studies; to promote research; to prepare reports and recommendations; to formulate standards; to coordinate activities; to stimulate interest and activity.

Sub-committee on Sub-surface Water Sources, Kenneth B. Huff, Chairman.
Sub-committee on Water Pumping and Distribution, George E. Trisler, Chairman.
Sub-committee on Water Conditioning, Harold H. Beaty, Chairman.
Sub-committee on Building Plumbing, Roy Lundquist, Chairman.
Sub-committee on Waste Disposal, Elmer R. Daniel, Chairman.

HYDRAULICS DIVISION, American Society of Civil Engineers.

Chairman, Executive Committee, Lorenz G. Straub, Director, St. Anthony Falls Hydraulic Laboratory, Hennepin Island, Minneapolis 14, Minn.

Purpose: The advancement and dissemination of knowledge relating to the occurrence of water in nature and its behavior in structures, water courses, and underground. In particular, the field of the Hydraulics Division shall embrace meteorology and hydrology as they affect the engineer, fluid mechanics in engineering usage, and applied hydraulics as a branch of engineering science which furnishes the basis for hydraulic design and for the practical use of water in the different specialized branches of hydraulic engineering. The Division was authorized April 19, 1938.

COMMITTEE ON FLUID MECHANICS.

Chairman, Vito A. Vanoni, Hydrodynamics Laboratory, California Institute of Technology, Pasadena 4, Calif.

Purpose: To further the advancement of hydraulics through coordination of endeavor with related fields of fluid mechanics.

JOINT COMMITTEE ON GROUND WATER HYDRAULICS.

Purpose: To study the physical laws governing the occurrence and movements of ground water and the engineering, economic, and legal aspects of its development, uses, and conservation.

COMMITTEE ON HYDRAULIC DATA AND FACTS.

Chairman, Paul Baumann, Los Angeles County Flood Control District, 751 South Figueroa St., Los Angeles 14, Calif.

Purpose: To stimulate, sponsor, and coordinate the gathering, compilation, and presentation of empirical data and facts, obtained from observations on existing structures and water courses.

Sub-committee on Gate and Dam Crest Coefficients, D. C. Bondurant, Chairman.

COMMITTEE ON HYDRAULIC RESEARCH.

Chairman, Harold M. Martin, Bureau of Reclamation, Denver Federal Center, Denver, Colo.

Purpose: To initiate, organize, sponsor, and coordinate research in the hydraulic field.

Sub-committee on Cavitation in Hydraulic Structures, Robert T. Knapp, Chairman.
Sub-committee on Density Currents, Albert S. Fry, Chairman.

COMMITTEE ON HYDROLOGY.

Chairman, Finley B. Laverty, 502 Lakeview Road, Pasadena, Calif.

Purpose: (a) To stimulate in civil engineering practice the adoption of precepts, theories, and design methods progressively developed in the field of applied hydrology; (b) to sponsor activities designed to increase knowledge of the phase of the hydrologic cycle beginning with the causes of rainfall and ending with the accumulation of runoff into channel flow; (c) to maintain cooperation with the Section of Hydrology of the American Geophysical Union, and other groups representing hydrology and related fields of science; and (d) to encourage cooperation between federal, state, and private interests in establishing and maintaining facilities for obtaining hydrometeorological data.

Sub-committee on Evaporation for Hydrologic Manual, Adolph F. Meyer, Chairman.
Sub-committee on Runoff for Hydrologic Manual, Walter B. Langbein, Chairman.
Sub-committee on Ground Water for Hydrologic Manual, Donald Baker, Chairman.
Sub-committee on Precipitation for Hydrologic Manual, Merrill Bernard, Chairman.
Sub-committee on Infiltration for Hydrologic Manual, S. W. Jens, Chairman.

JOINT COMMITTEE ON DESIGN AND OPERATION OF MULTIPLE PURPOSE RESERVOIRS.

Chairman, Raymond A. Hill, Suite 1000, Edison Building, Los Angeles 13, Calif.

Purpose: To study and report on the problems involved in the planning, design and operation of multiple-purpose reservoir systems with a view of obtaining an optimum watershed developmemt and utilization.

JOINT COMMITTEE ON FLOODS.

