HYDRAULIC RESEARCH in the UNITED STATES

National Hydraulic Laboratory, National Bureau of Standards
Washington, D. C.

U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS
WASHINGTON, D. C.

VOLUME 14 MAY 1950

U.S. DEPARTMENT OF COMMERCE
Charles Sawyer, Secretary

NATIONAL BUREAU OF STANDARDS
E. U. Condon, Director

National Hydraulic Laboratory
of the
National Bureau of Standards

HYDRAULIC RESEARCH IN THE UNITED STATES

Edited by Dorothy F. Sisson
Assisted by Thelma Smith

Volume 14 May 1950

CONTENTS

U. S. GOVERNMENT AGENCIES

CANADIAN LABORATORIES

"Hydraulic Research in the United States", a publication of the National Hydraulic Laboratory of the National Bureau of Standards, has been issued annually since January 1933 with the exception of the war years 1943 to 1946.

As heretofore, the information contained in this bulletin is 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.

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 829 refer to projects which are reported for the first time in this issue.

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.

Copies of this bulletin are available to interested persons and organizations without charge, and may be obtained by writing to the Chief, National Hydraulic Laboratory, National Bureau of Standards, Washington 25, D. C. A mailing list is maintained which includes the names and addresses of persons and organizations who have requested this service in writing. A limited number of copies of Volume 13 are available; the supply of all other issues is exhausted.

A similar bulletin, "Hydraulic Research", compiled and published by the International Association for Hydraulic Structures 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. Information concerning membership in the Association may be had by addressing the secretary, Prof. Thijsse, or the president, Dr. Lorenz G. Straub, St. Anthony Falls Hydraulic Laboratory, Hennepin Island, Minneapolis 14, Minn.

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.

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 LOCOMOTIVE WORKS, I. P. Morris Department.

Inquiries concerning Projects Nos. 271, 518, and 797 to 799, incl., should be addressed to Mr. H. J. Davis, Supervisor of I. P. Morris Hydraulic Laboratory, The Baldwin Locomotive Works, Eddystone, Pa.

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

(b) Laboratory project.
(d) Experimental; applied research for design.
(e) Runners of various designs in combination with different turbine settings are being tested in the I. P. Morris closed flume 11-inch cavitation laboratory. Measurements of efficiency, horsepower, cavitation, runaway speed, thrust and blade torque are taken.
(f) Active.
(g) The information so obtained is particularly helpful in solving difficult design questions relating to mechanical as well as hydraulic problems.

(518) HIGH SPECIFIC-SPEED FRANCIS-TYPE HYDRAULIC TURBINE MODEL.

(b) Department of the Army, Corps of Engineers, Norfolk District, for the Buggs Island Hydro-electric Plant.
(d) Experimental; applied research for design and as a basis for acceptance of prototype.
(e) Turbine models homologous from casing intake to draft tube discharge were tested in the I. P. Morris closed flume 11-inch cavitation laboratory. Measurements pertinent to design problems as well as those which establish field performance were taken on several model runners. This included measurements of efficiency, horsepower, cavitation, runaway speed and hydraulic thrust.
(f) Completed.
(g) The tests made on the final design were approved by the Corps of Engineers.

(797) ADJUSTABLE PROPELLER-TYPE HYDRAULIC TURBINE MODEL.

(b) Tennessee Valley Authority, Knoxville, Tennessee, for the Chickamauga Power Plant.
(d) Experimental; applied research for design.
(e) Homologous turbine models were tested in the I. P. Morris closed flume 11-inch cavitation laboratory. Measurements pertinent to design problems as well as those which establish field performance were taken on several model runners. This included measurements of efficiency, horsepower, cavitation, runaway speed, hydraulic thrust and blade torque.
(f) Completed.
(g) Results of tests were incorporated in the final design of the prototype unit.

Baldwin Locomotive Works
Polytechnic Institute of Brooklyn

(798) INTERMEDIATE SPECIFIC-SPEED FRANCIS-TYPE HYDRAULIC TURBINE MODEL.

(b) Department of the Army, Corps of Engineers, Garrison District, for Garrison Dam.
(d) Experimental; applied research for design and as a basis for acceptance of prototype units.
(e) Homologous turbine models are to be tested in the I. P. Morris 11-inch closed flume cavitation laboratory.
(f) Active. Models are in process of construction.

(799) LOW SPECIFIC-SPEED FRANCIS-TYPE HYDRAULIC TURBINE MODEL.

(b) The City of Seattle, Washington, for Ross Dam.
(d) Experimental; applied research for design.
(e) Homologous turbine models are to be tested in the I. P. Morris 11-inch closed flume cavitation laboratory.
(f) Active. Models are in process of construction.

POLYTECHNIC INSTITUTE OF BROOKLYN.

Inquiries concerning Projects Nos. 519 to 525, incl., and 800 to 802, incl., should be addressed to Dr. Chilton A. Wright, Professor of Hydraulic and Sanitary Engineering, Polytechnic Institude of Brooklyn, 99 Livingston St., Brookkyn 2, N. Y.

(519) A STUDY OF HYDRAULIC ACCUMULATORS AND THEIR CONTROLS.

(b) Laboratory project.
(d) Compilation and analysis; undergraduate thesis.
(e) This is an attempt to write a history of hydraulic accumulators and related equipment, together with an analysis of the factors to be considered in the determination of efficient combinations of pumps and accumulators.
(f) Project completed, thesis available on loan.

(520) THEORETICAL AND EXPERIMENTAL WORK ON WEIRS.

(b) Laboratory project.
(d) Experimental; undergraduate thesis.
(e) The thesis consists of the theoretical study of submerged and free overfall weirs. Experimental data will be obtained to show compensation for end contraction in a rectangular contracted weir by use of a Cippoletti weir, and to determine constants to be applied to the head on the weir crest of a submerged weir to obtain the equivalent head for the same weir with free overfall.
(f) Project completed, thesis available on loan.

(521) DESIGN AND CONSTRUCTION OF AN IMPROVED PRESSURE BOX FOR THE HYDRAULIC LABORATORY.

(b) Laboratory project.
(d) Experimental; undergraduate thesis.
(f) Project completed, in use in laboratory.

Polytechnic Institute of Brooklyn

(522) THE INVESTIGATION OF THE EFFECT OF VELOCITY ON THE FRICTION COEFFICIENT IN MANNING'S OPEN-CHANNEL FORMULA.

(b) Laboratory project.
(d) Experimental; undergraduate thesis.
(e) This thesis project has been adopted to investigate the dependencies of the roughness factor of Manning's flow formula upon the velocity as well as the character of the channel lining. The project will encompass an introduction to open-channel flow, the compilation of all pertinent data, experiments which will indicate practical results, and conclusions deduced from these experiments.
(f) Project completed, thesis available on loan.

(523) VELOCITY DISTRIBUTION IN OPEN-CHANNEL FLOW.

(b) Laboratory project.
(d) Experimental; undergraduate thesis.
(f) Project completed, thesis available on loan.

(524) STUDY OF FLOW IN A STEEP CHUTE.

(b) Laboratory project.
(d) Experimental; graduate thesis.
(e) The purpose is to study flow conditions in a rectangular chute making angles of from ten to thirty degrees with the horizontal. A number of runs will be made, varying the rate of flow, roughness, and slope.
(f) Active. 8 inch by 8 inch flume of plexi-glass in process of construction.

(525) MODEL TEST OF DE LOIZA RIVER DAM.

(b) Buck, Seifert and Jost, 219 East 19 St., New York, N. Y.
(d) Experimental; design.
(e) Model test of dam for the Puerto Rico Aqueduct and Sewer Service, San Juan, Puerto Rico. Object is to determine best type of spillway buckets to produce a minimum of scour and a submerged type of flow at all river stages. A wooden 1:48-scale model has been installed in a glass flume 10 inches wide. The river bed is simulated by gravel about 1/8 inch in diameter. Flows up to 2.5 cfs are run in the model, and photographs taken of the flow conditions. The scour profile is secondary and is taken on runs with maximum flows.
(f) Completed. Report finished.
(g) A change in the original design was shown to be advantageous.

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

(d) Experimental; graduate thesis.
(e) A study to determine accuracy and loss of head for various flows and approach conditions.
(f) Active.

Polytechnic Institute of Brooklyn
California Institute of Technology

(801) STUDY OF FLOW IN A PARABOLIC WEIR.

(d) Experimental; undergraduate thesis.
(e) Design and construction of parabolic weirs for determining the nature of flow and coefficients.
(f) Active.

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

(d) Experimental; undergraduate thesis.
(e) Determination of effect of Reynolds' number on discharge coefficient for a 1-inch Gentile flow meter. The Reynolds' number will be varied by changing the temper of the oil used in the test.
(f) Active.

CALIFORNIA INSTITUTE OF TECHNOLOGY.

Inquiries concerning Projects Nos. 6, 7, and 11 should be addressed to Dr. V. A. Vanoni; inquiries concerning Projects Nos. 8, 12, 15, 16, 804, 805, 807, and 808 should be addressed to Dr. Robert T. Knapp; inquiries concerning Projects Nos. 17 and 803 should be addressed to Dr. M. S. Plesset, and inquiries concerning Projects Nos. 279 and 806 should be addressed to Dr. D. A. Morelli, California Institute of Technology, Pasadena 4, Calif.

(6) MECHANICS OF SUSPENDED LOAD TRANSPORTATION.

(b) Laboratory project.
(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.
(f) Project is continuing.
(g) A set of experiments has been completed and reported upon.
(h) "Study of suspended sediment in closed channels", H. M. Ismail, Ph.D. thesis, 1948. (Available on loan).

(7) TRANSPORTATION OF BED MATERIAL LOAD.

(b) Laboratory project.
(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.
(f) The study is being continued.

(8) DENSITY CURRENTS.

(b) Laboratory project.
(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.
(f) The study is being continued.

(11) PIPE AND WIRE REVETMENT FOR STREAM CONTROL.

(b) U. S. Department of Agriculture, Soil Conservation Service.
(d) Field investigation, experimental; applied research.
(e) To obtain information upon which to base improvements on the design of pipe and wire revetments for streams. The study includes field investigations and laboratory experiments. Existing installations of pipe and wire revetment in the intermittent streams of Southern California and the Southwest are observed to determine the action and the effect of the various components of a revetment system. Practical data on flows, failures, etc., available in the files of the agencies responsible for the installations, are analyzed. The laboratory program is designed to determine the general behavior of this type of revetment and to evaluate any modifications which are suggested by the field study.
(f) All data have been collected and report is being prepared.

(12) INVESTIGATION OF WAVES AND SURGES IN APRA HARBOR, GUAM, M. I.

(b) Bureau of Yards and Docks, U. S. Navy Department.
(d) Experimental; for design.
(e) Design study of wave and surge motion in Apra Harbor to guide the development of the harbor. Most of the work was done on a model with a scale ratio of 1:360.
(f) Experiments and the report have been completed.
(g) "Model studies of Apra Harbor, Guam, M. I.", Report No. N-63, June 1949. (Available upon request).
See also Project No. 528, "Waves and Surges in Apra Harbor, Guam, M. I.", University of California, page 16.

(15) STUDIES OF CAVITATION PHENOMENA.

(b) Bureau of Ordnance and Office of Naval Research, U. S. Navy Department.
(d) Experimental; basic research.
(e) Visual and photographic observations are made of cavitation on bodies of revolution and on other shapes, with a view to obtaining a physical picture of the cavitation phenomena. The problem will then be attacked analytically. For this work, a water tunnel with a working section of 14 inches in diameter and with a maximum velocity of 100 fps is available. Motion pictures have been taken at rates as high as 30,000 per second, and equipment is being developed for materially increasing this rate. This study includes actual study of growth and collapse of individual cavitation bubbles as well as a study of the various different kinds of cavitation that have been observed in the experiments made in the past. The objective in the latter study is to relate the types of cavitation with the physical conditions under which it occurs.
(f) The project is progressing actively.

887657 O—50——2

California Institute of Technology

(16) HYDRODYNAMIC FORCES ON SUBMERGED BODIES.

(b) Bureau of Ordnance, U. S. Navy Department.
(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. Once this is done, 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 in cross section, 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.
(f) The project is proceeding actively.
(h) "Air resorption in water tunnels", F. B. Brown, Report No. N-62, March, 1949. (Available upon request).
"Hydrodynamic characteristics of the free surface water tunnel", J. P. O'Neill, Report No. N-65, May, 1949.

(17) THE ANALOGY BETWEEN SURFACE SHOCK WAVES ON LIQUIDS AND SHOCKS IN COMPRESSIBLE GASES.

(b) Bureau of Ordnance, U. S. Navy Department.
(d) Experimental; basic research.
(e) To investigate the applicability of the water analogy to the study of shocks in gases and to develop techniques for making measurements of surface shock waves on liquids, A specially built ripple tank about 4 feet wide and 6 feet long is used in these studies. Waves of different shape and intensity are produced in this tank, which is normally filled to 1/2-inch depth. Observations of these waves are made visually, by still and motion pictures, and by special electric depth gages which give a continuous record on an oscillograph.
(f) The project is progressing actively.
(h) "The analogy between the flow of a liquid with a free surface and the two-dimensional flow of a gas", F. R. Gilmore, Report M-54.1, March 1949. (No copies available).
"The analogy between surface waves in a liquid and shocks in compressible gases - experimental study of wave forms", H. E. Crossley, Jr., Report M-54.2, April 1949. (Available on loan).
"Analogy between surface shock waves in a liquid and shocks in compressible gases", H. E. Crossley, Jr., Report N-54.1, August 1949. (Available upon request).

(279) FLOW IN ROTATING CHANNELS

(b) Office of Naval Research, U. S. Navy Department.
(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 in order 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 moving pictures.

(f) A study is in progress of a series of rotors to find the magnitude of the deviations from the ideal patterns of flow postulated by the usual design theories. This study includes measurements of overall characteristics and detailed flow observations.

(h) The progress to August 1949 has been reported in a paper, "Head and flow observations on a high-efficiency free centrifugal pump impeller", presented to the Annual Meeting of the A.S.M.E., November 1949.

(803) DYNAMICS OF CAVITATION BUBBLES.

(b) Office of Naval Research.
(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.
(f) Project is progressing actively.
(h) "Dynamics of cavitation bubbles", M. S. Plesset, Journal of Applied Mechanics, Vol. 16, No. 3: 277-282, September 1949.

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

(b) Bureau of Ordnance and Office of Naval Research, U. S. Navy Department.
(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 incipent 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.
(f) Active.
(g) Apparatus has been built and preliminary experiments have been started.

(805) DYNAMICS OF PARTICULATE MATTER IN FLUID SUSPENSIONS.

(b) Office of Naval Research, Department of Navy.
(d) Basic experimental and theoretical research.
(e) Experimental and analytic studies will be made of the transportation of solid particles by turbulent flows of air and water with a view to obtaining an understanding of the relationships between the motion of the fluid and the particles. The study will include transportation of particles by density currents with particular reference to the mechanism of sediment transfer across interfaces.
(f) Active.

California Institute of Technology
University of California

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

(b) Laboratory projects.
(d) Basic and precise research studies.
(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. Dynamometers with precision speed controls are available up to 450 horsepower output or input, and for speeds up to 5,000 rpm. Accurate instruments for measuring pressures, flow rates, speeds, and torques are provided. Special equipment for the study of cavitation has been developed.
(f) At present, work is being conducted on hydraulic propulsion units.
(h) "The Hydraulic Machinery Laboratory at the California Institute of Technology", R. T. Knapp, Trans. A.S.M.E.: 663-676. November 1936.

(807) INVESTIGATION OF WAVES.

(b) Bureau of Yards and Docks, Department of the Navy.
(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) Active.
(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.

(808) EXPERIMENTAL STUDIES FOR HARBOR DEVELOPMENT.

(b) Bureau of Yards and Docks, Department of the Navy.
(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.
(f) Active.

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

Inquiries concerning Projects Nos. 19 to 25, incl., and 809 should be addressed to Dr. F. J. Veihmeyer, Division of Irrigation, College of Agriculture, University of California, Davis, California.

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

(b) California Agricultural Experiment Station.
(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.
(f) Active.
(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.
(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.
(f) Active.
(g) Studies are continuing on fundamentals on plant-soil-water relationships.
(h) "The permanent wilting percentage as a reference for the measurement of soil moisture", F. J. Veihmeyer and A. H. Hendrickson, A.G.U. Trans. 29(6):887-896. December 1948.
"Methods of measuring field capacity and permanent wilting percentage of soils", F. J. Veihmeyer and A. H. Hendrickson, Soil Sci. 68(1): 75-94, July 1949.

(21) STUDY OF HYDRAULICS OF SPRINKLING SYSTEMS.

(b) California Agricultural Experiment Station.
(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.
(f) Active.
(g) Facilities available permit high speed photographs of sprinkler jets in order to record characteristics of these streams.

(22) STUDY OF THERMODYNAMICS OF SOIL MOISTURE.

(b) California Agricultural Experiment Station.
(d) Field and laboratory; basic research (some results being used for doctor's thesis).
(e) The ability of soil to supply water to plants, and methods of measuring free energy or potential of soil moisture are being studied.
(f) Active.
(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.

(23) HYDROLOGY OF IRRIGATION SUPPLIES IN CALIFORNIA.

(b) California Agricultural Experiment Station.
(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.

(f) Active.
(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.
See also Project No. 27, "Hydrological Effects of Range Management Practices", University of California, Division of Irrigation and Soils, Los Angeles, Calif., page 11.

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

(b) California Agricultural Experiment Station.
(d) Experimental; design.
(e) Hydraulics of irrigation systems to better the design and efficiency of irrigation structures and equipment are being studied. A program is being initiated to investigate the capacities and head losses in standard orchard and alfalfa valves used on concrete pipe lines.
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.
(f) Active.
See also Project No. 29, "Farm Irrigation Structures", University of California, Division of Irrigation and Soils, Los Angeles, Calif., page 11.

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

(b) California Agricultural Experiment Station.
(d) Field and laboratory investigation; basic and applied research.
(e) Soil infiltration rates are being studied with particular reference to quality of water applied.
(f) Active.
(g) Application of gypsum to irrigation water containing 50 percent or more sodium results in increased depth of penetration.
See also Project No. 28, "Physical and Chemical Factors Affecting Soil Permeability", University of California, Division of Irrigation and Soils, Los Angeles, Calif., page 11.

(809) SOIL PERMEABILITY AND LAND DRAINAGE.

(b) California Agricultural Experiment Station.
(d) Field and laboratory basic and applied research.
(e) Permeability studies are being conducted in the field in conjunction with mathematical analyses of drainage problems.
(f) Active.

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

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

(26) DRAINAGE INVESTIGATIONS IN COACHELLA VALLEY, CALIFORNIA.

(b) Present work cooperative between this division and the Coachella Valley County Water District, Coachella, Calif.; Regional Salinity Laboratory, U. S. Department of Agriculture, Riverside, Calif.; and U. S. Bureau of Reclamation, Region III, Boulder City, Nev.
(d) Field investigations; applied research and design.
(e) The purpose is to develop economical techniques for observing the piezometric surfaces, the permeability, and the most feasible methods of draining the various aquifers which might contribute to drainage problems with the advent of Colorado River water for irrigation in the valley.
(f) Active.
(g) A network of observation wells on a one-mile grid pattern throughout the Valley has been substantially completed providing information on water levels, vertical gradients, stratigraphy and water quality. Now, the possibility of correlating stratigraphy and permeance is being investigated, as well as the effectiveness and economy of various drainage methods, and the development of suitable techniques for the determination of permeance.

(27) HYDROLOGICAL EFFECTS OF RANGE MANAGEMENT PRACTICES.

(b) Laboratory project; coordinated with similar work by the Station under Dr. F. J. Veihmeyer, College of Agriculture, Davis, Calif.
(d) Experimental; applied research.
(e) The purpose of this study is to evaluate the effects of watershed burning on runoff and erosion in southern California.
(f) Active.
(g) Data for the past year scant because of light rainfall.
See also Project No. 23, "Hydrology of Irrigation Supplies in California", University of California, Division of Irrigation, Davis, Calif., page 9.

(28) PHYSICAL AND CHEMICAL FACTORS AFFECTING SOIL PERMEABILITY.

(b) Laboratory project, coordinated with similar studies by the Station under Dr. F. J. Veihmeyer, College of Agriculture, Davis, Calif.
(d) Experimental; applied research.
(e) A study of how infiltration into and both saturated and non-saturated flow through soils is affected by various physical and chemical factors.
(f) Active continuing project; certain phases are being summarized for publication.
(g) Differences in soil permeability, resulting differences in the chemical nature of the irrigation water have been reported.
(h) "Irrigation of citrus orchards with waters of different chemical characteristics", M. R. Huberty and H. E. Pearson, a progress report. Proc. Am. Soc. for Hort. Sci. 53: 62-70, 1949.
See also Project No. 25 under the same title, University of California, Division of Irrigation, Davis, Calif., page 10.

(29) FARM IRRIGATION STRUCTURES.

(b) Laboratory project, coordinated with similar work under Dr. F. J. Veihmeyer, College of Agriculture, Davis, Calif.
(d) Experimental and field investigations; applied research and design.
(e) Improvement in the design and operating performance of farm pipe lines, control structures, and sprinkling systems.

(f) A continuing project, with only one phase now active.
(g) Failure of plain (non-reinforced) concrete pipe has been shown to be structured, not related to water pressure or hammer. It is related to the Poisson's ratio lateral strain resulting from the axial restraint of wetting expansion, plus circumferential strains resulting from differential wetting of the pipe wall. Also, the relations of wetting expansion to humidity and the moisture conditions around and in the pipe have been investigated. Information will be published in the near future.

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., should be addressed to Prof. R. G. Folsom, Department of Engineering, University of California, Berkeley 4, California.

(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. These are 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.
(f) Active. A summary report is being prepared which will include the results of these tests and those available in the literature.

(35) OSCILLATORY WAVES.

(b) Laboratory project.
(d) Experimental; for graduate thesis.
(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 when the waves pass over various types of bottom discontinuities are studied.
(f) Active.
(h) "Experimental study of surface waves in shoaling water", R. L. Wiegel, M.S. thesis, University of California, February 1949.
"Effect of surface tension on wave velocity in shallow water", A. J. Chinn, M.S. thesis, University of California, June 1949.

(38) STRUCTURES EXPOSED TO WAVE ACTION.

(b) Laboratory project.
(d) Experimental.
(e) To obtain experimental data for the design and location of such shore protection works as groins, jetties, and bulkheads. Present work involves the measurement of pressures exerted on structures subjected to wave action.
(f) Active.
(h) "Wave action on a model piling", J. R. Morison, M. P. O'Brien, J. W. Johnson, and S. A. Schaaf, September 1949.

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

(b) Laboratory project.
(d) Experimental and theoretical research; Ph.D. and M.S. theses.
(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, and a mixture of water and carbon dioxide, 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) One Ph.D. thesis and two M.S. theses completed; one Ph.D. and one M.S. thesis in progress.
(h) "The two-phase flow of ammonia in porous media". H. G. Spencer, M.S. thesis, 1945. "Two-phase flow of water through porous media". J. J. Krauklis, M.S. thesis, 1943. "Steady flow of two-phase, single-component fluids through porous media". F. G. Miller, Ph.D. thesis, 1949.

(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 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 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.
(f) Active.
(g) Experimental data obtained and being correlated on the metering of mixtures.
(h) "Flow characteristics of solids-gas mixtures in a horizontal and vertical conduit", L. Farbar, Industrial and Engineering Chemistry, Vol. 41: 1184, June 1949.

(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 liquid phases are flowing in viscous and 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 tubes at various orientations. Pressure drop and fluid distribution 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.
(h) "Pressure drop accompanying two-component flow through pipes", L. M. K. Boelter and R. H. Kepner, Ind. and Eng. Chem., Vol. 31: 426-434, 1939.
"Isothermal pressure drop for two-phase, two-component flow in a horizontal pipe", R. C. Martinelli, L. M. K. Boelter, T. H. M. Taylor, E. G. Thomsen, and E. H. Morrin, Trans. A.S.M.E., Vol. 66: 139-151, 1944.

"Two-phase, two-component flow in the viscous region", R. C. Martinelli, J. A. Putnam, and R. W. Lockhart, Trans. Amer. Inst. of Chem. Eng., Vol. 42, No. 4: 681-705, 1946.

(43) A PITOT TUBE STANDARD FOR FLOW MEASUREMENT.
(b) In cooperation with Turbine Pump Manufacturers Association.
(d) A laboratory experimental determination of Pitot tube characteristics to be expected in field applications. The work is of applied research and development and forms the basis of an 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.
(f) Active.
(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.
(h) "Performance characteristics of Pitot tubes in water pipes", W. A. Page, Master's thesis.

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

(b) Laboratory project.
(d) Experimental and theoretical investigation; 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 milliameter.
(f) Active.

(47) GRAVITY WAVES AND RELATED PHENOMENON.

(b) Office of Naval Research, U. S. Navy Department.
(d) Theoretical, laboratory and field 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.
(f) Active.
(h) "Diffraction of water waves passing through a breakwater gap", F. L. Blue, Jr. and J. W. Johnson, Trans. A.G.U., Vol. 30, No. 5: 705-718, October 1949.
"Measurement of ocean waves", R. G. Folsom, Trans. A.G.U., Vol. 30, No. 5: 691-699, October 1949.
"Water table elevations in some Pacific Coast Beaches", J. D. Isaacs and W. N. Bascom, Trans. A.G.U., Vol. 30, No. 2: 293-294, April 1949.
"The measurement of wave heights by means of a float in an open-end pipe", J. D. Isaacs and R. L. Wiegel, Trans. A.G.U., Vol. 30, No. 4: 501-506, August 1949.
"Impulsive waves in shallow water as generated by falling weights", J. W. Johnson and K. J. Bermel, Trans. A.G.U., Vol. 30, No. 2: 223-230, April 1949.

"Scale effects in hydraulic models involving wave motion", J. W. Johnson, Trans. A.G.U., Vol. 30, No. 4: 517-525, August 1949.
"The dissipation of wave energy by bottom friction", J. A. Putnam and J. W. Johnson, Trans. A.G.U., Vol. 30, No. 1, February 1949.
"The dissipation of wave energy by flow in a permeable sea bottom", J. A. Putnam, Trans. A.G.U., Vol. 30, No. 3: 349-356, June 1949.
"The Prediction of longshore currents", J. A. Putnam, W. H. Munk, and M. A. Traylor, Trans. A.G.U., Vol. 30, No. 3: 337-345, June 1949.
"Forecasting waves and surf", Robert Stump, Results of War Research of Interest to Engineers, Shore and Beach, Vol. XVI, No. 1, April 1948.
"An analysis of data from wave recorders on the Pacific Coast of the United States", R. L. Wiegel, Trans. A.G.U., Vol. 30, No. 5: 700-704, October 1949.

(280) SEDIMENT TRANSPORT.

(b) Laboratory project.
(d) Theoretical and experimental; Doctor's thesis.
(e) Measurement of the hydraulic forces on the surface particles of a sediment bed. The information is used for comparison with existing theories of sediment transport and friction.
(f) Active.
(g) Existence of lift forces as predicted in "Formulas for the transportation of bed load", H. A. Einstein, Trans. A.S.C.E., Vol. 107: 561-574, 1942, is substantiated. Average values of lift and shear forces are determined and also the statistical distribution with time of the lift force.
(h) "Hydrodynamic forces acting on particles in the surface of a stream bed", E. A. El-Samni, Doctor's thesis, available at the Graduate Division of the University of California, Berkeley, Calif.
"Hydrodynamic forces on a rough wall", H. A. Einstein and E. A. El-Samni, Review of Modern Physics, July 1949.

(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.
(f) Theoretical studies and experimental program under way.
(g) 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) "Fluid saturation in porous media by x-ray technique", A. D. K. Laird and J. A. Putnam, presented before A.I.M.E. Petroleum Division Meeting, Los Angeles, October 1949 (in press).

(526) CALIBRATION OF THICK A.S.M.E. NOZZLES.

(b) Laboratory project; in cooperation with the A.S.M.E. Fluid Meters Committee.
(d) Experimental.

(e) Standard A.S.M.E. 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) Testing 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) A paper and report are in the process of preparation. The paper, "Determination of A.S.M.E. nozzle coefficients for variable external dimensions", was presented by R. G. Folsom at the A.S.M.E. Annual Meeting in New York in December 1949.

(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, are being measured by wave recorders and photographic methods and correlated with the atmospheric disturbances causing these phenomena.
(f) Active.
See also Project No. 12, "Investigation of Waves and Surges in the Apra Harbor, Guam, M. I.", California Institute of Technology, page 5.

(528) LITTORAL SEDIMENT FLOW ON A BEACH.

(b) Beach Erosion Board, Washington, D. C.
(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 jetties.
(f) Active.
(h) "Sand transport along an infinitely long, straight beach", Thorndike Saville, Jr., M.S. thesis, June 1949.
See also Project No. 970, "Study of the Effects of Jetty Construction at Mission Bay, California, on the Movement of Littoral Drift," Beach Erosion Board, page 127.

(530) PARTICLE SEGREGATION ON DEGRADING SEDIMENT BEDS.

(b) Laboratory research and U. S. Army Corps of Engineers.
(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) Active.

(810) VERTICAL SHAFT PUMP SUCTION REQUIREMENTS.

(b) Peerless Pump Division of the Food Machinery Corporation.
(d) An experimental investigation on the quantity of air pumped by vortices formed in the suction bay of typical vertical shaft pump suction arrangements.

(e) 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) Experimental work completed, thesis in preparation.

(812) REVETMENT STUDY.

(b) U. S. Army, Corps of Engineers.
(d) Experimental.
(e) To find proper spacing of permeable revetment structures in river bends, especially the Salinas River, California.
(f) Active.

(813) FLUID RESISTANCE IN ACCELERATED MOTION.

(b) Laboratory project.
(d) Experimental; for graduate thesis.
(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 in terms of a correlative modulus has been developed that includes the acceleration of the system. A continuation with other bodies is planned.
(f) Active.
(h) "Virtual mass of disks", R. Balent, M.S. thesis, 1949.

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) Active. Influence of rain distribution and droplet size currently being investigated.
(h) Master's thesis in preparation by J. S. Guzman and A. A. Cohan.

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) Temporarily inactive awaiting new funds.
(g) Three and a half years have been devoted to field and laboratory research.

CARNEGIE INSTITUTE OF TECHNOLOGY, Department of Civil Engineering.

Inquiries concerning Projects Nos. 534 and 815 should be addressed to Prof. F. T. Mavis, Carnegie Institute of Technology, Pittsburgh, Pa.

(534) HYDRAULICS OF RECTANGULAR CULVERTS.

(b) Laboratory project.
(d) Experimental; for design and master's thesis.
(e) Studies were made on a horizontal rectangular conduit with free and submerged outlets in order (1) to compare the hydraulic characteristics of the rectangular conduit with those of thin-plate weirs and (2) to establish relationships between headwater, tailwater, and discharge in a form useful to the engineer.
(f) Completed.
(g) The coefficient, K, in the equation $Q = KAH^{1/2}$ was determined experimentally for 60 square and rounded entrances. The effect of submergence on a rectangular conduit is expressed in a single diagram. The relationship is valid for all rates of flow and all "submergence factors." It supplements earlier experimental data for thin-plate weirs and narrows the zone of uncertainty in the analysis of "short" conduits discharging freely and submerged.

(815) FORCES ON END SILLS.

(b) Laboratory project.
(d) Experimental; for design and bachelor's thesis.
(e) Studies were made to determine the forces on sills in a hydraulic jump and the corresponding changes in the length and height of jump for different heights of sills placed throughout the jump.

(f) Partially completed.
(g) The dynamic force was correlated by the use of the drag coefficient, and other relationships were in dimensionless form.
(h) "A study of forces on rectangular end sills in a hydraulic jump in a level, rectangular channel", J. K. Hallenburg and R. M. Weaver, Bachelor's thesis, Carnegie Institute of Technology, June 1949.

CASE INSTITUTE OF TECHNOLOGY, Department of Civil Engineering and Engineering Mechanics.

Inquiries concerning Projects Nos. 816 to 818, incl., should be addressed to Prof. George E. Barnes, Department of Civil Engineering and Engineering Mechanics, Case Institute of Technology, Cleveland 6, Ohio.

(816) LOSSES IN TRANSITIONS.

(b) Laboratory project for Master's thesis.
(d) Experimental; for evaluation of loss constants.
(e) Model study of transition sections.
(f) Active.

(817) EFFECT OF HYDRAULIC RADIUS ON RESISTANCE COEFFICIENTS FOR CLOSED CONDUITS.

(b) Laboratory project for Master's thesis.
(d) Experimental; for determination of resistance coefficients for tubes of the same hydraulic radius and surface roughness but differing in cross-sectional shape.
(e) Active.

(818) SHORE PROTECTION STRUCTURES UNDER WAVE ACTION.

(b) Laboratory study for Bachelor's thesis.
(d) Experimental.
(e) Model study with wave machine in 3-foot wide flume, of relative suitability of various types of permeable groins in killing wave action on sloping beaches.
(f) Active.

COLORADO A & M COLLEGE.

Inquiries concerning Projects Nos. 52, 535 to 540, incl., and 819 to 829, incl., should be addressed to Prof. Maurice L. Albertson, Department of Civil Engineering, Colorado A & M College, Fort Collins, Colorado.

(52) HYDRAULIC SAND SEPARATOR.

(b) Laboratory project.
(d) Experimental; applied research.
(e) The project is a combined theoretical and experimental study which, if successful, will give data valuable in the design of hydraulic models.
(f) Active.
(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. The apparatus has been checked for duplication of results, and this check indicates that duplications within plus or minus one percent are obtained. At the present time a design is being prepared for a pilot apparatus to perform sand separation on a continuous basis of operation.

(53) SAND TRAPS AND SLUICEWAYS.

(b) U. S. Soil Conservation Service, Colorado Agricultural Experiment Station.
(d) R. L. Parshall, U. S. Soil Conservation Service, Colorado A & M. College, Fort Collins, Col.
(d) Experimental; applied research.
(e) An experimental study 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 ratio 1/10 to base final design of this type of sand trap for Consolidated Irrigation District, main canal Selma, California. Channel bed 90 feet, capacity 2,100 sec. ft. Largest structure of this type of device yet constructed. In operation 1948 and 1949.
(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) U. S. Soil Conservation Service, U. S. Bureau of Reclamation, State Engineer of New Mexico, and State Engineer of Wyoming.
(c) H. Stockwell, U. S. Soil Conservation Service, Colorado A & M College, Fort Collins, Col.
(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.
(f) Active.
(g) Snow measurement data are correlated with runoff to establish a relationship. Once the relationship is established, the snow measurement data are used to predict the runoff for the coming season.
(h) For 1949, Colorado Agricultural Experiment Station, Miscellaneous Series Papers Nos. 426, 427, 428, 432, 433, 434, 436, 437, 438, 442, 443, and 444. These are the monthly Snow Survey reports for the Rio Grande, Colorado and Missouri-Arkansas Drainage Basins.

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

(b) U. S. Soil Conservation Service, Division of Irrigation and Water Conservation; Colorado Agricultural Experiment Station.
(c) C. H. Rohwer, U. S. Soil Conservation Service, Colorado A & M College, Fort Collins, Col.
(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) Testing completed and report on work prepared.
(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) Publication of report pending.

(57) PHOTOGRAPHIC METHOD FOR MAKING SNOW SURVEYS.

(b) Laboratory project.
(c) Maxwell Parshall, Colorado A & M College, Fort Collins, Col.
(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.
(f) Active.
(g) Fairly good correlation between snow covered area and annual runoff 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, U. S. Soil Conservation Service, Colorado A & M College, Fort Collins, Col.
(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 covering the results of these investigations so that the necessary information will be available to well-screen manufacturers, well drillers, and farmers.
(f) Active.
(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.
(h) "Hydraulic properties of well screens", G. L. Corey, Master's thesis, Colorado A & M College, June 1949 (Confidential report).

887657 O—50—3

(535) FLOW IN CHANNELS OF DEFINITE ROUGHNESS.

(b) Laboratory project.
(d) Experimental; for design and for masters' theses.
(e) This project is intended 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. Further investigations include the determination of the sediment carrying capacity of channels with definite roughness.
(f) Active.
(g) Equipment is under construction.

(536) MODEL STUDIES FOR BHAKRA DAM.

(b) International Engineering Company, Inc.
(d) Experimental; applied research for design.
(e) The purpose of the project is to study the various hydraulic features and to: (1) determine the flow characteristics and relative desirability of various spillway designs and locations, (2) determine the most desirable apron design and to study the action of the stilling pool during discharges of various spillways and outlets, (3) calibrate the various spillways and outlets and determine the pressure distribution throughout the tunnel spillway, (4) evaluate the erosion downstream from the stilling basin and the tunnel spillway outlet, (5) determine the necessary height of training walls of the spillway and the stilling basin, and (6) determine the proper height of the eyebrows over the river outlets on the spillway face.
(f) Active.
(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 Experiment Station, November 1949.

(537) VORTEX TUBE SAND TRAPS.

(b) Laboratory project.
(d) Experimental; for design and for masters' theses.
(e) The purpose is to obtain generalized data for design of the most efficient vortex tube as a sand trap in a canal.
(f) Active.
(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) "Vortex tube sand traps", G. L. Koonsman, Master's thesis, Colorado A & M College, in preparation.

(538) HYDRAULICS OF SPILLWAYS.

(b) Laboratory project.
(d) Experimental; for design and for masters' theses.
(e) The purpose is to obtain generalized design information for spillways having the shape of the underside of the nappe from a sharp crested weir.
(f) Active.

(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.

(539) STILLING WELLS FOR METER GATES.

(b) Armco Drainage & Metal Products, Inc.
(d) Experimental; applied research and for design.
(e) The purpose of this project is 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.
(f) Active.

(540) BED LOAD FLUME.

(b) U. S. Geological Survey, Colorado Agricultural Experiment Station.
(d) Experimental; applied research.
(e) Design and testing of a hydraulic structure which will force into suspension the bed load carried by a stream so that it can be measured by means of a suspended load sampler.
(f) Completed.
(g) A successful model was designed and tested in the laboratory and a prototype built in the field. Measurements taken on the field structure indicate that it acts in a manner identical to that predicted as a result of the model tests.
(h) "Loup River bed load measurement structure", M. L. Albertson, July 1948. Mimeographed.

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

(b) Section project.
(c) W. E. Code, Colorado A & M College, Fort Collins, Col.
(d) Field investigation; applied research.
(e) Location of wells, flow measurements, compilation of well logs and watertable elevations,
(f) Active.
(g) All irrigation wells have been located and technical information recorded. Some foundation material for a map has been assembled.

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

(b) Soil Conservation Service, Colorado Agricultural Experiment Station.
(c) C. H. Rohwer, U. S. Soil Conservation Service, and Ralph L. Rollins, Agricultural Experiment Station, Colorado A & M College, Fort Collins, Col.
(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 preinvestigations of seepage and interpreting the results for the purpose of predicting the seepage from proposed canals. The various methods of measuring seepage will be evaluated in order to determine the limitations and advantages of each method.

(f) Active.
(h) "Seepage losses from irrigation channels", Technical Bulletin 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, Col.
(d) Field investigation; applied research.
(e) Measurements of water table elevation in 190 selected wells are made twice annually.
(f) Active.
(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 U. S. 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. This will be related to evaporation from free surfaces, land areas with various soil and crop covers, plant surfaces; and to heat losses from animals.
(f) Active.

(823) SCOUR IN A STILLING BASIN.

(b) Laboratory project.
(d) Experimental; for design and master's thesis.
(e) A laboratory study of the scour which is experienced 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.
(f) Active.
(g) A study has been completed on this subject, taking the special problem of comparing the scour which results from a solid jet as compared 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. The results of this study 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 would be expected, it was found that the larger the bed material, the smaller the degree of scour. As the depth of the water in the stilling basin increased, however, the scour likewise increased until a maximum point was reached beyond which scour continued to decrease as the depth increased.
(h) "Comparison of scour by hollow jets and solid jets of water", D. Dodiah. Master's report, Colorado A & M College, in preparation.

(824) HEAD LOSSES FROM BRIDGE PIERS.

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

(e) The purpose of the project is 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.
(f) Active.

(825) MODEL STUDIES FOR HIRAKUD DAM.

(b) International Engineering Company, Inc.
(d) Experimental; applied research for design.
(e) The purpose of the project is to evaluate the flow conditions through the hydraulic features of the structure. Of particular importance is the flow through the sluiceways and the stilling basin.
(f) Active.
(g) The test results are given in the report to International Engineering Company.
(h) Report now in preparation.

(826) MODEL STUDIES FOR RIHAND DAM.

(b) International Engineering Company, Inc.
(d) Experimental; applied research for design.
(e) The purpose of the project is to evaluate the hydraulic features of the structure. Of particular importance is the flow in the stilling basin and the effect of the air-step on the crest intended to entrain air to prevent cavitation and erosion of the spillway face and bucket.
(f) Active.
(g) Testing is now in progress.

(827) AERATION OF SPILLWAYS.

(b) International Engineering Company, Inc.
(d) Experimental; applied research for design.
(e) The purpose of this project is to determine the general relationships which exist in connection with the air entrainment and general aeration of the nappe flowing over a spillway crest. This research is being conducted as a special and separate part of the model studies for Bhakra Dam.
(f) Active.
(g) Testing in progress.

(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 from 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.
(f) Active.
(g) Two masters' theses have been written on this subject. 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, August 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.

(829) CORRELATION OF PRECIPITATION WITH TREE RINGS.

(b) Laboratory project.
(d) Experimental and field investigation; fundamental and applied research.
(e) The purpose of the project is to: (1) make a thorough analysis, from the engineering point of view, of the biological relationships involved in the development of tree rings, (2) to determine the feasibility of using tree rings as an indicator of precipitation, (3) to prepare a complete report on the literature available to date, and to show how hydrologic engineers can utilize this information to supplement precipitation data.
(f) Completed.
(g) By using existing literature and experimental data it was found that tree rings could be correlated with precipitation in such a manner that they can be very helpful in estimating probable precipitation. A special process of eliminating other variables must be used.
(h) "Correlation of precipitation with tree rings", Satnarayan Singh, Master's report, Colorado A & M College, July 1949 (available on loan).

COLORADO UNIVERSITY, Hydraulics Laboratory, Department of Civil Engineering.

(830) FLOW IN SHORT TUBES.

(b) Laboratory project.
(c) Prof. Warren DeLapp, University of Colorado, Boulder, Colo.
(d) Experimental; basic research and masters' theses.
(e) Tests will be made using smooth pipes varying in diameter from 1 inch to 4 inches with a sharp-edged entrance to study boundary layer development and energy losses.
(f) Active.

(831) SUPERCRITICAL VARIED FLOW IN OPEN CHANNELS.

(b) Laboratory project.
(c) Prof. Warren DeLapp, University of Colorado, Boulder, Colo.
(d) Experimental; basic research and masters' theses.
(e) Tests are being conducted in a rectangular channel 8 inches wide on a steep slope with accelerated flow. Study is being made of water surface profiles and energy losses.
(f) Active.

(832) FRICTION FACTOR FOR SMOOTH PIPES.

(b) Laboratory project.
(c) Prof. C. M. Smith, University of Colorado, Boulder, Colo.
(d) Experimental; basic research and master's thesis.
(e) Tests are being made using 2 inch diameter brass and aluminum pipes to determine the friction factor.
(f) Active.

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

Inquiries concerning Projects Nos. 60, 61, 62, 541, 289, and 290 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, dealing with flow of air through beds of lead shot, sand, gravel, etc., is a continuation of the work systematically pursued since 1936 and interrupted by the war. It is anticipated that the results will furnish material permitting presentation of an integrated account of the phenomenon as a whole.
(f) Active.

(61) ELECTROMAGNETIC VELOMETER.

(b) Laboratory project.
(d) Theoretical and experimental; basic research.
(e) To develop instrumentation and technique to record reliably and conveniently 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 in reservoirs, etc. The possibility of using electrostatically charged molecules for determining flow velocities is being explored.
(f) Active.

(62) HYDRAULICS OF STRUCTURES.

(b) Laboratory project.
(d) Theoretical and experimental; basic research and for masters' theses.
(e) Preliminary master thesis research is in process on the following problems: (1) Boundary layer regimen in intake reaches of open channels, and (2) flow patterns over beds curved in the vertical plane. An orientation thesis has been completed on the effect of tailwater on flow regimen over spillways.
(f) Active.
See Project No. 541 immediately following.

(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) Experimental work on a model of a customary spillway form operating under submerged conditions completed. The conclusions reached are being checked on a second model of a different size as a Master research project.

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

(b) Laboratory project.
(d) Experimental; for masters' theses.
(e) A wide range of systematic experimental studies is planned with emphasis on the physical aspects of the phenomena. Research will start with the following particular cases: (1) Expansion in conduits, and (2) knees and sharp bends in conduits.
(f) The experimental work for studies of expansion in closed conduits and on conical diffusers about to be completed.

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

(b) Laboratory project.
(d) Experimental; M.S. thesis.
(e) To establish rational forms for bell mouth entrances, and to investigate the boundary layer regimen in the outlet conduits.
(f) Active. Following the completion of orientation thesis on rational forms of bell mouth entrances and boundary layer regimen in outlet conduits, systematic studies are carried on on both projects by way of laboratory investigation and master's thesis.

UNIVERSITY OF DELAWARE, Division of Chemical Engineering.

Inquiries concerning Projects Nos. 833 to 839, incl., should be addressed to Prof. O. P. Bergelin, and Project No. 840 should be addressed to Prof. S. A. Guerrieri, Division of Chemical Engineering, University of Delaware, Newark, Del.

(833) TWO-PHASE, CO-CURRENT, STRATIFIED FLOW IN A HORIZONTAL TUBE (WATER AND AIR).

(b) Laboratory project.
(d) Experimental and theoretical; basic research for doctor's thesis.
(e) Pressure drop, liquid depth, hydraulic gradient and air phase velocity distribution were measured for the co-current flow of two phases in a 2-inch tube in order to evaluate energy exchanges at the interface and at the tube wall. The two phases were introduced through a gradually tapering entrance section in order to give stratified flow with a minimum of disturbance. Theoretical relations were developed for the energy loss at the interface and for the pressure drop in this type of flow.
(f) Completed.
(g) The characteristics of the energy loss at the pipe wall in two-phase flow are similar to those in single-phase flow. Energy transfer from gas to liquid takes place without loss for low relative velocities between gas and liquid where the interface is smooth. At higher relative velocities waves form on the interface and energy is dissipated. The wavy liquid surface of the water acts in a manner similar to a rough solid boundary to the moving gas stream and the characteristics of energy loss by the gas are the same as across a rough solid wall. Wave formation in these experiments is shown to be equivalent to loading in packed towers.
(h) "Interfacial shear and stability in two phase flow", C. Gazley, Jr., Ph.D. thesis, August 1948.
"Report of the Heat Transfer and Fluid Mechanics Institute", California, 1949.

(834) TWO-PHASE, CO-CURRENT FILM FLOW IN A VERTICAL TUBE (WATER AND AIR).

(b) Laboratory project.
(d) Experimental and theoretical; basic research for doctor's thesis.
(e) Water flows as a film down the inside wall of a one inch vertical tube. Air is introduced co-currently as a moving core. Pressure drop and film thickness are to be obtained in order to verify theoretical equations developed which relate film thickness to pressure drop for turbulent flow. Data on wave profiles will be taken to determine the true interfacial area and this information will be applied to heat and mass transfer problems. An electrical capacitance system is to be used for the film thickness and wave formation studies.
(f) Active.
(g) Accurate pressure drop data have been obtained for various water rates. Friction factor curves indicate that the wavy interface acts as a solid roughness to the moving gas stream. This roughness changes in type with changing air and water rates.
(h) "An investigation of pressure drop for isothermal two-phase film flow in a vertical tube", A. E. Dukler, M.S. thesis, 1949.

(835) THE EFFECT OF HYDRAULIC GRADIENT ON TWO-PHASE, STRATIFIED FLOW (WATER AND AIR).

(b) Laboratory project.
(d) Experimental; for master's thesis.
(e) The hydraulic gradient was determined for the case of two-phase co-current flow in a one inch horizontal tube. Liquid level was measured with a hook gage at various points in the tube and the hydraulic gradient obtained from these measurements. The effect of air and water velocity on hydraulic gradient was determined. Pressure drop data were also obtained.
(f) Completed.
(g) Hydraulic gradient in this system decreases with increasing air rate and increases as the water rate is increased. In the two-phase flow the gradient is not constant along the length of the tube and as a result the gradient at any point must be known before a true gas phase pressure drop can be calculated from experimental data.
(h) "Two-phase flow of fluids; the effect of hydraulic gradient on stratified flow", E. K. Holden, Master's thesis, 1948.

(836) MEASUREMENT OF FILM THICKNESS AND WAVE PROFILES FOR FLOW DOWN A VERTICAL PLATE.

(b) Laboratory project.
(d) Experimental; basic research for master's thesis.
(e) The thickness of films of fluid flowing in laminar and turbulent flow are being measured. Water as well as various oils will be used in an attempt to check the Nusselt equations for laminar flow and to verify new theoretical equations for the turbulent region. An electrical capacitance system has been devised for measuring film thickness. An extension to this capacitance system is under construction to permit evaluation of the surface profiles of the wavy liquid film.
(f) Active.
(g) A series of experiments on a small plate has been completed and indicates that the technique is satisfactory. A larger plate is now under construction.

(837) TWO-PHASE FLOW IN A HELICAL COIL.

(b) Laboratory project.
(d) Experimental.

(e) Pressure drop data and motion pictures were obtained for the flow of water and air co-currently downward through a 5-3/8 inch diameter, 12 turn, helical coil of 1/2 inch i.d. fitted with two turns of glass.
(f) Completed.
(g) Several transitions in flow type were observed which were equivalent to the changes occurring in straight pipe. At low air rates flow was stratified while at higher rates annular flow was maintained. Pressure drop was higher than in flow through straight pipe. Friction factor - Reynolds number curves were obtained which indicate a transition at the theoretically acceptable point for helical flow.
(h) "A study of two-phase co-current flow in a helix", C. Q. Wright III, B.Ch.E. thesis, 1949.

(838) HEAT TRANSFER BETWEEN PHASES IN TWO-PHASE CO-CURRENT FLOW.

(b) Laboratory project.
(d) Experimental.
(e) Equipment is now under construction to permit evaluation of the heat transfer rate between two phases in an adiabatic wetted wall column. Information thus obtained will serve as a basis for theoretical studies and for the application of hydrodynamic data and theory.
(f) Active.

(839) PRESSURE DROP IN TWO-PHASE COUNTERCURRENT FLOW IN HORIZONTAL AND INCLINED TUBES.

(b) Laboratory project.
(d) Experimental.
(e) Equipment is now under construction for the accurate evaluation of critical phenomena as well as types of flow in two-phase countercurrent flow.
(f) Active.

(840) HEAT TRANSFER BY NATURAL CONVECTION.

(b) Office of Naval Research, Project Squid.
(d) Experimental; basic research for doctoral thesis.
(e) Data will be obtained on the cooling effect of liquids under conditions of free convection and counterflow in a vertical tube, of which the bottom end is closed and the top end opens directly into a plenum chamber. This work will include the measurement of rates of heat flow and temperature profiles for a range of temperatures, temperature gradients, tube lengths, and liquids to give as large as possible variation in the controlling variables.
A supplementary visual and photographic study with air and other gases will also be made of gas flow and heat transfer under conditions of free convection superimposed counter flow.
(f) Active.

GEORGIA INSTITUTE OF TECHNOLOGY, School of Civil Engineering.

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

(b) Florida Power Corporation, St. Petersburg, Fla.

(c) Professor Harold R. Henry, Georgia Institute of Technology, Atlanta, Ga.
(d) Experimental; for design.
(e) A 1:120 model of the spillway, adjacent abutments and about 1200 feet of river channel (both fixed and movable) and a 1:30 sectional model including 3 bays of the spillway are being constructed and tested. Objectives include a study of the effect of proposed additions to the apron of the spillway in eliminating harmful erosion, and a satisfactory schedule of spillway gate operation.
(f) Active.

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, and Bureau of Reclamation.
(c) Prof. C. C. Warnick, College of Engineering, University of Idaho, Moscow, Idaho.
(d) Experimental; design and development.
(e) Tests are being conducted on movement of air around precipitation gages using a slow-speed wind tunnel. Information is being sought regarding proper design of windshields. Storage precipitation gages have been installed at Mullan Pass, Idaho to check the performance of various shield designs under actual operating conditions against performance observed in wind tunnel studies.
(f) Active.
(g) One year of testing has been completed. Some rather interesting photographs have been obtained illustrating wind behavior around the gages with and without windshields. A new tunnel was completed during the summer of 1949 which will permit a more thorough testing program.
(h) A paper "Wind studies on shielded snow gages" was presented at the annual meeting of the Western Snow Conference, Denver, Colorado, April 26, 1949. This paper will be published later in the proceedings of that organization.

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

(b) Laboratory project; in cooperation with United States 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 meters, and volumetric measurements of loss from pondage sections. Unlined and compacted earth canals are being studied near Post Falls, Idaho, in an attempt to provide simpler means of evaluating seepage losses and to give information on the effectiveness of earth-lined canals.
(f) Active.
(g) Two years of field experimentation have been completed and data are being processed.
(h) Progress report of the first year of study was issued in April, 1949. (No copies available for loan.)

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

(b) Laboratory project; in cooperation with Research Division, Soil Conservation Service, and Bureau of Reclamation. This project is carried on under the 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) The project is for the purpose of developing a self cleaning screen for sprinkler systems, and to determine hydraulic performance of current sprinkler system design.
(f) Active.

ILLINOIS INSTITUTE OF TECHNOLOGY, Technology Center.

(1) TURBULENT FLOW IN ARTIFICIALLY ROUGHENED PIPES.

(b) Laboratory project with support from Research Corporation and others.
(c) Dr. V. L. Streeter, Illinois Institute of Technology, Technology Center, Chicago, Ill.
(d) Experimental; basic research.
(e) To investigate the relationships between friction factor "f", velocity distribution profile, and geometrical types of roughness at fully developed turbulent flow by using artificially roughened pipes. The roughness is a square groove, machined on the inside surface of a 4.5 inch aluminum pipe. For the same roughness pattern, three different relative roughnesses cut into pipes have been investigated. Velocity distributions and pressure drops were measured over a range of Reynolds numbers from 20,000 to about 1×10^6. New equations for velocity distributions were obtained which better satisfy the data than existing formulas.
(f) Completed.
(h) Final report "Turbulent flow and heat transfer in artificially roughened pipes".

ILLINOIS STATE WATER SURVEY DIVISION.

(551) RUNOFF FROM SMALL WATERSHEDS.

(b) Laboratory project, carried out in cooperation with U. S. Geological Survey.
(c) 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.
(f) Active.
(g) Twenty years of continuous measurements have been completed.
(h) "Hydrology of five Illinois water supply reservoirs", W. J. Roberts. Bulletin 38, Illinois State Water Survey Division, 260 pp. 1948.

(552) SEDIMENTATION OF ILLINOIS RESERVOIRS.

(b) Laboratory project, in cooperation with Office of Research, U. S. Soil Conservation Service, and Illinois Agricultural Experiment Station.
(c) 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 thirteen lakes in Illinois. Sediment samples are being analyzed and complete surveys of watershed soil type, slopes, land use, and conservation practices are being made.
(f) Active.
(g) Results at Lake Decatur, Decatur, Ill., showed correlation between rate of sedimentation in the reservoir and the land use on the watershed.
(h) "Causes and effects of sedimentation in Lake Decatur", C. B. Brown, J. B. Stall, E. E. DeTurk. Bulletin 37, Illinois State Water Survey Division, 62 pp. illus., March 1947.
"The silt problem at Spring Lake, Macomb, Illinois", J. B. Stall, L. C. Gottschalk, A. A. Klingebiel, E. L. Sauer, and E. E. DeTurk. Report of Investigation No. 4, Illinois State Water Survey Division, 87 pp. illus., 1949.

(553) CLOUD PHYSICS PROJECT.

(b) Laboratory project, in cooperation with the Pfister Hybrid Corn Co., El Paso, Ill.
(c) 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 areal extent of each rain area and movement. Rainfall data are collected over a concentrated network of 46 rain gages and correlated with the radar for quantitative rainfall measurement. Movies are being made of the PPI scope.
(f) Active.
(g) Results indicate that radar will give an accurate picture of rainfall extent. Radar can be used for short period rainfall forecasts.
(h) "Radar and rainfall", G. E. Stout and F. A. Huff. Report of Investigation No. 3, Illinois State Water Survey Division, 80 pp. 1949.
"Report on May--September, 1949 rainfall". Illinois State Water Survey Division, 24 pp. mimeo.

(555) EVAPORATION IN ILLINOIS.

(b) Laboratory project.
(c) W. J. Roberts, Illinois State Water Survey Division, Box 232, Urbana, Ill.
(d) Field investigation; applied research.
(e) Measurements are being made of evaporation at two Class A pan-type stations and one psychrometric station on a small lake. An installation has been made at Urbana and includes a Class A pan-type station plus automatic dew-point and temperature recorders located at different elevations above a nearby stream. This installation is furnishing a continuous record of the vapor pressure gradient which is being correlated with the pan evaporation measurements.
(f) Active.
(g) Measurements have been made with the automatic equipment during one growing season, and no general interpretation of these data has been made.
(h) Records are published in the monthly Climatological Data Bulletins of the U. S. Weather Bureau.

(556) PERMEABILITY OF GRADED SAND MIXTURES.

(b) Laboratory project.
(c) Max Suter, Head, Engineering Research Subdivision, Illinois State Water Survey Division, Box 232, Urbana, Ill.
(d) Experimental; basic research.

(e) The permeability of known mixtures of graded sand is measured to determine functional changes.
(f) Suspended, waiting for completion of Peoria laboratory.
(g) Preliminary tests show a non-linear change in permeability in gradually varied mixture from one size of sand to a smaller one with a minimum permeability at from 60 to 70 percent of the larger size and 40 to 30 percent of the smaller size in tightest packing.

(557) TURBULENT FLOW THROUGH GRANULAR MEDIA.

(b) Laboratory project.
(c) Max Suter, Head, Engineering Research Subdivision, Illinois State Water Survey Division, Box 232, Urbana, Ill.
(d) Experimental; basic research.
(e) Critical flow is determined to define conditions under which turbulent flow occurs outside of well screens.
(f) Suspended, waiting for completion of Peoria laboratory.
(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.
(c) Max Suter, Head, Engineering Research Subdivision, Illinois State Water Survey Division, Box 232, Urbana, Ill.
(d) Field investigation; basic research.
(e) Sand boils occur during floods in leveed districts. These are mapped, classified, and sampled. Also sampled are river and nearby well waters.
(f) Active whenever floods occur.
(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.
(c) Max Suter, Head, Engineering Research Subdivision, Illinois State Water Survey Division, Box 232, Urbana, Ill.
(d) Experimental laboratory and field investigation; basic research.
(e) Experimental field pit designed ready for letting construction contracts. Determination of amounts of water that can be put into the ground and its reduction by silting. Effect of infiltered water on chemical and bacteriological changes of ground water.
(f) Suspended, waiting for completion of Peoria laboratory.

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

(b) Laboratory project.

(c) Max Suter, Head, Engineering Research Subdivision, Illinois State Water Survey Division, Box 232, Urbana, Ill.
(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.
(f) Active.
(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) "A pilot study of ground water resources in Peoria County, Ill.", Max Suter. Trans. American Geophysical Union, Vol. 24, Pt. II: 493. 1943.
"Apparent changes in water storage during floods at Peoria, Ill.", Max Suter. Trans. American Geophysical Union, Vol. 28; 425. 1947.
A manuscript of a general report is ready for publication.

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

(b) Laboratory project.
(c) Max Suter, Head, Engineering Research Subdivision, Illinois State Water Survey Division, Box 232, Urbana, Ill.
(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.
(f) Active.
(g) The existence of a recession was proven in locally overpumped areas.
(h) "Ground water studies in the East St. Louis district." The Illinois Engineer, Vol. 18: 16. 1942.

(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.
(f) Active.
(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 area.

(f) Active.
(g) Data show little, if any, communication between two glacial aquifers. Withdrawal in heavily pumped area exceeds recharge by 30 percent.

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

(b) Office project.
(c) Max Suter, Head, Engineering Research Subdivision, Illinois State Water Survey Division, Box 232, Urbana, Ill.
(d) Theoretical; basic research.
(e) Development of formulas that could be used for conditions of variable flow.
(f) Inactive.
(g) Formulas developed for most important types of variable flow, but the series obtained have not been calculated for wide ranges.

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

Inquiries concerning Projects Nos. 562 and 846 to 848, incl., 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) Research.
(d) Basic research and master's thesis.
(e) A lucite channel 6-inches in cross-section and 15 feet long will be used to study velocity distribution in such a channel and to find the criterion to determine laminar or turbulent flow in open channels.
(f) Completed and thesis now on file in University Library.

(846) AN ANALYTICAL AND EXPERIMENTAL STUDY OF SMALL CENTRIFUGAL PUMPS.

(b) Laboratory project.
(d) Experimental; basic research and master's thesis.
(e) Tests are first made on a pump as built by manufacturer, then later with a lucite casing in order that photographic studies can also be made.
(f) Active.

(847) AN EXPERIMENTAL INVESTIGATION OF THE LIMITATIONS OF THE ESTABLISHED FORMULA USED IN THE ANALYSIS OF FLOW IN OPEN CHANNELS FOR VARIOUS CHANNEL CROSS-SECTIONS, SURFACE ROUGHNESS AND SLOPES.

(b) Laboratory project.
(d) Experimental; basic research.
(e) Data has been obtained on a channel 5 feet x 5 feet in cross-sections and approximately 163 feet long using various roughness. Work is now in progress on channel cross-sections other than rectangular.

(f) Active.

(848) THE EFFECT OF SIZE (SCALE EFFECT) ON THE PREDICTIONS OF PROTOTYPE FLOW FROM MODEL TESTS IN OPEN CHANNEL.

(b) Laboratory project.
(d) Experimental; basic research.
(e) Tests are being carried out in tilting flumes of rectangular cross-section - 6 inches x 6 inches; and 18 inches x 22 inches; and later on channels of about 5 feet x 5 feet in cross-section.
(f) Active.

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

(296) INVESTIGATION OF STORM DRAINS FOR EXPRESS HIGHWAYS.

(b) Laboratory project, in cooperation with Illinois Division of Highways, and U. S. Public Roads Administration.
(c) Prof. J. J. Doland, Director of Research, and John C. Guillou, Civil Engineering Department, University of Illinois, Urbana, Ill.
(d) Experimental; basic research and design.
(e) Tests are being conducted on 1:3 and 1:2 models to determine the flow characteristics on pavements, gutters, grates, inlet boxes, catch basins, and collecting systems.
(f) Active.

(564) HYDROLOGY OF URBAN AREAS.

(b) Laboratory project, in cooperation with the Illinois Water Survey Division and U. S. Geological Survey.
(c) Prof. J. J. Doland, Director in charge of Hydraulic Research, Civil Engineering Department, University of Illinois, Urbana, Ill.
(d) Experimental; for design and masters' theses.
(e) Eleven recording rain gages, one complete evaporation station including recording dew-point device, one radar station, and two recording stream gaging stations are installed for the determination of rainfall and runoff for an area comprising about eight square miles.
(f) Active.

IOWA INSTITUTE OF HYDRAULIC RESEARCH, State University of Iowa.

(66) HYDROLOGIC STUDIES, RALSTON CREEK WATERSHED.

(b) Cooperative project; Iowa Institute of Hydraulic Research, U. S. Department of Agriculture, U. S. Geological Survey.
(c) Prof. J. W. Howe, State University of Iowa, Iowa City, Iowa.

887657 O—50— 4

(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 U. S. 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.
(f) Active.
(g) Yearly records available for examination at Iowa Institute of Hydraulic Research.
(h) Reports prepared annually since 1924 available in files at Iowa Institute of Hydraulic Research.

(67) COOPERATIVE SURFACE-WATER INVESTIGATIONS IN IOWA.

(b) Cooperative project; Iowa Institute of Hydraulic Research and U. S. Geological Survey.
(c) V. R. Bennion, Iowa Institute of Hydraulic Research, Iowa City, Iowa.
(d) Field investigations; applied research.
(e) Stream-flow measuring stations maintained throughout the State of Iowa cooperatively on a continuing basis. Records collected by standard methods of U. S. Geological Survey.
(f) Active.
(g) Records of stream flow and sediment discharge computed yearly.
(h) Records contained in Water-Supply Papers available through offices of the U. S. Geological Survey.

(68) HYDROLOGIC STUDIES, RAPID CREEK WATERSHED.

(b) Cooperative project; Iowa Institute of Hydraulic Research, U. S. Department of Agriculture, U. S. Geological Survey.
(c) Prof. J. W. Howe, State University of Iowa, Iowa City, Iowa.
(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 U. S. Geological Survey; rainfall records at five automatic recording stations collected by Soil Conservation Service. Continuous records since 1941 of precipitation, runoff, ground water levels, and vegetal cover.
(f) Active.
(g) Yearly records available for examination at Iowa Institute of Hydraulic Research.

(69) RELATION OF SEDIMENT CHARACTERISTICS TO BED EROSION.

(b) Sponsored in part by the Iowa Institute of Hydraulic Research and in part by the Office of Naval Research, U. S. Navy Department.
(c) Emmett M. Laursen, State University of Iowa, Iowa City, Iowa.
(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 to be conducted in glass-walled flume 15 feet long, 3 feet deep, 1-1/2 feet wide. Selected geometrical proportions will be kept constant during all runs, the variables being the rate of flow, the mean diameter and standard deviation of the sediment, and the time and depth of scour.
(f) Active.

(72) ELECTRICAL ANALOGY OF THREE-DIMENSIONAL FLOW.

(b) Sponsored in part by the Iowa Institute of Hydraulic Research and in part by the Office of Naval Research, U. S. Navy Department.
(c) Dr. Hunter Rouse, State University of Iowa, Iowa City, Iowa.
(d) Experimental; basic research.
(e) To utilize the electrical analogy in the determination of the pressure distribution around bodies of revolution and along nozzle contractions and the profile forms of three-dimensional jets. Velocity and pressure distributions were determined along the boundary of Lucite models of various bodies of revolution, or segments thereof. Free-surface profiles are determined to satisfy the conditions of constant velocity or constant piezometric head along the surface.
(f) Completed.
(h) "Use of the three-dimensional electrical analogy in the design of conduit contractions", M. M. Hassan. Doctor's thesis. August 1948. (Available on loan.)
"Deflection of a liquid jet by a perpendicular boundary", Andre Leclerc. Master's thesis. August 1948. (Available on loan.)
"Electrical analogy facilities design of cavitation-free inlets and contractions", Hunter Rouse and M. M. Hasaan. Mechanical Engineering, Vol. 71, No. 3: 213, March 1949.
"Characteristics of irrotational flow from axially symmetric orifices", Abdel-Hadi Abul-Fetouh. Doctor's thesis. August 1949. (Available on loan.)
"Application of the electrical analogy in fluid mechanics research", P. G. Hubbard. Review of Scientific Instruments, December 1949.

(73) MEASUREMENT OF TURBULENCE IN FLOWING WATER.

(b) Office of Naval Research, U. S. Navy Department.
(c) Dr. Hunter Rouse, State University of Iowa, Iowa City, Iowa.
(d) Experimental; basic research and masters'.theses.
(e) To develop practical instruments for the measurement of turbulence in flowing water. Electromagnetic and hot-wire devices, the effects of variation of electrical potential at a liquid-solid interface, and sensitive electrical pressure elements are being studied experimentally with the goal of devising an instrument which will indicate instantaneous and root-mean-square magnitudes of velocity components along three axes.
(f) Active.
(h) "The development of a turbulence pitot for use in water", D. W. Appel. Master's thesis. June 1949. (Available on loan.)

(75) DIFFUSION OF SUBMERGED JETS.

(b) Sponsored in part by the Iowa Institute of Hydraulic Research and in part by the Office of Naval Research, U. S. Navy Department.
(c) Dr. Hunter Rouse, State University of Iowa, Iowa City, Iowa.
(d) Experimental; for master's theses.
(e) To provide information as to distribution of velocity and turbulence in two- and three-dimensional submerged jets. The velocity distribution in the air jet with unlimited boundary was 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 from a submerged sluice gate. The air jet with limited boundary is under investigation.
(f) Active.

(h) "Diffusion of submerged jets", M. L. Albertson, Y. B. Dai, R. A. Jensen, and Hunter Rouse. Proc. A.S.C.E., Vol. 74, No. 10: 1571, December 1948. Discussion by W. D. Baines, Proc. A.S.C.E., Vol. 75, No. 10: 1019, September 1949, and by H. R. Henry (publication pending).
"Diffusion of flow under a submerged sluice gate", H. K. Liu. Master's thesis. February 1949. (Available on loan.)
"A study of flow from a submerged sluice gate", H. R. Henry. Master's thesis. February 1950. (Available on loan.)

(76) GRAVITATIONAL PHENOMENA IN STRATIFIED FLOW.

(b) Sponsored in part by the Iowa Institute of Hydraulic Research and in part by the Office of Naval Research, U. S. Navy Department.
(c) Dr. Hunter Rouse, State University of Iowa, Iowa City, Iowa.
(d) Theoretical and experimental; basic research and masters' theses.
(e) To provide general information on flow characteristics, such as velocity distribution and pattern and distribution of turbulence for relative motion between fluids of slightly different density due to heat, salinity, or suspended sediment. Studies involve characteristics of sub-surface waves, diffusion across an interface, and mixing due to gravitational convection.
(f) Active. Present phase of project involves free convection from single and parallel line sources.
(g) Characteristics of sub-surface waves, diffusion, and patterns of mean flow and turbulence have been investigated and reports on those phases prepared.
(h) "Gravitational convection from line sources", H. W. Humphreys. Master's thesis. February 1950. (Available on loan.)

(78) MODEL STUDY OF SANTA CECILIA DAM AND PUMPING PLANT.

(b) Canadian-Brazilian Services, Ltd., Toronto, Canada, consultants for Rio de Janeiro Tramway, Light, and Power Company, Ltd.
(c) D. E. Metzler, State University of Iowa, Iowa City, Iowa.
(d) Experimental; applied research and master's thesis.
(e) Following earlier studies on sediment control, a half-model of one Tainter gate at a 1:14 scale was installed in a 2.5-foot glass-walled channel for study of the discharge characteristics and the pressure distribution on the gate and on the channel bottom under the gate.
(f) Completed.
(g) Reports of results submitted to Canadian-Brazilian Services, Ltd., Toronto, Canada.

(79) CAVITATION.

(b) Sponsored in part by Iowa Institute of Hydraulic Research and in part by the Office of Naval Research, U. S. Navy Department.
(c) Dr. John S. McNown, State University of Iowa, Iowa City, Iowa.
(d) Experimental and theoretical; basic research and masters' theses.
(e) Basic design information on pressure distribution around systematically varied boundary forms under various degrees of cavitation is sought. Tests are conducted in a 13-inch variable-pressure water tunnel. Measurements are made to determine effect of variation of boundary form, Reynolds number, and degree of cavitation on the pressure distribution around two- and three-dimensional boundaries by using 1-inch models. The boundary forms include the ellipsoidal, conical, and rounded head forms - from elongated to blunt and concave - at various angles of yaw; conical and rounded tail forms; and strut and propeller sections. Exploratory tests have been conducted in a small

demonstration water tunnel on the pressure distribution and cavitation characteristics in the vicinity of a boundary discontinuity such as a gate slot. These experiments are being continued in a two-dimensional test section of the larger water tunnel to obtain data for a systematic series of slot dimensions and superelevations and curvature of the downstream edge of the slot. Studies are being conducted on high-velocity submerged jets, using underwater noise as a criterion, to determine cavitation parameters. Tests are being made to evaluate the relations between the cavitation index K_1 and temperature, relative velocity, and nozzle geometry.

(f) Active.

(g) A bulletin has been prepared, describing the preliminary tests and the results of measurements on various head forms at zero angle of yaw. Studies of the effects of yaw angles other than zero, and the boundary discontinuity have been completed and theses prepared.

(80) TURBULENCE BEHIND SCREENS.

(b) Office of Naval Research, U. S. Navy Department.

(c) W. D. Baines, State University of Iowa, Iowa City, Iowa.

(d) Experimental project; basic research.

(e) The energy losses due to flow through screens, and the scale, intensity, and rate of decay of the resulting turbulence have been investigated, together with the effect of screens on inequalities of the velocity distributions. The screens studied were formed of bar lattices or of uniformly perforated plates with systematic variations of scale and area proportions. The pressure drop across these screens and the scale of the turbulence at various distances downstream were measured in a low-velocity air tunnel. The techniques used for measuring turbulence were: hot-wire anemometer, heat diffusion, and gas diffusion. An eventual comparison of results in air and water is planned.

(f) Completed.

(g) The influence of screen geometry on the characteristics of both the mean flow and the turbulence has been determined.

(h) "An investigation of flow through screens", W. D. Baines and E. G. Peterson. Report prepared for the Bureau of Ships and the Office of Naval Research, U. S. Navy Department, July 1949.

(81) MATHEMATICAL ANALYSIS OF PRESSURE DISTRIBUTION.

(b) Office of Naval Research, U. S. Navy Department.

(c) Dr. John S. McNown, State University of Iowa, Iowa City, Iowa.

(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. The pressure distributions around faired boundary forms are obtained mathematically, assuming that viscous effects are negligible. Both exact and approximate methods are used, and wherever possible the results are compared with experimental measurements determined in other studies. The study includes ellipsoidal and rounded head forms with cylindrical afterbodies, two-dimensional wedge shapes with various nose angles, faired struts, and two-dimensional inlet sections. One form has been studied at small angles of yaw. The methods of hydrodynamics, including modifications of the approximate source-sink method presented by von Kármán, are utilized. The relaxation technique is being applied to such problems as 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 also being sought.

(f) Active.
(g) Computations for wedge shapes of various angles and representative computations for several boundary forms have been completed. The method of relaxation has been applied to problems of efflux and cavitation-pocket formation in axisymmetric flow. A relatively rapid method of approximation, depending upon the 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 78, "Cavitation", page 40.
(h) "Characteristics of irrotational flow from axially symmetric orifices", Abdel-Hadi Abul-Fetouh. Doctor's thesis. August 1949. (Available on loan.)
"Pressure distributions from theoretical approximations of the flow pattern", J. S. McNown and En-Yun Hsu. Proceedings of the 2nd Heat Transfer and Fluid Mechanics Institute, Berkeley, Calif., June 1949.

(82) HYDRAULICS OF MANIFOLDS.

(b) Laboratory project; sponsored by the Committee on Hydraulic Research, Hydraulics Division, A.S.C.E.
(c) Dr. John S. McNown, State University of Iowa, Iowa City, Iowa.
(d) Experimental; for masters' theses and design.
(e) Divided and confluent flow in pipe lines have been studied. Tests were conducted in a 2-inch smooth brass pipe with a single right-angle lateral to determine the effect of discharge ratio and diameter ratio 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.
(g) Pressure variations for both divided and confluent flow have been determined, and rational explanations have been made of various phases of the occurrence.

(298) FALL VELOCITY OF SEDIMENT.

(b) Laboratory project.
(c) Dr. John S. McNown, State University of Iowa, Iowa City, Iowa.
(d) Experimental; basic research and masters' theses.
(e) The effect of a cylindrical boundary and the particle shape on the fall velocity of individual particles, and the effects of concentration on the rate of settlement of sediment samples are being investigated. The fall velocities of spheres of various sizes, falling along the axes of vertical cylinders of selected diameters and through fluids of different viscosities, have been determined. Data have been collected through use of stroboscopic timing and a thermostatically controlled bath for sphere to cylinder diameters ranging from zero to unity, and for all Reynolds numbers from less than 1000. Approximate theoretical analyses have been made which agree well with the experimental results within the Stokes' range. The fall velocities for a variety of regular shapes have been determined, using the same equipment and technique. Measurements are also being made of the effect of particle spacing, using clouds of uniform sediment.
(f) Active.
(g) Study of the cylindrical boundary effect has been completed and investigation of the effects of shape is nearly complete. Ratios of the principal axes have been found to be significant shape parameters. Experiments on the effects of sediment concentration are under way.

(h) "Effect of shape of particles on their settling velocity", Jamil Malaika. Master's thesis. February 1949. (Available on loan.)
"Particle shape and settling velocity", J. S. McNown and Jamil Malaika. Proc. American Geophysical Union, December 1949.

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

(b) Sponsored in part by the Iowa Institute of Hydraulic Research and in part by the Office of Naval Research, U. S. Navy Department.
(c) Prof. J. W. Howe, State University of Iowa, Iowa City, Iowa.
(d) Experimental; applied research and masters' theses.
(e) To determine pressure distributions on three-dimensional building forms of various proportions, for winds of different velocities and angles. Building models were constructed of 1/8-inch lucite plates with suitable piezometric openings and length-width ratios of 1, 2, and 4; height-width ratios of 1/2, 1, 3/2; and roof angles of 0 degrees, 15 degrees, and 30 degrees, were tested in a low-velocity air tunnel with approaching wind directions of 0 degrees, 45 degrees, and 90 degrees, and maximum air velocity of 35 fps. Studies of block forms and hangar-type structures completed; investigations now being made of effects of eaves and parapets.
(f) Active.
(g) Contour maps of pressure distribution, prepared from test results, 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.
(c) Dr. Hunter Rouse, State University of Iowa, Iowa City, Iowa.
(d) Experimental; for doctor's and masters' theses.
(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) Completed.

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

(b) Laboratory project.
(c) Prof. J. W. Howe, State University of Iowa, Iowa City, Iowa.
(d) Field investigation; applied research for masters' theses.
(e) A study of storm intensities, areal extent, and runoff for the development of the form of the unit hydrograph for the Iowa River.
(f) Active.

(567) A STUDY OF FLOW OVER LATERAL SPILLWAYS.

(b) Laboratory project; partially supported in 1948-49 by A.S.C.E. through J. Waldo Smith award.
(c) Dr. John S. McNown, State University of Iowa, Iowa City, Iowa.

(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.
(f) Active.
(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 was found to increase with increasing depth and crest length and to decrease 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", R. J. Kennedy. Master's thesis. August 1948. (Available on loan.)

(568) SCOUR AT BRIDGE PIERS AND ABUTMENTS.

(b) Iowa State Highway Commission and U. S. Bureau of Public Roads.
(c) Emmett M. Laursen, State University of Iowa, Iowa City, Iowa.
(d) Experimental; applied research.
(e) To investigate the effects of pier and abutment geometry, sediment properties, and stream-flow characteristics on the rate and pattern of scour, to the end of providing safe design criteria.
(f) Initial phase, the study of pier and abutment geometry, is in progress. Equipment for the study of the effect of stream-flow characteristics is under construction.

(569) DESIGN AND CONSTRUCTION OF SEDIMENT TRANSPORT FLUME.

(b) Office of Naval Research, U. S. Navy Department.
(c) Emmett M. Laursen, State University of Iowa, Iowa City, Iowa.
(d) Experimental; basic research and masters' and doctors' theses.
(e) Flume is intended for simultaneous study of bed load and suspended sediment load transportation. Flume has an overall length of 100 feet, a width of 3 feet, and a depth of 15 inches, with controlled variation in slope from minus 0.5 percent to 1.0 percent, and a maximum discharge of 10 cubic feet per second.
(f) Completed.

(571) CONSTRUCTION OF A VARIABLE-PRESSURE WATER TUNNEL.

(b) Office of Naval Research, U. S. Navy Department.
(c) Dr. Hunter Rouse, State University of Iowa, Iowa City, Iowa.
(d) Experimental; for basic and applied research, masters' and doctors' theses.
(e) Tunnel is developed primarily for study of flow around two-dimensional bodies, although interchangeable test sections will be provided. Initial test section will have a width of 6 inches and depth of 2 feet, with maximum water speed of 40 fps.
(f) Completed.

(572) CONSTRUCTION OF LOW-VELOCITY AIR TUNNEL.

(b) Office of Naval Research, U. S. Navy Department.
(c) Dr. Hunter Rouse, State University of Iowa, Iowa City, Iowa.

(d) Experimental; for basic and applied research, masters' and doctors' theses.
(e) Tunnel is of the recirculating type; fan is driven by hydraulic motor with sensitive speed control. Test section is octagonal, 30 feet long, 5 feet across. Air speed ranges from 10 to 100 fps.
(f) Completed.

(849) MODEL STUDY OF SANT'ANA DAM.

(b) Canadian-Brazilian Services, Ltd., Toronto, Canada.
(c) Emmett M. Laursen, State University of Iowa, Iowa City, Iowa.
(d) Experimental; applied research.
(e) A 1:30 model of one bay of the Sant'Ana Dam, including Tainter gate, was installed in a 2.5-foot glass-walled channel. Discharge characteristics of the spillway and gate, pressure distribution on the spillway, and appurtenances to minimize scour at the toe of the dam are being studied.
(f) Completed.

(850) MODEL STUDY OF SANTA CECILIA CANAL TRANSITIONS.

(b) Canadian-Brazilian Services, Ltd., Toronto, Canada.
(c) Emmett M. Laursen, State University of Iowa, Iowa City, Iowa.
(d) Experimental; applied research.
(e) Studies are being made to develop an economical design for two open-channel expansions in a canal system through use of 1:25 scale models. 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 a transition from rock cut to trapezoidal section in earth along a curve. Both are being studied for economy of construction, head loss, and scour downstream.
(f) Active.

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

(b) Laboratory project, sponsored by the Office of Naval Research, U. S. Navy Department.
(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 utilized to study turbulence behind screens and in a free jet and in boundary-layer studies.
(h) "A constant-temperature hot-wire anemometer for the measurement of turbulence in air", P. G. Hubbard. Master's thesis. February 1949. (Available on loan.)
"Application of a D-C negative-feedback amplifier to compensate for the thermal lag of a hot-wire anemometer", P. G. Hubbard. Proc. of the National Electronics Conference, Vol. 4: 171-178, 1948.

(852) EVALUATION OF UNCONFINED FLOW TO MULTIPLE WELLS BY THE MEMBRANE ANALOGY.

(b) Laboratory project.
(c) Dr. Hunter Rouse, State University of Iowa, Iowa City, Iowa.
(d) Experimental; for doctor's thesis.
(e) The study was for the purpose of delineating the characteristics of flow in unconfined wells. It was divided into two parts: (1) a model study of the nature of unconfined flow to determine the shape of the free surface near the well and boundary conditions near the well; and (2) the development of a membrane analogy from which multiple-well flow characteristics could be established.
(f) Completed.
(g) Functional relations were developed from experimental data which may be applied to the solution either of single or multiple systems.
(h) "Evaluation of unconfined flow to multiple wells by the membrane analogy", V. E. Hansen. Doctor's thesis. June 1949. (Available on loan.)

(853) DESIGN OF HYDRAULICS LABORATORY EQUIPMENT.

(b) Central University of Venezuela, Caracas, Venezuela.
(c) Dr. Hunter Rouse, State University of Iowa, Iowa City, Iowa.
(d) Contract project.
(e) Design of modern equipment for student instruction in fluid mechanics and applied research in hydraulic engineering.
(f) Active.

(854) A SYSTEMATIC STUDY OF THE DRAG OF ROUGH SURFACES.

(b) Office of Naval Research, U. S. Navy Department.
(c) W. Douglas Baines, State University of Iowa, Iowa City, Iowa.
(d) Experimental and theoretical; basic research and doctor's thesis.
(e) A comprehensive review of known references on the drag of flat surfaces has been completed. Preliminary experimental investigation of the drag of smooth and rough surfaces is underway in the low-velocity air tunnel. Exhaustive measurements of the relation between drag, roughness, and Reynolds numbers, in the range 10^3 to 10^7, are planned.
(f) Active.

THE JOHNS HOPKINS UNIVERSITY, Institute of Cooperative Research.

Inquiries concerning Projects Nos. 855 and 856 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 Highway Commission.
(d) Experimental; basic research and design.
(e) Tests on 1:2 model curb, gutter and combination inlets of various designs for capacity changes with velocity and depth of flow, crown of street, depth and design of depression, absence or presence of deflector. Laboratory studies will be followed by field investigation.

(f) Active.
(g) Tests on curb and gutter inlets without depression completed and rating formulas derived.

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

(b) Baltimore City, Baltimore County and the Maryland State Highway Commission.
(d) Field investigation; basic research and design.
(e) Study of rainfall and runoff as affected by types and patterns of ground surfaces, length and degree of slopes, pattern of drainage ways. Recording instruments for rainfall and runoff measurements will be installed on several small urban areas varying in extent of urbanization.
(f) Active.

LEHIGH UNIVERSITY, Department of Civil Engineering.

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

(b) A.S.C.E. Sub-Committee on Cavitation.
(c) Prof. W. J. Eney, Head, Department of Civil Engineering, Lehigh University, Bethlehem, Pa.
(d) Experimental; basic research.
(e) Determination of pressure variation as a function of velocity head, magnitude of misalignment, and Froude number. An attempt will be made to correlate data with cavitation phenomena experiences with hydraulic structures; also to define misalignment tolerances for hydraulic structures. Pressure is measured along the bottom of an open channel in which a transverse step of variable height has been placed. Velocity and depth of flow, size and shape of steps are varied.
(f) Active.

(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 for project.
(c) Prof. W. J. Eney, Head, Department of Civil Engineering, Lehigh University, Bethlehem, Pa.
(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. For flood control project requiring definite stage-discharge relationship. Both bell-mouthed orifice and I.S.A. flow nozzle are being investigated.
(f) Completed. Brief report for publication in progress.

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

(857) DETERMINATION OF DISCHARGE COEFFICIENTS FOR SECTOR GATES.

(b) Laboratory project.
(c) 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 feet, 38 feet, and 40 feet was constructed. Tests to be made to determine discharge rates at various gate openings and differential heads.
(f) Active.

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

(b) Laboratory project.
(c) 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 effect of submergence on discharge.
(f) Active.

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

(b) Laboratory project.
(c) 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.
(f) Equipment being constructed.

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

(b) Laboratory project, in cooperation with the U. S. Geological Survey.
(c) George M. Slaughter, School of Hydraulic Engineering, 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 a sand media. Tests will range from distilled water through sea water.
(f) Equipment is under construction and viscosities are being determined for the different salt water samples.

(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) George M. Slaughter, School of Hydraulic Engineering, Louisiana State University and A & M College, Baton Rouge 3, La.
(d) Theoretical and experimental; applied research for master's thesis.
(e) Unit hydrographs will be derived from existing data. These hydrographs and the drainage basin characteristics will be compared in an effort to derive coefficients for the construction of synthetic unit hydrographs.
(f) The derivation of unit hydrographs is in progress for 20 Louisiana streams.

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

(b) Laboratory project.
(c) George M. Slaughter, School of Hydraulic Engineering, Louisiana State University and A & M College, Baton Rouge 3, La.
(d) Theoretical; applied research for master's thesis.
(e) An attempt is being made to collect and correlate a major portion of existing data on this subject into one paper. No additional basic data will be obtained.
(f) Collection of existing data is in progress.

(863) THE EFFECT OF WETTING AGENTS ON MODEL SPILLWAY COEFFICIENTS.

(b) Laboratory project in conjunction with engineers of the Waterways Experiment Station, Vicksburg, Miss.
(c) Prof. S. E. Lawrence, Louisiana State University and A & M College, Baton Rouge 3, La.
(d) Experimental; applied research for master's degree.
(e) Use of various wetting agents applied to standard weirs in Waterways Laboratory and the use of other allied Government equipment there.
(f) Active.
(g) The tests of wetting agents may show possibilities of economics in model construction of weirs, etc.
(h) Test data largely secured from test on models and R. C. Wartelle, M.S. Thesis, 1950.

(864) WAVE GENERATING APPARATUS AND ITS MODEL APPLICATION.

(b) Thesis for Master of Science degree in hydraulic engineering.
(c) Prof. S. E. Lawrence, Louisiana State University and A & M College, Baton Rouge 3, La., Acting Director, School of Hydraulic Engineering.
(d) Research for master's thesis.
(e) Model constructed in Hydraulic Laboratory, Louisiana State University. Study and use of apparatus at Waterways Experiment Station, Vicksburg, Miss.
(f) Active, partly completed.
(g) Research and tests cover an investigation of basic wave motion principles and also apparatus for laboratory reproduction of waves for their intimate study.
(h) Apparatus in Louisiana State University and Waterways Experiment Station, Vicksburg, Miss. H. C. Meyer, Jr., M.S. thesis, 1950.

(865) BEACH PROTECTION OF GRAND ISLE AT GULF COAST.

(b) Laboratory project.
(c) Dr. V. Merkys, School of Hydraulic Engineering, Louisiana State University and A & M College, Baton Rouge 3, La.
(d) Theoretical and experimental; graduate research.
(e) A steel tank 20 feet x 8 feet x 1 foot was built; a wave machine is being constructed. The purpose of the work is to investigate the methods of beach erosion control to determine the form and direction of protection works best suited to Grand Isle, La.
(f) Active.

(866) A STUDY OF TIDEWATER SEAWAY CANAL FROM NEW ORLEANS TO GULF COAST.

(b) Laboratory project.
(c) Dr. V. Merkys, School of Hydraulic Engineering, Louisiana State University and A & M College, Baton Rouge 3, La.
(d) Theoretical and experimental; basic research.
(e) Laboratory studies of possible channels to determine the action of waves and currents. Qualitative study of scour patterns for various arrangements and quantitative comparison of scour.
(f) Active.

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

(b) Laboratory project, for information.
(c) Dr. V. Merkys, School of Hydraulic Engineering, Louisiana State University and A & M College, Baton Rouge 3, La.
(d) Theoretical and experimental; basic research.
(e) The study subject involves an investigation of floating breakwaters of varying dimensions and roughness in order to determine maximum dissipation of the wave amplitude with a minimum of detrimental effects upon the dissipating breakwaters. The floating breakwaters are tested in a 40 foot x 3 foot x 3 foot wave tank.
(f) Active.

(868) A MOVABLE RIVER BED MODEL STUDY WITH CONSIDERATIONS TO THE CONDITIONS OF MUNICIPAL DOCKS, MISSISSIPPI RIVER, BATON ROUGE, LA.

(b) Laboratory project.
(c) Dr. V. Merkys, School of Hydraulic Engineering, Louisiana State University and A & M College, Baton Rouge 3, La.
(d) Experimental graduate research.
(e) A model study to determine flow characteristics and scouring action to find corrective measures to increase the depths along the wharfs situated on convex river side.
(f) Active.

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

Inquiries concerning Projects Nos. 306 to 311, incl., and 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.
(f) Active; partly completed.

(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 not possible so far.
(h) "The scour around pile bridge piers", R. D. King and L. E. Cox. M.S. thesis. June 1947.
"Comparative studies of scour around bridge piles", C. H. Banks and J. E. Schremp. M.S. thesis. June 1948.

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

(b) Laboratory project. Initially sponsored by the 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.
(f) Active; partly completed.
(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 current were determined. Critical state of flow beyond which mixing occurs was determined for a large range of characteristic parameters. Work to be continued with a wider reservoir to reduce wall effects.
(h) "Characteristics of density currents", D. R. F. Harleman. M.S. thesis, June 1947.
"Sedimentation in storage reservoirs", E. Kuiper, M.S. thesis, June 1947.
"Investigation of mixing criteria for density currents", E. T. Podufaly and C. C. Noble. M.S.thesis. June 1948.

(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 contractions.
(f) Completed.
(g) Basic tests for a limited range of Froude numbers in high velocity channel have verified essentially the theoretical analysis.
(h) "Design of channel contractions", A. T. Ippen and J. H. Dawson, Proc. A.S.C.E.: 1348-1368, November 1949.
"Mechanics of supercritical flow", A. T. Ippen, Proc. A.S.C.E.: 1292-1317, November 1949.
"Theoretical investigation of standing waves in hydraulic structures", A. A. Stone. Master's thesis, September 1946.
"Standing waves in supercritical flow of water", M. P. Barschdorf and H. G. Woodbury. Master's thesis, June 1947.
"Channel transitions in supercritical flow of water", J. C. Adams, Jr. B.S. thesis, June 1948.

(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.
(f) Active.
(g) A lucite wave tank of 18 inches x 12 inches cross-section has been built with a tilting device. Experimental techniques to photograph particle motion within a wave have been developed.
(h) "Measurement of the characteristics of small waves", J. V. Allen and J. F. Michel. Master's thesis, June 1947.
"Forms and propagation of waves in shallow water", A. H. Bagnulo and R. B. Burlin. Master's thesis, June 1948.

(310) A THEORETICAL STUDY OF FLOOD WAVES RESULTING FROM SUDDEN DAM DESTRUCTION.

(b) Laboratory project.
(d) Theoretical; graduate thesis.
(e) Study of formation of flood waves due to a sudden dam failure and of their progress downstream. Prediction of maximum water elevation.
(f) Completed.
(g) Survey of theoretical and experimental solutions. Development of feasible methods of stage prediction on basis of information available.
(h) "A theoretical study of flood waves resulting from sudden dam destruction", T. M. Nosek and R. I. Dice. Master's thesis. June 1947.

(311) HYDRAULIC ANALOGY TO SUPERSONIC FLOW OF GASES.

(b) U. S. Air Forces.
(d) Experimental; basic research.
(e) The theoretical analogy to supersonic flow of gases by means of hydraulic shock waves has been worked out before. The project is to provide experimental evidence for a wide range of Froude numbers as to the extent to which hydraulic shock waves conform to the theoretical analysis.
(f) Active. Partly completed.
(g) A high velocity flume of 40 foot length and of 4 foot width has been constructed. The flume can be tilted up to slopes of 10 percent. For 30 feet of the flume the bottom consists of glass for easier observation of wave patterns. Extensive measurements for a wide range of conditions have been completed and analyzed. The results show that the theory of hydraulic shock waves has been essentially confirmed.
(h) "Viscous effects on standing waves in supercritical flow", C. E. Carver. M.S. thesis, September 1949.
A comprehensive report on the first phases of this project has been submitted to the sponsor.

(577) CHARACTERISTICS OF SOLITARY WAVES.

(b) Laboratory project; also sponsored by the Office of Naval Research.
(d) Experimental investigation of solitary wave characteristics for comparison with various mathematical theories. Graduate research.
(e) 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. The work is done in the lucite wave tank mentioned in Project 309, page 51.
(f) Active. Partly completed.

(g) A series of measurements of wave celerity and wave form have been made, and the results analyzed.
(h) "Profile characteristics of solitary waves", B. C. Burnell and D. E. Lockard. M.S. thesis, June 1949.
A paper entitled "Characteristics of solitary waves" was prepared for the annual meeting of the A.S.C.E., January 1950.

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

(b) Laboratory project; sponsored by the Engineering Foundation and by the 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.
(f) Active.
(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 electro-magnetic probes for this purpose have been abandoned due to the multitude of inherent difficulties. A combination of Pitot tube and pressure cells with strain gages is now under investigation.

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

(b) Office of Naval Research, U. S. Navy Department.
(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. Total resistance and pressure distributions are to be determined for such flow.
(f) Active.
(g) A pilot model of the water tunnel necessary for this work has been constructed, and special flow control mechanisms for water and air have been completed. The development of the electronic instrumentation for automatic control of velocities and accelerations is now underway.

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

(b) U. S. Public Health Service.
(d) Experimental; basic research.
(e) In the activated sludge process for sewage and industrial waste treatment, oxygen is transferred from the air supplied by various methods of air dispersion. The nature of the oxygen transfer is to be explored experimentally, and quantitative measurements of this transfer will be carried out systematically for different dispersion methods. With this information, means of more efficient oxygen transfer may be devised.
(f) Active.
(g) 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 energy transfer from uniformly distributed bubbles of constant frequency and diameter are now underway in a 6 inch diameter lucite column.

887657 O—50——5

(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 transient stability of hydro units. Subsequent investigations are to include other variables.
(f) Active.
(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) "Stability of surge tanks", H. M. Paynter. M.S. Thesis, June 1949.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY, Department of Mechanical Engineering.

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

(b) Laboratory project.
(c) Prof. B. G. Rightmire, Massachusetts Institute of Technology, Cambridge 39, Mass.
(d) Experimental; basic research; student theses.
(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.
(f) Active.
(g) Pressure waves of 1000 psi amplitude and building up at a rate of 100 psi per microsecond have been found to deform an aluminum surface after 100,000 applications. Depth of deformation is about 0.001 inch.
(h) "Material testing by means of liquid impact, I", C. G. Bragaw. Master's thesis, Massachusetts Institute of Technology. June 1948.
"Material testing by means of liquid impact, II", L. E. Sobolewski, et al. Master's thesis, Massachusetts Institute of Technology. September 1948.
"A study of damage to metals caused by liquid impact", W. D. Allingham. Master's thesis, Massachusetts Institute of Technology. September 1948. (All available on loan.)

(870) INTERACTION OF HEAT, MASS AND MOMENTUM TRANSFER IN BOUNDARY LAYERS.

(b) Laboratory project; sponsored by Industrial Fellowships from Standard Oil (Indiana) and Proctor and Gamble.
(c) Prof. H. S. Mickley, Department of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge 39, Mass.
(d) Experimental and theoretical; doctor's thesis.
(e) Study of heat transfer coefficients from a flat plate to a low-velocity air stream with suction or injection of air through the porous surface of the plate. Experiments of this type can be correlated in a manner that should permit more accurate calculation of simultaneous heat transfer, mass transfer and friction than is now possible. Laminar and turbulent boundary layers will be studied.
(f) Active.
(g) The theoretical work is essentially completed. No data have been obtained.

(871) STUDY OF FLOW CHARACTERISTICS IN TURBINE NOZZLES.

(b) General Electric Company, Turbine Engineering Division, Schenectady, N. Y.
(c) Prof. E. S. Taylor, Gas Turbine Laboratory, Massachusetts Institute of Technology, Cambridge 39, Mass.
(d) Experimental; applied research and master's thesis.
(e) The purpose of the project is to ascertain the relationships between boundary layer effects and certain sudden drops in efficiency observed by the General Electric Company in the testing of a specific nozzle design, the so-called "Battleship Partition". A scale model of these nozzles has been installed in the variable density wind tunnel at the Gas Turbine Laboratory and the flow through the model is to be studied with the optical interferometer.
(f) Active.

(872) THE INTERFEROMETER APPLIED TO STUDY OF LAMINAR BOUNDARY LAYER.

(b) Laboratory project.
(c) L. A. DeFrate, Department of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge 39, Mass.
(d) Experimental and theoretical; applied research for thesis.
(e) The interferometer is used to determine the density in the boundary layer of a flat plate in a supersonic stream. This information can then be used to solve the boundary layer equations. The solution is by simple quadrature in the case of zero pressure gradient, and an approximate solution is possible in the case with large pressure gradient in the direction of flow.
(f) Current activity is directed toward obtaining interferometer photographs of the boundary layer.

(873) INTERACTION OF SHOCK WAVES WITH BOUNDARY LAYERS ON A FLAT PLATE.

(b) Bureau of Ordnance, U. S. Navy Department.
(c) Prof. E. P. Neumann, Gas Turbine Laboratory, Massachusetts Institute of Technology, Cambridge 39, Mass.
(d) Experimental and analytical; basic research for doctor's thesis.
(e) The reflection of an oblique shock from a boundary layer on a flat plate in a supersonic stream is being studied with schlieren and interferometer apparatus, and impact probes. Reynolds number, shock strength, and Mach number are varied.
(f) Active. Will be discontinued shortly.
(g) The pressure rise is communicated upstream by the subsonic portion of the boundary layer and results in thickening and perhaps separation of the boundary layer. Thus an oblique shock is generated upstream of the point of incidence. An expansion wave, followed by a compression shock, emanates from the point of incidence. Further results will be published soon.
(h) "Some experiments on the interaction of shock waves with boundary layers on a flat plate", A. H. Shapiro, E. P. Neumann, and F. W. Barry, Meteor Report No. 29, M.I.T. October 1948.
"Some experiments on the interaction of shock waves with boundary layers on a flat plate", F. W. Barry, A. H. Shapiro and E. P. Neumann, A.S.M.E. Paper No. 49-A-3. Available on loan from Gas Turbine Laboratory, Massachusetts Institute of Technology.

(874) AN INVESTIGATION OF THE INFLUENCE OF ORIFICE GEOMETRY ON STATIC PRESSURE MEASUREMENTS.

(b) Laboratory project.

(c) Prof. E. P. Neumann, Gas Turbine Laboratory, Massachusetts Institute of Technology, Cambridge 39, Mass.
(d) Experimental; master's thesis.
(e) The project was designed to determine experimentally the order of magnitude of error introduced in the measurement of static pressure by means of orifices inserted in the wall of a duct. Small static pressure holes of various sizes and shapes were drilled in the wall of circular tubes. These holes had various edge forms and various cross sections. The static pressure was measured with air and water flowing through a tube.
(f) Inactive.
(g) It was found that a radius applied to the edge of the orifice produced a positive change in the pressure reading, while a countersink produced a negative change.
(h) "An investigation of the influence of orifice geometry on static pressure measurements." Master's thesis, 1949.

(875) AN INVESTIGATION OF EJECTOR DESIGN BY ANALYSIS AND EXPERIMENT.

(b) Sponsored jointly by the Elliott Company, Jeannette, Pa., and Bureau of Ordnance, U. S. Navy Department.
(c) Prof. J. H. Keenan or Prof. E. P. Neumann, Gas Turbine Laboratory, Massachusetts Institute of Technology, Cambridge 39, Mass.
(d) Experimental and analytical; design.
(e) A one-dimensional method of analysis of jet pumps or ejectors is presented. The analysis considers mixing of the primary and secondary streams at constant pressure, and mixing of the streams at constant area. For the analytical conditions considered, better performance can be obtained when constant-pressure mixing is employed. A comparison between experimental and analytical results shows some good agreement over a broad range of variables. Some experimental data on the length of tube required for mixing of the two streams are presented. A method for jet-pump design is given.
(f) Active. Work is continuing to devise design relations to handle fluids of various molecular weights, specific heats and temperatures.
(h) "An investigation of ejector design by analysis and experiment", J. H. Keenan, E. P. Neumann, and F. Lustwerk, Paper No. 49-A-25, Massachusetts Institute of Technology.

(876) THE APPLICATION OF CAPILLARY TUBES AS REFRIGERANT METERING DEVICES.

(b) Laboratory project.
(c) A. L. Hesselschwerdt, Department of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge 39, Mass.
(d) Experimental; basic research.
(e) Capillary, or restrictor, tubes have been successfully used on small, domestic refrigerating units. Little is known concerning the relationships between length, diameter, and capacity as affected by operating conditions. The above investigation has been the subject of several theses under essentially adiabatic conditions. Further investigation is planned under non-adiabatic conditions.
(f) Active.
(g) Data, obtained to date, indicate a possible, positive, relationship between bore, length, and load for the adiabatic case. Confirming tests are needed.

(877) INVESTIGATION OF HYDRAULIC GEAR PUMP AND MOTOR.

(c) S. D. Smith, Department of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge 39, Mass.
(d) Experimental; for master's degree.
(f) Completed.

(g) Over the range of 200 through 400 rpm, the pump delivery and the input torque to the pump are greater for the pump with the plain pump pins than with the redesigned pump pins. The conclusion which may be drawn from the experiment is that the redesigned pump is a definite improvement over the pump with plain pump pins and that its characteristics are on a level and perhaps higher than those of the straight spur-gear type of pump.

(878) INVESTIGATION OF FLOW THROUGH TWO CIRCULAR ORIFICES IN SERIES.

(b) Laboratory project.
(c) Prof. Warren M. Rohsenow, Department of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge 39, Mass.
(d) Experimental; applied research.
(e) The effect of orifice spacing and ratio of orifice areas on axial pressure profile, vena contracta location, and flow coefficients is being investigated for water flowing in a 4 inch diameter pipe. Further photographic studies of air flowing in a two dimensional model are projected.
(f) Active.

(879) HEAT TRANSFER WITH LOCAL BOILING OF WATER IN FORCED CONVECTION.

(b) Office of Naval Research.
(c) Prof. Warren M. Rohsenow, Department of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge 39, Mass.
(d) Experimental; basic research.
(e) Water which is at a temperature below its boiling point is heated by flowing through a tube whose surface temperature is above the boiling point. There is no net evaporation of the fluid. Range of investigation will extend from atmospheric pressure up to 2000 psia with tube of approximately 3/16 inch diameter by 9 inches long. Both heat transfer coefficient and pressure drop will be obtained.
(f) Active.

(880) MEASUREMENT OF RECOVERY FACTORS AND HEAT-TRANSFER COEFFICIENT FOR AIR FLOWING AT SUPERSONIC VELOCITIES IN A TUBE.

(b) Office of Naval Research, U. S. Navy Department.
(c) Prof. J. Kaye, Department of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge 39, Mass.
(d) Experimental; basic research.
(e) The objective of this project is to obtain data for recovery factors and heat-transfer coefficients in a field where few are available, namely for supersonic flow of air. In addition, friction factors are measured simultaneously for supersonic flow of air.
(f) Active.
(g) Some preliminary results may be found in the publication listed below.
(h) "Report of progress on measurements of friction coefficients, recovery factors, and heat transfer coefficients for supersonic flow of air in a pipe", J. Kaye, J. H. Keenan, and W. H. McAdams, Heat Transfer and Fluid Mechanics Institute, 1949.

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

(b) Laboratory project.
(c) A. H. Shapiro, Department of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge 39, Mass.

(d) Experimental; basic and applied research for masters' theses.
(e) Impact tubes will be calibrated in a stream of viscous oil to find the effects of Reynolds number and thus yield information about the interpretation of data obtained with very small probes with such fluids as water or air.
(f) Active.

(882) MIXING OF COAXIAL GAS JETS.

(b) Bureau of Ordnance, U. S. Department of Navy.
(c) A. H. Shapiro, Department of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge 39, Mass.
(d) Experimental; basic and applied research for master's and doctoral theses.
(e) A round jet mixes with a coaxial annular jet of different temperature, different speed, and different chemical composition. Measurements are made of the transfer of mass, momentum, and heat. The effects of velocity ratio and density ratio of the streams are being investigated, as well as the effect of initial turbulence.
(f) Active.
(g) The mixing of isothermal jets over a wide range of velocity ratios has been investigated in detail.
(h) "Material and momentum transfer in coaxial gas streams", W. Forstall, Jr., Sc.D. thesis, 1949.
"Effects of velocity ratio and initial turbulence on the mixing of coaxial gas streams", R. S. Crosby, Master's thesis, 1949.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY, Propeller Testing Tunnel, Department of Naval Architecture and Marine Engineering.

Inquiries concerning Projects Nos. 883 to 888, incl., should be addressed to Prof. Frank M. Lewis, Director, Propeller Testing Laboratory, Massachusetts Institute of Technology, Cambridge 39, Mass.

(883) INTERNATIONAL COMPARISON TESTS.

(b) International Conference of Ship Tank Superintendents.
(d) Basic research.
(e) Comparison tests of certain propellers are being carried on in all available tunnels in the world.
(f) Active.

(884) BOW PROPELLERS FOR STEERING.

(b) Grace Lines.
(d) Applied research and design.
(e) To determine the characteristics of a bow propeller arranged transversely in a tube.
(f) Active.

(885) CAVITATION CHARACTERISTICS OF WIDE BLADE PROPELLERS.

(b) Laboratory project.
(d) Basic research.
(e) To determine the characteristics of blade shape which will defer cavitation.
(f) Suspended temporarily.

(886) VIBRATION STUDIES.

(b) Laboratory project; student thesis.
(d) Basic research, measurements of the vibratory.
(e) Pressure field adjacent to a propeller and on adjacent surfaces.
(f) Continuing.

(887) CAVITATION TESTS OF STANDARD SERIES OF MERCHANT-TYPE PROPELLERS.

(b) Laboratory project.
(d) Design data.
(f) Continuing.

(888) RUDDER TESTS IN THE WAKE OF A PROPELLER.

(b) Laboratory project; student thesis.
(d) Experimental.
(e) Tests to determine the effect of the propeller wake on the performance of a rudder.
(f) Active.

UNIVERSITY OF MICHIGAN, Lake Hydraulics Laboratory, Department of Civil Engineering.

Inquiries concerning Projects Nos. 889 and 890 should be addressed to Dr. E. F. Brater, 320 West Engineering Building, University of Michigan, Ann Arbor, Mich.

(889) HARBOR MODEL STUDY FOR PORT AUSTIN, MICHIGAN.

(b) Sponsored jointly by the U. S. Corps of Engineers, and the Michigan Waterways Commission.
(d) Experimental; applied research.
(e) For the determination of the best breakwater arrangement, a model of the harbor was built with an undistorted scale of 1:75. Waves were generated by a plunging type wave machine 30 feet long. Storm waves were projected from three directions, and the reduction in wave height within the breakwaters was recorded for seven different breakwater arrangements. Velocities of current near the entrance and within the harbor were observed and recorded.
(f) Completed.