Chairman, Gerard H. Matthes, Broadway Central Hotel, Suite 518, New York 12, N. Y.

Purpose: To promote the collection and compilation of data pertaining to floods in the United States, including: the interpretation of flood data; methods of flood control; hydraulic factors underlying the design of flood control works; the operation of flood control works; prevention of flood damage by methods other than flood control.

Sub-committee on Check Dams, Debris Dams, and Debris Basins, E. B. Debler, Chairman.
Sub-committee on Flood Control Structures other than Reservoirs, G. R. Williams, Chairman.
Sub-committee on Underscour at Bridge-piers and Abutments, C. F. Izzard, Chairman.
Sub-committee on Review of Flood Frequency Methods, W. P. Creager, Chairman.

JOINT COMMITTEE ON SEDIMENTATION IN RESERVOIRS.

Chairman, Carl P. Vetter, Bureau of Reclamation, Boulder City, Nevada.

Purpose: To study and report on problems connected with the depositing of sediment in reservoirs, its prevention and reduction.

Sub-committee on Physical Aspects, H. F. Blaney, Chairman.
Sub-committee on Remedies, Nathan C. Grover, Chairman.
Sub-committee on Sources of Sediments, Carl B. Brown, Chairman.
Sub-committee on Economic Effects of Sedimentation, A. P. Learned, Chairman.

JOINT COMMITTEE ON SNOW, ICE, AND PERMAFROST.

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INTERNATIONAL INTERIM COMMITTEE, Sixth International Conference of Ship Tank Superintendents.

Chairman, K. S. M. Davidson, Director, Experimental Towing Tank, Stevens Institute of Technology, Hoboken, N. J.

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WATER RESOURCES DIVISION, American Water Works Association.

Chairman, Executive Board, R. M. Legette.

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TECHNICAL AND RESEARCH COMMITTEE, Society of Naval Architects and Marine Engineers.

Chairman, Edward L. Cochrane, Society of Naval Architects and Marine Engineers, 29 West 39th Street, New York 18, N. Y.

Sub-committee on Hydromechanics, K. S. M. Davidson, Chairman.
This committee issues annually a bulletin listing research projects in progress in the United States related to naval architecture and marine engineering. Copies may be obtained by addressing the Secretary, Herbert S. Howard, Hydromechanics Sub-committee, The Society of Naval Architects and Marine Engineers, 29 West 39th Street, New York 18, New York.
Sub-committee on Ship's Machinery, Mark L. Ireland, Jr., Chairman.
Sub-committee on Ship's Structures, Matthew G. Forrest, Chairman.

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INTERNATIONAL ASSOCIATION FOR HYDRAULIC STRUCTURES RESEARCH.

President, Lorenz G. Straub, Director, St. Anthony Falls Hydraulic Laboratory, Hennepin Island, Minneapolis 14, Minn.

The Association issues annually a bulletin listing hydraulic research in progress throughout the world (excepting United States and Canada, and the Soviet countries). Copies may be obtained on subscription by addressing the Secretary, Professor J. Th. Thijsse, Raam 61, Delft, Netherlands.

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BYRON JACKSON COMPANY.

Considerable research is underway relating to oil pipe lines and special valves as well as large centrifugal pumps.

COLORADO AGRICULTURAL AND MECHANICAL COLLEGE.

Dr. Maurice L. Albertson has been designated Head of Fluid Mechanics Research. The hydraulics laboratory is being increased by an extension 100 feet by 80 feet which is expected to be finished in the summer of 1951.

COLUMBIA UNIVERSITY, Fluid Mechanics Laboratory.

During the past year the laboratory has been overhauled and reorganized.

CORNELL UNIVERSITY, School of Civil Engineering.

During the past year the laboratory has been renovated. Piping, flumes, and undergraduate experimental setup have been altered to provide more floor space and greater accessibility. The top floor has been arranged with numerous demonstrations of fluid flow phenomena. A large wave tank has been constructed and is in use on studies of beach stability.

IOWA INSTITUTE OF HYDRAULIC RESEARCH.