(890) STUDY ON BEACH EROSION.

(b) Laboratory project; sponsored jointly by the Michigan Department of Conservation and the University of Michigan.
(d) Basic research.
(e) A bibliography of studies that have been carried on elsewhere on the subject of beach erosion has been prepared and is being made ready for publication. This will be followed by experimental work in the laboratory together with field investigations at nearby points on the Great Lakes.
(f) Active.

UNIVERSITY OF MICHIGAN, Experimental Naval Tank, Department of Naval Architecture and Marine Engineering.

(585) RESISTANCE OF BARGE TOWS.

(b) Department of the Army, Corps of Engineers.
(c) The District Engineer, Pittsburgh District, Corps of Engineers, Pittsburgh 19, Pa.; or Prof. Louis A. Baier, Room 326 West Engineering Building, University of Michigan, Ann Arbor, Mich.
(d) Experimental; design.
(e) Tests will be 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) Active; tests 50 percent completed.

MISSISSIPPI STATE COLLEGE, Engineering and Industrial Research Station.

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

(4) DEVELOPMENT OF SURFACE WAVES BY WIND.

(b) Laboratory project.
(d) General 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.
(f) 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) General 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.
(f) 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) General theoretical and experimental research.

(e) The effect of heating on the flow characteristics of various fluids is to be studied.
(f) Experimental apparatus is being designed and will be constructed in the near future.

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 Mettalurgy, 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) STUDY OF VERTICAL FLOW THROUGH SHORT PIPES AND TUBES.

(b) Laboratory project.
(c) Prof. J. B. Butler, Missouri School of Mines and Metallurgy, Rolla, Mo.
(d) Experimental; basic research.
(e) Tests are being conducted on vertical flow in pipes and tubes up to 2 inches in diameter. Experimental results are then checked by application of Bernoulli's theorem.
(f) Active.

(586) FLUID FLOW IN PIPES.

(b) Laboratory project.
(c) John G. Duba, Instructor in Civil Engineering, Missouri School of Mines and Metallurgy, Rolla, Mo.
(d) Library research; basic research and 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.
(f) Completed.
(g) A selected bibliography has been assembled.
(h) "Formulas for flow of fluids", J. G. Duba. Master's thesis, Missouri School of Mines and Metallurgy, June 1949.

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

(b) Laboratory project.
(c) James J. Trace, Instructor in Civil Engineering, 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 and necessitates a knowledge of the practicability of using one model of a water turbine for all installations for small output.
(f) Active; experiments are in progress.

(892) EFFECT OF APPROACH WINGS ON THE DISCHARGE OF A RECTANGULAR WEIR.

(b) Laboratory project.
(c) J. J. Trace, Civil Engineering Department, Missouri School of Mines and Metallurgy, Rolla, Missouri.
(d) Experimental; design.
(e) A 6-inch wide rectangular weir is being used for this experiment. The wings are adjusted from a maximum of 26 inches to a minimum and the discharge determined for different heads at each position of width. The length of the wings will be varied from a length equivalent to the weir width to a length equal to five times the weir width.
(f) Active.

(893) CALIBRATION OF A WEIR BY MEANS OF CRITICAL FLOW.

(b) Laboratory project.
(c) Prof. Vernon A. C. Gevecker, Civil Engineering Department, Missouri School of Mines and Metallurgy, Rolla, Mo.
(d) Experimental.
(e) Tests are being conducted in a celluloid model flume of variable slope containing a suppressed weir for the calibration of the weir by means of the critical flow theory.
(f) Active.

(894) PRECIPITATION-RUNOFF RELATIONSHIP ON THE GRAND RIVER BASIN IN MISSOURI AND IOWA.

(b) Laboratory project.
(c) J. Kent Roberts, Civil Engineering Department, Missouri School of Mines and Metallurgy, Rolla, Mo.
(d) Field investigation, for development and for master's thesis.
(e) Past records will be correlated in an effort to determine what relationship between monthly precipitation and runoff has occurred. If it is possible a relationship will be determined by which estimates of monthly or yearly yield can be made on ungaged streams in the basin.
(f) Active.

THE SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS

(895) THE WAVE-MAKING RESISTANCE OF SHIPS.

(b) Office of Naval Research.
(c) W. N. Landers, Secretary, The Society of Naval Architects and Marine Engineers, 29 West 39th Street, New York City.
(d) The compilation of 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 the existing data on the wave-making resistances of ship hull models which have been tested by the several towing tanks of this country. An analysis of the data, after correlation, to determine systematically the influences of differences of hull form on wave-making resistance and to establish the fundamentals of the subject.
(f) Active.
(g) A standard form entitled "Model resistance data", has been established to record model data and test results. Similarly, another standard form entitled "Expanded resistance data" has been developed 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 prepared. Model resistance data sheets covering 52 models have been completed and additional models have been selected to bring the total up to 60. It is expected ultimately to complete sheets for a total of 100 models. The corresponding expanded resistance data sheets are being prepared. Estimated completion, 1951.
(h) Model resistance and expanded resistance data sheets with explanatory notes for 40 models have been completed and are available for sale to members of the Society for $4.00 per set and to non-members for $5.00 per set.

NEWPORT NEWS SHIPBUILDING AND DRY DOCK COMPANY

Inquiries concerning Projects Nos. 123, 124, and 896 to 902, incl., should be addressed to C. H. Hancock, Hydraulic Laboratory, Newport News Shipbuilding and Dry Dock Company, Newport News, Va.
Much of the laboratory's work is described in "The equipment and methods used in operating the Newport News Hydraulic Laboratory", C. H. Hancock, Trans. Society of Nav. Arch. and Marine Engrs., Vol. 56. 1948.

(123) HYDRAULIC TURBINE TESTS.

(b) Laboratory project.
(d) Experimental; for design data on hydraulic turbines.
(e) Scale model turbines are tested with water at various speeds. Efficiency and unit horsepower are plotted against unit speed.
(f) As required.

(124) METER CALIBRATION TESTS.

(b) Hull Engineers Department, Newport News Shipbuilding and Dry Dock Company.
(d) Experimental; to determine calibration curve.

(e) Meters are tested at various heads and quantities by the usual 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 information.
(e) Tests are to determine the vane moment diagrams. The turbine load is applied by the dynamometer and the gates are controlled by the governor. The blades adjust automatically and the moment is measured by a spring dynamometer.
(f) As required.

(897) INLET CONDENSER HEAD VELOCITY DISTRIBUTION SURVEY.

(b) Engine Technical Department, Newport News Shipbuilding and Dry Dock Company.
(d) Experimental; for design information.
(e) Plexiglas scale model of inlet condenser head tested with water at three different rates of flow. The velocity distribution behind an analogous tube sheet was measured by an impact tube. Contours of velocity-head/head-loss across the tube sheet were plotted.
(f) Completed.

(898) SHIP MODEL DECELERATION TEST.

(b) Engine Technical Department, Newport News Shipbuilding and Dry Dock Company.
(d) Experimental; design information.
(e) The decelerating resistance of a ship model was measured at several rates of deceleration. The model results were compared with the ship results. A study is being made of the resistance of a ship undergoing deceleration.
(f) Semi-active.

(899) THE EFFECT OF THE BROAD FLAT STERN (ASSOCIATED WITH TWIN-SKEG DESIGN) ON THE SEAWORTHINESS OF SHIPS.

(b) Hull Technical Department, Newport News Shipbuilding and Dry Dock Company.
(d) Experimental; for design information.
(e) Two models, one a double ender, and the other with the same forebody and Section Area Curve but having a broad flat stern, were tested in the 56-foot model basin. The models were towed by a gravity-type dynamometer at a pull equal to a still water speed-length ratio of 0.90. The wave lengths were 0.50, 0.75, 1.00, 1.25, and 1.50 times the model length, and the wave heights equalled 0.05 the wave length. The models were dynamically ballasted to obtain longitudinal radii of gyration of 0.20 and 0.25 the model length, and were towed in head seas and stern seas for these two conditions.
Speed change and the limits of speed variation were measured. Pitching data (period, angle, and amplitude) were obtained through light trace photography. Visual observations were recorded. Still pictures and colored moving pictures were taken.
(f) Completed.

(900) THE EFFECT OF SLACK WATER BALLAST ON ROLLING IN WAVES.

(b) Hull Technical Department, Newport News Shipbuilding and Dry Dock Company.
(d) Experimental; for design information.
(e) A ship model was rigged athwart the model basin and allowed to roll and drift with the waves. Various depths of water were placed in scale model ballast tanks and the damping effect was measured. The opening in the center vertical keel and in the wing tank bulkheads, were altered to give the maximum damping effect.
(f) Completed.

(901) SHIP MODEL RESISTANCE TESTS.

(b) Hull Technical Department, Newport News Shipbuilding and Dry Dock Company.
(d) Experimental; for design data.
(e) Scale ship models are tested 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 length of time. This allows 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 about ten years ago in which the beam-draft ratio, the displacement-length ratio, and the prismatic coefficient are varied over a wide range. This project is continuing.
(f) Temporarily inactive.
(g) "The effects of size of towing tank on model resistance", J. P. Comstock and C. H. Hancock, Trans. Society of Nav. Arch. and Mar. Eng., Vol. 50. 1942.

(902) THE EFFECT OF MODEL FINENESS.

(b) Laboratory project.
(d) Experimental; for laboratory information.
(e) Friction forms and planes of various fineness coefficients (S/L^2) are being retowed in the 56-foot model basin. This is part of an investigation of ship model friction for small models.
(f) Active.
(g) "The effects of size of towing tank on model resistance", J. P. Comstock and C. H. Hancock, Trans. Society of Nav. Arch. and Mar. Eng., Vol. 50. 1942.

NEW YORK UNIVERSITY, Chemical Engineering Department.

Inquiries concerning Projects Nos. 589 and 590 should be addressed to Prof. John Happel, Department of Chemical Engineering, New York University, University Heights, New York 53, N. Y.

(589) TWO-PHASE FLUID SOLID FLOW.

(b) Laboratory project.
(d) Experimental; for master's thesis.
(e) Experiments to determine the flow characteristics of particle-fluid mixtures have been conducted as a guide to more extensive work on the pressure losses in catalyst carrier lines and flowing fluid beds. The experiments were carried out in a 1-3/4 inch I. D. lucite tube with air as the fluid medium.

(f) Completed.
(h) "An exploratory study two-phase fluid-solid flow", F. E. Zenz, thesis.

(590) PRESSURE DROP DUE TO FLUID FLOW THROUGH BEDS.

(b) Laboratory project.
(d) Experimental; for masters' theses.
(e) Experiments to determine effects of gradations in size of particles and their roughness on pressure drop. Spheres of different sizes will be supported in various assemblages and water passed through these systems.
(f) Equipment constructed.

NEW YORK UNIVERSITY, Fluid Mechanics Laboratory.

(592) STUDY OF THE DEVELOPMENT OF A BOUNDARY LAYER IN OPEN CHANNEL FLOW.

(b) Laboratory project.
(c) A. H. Griswold, Fluid Mechanics Laboratory, New York University, University Heights, New York 53, N. Y.
(d) Experimental; master's thesis.
(e) Experimental work is now being conducted in a smooth horizontal flume 3 feet wide and 35 feet long with water flowing at a depth of 8 inches. The presence and development of the boundary layer are being determined by means of Pitot tube traverses in various vertical sections. The hydraulic drop is also being studied.
(f) Active.
(g) The results should be available in thesis form within the next few months.

NORTH CAROLINA STATE COLLEGE OF AGRICULTURE AND ENGINEERING.

(593) DYNAMIC SIMILARITY OF SMALL HYDRAULIC MODELS.

(b) Laboratory project.
(c) Prof. N. W. Conner, or Prof. C. E. Feltner, Department of Engineering Research, North Carolina State College of Agriculture and Engineering, State College Station, Raleigh, N. C.
(d) Theoretical and basic research.
(e) To make a theoretical study of dynamic similarity of small hydraulic models and at large-scale ratios.
(f) Active.
(g) The experimental work has been completed, and the mathematical treatment is now being completed.
(h) The results will be published by the Department of Engineering Research of the North Carolina State College.

NORTHWESTERN UNIVERSITY, The Technological Institute.

(126) RESISTANCE OF BARGE FORMS IN SHALLOW WATER AND RESTRICTED CHANNELS.

(b) Laboratory project.
(c) Prof. W. S. Hamilton, Department of Civil Engineering, Northwestern Technological Institute, Evanston, Ill.
(d) Experimental; basic research.
(e) Tests are to be conducted in a towing tank to determine the resistance coefficients of simple barge forms in terms of the shape and dimensions of the forms relative to the depth and width of the water in which they are towed. Speed is to be measured with a spark chronograph and resistance with a recording dynamometer carried by the model.
(f) Suspended; satisfactory equipment completed; no test results.

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

(b) Laboratory project.
(c) Prof. L. H. Kessler, Department of Civil Engineering, Northwestern Technological Institute, Evanston, Ill.
(d) Experimental; for design.
(e) Tests are conducted to determine the 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.
(f) Active.
(g) The present phase of the 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 is now being developed.
(h) Progress report giving test data available on request.

(326) CAVITATION DAMAGES UNDER CONTROLLED CONDITIONS.

(b) Laboratory project.
(c) W. S. Hamilton, Associate Professor of Civil Engineering, Northwestern Technological Institute, Evanston, Ill.
(d) Experimental; basic research, for theses' work 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 engineering materials will be related to variables such as size of cavity, static load, dissolved air content, and proximity of material to point of cavity collapse.
(f) Active; the equipment is operating. A special device to permit calibration of the electronic pressure measuring apparatus by the sudden release of pressure has been constructed.

(594) PHOTOELECTRIC INVESTIGATION OF THE COAGULATION AND SEDIMENTATION CHARACTERISTICS OF LAKE MICHIGAN WATER.

(b) Laboratory project.
(c) L. H. Kessler, Professor of Civil Engineering, Northwestern Technological Institute, Evanston, Ill.

(d) Experimental; for masters' theses.
(e) A photoelectric apparatus has been developed to measure the turbidity of liquids. It includes a photoelectric cell, light source, amplifier, and ammeter. The ultimate objective is to determine the coagulent or coagulent aids which will eliminate low temperature sedimentation difficulties.
(f) Suspended.
(h) "Photoelectric investigation of the coagulation and sedimentation characteristics of Lake Michigan water", R. B. Banks and A. J. Fox. Master's thesis, Northwestern Technological Institute, December 1948. (Available on loan.)
"A photoelectric investigation of the coagulation and sedimentation of Lake Michigan water at low temperatures", B. H. R. Hemmeter, Master's thesis, Northwestern Technological Institute, October 1949. (Available on loan.)

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

(b) Laboratory project.
(c) Prof. W. S. Hamilton, Department of Civil Engineering, Northwestern Technological Institute, Evanston, Ill.
(d) Experimental; applied research, for theses or staff papers.
(e) A plane surface approximately 3 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. It is planned to determine the forces for various values of slope and correlate the forces with theory if possible.
(f) Active. The apparatus is installed and calibrated.

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

(b) Laboratory project.
(c) Professor L. H. Kessler or Professor M. B. Gamet, Department of Civil Engineering, Northwestern Technological Institute, Evanston, Ill.; or Mr. S. Logan Kerr, Consulting Engineer, Philadelphia, Pennsylvania.
(d) Experimental; basic research and for design.
(e) Tests have been conducted on two crude oils and on one gasoline, at temperatures from 60 degrees F. to 130 degrees F. and at pressures ranging from 0 to 1500 psig. Further tests will be made on other oils and gasolines as well as on water, both tap and distilled, and a variety of chemicals. Specific gravity and viscosity of all fluids tested will be determined over the range of temperature and pressure indicated above.
(f) Active.
(g) Completed 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) "Final report of joint surge conference", H. B. Britton, Chairman, Technical Committee, Joint Surge Conference; sponsored by Middle East Pipelines Limited, Trans-Arabian Pipe Line Company, Gulf-Shell Pipe Line. (Available on loan from A.S.M.E., A.S.C.E., A.W.W.A., A.P.I; Eng. Inst. of Canada; Inst. of Mech. Eng., London, England; Inst. of Civil Eng., London, England.)

(905) THE LIQUID-SOLID CYCLONE.

(b) Laboratory project.
(c) Prof. D. A. Dahlstrom, Chemical Engineering Department, Northwestern Technological Institute, Evanston, Ill.
(d) Experimental and field investigations. Basic and applied research with the purpose of obtaining optimum design and operating conditions.
(e) Application of centrifugal fields as obtained in the liquid-solid cyclone to the rapid classification, beneficiation and desliming of coal and minerals below the 100 mesh size.
(f) Active.
(g) Experimental and field investigations on the theory and operation of the liquid-solid cyclone have been completed making it possible to design equipment for any capacity and efficiency desired. Results will be found in the publications listed below. Present investigations with respect to classification, etc., have indicated that it is easily possible to deslime minerals and coal of minus 200 mesh refuse and work is now being conducted in an attempt to raise the size limit to 100 mesh.
(h) "Cyclone elimination of contaminating solids from process water", D. A. Dahlstrom and R. W. Maeser. Coal Technology: p. 2471. November 1948. Transactions A.I.M.E: 177 and 277. 1948.
"Cyclone operating factors and capacities on coal and refuse slurries", D. A. Dahlstrom, Mining Engineering, September 1949. Mining Transactions A.I.M.E: 184 and 331. 1949.

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

(b) Laboratory project.
(c) J. J. Moder and D. A. Dahlstrom, Department of Chemical Engineering, Northwestern Technological Institute, Evanston, Ill.
(d) Theoretical and experimental investigation. Basic and applied research with the purpose of determining optimum design and operating conditions, and the separation that can be expected for a given system. Work is being done for a doctor's thesis.
(e) Separation of close gravity solids by heavy liquids and the application of centrifugal fields as obtained in the liquid-solid cyclone is to be investigated. The particle range being considered is from 10 to 100 mesh and the particle specific gravity difference from .02 to .10.
(f) Active.
(g) Initial experimental evidence indicates that a very rapid separation between particles can be obtained with the 100 mesh point as a probable size limitation.

UNIVERSITY OF NOTRE DAME, Department of Engineering Mechanics, College of Engineering.

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

(b) Sponsored by the Office of Naval Research.
(c) Dr. K. E. Schoenherr or Dr. A. G. Strandhagen, College of Engineering, University of Notre Dame, Notre Dame, Ind.
(d) Basic theoretical analysis.

887657 O—50 —6

(e) The research concerns the stability of a marine ship towed by a hawser. It has been observed that some ships tend to keep a straight course while others tend to yaw excessively. The analysis will establish one or more conditions which must be satisfied in order to insure stability in tow.
(f) Active.
(g) The analysis indicates that a dynamically stable ship is not necessarily stable in tow. Also, there are indications that for any given conditions an optimum velocity of tow exists.

(908) DIRECTIONAL STABILITY OF MARINE SHIPS USING DIFFERENT SETS OF MOVING AXES.

(b) Laboratory project.
(c) Dr. K. E. Schoenherr or Dr. A. G. Strandhagen, College of Engineering, University of Notre Dame, Notre Dame, Indiana.
(d) Basic theoretical research.
(e) To compare the equations of motion and subsequent steps in the analysis of directional stability using two different sets of moving axes. The two sets of moving axes to which the forces are usually referred are either the body axes or the axes tangential and normal to the path of the ship. Both of the above mentioned types of axes were investigated for a ship moving in a plane parallel to the water-line surface. Also in this comparison it was necessary to analyze: (1) the effects of uncoupling of a system of differential equations defining the motion, (2) the effects of neglecting certain components of the hydrodynamic forces and moments on the system of equations defining the state of motion.
(f) Active.
(g) The limitations and advantages of each set of moving axes were established. Conditions which lead to an uncoupling of a system of equations defining the motion were found. A study of the usually assumed approximations in the hydrodynamic components on the state of motion is being carried out.

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

(b) Laboratory project.
(c) Dr. A. G. Strandhagen, College of Engineering, University of Notre Dame, Notre Dame, Ind.
(d) Basic theoretical research.
(e) Automatic controlling devices which actuate the stern elevator and which depends upon the characteristics of the transient state of the moving submarine are being analyzed. Both the path of the ship, with its accompanying oscillations and movement, and the time to reach a predetermined depth are compared with the path, oscillations, movement, and time involved in a constant setting or manually operated control. It is planned also to study the accompanying problems of dynamic stability.
(f) Active.
(g) The equations of motion of the submarine and the effects of the state of the moving submarine on the automatic controlling devices have been analytically expressed. The equations of the various paths of the ship are now being developed.

THE OHIO STATE UNIVERSITY, Robinson Hydraulic Laboratory.

(597) ELIMINATION OF PULSATION ERROR IN FLUID METERS.

(b) Laboratory project; sponsored by American Gas Association, and American Society of Mechanical Engineers.

(c) 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) Active; considerable data have been secured to show the effectiveness of certain pulsation dampening devices on the meter.
(g) Results indicate that effective dampeners can be designed to operate over a limited range.
(h) "Recent results in experiments with pulsation eliminators", D. J. Masson. 9th Annual Appalachian Gas Measurement Short Course, West Virginia University, August 1949. (Available on loan.)

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

(b) American Society of Mechanical Engineers and American Gas Association.
(c) Prof. S. R. Beitler, Robinson Laboratory, The Ohio State University, Columbus 10, Ohio.
(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 the 4-inch, 6-inch, and 10-inch lines, and these results are, at present, being analyzed.
(g) No final results or conclusions can be made with the limited amount of data analyzed to date (4-inch and 6-inch). However, tentative results are being disseminated.
(h) "Coefficients of discharge for eccentric and segmental orifices in 4-inch and 6-inch pipe lines", S. R. Beitler and D. J. Masson. Annual meeting A.S.M.E., New York, N. Y. December 3, 1948.

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

(b) Various manufacturers and users of flow meters.
(c) Prof. S. R. Beitler, Robinson Laboratory, The Ohio State University, Columbus 10, Ohio.
(d) Experimental; calibration for use.
(e) Many primary metering elements for flow measurement are being calibrated individually for accurate measurements.
(f) Active work in progress continually.
(g) Results indicate that published data on orifices and nozzles are satisfactory, but that material for venturi tubes is not complete. Results are reported to sponsors regularly.
(h) None at present. It is planned to publish a report on all results in the near future.

OKLAHOMA INSTITUTE OF TECHNOLOGY, Oklahoma A & M College.

(911) THE EFFECT OF SURGES ON THE CARRYING CAPACITY OF DRILLING MUD.

(b) Laboratory investigation and general interest of drilling contractors in the area.
(c) Prof. J. H. Dawson, Civil Engineering Department, Oklahoma Institute of Technology, Stillwater, Oklahoma.
(d) By using a streaming birefringant in a Fluid Polariscope along with a "Strobotac", we expect to visualize the motion of the fluid past chips and rock particles.
(e) To determine whether surges at the bottom of a well are detrimental to the carrying capacity of the drilling mud.
(f) The major parts of the equipment have been constructed and are now being assembled.

(912) THE COMPARATIVE ABILITY OF DESURGERS AND AIR DOMES AS DEVICES FOR DECREASING WATER HAMMER SURGES.

(b) Laboratory project in cooperation with the Valve Engineering and Development Company, Tulsa, Oklahoma.
(c) Prof. J. H. Dawson, Civil Engineering Department, Oklahoma Institute of Technology, Stillwater, Oklahoma.
(d) Experimental research on water hammer.
(e) To provide a means whereby designers will be able to determine the proper size of desurger for a given installation.
(f) Equipment has been constructed and preliminary runs have been made. At present we have a lot of data but cannot obtain a rational relationship between the variables.
(g) Various sizes of air domes and desurgers are installed in a pipeline. Surges generated by the quick closing of a valve in the pipeline are measured with electronic devices.

(913) THE EFFECT OF SURGES ON THE EFFICIENCY OF A PISTON PUMP.

(b) Laboratory investigation made possible through the cooperation of F. E. Meyers Pump Company and the Valve Engineering and Development Company.
(c) Prof. J. H. Dawson, Civil Engineering Department, Oklahoma Institute of Technology, Stillwater, Oklahoma.
(d) Experimental research in connection with the possibilities of improving the action and efficiency of piston type pumps.
(e) To provide a rational method for determining the size of air dome or desurger for a particular installation especially on large pumps handling oils for pipeline installations. Accurate measurementation of the overall efficiency of a piston pump coupled with various sizes of desurging equipment will provide an economical installation curve for each pump.
(f) Active.
(g) Tests have been run on a small pump. Larger units have been obtained and are now being set up for testing. Improvements in efficiency of over 10 percent have been obtained.

(914) THE USE OF A HYDRO-KINETIC TRANSDUCER FOR MEASURING FLUCTUATIONS IN PRESSURE.

(b) Laboratory investigation.
(c) Prof. Joe Norton, Division of Engineering Research, Oklahoma Institute of Technology, Stillwater, Oklahoma.

(d) Experimental investigation of the possibilities of the instrument for measuring surges of various types, and to provide an instrument which may be used for measuring pressures in engines or pumps.
(g) Comparative tests have been made with other electronic devices and mechanical indicators. Excellent comparisons are available. A report covering the use of this tool for measuring the surges generated by a piston pump has been prepared as a thesis. Additional tests are in progress.

(915) SURGE REMOVAL WITH THE FLUIDYNAMIC DESURGER.

(b) Valve Engineering and Development Co.
(c) Valve Engineering and Development Co., 1130 N. Boston, Tulsa, Oklahoma, or Prof. J. H. Dawson, Civil Engineering Department, Oklahoma Institute of Technology, Stillwater, Oklahoma.
(d) Experimental determination of the amount of surge in a pipeline with and without the Fluidynamic Desurger.
(e) To provide unbiased information on the ability of the instrument to remove repetitive surges such as generated by a piston pump or single surges such as caused by water hammer. Much additional information is being obtained from field installations of the Fluidynamic Desurger.
(h) Preliminary report submitted March 1949. Published articles, World Oil, December 1949 and Public Works, January 1950.

OREGON STATE COLLEGE, Hydraulics Laboratory.

(916) FLOW CHARACTERISTICS IN A SIPHON SPILLWAY.

(b) M.S. Thesis, and laboratory project.
(c) Roy Shoemaker, Instructor in Civil Engineering, Oregon State College, Corvallis, Oregon.
(d) Experimental; for master's degree.
(e) A model is being constructed similar to an existing siphon spillway that fails to function properly. An attempt will be made to find necessary changes in design to give proper operation of the prototype.
(f) Active.
(g) Model is practically complete for testing.

(917) SEWAGE FLOW METERS.

(b) Laboratory project in cooperation with City of McMinnville, Oregon.
(c) C. A. Mockmore, Department of Civil Engineering, Oregon State College, Corvallis, Oregon.
(d) Experimental; for undergraduate thesis.
(e) Standard sewer pipe being erected in hydraulics laboratory with various metering apparatus installed to permit flow with sediment as in normal flow in sewers.
(f) Active.
(g) Assembly of apparatus under way.

(918) RAINFALL-RUNOFF RELATIONSHIP.

(b) Laboratory project.
(c) Ronald McReary, Instructor in Civil Engineering, Oregon State College, Corvallis, Oregon.
(d) Experimental; for master's thesis.
(e) Field data are being taken on a small watershed near Corvallis, including rain gage measurements and stream flow data. Project has been in progress for about one year.
(f) Active.
(g) The area under study is small, partly cultivated and partly forested. It is typical in the Willamette Valley in Oregon, where there are very few thunderstorms, the rainfall being mostly orographic in origin. The purpose is to furnish flow data for design of area ways for small bridges and culverts.

THE PELTON WATER WHEEL COMPANY

Inquiries concerning Projects Nos. 600 and 919 should be addressed to I. M. White, Manager of Engineering, or P. B. Dawson, Jr., Section Engineer-Development, The Pelton Water Wheel Co., 2929 19th St., San Francisco 10, Calif.

(600) IMPULSE TURBINE MODEL.

(b) Laboratory project.
(d) Experimental; for design.
(e) Tests are being conducted on new bucket shapes to improve wheel efficiency.
(f) Active.

(919) DYNAMIC STRESS DETERMINATION.

(b) Laboratory project.
(d) Experimental; basic research.
(e) Tests are being conducted with strain gages to determine dynamic stresses in different parts of the impulse buckets.
(f) Active.

THE PENNSYLVANIA STATE COLLEGE, Hydraulics Laboratory, Department of Civil Engineering.

(131) SHAVER CREEK HYDROLOGIC STUDY.

(b) Cooperative project with U. S. Weather Bureau and U. S. Forest Service.
(c) C. J. Smith, Assistant Professor of Civil Engineering, The Pennsylvania State College, Pa.
(d) Field investigation; applied research.

(e) Long term study of the hydrologic action of a mountain watershed (area about 3.8 sq mi). Runoff is measured by a calibrated stream control, rainfall is measured with three recording rain gages, and evaporation from a standard pan.
(f) Active.

(330) STUDY OF LIQUID TURBULENCE.

(b) Laboratory project, supported by Research Corporation.
(c) Dr. A. L. Jorissen, Associate Professor of Civil Engineering, The Pennsylvania State College, State College, Pa.
(d) Experimental; basic research; doctor's thesis.
(e) It is planned to study the frictional resistance of various rough surfaces. Preliminary studies are made in a fluid polariscope in an attempt to correlate the flow pattern with the occurrence of turbulence.
(f) Active.
(g) The polariscope has been built and is being used for preliminary studies.
(h) "Liquid turbulence research project, Progress Report No. 1", V. L. Dutton, September 1949.

(603) PITOT TUBE STUDY.

(b) Laboratory project, supported by Ordnance Research Laboratory, U. S. Navy Department.
(c) Dr. A. L. Jorissen, Associate Professor of Civil Engineering, The Pennsylvania State College, State College, Pa.
(d) Experimental; master's thesis.
(e) A Pitot tube was desired for use in the W. Garfield Thomas Water Tunnel, of 2 inch maximum length, to measure speeds up to 60 fps with a constant coefficient.
(f) Completed.
(g) The Pitot static tube was designed. The effect of support strut size and location was studied.
(h) "Design of Pitot Static Tube for a large water tunnel", F. E. Shuster, M.S. thesis, The Pennsylvania State College, January 1949.

THE PENNSYLVANIA STATE COLLEGE, Ordnance Research Laboratory, School of Engineering.

(129) WATER TUNNEL FLOW STUDIES.

(b) Laboratory project in cooperation with the Hydraulics Laboratory.
(c) J. M. Robertson, Ordnance Research Laboratory, The Pennsylvania State College, P. O. Box 30, State College, Pa.
(d) Experimental; basic research, for design.
(e) Water tunnel components, of one-eighth prototype diameter, are studied in an experimental tunnel which does not include a model pump. A single pass system produces velocities up to 50 fps in the 6-inch working section. The sections are easily interchangeable, permitting rapid testing of various tunnel configurations and their interrelationships. Various nozzle contours, working section lengths, angles of diffuser, and one vaned turn combination have been studied. Experimental results are integrated with theoretical methods, to develop means for predicting prototype flow conditions.
(f) Tests completed; reports in progress.

(g) Studies of flow in nozzles, the working section, and the vaned turn are completed.
(h) "Hydrodynamic design of the 48-inch water tunnel at The Pennsylvania State College", D. Ross, J. M. Robertson, and R. B. Power. Trans. Soc. Naval Arch. and Mar. Engrs. Vol. 56, pp. 5-29, 1948. Also published in Engineering (London), July 16, 1948.
"Design of vaned turns for a large water tunnel", A. J. Turchetti and J. M. Robertson. To be published in Trans. A.S.M.E.
"The experimental water tunnel at the Pennsylvania State College", Ordnance Research Laboratory External Report No. 7958-89. April 17, 1948.
"Water tunnel working section flow studies", Ordnance Research Laboratory External Report No. 7958-97. June 15, 1948.
"Water tunnel diffuser flow studies - Part I - Review of literature," Ordnance Research Laboratory Report No. 7958-139. May 16, 1949.
"Water tunnel diffuser flow studies - Part II - Experimental research", Ordnance Research Laboratory External Report No. 7958-143. July 8, 1949.

(328) FLOW PAST SLOTS IN SURFACES.

(b) Laboratory project in cooperation with the Hydraulics Laboratory.
(c) J. M. Robertson, Ordnance Research Laboratory, The Pennsylvania State College, P. O. Box 30, State College, Pa.
(d) Experimental; for design and thesis.
(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.
(f) Tests are essentially complete.
(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.
(h) "Flow past a slot in a surface", H. W. Bennett, M.S. thesis, Dept. of Engineering Mechanics, The Pennsylvania State College, September 1949.

(605) FUNDAMENTALS OF SURFACE CAVITATION.

(b) Cooperative project with Department of Mineral Technology.
(c) Donald Ross, Ordnance Research Laboratory, The Pennsylvania State College, P. O. Box 30, State College, Pa.
(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) Active.
(g) "Gas evolution from supersaturated liquids", E. B. Marboe and W. A. Weyl. Mineral Industries, Vol. 18, No. 1, October 1948. Published by School of Mineral Industries, Pennsylvania State College. Also Mechano-Chemistry of Water, Research (London) Vol. 2, January-February 1949.

(920) ELECTROMAGNETIC ANALOGY FOR PROPELLERS.

(b) Laboratory project.
(c) Donald Ross, Ordnance Research Laboratory, The Pennsylvania State College, P. O. Box 30, State College, Pa.
(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.

(f) Active.
(g) Initial tests indicate agreement with theoretical calculations within the accuracy of the electrical equipment.
(h) "Development of electromagnetic analogy for computation of induced propeller velocities", B. W. McCormick, M.S. thesis, Dept. of Aeronautical Engineering, The Pennsylvania State College, June 1949.

(921) PROPELLERS FOR OPERATION IN SYMMETRIC WAKES.

(b) Laboratory project for U. S. Navy, Bureau of Ordnance.
(c) Donald Ross, Ordnance Research Laboratory, The Pennsylvania State College, P. O. Box 30, State College, Pa.
(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.
(f) Active.

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, Civil Engineering Department, 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 artificially roughened pipe raised the coefficient 10 percent.
(h) Given as a discussion at Annual Meeting of the A.S.M.E. will probably be published in Transactions soon.

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) Sponsored by the Princeton University Committee for fundamental research.
(c) Prof. A. Donald Hay, School of Engineering, Princeton University, Princeton, N. J.
(d) Experimental; basic research.
(e) 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.
(f) Active.

RENSSELAER POLYTECHNIC INSTITUTE, Hydraulic Laboratory, Mechanical Engineering Department.

(923) FLUID MAGNETIC BRAKE.

(b) Laboratory project.
(c) Prof. N. P. Bailey and/or Prof. J. J. Devine, Rensselaer Polytechnic Institute, Troy, N. Y.
(d) Experimental; for design and for master's thesis.
(e) Investigation of the properties of a magnetic fluid and the design of a brake, using carbonyl iron powder and oil, suitable for loading a small impulse water wheel.
(f) Active.
(g) Brake gives very accurate control of load from runaway speed to stalling conditions. Improvements in construction details and cooling are being worked upon.
(h) "Magnetic fluid brake", N. G. Sawyer, Master's thesis, Rensselaer Polytechnic Institute, June 1949.

ROCKY MOUNTAIN HYDRAULIC LABORATORY.

(332) TESTS OF SCOUR AROUND BRIDGE PIERS.

(b) Laboratory project.
(c) Prof. C. J. Posey, Engineering Building, State University of Iowa, Iowa City, Iowa.
(d) Experimental; basic research.
(e) Experiments during the summer of 1949 were on methods of preventing scour around single and twin-cylinder piers, using transparent piers as described in Volume 13.
(f) Continuation of tests is planned for summer of 1950.
(g) A chain mat around the upstream pier provided the best protection of any method tested.
(h) "Why bridges fail in floods", C. J. Posey, Civil Engineering, Vol. 19, No. 2, p. 42, February 1949.

ST. ANTHONY FALLS HYDRAULIC LABORATORY, University of Minnesota.

Inquiries concerning Projects Nos. 98, 99, 100, 103, 104, 105, 108, 333, 336, 338, 339, 611 to 616, and 924 to 930 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, 619 to 621 incl., 931 and 932 which are being conducted in cooperation with the U. S. Soil Conservation Service, should be addressed to Fred W. Blaisdell, Project Supervisor, U. S. Soil Conservation Service, St. Anthony Falls Hydraulic Laboratory, Hennepin Island, Minneapolis 14, Minn.

Inquiries concerning Projects Nos. 193 to 196, incl., 411, 412, and 982 to 985, incl., 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., pages 137 - 140.

(98) FLOW OF SUSPENDED SOLIDS IN PIPES.

(b) Laboratory project, in cooperation 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.
(f) Active.

(99) HYDRAULICS OF CULVERTS.

(b) Minnesota Department of Highways, in cooperation with U. S. Public Roads Administration.
(d) Theoretical; applied research, for design.
(e) Previous literature has been assembled and analyzed, and preliminary tests completed, to determine flow characteristics in a model culvert, both for full and part-full conditions. It is intended ultimately to arrive at generalized design criteria for optimum culvert designs for all field conditions.
(f) Suspended, awaiting additional funds for continuation.
(g) Rating curves obtained for conditions investigated. Mechanics of the flow investigated by means of velocity traverses, piezometer gradients, etc.
(h) Two progress reports completed and given to sponsoring agencies. Probably bulletins will later be published by the Laboratory for general distribution.

(100) AIR ENTRAINMENT RESEARCH.

(b) Office of Naval Research, U. S. Navy Department.
(d) Theoretical and experimental; basic and applied research.
(e) A testing channel 18 inches wide and 50 feet long, adjustable for slopes ranging from horizontal to vertical is now under construction. An inlet section designed to jet a uniform stream of water at the approximate terminal velocity for the set slope and discharge is being incorporated in the apparatus to permit air-entrainment studies over this relatively short (50 foot) reach. A method of obtaining traverses of air concentration in the flowing stream by electrical resistance measurements has been perfected. A method of obtaining velocity traverses in air-entrained flows has been devised, but is still being perfected. A high-speed motion picture program has been inaugurated to study the surface configurations of an entraining stream. Upon completion of the testing apparatus, the experimental program designed to study both the fully entrained flow and the entraining process will be continued. The experimental study will be conducted to guide the theoretical development and to be useful in applied design.
(f) Active.
(g) A review of the relevant literature has been completed and a summary report has been published. Reports on the development of the instruments for measuring air concentration and velocity are now being completed.
(h) "Air entrainment in flowing water, a summary and bibliography of literature", O. P. Lamb. St. Anthony Falls Hydraulic Laboratory Project Report No. 19. August 1949.

(103) EXPERIMENTAL AND ANALYTICAL STUDIES OF THE MECHANICS OF MOVEMENT OF SEDIMENT ALONG STREAM BEDS AND THE EFFECTS OF VISCOSITY ON SEDIMENT TRANSPORTATION.

(b) Sponsored by the Engineering Foundation.
(d) Experimental and theoretical; doctor's thesis.
(e) A recirculating system with heating equipment. Sediment is standard 20-30 Ottawa sand, and fluids used were water, sugar solution, and mineral seal oil. The experiments were intended to study the effect of viscosity upon bed-load movement. The main objective of the research was to arrive at rational formulas for bed-load movement in both turbulent and laminar flow regimes and to verify those formulas experimentally.
(f) Completed.
(g) Critical analysis of existing bed-load formulas led to the modification of the theories given by Einstein and Kalinske and the resulting equations gave similar forms which proved to be reliable in the estimation of the rate of bed-load movement. In the laminar flow, a new theory is introduced and has been verified experimentally.
(h) "Analytical and experimental study of the effects of flow characteristics and fluid viscosity upon the movement of bed-load in an open channel", M. G. Mostafa. Ph.D. thesis. October 1949. (Available on interlibrary loan.)

(104) FLOW DIVERSION RESEARCH.

(b) Office of Naval Research, U. S. Navy Department.
(d) Theoretical and experimental; basic and applied research and design.
(e) Work began with measurement of pressure and velocity distributions in radius elbows and was then extended to miter elbows with guide vanes. Experimental studies on effect of size, shape, and spacing of guide vanes and a theoretical investigation of the flow in one guide vane elbow are now being carried out. The project may be extended to include effects on guide vanes of various angles of turn, distorted velocity profiles, and expansions or contractions of the flow.
(f) Active.
(g) Principal results to date are included in or referred to in the publications listed below.
(h) "Hydraulics of conduit bends", A. G. Anderson. Bulletin No. 1, St. Anthony Falls Hydraulic Laboratory. December 1948. (May be purchased from the laboratory.)
"Fluid flow diversion by guide vanes in miter bends", E. Silberman. Project Report No. 8, St. Anthony Falls Hydraulic Laboratory. April 1949. (Available at several technical libraries and on loan from the laboratory.)

(105) WATER TUNNEL DESIGN STUDIES.

(b) David Taylor Model Basin, U. S. Navy Department.
(d) Experimental; applied research and design.
(e) Models of two different water tunnels have been tested to determine the operating characteristics of the prototypes and to improve upon the design where necessary. The first model tested was a 10:1 model of a tunnel with a closed test section 60 inches in diameter and 30 feet long. Tests were then made on a 4:1 model of a 24-inch tunnel which will operate as either a closed-jet or an open-jet tunnel. The investigation has been mainly concerned with the interactive effects of vaned elbows, diffusers, contraction and dynamometer shafts on the flow in the test section, and power requirements of the tunnel.
(f) Completed.
(g) Reports have been published describing flow patterns, energy loss, cavitation and turbulence characteristics of the test jets, and description of special instrumentation and controls.

(h) "Model experiments for the design of a 24-inch water tunnel", Project Report No. 22, December 1949. See also Project No. 486, page 177.

(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 are being determined for various shapes, sizes, and kinds of commercial culvert pipes, for flush and re-entrant type entrances, and for various discharges. Each pipe is 192 feet long and is tested under both full and part-full flow conditions.
(f) Active; experimental work in progress.
(g) Data obtained and analyzed for 36-inch, 24-inch, and 18-inch diameter corrugated circular pipes, for 36-inch, 24-inch, and 18-inch corrugated pipe arches, and for 24-inch diameter concrete pipe.
(h) Progress reports furnished to sponsoring agencies on results of tests on 24-inch corrugated pipe arch and 24-inch diameter concrete pipe.

(333) RAMAPADASAGAR DAM.

(b) Government of Madras, India.
(d) Experimental; for design.
(e) A large-scale, movable-bed, distorted model is being used, horizontal scale ratio 250:1, vertical scale ratio 100:1, to study the scour patterns and water surface levels consequent to constructing cofferdams that greatly restrict the flow.
(f) Experimental work on first construction stage completed; preliminary report prepared.
(g) Experiments on various cofferdam alignments and measurements of velocity directions in neighborhood of cofferdam indicated scour pattern and most favorable alignment.

(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) Nearly completed.

(338) SCOUR BELOW A SPILLWAY AND ITS PREVENTION.

(b) Laboratory project.
(d) Library research; for master's thesis.
(e) To summarize by study of technical literature the solution of the problem of scour below spillways.
(f) Completed.
(h) "A review of scour below a spillway and its prevention", A. Rodionov. Master's thesis, University of Minnesota. June 1949. (Available on interlibrary loan.)

(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 mixing at the interface of two liquids having slightly different densities and a relative motion.

(f) Active.
(g) Work to date has been confined mainly to design and construction of experimental equipment and library research.

(611) FLOW AROUND SPHERES ON THE BED OF A CHANNEL.

(b) Laboratory project.
(d) Theoretical and experimental; doctor's thesis.
(e) The objective is to determine the hydrodynamic effect of various systems of spheres located on the bed of a channel upon a given fixed sphere located at various positions with respect to the channel bed. The procedure involves measurement of pressure distribution on the fixed sphere at various flow conditions. It is anticipated that the results will be largely applicable to problems of sediment transportation.
(f) Active.

(612) SIMILARITY IN SCOUR BELOW A SPILLWAY.

(b) Laboratory project.
(d) Experimental; for master's thesis.
(e) Tests have been conducted in a horizontal glass-sided channel 20 inches in width. Three geometrically similar spillway models and three coarse sediments of similar size distribution and different mean grain size were employed. All practical combinations of model and sediment were tested with varying tailwater elevations and at different discharges with the thought of checking the already-existent logarithmic law of scour.
(f) Active. Experimental work completed; compilation and analysis of the data is proceeding.

(613) HORIZONTAL DISTRIBUTION OF VELOCITY AND DISCHARGE IN A FLAT TRIANGULAR CHANNEL.

(b) Laboratory project.
(d) Experimental; for master's thesis.
(e) A plain concrete open channel, of flat, triangular cross section such as used in highway and street gutters, was studied for the purpose of determining the effects of longitudinal slope, side slopes, and flow depth on the horizontal distribution of velocity and discharge.
(f) Completed.
(g) It was concluded that the velocity distribution over a large part of this type of channel is two-dimensional in each vertical plane, and that the mean velocity in each such plane is given reasonably well by the Manning formula. The results apply to fully developed turbulent flow only.
(h) "Transverse distribution of velocity and discharge for flow in a shallow triangular channel", C. L. Larson, master's thesis, University of Minnesota. October 1949. (Available on interlibrary loan.)

(614) DISTRIBUTION AND EFFECT OF HEAVY MINERALS IN BED LOAD.

(b) Laboratory project.
(d) Experimental; for master's thesis.
(e) A long (50 foot) channel was brought into equilibrium using a uniform sand of average specific gravity. Into this system, a known amount of magnetite sand of the same size and shape was introduced. The resulting variations in magnetite concentrations

both horizontally and vertically, the change in slope and character of the bed are recorded and tabulated for constant discharges and bed loads.
(f) Completed.
(g) Experiments gave qualitative results concerning the manner in which heavy minerals move and are distributed vertically and longitudinally in the bed.
(h) "The effect and distribution of heavy minerals in bed load", J. E. Colcord. Master's thesis. University of Minnesota. (Available for interlibrary loan.)

(815) 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.

(816) FLOW THROUGH GRANULAR MEDIA.

(b) Laboratory project.
(d) Experimental and theoretical; for master's thesis.
(e) Tests were made of head loss resulting from flow through uniform-sized media of varying shapes. Dimensionless numbers were developed through consideration of the forces, as well as dimensions and the relationship between the dimensionless numbers was determined by experiment.
(f) Completed.
(g) Results of 592 runs were plotted in the conventional curve of friction factor versus Reynolds number. Curves were also plotted using the derived dimensionless numbers, which included a modified Reynolds number and Euler number.
(h) "The effect of particle shape on permeability", D. Barr, master's thesis. University of Minnesota. October 1949. (Available for interlibrary loan.)

(924) FREE-JET WATER TUNNEL DESIGN STUDIES.

(b) Office of Naval Research.
(d) Experimental; applied research and design.
(e) A pilot model vertical free-jet installation is to be built to determine the feasibility of recovering the energy of the free jet. If successful, the final tunnel design should be capable of attaining extremely low cavitation indices with moderate power requirements.
(f) Active.

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

(b) Laboratory project.
(d) Experimental; master's thesis.
(e) An analysis is being 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 have been tested and various-sized spherical beads are being used as the sediment.
(f) Active.

(926) ENTRANCE LOSSES IN MODEL CIRCULAR CULVERT.

(b) Laboratory project.
(d) Experimental; master's thesis.
(e) Entrance losses are determined for various entrance conditions with a 4-inch diameter Lucite pipe. Sharp-edged and rounded entrances are tested, as are various approach channel widths and positions of approach channel invert. For each entrance condition, the variations of entrance loss with head over invert and with pipe Reynolds number are determined.
(f) Experimental work complete.
(g) Experimental data now being analyzed and thesis being written.

(927) MODEL STUDIES OF SEDIMENTATION BASINS.

(b) Laboratory project.
(d) Experimental; basic research and master's thesis.
(e) Tests were conducted on models of sedimentation basins to determine the relationships governing the magnitude and location of sediment deposited in model and prototype basins. The discharge, Reynolds number, sediment size and inlet characteristics were varied.
(f) Inactive.
(g) The effect of entrance conditions upon sediment retention and flow-through efficiency has been established for several entrance designs. Methods and the limitations thereof have been proposed for relating model and prototype retentions.
(h) The following pertinent masters' theses are available on interlibrary loan:
"An experimental study of a model sedimentation basin", A. G. Anderson. Master's thesis, University of Minnesota. June 1935.
"An experimental study of a model sedimentation basin", B. K. Banerjee. Master's thesis, University of Minnesota. October 1947.
"An experimental study of a model sedimentation basin", N. Das Gupta. Master's thesis, University of Minnesota. April 1949.
"Model study of a sedimentation basin", C. E. Bowers. Master's thesis, University of Minnesota, June 1949.

(928) STUDY OF FLOW OVER ROUND-CRESTED WEIRS.

(b) Laboratory project.
(d) Theoretical and experimental; for master's thesis.
(e) The basic purpose of this study was the study of curvilinear flow in the vertical plane. Such curvilinear flow was created by using round-crested weirs of three different radii of curvature. Pressure and total head distributions in a vertical plane and surface profiles were measured for each weir under varying discharges and head. The measured data were reduced to dimensionless curves relating discharge, bed pressure, energy distribution, Froude number, etc. to the ratio of critical depth of radius of curvature.
(f) Completed.
(g) It was shown that in curvilinear flow under a given head, maximum discharge, critical depth, velocity head, and Froude number are all increased over the corresponding values in rectilinear flow.
(h) "Test of round-crested weir", T. D. Chen. Master's thesis. University of Minnesota, August 1949. (Available on interlibrary loan.)

(929) STUDY OF RESORPTION OF AIR BUBBLES.

(b) Office of Naval Research and David Taylor Model Basin, U. S. Navy Department.
(d) Theoretical and experimental; basic and applied research.
(e) Project involved determination of factors involved in resorption of gas bubbles in liquid and an experimental study directed at verifying the analysis and determining certain experimental constants for air bubbles in water.
(f) First phase completed. Additional phases may be added.
(g) Methods of calculating rate of resorption of air bubbles in water tunnels are presented and several suggestions for speeding resorption are made.
(h) "Air bubble resorption", E. Silberman, Technical Paper No. 1, Series B, St. Anthony Falls Hydraulic Laboratory. August 1949. (May be purchased from the laboratory.)

(930) VISCOUS FLOW IN OPEN CHANNELS.

(b) Laboratory project.
(d) Experimental research for master's degree. Part of a larger continuing program.
(e) Measurements were made in an open channel of circular arc cross section of variation of head loss with changes in slope, depth, and viscosity of the fluid. These results were compared statistically with similar results for a 90 degree triangular and for a rectangular cross section.
(f) Completed.
(g) It was determined that for Reynolds numbers in the lower turbulent range, shape of channel was relatively unimportant in applying a head loss formula of the Darcy type. The hydraulic radius was found to be a suitable length parameter.
(h) "A study of viscous flow in an open channel having a circular arc cross section", D. K. Donovan, master's thesis, University of Minnesota, September 1949. (Available on interlibrary loan.)

(111) DROP INLET CULVERT WITH PIPE CONDUIT.

(b) Division of Drainage and Water Control, Soil Convervation Service, U. S. Department of Agriculture, in cooperation with the Minnesota Agricultural Experiment Station and the 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.
(f) Active.
(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) "Preliminary results of tests on pipe bleeders laid on steep slopes", F. W. Blaisdell, U. S. Department of Agriculture, Soil Conservation Service, 9 pp., November, 1942. (Available on loan.)

(112) DROP SPILLWAY WITH BOX INLET.

(b) Division of Drainage and Water Control, Soil Conservation Service, U. S. Department of Agriculture, in cooperation with the Minnesota Agricultural Experiment Station and the 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.

887657 O -50— -7

(f) Active.
(h) "The hydraulic design of rectangular spillways", A. N. Huff, U. S. Department of Agriculture, Soil Conservation Service, 64 pp., October 1943. (Copies may be obtained by addressing Project Supervisor, Soil Conservation Service, St. Anthony Falls Hydraulic Laboratory, Hennepin Island, Minneapolis 14, Minn.)

(114) DIVERGING TRANSITION FOR SUPERCRITICAL VELOCITIES.

(b) Division of Drainage and Water Control, Soil Conservation Service, U. S. Department of Agriculture, in cooperation with the Minnesota Agricultural Experiment Station and the 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) Active.
(h) "Flow through diverging open channel transitions at supercritical velocities", F. W. Blaisdell, U. S. Department of Agriculture, Soil Conservation Service, Report No. MN-R-3-33, 30 pp., June 1947.
"Supercritical flow in straight-wall diverging channels on normal slope", M. H. Berg. Master's thesis, University of Minnesota, 36 pp., August 1948.
(Loan copies may be obtained by addressing Project Supervisor, Soil Conservation Service, St. Anthony Falls Hydraulic Laboratory, Hennepin Island, Minneapolis 14, Minn.)

(619) STREAM CHANNEL EROSION AND SEDIMENTATION.

(b) Division of Drainage and Water Control, Soil Conservation Service, U. S. Department of Agriculture, in cooperation with the Minnesota Agricultural Experiment Station and the St. Anthony Falls Hydraulic Laboratory.
(d) Experimental; applied research.
(e) Laboratory measurements of scour and transportation of sediment are anticipated as an aid in the solution of channel control problems on specific streams. The first phase of the work will be a review of the pertinent literature.
(f) The project is just being started.

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

(b) Soil Conservation Service, Regions 2 and 3, U. S. Department of Agriculture; and U. S. Navy Department.
(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) Experimental work complete; reports being prepared.

(621) JUNCTION OF DRAINAGE PIPES AND PAVED CHANNELS.

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

(e) Models of the structures used at the head end of trapezoidal open channels flowing at supercritical velocities were constructed. Several pipes of different sizes enter these structures at various angles. Several structures were studied.
(f) Experimental work complete; report being prepared.

(931) DETENTION STORAGE STRUCTURE.

(b) Soil Conservation Service, Regions 2 and 3, U. S. Department of Agriculture; and U. S. Navy Department.
(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) Experimental work complete; report being prepared.
(g) It was necessary to increase the size of the orifice to enable it to pass the design flow.

(932) STRAIGHT DROP SPILLWAY.

(b) Soil Conservation Service, Regions 2 and 3, U. S. Department of Agriculture; and U. S. Navy Department.
(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 away from the horizontal curve to achieve better flow conditions through and below the structure. The upstream channel was paved near the structure to eliminate scour at the ends of the weir notch. A new type of stilling basin was developed after obtaining unsatisfactory results from two standard types of basins, including the type now in use at Whiting Field.
(h) "Model studies for Whiting Field Naval Air Station; straight drop spillway", C. A. Donnelly and F. W. Blaisdell, U. S. Department of Agriculture, Soil Conservation Service, Report No. MN-R-3-37, 37 pp., July 1949.

S. MORGAN SMITH COMPANY

Inquiries concerning Projects Nos. 933 to 936, incl., should be addressed to R. Sahle, Hydraulic Engineer, Supervisor of the S. Morgan Smith Company Laboratory, York, Pa.

(933) FRANCIS TYPE TURBINE TEST MODEL. EFFICIENCY AND HORSEPOWER TEST.

(b) Tenkiller Ferry Dam, Arkansas River Watershed, Illinois River, Oklahoma, Corps of Engineers, Tulsa District.
(d) Experimental; applied research.

(e) A 14-1/2 inch model turbine with elbow draft tube and spiral case was made homologous in design to that of the prototype size unit. The test was conducted over a wide range of speeds and sufficient number of gate openings to cover the entire range of heads from 103.5 to 181 feet. Test was made with spiral case under approximate head of 10 feet.
(f) Completed.
(g) The results of the model test assured the Corps of Engineers that the prototype unit will fulfill the guaranteed efficiency and horsepower when tested after installed.

(934) ADJUSTABLE BLADE PROPELLER TYPE TURBINE MODEL - EFFICIENCY, HORSEPOWER, CAVITATION BLADE BALANCE, RUNAWAY SPEED TESTS.

(b) McNary Dam Project, Columbia River, Oregon - Washington. Corps of Engineers, Department of the Army, Portland District, Portland, Ore.
(d) Experimental; applied research.
(e) Model tests are being conducted in the cavitation test stand on a complete 12 inch model with plate steel semi-spiral scroll and plate steel elbow draft tube homologous in design to that of the prototype size unit. The runner tested was of the adjustable blade Kaplan type having six blades. The pitch of the blades was automatically controlled by means of a hydraulic operated servomotor built in the shaft. The draw rod connecting the cross head in the hub and the servomotor piston, the two oil pipes extending from the oil head to either side of the servomotor piston was carried within the bores of the model turbine shaft and the dynamometer shaft. The oil pressure to the system was supplied by a constant pressure oil pump.
(f) Active.

(935) ROTOVALVE TESTS. HEAD LOSS AND TORQUE TESTS.

(b) Laboratory project.
(d) Experimental; applied research.
(e) Tests were made on a 6 inch diameter Rotovalve of various designs. The valves were installed in the closed system pump test stand. The water was circulated in the system by means of an adjustable blade pump. The quantity of water flowing through the valve was measured by a calibrated Venturi meter. Readings of the various piezometer connections in the 6 inch pipe line and Rotovalve body were taken and recorded. Torque required to operate the plug was determined by means of a hydraulic operated piston.
(f) Active.
(g) Results show that by proper design the head loss through valve and torque required to operate valve can be greatly reduced.

(936) IMPULSE TURBINE TESTS.

(b) Laboratory project.
(d) Experimental; for design.
(e) Tests are being made on new bucket designs to improve the performance. These tests are being conducted in a new improved impulse wheel test stand.
(f) Active.

SOUTHERN METHODIST UNIVERSITY, School of Engineering.

Inquiries concerning Projects Nos. 623 and 937 should be addressed to Prof. I. W. Santry, Jr., School of Engineering, Southern Methodist University, Dallas 5, Tex.

(623) DIATOMACEOUS EARTH AS A FILTER MEDIUM.

(b) Laboratory project.
(d) Experimental; senior civil engineering student thesis.
(e) Tests are proposed, in the study of diatomaceous earth as a filter medium, to determine the hydraulic head losses through the medium under actual conditions of variable loads of raw water and sewage.
(f) Suspended.

(937) RAINFALL DISTRIBUTION.

(b) Laboratory project; also in cooperation with the city of University Park, Texas.
(d) Experimental; senior civil engineering student thesis and for development.
(e) Determination of variations and magnitudes of rainfall in the city of University Park. Also calibration of possible rainfall indicators.
(f) Active.

STANFORD UNIVERSITY, Hydraulic Laboratory.

Inquiries concerning Projects Nos. 624 to 627, incl., should be addressed to Prof. John K. Vennard, Director, Stanford University, Hydraulic Laboratory, Stanford, Calif.

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

(b) Office of Naval Research.
(d) Experimental; basic research.
(e) Study of dynamics of cavities in non-flow apparatus under simplified conditions, to gather more information on mechanism of expansion and collapse.
(f) Apparatus completed and instrumentation for pressure measurement well along. High speed motion pictures to be taken soon.

(625) MODEL STUDY OF SPILLWAY OF A SEYHAN RIVER DAM.

(b) International Engineering Company.
(d) Experimental; applied research.
(e) Model study to obtain spillway coefficients, and improve flow conditions upstream from spillway. To improve design of bucket at downstream end of spillway.
(f) Project canceled because of design changes.

(626) EFFECT OF POROSITY ON PERMEABILITY.

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

(e) Permeability tests to be made on artificial assemblages of spheres with water and oil. Large variation of porosity of assemblage should allow extension of the basic laws which have been obtained from tests with small porosity variation.
(f) Almost completed.
(g) Tests with water and oil flowing through lead shot and sand confirm the Blake-Kozeny-Hatch relationship between porosity and permeability.

(627) STUDY OF TURBULENT BOUNDARY LAYERS.

(b) Laboratory project.
(d) Experimental; basic research.
(e) Study of velocity profiles and pressure drops in 2 inch diameter brass pipe downstream from bell mouth entrance.
(f) Equipment improved and extended; experimental techniques being perfected.

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

(b) Laboratory project.
(c) Claud C. Lomax, Stanford University, Hydraulic Laboratory, Stanford, Calif.
(d) Experimental; basic research.
(e) Settling velocities will be measured for particles which have easily defined geometric shapes. Most of the tests will be made for velocities above the Stokes range. The variables will include density and viscosity of the fluid and density and shape of the particle. An attempt will be made to correlate the fall velocities with those of equivalent spheres on the basis of some common physical property.
(f) Equipment partially constructed. Experimental program suspended until wider search of literature is completed.

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 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 and 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, seaplanes, and seaplane floats.

(340) PLANING SURFACES (Project CC839).

(b) Office of Naval Research, U. S. Navy Department.
(c) Prof. B. V. Korvin-Kroukovsky, Experimental Towing Tank, Stevens Institute of Technology, 711 Hudson St., Hoboken, N. J.
(d) Experimental; basic research.

(e) To investigate the fundamental factors affecting the performance of planing surfaces and the wave shape formed in wake of the planing surface. Investigations will extend from elementary planing surfaces of several dead-rise angles through warped, concave, or flared planing surfaces with Vee or pointed steps.
(f) Active.
(h) "Wave contours in the wake of 30 degree dead-rise planing surface." Technical Report No. 339.
"Wave contours in the wake of 10 degree dead-rise planing surface." Technical Report No. 344.
"Wetted area and center of pressure of planing surfaces." Technical Report No. 360.
The following reports were published under the Sherman Fairchild Fund by the Institute of Aeronautical Sciences:
"The discontinuous fluid flow past an immersed wedge." Technical Report No. 334.
"An analysis of the fluid flow in the spray root and wake regions of flat planing surfaces." Technical Report No. 335.
"On the pressure distribution for a wedge penetrating a fluid surface." Technical Report No. 336.
"Wave contours in the wake of 20 degree dead-rise planing surface." Technical Report No. 337.
The following reports are in process of publication:
"Wetted length and center of pressure of Vee-step planing surfaces." Technical Report No. 378.
"On the penetration of a fluid surface by a wedge." Technical Report No. 381.
"A study of the flow, pressures and loads pertaining to prismatic Vee-planing surfaces." Technical Report No. 382.

(343) HYDRODYNAMICS INVESTIGATION OF A SERIES OF HULL MODELS SUITABLE FOR SMALL FLYING BOATS AND AMPHIBIANS (Project 1024).

(b) National Advisory Committee for Aeronautics.
(c) W. C. Hugli, Jr., Experimental Towing Tank, Stevens Institute of Technology, 711 Hudson Street, Hoboken, N. J.
(d) Experimental; design.
(e) To obtain hydrodynamic information on a series of hull models suitable for small flying boats and amphibians. A series of hulls which will entail probably 27 combinations will be tested for hydrodynamic characteristics including resistance, upper and lower limits of stability, center of gravity ranges, main spray characteristics, landing, high speed resistance, and effect of hull form and proportions.
(f) Active.
(h) Report in preparation.

(345) ANALYSIS OF TESTS CONDUCTED ON 20 VEE-BOTTOM BOAT HULLS U.S.T.M.B. SERIES 50 (Project CH1014).

(b) David Taylor Model Basin, Bureau of Ships, U. S. Navy Department.
(c) A. B. Murray, Experimental Towing Tank, Stevens Institute of Technology, 711 Hudson St., Hoboken, N. J.
(d) Theoretical; design.
(e) To analyze the results of an earlier investigation on a series of Vee-bottom motor boat hulls tested at the Experimental Towing Tank and reported in Experimental Towing Tank Report No. 153.
(f) Completed.
(g) Contour charts of run and trim have been prepared and published.
(h) "Tests of 20 related models of V-bottom motor boats TMB Series 50", Report R-47, Navy Department, The David Taylor Model Basin. March 1949.

(348) CORRELATION OF POWER BOAT RESISTANCES (Project R811).

(b) Laboratory project.
(c) A. B. Murray, Experimental Towing Tank, Stevens Institute of Technology, 711 Hudson St., Hoboken, N. J.
(d) Theoretical; design.
(e) To determine the effect on resistance of various hull proportions, drafts, trims, and hull features of high speed motor boats. All previous test results of high speed motor boats will be compiled and correlated in this project. Over 100 different models are involved.
(f) Active.
(h) In progress.

(350) SAILBOAT FORM RESEARCH (Project R972, formerly R857).

(b) Sparkman and Stephens, A. E. Luders, F. C. Geiger, Philip Rhodes, Herman Whiton and others.
(c) A. B. Murray, Experimental Towing Tank, Stevens Institute of Technology, 711 Hudson St., Hoboken, N. J.
(d) Theoretical; design.
(e) To determine the effect of various form changes and proportions upon the sailing performance of a series of related sailing yacht hulls. A model of a 32-foot sailing yacht (New York 32) is being used as the parent model in this project. The proportions of the models will be systematically varied in beam, draft, and displacement. Other variations to be undertaken in later phases of the project will include variations in stern overhang, transom width, and fore and aft positioning of the keel.
(f) Inactive.
(g) The results of these model tests are being presented to subscribers to the project in Technical Memorandum No. 85, which will be in 12 or more parts. The first three parts have now been completed, viz., Part I, "The program and its history"; Part II, "Performance of the New York 32 as designed"; and Part III, "Effect of change of stability and sail area on the performance of the New York 32". Computations and tests have been completed for Parts IV and VI, and full-size performance tests have been carried out for inclusion as an appendix to Part II.

(351) SELF-PROPELLED TESTS (Project R898).

(b) Laboratory project.
(c) J. T. Tothill, Experimental Towing Tank, Stevens Institute of Technology, 711 Hudson St., Hoboken, N. J.
(d) Experimental; development.
(e) To determine if successful self-propelled testing can be conducted using models of less than 12-foot length. Self-propelled tests will be conducted on a 7.8-foot model of the German motor ship "San Francisco", of which considerable full-scale trial data are available, to determine if SHP test results from a model of this size are practical.
(f) Active.
(g) Resistance tests have been made on three different sized models of this vessel to

check for possible wall effect, and self-propelled tests will be made at a future date.

(631) DETERMINATION OF SHIP STEERING STABILITY BY FORCED OSCILLATION WITH RUDDERS (ZIG-ZAG TESTS) (Project CK1120).

(b) Office of Naval Research, U. S. Navy Department.
(c) B. V. Korvin-Kroukovsky, Experimental Towing Tank, Stevens Institute of Technology, 711 Hudson St., Hoboken, N. J.
(d) Theoretical and experimental; applied research.
(e) Methods of obtaining certain combinations of hydrodynamic parameters, particularly one which forms a criterion of unsteered dynamic stability, are being investigated analytically and experimentally, using rudders to force zig-zag oscillations. Tank experiments are in progress on a destroyer and a battleship model, with the object of selecting appropriate methods of controlling the model and of recording data. Two methods of controlling the heading angle are being tried, (1) a method using a radio control on the rudder, and a mirror system to signal an observer, who manually sends the radio signal, and (2) a method using a gyroscope which automatically changes the rudder angle when the heading has deviated a predetermined amount. Tests of a destroyer (full size) have been made and are being analyzed.
(f) Temporarily suspended. Theoretical basis for tests completed.
(g) Experimentally, the method shows promise of providing a practical test procedure. Indications are that it will provide only means practical at present for correlating course-keeping ability of model and prototype.
(h) Theoretical basis for work described in an unpublished Technical Memorandum T. M. No. 83, "Determination of ship parameters from forced motions."

(632) SPRAY STRIP STUDY (Project R1029).

(b) Laboratory project.
(c) A. B. Murray, Experimental Towing Tank, Stevens Institute of Technology, 711 Hudson St., Hoboken, N. J.
(d) Experimental; for design.
(e) To obtain additional information on the effect of spray strips on the running resistance and general behavior of Vee-bottom high speed hulls. Tank tests over a period of years on models with and without spray strips are being analyzed.
(f) Active; the project is nearly completed, and a report will soon be prepared.
(g) Spray strips are, in most cases, remarkably effective. These strips usually improve the running trim and cause a pronounced saving in effective horsepower. Full-size results largely confirm the model tests.
(h) "Effect of spray strips on various power boat designs", Experimental Towing Tank Memorandum TM-99.

(633) UNDERWATER FLOW STUDIES (Project R1110).

(b) Laboratory project.
(c) William Sutherland and Randolph Ashton, Experimental Towing Tank, Stevens Institute of Technology, 711 Hudson St., Hoboken, N. J.
(d) Experimental; development.
(e) Development of method of indicating direction of flow at or near the surface of models by photographing tufts streaming with the flow.

(f) Completed.
(g) Method developed has proved useful in visualizing flow conditions.
(h) "Underwater photographs of flow patterns", Experimental Towing Tank Memorandum No. TM-86.
"An underwater photographic method for determining flow lines of ship models", Experimental Towing Tank Memorandum No. TM-101.

(940) DETERMINATION OF WAKE FACTOR AND THRUST DEDUCTION OF A TOWBOAT WITH AND WITHOUT PRESENCE OF BARGE FLEET (Project T1256).

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

SYRACUSE UNIVERSITY, Department of Chemical Engineering and Institute of Industrial Research.

Inquiries concerning Projects Nos. 634, 635, 941, and 942 should be addressed to Dr. C. S. Grove, Jr., Professor of Chemical Engineering, Thompson Road Campus, Syracuse University, Syracuse, N. Y.

(634) FLUID DYNAMICS OF MECHANICAL FIRE-FIGHTING FORMS.

(b) Sponsored by Naval Research Laboratory through Office of Naval Research, U. S. Navy Department.
(d) Experimental and theoretical; basic research for design and doctors' and masters' theses.
(e) Mechanical fire-fighting foam is generated by pumping water containing a foaming agent through a chamber where compressed air is added. Homogeneity is attained by pumping the air-water (foam agent) mixture through to second pump. Pressure drop as a function of physical properties, e.g. viscosity, surface tension, and bubble size, is measured. A correlation between pressure drop and physical properties is being sought for design purposes.
(f) Active.
(h) "Correlation of viscosity and other physical properties of mechanical fire fighting foam", W. C. Marsh. Master's thesis. September 1949. (Available on loan.)
"Viscosity of fire fighting foams", W. C. Marsh, G. E. Wise, J. B. Gray, and C. S. Grove, Jr. (Publication pending.)

(635) FLOW CHARACTERISTICS OF AIR-SOLID SYSTEMS.

(b) Laboratory project.
(d) Experimental and theoretical; basic research for doctors' and masters' theses.

(e) Air under controlled pressure is allowed to flow through a pipe line where a metered amount of powdered solid is picked up, e.g. powdered "cracking" catalysts. Efforts are being made to evaluate effect of particle weight and shape on rate of acceleration of particle in air stream. The aim is a correlation of fundamental data which will permit design calculations of pipe sizes, pressure drop, etc.
(f) Active. Initial studies on 1/8 inch standard pipe line have been completed.
(h) "The flow mechanism of catalytic cracking catalysts", R. E. Ringelman. Master's thesis, State University of Iowa. January 1948. (Available on loan.)
"The flow characteristics of solid-gas streams in pipes", R. E. Ringelman and C. S. Grove, Jr. (Publication pending.)

(941) BUBBLE SIZE IN MECHANICAL FIRE-FIGHTING FOAMS.

(b) Sponsored by Naval Research Laboratory through Office of Naval Research, U. S. Navy Department.
(d) Experimental and theoretical; basic research for design and masters' theses.
(e) Mechanical fire-fighting foam generated by various means is photographed and bubble size analyzed. The major aim is a relation between bubble size and such variables as total pressure on system, age of foam, type of foaming agent, temperature, and surface tension.
(f) Active.

(942) SURFACE TENSION OF WATER-FOAMING AGENT MIXTURES.

(b) Sponsored by Naval Research Laboratory through Office of Naval Research, U. S. Navy Department.
(d) Experimental and theoretical; basic research for design and master's thesis.
(e) Surface tension of mixtures of foaming agents and water is measured. Variables, such as pressure on system, type of agent, concentration of agent and temperature are being studied. The aim is to determine the effect on surface tension of these variables and the relation of these variables to foam generation and stability of foam.
(f) Active.

(943) THEORETICAL INVESTIGATION OF COMPRESSIBLE FLUID FLOWS AT HIGH SUBSONIC SPEEDS FOR GASES GOVERNED BY EQUATIONS OF STATE APPROXIMATING ARBITRARILY CLOSELY THE ADIABATIC EQUATION OF STATE.

(b) Subsidized by N.A.C.A.
(c) A. Gelbart, Department of Mathematics, Syracuse University, Syracuse, N. Y.
(d) Basic; theoretical research.
(e) General theoretical parametric representation is given for the two-dimensional, steady, nonviscous flow of a compressible fluid. The derived equation is such that by an almost trivial computation the velocity and pressure distributions are obtained of flows around bodies very closely approximating preassigned shapes for a gas governed by equations of state which very closely approximate the adiabatic equation of state. This is done by essentially reducing the problem to the same kind as when the equation of state is the linearized equation of state, by solving the linearized problem repeatedly a finite number of times, each time under slightly different conditions.
(f) Completed.
(g) This method can be continued for the case of supersonic velocity, as well as for velocities both subsonic and sonic.

THE UNIVERSITY OF TENNESSEE, Department of Civil Engineering.

(353) WEARING OF SAND PARTICLES.

(b) Laboratory project.
(c) Prof. J. C. Bridger, Department of Civil Engineering, University of Tennessee, Knoxville 16, Tennessee.
(d) Experimental; basic research for master's thesis.
(e) A revolving drum partially filled with water and sand was operated through a range of speeds simulating flow conditions in natural streams to produce movement of the sand particles. Wear on the particles was measured by sieve analysis and by camera lucida projections of the sand particles.
(f) Completed.
(g) This study indicates that the wearing of sand particles by rolling and sliding over each other is a chipping and splitting action rather than a gradual rounding of sharp edges and corners. In a sand mixture large particles tend to wear more rapidly than small, and heavy particles tend to round off more quickly than light.
(h) "Wearing of sand particles", Harbans Singh, master's thesis, August 1948. (Available on loan.)

(354) STUDY OF DESIGN OF BLOCKS AND SILLS FOR STILLING BASIN.

(b) Laboratory project.
(c) Prof. H. H. Ambrose, Department of Civil Engineering, University of Tennessee, Knoxville 16, Tennessee.
(d) Experimental; applied research for master's thesis.
(e) The effect of size of a series of geometrically similar sets of blocks (simulating baffle piers) on the performance of the hydraulic jump was investigated for the purpose of determining a relationship between the size of block and allowable tailwater deficiency with good hydraulic jump performance under given conditions of high velocity flow.
(f) Completed.
(g) Curves are presented showing the relationship of the ratio of the depths below and above the jump to Froude's number for varying sizes of rectangular blocks. The use of baffle piers to augment somewhat deficient tailwater depth for the hydraulic jump is demonstrated. The stabilizing effect of the piers increases with the ratio of the height of the pier to the depth of water upstream.
(h) "Effect of rectangular baffles on the hydraulic jump", M. A. Ahmad, master's thesis, August 1948. (Available on loan.)

(355) STUDY OF PIPE ELBOWS AS A METHOD OF FLOW MEASUREMENT.

(b) Laboratory project.
(c) Prof. J. R. Fleming, Civil Engineering Department, University of Tennessee, Knoxville 16, Tennessee.
(d) Experimental; applied research for master's thesis.
(e) A series of 2½-inch commercial elbows of various types with several different methods of providing piezometric openings, and with varying approach conditions were studied for the purpose of ascertaining their reliability as a flow meter.
(f) Completed.
(g) The general conclusion drawn from this investigation was that elbow meters, even though uncalibrated, are more reliable than has been believed heretofore. Specifically, for uncalibrated elbow meters of a given size made from standard 90-degree fittings, flow measurements agree within about 10 percent for all types of fittings,

and within about 2 to 5 percent for each individual type of fitting.

(h) "The use of pipe elbows as flow meters", Bakhteyar Husain, master's thesis, August 1948. (Available on loan.)

(944) HYDRAULIC FRICTION.

(b) Laboratory project; sponsored by the Engineering Experiment Station, University of Tennessee, Knoxville 16, Tennessee.
(c) Dr. G. H. Hickox, Associate Director, Engineering Experiment Station, University of Tennessee, Knoxville 16, Tennessee.
(d) Experimental; basic research.
(e) A rather long range investigation is planned to determine head losses due to pipe friction in the flow of water through a pipe line in which the roughness of particles will be varied as to size, uniformity of size, and distribution. An experimental pipe line constructed of plastic tubing 4 inches in inside diameter will be utilized and will be roughened appropriately. The purpose of this study is to define more completely the relationship between the friction factor and Reynold's number in the transition from "smooth" to "rough" turbulent flow, in terms of the roughness pattern.
(f) The construction of the test line and appurtenances is essentially complete. Tests will be under way soon to check conformity of the test line with the smooth pipe law and the reliability of some newly-developed instrumentation.

TEXAS A & M COLLEGE, Engineering Experiment Station.

(945) FLOW OF WATER THROUGH BOX CULVERT MODELS.

(b) Laboratory project.
(c) R. E. Schiller, Jr., Civil Engineering Department, Texas A & M College, College Station, Tex.
(d) Experimental; for design and for master's thesis.
(e) Tests were conducted on plexiglas models of Texas Highway Department box culverts with straight wing walls and with flared wing walls to determine relative capacities and flow characteristics. A flared wing design was discovered that should, with sufficient heads, flow full under all conditions. Discharges under free outfall conditions could be increased as much as 30 percent.
(f) Suspended.
(g) Studies of straight wing wall model culverts have been completed.
(h) "The flow of water through box culvert models", R. E. Schiller, Jr. Master's thesis, June 1949. (Available on loan.)

(946) HYDRAULIC MODEL STUDY OF THE HEART BUTTE DAM STILLING BASIN.

(b) Laboratory project.
(c) H. J. Miles, Professor of Hydraulics, Texas A & M College, College Station, Texas.
(d) Experimental; for master's thesis.
(e) The size and location of the hydraulic jump was determined for variations in the original design.
(f) Completed.
(g) The effects of variations in the design on the efficiency of the jump as an energy dissipator were determined.

(h) "A hydraulic model study of the Heart Butte Dam Stilling Basin", B. T. Blankinship, master's thesis, August 1948. (Available on loan.)

THE UNIVERSITY OF TEXAS, Department of Civil Engineering.

Inquiries concerning Projects Nos. 358, 637, 947, and 948 should be addressed to Walter L. Moore, Associate Professor of Civil Engineering, The University of Texas, Austin, Tex.

(358) USE OF A TOTAL HEAD MEASUREMENT IN THE DETERMINATION OF WEIR FLOW.

(b) Laboratory project.
(d) Experimental; applied research.
(e) An investigation of the use of a total head measurement in determining the flow over weirs with particular emphasis on low weirs with a high approach velocity.
(f) Suspended.

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

(b) Laboratory project.
(d) Experimental; for design.
(e) The purpose of the flume was intended primarily for the study of problems in two-dimensional flow with a free surface. The glass-walled portion was 1 foot wide and included a section 4 feet deep and 6 feet long followed by a section 2 feet deep and 18 feet long. The slope of the entire flume could be readily adjusted by a single jack.
(f) Completed. Operation is satisfactory.

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

(b) Conducted for Abraham Strieff of Fargo Engineering Company.
(d) Experimental; basic research.
(e) A preliminary investigation will be made by observing the blow out process through the transparent side of a 3 foot by 4 foot by 6 inch box. The effect of factors other than critical exit gradient will be studied. Continuation of the study will depend on the results of the preliminary tests.
(f) Active.

(948) DIFFUSION OF A TWO DIMENSIONAL SUBMERGED JET.

(b) Laboratory project.
(d) Experimental; M.S. thesis.
(e) An experimental study will be made of the diffusion of a water jet as influenced by the presence of solid boundaries. Detailed measurements of pressure and velocity will be made.
(f) Active.

UTAH STATE AGRICULTURAL COLLEGE, Engineering Experiment Station.

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

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

(b) Laboratory project. Cooperation and financial assistance furnished by the U. S. Geological Survey, the Armco Drainage and Metal Products Company, and the Douglas Fir Plywood Association. The field studies were conducted at the outdoor cooperative (Soil Conservation Service, Utah State Agricultural College) Irrigation Research Laboratory.

(d) Experimental and field investigation; applied research and development, master's thesis.

(e) The purpose of the study is to develop a satisfactory water measuring device for open channels, operating on the principle of the Venturi tube, that can be used for irrigation channels on very flat gradients where a minimum loss of head can be permitted. The investigation was divided into two parts: (1) a laboratory study in a flume 6 inches wide and 22 inches deep, to determine characteristics of a curved cover section forming a modified Venturi tube with a rectangular throat, and with all change in cross section being produced by the shape of the cover section. The dimension of the throat is adjustable by moving cover section vertically; (2) a field study in a concrete lined canal in which a 2-foot wide rectangular concrete flume was constructed. Determinations of tne value of the coefficient of discharge, and overall head loss, were undertaken.

(f) Active.

(g) Preliminary laboratory and field studies completed. Additional studies underway.

(h) "A modified Venturi section for measuring irrigation water in open channels", J. E. Ferguson, master's thesis. May 1949. (Available on loan.)
"A modified Venturi section for measuring irrigation water in open channels", J. E. Ferguson and J. E. Garton. Agricultural Engineering. (In Press.)
"Field studies of a modified Venturi section for metering flow in open channels", J. E. Garton, master's thesis. Utah State Agricultural College. August 1949. (Available on loan.)

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

(b) Laboratory project. Engineering Experiment Station and Aluminum Company of America.

(d) Experimental; applied research and master's thesis.

(e) Purpose of the investigation is to determine friction loss factors for new aluminum extruded irrigation tubing. To compare the friction loss factors for extruded aluminum tubing that has been in service for an extended period of time with that of new tubing. To determine the friction factors for several makes of commercial irrigation sprinkler pipe complete with couplings. To determine the hydraulic characteristics of sprinkler pipe couplings with outlets in the coupling.

(f) Completed.

(g) The friction factor for new aluminum tubing was found to be in very close agreement with that presented in the literature for "smooth tubing". It was found that the friction factor for used tubing was approximately the same as that for new tubing for Reynold's numbers of approximately 6×10^4 but that it remained relatively more constant for increasing value of Reynold's number and was approximately 25 percent higher for Reynold's number of 4×10^5. The head loss attributable to the special couplings was found to be relatively small when there was deflection at the coupling. The coupling loss could be expressed by the equation $h_c = K_c \frac{V^2}{2g}$

where the value of K_c is of the magnitude of 0.12 to 0.20. The experimental data for pressure recovery at a coupling with side outlet agreed very well with the theoretical curves developed for manifolds and with experimental data found in the literature.

(h) "The determination of the friction factor for new and used aluminum tubing and head losses in sprinkler-pipe couplers", H. M. Olson, master's thesis. (Available on loan.)
"A study of hydraulic losses in sprinkler irrigation couplers", D. A. Buhr, master's thesis. (Available on loan.)

(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 of the study 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) Active. Preliminary work started.

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

(b) A field study in cooperation 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) Active. Preliminary work started.

UNIVERSITY OF UTAH, Department of Civil Engineering.

(638) THE THEORY OF TWO-DIMENSIONAL POTENTIAL FLOW IN LEAKY SYSTEMS.

(b) Laboratory project.
(c) Prof. C. E. Jacob, Department of Civil Engineering, University of Utah, Salt Lake City, Utah.
(d) Theoretical; basic research for doctor's thesis.
(e) An analytical study of flow in confined groundwater bodies from which there is leakage at a rate proportional to the head. An attempt is being made to determine "Green's functions" for several combinations of lateral study problems in drainage and stability of levees. The theory will be checked by layered electrolytic models.
(f) Completed.
(h) "A study of two-dimensional flow in leaky systems", Mahdi Hantush, doctor's thesis, June 1949.

(639) HYDRAULICS OF MANIFOLDS.

(b) Laboratory project.
(c) Prof. J. R. Barton, University of Utah, Salt Lake City, Utah.
(d) Experimental; for design and master's thesis.

(e) (1) Tests were conducted on a small commercially designed perforated pipe underdrain for a rapid sand filter to determine the flow pattern, optimum ratio of manifold and lateral size, optimum ratio of lateral and orifice size.
(2) Tests are now being run to study the problem of lateral discharge from an orifice in the side of a pipe.
(f) (1) Completed. (2) Active.
(h) "Perforated pipe underdrains for small rapid sand filters", G. K. Borg, master's thesis, June 1949.

(953) A STUDY OF HEAD LOSS THROUGH BROKEN BACK CHANNEL TRANSITIONS.

(b) Laboratory project.
(c) Prof. J. R. Barton, University of Utah, Salt Lake City, Utah.
(d) Experimental; for design and master's thesis.
(e) Studies are being made in a small flume 4 feet wide by 36 feet long on the energy losses through broken back transitions in open channels.
(f) Active.

THE STATE COLLEGE OF WASHINGTON, Hydraulic Laboratory, Department of Civil Engineering.

(640) PROBLEMS OF BREAKAGE AND REDUCTION IN FLOW IN CONCRETE IRRIGATION PIPE.

(b) Division of Industrial Research, State College of Washington; and Concrete Products Association of Washington; directed by Department of Civil Engineering.
(c) C. L. Barker, Professor of Hydraulic Engineering, Washington State College, Pullman, Wash.
(d) Experimental and field investigation; applied research.
(e) The purpose of this project is to determine the causes of breakage and reduction in flow when concrete irrigation pipe is used for the conveyance of water, and to find ways of eliminating these problems. General field tests and studies were made to determine the conditions existing with each problem. Hydraulic model studies are planned to establish more quantitative and qualitative results.
(f) Completed.
(h) "Study of breakage and reduction of flow in concrete irrigation pipe", Report in Bulletin #204, Washington State Institute of Technology, State College of Washington.

(641) THE HYDRAULICS OF SPRINKLER IRRIGATION SYSTEMS.

(b) Sponsored by the Division of Industrial Research, State College of Washington.
(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", master's thesis, 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.

887657 O—50——8

(f) Active.
(h) "The hydraulics of sprinkler irrigation systems", M. R. Carstens, Division of Industrial Research, State College of Washington. (Report in process of publication.) 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 in (e). The graphical solution includes also the summation of discharge ratios up to and including any branch from the downstream branch.

(954) A STUDY OF AIR POCKETS IN ENCLOSED CIRCULAR CHANNELS.

(b) Laboratory project.
(c) Charles Behlke, Department of Civil Engineering, State College of Washington, Pullman, Wash.
(d) Experimental and theoretical; for master's thesis.
(e) A study of the geometrical characteristics of air pockets in flow in enclosed channels.
(f) Completed.
(g) The energy equation for drawdown curves in circular enclosed channels is very accurate except in the regions of very appreciable curvature, if only one dimensional flow is assumed. The equation is more accurate at large slopes.
(h) Unpublished master's thesis available for loan.

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, Setttle 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.
(h) "Experimental investigation into the internal pressure and velocity variations in a large pipe, introduced by sudden expansion", W. W. Saxton, Laboratory Report, June 1948.

(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.
(f) Active.
(g) Results are in form of initial data only.
(h) "An investigation of the influence of shape upon the flow of water in closed conduits", H. A. Smallwood, master's thesis, August 1949. (Essentially a progress report.)

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

(b) Laboratory project.
(d) Experiment; 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) Active.
(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.
(h) "Influence of random roughness in pipes", Bulletin No. 115, Engineering Experiment Station, University of Washington, Seattle 5, Wash.
"An engineering concept of flow in pipes", C. W. Harris, Proceedings American Society of Civil Engineers, May 1949.

UNIVERSITY OF WISCONSIN, Hydraulic Laboratory.

(365) MODEL TESTS OF PETENWELL DAM SPILLWAY.

(b) Wisconsin River Power Company
(c) Dr. Arno T. Lenz, Hydraulic Laboratory, University of Wisconsin, Madison 6, Wis.
(d) Experimental; for design.
(e) Additional tests to determine final design of spillway structure of dam now under construction on Wisconsin River were made with a 1:80 model of seven spillway gates, one regulating bay gate, and the powerhouse, to determine effects of combined operation of several units. Model tests on a 1:25 scale of a single bay at Castle Rock Dam were also made.

(f) Completed.
(h) Report by Dr. A. T. Lenz available on loan.

(149) EFFECT OF SUBMERGENCE ON DISCHARGE OF SHARP-CRESTED WEIRS.

(b) Laboratory project.
(c) Prof. J. R. Villemonte, Hydraulic Laboratory, University of Wisconsin, Madison 6, Wis.
(d) Experimental; for doctoral thesis.
(e) Tests were run with various conditions of submergence on sharp-crested weirs with various shapes.
(f) Completed.
(h) "Submerged weir discharge studies", J. R. Villemonte, Engineering News-Record, Vol. 139, No. 26: 866-869, December 25, 1947.
A doctoral thesis has been completed and can be made available through inter-library loan system. Publication of thesis is in progress.

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

(b) Laboratory project.
(c) Prof. J. R. Villemonte, Hydraulic Laboratory, University of Wisconsin, Madison 6, Wis.
(d) Experimental; for bachelor's thesis.
(e) Head loss measurements are being made on straight copper and galvanized iron standard pipe of various sizes.
(f) Active.

(367) DISCHARGE COEFFICIENTS OF ORIFICES ON SLEEVES IN THE ENDS OF PIPES UNDER LOW HEADS.

(b) Laboratory project.
(c) Prof. J. G. Woodburn, Hydraulic Laboratory, University of Wisconsin, Madison 6, Wis.
(d) Experimental; for bachelor and M.S. theses.
(e) To determine the relation of discharge to head for orifices on the ends of pipe for use in locations where it is not possible to tap the side of the pipe to determine the head. Orifices 1/4, 3/8, 1/2, and 2/3 of the diameter of 8-inch, 10-inch, and 12-inch pipes have been tested at heads up to about 2 feet, including weir flow.
(f) Inactive. One bachelor and one master's thesis have been completed. Results will be analyzed for possible publication.

(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) Active. Five M.S. theses have been completed.

(369) HEAD DISCHARGE RELATIONSHIP OF FLOW INTO TROUGHS HAVING A U-SHAPED CROSS-SECTION.

(b) Laboratory project.
(c) Dr. G. A. Rohlich, Hydraulic Laboratory, University of Wisconsin, Madison 6, Wis.

(d) Experimental; for bachelor's thesis.
(e) U-shaped trough weirs, 8 inches on a side, and forming a rectangular loop 38 feet in circumference were tested up to heads of 0.05 feet. Such troughs are used in final effluent sedimentation tanks.
(f) Inactive. Two bachelor theses have been completed.

(645) FRICTION FACTORS IN A SMALL ARTIFICIALLY-ROUGHENED FLUME.

(b) Laboratory project.
(c) Dr. A. T. Lenz, University of Wisconsin, Hydraulic Laboratory, Madison 6, Wis.
(d) Experimental; for bachelor's thesis.
(e) Studies have been made on an all glass flume 10 inches wide, 7 inches deep, and 40 feet long, roughened artificially by special carborundum cloth linings.
(f) Inactive. One bachelor's thesis is 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 closing the influent with sodium phosphate and making chemical tests at regular intervals to indicate the phosphorous concentration in the effluent. Three different inlet baffles are presently being tested, both for hydraulic characteristics and wax retention (mentioned last year).
(f) Active.
(g) Hydraulic characteristics of the tank with simple vertical influent baffle indicate serious short circuiting.

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

(b) Laboratory project.
(c) Prof. J. R. Villemonte, Hydraulic Laboratory, University of Wisconsin, Madison 6, Wis.
(d) Experimental; for master's thesis.
(e) Submergence tests are being run with various conditions of submergence on a standard 6 inch Parshall flume.
(f) Active.

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

(b) Laboratory project in cooperation with Ladish Co., Cudahy, Wis.
(c) Prof. J. R. Villemonte, Hydraulic Laboratory, University of Wisconsin, Madison 6, Wis.
(d) Experimental; for master's and doctoral degrees.
(e) A circulating system of 2-inch seamless steel pipe will contain a 20 foot test section in which energy losses will be measured by latest type strain gage for oil flowing. Line pressures will be varied from 100 to 2000 psi and test pipes diameters from 1/2 to 2 inches. It is expected that the tests will show the effect of high line pressure on the friction factor for both laminar and turbulent flow.
(f) Active.

(957) THE EFFECT OF PRESSURE AND TEMPERATURE ON VISCOSITY AND UNIT WEIGHT OF WATER AND CERTAIN LIGHT OILS.

(b) Laboratory project.
(c) J. G. Slater, Hydraulic Laboratory, University of Wisconsin, Madison 6, Wis.
(d) Experimental; for bachelor's thesis.
(e) The terminal velocities of small, colored plastic spheres falling in the media will be observed by use of newly designed apparatus. Absolute viscosities will be computed from Stoke's law. Unit weights will be determined volumetrically. The pressures will be varied from atmospheric to 2000 psi and the temperatures from 60 degrees to 100 degrees F.
(f) Active.

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

(b) Laboratory project in cooperation with Ladish Co., Cudahy, Wis.
(c) Prof. J. R. Villemonte, Hydraulic Laboratory, University of Wisconsin, Madison 6, Wis.
(d) Experimental; for bachelor thesis.
(e) Head losses over and above those in straight pipe of same centerline length will be observed for a wide variety of welding pipe fittings, including one and two gore miter turns. Most fittings will be 4 inches in diameter.
(f) Active.

(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, Lake Investigations Committee and U. S. Public Health Service.
(c) Dr. A. T. Lenz and Dr. G. A. Rohlich, 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.
(f) Active.
(g) Two 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 will be included before the project is completed.
(f) Active.

WORCESTER POLYTECHNIC INSTITUTE, Alden Hydraulic Laboratory.

Inquiries concerning Projects Nos. 647 to 650, incl., and 961 to 965, incl., should be addressed to Dr. C. M. Allen, Director, Alden Hydraulic Laboratory, Worcester Polytechnic Institute, Worcester, Mass.

(647) CALIBRATION OF GENTILE TYPE FLOW METERS.

(b) Bethlehem Foundry & Machine Company.
(d) Experimental; development.
(e) Six Gentile type flow tubes were calibrated over a Reynolds number range from 100,000 to 800,000. The meters were of different throat ratios and of different mechanical designs. The tests were preliminary and exploratory in nature, determining the possibilities of the meters.
(f) Completed. Report submitted to sponsor.
(h) A brief report describing these tests was presented at the Fluid Meter Session of the American Society Mechanical Engineers in New York in December 1949.

(648) DESIGN OF SHIP ROD.

(b) Pitometer Log Corporation.
(d) Experimental; development.
(e) The purpose of the project is to develop a rod suitable for application to high speed surface craft of shallow draft.
(f) Completed.
(h) Final reports submitted to Pitometer Log Corporation.

(649) GOOSE POND SPILLWAY TEST.

(b) Granite State Electric Company (New England Power Association).
(d) Experimental; for design.
(e) The purpose of the project was 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 on this project may be continued.

(650) NEVERSINK TAIL RACE POOL.

(b) Charles T. Main, Inc.
(d) Experimental investigation.
(e) The purpose of the tests was to determine the nature of the flow conditions at the entrance to a tunnel at the downstream end of the tailrace pool. A 1:15 scale model was constructed comprising the draft tailrace pool and approximately 15 diameters of conduit. Lucite windows were provided in the conduit to permit observation and photographs of the flow conditions. Piezometers were installed to measure the hydraulic gradient.
(f) Completed. Final report submitted to Charles T. Main, Inc.

(961) VALVE TESTS.

(b) W-K-M Company, Houston, Texas.
(d) Experimental; for design.

(e) Losses were measured at various valve openings on 4 inch, 8 inch and 16 inch gate valves of the same design. Maximum discharges of 27 cfs were reached on 16 inch valves. The loss data of the three valves were correlated on a single curve sheet.
(f) Completed. Final report submitted to W-K-M Company.

(962) HOOSIC FALLS SPILLWAY TEST.

(b) Central Vermont Public Service Corporation.
(d) Experimental; basic research.
(e) The object of the test was to determine the reason for localized erosion at the end of the apron on the Hoosic Falls spillway. A 1:16 scale model was constructed and various flood flows were used to simulate conditions of operation in the field. It was found that the apron was satisfactory if it is maintained in good condition. Experimental evidence indicated that the local erosion was the result of damage to the end of the apron and that no further remedial action was necessary.
(f) Completed. Final report submitted to Central Vermont Public Service Corp.

(963) CALIBRATION OF KENNISON NOZZLE.

(b) Builders Providence, Inc.
(d) Experimental.
(e) A new size of meter was calibrated to maximum discharge of 30 cfs and discharge coefficients and operating characteristics were determined.
(f) Completed.

(964) MEASUREMENT OF TURBULENCE.

(b) Office of Naval Research.
(d) Experimental; for design.
(e) The purpose of this investigation is to determine the feasibility of measuring turbulence in water using diffusion of salt solution.
(f) Active.

(965) HOLYOKE INTAKE DESIGN.

(b) Jackson & Moreland.
(d) Experimental investigation.
(e) A 1:50 model has been constructed of the proposed power house intake and fore-bay arrangement. Model tests are to be made determining loss of head, stability of flow conditions, effect of flood flows on fore-bay, and ice diversion.
(f) Active.

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

(261) WATERSHED MANAGEMENT RESEARCH, CALIFORNIA.

(b) California Forest and Range Experiment Station, Forest Service, U. S. Department of Agriculture; Division of Forestry, Department of Natural Resources, State of California; and other agencies.

(c) S. N. Wyckoff, Director, or E. A. Colman, Chief, Division of Forest Influences, California Forest and Range Experiment Station, P. O. Box 245, Berkeley 1, Calif.

(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 progress.

(f) Active.

(g) Investigation of wind effect on rain catch showed that 1-foot high gages at exposed windy locations caught about 3 percent more rain than adjacent standard 40-inch high vertical 8-inch diameter rain gages.

A study of the interception of rainfall by shrub type vegetation indicated an annual loss of 11 percent of the rainfall in the oak-ceanothus chaparral in the San Dimas Forest compared with an 8 percent loss in the foothill woodland chaparral of central California. In the latter area, partly deciduous vegetation caused an average annual rainfall loss of 5 percent.

Fiberglas soil moisture indicating units tested under field conditions through four soil drying cycles maintained the same soil moisture-electrical resistance relation through these cycles.

Results of several years experimentation with more than 50 species of trees and shrubs for erosion control planting in southern California mountains were prepared for publication.

(h) "Geology of the San Gabriel Mountains, California, and its relation to water distribution", H. C. Storey. California Department of Natural Resources, Division of Forestry. 19 pp., illus. map. 1948.

"Manual of instructions for use of the fiberglas soil-moisture instrument", E. A. Colman. California Forest and Range Experiment Station. Multilithed. 19 pp. October 1948.

"Instrument facilitates setting of weir zero values", P. B. Johnson and H. C. Storey. Civil Engineering 18(11): 41-42. November 1948.

"The problem of sampling rainfall in mountainous areas", E. L. Hamilton. Proceedings of the Berkeley Symposium on Mathematical Statistics and Probability. University of California Press. 469-475. 1949.

"Nomograph determination of stem surface areas", E. L. Hamilton. Journal of Forestry, 47(1): 57. January 1949.

"The fiberglas electrical soil-moisture instrument", E. A. Colman and T. M. Hendrix. Soil Science, 67(6): 425-438. June 1949.

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

Inquiries concerning Projects Nos. 652 to 655, incl., should be addressed to the Director, Intermountain Forest and Range Experiment Station, Ogden, Utah.

(652) SOIL RELATIONS (IN WATERSHED MANAGEMENT AND PROTECTION).

This project is a continuation of the work listed under Projects Nos. 371, 372, and 373 in Volume 12 of this bulletin.

(b) Branch of Research, Forest Service, U. S. Department of Agriculture.

(d) Field investigation; basic and applied research.

(e) Tests on plots and small watersheds of the effects of forest, brush, and herbaceous plant cover in natural, depleted, and restored condition on the infiltration, storage, fertility, biology, and stability of forest and range lands soils; to determine land use practices for stabilizing eroding watershed soils and for maintaining soil stability under the impact of grazing, logging, and other wild land uses. Studies are under way on coarse, granitic soils of southwest Idaho; various soils on steep slopes of Wasatch Mountains in northern Utah; and on heavy limestone soils on Wasatch Plateau in central Utah.

(f) Active.

(g) Infiltrometer tests show steep granitic mountain soils of southwestern Idaho require about a 70 percent covering of plant and litter material at the soil surface for satisfactory control of summer storm runoff and erosion. Essentially similar amounts of ground surface covering are needed for controlling overland flow on heavy, clay soils on Wasatch Plateau in south-central Utah. Straw mulching or seeding of grasses was found to be effective for preventing overland flow and erosion on depleted flood source areas in Wasatch Mountains of northern Utah.

(h) "Landslides and sedimentation in the North Fork of the Oregon River, May 1949", A. R. Croft and J. A. Adams Jr. Submitted for publication in Proceedings of Utah Academy of Science, Arts and Letters, 1950.
"Watershed condition and flood potential", H. W. Lull. Jour. Forestry 47(1): 45-48. January 1949.

(653) WATER RELATIONS (IN WATERSHED MANAGEMENT AND PROTECTION).

This project is a continuation of the work listed under Projects Nos. 372 and 373 in Volume 12 of this bulletin.

(b) Branch of Research, Forest Service, U. S. Department of Agriculture.

(d) Field investigation; basic and applied research.

(e) Tests on watersheds of the effects of forest, brush, and herbaceous plant cover, and of mechanical soil stabilizing structures, on runoff characteristics of mountain watersheds; to determine land use treatments required for flood control and for maximum yields of usable stream flow.

(f) Active.

(g) Long-range stream flow studies are under way on experimental watersheds at Great Basin Research Center near Ephraim, Utah, and Wasatch Research Center, Farmington, Utah.

(h) "Watersheds and how to care for them", G. W. Craddock and C. R. Hirsh. U. S. Department of Agriculture Yearbook 1949: 603-609.
"Forest influences: growth of a concept", H. W. Lull. Jour. Forestry 47(9): 700-705. September 1949.
"Understanding our watersheds", R. W. Bailey. Reclamation Era, 35 (10): 218-220. October 1949.
"Forest and range management in flood and sediment control", R. W. Bailey, Northwest Science Quarterly. January 1950.

(654) PLANT RELATIONS (IN WATERSHED MANAGEMENT AND PROTECTION).

(b) Branch of Research, Forest Service, U. S. Department of Agriculture.
(d) Field investigation; basic and applied research.
(e) Tests on plots and watersheds of the effects of forest, brush, and herbaceous cover on interception and evapo-transpiration losses; to determine the kind of plant cover required for producing maximum yields of useful runoff from watersheds. Principal effort now limited to study of evapo-transpiration loss in aspen-herbaceous cover on Wastach Mountains, northern Utah.
(f) Active.
(g) Three years of records show evapo-transpiration deficit (amount of water required to recharge a 6-foot deep watershed mantle to field capacity at the end of the summer growing season) to be about 5 inches on bare sites, 8 inches on sites having a plant cover of grasses and other herbs, and 12 inches on areas having a stand of aspen trees and understory of herbaceous plants.
(h) "A water cost of runoff control", A. R. Croft, Journal of Soil and Water Conservation. January 1950.

(655) CLIMATIC RELATIONS (IN WATERSHED MANAGEMENT AND PROTECTION).

(b) Branch of Research, Forest Service, U. S. Department of Agriculture.
(d) Field investigation; basic and applied research.
(e) Measurements and studies of climatic factors including precipitation, temperature, wind, etc., that have a bearing on the hydrologic behavior of forest and range watershed lands. These studies are confined to experimental watershed areas at the Boise Research Center near Idaho City, Idaho; Wasatch Research Center, Farmington, Utah; and Great Basin Research Center, near Ephraim, Utah.
(f) Active..
(g) Snow fences 11 feet high and 50 feet long installed in open areas at 10,000 feet elevation on Wasatch Plateau in south-central Utah produced snow drifts comparable in size and shape to those that formed naturally in lee of dense fir tree clumps. The induced drifts contained 15 inches of water when snow had melted from undrifted sites. The drifts persisted for 15 to 21 days. Records from a network of rain gages on the Wasatch Mountains of northern Utah show that rainfall rates in excess of 8 inches per hour for 5 minutes may occur over an area of about 1 square mile during summer storms; rates of 6 inches per hour occurred over areas of about 4 square miles; 2 inches per hour rates were areas in excess of 30 square miles.
(h) "Induced snow drifting for water storage", H. W. Lull and H. K. Orr. Accepted for publication in Jour. of Forestry, 1950.
"Summer rainfall characteristics in northern Utah", A. R. Croft and R. B. Marston. Trans. American Geophysical Union. February 1950.

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

Inquiries concerning Projects Nos. 374, 375, 656, 966, and 967 should be addressed to V. L. Harper, Director, or Arthur Bevan, Chief, Division of Flood Control Surveys, Northeastern Forest Experiment Station, 102 Motors Ave., Upper Darby, Pa.

(374) FROST SURVEY IN ALLEGHENY RIVER WATERSHED.

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

(e) Periodic frost observations, made during the winter of 1947-48 on 60 sites in forest and open areas in gaged subwatersheds of the Allegheny River watershed, are being analyzed to determine the influence of cover and site conditions on type and depth of frost and runoff.
(f) Active.

(375) FROST SURVEY AT SELECTED SITES IN THE NORTHEASTERN UNITED STATES.

(b) Laboratory project.
(d) Field investigation; applied research.
(e) Periodic frost observations, made during the winter of 1947-48 on 60 sites over a wide range of land use and condition in New England, New York, and northern Pennsylvania, are being analyzed to determine the effect of cover type and site condition on ground freezing in the northeastern United States. Field observations were made on 12 sites in Pennsylvania during the winter 1948-49. Additional data were secured during the winter 1949-50.
(f) Active.
(g) Analysis indicates the following factors to be significant in the formation of concrete or impervious frost: temperature deficiency accumulation and average temperature on the day of observation, depth of snow mantle, soil drainage, land use, litter depth and humus type. Soil freezing increased with temperature deficiency accumulation, but this relationship was modified by temperatures immediately preceding observation. Increasing snow depth tended to inhibit soil freezing. Poorly drained soils had more concrete frost than moderately or well-drained soils. Only 6 percent of the observations in undisturbed woods showed concrete frost, while 93 percent of the observations on bare ground showed this type of soil freezing. Pastures, cornfields and hayfields contained 73 percent concrete frost. 53 percent of the observations on burned forests and 35 percent on grazed woodlands showed concrete frost. Increasing litter depth tended to show an inhibiting effect upon soil freezing.

(656) FOREST INFLUENCES INVESTIGATION (WATERSHED MANAGEMENT).

(b) Laboratory project; in cooperation 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. When this has been accomplished, the cover will be converted by planting and fire protection to a commercially valuable type, and the effect on water relations will be measured. Recording rain and snow gages have been installed; two climatic stations have been established and equipped to measure air temperature, humidity, and wind movement. A streamgaging station and three groundwater wells have been constructed and equipped with waterstage recorders. Permanent sites for measurement of soil moisture have been selected and marked. Periodic water quality determinations are being made. Soil freezing observations will be made at periodic intervals. Installations will be established to measure rainfall interception.
(f) Active.
(h) "Watershed research in the Delaware and Lehigh", H. C. Storey, Forest Leaves, Vol. 34, No. 1: 15-16, January-February 1949.

(966) FOREST INFLUENCES INVESTIGATION (WATERSHED MANAGEMENT).

(b) Laboratory project.

(d) Field investigation; basic and applied research.
(e) Studies were initiated in August, 1949, on the Pocono Experimental Forest in Wayne County, Pa., to determine the effects of certain forest management practices and logging operations upon the quantity and quality of water yielded by a small watershed. Recording rain and snow gages have been installed and a streamgaging station constructed. Periodic water quality determinations have been started. Installations will be established to measure soil moisture, rainfall interception, groundwater fluctuations, air temperature and humidity, and wind movement. Observations of snow depth and water content will be made.
(f) Active.

(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 the following values: Percolation rate, detention storage capacity, retention storage capacity, volume weight, and organic content. The information was obtained primarily 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.
(f) Active.
(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 differences between soil moisture values were detected for differing conditions of cover and use.

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

(968) FOREST INFLUENCES INVESTIGATIONS.

(b) Laboratory project.
(c) Director Charles L. Tebbe, Northern Rocky Mountain 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 underway at Priest River Experimental Forest, Idaho.
(f) Active.

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

(969) EFFECT OF LOGGING OPERATIONS ON STREAM FLOW.

(b) Experiment Station project.
(c) Dr. J. A. Hall, Director, Pacific Northwest Forest and Range Experiment Station, 423 U. S. Court House, Portland 5, Oregon.
(d) Field investigation; basic research.
(e) A study is being made on the Blue River Experimental Forest (McKenzie River drainage, Central Oregon Cascades) to determine what changes in stream flow will follow logging operations planned according to current Forest Service practice. A stream-gaging station has been installed at the mouth of Lookout Creek at the lower end of the experimental forest. Logging plans are now being worked out. This is a long-time study; tentative plans include studies on small (400-acre) watersheds within the main study area to determine the effects of various logging treatments within a shorter period.
(f) Active.