Engineering Hydraulics, the Proceedings of the Fourth Hydraulics Conference held at Iowa City in June 1949, is now available in book form from John Wiley & Sons, New York.
Dr. John S. McNown is on a one-year assignment to teach at the University of Grenoble and to conduct research at the Neypric Hydraulics Laboratory in France. Professor Antoine Craya of Grenoble, is taking Dr. McNown's place during his absence.
Mr. Simon Ince, Research Associate, is presently compiling a comprehensive history of hydraulics. He will welcome suggestions as to rare source material, illustrations, and other pertinent information relative to the development of the science in this country and abroad.
On October 2-4, 1950, the Institute was host to the Eighth Underwater Ballistics Conference, sponsored by the Office of Naval Research. A total of 85 participants attended from the United States and England.

THE JAMES LEFFEL & CO.

The continuing progressive program will include general testing of model turbines to determine characteristics, special tests to fit requirements of specific installations, and experiments to determine environmental effects on turbine performance of conditions or limitations of settings. Reaccumulation of information and increase in skill in testing technique has led to installation of instruments and devices permitting more accurate results over wider ranges of performance.

UNIVERSITY OF MASSACHUSETTS.

The Gunness Engineering Laboratories Building completed in 1949 provides 1400 square feet of floor area for the fluid mechanics laboratory. It is provided with a reservoir capacity of 16,500 gallons below flow level, and a 1500 gpm centrifugal pump supplies a constant head tank. Designed primarily as an undergraduate instructional laboratory, space and equipment are available for hydraulic research which will be started this year.

PELTON WATER WHEEL COMPANY.

During the past year a mountain laboratory in the Southern Edison Company Plant # 1 at Big Creek has been completed for high head tests up to 2000 feet.
The Pelton Laboratory in San Francisco is being rearranged to permit several simultaneous tests, including reaction and impulse turbine efficiency tests.

THE PENNSYLVANIA STATE COLLEGE, Ordnance Research Laboratory.

The Garfield Thomas Water Tunnel has been in operation since March 1950. Velocities as high as 83 fps have been obtained in the 48-inch diameter working section. Tests of bodies in the tunnel are starting; propeller tests should be underway in the spring of 1951.

PURDUE UNIVERSITY.

Professor F. W. Greve died June 13, 1950. W. I. Freel, Associate Professor of Civil Engineering, has been assigned to the hydraulic laboratory.

TEXAS ENGINEERING EXPERIMENT STATION, A & M College of Texas.

Professor Carl W. Morgan is in charge of the laboratory during the absence of Professor Walter L. Moore, who is on leave for a year to continue academic work at the Iowa Institute of Hydraulic Research.

WAYNE UNIVERSITY, Department of Civil Engineering.

It is expected that the new engineering building will be completed within a year, and the new Hydraulic Laboratory will then be ready for use.

UNIVERSITY OF WISCONSIN, College of Engineering.

During the summer of 1950, Dr. Arno T. Lenz was with the Bureau of Reclamation in Idaho working on an irrigation water supply and return flow problem in connection with the Rathdrum Prairie Project.

DEPARTMENT OF THE ARMY, CORPS OF ENGINEERS, Waterways Experiment Station.

A considerable portion of the work of the Waterways Experiment Station during the year has been of a general nature to provide basic data for the developmemt of design criteria. Particular emphasis has been placed on the procurement of field data, and an active program of field data collection has been initiated.

DEPARTMENT OF THE INTERIOR, BUREAU OF RECLAMATION, Denver Federal Center, Denver, Colo.

On July 20 and 21, 1950, the Engineering Center, of which the Hydraulic Laboratory is an integrated part, was dedicated and an open house was held. During two days an estimated 40,000 visitors inspected the laboratories. Dr. Edward U. Condon, Director of the National Bureau of Standards, delivered the dedication address.
The position of Head of the Hydraulic Laboratory, left vacant by the death of J. E. Warnock in December 1949, has been filled by the appointment of Harold M. Martin.

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DEPARTMENT OF THE NAVY, OFFICE OF NAVAL RESEARCH.

Dr. E. Bromberg, formerly of Reeves Instrument Corporation, has been appointed Head of the Mechanics Branch of ONR. Dr. Bromberg relieved Dr. John V. Wehausen who became Editor of Mathematical Review.

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