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

Inquiries concerning Projects Nos. 376, 377 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) The project includes studies of the influence of grazing, timber cutting, and revegetation of depleted watershed lands upon water supplies and more particularly upon erosion and sedimentation. Infiltration and erosion are measured by portable equipment. The purpose is to solve problems in watershed management for the forest- and range-covered watershed lands of the Rocky Mountain Front Range.
(f) Active.
(g) An increase in surface runoff from bunchgrass ranges as grazing pressure was intensified was found by measuring runoff from natural precipitation on permanently established plots and from artificially applied rainfall on infiltration plots. Erosion on the 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. Four 1-acre watersheds have been cleared of young pine cover after 10 years of measuring runoff and erosion to obtain pretreatment effects. 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.
(h) "Relation of grazing to runoff and erosion on bunchgrass ranges", E. G. Dunford. Rocky Mountain Forest and Range Experiment Station. Research Note No. 7. August 1949.

(377) FOREST INFLUENCES RESEARCH, FRASER EXPERIMENTAL FOREST.

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

(e) Experiments are designed to show the influence of lodgepole pine and spruce-fir forests and of the 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) Active. First phase of experiments in mature lodgepole pine completed in 1944. Studies of thinning in immature lodgepole pine completed in 1949.
(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) "Some observations on fall soil-moisture deficits under forest cover and their relation to the winter snow pack", B. C. Goodell, Proceedings, Western Snow Conference: 152-156. February 1949.
"Effect of timber cutting on water available for streamflow from a lodgepole pine forest", H. G. Wilm and E. G. Dunford. U. S. Department of Agriculture Tech. Bulletin No. 968. November 1948.

(379) TRAPEZOIDAL FLUMES FOR OPEN-CHANNEL FLOW.

(b) Laboratory project.
(d) Experimental; design.
(e) The initial stages of analyzing the range and watershed problems in the upper Colorado River basin are essentially complete. Experiments are being laid out to show the influence of forest and range vegetation on water yields, erosion, and sedimentation. Three years of streamflow records have been obtained from three small, high-altitude forested watersheds, one of which has been logged to show effect of timber cutting. Small grazing and reseeding experiments have been established and portable infiltration plots are being used to associate infiltration rates and rates of erosion with recognized vegetative cover types.
(f) Active.
(g) Preliminary results from small forested watersheds show that partial cutting has not altered the water quality, indicating very little erosion from logging in high altitudes of the Rocky Mountains. Infiltration tests on grazing lands have shown that exclusion of cattle from heavily grazed ranges increases moisture absorption rates by as much as 11 times. Gophers will increase absorption rates where grazing is heavy but decrease rates below those found under complete protection.
(h) Publications being processed.

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) I. T. Haig, Director, 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 and land management practices on water yield and water quality and develop standards and methods of watershed management. On the 5500-acre Coweeta Hydrologic Laboratory are approximately 35 individual watersheds whose stream flow is being continuously gaged. There are 13 recording and 63 non-recording (standard) rain

gages, 21 recording and 19 non-recording ground water wells, 7 recording hygrothermographs, 2 recording anemometers, and 1 evaporation pan. Water samples for quality analysis are collected on a weekly and storm period basis from selected experimental watersheds. 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.

(f) Active. 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 up to 1/2 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 stream temperatures and causes the trout to leave.

(h) "Protecting quality of stream flow by better logging", J. A. Lieberman and M. D. Hoover, Southern Lumberman 177(2225):236-240. December 15, 1948.
"Watershed studies producing valuable information", E. A. Johnson, Outdoor News Bulletin 3(11), June 3, 1949.
"Climatic factors controlling roadside design and development", C. R. Hursh, Highway Research Board, Twenty-eighth Annual Meeting Committee on Roadside Development: 9-19, September 1949.
"Watersheds and how to care for them", G. W. Craddock and C. R. Hursh, U. S. Department of Agriculture Yearbook, Trees: 603-609. 1949.

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

(657) FOREST INFLUENCES INVESTIGATIONS AND WATERSHED MANAGEMENT.

(b) Laboratory project.

(c) Raymond Price, Director, Southwestern Forest and Range Experiment Station, Box 951, Tucson, Ariz.

(d) Experimental; field investigation; basic and applied research.

(e) To determine the influence of vegetation on stream flow, water uses, and water losses, and erosion and sediment production. Work center is at Sierra Ancha Experimental Forest with additional experimental watersheds and plots in representative areas throughout the Salt River watershed. Watersheds are equipped to measure stream flow, precipitation, ground water levels, infiltration, and climate. The calibration period on the watersheds in the pine-fir forest area is nearing completion and treatment will include silvicultural thinning, cutting of riparian trees, belt cutting, and denudation, to study the effect of timber harvest on rate, quality, and quantity of water yield. Watersheds in the grassland-chaparral-pine type, the chaparral-grassland type, and the desert-grassland type have been through the calibration period and are under grazing treatment to determine the effect of vegetation manipulation on rate, quality, and quantity of water yield. Water utilization by semi-

desert and chaparral vegetation was related to total water yield is studied by periodic weighing of natural soil blocks in open-top containers under natural influence of climate, and the measurement of precipitation and of surface and subsurface runoff from small and large lysimeters of natural soil blocks.

(f) Active.

(g) Least susceptible to erosion are heavy textured soils derived from quartzite and more susceptible are coarse textured soils derived from granite. Soils with best surface protection, including rock and litter, showed least erosion. Evapo-transpiration loss of water from drained slopes is largely that retained by the soil and stream bottom or riparian vegetation uses considerable water otherwise available for stream flow. Evaporation from bare soil takes almost as much water as vegetation, and the vegetation on deteriorated sites uses more water than desirable perennial grasses. Water yield occurs mainly in winter as subsurface runoff from low intensity storms. There are increases in summer surface runoff and erosion and significant decreases in average areal infiltration capacities from overgrazing, but winter percolation appears to be independent of grazing.

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

Inquiries concerning Projects Nos. 384 to 391, incl., 393 and 658 should be addressed to George D. Clyde, Chief, Division of Irrigation and Water Conservation, U. S. Soil Conservation Service, College Hill, Box D, Logan, Utah.

(384) A SINGLE FORMULA FOR FLOW OF WATER IN PIPES.

(b) Laboratory project.

(d) Experimental; development.

(e) Three formulas were taken for flow of water in wood stave, in concrete, and in riveted steel, welded steel and such metal pipes, and the data and resulting formulas were analyzed in terms of conformity with a single formula. The background, theoretical and empirical, of all other formulas used to any great extent are explained.

(f) Completed except for publication.

(g) A basic formula was developed from about 600 tests on some 100 reaches of commercially smooth pipe less than one year old, varying from one inch to 216 inches in diameter with velocities of 1 to 50 fps. The experimental data coincide remarkably well with the basic formula.

(h) Manuscript has been prepared for submission to A.S.C.E. Proceedings.

(385) FLOW OF WATER IN CONCRETE PIPE.

(b) Laboratory project.

(d) Experimental; applied research.

(e) To meet the irrigation demand for concrete pipe by bringing Departmental Bulletin 852, "Flow of water in concrete pipe" up to date with data on results of processes of manufacture not available when bulletin was originally written.

(f) Active.

887657 O - 50 - 9

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

(b) Laboratory project.
(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 deposit 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.
(f) Active.
(g) Progress report No. 10, "Silt load of Texas Stream 1947-48", has been multilithed.

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

(b) Laboratory project.
(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.
(f) Active in several states. Snow cover--runoff relations are being established and used as basis for water forecasts.
(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.
(h) "Snow layer density changes", R. A. Work. Trans. American Geophysical Union, Vol. 29, No. 4, Part I: 525-546, August 1948.

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

(b) Laboratory project.
(d) Experimental; basic research.
(e) (1) To determine the effect of deviation from normal of late fall and early spring precipitation on the established snow cover - 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, consisting of a standard rain gage, a recording rain gage, and a recording thermograph. Soil samples are taken for a determination of soil moisture.
(f) Active. Observations for several seasons will be needed to ascertain any trend in relationship between the various phenomena.

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

(b) Laboratory project.
(d) Experimental; basic research.

(e) (1) The objective is 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 higher initial rates. Field tests are being made on test ponds and strips, as follows: (1) chemical, (2) mechanical, (3) addition of organic matter, (4) operational procedures, and (5) vegetation.
(f) Active.
(h) "Water spreading for ground water replenishment", D. C. Muckel, Agricultural Engineering: 74-78, February 1948.

(390) IMPERIAL VALLEY DRAINAGE INVESTIGATIONS.

(b) Laboratory project.
(d) Experimental; applied research.
(e) The objectives are (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.
(f) Active.
(h) "Report on drainage investigations in irrigated areas of Imperial Valley, California", 95 pages, mimeographed. (Limited number available.)

(391) SAN FERNANDO VALLEY DRAINAGE INVESTIGATIONS.

(b) Laboratory project.
(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.
(f) Active.
(h) "Progress report on cooperative investigations in San Fernando Valley, Los Angeles, California, 1947-48". Mimeographed. (Available to non-cooperators on loan.)

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

(b) U. S. Soil Conservation Service and the Washington Agricultural Experiment Station.
(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. Application and runoff measured by automatic water level recorders on type HS flumes. Detailed soil moisture determinations made with soil tube, gravimetric plugs, and resistance blocks. This project is being conducted at the U. S. Department of Agriculture, Soil Conservation Service, Irrigation Experiment Station, Prosser, Wash.
(f) Active.
(h) Articles presented before the American Society of Agronomy, August 1948 and the American Society of Agricultural Engineers, December 1948 are in preparation for publication.

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

(b) Laboratory project.
(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.
(f) Active.
(h) "Basic land values", Bulletin 223, Arizona Agricultural Experiment Station. July 1949. Mimeographed.

(53) SAND TRAPS AND SLUICEWAYS.

(55) SNOW COURSE MEASUREMENTS AND FORECAST ANALYSIS.

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

(287) PERFORMANCE TESTS OF WELL SCREENS.

(b) Soil Conservation Service, in cooperation with Colorado Agricultural Experiment Station, Colorado A & M College, Fort Collins, Colo. For complete reports, refer to the above numbered projects, listed under Colorado A & M College, pages 20 and 21.

U. S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE,
Irrigation Experiment Station, Prosser, Wash.

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

This project is reported under the U. S. Department of Agriculture, Soil Conservation Service, Division of Irrigation and Water Conservation, page 119.

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

(151) LINING OF IRRIGATION CANALS AND DITCHES.

(b) Laboratory project; U. S. Soil Conservation Service, Utah State Agricultural College, and Bureau of Reclamation cooperating.
(c) C. W. Lauritzen, Research Project Supervisor, Soil Conservation Service; and O. W. Israelsen, Research Professor of Irrigation and Drainage, Utah Agricultural Experiment Station, Logan, Utah.
(d) Experimental; basic and applied research.

(e) Linings for irrigation canals and ditches are being tested to develop 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; (3) field testing at selected sites to determine relative durability under varying subgrade and climatic conditions.
(f) Active.
(h) "Lining of canals and reservoirs saves land as well as water", C. W. Lauritzen and O. W. Israelsen. Farm & Home Science. June 1949.
"Linings for irrigation canals", O. W. Israelsen and C. W. Lauritzen. The Reclamation Era. August 1949.
"Canal linings tested in field", C. W. Lauritzen and O. W. Israelsen. Soil Conservation. November 1949.

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, U. S. Department of Agriculture, and the State Agricultural Experiment Stations of Ohio, Texas, and Nebraska.
(c) Lewis A. Jones, Chief, 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 rainfall disposal factors, such as 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.
(f) Active.
(h) "Has the small-area flood been neglected", L. L. Harrold, Civil Engineering 19: 38-39. 1949.
"The loss of soil as determined by watershed measurements", L. L. Harrold, Agricultural Engineering 30: 137. 1949.
"Infiltration, soil moisture, and land use relationships with reference to surface runoff", L. Schiff and F. R. Dreibelbis. Trans. A.G.U. 30: 75-88. 1949.
"Movement of water within the soil and surface runoff with reference to land use and soil properties", L. Schiff and F. R. Dreibelbis. Trans. A.G.U. 30: 401-411. 1949.
"Preliminary studies on soil permeability and its application", L. Schiff and F. R. Dreibelbis. Trans. A.G.U. 30: 759-766. 1949.
"Surface runoff supply estimates based on soil-water movements and precipitation patterns", L. Schiff. Soil Conservation Service Tech. Pub. 86, October 1949.

U. S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, Purdue Agricultural Experiment Station.

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

(b) U. S. Soil Conservation Service, Research Branch; and Purdue University, Agricultural Experiment Station.
(c) R. B. Hickok, Research Supervisor, Soil Conservation Service, Agricultural Engineering Building, Purdue University, Lafayette, Ind.
(d) Experimental; for design.
(e) To study the effects of types of land-use and cultural practices as a means of reducing the rates and amounts of surface runoff, for purposes of soil and moisture conservation and upstream flood control. Continuous records of rainfall and runoff are collected for 20 small watersheds, and records are kept on watershed cover, soil character and conditions, farming operations, etc. The results are intended to be applicable for soil conditions, climate, and agriculture generally representative of a large part of the eastern section of the corn belt.
(f) Active.
(g) Individual storm-runoff summaries, seasonal runoff totals, and critical rate data are available for eight years for permanent pasture and wood lots and for corn, wheat, and meadow under the "prevailing" type of treatment; and 7 years for corn, and 5 years each for wheat and meadow under the conservation type of treatment.
(h) "Some runoff control and moisture conservation possibilities", R. B. Hickok, I. D. Mayer and H. Kohnke, Agricultural Engineering, U. 29, No. 6: 257-261, June 1948. (Available on loan.)

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, 619, 620, 621, incl., 931 and 932. Inquiries should be addressed to Fred W. Blaisdell, U. S. Soil Conservation Service, St. Anthony Falls Hydraulic Laboratory, Hennepin Island, Minneapolis 14, Minn.

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, U. S. Department of Agriculture and the Oklahoma Agricultural Experiment Station.
(c) Lewis A. Jones, Chief, Division of Drainage and Water Control, 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.

(f) Active.

(g) For the vegetal linings and range of velocities utilized in the tests, Manning's n was found to vary as some function of the product of velocity and hydraulic radius.

(h) "Flow of water in channels protected by vegetative linings", W. O. Ree and V. J. Palmer, U. S. Department of Agriculture Technical Bulletin 967, February 1949.

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

Inquiries concerning Projects Nos. 395, 396 and 397 should be addressed to M. H. Gallatin, Project Supervisor, Soil Conservation Service, Sub-Tropical Experiment Station, Homestead, Fla.

(395) STUDIES OF CHLORIDE INTRUSION INTO MARL LANDS OF SOUTH FLORIDA.

(b) Field investigations, in cooperation with Sub-Tropical Experiment Station, University of Florida, and Dade County Division of Water Control.

(d) Experimental; basic research.

(e) Periodic sampling in the Miami and Homestead areas on canals with and without chloride barriers to study the effectiveness of these structures in control of the intrusion of chlorides. Sampling in areas of heavy pumping to study what effect this has on the movement of chlorides inland. Observations are made on the tolerance of crops grown on the various soil types to the concentration of chlorides.

(f) Active.

(g) Present study must be continued over at least two more seasons before sufficient data are available to state definitely the effectiveness of barriers. In areas of heavy pumping out of deep rock ditches lowering of the fresh water head results in chloride intrusion.

(h) Monthly reports on existing conditions to Dade County Engineers. At completion of project, a bulletin will be written covering intrusion studies, effectiveness of chloride barriers, and plant tolerance.

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

(b) Experimental Research, in cooperation with the Sub-Tropical Experiment Station, University of Florida.

(d) Experimental, field investigation; design, operation.

(e) The experiment covers 30 acres of deep marl. Records are kept of all water removed, cost of removal, seepage into ditches, infiltration capacity, effect of sloughs and pot holes on removal of water, effectiveness of bedding and size of beds to facilitate faster removal of surface water and also on tillage methods, sub-soiling, and mole drainage as it affects removal of water. Records are kept of time of plowing and disking with relation to surrounding undrained land. Crop records and planting records are kept by the Sub-Tropical Experiment Station.

(f) Active.

(g) Work has not been in progress over a long enough period to complete any part of the project or make any definite conclusions.

(h) Yearly summary report submitted to Chief of Division of Drainage and Water Control, Soil Conservation Service, Washington, D. C.

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

(b) Experimental research, Soil Conservation Service in cooperation with the Sub-Tropical Experiment Station, University of Florida.
(d) Experimental; field investigation.
(e) To determine cycle, rates of application, and types of irrigation systems best suited to 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) the responsiveness of the water table to rainfall; and (5) the water table as affected by ground water conditions in the Everglades.
(f) Active.
(g) Data to date show definite correlation between water table and irrigation cycle. Rates of application governed by maturity of grove, amount of organic matter, types of material and depth of scarification.
(h) Summary report submitted to Chief of Division of Drainage and Water Control, Soil Conservation Service, Washington, D. C.

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

Inquiries concerning Projects Nos. 181 to 185, incl., 399, 660 to 664, incl., 970 to 977, incl., should be addressed to The Resident Member, 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) The purpose is to evaluate the effect of wave form, initial beach slope, and sand grain size in determining the equilibrium profile of beaches. Experiments are conducted in a concrete wave tank, 88 x 14 x 4 feet in size. Tests have been made with an original beach slope of 1:15, 1:30 and a combination of 1:10 and 1:20; wave periods of 1.3, 1.75, 2.2, 2.75 and 3.3 seconds; wave height of about 0.4 foot; 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.
(f) Active.
(h) Quarterly Summary, Waterways Experiment Station.

(182) STUDY OF WAVE REFLECTION.

(b) Laboratory project.
(d) Experimental; basic research.
(e) The purpose is to develop a method of determining the amount of energy absorbed from an incident wave by selected shore line structures and selected beach profiles, and to develop the fundamental equations defining this absorption of energy and to evaluate the unknown coefficients thereof. The tests were made in a wooden flume, 66 feet long, and 7 inches by 10 inches in cross section. Solitary wave crests were made to impinge upon various substances mounted in the end of the tank, and the energy of the reflected wave was determined.
(f) Completed.

(h) Quarterly Summary, Waterways Experiment Station.
"Reflection of solitary waves", Tech. Memorandum No. 11. (In press.)

(183) SETTLING VELOCITY OF BEACH SANDS.

(b) Laboratory project.
(d) Experimental; basic research.
(e) The purpose is to develop an apparatus capable of measuring the settling velocity characteristics of representative beach samples as a possible index to their action under various types of wave attack. The apparatus consists essentially of a water column in a pipe through which the sand settles and manometer tubes to measure the change in pressure as the sand passes opening in the side of the pipe. The change in level in the manometer tube is recorded by a combination float. rotating mirror, lamp and moving photographic film.
(f) Completed.
(h) Quarterly Summary, Waterways Experiment Station.
"A manometric settling velocity tube", M. A. Mason, Trans. A.G.U., Vol. 30, No. 4: 533-538. August 1949.

(184) STUDY OF MODEL SCALE EFFECTS.

(b) Laboratory project.
(d) Experimental; basic research.
(e) The purpose is to determine the laws of model similarity governing the action of waves on movable sand beaches. The tests are made in a wave tank 42 feet by 1.5 feet by 2 feet. 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".
(f) Active.
(h) Quarterly Summary, Waterways Experiment Station.
Preliminary paper in Beach Erosion Board Bulletin, Vol. 1, No. 2, July 1, 1947.

(185) STEEL SHEET PILING INVESTIGATION.

(b) Laboratory project.
(d) Field investigation; applied research.
(e) The purpose is 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) The report has been completed and is being edited for publication.
(h) Quarterly Summary, Waterways Experiment Station.

(399) DEVELOPMENT AND CONSTRUCTION OF 6-FOOT WAVE TANK

(b) Laboratory project.
(d) Experimental; design.
(e) The purpose is 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. Construction work on the tank has been initiated and is scheduled for completion in the spring of 1950.

(f) The model tests have been completed. Construction of large wave tank is about 30 percent complete.

(h) Quarterly Summary, Waterways Experiment Station.
Beach Erosion Board Bulletin, Vol. 3, No. 4, October 1, 1949.

(660) OBSERVED WAVE CHARACTERISTICS.

(b) Laboratory project; additional research by New York University.

(d) Field investigation; basic research.

(e) The purpose is 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) Active.

(h) Quarterly Summary, Waterways Experiment Station.

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

(b) Laboratory project.

(d) Field investigation; basic research.

(e) The project is 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, California. The rate of movement of this material from the placement areas is being studied by frequent hydrographic surveys. The intensity and direction of the waves are being recorded.

(f) Field work completed. Study of data active.

(h) Quarterly Summary, Waterways Experiment Station.

(662) DEVELOPMENT OF BEDLOAD SAMPLER FOR OCEAN BEACHES.

(b) Laboratory project.

(d) Experimental; development.

(e) The purpose is to develop an apparatus which can be used to measure the amount of sand moving along the bottom by currents and wave action. Several 1:5 scale models were constructed and tested in the wave tanks at the laboratory. The most promising, a tunnel type, 9 inches long, 2.8 inches wide, 0.4 inches high in front and 1.8 inches high in back, was made in full-scale model. Some field tests have been conducted with the tunnel type samplers. Further work with these samplers has been suspended until a reliable method of analyzing the data therefrom can be determined.

(f) Suspended.

(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) The purpose is 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, New Jersey. The movement of sand is being studied by frequent hydrographic surveys. The 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) Active.
(h) Beach Erosion Board Bulletin, Vol. 3, No. 2, April 1, 1949.
Quarterly Summary, Waterways Experiment Station.

(664) DEVELOPMENT OF SUSPENDED SAND SAMPLER.

(b) Laboratory project.
(d) Experimental; development.
(e) The purpose is 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, California.
(f) Completed.
(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) The purpose is to observe the effects of construction of the two jetties at Mission Bay, California, 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.
(f) Active.
(h) Quarterly Summary, Waterways Experiment Station.
See also Project No. 529, "Littoral Sediment Flow on a Beach", University of California, page 16.

(971) COMPARATIVE STUDY OF PERMEABLE AND IMPERMEABLE GROINS.

(b) Laboratory project by and at University of California.
(d) Experimental; basic research.
(e) The purpose is to determine the 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.
(f) Active.
(h) Quarterly Summary, Waterways Experiment Station.

(972) STRUCTURAL DESIGN OF SHORE STRUCTURES.

(b) Laboratory project.
(d) Experimental; basic research.
(e) The purpose is to prepare a handbook on the design of shore structures. A review of literature on the design of shore structure is being made. Field and model tests on the wave pressures 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. Tests of wave pressures on structures, both full scale and model will be made utilizing modern measuring and recording equipment.
(f) Active.
(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 at the Beach Erosion Board laboratory. 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. A full-scale model of a compressed-air wave generator for use in the coast model test basin is being constructed and will be tested in the concrete wave tank presently in operation in the laboratory.
(f) Active.
(h) Beach Erosion Board Bulletin, Vol. 3, No. 4, October 1, 1949.
Quarterly Summary, Waterways Experiment Station.

(974) SURVEY METHODS - SHALLOW WATER SOUNDINGS.

(b) Laboratory project.
(d) Experimental; applied research.
(e) The purpose of this investigation is to develop improvements in shallow water hydrographic survey methods from a review of present methods and the introduction of new techniques. A large accumulation of data by a questionnaire has been collected on present methods and costs of shallow water surveying. Analysis of data is in progress. New instruments to aid in survey boat positioning are being reviewed for possible application to the needs of the Corps of Engineers.
(f) Active.
(h) Beach Erosion Board Bulletin, Vol. 2, No. 2, April 1, 1948.
Quarterly Summary, Waterways Experiment Station.

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

(b) Laboratory project.
(d) Field investigation; applied research.
(e) The purpose is 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.
(f) Active.
(h) Quarterly Summary, Waterways Experiment Station.

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

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

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

(b) Laboratory project.
(d) Experimental; development.
(e) The purpose is 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 disc 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.
(f) Active.
(h) "An ocean wave measuring instrument", Tech. Memorandum No. 6, Beach Erosion Board. Quarterly Summary, Waterways Experiment Station.

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

Inquiries concerning Projects Nos. 189 to 192, incl., 401 to 410, incl., 665, 666, 667, 978 and 979, should be addressed to R. B. Cochrane, Head, Hydraulic Design Section, Portland District, Corps of Engineers, 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 type, 1:100-scale, undistorted model, constructed of concrete, reproduces a 3.7 mile reach of the Columbia River, at the site of McNary Dam. After verification of the natural river conditions were completed, 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 in the interest of navigation and power generation, 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 structures, especially that of the powerhouse, would be necessary. Tests on 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 the first and second stages of construction.

(h) Preliminary reports have been issued on the various phases of 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, including ogee crest, piers, 50-foot by 50-foot gates, and stilling basin. 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. Certain problems pertaining to fishladders were also studied.
(f) Tests are nearing completion.
(g) Several shapes of piers, arrangements of stilling basins and types of radial and vertical life gates were tested. Based on these tests a pier with an elliptical-shaped nose, split vertical lift gates and stilling basin with two rows of baffle piers have been adopted.
(h) Sixteen preliminary reports have been issued.

(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 model reproduces on a scale of 1:25 a section of the forebay, the lock chamber complete with ports, culverts, and control valves of the filling and emptying systems, 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 86 feet wide by 675 feet long.
(f) Active.
(g) Tests show that a bottom lateral culvert system is more satisfactory than a longitudinal culvert system. Negative pressures in the culverts downstream from the filling valves, in the reversed position, can be reduced by opening the valves at a non-uniform rate.
(h) Five preliminary reports have been issued.

(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 model was constructed to a scale of 1:50 with a portion of the forebay and 120-foot earth-filled dam, gravity-type 200-foot-wide spillway, stilling basin, the five 5-foot by 6-foot sluiceways, and a portion of the tailbay being reproduced. Hydraulic characteristics of the spillway and stilling basin as designed were studied.
(f) Tests have been completed.
(g) Results indicated that with the stilling basin sloped 1 on 21.3, with a broadcrested-type 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) Preliminary reports completed. 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 model, constructed to a scale of 1:16, reproduced a section of the fishladder proposed for McNary Dam, including a 180 degree bend and 13 bays upstream and 7 bays downstream therefrom. Flow conditions in the fishladder were studied for various widths, slopes, head on the weirs, and the effect of submerged orifices and shapes and sizes thereof on the flow conditions within individual pools between the weirs.
(f) Tests have been completed.
(g) Tests show that 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 the most satisfactory.
(h) 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 model was constructed to a scale of 1:10, and reproduced a 3-bay section of the 30-foot wide fishladder. The 20-foot by 30-foot center bay contained a diffuser consisting of a chamber 8 feet in depth beneath the normal flow of the ladder. Flow was introduced into this diffuser from an auxiliary water supply system. The diffused flow was extruded into the bottom of the fishladder through baffles to merge with 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 have been completed.
(g) Tests on a revised design showed that a stepped floor in the fishladder underneath the diffuser was the most satisfactory in distributing auxiliary water inflow 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 model is of the fixed-bed type constructed to a scale of 1:72. A section of the prototype forebay extending some 2,000 feet upstream from the dam, and the lower riverbed to a point 2,400 feet downstream from the dam, and 2200-foot section of the 250-foot high earth fill dam are included in the model, as well as a gravity spillway 149 feet wide having 5 tainter gate controlled bays and a stilling basin 149 feet wide and 175 feet long. These tests are being made to study the hydraulic performance of both a side channel spillway and a gravity type spillway to determine the most satisfactory type.
(f) Active.
(g) Tests completed on models of the original and revised designs of the side channel spillway indicate satisfactory operation of the revised design. Tests on the gravity spillway model indicate that satisfactory hydraulic jumps will exist in a baffled basin with a discharge of 245,000 cfs, and in an unbaffled basin with a discharge of 175,000 cfs.

(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 model, on a scale of 1:25, includes a portion of the forebay, 750 feet by 1,000 feet; the intake tower containing the tunnel entrances; the 20-foot flood-control tunnel and 27-foot power tunnel; 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 have been 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.
(h) Four preliminary reports have been issued and the final report is being compiled. Conduits through the gravity type spillway have been adopted in place of the design which was tested.

(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 model, of the fixed bed type on an undistorted scale of 1:100, reproduces the river from mile 8.3 to mile 11.0. The 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 86 feet wide by 500 feet long 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 model will consist of a 3-bay section of the spillway dam constructed to a scale of 1:32. 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 86 feet wide by 500 feet long will be investigated first in a model on a scale of 1:25 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 model, of the fixed bed type, on a scale of 1:80, includes the Columbia River from mile 545.8 to mile 544.1. The 21-bay spillway and 20-unit powerhouse will be reproduced. Normal operating head will be 162 feet. This study is being made 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.
(f) Construction of the model has been completed and testing of the powerhouse approach channel has begun.

(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 model is sectional and consists of three 40-foot wide bays of the gate-controlled spillway dam on a scale of 1:33. The purpose is to determine the most effective and economical stilling basin design, to check the performance of the modified end bays of the spillway, and to verify the performance of the sluices.
(f) Construction of the model has been completed and testing of the stilling basin has been begun.

(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 model, on a scale of 1:25, reproduces a section of the powerhouse forebay, one 23-foot penstock complete from entrance through turbine scroll case, and the entrances of the adjacent penstocks on either side. Normal head for the dam is 162 feet. Provisions will be made to permit extension, at a later date, of the penstock length and installation of a turbine wheel and an electric dynamometer to measure relative turbine efficiency. The purpose is to develop the most efficient and satisfactory penstock entrance and transition sections, and to investigate the effect of angularity of entrance, varying curvatures of transitions, piers, and guide vanes.
(f) Construction of the model was suspended pending decision as to necessity of such a model as shown by results of general model study.

(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 model, on a scale of 1:10, includes a single spillway bay complete with 50-foot by 50-foot split-vertical gate. Pressures underneath the gate, in the gate slots, and in the spillway crest will be measured with pressure cells for several gate positions and discharges. Upon completion of the McNary gate studies, the model will be modified to simulate the Bonneville Dam vertical-lift gate and tests will be made to check pressures and general hydraulic characteristics under various flow conditions.
(f) Active.

887657 O—50——10

(g) Tests indicate that with adjacent bays operating and with flow through small openings between gate sections, and the gate in the upstream slots, venting is insufficient to prevent the occurrence of vibrations. With the gate in the normal downstream slot position, satisfactory performance obtains for all flow conditions and gate arrangements.
(h) One preliminary report has been issued.

(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 sectional model with a scale ratio of 1:20 was constructed to make a detailed study of the reverse tainter valve. A study is currently under way on a valve in which all structural features have been simulated. Comparisons will be made of various shapes of the lip on the bottom edge of the valve.
(f) Active.
(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 operations.
(h) Two preliminary reports have been issued.

(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 model, on a 1:16 scale, reproduces the auxiliary water supply system in the lower end of the fishladder and complete diffusion chambers to add sufficient water in the submerged portion of the ladder to maintain selected velocities. Pressures were observed in critical sections of the water supply systems to the diffusion changers to determine the hydraulic grade lines and to locate low pressure areas which might be detrimental to the prototype structure.
(f) Active.
(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, Oregon.
(d) Experimental; for design.
(e) The model, on a scale of 1:19.2, consists of an outlet conduit, including a bellmouth entrance and 6.75 foot by 12.0 foot intake conduit, a tainter valve, and an expanding outlet conduit section downstream from the valve. The purpose is to determine whether open-channel flow will exist in the conduit outlet with all operating conditions, as well as obtaining capacity curves and pressures.
(f) Construction has been completed and tests are in progress.

(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 model, to be constructed to a scale of 1:28.75, will include the tunnel entrance, a 1,200-foot straight section of 23-foot diameter tunnel, a seven branch manifold with hooded Howell-Bunger valves, and a stilling basin. The purpose is to determine the hydraulic characteristics of the tunnel including the action of hooded Howell-Bunger valves when partially submerged by tailwater.
(f) Model design is in progress.

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 Enginders, Fort Peck, Mont.
(d) Experimental; for design.
(e) The model reproduces, to a scale of 1 to 73.5, the three high velocity discharge tunnel outlets, the powerhouse 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 concentrations of flow over the end of the apron cause excessive erosion along the right bank and the adjacent channel bed. The project is to develop a satisfactory method and the best structures for reducing this erosion.
(f) Report in preparation.
(g) Tests indicate that satisfactory conditions will be obtained through increasing the spread of flow by training walls extending downstream from the tunnel outlets, and baffle piers on the apron in a single row upstream from and approximately parallel to the edge of the apron.
(h) "Laboratory tests on hydraulic model of tunnel outlet protection works at the Fort Peck Dam". May 1949.
"Supplemental laboratory tests on hydraulic model of tunnel outlet protection works at the Fort Peck Dam". October 1949.

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 of the Chief of Engineers.
(c) District Engineer, Little Rock District, Corps of Engineers, Little Rock, Ark.
(d) Experimental; design and operation.
(e) A 4-foot wide by 6-foot high tainter gate was constructed and installed at Norfolk Dam at the downstream end of an existing conduit. It was operated under a head of about 180 feet. 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) Construction of the project has been completed and tests made on gate leaf. Tests have been completed on hydraulic seals and will be made on other types of seals.
(g) The results indicate that the tainter gate operated in a satisfactory manner. The hydraulic seals which have been tested are not considered adequate.

(670) PROTOTYPE TESTS OF SLIDE GATES.

(b) Department of the Army, Office of the Chief of Engineers.
(c) Director, Waterways Experiment Station, P. O. Box 631, Vicksburg, Miss.
(d) Experimental; design and operation.
(e) The downstream gate of one outlet, 4 feet by 6 feet, was used for tests on high-pressure slide gates. The main purpose was to determine the hydraulic downpull forces on two gates of different design; one wherein the gate lip was flat, and the other with a 45 degree sloping front face with a 2-inch sealing surface on the bottom. Other phases of the program included determination of the air requirement downstream from the two gates when operated at various openings to regulate the discharge; study of the performance and operation of the gates under high heads (approximately 165-foot); the study of pressure conditions on various parts of the gates; a study of the flow and pressure conditions in the conduit immediately downstream; and the study of vibration and movement in the gates.
(f) Field tests completed and preliminary report issued.
(g) Tests indicated that the gate with 45 degree upstream slope was superior in all respects to the one with a bottom parallel to the conduit floor.
(h) Copies of the preliminary report may be obtained from the Director, Waterways Experiment Station, Vicksburg, Mississippi.

DEPARTMENT OF THE ARMY, CORPS OF ENGINEERS, Los Angeles District.

Inquiries concerning Projects Nos. 188, 671, 980 and 981 should be addressed to the District Engineer, Los Angeles District, Corps of Engineers, P. O. Box 5180 Metropolitan Station, Los Angeles 55, Calif.

(188) HYDRAULIC MODEL STUDY, LOS ANGELES RIVER CHANNEL IMPROVEMENT, WHITSETT AVENUE TO TUJUNGA WASH.

(b) Laboratory project.
(d) Experimental; for design.
(e) Tests were conducted on a 1:30-scale model to determine the effect on water surface of a series of curves and reverse curves with transition spirals and superelevated bottoms for rectangular channels with various discharges; and to determine the flow conditions at the confluence with Tujunga Wash for various combinations of discharges.
(f) Completed.
(g) Velocity of flow was supercritical. It was found that longitudinal slope of channel should be at least 25 percent greater than critical slope to eliminate undulating surface waves.
(h) "Hydraulic model study, Los Angeles River improvement, Whitsett Avenue to Tujunga Wash". (Available for loan.)

(671) HYDRAULIC MODEL STUDY OF THE CONFLUENCE OF SAWTELLE-WESTWOOD CHANNEL AND BALLONA CREEK.

(b) Laboratory project.
(d) Experimental; for design.
(e) Tests were conducted on a 1:30-scale model of the confluence of the Sawtelle-Westwood Channel and Ballona Creek to study flow conditions for various combinations of discharges in the two channels.
(f) Completed. Preparation of report is in progress.
(g) A satisfactory confluence design was obtained.

(980) HYDRAULIC MODEL STUDY, WHITTIER NARROWS FLOOD-CONTROL BASIN.

(b) Laboratory project.
(d) Experimental; for design.
(e) Three models are being used. A 1:24-scale model of the Rio Hondo outlet works will provide data on the operation of the four 30 foot by 20 foot radial sluice gates and the downstream transition. A 1:42-scale model of a half plan of the spillway will provide data on the operation of nine 50 foot by 29 foot tainter gates. A 1:60-scale general model of the flood-control basin will provide data on the over-all operation of the project.
(f) Active. Tests are in progress.

(981) HYDRAULIC MODEL STUDY OF THE CONFLUENCE OF TUJUNGA WASH AND PACOIMA WASH CHANNELS.

(b) Laboratory project.
(d) Experimental; for design.
(e) Tests are being conducted on a 1:30-scale model of the confluence of Tujunga Wash and Pacoima Wash Channels to determine the best means of joining these two streams, the velocity of each being about 35 feet per second.
(f) Active, Tests are in progress.

DEPARTMENT OF THE ARMY, CORPS OF ENGINEERS, St. Paul District.

In cooperation with St. Anthony Falls Hydraulic Laboratory.

Projects Nos. 193 to 196, incl., were conducted at Iowa Institute of Hydraulic Research until June 1948. Subsequent activities continued at St. Anthony Falls Hydraulic Laboratory and St. Paul District Office.

Inquiries concerning Projects Nos. 193 to 196, incl., 411, 412, and 982 to 985, incl., 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.

(193) AIRFIELD DRAINAGE STRUCTURES INVESTIGATION.

(b) Chief of Engineers, Corps of Engineers, Department of the Army, Washington, D. C.
(d) Experimental; for design.
(e) Models were tested to determine the capacities of paved airfield gutters for various roughnesses, surface textures, and gradients; and to determine discharge characteristics of typical commercial inlet gratings and curb inlets for various approach slopes. The general model consisted of a portion of pavement, slab, and gutter to full scale with 5 successive gutter gradients. Various commercial grate inlets 1/4,

1/3, and 1/2 size were tested in the general model at the 5 gutter gradients, and curb gutter inlets were tested at 3 gradients.

(f) Completed.

(g) The "n" value in Manning's formula was about 0.013 for uniform flow in the model of the shallow runway gutter with a simulated belted concrete finish. With runoff from an adjacent runway, the flow was about 10 percent deeper. Flush type inlets in a continuous gutter operated best with gratings of bars running parallel to the gutter and with the gratings extending across the gutter. The flow intercepted depended on the gross width and length of opening. The discharge capacity of grated inlets in a ponded area was defined reasonably well by the theoretical weir formula for heads less than about 0.4 foot and by the orifice formula with a coefficient of about 0.67 for a submergence greater than about 1.4 feet. In the intermediate range, vortices altered the flow characteristics. The curb gutter inlets tested were relatively inefficient.

(h) "Airfield drainage structure investigation", Hydraulic Laboratory Report No. 54. April 1949. (Available for sale.)

(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) Improved designs of point-integrating and depth-integrating sediment samplers and new laboratory apparatus have been developed to improve the methods and equipment used in the measurement and analysis of sediment loads in streams. Based on extensive field tests, the mechanical features and streamlining of both the point-integrating and depth-integrating samplers have been improved to provide better operating characteristics and greater stability over a wider range of stream sampling conditions. The development of an economical and rapid, yet accurate, laboratory method of determining particle size gradations of fluvial sediment has been initiated.

(f) Active.

(g) Samplers already developed were produced in quantities to meet the needs of the Federal cooperating agencies. A depth-integrating suspended sediment sampler, US DX-49, was designed for improved stability in fast streams and experimental models were tested.

(h) Operation and maintenance of US P-46 suspended sediment sampler", February 1949. (Available for loan.)

(195) OHIO RIVER, FILLING AND EMPTYING SYSTEMS FOR NEW CUMBERLAND LOCKS.

(b) Pittsburgh District, Corps of Engineers, Department of the Army.

(d) Experimental; for design.

(e) Tests were made in models at a scale of 1:25 to check the design of the filling and emptying systems and to develop improvements. The 1200-foot long main lock will be filled and emptied through a series of side-wall lock chamber ports, and the 600-foot auxiliary lock through a lateral system in the chamber floor.

(f) Tests have been completed and a final report is being prepared.

(196) MISSISSIPPI RIVER, FILLING AND EMPTYING SYSTEM FOR NEW 1200-FOOT LOCK AT LOCK AND DAM NO. 19, KEOKUK, IOWA.

(b) Rock Island District, Corps of Engineers, Department of the Army.

(d) Experimental; for design.

(e) Tests were conducted to check the design of the hydraulic system. Model 1, 1:25 scale, simulated the 110-foot by 1200-foot lock with intermediate gates which provided for 800-foot and 400-foot chambers. The normal lift was 38.2 feet. The upstream service gate, a submergible tainter gate, was used to supplement the bottom filling system for the 1200-foot and 800-foot chambers. For the 400-foot chamber the bottom-filling system had intakes in the chamber upstream. The final design, Model 2, had no intermediate gates. A through culvert system with lock chamber laterals was used for both filling and emptying.
(f) Tests have been completed and a final report is being prepared.

(411) ST. ANTHONY FALLS LOWER DAM SPILLWAY AND LOCK TAINTER GATES.

(b) St. Paul District, Corps of Engineers, Department of the Army.
(d) Experimental; for design.
(e) The model of the lower dam spillway at a scale of 1:26.4 was tested to check the design of the tainter gate stilling basin and the profiles of sill and gate for pressure distribution. The study of the lock tainter gates includes the determination of pressures over gate and sill, and water surface profiles through the lock when operated as a spillway to pass floods.
(f) Active.
(g) Tests on the tainter gate for the lower lock, 25-foot lift, have been completed.

(412) ST. ANTHONY FALLS LOCKS.

(b) St. Paul District, Corps of Engineers, Department of the Army.
(d) Experimental; for design.
(e) The model study includes two locks, an upper lock with a lift of 50 feet and a lower lock with a lift of 25 feet, both locks being 56 feet wide and 400 feet long, at a scale ratio of 1:22.4. The proposed lower lock is to be filled and emptied through a single culvert lock chamber lateral system. The upper lock will utilize a culvert in each wall and a system of lock chamber laterals for both filling and emptying.
(f) Active.
(g) Tests on the hydraulic system for the lower lock have been completed.

(982) MODEL STUDY OF OUTLET STRUCTURE FOR ORWELL DAM, OTTERTAIL RIVER, MINN.

(b) St. Paul District, Corps of Engineers, Department of the Army.
(d) Experimental; for design.
(e) Tests were conducted to check the adequacy of the proposed outlet structure. The model, built to a scale of 3:100, included the full length of conduit and stilling basin. Revisions were made in the design of conduit transition and stilling basin to improve flow conditions.
(f) Tests have been completed and a final report is being prepared.

(983) MISSISSIPPI RIVER CHANNEL IMPROVEMENT AT SMITH AVENUE BRIDGE, ST. PAUL, MINNESOTA.

(b) St. Paul District, Corps of Engineers, Department of the Army.
(d) Experimental; for design.
(e) Tests are being conducted to study the sedimentation problem in the present channel and to develop corrective measures. The model was constructed to a scale of 1:100 horizontally and 1:25 vertically. It simulates a river channel 1 mile long with the Smith Avenue bridge located at the downstream 1/3 point.

(f) Active.

(984) CORALVILLE RESERVOIR SPILLWAY AND OUTLET STRUCTURE.

(b) Rock Island District, Corps of Engineers, Department of the Army.
(d) Experimental; for design.
(e) The proposed reservoir has a 23-foot diameter outlet conduit with three control gates for discharges up to 20,100 cfs and a 495-foot spillway for discharges up to 240,000 cfs. Model tests, on a scale of 1:36, are being conducted to check the performance of the conduit and to determine spillway discharge coefficients and flow characteristics. The spillway model at a scale of 1:100 simulates 5,400 feet of river and the entire dam with outlet structure on left and spillway on right.
(f) Active.

(985) FILLING AND EMPTYING SYSTEMS FOR HIGH-LIFT LOCKS (C. W. 820).

(b) Chief of Engineers, Corps of Engineers, Department of the Army, Washington, D. C.
(d) Experimental; applied research.
(e) This study is 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 simulating at a scale of 3:100, a 110 by 1,200-foot lock with a maximum lift of 150 feet.
(f) Active.
(g) Tests have been completed in models of the New Cumberland Locks, Ohio River, and the proposed 1,200-foot Keokuk Lock, Mississippi River, for lifts up to 80 feet and in a model of the lower lock, St. Anthony Falls, Mississippi River, for a lift of 50 feet. The general lock model is being built.

DEPARTMENT OF THE ARMY, CORPS OF ENGINEERS, Waterways Experiment Station.

Inquiries concerning Projects Nos. 201, 205, 211, 213, 218, 219, 221, 224, 226, 227, 230, 233, 234, 236, 237, 239, 243, 249, 251, 252, 255, 257, 416, 417, 419, 420, 423, 425, 426, 428, 429, 430, 672 to 683, incl., and 986 to 1004, incl., should be addressed to The Director, Waterways Experiment Station, Corps of Engineers, P. O. Box 631, Vicksburg, Miss.

(201) MODEL STUDIES OF SPILLWAY, STILLING BASIN, AND SLUICE, CONEMAUGH DAM, CONEMAUGH RIVER, PENNSYLVANIA.

(b) The District Engineer, Pittsburgh District, Corps of Engineers, Pittsburgh, Pa.
(d) Experimental; for design.
(e) Tests were conducted on three models to determine a suitable design for stilling facilities below the spillway, shape of crest, and allied features, and to develop an adequate design for the conduits. The models were: (1) a 1:60 comprehensive model, reproducing the entire problem area; (2) a 1:24 section model for determining the best design of each type stilling basin produced by tests conducted on the comprehensive model; and (3) a 1:15 model of one of the sluices for selecting the most favorable invert elevation, intake and trash-rack design, and outlet design.
(f) Completed.

(g) The original stilling basin, with horizontal apron 157.5 feet long and an end sill, was satisfactory for all discharges. With the apron shortened 32.5 feet, action was satisfactory at all discharges and excellent at discharges less than 200,000 cfs. Closure of the bulkhead slot through the sluice intake improved pressure conditions along the top entrance curve; otherwise performance of the sluice intake and trash rack of basic design was entirely satisfactory. A sluice with horizontal alignment was necessary to obtain adequate jet dispersion without excessive reduction in discharge and warped surfaces for the flared side walls of the deflector-type outlet portal were required to obtain satisfactory pressure conditions.

(h) "Spillway and sluices for Conemaugh Dam, Conemaugh River, Pennsylvania; model investigation." Waterways Experiment Station Technical Memo. No. 2-272. April 1949. (Available for sale or loan.)

(205) MODEL STUDY OF CONDUITS, DETROIT DAM, NORTH SANTIAM RIVER, OREGON.

(b) The District Engineer, Portland District, Corps of Engineers, Portland, Ore.

(d) Experimental; for design.

(e) To analyze the hydraulic characteristics of the flood-control conduits and to develop corrections for undesirable conditions, tests were conducted on 1:16 models of a rectangular conduit with vertical slide gates and of a circular conduit with a hollow jet valve.

(f) Completed.

(g) Alterations to conduit alignment were desirable to improve performance. The intake curve of the rectangular conduit was lengthened to eliminate a dip in the pressure gradient and the exit portal section was realigned to direct the jet downward along the spillway face. In the circular conduit the section below the valve was changed from a pressure conduit to a nonpressure conduit for all flows and aligned to the path of the jet so that flow below the exit portal followed the slope of the spillway face.

(h) "Flood-control conduits for Detroit Dam, North Santiam River, Oregon; model investigation." Waterways Experiment Station Technical Memo. No. 2-302. October 1949. (Available for sale or loan.)

(211) MODEL STUDIES OF OUTLET WORKS, SPILLWAY AND STILLING BASIN, GARRISON DAM AND RESERVOIR, MISSOURI RIVER, NORTH DAKOTA.

This report includes the study previously reported as (210).

(b) The District Engineer, Garrison District, Corps of Engineers, Bismarck, N. D.

(d) Experimental; for design.

(e) A 1:100 model of the spillway, reproducing the approach channel, crest structure, chute, stilling basin, and 2200 feet of the pilot channel, and a 1:41.6 model of one complete bay and two adjacent half bays of the spillway crest are being used to determine the hydraulic performance of the proposed approach channel, crest, chute, stilling basin and pilot channel and to correct unsafe conditions. To determine the performance of the proposed conduits and stilling basins under diversion and reservoir operation conditions and to devise corrections for any unsafe conditions, the following two models are being employed. A 1:50 model simulates the downstream 300 feet of the eight tunnels, the flood-control stilling basin, the temporary stilling basin for diversion flows formed by the powerhouse foundations, and 1000 feet of the outlet channel. A 1:25 model reproduces one of the 22-foot-diameter flood-control conduits, including the intake with its tainter-type service gate, the upstream and downstream transitions and the upstream portion of the stilling basin; the 26-foot tunnel is also tested in this model by substituting an alternate transi-

tion, conduit, and upstream section of the stilling basin. Of special interest is the use of a tainter gate for control of conduit flow. Incidental models were tested in the vacuum tank to determine the cavitation characteristics of the emergency slide gate slots and the articulated tunnel joints.

(f) Active.

(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) Discharge coefficients, head-discharge relationships, effect of stilling-basin design on the hydraulic jump, and effect of crest shape on hydraulic efficiency were determined in a 1:20 model. A 1:30 model reproducing two full and two half bays was used to test various weir shapes.
(f) Tests have been completed; preparation of final report is in progress.
(g) A simplified weir control increased flow capacity for submerged conditions.

(218) CONDUIT INTAKE MODEL TESTS.

(b) Office, Chief of Engineers, U. S. 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 with entrance flared in four directions, and (b) a gated tunnel with rectangular entrance and floor at same elevation as approach channel (entrance flared in three directions). Tests are being conducted on a 1:20 model of a conduit 5.67 feet wide by 10.0 feet high. Heads in tests range up to 300 feet prototype.
(f) Active.
(g) Initial tests with conduit flared in four directions indicate 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 dimension of the conduit.

(219) SLIDE GATE MODEL TESTS.

(b) The Chief of Engineers, U. S. Army, Washington, D. C.
(d) Experimental; applied research.
(e) A general study is being made 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 is being used, reproducing the gate slots, the slide gate, a portion of the conduit upstream and downstream from the gate section, and the air vent. Also a 1:10-scale gate with a 45 degree 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.
(f) Active.
(g) Tests conducted with a gate slot 2.5 feet deep and 4, 3, and 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 RESULTS OF MODEL TESTS AND PROTOTYPE OBSERVATIONS.

(b) The Chief of Engineers, U. S. Army, Washington, D. C.

(d) Experimental and field investigations; for design.
(e) Procurement and analysis of prototype observations and results of model tests, with the ultimate objective of furnishing accurate design data, and thus affecting economies and efficiency in future design work. The investigation includes hydraulic structures, open channels, harbors, and tidal estuaries.
(f) Active.
(g) Equipment for obtaining data from prototype structures was procured or fabricated. Observations will be made as opportunity permits.

(224) HYDROLOGICAL RESEARCH PROJECT, WATERWAYS EXPERIMENT STATION LAKE WATERSHED, MISSISSIPPI.

(b) The Chief of Engineers, U. S. Army, Washington, D. C.
(d) Field investigation; applied research.
(e) To augment pertinent data and to advance the knowledge of the hydrological characteristics of any drainage basin, a comprehensive study of the hydrology of the Waterways Experiment Station Lake Watershed was conducted. Two investigations were included: (1) a study of the rainfall-runoff relation, using the unit-hydrograph methods; and (2) a study of evaporation,
(f) The study has been completed; preparation of final report has been indefinitely suspended.

(226) POTAMOLOGY INVESTIGATIONS.

(b) The President, Mississippi River Commission, Corps of Engineers, Vicksburg, Miss.
(d) Experimental and field investigation; applied research.
(e) The investigation includes: (1) development of a suitable material and model operating technique to obtain an erodible-bank, movable-bed model responding to the laws of channel meandering in the same degree as its counterpart in nature, for predicting future changes in the courses of specific reaches of alluvial rivers; (2) flume tests of revetted banks of erodible materials to study the manner in which articulated concrete and other types of revetment fail, for developing designs for more permanent revetments; and (3) detailed investigations and studies of certain revetments in the Mississippi River itself to determine why and how such revetments are subject to failure. A study of erodibility characteristics of various natural and synthetic erodible materials is being conducted in two small flumes. A large flume which permits the modeling of a specific reach of the Mississippi River to scales of 1:100 vertically and 1:400 horizontally is being used in adapting these erodible materials in modeled bends of unstable reaches of the river. For the study of revetment failures on erodible banks, a section of a typical bend of the Mississippi River is reproduced to an undistorted scale of 1:50. The mass and strength of the revetment and all forces affecting its stability are reproduced as nearly to scale as possible. A comprehensive model investigation of revetment to an undistorted scale of 1:50 is being conducted in a large bank-stabilization flume approximately 125 feet wide, 600 feet long and 3.5 feet deep, in which is reproduced a typical bend of the Mississippi River.
(f) Active.

(227) MODEL STUDY OF FLOOD CONTROL PROJECT, BRADY CREEK, BRADY, TEXAS.

(b) The District Engineer, Galveston District, Corps of Engineers, Galveston, Tex.
(d) Experimental; for design.

(e) Tests were conducted to verify and supplement hydraulic design computations for the proposed improvement channel and to determine means of eliminating any undesirable flow conditions. The model was of the fixed-bed type with scales of 1:150 horizontal, and 1:100 vertical.
(f) Completed.
(g) Results indicate: (1) the project levee grade should be raised 1.0 to 1.5 feet between levee stations 35-00 and 69-00; (2) the low steel of Highway 87 bridge should be raised 0.8 foot to give a clearance of 1.0 foot; (3) bridge structures and bank riprap should be examined in the light of the magnitude of observed velocities; and (4) consideration should be given to modification of the south-bank approach to the Gulf, Colorado and Santa Fe Railroad bridge as developed in model tests.
(h) "Flood protection plans for Brady, Texas; model investigation." Waterways Experiment Station Technical Memo. No. 2-270. March 1949. (Available for sale or loan.)

(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) The fixed-bed model, on an undistorted scale of 1:60, reproduces about 1.5 miles of Wills Creek, from its confluence with the North Branch of the Potomac River to above the city limits of Cumberland and 4 miles of the North Branch of the Potomac River. Purpose is to study and develop proposed plans for the protection of Cumberland from floods.
(f) Active.

(233) MODEL STUDY OF CHANNEL IMPROVEMENTS, JOHNSTOWN, PENNSYLVANIA.

(b) The District Engineer, Pittsburgh District, Corps of Engineers, Pittsburgh, Pa.
(d) Experimental; for design.
(e) Tests were used to determine the most economical and effective design for the improvements of the channels of the Conemaugh River, Stony Creek, and the Little Conemaugh River, near Johnstown, so floods equal to that of March 17-18, 1936, would be carried within banks. The model was of the fixed-bed type with scales of 1:200 horizontal and 1:80 vertical.
(f) Completed.
(g) Tests showed that, under conditions of the 1936 flood, improved channels lowered the cumulative backwater effects of bridges by about 2 feet at The Point. For bankfull stages or lower, bridges have a negligible effect. Tests on Conemaugh River revealed the optimum plan for improvement to be a combination of "alternate alignment" and scheme-1 raised invert. Raising of invert elevation of the project design 2 feet for a reach of about 2 miles eliminated 200,000 cubic yards of rock excavation, saving about $300,000. The most desirable plan for improvement of Stony Creek embodies disposal-area levee near the B. & O. RR bridge; retaining walls at Ferndale bridge and Solomon Run; corrective dredging from sta 163-00 to sta 214-00; new piers for the B. & O. RR bridge; drop structure at sta 120-00; and removal of City Garage or installation of a parapet wall near Franklin Street bridge. For Little Conemaugh River substitution of a through-span structure for the existing Maple Avenue bridge; weir at sta 75-00; enlarged section near Walnut Street bridge; barrier dam at sta 7-00; and a transition at The Point, were effective in increasing flood capacity.
(h) "Flood-control project for Johnstown, Pennsylvania; model investigation." Waterways Experiment Station Technical Memorandum No. 2-303. November 1949. (Available for sale or loan.)

(234) MODEL STUDY OF MEMPHIS HARBOR, 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) Tests have been completed; preparation of final report is in progress.

(236) MISSISSIPPI BASIN MODEL.

(b) Office, Chief of Engineers, U. S. 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 Glasgow, the Arkansas River from Blackburn Dam, 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 and Upper Mississippi Rivers are in operation.
(f) Active.

(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. Effects of Alternate Plan 1 on stages of the project and 1945 floods at and near Morgan City, La., were studied as part of the comprehensive investigation to evaluate the relative merits of various plans for flood control below Morgan City. Tests were made to determine the effects of the Morganza Floodway control structure and the proposed railroad and highway high-level crossing on flood stages and flow distribution; and the effectiveness of the control structure in directing flow from the Mississippi River into the Morganza Floodway. Operational plans for the Old River closure structure are being studied to determine the most efficient and effective plan for 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 closure structure.
(f) Tests of Alternate Plan 1 are completed; tests of the combined control structure and high-level crossing for the Morganza Floodway are complete; tests of Old River closure structure are in progress.
(g) Results of tests of Alternate Plan 1 will be included in a comprehensive report on all plans for flood control below Morgan City. Tests of the Morganza Floodway control structure under project-flood conditions revealed that for each successive 500-ft increase in opening width between 3500 and 5000 feet, the peak Morganza Floodway discharge would be increased 17,000, 16,000, and 17,000 cfs; these increases would have little effect on the peak discharge of the Mississippi River. Clearing the floodway area above the Texas and Pacific Railroad branch line increased the effect-

iveness of the control structure and resulted in reduced crest stages at Angola and in the Red-Ouachita backwater area. Tests of the 1927 and 1945 floods revealed that a total opening of 3000 feet in the Morganza Floodway control structure would be sufficient to reduce the peak Mississippi River discharge below the desired maximum of 1,500,000 cfs.

(h) "Combined control structure and high-level crossing -- Morganza Floodway; model investigation." Waterways Experiment Station Technical Memo. No. 2-275. May 1949. (Available on loan.)

(239) MODEL STUDY OF HIGH-LEVEL CROSSINGS, MORGANZA FLOODWAY.

(b) The District Engineer, New Orleans District, Corps of Engineers, New Orleans, La.
(d) Experimental; for design.
(e) Flow conditions through and below trestles of proposed high-level crossings of floodways; the possibility of improvements in design; and the effects on stages upstream from the embankments of the high-level crossings were studied in a fixed-bed model with scales of 1:600 horizontally and 1:50 vertically.
(f) Completed.
(g) Tests indicated that the original design of the Texas and Pacific Railroad main-line crossing would result in excessive velocities at the ends of each embankment section and along the upstream and downstream sides of the center embankment. Tests of 11 modifications of the original design indicated that these velocities could be reduced below the 5 fps criterion by a system of spur dikes along the embankment section.
(h) "High-level crossings, Morganza Floodway, Louisiana; model investigation." Waterways Experiment Station Technical Memorandum No. 2-290. July 1949. (Available on loan.)

(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 to 34 feet 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 model with scales of 1:1000 horizontal, and 1:50 vertical. The model was equipped with automatic tide controls. Salt water was introduced into the ocean water supply system, and fresh water was introduced at the upper end of the model.
(f) Tests have been completed; preparation of final report is in progress.

(249) MODEL STUDY OF WAVE AND SURGE ACTION, MONTEREY HARBOR, CALIFORNIA.

(b) The District Engineer, San Francisco District, Corps of Engineers, San Francisco, Calif.
(d) Experimental; for design.
(e) The most effective location for the proposed companion breakwater and breakwater extension to afford maximum protection against wave and surge action was determined by tests of a fixed-bed model with scale of 1:100.
(f) Completed.
(g) It was concluded that; (1) plan 1 or plan 2 would be satisfactory with respect to short- and intermediate-period wave action, but would not provide adequate protection from long-period waves of relatively high amplitude; (2) adoption of the plan-1A shore-end connection would not be advisable; and (3) the more expensive impervious-type breakwater would provide no better protection than the cheaper pervious-type breakwater.
(h) "Wave and surge action, Monterey Harbor, Monterey, California; model investigation."

Waterways Experiment Station Technical Memo. No. 2-301. September 1949. (Available for sale or loan.)

(251) MODEL STUDY OF SAVANNAH RIVER HARBOR, GEORGIA.

(b) The District Engineer. Savannah District, Corps of Engineers, Savannah, Ga.
(d) Experimental; for design.
(e) Means of improving and maintaining the ship channel from Savannah to the Ocean, and the effect of proposed improvements on adjacent recreation beaches were studied in a fixed-bed model with scales of 1:1000 horizontal, and 1:150 vertical, and with automatic tide controls. Salt water was introduced at the ocean supply, and was colored to permit visual observation of salinity currents.
(f) Completed.
(g) The results indicated that: (1) twin extensions to the existing jetties would cause undesirable changes in the harbor; (2) an extension to the existing north jetty, along the alignment of the present bar channel, would probably improve hydraulic and shoaling conditions in the entrance channel and would not affect conditions in the inner harbor, but benefits would probably not warrant its cost; (3) improvement of the inner harbor, from changes in channel width, depth, and alignment, would probably reduce shoaling in certain reaches in which serious shoaling occurs at present; and (4) deepening the harbor navigation channels from 30 to 34 feet below mlw, over existing channel widths, would reduce mean current velocities and probably result in increased rates of shoaling.
(h) "Plans for improvement of navigation conditions and elimination of shoaling in Savannah Harbor, Georgia, and connecting waterways; model investigation." Waterways Experiment Station Technical Memo. No. 2-268. March 1949. (Available for sale or loan.)

(252) PILOT MODEL STUDY OF SOUTHWEST PASS, MISSISSIPPI RIVER, LOUISIANA.

(b) The District Engineer, New Orleans District, Corps of Engineers, New Orleans, La.
(d) Experimental; for design.
(e) A pilot model was constructed to develop special model appurtenances and operating technique required to reproduce prototype density currents in Southwest Pass by the simultaneous removel of salt water and introduction of fresh water at the upstream end of the model; and to select a movable-bed material that will move at the same rate (to scale) as that of the prototype without serious exaggeration of the model discharge and velocity scales. These data and model appurtenances will be used for the comprehensive model study of plans for improving Southwest Pass. The movable-bed pilot model has scales of 1:500 horizontal and 1:100 vertical. Reproduced are prototype tides and tidal currents in the Gulf of Mexico, density flow and fresh-water flow in Southwest Pass, and the movement of bed load material in lower Southwest Pass and the bar channel.
(f) Tests to determine the type of bed material best suited for the comprehensive model study were completed. The study was placed in inactive status until results of the field data-collection program are available.

(255) MODEL STUDY OF SHOALING IN THE BAR CHANNEL, UMPQUA RIVER, OREGON.

(b) The District Engineer, Portland District, Corps of Engineers, Portland, Ore.
(d) Experimental; for design.
(e) Tests were used to determine whether the relocation or improvement of the South Jetty will effect an appreciable decrease in the present heavy rate of shoaling in the

entrance channel. The movable-bed model had scales of 1:400 horizontal and 1:80 vertical. Provisions were made for reproducing waves from any direction from northwest to southwest, tides of any type, and littoral currents either up or down the coast.
(f) Completed.
(g) Results indicated that plan 1A would be the most effective of the plans tested in reducing shoaling in the entrance channel.
(h) "Plans for reduction of shoaling at the entrance to Umpqua River, Oregon; model investigation." Waterways Experiment Station Technical Memo. No. 2-277. May 1949. (Available on loan.)

(257) MODEL STUDY OF STABILITY OF RUBBLE-MOUND BREAKWATERS.

(b) The Chief, Bureau of Yards and Docks, U. S. 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 for hypothetical prototype breakwaters.
(f) Active.

(416) MODEL STUDY OF STILLING BASIN, BUGGS ISLAND DAM, ROANOKE RIVER, VIRGINIA.

(b) The District Engineer, Norfolk District, Corps of Engineers, Norfolk, Va.
(d) Experimental; for design.
(e) Tests were used to determine the angle of bucket lip which will deflect bottom flow away from the exit channel sufficiently to prevent scour in the area immediately downstream from the lip. The model reproduced a 171.5-foot section of the prototype to a scale of 1:35.
(f) Completed.
(g) Tests of seven designs indicated that depth of tailwater with respect to elements of the bucket, the height of bucket lip with respect to the channel floor, and the slope of the bucket lip were equally important in governing bucket action. Also eddy action in the exit area and erosion of the exit channel influenced bucket performance to a considerable degree.
(h) "Bucket-type energy dissipator, Buggs Island Dam, Roanoke River, Virginia and North Carolina; model investigation." Waterways Experiment Station Technical Memo. No. 2-281. June 1949. (Available on loan.)

(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, were studied in a 1:20 model.
(f) Testing is completed; preparation of final report is in progress.
(g) Tests showed it was feasible to fill a lock chamber through sector gates in a reasonable time. Maximum head on the gates was 18.5 feet.

(419) SLIDE GATE TESTS, NORFORK 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 the air vents, for four types of gates, were determined in a 1:6 model. 1:10 gates with 60-degree and 45-degree lips were designed to fit the 1:6 gate slots for study of the effect of conduit height on pressure conditions on the gate lip.
(f) Completed.
(g) Of the four 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 Norfork 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.
(h) Results will be incorporated in the comprehensive report on the model and prototype study of slide gates for Norfork 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) Discharge coefficients of the 84-inch Howell-Bunger valves, and stilling-basin action below the valves with emphasis on pressures at the end sill were studied in a 1:16 model.
(f) Completed.
(g) Tests showed the need for a hood over the valves to prevent flow from being projected onto the access road along the right side of the stilling basin. Hoods having semi-circular tops of 8.75-foot radius 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.
(h) "Conduits and Howell-Bunger Valves, Narrows Dam, Little Missouri River, Arkansas; model investigation." Waterways Experiment Station Technical Memo. No. 2-294. August 1949. (Available for sale or loan.)

(423) MODEL STUDY OF SPILLWAY, BENBROOK DAM, TRINITY RIVER, TEXAS.

(b) The District Engineer, Galveston District, Corps of Engineers, Galveston, Tex.
(d) Experimental; for design.
(e) Tests were used to investigate and correct any objectionable flow characteristics which might result from concentration of flow through the 100-foot rectangular notch; to check the top grade of the right training wall; and to verify the spillway discharge coefficients. A 1:60 model reproduced 900 feet of the approach area, the spillway, and 2000 feet of exit channel.
(f) Completed.
(g) In the model tests flow in the approach channel and over the spillway of original design appeared satisfactory. Flow conditions at the abutments were improved slightly by rounding the abutments. Head-discharge relations as determined on the model agreed closely with computations. Downstream from the spillway the concentration of flow through the low weir, during high discharges, created standing waves which diverged from the junction of flow over the two weir sections causing considerable water to splash over the wall. No means of eliminating or reducing the height of these waves was found. To protect the sides of the exit channel from the wave action, tests indicated that the left training wall should be extended. High velocities were measured in the exit channel for all discharges. For low discharges flows

887657 O—50——11

were confined to the center of the channel.

(h) "Spillway for Benbrook Dam, Clear Fork of the Trinity River, Texas; model investigation." Waterways Experiment Station Technical Memo. No. 2-269. March 1949. (Available for sale or loan.)

(425) COMPREHENSIVE MODEL STUDY, DELAWARE RIVER, PENNSYLVANIA.

(b) The District Engineer, Philadelphia District, Corps of Engineers, Philadelphia, Pa.
(d) Experimental; for design.
(e) Model will be 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, and reproduces the entire tidal portion of Delaware River and Bay from the Capes to Trenton, including tidal portions of major tributaries. 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.
(f) Active.
(g) Hydraulic adjustment of the model is in progress; tests have not been initiated.

(426) MODEL STUDIES OF EAST BRANCH RESERVOIR, 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 spillway, of the trough into which water flows from the overflow weir, and of the dispersion bucket at the downstream end of the spillway chute; also to investigate the sufficiency of the intake, control tower, and stilling basin of the outlet works, and to study hydraulic forces acting on the control gate 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) Testing is completed; preparation of final report is in progress.

(428) MODEL STUDY OF WAVE AND SURGE ACTION, OSWEGO HARBOR, NEW YORK.

(b) The District Engineer, Buffalo District, Corps of Engineers, Buffalo, N. Y.
(d) Experimental; for design.
(e) Tests were used to determine the storm directions causing maximum wave action in the existing harbor, and the most effective position of a breakwater to improve harbor protection. Effects of spending-beach construction were also investigated to determine the most economical means of reducing wave action inside the harbor. The model was of the fixed-bed type, with a scale of 1:100.
(f) Completed.
(g) Results showed that: (1) the originally proposed breakwater plan would not be adequate; (2) a breakwater plan developed during the model study, would be satisfactory; (3) an artificial spending beach should be constructed at the southeast corner of the New York State Barge Canal Terminal; (4) an alternate breakwater plan developed during the model study would afford more effective protection from wave action; and (5) the existing impervious vertical-walled wharves in Oswego Harbor magnify the action of waves which gain entrance into the harbor through the navigation opening, making it desirable to avoid construction of additional wharves or other harbor structures of this type, unless the structures are to be located in harbor areas amply protected from wave action.
(h) "Wave action and breakwater location, Oswego Harbor, New York; model investigation."

Waterways Experiment Station Technical Memo. No. 2-291. July 1949. (Available for sale or loan.)

(429) MODEL STUDY OF WAVE AND SURGE ACTION, LONG BEACH HARBOR, CALIFORNIA.

(b) The City of Long Beach, Calif.
(d) Experimental; for design.
(e) Tests were used to study the effects on wave and surge action of the proposed installations in the Navy-Long Beach Harbor and the proposed Southeast Basin. In the Southeast Basin, data were desired for the selection of pier alignment and location of navigation opening. The fixed-bed model was constructed to scales of 1:300 horizontally, and 1:60 vertically. The Long Beach Harbor developments were constructed in the model to scale.
(f) Completed.
(g) Results indicated that a Southeast Basin Harbor can be constructed which will be relatively free of troublesome wave and surge action; that construction of the proposed improvement works in the existing Long Beach Harbor would not affect the overall efficiency of the Long Beach Harbor or the Navy Harbor at Terminal Island; that installation of the proposed Southeast Basin, in conjunction with improvements proposed for the existing Long Beach Harbor, would tend to increase surge conditions in both the Navy and Long Beach Harbors for waves with periods ranging from 3 to 4 minutes; and that installation of the proposed Southeast Basin would impair entrance conditions to the Navy-Long Beach Harbors for short-period waves.
(h) "Wave and surge action, Long Beach Harbor, Long Beach, California; model investigation." Waterways Experiment Station Technical Memo. No. 2-265. September 1949. (Available on loan.)

(430) MODEL STUDIES OF BREAKWATER LOCATION AND STABILITY, EAST BEAVER BAY HARBOR, LAKE SUPERIOR, MINNESOTA.

(b) Oglebay Norton and Company, Cleveland, Ohio.
(d) Experimental; for design.
(e) Tests were used to determine the best type of breakwater design and the most effective location for the navigation opening which will provide maximum protection against short-period wave action. The model for studying the breakwater location was of the fixed-bed type, with a scale of 1:150. The model for studying breakwater stability was a section of the prototype breakwater constructed of sized (to scale of 1:30) prototype breakwater materials.
(f) Completed.
(g) Results showed that: (1) the originally proposed harbor plan would not afford adequate protection to the docks and ships within the harbor, and would not provide safe navigation entrance conditions; (2) the originally proposed harbor plan would provide adequate protection if spending beaches were added in critical areas, and if the breakwater leg from Pancake Island to shore were realigned and raised; and (3) the best breakwater plan tested involved a navigation opening 600 feet wide immediately east of Gull Island. Results of the stability study indicated that: the stability of rubble breakwaters is improved by the process of damage and repair; rubble breakwaters of the design tested would be unstable under the attack of waves higher than 10 feet when constructed by dumping material from the sides and lakeward end but would provide adequate protection without requiring extensive repairs when constructed by the conventional method of dumping material from floating equipment; rubble breakwaters constructed by the end- and side-dump method would require about three times as much material for maintenance during construction, and about two and one-half times as much material for maintenance for a 40-year period after construction,

as breakwaters constructed by dumping material from floating equipment.

(h) "Wave action and breakwater location, East Beaver Bay Harbor, Lake Superior, Minnesota; model investigation." Waterways Experiment Station Technical Memo. No. 2-295. July 1949. (Available on loan.)
"Breakwater stability, East Beaver Bay Harbor, Lake Superior, Minnesota; model investigation." Waterways Experiment Station Technical Memo. No. 2-296. July 1949. (Available on loan.)

(672) MODEL STUDIES OF LYNNHAVEN BAY AND INLET, VIRGINIA.

(b) The District Engineer, Norfolk District, Corps of Engineers, Norfolk, Va.
(d) Experimental; for design.
(e) Tests have been 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 on the beaches adjacent to the inlet. Two models were used: (1) a fixed-bed model, reproducing all of Lynnhaven Bay and Inlet and a portion of Chesapeake Bay, with 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 Chesapeake Bay, with scales of 1:400 horizontal, and 1:80 vertical.
(f) Tests have been completed; final report is being prepared.

(673) GENERAL SPILLWAY MODEL TESTS.

(b) The Chief of Engineers, U. S. Army, Washington, D. C.
(d) Experimental; applied research.
(e) Tests 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. Tests are conducted on a 1:40 section model reproducing a minimum of three gates. The drop from spillway crest to bucket will be varied to study the effect of nappe thickness.
(f) Active.
(g) Tests indicated a discharge coefficient of 4.03 and a pier contraction coefficient of 0.010 at the design head of 30 feet. Above the design head discharge coefficients increased only slightly reaching a maximum of 4.10 for a pool 33-1/2 percent above design head. Pier contraction coefficients indicated negative values for pool elevations above design head.

(674) MODEL STUDIES OF FORT RANDALL DAM, MISSOURI RIVER, SOUTH DAKOTA.

(b) The District Engineer, Omaha District, Corps of Engineers, Omaha, Nebr.
(d) Experimental; for design.
(e) A 1:100 comprehensive model was used to determine the 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 general over-all flow conditions in the exit area. An outlet stilling-basin model, to scale of 1:50, was used to develop a stilling basin, below the power conduits to 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. An intake and flood-control conduits model, to scale of 1:25, was used to determine

the character of flow for various reservoir levels; measure the loss coefficients of the intake structure; investigate pressures in critical regions of the transition section; and determine the effects of partial gate operation upon downpull and oscillation of the gates and upon air requirements. Supplementary tests were conducted on a 1:30 model of a portion of the intake, one service gate, air vents, and portion of the tunnel to provide preliminary data on gate performance and to develop instrumentation for use on the 1:25 model.

(f) Testing has been completed; the final report is in preparation.

(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 in design of the structure, and to correct unsatisfactory conditions. Special consideration was given to flow conditions through the drop in the tunnel immediately below the control structure.
(f) Tests have been completed; preparation of the final report is in progress.

(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) Tests have been completed; the final report is being prepared.
(g) The model tests indicate the necessity for increasing the length of the left guide wall to the lock chamber. Openings through the wall also improved conditions for tows entering the lock.

(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) Testing has been completed; preparation of the final report is in progress.
(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.

(678) CHARLESTON HARBOR MODEL STUDY.

(b) The District Engineer, Charleston District, Corps of Engineers, Charleston, S. C.

(d) Experimental; for design.
(e) Tests are used 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 model is of the fixed-bed type, with scales of 1:800 horizontally, and 1:80 vertically. Shoaling studies will be made by injecting finely-ground gilsonite into the model channels.
(f) Active. Field data are being collected by the Charleston District.

(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 means for minimizing the excessive rate of shoaling in the 25-foot reach of the south channel. The model is of the fixed-bed type, with scales of 1:600 horizontally, and 1:100 vertically. Shoaling studies are made by injecting finely-ground gilsonite into the model channels.
(f) Preliminary tests have been completed. Final tests await completion of field data collection to show source of shoaling material and its movement and deposition throughout the problem area.

(680) VACUUM TANK TEST OF TAINTER VALVE, McNARY DAM, COLUMBIA RIVER, OREGON.

(b) The District Engineer, Portland District, Corps of Engineers, Portland, Ore.
(d) Experimental; for design.
(e) Tests were made on a 1:20 model in a vacuum tank to determine whether cavitation will occur in the low pressure region just downstream from the valve, and whether lowering the valve will eliminate such cavitation.
(f) Completed.
(g) Cavitation will occur in the prototype unless the invert of the culvert at the valve section is lowered or some other means is adopted to reduce the severity of cavitation conditions.
(h) "Vacuum tank tests of model tainter valve for McNary Dam." Waterways Experiment Station Technical Memo. No. 2-282. June 1949. (Available on loan.)

(681) TAINTER TEST GATES FOR SLUICES, NORFORK DAM.

(b) The District Engineer, Little Rock District, Corps of Engineers, Little Rock, Ark.
(d) Experimental; for design.
(e) Tests were performed on a 1:6 model reproducing as nearly as possible the actual operating conditions of the prototype. Piezometer measurements were made at the same locations as on the prototype.
(f) Completed.
See Project No. 669, "Test of Tainter Gate for Control of Conduit Flow," page 135, for prototype tests.

(682) HYDRAULIC CAPACITY OF MEANDERING CHANNELS IN STRAIGHT FLOODWAYS.

(b) Office, Chief of Engineers, U. S. Army, Washington, D. C.
(d) Experimental; applied research.
(e) This investigation comprises 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; valley slope; water-surface slope; and ratio of overbank area to channel area. The model consists of a flume 30 feet by 100 feet.

Scales are proportionate to average conditions in nature so that the data can be applied to natural problems.
(f) Active.

(883) 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) Tests are used to make 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 to make 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 is used. For study of surges and concentration time, a general model to a scale of 1:32 is used.
(f) Active.

(986) MODEL TESTS OF UPSTREAM EMERGENCY DAM, CHEATHAM DAM, CUMBERLAND RIVER, TENNESSEE.

(b) The District Engineer, Nashville District, Corps of Engineers, Nashville, Tenn.
(d) Experimental; for design.
(e) Tests in a 1:12 model are 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.
(f) Active.

(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) To study and develop proposed plans for flood control within the city of East Peoria, Ill., tests are being made on a fixed-bed model built to an undistorted scale of 1:60.
(f) Active.

(988) MODEL STUDY OF SPILLWAY, GENEGANTSLET RESERVOIR, NEW YORK.

(b) The District Engineer, Baltimore District, Corps of Engineers, Baltimore, Md.
(d) Experimental; for design.
(e) Tests in a 1:36 model are used to study and, if necessary, provide means for improving flow conditions in the curved approach to the spillway, over the spillway crest, and in the converging chute.
(f) Active.

(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 fixed-bed model reproduces approximately 14.5 miles of the Mississippi River to linear-scale ratios of 1:400 horizontally and 1:150 vertically. It is convertable into a movable-bed model, and can be extended to include study of other problems upstream. Tests are used to study 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.

(f) Active.

(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) Tests have been completed; preparation of the final report is in progress.
(g) Hydraulic forces acting on the valve leafs were reduced appreciably by use of deflector plates.

(991) MODEL STUDY OF OUTLET WORKS, TEXARKANA DAM, TEXAS.

(b) The District Engineers, New Orleans District, Corps of Engineers, New Orleans, La.
(d) Experimental; for design.
(e) To develop an economical and safe stilling basin for the two outlet conduits, tests are being conducted on a 1:25 model.
(f) Active.

(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 are used to investigate the hydraulic performance of the spillway, spillway bucket and conduits and to effect revisions demonstrated to be desirable; particular attention will be given the performance of the flip bucket and flow conditions from the conduits. Four models are 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) Active. All tests on models (2) and (3) have been completed.
(g) Results indicate the feasibility of shaping the spillway crest for a head much lower than the design head.

(993) CAVITATION RESEARCH.

(b) Chief of Engineers, U. S. 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 tested in a vacuum tank.
(f) Active.

(994) EFFECT OF MODEL DISTORTION.

(b) Chief of Engineers, U. S. 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 60 feet long with 2-foot sidewalls connected at the bottom by a continuous hinge so that the central angle can be varied to change the distortion.
(f) Construction of the triangular flume is in progress. Earlier tests conducted in

rectangular flumes have been abandoned.

(995) SIMULATION OF AIR ENTRAINMENT IN MODELS INVOLVING HIGH VELOCITY FLOW.

(b) Chief of Engineers, U. S. Army, Washington, D. C.
(d) Experimental; applied research.
(e) This investigation comprises a study, by means of existing models, of cause and effect of air entrainment to compare air entrainment in model and prototype and study methods of simulating air entrainment in models.
(f) Tests have not been initiated.

(996) USE OF AIR INSTEAD OF WATER IN MODEL TESTING.

(b) Chief of Engineers, U. S. 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, U. S. Army, Washington, D. C.
(d) Experimental; applied research.
(e) Tests will be conducted on various type sluice outlet portals to determine the relative effectiveness of each type. Initial tests will be conducted with a 1:16 model of an 84-inch Howell-Bunger valve. Then tests will involve sluice outlets with flared sidewalls and with tetrahedral floor deflector blocks.
(f) Tests have not been initiated; the test program is being developed.

(998) STUDY OF WAVE FORCE ON BREAKWATERS.

(b) Office, Chief of Engineers, U. S. Army, Washington, D. C.
(d) Experimental; applied research.
(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. Tests will be conducted in the wave tank with breakwaters constructed in one end.
(f) Tests have not been initiated; the test program is being developed.

(999) STABILITY OF RUBBLE-MOUND BREAKWATERS.

(b) Office, Chief of Engineers, U. S. 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. Tests will be conducted in existing model basins on breakwaters constructed to a scale of 1:45.
(f) Tests have not been initiated; the test program is being developed.

(1000) ROUGHNESS STANDARDS FOR HYDRAULIC MODELS.

(b) Office, Chief of Engineers, U. S. Army, Washington, D. C.
(d) Experimental; applied research.
(e) A general study of roughness standards for models is being 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 and other models can be eliminated. Tests are conducted in three rectangular flumes. Similar tests for two-dimensional flow are planned for the future.
(f) Active.
(g) Tests have been completed and data are being analyzed on the following types of artificial channel roughness: brushed concrete, concrete ridges, scored concrete, sand, expanded metal, and screen wire. Tests are in progress using concrete cubes at various spacings.

(1001) SCALE EFFECTS ON SPILLWAY DISCHARGE COEFFICIENTS.

(b) Office, Chief of Engineers, U. S. Army, Washington, D. C.
(d) Experimental; applied research.
(e) Tests will be conducted on existing spillway models to determine the effect of the size of a model on spillway discharge coefficients.
(f) Review of existing model data now in process.

(1002) SCALE EFFECTS IN HARBOR MODELS.

(b) Office, Chief of Engineers, U. S. 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 approval of the proposed testing program.

(1003) STUDY OF HARBOR DESIGN.

(b) Office, Chief of Engineers, U. S. 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) Tests have not been initiated.

(1004) HYDRAULIC INSTRUMENTATION.

(b) Office, Chief of Engineers, U. S. Army, Washington, D. C.
(d) Experimental; development.
(e) Various types of instruments for use in hydraulic models are being developed and tested.
(f) Work was continued on development of an improved wave-height measuring device, investigation of pressure cells for use in hydraulic models, and new high- and low-range velocity meters.

U. S. DEPARTMENT OF COMMERCE, NATIONAL BUREAU OF STANDARDS,
National Hydraulic Laboratory, Washington, D. C.

Inquiries concerning Projects Nos. 154, 159, 166, 432, 433, 1005 to 1009, incl., should be addressed to the Chief, National Hydraulic Laboratory, National Bureau of Standards, Washington 25, D. C.

(154) AGING TESTS OF PIPES.

(b) U. S. Treasury Department.
(d) Experimental; for design and operation.
(e) Data are obtained to determine the effects of long-continued service on the hydraulic friction of pipes. Specimens of 1-1/4 inch pipes of nine different materials have been installed in a cold-water service line, and specimens of 3/4 inch pipes of seven different materials in a hot-water service line at the National Bureau of Standards. The hydraulic friction in these specimens is compared with the friction in smooth copper pipes.
(f) Tests were started in 1936. Final tests were made in December 1949. Report is being prepared.

(159) MODEL LAWS FOR DENSITY CURRENTS.

(b) Waterways Experiment Station, Corps of Engineers, Department of the Army, Vicksburg, Miss.
(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 project is subdivided into about a dozen specific problems. The two major problems are: (a) the motion of a heavy liquid, initially confined in a "lock", when suddenly released into a long channel filled with a lighter liquid; and (b) the motion of a heavy liquid initially confined in a tank of large area (a "sea") into a long channel filled with either a still or a flowing lighter liquid.
(f) Most of the experimental work on the "lock" problem has been completed and work on the "sea" problem has been started. Experiments on the damping of a solitary wave in the interface between two non-moving liquids of different densities have been completed and a report is being prepared.
(h) "Interfacial instability and mixing in stratified flows," Garbis H. Keulegan, Journal of Research, National Bureau of Standards, Vol. 43, RP2040, pp 487-500, November 1949.

(166) WET VENTING, STACK VENTING, AND SELF-SIPHONAGE OF PLUMBING SYSTEMS.

(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 stack and wet venting of plumbing fixtures and fixture self-siphonage. The drainage systems were constructed of transparent plastic pipe and fittings so that motion pictures of the flow could be obtained.
(f) Completed except for publications.
(h) National Bureau of Standards, Building Materials and Structures Report BMS 118, "Stack venting of plumbing fixtures", by John L. French, 1950.
A 16-mm motion picture film with sound commentary was prepared. For the loan of this film, communicate with the Housing and Home Finance Agency, Washington 25, D. C.

(432) FROST CLOSURE OF THE STACK VENTS OF PLUMBING SYSTEMS.

(b) Laboratory project.
(d) Experimental and theoretical; applied research.
(e) To obtain data for code-making authorities, studies were made of the factors affecting frost closure of roof vents.
(f) Completed except for publication.

(433) CAPACITIES OF PLUMBING STACKS.

(b) Housing and Home Finance Agency.
(d) Experimental; applied research.
(e) To determine the capacities of plumbing stacks, a vertical stack about 60 feet high has been tested. Detailed observations have been made 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.
(f) Completed except for reports and publications.
(g) A theoretical analysis, supplemented by experimental data, has made it possible to compute the back pressures on the horizontal drains at intermediate floors of a multi-story building when the rate and velocity of flow from higher floors and the rate of flow from the horizontal branches are known. This 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.

(685) ORIFICE METERS.

(b) Cooperative sponsors: American Gas Association; American Society of Mechanical Engineers; Bureau of Ships, U. S. Navy Department; National Bureau of Standards.
(c) Howard Bean, Chairman, Joint A.G.A., A.S.M.E. Committee on Orifice Meters, National Bureau of Standards, Washington 25, D.C.
(d) Experimental; applied research.
(e) To obtain added 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 particular effects of globe valves and plug valves preceding an orifice; and (3) possible development of a field method of evaluating pipe roughness. Experimental work will be carried on with steam at the Naval Boiler & Turbine Laboratory (Philadelphia Navy Yard); with natural gas at the Rockville, Maryland measurement station; and with water at the National Hydraulic Laboratory, National Bureau of Standards, Washington, D. C.
(f) Continuing project. Experimental work now in progress.
(h) "Preliminary test results in A.G.A., A.S.M.E., Rockville orifice research", by F. M. Partridge. Published in Gas, April 1950, page 75. Also in Instruments, February 1950, page 189.

(1005) STANDARDS FOR HOUSE SEWER PIPE.

(b) Housing and Home Finance Agency.
(d) Experimental and theoretical; applied research.
(e) The purpose of this project is to establish standards for house sewer pipe and to determine whether several types of pipe meet the requirements. Data will be gathered regarding leakage at joints, suitability of joints, root penetration, moisture absorption, heat resistance, flexural strength, etc.
(f) Preliminary studies have been made, standard requirements are being discussed, and plans are being made for the test program.

(1006) WIND GENERATED WAVES AND SET-UP.

(b) Laboratory project.
(d) Theoretical and experimental; basic and applied research.
(e) The purpose is to determine (a) relations between wind force, fetch, depth, and wave characteristics for wind-generated waves in shallow water, and (b) relations between wind force, fetch, depth, length, wave characteristics, and set-up (wind tide).
(f) Experimental work has been completed in one channel and a paper on set-up is nearly completed. It is planned to write also a paper on waves, and to extend the results by experiments in a larger and longer channel in the near future.

(1007) ABSORPTION AND REFLECTION OF WAVE ENERGY BY POROUS BARRIERS.

(b) Laboratory project.
(d) Experimental and theoretical; basic research.
(e) Solitary waves of various heights in various depths were reflected against porous barriers with vertical upstream and downstream faces and various thicknesses. Dimensions of reflected waves and elevations of the water surface at the face of the barrier at the instant of reflection were measured. The amount of reflected energy is being correlated with the movement of water in the barrier. The barriers were composed of glass spheres about 1/2 inch in diameter.
(f) Experimental work is completed; study of the results and preparation of a paper are in progress.

(1008) STUDY OF TSUNAMIS.

(b) Laboratory project; and Committee on Tsunamis of the American Geophysical Union.
(d) Theoretical; basic research.
(e) The project includes a comprehensive study of the literature, and mathematical analysis applying the Cauchy and Poisson theories for the two-dimensional case with initial conditions of (a) elevated water surface over a restricted area due to seismic action, and (b) sudden reduction of surface pressure over a restricted area due to a hurricane.
(f) An annotated bibliography has been completed which will be published soon by the Hydrographic Office of the Navy. Mathematical studies are in progress.

(1009) VERTICAL DROP IN STORM SEWER.

(b) Bureau of Public Roads, Department of Commerce.
(d) Experimental; design and development.
(e) Model tests were made of a vertical drop connecting a 12-foot horse-shoe storm sewer with an 8-foot arch sewer at a lower level to determine head losses, feasible changes in design to reduce head losses, and data for use in future designs.
(f) Completed.
(h) Report submitted to Bureau of Public Roads. See Project No. 1009, page 163.

U. S. DEPARTMENT OF COMMERCE, WEATHER BUREAU

Inquiries concerning Projects Nos. 1010 to 1015, incl., should be addressed to Merrill Bernard, Chief, Climatological and Hydrologic Services, U. S. Weather Bureau, Washington 25, D. C.

(1010) ELECTRONIC FLOOD ROUTING MACHINE.

(b) U. S. Weather Bureau.
(d) Experimental; applied research.
(e) A basic circuit for an electronic analog computer to solve flood wave problems has been developed. Project is now aimed at determining full potential usefulness and developing a working model in form for convenient use.
(f) A model has been constructed under contract and is being tested.
(h) "Electronic device speeds flood forecasting", R. K. Linsley, L. W. Foskett, and M. A. Kohler, Engineering News Record, Vol. 141, No. 26: 64-66. December 23, 1948.

(1011) SHORT RANGE SNOW-MELT FORECASTING.

(b) U. S. Weather Bureau.
(d) Experimental; applied research.
(e) Work is under way to develop relations between streamflow resulting from melting snow and appropriate meteorological parameters. A statistical approach is being attempted. Project is aimed at developing procedures for use in Bureau's river forecasting program.
(f) Active.
(g) A reasonably adequate procedure has been established and is being refined and tested.

(1012) AUTOMATIC RADIO REPORTING RAIN GAGE.

(b) U. S. Weather Bureau.
(d) Field test.
(e) A simple telemetering device has been constructed on contract for use with standard recording rain gage. Necessary radio components are to be assembled and the equipment installed for field test.
(f) Active.

(1013) PRESSURE ACTUATED RIVER GAGE.

(b) U. S. Weather Bureau.
(d) Field test.
(e) A gage has been constructed under contract and is being laboratory tested for accuracy. It will be installed under field conditions for service tests.
(f) Active.

(1014) UTILIZATION OF SOIL MOISTURE DATA IN FORECASTING STREAMFLOW.

(b) U. S. Weather Bureau.
(d) Field investigation.
(e) Standard electrical resistance soil moisture and temperature equipment is being installed in selected areas. After sufficient data is obtained statistical tests will be utilized to determine whether such data can be used to improve forecasts of runoff from rainfall.
(f) Active.

(1015) MEASUREMENT OF EVAPORATION.

(b) U. S. Weather Bureau.

(d) Theoretical and field investigation; basic and applied research.
(e) Studies are under way pointed toward the design of a pan evaporation index station and its utilization for estimating evaporation from lakes and ground surfaces.
(f) Active.
(g) A satisfactory correlation between pan evaporation and meteorological parameters has been demonstrated. Design of the evaporation index station is well along. Studies of suitable instruments continues.

U. S. DEPARTMENT OF COMMERCE, BUREAU OF PUBLIC ROADS.

(99) HYDRAULICS OF CULVERTS.

(b) Minnesota Department of Highways, in cooperation with Bureau of Public Roads.
For a complete report on this project, refer to Project No. 99, listed under St. Anthony Falls Hydraulic Laboratory, page 79.

(296) INVESTIGATION OF STORM DRAINS FOR EXPRESS HIGHWAYS.

(b) University of Illinois, Illinois Division of Highways, and Bureau of Public Roads.
For a complete report on this project, refer to Project No. 296, listed under University of Illinois, Civil Engineering Department, page 37.

(568) SCOUR AT BRIDGE PIERS AND ABUTMENTS.

(b) Iowa State Highway Commission and Bureau of Public Roads.
For a complete report on this project, refer to Project No. 568, listed under Iowa Institute of Hydraulic Research, page 44.

(1009) VERTICAL DROP IN STORM SEWER.

(b) Bureau of Public Roads.
(c) Carl F. Izzard, Chief, Hydraulics Branch, Bureau of Public Roads, Washington 25, D.C.
For a complete report on this project, refer to Project No. 1009, listed under National Bureau of Standards, National Hydraulic Laboratory, page 161.

U. S. DEPARTMENT OF THE INTERIOR, GEOLOGICAL SURVEY.

(169) UNSATURATED FLOW OF WATER IN RELATION TO GROUND-WATER RECHARGE.

(b) U. S. Geological Survey, Water Resources Branch.
(c) 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) Active.
(g) Certain definite relations between discharge and time have been found for uniform

sand. The results appear to be independent of the grain radius. A preliminary paper is in preparation.

(170) THE SPECIFIC YIELD OF ROCKS FOR WATER.

(b) U. S. Geological Survey, Water Resources Branch.
(c) W. O. Smith, U. S. Geological Survey, Washington 25, D. C.
(d) Experimental and theoretical; basic research.
(e) Mechanics involved in the determination of specific yield of porous media. Specific yield of soils and sediments as related to drainage problems.
(f) Active.
(h) Report in preparation.

(436) SEDIMENTATION STUDIES IN INLAND WATERS.

(b) U. S. Geological Survey, Water Resources Branch.
(c) W. O. Smith, U. S. Geological Survey, Washington 25, D. C.
(d) Field investigation; experimental and theoretical; applied research.
(e) (1) To investigate the factors which govern 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. Complete determination of bottom contours with echo sounding methods, determination of thermal and salinity structures, investigation of density current phenomena and density current patterns, physical properties of sediments, development of underwater photographic techniques, and underwater coring are included in the program.
(f) Active.
(h) Report in preparation.

(437) STAGE-DISCHARGE RELATIONS UNDER BACKWATER CONDITIONS.

(b) U. S. Geological Survey.
(c) W. D. Mitchell, U. S. Geological Survey, Champaign, Ill.
(d) Experimental; applied research.
(e) Analyses are being made of backwater data obtained in Project 64, "The Backwater Profile for Steady Flow in Open Channels", page 25, Vol. 12, to test and develop methods for obtaining discharge ratings for rivers under conditions of changing backwater for use in stream gaging practice.
(f) Active.
(g) Preliminary results indicate that present methods of preparing backwater ratings are in need of revision.
(h) Progress report is on file.

(439) EFFECT OF REFORESTATION ON STREAM FLOW.

(b) U. S. Geological Survey.
(c) 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.
(f) Active.
(h) Progress reports on file show very little effect to date.

(440) MULTIPLE-STEP DRAWDOWN TEST.

(b) U. S. Geological Survey.
(c) M. L. Brashears, Jr., U. S. Geological Survey, Jamaica, N. Y.
(d) Field investigation; applied research.
(e) Multiple-step drawdown tests of ground-water wells are being explored, to develop means for determining well and screen head losses.
(f) Active. Additional field data are being collected and assembled.

(441) GEOLOGY OF CACHE VALLEY.

(b) U. S. Geological Survey.
(c) H. E. Thomas, U. S. Geological Survey, Salt Lake City, Utah.
(d) Field investigation; basic research.
(e) Identification and correlation of aquifers, faults, ground-water dams, and other pertinent hydrologic features in Cache Valley, where there are exceptional exposures of the Cenozoic rocks.
(f) Active. Report is in preparation.

(445) SMALL RESERVOIRS IN ARID REGIONS.

(b) U. S. Geological Survey.
(c) H. V. Peterson, U. S. Geological Survey, Los Angeles, Calif.
(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.
(f) Active.
(g) Progress reports are on file.

(447) THERMO-TRANSFER AND ELECTRO-TRANSFER PHENOMENA IN SOILS AND SEDIMENTS AND THEIR RELATION TO GROUND-WATER RECHARGE.

(b) U. S. Geological Survey.
(c) 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.
(f) Active.

(448) UNDERWATER PHOTOGRAPHY IN INLAND WATERS.

(b) U. S. Geological Survey, Water Resources Branch.
(c) W. O. Smith, U. S. Geological Survey, Washington 25, D. C.
(d) Experimental and field investigation; applied research.
(e) Development of techniques of underwater photography and their use in identifying rock structures.
(f) Active.

(449) SONIC PROPERTIES OF SOILS AND SEDIMENTS.

(b) U. S. Geological Survey, Water Resources Branch.
(c) W. O. Smith, U. S. Geological Survey, Washington 25, D. C.

887657 O—50——12

(d) Experimental and theoretical; basic research.
(e) Development of techniques for determining sonic properties of soils and sediments and their application to problems of fluid flow.
(f) Active.

(450) ELECTROLYTIC POTENTIAL MODELS FOR SOLUTION OF PROBLEMS IN GROUND-WATER HYDRAULICS.

(b) U. S. Geological Survey, Water Resources Branch.
(c) 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.
(f) Active.

(451) ELECTRIC AND MAGNETIC PROPERTIES OF SOILS AND SEDIMENTS.

(b) U. S. Geological Survey, Water Resources Branch.
(c) W. O. Smith, U. S. Geological Survey, Washington 25, D. C.
(d) Experimental and theoretical; basic research.
(e) (1) Development of methods to measure electrical resistance, the electrical capacitance, and the magnetic susceptibilities of soils and sediments for a wide range of frequencies; (2) application of basic knowledge to problems in fluid flow in porous bodies.
(f) Active. Preliminary experimental work is in progress.

(688) HYDROLOGY OF SINKHOLE PONDS.

(b) U. S. Geological Survey and Emory University.
(c) E. L. Hendricks, U. S. Geological Survey, Baton Rouge, La.
(d) Field investigation; applied research.
(e) Study of fluctuations in level of sinkhole ponds in relation to precipitation, evaporation, and ground-water levels; study of water temperatures; and study of ground-water movement.
(f) Completed. Reports are in preparation.

(689) SANTA CLARA VALLEY SUBSIDENCE.

(b) U. S. Geological Survey.
(c) J. F. Poland, U. S. Geological Survey, Santa Barbara, Calif.
(d) Field investigation; applied research.
(e) To examine physical properties of sediments; to construct maps showing change in water pressure level; to compute theoretical compaction, and compare with observed subsidence; to develop relationship between changes in water pressures (or levels) and land subsidence, and to determine to what extent process is reversible.
(f) Active.

(690) DISCHARGE THROUGH MULTIPLE OPENINGS.

(b) U. S. Geological Survey.
(c) 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.
(f) Active.
(g) A large number of data are being collected.

(691) COMPUTING PEAK DISCHARGES BY INDIRECT METHODS.

(b) U. S. Geological Survey.
(c) 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.
(f) Active.
(g) A large number of data are being collected.

(1016) INTERPRETATION OF ELECTRIC LOGS.

(b) U. S. Geological Survey.
(c) 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.
(f) Active.
(h) Preliminary report in preparation.

(1017) INDUCED INFILTRATION FROM STREAMS.

(b) U. S. Geological Survey.
(c) M. I. Rorabaugh, U. S. Geological Survey, Louisville, Ky.
(d) Field investigations; theoretical studies.
(e) Studies of yields of wells near streams, and relations of yields to location of stream, head, character of bottom, physical characteristics of aquifer, temperature of water, types of wells, etc.
(f) Active.
(g) Formulas and charts have been developed for predicting yields of wells on basis of data obtained from tests.
(h) "Ground-water resources of the northeastern part of the Louisville area, Kentucky", M. I. Rorabaugh, mimeographed, City of Louisville Water Company. July 1948.

(1018) GROUND-WATER CHARACTERISTICS FOR DRAINAGE DESIGN.

(b) U. S. Geological Survey.
(c) J. G. Ferris, U. S. Geological Survey, Lansing, Mich.
(d) Field investigations; basic research.
(e) Studies are being made of drawdown in wells near drainage ditches. Theoretical studies are being made to develop formulas for relating drawdown and discharge of ditch to drawdown in wells and physical characteristics of aquifer.
(f) Active.

(g) A method has been developed to predict drawdown near a ditch discharging at a constant rate. Study is now in progress to develop a method for doing the same with a ditch in which the head is kept at a constant level.
(h) "A quantitative method for determining ground-water characteristics for drainage design", J. G. Ferris, manuscript. Presented at meeting of American Society of Agricultural Engineers, Michigan State College. June 20, 1949.

(1019) MINE-DRAINAGE STUDIES.

(b) U. S. Geological Survey.
(c) W. T. Stuart, U. S. Geological Survey, Ishpeming, Mich.
(d) Field investigations; basic and applied research.
(e) Studies of drainage of iron mines and not efficient design and sparing of drains. Includes studies of sources of water and areas of natural discharge.
(f) Active.
(g) Comparisons of different types of drains have been made, and theoretical efficiencies of each computed.
(h) "Ground-water problems of the Iron River District", W. T. Stuart, C. V. Theis, and G. M. Stanley, Tech. Report No. 2, Department of Conservation, State of Michigan. June 1948.

(1020) HEAD-LOSS TESTS OF FLOWING ARTESIAN WELLS.

(b) U. S. Geological Survey.
(c) S. W. Lohman, U. S. Geological Survey, Denver, Colo.
(d) Field investigations; basic research.
(e) Tests are being made of residual head loss in shut-in flowing artesian wells. Theoretical studies have been made to develop a formula for determining the coefficient of transmissibility from these tests.
(f) Active, report in preparation.
(g) Method has proven successful in numerous tests in Colorado.

U. S. DEPARTMENT OF THE INTERIOR, BUREAU OF RECLAMATION.

Inquiries concerning Projects Nos. 460 to 465, incl., 692 to 707, incl., and 1021 to 1034, incl., should be addressed to the Chief Engineer, Bureau of Reclamation, Denver Federal Center, Denver, Colo.

(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 the critical features of the uncontrolled morning-glory spillway combined with outlet gates and tunnel.
(f) Observations completed; report in progress.
(g) The chief subjects of investigation were the prevention of serious vortices and cavitation erosion in the spillway throat and transition.

(461) BOYSEN DAM SPILLWAY.

(b) Laboratory project.
(d) Experimental; for design.
(e) A 1:48 model was used for gate, chute, and stilling basin studies.
(f) Studies completed; report prepared but not reproduced.
(g) Adequacy and efficiency of the hydraulic design as modified by exigencies of construction conditions were determined.

(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) Studies completed; report not completed.
(g) Directing the valves downward at an angle into a relatively deep pool, together with special shaping of the basin walls, develops an effective outlet works.

(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 model was used to test diversion scheme for construction purposes.
(f) Studies completed; report suspended.
(g) The chief attainments were determining type and proportions of spillway stilling device; rectangular-type stilling basin proved most feasible for the receding tailwater which could be expected.

(464) MEDICINE CREEK DAM SPILLWAY.

(b) Laboratory project.
(d) Experimental; for design.
(e) A 1:60 model was used to determine the adequacy of the proposed design of spillway for the earth-fill dam.
(f) Laboratory studies completed.
(g) Approach to spillway gates was only slightly modified.
(h) "Hydraulic model studies for the design of the Medicine Creek Dam Spillway", J. C. Schuster.

(465) FRIANT-KERN CANAL TURNOUT.

(b) Laboratory project.
(d) Experimental; for design.
(e) A 1:24 model of a section of the canal is being used to procure design data for prevention of collection of debris at turnouts; to determine best proportions for various features of turnouts.
(f) Suspended.

(692) ARROWROCK DAM OUTLET VALVE.

(b) Laboratory project.
(d) Experimental; applied research.
(e) Tests were made on a 6-inch model of the Ensign-type valve to determine whether minor alterations to the throat would prevent cavitation at high heads.
(f) Completed.
(g) It was determined that the valves now in place could not be made to operate cavitation-free by minor alterations alone.
(h) "Hydraulic model studies of the Ensign balanced valves, Arrow Rock Dam", Donald Colgate.

(693) CEDAR BLUFF DAM OUTLET WORKS.

(b) Laboratory project.
(d) Experimental; for design.
(e) A 1:12 model was used to determine the adequacy of the irrigation outlet works, controlled by a single slide gate.
(f) Studies completed.
(g) Studies revealed that the efficiency of the stilling basin was affected by the shape of the cross-section of the slide gate and the relative proportions of the gate slots.
(h) "Hydraulic model studies of Cedar Bluff Dam Outlet Works, Cedar Bluff Unit, Missouri Basin Project, August 3, 1948", W. P. Simmons, Jr.

(694) CANAL DRAIN FLAP VALVES.

(b) Laboratory project.
(d) Experimental; for design.
(e) Tests on 4-inch models of flap valves are being made to determine the hydraulic characteristics which would affect their behavior in seepage drains in large canals. Modification of these valves is made to improve operating characteristics.
(f) Completed.
(g) A flap valve was developed which was especially adaptable to canal seepage drains together with the mode of installation of such valves.
(h) "Study of the hydraulic characteristics, control devices, underdrain system--Friant-Kern Canal-- Central Valley Project", J. C. Schuster.

(695) SOAP LAKE SIPHON BLOWOFF STILLING POOL.

(b) Laboratory project.
(d) Experimental; for design.
(e) Tests were made on a 1:5 model of a drain turnout at the low point of an inverted siphon to develop the most effective and economical means of dissipating energy of high pressure waste water which flows into an unlined canal. The pertinent feature of the outlet is a valve in the vertical pipe discharging down into a stilling well, the top of which is below the grade of the canal. The proportions of the well and its shape were the pertinent subjects of investigation.
(f) Completed.
(g) The well was developed for a maximum discharge of 75 second-feet and a head of 212.5 feet. The minimum size for these conditions was 7.5 feet square and 11 feet deep. A 16-inch-discharge pipe extended vertically downward into the center of the well and terminated 2.5 feet above the floor. The turbulence was dispersed for optimum energy dissipation by fillets 3 feet 2 inches above the floor placed in the corners of the well.
(h) "Hydraulic model studies of the stilling well for the blowoff structure, Soap Lake Siphon, Columbia Basin Project, Washington."

(696) PLATORO DAM OUTLET WORKS.

(b) Laboratory project.
(d) Experimental; for design.
(e) A 1:9.55 model was used to study the adaptability of the jet-flow high pressure regulating valve to application in an outlet tunnel; principal point of study was ventilation.
(f) Suspended.

(697) MASONVILLE SIPHON TURNOUT.

(b) Laboratory project.
(d) Experimental; for design.
(e) A 1:6 model was used to develop a stilling-well and weir basin for a turnout structure which releases water from an inverted siphon. The principal problem was quieting high-velocity flow in a vertical stilling-well which discharges into a weir pond.
(f) Completed.
(g) A satisfactory solution of the vertical stilling-well problem was obtained by submerging the 12-inch inlet pipe to within 1 foot of the 4 foot by 6 foot by 10 foot deep stilling-well floor, by replacing the 4 foot by 2.5 foot orifice in the baffle wall between stilling-well and weir basin by fifteen 1-foot square orifices, and by increasing the length of the weir basin from 9 to 12 feet.
(h) "Hydraulic model study of the Masonville Siphon Turnout Structure--Horsetooth Feeder Canal--Colorado-Big Thompson Project, Colorado", J. C. Schuster and W. P. Simmons, Jr. Hydraulic Report No. 237. February 1949.

(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 valve in controlling medium head normal flow discharging into the elbow of the combination spillway and outlet works. Aeration was the principal subject of investigation.
(f) Suspended.

(699) DICKINSON DAM SPILLWAY.

(b) Laboratory project.
(d) Experimental; for design.
(e) Tests on a 1:36 model of the earth dam spillway with an uncontrolled crest were made to determine hydraulic characteristics of the crest, and suitability of the stilling basin.
(f) Completed.
(g) Experiments were made to determine the effect of moderate negative pressures on the downstream area of the crest to increase the coefficient of discharge.
(h) "Hydraulic model studies with design of Dickinson Dam Spillway", G. L. Beichley.

(700) HORSESHOE DAM SPILLWAY.

(b) Salt River Water Users' Association.
(c) Chief Engineer, Bureau of Reclamation, Denver Federal Center, Denver, Colo.; or Leeds, Hill, Barnard and Jewett, consulting engineers, Los Angeles, Calif.
(d) Experimental; for design.

(e) A 1:36 model of the uncontrolled crest of the spillway was tested to determine the effect of mounting piers and gates on the maximum floor discharge capacity of the spillway.
(f) Studies completed.
(g) A unique design of piers and gates allowed a very favorable discharge over the crest with a minimum of disturbance downstream.
(h) A letter report was written to the consulting engineers.

(701) HORSETOOTH OUTLET WORKS.

(b) Laboratory project.
(d) Experimental; for design.
(e) A 1:24 model was used to develop a satisfactory stilling pool which would accommodate two 72-inch medium-head hollow-jet valves.
(f) Completed.
(g) The principal problem was to quiet the flow from the valves before it entered the irrigation distribution canal which is unlined.
(h) "Hydraulic model studies of the outlet works--Horsetooth Dam--Colorado-Big Thompson Project, Colorado", W. E. Wagner.

(702) BONNY DAM OUTLET WORKS.

(b) Laboratory project.
(d) Experimental; for design.
(e) A 1:8 model is being used to develop a stilling pool of proportions to quiet the flow from one 72-inch hollow-jet valve before entering an unlined canal.
(f) Completed.
(g) A stilling basin of conservative proportions was developed with the use of the hollow-jet valve in a declined discharging position, thereby making it possible to use greater depth and shorter length pool.
(h) Report has been written in draft form but not reproduced.

(703) BONNY DAM SPILLWAY.

(b) Laboratory project.
(d) Experimental; for design.
(e) A 1:16 model was used to study the operating characteristics of the uncontrolled spillway crest, normal flow short tube outlet, and the stilling basin.
(f) Completed.
(g) A spillway crest with slightly negative pressures on the downstream portion was used to increase the coefficient of discharge. Short-tube outlets were developed without danger of high negative pressures and attendant cavitation.
(h) Report completed. Not yet reproduced.

(704) CEDAR BLUFF DAM SPILLWAY.

(b) Laboratory project.
(d) Experimental; for design.
(e) A 1:48 model is being 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) Active.

(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 pool.
(f) Active.
(g) The principal problems have been in connection with the determination of a satisfactory crest shape and aeration to prevent cavitation erosion. In connection with design of the crest, 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.

(706) SAND HOLLOW WASTEWAY TRAPEZOIDAL DROP.

(b) Laboratory project.
(d) Experimental; for design.
(e) A 1:6 model of a canal drop, trapezoidal in cross-section, was used to develop a structure less costly than the heretofore conventional drop which is rectangular in cross-section.
(f) Completed.
(g) A successful solution was attained by installing a ridge in the chute and stilling basin bottom to divide the flow up into two streams. Baffle piers in the stilling basin were used to improve pool action.
(h) "Hydraulic model study of trapezoidal drop structures--Sand Hollow Wasteway--Boise Project near Caldwell, Idaho", L. J. Glaser and W. E. Wagner.

(707) WYOMING CANAL DROPS.

(b) Laboratory project.
(d) Experimental; for design.
(e) 1:6 model was used in developing canal drops, trapezoidal in cross-section, thereby reducing cost of the structures from that of conventional rectangular cross-section.
(f) Completed.
(g) Ridges dividing the flow down the chutes were adopted to maintain stability in the stilling basin. Baffle piers in the basin were used also.
(h) Reports suspended for more urgent work.

(1021) KEYHOLE DAM SPILLWAY.

(b) Laboratory project.
(d) Experimental; for design.
(e) Tests are being 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 the flood into the riverbed downstream.
(f) Active.
(g) A satisfactory spillway crest and chute have been developed, and an erodible bed is being used in the investigation of the proportions of ski-jump bucket that will throw the trajectory far enough downstream to prevent the undermining of the dam structure. No stilling basin is contemplated for this spillway.

(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, is being investigated for hydraulic performance.
(f) Active.
(g) The investigations so far indicate that 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.

(1023) FALCON DAM SPILLWAY.

(b) International Boundary Commission, L. M. Lawson, Commissioner.
(d) Experimental; for design.
(e) A 1:130 model of the Falcon Dam on the Rio Grande is being 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. The model, some 40 feet wide and 60 feet long, utilizes specially selected fine sand for the erodible bed and has given satisfactory performance.
(f) Active.

(1024) FALCON DAM, UNITED STATES OUTLET WORKS.

(b) International Boundary Commission, L. M. Lawson, Commissioner.
(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 degrees downward into the pool is giving a good hydraulic performance. Model valves are 3 inches in diameter, and the proportions of the stilling basin are being developed for the most economic use.
(f) Active.

(1025) FALCON DAM, MEXICAN OUTLET WORKS.

(b) International Boundary Commission, L. M. Lawson, Commissioner.
(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, is being investigated for hydraulic performance. This is a companion project to the Falcon Dam United States outlet works study being made on a slightly different scale.
(f) Active.

(1026) SHADEHILL DAM SPILLWAY.

(b) Laboratory project.
(d) Experimental; for design.
(e) A 1:273 model of a morning-glory type spillway for the Shadehill earth dam was investigated for hydraulic performance throughout. The spillway consisted of a morning-glory type crest with a vertical shaft and elbow which connected to a long tunnel discharging into a stilling basin which preceded discharge into the river.
(f) Studies completed. Report in progress.

(g) Principal points of study were the pressures within the throat of the morning-glory spillway and the elbow, together with the aeration of the tunnel from the downstream portal upstream. Small vortices formed at large discharges but were not objectionable after the downstream end of the elbow was constricted, causing the depth of the flow in the tunnel to be about 7/8 the diameter of the tunnel. Sand-cement erosion beds were used to determine the relative effectiveness of various types of stilling basins downstream from the spillway tunnel.

(1027) DIVERSION DAM SPILLWAY BUCKET STUDIES.

(b) Laboratory project.
(d) Experimental; for design.
(e) A series of studies for three diversion dam spillway buckets was conducted to determine the best proportions of the bucket operating under submerged flow conditions in alluvial streambeds.
(f) Laboratory work completed. Report being written.

(1028) HYDRAULIC PERFORMANCE TESTS ON IRRIGATION WATER METERING DEVICES.

(b) Laboratory project.
(d) Experimental; for design.
(e) A series of laboratory studies is being performed on a number of metering devices proposed for use in canal turn-outs and in irrigation pipeline distribution systems to determine their hydraulic characteristics for design purposes. Among those being investigated are a 12-inch and a 24-inch meter gate, a series of four sizes of the Fresno Venturi meters, and a series of two sizes of a modified Venturi-type meter used by the Consolidated Irrigation District of California.
(f) Active.
(g) 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--YAKIMA STORAGE PROJECT.

(b) Laboratory project.
(d) Experimental; for design.
(e) A 1:42 model was used in the design for the rehabilitation of a side-channel spillway, particularly the downstream end of the spillway chute. The principal task was to divert high-velocity spillway discharge through a relatively short previous bend into the riverbed, This was accomplished by utilization of a superelevated channel.
(f) Active.

(1030) OCHOCO DAM SPILLWAY--DESCHUTES PROJECT.

(b) Laboratory project.
(d) Experimental; for design.
(e) A 1:36 model was used to develop a method of directing high-velocity spillway discharge down a steep chute through an angle of approximately 15 degrees into and in line with the streambed downstream from the dam. The objective was accomplished by the use of curved deflector piers at the base of the chute.
(f) Studies completed. Report being prepared.

(1031) CALIBRATION OF A 12-INCH NEEDLE VALVE.

(b) Laboratory project.
(d) Experimental calibration for field use.
(e) A 12-inch needle valve was tested in the laboratory to determine the following characteristics: Coefficient of discharge, minimum pipe size for meter, minimum valve operating pressure head, and calibration curves for full-open position.
(f) Studies completed. Report available.
(h) "Hydraulic characteristics of a 12-inch needle valve for Granby Dam auxiliary outlet", Donald Colgate.

(1032) TECOLOTE TUNNEL--SANTA BARBARA PROJECT.

(b) Laboratory project.
(d) Experimental; for design.
(e) To determine a satisfactory means of dissipating the energy from the high-velocity jet from the water-regulating valve located in the tunnel. This was accomplished using a 1:10-scale model. The prototype design will not use the conventional stilling pool, but will incorporate baffles in the tunnel with the valve discharging submerged.
(f) Active.

(1033) ANCHOR DAM SPILLWAY--MISSOURI RIVER BASIN PROJECT--OWL CREEK UNIT.

(b) Laboratory project.
(d) Experimental; for design.
(e) A 1:30 model was used to determine the hydraulic characteristics of an overfall spillway for the concrete arch dam and the erosive action in the river channel immediately downstream from the dam. Studies were made to determine the best bucket profile, taking into consideration the pressures on the spillway and delivery of the flood discharge downstream from the dam.
(f) Studies completed. Report being prepared.

(1034) EMERGENCY 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. This was accomplished by using a laboratory rig capable of producing velocities of from 1 to 16 feet per second.
(f) Active. A few project investigations have been completed. Others are in progress. Reports are written as individual projects are completed.

U. S. NAVY DEPARTMENT, DAVID TAYLOR MODEL BASIN.

Inquiries concerning Projects Nos. 178, 466, 467, 468, 470, 709 to 712, incl., should be addressed to The Director, David Taylor Model Basin, U. S. Navy Department, 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. A special miniature model basin has been designed in which tests will be made of free and forced oscillations of cylinders with continuous recording of the forces.
(f) Inactive.

(466) VARIABLE PRESSURE WATER TUNNEL - 24-INCH.

(b) Laboratory project.
(d) Experimental; design.
(e) The design, construction, and calibration of a 24-inch variable-pressure water tunnel, to provide a jet of water approximately 24 inches in diameter and traveling at a speed of 50 knots. Provisions will be made to vary the pressure of a jet from pressures approaching vapor pressures to at least 2 atmospheres. A 1:4 model study of the proposed design is being made at the St. Anthony Falls Hydraulic Laboratory, University of Minnesota. The test section will be provided with proper fittings so that the tunnel may be operated as an open or closed jet.
(f) Active. The preliminary hydraulic design of the tunnel has been completed. A dynamometer is being developed for propeller tests.
See also Project No. 105, "Water Tunnel Design Studies", St. Anthony Falls Hydraulic Laboratory, page 80.

(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 electromagnetic 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.
(f) Active.
(h) "Measurement of intensity of turbulence in water by dye diffusion", M. S. Macovsky, W. L. Stracke and J. V. Wehausen. TMB Report 700. July 1949.

(468) FRICTIONAL RESISTANCE RESEARCH.

(b) Laboratory project.
(d) Experimental and theoretical; basic research.
(e) An extensive program to find more precise information about the frictional resistance of ship models, with particular emphasis on the boundary layer about hydrodynamic forms and means for stimulating turbulence to simulate full-scale boundary-layer conditions on the model. Instrumentation is being developed for detecting transition, for measuring the intensity of turbulence, and for measuring boundary-layer thickness.

Theoretical and experimental research on methods for characterizing hydraulic roughness of surfaces and frictional resistance of such surfaces, for a better understanding of the mechanism of frictional resistance arising from surface roughness. Extensive tests are planned to compare the resistance qualities of various ship bottom paints. Large flat plates are now being made, with coatings such as zinc chromate, cold plastic, hot plastic as presently applied, and hot plastic applied by new flame spray method developed at Mare Island Naval Shipyard, for towing tests. Determination of laminar and turbulent flow about a ship model by means of chemical compounds is under way. Preliminary tests indicate that in turbulent areas the chemical is washed away while in laminar flow areas it is unaffected. Studies are also being conducted on the effect of transverse curvature on frictional resistance.

(f) Active.

(g) The hot-wire anemometer is being used successfully for measuring boundary-layer thickness and transition to turbulent flow. Boundary layer surveys have been made about the hull of a ship model, both with and without various turbulence stimulating devices and a comparative evaluation of the various stimulators have been made from the hot-wire surveys. Studies of boundary layer flow on flat plates under various conditions of stimulation with and without artificially imposed pressure gradients will be undertaken in the near future.

(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 hydrodynamic forms using the method of electric analogy. Equipotential lines may be mapped with a searching probe and pantograph, or the velocity distribution may be obtained directly, using a double-electrode probe. The apparatus is adaptable to both two- and three-dimensional forms.

(f) Active. Preliminary results obtained have been very satisfactory.

(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. It has been found that notwithstanding the serious limitations of the theory, its application to practical problems is promising. Therefore, functions are being prepared which will permit the computation of the wave resistance of normal ship forms as a routine matter.

(f) Active.

(710) TEST OF MAIN INJECTION SCOOPS AND OVERBOARD DISCHARGES.

(b) Bureau of Ships, U. S. Navy Department.

(d) Experimental; for design.

(e) Model tests are to be conducted to improve the design of main injection scoops and overboard discharges 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.

(f) Inactive; equipment is ready but testing is held up by higher priority work.

(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. Tests have been made on two Venturi-type test sections in a specially designed apparatus, with both fresh and sea water.
Another phase is concerned with the steady state cavity as formed behind a bluff obstacle in a stream. The shape of the bubble, the pressure gradients and temperatures within the bubble have been measured. The drag of various shapes in a cavity have also been measured. The work will include two- and three-dimensional cavity studies, questions of history of flow (i.e., type of cavitation obtained in a given pressure field, and the time element with regard to preliminary settling and also rate of acceleration), and pressures developed at collapse.
(f) Active; the experimental work in the first phase is completed and data are being analyzed. Work on the second phase is continuing.
(h) "The determination of critical pressures for the inception of cavitation in fresh and sea water", S. F. Crump. TMB Report No. 575. October 1949.

(712) VARIABLE-PRESSURE FREE-SURFACE TEST FACILITY.

(b) Laboratory project.
(d) Experimental; design.
(e) Design studies and research are conducted for the construction of either a variable-pressure circulating water channel or a variable-pressure model basin. This facility will provide a test section water speed of 10 knots or a carriage speed of 10 knots. Provisions will be made to vary the test section pressure from about vapor pressure to 1 atmosphere.
(f) Suspended.

U. S. NAVY DEPARTMENT, NAVAL ORDNANCE LABORATORY.

(713) PRESSURE FIELD SURROUNDING HIGH-VELOCITY SPHERES IN WATER.

(b) Office of Naval Research and Bureau of Ordnance, U. S. Navy Department.
(c) Dr. J. Howard McMillen, Naval Ordnance Laboratory, White Oak, Silver Spring 19, Md.
(d) Experimental and theoretical; basic research.
(e) Measurements of the pressure field ahead of a sphere traveling with velocity 0.2 that of sound is being measured by spark shadowgram method. Pressures range from 500 to 50 atmospheres. A grid is used to measure deflection of optical rays in the pressure field surrounding the sphere. Measurements are being compared with steady-state potential flow theory after it has been corrected for finite velocity of pressure adjustment.
(f) Active.
(g) Preliminary results show that the pressure falls off more slowly with the radial distance than the perfect fluid theory predicts.

(714) ENTRY OF HYPER-VELOCITY SPHERES INTO WATER.

(b) Office of Naval Research and Bureau of Ordnance, U. S. Navy Department.
(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 fps. Refraction of the light rays and their relationship to the impact pressure and shock wave is being investigated.
(f) Active.
(g) It was found that immediately after entry, the shock wave is opaque to light. After immersion to about ten sphere diameters, the refracted light from the shock-wave front breaks up into lines and bands.

(715) WATER-ENTRY CAVITY FORMATION.

(b) Office of Naval Research and Bureau of Ordnance, U. S. Navy Department.
(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 is being carried out. The velocity range is that used in model studies for weapons and is below 200 fps. For the most part, spheres and cylinders are being used, and emphasis has been on vertical entry.
(f) Active.
(g) Information has been obtained on times of deep-closure and surface-seal, velocity of cavity wall, splash characteristics, and behavior of jets.

(716) SCALING LAWS OF WATER ENTRY.

(b) Office of Naval Research and Bureau of Ordnance, U. S. Navy Department.
(c) Dr. Albert May, Naval Ordnance Laboratory, White Oak, Silver Spring 19, Md.
(d) Experimental; basic and applied research.
(e) The investigation is 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 atmosphere above the water. Entry velocities range from 15 to 250 fps. Most of the work has been with spheres at vertical entry.
(f) Active.
(g) Results so far have shown the general trend of the scaling behavior, but more data are required before definite scaling relationships can be established.

(717) DRAG COEFFICIENTS OF SPHERES AND CYLINDERS AT WATER ENTRY.

(b) Office of Naval Research and Bureau of Ordnance, U. S. Navy Department.
(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) Active.
(g) Drag coefficient for low-velocity spheres during cavity stage depends significantly on the Reynolds and Froude numbers, as well as on gas density above the water. Preliminary data at velocities above 5000 fps (supersonic) indicate that the drag coefficient is higher than for subsonic spheres.

U. S. NAVY DEPARTMENT, BUREAU OF SHIPS, U. S. Naval Engineering Experiment Station.

Inquiries concerning Projects Nos. 472, 473, 1035 and 1036 should be addressed to the Director, Bureau of Ships, U. S. Navy Department, Washington 25, D. C.

(472) CONDENSER TUBE ALLOYS: SEA WATER CORROSION AND EROSION.

(b) Bureau of Ships, Navy Department.
(d) Experimental; for design.
(e) This investigation is 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. In the present run 12 alloys are being studied. Future work includes tests of other alloys, and a study of the effect of water box design and the value of plastic inserts for the protection of tube inlets.
(f) Active.
(h) The first test report, C-3428, should be available in the early part of 1951.

(473) SALT WATER PIPING: MATERIALS AND DESIGNS.

(b) Bureau of Ships, Navy Department.
(d) Experimental; for design.
(e) Full scale experimental piping systems have been installed at the Marine Test Site, Kure Beach, N. C. for testing in sea water at various velocities. A number of materials, the most important of which are modifications of standard 70:30 copper-nickel alloy, are being studied to determine the effectiveness of plastic inserts for the prevention of corrosion-erosion damage on the downstream side of fittings. Various designs of fittings are being explored, including a special design enabling the insertion of the plastic inserts. Objectives include reduced weight, longer life, higher allowable water velocities and the conservation of critical materials.
(f) Active.
(g) Preliminary results include data on systems tested in brackish Severn River water and on periodic inspections of systems operating in sea water at Kure Beach. All results are included in the following references, available from the Bureau of Ships.
(h) Test Reports as follows:
C-1195, "Preliminary report on erosion effect of orifice plate on valve". December 30, 1944.
C-1195-C, Final report on above. June 2, 1945.
C-1195-B, "Effect of bronze fittings and heated sections on Cu-Ni piping". March 23, 1945.
C-1195-D, "Preliminary report on valves with monel seats and with discs overlaid with silver brazing alloy". June 15, 1945.
C-1195-D-1, Continuation of above. May 14, 1946.
C-1195-E, "Effect of velocity and turbulence on corrosion rates of salt water piping alloys". June 10, 1945.
C-1195-F, Continuation of above. December 10, 1945.
C-2369, "Flanges and fittings, silver brazed, standard and modified, for use in salt water piping". December 10, 1946.
C-2369-B, Same as above. December 31, 1947.
C-3176-B, "Materials and design features for salt water piping systems". March 9, 1949.
C-3176-C, "Paint for protection of metal surfaces exposed to moving sea water". June 1, 1949.

887657 O—50——13

(1035) VARIABLE CAPACITY PLUNGER PUMPS.

(b) Bureau of Ships, Navy Department.
(d) Field investigation; for operation.
(e) Two designs of variable stroke plunger pumps were tested to determine performance characteristics when handling fuel oil of various viscosities and at varying capacity rates when operating under automatic control. On one pump, stroke variation was accomplished by applying reciprocating motion from the crank shaft so as to oscillate the plunger connecting-rod laterally. The free end of the connecting rod was attached to a shoe which was guided in a circular pivoted arc. The radius of the arc was equal to the connecting rod length. Plunger stroke was therefore dependent upon the angular position of the arc which was positioned by a hydraulic piston.
On the other pump, the variation in stroke was accomplished by variable throw eccentrics positioned radially by a hydraulic piston. On both units, the hydraulic pistons were actuated by oil supplied from the pump forced lubrication system, and air pressure controllers were used to operate pilot valves in the oil supply to the hydraulic pistons.
(f) Completed.
(g) One of these pumps functioned as intended. Operation of the other unit was generally accompanied by fluctuations in the pump discharge pressure.
(h) "Variable capacity pump for class M-1 and M-2 service", Test C-3506, August 9, 1949. Test C-3637, January 1950. Obtainable only through Bureau of Ships.

(1036) RETURN LINES FOR LUBRICATING OIL SYSTEMS.

(b) Bureau of Ships, Navy Department.
(d) Experimental; for design.
(e) The factors governing the flow of lubricating oil in return lines from shipboard turbine main bearing housings to the lubricating oil sump were determined because of difficulties experienced with oil leakage on certain shipboard installations, apparently caused by flooded housings. Laboratory set-ups simulated actual installations comprising two bearings and a common return sump. Controlled variables were: oil flow rate, vented or closed housings, amount of air in the oil and free or submerged delivery into return sump.
(f) Completed.
(g) Under certain conditions, air from one housing was entrained and compressed by return oil falling by gravity in the vertical return pipe and subsequently was forced into the other housing, where the similar pumping effect was less pronounced. This resulted in flooding of the second housing, the development of positive pressure therein and the loss of oil through the shaft seals. The report contains curves and data to serve as a guide in correcting similar existing difficulties and useful in the design of new installations.
(h) "Venting of oil lines and elbows", Test C-3270. Obtainable only through Bureau of Ships.

U. S. NAVY DEPARTMENT, NAVAL BOILER AND TURBINE LABORATORY.

(1037) ORIFICE METER INSTALLATION.

(b) Laboratory project; also sponsored by the Joint AGA, ASME Committee on Fluid Meters.

(c) Attn. Code 760, Director, Naval Boiler and Turbine Laboratory, Philadelphia Naval Base, Philadelphia 12, Pa.
(d) Experimental; applied research.
(e) Tests are being conducted with an orifice metering section in a 4-inch steam line with a globe valve, expansion bend, and combination of the valve and bend at various distances preceding the orifice, and at various orifice ratios, to determine the minimum length of straight pipe required before the orifice.
(f) Active.

TENNESSEE VALLEY AUTHORITY, Hydraulic Data Branch.

Inquiries concerning Projects Nos. 723 to 775, incl., 777, 778, 779, 780, 782, 783, 785, 786, 787, and 1038 to 1042, incl., should be addressed to Albert S. Fry, Chief, Hydraulic Data Branch, Tennessee Valley Authority, Knoxville, Tenn.

Hydraulic Laboratory Section, Norris, Tenn.

(723) FONTANA DAM, SPILLWAY MODEL STUDIES.

(b) Tennessee Valley Authority.
(d) Experimental; for design.
(e) Tests on models at scales of 1:100 and 1:51 were made to develop spillway structures for Fontana Dam that would dissipate the energy of flood overflows without danger of damage to the dam or adjacent structures.
(f) Tests completed; report in preparation.
(g) A spillway utilizing the two tunnels constructed for diversion of river flow during construction was developed. Water enters the tunnels through tainter gates back of inclined tunnels intersecting the diversion tunnels. Curved buckets at the outlet ends of the diversion tunnels throw the spillway discharge into the air and spread this over the entire width of the river for several hundred feet downstream. A small curved, emergency spillway discharging through a short tunnel under the reservoir rim provides for excess discharge.

(724) FONTANA DAM, LOW-LEVEL OUTLET, HOWELL-BUNGER VALVE MODEL STUDIES.

(b) Tennessee Valley Authority.
(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; report in preparation.
(g) Structures in the neighborhood of the Howell-Bunger valve were developed which gave satisfactory flow conditions in the 15-foot diameter tunnel below this area. These structures were also designed to keep to a minimum quantity the air required when the valve is discharging.

(725) FONTANA DAM, LOW LEVEL OUTLET, OUTLET STRUCTURE MODEL STUDIES.

(b) Tennessee Valley Authority.
(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 without danger of damage to any adjacent structures.

(f) Tests completed; report in preparation.
(g) A comparatively simple outlet structure, satisfactory under all conditions, was developed.

(726) FONTANA DAM, CAVITATION STUDIES.

(b) Tennessee Valley Authority.
(d) Experimental; for design.
(e) Tests were made to develop specifications for permissible variation in tunnel alignment so as to prevent cavitation damage to the walls of the Fontana spillway tunnels. They were conducted in open and closed channels having obstructions on the floors or sides in the form of portions of circular curves of known radii and height.
(f) Tests completed; report in preparation.
(g) Data were obtained to formulate specifications setting up the maximum permissible height and length of irregularities on the tunnel surface.

(727) HALES BAR DAM, SPILLWAY MODEL STUDIES.

(b) Tennessee Valley Authority.
(d) Experimental; for design.
(e) Tests were made on a 6-bay 1:34.76 model of the spillway to develop a modification of the existing apron to prevent erosion and to aid in reconstruction and raising of the dam.
(f) Tests completed; report in preparation.
(g) The necessary modifications to the existing spillway were determined.

(1038) HALES BAR DAM, SPILLWAY APPROACH STUDIES.

(b) Tennessee Valley Authority.
(d) Experimental; for design.
(e) Tests were made on a model at a scale of 1:65 to determine the effect of the remains of cofferdam structures upstream of the spillway on the spillway discharge and to determine the amount of the obstructions which should be removed.
(f) Testing in progress.

(1039) CHANNEL STUDIES BELOW HALES BAR DAM.

(b) Tennessee Valley Authority.
(d) Experimental; for design.
(e) Tests on a 1:65 scale model are to be made to study the effect of various channel alignments on the spillway discharge and navigation conditions, and to determine the effect of the location of the proposed lock and of the operation of the spillway gates on navigation conditions.
(f) The model is nearing completion.

(728) SOUTH HOLSTON AND WATAUGA DAMS, SPILLWAY MODEL STUDIES.

(b) Tennessee Valley Authority.
(d) Experimental; for design.
(e) Tests on 1:100 and 1:51 models were made to develop a morning-glory type of spillway which would safely handle the flood overflows.
(f) Tests completed; preliminary report prepared.

(g) The tests resulted in modifications to the usual type of morning-glory structure which produced satisfactory operating characteristics. These consist primarily of properly located piers on the spillway crest and a deflector in the vertical shaft which deflects the flow against the outside of the 90 degree vertical bend at the bottom of the shaft.

(729) SOUTH HOLSTON AND WATAUGA DAMS, SLUICEWAY MODEL STUDIES.

(b) Tennessee Valley Authority.
(d) Experimental; for design.
(e) Tests on 1:34 and 1:51 models were made to develop structures that would dissipate the energy from the discharge through two 96-inch Howell-Bunger valves located in a tunnel 34 feet in diameter. Structures were also developed to produce satisfactory flow conditions at a 29 degree Y intersection where the discharge from the Howell-Bunger valves entered the tunnel leading from the morning-glory spillway.
(f) Tests completed; report prepared.
(g) A roof section and a heavy weir placed just below the Howell-Bunger valves were developed which gave satisfactory flow conditions. These structures, combined with those developed at the Y intersection, gave satisfactory operation through the entire tunnel system. The Y structures consisted of a small weir and two vertical piers, all specifically shaped to give the proper operating characteristics.

(730) SOUTH HOLSTON DAM, SPILLWAY OUTLET MODEL STUDIES.

(b) Tennessee Valley Authority.
(d) Experimental; for design.
(e) Tests on a 1:51 model were made to develop an outlet structure that would dissipate the energy from the morning-glory spillway and the Howell-Bunger valve sluiceway without danger of damage to the tunnel or outlet structures.
(f) Tests completed; report prepared.
(g) A spillway outlet which dissipated the energy within the stilling basin was developed by flaring the 34-foot diameter tunnel outlet, depressing the roof, and placing a spreader pier and deflecting block in the center of the outlet. A stilling basin, 350 feet long and flaring to a width of 125 feet with a 6-foot end sill, was used beyond the outlet structure.

(731) SOUTH HOLSTON DAM, SURGE TANK MODEL STUDY.

(b) Tennessee Valley Authority.
(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) The results indicate that 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.

(b) Tennessee Valley Authority.

(d) Experimental; for design.
(e) A fixed-bed 1:70 model of the river in the vicinity of the powerhouse was built to determine whether bed load moved by the spillway discharge would be deposited in the powerhouse tailrace and, if so, how such deposition 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 immediately below.

(733) HENDERSON COUNTY WEIR CALIBRATION.

(b) Tennessee Valley Authority.
(d) Experimental; for design.
(e) Studies were made on a 1:5 model of a modified Columbus deep-notch weir approximately 40 feet wide with a silting basin approximately 150 feet long, upstream from the weir.
(f) Tests completed; preliminary report prepared.
(g) The ratings for various amounts of silt in the silting basin were determined, and a modification of the silting basin developed.

(734) WHITE CREEK SILT SAMPLER.

(b) Tennessee Valley Authority.
(d) Experimental; for design.
(e) Full-scale studies were made to develop a continuous sampling device which would collect 1/100,000 part of any discharge between 0.7 and 244 cubic feet per second.
(f) Design, calibration, and field installation completed; report in preparation.
(g) The developed sampler consists of a weir plate shaped to pass approximately 1/100 of the flow over the main measuring weir. Following the weir plate are two splitting sections, one of which recovers approximately one-tenth of the discharge, the other one-half. The final splitting is achieved by ponding the water in a bucket which tilts automatically when the water reaches a given level. The sampler was calibrated in the laboratory and was found to retain 1/105,000 part of the total stream discharge. The sample is stored for future sampling and testing.

(1040) A STUDY OF THE EFFECT OF MODEL SIZE ON SPILLWAY DISCHARGE COEFFICIENTS.

(b) Tennessee Valley Authority in cooperation with the American Society of Engineering Education and the University of Tennessee.
(d) Experimental; applied research for master's thesis.
(e) Tests on models at scales of 1:50, 1:100, and 1:200 of three bays of the Pickwick Landing Dam spillway were conducted to determine the effect of the model scale on the free discharge coefficient.
(f) Tests completed; report prepared.
(g) The test results showed that the discharge coefficient curves obtained from each model were identical for all prototype heads between 3 and 45 feet.
(h) "A study of the effect of model size on spillway discharge coefficients", C. R. Ownbey, submitted to the University of Tennessee. June 1949.

(735) TURBINE DISCHARGE RATINGS.

(b) Tennessee Valley Authority.
(d) Field tests; applied research.

(e) Field measurements of turbine discharges are being made in an attempt to rectify discrepancies and increase accuracy in the reported discharges at many of the Authority's dams. Gibson tests, made at Norris Dam to rate the turbines, gave excellent verification of the accuracy of current-meter measurements made under normal conditions. For dams on tributary rivers with only one or two units, the discharges are to be determined by current-meter measurements in the river a short distance below the dam. On the main river, with several units in operation at each dam and river stages not easily stabilized, discharges are to be determined for individual turbines by obtaining velocity traverses in the turbine intakes. Propeller type current-meters, mounted to swing freely in the horizontal and vertical directions and equipped with a device for transmitting the magnitudes of the angular motions to the deck, will be used. The results are to be used in obtaining discharge coefficients for the scroll case pressure taps. Hourly and daily discharges can then be obtained by standard flow-meter methods.
(f) The Norris and Fontana units have been rated. Equipment is being developed for measurements at the main-river dams. Testing at the tributary installations is being carried forward as rapidly as possible.
(g) To develop the instruments for the turbine intake measurements, enough necessary equipment to allow the use of one meter was built at the Laboratory. This meter and auxiliary equipment was rated at the National Bureau of Standards and then field-tested at Watts Bar Dam. These tests proved that the basic ideas are sound and practical, but some redesign and expansion are desirable.

(736) APALACHIA DAM, SPILLWAY RATING.

(b) Tennessee Valley Authority.
(d) Experimental; operation.
(e) Tests are to be used in determining the discharge ratings for all anticipated operating conditions. The tests will be checked by field measurements wherever possible. Discharge tables in a form suitable for operating purposes will be prepared from the combined model and field test data.
(f) Model studies are completed.

(737) CHATUGE AND NOTTELY DAMS, SLUICE RATING.

(b) Tennessee Valley Authority.
(d) Field investigation; operation.
(e) Field measurements of discharge and pressures, made on the Howell-Bunger valve used to control the discharge through this sluiceway, were used to compile tables of the discharge for any valve opening at any gross head value within the expected operating range.
(f) Field tests completed; discharge tables completed and issued.

(738) CHEROKEE DAM, SPILLWAY RATING.

(b) Tennessee Valley Authority.
(d) Experimental; operation.
(e) Tests are to be used in determining the spillway discharge ratings for all anticipated operating conditions. The model tests will be checked by field measurements wherever possible. Discharge tables in a form suitable for operating purposes will be prepared from the combined model and field test data.
(f) Model studies are completed.

(739) CHEROKEE DAM, SLUICE RATING.

(b) Tennessee Valley Authority
(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 eight sluices. Tables showing the discharge for any gate opening at any headwater elevation within the operating range are to be prepared.
(f) Discharge and pressure measurements are partially completed. Work is continuing.

(740) CHICKAMAUGA DAM, SPILLWAY RATING.

(b) Tennessee Valley Authority.
(d) Experimental; operation.
(e) Tests were used in determining the spillway discharge ratings for all anticipated operating conditions. The model tests will be checked by field measurements wherever possible. Discharge tables in a form suitable for operating purposes were prepared from the model test data.
(f) Testing completed; tables prepared and issued.

(741) DOUGLAS DAM, SPILLWAY RATING.

(b) Tennessee Valley Authority.
(d) Experimental; operation.
(e) Tests are to be used in determining the spillway discharge ratings for all anticipated operating conditions. The model tests will be checked by field measurements wherever possible. Discharge tables in a form suitable for operating purposes will be prepared from the combined model and field test data.
(f) Model studies are completed.

(742) DOUGLAS DAM, SLUICE RATING.

(b) Tennessee Valley Authority.
(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 eight sluices. Tables showing the discharge for any gate opening at any headwater elevation within the operating range are to be prepared.
(f) Discharge and pressure measurements are partially completed. Work is continuing.

(743) FONTANA DAM, LOW-LEVEL OUTLET RATING.

(b) Tennessee Valley Authority.
(d) Field investigation; operation.
(e) Field measurements of discharge and pressures were made on the Howell-Bunger valve used to control the discharge through this sluiceway. These measurements were used to compile tables of the discharge for any valve opening at any gross head value that lies within the expected operating range.
(f) Field tests completed; discharge tables completed and issued.

(744) FONTANA DAM, LOW-LEVEL OUTLET, AIR DEMAND STUDIES.

(b) Tennessee Valley Authority.
(d) Field investigation; operation.
(e) Field measurements of the air demanded by the operation of the 84-inch Howell-Bunger valve were made by the use of a portable anemometer in the access gallery leading to the valve chamber. The valve was operated through its entire range of openings and at heads ranging from 168 to 309 feet.
(f) Tests completed; 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. It was also found that a constant ratio of air to water exists at each valve opening position.

(745) FONTANA DAM, SLUICE RATING.

(b) Tennessee Valley Authority.
(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 showing the discharge for any gate opening at any headwater elevation within the operating range are to be prepared.
(f) Discharge and pressure measurements are partially completed. Work is continuing.

(746) FORT LOUDOUN DAM, SPILLWAY RATING.

(b) Tennessee Valley Authority.
(d) Experimental and field investigation; operation.
(e) Tests are to be used in determining the discharge ratings for all anticipated operating condutions. The model tests will be checked by field measurements wherever possible. Discharge tables in a form suitable for operating purposes will be prepared from the combined model and field test data.
(f) Model studies are completed.

(747) GUNTERSVILLE DAM, SPILLWAY RATING.

(b) Tennessee Valley Authority.
(d) Experimental and field investigation; operation.
(e) Tests were used in determining the discharge ratings for all anticipated operating conditions. The model tests will be checked by field measurements wherever possible. Discharge tables in a form suitable for operating purposes were prepared from the model test data.
(f) Testing completed; tables prepared and issued.

(748) HALES BAR DAM, SPILLWAY RATING.

(b) Tennessee Valley Authority.
(d) Experimental and field investigation; operation.
(e) Tests are to be used in determining the discharge ratings for all anticipated operating conditions. The model tests will be checked by field measurements wherever possible. Discharge tables in a form suitable for operating purposes will be prepared from the combined model and field test data.
(f) Model studies completed; preliminary rating tables issued.

(749) HIWASSEE DAM, SPILLWAY RATING.

(b) Tennessee Valley Authority.
(d) Experimental and field investigation; operation.
(e) Tests were used in determining the discharge ratings for all anticipated operating conditions. The model tests will be checked by field measurements wherever possible. Discharge tables in a form suitable for operating purposes were prepared from the model test data.
(f) Testing completed; tables prepared and issued.

(750) HIWASSEE DAM, SLUICE RATING.

(b) Tennessee Valley Authority.
(d) Field investigation; operation.
(e) Field measurements of discharge were used to establish the discharge ratings for the four sluices. Tables showing the discharge for a wide-open gate at any headwater elevation within the operating range were prepared.
(f) Tests completed; tables computed and issued.

(751) KENTUCKY DAM, SPILLWAY RATING.

(b) Tennessee Valley Authority.
(d) Experimental and field investigation; operation.
(e) Tests were used in determining the discharge ratings for all anticipated operating conditions. The model tests will be checked by field measurements wherever possible. Discharge tables in a form suitable for operating purposes were prepared from the model test data.
(f) Testing completed; tables prepared and issued.

(752) NORRIS DAM, SLUICE RATING.

(b) Tennessee Valley Authority.
(d) Field investigation; operation.
(e) Field measurement of discharges and differential pressures in the sluices were used to establish the discharge ratings for the eight sluices. Tables showing the discharge for any gate opening at any headwater elevation within the operating range were prepared.
(f) Tests completed; tables computed and issued.

(753) OCOEE NO. 3 DAM, SPILLWAY RATING.

(b) Tennessee Valley Authority.
(d) Experimental and field investigation; operation.
(e) Tests are to be used in determining the discharge ratings for all anticipated operating conditions. The model tests will be checked by field measurements wherever possible. Discharge tables in a form suitable for operating purposes will be prepared from the combined model and field test data.
(f) Model studied are completed.

(754) PICKWICK LANDING DAM, SPILLWAY RATING.

(b) Tennessee Valley Authority.

(d) Experimental; operation.
(e) Tests were used in determining the discharge ratings for all anticipated operating conditions. The model tests will be checked by field measurements wherever possible. Discharge tables in a form suitable for operating purposes were prepared from the model test data.
(f) Testing completed; tables prepared and issued.

(755) WATTS BAR DAM, SPILLWAY RATING.

(b) Tennessee Valley Authority.
(d) Experimental; operation.
(e) Tests are to be used in determining the discharge ratings for all anticipated operating conditions. The model tests will be checked by field measurements wherever possible. Discharge tables in a form suitable for operating purposes will be prepared from the combined model and field test data.
(f) Model studies are completed.

(756) WILSON DAM, SPILLWAY RATING.

(b) Tennessee Valley Authority.
(d) Experimental and field investigation; operation.
(e) Tests were used in determining the discharge ratings for all anticipated operating conditions. The model tests will be checked by field measurements wherever possible. Discharge tables in a form suitable for operating purposes were prepared from the model test data.
(f) Testing completed; tables prepared and issued.

(757) APALACHIA DAM, TUNNEL FRICTION.

(b) Tennessee Valley Authority.
(d) Field investigation; for design.
(e) Field test measurements were made to determine the friction and roughness coefficients for three different surfaces. The sections tested were an 18-foot diameter steel pipe coated with bituminous paint, an 18-foot diameter concrete-lined tunnel, and unlined rock tunnel of 20- and 22-foot nominal diameters. Discharges during the tests varied from 975 to 3210 cubic feet per second.
(f) Project completed.

(758) CHEROKEE DAM, PROTOTYPE CHECK TESTS.

(b) Tennessee Valley Authority.
(d) Field investigation; applied research.
(e) Field measurements of pressures in sluices are being obtained when operating conditions will allow. These are to be compared with the pressures measured during the model tests..
(f) Work continuing.

(759) DOUGLAS DAM, PROTOTYPE CHECK TESTS.

(b) Tennessee Valley Authority.
(d) Field investigation; applied research.

(e) Field measurements of pressures in sluices are being obtained when operating conditions will allow. These are to be compared with the pressures measured during the model tests.
(f) Work continuing.

(760) FONTANA DAM, PROTOTYPE CHECK TESTS.

(b) Tennessee Valley Authority.
(d) Field investigation; applied research.
(e) Plaster surface impressions of carefully located sections are taken after each interval of extended tunnel discharge operation. These are inspected and compared to determine if there is any evidence of damage to this tunnel surface. The entire tunnel surface is carefully examined to determine if any damage due to erosion, cavitation, or structural failure has occurred.
(f) Work continuing.
(g) Inspections have been made in September 1946 and October 1949.

(761) KENTUCKY DAM, PROTOTYPE CHECK TESTS.

(b) Tennessee Valley Authority.
(d) Field investigation; applied research.
(e) Field measurements are made, when operating conditions will allow, of lateral pressures on the face of the spillway piers and on the submerged baffle piers on the spillway apron. These are to be compared with the results of the model tests.
(f) Work continuing.

(762) SOUTH HOLSTON DAM, PROTOTYPE CHECK TESTS.

(b) Tennessee Valley Authority.
(d) Field investigation; applied research.
(e) An electrical pressure cell is being installed in the South Holston penstock to obtain pressure data during turbine operation, which can then be compared with the data obtained from the model tests. The relative accuracy of the surge tank model can thus be determined.
(f) Design for the installation of the cell is complete. Construction of the penstock and installation of the cell is anticipated during the next year.

(763) HIWASSEE DAM, PROTOTYPE CHECK TESTS.

(b) Tennessee Valley Authority.
(d) Field investigation; applied research.
(e) Field measurements of pressures in sluices are being obtained when operating conditions will allow. These are to be compared with the pressures measured during the model tests.
(f) Work continuing.

(1041) DEVELOPMENT OF PRESSURE AND DIFFERENTIAL PRESSURE RECORDER.

(b) Tennessee Valley Authority.
(d) Experimental; for development and operation.
(e) To develop an instrument for recording differential pressures and pressures accurately.

(f) Development is in progress.
(g) A recording instrument has been developed which will record accurately pressures or differential pressures 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.

Hydro-Meteorological Section, in collaboration with Field Investigations Section.

(764) DETERMINATION OF SEDIMENT CARRIED IN SUSPENSION BY TENNESSEE RIVER AND TRIBUTARIES.

(b) Tennessee Valley Authority.
(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.
(g) The project furnishes positiye data on the quantity of sediment carried into each reservoir and on the relative erosion of various areas.

(766) GROUND WATER INVESTIGATIONS.

(b) Tennessee Valley Authority.
(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 have been discontinued.
(g) Preliminary reports have been prepared for internal use; conditions have been found to be normal at all sites studied.

(767) RESERVOIR RIM INVESTIGATIONS.

(b) Tennessee Valley Authority.
(d) Field investigation; basic research.
(e) To determine the leakage, if any, through rims of new reservoirs, and to check conditions for other reservoirs. Ground water levels are observed in observation wells, and post-impoundage levels are compared with pre-impoundage records; stream flow from rim areas is likewise measured by gaging stations and weirs, and volumes of flow are compared to determine whether any increase has occurred after creation of a reservoir. Observations are being made at Kentucky, Guntersville, Watts Bar, Fort Loudoun, Norris, Cherokee, Douglas, and Watauga Reservoirs.
(f) Active.
(g) Preliminary report has been prepared for internal use. No serious leakage conditions have been found.

(769) RESERVOIR AND STREAM TEMPERATURES.

(b) Tennessee Valley Authority.
(d) Field investigation; basic research.
(e) Study of water utilization and water movement as concerns industrial plant locations

and stream pollution. Variations in water temperature from surface to bottom throughout the year are determined by soundings taken with Bathythermograph or resistance thermometer along established ranges across reservoirs, and by continuous recording temperature gages at selected stations on natural streams. Observations have been completed in Norris, Cherokee, Douglas, Hiwassee, and all main-stream reservoirs. They are being continued in Watts Bar Reservoir and at certain water levels in Fontana Reservoir, and have been initiated in Watauga Reservoir. Recorders are in service below the major projects on all principal tributaries of the Tennessee River above Chattanooga and at two depths in Kentucky Reservoir near Johnsonville, Tennessee.

(f) Active.

(770) INVESTIGATION OF WINDS AND WAVE HEIGHTS.

(b) Tennessee Valley Authority.
(d) Field investigation; basic research.
(e) Investigation for obtaining factual data on occurrence of waves of various heights as concerns navigation on TVA lakes; also to develop relationship of wave heights to winds for design purposes. Three installations which measure and record wave heights and wind velocities and directions were placed in TVA reservoirs at water depths of 40 feet, 30 feet, and 10 feet. Special apparatus capable of measuring waves 7 feet in height was designed. Records collected over a period of several years will be correlated to show the relation between winds and wave heights and the frequency of occurrence of high waves. Observations have been discontinued in Wheeler Reservoir and are now being made in Kentucky Reservoir.
(f) Active.
(g) Records are analyzed currently, and special requests are answered by reference to the available data.

(771) GALLERY DRAINAGE IN LARGE DAMS.

(b) Tennessee Valley Authority.
(d) Field investigation; design.
(e) Weirs are placed in main galleries, and drainage is measured as a check on tightness and stability of dams. Observations are made in Pickwick Landing, Watts Bar, Fort Loudoun, Hiwassee, Fontana, Norris, Cherokee, and Douglas Dams.
(f) Active.
(g) Reports are prepared annually for internal use.

(783) WHITE AND RICHLAND CREEKS - DETERMINATION OF ROUGHNESS COEFFICIENT.

(b) Tennessee Valley Authority.
(d) Field investigation; basic research.
(e) Determination of roughness coefficients in several river reaches of known discharge is being made to extend the knowledge of relation between roughness coefficient and physical characteristics of river channels.
(f) Active.

(786) WATER TRAVEL IN NATURAL STREAMS.

(b) Tennessee Valley Authority.
(d) Field investigation; applied research.
(e) Studies are made for observing and measuring the sanitary and chemical changes taking place in water during its passage downstream. A given mass of water is identified by

its electrical conductivity characteristics, or in special cases by means of titration for varying chemical concentration.
(f) Observations have been made since 1943 and are being continued.

(787) MOVEMENT OF WATER THROUGH LARGE RESERVOIRS.

(b) Tennessee Valley Authority.
(d) Field investigation; applied research.
(e) Same as Project No. 786, "Water Travel in Natural Streams", page 194, except that the investigator must travel through the reservoir collecting samples rather than wait for the water to pass a certain station, due to slower water travel.
(f) Studies have been made in Cherokee, Douglas, Fort Loudoun, and Watts Bar Reservoirs, and are being continued.
(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. For example, 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.

(b) Tennessee Valley Authority.
(d) Field investigation; 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.
(f) Active reports on certain tributaries are in progress.

(773) INVESTIGATIONS OF SPRINGS AND RUNS BELOW DAMS.

(b) Tennessee Valley Authority.
(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.
(f) Active.
(g) Records have shown no appreciable leakage through any dam which has been constructed to date.

(774) RADIO GAGES FOR REPORTING RAINFALL AND RIVER STAGES.

(b) Tennessee Valley Authority.
(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. Nineteen radio rain gages and 23 radio stream gages are now being operated with a high degree of reliability. Wherever electric power is within a reasonable distance, A-C

converters have been installed with stand-by batteries charged automatically and switched into operation in event of a power failure.
(f) Active.
(g) The gages have provided a prompt means of obtaining reports when other forms of communication have been disrupted, and from localities where other forms of communication or the services of observers are unavailable.

(775) BACKWATER EFFECT OF RESERVOIRS ON SMALL TRIBUTARIES.

(b) Tennessee Valley Authority.
(d) Field investigation; operation.
(e) On small tributaries where backwater from reservoirs might conceivably cause tributaries to flood adjacent lands at elevations higher than level pool, automatic crest markers were located to record the crest elevations reached by the tributary floods. Profiles obtained before filling of a reservoir are compared with those for similar discharges after filling to determine the effect of backwater. Crest markers are in service in Kentucky, Chickamauga, Watts Bar, and Hales Bar Reservoirs.
(f) Active.

Hydraulic Investigations Section in collaboration with Field Investigations Section.

(765) EVAPORATION IN THE TENNESSEE BASIN.

(b) Tennessee Valley Authority.
(d) Field investigation; applied research.
(e) Purpose is to provide data for estimating reservoir losses and to derive a general rule, applicable to the Tennessee River Basin, that will permit the computation of evaporation from known meteorological phenomena. Accurate daily measurements are made of evaporation from a pan at six locations in the Basin, together with readings of standard meteorological equipment.
(f) Continuous records are being kept.

(768) PRECIPITATION IN TENNESSEE RIVER BASIN.

(b) Tennessee Valley Authority.
(d) Field investigation; basic research.
(e) A comprehensive study of rainfall and other weather phenomena in and adjacent to the watershed for purposes of water dispatching and improvements in water-control techniques; also for storm studies as related to maximum precipitation, rainfall-runoff relation, spillway design and operation, and other purposes. Records from approximately 550 TVA, U. S. Weather Bureau, and private rain gages in the Tennessee Valley are used to furnish meteorological data for planning and operating water-control projects and for agricultural and other purposes. Special investigations are made of unusual storms.
(f) Continuous records are kept.
(h) The bulletin, "Precipitation in Tennessee River Basin", is issued monthly by the Hydraulic Data Branch, Tennessee Valley Authority. An annual summary bulletin is also issued.

(1042) WIND VELOCITIES AND DIRECTIONS - WHITETOP MOUNTAIN.

(b) Tennessee Valley Authority in cooperation with U. S. Weather Bureau and Radio Station WOPI, Bristol, Tennessee.

(d) Field investigation; basic research.
(e) In connection with considerations of 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.
(f) Active.
(h) Beginning in October 1949, abstracts of the records are being published monthly in "Precipitation in Tennessee River Basin" (Project No. 768).

Hydraulic Investigations Section.

(777) RUNOFF-SILT INVESTIGATIONS ON SMALL WATERSHEDS.

(b) Tennessee Valley Authority.
(d) Field investigation; basic and applied research.
(e) The purpose is 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.
(f) Active.
(g) The projects in most instances have not been in operation a sufficient period for publication of final results.

(778) EFFECT OF ALTITUDE UPON RAINFALL.

(b) Tennessee Valley Authority.
(d) Field investigation; basic research.
(e) At four locations, rainfall data have been or are being collected for the purpose of determining the effect of altitude upon rainfall. 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.
(f) Active.

(779) MAXIMUM POSSIBLE PRECIPITATION IN TENNESSEE VALLEY.

(b) Tennessee Valley Authority, in cooperation 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.
(f) Active.
(g) Results will be published as one of the current series of hydrometeorological reports by the U. S. Weather Bureau and cooperating agencies.

(780) MONTHLY EVALUATION OF GROUND-WATER STORAGE.

(b) Tennessee Valley Authority.
(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.
(f) Active.
(g) Results are reported monthly within the organization.

887657 O—50——14

(782) SNOWFALL IN GREAT SMOKY MOUNTAINS.

(b) Tennessee Valley Authority, in cooperation with U. S. Weather Bureau and National Parks Service.
(d) Field investigation; basic research.
(e) Daily observations are made of snowfall, its water equivalent, temperature, and relative humidity data over a range with altitude variations from 1400 to 6300 feet in the Great Smoky Mountains National Park.
(f) Active.
(h) Processed data are available currently through cooperating agencies.

(785) SEDIMENTATION OF EXISTING RESERVOIRS.

(b) Tennessee Valley Authority.
(d) Field investigation; basic research.
(e) Selected ranges across reservoirs are probed and sounded for original and present bottom elevations, volumetric samples of deposited sediment are collected and analyzed, and tha quantity and distribution of sediment are computed to determine the quantity of sediment deposited by the stream, the probable life of the reservoir, the effect of sediment storage upon navigation channels and upon the sedimentation of downstream reservoirs, and to obtain data for estimating the probable sedimentation in comparable future developments. Echo sounding equipment has been used. Special mobile equipment has been developed for this work.
(f) Active. Field work is continuing in all reservoirs operated by the Authority.

THE UNIVERSITY OF BRITISH COLUMBIA, Department of Civil Engineering.

(1043) LOSS OF HEAD THROUGH FISH SCREENS.

(b) Experiments conducted by International Pacific Salmon Fisheries Commission.
(c) Professor E. S. Pretious, Department of Civil Engineering, The University of British Columbia, Vancouver, Canada.
(d) Basic research; for design.
(e) Tests were conducted on screens of different mesh sizes and gage with different angles of attack with the water.
(f) Suspended.
(h) Report waiting completion of project.

(1044) FRASER RIVER MODEL.

(b) Department of Public Works, Canada, in cooperation with the National Research Council of Canada and the University of British Columbia.
(c) Mr. J. H. Parkin, Director of Division of Mechanical Engineering, 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. The model occupies a tract of land roughly 3 acres in extent and represents the entire lower Fraser River from the Strait of Georgia to the head of tidewater at Sumas. It also includes Pitt Lake, which is tidal.
(f) Active.
(g) Model under construction.
(h) Progress and technical reports submitted periodically to the sponsors.

ECOLE POLYTECHNIQUE DE MONTREAL, Hydraulics Laboratory.

(266) HYDRAULIC MODEL STUDIES OF DIFFERENT SPILLWAY PROFILES.

(b) Laboratory project.
(c) Professor 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. Seven profiles have been studied, including two modifications of the Creager-Justin profile upstream of crest line.
(f) Suspended.

(268) CALIBRATION TESTS OF A SHARP-CRESTED PARABOLIC WEIR.

(b) Laboratory project.
(c) Professor Raymond Boucher, Ecole Polytechnique, Montreal 18, Canada.

(d) Experimental; applied research.
(e) To obtain the head-discharge curves and head-discharge coefficient curves for a sharp-crested parabolic weir (21-inch maximum width by 18-inch maximum height) having a capacity of 3 cfs. This weir is to be used in a new flume for model testing and open channel studies.
(f) Suspended.

(791) NEW METHOD OF UTILIZING THE WATER HAMMER FOR THE DETECTION OF LEAKS IN PIPES.

(b) Laboratory project.
(c) Professor 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.
(f) Active.

(1045) MODEL STUDY OF SPILLWAY AND FLOOD CHANNELS FOR TRENCHE DEVELOPMENT, SAINT-MAURICE RIVER, QUEBEC, CANADA.

(b) The Shawinigan Engineering Company, Limited, Montreal.
(c) Professor Raymond Boucher, Ecole Polytechnique, Montreal 18, Canada.
(d) Experimental; for design.
(e) Tests in a 1:75 model are being conducted to investigate the performance of the spillway and the curved flood channels as originally designed, to determine the height of the walls between the curved flood channels, and to verify the spillway discharge coefficients.
(f) Active.

(1046) MODEL STUDY OF THE ICE CONDITIONS ON THE SAINT-FRANCIS RIVER AT BROMPTONVILLE.

(b) The Foundation Company of Canada Limited, Montreal.
(c) Mr. J. M. Thomas, P. Eng., The Foundation Company of Canada Limited, Montreal 25, Canada.
(d) Experimental; applied research.
(e) Tests are conducted to investigate the causes of ice jams on the Saint-Francis River at Bromptonville. A model, of the fixed-bed type, reproduces 6500 feet of the river to an undistorted scale of 1:100. Paraffin wax is used to simulate ice.
(f) Active.

NATIONAL RESEARCH COUNCIL, Division of Mechanical Engineering.

Inquiries concerning Projects Nos. 475, 792, 793, 795, 1044, and 1047 should be addressed to The Director, Division of Mechanical Engineering, National Research Council, Ottawa, Canada.

(475) DESIGN OF TERMINAL DIFFUSERS.

(b) Laboratory project.
(d) Experimental; applied research.

(e) Tests were conducted on a number of cones of different length and included angle designed to recover a portion of the velocity head of a stream discharging into a reservoir.
(f) The project is suspended.
(g) Good efficiencies were obtained with wide angle cones using vanes to induce rotation. The results are contained in Laboratory Note: HY-1-49, "Performance of Short Terminal Diffusers" by J. B. Bryce.

(792) DIVERSION OF LOGS FROM A POWER PLANT INTAKE.

(b) Laboratory project.
(d) Experimental; for design.
(e) A study is being conducted on an existing design of power plant having the entrance to the forebay adjacent to the entrance of log chute. Difficulty is experienced in preventing logs from entering the forebay when the plant is operating at full load. Flow conditions were investigated with a 1:100 scale model and the control of logs is being studied with a 1:25 scale model using guide booms, racks and troughs.
(f) Active.
(g) Good results have been obtained with a trough to carry the logs across the entrance to the forebay.

(793) MODEL TESTS OF SPILLWAY.

(b) Department of Agriculture, Canada.
(d) Experimental; for design.
(e) A 1:60 scale model of a 12-bay inlet structure, transition section, rectangular canal and chute was studied to determine the discharge capacity and to investigate certain modifications.
(f) Completed.
(h) "Model studies of spillway for St. Mary Milk River Project", F. Rueter.
"Further model studies of spillway for St. Mary Milk River Project", A. E. Fee.

(795) SELF-PROPELLED MODEL TESTS.

(b) Laboratory project.
(d) Experimental; applied research.
(e) Two self-propulsion dynamometers have been calibrated and minor modifications made. Several methods of manufacturing small screws have been considered.
(f) Active.

(1044) FRASER RIVER MODEL.

(b) Department of Public Works, Canada.
See Project No. 1044, page 199.

(1047) FORCES ON LOGS IN A FLOWING STREAM.

(b) Laboratory project.
(d) Experimental; applied research.
(e) The drag and downward forces acting on logs floating in a flowing stream are being measured on model logs in a small flume to obtain information on the formation of

log jams behind holding booms.
(f) Active.

QUEEN'S UNIVERSITY, Faculty of Applied Science.

(1048) TIDAL MODEL OF STRAIT OF CANSO.

(b) Board of Engineers on the Crossing of the Strait of Canso.
(c) D. S. Ellis, Professor of Civil Engineering, Queen's University, Kingston, Ontario, Canada.
(d) Applied research.
(e) A model, with scales of 1:4800 horizontal and 1:360 vertical, of the Strait of Canso between Cape Breton and the Nova Scotia mainland was constructed to determine the effect on tidal currents of a causeway across the Strait. The strait, about 18 miles long and 3500 feet wide at its narrowest point, extends from the Atlantic Ocean to the Gulf of St. Lawrence.
(f) The tidal mechanism is being altered to use separate motor drives at each end. Work is being continued to see how well this model will reproduce the main features of flow through the Strait.
(h) A brief description of the project was given in the report of the Board of Engineers to the Dominion Government and to the Government of Nova Scotia.

UNIVERSITY OF TORONTO, Department of Mechanical Engineering.

Inquiries concerning Projects Nos. 1049, 1050, and 1051 should be addressed to Prof. G. R. Lord, Department of Mechanical Engineering, University of Toronto, Toronto, Canada.

(1049) PERFORMANCE OF SPILLWAY OF SPECIAL OGEE SECTION.

(b) Laboratory project.
(d) Experimental; for design and for master's thesis.
(e) Tests of a special spillway section are being carried out in a flume constructed for the purpose. The results are to be used to add to the design information available.
(f) Active.

(1050) THE PERFORMANCE OF A SLUICEWAY HAVING SPILLWAY AT THE SAME ELEVATION AS THE UPSTREAM AND DOWNSTREAM APRONS.

(b) Laboratory project.
(d) Experimental; for design and master's thesis.
(e) Tests are being conducted in a flume of a sluiceway with piers, where the crest elevation is at the level of the upstream and downstream aprons.
(f) Active.

(1061) ENERGY DISSIPATION AT THE BASE OF A FLOOD CONTROL SPILLWAY.

(b) Upper Thames Valley Authority.
(d) Experimental; for design.
(e) Tests are being conducted on a scale model of the sluiceway of the proposed Conestogo Dam, to be located on a branch of the Grand River. The problem is a difficult one due to the low tail water levels encountered.
(f) Active.

The foreign publications which have been received by the agencies listed below are available on loan, unless otherwise indicated.

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

Direct inquiries to The Resident Member, Beach Erosion Board, 5201 Little Falls Road, N. W., Washington 16, D. C.

ENGLAND

Barber, N. F.	"A simple frequency analyser which measures phase." Admiralty Research Laboratory, Teddington. A.R.L./R6/103.30/W.
Darbyshire, J.	"Sea waves and microseisms." Admiralty Research Laboratory, Teddington. A.R.L./R.1/103.50/W, March 1948.
Doodson, A. T.	"A current meter for measuring turbulence." The Hydrographic Review, Vol. XVII, No. 1, May 1940, pp. 79-100.
Guelke, R. W. and Schoute-Vanneck, C.A.	"The measurement of sea-water velocities by electro-magnetic induction." Journal Inst. of Electrical Engineers, Vol. 94, Part II, No. 37, February 1947, pp. 71-74.
Kreisel, G.	"Surface waves." Department of Scientific Research and Experiment, Admiralty. S.R.E./Wave/I, II and III.
Longet-Higgins, M. S.	"A theory of microseism generation." Admiralty Research Laboratory, Teddington. A.R.L./R.2/103.50/W, August 1948.
Ursell, F.	"An optical device for deducing the pressure due to low waves given a continuous record of the surface elevation." Admiralty Research Laboratory, Teddington. A.R.L./103.15/R.4/W, August 1945.

FRANCE

Allard, Pierre	"Relations hydrodynamiques dans les mers littorales application an bassin oriental de la Manche." Annales de Geophysique t.5, fasc. 1, 1949, pp. 25-60. (Photostatic copy, in French, English summary.)
Gridel, Henri	"Essai d'application des resultats de la physique ondulatoire a l'etude des phénoménes de propagation de la houle." Annales des Ponts et Chaussées, Jan-Feb and May-June 1946, pp. 77-105, 330-351.
Nizery, A.	"Étude des déformations de la houle au voisinage d'une jétee." La Houille Blanche, Numéro special "A", pp. 628-632, 1948. (Photostatic copy, in French.)

GERMANY

Engelhardt, Wolf von	"Ueber die schwermineralsande der Ostseekuste zwischen Warnemunde und Darsser Ort und ihre bildung durch die brandung." Zs. Agnew. Miner., Bd. 1, H.1, 1937, pp. 30-59. (Photostatic copy, in German.)
Hansen, Walter von	"Neuere ergebnisse der gezeitenforschung." Die Naturwissenschaften, Jahrgang 35, Heft 9, 1948, pp. 257-288. (Photostatic copy, in German.)

Lamcke, Kurt — "Naturliche anreicherungen von schwermineralism in kustengebieten." Geol. Meere u. Binnengew, Bd. 1, H.1, 1937, pp. 106-125. (Photostatic copy, in German.)

Sindowski, Karl Heinz — "Korngrössen - und schwermineralverteilung in rezenten strandsanden der mecklenburgischen Ostseekuste." Zentr. Miner. Abt. A, Nos. 5-6, 1938, pp. 136-149, 161-167. (Photostatic copy in German.)

U. S. DEPARTMENT OF THE ARMY, CORPS OF ENGINEERS, Waterways Experiment Station.

Direct inquiries to The Director, Waterways Experiment Station, Corps of Engineers, P. O. Box 631, Vicksburg, Miss.

ARGENTINA

Ballester, Rodolfo E. — "Valvulas para la regulación de la descarga des los embalses de San Roque, la Viña y Cruz del Eje." (Discharge regulation valves of the San Roque, La Vina and Cruz del Eje Basins.) From La Ingenieria, Buenos Aires, No. 856, Febrero 1946. (In Spanish.)

AUSTRALIA

Nimmo. W. H. R. — "The World's water supply and Australia's portion of it." Sydney, Australia, 1949.

AUSTRIA.

Grzywienski, Anton — "Flusskraftwerke und stromwerke." (Stream and river power projects.) Vienna, Springer, 1948. (In German.)

BELGIUM

Annales des travaux publics de Belgique, Vol. 101, October 1948+.

CANADA

Engineering Journal Vol. 31, No. 10-12, Oct-Dec, 1948, Vol. 32, No. 1-4, Jan-April, 1949.

ENGLAND

Civil Engineering Vol. 43, No. 508-, October 1948-.

Engineering, Vol. 166, No. 4314-4327, Oct-Dec 1948, Vol. 167, No. 4328-4329, January 1949.

Inglis, Sir Claude Cavendish — "Meanders and their bearing on river training." Inst. of Civil Engineers, Maritime and Waterways Engineering Division. Maritime papers No. 7, 1948.

Inst. of Civil Engineers Journal, Vol. 30, No. 8-, October 1948-.

Lamoen, J. — "Tides and current velocities in a sea-level canal." From Engineering, July 29, 1949.

FRANCE

Almeras, P. "Influence de l'inertie de l'eau sur la stabilite d'un groupe hydro-electrique. (Influence of water inertia upon the stability of a hydroelectric unit.) 1945. From La Houille Blanche, p. 81-110, November 1945, (in French).

Blanchet, Charles "Sur le probleme des remous et des pertes de charge produits par les singularites dans les canaux et rivieres." (The problem of turbulence and head losses produced under various conditions in canals and rivers.) 1945. From La Houille Blanche, November 1945. (In French.)

Campus, Fernand "Travaux et recherches preparatoires du Laboratoire d'Hydraulique Fluviale et Appliquée aux Constructions." (Preparatory work and research of the Laboratory on fluvial and applied hydraulics.) Liége, H. Vaillant-Carmanne, 1941. From Travaux du Centre d'Étude des Eaux, 1941. (In French.)

Craya, A. "Calcul graphique des regimes variables dans les canaux." (Graphical analysis of intumescence in channels.) n.p., 1945-46. From La Houille Blanche, Nov. 1945, Mars. 1946. (In French.)

Le Génie Civil, Vol. 125, No. 19+, October 1948+.

Holsters, H. "Le calcul du mouvement non permanent dans les rivieres par la methode dite des 'lignes d'influence." (Computation of non-uniform flow in rivers by the so-called method of 'Lines of influence'.) From Revue Generale de l'Hydraulique, Nos. 37, 38, 39, 40 and 41, 1947. (In French.)

La Houille Blanche, Vol. 3, No. 5+, Sept-Oct 1948+.

Lamoen, J. "Essais sur modèles reduits pour des barrages-deversoirs; Premiere partie: Étude des effets d'echelle." (Model studies of overflow dams; Part one: Study of the effect of scale.) From Bulletin du Centre d'Études, de Recherches et d'Essais scientifiques des Constructions du Génie civil et d'Hydraulique fluviale.) (Tome III - 1948.) (In French.)

Revue Generale de l'Hydraulique, No. 49+, 1949+.

Virchaux, J. "Charmilles." Workshops of Charmilles S. A. Geneve. The hydro-electric power turbines of Kembs. (In English.)

GERMANY

Bauplanung und Bautechnik, Vol. 2, No. 10+, October 1948+.

Die Bautechnik, Vol. 26, No. 1+, January 1949+.

Proetel, H. "Modellversuche und Planungen für die Ausbildung der Schwung-schleusen." (Model tests and studies for the design of locks utilizing the kinetic energy of the water.) Die Bautechnik, Vol. 25, No. 1, p. 3-15, January 1948. (Photostatic copy, in German.)

U. S. Office of Military Government for Germany. Field Information Agency, Technical reports. No. 1008, Kirschmer, Otto. "Losses due to evaporation and melting of the Alpine snow cover prior to spring thaw." 1946. No. 1091, Kirschmer, Otto. "Asphalt lining of canals and storage basins, and asphalt lining of vertical walls." 1946. (Articles in German with English abstract.)

HUNGARY

Bogardi, J. "A lebegtetett hordalek tomenysege." (River deposits in suspension.) National Water Board. Hydrographical Section. Studies No. 5, 1948. (In Hungarian.)

Hungary. Ministry of Agriculture. Hydraulic proceedings 1/1948. Budapest, 1948. (English summaries.)

Lukacs, A. "A korosvolgyi ontozesek vizrajzi szempontbol." (Circular irrigating channels from the standpoint of hydraulics.) National Water Board. Hydrographical Section. Studies No. 6, 1948. (In Hungarian.)

INDIA

Central Board of Irrigation. Abstracts, No. 102+, October 1948+.

Central Board of Irrigation. Journal, Vol. 5, No. 4+, October 1948+.

Central Board of Irrigation. New projects for irrigation and power in India. 2d edition. Simla, 1948. Popular series, Leaflet No. 3. (In English.)

Central Waterways, Irrigation and Navigation Research Station. Annual report (technical) of work done during the year 1947. Poona, 1948. Research publication No. 12. (In English.)

Irrigation Research Station. Memorandum to the Chief Engineers, annual report on research progress during the year 1948, Irrigation Research Station, United Provinces. Allahabad, India, 1949. Technical memorandum No. 19. (In English.).

ITALY

The next 20 citations are from Istituto di Idraulica e Costruzioni Idrauliche del Politecnico di Milano, Memorie e Studi. (In Italian.)

Citrini, Duilio "Canali rettangolari con apporto laterale di portata." (Rectangular channels with lateral discharge supply.) N. 68, 1948.

Citrini, Duilio "Canali rettangolari con portata e larghezza gradualmente variabili." (Rectangular channels with gradually varying discharge and length.) N. 52, 1942.

Citrini, Duilio "Modellatori a risalto guida al progetto." (Model studies as guides to projects.) N. 44, 1941.

Citrini, Duilio	"Nuove richerche sulla diffusione di una vena liquida in un campo di liquido in quiete." (New research in the diffusion of a liquid jet in a body of liquid at rest.) N. 66, 1947.
Franzi, Giovanni	"Sul moto dei liquidi con materie solide in sospensione." (Liquids in motion with solid material in suspension.) N. 47, 1941.
Gentilini, Bruno	"Esperienze sull'efflusso dai tubi addizionali cilindrici." (Experiments on flow from additional cylindrical tubes.) N. 54, 1943.
Gentilini, Bruno	"Stramazzicon cresta a pianta obliqua E A zig-zag." (Weirs with crest at an oblique plane zig-zag." N. 48, 1941.
Gentilini, Bruno	"Sui processi di efflusso piano. Introduzione a una ricerca sperimentale." (Conditions of smooth flow. Introduction to an experimental research.) N. 42, 1941.
Marchetti, Aldo	"Perdite di carico per regime uniforme nelle condotte dalmine di cemento-amianto con anima di acciaio, rivestite internamente di bitume centrifugato." (Losses of pressure under uniform conditions in "Dalmine" pipes ----.) N. 56, 1944.
Marchetti, Aldo	"Prove su un modello di galleria forzata con diversi pozzi piezometrici." (Model test on the pressure gallery with various piezometric shafts.) N. 49, 1941.
Marchetti, Mario	"Efflusso da lancie e bocchelli antincendi." (Flow from jets and upstream outlets.) N. 67, 1947.
Marchetti, Mario	"Il calcolo dell'energia defluente nelle condotte forzate durante il moto vario." (Computation of discharging energy in pressure pipes during varied flow.) N. 50, 1941.
Marchetti, Mario	"Impianti interni di distribuzione d'acqua una applicazione del calcolo delle probabilita." (Domestic installations of water distribution - an application of the calculation of probability.) N. 69, "Le perdite di carico nei tubi zincati." (N. 70), 1948.
Marchetti, Mario	"L'Influenza del colpo d'ariete sulla regolazione delle turbine." (Effect of water hammer on turbine regulation.) N. 41, 1941.
Marchetti, Mario	"Profili altimetrici di massimo tornaconto delle opere di convogliamento d'acqua." (Height profiles for maximum advantage in the operation of conveying water.) N. 55, 1944.
Marchi, Giulio de	"Canali con portata progressivamente crescente." (Channels with progressively increasing discharge.) (Grondaie e collettori di sfioratori.) N. 45, 1941.
Marchi, Giulio de and Filippelli, Gennaro	"Esperienze sulle erosioni d'alveo a valle di traverse." (Experiments on bed erosion below a dam.) N. 51, 1942.
Marchi, Giulio de	"Onde di depressione provocate da apertura di paratoia in un canale indefinito." (Depression waves caused by the opening of a sluice in an indefinite channel.) N. 57, 1945.

Marchi, Giulio de	"Profili longitudinali della superficie libera delle correnti permanenti lineari." (Longitudinal free surface profiles of permanent. linear currents.) N. 65.
Marchi, Giulio de	"Sistemazione dello sbocco del Lago Maggiore." (Systematization of the Lago Maggiore outlet.) N. 40, 1940.
Ghetti, Augusto	"Sul colpo d'ariete nelle condotte tra cui e' inserita una turbina idraulica." (Water hammer in pipes between which there is a hydraulic turbine.) Milan, Industr Grafiche Italiane, 1948. From L'elettrotecnica, Vol. XXXV, No. 3, 1948.
Puppini, Umberto	"Idraulica." (Hydraulics.) Bologna, Italy, Zanichelli, 1947. (In Italian.) A text.

MEXICO

Mexico. The Papaloapan Commission	"General plan for the rectification of the Papaloapan River." Convention of ASCE at Mexico, D. F., July 1949. (In English.)

NETHERLANDS

De Ingenieur, Vol. 60, No. 40, October 1948.

NEW ZEALAND

Grant, A. P.	"Channel improvements in alluvial streams." Wellington, New Zealand Institution of Engineers, 1948. From Proc. 1948, Vol. XXXIV. New Zealand Inst. of Engineers. Technical bulletin (restricted) No. 1.

PAKISTAN

Ahmad, Mustaq	"Experiments on design and behavior of spurs." Lahore, India. Irrigation Research Institute. Research Publication, Vol. 2, No. 27. (In English.)

SPAIN

Masachs Alavedra, Valentin	"El regimen de los rios peninsulares." (Behavior of peninsular rivers.) Prologo del Dr. Maximino San Miguel de la Camara. Barcelona, Consejo Superior de Investigaciones Cientificas, Instituto "Lucas Mallada," de Investigaciones Geologicas, 1948. (In Spanish.)

SWEDEN

Hellström, B.	"Measures to reduce scour below dams." (Royal Institute of Technology, Stockholm, Institution of Hydraulics Bulletin No. 19, 1948. (In English.)
Hellström, B.	"Recent model tests at the hydraulic laboratory Stockholm." Royal Institute of Technology. Institution of Hydraulics Bulletin No. 20, 1948. (In English.)
Inglis, Sir Claude Cavendish	"Historical note on empirical equations, developed by engineers in India for flow of water and sand in alluvial channels." International Assoc. for Hydraulic Structures Research, 2d meeting, Appendix No. 5, 1948. (In English.)

Reinius, Erling — "The stability of the upstream slope of earth dams." Kommittee for Byggnadsforskning. Meddelanden nr 12, 1948. (In English.)

Teknisk Tidskrift, Vol. 78, No. 36+, October 1948+.

SWITZERLAND

Schweizerische Bauzeitung, No. 40+, October 1948+.

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.

ARGENTINE

Ballester, Rudolfo E. — "Valvulas para la regulación de la descarga de los embalses de San Roque, La Viña y Cruz del Eje." Reprint, La Ingenieria, No. 856, Buenos Aires, February 1946.

Macagno, E. O. — "Referencias Bibliographicas," No. 1. (Surge tanks - bibliography.)
"Referencias Bibliographicas," No. 2. (Movement of liquids through porous media - bibliography.)
Instituto de Hidráulica, Facultad de Ingeneria de la Universidad Nacional de Cuyo. San Juan, 1949.

BELGIUM

Bonnet, L.
Lamoen, J. — "Étude des portes belges de la mer du Nord, essais sur modèles réduits." (Study of Belgian harbors on the North Sea, model tests.) Reprint, Annales des Travaux Publics de Belgique, June, August, October, December 1948.

Lamoen, J. — "Essais sur modèles reduits pour des barrage déversoirs. Seconde Partie: Étude des affouillements et annexes au mémoire." (Model studies of dam spillways. Second part: Study of erosion and appendices.) Reprint, Bulletin de Centre d'Études, de Recherches et d'Essais scientifiques des Constructions du Génie civil et d'Hydraulique fluviale. Tome IV - 1949.

CZECHOSLOVAKIA

"Státni Ústav Hydrologicky" T. G. Masaryka V Praze, Praha, 1948.
No. 69. "The most economical size of storage volumes in the catchment area of the river Vltava (Moldau) upstream of Štěchovice," by Alois Bratránek.
No. 70. "Spillway of a dam," by Lasislav Lískovec.
No. 71. "L'hydrologie comme base de l'économie des eaux," by Jan Novotný.
No. 73. "Fluctuation des phénomènes naturels et leur utilisation pour les prévisions à longue durée," by Alois Bratránek.

FRANCE

La Houille Blanche, Grenoble.
Numéro Special A/1949
Numéro Special B/1949
4Année, 1949, Nos. 1-5.

Mémoires & Travaux de la Société Hydrotechnique de France, Paris. Vol. 2, 1949.

Nizery, Andre — "Le Laboratoire National d'Hydraulique." 1949.

Calfas, P. — "Le Laboratoire Central d'Hydraulique." Reprint from Génie Civil, April 15, 1948.

HUNGARY

Vízügyi Közlemények (Hydraulic Proceedings). Hungarian Ministry of Agriculture, National Water Board, Budapest. No. 2, 1948.

INDIA

Annual report of the River Research Institute of West Bengal, 1948. Publication No. 4, Government of West Bengal, Directorate of Irrigation and Waterways, Alipore. (English.)

Annual report (technical) of work done during the year 1945, and index for 1937 to 1945. Research Publication No. 10, Indian Waterways Experiment Station, Poona. (English.)

Annual report (technical) of work done during the year 1947, and index for 1943-1947. Research Publication No. 12, Central Waterways, Irrigation and Navigation Research Station, Poona. (English.)

Annual report of work done during the year 1948. Research Publication No. 3, Hydraulic Research Station Krishnarajasagar, Mysore, 1949.

ITALY

Marzolo, Francesco
Ghetti, Augusto — "Fiumi Lagune e Bonifiche Venete." Guida bibliografica. Istituto Veneto di Scienze Lettere ed Arti - Venezia, 1949.

Tonini, Dino — "Installazioni per controlli e misure alla diga del Lumiei." Reprint from L'Energia Elettrica Nos. 10-11, Vol. 25, 1948.

Tonini, Dino — "Sulla ricerca di un tempo caratteristico di deflusso." Reprint from Giornale del Genio Civile, No. 9, September 1948.

NETHERLANDS

International Association for Hydraulic Structures Research.
"Hydraulic Research 1938-1947," Vol. 3.
"Hydraulic Research 1948," Vol. 4. (English and French.)

SWEDEN

Johnsson, O. Harald — "Termisk-hydrologiska studier i sjön Klämmingen." Reprint from Geografiska Annaler, Häft 1-2, 1946.

Lindguist, E. G. W.
Anderberg, Sven — "Kalkvattenberedning med avsättnings bassänger." Reprint from Kommunalteknisk Tidskrift, No. 4, 1948.

Institution of Hydraulics, Royal Institute of Technology, Stockholm
Bull. No. 18. "The stability of the upstream slope of earth dams," by Erling Reinius. (English.)
Bull. No. 19. "Measures to reduce scour below dams," by B. Hellström. (English.)
Bull. No. 20. "Recent model tests at the Hydraulic Lsboratory, Stockholm," by B. Hellström. (English.)
Bull. No. 22. "Decay and repair of concrete and masonry dams," by B. Hellström. (English.)

SWITZERLAND

Kirschmer, Otto — "Zerstörung und Schutz von Talsperren und Dämmen." Reprint from Schweiz. Bauzeitung, Vol. 67, No. 20, 21, 1949.

U. S. DEPARTMENT OF THE INTERIOR, BUREAU OF RECLAMATION.

Direct inquiries to the Chief Engineer, Bureau of Reclamation, Denver Federal Center, Denver, Colo.

ALGERIA

Terres et Eaux. (Bi-monthly.)

AUSTRALIA

Commonwealth Engineer. (Monthly.)
Spillway.
State Rivers.

CHILE

Revista Chilena de Ingeniera. (Bi-monthly.)

FRANCE

La Houille Blanche. (Bi-monthly.)
L'Eau. (Monthly.)
Le Géni Civil.
Mémoires et Travaux de la Société Hydrotechnique de France - Paris.

GERMANY

Wasser und Boden. (Monthly.) Hamburg - British Zone.

HUNGARY

Vízügyi Közlemények. (Monthly.)

INDIA

Journal of the Central Board of Irrigation. (Quarterly.)

ITALY

Boni fiche Irrigazioni e Miglioramenti Fondiari.
Elettro Tecnica.
Giornale del Genio Civile. (Monthly.)
L'Energia Ellettrica. (Monthly.)

MOROCCO

La Terre Marocaine. (Monthly)

PHILIPPINES

Philippe Engineering Record.

SPAIN

Revista de Obras Publicas. (Monthly)

U. S. DEPARTMENT OF NAVY, DAVID TAYLOR MODEL BASIN.

Direct inquiries to The Director, David Taylor Model Basin, U. S. Navy Department, Washington 7, D. C.

NETHERLANDS

Aken, J.A. van — "Bepaling van de schroefgegevens van sleepboten met behulp van $\mu - \sigma$ -diagrammen." (Determination of propeller data of tugboats by means of $\mu - \sigma$ -diagrams.) Neth. Model Basin Publ. 70, 1948. Reprint from Polytechnisch Tydschrift, No. 49-50, December 14, 1948.

Aken, J.A. van — "Methoden voor het bepalen van de virtuele spoed..." (Methods for determination of the effective pitch as a means of correcting pitch of ship screws which differ from standard series.) Neth. Model Basin Publ. 80, 1949. Reprint from Polytechnisch Tijdschrift, Vol. 4, No. 17-18, May 3, 1949.

Balhan, J. — "Een onderzoek naar de toepassingsmogelijkheden van profielen met constante drukverdeling voor scheepsschroeven." (A research into the application of profiles with constant pressure distribution on the back for ship propellers.) Neth. Model Basin Publ. 79, 1949. Reprint from De Ingenieur, No. 17, 1949.

Balhan, J. — "Een critische vergelijking van de voornaamste methoden van toepassing van de werveltheorie bij het ontwerp van scheepschroeven op haar practische bruikbaarheid." (A critical comparison of the most important methods for designing ship propellers according to the circulation theory.) Neth. Model Basin Publ. 76, 1949. Reprint from Schip en Werf, Nos. 9-11, April 29-May 27, 1949.

Groot, D. de — "Ontwerpen van schroeven met groot bladoppervlak met behulp van de Gawn-serie in -s vorm." (Design of propellers with large blade areas according to the Gawn series in -s form.) Neth. Model Basin Publ. 85. Reprint from Schip en Werf, No. 16, August 5, 1949.

Klis, J.K.D. van der, Kamps, J. — "Enige Gegevens voor het Ontwerpen van scheepsvormen voor a Zeegaande Vracht-en Passagiersschepen, B. Kustvaartuigen." (Data on the designs of ship forms for (a) sea-going freight and passenger ships, (b) coasters.) Neth. Model Basin Publ. 73, 1948. Reprint from Schip en Werf, No. 24, November 26, 1948.

Lammeren, W.P.A. van — "Resultaten van enkele proefnemingen ter bepaling van de invloed van de nauwkeurigheid van de fabricage van scheepsschoeven op haar cavitatie-eigenschappen en haar rendement." (Results of several

experiments in the determination of the influence of the accuracy of the manufacturing of ship propellers on cavitation properties and on output.) Neth. Model Basin Publ. 72, 1949. Reprint from Schip en Werf, No. 3, February 4, 1949.

Lammeren, W.P.A. van — "Enkele constructies ter verbetering van het rendement van de voortstuwing." (Several designs for improving the propulsive efficiency.) Neth. Model Basin Publ. 77, 1949. Reprint from Schip en Werf, No. 7, April 1, 1949.

Lammeren, W.P.A. van
Van Aken, J.A. — "Een uitbreiding van de systematische 3- en 4- bladige schroefseries van het Nederlandsch Scheepsbouwkundig Proefstation." (Review of the systematic 3 and 4-bladed propeller series of the Netherland Model Basin.) Neth. Model Basin Publ. 78, 1949. Reprint from Schip en Werf, No. 13, June 24, 1949.

Manen, J.D. van — "Onderzoek naar de mogelijkheid in de tunnel een juist beeld te verkrijgen van de in werkelijkheid aan de schroef optredende cavitatieverschijnselen." (Analysis of the possibilities to reproduce in the tunnel the cavitation-phenomena, which occur in reality with ship propellers.) Neth. Model Basin Publ. 82, 1949. Reprint from De Ingenieur, No. 23, 1949.

SPAIN

Acevedo, Manuel Lopez — "Skin friction resistance." Madrid, Canal de Experiencias Hidrodinamicas, 1948. (In English.) Contribution to the discussion on skin friction resistance, presented to the Fifth International Conference of Ship Tank Superintendents, London, September 1948.

Acevedo, Manuel Lopez — "The use of turbulence-producing devices in model experiments." Madrid, Canal de Experiencias Hidrodinamicas, 1948. (In English.) Statements of the El Pardo Ship Tank on the issues raised by Dr. K. S. M. Davidson in the Introductory Remarks, Fifth International Conference of Ship Tank Superintendents, London, September 1948.

U. S. DEPARTMENT OF NAVY, OFFICE OF NAVAL RESEARCH.

A large number of foreign publications are received by this Office. These are abstracted and indexed by the Navy Research Section, Library of Congress, Washington 25, D. C. to whom inquiries for appropriate bibliographies should be addressed.

NATIONAL RESEARCH COUNCIL.

Direct inquiries to The Director, Division of Mechanical Engineering, National Research Council, Ottawa, Canada.

FRANCE

La Houille Blanche. Grenoble. October 1948 to date.

Association des Ingenieurs-hydrauliciens	Annuaire 1948-1949. Grenoble, 1949. (French)
Bass, J.	Applications de la mécanique aléatoire a l'hydrodynamique et a la mécanique quantique. Ministère de l'Air, P.S.T. 227, 1949. (French)

INDIA

Iyer, V. G. and Rao, N.S.G.	Annual report 1947. Government of Mysore, Hydraulic Research Station, Krishnarajasagar, Research publication No. 2, 1948.

NETHERLANDS

Burgers, J. M.	"Damped oscillations of a spherical mass of an elastic fluid." Delft Technische Hogeschool, Mededeling 59, 1948. (English)

RUSSIA

Gidrotekhnicheskoe stroitel'stvo. Hydraulic engineering. Moscow, January 1949 to date. (Russian)

SWEDEN

Edstrand, H. and Rödström, R.	"The resistance of a barge with the bottom air lubricated." Swedish State Shipbuilding Experimental Tank, Med. 12, 1949. (English)
Tiselius, K.	"The electrical equipment of the Swedish State shipbuilding experimental tank." Swedish State Shipbuilding Experimental Tank, Med. 11, 1949. (English)

Translations of foreign articles have been prepared at the laboratories listed below, and are available on loan. Requests should be directed to the agency indicated.

U. S. DEPARTMENT OF THE ARMY, CORPS OF ENGINEERS, Waterways Experiment Station.

Direct inquiries to The Director, Waterways Experiment Station, Corps of Engineers, P. O. Box 631, Vicksburg, Miss.

Almeras, P.	"Quelques problemes poses par le remplissage de ecluses de navigation." (A few problems involved in the filling of navigation locks.) From La Houille Blanche. Troisieme Année, No. 5: 408-415, September-October 1948. By Arthur Haritos. Translation No. 49-5.
Boussinesq, J.	"Sur le mouvement permanent varie de l'eau dans les tuyaux de conduite et dans les canaux decouverts." (On the varied permanent movement of water in conduits and in open channels.) From Comptes Rendus des Seances de l'Academie des Sciences, Vol. LXXIII, pp. 101-105, Paris, France, 1871. By William W. Geddings, Jr. Translation No. 49-8.
Cavanilles, Ramon Iribarren	"Corrientes y transportes de arenas originados por el oleaje." (Currents and sand transportation originated by action of waves.) From Revista de Obras Publicas, Madrid, Mayo y Junio de 1949. By Arthur Haritos. Translation No. 49-3.
Henke, Lieutenant	"Eissprengungen an der Kuste und Versuchssprengen mit Thermit." (Ice blasting along the coast and blasting tests with thermite.) From Zeitschrift fur das Gesamte Schiess und Sprengstoffwesen 25: 62-63, February 1930. By Arthur Haritos. Translation No. 49-1.
Laszloffy, W.	"Regime des glaces des rivieres." (Behavior of ice in rivers.) From La Houille Blanche, Troisieme Année, No. 6, November-December 1948. By Arthur Haritos. Translation No. 49-6.
Lemoine, R.	(Hydraulic study of the Donzere-Mondragon lock.) Laboratorie Dauphinois D'Hydraulique Neyrpic Grenoble - Beauvert, June 1948. By Arthur Haritos. Translation No. 49-12.
Partiot	"Mémoire sur les marees fluviales." (Memorandum on fluvial tides.) From Comptes Rendus des Seances de l'Academie des Sciences, Vol. LXXIII, pp. 91-95, Paris, France, 1871. By William W. Geddings, Jr. Translation No. 49-7.
Perez, Fernando Rodriguez	"Influencia de la pendiente del fondo en la altura de la ola; Comentario, por Ramon Iribarren Cavanilles." (Influence of bottom slope on wave height. Commentary by Ramon Iribarren Cavanilles.) From Revista de Obras Publicas, Madrid, Julio de 1946. By Arthur Haritos. Translation No. 49-2.
Saint-Venant, Mr. de	"Theorie du mouvement non permanent des eaux, avec application aux crues de rivieres et a l'introduction des marées dans leur lit." (Theory of the nonpermanent movement of waters, with application to the floods of rivers and to the introduction of the tides within their beds.) From Comptes Rendus des Seances de l'Academie des Sciences, Vol. LXXIII, pp. 147-154, 237-240, Paris, France, 1871. By William W. Geddings, Jr. Translation No. 49-9.

Vernet, M. "Profil d'une lame deversante deprimée Notules Hydrauliques." (Profile of a depressed discharging sheet.) From La Houille Blanche. Troisieme Annee, No. 3: 272-273, Mai-Juin 1948. By William W. Geddings, Jr. Translation No. 49-4.

U. S. DEPARTMENT OF THE INTERIOR, BUREAU OF RECLAMATION.

Direct inquiries to the Chief Engineer, Bureau of Reclamation, Denver Federal Center, Denver, Colo.

Aravin, V. I. "Pritok Gruntovykh Vod k Vodosboram." (Flow of Groundwater to Drainage Channels.) Izvestiia Nauchno-Issledovatelskogo Instituta Gidrotekhniki (Trans. of the Scientific Research Inst. of Hydrotechnics) Moscow, U.S.S.R., Vol. XVIII: 4-43, 1936. Translated by I. Mittin and H. Marek, Jr. May 1949. (Rough draft.)

Arkhangelsky, B. V. "Eksperimentalnoe Issledovanie Technosti Skal Gidravlisheskoi Krupnosti Chastits." (Experimental investigation of the accuracy of elutriation scales used in grain-size distribution analysis.) Trans. Scient. Research Inst. of Hydrotech., A.S. Moscow, U.S.S.R., Vol. XV, 1935. Translated by I. Mittin and H. Marek, Jr., October 1948.

Bratránek, Alois "Dlouhodobe Predpovedi Vodnich Prutoku na Vltave ve Štěchovicich pro Obdobi Sucha." (Long-term forecasts of discharges of the Moldrau (Vltava) River at Štěchovice, Czechoslovakia, for dry periods.) Bulletin "Work and Studies" (Prace a Studie), National Hydrol. and Hydrotech. Institutes of T. G. Masaryk, Prague-Podlaba, Czechoslovakia. No. 29, 1938. Translated by H. Marek, Jr., October 1948.

Kirschmer, Otto "Der Stand des hydraulischen Versuchswesen in Deutschland." (The Status of Hydraulic Research in Germany.) Wasserkraft und Wasservirschaft (Water Power and Water Economy), Germany, 1941. Translated by Ferdinand Stenger (from FIAT Final Report No. 1113 of May 30, 1947), February 1949.

Reltov, B. D. "Issledovanie Filtratsii v Usloviiakh Prostranstvennoi Zadachi po Metodu Elektro-Gidrodinamicheskikh Analogii Akad. N. N. Pavlovskogo." (Percolation of groundwater investigated as a three-dimensional problem by means of electro-hydrodynamical analogy proposed by Prof. N. N. Pavlovsky.) Izvestiia Nauchno-Issledovatelskogo Instituta Gidrotekhniki (Trans. of the Scientific Research Institute of Hydrotechnics), Moscow, U.S.S.R. Vol. XV; 1-18, 1935. Translated by I. Mittin and H. Marek, Jr., July 1949. (Rough draft.)

Ron, Josef "Mereni Ovzdusnych Srazek Srazkomernym Totalizatorem." (Measurements of atmospheric precipitations with a totalizer.) Bulletin "Work and Studies" (Prace a Studie), Nat. Hydrol. and Hydrotech. Institutes of T. G. Masaryk, Prague-Podlaba, Czechoslovakia, No. 60, 1946. Translated by H. Marek, Jr., October 1948.

Scimeni, Ettore — "Sulla Validita Della Regola di Thoma per le Vasche Oscillazione Degli Impianti Idroelettrici." (On the validity of Thoma's Rule for surge tanks of hydroelectric plants.) L'Energia Elettrica (Electrical Energy). Milan, Italy, Vol. XXIV; Nos. 11 and 12; 537-541, 1946. Translated by R. G. Scott, February 1949 (rough draft).

Sdobnikov, D. V. and Mikhalevich, P. A. — "Nabliudeniia za Filtratsiei v Osnovanii Betonnoi Plotiny." (Observations of water percolation in the foundation of a concrete dam.) Gidrotekhnicheskoe Stroitelstro (Hydrotechnical Construction) Moscow, U.S.S.R. Vol. 15, No. 11: 19-22, 1946. Translated by I. Mittin and H. Marek, Jr. January 1949 (rough draft).

Viazemsky, O. V. — "O Vliianii Neplotnostei v Antifiltra-tsionnykh Diafragmakh Zemlianykh Plotin." (The effect of unsound places in the cores of earth dams.) Gidrotekhnicheskoe Stroitelstro (Hydrotechnical Construction), Moscow, U.S.S.R. Vol. 15, No. 12: 13-16, 1946. Translated by I. Mittin and H. Marek, Jr. April 1949 (rough draft).

U. S. DEPARTMENT OF THE NAVY, DAVID TAYLOR MODEL BASIN.

Available free to all government agencies and on loan to other activities by writing to The Director, David Taylor Model Basin, U. S. Navy Department, Washington 7, D. C.

Bleuzen, J. — "L'Étude de la giration au Bassin d'Essais des Carenes." (Study of turning tests at the Paris Model Basin.) Translated by R. Widmer, September 1949, from Association Technique Maritime et Aeronautique, Bulletin, Vol. 45, 1946, pp. 477-496. TMB Translation No. 222.

Byrn, T. — "Steiggeschwidigkeit von Luftblasen in Flussigkeiten." (Speed of rise of air bubbles in liquids.) Translated by F. A. Raven, June 1949, from Forschung, Vol. 4, No. 1, January-February 1933. TMB Translation No. 132.

Gurevich, M. I. — "Nekotorye Zamechaniia o Statsionarnykh Skhemakh Kavitatsionnogo Obtekaniia Plastinki." (Some remarks on stationary schemes for cavitation flow about a flat plate.) Translation and comments by J. V. Wehausen, November 1948, from Bulletin de L'Academie des Sciences de L' URSS, Class des Sciences Techniques, No. 2, 1947, pp. 143-150. TMB Translation No. 224.

Klemm, Alfred — "Kataphorese von Gasblasen." (Cataphoresis of gas bubbles.) Translated by F. A. Raven, September 1949, from Physikalische Zeitschrift, Vol. 39, No. 22, November 15, 1938, pp. 783-793. TMB Translation No. 137.

ADVISORY COMMITTEE ON BASIC RESEARCH IN UNDERWATER BALLISTICS, Office of Naval Research, U. S. Navy Department.

Chairman, Garrett Birkhoff, Harvard University, Cambridge, Mass.

Purpose and aims: (a) to plan an effective hydrodynamics research program; (b) to aid the coordination of research and development; (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.

The major task at present is the preparation of a long range program of fundamental research.

COMMITTEE ON TIDAL HYDRAULICS, Department of the Army, Corps of Engineers.

Chairman, Clarence F. Wicker, District Engineer's Office, Philadelphia, Pa.

Purpose: To study the available theory on tidal hydraulics and the tidal hydraulics problems of the Corps of Engineers to determine whether a program of general experimentation is needed.

RESEARCH COMMITTEES OF THE SECTION OF HYDROLOGY, American Geophysical Union, 1530 P Street, Washington 5, D. C.

The Committees are in process of reorganization. For information write Waldo E. Smith, Executive Secretary, American Geophysical Union, at the address above.

COMMITTEE ON LETTER SYMBOLS FOR HYDRAULICS, American Standards Association.

Chairman, J. M. Robertson, Ordnance Research Laboratory, The Pennsylvania State College, P. O. Box 30, State College, Pa.

Purpose: This committee is preparing to review the 1942 Standard, Letter Symbols for Hydraulics, and to determine whether any changes are required.

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.

COMMITTEE ON APPLIED HYDRAULICS, Civil Engineering Division, American Society for Engineering Education.

Chairman, Walter L. Moore, Dept. of Civil Engineering, The University of Texas, Austin, Texas.

Purpose: To promote advancement in the teaching of hydraulic engineering and fluid mechanics courses.

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, George H. Hickox, Associate Director, Engineering Experiment Station, University of Tennessee, Knoxville, Tenn.

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 development 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.

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.

WATER RESOURCES DIVISION, American Water Works Association.

Chairman, Executive Board, R. M. Legette.

HYDROMECHANICS SUB-COMMITTEE OF THE RESEARCH AND TECHNICAL COMMITTEE, Society of Naval Architects and Marine Engineers.

Chairman, K. S. M. Davidson, Director, Experimental Towing Tank, Stevens Institute of Technology, Hoboken, N. J.

The Sub-committee is organized to conduct, promote, and foster research in hydrodynamics affecting the design of ships.
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 39 St., New York 18, N.Y.

INTERNATIONAL ASSOCIATION FOR HYDRAULIC STRUCTURES RESEARCH.

President, Lorenz G. Straub, Director, St. Anthony Falls Hydraulic Laboratory, Hennepin Island, Minneapolis 14, Minn.
The next triennium conference will be held in Delhi, India, February 1951.
The Association issued Volume 4 of its bulletin, "Hydraulic Research", covering the year 1948 in August 1949. The bulletin contains reports from 52 laboratories in 20 countries, mostly European.

Information concerning membership in the Association may be obtained by addressing its President, Lorenz G. Straub, Director, St. Anthony Falls Hydraulic Laboratory, Hennepin Island, Minneapolis 14, Minn., or its Secretary, J. Th. Thijsse, Raam 61, Delft, Netherlands.

GENERAL.

Attention is called to the articles on laboratory practice appearing in the journal LA HOUILLE BLANCHE (Grenoble, France). These articles (in English) contain many valuable ideas and suggestions. The journal also contains many papers on hydraulics in English, extensive bibliographies, and other material.

BUCKNELL UNIVERSITY, Lewisburg, Pa.

Robert A. Gardner, Associate Professor of Civil Engineering.
The hydraulic laboratory is used for instruction only.

BYRON JACKSON COMPANY, P. O. Box 2017, Terminal Annex, Los Angeles 54, Calif.

W. N. Beadle, Vice-President.
The new pump test laboratory is used for research on centrifugal pumps and submersible electric motors.

CALIFORNIA STATE POLYTECHNIC COLLEGE, San Luis Obispo, Calif.

Prof. R. H. Reece, Mechanical Engineering Department.
The new mechanical engineering laboratory is nearing completion.

CARNEGIE INSTITUTE OF TECHNOLOGY, Department of Civil Engineering, Pittsburgh, Pa.

Prof. F. T. Mavis, Head, Department of Civil Engineering.
The new laboratory is in operation. More space, new facilities, and an improved layout provide for a more diversified and intense plan of hydraulic research.

UNIVERSITY OF CONNECTICUT, Hydraulics Research Laboratory, Box U-37, Storrs, Conn.

Victor Scottron, Associate Professor of Civil Engineering.
The permanent equipment of the laboratory is completed and installation of operating equipment is in progress.

GEORGIA INSTITUTE OF TECHNOLOGY, Atlanta, Ga.

Professor Harold R. Henry is in charge of the laboratory during the leave of absence of Professor Kindsvater.

IOWA INSTITUTE OF HYDRAULIC RESEARCH, State University of Iowa, Iowa City, Iowa.

Dr. Hunter Rouse, Director.
The fourth hydraulics conference was held by the Institute June 12-15, 1949, with a record attendance of 430 engineers. Its purpose was the development of a book on "Engineering Hydraulics." Preprints of chapters of a book on "Engineering Hydraulics" formed the bases for discussion at the conference. The book will be published in 1950 by John Wiley & Sons, New York.

THE JAMES LEFFEL & COMPANY, Springfield, Ohio.

J. Robert Groff, President and General Manager.
During 1949 and in 1950 the program centers around testing of models for various field installations. Experimental development on hydraulic turbines of Francis and Propeller types and their environmental conditions will continue, and special problems including cavitation will be investigated.

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

John B. Cournyn, Asst. Professor of Civil Engineering, in charge of Hydraulics Laboratory.
The College of Engineering moved into its new buildings in June 1949. The laboratory is designed for testing large and small models of harbors, flood control works, power plant intakes, pumps and other similar projects. It has a pumping capacity of 9 cfs under a pressure head of 350 ft. Also included is a glass-walled tilting flume 4 feet wide and 4 feet deep with a length of 30 feet, intended primarily for the study of problems in two-dimensional flow with a free surface.

THE PENNSYLVANIA STATE COLLEGE, Ordnance Research Laboratory, School of Engineering, State College, Pa.

The Garfield Thomas Water Tunnel was dedicated on October 7, 1949. The working section of this tunnel is 48 inches in diameter and 14 feet long. The velocity will be variable from 6 to 60 fps and the pressure from 3 to 60 psi. The finished tunnel will be used by the Ordnance Research Laboratory for tests on propellers and underwater bodies for the U. S. Navy Bureau of Ordnance. Dr. J. M. Robertson will be Director of the Water Tunnel Operations.

PURDUE UNIVERSITY, School of Civil Engineering and Engineering Mechanics, Lafayette, Indiana.

Director, R. B. Wiley, Head, School of Engineering and Engineering Mechanics.
F. W. Greve, Professor of Hydraulic Engineering.
Harold C. Woodsum and Robert Earl Roberts are new members of the staff.

UNIVERSITY OF TENNESSEE, Department of Civil Engineering, Knoxville, Tenn.

A new Civil Engineering building has just been completed. While the hydraulic laboratory will not be moved, additional space will be realized as the soils laboratory and surveying equipment are transferred to the new building. Part of this space will be used for storage and a small machine shop. It is expected that construction will be started this year on an 8 by 12-inch aluminum flume, 60 feet long, with large vertical adjustments for changes in slope.

WAYNE UNIVERSITY, Department of Civil Engineering, Detroit 1, Mich.

Dudley Newton, Head, Department of Civil Engineering.
A new engineering building under construction will include a well-planned hydraulic laboratory located on three floors. Hydraulic research will be started on completion of the laboratory.

UNIVERSITY OF WISCONSIN, College of Engineering, Madison, Wis.

Dr. James G. Woodburn, former head of the laboratory, has been appointed chairman of the Civil Engineering Department. Dr. Arno T. Lenz is the new head of the laboratory.

U. S. DEPARTMENT OF THE ARMY, OFFICE OF THE CHIEF OF ENGINEERS, Beach Erosion Board, 5201 Little Falls Road, N. W., Washington 16, D. C.

Research facilities are being expanded by the construction of a large wave tank and a coast model test basin. The 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 capable of producing a maximum wave 6 feet in height and 300 feet in length, in a normal water depth of 15 feet. The tank will be used for the study of the design of upstream slope protection for earth dams, sea walls, breakwaters, other harbor protective structures, and other structures subject to wave action. The coast model test basin will be 300 feet by 150 feet in plan and 3 feet deep. A test area of about 200 feet by 100 feet, with a water depth of 2 feet in the offshore, will be utilized in conducting tests. Wave generators will produce a maximum wave in the magnitude of 2/3 feet in height. Facilities for simulating tides will be provided. The basin will be used to study methods of controlling inlets to prevent damage to adjacent shores; means of reducing wave and current action on beaches; the general behavior of barrier beaches; methods of protecting and building beaches without damaging adjacent beaches; plans to prevent shoaling of navigation channels; and specific areas of severe coastal erosion when warranted.

U. S. DEPARTMENT OF THE ARMY, CORPS OF ENGINEERS, Waterways Experiment Station, P. O. Box 631, Vicksburg, Miss.

On August 10, 1949 the Waterways Experiment Station was transferred from the jurisdiction of the President, Mississippi River Commission, to the direct jurisdiction of the Chief of Engineers, U. S. Army.

A new Hydraulics Division office building, containing 4200 sq. ft. of floor space and a 20.5-ft. conference room equipped with recording instruments and a moving picture projector, was completed January 10, 1949.

The Waterways Experiment Station has entered into a formal agreement with the Louisiana State University and Mechanical College whereby accepted students spend a tour of four months at the Waterways Experiment Station assisting in at least three different types of laboratory projects under direct supervision of the Waterways Experiment Station's staff. A completed tour satisfies in part the requirements for a Master of Science degree.

U. S. DEPARTMENT OF THE INTERIOR, BUREAU OF RECLAMATION, Denver Federal Center, Denver, Colo.

Design studies for a large construction program have precluded research this year. Greater attention has been paid to sedimentation problems, particularly regarding design of diversion dam structures and canal headworks. Also emphasized were field studies on seepage tests in connection with development of lower-cost canal linings, pumping plant performance, and the river diversion problems in the tidal estuary of the Sacramento-San Joaquin delta.

U. S. DEPARTMENT OF THE NAVY, Office of Naval Research, Washington, D. C.

Dr. Mina Rees has been appointed Director of the Mathematical Sciences Division. Dr. John V. Wehausen, formerly hydrodynamics consultant at the David Taylor Model Basin, has been named Head of the Mechanics Branch.

U. S. DEPARTMENT OF THE NAVY, U. S. Boiler and Turbine Laboratory, Philadelphia Naval Base, Philadelphia, Pa.

Captain E. Kranzfelder, USN, Commanding Officer and Director.

This is the sole United States Government agency where full-sized boilers and propulsion equipment can be tested under simulated service conditions with variables accurately controlled. Facilities include:

a. Fuel oil and distilled water storage of approximately 300,000 gallons each.
b. Fuel oil and water piping systems operable at pressures roughly 1000 and 2500 psi respectively.
c. Fuel oil and water weighing systems among the most accurate in the country for high capacity work; they are capable of weighing to 40,000 and 400,000 lbs/hour respectively.
d. Air systems operable at 120,000 cfm, and at pressures to 100" (w.g.), 80,000 cfm at 150" (w.g.).
e. Steam piping systems for high working pressures and temperatures.
f. Desuperheating systems with three pressure reducing stations controllable manually or automatically, having capacity range of 350,000 to 30,000 lbs. of steam per hour and wide temperature range.
g. Condensing system of four units, two of total capacity of 600,000 lbs per hour superheated steam, two of total capacity of 175,000 lbs. per hour saturated steam.
h. Circulating water capacity of 150,000 gpm maximum.
i. Instruments for measuring pressures, temperatures, flow rates, steam quality, gas analysis to high degrees of accuracy.

SUBJECT INDEX

887657 O—50——16

This bulletin may be obtained by hydraulic laboratories, libraries, accredited hydraulic engineers, etc., by a written request addressed to the Chief, National Hydraulic Laboratory, National Bureau of Standards, Washington 25, D. C. Distribution is made to foreign laboratories on an exchange basis.

☆ U. S. GOVERNMENT PRINTING OFFICE : O—1950